No. LXXV.

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No. LXXV—(*continued.*)

ART.—VII. *The Ancient Indian Symbol for the Foreign Sound Z.*

THE DISPUTED SYMBOL IN THE NAME OF CAṢṬANA'S FATHER.

An article in the *Calcutta Review*, I-1, October 1921, over the signature of Mr. N. G. Majumdar on the subject of the Andhau Inscriptions, stimulated my curiosity as to the symbol used to represent the *Z* sound in the name of Zamotika, the father of Caṣṭana, the first (or, if we include Nahapāna in the list of succession, the second) in the line of Kṣatrapas and Mahākṣatrapas of Western India. I started an inquiry into the phonetic side of the question, and it is from the phonetic aspect of it that I propose to approach the subject, for, so far as I can gather, the scholars who have hitherto tackled the point have confined themselves to the epigraphic aspect.

Before, however, I handle the phonetic considerations affecting the question, it will be useful to review the situation and the opinions and conclusions arrived at by scholars hitherto. It may be noted that the symbol for *Z* in the name of Zamotika has been considered as found either on coins or in inscriptions.

The earliest scholar in the field appears to have been Pandit Bhagavānlāl Indraji who advanced two distinct theories :—

(*a*) that the name began with *Ysa*-Ysamotika (ट्समोतिक) wherein *Ysa* (ट्स) was intended to represent the Greek *Z* which has nothing corresponding to it in Sanskrit.[1]

(*b*) that it began with *Ghsa* (ट्स) *Ghsamotika* (ट्समोतिक) where *Ghsa* (ट्स) was an invention to represent the *Z* or *X* sound of Greek.[2]

Apparently the former view appears in 1896 A.D., the date of the *Bombay Gazetteer*, Vol. I, Part I, and the latter belongs to A. D. 1890, as shown in Prof. Rapson's edition of the Pandit's article. But,[3] as Pandit Bhāgavānlāl died in March 1888, it is clear that the opinion expressed in the former was an earlier expression, while that in the latter was a later one revising the earlier view. Thus, the *Ysa* theory was eventually given up by Pandit Bhagavānlāl in favour of the *Ghsa* theory, though we are not in possession of the grounds on which he altered his view.

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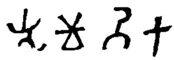
1 *Bom. Gazetteer*, Vol. I, Part I, page 31, Foot-note.
2 J. R. A. S., 1890 A.D., p. 644.
3 J. R. A. S., 1890 A.D., p. 639.

The scholar next in order of time who has dealt with this subject appears to be Prof. Rapson whose conclusions may be summarized as under[1] :—

(*a*) that the coins of Caṣṭana speak of him as son of Ghsamotika ;

(*b*) that this Ghsamotika would seem to be the Indian transliteration of some foreign name, probably Persian and

(*c*) that the reading of this name by Burgess as under :—

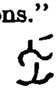
 (स्यमोतिक) *Syamotika*

can, by a very slight correction, yield *Ghsamotika.*

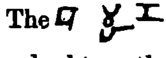
It should be noted that this paper of 1890 A. D. by Prof. Rapson was (as is stated by him in the opening paragraph) but a supplement to Pandit Bhagavānlāl's posthumous article published in 1890 A. D. It is therefore possible that he accepted the reading *Ghsa* favoured by the Pandit in revision of his (the Pandit's) earlier reading *Ysa.*

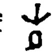
Next, we find Dr. F. W. Thomas, in 1906[2] A. D., holding that *Ghsamotika* is undoubtedly a Scythic name. He obviously accepts the *Ghsa* reading and not the *Ysa* reading, although, it may be noted, that a little earlier[3] in the same article he is inclined to read the *Y* (for *J*) in the name *Miraboyana* as the Persian[4] *Z* or rather as the sound intermediate between *J* and *Y*, *i.e.*, *Ž* (=French J=ज़्य).

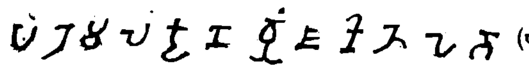
I may note here that eighteen years earlier (J. R. A. S., 1881 A.D., pp. 526-527, "*The Epoch of the Guptas*") Dr. Thomas favoured Burgess' reading *Syamotika.* He says there :—

"I conclude that the *S* has been placed below the *Y* for the convenience of conjunction; an option often exercised in the Indo-Pālī Inscriptions." In footnote 1 he supports this by instances :—" In .·.  *Isyā* in the Delhi column, J. A. S. B. vi-577, 584, the letters are otherwise placed" (*i.e.*, in true sequence, he admits) " but " he proceeds "  =*vy* is frequent,

1 *The Coinage of the Mahākṣatrapas and Kṣatrapas of Surāṣṭra and Mālava*, J. R. A. S., 1899, A.D., pp. 370-371.
2 Śakasthāna, J. R. A. S., 1906 A.D., pp. 211 and 215.
3 J. R. A. S., 1906 A.D., p. 205 and n. 3.
4 Later on in 1908 A.D. Prof. Rapson has accepted Dr. Thomas' view that the name, *Ghsamotika*, was Scythic in origin. (*Catalogue of Coins*, civ., also cxi, n. 1)

Girnār, viii, 1, ix, 8. The  Bāhmaṇa, Girnār, viii 3, ought to dispose of any doubt on the subject."

That स्यमोतिक is not the correct reading will, however, be seen from the very theory of convenience of conjunction, and from the fact that Dr. Thomas does not produce a case of inverted स्य, nay, *Isyā* given by him is in the true order. Again, if  (vy) is frequent we have also  in Rudradāman's Girnār Inscription belonging to a period subsequent to 72 *Śaka*:

 (परम लक्षणव्यंजनैरुपेत); *Vide* Pandit Gaurīshankar Ozā's *Indian Palæography*, Plate VIII, and page 55 giving remarks and Nāgari transliteration thereof.

Bāhmaṇa, too, is not a conclusive instance for Dr. Thomas' theory, for the reason already given, and for the additional reason that in the Prākrits including Pāli conjuncts with ह in them (whether original or vicarious) change the place of ह from the top to the bottom in the transit from Sanskrit to Prākrit. See *Si*, *He*. VIII-ii-74 where ह्म (Skr.) is specifically included with क्ष्म, श्म, ष्म, स्म as changing to म्ह; and the instance is given of ब्राह्मण: changed to बम्हणो. In the gloss Hemacandra distinctly says:—मकाराक्रान्तो हकार आदेशो भवति. For similar condition in Pāli see Dr. Bhāndārkar's *Philological Lectures*, p. 35, and also p. 65 where the very word of the Girnār edict viii, 3 cited by Dr. Thomas is shown as बाम्हण (म् top, ह bottom); also see Muller's "*Simplified Grammar of the Pali Language*," pp. 57-58, which show that ह (original or evolved out of sibilants) in conjuncts with nasals undergoes metathesis.

The same *Ghsa* spelling is accepted by the Rev. Mr. H. R. Scott in his paper on the *Coins of Nahapāna.*[1]

Thereafter, Prof. Devadatta R. Bhāndārkar in his Epigraphic Note on *Sātakarṇi* of the Girnār Inscription,[2] adhered to the reading *Ghsa* in his transcription of the initial portion of the Andhau inscriptions.

Thereafter, we find Prof. Lüders, in 1913 A. D. holding the view that the name of Caṣṭana's father contains the compound *Ysa* and not *Ghsa* observing that "2000 years ago our ancestors

1 J. B. B. R. A. S. Vol. XXII, 1906 (A.D.), p. 225.
2 J. B. B. R. A. S. Vol. XXIII, p. 68.

transliterated the letter 'Z' by य्स."[1] This view was based on an inspection of the estampages of the Andhau inscriptions sent to him by Prof. D. R. Bhāndārkar.

In 1915 A. D. Prof. Devadatta R. Bhāndārkar, when he was able to examine carefully the stone inscriptions of Andhau in the original, was convinced that the reading *Ysamotika* was correct. He embodied his view in his *Progress Report*[2] to the effect that the name was most clearly *Ysamotika* and not *Ghsamotika* as proposed by Prof. Rapson, that the conjunct *ysa* was singular and an attempt to represent some foreign sound like the Greek *Z* in names like Zeonites, and that similarly the name of Rudradāman's son was Dāmaysada and not Dāmaghsada, the occasional variation of the name as Dāmajada lending support to this view by the *J* in it.

We are not here concerned with the controversy whether Prof. Lüders' discovery was ignored wilfully by Prof. Devadatta Bhāndārkar, or whether it was an unintentional omission. My object to-day is, as I have said at the outset, to examine the problem, *viz.*, the relative claims of the *Ysa* and the *Ghsa* readings on a phonetic basis.

Let us, then, proceed to this task; the brief survey of the history of the question given above will serve as a useful groundwork for our inquiry.

As I have already hinted, the conclusions arrived at on the letter-formation in this case were based almost entirely on palæographic considerations; the phonetic aspect of the question has remained in the background and received recognition by scholars hitherto only in a very incidental and latent manner. Thus, when Pandit Bhagavānlāl contended that य्स or घ्स was invented to represent the foreign sound *Z*, he did not go behind the Indian symbol and examine how such a symbol was calculated to represent that sound, and yet he must have felt some inner working of phonetic grounds when he made that statement, especially when he gave up *ysa* य्स and accepted *Ghsa* घ्स.

1. Article entitled *Die Śakas und die Nordarische Sprache*, in the Proceedings of the Royal Prussian Academy (*Sitzungsberichte* of the Prussian Academy).

It is rather important to ascertain whether the copies sent by Prof. D. R. Bhāndārkar to Prof. Lüders were *transcripts* or *estampages*, for the latter would be faithful reproductions, while the former may be vitiated by several factors, *e.g.*, imagination of the transcriber, want of accuracy of observation and the like. I put this *caveat*, because while the words of Prof. Lüders quoted in the correspondence in the Modern Review, September 1921, p. 328, speak of "impressions" (*i.e.*, estampages) of the inscriptions, Prof. D. R. Bhāndārkar's description of the stone inscriptions shows that they "would not yield any satisfactory estampages" that "the letters are so curiously weather-worn that they do not yield even passable estampages, but it is possible to prepare satisfactory transcripts" (*Pr. Rep. Arch-Survey, W.C.* 1905-6, p. 35 and *Ibid* 1914-15 p. 8).

2. Progress Report of the Archæological Survey, W. Circle, 1914-15 A.D. Part *II* (*b*), P. 67 para 15.

Similarly, when Prof. Rapson read  as घ्स and virtually discarded the reading स्य (*sya*) given by Burgess, thus adhering to the order of the components of the conjunct, his subconscious feeling must have had a phonetic line of thought acting on it. Again Dr. Thomas touches the phonetic side just lightly when he speaks of the French *J* sound of the *Y* (for *J*) in the name Miraboyana. Lastly, Prof. Devadatta Bhāndārkar's preference for *Ysa* on the special ground that in Dāmaysada the variation, Dāmajada, has a *J* which alone can yield the foreign sound of *Z*, indirectly suggests a phonetic basis.

All the same, I may be permitted to observe that all these scholars have touched only the fringe of the phonetic side of the problem, and no blame attaches to that fact, for their attention was naturally confined to, and absorbed by, epigraphic considerations. To-day I intend to apply phonetic tests in the consideration of this problem and find out which solution is favoured most by the results of such a test.

Well, then, we have to choose between two symbols, य्स (*Ysa*) and घ्स (*Ghsa*). It may be premised that the dispute owes its origin to two causes :—

(1) The great similarity between the letters य and घ in the alphabet of the Kṣatrapa period, so that one could be easily mistaken for the other ;

(2) The relative value, as regards permanency and preservation, of the writing on coins on the one hand and in stone inscriptions on the other. For, while it may be contended that the writing on coins may very often be faulty in the shaping of the letters and figures on account of limited space, etc., and scholars consider it not always a safe guide for the correct reading of names, it can with equal strength be argued that stone inscriptions are as often misleading or doubtful in consequence of the exposure to the action of weather, wear and tear, and similar forces.

I do not add as a third cause the possible factor of the ignorance of engravers as leading to faulty or misleading shaping of letters, on coins and stone equally.

I may observe that, after all, the य and घ on the coins are not quite undistinguishable mutually. A careful comparison between coin No. 260 and No. 494 (Plates X and XIV respectively) in Rapson's *Catalogue of Coins* will show that the घ in घ्समोतिक in the former and the य in विजयसेन in the latter are minutely distinguishable. So also in शाम घ्स वस in coin No. 281 (Plate X).

In any case, there is no doubt that in the present instance the letters घ and य have been regarded by scholars as liable to be mistaken, one for the other. It may therefore be useful if a test other than the epigraphic examination of the subject can throw some independent light. Hence the value of the phonetic test. But before I proceed to place before you my application of this independent test it would be as well to meet one or two possible objections to the whole inquiry.

First, we are told by Prof. Luders that "2000 years ago[1] our ancestors transliterated the letter '*Z*' by य्स." It may be asked, what outside proof is there for this statement? Are there instances other than that of this name, Zamotika, where *Z* was so transliterated in ancient India? Does Zamotika occur anywhere in Greek or Scythic record as a name with a *Z* (or say X) in it? Or is it after all a case of begging the question by basing this statement on the existence of a य्स or घ्स in the name as found on the coins and in these inscriptions?

Secondly, we have seen above that Dr. Burgess transliterates the first letter in this name as स्य (Sya) in spite of the fact that य comes at the top and स् at the bottom, and the general rule is that in a conjunct the letter pronounced first is written as a top letter and that pronounced next is written as a bottom letter. Why then did Dr. Burgess invert the order in transliterating this conjunct? Was it because he found that य्स was an unpronounceable combination and therefore the only possible way in which these letters could combine being स्य he read it as such स्य, Sya? Pandit Gaurishankar Oza tells us[2] that in certain cases such inverted conjuncts are the result of the ignorance of the scribes or engravers. True, he speaks thus with regard to the writings in the time of Aśoka and with

1 Prof. Rapson places Castana's coins in the period between 46 and 72 Śaka era (=124 and 150 A.D.). The Andhau inscriptions of Rudradāman bear the year 52, Śaka era (=A.D. 130). *See* Progress Report, Arch. Survey W. Circle 1905-06 A.D., p. 35

Dr. Thomas (J. R. A. S., 1881 A.D, 525) bases his chronology of the Kṣatrapa rulers on the assumption that the years were of Vikrama era; it is, however, now generally accepted that they pertain to the Śaka era.

2. *The Palæography of India* (Hindi), second edition, p. 48, he says:—

संयुक्त व्यंजनोंमें कितने एक स्थानोंमें पहिले उच्चारण होनेवाले को ऊपर और पीछे उच्चारण होनेवाले को उसके नीचे जोडा है (देखो, म्य. म्हि. र्य, स्ति, स्व) जो शुद्ध है, परंतु कहीं कहीं दूसरे को और पहिलेको नीचे लिखा है (देखो, त्म, स्या, व्यो, स्टा, ष्मा) जो अशुद्ध है, और यह प्रकट करता है कि लेखक शुद्ध लिखना नहीं जानता था.

reference to conjuncts in which स्य is not mentioned ; and an examination of the specimens given by him of the Kṣatrapa period shows that स्य is invariably written as in the natural order, स at the top and य at the bottom.[1] But it may be that in the case of the name which we are now considering the inversion may, for that very reason be a mere error of the engraver due to his ignorance, an error continued by tradition and imitation from coin to coin and inscription to inscription (if more inscriptions than one are found). Thus, after all, the real name may have been स्यमोतिक (Syamotika)—as read by Dr. Burgess,[2] and all these "guesses at truth" about a foreign Z and its Indian symbolization may be like the guesses of antiquarians caricatured by Dickens in the person of Mr. Pickwick who claimed to have discovered various important conclusions from the rude signature of a villager on a slab of stone, engraved in defiance of all rules of orthography, and our स्यमोतिक or ध्समोतिक may prove to be another BILL STUMPS HIS MARK !

But the reputation of the great scholars who have dealt with this name hitherto is in no fear of ridicule as so many Messrs. Pickwick at the hands of another Dickens. Whatever the case with other conjuncts written in Aśoka's time, the case of स्य in the Kṣatrapa period is placed beyond doubt. It is invariably written correctly, स् above and य् below, as I have shown in the instances cited in note 14 just above ; besides, it is possible to conceive an alternative to ignorance, *viz.*, convenience of arrangement of the component letters giving rise to inversion. This very possibility was suggested by Dr. Thomas at one time (J. R. A. S., 1881, pp. 526-27, see *supra* p. 160). Thus the chances of the engraver's ignorance and consequent error are minimized if not altogether eliminated. Then, again, we have at least one other name where we have टस or ध्स in the inverted order and where it is not easy to substitute स्य for it ; it is the name of the son of Rudradâman, which is written as *Dāmaysada* or *Dāmaghsada* and also written as *Dāmajada*, where the J by its sound like the French Z mentioned by Dr. Thomas in the case of another name, would point to a Z sound in the टस or ध्स symbol found

1. Thus we find स्य invariably in the correct order in the specimens given in the appended plate (SYA).

2. Dr Burgess speaks of this coin as that of Syamotika himself and Prof. Rapson did not dispute this view at first (J. R. A. S., 1899 A.D., p. 370). But in 1908 A.D. *Catalogue of Coins*, 71) Prof. Rapson advances a reasonable conjecture that the coin (now missing) may have been one of Caṣṭana with the name of his father only legible in the inscription. I say this is reasonable because Ghsamotika was never a ruling *satrap* and had no titles.

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in the variants of the same name.[1] And as Prof. Rapson tells us, the workmanship of the Greek legends was at its best during the period beginning with the reign of Dāmaghsada (J. R. A. S., 1899 A.D., p. 358).

We may therefore venture to proceed, and take up the phonetic test finally, so repeatedly deferred till now in this paper.

First, then, य्स.—Obviously य्स is an impossible conjunct and—the question of ignorant inversion being set aside—the only reasonable inference would be that the (य्) must be some diacritical mark to represent some uncommon, out-of-the-way, sound ; स्यमोतिक (Syamotika) being set aside for reasons already stated, we must regard य in य्समोतिक as a diacritical mark, and that mark, we are told by the scholars already named, was used to represent a Z-like sound. Now we have some clue to the use of य् as a diacritical mark, in another class of phonetic symbolization. Mârkaṇḍeya, in his *Prâkṛta-Sarvasva,* gives य्च (*Yca*), य्ज (*Yja*) as forms of the respective palatals in Māgadhî, Vrâcaḍa Apabhraṁśa, and Kekaya-Paiśâciki.[2] The impossibility of conjuncts having य् as the first member at once shows that Mārkaṇḍeya intended the य् as a diacritical mark. Sir George Grierson has clearly shown that this was a mark to indicate the pure palatal sound of the palatals, as distinguished from the dentopalatal sound peculiar to the Standard Prakrit.[3] I may here suggest that Mārkaṇḍeya's selecting the top position for य for this special purpose instead of the bottom one as used to be done by writers of Kâshmîrî at one period (thus :— च्य, छ्य, ज्य), and as is also found in a Valabhi copper-plate of A. D. 530 (Valabhi *Samvat* 210) by Dr. Sten Konow in the case of the word[4] ज्याबाल (Jyâbâla) to mark the Sanskṛit sound of ज, and as was the widely prevalent practice in Old Gujarâtî Mss. (च्यार, च्यालीस, च्यारि, विच्यारि, etc.) *e.g., Vimala-prabandha* (V. S. 1508) Bhalaṇa's *Kâdambarî,* (V. S. sixteenth century), *Vasanta-Vilâsa* (V. S.

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1 We need not detain ourselves here with the question whether we should read the second member of this name as *Zada* (झड) with Pandit Bhagavânlâl, or as झाद (*Zâda*) with Prof. Rapson and others ; (*vide* Prof. Rapson's paper on the '*Coinage' of the Mahâkṣatrapas and Kṣatrapas,* J. R. A. S., 1899 A.D., p. 374; also his *Catalogue of Coins* cxxii, § 97). I am inclined to accept Prof. Rapson's reading *Zâda* (झाद) and his interpretation, *Zâda* (Persian)=Son, literally, "born" (Skr. जात —*Jāta*), and would venture to add the guess that Dâmazâda was intended to convey the sense—the son of the *Dâma* ancestors, as the names of his grandfather and father (Jayadâman and Rudradâman) end in *Dâman.*

2 *Prâkrta-Sarvasva* xii-21, xviii-2, and xx-4, (Vizagapattam Edition).

3 *The Pronunciation of Prâkrt Palatals.*' J. R. A. S., 1913 A.D., p. 391, ff.

4 *Epigraphia Indica,* Vol. XI, p. 105.

1508) etc.,—this preference, I say, of Mârkaṇḍeya's of the top position for य् indicates that he intended a pointed distinction of the pure palatal sound, which with य् as the bottom letter might lead to a mistake of the conjunct for a real conjunct with a strong य् (*i.e.*, for instance, the य् in चिच्यार may be erroneously sounded strong as that in चिछ्यात). (A full discussion of the palatals in this aspect will be found in my[1] *Philological Lectures, Vol. I., pp.* 345-359, where I have also summarized Sir George's excellent paper just referred to above). We need not go astray, however, into this point here. What concerns us here is the diacritical use of य्. We can easily infer that such a use of an unpronounceable component of a conjunct was prevalent, and Mârkaṇḍeya must have adopted the symbol because of such practice in earlier ages, as in the case of the य् in the name *Ysamotika.*

There are, however, two important considerations which clash with the acceptance of य् as a diacritical mark in *Ysamotika* :—

Firstly, Mârkaṇḍeya flourished some time about the middle of the fifteenth century A. D.[2]. Between the Kṣatrapa period (the second century A. D.) and the fifteenth century—a gap of over a thousand years,—we do not find such a use of य् as a diacritical mark, not even to mark the pure palatal nature of the letters of the च्यवर्ग; this use of य् for that purpose would seem to be an original invention of Mârkaṇḍeya's.

Secondly, The function of य् even as a diacritical mark, would naturally be confined to pure palatalization of the letter coming in contact with it, as in the case of य्च, य्छ, य्ज, of Mârkaṇḍeya, but to expect the य् mark to indicate a sound like Z, quite unconnected phonetically with य्, is hardly conceivable. It would be rather far-fetched to argue that the य् through its kindred sound J (ज) would suggest the Z sound ; although in the case of Dâmajada and Miraboyama the J and Y are accepted as suggesting the Z and Ž sounds respectively. There is a clear distinction between the two cases. The J in Dâmajada and the Y in Miraboyana are independent letters functioning a distinct sound of their own, whereas in य्स the position occupied by य् is quite a dependent one, as

1. Expected to be out soon, under the title *Gujarâti Language and Literature* MacMillan & Co., now out (July 1923).

2. Sir George Grierson (J. R. A. S., 1913, p. 391) places Mârkaṇḍeya in the middle of the seventeenth century, and refers to Pischel, Pr. Gr. § 40 But a reading of the same reference with the help of my friend, Rev. Father Zimmermann, has brought me to fixing Mârkaṇḍeya two centuries earlier (See my *Gujarâti Language and Literature*" p. 261).

a mere diacritical indicator, where, if it ever indicated the Z sound the presence of the स (s) would be superfluous and uncalled for.

Then, now, ह्स.—We have thus to fall back on ह्स as our only possible help, and phonetically it furnishes real help. We may at once discard the possibility of ह्स being an inversion for स्ह, for स्ह represents no conceivable sound as स्ह would, if ह्स were taken as an inverted conjunct. So we are left with ह्स in sole possession of the field, and with a just right for such possession, of course on phonetic grounds. These grounds are :—

(*a*) First, ह् in ह्स is not required to be a mere diacritical mark, but by its very nature, (as I shall show at once below), it has phonetic capability, in combination with the स्, to present the Z sound to the ear ; it is thus a fairly successful attempt to represent by means of Indian letters the foreign sound of Z ;

(*b*) Secondly, an examination of the स्थान, and प्रयत्नs, *i.e.*, the places and modes of sound-production (or, as Brugmann names them, place of articulation, and form of articulation), of the components of ह्स will leave no doubt that it approaches the Z sound to the nearest point possible.

Thus :—

1 घ्=क्+aspiration and sonance.

2 ह्स will be (क्स)+aspiration and sonance.

3 Z has :—

(i) Dento-palatal[1] स्थान,

(ii) Sonance,

(iii) Sibilation,

(iv) a certain amount of aspiration.

4 Z in certain Greek names is used to take the place of the Prâkrit dento-palatal letters, *e.g.*,

Pazalai for पञ्चाल;

Ózéne for उज्जयिनी.

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1. The स्थान may perhaps be accurately described as वर्त्से, known to the *Prâtiśâkhyas* (*vide Ṛk-Prâtiśâkhya*, 1 20, Max Muller's edition)· वर्त्से is described by Uvvaṭa as दन्तमूलादुपरिष्टादुच्छूनःप्रदेशः *i.e.*, the prominent portion above the roots of the teeth (under the gums, of course).

(5) X (which generally represents *Ksa* क्स) is used to represent the Z sound in several Greek names, —*e.g.*, Xerxes, Xenophon, Xenophanes, Xemocrates Xenia, Xavier, Xanthus, Xanthippus, Xanthippe.

All these considerations will show how very well fitted घ्स is to represent the Z sound. True, there is one distinction, घ्स starts with the guttural nature of घ्, if pronounced with a deliberate reproduction of all the elements of the composition of the conjunct, while *Z* does not possess any guttural element in its sound. But a comparison with the initial X in names like Xerxes, Xenophon, etc., and the genesis of its Z sound, will tell us that a subordination or almost total suppression of the guttural element in घ् and X (क्स), combined, in the case of X, with an introduction of the sonant and aspirant elements into its sound, gives a sure approximation to the *Z* sound in either (घ्स as well as X). Try to pronounce either under such conditions, and you have the Z sound as a resultant.

Thus the question of the name of Caṣṭana's father examined in the light of phonetics receives a solution which favours the reading of घ्स (*Ghsa*) for the initial letter of Zamotika (घ्समोतिक).

To summarize the matter treated in this paper, I may state that, य and घ being likely to be mistaken, one for the other in the name of Zamotika on coins and the Andhau inscriptions, and the inversion in the conjunct य्स or घ्स being capable of being regarded either as erroneous or deliberate, there are before us four alternative readings, (a) य्स (b) स्य, (c) घ्स (d). स्घ.

That, of these (*b*) is disposed of as unlikely because that conjunct has always been seen in its natural sequence (स्य) in Kṣatrapa record, and because स्य will not fit in the case of the name, Dāmaghsada (Dāmaysada), as there is a variant, Dāmajada, which would clash with the स्य hypothesis;

That, (*a*) and (*d*) are unpronounceable, and of these (*d*) is to be discarded at once as serving no possible purpose;

That, (*a*) may be conceived as having य् as a diacritical mark, as in the case of Mārkaṇḍeyas य्च, य्छ, य्ज; but in this case य् has a purpose, *viz.*, to indicate the pure palatal nature of the च etc., whereas in य्स no such purpose is possible, and it cannot indicate Z as य् is not kindred to Z (except through J and its French sound), and this slight possibility is rendered nugatory because the स् would be left without an object;

That, the only possible alternative left is (*c*) घ्स and its capability to represent the Z sound is strongly indicated by the phonetic functions of घ् and स् severally and jointly.

I therefore favour the reading घ्स (*ghsa*) on phonetic considerations which lend an independent support to the palæographic considerations advanced by Pandit Bhagavānlāl and Professor Rapson.

Bandra, $\frac{26\text{-}12\text{-}1921}{1\text{-}1\text{-}1922}$. N. B. DIVATIA.

P.S.—To completely verify facts I intended to obtain an inspection of the impressions of the Andhau Inscriptions ; and with that view I requested the Superintendent of Archæological Survey, Western Circle, to oblige me and he was good enough to promise to send them for my inspection. But I regret that, owing to unknown circumstances, the impressions have not been sent to me till now, though I had applied over six months ago.

At last in July 1923 (just before this paper was in proofs) I was given the chance of examining these impressions through the courtesy of the officer in charge. In the meanwhile the Inscriptions in question have been already published in the *Epigraphia Indica* for January 1921. In both these places the conjunct appears more like *ysa* than *Ghsa* ; though, as Mr. Bannerji, in editing these inscriptions, has remarked, they have suffered much through corrosion, and this fact should lead one to caution before deciding one way or the other in this respect.

ART. VIII.—*Two Arabic Medicine-Cups.*

BY

CH: MUHD ISMAIL, M.A., H.P., M.R.A.S.

In August 1874, Mr. Rehatsek, an Honorary Member of this Society, while reading a paper on "Evil Eye, Amulets, Recipes, etc., said at the outset :—" Superstitious persons often resort to means believed by them to be supernatural in order to ascertain furture events, to ward off calamities, or to heal diseases. Some of these practices are of semi-religious character, inasmuch as the formulæ are either quotations from the Korán itself, or addresses to the Deity and to certain angels, all to be recited in Arabic. In Bombay many persons make a living by either privately or publicly offering their services to the people, and there are certain stations where men dressed in a religious garb sit with a book called *Fálnámáh*, and are ready to tell the fortune of any person for a few coppers." (Vide p. 299 Vol. X 1874 of J. B. B. R. A. S.) What was said by Mr. Rehatsek about fifty years ago is true to-day also. Professional palmists and astrologers, usually wearing green or saffron coloured robes are still to be seen, probably in a far greater number, wandering in the streets of Bombay and sitting with their *fálnámáh*, slate and pencil and dice, on the skirts of the Maidan near Bori Bandar and on the foot-path of Grant Road. Some of these people seem to be too busy to attend to a greater number than that fixed by them. There have been examples when predictions have proved to be correct, where fortunes have been rightly read, and where talismans and amulets have had their desired effect. Where all apparent means of getting a thing fail, and when all available medicines prove useless, the man will do anything to attain his object or to get rid of his trouble. He will resort to the means known to the superstitious and if in some way or another he succeeds in his undertaking, he will probably begin to believe in such practices. The above mentioned writer, who took a special interest in amulets, &c., while describing a talismanic cup says :—" The cup is also at present although not as much as formerly in great demand, and is said to be used not only by Hindu, Muslim, and Parsi, but also by European women in Bombay and to be a very effective talisman, inasmuch as all confinements where it has been used are stated to have been happy ones." [1] A well cultured brain and a materialist will hardly believe in the ridiculous practices followed by the credulous mind. It cannot be imagined what penances are undergone and what hardships are borne by those mad after a thing. Women, especially those desiring to have a child, have been seen sitting and repeating certain formulæ taught by a faqir or a guru and bathing in the darkest nights and in the most desolate and dreadful graveyards. Some renounce the use of salt for years. To procure a happy delivery all possible means are resorted to. Amulets, talismanic cups, etc., are often used. Those persons who do not believe in the black art, magic, etc., still have faith in the virtues of certain articles inscribed with holy characters. A lady of my family possesses a brass cup which she prizes most of all the things given her as dowry. That cup, she says, has been handed down to them from her great-grand-father, and I find that whenever it has been used confinements have been happy ones. There is nothing inscribed on this cup excepting two names of God Al-Kafi (the sufficient) and al Shafi (the Healer). A few days ago a certain European gentleman was sent to me by the Head Clerk of the Society. He wanted to get deciphered an ornament inscribed with rude Persian character in imitation of a coin. He was rather disappointed on getting the information for he wished to send it to his wife in England as a present. He believed that certain ornaments inscribed with religious formulæ, etc., worn on waist by Indian ladies kept them chaste and safe from maladies.

Though Arabic is the usual language used in the amulets and talismanic cups and the quotations are often from the Quran yet it is not to be supposed that they originated in Arabia, the cradle of Islam. Though Arabic was one of the most superstitious countries of the world before the appearance of Muhammad, yet in Arabia Felix such superstitions became unknown very shortly after the advent of Islam. Talismanic cups, described so far, have a definitely Persian origin. Persia is a country famous for the manufacture of these things. Last week a Parsi gentleman, named J. B. R. Kotwall, of Bandra, brought for my inspection two brass cups which he said were for sale. Both of these had drawings depicting mythological scenes and one had three couplets

1 *Vide* Ind. Ant., Vol. III, 1874, p. 36.

of the famous poet Hafiz on the concave side and the names with figures of some Sassanian Emperors on the convex. Persians are still as deep in superstition as they were two centuries back. I am tempted to give the following anecdote to support this statement. Mr. Rasul Baksh, a resident of Sindh, and a student of D. J. College, Karachi, following the movement of the day like so many other Sindhis went on Hijrat. He went so far as Persia and became penniless. A sympathetic gentleman seeing him in this plight advised him to become a quack doctor and put on the garb of an astrologer, for that was the most lucrative trade. By this profession, he passed his time comfortably in Persia before coming to India. Last year this gentleman graduated from the Baroda College. This story, which is from the statement of Mr. Rasul Baksh himself, is in all probability true.

So far ten brass cups which are supposed to have medicinal properties and talismanic efficacies have been described by Mr. Rehatsek. Eight of these belonged to this society and a paper on them was read by him. (Vol. X of J. B. B. R. A. S., pp. 150—163.) He also got one of them published in Vol. III of Indian Antiquary, p. 12. This cup, which was the smallest and the most beautiful has gone, it is not known where probably it has been lost ! The other seven have been lent to the Prince of Wales Museum of Western India. They are now exhibited in a show case in the South West corner of the Mezzanine Floor of that institution. The description by the same gentleman of two other cups will be found on p. 36 Ind. Ant. Vol. III 1874 and p. 204 Vol. XIV J. B. B. R. A. S.

The two cups lying on the table once belonged to the late Sir Ratan Tata, who with his rich collection of pictures, paintings, jades, etc., bequeathed them to the Prince of Wales Museum. Such cups are made and were once manufactured in bigger quantities at Bedar in H. E. H. the Nizam's dominions, a city which has given a particular name "Bedri work" to the inlaid work on *hukkas*, cups and other utensils. The metal used for these cups seems to be gun-metal inlaid with rather base silver. In both cases the outer side has an artistic design inscribed upon it, and the concave a religious formula in it. Such cups are not common now, and they are manufactured in smaller quantity as their purchasers have become rather few and those who buy them, buy them as curios. Those people who possess them, use them very seldom. They keep them covered in rich cloth and take them out only now and then to remove a colic pain, etc., or to give water for happy delivery. Rich people, however, sometimes drink water from these cups to ward off a disease or for the sake of blessing.

Both the cups have 'Ayatu-al-Kursi or 'Throne verse' inscribed in them. This verse is one of the most important verses of the Quran and such a sublime one that no translation, in the opinion of the best experts, can come up to the dignity of the original. It is usually recited after each of the five daily prayers. The Mishqát al Masábih, a well known book on the Hadis, records the following tradition concerning it, "I heard the prophet say in the pulpit, 'That person who repeats 'Ayat-ul-Kursi after every prayer, nothing prevents him entering into Paradise but life, and whoever says 'Ayatu-ul-Kursi when he goes to his bed chamber, God will keep in safety, his house, and the house of his neighbour.' It is also believed that one who repeats it will have no fear in a frightful place. The bigger cup has the words الله شافی , Allah-o-Shafî, in the centre. These words are always recited when taking a medicine or giving medicine to a child. It is often combined with الله کافی Allah-o-Kafi (God the sufficient). The words Kafi and Shafi are the attributes of God known as Asma-ul-Hasna. The smaller cup has besides Ayatul-Kursi the often repeated Shiite verses invoking the help of Ali to escape from misery. They are often engraved on small copper plates and precious metals and stones that are not only used as charms for children but are also worn by grown up people. These verses, or a portion of them will be found on Shiite inscription stones and on coins of Shiite Kings of Persia especially Shah Ismail Safvi. Baber, though a Sunni struck coins with this formula when he was in alliance with this emperor.

The centre of the smaller cup has the name of God, (*Allah*) and the pure five bodies *Panjtan pak*, prophet Muhammad, Ali his son-in-law, Fatima his daughter, and Hasan and Husain the two sons of Ali.

Inscription.
I *Bigger Cup.*

(1) Lines from the top.

بسم الله الرحمٰن الرحيم – لا اله الا هو الحي القيوم

لا تاخذه سنة ولا نوم له ما في السمٰوات و ما في الارض ط

(2)

من ذالذی يشفع عنده الا باذنه يعلم ما بين
ايديهم و ما خلفهم ولا يحيطون

(3)

بشی من علمه الابما شاء و سع كرسيه السموات
والارض ولا

(4)

يؤده حفظهما و هو العلي العظيم

(5) Centre :

الله شافي!

II Smaller Cup.

(1) Lines from the top to be read by inverting the cup.

بسم الله الرحمن الرحيم ــ الله لا اله الا هوالحي القيوم
لا تاخذه سنة ولا نوم له ما فى السموات وما فى الارض من ذا الذي
يشفع عنده الا باذنه يعلم مابين ايديهم وما خلفهم

(2)

ولايحيطون بشي من علمه الابماشاء وسع كرسيه
السموات والارض ولايؤده حفظهما (و) هوالعلي العظيم ناد عليا
مظهر العجائب تجده عونا لک

(3)

فى النوائب ــ كل هم وغم سينجلي بنبوتک يامحمد
بولايتک يا علي يا علي يا علي

(4) Centre :

الله محمد على فاطمه حسين حسن

Translation.

Lines 1—4 in I and 1-2 (a portion of 2) in II, *i.e.*, of Ayat ul-Kursi.

Allah : there is no God but He, the Ever-living, the Ever-subsisting (by whom all subsist) : neither slumber seizeth Him nor sleep. To Him belongeth whatsoever is in the earth. Who is he who can intercede with Him, unless by his permission ? He knoweth what (hath been) before them, and what (shall be) after them ; and they shall not comprehend ought of His knowledge, save that He willeth. His throne (knowledge) extends over the heavens and the earth ; and the preservation of them tireth Him not ; and He is the most High, the Great. (Chap. ii, V, 256). Line 5 of I.

God is restorer to health.

Lines 2-3 of II, the Shia formula. Invoke 'Alî the manifestator of wonders, Thou wilt find him succour in misery, all grief and sorrow will soon disappear. By thy prophethood of Muhammad, by thy friendship (with God) Oh 'Alî, Oh 'Alî, Oh 'Alî !

Bombay, 10*th July* 1922. MUHD. ISMAIL.

Art.—IX. *Side Lights on the Past History of the Parsis.*

The Revival of Sun-worship and its connection with the First Advent and Settlement of the Zoroastrian Priests in India.

By

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There was a time when the ancestors of the Hindus and of the Parsis lived side by side, belonged to the same Aryan Race, spoke the same language and followed the same religion. The resemblance between the Vedic Sanskrit and the Avesta language is very striking and interesting; and it is gratifying to find that the need for a careful and comparative study of the old Sanskrit and of the Zoroastrian literature is recently engaging the attention of some of our well known oriental scholars. "The study of the Avesta literature of the Parsis," observes Dr. Bhandarker, "has been associated with the study of our Sanskrit literature." There is a close resemblance between the languages of this literature and of the Vedic Sanskrit, so much so that, with but the slightest changes, certain passages from the one can be turned into the other. As a matter of fact, there is a remarkable similarity between the language of the Avestan Gathas and the Vedic language, and by the application of the phonetic laws, the former can be easily rendered into the latter tongue. Similarly, the names of the deities and heroes of the Avesta literature show a remarkable resemblance, as will be seen from the instances given below:—The word 'Asura' which in modern Sanskrit signifies the evil spirit, did not convey that sense in the early period of the Rig Veda literature. This word occurs in the Rig Veda very frequently, and it has been found that in ninety cases out of one hundred and five it occurs in the sense of good or powerful beings and it is only in fifteen cases that it conveys the sense of evil.

In the Avesta literature the word 'Asura' becomes 'Ahur' which according to the laws of phonetic changes, is a corruption of the Vedic word 'Asura', and here it conveys the same meaning as in the earlier portions of the Rig Veda. All this tends to show that up to the time when the earlier portions of the Rig Veda were composed, the ancestors of the Hindus and Zoroastrians lived together amicably, and that the actual schism took place about the time when the word 'Asura' began to assume the sense of evil in the Vedic literature.

Let us now compare certain names and expressions from the sacred literature of these two communities and see what further evidence we can gather on this subject. The expression 'Asura Mahas' occurs in the Rig Veda in the sense of the great God or Supreme Being, and Professor Rajwade opines that the Zoroastrian 'Ahur Mazdah' and the Chaldean 'Assar Mazash' are identical and that the latter names are corrupt forms of the 'Asura Mahas' of the Rig Veda. This scholar further observes that whoever was the borrower, it is clear that the Chaldeans, the Indian Aryans, the Greeks and the Zoroastrians were once neighbours and that they had a common religion and common gods among whom 'Asura was the greatest.' Among the other deities that were common to the ancestors of the Hindus and of the Parsis the following may be mentioned:—(1) (Vedic Aditya) 'Bhaga' corresponds to Avestan 'Bagha,' (2) Vedic Vayu (Wind) is the same as Avestan Vayu, (3) Vedic Apàm Napat (the son of waters) is equal to Avestan Apam Napat, (4) Vedic Gandharva (celestial musician) is the prototype of the Avestan Gandarewa, (5) the Avestan Mithra is the same as Vedic Mitra, (6) the Avestan Naonhaethya is identical with Vedic Nasatya, (7) the Zoroastrian Indhra corresponds to Vedic Indra, (8) the Vedic deity Trita can be identified with Thraetan of the Zoroastrians, (9) the Avestan Keresaspah is equal to Krisasna of the Vedic literature and (10) the deity Yima of the Zoroastrians is Yama of the Vedas.

As in the Vedic literature the father of Yama is Vivasvat, so the father of Yima in Avesta is Vinanghvat, and Thraetan in Zoroastrian literature is the son of Athwya while the patronymic of Trita in the Veda is Aptya.

Yama (Avestan Yima) as has already been stated was believed to be the son of Vivasvat and Vivasvat is identical with Vinanghvat of the Zoroastrians. According to Sanskrit writers like Kalidas and others, Manu the Law-giver of the Hindus was also believed to be an offspring of Vivàsvat or the God of Light. In his great poem the Raghu Vansa, Kalidas speaks of Manu as follows :—

वैवस्वतो मनुर्नाम माननीयो मनीषिणाम् ।

आसीन्महीक्षितामाद्यः प्रणवश्छंदसामिव ॥

That is, there was a king by name Manu, the son of Vivasvat, esteemed by the wise, who was the first of all the kings, as the sacred syllable 'OM' is of all the Vedas.

It seems that on the authority of the above description as well as of the fact that Manu was believed to be the son of Vivasvat (the God of Light), Professor Roth was led to suppose that Yama and Manu are identical and accordingly he concluded that Yama (Avestan Yima) was the originator of the Human Race, and was identical with the Adam of the Bible. But this appears to be a misconception because nowhere in the whole range of the Sanskrit literature[1] of the Hindus, do we find any reference to the identity of Manu with Yama. And moreover, while we find the name Yima—the prototype of the Sanskrit Yama in the Avestan literature—we do not come across any mention of Manu therein.

Similarly, some Zoroastrian writers are under the wrong impression that Yama as described in the Hindu sacred books is a dreadful deity, and that Asura is always described as an evil spirit. It is true that in the later works like the Garud Purana, etc., Yama is so described. But in the earlier sacred books of the Hindus, Yama is described in the character of Dharma Raja, that is, the Lord of Justice. For instance, in the Brahma Yajna, Mahâlaya and other rituals as described in the Shrârddha Prayogâvali and Âhnik Sûtrâvali, Yama is referred to, first as Dharma Raja and then as Vivasvata, Antaka, etc. Similarly, in the Sanskrit Dictionery of Amarsinha who lived in the sixth century of the Christian Era, Yama is described as follows :—

धर्मराजः पितृपतिः समवर्ती परेतराट् ।

कृतान्तो यमुनाभ्राता शमनो यमराड्यमः ॥

(*Vide* Amarakosha, page 8, verse 66.)

We have already stated that the word 'Asura' is not always used in the sense of evil in the Hindu sacred works and in the Rig Veda, in ninety cases out of one hundred and five, it is used in the good sense, and only in fifteen cases in the sense of evil spirit.

1. It is true that the name Savarni Manu occurs in the Rig Veda. But there it does not allude to Manu as the son of Savarna, but as Prof. Max Muller rightly observes, it refers to Savarnâ, the second wife of Vivasvat. The fable of Manu appears to be of a later date. Prof. Max Muller further observes that for some reason or other, Manu, the mythic ancestor of the race of man, was called Sâvarni meaning possibly, the Manu of all colours, *i.e.*, of all tribes or castes.
(*Vide* Max Muller's Lectures on the Science of Language.)

"In both religions," observes Dr. Macdonell, "the term 'Asura,' equal to Avestan 'Ahura,' is applied to the highest gods, who in both are conceived as mighty kings, drawn through the air in their war chariots by swift steeds, and in character benevolent, almost entirely free from guile and immoral traits."

From what has been stated above, it will be plainly perceived that there is sufficient evidence to lead us to the conclusion that at one time the ancestors of the Indian Aryans and of the Zoroastrians lived together, spoke the same language, followed the same religion and that owing to some unknown cause a friction arose between these two communities and that after this schism they began to hate and despise each other. What was the place of their original residence before the cleavage, what language they spoke, and what were the causes of their separation are questions which require a careful research and critical investigation at the hands of oriental scholars. Several eminent Scholars have written on the subject of the original home of the Aryans, but there is no concensus of opinion on the subject. But, whatever may be the exact place of the original abode of the Aryans, one thing appears to be clear and it is that India was not the original abode of the Indo-Aryans, because the Rig Veda contains several hymns, which, from their description, do not appear to have been composed in India. As regards the language, it was neither Sanskrit nor Zend-Avesta. In my opinion, it was that language which the Aryans spoke before it was refined and called 'Sanskrit or the reformed tongue." The Sanskrit language, before it was reformed or remodelled was known as Gîrvân or Gîrvâni and this Gîrvâni was in my opinion the language of the two communities before the schism took place. As regards the cause or causes of separation, opinions differ. An Avesta scholar Dastur Naoshervan, while pointing out the remarkable resemblance, between the language of the Rig Veda and of the Parsi Gathas, observes, "The results of the comparison show a great phonetic and etymological similarity between the two languages; and this points to a period when the Vedic and Avestan Aryans began to secede from each other." And he believes that the parting was due to a revolt on the part of the Zoroastrians against the domination of the Vedic language and the Vedic religion. Professor Rajwade, in his interesting paper on "Asurasya Mâya," expresses the view that the cause of the separation must have been some religious differences in the mode of worship. Perhaps the Indian Aryans gerarded Indra as the supreme deity, while the Zoroastrians clung tenaciously to Asura. The reasons mentioned above may have operated to some extent in causing the friction, but in my opinion the main cause of the schism was some difference over the mode of worship of the Sun and Fire.

In ancient times the God of Light was held in great reverence not only in Persia and India, but also in various other countries of the world such as Japan, China, Egypt, Babylonia, Asyria and in several European countries, also including England and Scotland, as will be shown hereafter :—To the Persians the Sun was the eye of Ormuzd, and to the Egyptians the right eye of Demurge.[1] In the Summer solstice the Egyptians marked their houses, furniture and trees red.[2] The worship of Samas, the Sun-god, was wide-spread in Babylon, and his votaries were numerous. He was called the king of judgment, the son of Eu ; his wives names were Malkit, Gula and Anunit. The cities in which his worship was practically favoured were Larsa or Senkereh and Sippara in Babylon. The Sun-god of Sippara was a well known deity in the time of Sargon, B. C. 3800, for he mentions this god and no other.[3]

Sun-worship or rather Fire-worship seems to have been prevalent in Sardinia, and the following festival appears to be a remnant of the same. In the beginning of April young men and young women agree to be god-fathers and god-mothers of St. John. At the end of May the youths make a vase or bark, fill it with rich soil, and plant grain of barley or wheat. By twenty-one days it is filled by a spreading vigorous plant. It is called Hermes or more commonly, Sunennere, a Sardinian word perhaps meaning garden. On the eve of St. John the vase ornamented with ribbons is exposed on a balcony decorated with garlands and flags. It used to have also a little female and phallic emblems moulded in clay as were shown at the feasts of Hermes. A great fire was lighted in the square, round which they gambolled. The god-father and god-mother stand on opposite sides of the fire, and each holds the opposite ends of a stick, which they pass rapidly backwards and forwards. So hand of each passes thrice through the fire. Then they go to a church, and dash the vase on the church-door and sit in circle and eat eggs and herbs. A cup of wine is passed round, and each drinks to the health of the god-father and god-mother of St. John. Then they sing and dance.[4]

1. Grimm's Teuto, Myth., II, 702.
2. Maurice's Ind. Ant., VI, 223.
3. Budge's Babylonian Life and History, p. 134.
4. Forester's Corsica, 333-335.

Over Europe, the Sun festivals are still kept up. Christmas Day originally in honour of the winter solstice; Easter in honour of the Spring equinox; and St. John's eve or midsummer eve at the summer solstice. These days were on the introduction of Christianity changed from sun feasts to Christian festivals. But several of the old sun practices, the burning of bonfires, the running of fiery wheels and others, were kept up till lately in the outlying parts of England and Scotland.[1]

Curiously enough, at the present day, the worship of the sun is not much in favour among the masses in India and according to the Puranas, some indignity attaches to those who consecrate or take part in the consecration of temples dedicated to the Sun-god. A strong belief prevails among the orthodox Hindus that some misfortune or calamity is sure to occur to those who build or participate in the construction or consecration of such temples. And this is the reason why we see few such temples, while we find in every town and every village many temples of such deities as Shiva, Ganapati, Krishna, Rama, Lakshmi Narayana and others. What is the reason of this ban on the construction and consecration of the temples of the God Surya? In my opinion, in the correct solution of this question, lies the secret or unknown cause of the schism between the Indian Aryans and Iranian Zoroastrians. Both the communities revered the God of Light and the God of Fire equally, but it appears that a serious dispute arose about the mode of worship. The followers of Zoroaster probably insisted on having temples for the Gods of Light and Fire. The Indian Aryans objected to this as they did not see the necessity of having such temples. When the God of Light could be seen in the sky with one's own eyes and worshipped why should they build temples for the Sun-god. Again, in their daily Vaishvadeva and Brahma Yajna rituals they could pay homage to Agnyagaras or Agiaris for the worship of the Fire God. The ancestors of the Parsis on the other hand, must have insisted on the necessity of having such temples for the God of Fire and the God of Light and eventually the dispute grew stronger and stronger day by day and at last it resulted in the permanent separation of these two communities. Even upto this day, it is considered very unlucky for orthodox Brahmins to take part in the consecration ceremony of the temple of the Sun-god, and for exceptional reasons, if it is deemed desirable, to build and consecrate such temples, the consecration ceremony must be performed by a priest belonging to the Maga or Bhojaka caste. As an illustra-

1. Prim. Cult., II, 350-398.

tion of this belief, I may be permitted to quote the following account which was contributed by me to the columns of the Bombay City Gazetteer, Vol. III :—

"Although the Sun is one of the principal deities, very few temples are dedicated to the worship of the Sun-god in India. One of the chief reasons assigned for this is that the consecration rites of a Surya Narayana temple are very elaborate, and for their proper performance learned Brahmins of the Saura or Maga division are required. As such Brahmins are not available, and as any flaw or defect in the due performance of the rites is believed to bring misfortune, few people venture to build temples for this deity, preferring to worship the great luminary in the morning and at noon at home. Through the munificence of a Kapole merchant of Bombay, Harjivan Vassonji Manyar, the city has recently obtained a beautiful temple dedicated to the worship of the Sun God. This temple of Shri Surya Narayana is situated in Surajwadi Pinjrapole lane, Bhuleshwar. The foundation stone was laid by the owner Harjivan in 1895. Unfortunately, a few months later Harjivan Vassonji died. The work of building the temple was however continued by his wife Radhabai, and it was completed in 1899. Great care was taken to obtain Brahmans well versed in the Hindu scriptures to perform the consecration ceremony, and these difficult rites were performed with the help of a Maga Brahmana."

Who the ancestors of these Maga priests were and under what circumstances they came to India, we shall see presently.

The ancestors of these Maga or Bhojaka priests originally belonged to the country called Shakadvipa or Shakastana which I identify with "Scistan" of Persia. The Brahma Parva of the Bhavishya Maha Purana contains an interesting account of these Magas, the Sunworshippers, and of the cause of their advent and settlement in India. According to this narrative, Prince Samba of the Yadava dynasty and described in the Brahma Parva as one of the sons of Shri Krishna of Dwarka, once happened to offend the sage Durvâsa. Durvâsa cursed him and as the result of this curse, Sâmba became afflicted with leprosy. Various remedies were resorted to but without effect and at last Prince Sâmba sought the help and advice of the sage Nârada. Nârada told him that Sunworship was the best cure for leprosy and consequently Sâmba proposed to build a temple for the God of Light. A temple was built on the river Chinab at Multan, but a great difficulty was experienced in finding out priests to perfrom the consecration ceremony. Owing to the ban on the construction and consecration of the temple of the Sun, no Brahmin priest would consent to officiate at the consecration ceremony. In these circumstances the sage Nârada advised Sâmba to seek the help of the sage Gaura Mukha and this was done. That sage supplied him with the following account :—

These Maga priests were descended from the great sage Jarasasta[1] (Zoroaster) and this Jarasasta was descended from the union of the Sun with his wife Nikshubha. This Nikshubha was the daughter of Rijivha who belonged to the Gotra or family stock of Mihira or Mihr. These Magas are well qualified to duly perform the worship of the Sun God and they alone, and no others, are entitled to accept gifts made to the deity. They always kept beards. In their right hand they hold a certain object and in their left hand they hold the Kavacha, *i.e.*, an amulet or a coat of mail, while reciting their prayers which they do five times during the day; and especially while receiving and returning gifts, they cover their face with a piece of cloth. They restrain their breath during their prayers or mental recitation of the names of the deity, and take their meals by observing Mauna or silence.

Having heard this account of the Magas, Prince Sâmba asked Gaura Mukha to tell him the name of the country in which the Magas lived. But on this point Gaura Mukha confessed his inability to give the requisite information and referred him to get the information from the God of Light. Accordingly, Sâmba prayed to the God of Light to help him in finding out the country of residence of the Magas and the deity was pleased to give him the following information. The country of these Magas, according to this legend, is on the opposite side of Jambu Dvipa (India) and it is encircled by the Kshira-Sagar or Milky Ocean, and it is called Shakadvipa. The inhabitants of this Shakadvipa are divided into four classes called (1) Maga, (2) Magaga, (3) Managa and (4) Mandaga. The Magas belong to the priestly class, the Magagas are warriors, the Managas are traders and the last class Shudras. The Magas have their own Vedas but they are different from or opposite to the Vedas of the Indo-Aryans. They put round their waist the sacred thread called Avyanga Avesta word 'Aiwyaonghan (?),' which is made out of the cast-off skin of snakes. This Avyanga is very sacred to the Sun and the cause of this is narrated (in the Brahma Parva) as follows :—During a certain period of the year the serpent King Shesha

1. *Vide* Prof. D. R. Bhandarker's "Foreign Elements among Hindu Population," p. 12; also Brahma Parva, Bhavishya Maha Purana, Ch. 139.

serves the Sun God as his attendant on his chariot. At the end of the period of his attendance, the snake king offers to the deity a belt made of his own cast-off golden skin and out of affection for his attendant, the God of Light puts on this belt round his waist. For this reason it is considered essentially necessary for every Maga Sunworshipper to put on the Avyanga especially at the time of worship.

After having obtained the requisite information about Shakadvipa and its inhabitants, Sâmba went to Shakadvipa and from that country he brought to India eighteen Maga priests. It has already been stated that Sâmba had built a temple of the Sun on the Bank of the river Chandrabhaga (Chenab) at Mitravana or Multan. By the help of the Maga priests the consecration ceremony of this temple was performed and Sâmba was able to worship the Sun God according to the rituals prescribed by the Maga priests. And as the result of his piety and worship, it is said, Sâmba was cured of his ailment and was fully restored to his former strength and vigour of youth. Out of gratitude Sâmba presented to the Maga priests the town of Mitravana (Multan) which was named Sambapura, and he got the Maga priests married to the daughters of men of the Bhoja tribe. And on this account the Maga priests and their descendants came to be styled Bhojakas.

The Maha Bharata also contains a short account of Shakadvipa and its inhabitants. In the Bhishma Parva of the Maha Bharata, Chapter XI, we find the following verses :—

तत्र पुण्या जनपदाश्चत्वारो लोकसंमताः ॥
मंगाश्चमशकाश्चैव मानसा मंदगा स्तथा ।
मंगा ब्राह्मण भूयिष्ठाः स्वकर्म निरता नृप ॥
मशकेषु च राजन्या धार्मिकाः सर्वकामदाः ।
मानसाश्च महाराज वैश्यधर्मोपजीविनः ॥
सर्वकामसमायुक्ताः शूरा धर्मार्थनिश्चिताः ।
शूद्रास्तु मंदगा नित्यं पुरुषा धर्मशालिनः ॥
न तत्र राजा राजेन्द्र न दण्डो नच दण्डिकाः ।
स्वधर्मेणैव धर्मज्ञास्तेरक्षन्ति परस्परम् ॥

(Maha Bharata, Bhishma Parva, Ch. XI.)

That is to say the people of this country (Shakadvipa) are all virtuous and they are divided into four classes, *viz.* (1) Manga, (2) Mashaka (3) Manasa and (4) Mandaga. The Magas or Mangas are mostly Brahmins or priests, the Mashakas are warriors, the Manasas belong to the trading community and the Mandagas are Shudras. And they are all very pious. They have no king, no punishments and no judicial functionary to inflict punishment. They know their duties well and as they are very pious, they are able to protect one another by the strict observance of their respective duties.

Here the most interesting point is the statement that the people of Shakadvipa had no king and no judicial officials to settle their disputes. From the above description it appears that the Magas had a democratic form of Government and that they settled their own disputes. In the course of my research through the pages of the different editions of the Maha Bharata, I have come across a passage in the Bhishma Parva (VI. 6.) which in my opinion distinctly refers to the ancestors of our Parsi brethren. It is as follows:—

दक्षिणेन तु नीलस्य मेरोः पार्श्वे तथोत्तरे ।
उत्तराः कुरवो राजन्पुण्याः सिद्धनिषेविताः ॥
तत्र वृक्षा मधुफला नित्यपुष्पफलोपगाः ।
पुष्पाणि च सुगन्धीनि रसवन्ति फलानिच ॥
सर्वकामफलास्तत्र केचिद्वृक्षा जनाधिप ।
अपरे क्षीरिणो नाम वृक्षास्तत्र नराधिप ॥
येक्षीरन्तिसदा क्षीरं षड्रसंचामृतोपमम् ।
वस्त्राणिच प्रसूयन्ते फलेष्वाभरणानिच ॥
भारुण्डा नाम शकुना स्तीक्ष्णतुण्डामहाबलाः ।
तान्निर्हरन्तीह मृतान्दरीषु प्रक्षिपान्ति च ॥

(Maha Bharata, Bhishma Parva, Ch. VI.)

The purport of the above is this. To the south of the Nila mountain and to the north of the mountain Meru lies the country called the Uttara Kurus. This country is holy and it is the haunt of the celestial beings called Siddhas. In this country, trees bear fruits and flowers during all the seasons of the year. The fruits are sweet and full of juice and the flowers are sweet-scented. Moreover, some trees give milky juice which is as sweet as nectar, and there are other trees which are useful for making clothes, and ornaments are made out of their fruits. There are mines of jewels and the sand resembles minute grains of gold. There are certain birds called Bharundas who possess sharp bills. These birds seize dead bodies and throw them into dales.

I have not been able to identify exactly the site of the country called Uttara Kurus. But from the description given above, I am inclined to think that it must have been somewhere in northern Persia or in Mesopotamia. The name Kars is also suggestive and perhaps the site of the Uttara Kurus might have been the region round Kars. Whichsoever might be the exact site of the holy country of Uttara Kurus, one thing is clear and it is that the inhabitants of this country belonged to the Zoroastrian race. And in support of this view, further evidence can be adduced from the Maha Bharata itself. In the Bhishma Parva (Ch. VI, Verse 7) we find the following :—

देवलोकच्युताः सर्वे निवसन्त्यत्र मानवाः ।
शुक्लाभिजनसंपन्नाः सर्वे सुप्रियदर्शिनः ॥

i.e., the people of the north or the Uttara Kurus are all good looking and of pure and noble descent and they are those who have lost the Devaloka, that is the country of the Devas. Now, we know the Devaloka or Swarga on the earth is either Trivishtapa (Tibet) or Brahmá Varta. For, Manu says :—

ते वसन्ति जनाः स्वर्गे ये वसन्ति त्रिविष्टपे ॥

which means that those people who live in Trivishtapa live in the Swarga or Devaloka and Brahmá Varta has been described by Manu as Devanirmita, *i.e.*, the land specially created by the Devas. We have already shewn that the Zoroastrians after the schism with their Indo-Aryan brethren had lost, or become separated from, Devaloka, *i.e.*, the country of the Devas. Again, the expression *Shuklabhijanasampannah* that is born of pure and noble lineage is significant and in my opinion it applies most appropriately to the Zoroastrians who like the high class Brahmins of India have generally very little intermixture of foreign elements in them and who can therefore be justly described as born of pure and noble descent.

While the Maha Bharata gives a description of Shakadvipa and its inhabitants, there is no allusion in that great epic, to the migration of the Maga priests to India. This event must have therefore occured long after the period of the Maha Bharata. We have already stated that after their arrival, the Maga priests were married to the daughters of the Bhoja tribe. From the account given in the Brahma Parva (Ch. 146-147), it seems that at first a great difficulty was experienced to the admission of the Maga priests into the fold of Hinduism. In order to surmount these difficulties, legends about the great piety and sanctity of the Magas appear to have been invented. And it was circulated that the great sages Narada and Parvata considered it an honour to dine at the house of the Maga or Bhojaka priests. In the Brahmá Parva (Ch. 147) it is further stated :—

पूजिते भोजके देवः श्रीसूर्यः पूजितो भवेत् ।
यस्य भुञ्जन्ति वै गेहे भोजका यदुनन्दन ॥
तस्य भुङ्क्ते स्वयं गेहे भानुर्ब्रह्मा तथा शिवः ।

i.e., worshipping a Bhojaka priest is equivalent to worshipping the God of Light. If a Bhojaka dines at one's house, it should be considered as meritorious as if the Gods Surya, Brahma and Shiva had dined there.

The effect of this panegyric of the Magas was that eventually the Magas or Bhojakas became assimilated with the Hindu society and came to be recognized as Maga or Bhojaka Brahmins. The narrative of the Maga priests is corroborated by the writings of historical personages and by stone inscriptions as will be shown below. In his Brihat Sanhita, Varaha Mihira, the celebrated astronomer of India, who flourished in the beginning of the sixth century of the Christian Era, refers to the Magas and observes that the Maga priests are best qualified to consecrate the temple of Shri Surya. In an inscription found in Nepal and belonging to the middle of the sixth century A.D. (*vide* proceedings of the Bengal Asiatic Society, 1901, p. 3), it is stated that in the age of Kali, the Magas and Brahmins would be treated on a footing of equality. The next inscription in which we find a reference to the Magas, is the Ghatiala inscription of Kakkuka dated Vikrama Samvata 918 corresponding to 861 A.D. It is stated that the inscription was drawn up by a person named Mitra Ravi who belonged to the Maga community.[1] There is a stone inscription at Govindpur in the Gaya district of Bengal which is more interesting and important than those mentioned above, especially as it alludes to the Magas and their patron Prince Samba. It bears the date Shaka 1050 that is 1138 A.D., and gives the following description of the Magas[2]: —

देवो जीयांस्त्रिलोकी मणिरयमरुणो यन्निवासेन पुण्यः ।
शाकद्वीपस्सदुग्धाम्बुनिधिवलयितो यत्र विप्रा मगाख्याः ॥
वंशस्तत्र द्विजानां भ्रमिलिखिततनोर्भास्वतः स्वांगमुक्तः ।
शाम्बो यानानिनाय स्वयमिहम्महितास्ते जगत्यां जयन्ति ॥

The purport of the above is as follows :—

" Victory to the celestial Aruna (Dawn) who is the ornament of the three worlds and whose presence gives sanctity

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[1] *Vide* Prof. Bhandarker's Foreign Elements, p. 12.
[2] *Vide* Epegraphica Indica, p. 330.

to the land of Shakadvipa which is surrounded by the Milky Ocean, and where the Brahmins called Magas dwell. These Magas belong to a race of Brahmins sprung from the grazed body of the Sun. Samba brought them here from Shakadvipa and they are highly esteemed (Mahitah) on this earth."

From the accounts of the various inscriptions given above, it appears that in the fifth and sixth centuries of the Christian Era the Magas were recognized as the Brahmins best qualified to perform the consecration ceremony of the temples of the Sun. The descendants of these Magas are found at present in Cutch, Sind, Marwar, Kashmir, in some parts of Kathiawar, and the United Provinces. They are known as Bhojakas, Sevaks, Maga Brahmins and Shakadvipi Brahmins.

The Magas of Shakadvipa seem to be identical with the tribe of the Magi priests or wisemen of the East mentioned in the Bible. They exercised a considerable influence both ecclesiastical and political in ancient Persia, for we find from Herodotus and other writers that after the death of Cambyses, a faction of the Magi was instrumental in placing on the throne of Persia as King, a spurious person named Psuedo-Smerdes. The Magi falsely declared that Psuedo-Smerdes was the brother of Cambyses, but a Persian nobleman named Otanes, discovering the deceit, conspired with Darius and other five chiefs and put Psuedo-Smerdes to death after he had reigned for eight months. Along with the aforesaid pretender several Magi who supported him were also put to death.

The Masakas mentioned in the Maha Bharata seem to be another important section of the inhabitants of Shakadvipa (Seistan). They were a warlike tribe and probably their power and influence are traceable in the names Maskat, Meshed and Mesopotamia. Similarly in the names Medes and Media is traceable the class of Madas (Mandagas of Shâkadvipa). In ancient times there was a frequent intercourse between India and Persia and there are records not only of commercial and social intercourse but also of migrations and expeditions from India to Persia and *vice versa*. From the evidence of the Cuneiform inscriptions and other monuments, we find that at a very remote period during the existence of a powerful Assyrian monarchy, there took place a great migration of the Aryan nation westward from beyond the Indus toward Persia and Media.[1] According to the celebrated poet Kalidas, the King Raghu had carried on a successful expedition to the country

1. *Vide* Kalidasà's Raghuvansha.

of the Parasikas (Parsis) and on this subject we find the following description, in his account of the kings belonging to the dynasty of the Raghus :—

पारसीकांस्ततो जेतुं प्रतस्थे स्थलवर्त्मना ।
इन्द्रियाख्यानिव रिपूंस्तत्त्वज्ञानेन संयमी ॥

After this (*i.e.*, after bringing the region about the mountain Trikuta under his control), he (Raghu) started by a land route to conquer the Persians as a man possessed of self-control proceeds with the help of the knowledge of truth, to subdue the foes known as the senses (passions). It was easier to reach Persia by the sea-route than by land ; but Raghu seems to have chosen the land route for strategic reasons. For, in that case, he would be able to use the whole of his cavalry. Kalidas (*vide verses* Ch. IV. 62-63) gives us further description of the Persian soldiers and of the battle. The Persians also possessed cavalry and their soldiers were armed with bows and arrows and had beards. The Raghu's forces headed by his powerful cavalry attacked the forces of the enemy, clouds of dust were raised and thereby the Persian soldiers were blinded and confused. On the other hand there was no confusion in the Raghu's army and his soldiers being skilful marksmen were able to hit the enemy accurately and the result was that the battlefield was strewn with the bearded heads and corpses of the Persian soldiers. The Persians finding themselves unable to withstand the assaults of the Raghu's forces surrendered themselves to the mercy of the conqueror. Eventually, King Raghu and his brave soldiers were sumptuously entertained in the vineyards where handsome carpets and dearskins were spread for them.

During the reign of Darius, the region about the Indus formed the twentieth satrapy of his Empire. Darius and some of his successors are said to have held sway over northern India, but there are no important traces of their power and influence in this country, as we have of the rule of Nahapana, Chastan and other Kshatrapas who ruled in western and northern India. The Kshatrapa rule commenced from 70 B.C. and lasted for about three centuries. There were two dynasties of the Kshatrapas, the Northern and the Western. The sway of the Northern Kshatrapas extended from the Kabul Valley to the confluence of the Ganges and the Jumna ; and the sway of the Western Kshatrapas extended from Ajmere in the north to the North Konkan in the south and from Malwa in the east to the Arabian sea in the west. In addition to these, there were two other branches of the Kshatrapas in India, but they were not of any special importance. Most of these Kshatrapa rulers appear to have adopted Hindu names, Hindu customs, and Hindu religion, *i.e.*, either Brahmanic Hinduism or Buddhism. For instance, we find that the name of the founder of the Western Kshatrapas is Nahapan, a foreign name, but his successor and son-in-law Ushavdât (Vrishabhadat) appears to have a Hindu name. Again, it is noteworthy that Ushavdat's father is called in the Nasik inscription of Nahapan by the name of *Dinika* (Diniksh) which appears to be a Persian name. It should also be noted that the word Kshatrapa is of foreign origin being identical with the word Satrap (Persian 'Satrapavan') which term was applied to the Governor of a Province as shown below :—

In the Behistan inscription of Darius Hystaspes the celebrated king of Persia (520 B.C.), the word Kshatrapa occurs twice in connection with the Governors of Bactria and Anatosia ; and from the coins and inscriptions of Nahapan, Chastan, and their successors, it seems clear that these Kshatrapas were Persians by nationality.

The Persian connection with India was very old, and for some centuries before the Arab conquest of Persia it had grown very close. Close relations between India and Persia date from the revival of the Persian Power under the Sassanian kings (A.D. 226-650). In the fifth century we find that the Persian King Behram Gor being attacked by the white Hunas, had come to India to seek military help from Indian Princes against his enemies. In later times, both Nausharwan the Just (A.D. 531—579) and his grandson Parviz (A.D. 591—628) were united by treaties and by the interchange of valuable presents with the rulers of India. In connection with these treaties, it is interesting to note that Nausharwan's embassy to Pulikeshi II, the ruler of Badami in the Southern Maratha Country, is believed to be the subject of one of the paintings in the Ajanta caves. In the seventh century, it is noticed that Indians were settled in the chief cities of Persia enjoying the free exercise of their religion. And this clearly shows that friendly relations existed in the seventh and eighth centuries between India and Persia. After the defeat of the Persian king Yazdegard by the Arabs in the seventh century the Parsis fled into the hills. They concealed themselves there for a hundred years. At last after suffering much hardship, they moved to the coast and settled in the City of Ormuz. After they had stayed at Ormuz for a period of fifteen years, they were again attacked by the Arabs. Consequently, they fled from Persia and coming to India sought protection at the hands of the kind-hearted king of Sanjan, who appears to have been a Prince of the celebrated Yadav dynasty.

It is curious as well as interesting to find that on both the occasions of their migration, *i.e.*, on the first as well as on the last occasion, the followers of Zoroaster appear to have received the sympathy and support of Princes belonging to the Yadav dynasty. The Parsis owe a great debt of gratitude to the Princes as well as to the people of India, for, on their account, the Hindu Princes and people of the Northern Konkan and of Gujarat were not unfrequently molested by the Arabs, the inveterate enemies of the Zoroastrian Persians. It appears very strange that the Parsis should not have kept any record except the words 'Jade Rana,' about the name, designation and dynasty of the kind-hearted ruler of Sanjan who gave them support, sympathy and shelter during the most critical period in the history of their race.

As the Silaharas held sway over the Northern Konkan for a long time, some writers believe that the Jade Rana of Sanjan must have been a king of the Silahara dynasty, and others opine that Jade Rana or Vanraj Chavda of Gujarat might have been the benefactor of the Parsis. But there is no evidence whatever to support any of these two theories. In the first place, none of the names or birudas of the Silahara kings from Kapardi I to Someshwara the last coincides with the name Jade Rana, and similarly the capital of the Silaharas was Sristhana and not Sanjan. Most of the Silahara kings called themselves Tagara-Puravaradhishvara, *i.e.*, the Lords of the City of Tagara. This city being the capital of the earlier Silaharas, the benefactor of the Parsi immigrants of Sanjan does not therefore seem, to be a Silahara Prince.

Now, we find from the Parsi traditions and from the account given in the Kisseh-i-Sanjan that the Parsi immigrants landed at Sanjan and went straight to the ruler. The benefactor of the Parsis therefore must have been staying at Sanjan and not at Patan which was the capital of the Solankis of Gujarat.

On the other hand therefore there are reasonable grounds to support that the Jade Rana of Sanjan was a Prince of the Yadav dynasty. At the end of the civil war, after Dwarka was destroyed and deserted, the Yadavas dispersed in different directions. Some of them went to Cutch and others settled in Gujarat and Kathiawar, and there, they founded minor dynasties of their own. Thus the Jadejas of Cutch are no others than the descendants of the Yadavas. The word 'Jadeja' is a corrupt form of the word 'Jadavaja' or 'Yadavaja' which means descendants of the Yadavas. And I am therefore of opinion that the Jade Rana of Sanjan was in reality a Jadeja Rana, *i.e.*, a king belonging to the Yadava dynasty.

The points treated of, and the conclusions arrived at, in the foregoing pages may be summarised as follows :—

In the preceding pages I have tried to show that the ancestors of the Hindus and Parsis at one time belonged to the same race, spoke the same language, worshipped the same deities and observed identical rituals, customs and ceremonies; that the language they spoke was neither modern Sanskrit nor Avesta, that perhaps it was that from of old Sanaskrit which is known as Girvan or Girvani. An attempt has also been made to show that the chief cause of the schism and of the subsequent separation of the two communities was some difference or dispute about the mode of worship in connection with their principal deities, *viz.*, the god of Light and the god of Fire. After their separation, the two communities became inveterate foes and began to hate and despise one another. They changed their respective language, customs, and the attributes of their deities. The separation appears to have taken place about the time when the word 'Asura' began to assume the sense of evil in the hymns of the Rig Veda; and this period, in my opinion, was the time of the composition of the tenth Mandala of the Rig Samhita. Iran or the country of the Parsikas was invaded and subdued several times by the Indo-Aryan Princes, such as Raghu, Partha and others. Similarly, portions of India such as Sind and Peshwar, were for some time under the rulers of Iran. These circumstances tended to establish mutual intercourse and the exchange of mutual culture and civilization. The first colony of the Parsis in India was that of the Maga priests from Shakadvipa or Scistan. They became assimilated with the Hindu population, stories were invented in the Puranas about their great sanctity, and eventually they were raised to the position of high caste Brahmins. They were styled as Maga or Bhojaka Brahmins, and they alone were declared to be fit to consecrate the temples of the God of Light.

The inhabitants of Shakadvipa as well as of the Uttar Kurus mentioned in the Hindu Epics, were, in my opinion, identical with the ancestors of the modern Zoroastrians. The people of Shakadvipa had a democratic or republican form of Government, there being no king; and the inhabitants of the Uttar Kurus did not burn or bury their dead. The bodies of their dead persons were carried away by birds called Bharundas who possessed sharp bills and who threw them into vales. The inhabitants of the Uttar Kurus mentioned in the Maha Bharata were therefore in my opinion identical with the ancestors of the modern Zoroastrians.

The identity of Jade Rana, the Patron Prince of the Parsis, has for a long time remained undiscovered and unsettled. In this paper, considerable evidence has been adduced to show that the Jade Rana of Sanjan was one of the princes of the great Yadava or Jadava dynasty, the Yadavas having, after the destruction of Dwarka, founded large or small kingdoms in the Deccan, Konkan, Kachha, Gujarat and Kathiawar.

I do not claim finality for the views expressed, or to the conclusions arrived at, in this paper; and I shall be delighted if any scholar in future will throw more light on the subjects discussed in this paper.

Art. X.—*Garcia d'Orta, a Little Known Owner of Bombay.*

BY

A. X. SOARES.

Macaulay once doubted whether one in ten Englishmen of highly cultivated minds could tell whether Sujah Dowlah ruled in Oudh or in Travancore, or whether the Holkar was a Hindu or a Mussalman. Though the knowledge of India and affairs Indian has considerably improved amongst Englishmen since Macaulay penned this statement, we might in a like strain presume to doubt whether one in a thousand, not only Englishmen, but also educated Indian gentlemen of highly cultivated minds, could say without consulting their cyclopedias or other works of reference who Garcia d'Orta is. Whatever excuse the rest of India may claim to be oblivious of the memory and fame of d'Orta, Bombay can plead none such, for the little fishing village which contained the germ of the *Urbs Prima in Indis* that was to be, was held in fee simple by the subject of this paper; he was a manor-lord of 'Mombayn' though, it is true, under this name was included a much smaller area than the present city of Bombay takes in. But Garcia d'Orta has other claims than his one time ownership of what has developed in our day into the second city of the British Empire, to a grateful remembrance by posterity, and, above all, by the people of India. He was the earliest, if not the very first, of that noble band of Europeans, men like William Jones Colebrooke, Anquetil Du Perron, Prinsep, Fergusson, Dubois, Hooker and others who were seized with an absorbing passion for studying the ways and habits, social customs and practices, the language, art and religion, the flora and the fauna, in a word, for understanding the life of the peoples of the East, and, in particular, that of India, and who aimed at spanning the gulf between the East and the West by a bridge of sympathy which can be reared up alone by intimate contact and first hand knowledge.

The large fund of information that d'Orta had garnered during more than a generation he was in the country, he set down in his famous *Coloquios dos Simples e Drogas da India* (*Colloquies of the Simples and Drugs of India*). The title of this encyclopedic work is misleading, for it is not merely a treatise in which its author describes the new trees and plants which he became acquainted with during his long sojourn in the East and their therapeutical properties, but it is a mine of information in respect of the social and political conditions of an epoch which is not the least eventful in Indian History—a period, which takes in the establishment of the Tartar or Moghul dynasty in India, the overthrow of that dynasty by Shere Shah of the Soor family, the restoration of the exiled Moghul sovereign Humayun and more than a decade of the reign of the Great Akbar. By a curious coincidence, this period also synochronises with the rise and culmination of the Portuguese power in India.

We have said that the *Colloquies* is a mine for information of all sorts, other than botanical. In it now d'Orta will launch out into an etymological discussion as regards the derivation of a name like that of the Maldives, now relate with evident relish anecdotes about fights between cobras and the mungoos; he will avail himself of a visit to the court of Nizam Shah of Ahmednagar, to tell us all about the vexed internal history of the Deccan, nor does he not deem it improper for his great learning to acquaint us with the way chess was played in India. He is the first European to visit the Caves of Elephanta, and to give us an account of them and also of the population of Bassein and Salsette ; he has a detailed account of the Parsees whom he found settled there and whom he calls 'Coaris.' He tells us of the ancient trade connection between China and the Western coast, and, how, even in his own time, the citizens of the Celestial Empire carried on a flourishing trade between their own country and Malacca, Java and other adjoining places. He is the earliest writer to give an account of the mines of Golconda, and with a naiveté that is charming, retails to us fables and myths which were current in his time.

The works which the early Portuguese chroniclers have left are surprisingly many, and they cover a variety of subjects and countries, but they are singularly deficient in giving us an accurate picture of the daily life of the people of the time : this defect is, to a large extent, made good by the *Colloquies*. D'Orta's account of the professional call to the house of a half-caste woman of doubtful character or to that of a hidalgo attacked by cholera, his scientific discussions with the powerful Sultan of Cambay or with his friend Nizam Shah of Ahmednagar, his description of the bazar of Diu and of the wiles of the bania with whom he entered into conversation there, are historical vignettes by far more suggestive than many chapters of Barros or Couto. It is just this aspect of his work that makes Mr.

R. S. Whiteway in his introduction to the *The Rise of Portuguese Power in India*, 1497-1550, very correctly remark 'the *Colloquies* cover far more ground than its title promises.'

What we have till now said has reference to the digressions that are interspersed throughout the work, and the author enters into them with even a sort of apology, because he is afraid they may detract from the scientific character of his work. 'I am disinclined to waste a colloquy on matters that do not appertain to science, because readers will say that I have been engaged in writing a story-book,' is the remark with which he preludes his discursive remarks on the history of the Deccan or more correctly of Balagate, and there are very many similar apolegetic advertences in the book. If d'Orta was so keen in maintaining the scientific character of his work, how is it regarded by present day scientists in view of the many developments that have taken place in the science of botany, materia medica and pharmacopœia since the 16th century? It is enough to quote in answer to this very apposite query the opinion of Hanbury and Fluckiger one of the latest and best works on materia medica. "The *Colloquies* are above all notable by reason of the richness of information and the exactitude of the descriptions. No one has as yet described the drugs of India with greater care, nor collected with regard to them information of greater value than Garcia. Always when we treat of Indian drugs it will be necessary to turn to Garcia; in spite of its defects which for the greater part must be attributed to the time in which he wrote, the *Colloquies* will always occupy a place of honour in the history of Pharmacopœia." Again, his book is cited by the most famous of modern workers in the same field, by Guibourt, Professor of the Paris School of Pharmacy, by Professor J. F. Royle of King's College, London, by Hanbury, one of the most ardent investigators of the history of drugs in our time, and by F. A. Fluckiger of the University of Strasburg, both of whom we have mentioned above. We need not quote any more evidence to prove the scientific importance of our author's work, but it might prove both interesting and instructive to note that the earliest description and account of many plants and drugs and their properties we owe to our author. To mention only a few, the nimb (*melia azadirachta*), the bel fruit (*aegle marmelos*), the parizatac (*nycthantes arbor tristis*), the Mahratti "aonla" (*phyllantus emblica*), the kokam (*Garcinia indica*) are some of the trees that were for the first time described by the writer of the *Colloquies*; he was likewise the first to give a correct account of camphor, benjoin, cardamons, cate or catechu.

The *Colloquies* was one of the earliest, in fact, the third book printed in Roman characters by means of the moveable type in India. Therefore, even from the standpoint of its commemorating the introduction of the printing press into this country, one of those events, which has done more to revolutionise the history of this continent than any other single event, the *Colloquies* are well worthy of remembrance.

If Garcia's name and fame are not so well-known as they might have been among scholars and students in India, it is, because, till very recently, there was no translation of his *Colloquies* in English. Sir Clement Markham filled the lacuna by bringing out a translation of the work in an edition limited to 250 copies which of necessity makes the volume not only very expensive but rare; the translation is dedicated to Sir George Birdwood whom the translator very happily and aptly calls the 'Garcia da Orta and much more of British India.' It is of this translation that we propose to treat after we have set out, as briefly as the subject will allow, an account of Orta's career both in Europe and India. The *Colloquies* in their original language, Portuguese, were edited at the request of the Lisbon Academy of Sciences by Count de Ficalho who completed the task in 1891; it is not possible to praise too highly the erudition and industry of this monumental edition which will stand as a memorial as much to the memory of d'Orta as to the learning and indefatigable researches of the editor. Dr. Gerson da Cunha who devotes a considerable space to d'Orta in his 'Origin of Bombay,' and also Markham, have drawn exclusively upon the Count's work for their material. Since the publication of this edition 31 years ago, some additional material in connexion with d'Orta 's career in Europe has come to light; but even this will not help us to fix the date of his birth or death.

We have no record of Garcia's birthday; the baptismal registers of Elvas, where he is said to have been born, go back only up to the year 1532 and Garcia was in all probability born in the last decade of the 15th century. We have no reliable information as to who were his parents, what were their names or their social standing. Senhor A. Thomas Pires, who has published a brochure entitled '*Studies and Notes on Elvas*', tells us that after going through all the available materials and deducing from them conclusions, which appear to him not unwarranted, he believes it is possible to hazard the opinion that one Jorge d'Orta, a petty shopkeeper, was the father of the naturalist; that he had a brother Francisco d'Orta who was a Bachelor of Laws, and a sister Beatrice who was married to a lawyer, Gabriel Luis, and that a Surgeon, Jorge d'Orta, was either a younger brother of his or his brother's son. These are all conjectures and no more. We tread on surer ground when we go over his early career at the Universities. Garcia's parents must very certainly have belonged to a class which valued education, for they provided young Garcia with the very best education it was possible to obtain in his day, and this at the Universities of Salamanca, then known as the 'New Athens,' and at Alcalá de Henares. We have several references in the *Colloquies* to his doings at these seats of learning, and, if we fix his birth at about 1490, it is very probable that he studied in Spain during the years 1515-1520. Garcia, it was fortunate for him, was at the Spanish Universities when they were pulsating with the new life of the Renascence of which Spain had felt the first stirrings in the closing quarter of the 15th century. This was the age of Ferdinand and Isabel, of Columbus and of the wealth of Peru, one of the most glorious pages in the annals of Spanish history, only so much blackened by the fumes of the Inquisition fires. The University of Salamanca enjoyed at this time the reputation of being one of the most important centres of scientific learning, and that not only in the Iberic Peninsula but in Europe; it was this fact that naturally drew to it young Garcia away from his own country and its University at Lisbon. He probably pursued his medical studies there. The medical school of Salamanca like that of every other continental University was in this age dominated by the writings of Hippocrates, Galen and Avicenna, for the reaction against Mohammedan learning and culture had not yet begun in Spain. In natural history Aristotle reigned supreme. Botany as a science did not exist, though the value of plants in the work of healing was not ignored. The Materia Medica of Dioscorides in its original form or with the annotations and commentaries of Avicenna, Mesui, Serapian or Moco was the standard text book. It is necessary to know this and also to remember that this was an age which believed in the authority of great names and of citations, to appreciate the advance that is made by d'Orta, who, though he does not cease to treat the names of authorities with the customary deference, brings personal observation and experiment to bear on the plants, drugs and their properties he is describing, and, when in the light of these his opinions do not accord with those of the great masters, he does not hesitate to say they have erred. It is difficult for us, at the present day to realise the amount of courage that was necessary to overthrow the accepted truths of the ancient doctors which had such an extraordinary hold on the reverence of learned men in that age;

this courage Garcia no doubt possessed, for he is not dismayed to say that 'Mateolo Sinense, a learned man talked much of elephants and not with so many truths as I have related' or to challenge the descriptions of the pepper tree, its cultivation, the mode of gathering of the seed as given by Dioscorides, Pliny, Serapian, Galen, Avicenna and even by St. Isidore (who he naively remarks must, as a saint, be considered a high authority) and which he unequivocally calls so many fables. These are only two instances among a large number that are to be found in the *Colloquies*.

To attend lectures at the University, it was necessary to be a Bachelor in Arts which then implied a knowledge of Aristotelian Logic, Mathematics, Music, Greek and Hebrew. Latin was the language in which the learned not only wrote but also conversed and lectured in; the professors of the more important chairs were expressly directed not to use the romance languages in teaching. It is curious to note that in an age which was remarkable for its submission to authority, the constitutions of the University sanctioned practices which are not only unknown to-day but would be looked upon as subversive of all discipline, even at seats of learning, in the most advanced democracies; think of it, the students were allowed to take part in assessing the merits of applicants to a vacant University chair and to vote in favour of the candidate they favoured; the students therefore played no unimportant part in the selection of their professors and it was believed that this practice helped to beget a sort of intimacy and solidarity between the teacher and the taught.

It is not possible for us to say, with any certainty, what course of studies Garcia pursued at Salamanca. Ficalho thinks it very likely that he took his Arts degree in Salamanca and also studied medicine there, and that he went to Alcalá, which was just then rising into prominence under the care and patronage of the famous Cardinal Ximenes Cisneros, in order to listen to the lectures of some of the distinguished professors in medicine of that University. The existing archives of the Universities of Salamanca and Alcalá go back only to the years 1546-7 in the case of the former, and to 1548 in the case of the latter, and hence the difficulty of making any definite assertions with regard to the course of studies that d'Orta pursued at either of these Universities.

From the references to d'Orta in the records of the Lisbon University, we know that he had taken the degree of Licentiate of Medicine and not the Doctorate; this was not because he lacked the necessary qualifications, but, because he evidently fought shy of the solemn and pompous processions on horseback through the streets of Salamanca or Alcalá, accompanied by trumpeteers, the visit to the bull fight and the entertainment with refreshments to all that joined in the cavalcade, that the conferring of the Doctorate in those days implied. It is a matter of curious wonder, to us of the present day, to note that the new doctor had to present to each of his examiners and also the doctors and masters in his faculty who might be present at the examination session, two dobras, (a dobra was a gold coin of the value of about £3-12) a torch or flambeau, a box of confits, and three brace of fowls. As the examination got over, as a rule, in the evening, a sumptuous dinner had to be prepared for the examiners which ran into several courses, at which, the flow of learned speech was not unaccompanied by the flow of rich and generous wines, and, all this, of course, at the cost of the new doctor. Examinations and examining was not then the barren, soulless business-affair it is to-day. No wonder that young Garcia who was prudent enough to see that his ambitions in the directions of the doctorate had to be bounded by the length of his purse, was content to remain a Licentiate.

After leaving the Spanish Universities, Garcia, very naturally, desired to set up in practice in his own country, and, particularly, in or near his own native town; before he could do so, he had, however, according to a royal decree of John I of Portugal, to be certified by the reigning sovereign's Physician of his competence to do so. There have come down to us two documents, in the first of which 'King John III makes it known to all whom it may concern that the Licentiate Garcia d'Orta, the physician residing at Castello da Vide, is permitted to go about on a mule or a pony during such time as he does not own a horse.' In the second which is dated five days latter, *viz.*, the 10th April 1526, the same king in view of the learning and scientific attainments of d'Orta and also because of his having satisfied His Majesty's Physician-in-chief both in the theory and practice of medicine, permits him to practice in all his kingdoms and dependencies. The privilege of being allowed to ride a mule or a pony may appear to us curious if not ridiculous; but these were days when the Iberic peninsula was in a ceaseless state of war with the Moors, and no measure to render the fighting efficient could well be despised; improving the breed of their horses by discouraging the use of small statured animals was not the least important of these.

Garcia, as we then see, started life as a physician at Castello de Vide. He did not remain there very long; either he found the life of the practitioner dull and irksome, or, it may also be, practice in a suburban town did not satisfy his aspirations or provide enough scope for his abilities, for, within a year, that is, on the 16th January 1527, he presented himself as a candidate for the Chair of Logic which was vacant at the University of Lisbon. He was not, however, successful, for, one João Ribeiro, a Master of Arts of the University of Paris, was selected to fill this appointment. In the same year the professorship of Moral Philosophy also fell vacant and d'Orta was again one of the competitors for this post, but with no better result. There is an entry in the University registers which shows that on the 5th January 1530 he was appointed to the chair of Natural Philosophy for the period of one year, though, from other references, it appears, that he continued to hold this appointment for a much longer period; in 1532, in addition to this work, he was also made to act for the Professor of Logic; in October of the same year, he was elected a member of the committee of professors who had to look after the financial and administrative work of the University; in the terminology that obtains at our University of Bombay, he was appointed one of the University Syndics. Our object in referring to these academic appointments held by d'Orta is, to account for the erudition he displays in the *Colloquies* and to point out, that, at the time he was in India, he was, without any doubt, the most learned and scholarly European in the country. Over fifty writers, ancient and contemporary, Greek, Roman, Italian, Spanish, Dutch, French, Swiss and Arabian he lays under contribution and quotes in his *Colloquies*; the display of such learning would have been impossible without his studies at the Universities and his academic connexions in Lisbon.[1]

The Portugal of this period was bursting with life and activity. In a quarter of a century that preceded the time of which we are speaking, this small oountry and its people crowded achievements in their history which might well have made a more powerful nation, or a more populous and extensive country, swell with pride. Not to speak of the earlier successes achieved under the guidance and direction of Prince Henry the Navigator in opening the western coast of Africa, we find, that from about the year 1486 when Bartolomew Dias doubled the Cape of Good Hope, the country witnessed a new and more

1 Estudos e Notas Elvenses by Thomas Pires, 1905, and, Garcia d'Orta, Notas sobre a sua passagem pelo estudo e escolas gerais de Lisboa, 1527-1534 by Dr. Teixeira de Carvalho. Coimbra 1915.

memorable and eventful era of discoveries and explorations.[1] The East was throwing into the lap of Portugal its dazzling wealth and treasures. Lisbon was the mart of Europe. But the wealth of Ind was not without its influence on the social and economic life of the country; high and low now dreamt of nothing but the immense fortune that awaited all those who dared to face the long and perilous voyages to the East and sojourn there for a brief space. Amidst all this rush for the newly discovered Eldorado, there were not wanting discerning and wise heads who foresaw how 'the fragrance of the cinnamon' would lead to the depletion of the population of the country, and, how the contact with the East and the new standards of life and thought it would introduce would relax the moral fibre of the people and ultimately lead to the ruin of the country. A Portuguese writer of a little later date very tersely summarises the situation. He says, 'the Portuguese plundered India ; India corrupted them; they are both quits.'

The *fames sacri auri*, and, it may also be, the spirit of emulation that was called into being by the memorable deeds of prowess and daring in the East, could not be kept away from academic centres like the University of Lisbon, which, as a rule, are known for their love of learning and ease and poverty. The feverish yearning to go to the Indies did not spare d'Orta ; it would be improper to suppose that in his case it was merely the seeking after gold that made him decide to bid good-bye to the University and its cultured ease, and to accept the invitation of Martim Affonso de Sousa, the friend of himself and his family, to proceed to India early in March 1534. It is true, his position at the University was not secure ; moreover, the salaries of the professorate, then, as now, were exiguous, and, little wonder, if the desire to improve his fortune should have had its due weight with our physician ; but besides these motives, it appears to us that one other of no small importance must have weighed with him in arriving at the decision, and, a due appreciation of it will enable us to place in proper perspective d'Orta's contribution to the scientific awakening in his country. Mr. K. G. Jayne, in his article on *Portugal* in the Encyclopedia Britannica, says:—'The reformation never reached Portugal, but even here the critical tendencies which elsewhere precede reform were already at work. Their origin is to be sought not so much in the Revival of Learning as in the fact that the Portuguese had learned on their voyages of discovery to see and think for themselves. The true scientific spirit may be traced through the *Roteiros* of D. João de Castro and

1 Encly. Brit. Art. Portugal.

the *Colloquies* of Garcia de Orta—men who deserted books for experiment and manifested a new interest in the physical world.' It was just this interest in the physical world, the desire to see and observe new countries, new peoples, new phenomena and plants and drugs, as much as any other motive, which must have made the Professor of Natural Philosophy to give up his *otium cum studio* life at the University for the then much talked of and mysterious East.

Following the trade instincts of the day, d'Orta with his small savings bought some commodities and drugs, among others, as he himself tells us, 'five quintaes of guaiacao (Guaiacum officinale)[1] to be sold at a profit in India, and joined the staff of Dom Martim Affonso de Sousa who had been appointed Admiral-in-chief of the Eastern waters, an appointment which ranked second only to that of the Viceroy of India, as his personal physician.

There is reason to believe that the family of d'Orta occupied a position of dependency on that of Sousa, and, that in consequence, young Garcia and Martim Affonso who were more or less of the same age had known each other in their boyhood. This early association had been renewed when Affonso went to Salamanca to court his bride, D. Anna Pimentel, about the same time that d'Orta was at the University there; when a seasonable opportunity offered itself, de Sousa did not forget to exercise his patronage in his friend's favour.

The fleet of five ships, one of which, the *Rainha*, was the flagship of Martim Affonso and aboard which was our physician, sailed from the Tagus on the 12th March 1534; it arrived in Goa in September of the same year. The period in which d'Orta arrived in India was eventful not only in Indian history as a whole, but, especially in that of the Portuguese in India.
At this stage it becomes necessary to survey very briefly the events which then occupied the attention of the Portuguese in India, and also, the political conditions that obtained in a part of our western coast.

Nuno da Cunha was at this time Governor of Portuguese India; he had taken charge of his office on the 25th November 1529, and, agreeable to the instructions which he brought with him from his sovereign, either to take Diu or to build a fortress there, early in 1531, he sailed with an imposing fleet against this little promontory to the south of Kathiawar; his attempt to take the place which was then defended by Malik

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1 Coll. 47.

Toghan, the governor of Bahadur Shah of Guzerat, was a failure. Da Cunha however did not abandon the idea of taking the place which was so necessary for the Portuguese trade ; it was a very important link between Goa and all the r trading settlements on the Western coast, on the one hand and Ormuz, the Persian Gulf and even the Straits of Babal-mandeb, on the other. What he had failed to achieve by force of arms, he now tried to secure by means of diplomacy. A meeting between da Cunha and Sultan Bahadur Shah was arranged and the former set out for Diu which was to be the place of the conference, but, when he arrived there, he found that Bahadur's mood had changed, and he would not fix a day for the interview and Nuno left Diu in a rage. Meanwhile Bahadur Shah relented and sent an ambassador whom the Portuguese call Xacoez—Khwaja Sheikh Iwaz—who carried with him advantageous terms of peace. The ambassador came up with Nuno da Cunha at Bassein. Nuno thought it desirable to take counsel in a matter of such importance with an official who was second only to himself in power and influence, Martim Affonso de Sousa. As we have said before, Martim Affonso had arrived in India in September 1534, and, soon after, had been ordered to proceed to the North to keep an eye on the coast of Cambay. The Admiral, sailing northwards, halted at several ports and among these was Bombay. Garcia was with him and the learned physician keen on acquainting himself not only with the natural history but also the antiquities of the surrounding country, paid a visit from Bombay to the Elephanta Caves of which he is the first European to give us an account, and this he does in the colloquy on the Turbit. When Martim Affonso in compliance with the governor's invitation went to Bassein, Garcia was also with him and was, no doubt, trying to acquire an insight into the politics of the country and into the tortuousness of Oriental diplomacy. The terms of the proposed treaty were, after some negotiations, found acceptable by the Portuguese authorities, and the signing of the treaty between the two high contracting parties which took place at Bassein on the 23rd of December 1534 was celebrated with great éclat. During these negotiations, Count Ficalho conjectures that Garcia must have made the acquaintance of the 'Coje Percolim,' the rich Persian merchant who was employed by the Portuguese in their intrigues against Malik Toghan, the Governor of Diu, and whose signature as an interpreter the Treaty bears. D'Orta refers to him in very flattering terms and also to the information he obtained from him regarding aloes, their place of origin, and their quality. The early months of 1535, our physician with his master, Martim Affonso, spent at Bassein, and to their stay there, we are indebted for the description of Bassein and Salsete, an account of the Kenery caves and for detailed particulars of the inhabitants which made up the population of Bassein; this description[1] in the Colloquies is a classic with regard to the early ethnographical history of Bombay and its environs.

Matters of importance were now brooding, and the Admiral and his physician would soon be called upon to take actual part in fighting and be forced to draw the sword on behalf of Bahadur Shah against his enemies the Moghuls. It was not without an object that Bahadur Shah had shown so much anxiety to buy peace from the Portuguese at the sacrifice of Bassein and the integrity of Diu; he had feared being crushed between the Portuguese on the one hand and the Moghuls on the other. He had incurred the hatred of Humayun by refusing to surrender a relative of the Moghul Emperor who had made an attempt on his life and who had sought and received shelter at Bahadur's court. The Moghul troops were set in motion against Bahadur Shah and the Sultan's army was badly shattered by them. Bahadur Shah, whose pusillanimity and irresoluteness appear to be the outstanding features of his character, abandoned Ahmedabad, his capital, and sought safety in flight to Diu. From this place he sent a Portuguese, Diogo de Misquita, to the Governor of Goa to plead for urgent succour against his enemies; this messenger, on his way to Goa, met Martim Affonso at Chaul, and gave the latter a full account of the low condition of Bahadur Shah's fortunes. Martim Affonso saw in this predicament of the Guzerat Sultan an admirable opportunity of obtaining from him permission to construct the much and long desired fortress at Diu and forthwith proceeded to Diu with only four light vessels. As was to be expected, Bahadur Shah was prepared to make any concessions, if only, he could expect Portuguese help, and lost no time in granting permission to have the fortress erected. Very shortly after, Nuno da Cunha arrived at Diu and a treaty was signed between him and Bahadur Shah by which the grant of the site for the fortress was confirmed, in return for which, the Portuguese were to help him against the Moghuls. The Portuguese lost no time in beginning work on the fortress; the foundations were laid in October 1535 and it was completed in March of the following year, and, during this time, every one from the highest hidalgo down to the humblest marine took his share in the work of construction. 'The Portuguese fight like heroes and work like begaries' is what Nuno is

1 Coll. 54.

reported to have remarked to Bahadur Shah. D'Orta was in Diu during this time; he tells us himself that :—

"When that invincible Captain Martim Affonso de Souza came to Diu with forty men, by order of Sultan Bahadur, who was the most powerful king of Mourama, and with so much force and risk, occupied his city of Diu, so renowned throughout the world, I was with him. After we received the permission of the king to build a fortress, I was idle, looking upon the opulence and traffic of the city. One day being in the bazar in the afternoon, sitting at the door of one of the merchants they call Banians, a woman came past with a sack of dried Turbit for sale. As I was an expert in medicines, and had heard that they were brought there for our ships, I asked the Banian what it was. He replied that it was Terumbu, and that we and the Moors gave it that name, but that the Mahrattas (who are gentios) call it Barcaman. I then asked for what it was bought and its use. He said it was of use to purge the stomach, that it was considered a good medicine, and was taken by the merchants in their ships to Arabia and Ormuz. He praised it much and asked me if I wanted to buy it, and he showed me its gummosity and whiteness. As I knew that our people valued it, I bought it, each maund for a tanga, which is 60 reis, one maund being 27 pounds. But he gave the woman very little. From what I afterwards heard from some other Banians he doubled the price to me twice over."[1]

Even the ingenuousness of the Portuguese Professor and Physician could not be blind to the wiles of the ubiquitous Bania.

In return for the concessions at Diu, the Portuguese had to help Bahadur Shah in driving the Moghuls from Guzerat; the task was well-nigh a hopeless one, but their part of the obligations had to be carried out. Martim Affonso readily offered to lead a contingent of the Portuguese; five hundred of the most valiant Portuguese soldiers volunteered to serve with him and among these was a group of young and brave hidalgos who were always to be found by the side of their commander in moments of peril. D'Orta, too, as was to be expected, did not remain behind but accompanied his chief. Bahadur Shah went with the expedition, and, we are told, was always to be found by the side of the Admiral. The expedition traversed Katiawar and when it came near Ahmedabad it was threatened by Mirza Askari's cavalry of about 8,000 chosen men. But by a clever stratagem of Martim Affonso who massed thousands of the flying villagers on his flanks and whom the Moghul commander mistook for fighting men, the attack never came off and the ever vacillating Bahadur, glad to have got out of this scrape so cheap, lost no time in returning to Diu. There are two brief references in the *Colloquies* to this campaign[2] in which, as we have said before, their author took part; we should much have prized a detailed description

1 Coll. 45. 2 Coll. 27 & 36.

of this expedition from our physician. The expedition, to say the least, was a piece of foolhardiness. Not long after their return to Diu, d'Orta and his chief went to Goa and spent the rainy months there (1536).

He was not to remain there long, for, as soon as the rains were over, Affonso de Sousa was ordered to the Malabar coast to help there the Raja of Cochin against his neighbour, the Raja of Calicut, in one of their interminable quarrels.

The Arab trade connexion with Malabar had existed from very early times and, as a consequence of it, Mohamedanism had obtained a strong footing in the country, so much so, that in the 9th century, Perumal, the last king of Malabar, turned Mohamedan and dividing his kingdom amongst numerous chieftains went on a pilgrimage to Mecca. The ruler of Calicut enjoyed a sort of primacy over the other chiefs and was known as the Samuri—the Portuguese call him Zamorin. In early times, the population of Calicut had been increased by the immigration of Mohamedans from Arabia whose descendants were now rich and flourishing traders; these saw in the arrival of the Portuguese serious rivals to their trade and, therefore, it is not to be wondered at, that when Vasco de Gama first landed at Calicut, he found the Mohamedan influence so powerful there that his efforts to build a factory at Calicut proved futile; similar efforts made by Cabral two years later met with no better result. The Portuguese, in order to counteract the hostility of Calicut, dominated, as we have said before, by the Mohamedans, entered into an alliance with the Raja of Cochin who, though not so powerful as his neighbour of Calicut, had yet managed to shake himself free from any dependence on him. In Malabar, therefore, we have the spectacle of two ancient Hindu kingdoms, one of which, Calicut, represented the Mohamedan influence and the other, Cochin, that of the new arrivals, the Portuguese.

At the time of which we are writing, the Samuri of Calicut, according to the Portuguese chroniclers, desired to have himself crowned at the sacred stone at which it had been the practice for the Calicut sovereigns to be crowned; this famous stone which puts us in mind of the 'stone of destiny' at Scone rested at first in Cochin but had been removed to Eddapalli. (the Portuguese chroniclers call the place Repelim). The Raja of Cochin was opposed to the Samuri's crossing over to Eddapalli through his territory, because he thought that this move might be in the nature of a covert and indirect assertion of his suzerainty over him and the Raja of Eddapalli. The

Samuri in the pursuit of his object marched through the principality of Cranganore and burnt an old Church of the St. Thomas Christians there, and, encamped on one of the banks of the river separating Cochin and Cranganore; on the other bank, were the troops of the Cochin Raja reinforced by the Portuguese, who had been roused to come to his assistance as much by their political alliance as by their desire to avenge the insult offered to their religion by the wanton burning of the Christian church.

When news was brought to Nuno da Cunha of the open hostilities between the two rulers, he lost no time in ordering Martim Affonso de Sousa to proceed to the help of Cochin. The Portuguese Admiral decided to put an end to the quarrel by attacking Eddapalli and having the sacred stone removed from there and placing it in charge of its former guardians, the Rajas of Cochin. Due to the reckless bravery of Martim Affonso and of that faithful band of valiant admirers of his who were always by his side, the place was taken and the stone which was lying in a temple discovered. D'Orta was present at the taking of Eddapalli and gives us a description of the fighting there as well as of the stone whose origin he attributes to the Chinese who 'left a stone in Cochin as a mark in memory of their having been there.' d'Orta is evidently repeating the traditions that were current about it. From the description of it left to us by the Portuguese chroniclers there can scarcely be a doubt that it was the *linga*, the emblem of Shiva, the creator, and, as it is well known, Shaivism was specially strong in the South.

Garcia d'Orta's visit to Malabar is very important from the point of view that he had a splendid opportunity to observe for himself the trees which provided the rich and profitable cargoes for the Portuguese ships on their homeward voyages, to get an idea of the way they were cultivated and to see how far the description of them and their uses coincided with or differed from that given by ancient writers. Malabar was the home of the *pimenta*, the *piper nigrum*, the *gingiber officinale* and the cocoanut, from very early times.

In all probability, the wet season of 1537 he and his master Martim Affonso spent at Cochin. But when the fair season began, the latter went out to sea with his fleet in pursuit of a large fleet of foists (paraus) got together by the Arab party in Calicut, commanded by Ali Ibrahim Marakkar, which aimed at carrying assistance to one of the two factions in Ceylon which was opposed to the Portuguese. Martim Affonso with his fleet carrying about 600 Portuguese combatants came up with the Mohamedan fleet at Vedalai (the Portuguese chroniclers call it Beadala) in the gulf of Manaar where Alli Ibrahim had fortified himself; the Mohamedans numbered about 8,000 but they were defeated, their camp captured and their ships burnt. The spoil that fell into the hands of the Portuguese was considerable. In all probability, d'Orta was present on the Admiral's ship on this occasion. He refers to this action in his Colloquy on the Cinnamon,[1] but there is reason to believe that his version of the losses sustained by the enemy is open to question. This is what he says, "The King of Cochin remained deeply obliged to the Captain Martim Affonso de Sousa who sent him the umbrella, which he took from the paraus in Beadalla, (there were 57 of these paraus there) where 15,000 men were killed, there being only three hundred survivors. He also took 600 pieces of artillery and more than one thousand muskets."

After this success, d'Orta went with the fleet to Colombo. In Ceylon, the ruling king, Bhuwaneca Bahu VII, whom the Portuguese chroniclers call Boenegobago, was very friendly towards the Portuguese on whom he counted for help and protection against his enemies. His younger brother, Mayya Dunnai, the Madunne of the chronicles, was at the head of the nationalist party which was opposed to any foreign alliance, in this case with the Portuguese, and fomented not only hatred against them but even measures for their extermination. It was natural that the Mohamedan element in Ceylon seconded these wishes of Dunnai and it was with a desire to help him in the realisation of his schemes of driving away the Portuguese that Marakkar (the Portuguese Pachimarca and Patemarcar) had sailed with a large fleet to Vedalla. When the insurgent brother received news of the complete destruction of this fleet, he promptly raised the siege of Cotta in which his elder brother, the ruling chief, had been invested by him. It was to succour Bhuwaneca that Martim Affonso had hastened to Colombo. But when he arrived there, he found that the two brothers had been reconciled. d'Orta was doubtless with Martim Affonso on this voyage to Ceylon; his stay there was brief; but, it is possible, to trace to this visit, his description of the cinnamon which has all the appearance of being the fruit of personal and direct observation. Many other references to this fertile island are to be found scattered throughout the work, such as, his description of the way elephants are captured or the list of the precious stones that are

1 Coll. 15.

to be found there. These instances are sufficient evidence of the thoroughness with which he collected all possible information relative to any place which he visited.

We have many references to the Moluccas, Sumatra and Bengal in the *Colloquies* but there is no direct mention in them of his ever having visited these places, nor is there any other evidence to point to his having done so. Ceylon therefore marks the southernmost limit of d'Orta's travels in India. He could not have been long in Ceylon, for, according to some chroniclers, Martim Affonso is reported to have anchored in the harbour of Cochin during the rains of 1538, and, according to others, in that of Goa.

In 1538, on the 24th September, D. Garcia de Noronha, nephew of the great Albuquerque, reached Goa as Viceroy, at the time when the fortress of Diu was being besieged by the Turkish fleet under Suleiman, by sea, and, by the armies of the Guzerat Sultan under Sifar Agha, by land. The Viceroy was accompanied by his son, D. Alvaro de Noronha, who had been appointed the Admiral of the Eastern waters in place of Martim Affonso. To him Affonso promptly handed over the charge of his great office and, disgusted with the vacillating policy of the newly arrived Viceroy in respect of the measures taken to relieve Diu and the listlessness with which the Portuguese commanders pursued the Turkish fleet after they abandoned the siege, he begged leave to be allowed to return to Portugal; this was granted and Martim Affonso, soon after, went to Cochin and there boarded a vessel that was bound for Portugal. But Garcia d'Orta, his physician and the friend of his youth and his companion in so many thrilling events of the past four years, remained behind. It may be, he thought, that it would be more profitable for him to settle down in Goa as a practitioner, having seen for himself the large field both in Goa and among the Indian princes of the neighbourhood there was for the lucrative exercise of a profession which at that time certainly did not have any members with d'Orta's proficiency; what is equally likely, the scientific curiosity in the plants and drugs of India and the East generally, roused in him by his travels and by his contact with the people of the different parts he visited, and, the desire to carry on a scientific investigation of the materia medica of these plants and drugs, might have strengthened his inclination to stay behind. We shall see later on that he was not mistaken with regard to his expectations of a lucrative practice in this country.

The scene of d'Orta's activities will now be Goa; only occasionally is he absent from it when he is called on professional business by some of the princes in the neighbourhood, as he often used to be by his friend Nizam Shah (to give him his full name, Bahram Nizam Shah of Ahmednagar) or to visit his manor of Bombay. Garcia lived in Goa for more or less thirty years; his position as a physician must have given him access to the highest and the lowest society of that great emporium in that age, and it is, therefore, to be regarded as a matter of sincere regret that d'Orta leaves no detailed history of these times which, from many standpoints, would have been as piquant and interesting as from the purely historical, invaluable.

Goa was the Portuguese capital of their Eastern Empire and the period covered by d'Orta's stay there marked the culminating period of their history in the East. No wonder, that in the city of Goa were concentrated all the virtues and vices that foreign domination and trade and wealth bring in their train. We shall briefly survey the political and social life of the city at this time to be able to picture the sort of background of the scene in which our physician moved. The Viceregal Court, the military and the Naval forces, the civilian officials and the clergy, to which must be added the indigenous population who were content to play a very passive rôle, practically speaking that of spectators, sum up the *dramatis personae* in the spectacle of the early Portuguese successes in the East.

The Viceroy's Court in Goa was, it is said, in no way inferior in pomp and grandeur to that of Lisbon or, for that matter, to that of any other European court of that age. Such pomp as is attested to by reliable travellers of a later date, when the Portuguese fortunes had already been dimmed, could only be possible for officials who were not careful about the proper administration of the country's finances. The highest officials not excluding the governors and viceroys were charged, not infrequently, with dishonesty in respect both of public and private funds; many governors doubtlessly used to return very rich to Portugal. Contact with the East and the facility of acquiring wealth had relaxed the moral fibre, and, what is more, the character of the Portuguese relations with the Orient, in part military, in part commercial, could not but lead to a false value of lines of conduct. Men that fought like heroes today might be seen busy trying to make the most profitable bargains in the purchase of ginger and pepper and cinnamon on the morrow, and this can be said as much of governors and sea-captains as of the lowest placed soldiers or marines. Offices were given to broken down noblemen and their friends to enable them to make good their fortunes in the East. Already in 1508 D. Francisco de Almeida had sounded the note of warning. When writing to his sovereign he had said that his Majesty could never expect to be well served when his officers, both revenue and of justice, did not scruple to play the rôle of merchants. Conditions became much worse when the Portuguese decadence had long set in. But, at the time of which we write, there were yet many governors or viceroys who maintained the high character of their office unstained.

In all societies the lower strata take their cue from the one above them, and the hidalgos of whom there were quite a large number in Goa, for they represented the bureaucracy of Portuguese India and were the commanders of ships and of fortresses, were not slow to imitate the ways of the governors. Very few of them came out of the fire of temptations that surrounded them unscathed, and it is refreshing to note that among the hundreds that have left behind them a name for cupidity and cruelty there are to be found men like Duarte Pacheco, D. Lourenço de Almeida, D. Fernandes de Castro, Heitor Silveira of Diu fame, Manuel de Souza de Sepulveda, who relieve the sombreness of the picture by their bravery disinterestedness and chivalry.

The men who came out to India as soldiers were not of as sterling a metal as one should like to have seen; as is to be expected, the lure of the East with the stories of its untold wealth and the ease of acquiring it had proved too strong for men of all conditions and characters. Later on, when the casualty and sick lists overcame the cupidity and greed of such men, the prisons were made to contribute their quota to the fighting strength of the East. When Garcia de Noronha, to whom we have referred above, was coming out as Viceroy (1540-2) 'to man the 11 ships of his fleet, extraordinary expedients were adopted, for, so scarce were the men in Portugal that outlaws had to be tempted in and prisoners released by a pardon general to all offenders save those against religion and the King.' The long voyages, the crowded ships, the bad quality of the water and the food on board made many victims to scurvy. It is surprising to note that at this time in spite of the continual state of warfare in which the Portuguese were involved, and in view of the importance of an efficient soldiery for their campaigns, there seems to have been no regular organisation nor barracks provided, not even rations served; living in hired lodgings, in most cases far from respectable or decent, they overran Goa in bands trying to eke out their salaries, small and irregularly paid; not seldom, they pawned their arms in the taverns and ate their meals which some of the richer hidalgos provided for them or took advantage of the soup that was served out at the gates of the convent of St. Francis of Assisi and other religious houses. But when the rains ended and the fleets were got ready to proceed to Malabar or Cambay, the hidalgos who had obtained command of the foists or galleys went in search of these soldiers to man their vessels and selected, of course, only such as appeared strong and were well armed. The morals of these men were tried by all the seductions which the bazars in the East offer to men of their station in life. Among soldiers recruited and working in these circumstances, what wonder that a large number were attracted purely by prospects of booty and plunder? Avarice is a failing which the majority of them shared with their betters and, to correspond to the shining exemplars of honesty and selflessness that we meet in the hidalgo class, there are to be found among these soldiers and sailors men who could pride themselves on their sobriety, their capacity for suffering and their valour. To us of the present day who are used to think in terms of the rapid means of communication and comfortable, if not luxurious, means of travel, it is difficult to realise the hardships of ocean sailing of those days on small and cramped ships, the sufferings and the high mortality due to sickness, shipwrecks and fighting, sufficient to daunt the bravest. The wonder, therefore, is, that in this strange grouping of men were found the types who behaved like heroes, as in the siege of Diu, to take only an instance, a siege which will always rank not only among the brilliant exploits of the Portuguese in the East but even in the world's historic sieges.

The governors, the hidalgos and the soldiers represent the Court and the Military. The Civil life of the country was in the hands of the judiciary and the revenue officials, and of neither of the two classes can it be truly said that it was free from corruption. The complicated forms of European legal procedure, so unsuited to the people in the East with their notions of patriarchal justice, left ample scope for venal practices. The Revenue department which touched the life of the indigenous population more closely than the other state services did not yield to the military in avarice and, not infrequently, their rapacity led them to the oppression of the native inhabitants. Count de Ficalho briefly sums up the character of the civilian officials in these words: 'all these officials, the chief magistrates, the revenue comptrollers, the finance officers, the judges, the administrator general of the estate of deceased persons, the bailiffs and clerks who were in Goa, some of them married and with families, formed the class of public civil servants; with some honourable exceptions this class was tainted with the vices of the time and the place, many of their members being open to corruption and fond of mischief and intrigue; they had all the defects of the hidalgos without any of their brilliant qualities.' This much for the civil service in d'Orta's time.

It remains for us to speak of another body of men whose influence in mitigating the evils of the Portuguese dominion over the peoples of the East was not inconsiderable and who then played and have since then also played no small part in spreading the moral ascendancy of the Christian religion in the East. This was the clergy, both secular and regular. During the greater part of the time that d'Orta lived in Goa, D. Fr. Joaõ de Albuquerque was the Bishop of the place; though the religious zeal of this prelate was marked by acts which, according to our present day canons, cannot but be regarded as bigoted and fanatical, such as his burning of the books in the vernacular and the destruction of Hindu temples, nevertheless, all witnesses of the time testify to his poverty and his virtuous and austere life and to the justice of his ecclesiastical administration. The Franciscans from the time of the conquest of the city by Albuquerque had spread over Goa and other Portuguese cities in the East; by the middle of the 16th century a large variety of the Franciscan orders were to be found in Goa. In 1542 the Jesuits made their way into the place, and one of their earliest representatives to set his foot in Goa was that exemplar of Christian virtues, Francis Xavier; in 1548 the Dominicans established themselves in the city and the Augustinians or White Friars in 1572, that is, some years after the probable death of d'Orta. A dispassionate consideration will show that the influence of the religious orders during the first half of the 16th century was certainly beneficial, and their moral influence was felt as much by the Hindu population among whom the ascetic life, the abnegation and the voluntary sufferings of a Xavier or a Fr. Vicente would not pass uncommented as among the Portuguese themselves. We know for a certainty that a few months after Xavier's arrival in Goa the sharpness of his reproofs and denunciations led to a revival of religious practices and observances among the Portuguese which however proved to be only of temporary duration.

Francis Xavier had come down to Goa in the vessel of Martim Affonso when the latter was sent down as Viceroy; this fact alone would be sufficient to lead us to presume that d'Orta knew and had come in contact with this holy man. But we have a specific reference in the *Colloquies* to 'Mestre (Father) Francisquo, the theologian, who was a founder with Fr. Ignatius of the Holy Society, whose virtues and sanctities if they were written down would make a large book even if no reference was made to his conversion among the Paravars.'[1] From this it is quite evident that the physician was fully acquainted with the wonderful missionary successes of the saint. About 1546 under the direction of the fiery and fanatical Miguel Vas, the Vicar-General of Goa, was started the policy of persecuting the Hindu population of Goa and of destroying their temples which not only led to the depopulation of the country but undid the reputation for Christian charity and love which the suave and mild ways of his predecessors had achieved; the Inquisition which was introduced in 1560 was not calculated to strengthen the confidence of the non-Catholic population in their new rulers. Not a little of the responsibility for the ecclesiastical intolerance must be placed on the shoulders of the civil authorities and on the sovereigns of Portugal who seem to have been consumed with a burning zeal to make new Christians, and likewise on the spirit of the times. The civil and military authorities represented that element of the population which was for ever fluctuating, one that had no real and abiding interest in the country; the ecclesiastical authorities do not come within this remark.

A word now about the indigenous population. It was composed practically entirely of the Hindoos who lived in village communities that were to all intents and purposes autonomous. The Mohamedans who had settled in the place during the reign of Adil Shah of Bijapur had been forced to leave the city after its second capture by Albuquerque. Some of the Portuguese who had taken wives from the indigenous population lived in the city and their habits and manners of life were a compromise between those of the East and the West. All menial service was done by the lower classes of the native population, but some of the Hindoo traders of the place owned the most important shops that were to be found in the princi-

1 Coll. 35.

pal business thoroughfare of the City, the Rua Direita; these together with Armenians, Jews, Banias from Cambay and Chetties from the south, carried on the business of money changers and money-lenders.

Some of the Portuguese who had taken wives from the women of the country, in accordance with a well thought out plan of colonial policy, formed part of the permanent population of the city; their habits and ways of life, as we have said before, were a compromise between those of the East and the West. A very noteworthy fact that had a sinister effect on the social life of the Portuguese was the extreme rarity of Portuguese women in Goa at this time; rarely had an official sufficient courage to make his wife and children brave the sufferings of a protracted voyage to India and the influence of a tropical climate. The absence of their womenkind provided plenty of scope for intrigues of all kinds in which men and women of every grade were involved. One item of the social life of the wealthy and the powerful was the frequency of gala banquets; to the middle classes and the poor, the numerous feasts celebrated in the equally numerous churches with all their attendant pomp and processions and sports and cavalcades and displays of fireworks provided plenty of scope for diversion.

We have attempted to paint the background of the scene in which d'Orta moved about for well nigh thirty years. It is safe to presume that the gaiety of the social life of his time could scarcely appeal to one of his studious temperament and that he must have been absorbed for the greater part of his time in the business of his profession and in trying to acquire such information as would prove useful to him in his work. What time he was not absorbed in the business of his profession, he spent in the company of serious minded and distinguished friends, perhaps, trying to interest them in the information of the East which he had so assiduously and carefully collected. A man like d'Orta, accustomed to the academic atmosphere of the University, would not feel happy except in the company of books and men with a taste for knowledge and learning. Was it likely that he would find in Goa the proper environment and the right sort of company to enable him to carry on his researches and curious enquiries? Our answer is, yes. It is not conceivable that a book of the nature of the *Colloquies* which contains references and allusions to all the known literature on the varied and learned topics treated in it could have been written without the help of books or the collaboration of friends who felt an interest in the physician's investigations. But in making a definite assertion on this point we are not left wholly to speculation; there are positive statements of facts in the *Colloquies* themselves and in the lives of the men who figure at this time in the history of Portuguese India from which we can without any diffidence draw irrefutable conclusions.

It is not generally recognised that the discovery of the route to India was no mere chance incident but the result of efforts of generations to put to the proof the geographical and mathematical knowledge that had been fostered by Prince Henry, the Navigator; this explains why the discovery of the trade route to India coincided with the renascence of literary and scientific learning in Portugal; it also explains how it is that the men who came out to India, and we say this of every class, the hidalgos as well as the ordinary civil servants of the Crown, were not mere adventurers, though, they might have had to spend the greater part of their time fighting or trading; far from it, there were men among them with genuine scientific attainments and aptitudes. When they were free to sheath the sword or have a respite from preparing bills of lading, they could use the pen, and this, with great efficiency and perspicacity. To mention only a few names of the men who distinguished themselves in the service of their country, in history and in literature:—there was the famous João de Castro, one of the governors during the time that d'Orta lived in Goa; his claim to memory is not only because of his qualities as a valiant fighter but because of his having written the Log of the voyage from Lisbon to Goa (*Roteiro de Lisboa a Goa*) which has true scientific value. He was the first to give a true explanation of the rise of the Nile in Egypt; he notes the direction of the wind, the deviation of the needle, the effect of the wind on trees, the signs of rainfall. There was Martim Affonso de Sousa, the friend of our physician, who was a mathematician, a writer and a latinist, who showed d'Orta a Platine edition of '*In vitas summorum Pontificum ad Sixtum*' and from it elucidated the derivation of Rume, the name for Constantinople.[1] Duarte Barbosa had come to India only as a writer of the Portuguese factory at Cannanore but he has left us an account of what he saw and heard in India which is of invaluable importance to us to-day for forming a proper estimate of those times. There was Barros from 1528-67, during almost the whole of the time that d'Orta was in Goa, and to him we owe the *Decadas*. It

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1 Coll. 2.

would take us too long to enumerate the long list of names of the Portuguese chroniclers who at one and the same time made and wrote history and, incidentally also, helped in enriching and developing their country's literature which was at this time nothing more than an echo of the great doings of their countrymen in the East. We shall confine ourselves to enumerating only some of the names that we find mentioned in the *Colloquies*.

We have said that the Jesuits had come to Goa in 1542, and they were not long before they took charge of the famous College, or to speak more correctly, of the Seminary of *Santa Fé*, and lost no time in promoting the cause of learning. They were the first to set up a printing press in Goa, and they soon set about acquiring a knowledge of Sanskrit and other Indian languages. They had some very erudite members on the staff of this institution, and it, certainly, possessed a very full library which d'Orta, without a doubt, consulted. D'Orta we know from his *Colloquies* was acquainted with D. Fr. Ambrozio of the Order of the Preaching Friars ;[1] he enjoyed a great reputation as a mathematician, geographer and as a student of Chaldeic and Arabic. Then there were merchants who traded with China, Mesopotamia and various other parts of the East who had found time to observe geographical facts, habits of the peoples among whom they lived, the properties of curious and little known objects they came across in their respective trading centres or to ascertain the derivation of names and terms strange to them, and, when these came to Goa, Garcia would not be slow to eke out his knowledge by converse with them ; he mentions a few such by name in his book. Our author most certainly enjoyed the friendship of Dimas Bosque, the Physician to the Viceroy who wrote a commendatory introduction to the *Colloquies* and of the well known Latinist, Thomas Caide, who showed his appreciation of Garcia's work in some neat epigrams in Latin in which he very skilfully plays on d'Orta's name which in Portuguese means a garden. Last but not least, our physician enjoyed the society of the immortal Camoens ; his stay in Goa was not long, but, brief as it was, it was long enough to have brought him in contact with one who would be able to appreciate the universality of his knowledge, for Camoens was as familiar with the classics and history as with geography and the natural sciences ; the society of such a versatile genius who combined with his attainments an attractive personality could not but have appealed to our naturalist. We think we are not mistaken when we believe their relations to have been of mutual admira-

1 Coll. 50.

tion; of Camoens' regard for d'Orta we have proof in the Ode which the poet wrote in honour of his friend and which was published among other introductory notices in the *Colloquies*. It was the very first piece of the poet's writings to be printed; in it he plays very gracefully on d'Orta's name which, as we have said before, in Portuguese means a garden, and tells us how the physician had opened to the public an inspiring page. "How to thy neighbours like magic it seems. Taught of yore by the Muses of Ganges and Ind, full of learning as of years, in all that is known of the true healing art, old Chiron must bow before thee."

From this we see that Garcia was happy in the society of men of intellectual attainments and predilections not unlike his own, many of whom have also left monumental contributions to the history, science or literature of their country.

When d'Orta sailed to India in Martim Affonso's company, he had been favoured with the privilege of styling himself the "Physico del rei" or what is its modern equivalent, Honorary Physician to the King. He is often styled by many writers the "Physico-mor" or the Chief Medical Officer of the City of Goa; this is evidently a misrepresentation, for there is no evidence whatsoever to show that d'Orta occupied any official position in the city; he was a mere private practitioner. His learning and proficiency in his profession, no doubt, attracted to him the élite of the society for professional help, and we know for certain from his *Colloquies* that he was the private medical adviser of the Viceroy, D. Pedro Mascarenhas who had not brought with him any physician on his staff and who died as d'Orta says "in my hands."[1] But, as we have said before, in addition to the large practice he must have enjoyed in the city of Goa itself, his services were sought by the neighbouring Indian Princes. One of these, Burhan Nizam Shah, he mentions very frequently in his book and with great esteem and affection; he was, no doubt, on the most friendly terms with him, and the Ahmednagar sovereign had unbounded confidence in his ability. D'Orta tells us that he paid many visits to his Court and spent long stretches of time there and that he was treated with special regard. It was, evidently, during these visits that he had ample opportunities of studying the life and the habits and the manners of the peoples of the East and of coming into intimate contact with the physicians from Persia, Arabia and from India itself who used to seek the patronage of the Muslim Courts, and it was there that he was able to identify certain drugs and ascertain

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1 Coll. 13.

their names in the vernacular. After Martim Affonso had returned to Portugal in 1538, d'Orta, who was then free to give his time to his profession as he thought best, must have paid several visits to Ahmednagar. It is a pity that he has not left us an itinerary of his visit to Burhan Shah. Burhan was a Shiah, and according to the Portuguese chronicler, Diogo de Couto, "the most valorous, frank, liberal and just of all the Kings of his time." His Court was open to all religions and sects; a Hindoo was his finance minister, his name Kawur Sein; a Mohamedan, the saintly Shah Tahir, his Prime Minister; and a renegade and apostate Portuguese, Sancho Pires, known by the name of Franagui Khan, his Chief Commander of the Cavalry Division. Burhan was evidently very fond of his cavalry commander, for d'Orta tells us that he cured him of some ailments at the request of Nizam Shah and that the latter would every day visit the patient and took particular care to examine the sick room and would not allow any one else to treat him but him because he was afraid that the other physicians would kill him on account of his being a favourite with the King.[1] The history of this adventurer is one of singular interest and we shall report it in d'Orta's own words. In answer to the query as to whether he was a Moor or a Christian and rich, Orta gives this reply: "In secret he told me he was a christian, and he ate with me things forbidden to the Moors and spoke ill of them. He was not circumcised, though all supposed that he was, but I have seen and he was not. But he pretended to be a Moor and died worth 6,000 crusados of rent. It is true that with this rent the people who served him were paid, and I feel certain that if the devil had not first taken possession of him at Kulburga where he fell in combat, he would have carried out his promise of accompanying me to Goa. I had already secured for him a secret pardon from the Viceroy, D. Affonso de Noronha. He used to give largely to help needy Portuguese and to the Misericordia and other churches and to this I can attest."

D'Orta had, as he tells us himself, cured both Burhan and his son several times,[2] for which he received at various times more than 10,000 pardaus; that Burhan had great appreciation of his services is evident from what d'Orta tells us that he offered him 40,000 pardaus[3] as a retainer for visiting him during some months of each year which the physician did not accept. The fee is colossal, and there are those who cast doubts on the veracity of d'Orta with regard to this figure, but those who are acquainted with the fabulous offers that are made by Oriental sovereigns, much of which, if any at all, is paid for in presents,

Coll. 51. 2 Coll. 10 & 36. 3 Coll. 10.

should have no hesitation in accepting our physician's statement, though we do not wish to imply any reflection on the honesty of Burhan Shah.

That there was real intimacy between the Ahmednagar sovereign and d'Orta is established by the fact that the latter had taught Portuguese to Burhan's son and used to converse with him in that language.[1] D'Orta's visit to Ahmednagar is important, not only, from the point of view that we have many details of the political situation of that time from a reliable and observant eye witness, but because he helps us to form an estimate of the state of the science and knowledge of medicine among its practitioners in India. We have said that d'Orta had been brought face to face with many of the foremost medical men from all parts of Asia who congregated to the Court of Burhan. He must have carried on scientific discussions with them, and in this he must have been encouraged by his royal patient who, too, as he tells us, debated with him on scientific points. Did this converse with the Mohamedan hakims in any way help to improve our physician's knowledge of medicine? He learnt the properties of many drugs new to him, but, as far as medicine was concerned, as he tells us, they had nothing new to tell him, for they made use of Avicenna which they knew by heart, but they did not call him Avicenna but, very correctly- Abolahi.[2] Even the King had his copy of the *Canum*, and on one occasion helped to point out to d'Orta, to his utter confusion, how the betel was very different from the *folium indicum*, by reference to his copy of Avicenna.[3] These hakims also knew Rasis whom they call Benzacaria, and they were familiar with the writings of one of the Mesue. But it is historically important to note that they were on the other hand not familiar with the writings of their co-religionists of the Spanish School, Avenzoar or Avenrrhoes,[4] and this shows how the literature of the Spanish Arabs, in spite of the relations that then existed between the Mohamedan sovereigns of the East and the West, had only a limited circulation. d'Orta tells us also that these Mohamedan physicians were conversant with the works of Hippocrates, Galen, Aristotle and Plato, but that they had only fragments of them, not the complete works as in Greek.[5] The Mohamedan scholars owed these to the great literary developments in the reign of Harun al Raschid, and translations of them that were made during his reign and under Al Mamun and to the Nestorian schools of Edessa. From all this it is clear that as far as medical science went, d'Orta had nothing new to learn from the hakims, for he had studied all the books which they had

1 Coll. 36. 2 Coll. 2. 3 Coll. do Betre e outras cousas 4 Coll. 3. 5 Coll. .

studied at the Universities of Salamanca or Alcala. D'Orta knew the *vaidyas* in Goa and spoke with approbation of some of their methods of treatment and their observations of the pulse in the diagnosis of disease and in the ascertainment of the peccant humours; on the other hand he has hard things to say of their profound ignorance of anatomy: "they do not know where the liver is nor the spleen nor anything else."[1] He believed that they depended for their treatment simply on experience and custom.[2] He had no idea of the great Indian literature on Medicine, of the Ayur Veda or of the writings of Susruta or Charaka, nor is there anything in the *Colloquies* to show that he had any conception of the range and extent of Sanskrit learning in other directions. In part, this ignorance might have been due to the second rate *vaids* that must have been under the Portuguese rule practising in Goa and not men of any profound learning or wide reputation to attract the interest and curiosity of the European naturalist and physician.

We now come to a point which has especial interest to the citizens of Bombay, because it concerns the manorial rights that our physician once owned over what is a part of the present city of Bombay. In the colloquy on Faufel[3] (Betel-nut), he says, "there is a better supply of faufel or areca at Chaul and still better at Mombaim, land and island of which the King and Lord has made me a grant, paying a quit rent." Again in the colloquy on the Jack Fruit tree,[4] we are introduced to a man who, we are told, brings letters to our author from his tenant of Bombay and also a basket of Jamgomas (*flacourtia catophracta*) and, finally, in the thirty fourth colloquy d'Orta is given the pleasant piece of news that his tenant Simaõ Toscano had just arrived with a basket of mangoes from his Bombay-estate as a present for the Viceroy. In the course of the conversation that follows, not without a certain amount of pardonable pride, he tells us that in that island of his he owns a mango tree which has two gatherings, one at that season (about December) and the other in the end of May. Doubts have been thrown on d'Orta's claim to the lease of the island, and, for the simple reason, that one of the most industrious and careful workers among the archives of Goa, the late Senhor Joaquim Heliodoro de Cunha Rivara, an Honorary Member of our Branch, had not discovered among the Goa papers the deed by which this grant was made; secondly, because of the presumption against the grant of the whole island having been made to one in d'Orta's position in life; and lastly, because our physician declares that it had been made over to him in

1 Coll. 36. 2 Coll. 36. 3 Coll. 22. 4 Coll. 28.

perpetuity, for this is what the legal and technical use of the term "fatiota" would imply, and gifts in perpetuity are against the usage of that time when most grants were made for a specified number of lives. We must admit the force of the last argument, but we are against believing that the doctor used the term "fatiota" in its technical meaning, and are content to accept that the grant was made to him for a lifetime, and that, after his death, the island was to be, as actually was the case, to be given away to some one else. There would be considerable force in the second argument if the island, which had been given in fee simple to d'Orta, had at this time any large revenue, and on this subject definite and reliable information is available. Simão Botelho, quoted by Ficalho and also by da Cunha, tells us that the quit rent of the island in 1534, when it formed a part of the kingdom of the Sultan of Guzerat, was 14,400 fedeas, a fedea being equivalent to 15 reis or 4 pies; in 1535 under Portuguese rule it was raised to 17,000 fedeas, and in 1536 to 23,000 fedeas, in 1537 to 29,000 fedeas; in 1538 to 27,000; during these four years the revenue was collected directly by the government, but in 1539 it was farmed out for 26,292 fedeas and in 1540 for 28,190 and in 1541 for 28,100, in 1542 for 30,000, in 1543 for 31,000, in 1544 for 38,500, and in 1545 for the same amount: in 1546 for 1,375 pardaus (each pardau being equal to about 8 annas), in 1547 the island yielded the same but in 1548 owing to the zeal of Simão Botelho, the rent was raised to 1,432 pardaus and the island was leased to Mestre Diogo. "This exuberance of detail," as da Cunha phrases it, has its special purpose. It goes to show that the revenue of the Island was not so very large that the whole of the Island might not be made over by way of grant to one individual; in fact, there were single villages at this time in the Bassein district that yielded more; moreover, we have it on record that the whole island was given in grant to Mestre Diogo, and there is, therefore, nothing to prevent our accepting that it had likewise been leased to d'Orta after it had lapsed from its former lessee. Ficalho after weighing all the facts is led to the belief that the island must have been made over to d'Orta after 1548, and he thinks that it is not an unreasonable conjecture that it was a grant made to our physician by the Viceroy Pedro Mascarenhas, the same of whom d'Orta says that he passed away when under his treatment; we know that he had a great regard for his physician, and there is nothing improbable in the supposition that when the island from whatever cause, lapsed from Mestre Diogo to the Crown he decided to recompense d'Orta with it for his services to him. There are no other facts in the *Colloquies* from which we can draw conclusions other than that d'Orta had a garden in Bombay planted with choice fruit trees and, may also be, with medicinal plants in which he took such a deal of interest; it would also not be unreasonable to suppose that in this estate there was his manor house where he lived whenever he visited his property or where he used to rest on his way to and from his professional visits to the Court of Ahmednagar. This must have been the same house which was afterwards in the possession of D. Ignez de Miranda who figures in the documents of her time as the "*Senhora da Ilha*" and in whose mansion the treaty by which Bombay was to be handed over to the English was signed by Sir Humphrey Cook and the Portuguese delegates from Bassein on the 11th February 1665.

There is a good deal of material scattered over in the *Colloquies* from which it is possible to reconstruct the domestic life and habits of the naturalist and physician. To start with, there is no indication whatsoever to point out that d'Orta was married or that he left any family behind him. Fortune has been unkind to him in as much as it has left no traces of any document to attest to the date of his birth or death or any incident of his life in India; in the absence of any definite reference on this subject, it would be safe to draw our conclusions from the known habits of the naturalist, and they are decidedly in favour of a single blessedness; he was wedded to his researches and investigations. His household establishment, though it betokens the simple tastes of the scholar and the humanist, did not wholly show that he scorned delights and lived laborious days. He owned horses and rode on them when he paid his professional calls or went out for an airing after dinner;[1] he had a number of "boys" to look after these animals and to attend to other household duties. Then there were the large number of female servants, probably most, if not all, slaves, and among these the one that occupied the first place in his confidence was Antonia whom he entrusted with his keys and who had, thanks to his training, to identify the trees in his garden and knew where the hashish and other objects from his collection of natural history were kept.[2] His cookess was an expert in the refined cooking for which the Portuguese of that day were famous, and with this subtlest of subtle arts she combined knowledge of Indian drugs and prescribed a mixture of betel areca and catechu for spongy and receding gums,[3] a prescription difficult to beat even to-day. Another member of his household was the 'compradeira,' a name in its masculine form "compradeiro" so well known to the mercantile community in the Far East; her business was to make purchases in the bazar.[4]

1 Coll. 40. 2 Coll. 8 & 39. 3 Coll. 31. 4 Coll. 36.

Around these female officials there used to gyrate a number of slaves, one of whom we know was from the Deccan[1] and the others were blacks from Africa. It is curious to believe, in fact an irony, that when the professional services of their master were sought by the highest in the land, these creatures "of the earth earthy" would seek for their numerous infirmities, the help of an Indian physician, Malupa his name, [2] who would visit d'Orta's residence every morning to cure the negressess. This is a proof of the physician's tolerance, to allow his slaves to be treated by an Indian *vaid* in whose system of treátment they evidently had more confidence than in that of their master.

d'Orta had friends all over the Orient and they occasionally sent him presents of choice fruits and other products of their respective parts; we have ample evidence to show that he was an epicurean in the matter of his food, and combined with his knowledge of natural history and medicine the mysterious secrets of preparing recherche dishes. His special failing, it appears, was for fruits, and he mentions with evident pleasure the ber (*zizyphus jujuba*), the brindoes (*garcinia indica*), the oranges from Cochin better than those of Portugal,[3] the jack-fruit, the rose-apple and the mangoes which were served at his table; after fruit came preserves, and, it might interest many to know, he had tamarind preserved, in sugar and spoke of it as an excellent conserve.[4]

It is very safe to presume that in this house of his in Goa which occupied, as he tells us, a commanding position on some eminence from which he could see out to the river and watch the ships sailing into the port,[5] d'Orta had a fine collection of books, in fact a library of rare volumes; it is also safe to suppose that he kept in his house a collection of natural history specimens and of curios from the East: there are sufficient indications in the *Colloquies* to warrant us to affirm this.

Surrounded by distinguished friends, enjoying the respect of the highest in the land, cared for by numerous servants and attendants, affluent in circumstances, keen on the study of the East, its habits of life, its varied customs, its flora and its fauna, and writing down his researches and his observations in his *Colloquies*, d'Orta lived a quiet and, to all appearance, an uneventful life. No document bearing any reference to his death has been found, and we are once again left to speculation as to the date and place of this event. Camoens in his Ode, to which we have referred above, spoke of him as "full of years" and this was about 1563, the date of the publication of the

1 Coll. 36. 2 Coll. 54. 3 Coll. 31. 4 Coll. 63. 5 Coll. 34.

Colloquies; if we fix his birth in or about 1490, he must have then been about a little over the psalmist's three score and ten; it is scarcely likely that he who had spent the greater part of his life in India and been accustomed to the ease and comfort, the climate and the food of the East, would at this advanced age have returned to his homeland; we are therefore forced to the conclusion that he died in Goa; as it were to give him an additional claim to greatness, the date of his death like that of his birth and likewise the place of his burial are to us unknown and this oblivion he shares with many great names in history.

We have said that the first edition of his *Colloquies* was printed in Goa in 1563; besides this there was also one other edition published in Goa. The well-known Clusius made a Latin translation of the work in 1567 and several writers re-translated the Latin version of Clusius into Italian and French. In Portugal, the Count of Porto Seguro, F. A. de Varnhagem published an edition of the *Colloquies*, but, like those that preceded it in the other languages, is imperfect and sometimes unreliable. The standard edition of the *Colloquies* is by the Conde de Ficalho which together with his *Garcia da Orta e o seu Tempo* (from the original signatures recently discovered in Portugal, it is clear he wrote his name as d'Orta and not da Orta) has been drawn upon for this paper. The present writer cannot claim to have acquaintance with any work which has been edited with the fulness, erudition and a love for his subject as Ficalho has edited the *Colloquies*. I have said that d'Orta's *Colloquies* have been opened to English knowing students by its translation by Sir Clement Markham. Sir Clement has done invaluable work in editing quite a large number of books of the fifteenth and sixteenth centuries, but, for reasons unknown to the writer of this, his translation of d'Orta, we regret much to have to say it, does not do him much honour; it may well be that it was made under great stress of time or other work requiring more of his care and attention. The translation is full of errors, lacunae and presents in many instances a sorry idea of d'Orta and his work. I will take only one instance, by no means singular and exceptional, to point out what is meant by the by no means irresponsible allegations made above.

In his very third Colloquy d'Orta proceeds to describe amber and he says: "In the first place I shall tell you of a great error of Avenhrois, who says that it is a species of camphor which has its origin in the sea, floats over its surface, and that the best of its kind is that which is called in Arabic *Ascap*." This is the literal translation of the passage in the *Colloquies*, and here is

Markham's : "First I must tell you of a great error of Avenrrois who says that amber is a kind of camphor *which originates in the fountains of the sea, and not on the surface water,* and that the best is called by the Arabs Ascap." The italicised part will point out the very curious error into which Markham has been betrayed, and that, because he has translated the Portuguese "nada," which is the third person present tense of the verb "nadar" which means to float or swim, as the adverb "nada" which means 'nothing or not.' The violence done to the meaning of d'Orta is evident. The rest of this long passage is full of many wrong interpretations, none of which are as serious as the one we have quoted above, but for sheer mutilation, and what a mutilation of d'Orta, we have to go to the very end of this passage. There d'Orta tells us that "in the year 1555 there was found beyond Cape Comorin a piece of amber which almost weighed 30 quintals and the person who had made the find, mistaking it for tar, sold it very cheap; being distributed or divided among many persons it fetched no more than the current price. The locality where it was found was in front of the Maldive Islands, and, that this is true, is evident from the fact that sometimes it comes with the beaks of birds in it and at other times there are the shells of the molluscs mixed up with it because they stick to the amber." And this is Markham's version of the same passage : " In the year 1555 I found beyond Cape Comorin a piece of near 30 quintals, and thinking that the find was tar I held it very cheap. However on being divided among many persons it returned to its accustomed price. The *locality where I found it was in front of the Maldive Islands. It is evident that this is true because the pieces come sometimes in the beaks of birds, and at others in the shells of various molluscs, for they stick to the amber, and the birds have it lodged on them, the cleanest being the best.* This I tell you is the accurate information that can be had." How far the accuracy of information at which d'Orta aimed at in his description of amber has been secured by Markham, a comparison of the two versions will show. It is certainly difficult to make out any intelligible meaning from the latter part of his translation.

I have had the unpleasant task of finding fault with Sir Clement's translation, but at the same time it must be observed that it reflects the greatest credit on the translator to have essayed a task which till then none had attempted and which certainly was no easy one ; two members of our Society had undoubtedly the competence to perform it—I am referring to Dr. J. C. Lisboa, the botanist, and Dr. G. da Cunha whose contributions to our knowledge of Indo-Portuguese history are so well known—and it is difficult for me to explain why they never attempted it. Markham's translation, though in very many respects imperfect and unsatisfactory, will continue to be of considerable help to any one who attempts the task of making a fresh translation.

Dr. Gerson da Cunha in his "Origin of Bombay" says :—"Bombay has no memorial of Garcia da Orta. But his is one of those names to which the saying of Pericles may be applied : 'The whole world is their tomb.' Still if an earthly monument is to be raised to perpetuate his memory, it should be in his old garden in 'Bombay Castle." It was here that he laid the great foundation of that great science which has since counted among its votaries such distinguished names as Van Rheede, Rumphuius, Jacquemont, Wight and Hooker." That it would be a graceful act to honour the memory of one who was so intimately connected with our city, is unquestionable ; what the form of the memorial should be is the only question that need be considered, and in our opinion, as far as our Society is concerned, there could be no better monument to the genius of the great 'naturalist, humanist, anthropologist and ethnologist' than for us to bring out a translation of the *Colloquies* free from the defects that we have had to point out in Markham's, and thereby bring this great work to the notice of a wider public in British India and the English speaking countries.

ART. XI.—*Studies in Bhāsa.*

BY

V. S. SUKTHANKAR.

V. *A bibliographical note.*[1]

The effort to place the group of anonymous plays discovered in South India by Pandit Gaṇapati Sâstrî of Travancore has engaged the imagination and the pen of Indologists for over a decade; but no definite solution of that problem has yet been logically justified. Opinion is divided on more than one aspect of the plays. Opinion is sharply divided between those who place the dramas in the fifth century B. C. and those who place them in the tenth century A. D.; between those who ascribe them to the 'far-famed' Bhāsa, honoured by Kālidāsa and those who ascribe them to a poetaster whose name even is forgotten by posterity; between those who claim for them high literary merit and those who describe them as the miserable lucubrations of a plagiarist. These three aspects of the plays, it may be added, are not entirely independent of each other; in fact, the second and the third of them are really closely connected. For while, on the one hand, those who support the Bhāsa theory invariably claim to be able to recognize high merit in the plays; on the other hand, those who repudiate that theory at the same time deny the plays all real merit.

Despite the divers opinions held by scholars regarding the age and authorship of the plays, and despite the formidable phalanx of arguments advanced by them to support their respective claims, the significant difference, it seems to me, has been just on the question of the literary and æsthetic merits and defects of the dramas. Back of all the various aspects of the discussion seems to lurk, often unnoticed by the disputants themselves, this fundamental divergence. And æsthetic merit being a vague quality not amenable to exact measurement or computation, the difference of opinion as regards the place of these dramas in the history of Sanskrit literature will in all likelihood continue to exist,

[1] The paper was read at a meeting of the Society held on March 22nd, 1923.—For the first four studies in this series, see the *Journal of the American Oriental Society*, vol. 40, pp. 248–259; vol. 41, pp. 107–130; vol. 42, pp. 59–74; and *Annals of the Bhandarkar Institute*, vol. 4 (extra issue).

unless another fortuitous discovery happens to place in our hands some material which can give an unequivocal reply to the question of the age or the author of our dramas.

Although the suspicion voiced by Barnett[1] that few Sanskritists 'agree with the learned editor's ascription of them to Bhāsa,' appears to be *utterly* without foundation, it cannot be denied that a few critics who had first hailed the appearance of these plays with éclat and jubilation, have later, on re-examining the plays, become indifferent and turned away from them in considerable disappointment. But Pandit Gaṇapati Sâstrî's alluring theory has in the meantime made fresh conquests and found new adherents.

The Bhāsa question is now, it may be emphatically stated, as far away from being settled as ever before. The number of writers on the subject is steadily increasing and the field of research is gradually widening. It is therefore highly desirable that all students interested in the question should have, even at this stage, a list as complete as possible of the writers and their writings so that they may be able to tell at a glance what editions and translations are available, what the problems are, and what has been written concerning them.

Apropos of the remark of Barnett cited above, a few statistics may not be out of place. Here is a list of those who have, at one time or other, written on the subject, accepting the Bhāsa theory explicitly or implicitly: Amaranatha Sarma, Apte, Asuri Anantacharya, Banerji-Sastri, Baston, Beccarini-Crescenzi, Belloni-Filippi, Belvalkar, Bhatta, Bhide, Chaudhuri, Deb, Desapande, Dhruva, Gaṇapati Sâstrî, Gray, Gune, Harprasad, Hertel, Hillebrandt Jacobi, Janvier, Jayaswal, Jolly, Kale, Khuprekar, Konow, Lacôte, Lesny, Lévi, Lindenau, Mehendale, Morgenstierne, Ogden, Panna Lall, Paranjape, Pavolini, Pisharoti, Printz, Saunders, Suali, Thomas, Urdhwareshe, and Weller. It must be added that the enthusiasm of Sylvain Lévi has apparently cooled down considerably since he penned his ecstatic preface to Baston's (French) translation of Vāsavadattā; and now, I understand, he has joined the ranks of the opponents of the theory, which include the names: Barnett, Bhattanatha Svamin, Kane, Mahabal, Rangacharya Raddi, and Ramavatara Sarma. Whether the opponents of the Bhāsa theory are really so few, or whether they are over-modest and of a retiring disposition, it is cer-

[1] *J. R. A. S.* 1919, p. 233.

tain that the number of such as have expressed their views openly is *remarkably* limited. Between the two extreme sections lie the views of Winternitz and the present writer, who, while they recognize that the supporters of the theory have a good *prima facie* case, that the authorship of Bhāsa is a factor within the range of possibility, hold, on the other hand, that the evidence hitherto adduced does not amount to a conclusive proof of the proposition; they accept it merely tentatively, as a working hypothesis.

In passing it may be pointed out that the doubts propounded by Barnett, and the interpretation of the term *rājasiṁha* (occurring in the bharatavākyas of the plays) as a *nomen proprium*—features of the controversy generally associated with the name of Barnett[1]—had been made public by Pandit Ramavatara Sarma Pandeya in an article contributed to the little known Sanskrit journal *Śāradā* long before the appearance of Barnett's note in the *Journal of the Royal Asiatic Society*. In 1915 Pandit Ramavatara Sarma wrote expressing his doubts as to the validity of Gaṇapati Sâstrî's theory, ascribing the dramas to an anonymous court poet of a Kerala king Rājasiṁha. Barnett's first article on the subject, as far as I know, did not appear till 1919, that is, four years later.

Of the thirteen dramas comprising this group, the Svapnavāsavadatta is undoubtedly by far the most popular. Gaṇapati Sâstrî published some years ago the third edition of the text; and there are of this drama seven independent translations in five different languages (English, French, German, Gujarati and Italian). Like its remarkable namesake cited by Rājaśekhara in his Sūktimuktāvali, it may well claim to be able to withstand even the rigorous 'ordeal by fire.' Next in popularity stands that interesting little one-act episode Madhyama, which has been translated four times already and which richly deserves to be more widely known. The Pratimā and the Chārudatta have been translated twice each, and a new Italian translation of the Chārudatta is, I understand, in course of preparation. Of the remaining, the five major dramas Abhisheka, Avimāraka, Pañcharātra, Pratijñā, and Bālacharita, have been translated once only, while the four one-act Mahābhārata episodes Ūrubhaṅga, Karṇabhāra, Dūtaghaṭotkacha, and Dūtavākya, have not attracted serious attention so far. The Pratijñā is really an interesting

1 Barnett's objections have been criticized and refuted severally by Banerji-Sastri, Konow, F. W. Thomas, and Winternitz.

little drama of unquestionable merit ; but its third act (the so-called mantrāṅka) presents certain difficulties. That is perhaps the reason why it has not yet tempted any translator except the intrepid Keshavlal Dhruva.

Now as to the criticism of the dramas. A critical study of the Prakrit of the whole group has been made independently by two young German scholars Lesny and Printz. There is also an unpretentious little contribution on the subject by the present writer. The relationship between the Chārudatta and the Mṛichchhakaṭika has been exhaustively investigated by Morgenstierne. This monograph, taken in conjunction with two other papers dealing with the same subject that were almost simultaneously made public elsewhere, seems to establish beyond all reasonable doubt two facts : firstly, that the Chārudatta is a fragment ; and secondly, that it represents a version of the theme earlier than the Mṛichchhakaṭika. We have a scholarly contribution to the study of the source of the Svapna from the pen of Félix Lacôte, who has made a special study of the literature clustering round the Bṛihatkathā. The lexicographical peculiarities of the same drama have been studied and listed by the American Indologist Ogden. The late Dr. Gune has left us a small but thoughtful contribution to a study of the Pratijñā. A connected account of these dramas will be found in the Introductions to Pandit Gaṇapati Sâstrî's editions of the Svapna and the Pratimā respectively ; and in the sections on Bhāsa in Konow's *Das indische Drama* and Winternitz's *Geschichte der indischen Litteratur.*

Estimates of the age of these plays vary, as already averred, by about fifteen centuries. They have been assigned to the fifth century B. C. by Bhide ; third (or second) century by Gaṇapati Sâstrî ; to the first century B. C. by Jayaswal and Chaudhuri; to the second century A.D. by Konow, Lindenau and Suali ; to the third (or fourth) century by Banerji-Sastri, Jolly and Jacobi ; and to the fourth century by Lesny and Winternitz ; to the seventh century by Barnett and Nerurkar (on independent grounds); to the ninth century (or later) by Kane ; to the tenth century (or later) by Ramavatara Sarma Pandeya ; to the eleventh century (or later) by Rangacharya Raddi.

Very briefly summarized the arguments for and against the theory are the following. Among the most important arguments adduced in support of the theory are these. (1) The common authorship of the plays follows from the similarity of technique, style and thought informing these plays, and from the abundant instances of repetition and parallelism. One of these plays is styled the Svapnavāsavadatta, which is the title of a celebrated drama composed by Bhāsa. (2) A technical peculiarity of the prologues of the Bhāsa dramas has been noticed by Bāṇa in his Harshacharita, which peculiarity characterises also the prologues of our dramas. (3) The name of the author is never mentioned in the rudimentary sthāpanā of these plays, which testifies to their great antiquity, further evidenced by the archaic language and the technique of these plays. (4) Owing to their having been well-known plays, verses and passages from them have been cited and criticized by rhetoricians such as Bhāmaha, Daṇḍin, and Vāmana, although they do not name the source from which these verses and passages have been taken. (5) Apt expressions and felicitous similes have been borrowed from these plays by celebrated poets like Kālidāsa, Bhavabhūti and others. Being distinguished products of dramatic art, they are in style and matter worthy of the fame of the great Bhāsa. These are the arguments advanced in support of the theory. On the other hand, those who repudiate the Bhāsa theory do so mainly for the following reasons. (1) This Svapnavāsavadatta does not contain the verse quoted by a certain rhetorician as from a drama of the same name, which drama, it is said, is probably the original Svapnavāsavadatta of Bhāsa. Likewise these plays ascribed to the great dramatist do not contain any of the verses cited in anthologies as his verses. (2) The stanza quoted from the Harshacharita of Bāṇa has been grossly misinterpreted, and is quite irrelevant to the discussion. (3) The similarities of ideas and expression between these plays and the works of celebrated dramatists like Kālidāsa clearly prove that the author has unblushingly plagiarized from the works of other dramatists. (4) They contain irregularities of technique and a surprising number of grammatical blunders, which exclude the possibility of their being the works of any reputable author, not to speak of Bhāsa. Obviously works of mediocre quality, they are in every way unworthy of being ascribed to the distinguished dramatist Bhāsa. I have singled out here for the purpose of this survey, only the most important arguments advanced on either side. None of them appear to me incontravertible; the balance seems delicately adjusted. It is a question where the emphasis should be laid, and the answer to that question will largely depend on personal predilections.

The Bhāsa question has acquired fresh interest and importance through the discovery of other dramas such as the Mattavilāsa,[1] which apparently stand closer to our group than to the classical dramas like those of Kālidāsa, Bhavabhūti, and others. It is becoming increasingly evident that we have before us dramas, if not of Bhāsa, at least of a distinctly new school of dramatic art, and as such they are undeniably interesting and worthy of most careful study. There is nothing to be gained by peevishly brushing them aside as the lucubrations of a plagiarist, or as the creations of an ingenious forger (as one learned Indian critic[2] has averred), simply because they are not exactly what we expect them to be or want them to be. Already the study of them has yielded some fruitful result, and it is not too much to say that a deeper study of them may throw further ght on some of the obscure corners of this interesting field of inquiry.

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1 Not available to me.

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80. MACDONELL, A. A. Three plays of Bhasa in the Trivandrum Sanskrit Series. In Journ. Roy. As. Soc. 1913, pp. 186-190.

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81. MAHĀBAL, BH. B. Bhās va Kālidās (dusarī bājū). [Bhāsa and Kālidāsa : the other side.] In Vividhajñāna-vistāra, vol. 51 (1920), pp. 73-80. [In Marathi.]

Rejoinder to No. 66. Indignantly rejects the suggestion of Kālidāsa's indebtedness to these dramas of doubtful merit.

82 MEERWARTH, A. M. The dramas of Bhasa. A literary study. In Journ. and Proc. As. Soc. Bengal, N. S. vol. 13 (1917), pp. 261-280.

An appraisement of the literary and æsthetic merits of the plays, without reference to the question of authorship.

83. MORGENSTIERNE, GEORG. Über das Verhältnis zwischen Cārudatta und Mṛcchakaṭikā. Leipzig, 1921, pp. 80 + LXI.

See especially pp. 5-21.

Pāṇḍeya. See Rāmāvatāra Śarmā Pāṇḍeya (No. 87).

84. PARANJAPE, S. M. Chārudatta āṇi Mrichchhakaṭika. In Chitra-maya-jagat, 1915, pp. 46ff.—Priyadarśikā āṇi Nāgānanda hī koṇāchī, ibid. 1915, pp. 576ff.—Bhāsā vishayī kāhī goshṭī, ibid. 1916, pp. 91ff.—Bhāsāchi bhavitavyatā, ibid. 1916, pp. 381ff.

85. PRINTZ, WILHELM. Bhāsa's Prākrit. Frankfurt, A.M. 1921, pp. 47.

86. RAḌḌĪ, RAṄGĀCHĀRYA B. Bhās kiṁ ābhās ? [Bhāsa or his semblance ?] In Vividha-jñāna-vistāra (Bombay), vol. 47 (1916). [In Marathi.]

Emphatically rejects the Bhāsa theory, chiefly on the ground that these plays of questionable worth could not be the works of the great Bhāsa.

87. RĀMĀVATĀRA ŚARMĀ Pāṇḍeya. Mahākavir Bhāsah, In Śāradā (Allahabad), vol. 1 (Vikrama 1970 [1]), pp. 4-7. [In Sanskrit.]

[1] Vikrama 1970 corresponds to A. D. 1914-15.

Like Barnett (see Nos. 59-61), this writer assigns the plays to an anonymous court poet of a Pāṇḍya king Rājasiṁha; and estimates their age ca. 10th century A.D.

88. SMITH, V. A. Discovery of the plays of Bhāsa, a predecessor of Kalidasa. In Ind. Ant. vol. 40 (1911), pp. 87-89.

See No. 107.

89. SUALI, LUIGI. I drammi di Bhāsa. Firenze, 1912, pp. 36.

Reprinted from Giorn. Soc. Asiat. Ital. 1912. The article was continued in vol. 26 of the Journal, but the continuation is not available to me.—Assigns the dramas to ca. 2nd century A.D.

90. SUKTHANKAR, V. S. Studies in Bhāsa:

I. On certain archaisms in the Prakrit of these dramas. In Journ. Amer. Or. Soc. vol. 40 (1920), pp. 248-259.

II. On the versification of the metrical portions of the dramas. Ibid. vol. 41 (1921), pp. 107-130.

III. On the relationship between the Cārudatta and the Mṛcchakaṭika. Ibid. vol. 42 (1922), pp. 59-74.

IV. A concordance of the dramas. In Annals of the Bhandarkar Institute, vol. 4 (1923).

V. A bibliographical note. In Journ. Bombay Branch of the Royal As. Soc. vol. 26, pp. 230 ff.

91. SUKTHANKAR, V. S. A note on the dramas of Bhasa. In Shama'a (a Magazine of Art, Literature and Philosophy, published in Madras), vol. 3 (1922), p. 59 f.

A note of a popular character appended to the translation of the Svapnavāsavadatta, appearing in the same Magazine.

92. THOMAS, F. W. The plays of Bhāsa. In Journ. Roy. As. Soc. 1922, pp. 79–83.

Sets forth fresh reasons in support of the Bhāsa theory, being at the same a rejoinder to Barnett, ibid. 1921, pp. 587–589 (see No. 61).

93. VENKATARAMAN, T. L. The Date of Bhāsa. In Modern Review (Calcutta), vol. 14 (1913), p. 579 f.

Rejoinder to P. Chaudhuri's 'The Date of Bhāsa,' Mod. Rev. vol. 14 (1913), pp. 382-387. See No. 64.

94. WINTERNITZ, M. Der indische Dramendichter Bhāsa. In Ostasiatische Zeitschrift, Jg. 9 (1922), pp. 282-299.

Contents: 1. Is Bhāsa the author of the dramas attributed to him? 2. The date of Bhāsa. 3. Some observations on Max Lindenau's "Bhāsa-Studien" (see No. 79). The Appendix emphasises the writer's view that the ascription of the plays to Bhāsa is nothing more than a 'hypothesis,' which needs further investigation, and verification.

95. WINTERNITZ, M. Geschichte der indischen Litteratur, Band 3 (1922), pp. 184–202, 205 f., 209 f., 644–646; see also Index s. v. Bhāsa.

C. INCIDENTAL REFERENCES.

96. BHATTANATHA SVAMIN. Mayuraja. In Ind. Ant. 41 (1912), p. 141.

À propos of M. Krishnamacharya's ascription of Kiraṇāvalī and other dramas to Bhāsa (see No. 105).

97. DEB, HARIT KRISHNA. Udayana Vatsa-raja. Calcutta, 1919, pp. 1–9.

A brochure published by the author himself.—Mainly historical gleanings.

98. GRAY, LOUIS H. Vasavadatta, a Sanskrit romance by Subandhu, translated with an introduction and notes. New York, 1913, p. 1 f. (of the Introduction). (=Columbia University Indo-Iranian Series, vol. 8.)

99. JAYASWAL, K. P. Statues of two Śaiśunaka emperors (483–409 B. C.) In The Journ. Bihar and Orissa Research Soc. vol. 5 (1919), p. 98 f.

The Pratimā is cited here to establish the 'custom of maintaining a royal gallery of portrait statues,' such as those of the Sātavāhana kings at Nānāghāṭ, and of the Śaiśunāga kings, now preserved in the Indian Museum. Calcutta.

100. JOLLY, J. Kollektaneen zum Kauṭilīya Arthaśāstra. In Nachricht. königl. Gesell. Wissen. zu Göttingen, 1916, p. 353.

101. KALE, M. R. In the Introduction to his edition of the Ratnāvalī, Bombay, 1921, pp. xvii-xx.

Discusses the validity of the alleged quotations from the Kavivimarśa of Rājaśekhara, published by Narayan Sastri. See also the bhūmikā to the Vani Vilasa edition of the Priyadarśikā, p. xxvii.

102. **Konow, Sten.** In his review of Hillebrandt's edition of the Mudrārākshasa, Ind. Ant. vol. 43 (1914), pp. 65-67.

103. **Konow, Sten.** Zur Frühgeschichte des indischen Theaters. In Aufsätze zur Kultur- und Sprachgeschichte, vornehmlich des Orients, Ernst Kuhn zum 70. Geburtstage am 7. Februar 1916 gewidmet von Freunden and Schülern. München, 1917, pp. 106 ff.

Embodying views substantially the same as those expressed in his work 'Das indische Drama' (see No. 74).

104. **Konow, Sten.** In his review of W. Caland's edition of Gopālakelichandrikā, Ind. Ant. vol. 49 (1920), pp. 233-235.

Chiefly criticises Barnett's articles on the subject (see Nos. 59 & 60).

105. **Krishnamacharya, M.** A History of the Classical Sanskrit Literature, Madras, 1906, p. 67.

Refers to a tradition which ascribes the Udāttarāghava, Svapnavāsavadatta, and Kiraṇāvali to Bhāsa. That passage has been criticized by Bhattanatha Svamin, Ind. Ant. vol. 41, p. 141.

106. **Mehendale, K. C.** Date of Śūdraka's Mṛcchakaṭika. In Commemorative Essays presented to Sir Ramakrishna Gopal Bhandarkar, Poona, 1917, pp. 368-370, 374.

'It is an undoubted fact that the *Chārudatta* formed a unit in the *nāṭakachakra* of Bhāsa...The *Cārudatta* printed in the Trivendrum Sanskrit Series is evidently a fragment.'

107. **Narasimhachar, R.** In Archæological Survey of Mysore, Annual Report, 1909–10, p. 46.

The pertinent passages have been excerpted by V. A. Smith, Ind. Ant. vol. 40, p. 87 f. (see No. 88).

108. **Nerurkar, V. R.** In the Introduction to his edition of the Mṛichchhakaṭika, Bombay, 1919, pp. 14-19.

'Chārudatta and Mṛichchhakaṭika are probably the productions of one and the same author—namely Bhāsa. This is not the Pre-Kalidasian Bhasa. ..but a Bhāsa who was dhāvaka washerman by caste and who flourished in the time of Shri Harsha (7th Century—the first half).'

109. **Pischel, R.** In Götting. Gelehrte Anzeigen, 1883, pp. 1229 ff.

110. Saraswati, A. Rangaswami. The age of Bharavi and Dandin or the literary history of the Pallava period. In The Quarterly Journal of the Mythic Society, Bangalore, vol. 13 (1923), p. 686.

111. Saunders, Virginia. Some literary aspects of the absence of tragedy in the classical Sanskrit drama. In Journ. Amer. Or. Soc. vol. 41 (1921), pp. 152–156.

ART. XII.—*Two sets of Chālukya copper plates from Navasāri.*

BY

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These plates were made available to the Superintendent, Archæological Survey, Western Circle, for the purpose of photographing and taking ink impression by the kind services of Mr. P. B. Gothoskar, the librarian of the Bombay Branch, Royal Asiatic Society, as is mentioned in the Progress Report, Archæological Survey, Western Circle, for the year ending 31st March 1918. A short note on these plates is already published in Part II, p. 35-36 of the said report. The photographs and ink impressions were placed in the hands of Dr. V. S. Sukthankar for publication. Soon after, however, Dr. Sukthankar went on long leave and hence they were kindly given over to me by Mr. Banerji for editing[1]. I thus edit the first set of plates, *i.e.*, the so-called original and regular set which I will style hereafter as 'A' set of plates from the photographs as well as the ink impressions and the second one which will be styled as 'B' set with the help of only the photographs that were supplied to me. Along with these papers I was given also a typed copy of a short note on these plates written evidently by some one from that part of the province and intended to identify the places (villages) referred to in the plates[2]. The author of this note is not known even to the Society people. From the style and language however I conjecture that the author of it ought to be a Parsi gentleman and pleader by profession.

There are 3 impressions for set A and it appears that the first plate must have been inscribed on both sides while the second one on one side only; for the B set there are only two impressions and both the plates must have been inscribed on one side only. The size of all these plates seems to be about $9\frac{1}{2}'' \times 6\frac{3}{4}''$. Plates of both the sets are perforated but it is not possible to say anything as regards the existence of either the ring or the seal. From the impressions it can be seen that both the A and B plates are in a fair state of preservation, and that the letters

1 Dr. Sukthanker's notes on the plates were kindly given to me on the day I read my paper and I must express my gratitude for some points which I have availed of.

2 When I read this paper Dr. J. J. Mody declared that he was the writer of this note which is printed at the end as appendix A.

in the former are carefully engraved and pretty deep while the latter has been so carelessly engraved and the letters are so shallow that some of them have not come out clearly even in the photographs. Last two lines in A set have been engraved it seems by the same man who engraved the B set.

There are instances of the common mistakes of the scribe in writing *ś* for *s*, *b* for *v*, and *l* for *ṇ* at several places. Doubling of consonants and sporadic change of the Anusvāra into class nasal can also be met with. The character in both the plates are Nāgari and the average size of letters in A is $\frac{3}{8}$th of an inch while in B it is $\frac{1}{4}$th of an inch. The language also is Sanskrit in both the sets.

The major portion of the A plates is in verse, lines 4-11, 27-29 and 30-36 only being in prose, while the B plates are wholly in prose excepting the two usual imprecatory verses at the end.

A plates open with a bow to Vāsudeva and an invocatory verse to the Boar incarnation of Vishnu (l. 1-4). Immediately after this there is the date of the grant, *i.e.*, the Tuesday, the eleventh day of the bright fortnight of the month Margashira of the year 996 current of the Śaka erā (l. 4-5). Then there is the dynastic list of the Chāulukyas, beginning from Mularāja and mentioning in succession Durlabharāja, Bhimadeva and Karṇadeva (l. 6-9). During the regime of this Karṇadeva this grant was made by Mahamandaleshwar S'ri Durlabharāja whose head quarters were at the city of Nāgarsārikā in the Province of Lāta. This Durlabharāja also belonged to the same Chālukya family and was the son of Chandrarāja and grandson of Gāngeyya (l. 10-24). The remaining portion of the plates records the grant of the village Dhamaṇāchha, made by this Durlabharāja to Pandit Mahidhar (l. 25-34). Last 2 lines (l. 35-36) specifiying the boundaries of the village granted appear to have been added afterwards.

B plates begin rather abruptly with the dynastic list from Mularāja down to Karṇadeva (l. 1-6). There is the additional mention however of Chamuṇdarāja between Mularāja and Durlabharāja. Then follows the record of the grant with the same particulars as in the A plates with this difference that the date here is the eleventh day of the bright half of Kārtik of the year 1131 current of the Vikrama era. (l. 7-21). The plates end with the usual imprecatory verses and the names of the scribe and the messenger.

This Karṇadeva of the grant is the father of the illustrious king Siddharāja Jayasingha of the Chāulukyas of Aṇhilwāda. Karṇadeva ascended the throne in 1064 A.D. and is believed to have died in 1094 A.D. The only other record of his reign is the sunak grant dated 1148 V.E.[1].

The date of the A plates is given both in words as well as in figures as Tuesday, the eleventh day of the bright fortnight of the month Mārgashira of the year 996 current of the Śaka era; while that of the B plates is the eleventh day of Kārtika of the year 1131 of the Vikrama era. The Christian equivalent of the former is Tuesday, 2nd December 1074 A.D., while that of the latter is Sunday, 2nd November 1074 A.D., as calculated by Mr. K. N. Dikshit.

The Donor in the A plates is king Karṇadeva himself while in the B plates there is another person named Durlabharāja residing in Nāgasārikā and a feudatory of the king Karṇadeva. The Donee, however, in both the plates is the same, *viz.*, Pandit Mahīdhar of the Māndavya gotra, son of Brahmin Rudrāditya. B plates mention in addition the name Madhusudana as the grandfather of Pandit Mahidhara while A plates particularise the five Pravaras of the Pandit. This Pandit had come to Lātadesh from the Madhyadesh to which he originally belonged.

The village granted is Dhāmaṇāchchhā situated in the Talabhadrikā thirty-six, bounded on its east by Kālāgrāma, on the south by Toranagrāma, on the west by Āvalasādhi and on the north by Kachhāvali or Kachchhāvali. Out of these Dhāmaṇāchchhā and Tornagrāma have been identified with the modern Dhamdāchhā and Taranagam or Toranagam in the map by the Superintendent, Archæological Survey, Western Circle, in his progress report for the year ending 31st March 1918, p. 36. The remaining places also have been successfully identified by the gentlemen who wrote the notes on these plates. He identifies Kachchhāvaligrāma with Kachholi and Avalasātigrāma or Āmvalasātigrama with Amalsād, the railway station on the B. B. and C. I. lines. For Kālāgrāma he is not sure but ventures to suggest that it may be either the modern Khergām in the map or Kalvach, most probably the latter.

Besides the localities mentioned in connection with the grant there are references to three other places of interest. Durlabharāja, the donor in B plates, is described as living at Nāgaśarikā in the province of Lātadesha and the donee is said to have come from the Madhyadesha. Nāgasārikā is undoubtedly the

1 Epigraphia Indica, Vol. I, p. 317.

present Navasāri under Barodā Government. Lātadesha is the ancient name for the northern and Southern Gujarat. Madhyadesha is the holy place between the Ganges and the Yamunā.

To explain the existence of these two sets of plates recording the same grant is the last but not the least easy task in connection with these plates. In the Progress Report of the Archæological Survey of India, Western Circle, for the year ending 31st March 1918, it is stated on p. 36 "it does appear though, as if the first set, the one that is evidently the better of the two (A plates) is the original genuine document; the other seems to have been made later in imitation of it, as a substitute for it." The gentleman who had written a note on these plates holds the same view though on different grounds. He tries to explain as follows :—

"The document was first drawn by somebody say A, who was less of a lawyer. He did not mention the boundaries in the body of the document, as he ought to have done to identify the village. The flaw in the first document (A set) spoken of in the reports as original or genuine may have been latterly observed by B, who may be a better lawyer or drawer of legal documents, though he wrote a rather crude or bad hand. He at first thought of doing away with the flaw by writing the boundaries|at the end in his own hand and did so. Such additions in legal documents are likely to raise doubts about their being genuine. So on a second thought in order to remove the likelihood of such doubts he may have thought of preparing a second document observing the proper formality of mentioning the boundaries of the village granted. . . . .

However, as a result of the detailed examination, and comparison of both the sets, I am tempted to suggest a new theory about the solution of this problem.

If we minutely study the texts of both the plates the following points of difference will be easily noticeable :—

(1) B plates have been composed according to the type of other Chālukyan plates known to us, while the A plates distinctly resemble the South Indian plates.

(2) In the former, the date is given in the Vikrama era while in the latter it is in the Sāka era as is found in the majority of the South Indian plates.

(3) The former starts off rather abruptly, though in close conformity with other Chālukyan plates,[1] with the dynastic list, while the latter begins with the usual invocatory verses to various gods. Invocatory verse to Varāha incarnation is again a distinguishing feature of the southern plates.

(4) Usual imprecatory verses from Mahābhārata at the end are present in the former but are not found in the latter.

(5) The former gives the name of the grandfather of the donee which is absent in the latter.

(6) The name of Chāmunda is to be seen in the former while in the latter it is omitted through oversight.

(7) The boundaries and other particulars of the grant are fully given in the former while they were omitted wholesale in the latter. This seems to be considered as a serious omission and necessary insertions were made for the purpose by the same man who inscribed the original plates.

(8) The reference in glowing terms to the local representative Shri Durlabharāja and his ancestors which is a distinguishing feature of the A plates is altogether absent in the B plates.

(9) B plates form a duly authenticated document as the names of the scribe and the messenger are properly given therein while A plates seem to have been condemned and hence these formalities were never carried out therein.

All these points of difference naturally lead us to infer that the B plates were originally drafted and inscribed at the head-quarters of the Chālukyan princes and then they were forwarded to their local representative S'ri Durlabharāj who was in charge of territories round about Navasāri. This man instead of passing on the identical plates to the donee thought it prudent for reasons best known to him to draft out the contents of the grant in the style of other South Indian plates, taking the opportunity at the same time of satisfying his own vanity by inserting glowing references to himself as well as to his ancestors. When his amended copy was ready inscribed it must have been submitted for approval to the sovereign power and important insertion at the end about the boundaries ought to have been made at the head-quarters by the same scribe at that stage. Even with this correction these plates did not prove themselves to be quite in order. Hence they appear to have been condemned

[1] Indian Antiquary, Vol VI, p. 194 onwards.

for ever and never signed sealed or formally delivered. This explains the absence of the formal portion at the end. The above conclusion is fully supported by the respective dates. The Christian equivalent dates of the A and B plates are Tuesday, 2nd December 1074 A.D., and Sunday, 2nd November 1074 A.D., respectively. Thus the B plates have been inscribed earlier exactly by a month.

TEXT A SET.

Plate I-A.

(1) ॐ नमो भगवते वासुदेवाय ॥ पायात्कर्दमवांच्छया भगवतः व्राडांक्रु

(2) तेः क्रीडतो यस्याब्धिस्तृणबिंदुवत्परिगतो दष्ट्रांग्रभागे- कृतः ॥ अन्य

(3) स्मिन्नपि रेणुवद्विलसति क्षोणी युगान्तागमे लज्जावेश- विसस्तुलं–

(4) स्य दधतः सूत्कारसारं वपुः ॥ स्वस्ति शकसम्वत्सर- षडधिकनवत्य–

(5) धिकनवसंत्यां अंऽकतोपि ९९६ मार्गशिरशुदि ११ भौमे ॥ अ–

(6) द्येह महाराजाधिराजपरमेश्वरश्रीमूलराजदेवपादानुध्या- तपर–

(7) मभट्टारकमहाराजाधिराजपरमेश्वरश्रीदुर्लभराजदेवपा- दानु–

क्रोडा° दंष्ट्रा° °संस्थुल °नवशत्यां°

(8) ध्यातपरमभट्टारकमहाराजाधिराजपरमेश्वरश्रीभीमदेव- पादानं–

(9) ध्यातपरमभट्टारकमहाराजाधिराजपरमेश्वरश्रीकर्णदेव- कल्या–

(10) णविजयराज्ये सत्येतस्मिनं काले लाटदेशान्तःपातिनाग- सारिका–

(11) सां[3] तत्पादपद्मोपजीवी ॥ आसीद्वंदितपादपंकजपुराण्चौलुक्यरा–

(12) जान्वये सौर्योदार्यगुणान्वितो द[हर]जो गांगेयना–

(13) मा पुरा यस्याद्यापि दिवौकमां[4] प्रतिगृहं गायंति सि–

(14) द्धांगनाः ॥ कीर्तिं तस्य न यांति सांप्रतमहो वक्तुं गु–

(15) णामादृशैः ॥

Plate I-B.

(16) संभोगभूमिर्भुवि लब्धकीर्तिः श्रीचंद्रराजोथ ब–

(17) भूव तस्मातँ ॥ अद्यापि यस्य प्रभुतां प्रभूताः

(18) गायंति गति[6] खलु भूभुजोपि । जातः श्रीदुर्ल–

°पादानु- °तस्मिन् °यां °पुराचौलु- शौ यौंद[7] °कसां तस्मात् गाने

(19) भेशः क्षितिपतितिलकश्चंद्रराजात्प्रतापी । कीर्त्तिः सप्ताब्धिमध्ये वि--

(20) लशति[8] च बलाद्राजहंसीव नित्यं ॥ यस्योच्चैर्वाजिराजप्रसरखुर–

(21) पुटोत्खातनिर्भिन्नभूमेर्धूलीमेघावलीव प्रसरति गगने विभ्रमा–

(22) च्छादयंती ॥ गतभुवनकुलानि व्याप्तदिग्मंडलानि भृततुहि–

(23) नगिरीणि [क्रांत] तारापथानि । सरसकमलकंदच्छेदगौराणि कामं ।

(24) मसुरमरपते [र्नों] धाम्नि धामानि यस्य । स्नात्वा पुण्यमृदूदकेन विधिवो

(25) संतर्प्य देवान् पितृमूँ । धर्म्माशासनतत्परेण मनसा संपूज्य नारा--

(26) यणं । आहूयाखिलविप्रपंडितजनान् भ—मवाजा ददौ ॥ गो [प] स्यानि

Plate II.

(27) समस्तशास्त्रविधिना दानानि चान्यानि च । निजराजावली विराजितमहा--

क्षितिप° लसाति ।भित° विधिना पितॄन्

(28) मेडलेश्वरंश्रीदुर्ल्लभराजः स्वनियोगस्थातं । मंविपुराहित-सेनापत्यात्कपं--

(29) टलिकप्रभृतीन् समाज्ञापयति ॥ चला विभूतिः जॅणभंगि यौवनं कृतांतदँ--

(30) तांतरवर्त्ति जीवितं । त[थैाघवजु] पटलजीवितमाकलय्य । मध्यदेशादा--

(31) गतसकलवेदशास्त्रा [र्थ्थ] विदाय । मांडव्यगोत्रोत्पनार्य -मांडव्यभार्ग्ग--

(32) व्यअंगिराऊर्म्मिजमदग्निपंचप्रवरसयुतायँ । विप्ररुद्रा । दित्यसुत--

(33) पंडितमहीधराय । तलभद्रिकाषड्विंशत्पथके । उदकेन । सवृक्ष--

(34) मालाकुलं ससीमापर्यंतं धामणाच्छाग्रामं ददौ । पूर्वस्यां दिशि का--

(35) लाग्रामः दक्षिणस्यां दिशि तोरणग्रामः पश्चिमस्यां दिशि आवल--

(36) साढिग्रामः उतरस्यां दिशि कछावलीग्रामः ॥

मंडलेश्वर° °योगस्थान °पत्यक्षप क्षण °तदं °त्यन्नाय °संयुता सवृक्ष उत्तरस्यां

TEXT B SET.

Plate I-A.

(1) राजावली [पूर्व]वत् ॥ परमभट्टारकमहाराजाधिराज-परमेश्व--

(2) रश्रीमूलराजदेवपादानुध्यातपरमभट्टारकमहाराजाधिराज-

(3) श्रीचामुंडराजदेवपादानुध्यातपरमभट्टारकमहाराजाधिराज-

(4) श्रीदुर्लभराजदेवपादानुध्यातपरमभट्टारकमहाराजाधिराज-

(5) श्रीभीमदेव पादानुध्यातपरमभट्टारकमहाराजाधिराजश्री-
कर्ण्णदे-

(6) व [स्वभुज्य]मानानागसारिकाविषयप्रतिबद्धतलहदष-
[ट्त्रिंश]ता-

(7) न्तःपातिनः समस्तराजपुरुषान् ब्राह्मणोत्तरान् तन्निवासिज-

(8) नपदार्थं बोधयत्यस्तु वः संविदितं यथा श्रीविक्रमा-
दित्योत्पादि-

(9) तसंवत्सर [शते]ष्वेकादशसु एकत्रिंशदधिकेषु अत्रांक-
तोपि सं. ११३१

(10) कार्त्तिकशुदि ११ एकादशीपर्वणि चराचरगुरुमहेश्वर-
मभ्यर्च्य सं--

(11) सारासारता विचिंत्य पित्रोरा[त्मनश्चपुण्य]यसोभिवृद्धये
मध्यदेशा-

(12) दागताय अधीतसकलशास्त्राय मांडव्यगोत्राय ब्राह्मण-
मधुसूदन पौ-

°पदार्थं °दितं °संवत्स- °त्रिंश- °त्रांक- °यशो-

(13) त्राय रुद्रादित्यसुताय पंडितमहीधराय ससीमापर्यंतः
सहिरण्यभा--

(14) [गभो] गः सवृक्षमालाकुलः सदंडदशापराधः सोपरिकरः

(15) सर्वादायसमेतः पूर्वप्रदत्तदेवदायब्रह्मदायवर्ज्जंधाम

Plate I-B.

(16) णाछाभिधानग्रामः शासनेनोदकपूर्वमस्याभिप्रदत्तः

(17) [त]स्य च पूर्वस्यां दिशि—राईग्रामः। दक्षिणस्यां दिशि

(18) तोरणग्रामः। पश्चिमस्यां दिशि आम्बलसाढिग्रामः उत्तरस्यां

(19) दिशि कच्छावलीः इति चतुराघाटोपलक्षितग्राममेनं तन्नि-

(20) वासिजनपदैर्यथादीयमानभागभोगकरहिरण्यादिसर्वदास-

(21) र्वमाज्ञाश्रवणविधेयैर्भूत्वा अस्मद्वंशजैरन्यैरपि अस्माभि [
प्रदत्त-

(22) मुपनेतव्यं पालनीयं च ॥ उक्तं च भगवता व्यासेनः
षष्टिर्वर्षसह-

(23) स्राणि[1] स्वर्गे तिष्ठति भूमिदः आछेत्ता[2] चानुमंता च
तान्येव नर-

[1]°णस्यां °स्राणि आच्छेत्ता

(24) कं[3] वसेत् विंध्याटवीष्वतोयासु शुष्ककोटरवासिनः कृष्णस-

(25) र्पाः प्रजायंते भूमिदानापहारकाः ॥ २ ॥ लिखितमिदं
शासनं का-

(26) यस्थवटेश्वरसुतकेका-कृतकोत्र महासांधिविग्रहिक

(27) श्री-गादित्यइति

[3]°के.

Translation (abridged)—A Set.

Om ; Bow to God Vāsudeo. May the form of the boar of the God, who is playing that part through the desire for mud, who is unsteady through the sense of shame, on one side of whose tooth the ocean assumes the appearance of a drop of water on a blade of grass and on the other the earth looks like the sand at the time of the finish of the age, who is assuming the form which has that peculiar hissing for his strength, protect. On Tuesday, the eleventh day of the bright fortnight of Mārgashir in the year nine hundred and ninenty-six, by figure 996, of the Śaka era, to-day here when there was the beneficial and victorious reign of highly venerable, lord of lords, great lord illustrious Karṇadeva meditating on the feet of highly venerable, lord of lords, great lord, illustrious Bhimadeva who. medicated on the feet of highly venerable, lord of lords, great lord illustrious Durlabharājadeva, who meditated on the feet of lord of lords, great lord, illustrious Mularājadeva, (at that time) there was in Nāgasārikā (Navasāri) situated in the Lāta desha his dependent, a king named Gāngeya, possessed with valour and liberality and born of the (younger brother) in the family of venerable and old king Chāulukya ; the merits of his glory are still being sung in every house of the Gods by the wives of the Siddhās. It is not feasible by man like me to describe them. To him was born Chandrarāja who was the home of pleasures who had earned a name on the earth and whose greatness is verily sung by numerous kings even at present. From Chandrarāja was born the powerful king Durlabha, the ornament of kings, whose glory plays mightily and perpetually over the seven seas like a flamingo ; the dust raised by the hoof at the motion of whose pre-eminent and best horse spreads in the sky like the series of clouds covering the whole universe. His splendours very white like the piece of the bulb of the blooming lotus, that had passed through the worlds pervaded the sky, resorted to the Himalayas, crossed the path of the stars, could not accommodate themselves in the house of the lord of Gods.

Durlabharāja, the illuminator of his series of kings and lord of the great province, having bathed himself with holy earth and water according to the prescribed rules, having satisfied the Gods and forefathers, having worshipped Nārāyaṇa, with the mind ready (to obey) the dictates of religion and having summoned the learned men from the Brahmins, gave.. ......calves........alms and such other things according to the complete ceremony prescribed by the religious books, and orders the ministers, preceptors, generals, judges and others (as follows):—Prosperity is fickle, youth is transitory and life is as it were between the teeth of the God of death having considered life as.....................gave with libations of water the village Dhāmalāchchha, situated in the district of 36 (villages) called Talabhadrika, upto the boundary and along with all trees, nests, etc., to Pandit Mahidhara, son of Brahmin Rudrāditya, who has come from the Madhya Desha who is well versed in all Vedas and scriptures, born in the Māndavya family and has five pravaras, namely Māndavya, Bhārgavya, Angira, Urmi, and Jāmdagni.

On the east there is the village Kālāgrama, on the south Toranagrāma, on the west Āmvalasādhi and on the north Kachhāvali.

B Set.

Geneology as usual. The highly venerable lord of lords, the illustrious Karṇadeva, who meditated on the feet of the highly venerable lord of lords, illustrious Bhimadeva, who meditated on the feet of the highly venerable lord of lords, the illustrious Durlabharājadeva, who meditated on the feet of the highly venerable lord of lords, the illustrious Chāmundarājadeva, who meditated on the feet of the highly venerable lord of lords, the great lord the illustrious Mularājadeva, informs all royal officers, Brahmins and people of all communities residing in the Talabhadrikā thirty-six in the province of Nāgasārikā of which he was the ruler. May it be known to you that on the eleventh day of the bright half of Kārtika in the year eleven hundred and thirty-one, by figure 1131, of the era started by the illustrious Vikramaditya, the village named Dhāmaṇāchchhā, upto its boundaries,...................... has been granted by me with the water of the order, having worshipped the mighty god (Shiva) the lord of moveables and immoveables having considered the unreality of this world and for the increase of the sacred glory of his parents and himself, to Pandit Mahīdhara, son of Rudrāditya and grandson of Madhusudana of the Māndavya gotra, who had studied all the Shāstras and who had come from the Madhyadesha. On the east there is......, on the south Toranagrama, on the west Āvalsādhi and on the north the village Kachhāvali.

This grant of the village, marked out by four boundaries, granted by me, should be respected and maintained by its inhabitants,......, This order has been written by Keka......, son of Vateshwar, a Kayastha ; the messenger was the illustrious ....gāditya in charge of peace and war department.

APPENDIX A.

In his Progress Report of the Archæological Survey of India, Western Circle, for the year ending 31st March 1918 (Part 11 A. Epigraphy, pp. 35-36) "dated 1st September 1918, Mr. R. D. Banerji says as follows about two Chālukya Plates :—" To the keen interest taken by Mr. P. B. Gothaskar, Librarian of the Bombay Branch of the Royal Asiatic Society, in the search of Indian antiquities, we owe the recovery of two interesting copper-plates charters purporting to be issued by the Chālukya Karṇadeva of Anahilapataka. It was after a great deal of trouble that Mr. Gothaskar succeeded in obtaining the loan of them from him (the owner) for the purpose of photographing them. The negatives have been purchased by me for this department and will be filed in my office. It is intended to contribute a detailed description note on them to the Journal of the Bombay Branch of the Royal Asiatic Society." On inquiry from Mr. Gothaskar, in the middle of March this year, I learn that the Note has not been sent as yet by Dr. Sukthankar, the Assistant Superintendent, in whose hands the photographs have been placed for publication. In the meantime this short Note has been intended to identify the places referred to in the plates and noticed in the above Report.

The plates are said to refer to the Reign of the Chālukya Karṇa. One gives as its date 996 Śaka, and the other 1131 of Vikram. Both of them are made in favour of Brahmana Pandita

Mahidhara, son of Rudrāditya of the Mandavya gotra, who had come to Naosari from Madhydesa by the Mahamandaleswara Dulabhraja belonging to a feudatory of Chaulukya family of Nagasarika (Nausari) which acknowledged the suzarainty of the Gujarat Chaulukyas of Ahhilavada." The grants are for one and the same village Dhamalachcha. "The boundaries of the village are given as follows :—to the east, Kalagramma; to the south, Toranagramma; to the west, Avala (or Amvala) satigrama; to the north, Kachchachavaligrama." Mr. Banerji indentifies Dhamalachcha with the present Dhamadachchha and Toranagrama with Torangam and adds that the other place-names remain unidentified."

I beg to give here a small map of the locality round the village of the grant, as kindly drawn for me by Mr. Sorabji Muncherji Desai of Naosari from the Baroda State map.

From this map we can identify the other places as follows :— (1) Dhamalachchha, the village which forms the subject of the grant is as said by Mr. Banerji, the present Dhamadachchha, the Dhamadachha of the map. My forefathers belonged to Naosari and I remember hearing from boyhood that the mangoes which came to Naosari from Dhamdachchha-Kacholi were the best of those that came to be sold there. It was this familiarity with the name of the village which gave the best of its mangoes to Navasari that has led me to look into the matter of these grants and to make further inquiries. There is a well known mango-tree at Dhamdachha even now, known as (Daramyo ambo) *i.e.*, pomegranate-like mango-tree. Mr. Sorabji M. Desai informs me that it is at present mortgaged to his Desai family. The mango tree is called (pomegrante-like), because (2) The village referred to in the grants as Kachchhavaligrama as being on the north of Dhamdachcha is the Kachcholi in the map. In connection with the above mentioned famous mangoes it is always connected with Dhamdachha and spoken of as Dhamdachha Kacholi, on the analogy of the joint names of two cities or towns like Buda-Pesth, Bili-mora, Jehan-bordi. Dhamdachha is in the district of H. H. the Gaekwad and Kachholi in that of the British. (3) The Kalagrama of the Copper-plate grants, mentioned as situated on the east of the village granted may be either the modern ખેરગામ (Khergam in the map) or Kalvach, most probably the latter. (4) The Torangrama on the south is as identified in the Report the modern Tarangam, the Torangam in the map. (5) The Avala Satigrama or Anvala Satigrama of the copper plates, situated on the west is the modern Amalsār or Amalsād, the Amalsad of the map. The adjoining Railway Station on the B. B. and C. I. Railway is known by that name.

Naosari is spoken of in the grants as Nagasarika. In many old Parsee documents, it is spoken as Nagmandal ( ).

The learned writer of the Report says " The curious circumstances regarding these grants which are dated on different dates is that both of them are made in favour of the same person and convey the very same village. The wording of the grants is however, quite different in the two plates. It is as difficult to give a reason why two grants should have been made conveying the same village to the same person as to explain the difference in the dates and the writing."

It does appear though, as if the first set, namely, the one that is evidently the better of the two, is the original, genuine document ; the other seems to have been made later in imitation of it, as a substitute for it." I think the difficulty above referred to, is solved by what the writer says in the matter of what he calls the genuine document. He says : " It is perhaps worth noting that in the grant which is above held to be the original document, the portion containing the boundaries is written at the very end of the document and was added *seconda manu*, which is pulpably different from that in which the rest of the grant is written, and which rather resembles the clumsy lettering of the other grant under reference. The problems raised by this pair of grants cannot thus all be looked upon as solved." I beg to explain the above difficulty as follows :—

The document was first drawn by somebody, say A, who was less of a lawyer, He did not mention the boundaries in the body of the document, as he ought to have done, to identify the village. There are many places which bear same names or similar names. So, to identify a village or a place, the mention of boundaries is necessary. The flaw in the first document spoken of in the Reports as " original " or " genuine " may have been latterly observed by B, who may be a better lawyer or drawer of legal documents, though he wrote a rather crude or bad hand. He at first thought of doing away with the flaw by writing the boundaries at the end in his own hand and did so. Such additions on legal documents, are likely to raise doubts about their being genuine ; So, on a second thought in order to remove the likelihood of such doubts, he may have thought of preparing a second document observing the proper formality of mentioning the boundaries of the village granted.

While doing so, he, being a better lawyer or drawer of documents. may have thought it opportune to attend to the wording of the document and may have changed it accordingly. The difference in the dates also, is explained by the above view.

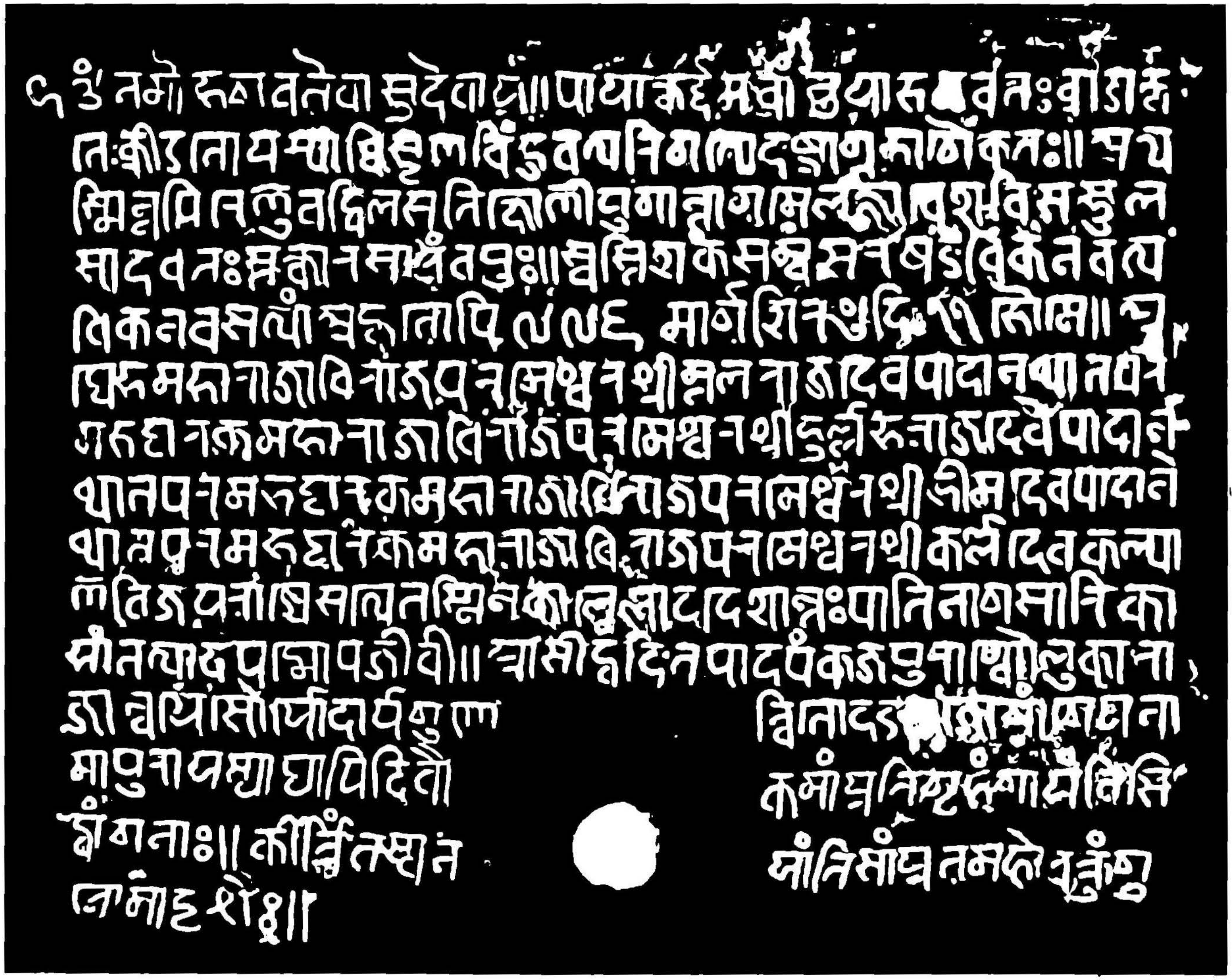
The first document is dated "Tuesday, the eleventh day of the bright half of Mārgasiraha in the Śaka year 996. This date corresponds to the Christian date...........

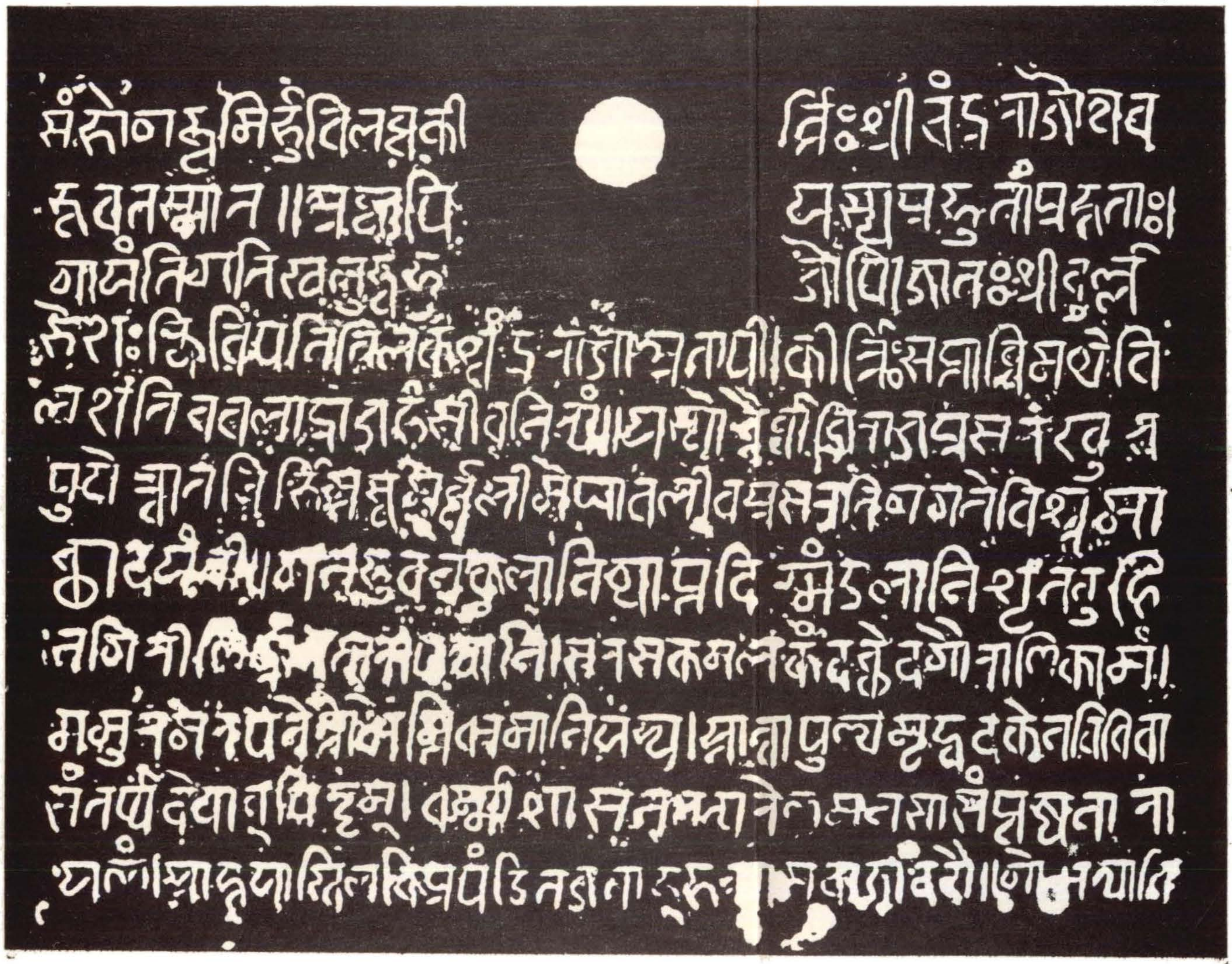
The second or revised document is dated "the eleventh day of the bright half of Kārtika in the Vikrama year 1131. This date corresponds to the Christian date...........

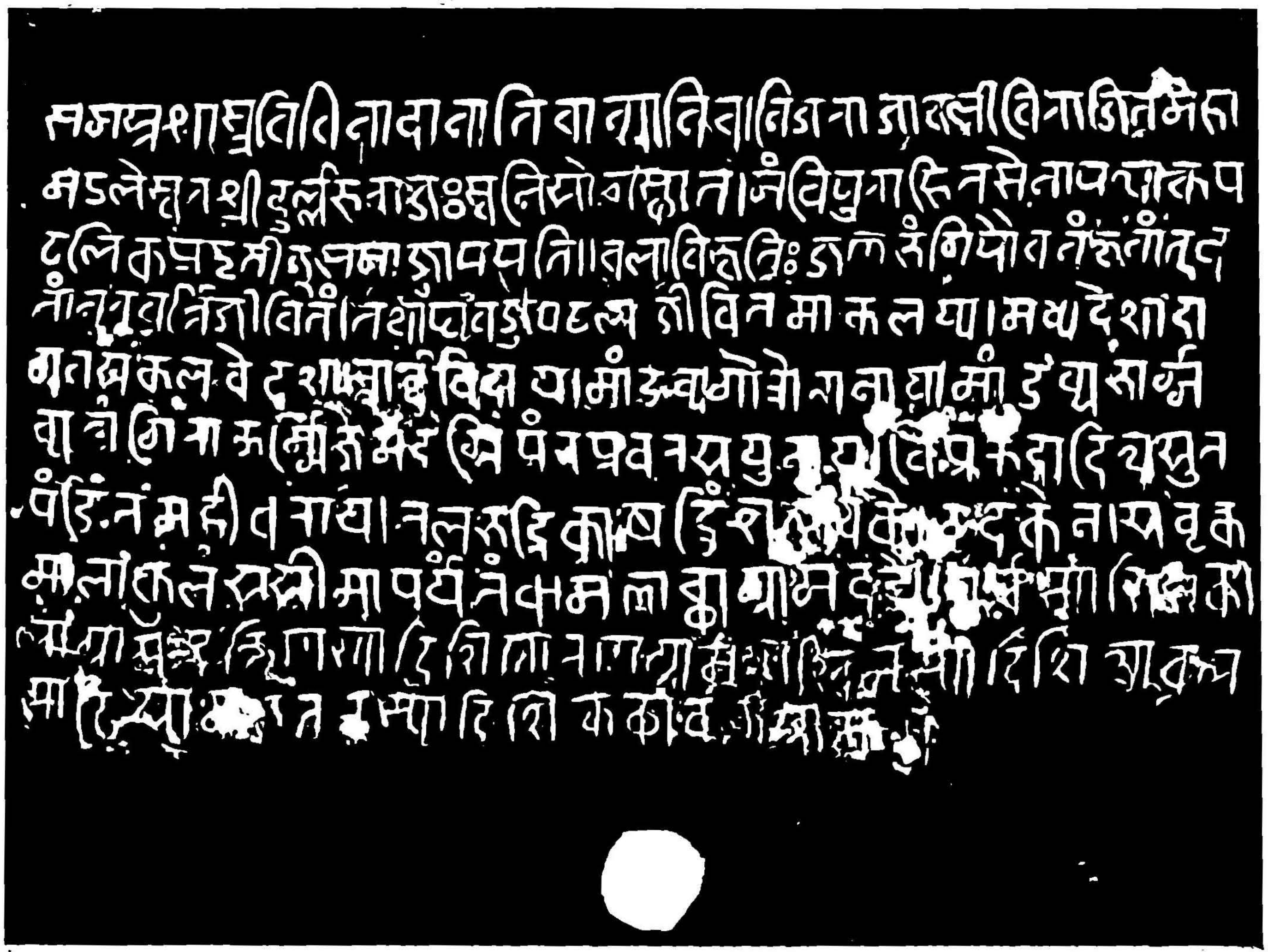
Thus we see, that the second revised and corrected document was made months and days after the first. Thus, as a matter of fact, the second document was a proper and more correct and legal document. But the preservation of the first plate or document was necessary to complete as it were the history of the grant of the village.

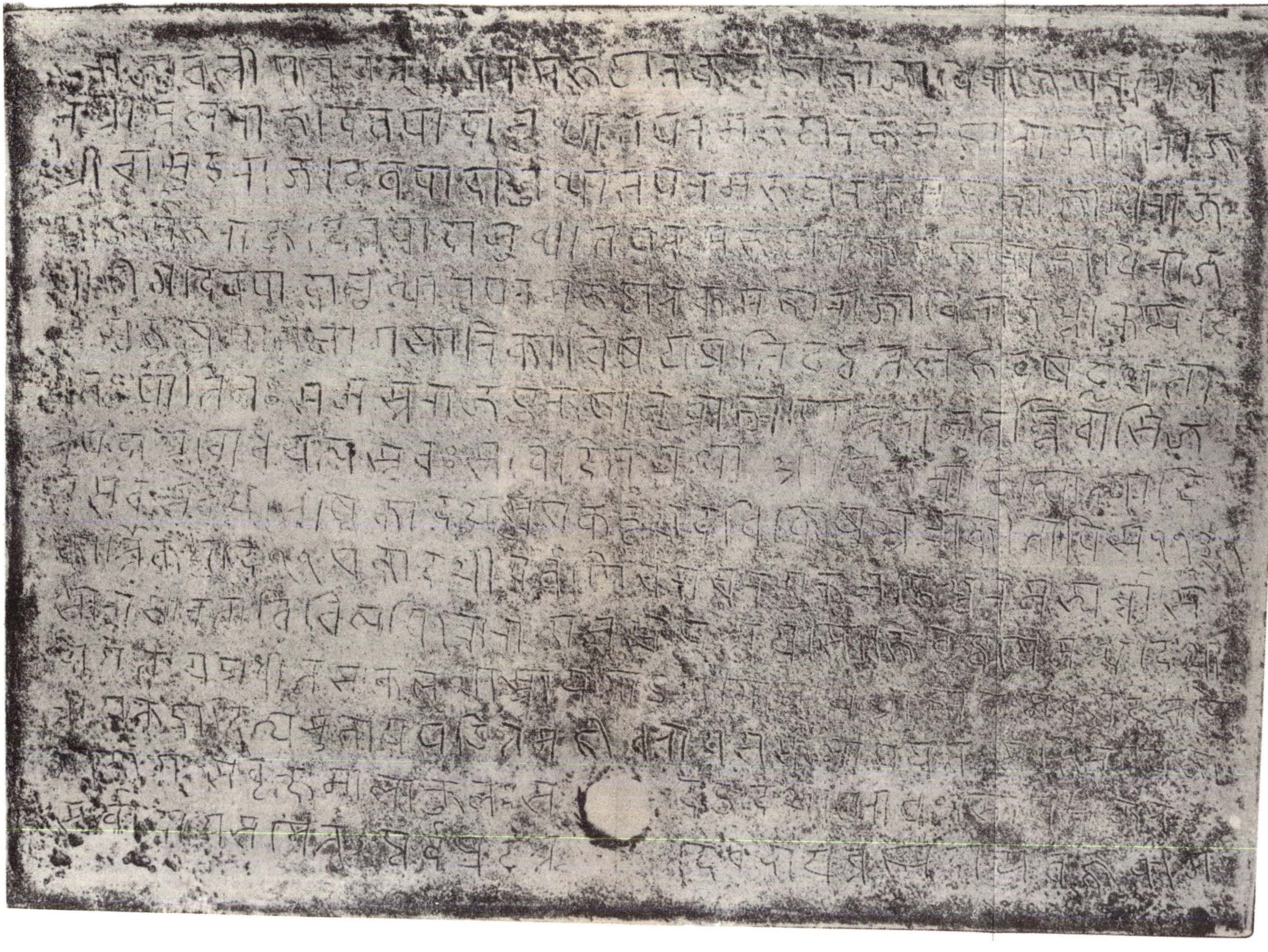
I have said above, that more than one town, village, place, hold the same name and that is especially the case in India. So, in naming the town, or village or place, one must be very careful. An amusing instance of neglect to do so is presented in an article entitled "Moguls and Jesuits" in the January issue of the East and West from the pen of..............

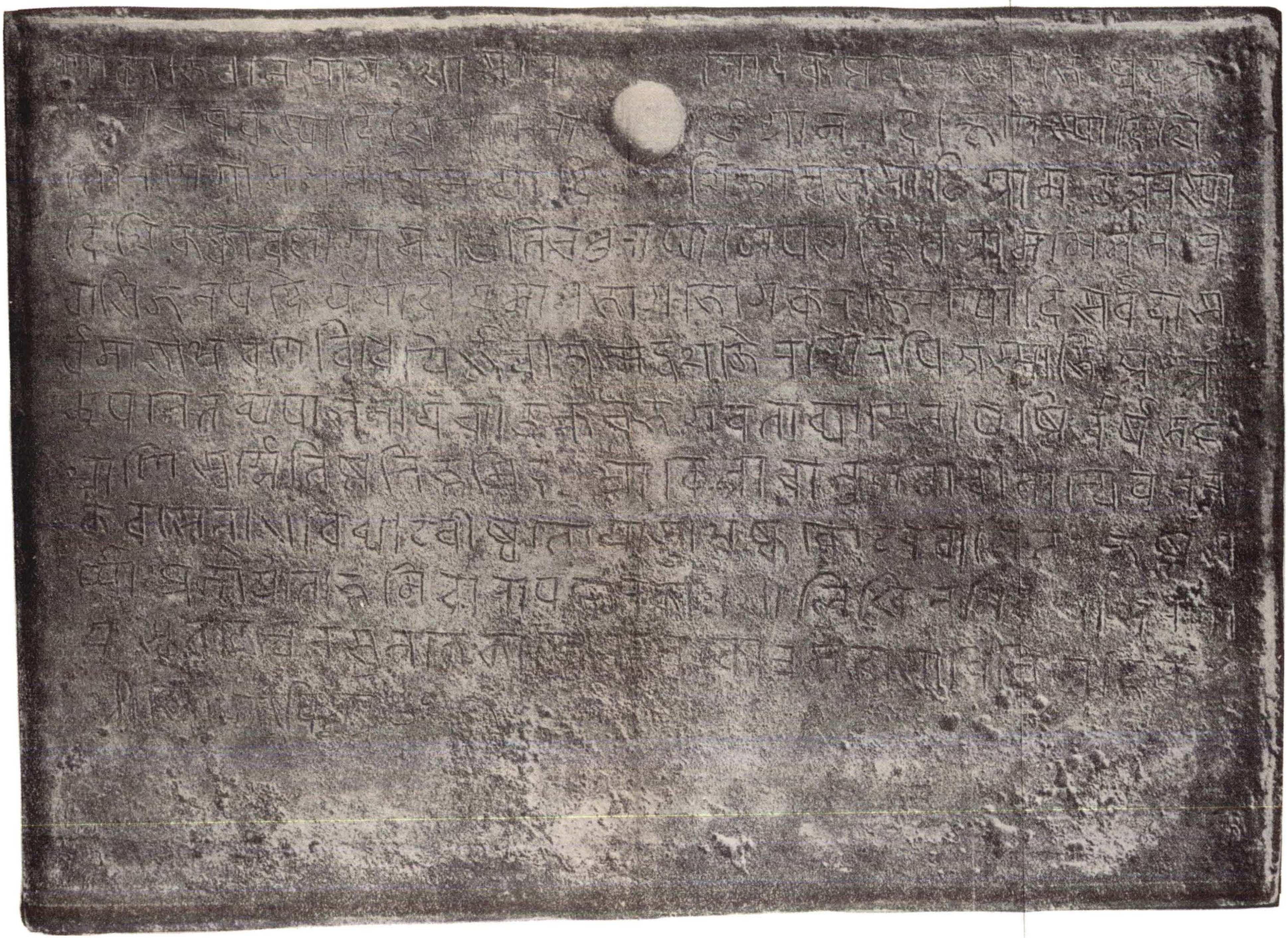
There are two Srinagars, one in Kashmir and another in Garhwal. In 1624, a Jesuit father D'Andrada by name, went to Chaprand in Tibet *via* the second Srinagar, *i.e.*, the one in Garhwal. After a stay of 20 years there, he left the place on account of a Revolution that arose there. Some time in the 18th century another father, Father Desidui who having read of Father D'Andrada's stay in Tibet, took the Srinagar mentioned by him to be the Srinagar of Kashmir and from there went to Lassha in Tibet. He found there a mission house of the Cappuchin Missionaries. It was vacant for the time being, the Cappuchin Missionaries having gone out of the country for some time. He took that to be the mission house referred to by Father D'Andrada and stayed there. Some time after, the real owners, the Cappuchin fathers returned and claimed their mission house from Father Desidui. He refused to vacate it saying that it was the mission house of our Jesuit D'Andrada. The dispute went to the Pope, who decided the matter in favour of the Cappuchins.











ART. XIII—*A Visit to the Great Wall of China. A Similar Wall of King Noshirwân (Chosroes I.) of Persia.*

BY

JIVANJI JAMSHEDJI MODI, B.A., PH.D., C. I. E.

Introduction.

Last year (1922), I had the pleasure and honour of representing this Society and four[1] other Societies and Institutions at the second Oriental Conference, held in the end of January at Calcutta. From Calcutta I had gone to Burma, the Strait Settlements of Singapore and Penang, French Indo-China, China and Japan. In my itinerary, I had included the world-known Great Wall of China, which had influenced the history of many ancient countries. I had the pleasure of visiting it on 1st April 1922. It was one of the dreams of my life to see this Great Wall, the construction of which was a landmark, not only in the history of China but also in the history of the then known world. Being the realization of one of the dreams of my life, I take my visit of it in the evening of my life as a landmark in the history of my life. The object of this paper is, (I) to give a brief description of my visit of the wall and of my impressions, and (II) to speak of a similar, though smaller, wall, built about 800 years later, in the West, near the Caspian Sea, by Anoushirawân or Noushirwân (Chosroes I) of Persia, who, like Justinian, his contemporary of Rome, was known as Noushirwân *adal, i.e.*, the Just, and of whose justice, his another contemporary, Mahomed, the great Prophet of Arabia, is reported to have said, that he considered himself very fortunate that he was born under the sovereignty of a just prince like Noushirwân. I speak of Noushirwan's wall as a wall similar to that of the Great Wall of China, because, like the great wall, it was built to keep away the inroads of a people, who were the descendants or an offshoot of the great people against whom the Chinese wall was built.

1. The University of Bombay, the Anthropological Society of Bombay, the K. R. Cama Oriental Institute and the Jarthoshti Din ni Khol Karnari Mandli.

The Great Wall of China, one of the wonders of the Ancient World.

We have often heard of the Seven Wonders of the ancient World.[1] The Westerners, or, to speak more correctly at present, the Middle Westerners of the ancient times, looked for their Wonders, only to the countries round the Mediterranean, which was more intimately known to them, and they did not include the Great Wall of the furthest East among their seven wonders, as they had hardly any opportunity to see it. It is not from any architectural point of view, but from the point of view of the great enterprise and its great length, and also from the point of view of the great and noble thought of the safety of his people which led to its structure by the King of China, that one can include the Great Wall in the list of wonders. Dr. Edgar J. Banks, in his "Seven Wonders of the Ancient World" very properly says that "it is a common weakness of modern man to imagine that his own age and his own country have progressed beyond all others." But imagine a continuous wall of the length of 1,500 miles, of the width of about 12 feet at the top, with 200 towers here and there across its whole length, built in a kind of wilderness of wildernesses, rising and falling over mountains and into valleys, and think, that the great wall was built by a great king of the remote past for securing the safety of his people from the frequent inroads of hordes of marauders, and you will then, I think, admit, that it must be a wonderful piece of work by a wonderful man, wonderfully solicitous for the good of his country.

Some speak of the Himalayas, the Great Wall of China and the Pyramids as the three greatest Wonders of the World. Of these three, one, the Pyramids are colossal mausoleums, which, one may say, are not of any practical utility. But think of the great practical purpose, the long wall of Nature, the Himalayas, has served in defending the extensive frontiers of India on the North; and from that, you can form an idea of the great purpose which the Wall of China has served in keeping off the inroads of marauding tribes into China. Fortunately, I have the pleasure of visiting all these three great wonders and I am in a position to form a clear idea of the purposes they have served. From the point of view with which it was built and from the fact of its being built in a wilderness, the Wall of China is very

1. The following are generally held to be the seven Wonders :—
   1. The Pyramids of Egypt, especially that of Cheops, built about 2900 B. C.
   2. The Wall and Hanging Gardens of Babylon from about 605 to 562 B. C.
   3. The Statue of Olympian Zeno by Phideus about 470 to 462 B. C.
   4. The Temple of Diana at Ephesus about 356 B. C.
   5. The Mausoleum or tomb of King Mauzolus of Caria, erected by his widow Artemesia, about 353 B. C.
   6. The Colossus of Rhodes, about 280 B. C.
   7. The Pharos or Watch-tower of Alexandria about 247 B. C.

properly taken to "have no paralled in the whole world, not even in the pyramids of Egypt."[1]

China, a Country of Walls.

From what you see, while travelling by train in China, and in Pekin itself, and from what you read in the books on China, you can say, that China is, as it were, a Country of Walls. The Great Chinese Wall has made it emphatically so. But, even before that wall was built in about 217 B. C., a Chinese King named Ts'ïn, who lived about 100 years before this time, had built a wall against the Tartars who were now and then attacking his people. It is said, that even about 50 years before that time, Ngwei, a powerful prince of the Tsin family had built a wall to keep off his neighbours.[2] The city of Pekin, "a mysterious picturesque interesting City" itself, has several walls,—the wall round the Forbidden city which included the quarters of the Emperors and his nobility, the inner wall, and the outer wall. Some parts of the country are said to have walls built to keep off prevailing injurious winds.

I

My visit.

We left Pekin on the morning of 31st March by a train, leaving that city at 7-25 a.m., and arrived at Nankou at about 10-45 a.m. From there, we went to see the great tombs of the Ming Kings (1368-1662 A. C.). From the station to the tombs, it is a ride on mules of about 3 hours. The distance is about 11 miles. Resting at Nankou for the night on returning from the tombs, we took the next day, at about 10 a.m., a train for the Ching-lung-chiao station which is the station to go up to the Wall. Our train had its engine at the back; so we had, from the front gallery of our carriage in front, a good look of the Nankou pass along which the train ascends. The Nankou ridge is about 1,900 feet high. I had the pleasure of crossing, in my previous travels, three mountain passes—the Khyber Pass on the way from Peshawar to Cabul, the Bubu pass in the Himalayas leading to the Kulu Valley, and the Banihal pass leading from Vernag in Kashmir to Jamoo. Out of these three passes, I was reminded of the Khyber Pass on seeing the wildly picturesque scenery of the Nankou Pass. In the case of the Khyber, I remember leaving Peshawar on an early morning in the end of March in 1887 shivering with cold, and returning at midday to Jamrud from Ali Musjid, all exhausted, riding for 10 miles and back under a torching sun. It was well nigh the same time of the

1. Calcutta Review of January 1903, Vol. 116. p. 40.
2. Ancient China simplified, by Prof. Edward Harper Parker (1908), p. 119.

year (1st April) when we crossed the Nankou pass by train and the weather here was cool. We saw snow here and there on some parts of the hills and also in some crevices down below. We began seeing the great Wall with its watch-towers here and there from the train. We saw from the train the old caravan route running in a zig-zag line here and there. We got down from the train at the Ching-lung-chiao station, and from there, about half an hour's walk of gradual ascent takes us to the top of a part of the wall. It was 12-10 when I placed my foot upon this historical wall, and the first words I wrote then with a glad heart in my note-book were "શુકરાના દાદાર! કે તું આખ્યે ઊમરે મને આ તવારીખી દીવાલપર લાવ્યો." *i.e.*, "I am grateful to Thee, O God! that you brought me at this age on this Historic Wall."

The wall had watch-towers at some distances, and here and there, there were rooms beneath the floor which may be godowns or store-rooms for military requisites. The wind was blowing terribly strong on the top of the Wall, and, though it was mid-day and I had an overcoat on my body, it seemed to pierce through. Leaving my friends, I proceeded a few hundred yards further and it was a grand and glorious sight from there, to see the noble wall rising and falling over precipices in a wilderness. Looking on your right and on your left, in your front and on your back, you can cast your physical eyes to long distances of space, and your mental eyes to long vistas of time —past ages which had now and then kings in China, as noble as in any other parts of the world, who thought more of their subjects than of themselves. I would have liked to stay or sit longer on this awe-inspiring wall in the wilderness and to meditate there on the ups and downs of Empires. But there was not much time to indulge in that luxury, and, once more thanking God, I left the wall, full of joy for having seen this great piece of the work of Man inspired by God. When I say, that I saw the great Wall of China and realized a dream of my life, I say, that I saw only a very small part of the great wall which extended through a large tract of the country. We had a second look at the Great Wall from a distance, from the train on the 3rd of April 1922 at about 5-15 p.m., when we were on our way to Japan *via* Fengtien or Mukden. From the Chin-Wang-tao station, we saw the Wall on our left. The wall commenced from Shanhaikuan at the Gulf of Pechili close by, which has a great harbour. But the distant view from here was not sufficiently impressive. That at the Nankou pass was one, which, as said by a traveller, "once seen, can never be effaced from the memory."[1] As said by another writer,

1. Charles E. D. Black in the Calcutta Review of January 1903, p. 34.

"It is one of the few great sights of the world that is not disappointing. It grows upon me hour by hour and from the incredible it becomes credible."[1]

The Extent of the Wall.

The wall is said to be 1,500 miles long. The most accessible part of it is that at the Nankou Pass. Its height varies from 20 to 50 feet. In some parts of it, at the distance of every 200 yards, there are watch-towers about 40 feet high. Some of these towers, in addition to being watch-towers for the sentries, served also as places for hurling stones towards the enemies. The base of the towers varied from 15 to 25 feet in thickness. It was 12 feet at the summit. In some parts, the wall is about 4,000 feet high from the sea level. Wherever it was more exposed to the marauding tribes, it was built of solid masonry. General Grant of America is said to have estimated, that the wall "took as much work as would have built all our (American) railroads, all our canals and nearly all our cities."[2] Another writer estimates the use of materials in its construction as follows:—"To give another idea of the mass of matter in the stupendous fabric, it may be observed that it is more than sufficient to surround the circumference of the earth at two of its greatest circles with two walls, each six feet high and two feet thick. It is to be understood that in the calculation is included the earthy part of the midst of the Wall."[3]

It is said, that about 30 lacs of men were engaged by the king in building this Great Wall. As the marauders, against whom the wall was being built, were likely to harass, and actually harassed, these builders who all were spread along a long line of the wall, an army of three lacs of men was required to protect the builders from harm. It is said on some authority that forced labour of 7,00,000 men[4] was employed over it.

A sketch of the History of China and the Builder of the Great Wall.

The Great Wall separates, as said by Mr. Geil,[5] two lands of the East, the Cold North and the Summer South. It also separates two great races—"the outward flowing white race of the North and the black-haired race on the south, now known as the Yellow race." In the same way, it separates two epochs in

1. Miss Eliza Schidmore, as quoted by the above writer, Ibid, p. 36.
2. The Great Wall of China by William Edgar Geil.
3. Calcutta Review of January 1903, p. 41.
4. It is said of the Emperor who built it that he had employed 7,00,000 eunuchs on the work of building his palaces. The eunuchs were castrated criminals whose crimes were lesser than those that deserved the punishment of death or of maiming, such as chopping off of feet or slicing of knees. (Ancient China simplified, by Prof. Parker, p. 119).
5 "The Great Wall of China" by William Edgar Geil.

the history of China—the Mythical age and the Historical age. The History of China is divided into four periods:—1. The most Ancient period. 2. The Ancient period (255-207 B. C.) 3. The Middle period and 4. The Modern period. Out of these four, the Great Wall divides the first two periods, and, "as the greatest monument of human industry, it has a noble history."

The pre-historic or semi-mythical history of China begins at about 2,500 B. C., when China, under its three successive rulers, is said to have passed into a stage of civilization. During this period, marriage was instituted, animals were domesticated, agriculture taught, medical art founded with the use of herbs, cities were founded, time began to be regularly counted and calendars formed, communication between cities was carried by boats on rivers and by carts on land, and silk industry commenced. Before this time, language, as it were, consisted of expression of thoughts by means of knots tied on strings, but during this period picture-writing began, which, later on, developed into the modern system of Chinese ideographs.

The next set of rulers of China, after the first batch of the above three kings and their successors, were known for the great engineering works in connection with the regulation of floods, one of which is said to have been as large as the great Deluge of the Bible in Mesopotamia. The flood period lasted for about 9 years and was ended by the construction of canals, the engineering feat of some of which is said to be as great as that of the Panama canal. One of these rulers, Yu is known as the great canal-builder (2205 B. C.).

Then reigned the Shang (Tang) or Yin dynasty (1766-1122 B.C.), which was followed by the Chou (or Chow) dynasty, founded by Wu Wang, who established a kind of feudal system in China by granting portions of the kingdom to his supporters. The rule of this dynasty was the longest in China (1122 to 249 B. C.). The proper historical history of China begins with the rule of this dynasty. The three great Chinese philosophers, Confucius, Mancius and Taotze were born during the rule of this dynasty. The feudal system of this dynasty weakened China after a number of years when the feudal princes grew strong and weakened the central power. So, a powerful nobleman of the country, named Shih Hivang (or Hwang)-ti, spoken of as the Napoleon of China, founded in 221 B. C., a new regime of the Tsin or Chin dynasty. This was, as it were, the foundation of China as a great united Empire, which continued as an empire, though under different dynasties and though now and then divided for short periods between rival rulers, for a long period of about 2,000 years, till it was overthrown in the beginning of this century and a Republic formed. Hwang-ti, the founder of the Empire, was a powerful man. When he found, that a number of people preferred the former Feudal system, and that scholars pointed for their authority for the advantages of that system to previous literature, he ordered the destruction by fire of all old literature which referred to old tradition. This was a great black spot on the brilliant life of this great man. He destroyed extensive libraries of old books formed by successive previous rulers of China, saving only scientific books on medicine, astrology, and husbandry and books on divination. He also buried alive a number of literary scholars who quoted old books in favour of the ancient rulers and against the then rulers. His name has therefore been condemned by later Chinese writers. He was to China what Alexander the Great was to ancient Iran; in the matter of destroying the country's old libraries, with this difference, that Alexander was a foreigner but Hwang-ti was a son of the soil. His name was cursed by the Chinese, as that of Alexander by the Persians. It was this king, who began building the Great China Wall in 214 B.C. to defend his country against the northern Tartars who formed a tribe of the great Hun nation. He entrusted his General Ming-tien with this great work. Chinese trade with Persia and, further on, with Rome flourished in the reign of this king. It was this great ruler Hwang-ti, who, from the name Tsin, where he was born and lived, gave his dynasty the name of Tsin or Chin, which dynasty, in its turn, gave the country its later name of Chin or China.[1]

One may perhaps say from the above act of the Emperor, that he was altogether opposed to education. But no ; from his point of view of the good of the country, his quarrel was, to speak in our modern style of speech, a quarrel with the Humanists, who are believed to be attaching too much importance to the Classics. He was, as it were, an anti-humanist, an extreme anti-classic of the worst type. But while he tried to destroy the old Chinese Classics, he attempted to liberalize general education. He wanted to introduce a style of writing by which books can be easily composed by the writers and understood by the readers. From this point of view, Mr. W. E. Geil places him in the rank of Peter the Great, Alfred the Great and even Bismark. He cared less for the few learned and more for enlightened commonalty.

[1] His dynasty was overthrown by the Hun dynasty, whose founder was to China what Ardeshir (Artaxerxes) Babegan was to Iran—the restorer of its ancient literature and encourager of learning. It was he with whom commenced the well-known Chinese system of literary examinations for the civil service of China.

What is said of this Great Emperor who built the Great Wall of China, reminds us of what we are told of Chandragupta, the father of Asoka. It is said, that Chandragupta was so much afraid of his enemies who looked at his rise with jealousy, that, to keep them off their watch, he did not sleep in one and the same palace every night, and that, in the same palace also, he slept in different rooms during the different parts of night. Similarly, it is said of the Chinese king, that powerful as he had become after uniting the different kingdoms, he was not afraid of human beings, but was afraid of evil spirits, who, he imagined, pursued him. So, in order to throw them off their scent, he slept each night in the different rooms of his great palace consisting of about 1,000 bed rooms. He built the wall to keep off the ancient Tartars of the Hun nation. But, by what is spoken of as "an irony of fate," the dynasty of the same Monchu Tartars recently ruled over China, till overthrown by the formation of the Republic. To emphasize this change, all the Chinese got their long hair cut off.

The building of this great wall of China, spoken of by the Chinese as Chang,-Ching, *i.e.*, the Great Wall, was preceded, as said above, by some walls on a smaller scale, here and there. M. Deguignes, in his History of the Huns, thus refers to the previous walls: "China was desolated since a long time, by the incursions made by the Tartars living on the North. Several small kings had erected a long wall on their frontiers to stop them. Tehing-van having become the master of the Empire joined them together and constructed one in his ancient country of Tsin, that which formed what we now call the Great Wall, of which he was not entirely the author as several writers of Europe have written."[1] M. Deguignes says, that one may regard this wall built to check the Huns as one of the Wonders of the World (une des marveilles du monde).[2]

The effect of the Great Wall upon the history of the world.

The Great Wall affected the history of the whole world. It is generally, and, to a certain extent, properly believed, that the downfall of the Roman Empire in the 5th Century was due to the eruption of the Teutonic tribes into Roman territories. But the cause which led the Germanic hordes to drive towards the Roman territories was the movement of the Hun tribes of Central Asia. The ancestors of these tribes

1 I give my translation from "Histoire Générale des Huns" par M. Deguignes (1756) Tome I Partie I p. 19.
2 Ibid, Tome I Partie II p. 19.

were, for a long number of years, invading the different countries of the East, and among these, the country of China. The Chinese Emperor having built in the 3rd Century B.C., the Great Wall for the defence of the Chinese Empire against the Huns, the latter turned towards the West. Though there was the interval of nearly eight centuries between the time (the 3rd Century B.C.) when the Great Wall was built and the time (5th Century A.C.) when the Roman Empire fell, one can well trace the influence of the Great Wall upon the Roman Empire. A great event in history exerts its influence for a number of years, both in the country itself and outside of it. The particular tribes of the Huns who were repulsed from China by the construction of the Great Wall turned back and fell upon the Yuechi tribes who were in front of them and drove them further back. The latter in their turn fell upon the Ut-Suivi tribes and drove them back. The latter again fell upon the Scythic tribes which had extended up to the Caspian sea, and so on.

In my paper on "The Early History of the Huns and their inroads in India and Persia" before this Society, I have dwelt at some length on the influence of this great wall, upon the History of China, Rome, India and Persia. In my paper on "The Hunas in Avesta and Pahlavi" in the R. G. Bhandarkar Commemoration Volume (pp. 65-80), I have touched in passing the question as to who the king was, who defeated and put an end to the Huna supremacy in India—Was he Yashodharma (Vikramaditya) or Baladitya? In this controversy, the history of Persia is appealed to, and I have ventured to believe "that the credit of the defeat of the Huns belongs to Yashodharma." I will not enter here into the great question of the influence of the Great Wall on the History of the then known world, but pass on, referring my readers to the above papers for details.

The ancient Huns who harassed China were divided into various tribes, known under different names in different countries and at different times. These tribes had, as it were, a continuous war with the Iranians, down from, what may be termed, the prehistoric times of the Kayânian dynasty to well-nigh the end of the Sassanian dynasty. Just as it was Yashodharma who broke the power of the Huns in India, it was Noshirwân (Chosroes I) who broke their power against Persia. They had some fight with the successors of Noshirwân, but their power was greatly broken by Noshirwân. This brings us to the second part of my paper, the Wall built by Noshirwân against the Khazars who were a tribe or an offshoot of the Huns.

II.

THE WALL OF NOSHIRWÂN OF PERSIA.

About 750 years after the above Chinese Wall, Noshirwân of Persia (Chosroes I, 531-579 A.C.), built a similar wall to protect his people living on the Caspian shores from the inroads of the tribes whose ancestors had knocked often at the gates of China and who were prevented by the Great Wall from entering China. As said above, I speak of Noshirwân's wall as a similar wall, not on account of its extent, because it was very small in comparison, but on account of the association of events. It also was, like the Great Wall of China, built against the Huns. Just as the great wall of China begins from the sea at the Gulf of Pechili Noshirwan's wall began from the Caspian Sea at Darband. Like the Chinese wall, it ran across mountains—mountains of the Caucassus range—and valleys and is said to have extended upto the Black Sea. Just as our Himalayas form a kind of natural bulwark against invaders from the North, the Caucassus formed a bulwark running across the regions between the Caspian Sea on the East and the Black Sea on the West. The mountains were crossed by two passes, one inland, known as the Darial Pass, and the other, close to the Caspian at Derbend, known as the Derbend Pass. In fact, the latter cannot strictly be called a Pass because it was a gap between the mountain and the Caspian. The latter was very important, and, as the old name of the place, Bab-al-abwâb (door of doors), and the modern name Darband (the closed door) signify, it was the Door of Doors or Gate of Gates for the people coming to Persia from the North. Prof. Jackson[1] speaks of it as the "Key to Persia," and says, that when Peter the Great of Persia returned to his country after his conquest of a part of Persia, he carried with him as a souvenir "the keys of the city of Derbend." The ancient Romans spoke of the Pass or Gate as Caspiæ Portæ, *i.e.*, the Caspian Gates. Several Arab and Mahomedan writers have referred to this work of Noshirwân. Maçoudi;[2] who lived in the early part of the 10th Century, was one of these.

The wall of Noshirwân according to Maçoudi.

Maçoudi, in his Chapter on Mount Caucasus (Chap. XVII) spoken of as El-Kabkh (القبخ), while speaking of the city of Bâb-el-Abwâb (Darband), describes the wall built by Kosroe Anoushirawân (كسرى انوشروان) from sea to sea, to keep off the Khazars,

[1] From Constantinople to the Home of Omar Khayâm, p. 60.

[2] MaCoudi was born at the end of the 9th Century at Baghdad. He travelled in India in 912-13 A. C. upto Multan. He was again in India at Cambay in 915-16. Thence he went to Ceylon and then to Madagascar. He had travelled on the shores of the Caspian. He died in Egypt in 956-57.

the Allans, the Turcs, the Serirs and other tribes, who were the offshoots of the great people known under the general name of Huns. He says, that "the Caucasus contained a number of tribes, about seventy-two in the least, each ruled by a separate chief and speaking a separate language. Noushirwân built, at the head of one of the defiles of this mountain, the city of Bâb-el-Abwâb (Lit. Gate of Gates), the city latterly known as Darband, which is situated at the foot of the Caucasus, on the Caspian Sea known as the Sea of the Khazars (بحر الخزر). He also built a large extensive wall which began from about a mile in the sea, and then, ascending lofty mountains and descending deep valleys, ran for 40 pharsangs,[1] ending at a place called Tabarestân. This length of 40 farsangs means the distance of about 120 or 160 miles. At the distance of every three miles or nearly three miles according to the importance of the road over which it opened, he placed an iron door near which he installed from the inside of the place a tribe of people to watch it (the gate) and the wall. This rampart was to present an insurmountable barrier to the attacks of the neighbouring tribes of Kabkh (قبخ), such as the Khazars, the Allans, the Turcs, the Serirs and other infidel people (انواع الكفار). In order to visit the cragged summits of the mountains of Kabkh and to run over their length and breadth, it required two months or more. The tribes inhabiting the mountains were so numerous that God alone can count them. One of the defiles of the mountain ended at the shore of the Caspian near Bâb-el-Abwâb and another at the sea of Mâyatis (بحر مايطيس), where lies the canal of Constantinople (قسطنطنيه). Over this sea (Caspian), also stands Trebizend, a centre of trade. Noushirwân settled the territories of all the above tribes with chiefs ruling over them just as Ardeshir, the son of Babak had done before him in the case of the princes of Khorasan. One of such territories was Shirwan (شروان), the chief of which was called Shirwân-shâh (شروان شاه)[2]." This territory, according to Maçoudi, was ruled over, in his time, by Mahomed, son of Yazed, who traced his descent from Behramgour, from whom the chief of the Serirs (سرير) also traced his descent. The chief of Khorassan, at the time of

1 A Farsang corresponds to a league, *i.e.*, three miles (Steingass). According to Wollaston, it is a league and three quarters, *i.e.*, it comes to about 4 miles. According to Herodotus (Bk. V. 53), an Iranian farsang was equal to 30 stades ("stadiums, or furlongs)," *i.e.*, 3¾ miles. (According to Webster, stadium was a Greek as well as a Roman measure. It was equal to 600 Greek or 625 Roman feet or 125 Roman paces, or to English 606 feet 9 inches). According to Strabo, some took a farsang to measure 40 stades and others 60 stades. According to the Pahlavi Zadsparam. (Chapt. VI. 8. S. B. E. Vol. V. p. 170) also, a farsang comes to about 20,000 feet, *i.e.*, 30 furlongs.

2 In this account, I have followed the Translation of Maçoudi by Barbier De-Meynard et Pavet de Courteille, Vol. II, pp. 1 *et seq.*

Maçoudi, was named Ismail, son of Ahmed. He also traced his descent from Behramgour.[1]

Later on, Maçoudi says of this wall that, "had not God by his rare sagacity, his all-power, and his love for his people, helped with his grace the sovereigns of Persia in the foundation of the city of Bab-el-Abwâb, in the construction of this wall, which extends over the continent (*i.e.*, over land), in the sea and over mountains, in the erection of different fortresses, and in the establishment of several colonies subject to the regularly constituted powers, there is no doubt, that the kings of Khazars, the Allans, the Serirs, the Turks would have invaded the territories of Berdeh, (بردعه), Er-Rân (الران) Bailaqân, Azarbaijân, Zenjân, Abhar, Kazwin, Hamdan, Dinawar, Nehavend and other countries which, *via* Koufah and Basra, gave entrance into Irak. Fortunately, God has opposed to their barbarities these barriers, which are necessary to-day more than ever when the power of Islam gets feeble and declines, when the Greeks rail at the Musulmans, when the custom of pilgrimmage falls into disuse, when one does no more hear of sacred war (*jehâd*), when the communications are interrupted and the roads are hardly safe—to-day (332 Hijri) when the different chiefs of the Mahomedan countries have isolated themselves and have made themselves independent in their governments, imitating in that (matter) the conduct of the satraps (ملوک الطوایف) after the death of Alexander upto the time of Ardeshir, son of Bâbak, son of Sâssân, who re-established the unity of the kingdom, caused the internal divisions to cease, and gave security to the people and culture to the country."[2] The wall according to Maçoudi, was called Sour et-Tien (سور الطین)[3] *i.e.*, wall of mortar.

Firdousi on Noshirwân's Wall.

After Maçoudi, Firdousi is the next known author who refers to the Wall of Noshirwân. He speaks of it under the head of :—

گشتن نوشیروان گرد پادشاهی خود و دیوار بر آوردن براه گذار

1. Among one of the pagan tribes of this district, there was prevalent in the time of Maçoudi, the custom of what we call Sutee in India. Maçoudi thus speaks of the custom : "They burn their dead by placing over the same funeral pile their beasts of burden, their arms and their dress. When a man dies, his wife is burnt alive with him ; but if a woman dies first, the husband does not submit himself to the same fate. When one dies unmarried they give him a wife after his death. Women desire arduously to be burnt with their husbands to enter with them into paradise (al Jinnat). This custom, as we have already remarked, has prevailed in India where the wife is burnt with her husband only when she consents." Vol II. p. 9.

2. Moçoudi par Barbier de Meynard, Vol. II, pp. 72-73.

3. Arab. *surat* صورت "A row of stones in a wall ; a structure" and *tin* طین clay or mortar. According to Prof. Jackson, the Armenians speak of the Pass across which the wall runs as Pahak Soral, "*i.e.*, the wall (saur) of protection" (From Constantinople to the Home of Omar Khayam, p. 61, n. 3.)

ایران و توران *i.e.*, "Noshirwân's travels within his kingdom and his constructing a wall on the route of passage between Iran and Turan." According to Firdousi, Noshirwân, after ascending his throne, went on a tour in his dominions. His heralds shouted to the people wherever he went and inquired if the subjects had anything to say to their sovereign. During this tour, he passed from Gurgan through the country (of Mazendaran) where are situated the towns of Sari and Amoul. The country was very beautiful and he praised God for the creation of such a beautiful land. One of his subjects there said to the king, that the vicinity of the Turcs, who passed that way, was a bar to their happiness of living in such a beautiful place. They often came there and plundered the country. The people there, therefore, prayed to the king to relieve them from these frequent inroads. The king sympathised with them. He ordered skilful architects from other countries and got a wall built there[1] under the supervision of an old Mobad.

Noshirwân's wall according to Yaqout.

According to Yaqout,[2] the city of el-Bab (*i.e.*, the Porte or gate) or Bâb-el-Abwâb (the Gate of Gates), behind which Noshirwân had built the above wall, was latterly known as Darband (*i.e.*, the Bar of a Door) or Darband-Sehirwan. Across the two necks of land which form the entrance of the port of the city, they had put up barriers to make the entrance very narrow,

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بدستور فرمود کز هند و روم ∴ کجا نام باشد بآباد بوم[1]
ز هر کشوری مردم پیش بین ∴ که استاد یابی بدین بر گزین
یکی باره از آب برکش بلند ∴ بنش پهن و بالای او ده کمند
بسنگ و بصاروج از ژرف آب ∴ بر آورده تا چشمهٔ آفتاب
همانا کزین گونه سازیم بند ∴ ز دشمن بایران نیاید گزند
نباید که باشد کسی زین برنج ∴ بده هرچه خواهند و بگشای گنج
کشاورز و دهقان و مرد نژاد ∴ نباید که آزار یابد ز باد
یکی پیر موبد بد آن کار کرد ∴ بیابان همه پیش دیوار کرد
دری بر نهادند از آهن بزرگ ∴ رمه یکسر ایمن شد از بیم گرگ
همه روی کشور نگهبان نشاند ∴ چو ایمن شد از دشت لشکر براند

Mecan's Calcutta Edition Vol. III, p. 1630, M. Mohl's small edition of "Le Livre des Rois" Vol. VI, pp. 144-45.

2. Dictionnaire Géographique, Historique et Littéraire de la Perse, par C. Barbier de Meynard (1861), p. 68. Yaquot was born in 1178 A. C.

and two strong and long chains closed the entrance of ships into the port without authority. Yaqout thus refers to the wall running from behind this city: "Above the city is a stone wall which extends over the mountain in the direction of its length; it is difficult to enter by that way the Mussulman countries on account of the difficulty of the routes and the narrow paths which lead to it. Besides this, a part of the wall advances into the city in the form of a promonotory and prevents the ships from approaching. It is built very solidly and rests upon strong strata. It is Noushirwân who is the builder of it.[1]........The ancient Kousroes (kings) never lost sight of this frontier and omitted nothing to make it impregnable on account of the dangerous vicinity (of hostile tribes). They confided its guard to Persian troops of tried fidelity, to whom they left the possession of all the territories which they could cultivate with a view to develop the resources of the country and to defend against the Turkish tribes and other infidels." The reason why Noushirwân built this wall is thus described:— "The Khazar tribe had made themselves masters of the Persian Empire upto Hamdân and Mosul. Noushirwân, on ascending the throne, sent some deputies to ask in marriage, the daughter[2] of their king and offering his to him, with a view to cement by that alliance their union against their common enemies. This proposition having been accepted, Noushirwân selected one of his most beautiful slave women. He sent her, under the name of his daughter, to the King of the Khazars, to whom, according to custom, he made magnificent presents. The Khakan (the King of the Khazars) then offered his own daughter to Khosro. Noushirwân demanded an interview to strengthen the bonds of friendship between them. They selected a propitious place and the two sovereigns lived there for some time." One day Noushirwân ordered one of his officers to select 300 of his best soldiers and to plunder the camp of the Khakan when they were all asleep. The next morning, the Khakan complained of what happened in his camp at night and asked for an explanation. Noushirwân pretended ignorance and said that he would make inquiries which ended in nothing. This was repeated twice. Then the Khakan, being irritated at the culprits not being traced, asked one of his generals to do a similar thing, *i.e.*, to plunder one night the camp of Noushirwân. When Noushirwân complained the next morning, the Khakan said: "Your camp has been put to this trouble only once but my

1. Gibbon alludes to the building of the wall and its gate by Noushirwan when he says: "The Persian assumed the guard of the gates of Caucasus." (Vol. III, p. 120, Edition of 1844).

2 Here, by the expression of exchange of daughters is meant the exchange of the royal brides of each's family.

camp has been thrice plundered." Then Noushirwân said: "This seems to be the work of evil-minded persons on both sides who wish to create a rupture in our friendship. I propose a project, which will benefit us both, if you accept it." On the Khakan asking, what it was, he suggested that a wall may be built between their territories to prevent the subjects of one entering into the territories of another without permission. The Khakan agreed and the wall was the result. It is said that when it was finished Noushirwân got his throne placed on the dam over the sea upto which the wall was extended and prostrating himself before God, thanked Him for having helped him to finish the great work. He then laid himself down on the throne and exclaimed: "I can now rest myself."

Noshirwan's wall referred to in the Turkish Derbend-namah.

The Derbend-namah[1] refers to Noshirwân's Wall. I give here a substance of the portion, which precedes the reference to Noshirwân's wall, showing that there existed then, even before the time of Noshirwân, a wall known as the Wall of Alexander: There reigned in Iran, a king named Kobad who ruled over the whole of Turkistan and Ajamastan (عجمستان). Anoushirawân Adil was the son of this King. In the North, there ruled over the Khazar tribe a king called Khakân Shâh (خاقان شاه) who also ruled over Russia (روسیه), Moscow (مسکو), Kazân (قزان), Crimea (قریم) and other countries. The seat of the throne of this Khâkân-shâh was on the sea-shore on the banks of the river Adil (عدل Volga). There was a constant war between Persia and the Khakân-shâh, which was put to an end by a peace, the principal term of which was, that King Kobad of Persia was to marry a daughter of the King of the Khazars. To prevent disturbances in future, Kobad proposed that a boundary wall may be constructed between the frontiers of the Persian territories and the territories of the Khazars. The Khakan proposed that the wall built by Iskander Zoulqarnin (اسکندر ذولقرنین) may form the boundary and that the Persian king may build a city there. The city was built and named Babul-abwâb

1 *Vide* Derbend-nameh or the History of Derbend, translated from a select Turkish version and published with the Texts and with Notes, by Mirza A. Kazem-Beg. (St. Petersburg 1851). According to Mirza Kazem-Beg, it was written at the end of the 16th century by Mahomed Awabi Aktachi (محمد اوابی اقطاشی) under the patronage of Ghazi Geral, a brother of Semiz Muhamed Gheral Khan, the Khan of Crimea. This was some time after the Ottomans subdued Aderbaizan and Daghistan in the reign of Sultan Murad III. A Persian translation of this Turkish Derbend-nameh is said to have been made in 1806 (Ibid, p. XI) by one Ali-Yar. Then there has been another Turkish version made from the Persian version.

Darbend and many Persians went and settled there. This being done, Kobad-shah sent the daughter of the Khakan-shah back inviolated to her father's court, apprehensive that, were children to be born of this marriage, such an event might in future ages be a cause of discord between two kingdoms, and might give occasion to the tribes of Khazar to possess themselves of the frontiers of Iran. The Khakan-shah was enraged at this conduct of Kobad and wars were again renewed. The new city of Darbend was invaded and Noshirwân, the son of Kobad, defended it.

Then we further read that Noshirwân himself also "erected a wall, at the distance of three farsakhs from Derbend which extended to the distance of ninety-two farsakhs."[1] Thereafter, "Prince Anoshirwân on the death of his father ascended the throne of the Kingdom and reigned. He filled with warriors all the cities and fortresses lying around Derbend and on the frontiers; and himself retired to his metropolis Medâyan, where he remained with a firm resolution to defend the boundaries of his Empire..........His object in building these towns and fortresses was to prevent Khakan-shah and the Khazarians from having it in their power to conquer Derbend........Thus the ancient kings endeavoured to defend Derbend in order that the Khazars might not gain possession of it; for, if the Khazars could have taken Derbend, all the kingdoms of Aderbaijan and Fârs would inevitably have fallen under their dominion."[2]

Tabari[3] on Noshirwan's spring of water at Derbend.

Tabari, though referrring to Noshirwan's war with the Khazars, does not refer to his wall. But he refers to a reservoir of water built by Noshirwan at the city. While speaking of the war of Maslama, son of Abdou'l Malik, governor of Armenia, with the Khazars, Tabari refers to Noshirwân's reservoir and describes a stratagem whereby the Khazars were made to run away from the city of Bab-al-Abwâb. According to this writer, there lived in the city 1,000 Kazar families. Maslama beseiged the city but to no purpose. One of the Khazars of the city proved treacherous to his tribe, and on the promise of a reward, he undertook to help Maslama. He asked from Maslama 100 sheep and oxen and took them to the reservoir of water built by Noshirwân from which the Khazars in the citadel of the fort drew their supply of water by a subterranean channel. He slew all the 100 animals there and rendered the water bloody. So, the Khazars in the citadel could not drink the water. Being thus deprived of their water,

1 Ibid, p. 7. 2 Ibid. pp. 7-9.
3 Tabari was born at Amol in Tabaristan in 838-9.

to avoid dying by thirst, they left the city. Thus, this stratagem brought the citadel into the hands of the Musulmans.

Prof Jackson's account of his visit to the wall.

Prof. Jackson, in his second book of travels in Persia, gives us a very interesting account of his visit to Noshirwân's Wall and of his researches there. We learn from it, that even now, after the lapse of nearly 14 centuries, one sees the relics of Sassanian times there on the banks of the Great Caspian.[1] The surest evidence of identifying the wall as the work of the Sassanians was the fact that "in the stones...... there were carved the oft-repeated figure of a ring with two lines hanging from it resembling the familiar Sasanian chaplet with streamers. These devises were generally carved high up at the sides."[2] According to Prof. Jackson, the construction of the wall is of large blocks, four feet in length and two feet in height but only eight inches broad between them. Many of the larger blocks, however, are of still greater proportions. Ibn Takil (903 A. D.) said that it would take fifty men to lift them. All the blocks are carefully set; and some of the oldest accounts of them speak of their being bound together by cramps of iron, so that they must have formed a perfect breastwork in the days when artillery was not known."[3]

That the Khazars, against whom Noushirwân built the wall at Darband, were a tribe of the Huns, is evident from the fact that the Armenians speak of the pass along which the wall is built as Honor Pahak, *i.e.*, the Watch or the protector against the Huns.[4] It is said that Noshirwân spent a good deal of money on this wall. Finding his treasury empty for further work, he is said to have "paid a surprise visit to Âzâd Mohân," who had "accumulated enormous wealth" at Kerman. Âzâd Mohân provided a sum of money, sufficient not only to complete the great work, but also to found the city of Astrabad.[5]

According to Deguignes, the Turcs, a tribe of the Huns, who made frequent inroads in the territories of the Persians near Media or Aderbadgan, were looked at peacefully by the Romans of Justin II, who was now and then at war with the Persians. They were taken to be, as it were, a check upon the Persians of Noushirwân. So, the Persian king, to put an end to their frequent inroads, built a great wall of 40 farsangs (quarante parsangues).[6] Noushirwân also built a city there called Darband.

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1 From Constantinople to the Home of Omar Khayâm (1911), Chap. V.
2 Ibid, p. 73. 3 Ibid, p. 61. 4 Ibid, p. 61.
5 "Ten thousand Miles in Persia" by Major P. M. Sykes (1902). p. 49.
6 Histoire General des Huns, par Deguignes Tome I, Partie II. p. 390.

Caterino Zeno, who was in Persia as ambassador from the Republic of Venice in the 15th Century, thus speaks of Derbend, the city of the wall: "Derbento is a city which was built in the passes of the Caspian mountains by Alexander, to resist the incursions of the Scytians, where the pass is so narrow that one hundred resolute soldiers could bar with their pikes the passage of a million of men."[1]

Wall of Alexander.

The Derbend-nameh, in its above description, refers to a previous wall built by one Sikandar Zu-l-qarnain. The word Zul-qarnain means bi-cornous or two horned (lit. master (zu) of two horns (*qarn*). There were two Sikandars or Alexanders, who were known by this name. The word *qarnin* or horns meant two directions, the East and the West. What was meant was that the person had conquered the whole world from the East to the West. The first of the two kings known by this name lived in the hoary past, and not much is known about him. The second of the two is Alexander the Great, spoken of by Eastern writers as Ben Phillicus, *i.e.*, the son of Philip.

Tabari refers to the wall near Derbend and speaks of it as the wall of Yajouj and Majouj (یاجوج و ماجوج Gog and Magog). From the way he describes the place of the wall, it seems, as if the place was somewhat mysterious and produced jewels of great value. He attributes it to one Zu'l-qarnain without joining the name of Askander to the word. It seems that he means the Sikander Zu-l-qarnain of some hoary antiquity and not Alexander the Great. Though Tacitus and others attribute the wall to Alexander the Great, perhaps the tradition about one Zu'l-qarnain has been transferred to another Zu-l-qarnain.

The Process of Constructing the Wall.

A part of Noshirwân's Wall extended into the sea and there, at the end, formed a kind of protection for the harbour also. We read the following about the process of the extension of the wall in the sea in Maçoudi's account[2] of the reign of Noshirwân. Maçoudi says:—[3]

1 Travels of Venitians in Persia, p. 44 (Hakluyt Society), quoted by Sykes.

2 Macoudi for Barber de Meynard, Vol. II, p. 196.

3 Macoudi says that the king received the title of Anousharavan (انوشروان) after his victory over Mazdak and his 80,000 followers who were killed in the country between Jazir and Nahrwan (جازر والنهروان). He says that the word means a "new king" (جدید الملک), Here, Maçoudi is wrong, the meaning being "immortal-souled." The word is originally anaosha urvan ([illegible] *i.e.*, of undying or immortal soul) in the Avesta, and Anoshak roban ([illegible] Ardai Viraf, I, 16) in the Pahlavi.

3

"The king was called at the city of El Bab and at the Caucasus by the incursions of the neighbouring kings. He built over the (Caspian) sea with the aid of leather bottles of inflated leather, a wall of rocks (*i.e.*, stone-slabs) tied together by iron and lead. The leather bottles sank down in water according as the construction (of the wall) was raised over it. When they settled at the bottom and the wall came over the level of the water, the divers armed with daggers and cutlasses broke the leather bottles; the wall entering deeply under the sub-marine ground, attained then the height of the bank. It exists even to-day in 332 (Hijri), and all that part of the wall of which the layers have plunged into water is called el keid (القيد) *i.e.*, the chain, because it stops the ships of the enemy who attempted to land on this side. They continued the same work along the shore between the Caucasus (جبل القبخ the mountain of Kabkh) and the sea. They opened the gates over the territories of the infidels and prolonged the wall across Mount Caucasus in the way, as said above, in describing this mountain and the city of El-Bab. Anoushirawân had, before its construction, long strifes with the kings of the Khazars and they pretend that he built the wall only to intimidate and subdue the peoples which inhabited this country."[1]

Persia's Communication with China.

We learn from Fridousi's account of the wall, that Noshirwân ordered skilful artisans (استاد) from all countries, China may be one of these countries. He must have heard of the Great Wall of China built against the Huns about 800 years before his time. So, when he found his own country open to the inroads of the descendants of these Huns, he very possibly sent for some architects from China also, who from their knowledge of the great Chinese Wall against the Huns might assist him in his work against the then Huns. There is no doubt that in those early times there was a trade communication between Persia and China. Mr. Parker, in his book on China[2] refers to the early trade of the West with China by the land route of Parthia. The Romans later on began the trade by the sea route. According to Chinese records "the Parthians carried on a land trade in waggons and sea trade in boats."[3] The distances of the stages in the route were all measured by Persian farsangs. It was the cupidity of the later Parthian traders that let slip the land trade from

1 I give my translation from the French translation of Barbier de Meynard.
2 China by E. H. Parker.
3 China, by E. H. Parker, p. 61.

the hands of the Persians to those of the Romans, who traded by the sea route.[1]

Dr. Rostovtzeff, in his recently published interesting book, "Irânians and Greeks in South Russia" (1922), speaks at some length of the influence of the Irânians on South Russia. It was the presence of the Sassanians and their predecessors on the shores of the Caspian, and their conquest and long stay in that direction that had led to the influence.

[1] In the great massacre of Canton in 879 A. C. about 120,000 Jews, Christians, Mahomedans and Zoroastrians are said to have been killed. Most of the Zoroastrians, killed in this massacre, may be the Zoroastrians driven away from Persia by the Arab conquest, but some of them may be traders.

ART. XIV.—*Prof. M. Winternitz at the meeting of the R.A.S., Bombay Branch, on October 11th, 1923.*

Mr. President, Ladies and Gentlemen,

I am exceedingly grateful to you for your very kind reception and the great honour conferred upon me by making me a fellow of your Society. And it is not only a great honour to me, but it also affords me a keen pleasure to be honoured by a Society that counts and counted among its members so many of the most illustrious scholars. The names of my own great Guru George Bühler, of the venerable Nestor of Indologists Sir Ramkrishna Gopal Bhandarkar, of Francis Kielhorn, of the great Pandits Shankar Pandit, Telang, Tilak and many others are connected with the Bombay Branch of the Royal Asiatic Society. To be enlisted with men like these among the members of this learned Society, is indeed an honour which I highly appreciate.

I have been asked to speak to you on some subject of interest to students of India and I have chosen that subject which is nearest to my thoughts and to my heart—*Mahābhārata Criticism*.

When about a quarter of a century ago I became acquainted with the South Indian manuscripts of the Mahābhārata in the Whish collection of the Royal Asiatic Society in London, it became at once clear to me, that the generally adopted text of the Mahābhārata, as we have it in the standard editions of Calcutta and Bombay, is not a sufficient basis for a critical study of the Great Epic. And at the International Congress of Orilentalists at Paris in 1896 I declared that a critical edition of the Mahābhārata is the *sine quâ non* for any research work connected with the Great Epic of India. And what is not connected with the Mahābhārata ? It is perfectly true that "what is not in the Mahābhārata is not in Bharatavarṣa." There is no part of the history of Indian literature, religion, philosophy, law and social institutions, for which the Mahābhārata is not an invaluable source of information.

But it is one of the most difficult problems to decide, how this source of information is to be used. If it is said—as you can read so often—that this or that occurs "already in the Mahābhārata," what does this mean ? It means nothing, unless we can decide, to which stratum of the Mahābhārata an information belongs.

For on this there cannot be the least doubt, that our Mahābhārata, as we have it now before us, is a very different work from the original epic poem of the battle of the Bhāratas. Though I do not think that it will ever be possible to reconstruct the epic in its very oldest and original form, when it might have been a poem of 24,000, or even only of 8,800 ślokas, we can yet try to do two things: (1) To find out those additions to, and corruptions of, the text which are of comparatively modern growth, and are due to the carelessness or arbitrariness of scribes and copyists; and (2) to apply the rules of historical and literary criticism to the story itself, to the episodes, and to the didactic parts of our text, in order to find out contradictions between different parts of the poem, or to trace earlier and later parts according to our knowledge of the history of religious ideas and social institutions in India. But the basis for such higher criticism and for any attempts at the reconstruction of the old poem must be *a critical edition of the text of the Mahābhārata* which as yet does not exist, but which happily is now in course of preparation at the *Bhandarkar Oriental Research Institute at Poona.* But this critical edition will help us only to purge the text from all later interpolations and bad readings. A careful collation of all manuscripts from different parts of India will, it is to be hoped, give us the text of the Mahābhārata as nearly as possible in the form, in which it may have been in the 4th century A.D.

But the oldest parts of the Great Epic probably go back to the 4th century B.C. How are we to decide, what belongs to the old epic, and what to a later stratum? To answer this question, I can only give you one or two examples.

One of the most important incidents in the main story of the epic is *the marriage of Draupadī to the five Pāṇḍava brothers.* Here there can be no doubt, that the story as related in the Mahābhārata in its present form is so full of inconsistencies, that it cannot possibly have been told in this form in the original epic.

In Adhyāya 169 of the Ādiparvan, Vyāsa meets the Pāṇḍavas and relates to them a story, how a certain Ṛṣi once had a daughter who could not obtain a husband. She prayed to the god Śiva, repeating several times her desire to obtain a virtuous husband. And Śiva said: "Thou shalt have five husbands." The maiden very naturally replies that she only wants one husband. But the god says: "Five times didst thou say, 'give me a husband,' therefore, thou shalt have five husbands in a future birth." This maiden was afterwards born as Kṛṣṇā, the daughter of the Pañcāla king Drupada, and Vyāsa concludes this story by telling the Pāṇḍavas that Kṛṣṇā was destined to be their wife, and that they should set out for the capital of Pañcāla, in order to obtain Draupadī. Accordingly the brothers are said to have started for Pañcāla, in order to be present at Draupadī's Svayamvara. Yet afterwards the story is told, how the Pāṇḍavas meet some Brahmans who tell them what a grand festival is to be held at the court of Drupada on the occasion of his daughter's Svayamvara. They invite the Pāṇḍavas to join them, suggesting that by some chance one of them might be lucky enough to win Draupadī. And Yudhiṣṭhira decides that they should all go together to the Svayamvara. This whole story has no meaning, unless we assume, that the Pāṇḍavas knew nothing about the Svayamvara, until they received the first intimation of it from these Brahmans.

Then follows the story of the Svayamvara in which Arjuna wins the beautiful Kṛṣṇā, after having drawn the bow of Drupada and hit the goal set up. The other princes are angry with King Drupada who is about to give his daughter to Arjuna. A fight ensues, in which the Pāṇḍavas who have come to Drupada's assistance, are victorious. Now the five brothers take Kṛṣṇā with them and return to the potter's house in which they were staying (in the disguise of Brahmans) with their mother Kuntī.

When entering the house, they announce to their mother the "alms" they have collected. Kuntī thinks that they have returned from their usual begging expedition and, without looking up, replies with the usual phrase: "May ye all enjoy it together." When she afterwards sees what kind of "alms" it is her sons have brought home this time, she is much embarrassed, and asks Yudhiṣṭhira what can be done in this dilemma, so that her word may not become untrue, and yet Draupadī should commit no sin. Yudhiṣṭhira, however, without answering his mother's question, addresses Arjuna, saying: "Thou hast won Draupadī in the Svayamvara, therefore thou alone shalt wed her." Upon this Arjuna replies: "Surely you do not want me to commit such a sinful act. That is not the law. Thou shalt wed her first, then Bhīma, then myself, then Nakula, and then Sahadeva." Now the brothers look at Draupadī, and seeing, how beautiful she is, they all fall in love with her. Seeing this, Yudhiṣṭhira suddenly remembers the story of Vyāsa and says: "Beautiful Draupadī shall be the wife of us all." And so the matter is settled without any reference to the words of Kuntī: "May ye all enjoy it together." Arjuna simply takes it for granted, that according to law Draupadī should be the wife of all the five brothers. And

Yudhiṣṭhira agrees to it, in order to prevent disunion among the brothers, and because he remembers Vyāsa's tale.

But the question regarding the lawfulness of Draupadī's marriage is raised again later on, when King Drupada says that the wedding of his daughter with Arjuna is to be celebrated, and Yudhiṣṭhira says: "I also shall have to marry her." Drupada does not seem to understand what Yudhiṣṭhira means, for he says: "Either you yourself may marry my daughter, or you may give her in marriage to whomsoever (of your brothers) you think fit." But Yudhiṣṭhira replies: "Draupadī shall be the wife of us all. Thus, O King, it has been ordained by my mother previously. Both I myself and the Pāṇḍava Bhīmasena are still unmarried, and this treasure, thy daughter, has been won by Arjuna. And there is an agreement settled between us, O King, that we shall enjoy every treasure together; and we do not wish to break this agreement. Kṛṣṇā shall lawfully become the wife of us all, she shall seize the hands of all of us, one after the other, before the fire."—

सर्वेषां धर्मतः कृष्णा महिषी नो भविष्यति ।
आनुपूर्व्येण सर्वेषां गृह्णातु ज्वलने करान् ॥

But Drupada says: "It has been ordained that one man should have many wives, but one has never heard, that one woman should have many husbands. Thou who art pure and versed in the law shouldst not commit an unlawful act that is opposed both to the Vedas and to worldly usage. How is it that thou hast formed such a resolution?" Yudhiṣṭhira, however, replies that this is an old established law (एष धर्मो ध्रुवः) and that the king should have no misgivings. Drupada is not satisfied by this, and proposes that the knotty point of the lawfulness of the polyandric marriage should be deliberated and finally settled in a committee consisting of Yudhiṣṭhira, Kuntī, and his son Dhṛṣṭadyumna. While these three are assembled to argue the point in the presence of the King, Vyāsa appears and says that Yudhiṣṭhira is right, that there is such an "eternal law," according to which Draupadī must be the wife of the five brothers. Then he takes King Drupada aside and relates to him privately a most confused story, the *Pañcendropākhyāna*: Indra had once offended the god Śiva. As a punishment he has to be reborn on earth in five parts, and an incarnation of Lakṣmī is to be his wife. The five Pāṇḍavas are incarnations of five particles of Indra, Draupadī is an incarnation of Lakṣmī, therefore, in marrying the five Pāṇḍavas, she has really only one husband. At the end of this story Vyāsa repeats again the tale of the maiden who said five times: "Give me a husband."

The *Pañcendropākhyāna*, as it is told here, is utterly inconsistent and confused. It occurs in a much better version in the Mārkaṇḍeya-Purāṇa. The other story, too, is found in a Purāṇa, the Brahmavaivarta-Purāṇa. Only in the Purāṇa the girl actually says five times: पतिं देहि, while in the Mahābhārata she only says: पतिं सर्वगुणोपेतामिच्छामि.

In my opinion there cannot be any doubt, that all the three different stories which are meant to justify the polyandric marriage of Draupadī, are later Pauranic legends, which were interpolated in the Mahābhārata, and that the original epic simply told the story of the marriage, without making any excuse for it. It is true, that polyandric marriage, though it occurs in some parts of India even to-day, never was a general Indian custom and certainly not acknowledged by Brahmanical law. But it seems that this marriage of Draupadī with five brothers was such an essential trait of the old epic tale, that no one ever thought of changing it, and the later revisers only endeavoured to justify it by inventing three different stories. No attempt was ever made to connect these stories properly with one another or with the main story. This clearly shows their character as interpolations. On the other hand, we find repeatedly the emphatic statement, that this is an old established custom, धर्मो ध्रुवः or सनातनो धर्मः This probably means, that polyandry was an old established custom in the *family of the Pāṇḍavas*, a tribal custom, not a general Indian custom. In Buddhist and Jain versions of the Draupadī-Svayamvara, Draupadī is said to have chosen not Arjuna, but all the five brothers at once.

Let me give you only one other example of the way in which we may try to find out earlier and later strata in the Mahābhārata by means of internal criticism. It is the account of the *death of Bhīṣma*.

Bhīṣma is one of the most pathetic figures in the whole of the Mahābhārata. Nearly related both to the Kauravas and the Pāṇḍavas, he lives at Duryodhana's court and is bound to fight against the Pāṇḍavas whom he loves as well as the sons of Dhṛtarāṣṭra. During the first ten days of the battle he leads the army of the Kauravas. Whenever the Kauravas are in danger of being defeated, Duryodhana reproaches Bhīṣma, that he was showing too much mercy towards the Pāṇḍavas. On the eighth day of battle Bhīṣma promises to fight without any mercy against everybody, except Śikhaṇḍin. For

Śikhaṇḍin had been born as a female, and had only become a man by exchanging his sex with a Yakṣa. On the ninth day of battle a terrible fight ensues, Bhīṣma raging in the field like the god of Death himself. With heavy losses the Pāṇḍavas are repelled by Bhīṣma at sunset. During the night the Pāṇḍavas hold counsel what to do. And strangely enough they decide to go, in the middle of the night, into the enemy's camp and ask Bhīṣma himself, what would be the best way of killing him. And Bhīṣma is kind enough to advise them, that they should send Śikhaṇḍin to fight against him, but behind Śikhaṇḍin Arjuna should hide himself and shoot at him. This absurd story is told at the beginning of VI, 107. But in the same Adhyāya it is Arjuna himself who, encouraged by Kṛṣṇa, proposes to kill Bhīṣma by hiding himself behind Śikhaṇḍin, and no reference at all is here made to Bhīṣma having himself given the advice to kill him in this treacherous manner. Then follows the description of the fighting on the tenth day of battle. Śikhaṇḍin, with Arjuna behind him, rises to fight against Bhīṣma, and continues to attack him, even when told by Bhīṣma, that he would not fight against him. Both Arjuna and Bhīṣma accomplish wonderful feats of bravery. Quite abruptly the story is told (vi, 115), that Bhīṣma is weary of life, and addresses Yudhiṣṭhira with the request to conquer him, whereupon Yudhiṣṭhira calls up his people, to fight the mighty hero. The battle continues. Finally Arjuna, standing hidden behind Śikhaṇḍin, shoots arrow upon arrow against Bhīṣma. Turning to Duḥśāsana Bhīṣma says: "These arrows which like messengers of Yama threaten to take my life; these arrows which, like angry, poisonous snakes, rush into my limbs,—these are not Śikhaṇḍin's arrows, they are the arrows of Arjuna." Once more he rises and sends an arrow against Arjuna, who however catches it up and breaks it in three pieces. Here again a story is told that Bhīṣma resolved to die, and that Vasus and Ṛṣis came down from heaven, to congratulate him on his resolution. Arjuna succeeds in smashing Bhīṣma's shield, and now the Pāṇḍavas rush against the unarmed warrior who at last, just before sunset, sinks to the ground, bleeding from wounds without number, and with so many arrows sticking in his body, that he does not touch the ground in his fall, but rests on a bed of arrows.

It was the *dakṣiṇāyana* when Bhīṣma fell. But a heavenly voice urged him to postpone his death to the *uttarāyaṇa*. For according to the Upaniṣads the soul has to pass the *uttarāyaṇa*, when going up to the world of Brahman. Hence a Yogin should die in the uttarāyaṇa. As Bhiṣma thus chose to die in the uttarāyaṇa, he was able to give to Yudhiṣṭhira all those instructions on philosophy and law which are contained in the Śānti and Anuśāsana-Parvans of the Mahābhārata.

It seems to me that there can be little doubt, that in the old heroic poem the advice to kill Bhīṣma by placing Arjuna behind Śikhaṇḍin, was given by Kṛṣṇa, and not by Bhīṣma himself; that the old poem did not contain the story of Bhīṣma being weary of life and asking Yudhiṣṭhira to be good enough to see to his being slain; and that in the old poem Bhīṣma after his fall lived only long enough to address some words of admonishment to Duryodhana and Karṇa.

By cutting down the Bhīṣmavadhaparvan in the way indicated, we shall get a more concise and a much more beautiful account of the story of Bhīṣma's death than that found in our present text. But this alone would not entitle us to designate the passages, which are meant to exculpate Arjuna from a heinous deed and at the same time to enhance the saintliness of Bhīṣma, as later additions. What entitles us to do so, is the fact, that these passages are brought in so abruptly and connected so loosely with the main story, that they at once betray themselves as spurious.

It must, however, be stated that Śaṅkara, the philosopher (8th century A.D.) knew already the story of Bhīṣma choosing the uttarāyaṇa for his death, as it is told in our Mahābhārata. The additions and changes were not made in recent times, and it is not probable that they will be confirmed as such by the evidence of manuscripts, unless we find Mahābhārata manuscripts that are much older than any of the manuscripts yet discovered.

But one thing is certain. If old manuscripts should be found, which would bear out some of the conclusions at which we have arrived by internal criticism, this would mean nothing less than changing our conjectures into scientifically established facts. All such critical work as I have indicated, can only lead to a more or less convincing conjectural or hypothetical restoration of the text, while in the evidence of the manuscripts we have substantial facts to build upon.

Even the collations of manuscripts so far as they have hitherto been carried on, have brought to light some important facts. Let me give you only a few examples. The god Gaṇeśa occurs in the Mahābhārata only in the introductory chapter, where he is made to write down the story of the Great War, recited to him by God Brahman himself. But no amount of argumentation could prove satisfactorily, that this story is a later interpolation. When, however, it is found that this story is omitted in some of the best manuscripts or in entire groups of manuscripts we can no longer doubt, that it did not form part of the original epic.

There is the Durgāstotra in the Virāṭaparvan. The occurrence of this stotra has been used as one of the arguments for declaring the Virāṭaparvan as one of the later parts of the Mahābhārata. But Mr. Utgikar has found that the best manuscripts of the Virāṭaparvan do not contain the Durgāstotra at all. Hence this argument can no longer be used. On the other hand, it would have been impossible to prove by mere arguing, that the Durgāstotra is an interpolation in the Virāṭaparvan.

There is only one passage (in the Sabhāparvan), where the term *nāṭaka* in the technical sense of a "drama" occurs in our Mahābhārata editions. The manuscript evidence shows that this one verse is a later interpolation, so that it can no longer been said, that the *nāṭaka* is mentioned "already in the Mahābhārata."

There can be no doubt, that in numerous cases we shall have to revise our views on the Mahābhārata as evidence for many a problem of the history of Indian literature and Indian religion, when once the *critical edition of the Mahābhārata* will have been published. This work has, as I said, now been begun at the *Bhandarkar Oriental Research Institute of Poona*, and I hope, that Indian and Western scholars will combine in this great task. As the Mahābhārata manuscripts are spread all over India, and on the other hand important manuscripts are also preserved in some of the great libraries of Europe, so it is desirable, that scholars of India and of the West should join in this laborious work, which for years has been planned and partly prepared in Europe under the auspices of the International Association of Academies. Whatever we may think about the co-operation between the East and the West as an ideal and a hope for the future development of mankind,—on this there can be no doubt, that for the progress of Indology, of all studies connected with India, the collaboration between Indian and Western scholars is not only desirable, but absolutely needed.

Proceedings of the Bombay Branch Royal Asiatic Society, 1921–22, *and a list of presents to the Library,* 1921.

Proceedings.

A meeting of the Society was held on Monday, the 4th July 1921.

Present :—Messrs. J. S. Sanzgiri, K. Natarajan, Prof. A. L. Covernton, Messrs. H. R. H. Wilkinson, W. R. Kerkar, E. M. Ezekiel, V. D. Muzumdar, V. R. Bhende, O. H. Nazar, the Rev. Fr. R. Zimmermann, Dr. Jivanji J. Modi, and Mr. A. F. Kindersley, the Hon. Secretary.

In the absence of the President, Dr. J. J. Modi, the senior Vice-President, was invited to take the Chair.

The minutes of the last meeting were read and confirmed.

Considered the following recommendations of the Managing Committee :—

(*a*) That a sum not exceeding Rs. 750 be placed at the disposal of the Hon. Secretary for distribution among the members of the Society's Staff, for the annual library checking.

(*b*) That a sum not exceeding Rs. 1,100 be sanctioned for printing 500 copies of Mr. V. B. Ketkar's " Indian and Foreign Chronology " as an extra number of the Journal.

(*c*) That the shelving accommodation in the Ground Floor Room be increased by carrying the present racks upto the ceiling and by putting up new racks, and that expenditure upto Rs. 2,000 be incurred during the current year for the purpose.

Recommendation (*a*).—Mr. Natarajan proposed that the recommendation be adopted. Dr. Daruvala seconded the proposal.

Carried unanimously.

Recommendation (*b*).—Mr. Wilkinson proposed and Mr. Natarajan seconded that the recommendation be accepted.

Carried unanimously.

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Recommendation (c).—Mr. Wilkinson proposed that the amount recommended be sanctioned. Prof. Covernton seconded the proposition, which was carried unanimously.

Considered the following recommendations of the Managing Committee in connection with the revision of salaries of the Society's staff :—

> That the scale adopted last year in the case of the superior staff be retained except in the case of Mr. Sabnis, who should be given Rs. 68 per mensem from 1st June 1921 instead of Rs. 64, and that an increase of Rs. 4 be granted to each of the peons with effect from 1st May 1921.

The Hon. Secretary explained that there was a misstatement in the report of the Secretaries, on which the recommendations of the Managing Committee were based, and suggested that the matter be referred back to the Managing Committee.

After some discussion the Chairman explained that the Managing Committee was competent enough to decide such a question as revision of salaries of the staff. It was not necessary to go to the General Body for sanction in the matter, as such a course meant unnecessary delay.

Rao Bahadur S. T. Bhandare then proposed that the recommendations of the Managing Committee as a whole be adopted.

Mr. Natarajan seconded the proposition.

Mr. Kerkar moved the following amendment :—

> That the increase to the salary of the peons recommended by the Managing Committee be accepted and that their recommendations in the case of the other members of the staff be referred back to the Managing Committee for report.

Mr. Muzumdar seconded the amendment.

On votes being taken the amendment was lost.

The original proposition being put to vote was carried by a majority.

A meeting of the Society was held on Wednesday, the 21st September 1921.

Present :—The Rev. Fr. R. Zimmermann, Rao Bahadur P. B. Joshi, Messrs. O. H. Nazar, C. V. Vaidya, H. Dow, D. G. Dalvi, Laxmidas M. Shrikant, and Mr. A. F. Kindersley, the Hon. Secretary.

In the absence of the President or any of the Vice-Presidents, Father Zimmermann was voted to the Chair.

The minutes of the last meeting were read and confirmed.

Mr. C. V. Vaidya read his paper on "The Exploded Myth of the Agnikula."

Rao Bahadur Joshi made a few remarks on the subject matter of the paper, and proposed a hearty vote of thanks to Mr. Vaidya for his interesting paper.

The Honorary Secretary made a few observations and seconded the proposal.

The Chairman commended the paper both for its subject and its method of treatment and heartily associated himself with the vote of thanks which was carried unanimously.

The proceedings then terminated.

A meeting of the Society was held on Monday, the 10th October 1921.

Present :—Dr. Jivanji J. Modi, Dr. C. J. J. Fox, Dr. E. A. Parker, Prof. P. A. Wadia, Messrs. V. P. Vaidya, H. R. H. Wilkinson, and Mr. J. E. Aspinwall, the Hon. Secretary.

Dr. J. J. Modi, one of the Vice-Presidents, was voted to the Chair.

The minutes of the last meeting were read and confirmed.

The following recommendations of the Managing Committee were considered :—

1. That the draft reply proposed by the Sub-Committee to the Government letter in connection with reciprocity between libraries be adopted.

Mr. Wilkinson proposed and Mr. Vaidya seconded that the recommendation be accepted.

Carried unanimously.

2. That the following addition be made at the end of Art. XLIII of the Rules :—

No Member shall be allowed to have more than two new works out at the same time. If a Member keeps a new work for more than 7 days and does not return it on receipt of a reminder from the Librarian, no new book shall be issued to him until he returns it."

Mr. Wilkinson proposed and Dr. Parkar seconded that the addition proposed be made.

Carried unanimously.

3. That further expenditure in the current year not exceeding Rs. 2,500 for the completion of the scheme recommended by the Sub-Committee for shelving accommodation in the Ground Floor Room be sanctioned.

Mr. Vaidya proposed and Mr. Wilkinson seconded that the sanction be granted.

Carried unanimously.

A meeting of the Society was held on Thursday the 27th October 1921.

Present :—Professors P. A. Wadia, A. X. Soares, Messrs. N. B. Divatia, A Montgomerie, J. A. Saldanha, E. M. Ezekiel, and Mr. J. E. Aspinwall, the Hon. Secretary.

In the absence of the President Mr. Montgomerie was voted to the Chair.

The minutes of the last meeting were read and confirmed.

Prof. Soares read his paper on "The Heritage of the Portuguese to the East, or the Influence of Portuguese on Languages of the East, with special reference to the languages of the Bombay Presidency."

A discussion followed in which Messrs. Saldanha, Ezekiel, and Divatia took part.

Mr. Ezekiel proposed a hearty vote of thanks to Prof. Soares for his interesting and learned paper which, being seconded by Mr. Divatia, was carried unanimously.

After passing a vote of thanks to the Chair the proceedings terminated.

A meeting of the Society was held on Tuesday, the 22nd November 1921.

Present:—The Rev. R. M. Gray, the Rev. Fr. R. Zimmermann, Dr. E. A. Parker, Mr. K.H. Vakil and Mr. J. E. Aspinwall, the Hon. Secretary.

The Rev. R. M. Gray was voted to the Chair.

The minutes of the last meeting were read and confirmed.

Considered the list of Newspapers and Periodicals taken by the Society.

It was resolved to add the following to the list from 1922 :—

Outlook, Shama'a, Young India, L'Illustration and Modern Languages Review, and to discontinue the following from the same date.

British Weekly, Statist, Poetry Review, T'oung Pao, Observer, Quarterly Journal of Microscopical Science, Expository Times Church Quarterly Review, Forum, and Modern Review.

Considered a letter from the Professor of History, Allahabad University proposing exchange of "Journal of Indian History" for this Society's Journal.

Resolved that the exchange be established.

A special general meeting of the Society was held on Saturday the 10th December 1921 to make a formal presentation of the Campbell Memorial Medal for 1921 awarded to Mr. R. Shama Sastry.

Dr. Jivanji Jamshetji Modi, B.A., C.I.E., one of the Vice-Presidents, in the Chair.

Present :—The Rev. Fr. R. Zimmermann, Dr. E. A. Parker, Dr. P. N. Daruvala, Messrs. V. P. Vaidya, H. R. H. Wilkinson, S. V. Bhandarkar, S. N. Pherwani, N. B. Divatia, R. Malaviya, H. A. Shah, O. H. Nazar, Kubalaya Raj, Miss. S. S. Paruck and Mr. J. E. Aspinwall, the Hon. Secretary.

Dr. Modi introducing Mr. Shama Sastry said that he was an eminent scholar who had made his name, not only in India, but elsewhere also, by bringing to light Kautilya's Arthashastra which has explained a good deal of what is said by Megasthenes, the Greek Ambassador in India. Mr. Shama Sastry has also published several other valuable books. The very fact that he has been honoured by the Calcutta University through its valued degree of Doctorate shows that his literary work is widely appreciated.

Dr. Modi then presented the medal to Mr. Shama Sastry.

Mr. Shama Sastry after expressing his thanks to the Society for the honour done to him read a paper on "Vishnu's Three Strides: the Measure of Vedic Chronology." The Chairman at the conclusion of the paper invited remarks from Members present when the Rev. Fr. Zimmermann said :—

"The thanks of the Members as well as of all Sanskrit scholars were due to the learned lecturer for the fresh light he had shed on one of the most difficult problems of the Vedas which would subsequently appear in detail in the Society's Journal."

After a vote of thanks to Mr. Shama Sastry and the President the proceedings terminated.

A meeting of the Society was held on Tuesday the 15th February 1922.

Sir N. G. Chandavarkar, President, in the Chair.

Present :—Messrs. V. P. Vaidya, Faiz B. Tyabji, T. S. Shajwalker, Ch. M. Ismail, H. R. H. Wilkinson, E. M. Ezekiel and Mr. J. E. Aspinwall, the Hon. Secretary.

Considered a letter from the Government of Bombay, dated 2nd December 1921, asking for the Society's opinion on the Bills introduced by Mr. Sheshgiri Iyer in the Legislative Assembly to amend the Hindu Law of Inheritance.

Resolved that a committee consisting of the Hon. Sir Lallubhai A. Shah, Mr. V. P. Vaidya, Mr. P. V. Kane, Rao Bahadur P. B. Joshi, Mr. J. R. Gharpure, Mr. Faiz B. Tyabji, Mr. S. V. Bhandarkar and the Rev. Fr. R. Zimmermann be appointed to consider the matter and report within three weeks.

A meeting of the Society was held on Wednesday, the 22nd March 1922.

Sir N. G. Chandavarkar, President, in the Chair.

Present :—The Rev. R. M. Gray, the Rev. Fr. R. Zimmermann, Professors P. A. Wadia, A. L. Covernton, Doctors E. A. Parker, P. N. Daruvala, D. A. De Monte, Rao Bahadur P. B. Joshi, Messrs. N. B. Divatia, P. V. Kane, V. P. Vaidya, H. R. H. Wilkinson, V. G. Dalvi, D. G. Dalvi, J. S. Sanzgiri, Ch. Md. Ismail, H. V. Divatia, A. A. Fyzee, C. R. Shah, S. V. Bhandarkar, N. M. Patwardhan and Mr. J. E. Aspinwall, the Hon. Secretary.

The Hon. Secretary submitted the report made by the Sub-Committee appointed on 13th February 1922 by the Society to consider a letter dated 2nd December 1921 from the Bombay Government for the Society's opinion on Mr. Sheshgiri Aiyar's bills.

Mr. Kane proposed that the report be adopted and that a reply be sent to Government in the terms of the report.

1. (*a*) the Bill as proposed is against the principles of Hindu Law as laid down in the Mitakshara and also as confirmed by Judicial decisions and usage, (*b*) it is not advisable that such legislation should be taken up by the Imperial Legislature. If legislation be necessary it may be left to the Provincial Legislature.

2. With regard to the Bill to amend the Hindu Law relating to exclusions, etc., it is unanimously resolved that the Sub-Committee is in sympathy with the principle of the Bill, but that the Bill does not go far enough, and also that it may be left to the Provincial Legislature to be dealt with.

Mr. V. P. Vaidya seconded the proposition.

Carried unanimously.

Sir Narayan Chandavarkar then vacated the Chair and Mr. V. P. Vaidya, one of the Vice-Presidents, took his place.

Mr. P. V. Kane read his paper on "Vedic basis of Hindu Law."

Rao Bahadur Joshi and Messrs. S. V. Bhandarkar, V. G. Dalvi, and Dr. Daruvala made a few observations on the paper.

After a vote of thanks to the President and to Mr. Kane for his learned paper the proceedings terminated.

The Annual Meeting of the Society was held on Wednesday the 22nd March 1922.

Sir Narayan Ganesh Chandavarkar, Kt., LL. D., President, in the Chair.

Present :—The Rev. R. M. Gray, the Rev. Fr. R. Zimmermann, Prof. A. L. Covernton, Prof. P. A. Wadia, Dr. E. A. Parker, Dr. P. N. Daruvala, Messrs. N. B. Divatia, P. V. Kane, V. P. Vaidya, H. R. H. Wilkinson, V. G. Dalvi, D. G. Dalvi, J. S. Sanzgiri, Ch. M. Ismail, H. V. Divatia, A. A. Fyzee, C. R. Shah, S. V. Bhandarkar, N. M. Patwardhan, Dr. D. A. De Monte, Rao Bahadur P. B. Joshi and Mr. J. E. Aspinwall, the Hon. Secretary.

The Minutes of the last General Meeting were read and confirmed.

The Hon. Secretary read the following Annual Report for 1921 with the Statement of Accounts and the Budget for 1922.

THE ANNUAL REPORT FOR 1921.

Members.

Resident—During this year 119 new Members were elected, 5 Non-Resident Members having come to Bombay were put on the Resident list. 67 resigned, 11 died and 16 having left Bombay were transferred to the Non-Resident Roll. The total number at the end of the year was 489 of whom 56 were absent from India. The number at the end of 1920 was 459.

Non-Resident.—14 new Members joined under this class, 16 having left Bombay were added to this list. 26 resigned, 1 died and 5 having come to Bombay became Resident Members. There were 182 Members at the close of the year, of whom 7 were absent from India. The number of Non-Resident Members at the close of 1920 was 184.

Obituary.

The Society regret to record the death of the following Members.

Resident.

Rao Bahadur S. T. Bhandare (Member of the Committee).
Mr. K. D. Dubash.
,, K. B. Sethna.
,, H. R. Greaves.
,, S. K. Poddar.
,, G. V. Kulkarni.
,, F. Littlewood.
,, Haji M. Allarakhia Shivji.
,, W. Dunkerley.
,, H. Broughton.
The Rt. Rev. L. J. Mylne.

Non-Resident.

Miss Manoramabai Medhavi.

Original Communications.

The following papers were read before the Society during the year.

The Exploded Myth of Agnikula. By C. V. Vaidya, M. A., LL. B.—21st September 1921.

The Heritage of the Portuguese to the East or the Influence of Portuguese on Languages of the East, with special reference to the Languages of the Bombay Presidency. By A. X. Soares—27th October 1921.

Vishnu's three Strides : the Measure of Vedic Chronology. By R. Shama Sastry—10th December 1921.

Library.

The issues of books and periodicals during the year under review were 54,937 volumes and serials :—12,030 new books, 18,380 periodicals, mainly current, and 24,527 old books. The daily average excluding Sundays, holidays and the first week of December, was 189. The total number of issues in the previous year was 47,532.

A detailed statement of monthly issues is given below:—

Monthly Issues.

	New books.	Old books.
January	3,002	1,719
February	2,595	1,651
March	2,557	2,120
April	2,778	2,149
May	2,361	2,067
June	2,500	2,023
July	2,338	2,494
August	3,199	2,673
September	2,726	2,303
October	2,486	2,033
November	2,236	1,432
December	1,632	1,863
	30,410	24,527

The issues of books under several subjects were as under:—

Fiction	19,357
Biography	2,098
Miscellaneous	1,875
Travel and Topography	1,737
Politics, Sociology, Economics	1,674
Oriental Literature	1,417
History	1,184
Poetry and Drama	989
Naval and Military	862
Literary History and Criticism	854
Philosophy	669
Reviews, Magazines (bound volumes)	543
Science, Natural History	414
Foreign Literature	395
Religion	393
Art and Architecture	381
Archæology, Folklore, Anthropology	381
Dictionaries, Grammars, Reference Works	361
Government Reports and Public Records	204
Classics	200
Physiology, Medicine	188
Astronomy, Mathematics	119
Logic, Works relating to Education	113
Botany, Agriculture	91
Law	58
Periodicals in loose numbers	18,380

Additions to the Library.

The total number of volumes added to the Library during the year was 1,539, of which 1,123 were purchased and 416 were presented.

Books, as usual, were received from the Government of India, the Government of Bombay and other Local Governments, and also from the Trustees of the Parsee Punchayet Funds, as well as from individual authors and donors. A catalogue of these additions, both according to authors and subjects, is in the press, and as usual, will be sent free to Members when ready.

The number of volumes added to the Society's Library by purchase and presentation under different sections is given in the following table :—

Section Number.	Subject.	Volumes Purchased.	Volumes Presented.
1.	Religion and Theology ..	15	0
2.	Philosophy	15	8
3.	Logic and Education	3	3
4.	Classics	16	0
5.	Literary History	33	1
6.	History and Chronology ..	41	10
7.	Politics, Political Economy, etc.	77	6
8.	Law	0	24
9.	Govt. Reports and Public Records	14	158
10.	Biography, Memoirs, etc. ..	64	5
11.	Archaeology, Antiquity, etc. ..	9	19
12.	Voyages, Travels, etc.	28	8
13.	Poetry and Drama	38	1
14.	Fiction	322	1
15.	Miscellaneous	56	0
16.	Foreign Literature	12	16
17.	Mathematics, Astronomy ..	4	2
18.	Art, Architecture, etc.	18	4
19.	Naval and Military	33	0
20.	Natural History, Geology, etc...	8	5
21.	Botany, Agriculture	1	35
22-23.	Physiology, Medicine, Surgery.	8	0
24.	Annuals, Serials, Transactions of Learned Societies ..	215	50
25.	Dictionaries, Grammars, Reference Works	33	9
26.	Oriental Literature	60	51
		1,123	416

The Papers and Periodicals, Journals and Transactions of Learned Societies subscribed for and presented to the Society during 1921 were :—

English Newspapers :—	
Daily	2
Weekly	29
English Magazines and Reviews :—	
Monthly	30
Quarterly	23
English Almanacs, Directories, Year Books ..	31
Foreign Literary and Scientific Periodicals ..	21
American Literary and Scientific Periodicals ..	27
Indian Newspapers and Government Gazettes ..	26
Indian and Asiatic Journals and Reviews ..	66

A meeting of the Society under Art. XX of the Rules was held on 22nd November for the purpose of revising the list of newspapers, magazines, etc., taken by the Society.

The following were taken from 1922.

L'Illustration.
Modern Languages Review.
Outlook.
Shama'a.
Young India.

and the following were dropped from the same date—

British Weekly,
Church Quarterly Review,
Expositor,
Forum,
*Modern Review,
Observer,
Poetry Review,
Quarterly Journal of Microscopical Science,
Statist,
*T'oung Pao.

New Catalogue.

The subjects part of the General Catalogue brought up to the end of 1917 is now ready for sale to Members at Rs. 7 and to Non-Members at Rs. 9. It covers 1250 pages *i.e.* about 250 pages more than the Authors' part.

* Has since been put on the list again by the Managing Committee,

A financial statement of its cost is again shown. The thanks of the Society are due to the Librarian for bringing this onerous work to a successful conclusion and also to the Committee Members, the Rev. R. M. Gray, Prof. P. A. Wadia, Dr. E. A. Parker, who have assisted him from time to time in reading and correcting the proofs.

Manuscript Catalogue.

The preparation of this important work is being carried on and its completion is expected during the current year.

Coin Cabinet.

The number of coins added to the Coin Cabinet of the Society during 1921 was 22, out of which 2 were gold, 15 silver, and 5 copper. 10 of these were presented by the C. P. Government, 4 by the Government of India, 4 by the Marwar Durbar, 2 by the Bikaner Durbar, 1 by the Bihar and Orissa Government and 1 by the Madras Government.

The coins are of the following description :—

Gold.

1 Kedara Dynasty of N. W. India (5th century A.D.)
Presented by the Bihar and Orissa Government.

2 Viraraya Fanam.
Presented by the Madras Government.

Mughal (Silver.)

2 Aurangzeb Alamgir
1 Surat 1098 Reg. 30
Presented by the C. P. Government.

1 ¿
1 Shah Alam
Presented by the Bikaner Durbar.

2 Faruksiyar
3 Shah Alam II,
Presented by the C. P. Government

4 Gadhaiya coins (*Silver*)
Presented by the Marwar Durbar.

1 Gadhaiya

Presented by the Government of India.

Ceylon **(Silver.)**

1 Queen Victoria 1892.

Presented by the Government of India.

Gujarath Sultans **(Silver.)**

1 Mahmud Shah III.

Presented by the C. P. Government.

Mughal **(Copper.)**

2 Mahammad Shah, Mint Ellichpur.

1 Alamgir II.

Presented by the C. P. Government.

1 Balabhi

1 Ceylon

George III 1815.

Presented by the Government of India.

Disposal of Treasure Trove Coins.

There were 3854 coins under examination at the close of 1920, and 1017 were received during the year. Of the latter, 804 silver were received from the Collector of Kolaba, 83 gold from the Collector of Bijapur, 7 gold from the Dist. Magistrate, Kanara, 50 silver from the Mamlatdar of Sinnar, 46 silver from the Mamlatdar of Chorasi, 17 gold from the Mamlatdar of Sirur and 10 silver from the Mamlatdar of Kopergaon. Out of these 804 silver from the Collector of Kolaba were returned as they possessed no numismatic value. 3495 have been reported to Government and are awaiting distribution. There are 572 coins still under examination.

Campbell Memorial Medal.

The 1920 Campbell Memorial Medal, awarded to Mr. R. Shama Sastry of Mysore, was formally presented to him on the 10th December. A special Medal for 1921 has been awarded to Rao Bahadur P. B. Joshi and it will be presented to him in the course of the present year. A financial statement is attached as usual.

Accommodation.

As a result of the Committee's appeal to Government for some assistance towards providing new shelving accommodation we have the gratification to report that the sum of Rs. 3,000, has been provisionally allocated in the coming Government Budget. This sum if passed is granted to the Society on the understanding that they expend a like amount for the same purpose.

During the past 6 months new staging has been erected at the cost of Rs. 2,500 in the only room left to the Society on the ground floor of the Town Hall, and when we can obtain possession of the two adjoining rooms set aside for us and at present occupied by the Stationery Department, we hope to provide sufficient staging accommodation to enable us to relieve our overcrowded shelves in the main Rooms and to carry on our work of filing current periodicals and records, which is at present more or less suspended.

When this additional space is available the Society hopes also to resurrect the old Bombay Geographical Society, whose presses, maps and records this Society has been unable to adequately display.

Accounts.

A statement of accounts for 1921 is subjoined. The total amount of subscription received was Rs. 23,554-8-0 as against 20,289-8-0 of the last year. Besides this Rs. 2,700 were received on account of Life-subscription from 6 Resident Members. The current account balance to the credit at the close of the year is Rs. 1,787-12-7.

The Government Securities of the Society including those of the Premchand Roychand Fund are for the face value of Rs. 43,600, of which Rs. 7,000 are from the Revenue Account and held partly to meet the Catalogue charges.

The Entrance Fees show Rs. 1,950, an increase of Rs. 405 over 1920, when this new source of income was first introduced. The cost of books and periodicals have shown no tendency to fall and the rupee exchange has been unfavourable throughout the year. Consequently our purchase of new works has been reduced from 1448 in 1920 to 1123 in the year under report.

The Books Selection Committee has recently decided to allocate specific amounts to each section of the Library we make purchases for, in order to keep within our Budget figures.

Budget.

It will be noticed that to meet the Society's requirements for the current year a deficit has to be shown of Rs. 4,217-8-5 which it is hoped will be met by increased revenue ; otherwise Members' subscriptions must be raised. Rs. 5 per half year for Resident Members only should produce over Rs. 4,000 per annum additional revenue. If this is found objectionable the question of meeting the non-recurring charges from the invested funds might be considered.

The expenditure on the shelving accommodation is a charge that need not be met from current money.—Rs. 3,500 under this heading has been paid from Revenue during the past two years. It must be remembered that it is an obligation of the coming Government grant for additional shelving that the Society should expend a like amount to the grant.

Finally there are increases over the last budget of Rs. 1,200 of account of the staff under the annual increments allowed, Rs. 3,000 for foreign periodicals and book-purchases by reason of advanced prices and low exchange and the necessity of making 3 half-yearly payments in one year through changing our London agents.

There are also Rs. 1,000 for publication of Oriental matter such as Indian Chronology, and Rs. 2,000 is shown for the up-keep of Oriental literature.

Mr. S. V. Bhandarkar proposed that the report be adopted.

,, P. V. Kane seconded the proposal.

The report was adopted unanimously.

Mr. V. P. Vaidya proposed that the recommendaton of the Managing Committee that Rs. 750 be granted to the Staff for annual Library checking be passed.

Dr. Daruvala seconded and the proposition was carried unanimously.

Mr. H. R. H. Wilkinson proposed that the Committee of Management for 1922 and the auditors for the year should be as follows.

Presidents.

Sir Narayan G. Chandavarkar.

Vice-Presidents.

Dr. J. J. Modi
Sir Lallubhai Shah
Sir Norman Macleod
Mr. V. P. Vaidya

Members.

Mr. J. E. Aspinwall
,, H. R. H. Wilkinson
Dr. D. A. De Monte
Prof. P. A. Wadia
The Rev. R. M. Gray
Prof. A. L. Coverntou
Mr. K. Natarajan
Dr. P. N. Daruvala
Mr. S. V. Bhandarkar
,, L. W. Young
Mr. P. V. Kane
The Rev. Fr. R. Zimmermann
Mr. E. M. Ezekiel
Prof. Shaik Abdul Kadir
Mr. A. Montgomeire, I.C.S.
,, J. S. Sanzgiri
Prof. Mahammad Abbas
Mr. Faiz B. Tyabji
Mr. Ch. Mahammad Ismail
,, Purshottam V. Mowji
,, B. K. Wagle

Auditors.

Mr. K. Mac Iver Mr. A. B. Agaskar

Mr. V. P. Vaidya proposed that Dr. E. A. Parker be appointed Hon. Secretary for 1922. Mr. Wilkinson seconded the proposition.

Carried unanimously.

Mr. V. P. Vaidya proposed that the meeting records its appreciation of the services rendered by the retiring Secretary Mr. J. E. Aspinwall. Dr. Daruvala seconded the motion.

The President paid a tribute to the work done by Mr. Aspinwall during the past three years as Secretary and many years as a member of the Committee.

Carried unanimously.

Mr. Aspinwall expressed thanks for the President's remarks and the vote of the meeting.

The President in his speech made a reference to the death of Rao Bahadur S. T. Bhandare who had been a member of the Managing Committee and had taken a keen interest in the Society's affairs, and added that his decease was a great loss to the Society.

Bombay Branch

Statement of Receipts and Disbursements

Balance on 31st December 1920—		
Amount in the Savings Bank A/c	275 8 9	
,, in the Current A/c	1,760 3 9	
,, as a Fixed Deposit	8,000 0 0	
,, in hand	113 7 3	
		10,149 3 9
Entrance Fee	1,950 0 0	
Subscription of Resident Members ..	19,586 0 0	
,, of Non-Resident Members	3,968 8 0	
Government Contribution	4,200 0 0	
Sale proceeds of Journal Numbers ..	822 1 2	
,, of Annual Catalogues ..	37 8 0	
,, waste paper	89 4 0	
Jackson's Folk-lore Notes	3 0 0	
Interest on Government Securities, &c.	1,978 11 7	
		32,635 0 9
Subscription of Resident Life-Members	2,700 0 0	
Catalogue Fund (Sale proceeds of the New Catalogue)	175 0 0	
Replacement account	280 15 6	
		3,155 15 6
		45,940 4 0

Examined and found correct.

KENNETH MACIVER,
B. K. WAGLE,
Auditors.

Royal Asiatic Society.

from 1st January to 31st December 1921.

Recurring Expenditure—		
Books (including Rs. 133-8-6 for old books replaced)	6,152 9 7	
Subscription to Indian Newspapers ..	780 13 0	
„ to Foreign Periodicals ..	3,066 7 0	
Binding and Repairs	1,846 0 0	
Printing Charges	1,947 12 0	
Office Establishment	11,386 0 8	
Annual Library checking	750 0 0	
General Charges	998 4 6	
Stationery	980 8 0	
Postage	293 14 9	
Furniture and Fittings (Furniture Rs. 417-2-0)	2,567 2 0	
Insurance	468 12 0	
Electric Charges	368 0 11	
Gratuity to the late Mr. Gupte's children	180 0 0	
		31,786 4 5
Non-Recurring Expenditure—		
Govt. Securities for Rs. 10,000 ..	9,448 4 0	
General Catalogue	739 8 0	
Manuscript Catalogue	1,000 0 0	
Revised Edition of Folk-lore Notes ..	1,178 7 0	
		12,366 3 0
Balance (including Rs.1,928-0-0 of the Catalogue Fund) on 31st December 1921—		
Amount in the Savings Bank A/c	339 10 11	
„ in the Current A/c ..	1,112 8 1	
„ in hand	68 5 7	
Advanced to the Campbell Memorial Fund	267 4 0	
		1,787 12 7
		45,940 4 0

Invested Funds of the Society.

Government Securities at 6½ per cent.	1,100 0 0	
„ „ „ 5 per cent.	6,800 0 0	
„ „ „ 3½ per cent.	25,700 0 0	
Premchand Roychand Fund at 3½ per cent.	3,000 0 0	
		36,600 0 0
Securities purchased from the balance of Revenue Account at 5½ per cent.		7,000 0 0
		43,600 0 0

The Society's property and collections have been insured for three Lakhs of rupees.

J. E. ASPINWALL,

Honorary Secretary.

Bombay Branch

Budget Esti-

INCOME.	Budget 1921. Rs. a. p.			Actuals 1921. Rs. a. p.			Budget 1922. Rs. a. p.		
Entrance	1,500	0	0	1,950	0	0	1,750	0	0
Subn. Resident Members ..	16,750	0	0	19,586	0	0	19,000	0	0
Do. Non-Resident Members.	3,500	0	0	3,968	8	0	3,700	0	0
Government Contribution ..	4,200	0	0	4,200	0	0	4,200	0	0
Sale proceeds of Journals, etc.	300	0	0	951	13	2	550	0	0
Interest	1,750	0	0	1,978	11	7	1,800	0	0
	28,000	0	0	32,635	0	9	31,000	0	0
Subn. Resident Life Members.				2,700	0	0			
Catalogue Fund				175	0	0			
Replacement A/c				280	15	6			
Balance of the last year ..	10,149	3	9	10,149	3	9	8,787	12	7
Estimated Deficit for 1922 to balance budget							4,217	8	5
	38,149	3	9	45,940	4	0	44,005	5	0

Royal Asiatic Society.

mates for 1922.

EXPENDITURE.	Budget 1921. Rs.	a.	p.	Actuals 1921. Rs.	a.	p.	Budget 1922. Rs.	a.	p.
Books	5,000	0	0	5,836	5	7	6,500	0	0
Subn. Periodicals Foreign ..	2,500	0	0	3,066	7	0	4,000	0	0
Do. do. Indian ..	700	0	0	780	13	0	850	0	0
Printing	1,250	0	0	1,947	12	0	1,800	0	0
Binding	1,500	0	0	1,846	0	0	1,500	0	0
Office Establishment	11,280	0	0	11,386	0	8	12,600	0	0
Library Furniture and Fitting.	1,000	0	0	417	2	0	500	0	0
General Charges	1,250	0	0	998	4	6	1,000	0	0
Stationery	1,000	0	0	980	8	0	1,000	0	0
Postage	400	0	0	293	14	9	400	0	0
Insurance	468	12	0	468	12	0	468	12	0
Electric Charges	200	0	0	368	0	11	300	0	0
Gratuity	180	0	0	180	0	0	65	0	0
Annual Library Checking ..	....			750	0	0	....		
	26,728	12	0	29,320	0	5	30,983	12	0
Oriental Research—									
Folklore Notes	2,000	0	0	1,178	7	0	821	9	0
Manuscript Catalogue	2,700	0	0	1,000	0	0	1,700	0	0
Oriental Literature	....			316	4	0	2,000	0	0
Journal Publication etc. (including Extra Number) ..	1,500	0	0	....			2,500	0	0
Non-Recurring—									
General Catalogue	5,000	0	0	739	8	0	5,000	0	0
Shelving Accommodation ..	....			2,150	0	0	1,000	0	0
Government Promissory Notes.	....			9,448	4	0	....		
	37,928	12	0	44,152	7	5	44,005	5	0
	220	7	9	1,787	12	7			
	38,149	3	9	45,940	4	0	44,005	5	0

The Campbell Memorial Fund.

A Statement of Accounts ending 31*st December* 1921.

	Rs.	a.	p.		Rs.	a.	p.
Balance on 31st December 1920 ..	479	3	7	Cost of 1920 Medal	264	8	0
Interest (less Bank Commission) ..	139	0	0	Balance (in the Imperial Bank of India)	353	11	7
Rs. ..	618	3	7	Rs. ..	618	3	7

Invested Funds—

4% Bombay Port Trust Bonds	Rs. 3,000
4% Government Loan	„ 500
	Rs. 3,500

Statement of Accounts in connection with the General Catalogue of the Society.

Year.	Cost of Printing.			Cost of Establishment (Copying and checking clerks).			Total.				Rs.	a.	p.	Rs.	a.	p.
	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.	Sale proceeds .. 1917	864	8	0			
1914				624	13	6	624	13	6	,, ,, .. 1918	417	8	0			
1915				1,131	11	4	1,131	11	4	,, ,, .. 1919	260	0	0			
1916				996	3	5	996	3	5	,, ,, .. 1920	211	0	0			
1917	3,136	8	0	889	6	6	4,025	14	6	,, ,, .. 1921	175	0	0			
1918	125	0	0	1,282	15	7	1,407	15	7					1,928	0	0
1919				1,237	5	4	1,237	5	4	Stock unbound and bound						
1920				1,069	7	9	1,069	7	9	of Vol. I...	2,235	0	0			
1921	200	0	0	539	8	0	739	8	0	1000 unbound copies of Vol.						
										II at Rs. 5	5,000	0	0			
Total ..	3,461	8	0	7,771	7	5	11,232	15	5					7235	0	0
Estimated cost to complete Vol. II.							,000	0	0					9,163	0	0
										Apparent cost to the Society.				7,069	15	5
							16,232	15	5					16, 232	15	5

A meeting of the Society was held on Wednesday, the 5th April 1922.

Present :—The Rev. Fr. R. Zimmermann, Dr. P. N. Daruvala, Dr. O. Pertold, Messrs. G. V. Acharya, N. B. Divatia, P.V. Kane, E. M. Ezekiel, and Dr. E. A. Parker, the Hon. Secretary.

In the absence of the President and all the Vice-Presidents, Mr. N. B. Divatia was voted to the Chair.

The minutes of the last meeting were read and confirmed.

Mr. P. V. Kane read his paper on "Gleanings from the Sabarabhasya and the Tantravartika."

The Rev. F. Zimmermann after making some remarks on the paper, proposed a hearty vote of thanks to Mr. Kane for his interesting and learned paper.

Dr. P. N. Daruvala seconded the proposal. The Chairman commended the paper both for its subject and for its method of treatment, and associated himself with the vote of thanks which was carried unanimously. After passing a vote of thanks to the Chair the proceedings terminated.

A meeting of the Society was held on Friday, the 23rd June 1922.

Sir N. G. Chandavarkar, President, in the Chair.

Present :—Dr. O. Pertold, Dr. Jivanji J. Modi, the Rev. R. M. Gray, Prof. P. A. Wadia, Dr. P. N. Daruwala, Messrs. V. P. Vaidya, L. W. Young, M. J. Gajjar, S. R. Bakhale, N. B. Divatia, Ch. Md. Ismail, G. V. Acharya, and H. V. Divatia.

In the absence of the Hon. Secretary, the Rev. R. M. Gray read the minutes of the last meeting which were confirmed.

Considered the recommendation of the Managing Committee that the Resident subscription of the Society be increased to Rs. 60 per year.

Mr. V. P. Vaidya proposed and Dr. P. N. Daruvala seconded.

1. that "sixty" be substituted for "fifty" in line 2 of Art. XIVA para I.

2. that "in such cases" be added after the word "subscription" in line 12 of Art. XIVA para I.

3. that "fifteen" be substituted for "twelve and annas eight" in line 13 of Art. XIVA para I.

4. that "six" be substituted for "five" in line 15 of Art. XIVA para I.

Carried unanimously.

Prof. P. A. Wadia proposed that "six" be substituted for "five" in line 3 of Art. XV para I.

The Rev. R. M. Gray seconded the proposal.

Mr. V. P. Vaidya expressed himself against the proposal, so did Dr. P. N. Daruvala. The proposal being put to vote was declared lost.

Mr. V. P. Vaidya moved and Dr. P. N. Daruvala seconded that "fifty" be subtituted for "forty" in line 6 of Art. XV para, II.

Carried unanimously.

The Rev. R. M. Gray proposed that the above alterations come into operation from 1st July next. Prof. P. A. Wadia seconded and the proposition was carried unanimously.

The meeting then considered the Managing Committee's recommendation that clothes be given to peons, and that the necessary increase in the Budget (Rs. 700) be sanctioned.

Mr. V. P. Vaidya proposed and the Rev. R. M. Gray seconded that the recommendation be accepted.

Carried unanimously.

Mr. P. V. Kane being absent, the motions standing in his name fell to the ground. Prof P. A. Wadia expressed his desire to move them, but the President ruled that there being no provision in the rules of the Society allowing a Member present to move a motion, of which an absent Member has given notice, no Member can be allowed to take charge of the motion and that upon the ground that a motion of which a Member has given notice is his exclusive property.

A meeting of the Society was held on Monday the 10th July, 1922.

In the absence of the President Dr. Jivanji J. Modi occupied the Chair.

Present: The Rev. Fr. R. Zimmermann, Messrs, E. M. Ezekiel, P. V. Kane, Kubalaya Raj, Ch., Md. Ismail, N. B. Divatia and Dr. E. A. Parker, the Hon. Secretary.

The minutes of the previous meeting were read and confirmed.

Mr. N. B. Divatia read his paper on "The Ancient Indian Symbol for the Foreign sound Z, the Disputed Symbol in the name of Castana's Father."

Mr. P. V. Kane made some observations on the subject of the paper and moved a cordial vote of thanks to Mr. Divatia for his learned and interesting paper.

Dr. Modi heartily associated himself with the motion and expressed a wish that Mr. Divatia might read many more such interesting papers before the Society.

The motion was carried unanimously.

Mr. Ch. Md. Ismail then read his paper on "Two Arabic Medicine Cups."

Mr. Ezekiel proposed a hearty vote of thanks to Mr. Ismail for his interesting paper.

The vote was carried unanimously and the proceedings terminated.

A meeting of the Society was held on Monday, the 21st August 1922.

Present :—Dr. Jivanji J. Modi, Rao Bahadur P. B. Joshi, Dr. J. B. Dordi, Mr. H. J. Bhabha, Dr. O. Pertold, Miss G. J. Bahadurji, Dr. P. N. Daruvala, and Dr. E. A. Parker, the Hon. Secretary.

Dr. Modi, one of the Vice Presidents, was in the Chair.

The minutes of the previous meeting were read and confirmed. The Chairman then asked Rao Bahadur Joshi to read his paper on "Side Lights on the past History of the Parsis."

Rao Bahadur Joshi on account of his imparied eye-sight was unable to read the paper himself. He spoke briefly on the principal points and asked his son Ramrao to read the paper.

At the conclusion of the paper the Chairman made a few observations, and moved a cordial vote of thanks to Rao Bahadur Joshi for his very interesting and learned paper.

The motion was carried unanimously and the proceedings came to a close.

A meeting of the Society was held on Thursday, the 14th September 1922.

Present :—Dr. O. Pertold, Messrs F. Saldanha, W. L. Morgan, Prof. A. X. Soares and Dr. E. A. Parker, the Hon. Secretary. Dr. Pertold was voted to the Chair.

The minutes of the last meeting were read and confirmed. The Chairman then called on Prof. Soares to read his paper on "Garcia d'Orta, a Little Known Owner of Bombay."

At the conclusion, the Chairman proposed a hearty vote of thanks to Prof. Soares for his interesting and learned paper. The Hon. Secretary cordially associated himself with the proposal which was carried unanimously and the proceedings terminated.

A special general meeting of the Society was held on Monday, the 18th Sept. 1922 to give a reception to Dr. Sylvain Lévi, when Dr. Jivanji Jamshetji Modi, the senior Vice-President, was in the Chair.

Present :—Rao Bahadur P. B. Joshi, the Rev. Fr. R. Zimmermann, Messrs B. S. Lalkaka, R. N. Munshi, J. K. Mehta, J. S. Vaidya, H. A. Shah, C. R. Shah, Ch. Mahammad Ismail, G. V. Acharya, M. S. Javeri, S. N. Phervani, V. R. Bhende, B. W. Kissan, R. B. Mehta, M. G. Damania, N. B. Divatia, H. V. Divatia, J. Munster, M. J. Gajjar, Purshottam Vishram Mavji, K. M. Jhaveri, Kubalaya Raj., L. S. Dabholkar, Faiz B. Tyabji, B. K. Wagle, D. G. Dalvi, P. V. Kane, S. R. Bakhale, S. V. Bhandarkar, P. A. Wadia, H. J. Bhabha, E. M. Ezekiel, V. P. Vaidya, Seth Mavji Govindji, Prof. A. L. Covernton, Dr. J. B. Dordi, Dr. V. S. Sukthanker, Dr. O. Pertold, Dr. S. V. Ketker, Messrs. S. S. Patker, D. P. Frenchman, Dr. P. N. Daruvala and Dr. E. A. Parker, the Hon. Secretary.

Dr. Modi in welcoming Professor and Madame Lévi said that this was not the first time that a French scholar had honoured the Society with his presence. Prof. Darmesteter once visited these rooms and M. Eugène Burnouf had been a Corresponding Member of the Society. The late Mr. Manekji, Cursetji, to whose energy the admission of Indian Members to this Branch of the Society was due, had likewise been in correspondence with Prof. Darmesteter.

The Chairman added that Prof. Lévi was doubly welcome both for his distinguished services to Oriential Studies and as the disciple and successor of Prof. Darmesteter.

Fr. Zimmermann in moving that Prof. Lévi be enrolled as an Honorary Member of the Society referred at length to the great contributions made by the guest of the evening to Oriental research and pointed out that in the presence of so distinguished a European scholar among Indian scholars, the ancient unity of the Aryan race was again demonstrated and advanced.

Mr. V. P. Vaidya briefly and very suitably seconded the motion, adding further particulars of Dr. Lévi's scholastic activities.

The motion being put to the meeting was carried with applause.

Rao Bahadur P. B. Joshi thereupon recited Sanskrit verses of welcome specially composed by him for the occasion, an English translation being read by his son Ramrao.

Prof. Lévi, who was received with applause by the meeting, thanked the Society warmly for the welcome accorded, and the honour of Membership conferred upon him.

He proceeded to speak on the problem of ancient Indian navigation, saying that many evidences existed in the Greek, Jain and Buddhistic literature to show that Indian navigation for purposes of trade had existed in very ancient times, the produce of India having been carried in Indian ships from the west coast of the country as far as East Africa, just as similar commerce had existed between the east coast of India and the Strait Settlements.

The problem was partly archaeological and partly philological. As to the latter the Indian vernaculars of the west coast showed loaned words from foreign nations with which India had trade relations, but he would particularly direct attention to the need of the study of the former part of the problem.

We knew of the existence of old harbours up and down the west coast of India, but the exact localities, extent and character needed study by excavation and close archaelogical exploration. He hoped that members of this Society would some day undertake this great task and thereby add both glory to themselves and a great extension of knowledge to Oriental studies.

At the conclusion of Prof. Lévi's address the meeting adjourned for refreshment and general intercourse.

List of Presents to the Library, 1921.

Titles of Books. *Donors.*

ACTS passed by the Governor-General of India in Council, 1920.
Government of India.

ADHYATMA TATVALOKA—Nyayavijaya.
Manager, Yashovijaya Granthamala.

ADMINISTRATION REPORT, Ajmer-Merwara, 1919-20.
Government of India.

————————Assam, 1919-20.
Government of Assam.

————————Baluchistan Agency, 1919-20.
Government of India.

————————Bengal, 1918-19.
Government of Bengal.

————————Bihar and Orissa, 1919-20.
Government of Bihar and Orissa.

————————Bombay Port Trust, 1920-21.
Chairman of the Trust.

————————Bombay Presidency, 1919-20.
Government of Bombay.

————————Madras Presidency, 1919-20.
Government of Madras.

————————N. W. F. Province. 1919-20.
Government of N. W. F. P.

————————United Provinces, 1919-20.
Government of U. P.

AGRICULTURAL Operations in India, Review of, 1919-20.
Government of India.

————Research Institute, Pusa, Bulletins, Nos. 100 to 113, 115, 117, 119, 122 and 124.
Government of India.

————Research Institute, Pusa, Scientific Reports, 1919-20 and 1920-21.
Government of India.

————Statistics of India, 1918-19, Vols. I—II. and 1919-20, Vol. I.
Government of India.

AGRICULTURE Department, Bombay, Bulletins, Nos. 100, 102, 104, 106, 107 and 108.
Government of Bombay.

Titles of Books. *Donors.*

AGRICULTURE Department, Bombay Presidency, Annual Report, 1919-20.
Government of Bombay.

——— Department, Punjab, Report on the Operations, 1919-20.
Government of the Punjab.

AMENDED List of Ancient Monuments in Burma.
Government of Burma.

ANGAMI Nagas. By J. H. Hutton.
Government of Assam.

ARABIC History of Gujarat. By Ulughkhani, Edited by E. D. Ross, Vol. II.
Messrs. J. Murry & Co.

ARCHAEOLOGICAL Department, Mysore, Annual Report, 1920.
Government of Mysore.

——— Department, Nizam's Dominions, Report, 1918-19.
Government of the Nizam.

——— Superintendent, Northern Circle, Report, 1919-20.
Government of the Punjab.

——— Superintendent, Northern Circle, Mahomedan and British Monuments, 1916-19 and 1919-20.
Government of the Punjab.

——— Superintendent, Southern Circle, Annual Reports, 1919-20 and 1920-21.
Government of Madras.

——— Survey, Burma, Report, 1920-21.
Government of Burma.

——— Survey of India, Annual Reports, 1914-15, 1917-18 Part I, and 1918-19 Part I.
Government of India.

——— Survey of India, Eastern (now Central) Circle, Annual Report, 1919-20.
Government of Bihar and Orissa.

——— Survey, Eastern Circle, Illustrations from the Annual Report, 1918-19.
Government of Bengal.

——— Survey of India, Frontier Circle, Annual Report, 1920-21.
Government of the N. W. F. P.

Titles of Books. *Donors.*

ARCHAEOLOGICAL Survey of India, Memoirs Nos. 3, 8, 9 and 12.
Government of India.

AREA and Yield of Principal Crops in India, Estimates for 1919-20.
Government of India.

ASEF-UL-LUGHAT. Vols. XIV and XV.
Government of India.

ASPASIE et Phryné. By J. Bertheroy.
Hamid A. Ali, Esq.

ATAIQ-I-VAST-I-ASIA: Translation of Stein's Explorations in Central Asia.
Arch. Survey Dept., Delhi.

BANKS in India, Statistical Tables relating to, 1919.
Government of India.

BENGALI Literature in the 19th Century. By S. K. De.
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Hamid A. Ali, Esq.

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ZOROASTRIAN Ethics. By M. A. Buch. Baroda Durbar.

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Printed by B. Miller, Superintendent, British India Press, and published by Mr. E. A. Parker for the Bombay Branch, Royal Asiatic Society.

Proceedings of the Bombay Branch of the Royal Asiatic Society, 1922-23, *and a list of presents to the Library,* 1922.

Proceedings.

A meeting of the Society was held on Tuesday, the 28th November 1922.

Sir N. G. Chandavarkar, LL.D., President, in the Chair.

Present :—Messrs. J. Munster, S. V. Bhandarkar, V. R. Nachane, P. V. Kane, C. R. Shah, A. G. Mulgaokar, M. R. Bodas, D. G. Dalvi, J. E. Aspinwall, V. P. Vaidya, Prof. A. L. Covernton, Dr. P. N. Daruvala, and Mr. L. W. Young.

In the absence of the Honorary Secretary, Dr. E. A. Parker, the Financial Secretary, Mr. L. W. Young, acted for him.

The Minutes of the last meeting were read and confirmed.

Considered the revision of the list of newspapers and periodicals received by the Society.

Resolved that, funds permitting, the Society should subscribe for one year to the "Sunday Times," the "Bystander," and the "Criterion," and that the Committee should give priority to these in the order mentioned in the resolution.

Considered the following recommendations of the Managing Committee :—

(1) That a silver medal be awarded annually or triennially at the discretion of the Managing Committee to a member of the Society who has made distinguished researches within two years preceding the presentation.

Proposed by Mr. P. V. Kane and seconded by Dr. P. N. Daruvala.

Carried.

(2) That Art. V of the Rules should read as follows :—

"Any three members may propose to the Managing Committee the name of a member, foreigner or other person, who shall have materially contributed to promote the objects of the Institution either by donation or otherwise, for election by the members of the

Society as a Fellow of the Society, and on such proposal the Managing Committee may at their discretion submit the name or names for election at a general meeting of the Society. The number of such fellows shall not exceed thirty.

Any Fellow not being an ordinary member at the time of his election shall be exempt from subscription, but shall not hold office, nor have any voice in the administration of the Society's affairs.

The election of Fellows shall in every case be made by ballot ; if there be more nominees than there are vacancies, the election shall be determined by an absolute majority of vote."

Proposed by Mr. V. P. Vaidya and seconded by Dr. Daruvala.

Carried.

(3) That the Managing Committee be empowered under this Article to proceed forthwith to recommend the election of Fellows to the number of fifteen.

Proposed by Mr. P. V. Kane and seconded by Mr. V. P. Vaidya.

Carried.

(4) That such Honorary Members as are still living shall henceforth be designated Fellows.

Proposed by Mr. V. P. Vaidya and seconded by Mr. Bhandarkar.

Carried.

(5) That the wording of Art. VI be altered as follows :—

Para. I, add, after "City of Bombay," the words "or have a place of business within the City of Bombay."

Para. II, add, after "City of Bombay," the words, "and without a place of business within the City of Bombay."

Proposed by Mr. Vaidya and seconded by Mr. Bhandarkar.

Carried.

It was proposed by Mr. S. V. Bhandarkar and seconded by Mr. P. V. Kane that Art. XIV be amended by substituting the words "Fee Rs. 20" for the words "Fee Rs. 15" in line 2nd, page 4.

That Rule XVII be amended by substituting the words "subscribe in advance at the rate of Rs. 20 per annum or Rs. 6 a quarter if paid quarterly" for the words "subscribe in advance at the rate of Rs. 15 per annum or Rs. 4 a quarter" in lines 4 to 6, page 5.

Carried.

It was proposed by Mr. P. V. Kane and seconded by Dr. P. N. Daruvala that Mr. V. P. Vaidya be appointed Trustee of the Society in place of Sir Bhalchandra Krishna, deceased, and Prof. A. L. Covernton be appointed in place of Mr. H. R. H. Wilkinson, resigned.

Carried.

A Special General Meeting of the Society was held on the 16th February 1923.

His Excellency Sir George Lloyd, Governor of Bombay, presented to Rao Bahadur P. B. Joshi the special Campbell Memorial Medal, and a lantern lecture was given by Mr. B. C. Ellison, Curator of the Bombay Natural History Society, on "H. R. H. the Prince of Wales' Big Game shoot in the Nepal Tarai." There was a large and representative attendance of the Members of the Society. Among those present were: Sir Narayan Chandavarkar, Dr. Jivanji J. Modi, Mr. V. P. Vaidya, Prof. E. M. Ezekiel, Messrs. K. M. Jhaveri, H. J. Bhabha, Mahamad Ismail, Rao, Bahadur P. B. Joshi, Dr. C. J. J. Fox, Prof. P. A. Wadia, Dr. P. N. Daruvala, Sir N. C. Macleod, Rev. Fr. R. Zimmermann. Dr. O. Pertold, Prof. A. L. Covernton, Messrs. C. V. Mehta, D. V. Joshi, S. S. Patkar, T. S. Shejwalkar, D. G. Sowani, V. G, Bhandarkar, S. V. Bhandarkar, V. R. Bhende, J. P. Brander, B. S. Lalkaka, J. R. Gharpure, M. R. Bodas, Dr. D. A, Turkhad, and Mr. A. Hale-White.

The Hon. Sir Narayan Chandavarkar, President of the Society, having formally welcomed His Excellency, Dr. Jivanji J. Modi, the Senior Vice-President, introduced Rao Bahadur Joshi to His Excellency. In doing so, Dr. Modi said that by attending that meeting His Excellency was doing honour, not only to the Society but also to the memory of the late Sir James Campbell and to Rao Bahadur Joshi, a great scholar who had rendered valuable service to this and other literary societies. There was a time, Dr. Modi said, when Governors of Bombay were members of this Society, some of whom, great Oriental scholars, took keen interest in its work. Among these he named Jonathan Duncan, Sir John Malcolm, and both Elphinstones, who had contributed considerably to Oriental literature. But those times had gone. It was, however, peculiarly gratifying to have as their President that day, a Governor who was an Orientalist. The late Sir

James Campbell, Dr. Modi said, had left behind him a work, *viz.*, the Gazetteer, which would stand as a standard work for the study of anthropology and etymology, a work in which Rao Bahadur Joshi was his collaborator. Mr. Joshi had not only done good literary work and published articles in different journals, but he had been the guide, philosopher, and friend of many European and American scholars who had come to this country. Dr. Modi requested His Excellency to present the Special Campbell Memorial Medal to Mr. Joshi.

His Excellency then presented the medal to Mr. Joshi.

Mr. Joshi, in thanking His Excellency, said: Your Excellency, ladies and gentlemen, I am much obliged to Your Excellency for your kindness in attending this meeting and personally presenting to me the special Campbell Memorial Medal. This shows that your Excellency is always ready and willing to promote the cause of learning by encouraging those who devote their time and energy to literary pursuits. The late Sir James Campbell, in whose memory the medal has been founded, was one of those talented members of the Indian Civil Service, who, by their great literary and administrative work, have won distinction for themselves and credit for the noble service to which they belong, and so long as the 25 volumes of the Bombay Gazetteer are used by the administrators, the scholars and the public for purposes of reference, the name of Sir James Campbell will be remembered as that of a great scholar, historian and antiquarian. It was a pleasure as well as an honour to me to have been associated with that eminent scholar, first in the great Gazetteer work, and subsequently as a voluntary co-worker in his researches in the field of ancient history, antiquities, ethnography, religious belief, custom and folklore. Whether he was at Achnashie in Scotland, in India, or on the continent, Sir James Campbell was in constant communication with me on literary subjects, and in the numerous letters written by him from time to time, some of which are still in my possession, there is an ample testimony to his literary activity and to the variety of subjects dealt with by him. Sir James Campbell appreciated good work and was always helpful to those who helped him in his literary pursuits. In 1894 he brought my services to the notice of the Government and on his recommendation I was made a Fellow of the Bombay University, and in 1903 he brought my literary services to the notice of the Government of India through Bombay Government, and, as a result of that, I was granted by His Excellency Lord Northcote, the then Governor of Bombay, the Coronation certificate of Merit for "Research work for Campbell Gazetteer." As the certificate was granted in the name of the King-Emperor, it was a high honour ; but the medal which has been presented to me this evening is an honour of scarcely less value, and I consider it as a precious gift because it is associated with the name of Sir James Campbell, and be cause it will remain in my family as a precious memento of my literary connection with that eminent scholar, who was a patron of learning, the true friend and well-wisher of India.

Mr. Ellison then delivered his lecture which was illustrated with numerous lantern slides. After describing the physical character of the mountainous country of Nepal, he proceeded to give a history of the Royal visit to that country. Coming to the different shooting expeditions of His Royal Highness, he described the manner in which the first tiger was shot. It was on December 14th that a very large tiger had been seen, and a move was made to the shooting beat. That was quite near the Royal Camp at a place called Saraswati Khola. The party mounted the pad elephants and proceeded to the line of elephants with howdas in position by the river bed. H. R. H. mounted into his howdah. Everybody was expectant though nothing happened for some time. The news of a tiger was at last brought and the elephants moved forward towards a jungle on the other side of the huge river bed. Suddenly there was a stir in the line. All the elephants began to close up shoulder to shoulder and the great beasts stood to form the ring. All was expectancy. There was an outburst of shouting from the beaters. Out rushed a deer and escaped terrified into the jungle, shortly followed by others. Then the real thing happened and there was a cry : "Bagh, Bagh," from the beaters. The tiger at last! A glimpse of a yellowish form was seen in the long grass for the space of a few seconds and was at once lost to view. Once again it was seen behind a tree-trunk. Closer advanced the beaters, the tiger charged out, but he was a wary beast and seemed to know intuitively where the guns were posted, and gave them a wide berth. Again and again he was driven out only to seek cover in the long grass away from the guns. A shikari climbed a tree and pelted him with stones. The manœuvre succeeded and once again they got a half-length view of 'Stripes' as he made a spring at his tormentor in the tree top. The ring closed in upon him, but with a roar he drove into the long grass ; another roar and he showed himself quite near the Royal howdah. A moment's suspense and H. R. H. fired and a second afterwards two more shots rang out. The Prince had hit. The tiger though mortally wounded, had plenty of go in him and charged to the opposite side and was buried once more in the heavy cover. The ring closed in ; a shot rang out and the tiger rolled over dead. It taped 9 feet but he was a Royal beast and looked splendid.

A Rhino Shoot.

The lecturer next described the first rhino shoot of H. R. H. That was on December 15th. The party arrived at the spot where the shooting was to take place at 1 p.m., and an adjournment for lunch was agreed to with general acclaim. Several rhinos had been seen in the swamp in close proximity and the chances of a good afternoon's sport seemed assured. After lunch we mounted our elephants and it was not long before a rhino was discerned in the thick grass cover. H. R. H. whose position was rather disadvantageous, could scarcely see the animal from where he was fired. Lord Louis Mountbatten fired immediately afterwards and the rhino made off. A prolonged search was made for the beast. The blood-spattered leaves and grass showed clearly that the bullet had found its mark, but it was not till many days later that the beast was picked up dead. It was then too decomposed for preservation, but the skull and the horn were recovered. It proved to be the best of all the rhino heads obtained in Nepal during the present shoot.

A King Cobra.

The lecturer also described how H. R. H. killed a cobra. He said, on the evening of December 21st near the village of Persanni in British Territory, the Prince encountered a Hamadryad or king cobra which he luckily killed. The party were walking up jungle fowl at the time. H. R. H. first shot at the snake as it was moving away, and apparently hit it, for the brute turned and appeared to be about to attack him when he killed it with his second barrel. The snake was brought into camp with the rest of the day's bag. It was first assumed that it was an ordinary rat snake or Dhaman when examined in the fading light. Subsequently when the skin was examined at the Society's Museum in Bombay, the identity of the reptile was revealed. The Prince's king cobra taped 10 feet 3 inches. The Hamadryad, the largest known poisonous snake in the world, grows to about 15 feet in length. The record specimen now in the Society's Museum measures 15 feet 5 inches.

THE GOVERNOR'S SPEECH.

His Excellency the Governor then addressed the meeting. He said:—Sir Narayan, Dr. Modi, ladies and gentlemen, I desire to thank you most cordially for your kind welcome here to-day and also to express my gratification, that your distinguished President, Sir Narayan Chandavarkar, has been able to be present on this occasion. I am afraid that nowadays the major part of his valuable time is taken up by his duties as the President of another body, in the conduct of which we are all vitally interested. In point of age, it cannot compare with the Bombay Branch of the Royal Asiatic Society which was founded over a century ago, but you will doubtless agree with me, that though it is comparatively very young, it is growing up rapidly under the fostering care of your President.

It is unfortunately only too true that the complexity of modern administration leaves the Governor of a large and progressive Province very little spare time to devote to the study of Art, Science and Literature, the objects which your Society has done and is doing so much to promote, and there are occasions when I feel that I would prefer the leisured life of a scholar to the strenuous days which fall to the lot of the head of the Province. In the good old days when the reins of Government were in the hands of those distinguished predecessors of mine, to whom you, Sir, have referred, Government was content to confine its activities very largely to the preservation of law and order, and the collection of taxes. I say this without any disparagement to the great names you have mentioned. That was all that a Government was expected to do in those days, and they governed wisely and well according to the spirit of the times in which they lived. But now we are expected to undertake a great many duties closely affecting the welfare of the people, such as education, medical relief, sanitation, the regulation of labour and even the provision of housing accommodation for the masses, duties with which the State for centuries had very little concern. I do not complain of this; I think it is right that the State should look after, as far as possible, not only the lives and safety, but also the health and comfort of the people; but the result is that all those who are concerned in the administration have to confine their attention ever more closely to the numerous and complex problems with which they are confronted.

A Comparison.

Indeed, I think, that the saddest illustration of the truth of what I say is to be found in a comparison of the present day activities of the service to which Sir James Campbell belonged with those of his contemporaries. In his days and in ours, its members were and are men who had received the best education that England could give, and numbered among them the leading scholars of their year at the great universities. But in his day they were able to continue their studies in India, and they had ample leisure to devote to the scholastic pursuits, to which they were inclined, and in particular to Oriental learning and culture. In our day, however, the business of administration is so complex that even the keenest scholar among them will hardly find a few hours in the year to devote to scholarship, and he is lucky if the moments he snatches from his work are sufficient to keep him abreast of the current of modern thought.

But while the administrator can find little time to take a personal part, as he once did, in your researches he cannot afford to neglect the results of your labours, and I can assure you that I have found the Bombay Gazetteer, which was compiled by one of your most erudite members, a mine of valuable information. I have always felt that I should like to have an opportunity of meeting any one who had taken a share in its compilation, and I am glad to have this opportunity of thanking Rao Bahadur Joshi for the part which he took in the preparation of these fascinating volumes, from a perusal of which I have derived so much pleasure and profit.

GOVERNMENT GRANT.

We are all of us in Bombay painfully aware of the discomfort caused by want of room, and I find that your Society is no exception to the general rule. But as you know, my Government has recognised the value of your contributions to our knowledge of the East and especially of the Library which you have succeeded in collecting in the face of exceptional difficulties, and we are making a grant-in-aid which, we hope, will enable you considerably to extend your very limited accommodation (Applause). Your Vice-President, himself a very distinguished scholar, has given us a fascinating account of the work of the Society and the great scholars who have enhanced its reputation. It is, indeed, a wonderful tradition which you are carrying on, and for my part I do not attempt to hide the envy which I feel of the scholastic eminence which Rao Bahadur Joshi has attained. To be enrolled among the Campbell Medallists and to take rank with the great orientalists who have received that honour before him is a privilege which any layman would covet though he cannot hope to attain, and I congratulate you, Rao Bahadur Joshi, very heartily upon the great distinction you have won. (Applause.)

On the motion of Mr. V. P. Vaidya, a hearty vote of thanks was accorded to His Excellency.

A meeting of the Society was held on Monday, the 12th March 1923, at 6 p.m.

In the absence of the President, Dr. J. J. Modi, Vice-President; was in the Chair.

Present :—Rao Bahadur P. B. Joshi, Prof. E. M. Ezekiel, Messrs. Ch. Mahommad Ismail, G. V. Acharya, N. B. Divatia, S. V. Bhandarkar, P. V. Kane, F. M. Mehta, and T. S. Shejwalkar.

The minutes of the general meeting of 28th November 1922 were read and confirmed.

Prof. S. H. Hodivala, M.A., read his paper on "The Unpublished coins of the Gujerat Sultanat."

Mr. Ch. Mahommad Ismail moved a cordial vote of thanks to the lecturer saying that the paper was very interesting and showed what an amount of research was done by Prof. Hodivala in the matter.

Prof. Ezekiel seconded the motion which was carried unanimously and the meeting terminated.

A meeting of the Society was held on Thursday, the 22nd March 1923.

Sir Narayan G. Chandavarkar, President, in the Chair.

Present :—Dr. J. J. Modi, Rev. Fr. R. Zimmermann, Messrs. P. V. Kane, O. H. Nazar, G. V. Acharya, Rao Bahadur P. B. Joshi, Dr. V. S. Sukhthankar, Dr. P. N. Daruvala, Messrs. T. S. Shejwalkar, S. V. Bhandarkar, Kubalaya Raj, and B. K. Wagle.

The minutes of the last meeting were read and confirmed.

Dr. V. S. Sukhthankar then read his paper on "A Bibliographical note on the Bhāsa dramas."

Mr. P. V. Kane made a few remarks on the authorship of the plays supposed to be written by Bhasa and, in moving a cordial vote of thanks to Dr. Sukhthankar for his interesting paper on an absorbing topic of Oriental research of the present day, commended the care and labour of the author in bringing together all references and articles on the subject that have appeared in different languages.

Rev. Fr. Zimmermann and Rao Bahadur Joshi made some observations and heartily supported the vote of thanks.

The President, in associating himself with the proposition, warmly acknowledged, on behalf of the Society, the service Dr. Sukhthankar had done to oriental research by his very interesting and learned paper. He expressed a hope that Dr. Sukhthankar would make similar attempt and bring together definite evidenee on both sides of the question, viz., whether Bhāsa was the real author of the dramas that were attributed to him, so as to enable laymen to draw their conclusion therefrom.

At this stage Sir Narayan left the meeting and Dr. Modi occupied the Chair.

Mr. G. V. Acharya then read his paper on 'Two sets of Chalukyan copper-plates from Navasari.'

Rao Bahadur Joshi made some remarks on the subject of the paper and proposed a hearty vote of thanks to Mr. Acharya for his interesting paper.

Dr. Modi, in cordially endorsing the vote, pointed out that the note on the two plates referred to by Mr. Acharya in his paper and about the authorship of which he had made a guess had been really written by him and had been forwarded to the Archæological Superintendent, Western Circle, Poona, soon after the report of the Department for 1918, mentioning the plates, was published. Dr. Modi desired that his note should be incorporated in the present paper.

The Annual Meeting of the Society was held on Tuesday, the 27th March 1923.

Sir N. G. Chandavarkar, President, in the Chair.

President:—Dr. J. J. Modi, Messrs. V. P. Vaidya, J. E. Aspinwall, Rafiuddin Ahmad, S. V. Bhandarkar, P. V. Kane, N. B. Divatia, J. S. Sanzgiri, Dr. P. N. Daruvala, Messrs. O. H. Nazar, E. M. Ezekiel, T. S. Shejwalkar, B. K. Wagle, Kubalaya Raj, M. D. Altekar, Dr. D. A. DeMonte, and Mr. L. W. H. Young, the Acting Hon. Secretary.

The minutes of the last annual meeting were read and confirmed.

The Acting Secretary then read the Annual Report with the statement of accounts for 1922, and the Budget Estimates for 1923.

THE ANNUAL REPORT FOR 1922.

GENERAL SURVEY.

The membership of the Society continues to increase; 1921 saw 133 new Members added to the roll, and 1922, 127. There is every prospect that the great attraction of our library, if supported by a liberal and well-directed policy, will draw greater numbers every year to come.

The increase of the subscription, threatened every year since the war, became a fact in the past year, and it was gratifying to find that no one resigned on that account. Our first duty with the added income was to raise the salaries of the staff to meet approximately the present cost of living, for it is evident that the success of the library depends largely on the librarian and his assistants, on their efficiency and on their contentment. With regard to efficiency, we should like here to register our pleasure in the willingness and increasing capability of every member of the staff. With a rapidly growing membership, circulation and even library issue of books and papers is becoming a distinctly severe problem requiring patience on the part of members and versatility on the part of the staff, qualities which we gladly acknowledge to have been unfailing in both parties during the year. We are engaged in renewal of the fiction catalogue, the general catalogue having been set up in a stable form, and are planning a card catalogue under a modern system of subject-headings, and a complete revision of the circulation and library-service. None are more conscious than ourselves of the need for advance or overhauling in our methods, none either of the breaches and delays which ill-health causes in the execution of desired improvements.

A full and satisfactory supervision of the Society's activities as a learned body, as a circulating and reference library and as an organisation with limited financial assets requiring close economy has for some time exceeded the power of a single Hon. Secretary. The increase of sub-committees in two years from one to six, apart from temporary committees for special purposes; a signal renascence of activity in Oriental research manifest in the frequent papers read before the Society, in the institution of Fellowships of the Society and of a Silver Medal for research to be awarded biennially; an extended scheme for rearrangement of books in the library and the clearance of shelf-room by relegation of old journals to the File Room or of worthless volumes to oblivion; these, together with routine matters, sufficed to occupy a single Secretary. Finance, unconsidered in the above, required expert conduct, and the Committee of Management agreed to the creation of a Joint Secretaryship principally for finance, and was fortunate in securing Mr. L. W. H. Young to fill the office. It will be possible now to pay something like adequate attention to both the literary and the financial sides of the Society's business. It will be possible also, through this sharing of labour, to look forward hopefully to an early accomplishment of long-cherished plans.

In accommodation, the Society has been able during the year to fit out the ground-floor room, vacated by the Bombay Presidency Council of Women, as the Royal Geographical Society's library and map-room according to the scheme of Mr. J. E. Aspinwall. The room next the Committee Room has also been arranged and reserved for Oriental Research, and the catalogue of our Oriental Mss. being now complete, it is hoped that the Oriental Research Room will prove fruitful in the Society's learned interests and convenient to Oriental scholars.

The main hindrance to the development of Oriental Research for which the Society was founded lies in the present method of publication of contributions by its Members. An annual or semi-annual journal is dilatory and cumbersome. It is one of our most urgent needs that another system of publication, both expeditious and economical, should be decided upon. Unless such a course is adopted, the Society cannot hope to compete with the many specialist organisations now springing up, and take its rightful position as the leading body in Western India for the main branches of Oriental research.

MEMBERS.

Resident :—

On the roll on 1-1-22.	New admissions.	Non-Resident become Resident.	Resigned or ceased to be Members.	Transferred to the Non-Resident list.	Died.	Number of Members on 1-1-23.
489	108	10	71	11	7	518

Non-Resident :—

On the roll on 1-1-22.	New admission.	Resident, become Non-Resident.	Resigned or ceased to be Members.	Transforred to the Resident list.	Died.	Number of Members on 1-1-23.
182	19	11	29	10	1	172

Of the 518 Resident Members, 40 are Life Members and 42 are on the Absent list; and of the 172 Non-Resident Members, 12 are Life Members and 13 are absent from India.

Obituary.

The Committee regret to record the death of the following Members.

Resident.

Sir Balchandra Krishna (one of the Trustees of the Society).
Mr. R. N. B. Jeejeebhoy.
Mr. M. D. Jeejeebhoy.

Sir Vithaldas Thackersey.
Prof. Mahammad Abbas (Member of the Committee).
Mr. D. B. Mehta.
Mr. D. G. Chichester.

Non-Resident.
Dr. P. D. Gune.

Papers read before the Society.

5th April 1922—Gleanings from the Sabarbhashya and the Tantra-Vartika. By Prof. P. V. Kane, M.A., L.L.M.
10th July 1922—Ancient Indian Symbol for the Foreign Sound *Z* : the disputed Symbol in the name of Castana's father. By Prof. N. B. Divatia, B.A.
10th July 1922—Two Arabic Medicine Cups. By Mr. Ch. Mohamad Ismail, M.A.
21st August 1922—Sidelight on the past History of the Parsis. By Rao Bahadur P. B. Joshi, F.R.G.S.
14th September 1922—Garcia d'Orta, a little-known Owner of Bombay. By Prof. A. X. Soares, M.A.

Library.

Issues :—

Old Books.	New Books.	Loose Periodicals.	Total.	Average per working day.
27,786	12,499	18,611	58,896	201·7

The total number of issues in the previous year was 54,937.

Details according to subjects :—

Fiction	21,764
Miscellaneous	2,276
Biography	2,139
Voyages, Travels, &c.	1,872
Politics, Political Economy, &c.	1,712
History and Chronology	1,573
Oriental Literature	1,495
Poetry and Drama	1,420
Literary History and Criticism	825
Philosophy	655
Annuals, Serials, &c.	559

Naval and Military Works	547
Archæology, Anthropology, &c.	447
Art, Architecture	442
Dictionaries, Grammars, &c.	436
Natural History, Geology, &c.	417
Religion and Theology	410
Foreign Literature	258
Classics	254
Physiology, Medicine, &c.	192
Government Reports and Public Records ..	155
Mathematics, Physics, &c.	137
Logic and Works on Education	120
Law	97
Botany, Agriculture	83
Periodicals in loose numbers	18,611
Total ..	58,896

Additions :—

The total number of books added was 1,493, of which 1,236 were purchased and 257 were presented.

Particulars according to classes :—

Class number.	Subject.	Volumes purchased.	Volumes presented.
1.	Religion and Theology ..	20	0
2.	Philosophy	26	0
3.	Logic and Education	6	1
4.	Classics	6	0
5.	Literary History and Criticism.	46	3
6.	History and Chronology ..	59	3
7.	Politics, Political Economy ..	72	4
8.	Law	3	1
9.	Government Reports and Public Records	19	166
10.	Biography, Memoirs, &c. ..	44	3
11.	Archæology, Anthropology ..	17	6
12.	Voyages, Travels, &c.	41	9

13.	Poetry and Drama	46	10
14.	Fiction	329	0
15.	Miscellaneous	65	1
16.	Foreign Literature	0	0
17.	Mathematics, Astronomy, &c...	2	0
18.	Art, Architecture	25	0
19.	Naval and Military	9	1
20.	Natural History, Geology, &c.	11	1
21.	Botany, Agriculture	2	1
22–23.	Physiology, Medicine, Surgery.	1	1
24.	Annuals, Serials, &c.	282	17
25.	Dictionaries, Grammars, Reference Works	28	10
26.	Oriental Literature	77	19
		1,236	257

Books presented to the Society were received as usual from the Government of India, the Government of Bombay, and other Provincial Governments, as well as from the Trustees of the Parsi Punchayet Funds, other public bodies and individual donors.

A catalogue of these additions is in the press and will be sent to Members when published.

Papers and Periodicals :—

Papers and periodicals, journals and transactions of Learned Societies subscribed for and presented to the Society during the year were :—

English Newspapers :—	
Daily	2
Weekly	26
English Magazines and Reviews :—	
Monthly	26
Quarterly	24
English Almanacs, Directories, Year Books	32
Foreign Literary and Scientific Periodicals	27
American Literary and Scientific Periodicals ..	27
Indian Newspapers and Govt. Gazettes	29
Indian and Asiatic Journals and Reviews	73
	266

A meeting of the Society under Art. XXI. of the Rules was held on the 28th of November for the purpose of revising the list of the papers and periodicals received by the Society, and it was decided to subscribe to the following from 1923.

1 Sunday Times.

2 Bystander.

3 Criterion.

Manuscript Catalogue.

The work of cataloguing the Sanskrit and Pali Mss. in the collection of the Society, which was entrusted to Prof. H. D. Velankar, is nearly complete and the Committee hopes to publish the catalogue as soon as possible.

Coin Cabinet.

32 additions were made to the Coin Cabinet of the Society during the year under report. Out of these 7 were gold, 19 silver and 6 copper.

The coins are of the following description :—

Gold.

5 Haihaya dynasty of Mahakosala

 2 Prithvi Deva (1140–60 A.D.)

 1 Jagalla Deva (1160–75 A.D.)

 2 Ratna Deva (1175–90 A.D.)

1 Punch marked.

Presented by the C. P. Government.

1 Gajapati Pagoda.

Presented by the Bombay Government.

Silver.

MOGUL.

1 Akbar.

Presented by the Bombay Government.

1 Shah Jehan, Surat.

2 Aurangzeb, Surat, 23-1091 and 27-1095.

2 Shah Alam, Etawa and Surat.

2 Farukshyar, Shahajahanabad, Reg. 3, 4.

9 Mahammad Shah.

 3 Kora, Reg. 8, 3, 11.

9 Shahajahanabad, Reg. 4, 10-114 ×, 11, 12, 17, 22–1152.

2 Ahmed Shah, Benares, Katak, Reg. 4.

Presented by the C. P. Government.

Copper.

1 Malikambar.

Presented by the C. P. Government.

MOGUL.

1 Shah Jehan, Bairat.

1 Aurangzeb, Surat.

GUJARAT SULTANAT.

1 Muhammad Shah.

2 Ahmad III ?—964.

Treasure Trove Coins.

There were 4,067 coins with the Society at the end of last year, and 1,022 were received during 1922 ; the details of the latter are :—

Number of coins.	Metal.	From
7	Gold	Dharwar.
355	Silver	Kopargaon.
13	Silver	Taloda.
15	Gold	Nevasa.
500	Copper	Erandol.
8	Silver	Satara.
48	Gold	Bijapur.
76	Silver	
1,022		

Out of the total of 5,089 the following 3,495 were distributed or otherwise disposed of under the orders of Government, and 1,594 are still lying with the Society awaiting examination or distribution.

Institution.	Gold.	Silver.	Copper.
Prince of Wales Museum, Bombay	2	80	83
Indian Museum, Calcutta ..	0	1	0
Delhi ,, ...	0	9	10
Govt. ,, Madras ..	1	3	1

Provincial Museum, Lucknow.	0	1	2
Central ,, Lahore ..	2	0	0
Peshawar ,, ...	1	8	9
McMahon ,, Quetta ..	1	9	15
Rajputana ,, Ajmer ..	3	8	10
Phayre ,, Rangoon.	2	3	2
Dacca ,, ...	0	3	2
B. B. R. A. Society	1	1	5
British Museum, London ..	1	0	0
Fitzwilliam Museum, Cambridge	1	0	0
Durbar.			
Akalkot	0	1	0
Bhavnagar	1	1	2
Bansda	1	1	4
Baroda	1	0	0
Bhopal	1	1	1
Banganapalle	1	1	0
Cambay	1	1	3
Dholpur	1	0	0
Hyderabad	0	1	0
Indore	0	1	1
Idar	0	1	1
Jodhpur	1	0	0
Jaipur	1	0	0
Jind	1	0	0
Jhalwar	1	1	0
Jamkhandi	1	1	0
Kutch	0	1	0
Kolhapur	1	1	0
Kotah	1	1	0
Lunavada	1	1	2
Mysore	1	0	0
Mandi	1	0	0
Miraj J.	1	1	0
Pudukottai	1	0	0

Sirohi	0	1	0
Sitamau	1	1	1
Vala	1	1	2
Sent to the Mint	745	0	2,413
Total ..	781	145	2,569

The coins were examined for the Society by Mr. R. D. Banerji, M.A., Archæological Superintendent, Western Circle, Poona, and the Committee thanks him heartily for this assistance.

The Society had the honour of a visit from Dr. Sylvain Lévi, the great French Orientalist, during the year under report. Dr. Lévi was received by the Society at a General Meeting on 18th September when he was elected an Honorary Member of the Society. Dr. Lévi gave a short but interesting address on the Ancient Navigation of India on the occasion.

Appointment of new Trustees.

The Society having lost two of its old trustees, Sir Bhalchandra Krishna and Mr. H. R. H. Wilkinson—the first by death and the second by retirement from India—elected Mr. V. P. Vaidya, Bar.-at-Law, and Principal A. L. Covernton in their places.

Accounts.

A statement of accounts for 1922 is subjoined. The total amount of entrance fees was Rs. 1,905 and the amount of subscription received was Rs. 26,979 against Rs. 22,700 of the previous year, which is due to the increase in the subscription. Rs. 800 was received on account of Life-Membership from two Resident Members. The balance to the Society's credit in cash and at Bank on 31st December last was Rs. 2,354-7-4.

The Government Securities held by the Society including those of the Premchand Roychand Fund and of the Catalogue Fund are of the face value of Rs. 40,100.

There is no decline yet in the cost of books and periodicals. Our purchase of new books during the year under review totalled 1,236 against 1,123 in the previous year.

Government was pleased to sanction Rs. 3,000 for shelving in 1922 and in the Budget for 1923-24, now before the Bombay Legislative Council, a provision has been made for a further grant of Rs. 5,000. It is incumbent on the Society to meet part of the expenditure incurred on new shelving out of their funds, and if necessary the question of meeting the non-recurring charges from the Society's invested funds might be considered.

Expenditure.—The difference between the cost of foreign periodicals in 1922 and the relative budget figure for 1923 is due to our having changed our suppliers necessitating a payment in advance.

The whole question of salaries was carefully gone into by a Sub-Committee appointed by your General Committee and their recommendations were accepted. This resulted in the budget amount being exceeded by Rs. 949-8-6. Rs. 15,600 has to be budgetted for 1923.

The establishment of a Provident Fund for the staff is also under consideration.

In the Budget for 1923 is shown an item of Rs. 600 for Electric Charges ; this is due to there being some dispute with the suppliers, who have not submitted any bills for some time past.

In the General Charges is included the cost of the reception to Dr. Sylvain Lévi and preparations for the visit of H. E. the Governor of Bombay to the Society's rooms in December last, which unfortunately had to be postponed.

The special issue of the Society's Journal on "Indian and Foreign Chronology" was not ready before the close of the year, which accounts for the expenditure being less than that budgetted for under "Journal printing."

Dr. Modi proposed that the report be adopted.

Mr. Ezekiel seconded the proposal.

Carried unanimously.

Mr. V. P. Vaidya proposed and Dr. Daruvala seconded that the statement of accounts be accepted.

Mr. Rafiuddin Ahmad moved the following amendment : "provided copies of the annual report are circulated hereafter to Resident Members one week before the day of the Annual Meeting."

Mr. Nazar seconded the amendment.

Mr. Vaidya accepted the amendment, and the amended proposition being put to vote was carried.

On the motion of Mr. Kane, seconded by Dr. Daruvala, the budget estimates for 1923 were approved.

Mr. Aspinwall proposed that Sir N. G. Chandavarkar be requested to continue President of the Society.

Dr. Modi seconded the proposition. Carried unanimously.

On the motion of Mr. Ezekiel seconded by Dr. Daruvala, Dr. J. J. Modi, Sir Lallubhai Shah, Sir Norman Macleod and Mr. V. P. Vaidya were re-elected Vice-Presidents.

Mr. Vaidya moved and Mr. Nazar seconded that the following gentlemen be elected members of the Managing Committee for 1923 :—

Mr. J. E. Aspinwall,

Dr. D. A. DeMonte,

Prof. P. A. Wadia,

Prof. A. L. Covernton,

Mr. K. Natarajan,

Dr. P. N. Daruvala,

Mr. P. V. Kane,

Rev. Fr. R. Zimmermann,

Mr. E. M. Ezekiel,

Prof. Shaik Abdul Kadir,

Mr. J. S. Sanzgiri,

Mr. Faiz B. Tyabji,

Mr. S. V. Bhandarkar,

Mr. P. V. Mowji,

Mr. Ch. Mohammad Ismail,

Mr. B. K. Wagle,

Mr. M. P. Khareghat,

Dr. V. S. Sukhthankar,

Mr. M. D. Altekar,

Mr. Rafiuddin Ahmad,

Mr. G. V. Acharya,

Mr. N. B. Divatia,

Dr. C. J. Fox

and

Rao Bahadur P. B. Joshi.

Carried unanimously.

Mr. Vaidya proposed that Dr. E. A. Parker be re-elected Hon. Secretary, and Mr. L. W. H. Young, Hon. Financial Secretary of the Society.

The proposal being seconded by Dr. Daruvala was carried unanimously.

On the motion of Mr. Ezekiel, seconded by Mr. Acharya, Mr. K. MacIver and Mr. A. B. Agaskar were re-elected Hon. Auditors for 1923.

Mr. Vaidya, in proposing a vote of thanks to the outgoing Managing Committee, moved that the Society puts on record the valuable services rendered particularly by two members of that Committee, viz., the Rev. Mr. R. M. Gray and Mr. H. R. H. Wilkinson, whose departure for Europe entails upon the Society a great loss and who have given the Society useful assistance, the former by serving as its Honorary Secretary for several years and the latter as a member of the Managing Committee, and as a Trustee of the Society, and both taking keen interest in promoting the fortunes of the Society.

Mr. Aspinwall proposed a cordial vote of thanks to the auditors, Mr. K. MacIver and Mr. A. B. Agaskar, for their valuable services in auditing the accounts of the Society.

The proposal being seconded by Mr. Vaidya was carried unanimously.

Mr. Vaidya then proposed and Dr. Daruvala seconded that—

Shams-ul-Ulma Dr. Jivanji Jamshedji Modi, B.A., Ph.D., C.I.E., be elected representative of the Bombay Branch Royal Asiatic Society on the Board of Trustees of the Prince of Wales Museum of Western India.

Carried unanimously.

L. W. H. YOUNG,

Ag. Hon. Secretary.

The Bombay Branch

Statement of Receipts and Disbursements

	Rs. a. p.	Rs. a. p.
Balance 31st December 1921—		
Amount in the Savings Bank Account	339 10 11	
,, in the Current Account ..	1,112 8 1	
,, in hand	68 5 7	
,, advanced to the Campbell Memorial Fund	267 4 0	
,, War Bonds	7,000 0 0	
		8,787 12 7
Entrance Fee	1,905 0 0	
Subscription of Resident Members ..	22,999 0 0	
,, of Non-Resident Members.	3,980 0 0	
Government Contribution	4,200 0 0	
Sale proceeds of Journal Numbers ..	239 14 3	
,, of Annual Catalogue ..	31 1 7	
,, of waste paper	42 10 0	
Interest on Government Securities ..	1,631 6 6	
		35,029 0 4
Govt. Grant for Shelving	3,000 0 0	
Subscription of Resident Life-Members.	800 0 0	
Catalogue Fund (Sale of new catalogue copies)	740 3 3	
Replacement	69 5 10	
		4,609 9 1
		48,426 6 0

We have examined the account books and vouchers, and have obtained satisfactory information and explanation on all points desired. In our opinion, the accounts as drawn up, show the true and correct state of the affairs of the Society.

KENNETH MACIVER,
A. B. AGASKAR,
Hon. Auditors.

Royal Asiatic Society.

from 1st January to 31st December 1922.

	Rs.	a.	p.	Rs.	a.	p.
Books	8,904	6	5			
Subscription to Indian Newspapers, etc.	630	11	0			
,, to Foreign ,, ...	4,314	2	4			
Binding and Repairs	1,572	12	0			
Printing Charges	1,381	4	0			
,, Journal Number	1,339	8	0			
Office Establishment	13,549	8	6			
Annual Library Checking	750	0	0			
General Charges	1,468	13	6			
Stationery	733	14	0			
Postage	411	4	0			
Furniture and Shelving	2,082	3	0			
Insurance	523	12	0			
Electric Charges	127	9	11			
				37,789	12	8
Gratuity	365	0	0			
Govt. Securities	2,922	8	0			
Folklore Notes	283	8	0			
Mss. Catalogue	750	0	0			
General Catalogue	3,961	2	0			
				8,282	2	0
Balance—						
Amt. in the Current Account	136	9	8			
,, Savings Bank	2,022	14	1			
,, in hand	194	15	7			
				2,354	7	4
				48,426	6	0

Invested Funds of the Society.

		Rs.	a.	p.	Rs.	a.	p.
Government Securities ..	@ 6½ p.c.	1,100	0	0			
Do. do. ..	,, 5 p.c.	7,800	0	0			
Do. do. ..	,, 3½ p.c.	25,700	0	0			
Premchand Roychand Fund.	,, 3½ p.c.	3,000	0	0			
Catalogue Fund	,, 5 p.c.	2,500	0	0			
					40,100	0	0

The Society's property and collections have been insured for three Lakhs of rupees.

L. W. H. YOUNG,
Ag. Honorary Secretary.

The Bombay Branch

Budget Esti-

INCOME.	Budget 1922.			Actuals 1922.			Budget 1923.		
	Rs.	a.	p.	Rs.	a.	p.	Rs.	a.	p.
Balance	8,787	12	7	8,787	12	7	2,354	7	4
Entrance Fees	1,750	0	0	1,905	0	0	2,200	0	0
Subn. Resident Members ..	19,000	0	0	22,999	0	0	24,500	0	0
Do. N. R. Members.. ..	3,700	0	0	3,980	0	0	4,500	0	0
Govt. Contribution	4,200	0	0	4,200	0	0	4,200	0	0
Sale of Journal Nos.				239	14	3			
,, of Annual Catalogue ..	550	0	0	31	1	7	300	0	0
,, of Waste papers				42	10	0			
Interest	1,800	0	0	1,631	6	6	1,750	0	0
Subn. Resident Life-Members.	....			800	0	0	....		
Catalogue Fund	....			740	3	3	....		
Replacement	....			69	5	10	....		
Govt. Grant for Shelving ..	....			3,000	0	0	....		
Deficit	4,217	8	5	....			....		
	44,005	5	0	48,426	6	0	39,804	7	4

Royal Asiatic Society.

mates for 1923.

EXPENDITURE.	Budget 1922. Rs.	a.	p.	Actuals 1922. Rs.	a.	p.	Budget 1923. Rs.	a.	p.
Books	8,500	0	0	8,904	6	5	7,500	0	0
Subn. Periodicals. Foreign ..	4,000	0	0	4,314	2	4	2,800	0	0
,, ,, Indian ..	850	0	0	630	11	0	700	0	0
Printing	1,800	0	0	1,381	4	0	1,250	0	0
Binding	1,500	0	0	1,572	12	0	1,750	0	0
Office Establishment	12,600	0	0	13,549	8	6	15,600	0	0
Library Furniture and Shelving.	1,500	0	0	2,082	3	0	2,000	0	0
General Charges	1,000	0	0	1,468	13	6	1,000	0	0
Stationery	1,000	0	0	733	14	0	750	0	0
Postage	400	0	0	411	4	0	500	0	0
Insurance	468	12	0	523	12	0	523	12	0
Electric Charges	300	0	0	127	9	11	600	0	0
Gratuity	65	0	0	365	0	0	....		
Folklore Notes	821	9	0	283	8	0	538	0	0
Preparation of the Mss. Catalogue.	1,700	0	0	750	0	0	950	0	0
Printing Mss. Catalogue ..	....			....			750	0	0
Journal Printing..	2,500			1,339	8	0	2,500	0	0
Annual Library Checking ..	....			750	0	0	....		
General Catalogue	5,000			3,961	2	0	....		
G. P. Notes	....			2,922	8	0	....		
	44,005	5	0	46,071	14	8	39,711	12	0
Balance ..	....			2,354	7	4	92	11	4
	44,005	5	0	48,426	6	0	39,804	7	4

A meeting of the Society was held on Friday, the 20th April 1923, at 6 p.m.

In the absence of the President, Dr. Jivanji Jamshedji Modi occupied the Chair.

Present :—Messrs. T. S. Shejwalkar, G. V. Acharya, Kubalaya Raj, G. V. Padgaonkar, D. Levi, Prof. N. B. Divatia, and Dr. P. N. Daruvala.

The minutes of the last meeting were read and confirmed.

Dr. Modi read his paper on ' A visit to the great wall of China : A similar wall of King Noshirwan of Persia.'

Prof. N. B. Divatia proposed a hearty vote of thanks to Dr. Modi for his very interesting paper.

Dr. P. N. Daruvala seconded the proposition which was carried unanimously and the proceedings terminated.

A meeting of the Society was held on Friday, the 15th June 1923.

Present :—Messrs. V. P. Vaidya, K. G. Pradhan, Kubalaya Raj, G. V. Acharya, Ch. M. Ismail, S. S. Mehta, and M. G. Damania.

Mr. V. P. Vaidya, one of the Vice-Presidents of the Society, occupied the Chair.

The minutes of the last meeting were read and confirmed.

Mr. S. S. Mehta then read his paper on " Sakambhari (Sambhar) mentionea in Durga Saptasati."

The Chairman made a few remarks on the subject matter of the paper, and proposed a hearty vote of thanks to Mr. Mehta for his interesting paper.

The meeting was then brought to a close.

Titles of Books. *Donors.*

ADMINISTRATION of Civil and Criminal Justice in the Bombay Presidency, Report, 1921.
Government of Bombay.

——— of the Excise Department in the Bombay Presidency, Report, 1921-22.
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——— of Jails in the Punjab, Report, 1921.
Government of the Punjab.

——— of the Registration Department in the Bombay Presidency, Report, 1921.
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ADMINISTRATION REPORT, Ajmer-Merwara, 1920-21.
The Chief Commissioner.

——— Baluchistan Agency, 1920-21.
Government of India.

——— Bengal, 1919-20.
Government of Bengal.

——— Bihar and Orissa, 1920-21.
Government of Bihar and Orissa.

——— Bombay Presidency, 1920-21.
Government of Bombay.

——— Bombay Port Trust, 1921-22.
The Trustees.

——— Burma, 1919-20.
Government of Burma.

——— Madras Presidency, 1920-21.
Government of Madras.

——— Meteorological Department, Government of India, 1921-22.
Government of India.

——— of the Bombay City Improvement Trust, 1920-21.
The Trustees.

——— of the Municipal Commissioner for the City of Bombay, 1920-21.
The Commissioner.

——— of the N. W. F. Province, 1920-21.
Government of the N. W. F. Province.

——— Punjab and its Dependencies 1920-21.
Government of the Punjab.

Titles of Books.	*Donors.*
ADMINISTRATION REPORT, U. P. of Agra and Oudh, 1920-21.	Government of the U. P.
AGRA District Gazetteer.	Government of India.
AGRICULTURAL Journal of India, Vol. 16, 1921.	Government of India.
————Operations in India, Review of, 1920-21.	Government of India.
————Statistics of British India, 1920-21.	Government of India.
————Statistics of India, 1919-20. Vols. I & II.	Government of India.
ARCHÆOLOGICAL Department, Kashmir, Report, 1919-20.	The Kashmir Durbar.
————Department, Mysore, Annual Report, 1921 & 1922.	Government of Mysore.
————Department of the Nizam's Dominions, Report, 1919-20.	The Nizam's Government.
————Survey of Ceylon, Annual Report, 1920-21.	Government of Ceylon.
————Survey of India, Central Circle, Report, 1920-21.	Government of Bihar and Orissa.
————Survey of India, Report, 1919-20.	Government of India.
————Survey of India, Western Circle, Report, 1919-20.	Government of Bombay.
AREA and Yield of principal crops in India, estimates, 1920-21.	Government of India.
ASAF-UL-LUGHAT. By Aziz Jung Bahadur. Vol. XVI.	Government of India.
BIBLIOGRAPHY of religion (Mainly Avestan and Vedic). By J. E. Saklatvala.	The Author.
BIHAR and Orissa in 1921.	Government of Bihar and Orissa.
BOARD of Scientific Advice for India, Report, 1920-21.	Government of India.

Titles of Books. *Donors.*

BOMBAY Bacteriological Laboratory, Report, 1920.
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————Chamber of Commerce, Report, 1920, 2 vols.
The Chamber.

————Government Gazette, January to June 1921. Parts I to X and supplement.
Government of Bombay.

————Millowners' Association, Report, 1920 and 1921.
The Association.

————University Calendar, 1921-22 and 1922-23 (in one book)
The Registrar.

BOOK of the Seventh Royal Inniskilling Fusiliers. By G. A. Cooper-Walker.
The Author.

BOTANICAL Survey of India, Report, 1920-21.
Government of India.

BRITISH Museum, subject index, 1916-20.
The Trustees.

BUDGET of the Government of Bombay, 1922-23.
Government of Bombay.

CALCUTTA, old and new. By H. E. A. Cotton.
J. A. Stevens, Esq.

CAPITALS of Hindu-Mahomedan India: Agra and Delhi. By F. M. Pavri.
J. K. D. Dubash, Esq.

CATALOGUE of the exhibits in the economic products section. By S. N. C. Ayyar.
Government of Madras.

————of Greek coins of Arabia, Mesopotamia and Persia. By G. F. H.
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CENSUS of India, 1921.—Baroda. Part I.
Government of Bombay.

————of India, 1921.—Baroda, Parts II and III.
The Baroda Durbar.

————of India, 1921.—Bombay Presidency, 2 parts.
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———of India, 1921—Mysore, Part II.
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———Examiner to the Punjab Government, Report, 1921.
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——of Haidar Ali and Tipu Sultan. By J. R. Henderson.
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COMPLETE Works of Shakespeare. 10 vols.
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COOPERATION in Germany and Italy. By M. L. Darling.
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Rev. R. M. Gray.

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DAVID Sassoon Industrial and Reformatory Institution, Report on the working, 1921-22.
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DEPARTMENT of Agriculture, Bombay Presidency, Report, 1920-21.
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————of Agriculture, Punjab, Report on the operations, 1920-21. 2 parts.
Government of the Punjab.

————of Industries, Bombay Presidency, Report, 1920-21 and 1921-22.
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The Upsala University.

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DVYASRAYAKAVYA of Hemchandra. Ed. by A. V. Kathavate. Part II.
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EXTERNAL Land Trade of Sind and British Baluchistan, Report, 1921-22. Government of Bombay.

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FINAL report of the Second Revised Settlement, 1915-20, of the Ambala District. Government of the Punjab.

FIRST Book of Sanskrit. By Sir R. G. Bhandarkar.
J. P. Brander, I. C. S.

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GRAMMAR of the Chhattisgarhi dialect of Hindi. By Hira Lal Kavyopadhyaya.
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Mrs. R. M. Gray.

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V. B. KETKAR.

INDIAN AND FOREIGN CHRONOLOGY

WITH

THEORY, PRACTICE AND TABLES,

B.C. **3102** TO **2100** A.D.

AND

NOTICES OF THE VEDIC, THE ANCIENT INDIAN, THE CHINESE, THE JEWISH, THE ECCLESIASTICAL AND THE COPTIC CALENDARS

BY

VENKATESH BAPUJI KETKAR,

Author of the Sanskrit and Marathi Astronomical Treatises, Jyotirganitam, Ketaki, and Vaijayanti and Grahaganita, Nakshatra-Vijnâna and Goladvaya-Vimarsha or Problem of two bodies.

1923

Bombay:

PRINTED AT THE BRITISH INDIA PRESS

To

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Society of London, and of German,
Italian, and American
Oriental Societies,
&c., &c., &c.

THIS BOOK

undertaken and carried out under his

kind encouragement and advice

is

by permission

Respectfully Dedicated

Printed by B. Miller, Superintendent, British India Press,
and published by Mr. V. B. Ketkar, for the Bombay Branch,
Royal Asiatic Society.

PREFACE

Chronology is closely connected with history and archæology. The great importance of archæological research has been acknowledged by most of the advanced nations. The Indian Government has created a special department of Archæology for the discovery and preservation of the ancient relics of Indian arts and architecture. From the ruins of ancient cities now lying buried under ground, old inscriptions, tablets, coins, copper-plates, vases, monuments, etc., are being unearthed every year, and the work of comparing and verifying their dates so as to fix their chronological place, has vastly increased.

Books on Indian Chronology written and published under Government patronage, by scholars like Messrs. Warren, Sewell, and Pillai are at present available. But it may be said of them without disparagement, that they are much above the reach and comprehension of the class of average students. An elementary book written on the lines of Science Primers, explaining with clearness, the first principles of chronology and gradually leading the reader to a thorough understanding of the mathematical and astronomical theory of chronology is, we believe, a desideratum ; and the present book is written with the object of removing it.

The first three chapters are devoted to the explanation of Eras, the natural units of time and the importance of personal observation of stars and of the movements of the Sun and Moon among them. Chapter IV is intended to illustrate and fix the ideas about the five chief parts of the Hindu Panchânga. Chapter V explains the cause and the effects of the variable motions of the Sun and Moon on their ending times. Chapter VI proves conclusively the astonishing identity of the ancient and modern inequalities of the Sun and Moon. Chapters VII and VIII contain the definitions of the technical terms and the theory of the Adhika and Kshaya months.

The calculation of the Luni-Solar Calendar begins with Chapter IX. The next four chapters treat of the calculation of the Solar, Musalman, and Christian Calendars and of the Samvats of Northern India. Chapter XIV contains brief sketches of the Vedic, the Chinese, the Jewish and Ecclesiastical Calendars. Chapter XV and XVI treat of the Lunar and Solar Eclipses and of the various kinds of Time. Chapter XVII is intended for advanced readers and contains miscellaneous notes relating to theory, comment, and antiquarian research. The last Chapter XVIII is devoted to Bibliography and is followed by tables and a full Index.

It now remains to thank friends and well-wishers for their advice and help. My most hearty thanks are due to Prof. R. Zimmermann of St. Xavier's College, Bombay; and to Mr. P. V. Kane, M.A., High Court Pleader, Bombay, for valuable suggestions which have considerably added to the utility of this book; and also to Mr. D. V. Apte, B.A., of Hangandi. for information regarding the intricate system of Chronology adopted in the official correspondence during the Maratha Period.

It is impossible for me to express fully my thankfulness to the Bombay Branch of the Royal Asiatic Society which has, no doubt, done important service to Archæology by undertaking to print and publish this book of mine, the like of which has, so far as I know, never before appeared in print in this Presidency.

BELGAUM,
11*th October* 1921

V. B. KETKAR,
Author.

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INDIAN AND FOREIGN CHRONOLOGY

LUNI-SOLAR, SOLAR AND LUNAR

(B. C. 3102 to A. D. 2100.)

CHAPTER I

INTRODUCTORY

THE ERAS : TABLE 1

CHRONOLOGY is the science of ascertaining the exact moment of the time in days, months and years of a particular Era, when any past event actually took place. It is, therefore, closely connected with History and Astronomy. Time may be compared to an imaginary straight line, or to a high way, of which we can see neither the beginning nor the end. It is, therefore, absolutely necessary to agree upon an initial moment or *Epoch* as it is called, to measure time from. The time so measured has reference to the particular Era which begins at that Epoch. The Era is supposed to extend both in the past and the future without limit. Chronology treats, therefore, of the different Eras started by different nations at different Epochs. It furnishes the means with which one can fix or verify the dates of events mentioned in historical records, with reference to particular Eras ; and can establish concordance among them.

2. Table 1 gives the details of about 25 *Eras*. But all of them are not in use at present. Most of them have shared the fate of the nations that started them. Those Eras alone, that have been thought fit to serve as basis of Astronomical, Civil, and Ecclesiastical calculations, have survived. The Eras used at present in India, in civil, and religious transactions are : (i) The Kali Yuga or the Yudhisthira Era, (ii) The Vikrama Era, (iii) The Shaka Era, and (iv) the Christian Era. This last Era, which is the era of the present rulers of India, and which is used throughout the civilized world, has been chosen in Table 1 and elsewhere to serve as a thread of a string of beads, connecting all the other Eras.

3. The *years* are the chief constituents of the Eras. But they differ from each other in respect of their sub-divisions, or months. This difference introduces into Chronology the three systems of Calendars called the Luni-solar, the Solar, and the Lunar. The Shaka, the Christian and the Mahomedan Eras follow respectively the above three systems.

4. The years differ in other respects also, such as the mode of enumeration, their length and beginning. In some Eras, the years denote the number of years completed or elapsed as in the Shaka and Kali-yuga Eras. In others, as in the A.D. or Christian Era, they denote the *current* year. Again the years of the same system of Calendar begin with different months in different parts of India. The reader will do well to understand thoroughly the several details about each of the Eras given in Table 1, and also to bear in mind their points of agreement and difference.

5. Mutual conversion of the years of different Eras.—By conversion is here meant the calculation of years of different Eras, which begin in the same year of the Christian Era.

There are three chief scales of numbering the years in Chronology. They are—

(1) The Mathematical scale of expired years—

$$\ldots, -4, -3, -2, -1, E+0, +1, +2, +3, \ldots$$

(2) The Mathematical scale of current years—

$$\ldots, -3, -2, -1, -0, E+1, +2, +3, +4, \ldots$$

(3) The Historical scale of mixed years—

$$\text{B.C.} -4, -3, -2, -1, E+1, +2, +3, +4 \text{ A.D.}$$

The letter E indicates the year with which any Era adopting the scale, begins. In column 2 of Table 1, is noted the scale which each Era follows :—Scales (1) and (2) are homogeneous but in Scale (3) the B.C. years are expired and A.D. years are current.

On comparing the Scales (1) and (3) with (2) it is seen that—

(a) The expired years can be changed into current ones by simply adding to the former + 1 and for the converse by adding — 1.

(b) The historical years are changed into current ones of scale (2) by adding + 1 to the B.C. years only, leaving the A. D. years untouched and for the converse by adding — 1 to the minus years of Scale (2).

The formula for the mutual conversion of years of different Eras is—

$$A + B - C = X.$$

Where A is the given year of a given Era. B is the Christian year in which the given Era begins, as shown in col. 2 of Table 1. C is the Christian year in which the required Era begins (col. 2, Table 1). Then X will be the current year of the required Era.

Before solving for X, the given years A and the beginning years B and C must be changed into current years of Scale (2) by means of the above Rules (a) and (b). And after solution the current year X should be reduced, if necessary, to its original Scale of expired years by adding — 1.

Examples.—Required (1) the Kali-yuga, (2) the Shaka, (3) the Jewish, and (4) the Julian period years corresponding to 1920 A.D.; (5) the Kali-yuga year corresponding to 45 B. C.; (6) the Shaka and (7) Newar years corresponding to Kaliyuga 5000; and (8) the Christian year corresponding to Kaliyuga 3000.

	A.	*B. —C.*	*X.*				
(1)	1920 +	1 + 3101 =	5022	cur. or	5021	exp.	Kali.
(2)	1920 +	1 — 78 =	1843	do.	1842	do.	Shaka.
(3)	1920 +	1 + 3760 =	5681	do.	Jewish		Era.
(4)	1920 +	1 + 4712 =	6633	do.	Julian		Period.
(5)	— 44 +	1 + 3101 =	3058	do.	3057	do.	Kali.
(6)	5001 —	3101 — 78 =	1822	do.	1821	do.	Shaka.
(7)	5001 —	3101 — 879 =	1021	do.	1020	do.	Newar.
(8)	3001 —	3101 — 1 =	—101	do.	102	do.	B. C.

Table 38 presents the view of the mighty river Time whose tributaries, the Eras, flow together without mixing and sweep before them all mortal things.

CHAPTER II

ON THE NATURAL UNITS OF TIME AND THEIR USE

6. It appears that men derived their first ideas of time from observation of the most vivid and striking natural phenomena; and that the interval between any two consecutive phenomena gave them the idea about the units of time. Sunrise is the most striking of all the natural phenomena and consequently, the interval between two consecutive sunrises, came to be considered as the most important unit of time This, the smallest of the natural units, is called *Day*. It is noteworthy that it also coincides with the cycle of bodily functions of animals, such as work, sleep, digestion, etc.

7. The next phenomenon that struck men in their nomadic life, must have been the *Lunar phases*. They could easily watch from their huts, the varying phases, waxing from being a slender crescent, till the Moon appeared round and full, and then waning till she was reduced to a faint crescent, and finally lost sight of in the rays of the Sun, to appear again as a crescent on the Western horizon. This natural unit of time is called *Lunar month.* It consists of about 29½ days and its duration is long enough to suit the ordinary business of human life.

8. When hunting was found inadequate as a means of livelihood, men must have been forced to betake themselves to agriculture. This change naturally drew their attention to the phenomena of *Seasons*. They observed that the Sun rose on the Eastern horizon, at a particular point, at the commencement or about the beginning of a particular season. After a long and patient course of observation, they might have perceived, that the cycle of the seasons, exactly coincided with the cycle of the Solstices. This was a great discovery in that primitive state of humanity. The cycle of seasons or the *year*, which consists of about 365 days, was the longest of the three natural units of time. The course of sacrifices, which was kept up by the Rishis and priests, throughout the year, seems to have been originally intended as a means of ascertaining the advance of seasons, so essential to agriculture. The Vedic hymns very aptly say that the seasons dwell in the year.

9. The knowledge of Astronomy among all the ancient nations of the world, such as the inhabitants of Egypt, Assyria, India and China, seems to be limited to the ascertaining of the lengths of these three natural units. The Vedic Calendar as we know it at present, from the Vedânga Jyotisha, is based on these three units only. The Eras were then unknown, or if they existed at all, they were the regnal eras, *i.e.*, they began and ended with the reigns of each king. In the Hindu Purânas, Chronology is often based on the lists of kings, but very rarely on the lengths of their reigns.

CHAPTER III

OBSERVATION OF THE MOVEMENTS OF THE SUN AND THE MOON AMONG THE STARS

10. Importance of Personal Observations.—To solve mechanically, the problems of Chronology by means of rules and tables, without understanding their theory, does not, in our opinion, afford real pleasure. We therefore inteno to render help in this direction, to any student, if he is only willing to bestir himself a little to acquire knowledge by personal efforts and experience. For this purpose, he should first select a place, from which he can see the whole of the circular horizon, unhindered by buildings, trees or hills, and commence his observations at dusk. He will then see that the stars are slowly and continually moving from east to west; that new stars are rising in the east and the old ones are setting in the west during the whole night. If he continues these observations for a few days, he will be convinced of the diurnal motion of the stars, the Moon, ana the planets. But in the case of the Moon, he will notice this peculiarity, that in addition to her motion westwards along with the stars, she also moves eastward slowly among them. If he observes her positions relatively to stars, for a month, he will find that she has made one complete revolution in about 27⅓ days and has returned to the star, from which she had set out. The Stars Regulus (Maghâ), Spica (Chitrâ) or Antares (Jyesthâ) may conveniently be used as starting points in making this experiment (Fig. 1).

11. The Sun also moves like the Moon among the stars from west to east, and completes one revolution in about 365¼ days. But as the Sun and the stars cannot be seen side by side like the Moon, owing to his overpowering lustre, it is not easy to determine the exact period of his revolution among the stars without the aid of instruments. A rough estimate of it can be obtained by observing the mean duration of the *heliacal* risings and settings, of one of the bright stars like Canopus or Agastya which phenomena are given in a Panchânga every year.

12. The Sun's motion can only be inferred. The Moon appears to rise or set on the horizon of a place almost diametrically opposite to the Sun, on the Full Moon day. This cannot happen unless both the luminaries travel nearly along the same route over the sky. The route is called the *Zodiac* and the great circle which runs along the middle of it is called the *Ecliptic,* or the place where the eclipses happen. The observer's work will be much facilitated if he makes use of a star-atlas* in his observations.

13. The Earth considered as Motionless.—The ancient astronomers, with the exception of the Indian Astronomer Arya-bhatta, believed that the Earth remained fixed† in the centre of the Universe and that the Moon and the Sun revolved round her in 27⅓ and 365¼ days respectively. This belief continued to prevail till about the year 1500 A.D., when *Copernicus* declared that the Earth rotated round its axis and at the same time re volved round the Sun, with the Moon revolving round her. We shall

* The author's Marathi Nakshatra-Vijnâna contains 5 celestial maps and much useful information about the stars.

† Compare the words, Latin 'terra' and Sanskrit 'Sthira' meaning the Earth, the 'terra firma.'

however stick to the old belief, in explaining the ideas about the tithis, and nakshatras, as the appearances from the earth's surface easily lead to it. Their explanation we shall attempt in the next chapter.

14. The reader will have noticed that the chief drawback in the natural units of time is their *incommensurability* with each other (see Table 37, Days and Months). Not one of them is an exact multiple or a sub-multiple of any other. Men were therefore required to keep the account of time in these three units separately. The annual register, in which this account is kept, is called a *Calendar* or a *Panchânga.* The *Calendars* are called Lunar, Solar, and Luni-Solar, according to the importance given to one or the other or both of these units.

15. The Zodiacal section of the starry vault (Fig. 1) over the head of a person on the equator may be considered as the dial of a vast clock, over which the Sun and Moon revolve like the hour and minute hands. In the *Lunar Calendar,* the time is measured by the number of conjunctions of the Sun and the Moon hands on this dial, and 12 of these conjunctions, or *lunations* as they are called, are supposed to make one year. In the *Solar Calendar,* the existence of the Moon-hand is wholly ignored, and the years are reckoned by the number of revolutions of the Sun-hand alone, with reference to a fixed point or a star such as the Star Spica. The year is sub-divided into 12 months, each containing a certain number of days fixed arbitrarily or upon some principle.

16. The *Luni-Solar* Calendar is a complex thing and is rather difficult to comprehend. In it the months are unar, and the years are solar. The inconvenience caused by the incommensurability is remedied, however, by means of the intercalary months, which are peculiar to the Luni-Solar Calendar. The *tithis* mark the position of the Moon in relation to that of the Sun ; while the *nakshatras* denote her position in relation to a fixed starting-point. The Yogas are simply the sum of the distances of the Sun and the Moon from the starting-point, and as such they do not indicate any natural phenomenon.

CHAPTER IV

THE SKY-DIAL AND THE CLOCK-DIAL COMPARED

(Figure 1)

17. In the preceding chapters we have described how the Sun and the Moon appear to revolve continually along the same path among the stars, and how the periods of their revolutions were utilized by the ancient people to measure their time, which is the chief object of Chronology.

But with our eye, placed on the surface of the earth, it is impossible to see the whole of their path at one view, and consequently the description fails to be as clear and impressive as it ought to be. We shall, therefore, change our stand-point and describe their motions as they would appear to us from a most distant point perpendicular to the plane of their orbits.

18. View from an Imaginary Stand-point.—When seen from the surface of the Earth, only half the Ecliptic is visible above the horizon at any instant ; and the other half is hidden under it. In order to bring the whole of the Sun's orbit in our view, we must recede far away from the Earth, and place ourselves in empty space. We know, from daily experience, that objects begin to look smaller as we recede from them. We may, therefore, imagine to have travelled millions and millions of miles towards the *southern side* of the Ecliptic to a place whence the entire orbit of the Sun may look as small as the dial of a clock, and the Earth a mere point at its centre. We may also imagine, for the sake of analogy, that the Sun and the Moon revolve in the same circle with their own angular motions, and that they are connected with the common centre *E* of their orbits with bars, so as to present, in accordance with the Siddhantic or Ptolemaic system, the appearance of the hour and minute hands respectively. As we now no longer partake of the Earth's diurnal rotatory motion, we may imagine that we see the Sun's orbit, *i.e.*, the ecliptic, with the stars set on its rim, quite at rest, as shown in Fig. 1 and the Earth's southern hemisphere rotating clock-wise in 24 hours. Although a point, the Earth is here magnified so as to show Africa, Australia and South America, India being out of view.

19. View of the Ecliptic superposed by a Clock Dial.—Next suppose that the Ecliptic is superposed by a clock dial, so that the 12 o'clock point coincides with the zero starting point of Ashvini, and the 6 o'clock point coincides with the brilliant Star Spica when seen from E, the Earth's centre. In this position the hour divisions of the dial will coincide with the 12 equal divisions or Râshis of the Ecliptic, and each minute-space on the dial will contain six degrees of longitude on the Ecliptic. Consider another circle, concentric with the dial, to be drawn outside the dial, and to be divided into 27 equal parts from the same zero starting point of Ashvini, representing the 27 nakshatra-spaces. Also imagine that a smaller moveable card-board circle *ABC* has its diameter *KEA* firmly attached to the Sun-hand *EAS* by two clamps, so that it is always carried by the Sun-hand along with it like the ***alarm wheel*** in a clock. Suppose the circumference of this smaller moveable circle to be divided into 30 equal parts, representing the tithis, beginning from the point *A*.

20. Illustration.—Figure 1 will present a lucid and impressive picture of the daily movements of the Sun and the Moon in the sky, affording correct and vivid ideas of the tithi, the nakshatra, and the yôga, as understood in a Luni-Solar Calendar. From analogy we shall now call the hour and minute hands (*ES*, *EM*) on the dial, the Sun and Moon hands respectively. Now, suppose that the Sun and the Moon hands occupy in the sky the positions of the hour and minute hands respectively, when the time by the clock is 36 minutes past four o'clock. In this position the ***Sun-hand*** will be at the 23rd minute-space, and consequently its longitude from the origin *O* of Ashvini will be equal to $23 \times 6^\circ = 138$ degrees on the dial. The Sun-hand shall have also brought with it the ending point *A* of the 30th tithi or Amâvâsya, pointing to 138° degrees. Similarly, the ***Moon hand*** being at the end of the 36th minute-space, its longitude from the origin *O* will be $36 \times 6 = 216$ degrees, which are marked along the edge of the Zodiac.

21. The Tithi.—The angular distance *SEM* of the Moon from the Sun is called the *Elongation*, of which 12 degrees make one tithi. In the present instance 216° — 138° = 78° is the Elongation. This divided by 12 gives the number of *tithis* elapsed to be $6\frac{1}{2}$. Also the Moon-hand *EM* supports this calculation by crossing the tithi-circle exactly in the middle of the 7th tithi.

22. The Nakshatra.—The longitude of the Moon is 216°. This divided by $13\frac{1}{3}$° (the length of a Nakshatra-space) gives 16·2 as quotient. This means that the Moon-hand has travelled over 16 nakshatras and has finished a fifth part of the 17th nakshatra, which is called *Anurâdhâ*. (See Appendix.) The Moon appears to occupy this very position on the circumference of the outer circle in Fig. 1. The nakshatra occupied by the Sun is, for distinction, called the Mahânakshatra.

23. The Yoga.—The nakshatra of the Sun-hand is here similarly found out by dividing the Sun's longitude 138° by $13\frac{1}{3}$. The quotient is 10·35, which indicates that the Sun is moving in the 11th nakshatra called *Pûrvâ-Phalguni*. This is borne out by its position in Fig. 1 where it will be seen to have crossed a third of the 11th nakshatra. The sum of the nakshatras of the Moon and the Sun is called a *Yoga*, which literally means a 'Sum.' It is merely a numerical expression, and does not indicate any phenomenon. In this instance the Yôga is 16·20 + 10·35 = 26·55, *i.e.*, the 27th Yoga *Vaidhriti* is current.

24. The Mahapata.—When the sum of the tropical longitudes of the Sun and the Moon (*i.e.*, longitudes measured from the Vernal Equinox) amount to 180° or 360°, there is the possibility of the most dreaded and inauspicious time called *mahâpâta*, which is to be shunned by pious Hindus in religious ceremonies. In the former case it is called *Vyatipâta*, and in the latter case *Vaidhriti*. In the Vyatipâta, the two luminaries, when possible, attain equal declinations on the *same* side of the celestial equator, while in the Vaidhriti, they possibly do the same, but on the *opposite* sides of it.

Note.—The problem of finding the exact moment when the centres of the luminaries attain the same declination, was considered in ancient times, when spherical trigonometry was unknown as the most crucial test of an Astronomer's proficiency.

25. Karanas.—The halves of tithis are called *karaṇas*, so that there are 60 karaṇas, in a lunar month. They resemble the half-hourly strokes in a clock.

26. The Solar and the Luni-Solar months and dates.—The suṅ-hand in its annual course beginning with the zero point of Ashvini marks the Solar month and date on the dial. In Figure 1 it is in the sign Sinha and has finished three-fifths of it. The Solar date is, therefore, approximately the $\frac{30\times3}{5}$ = 18th of *Siṅha* or *Chingam* of Malâbâr (Table 15).

As the Moon-hand *EM* walks 13 times faster it overtakes the Sun-hand in each of her monthly revolutions. The instant, when the two hands are seen one over the other, is the ending moment of Amâvâsyâ (Sanskrita :— Amâ = together and Vasa = to dwell), or conjunction. It is also the last moment of the preceding Lunar-month and the beginning of the next. In the present case (Fig. 1) the Moon-hand indicates the 7th tithi, and the Sun-hand the 18th solar date. So twelve days after, the Sun-hand will enter the sign of Kanyâ, and the Kanyâ-Sankrânti will therefore occur on the 7 + 12 = 19th tithi or Vadi-chaturthi. Hence the current lunar month is *Bhâdrapada* (*vide* secs. 66 and 70) and the tithi is *Shukla-Saptami*.

The Pakshas.—After the Amâvâsyâ or conjunction, the phases of the Moon go on increasing till she comes to *K*, which point is moving with the Sun diametrically opposite to it. There she appears full and round, and the aspect is called Pûrnimâ or Full Moon. The period from Amâvâsyâ to Pûrnimâ is called *Shukla-paksha* or bright fortnight and that from Pûrnimâ to Amâvâsyâ is called *Krishna-paksha* or dark fortnight.

27. The perpetual Clock.—By practice one is enabled to state the number of the current tithi by a mere glance at the Moon's orb. The chief bright star in the nakshatra, which rises at about sunset opposite to the Sun, tells approximately the name of the Lunar month. It also shows the progress of the night by its altitude at any moment. Thus the ancient Hindus had turned the starry vault into a big eternal clock. It required no winding, nor was the motion of the hands affected by atmospheric changes. It was a real *Swayam-vaha, i.e.*, keyless Kâlayantra

28. The points of difference between the artificial and Heavenly Clocks.—We will now notice the points of difference. In the former the motions of the hands are uniform and commensurate, *i. e.*, they are related by simple ratios. In consequence of this interdependence the configurations of the tithis, nakshatras and yogas recur not only at fixed intervals but at fixed points on the dial. But these two essential properties being absent in the motions of the Sun and the Moon, the conjunctions, oppositions and quadratures, do take place at any time and at any point of the dial of the celestial clock. It often happens that at the moment when the Sun-hand reaches the zero point of Ashvini at the end of the Solar year, the Moon-hand is seen anywhere on the celestial dial. For instance (see Table 3), in the Kali-year 0, the Sun arrived at the zero of Ashvini on the Celestial Clock Dial on 3·579 (Tuesday, 34gh. 44 pa.), when the tithi was 27·795, *i.e.*, the Moon was on (27·795 × 2) = 55·6 minute-spaces distant from the Sun.

The absence of interdependence is therefore the reason why it is necessary to compute separately the positions of the Sun and the Moon on the heavenly dial, and thence to calculate the moments of the completion of the tithis, nakshatras, and yogas, and to publish them in a panchânga in advance for the observance of the religious rites and the performance of civil transactions.

The nature and cause of the variable motions will be explained in the next chapter, and the method of computation of the Luni-Solar Calendar will be described in Chapter IX.

CHAPTER V

MEAN AND TRUE POSITIONS

The variable Daily Motions of the Moon and the Sun. (Fig. 2.)

29. The ancient astronomers believed that the Sun, the Moon and the planets revolved with uniform motion in perfectly circular orbits, and that although the Earth's centre was the centre of the Ecliptic or Zodiac, yet the centres of their orbits were placed not in the Earth's centre, but at some distance from it. That owing to this eccentricity of their orbits, they are not seen by the observers on the Earth in places calculated with a mean uniform motion, and hence the necessity of the correction called the Equation of the Centre being made to their mean positions. This is vividly expressed by Bhâskarâchârya in the following verse :—

भूमेर्मध्ये खलु भवलयस्याऽपि मध्यं यतः स्यात्
यस्मिन् वृत्ते भ्रमति खचरो नास्य मध्यं कुमध्ये ।
भूस्थो द्रष्टा नहि भवलये मध्यतुल्यं प्रपश्येत्
तस्मात् तज्ज्ञैः क्रियत इह तद् दोःफलं मध्यखेटे ॥ ७ ॥

स्फुटगतिवासना, गोलाध्याये.

30. We mean to explain now the theory of the Equation of the Centre to our readers. In Fig. 1 the Earth E is placed, for convenience of demonstration, at the centre of the orbits of the Moon and Sun. But in reality it is at some distance from C, the centre of the Moon's orbit $ABPD$ as shown in Fig. 2. The line EC which is called the eccentricity, is produced both ways to meet the orbit in A and P. The point A, being furthest from the Earth E, is called the Apogee and the point P, being the nearest, is called the Perigee. The line AP is called the line of Apsides.

The orbit is divided into 12 equal parts from A, each part being equal to 30 degrees. Each equidistant point f is joined to E and O by lines fE and fC, and the dotted lines Cr are drawn parallel to the lines Ef. The angles ACf are called the mean anomaly, and the angles AEF and their equals, the angles ACr (Cr being drawn parallel to Ef), are called the true anomaly. The angles EfC being equal to the difference of the two anomalies AEf and ACf (Euclid I, prop. 32) are called the Equation of the Centre, and consequently, while the moon is moving in ABP,

Mean Anom. — Equ. of Centre. = True Anomaly.

The angles EfC being equal to their alternate angles fCr (Euclid I, prop. 29) are measured by the arc fr when expressed in degrees and minutes.

31. When the moon, in the course of her revolution, comes to the line of Apsides, *i.e.*, is at A or P, the arc fr vanishes and consequently the Equation of the Centre is zero at these two points. (*Vide* Table 32.)

If *Cf* be the direction of the Moon *f* with respect to the line *CA*, pointing to a star at infinite distance, when seen from *C* at a certain moment, then *Ef* or its parallel *Cr* will be her direction with respect to the same star-line *CA*, if seen from *E*, the Earth's centre.

32. It is manifest then that in the first half of her mean anomaly from 0 to 180 degrees, she (*r*) always appears behind her mean position *f*, and is always ahead of it in the second half, *i.e.*, from 180 to 360 degrees. (*Vide* Table 32.) Also, although the motion round the centre *C* is always uniform, *viz.*, 791′, she will appear to move with continually accelerated motion and enlarging disc in the first half of her anomaly, owing to the continuous decrease in her distance *fE* from the Earth E. Similarly her motion will appear continually retarded in the second half owing to the increase in her distance *fE* every moment, the minimum and maximum being 722′ and 859′. (*Vide* Table 25.)*

Considering the conditions of the problem, it is obvious that the Equation of the Centre must reach its maximum (302′) where *Ef* is perpendicular to *AP*. But in Table 32 we find the maximum given when *Cf* is perpendicular to *AP*, *i.e.*, when the mean anomaly is 90 or 270 degrees. This is no doubt wrong. The error may be traced to the infancy of Astronomy when it was guessed for the first time that the equation or inequality increased with the sine of the anomaly and not in arithmetical progression, as was supposed in the time of the Pitâmaha S°. The correct calculation required the knowledge of Trigonometry, which being then unknown, the primitive astronomers were content with the Tables 31 and 32 of the equation calculated with the sine of anomaly only, and called it sine-correction दो:फलम्. Bhâskarâchârya alludes to this defect but is unable to explain it. He simply calls it a strange theory and asks his pupils not to raise the question " why the annual parallax is not similarly computed with the sine of the commutation angle.

नाशंकनीयं न चले किमित्थं यतो विचित्रा फलवासनाऽत्र
स्फुटगतिवासना. ॥ ३७ ॥

What is said above in respect of the Moon's movement applies wholly to the Sun's movement also.

* *Note.*—The ancients explained all the inequalities by means of epicycles and eccentrics on the hypothesis of circular orbits and uniform motions. So we have done the same here. For elliptic theory see author's Marathi Grahaganita.

33. Effects of the Equations of the Centres of the Moon and the Sun, on the ending moments of tithis, nakshatras and yogas.—It is easy to see that when the Moon is behind her mean place, she will be late in arriving at the required distance to make up the required tithi, nakshatra and yoga. Therefore the correction to the mean ending moment, due to the equation of the Moon's centre, must be plus or additive in the first half of her anomaly. See Tables 7, 8 and 10. Similarly, owing to the advance of the Moon beyond her mean position, during the next half, she arrives sooner at the required distance, and the correction must, therefore, be minus or subtractive, so far as the Moon is concerned.

34. The lagging of the Sun behind its mean position increases the elongation and his advance diminishes it. So that a given tithi takes place earlier, and the correction must, therefore, be minus in the first half of his anomaly and plus in the next half, so far as the Sun is concerned. See Table 6.

The effect of the Sun's equation of centre, on the ending moment of a yoga, is similar to that of the Moon on the ending moment of a tithi. See Table 9. (*Plus* in the first half and *minus* in the second half of the Sun's anomaly.)

The Sun can produce no effect on the ending moment of a nakshatra, which depends entirely on the Moon's equation of the centre.

35. The suppression * and repetition or Vriddhi of tithis etc., how caused.—The equations of the centres of the Sun and the Moon by causing variations of the ending moments of the tithis, nakshatras and yogas, also shorten and lengthen their durations. The duration of a tithi varies between 54·0 gh. and 65·3 gh.; that of a nakshatra between 54·0 gh. and 66·3 gh.; and that of a yoga between 52·2 gh. and 61·5 gh. When the duration of a tithi exceeds 60 gh. it sometimes happens that the tithi begins shortly before the Sunrise on one day, continues during the 60 ghs.

* Of course kshaya tithis would occur even if the motions of the Sun and Moon were uniform, as a mean tithi of 59 gh. is smaller than a natural day of 60 gh.; but in that case they would occur at uniform intervals, as in the Vedic calendar, and there would be no tithi-vriddhi. The inequalities in the motions render the intervals between kshaya tithis irregular and make tithi-vriddhi possible.

of it, and ends shortly after the Sunrise of the following day. As the tithi on which the Sun rises is supposed to rule over that day, the same tithi is shown on the two consecutive days in the Panchânga. This is called *The tithi Vriddhi* or the *Trisparsha* tithi. On the contrary, when the duration is less than 60 gh., it occasionally occurs that a tithi begins shortly after the Sunrise of a day and ends shortly before the next Sunrise. In this case the tithi touches neither the preceding nor the following Sunrise; and is looked upon as a *kshaya-tithi* or expunged tithi, and is not shown in the Panchânga. The Vriddhi and kshaya of nakshatras and yogas occur under similar conditions. The yoga is more liable to be suppressed than repeated.

36. The difference between the mean and true motions of the Moon is greatest at A and P, and nil at B and D, *i.e.*, it varies as the cosine of the anomaly. The equation of the centre, which is the integral or the total sum of all the differences of motion, varies therefore as the sine of the anomaly according to the principle of Calculus. (*Vide* Sec. 38.)

CHAPTER VI

THE IDENTITY OF THE ANCIENT AND MODERN INEQUALITIES OF THE SUN AND THE MOON

37. The ancient Assyrian astronomers were undoubtedly the most intelligent and keen-sighted people. The absence of accurate instruments for measuring time and angles in those ages probably compelled them to limit their observations to eclipses only. It is really wonderful that under such difficulties they should have succeeded so nicely in their determination of the solar and lunar inequalities. Their co-efficients are of course the aggregate of the co-efficients of the modern inequalities as they appear on the occasion of the eclipses.

38. We shall now demonstrate how the chief modern inequalities of the Moon and the Sun can be combined into two groups, one depending on the solar, and the other on the lunar anomaly.

The following are the principal inequalities adopted by Prof. P. Hansen in his lunar and solar theories :—

The inequalities of the Moon.

Equation of centre ..	— 377′.4 sin. (☾'s anomaly.)
Evection	— 74′·4 sin. (☾ — ☉) — ☾'s anomaly.
Variation	+ 35′·7 sin. 2 (☾ — ☉).
Annual Variation ..	+ 11′·9 sin. ☉'s anomaly.
Parallactic Equation	— 2′·6 sin. 2 (☾ — ☉) — ☉'s anomaly.

The inequality of the Sun.

Equation of centre — 115′·3 sin. ☉'s anomaly.

39. At the time of the eclipses, the terms of the form 2 (☾ — ☉) in the above arguments become zero. Consequently the third lunar inequality, called variation, vanishes altogether. The fourth and the fifth inequalities can be grouped with the Sun's inequality with their signs changed, in order that they may not adversely affect the time of the eclipses by the transfer.

The fifth inequality twice undergoes the change of sign, first owing to its transfer, and secondly owing to the sign (—) minus attached to the Sun's anomaly in it, and therefore remains unchanged.

Consequently on the occasion of an eclipse the following two groups can be formed out of the six inequalities.

The Lunar Group.

{ — 377′·4 sin. ☾'s anomaly.
{ + 74′·4 sin. ☾'s anomaly.

The Solar group.

{ — 115′·3 sin. ☉'s anomaly.
{ — 11′·9 sin. ☉'s anomaly.
{ — 2′·6 sin. ☉'s anomaly.

40. By summing up these groups separately we obtain the following two single inequalities, representing in value all the chief modern inequalities.

☾'s equation = — 303′·0 sin. ☾'s anomaly.
☉'s equation = — 129′·8 sin. ☉'s anomaly.

— 432′·8

These are identical with the following two inequalities, determined from observation by the Assyrians twenty-five centuries ago. (See Table 37 under Sûrya Siddhânta.)

$$\text{☾'s equation} = -\ 302'\cdot 4 \text{ sin. ☾'s anomaly.}$$
$$\text{☉'s equation} = -\ 130'\cdot 5 \text{ sin. ☉'s anomaly.}$$
$$\overline{-\ 432'\cdot 9}$$

Note.—The author of this work believes that the above demonstration is entirely his own, and that he has not been anticipated before.

CHAPTER VII.

DEFINITIONS OF TECHNICAL TERMS

(Figure 3.)

The information and explanation given in the foregoing chapters may have, it is hoped, prepared the student's mind, to understand the definitions of the following terms, which are *technical.* Many of them will appear as mere recapitulations of what has been explained before.

TERMS SIGNIFYING SPACE

41. The Siddhantic or Ptolemaic System.—Ancient astronomers supposed that the Earth lay at rest in the centre of the Universe, and that the planets moved round it in circles in the following order, *viz.*, the Moon, Mercury, Venus, the Sun, Mars, Jupiter and Saturn. The sphere of the fixed stars moved far beyond the orbit of Saturn. Their motion was uniform and was due to a great whirlwind called Pravahânila.

42. The apparent circular path of the Sun among the stars is called the *Ecliptic.* (Figs. 1 and 3.) It is supposed to be divided into 360 degrees, each degree being subdivided into 60 minutes, and each minute being again subdivided into 60 seconds. The Moon and the planets always appear to move near it.

43. The initial point on the Ecliptic, from which the circular distances or longitudes of the Sun, the Moon and the stars are measured, is called the *first point of Ashvini,* or Ashvinyâdi. It is situated, according to the old Sûrya-Siddhânta quoted in the

Pancha-Siddhântikâ, diametrically opposite to the bright star Chitrâ (Spica, Fig. 1). But owing to an excess of about 3 mintues in the period of the sidereal year adopted in all the Siddhântas, this 1st point shifts itself forward, at the slow rate of about one degree in 420 years. [*Vide* sec. 200 (*a*) and sec. 152 (*c*).]

44. The 12 equal parts into which the Ecliptic is divided, beginning at the first point of Ashvini, are called *Râshis* or signs. The entry of the Sun into a Râshi is called his *Sankramaṇa* or *Sankrânti* (Fig. 1), which is often used as a synonym for Râshi.

45. The 27 equal parts into which the Ecliptic is divided, beginning from the first point of Ashvini, are called the *Nakshatras*. Generally, the most conspicuous star found in the space of each Nakshatra is called its *Yôga-târâ* (Fig. 1).

46. The distance of a heavenly body, measured eastward from the first point of Ashvini to the foot of the perpendicular dropped from the body upon the ecliptic is called its *longitude*, and the perpendicular is called its *latitude*. (Fig. 3.) *Pn* is the Moon's longitude and *nm* her latitude.

47. The angular distance of the centre of the Moon from the centre of the Sun is called her *elongation*. Twelve degrees of elongation make one *tithi-space* ; so that there are 30 tithi-spaces in the circle of elongation, which is denoted by the symbol (☾ — ☉). (See Figs. 1 and 3.)

48. The linear distance from the centre of the Earth to the centre of the orbit of the Moon, or to the centre of the supposed orbit of the Sun, is called the *eccentricity*. It produces the equation of the centre. (See the line *EC* in Fig. 2.)

49. The point on the circumference of the Moon's orbit, which is farthest from the Earth, is called the *Apogee* and the nearest point is called the *Perigee*. (Fig. 2.)

50. The angular distance of the Moon or the Sun, from their respective Apogees, as seen from the centre of their circular orbits, is called the *mean anomaly*, for instance, the angles *ACf* in Fig. 2. But as seen from the Earth's centre *E*, it is called the *eccentric* or *true* anomaly as the angles *AEf*.

51. *The equation of the centre* is the angular distance, by which the Sun or the Moon moving uniformly in the eccentric orbit, is seen behind or ahead of the mean position. It vanishes at Apogee and Perigee and attains its greatest value nearly half way between those two points. See the angles *EfC* or the arcs *fr* (Fig. 2).

52. *The Celestial Equator* is a great circle equidistant from the two poles. It cuts the ecliptic in two opposite points called the *equinoxes*. The point through which the Ecliptic passes to the northern side of the equator is called the *Vernal Equinox*, and the other point is called the *Autumnal Equinox*. (Fig. 3.) The equinoxes have a slow retrograde motion of $50''\cdot2$ per year.

53. The distance in degrees reckoned on the ecliptic from the vernal equinox to the foot of the perpendicular dropped on the ecliptic from a celestial body is called its *tropical longitude*. In Fig. 1 the angle *VES* (160°) and in fig 3, the arc *OS* are the Sun's tropical longitude.

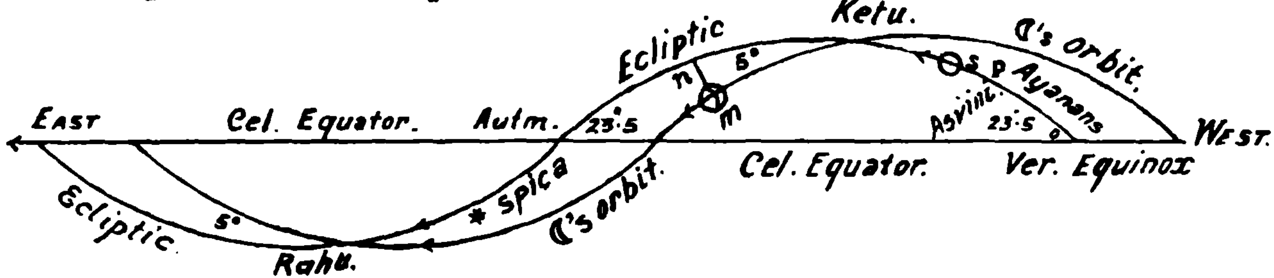
54. The tropical longitude of the first point of Ashvini reckoned in degrees is called *Ayanâmshas*. The *Ayanâmshas*, according to Munjal, increase slowly at the rate of about 59" per year, of which about $8''\cdot5$ are due to the annual shifting eastward of the first point of Ashvini (P), owing to the excess of the sidereal year of Surya S°, and $50''\cdot2$, due to the actual precession of the Vernal Equinox (0). (Fig. 3.)

55. The orbit of the Moon cuts the ecliptic in two opposite points called *nodes*. The node through which the orbit passes to the northern side of the ecliptic is called *Rahu*, and the other is called *Ketu*. These nodes have a daily retrograde motion of about 3′ (Fig. 3).

56. The longitude of that point of the Ecliptic which is in contact with the horizon of a place, at a given moment, is called the *Lagna* at that moment.

57. The independent variable often expressed in angle or time, on which depends the value of a dependent variable, is called an *Argument*. It is always stated at the head of each table and is shown on one or two sides of it.

Fig. 3 Illustrating the Definitions.



A table has sometimes two arguments and is then called a table of *double entry*, as the Tables 12, 28, 35, 36. One of them is shown on the vertical side, and the other on the horizontal side of the table. In this case the quantity to be found out lies at their crossing point.

58. The angular correction made to the mean value, in order to obtain the true one, is called an *equation* or an *inequality*, as the angle *EfC*. (Fig. 2.)

TERMS SIGNIFYING TIME

59. The instant, when the true Sun arrives at the initial point of Ashvini P (Fig. 3), is called the *Meshâdi* or Epoch of the commencement of the Hindu sidereal year. (Table 3.)

60. The time, in which the Sun departing from any fixed star, returns to the same star, is called the *sidereal year*. According to the Sûrya Siddhanta its length is 365·258,756,484 days. But according to Prof. Newcomb it is 365·256,898,4 days.

One-twelfth of a sidereal year is a mean solar month, and the time taken by the true Sun in passing through a given Râshi, is the true solar month corresponding to that Râshi. (*Vide* Section 70.)

61. The time that passes between two conjunctions of the Sun and the Moon is called a *lunation* or a *lunar month*. Its mean duration is 29 530,587,946 days. One-thirtieth of a lunar month is a mean tithi or lunar day, and its length is ·98435 of a day.

62. The period in which the Moon makes one complete revolution, with reference to any fixed star, is called a *sidereal month*. Its length is 27·321,674,160 days.

63. The time of the Moon's revolution from apogee to apogee is called an *anomalistic month*. Its length is 27·554,599,9 days.

64. The time reckoned in ghatis from the apparent Sunrise at a place is called *Sâvana*. It is employed in the performance of the Hindu religious ceremonies.

Note.—1 day = 60 ghatis ; 1 ghati = 60 palas ; 1 hour = 2·5 ghatis ; 1 minute = 2·5 palas and 1 pala = 0·4 of a minute.

CHAPTER VIII

THE THEORY OF THE ADHIKA AND KSHAYA MONTHS

(*For practical determination, vide* sec. 108.)

65. The *adhika* or the intercalary month is a peculiarity of the Luni-solar calendar, and is due to the excess of the solar year over the lunar, by 11·0648 tithis. This excess amounts to one lunar month in 32·532 solar months, or 7 lunar months in about 19 solar years.

The luni-solar calendar is the most ancient and has been in use among the Chaldeans, the Hindus, the Jews, and the Chinese. The intercalary months were assigned by them to certain fixed years of their cycles (*vide* secs. 129, 151, 154) and being calculated with mean motions, there was no possibility of a *Kshaya* month.

It were the Hindus, it appears, who first took the bold step of introducing into their calculations the true motions and positions of the Sun and the Moon. But this step opened a doorway for the strange and hitherto unknown *Kshaya* month, *i.e.*, the suppressed month.

66. Lunar months how named.—That lunar month in which the Sun enters the Mesha Râshi is called Chaitra ; that in which he enters the Vrishabha Râshi is called Vaishâkha, and so on. The lunar month in which no Sankramaṇa occurs is called *adhika* and bears the same name as that of the next lunar month. That lunar month, in which two Sankramaṇas occur, gets two names,* of which the first is retained and the second is suppressed or joined to the preceding.

67. Importance of the Adhika months.—Table 2 furnishes all the Adhika and Kshaya months that have occurred or shall occur from Shaka years 0 to 2105. In calculating the ending moment of a given tithi it is absolutely necessary to know beforehand whether the given year contains any Adhika or Kshaya month. For without this knowledge it is impossible to determine the exact number of tithis intervening between the epoch of the Mesha Sankrânti and the given tithi. (*Vide* sec. 79.)

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* The author has seen at Hubli a manuscript copy of an old panchâng containing a *Kshaya* month. It contained a month having two names joined together, as Mârgashirsha-Pausha.

68. Prescience of the Adhika months.—When the elements for the epoch of Mesha-Sankrânti are calculated (sec. 77), the tithi, or the *Tithi-Shuddhi** as it is called by way of pre-eminence, can tell us whether the year contains an Adhika month, and if so, what month is most likely to become Adhika. An Adhika month is possible only if the tithi-Shuddhi is between 19 and 31, and is impossible outside these limits. For instance the Tithi-Shuddhi for Kali-year 0 in Table 3 is 27·795. This Ṭithi-Shuddhi lying between the said limits, the year 0 contained an Adhika month, which was most probably Jyestha as the next section shows.

69. The limits of the Adhika and Kshaya months.—The following are the limiting values of tithi-shuddhi within which each of the months shown against them may possibly become Adhika or Kshaya.

Note.—The limits are common to Sûrya, Arya, and Brahma siddhantas alike.

Limits of Tithi-Shuddhi.

Between—	29·6—31·2	Adhika	Chaitra	is possible.
,,	28·2—30·4	,,	Vaishâkha	,,
,,	26·4—29·1	,,	Jyestha	,,
,,	24·5—27·3	,,	Ashâḍha	,,
,,	22·4—25·3	,,	Shrâvana	,,
,,	20·8—23·3	,,	Bhâdrapada	,,
,,	19·8—21·7	,,	Ashvina	,,
,,	19·3—20·6	,,	Kârtika	,,
,,	19·3—20·1	,,	Mârga-Shîrsha	or
,,		Kshaya	Kârtika	
,,	19·4—20·1	,,	Mârga-Shîrsha	,,
,,	19·5—20·2	,,	Pausha	,,
,,	19·3—20·7	Adhika	Phâlguna	,,

Note 2.—The limits of the months Kârtika, Mârgashîrsha and Pausha are nearly equal; and as such are of little practical value. It is only after actual calculations of the times of the Sankrântis and new Moons, that we are able to decide which of them is Adhika or Kshaya.

* The week-day of the Mesha Sankranti is similarly called *Abdapa*, *i.e.*, the lord of the year.

2 8 *

70. A solar month is often called by the name of the Rashi, in which the Sun is moving and its length is the time which he takes to cross the Rashi. In the following table are given the names of the lunar months, and the names of the solar months, connected with them in the manner stated in the first sentence of section 66, and also the lengths of the solar months in days according to the Sûrya-siddhânta :—

Name of Lunar month.	Connected Solar month.	Length of Solar month in days.	Name of Lunar month.	Connected Solar month.	Length of Solar month in days.
Chaitra ..	Mesha ..	30·91	Ashvina..	Tula ..	29·89
Vaishâkha	Vrisha ..	31·42	Kârtika..	Vrischika	29·49
Jyeshthâ ..	Mithuna.	31·64	Mârga ..	Dhanu ..	29·32
Ashâdha ..	Karka ..	31·48	Pausha ..	Makara ..	29·45
Shrâvana..	Sinha ..	31·02	Mâgha ..	Kumbha	29·82
Bhâdra ..	Kanya ..	30·44	Phâlguna	Mina ..	30·35

Note.—The lengths of the solar months remain invariable for centuries, but those of the Lunar months vary between 29·27 and 29·82 days.

71. Aptitude of months for becoming Adhika and Kshaya.—A lunar month can become Adhika if the duration of the solar month connected with its preceding month is greater than that of a lunar month, and it can become Kshaya, if the duration of the solar month connected with itself is less. See the preceding section.

The 7 months from Phâlguna to Ashvina fulfil the first condition only, and can on that account become always Adhika but can never become Kshaya. The Kârtika and Mârgashirsha months fulfil both the conditions in respect of the limits (29·27 — 29·82 days) of a lunar month, but within a very small margin. They therefore can become both Adhika and Kshaya, but, rarely.

The month Pausha has almost no chance of becoming Adhika, but has a greater chance of becoming Kshaya than the month Mârgashirsha. The month Mâgha can become Adhika but not Kshaya. But the limits are so narrow, that it has never become either Adhika or Kshaya.

72. The limits of a Kshaya month are so narrow and so nearly identical with those of an Adhika that it is generally preceded and followed, though not immediately, by an Adhika month, so that there are often two Adhika months when a Kshaya month occurs. The shortest period of its recurrence is 19 years, in which the change in the tithi-shuddhi is only 0·231, but that in the Moon's anomaly is — 50°·3. The other periods of recurrence are 46, 65, 122, and 141 years, made up of multiples of 19 plus 8·

Ganesh Daivajna gives in a verse the following Shaka years which contain a Kshaya month according to the Sûrya Siddhânta 1462, 1603, 1744, 1835, 2026, 2045, 2148, 2167, 2232, 2373, 2392, 2514, 2533, 2655, 2674, 2796 and 2815. He also gives additional Shaka years which contain a Kshaya month when calculated by the Arya Siddhânta. They are 1481, 1763, 1904, 2129, . 2186 and 2251.

CHAPTER IX.

THE LUNI-SOLAR CALENDAR

According to the Sûrya Siddhânta.

73. This calendar has been in use in India from the earliest time down to the present. In its present form, probably since Shaka 200, it uses the true positions of the Sun and the Moon instead of the mean ones as in Vedânga Jyotisha. Though this was a real advance in the right direction, yet it has necessitated troublesome calculations. The solar calendar is much simpler to calculate, and seems, therefore, to have been adhered to by our brethren, the Bengalees and the South Indians.

74. The Sankalpa.—Before proceeding with any religious ceremony, a pious Brahmin must declare solemnly his intention to perform it according to the formula called Sankalpa. The *Sankalpa* opens with the recital of the chronological order of the grand divisions and subdivisions of time beginning with the *Shri-Shveta-Vârâha Kalpa* down to the very tithi, nakshatra, yoga and karaṇa of the day, as well as of the geographical position of the place and of the signs occupied by Jupiter and other planets. A Panchânga is therefore as much necessary to his religious life as food and water are to his worldly existence. It is this inseparable connection of Astronomy with the Hindu religion that has saved the former from total neglect.

75. The three chief Siddhântas and the parts of India where they are used.—A comprehensive standard work on the theory and practice of Astronomy is called a *Siddhântâ*. There are three such works, *viz.*, the Sûrya S°, the Ârya S° and the Brahma S°. The first is used throughout the Indian Peninsula on account of its greater accuracy. The second is used in Malabar, Travancore and the Tamil Districts of Madras, while the third is followed in Gujerath and parts of Rajputana, but is at present being gradually abandoned in favour of the first.

76. The Karanas or Manuals.—In the Siddhântas the calculations are made from the Epoch of Mahâyuga, or of the Kaliyuga, and consequently it is almost impossible to compute a Panchânga directly from any of them. Rudimentary tracts, called the *Karaṇas* (not to be confounded with the half of a tithi), based on these Siddhântas have, consequently, sprung up from time to time, and have been given up in favour of new and better ones. At present the Karanas of Surya S°, which have been extensively used in Upper India and Bengal, are the *Makarand* and the *Râmavinoda*. The *Grahalâghava* of Ganesh, which is far superior to them, is used in Central India and the Deccan. Those of the Arya S° are the *Vâkya-karana*, the *Karana prakasha* and *the Parahita*. These are followed in Malabar and South India. The Karaṇa-Kutûhala of Bhâskara follows the Brahma S°.

TO CALCULATE THE ENDING MOMENT OF A TITHI IN UJJAIN MEANTIME (U.M.T.)

77. Method.—When the given year is of the Shaka Era, add 78 to it and the sum will indicate the A.D. year. With the century of the A.D. era as argument, enter Table 3 and take down the elements for that century. Below them write their increase for odd years given in Table 4, and add up the elements separately. The sums will represent the values of the elements at the commencement of the given solar year, which is the same as the Moment of Mesh-Sankrânti otherwise called *Meshâdi*.

78. Complete the fractional tithi by adding to it its complement in decimal fraction. Diminish the complement of the tithi by one sixty-fourth part of itself and call the remainder C.

Write the value of C below the elements of Vâra, date, and the Sun's anomaly and put zero below those of Râhu and Ayanâmsha when they are required (*vide* sections 162, 169, 175).

Multiply C by 13 and place the product below the element of the Moon's anomaly as degrees.

Add up all the elements separately and denote them by S. This part of the working is called the *completion of the Tithi-Shuddhi,* whereby we obtain the values of the elements at the ending moment of the tithi-Shuddhi.

79. Refer the Shaka year to Table 2, and see if it contains any Adhika or Kshaya month. Then count the number of tithis elapsed from the beginning of the Luni-Solar year (which begins on the first tithi of Chaitra) to the end of the given tithi, taking into account the 30 tithis of the Adhika month, and omitting the 30 tithis of the Kshaya month if there be any, and denote the total by T.

Deduct from T the completed tithi-shuddhi S, and call the remaining tithis R. Thus $T - S = R$, and $S + R = T$.

Enter Table 5 with R as argument, write the increments below the elements denoted by S, and add them separately. The sums will be the mean elements at the ending moment of the given mean tithi, T.

80. To obtain the ending instant of the true Tithi, as seen from the Earth's centre, and the English date corresponding to it.

Enter Table 6 with Sun's anomaly as its argument, take out the Sun's equation of centre, expressed as fraction of a day, and place it below the Vâra and English date.

Multiply the Sun's equation by 12 (more correctly by 12·2), put the product as degrees below the Moon's anomaly and add them up.

With this corrected anomaly of the Moon, enter Table 7, take out the Moon's equation of centre, and place it below Vâra and date.

Add up the three quantities according to their signs. The integers of Vâra indicate the number of the *Week day;* one indicating Sunday, two indicating Monday, and so on.

Multiply the fraction of the Vâra by 60, and the integers of the product will denote the ghatis. Multiply again the fraction of ghatis by 60, and the product will represent the number of palas.

Thus we arrive at the *Vâra, ghatis* and *palas*, of the time when the tithi ends.

81. *To determine the English month and date.*—All that one has to do now is to refer to Table 11, and find out the highest number of days that can be subtracted from the total of days, calculated in the column headed " A.D. date " and to subtract them. The remainder will show the month and date of the Christian Era, the year being shown in the third column of the working. (*Vide* Sec. 82, type of calculation.) The year should be increased by unity when the date passes December 31.

Note 1.—The English date is here supposed to begin at mean sunrise of Ujjain.

Note 2.—In finding out the highest number of days from Table 11, attention should be paid to the English month of Meshâdi. The Table 11 does not contain a column for February which is very rarely needed, it being required only if the calculations are intended for a year of the Christian Era anterior to B. C. 1500. In this case it should be ascertained by the rule in Section 144, whether or not, the given year is a leap year, and if it be leap, the highest number of days counted from March should be increased by 29, and by 28 if the year be a common one.

Note 3.—For convenience of comparison, we shall work out, as far as possible, the examples chosen by Mr. L. D. Pillai in his Indian Chronology.

82. Example.—Required to calculate the ending moment of Mâgha Krishna Tritîyâ of Shaka year 1831.

On referring to Table 2 we see that in 1831 the month Shrâvaṇa was adhika. Counting this adhika, which precedes Mâgha, we obtain 11 for the number of months elapsed since the beginning of the Luni-Solar year 1831. Consequently the required tithi is the (11 × 30) + 18 = 348th from the beginning :—This is denoted by T in the following working :—

TYPE OF CALCULATION

Tithi—Mâgha Krishna 3 *of Shaka* 1831.

Explanation.	Shak year.	A. D. year.	Tithi.	Vâra.	A. D. date.	☾'s anom.	☉'s anom.
Tab. .. 3	1822	1900	13·027	5·620	A.12·620	7°·50	280°·60
4	8	8	28·518	3·070	0·070	16·80	0·00
4	1	1	11·065	1·259	0·259	92·09	0·00
At Meshâdi.	1831	1909	22·610	2·949	A.12·949	116·39	280·60
Complement	..	.. ..	·390	0·384	0·384	4·99	·38
S, the completed tithi ..			23	3 333	13 333	121 38	280 98
			300	1 306	295 306	258 20	291 00
Tab. 5, Arg. R. 325 ..			20	5 687	19·687	257 20	19·40
			5	4 922	4·922	64·30	4·80
T, the desired mean tithi ..			348	1·248	333·248	341·08	236·18
Tab. 6, Sun's Eqn. Arg : 236° 2 ..				+·149	+0·149	+1·78	+·149×12
Tab. 7, Moon's Eqn. Arg: 342°·9 ..				—·133	—0·133	342·86	= + 1·78
End of the desired true tithi T. ..				1·264	333·264		
Tab. 11. April 0 to Feb. 0				..	306·		
Engl. date A.D. 1910. Feb. Sunday				..	27·264	= 15 gh.	50 palas.
The same by D. B. Pillai ..				..	27·264	= 15 gh.	50 palas.

EXPLANATION

83. The computation upto the elements of the desired mean tithi T, is too easy to require explanation. We then enter Table 6 with Sun's anomaly 236°·18 as its Argument, and take out the *Sun's equation* + ·149 day, and write it below the Vâra and date.

We then multiply the Sun's equation, +0·149, by 12, and add the product, + 1°·78, to the Moon's anomaly 341°·08, and obtain 342°·86. With this value of Moon's anomaly, we enter Table 7 and obtain —0·133 day, for the *Moon's equation* of the centre, and we write it below that of the Sun, in the columns of Vâra and date. Lastly we add up the three quantities according to their signs, and get Vâra 1·264 as the *ending moment* of the required tithi.

The integer 1 in the Vâra indicates that the tithi ended on a Sunday. The fraction 0·264 multiplied by 60, yields 15·84 ghatis, and the fraction 0·84 multiplied by 60, yields 50 palas. So the result is that the tithi *Mâgha Krishna* 3, *of Shaka year* **1831**, *ended on a Sunday at* 15 *gh. and* 50 *palas, after the mean Sunrise at Ujjain.* Fractions of a day are easily converted into ghatis and palas by means of Table 40.

This result is in complete agreement with that obtained by D. B. Pillai in his Chronology, page 15.

84. The English date.—In the column for date we have A. 333 days. By referring to Table 11, under April, we see that the highest number that can be subtracted from 333 is 306 upto the end of January or February 0. This being subtracted we get 27th of February 1910, because the year 1909 ended on December 31 and the year 1910 commenced on January 1.

Note.—The method of converting the meantime of Ujjain into the time reckoned from the true Sunrise of any place is explained in Chapter XVI.

CALCULATION OF THE ENDING MOMENT OF A NAKSHATRA

85. Connected with a month and Tithi.—A nakshatra or a yoga, unless connected with any lunar month, has *no significance* at all. We shall, therefore, explain here how to calculate the ending moment of a nakshatra, concurrent with a given tithi, at mean sun-rise. (*Vide* Section 116.)

86. Definition.—A tithi counted from the preceding New Moon of a current month is a *monthly tithi,* while the same counted from the beginning of Chaitra is called an *annual tithi.* In the present example 18 is the monthly tithi, and 348 is the annual tithi.

Note.—Here the words tithi and yoga should be understood to mean the spaces indicated by them and not the times.

87. Method.—Put the monthly tithi and the Sun's anomaly into their places in the following formula, and solve it for the nakshatra. The nakshatra thus derived will be running at the moment indicated by the Vâra of the mean tithi T.

$$\frac{3}{40}\left\{(12^\circ \times \textit{monthly tithi}) + \odot\text{'s } \textit{anom.} + 77^\circ{\cdot}26\right\} = \textit{Nak.}$$

Then in place of the annual tithi T, in the preceding calculation, put the fractional nakshatra, and retain only the Moon's anomaly, omitting the Sun's anomaly as unnecessary.

Complete the fractional nakshatra by adding to it its decimal complement. Increase this decimal complement by one-eightieth part of itself and then add it to Vâra.

Multiply the increased complement by 13, and add the product to the Moon's anomaly as degrees.

With the Moon's anomaly take out from Table 8 the Moon's equation for Nakshatra and add it to the Vâra.

The result will be the *ending moment* of the completed nakshatra from the mean Sunrise of Ujjain.

88. Example.—Find the ending moment of the nakshatra current with Mâgha Krishna Tritîyâ of Shaka year 1831.

Putting the monthly tithi 18 and the Sun's anomaly 236°·18 into the preceding formula and solving it for nakshatra, we get 12·708 as mean nakshatra current with the 18th tithi. The fraction ·708 belongs to the 13th nakshatra which is named Hasta. (*Vide* the Appendix.)

$$\frac{3}{40}\left\{(12^\circ \times 18) + 236^\circ{\cdot}18 + 77^\circ{\cdot}26\right\} = 12{\cdot}708 \text{ Nakshatras.}$$

Replacing the annual tithi 348 by 12·708, and bringing down the Vâra and the Moon's anomaly from the type of calculation, Section 82, we have for—

Type of Calculation of a Nakshatra.

Explanation.	Nakshatra.	Vâra.	☾'s anom.
Nakshatra current at T. ..	12·708	1·248	341°·08
Complement	·292	·296	3·85
Completed nakshatra	13·000	1·544	344·93
Table 8, Arg. 344° 93	....	— 109	☾'s eqn.
Hasta nakshatra ends, Sunday..	....	1 435	= 26gh. 6pa.

CALCULATION OF THE ENDING MOMENT OF A YOGA

89. Method.—It is similar to that of a nakshatra. Calculate the current mean yôga by the following formula, employing in it the mean nakshatra, obtained by the formula of Section 88

$$2 \times \textit{nakshatras} - 0{\cdot}9 \times \textit{monthly tithis} = \textit{yoga}.$$

Put this yoga in place of the tithi as before. Complete it by adding to it its decimal complement. Diminish the complement by one-seventeenth (17th) part of itself, and add it to Vâra and to the Sun's anomaly. Multiply the diminished complement by 13, and add the product in degrees to the Moon's anomaly.

Then with the Sun's anomaly, take out from Table 9 the Sun's equation of centre and write it under the Vâra.

Multiply the Sun's equation by 14, and add the product in degrees to the Moon's anomaly; with the Moon's anomaly thus corrected, take out from Table 10 the Moon's equation, and write it below that of the Sun. Then add up the Vâra and the two equations according to their signs.

The result will be the *ending moment* of the completed yoga from the mean Sunrise of Ujjain.

90. Example.—Find the ending moment of the yoga concurring at mean Sunrise with Mâgha Krishna 3 of Shaka year 1831.

First we calculate the current yoga by the above formula of Section 89, and get for it 9·216; the fraction ·216 belongs to the yoga Gaṇda. (*Vide* the Appendix.)

$$(2 \times 12{\cdot}708) - ({\cdot}9 \times 18) = 9{\cdot}216 \text{ yogas.}$$

Type of calculation of a Yoga.

Explanation.	Yoga.	Vâra.	☾'s anom.	⊙'s anom.
Yoga current at T. ..	9·216	1·248	341°·08	236°·18
Complement ..	·784	·738	9·59	·74
Ganda Yoga	10·000	1·986	350·67	236·92
Tab. 9, Arg. 237°, Sun's equation		— 061	— 0·85	·061 × 14
Tab. 10, Arg. 350°, Moon's equation ..		—·067	349·82	= —0·85
Ganda Yoga ends. Sunday		1·858	=51 gh.	29 palas

91. It often so happens that the nakshatra and the yoga, calculated as above, end on the preceding or the following day. In such a case the completed nakshatra, yoga and the anomalies should be increased or diminished by unity, and by its motion given in Table 18. For an instance of this kind, see the calculations under Sections 95, 96.

92. The theory of the formulæ of deriving mean nakshatra and yoga (Secs. 87, 89), from the elements of a given mean tithi, will be understood from the following diagram.

Elongation.　　Sun's anomaly　　Longi. of ☉'s Apogee

<——|——————|——————|——————

M Monthly tithi S　　　　A　　77°·26　　O

Suppose that O, A, S, and M, are the positions of the first point of Ashvini, the Sun's apogee, the Sun and the Moon respectively at the ending moment of a mean tithi.

Then OM = The Nakshatra ; and OM + OS = The yoga. It is manifest from the above diagram that—

OM = MS + SA + AO .. .. .. Sec. 87.
Nak = Elogation + Sun's anom. + Longi. of ☉'s Apogee.

And—

OM + OS = 2 × OM — MS ... . Sec. 89.
Yoga = 2 × Nak. — Elongation, expressed as Nak.

93. Given any English date, to find the tithi concurring with it.—When the tithi concurring with a given English date, is desired, we should proceed according to the method given in Sections 77, 78, as far as the completion of the tithi-Shuddhi, denoted by S in the type of calculation.

Then with the help of Table 11, count the number of days that elapse upto and including the given date.

Subtract from this number, the fractional date of the completed tithi-shuddi S. Increase the remainder by one-sixty-third part of itself, and make the increased number a round one by completing it.

Take this round number for R and calculate, as before, the ending moment of the resulting tithi, S + R = T.

Should the tithi T thus found, end on either the preceding or the following date, the number of the tithi should be corrected so as to tally with the given date.

For instance suppose that it is required to calculate the tithi which concurs with the Sunrise of the English date, Sunday, the 27th of February 1910.

In the example of Section 82 the completed tithi shuddhi S is 23 and the date is April 13·333. We know from Table 11 that the period from April 0 to 27th February is 306 + 27 = 333 days.

Subtracting 13·333 days from 333 days we get 319·667 days. Dividing these by 63 we get 5·074 as quotient. Adding 319·667 and 5·074 we get 324·741 or in round number 325 tithis, which represent R in this instance.

With this R we proceed as in the example of Section 82, and arrive at the result that 23 + 325 = 348 = T which was Mâgha Krishna 3, of Shaka year 1831, as Shrâvaṇa was adhika in 1831 by Table 2.

THE MOST ANCIENT TITHI MENTIONING THE WEEK-DAY

94. Example 2.—Calculate the ending moment of Ashâdha Shukla dwâdashi, Thursday, in Kaliyuga year 3585 or Shaka year 406.

This is the celebrated test problem selected by Mr. Dixit and others in their works on Chronology. The date appears on a pillar erected by the king Budha-Gupta at *Eran* (Lat. 24° N Long. 78° 15′ East from Greenwich) in the Central Provinces. It is the oldest inscription that mentions the week-day along with the tithi.

We conclude from Table 2, that Shaka year 406 contained no adhik month, and, therefore, the tithi was 102nd from the beginning of the Shaka year 406. Also the tithi-shuddhi 5·222 in the working, supports the conclusion. (*Vide* Section 68.)

Ashâdha Shukla 12 *of Shaka year* 406.

Explanation.	Shaka year.	A.D. year.	Tithi.	Vâra.	A.D. date.	anom.	☉'s anom.
Tab. 3	322	400	5·777	0·486	M.17·486	104°·20	280°·6
,, 4	84	84	29·445	0·735	0·735	175·93	0·0
At Meshâdi ..	406	484	5·222	1·221	M.18·221	280·13	280·6
Complement ..	..	..	·778	·776	·776	9·96	·8
S, completed tithi ..			6	1·987	18·987	290·09	281·4
Tab. 5 Arg. R. 96 ..			90	4·592	88·592	77·50	87·3
			6	5·906	5·906	77·20	5·8
T, Ashâdha 12			102	5·485	113·485	84·79	14·5
Tab. 6, Arg. 14°·5, ☉'s eqn. ..			..	—·046	—·046	—·55	=—·046
Tab. 7, Arg. 84·24 ☾'s eqn. ..				+·414	+·414	84·24	× 12
End of Ahsâdha 12			..	5·853	113·853	= 51 gh.	11 pa.
Tab. 11, March 0, to June 0					92·		
Engl. date A.D. 484 June			..	Thurs.	21·853		
By D. B. Pillai, Chron. age92			..	..	21·853	= 51 gh.	11 pa.

The above calculation shows that Áshâdha Shukla 12, Shaka year 406, ended on a Thursday at 51 gh. and 11 palas, and that the English date on that day was June 21 A.D. 484.

The week-day, Thursday, confirms the truth and genuineness of the Inscription.

95. We shall now calculate the *nakshatra* and *yoga* of this memorable date according to Sections 87—91.

By Sections 87 and 89—

$$\tfrac{3}{40}\left\{(12^\circ \times 12) + 14^\circ\cdot 5 + 77^\circ\cdot 26\right\} = 17\cdot 682 \text{ Nakshatra.}$$

$$\left\{(2 \times 17\cdot 682) - (0\cdot 9 \times 12)\right\} = 24\cdot 564 \text{ Yoga.}$$

Calculation of the Nakshatra on Ashâdha 12, *Shaka* 406.

Explanation.	Nakshatra.	Vâra.	☾'s anom.
At the end of 102nd tithi ..	17·682	5·485	84°·79
Complement	·318	·319	4·16
This Nak. falls on Friday ..	18·	5·804	88·95
By Sec. 91 and Table 18 ..	—1	—1·012	—13·22
Anurâdhâ	17	4·792	75·73
Tab. 8, Arg. 75°·73 ☾'s eqn.	..	+·377	
End of Anurâdhâ at ..	10 gh. 8 p.	5·169	Thursday.
By D. B. Pillai, Chro. page 12	10 gh. 12 p.	5·170	

96. Next let us calculate the yoga

Calculation of the Yoga on Âshâdha 12, *Shaka* 406.

Explanation.	Yoga.	Vära.	☾'s anom.	⊙'s anom.
At the end of 102nd tithi	24·570*	5·485	84°·79	14·5°
Complement ..	·430	·405	5·26	·4
Yoga ends next day ..	25	5·890	90·05	14·9
Sec. 91, Table 18	—1	—·941	—12·30	—·9
Shukla Yoga	24	4·949	77·75	14·0
Tab. 9, Arg. 14°, ⊙'s eqn.		+·038	+·56	= { +·040
Tab. 10, Arg. 78 ☾'s eqn. ..		+·355	78·31	×·14
Shukla ends, Thursday		5·342	20 gh.	31 pa.
By D.B. Pillai, Chro. page 12.. ..		5·340	20 gh.	24 pa.

97. Calculation of the Christian date on which Buddha died B. C. 483, Kartika Shukla 8.—The date appears in an article by Dr. Fleet in the Journal of the Royal Asiatic Society for 1909. We shall work out this problem as an illustration of the method of calculating a tithi occurring in B. C. years, which lie beyond the limits of Table 2.

* The correct figure for the Yoga is 24·564 and not 24·570.

In the working of this example below, the tithi Shuddhi, *i.e.*, the tithi at Meshâdi is 26·6. It falls within the limits of possibility of adhika Jyestha (*vide* Section 69) which precedes Kârtika. The number of months elapsed since Chaitrâdi is, therefore, 8, and the tithi in question is 248th.

In Table 3, the year B. C. 483 lies between B. C. 501 and B. C. 401 and commences 18 years after B. C. 501.

Note.—B. C. years are to be considered as minus. They succeed in the descending order.

Calculation of the Christian date of Buddha's death.

Kârtika Shukla 8, Shaka — 560 October 13, B. C. 483, Tuesday

Explanation.	Shaka year.	B. C. year.	Tithi.	Vâra.	B. C. date.	☾'s anom.	☉'s anom.
Tab. 3	—578	—501	7·427	1·605	M·9·605	19°·23	280°·6
,, 4	16	16	27·037	6·140	0·140	33·51	0·0
,, 4	2	2	22·130	2·517	0·517	184·19	0·0
At Meshâdi ..	—560	—483	26·594	3·262	M·10·262	236·93	280·6
Complement ..	..	..	·406	·400	·400	5·20	0·4
S., completed tithi ..			27	3·662	10·662	242·13	281·0
Tab. 5, R. 221 ..			200	0·871	196·871	52·10	194·0
			20	5·687	19·687	257·20	19·4
			1	0·984	0·984	12·86	1·0
T, Kârtika Sh. 8 ..			248	4·204	228·204	204·33	135·4
Tab. 6, Arg. 135°·4 ..			..	—·127	—·127	—1·53	—·127
Tab. 7, Arg. 202·8			..	—·149	—·149	202·80	×12=
Kârtika. Sh. 8, ends ..			..	3·928	227·928	..	—1·53
Tab. 11, Mar. 0 to Oct. 0 ..			..	..	214·000	..	..
Date B. C. 483, Oct. 13, Tuesday			..	..	13·928	55 gh.	41 pa.
By D. B. Pillai, Oct. 13, Tuesday			..	..	13·920	55 gh.	12 pa.

98. In the above example we have assumed, on the strength of Section 69, that Jyestha was adhika in B. C. 483. We shall now show from actual calculation that our assumption was a fact.

We take down the following elements for the Meshâdi of B. C. 483 from the preceding working.

Calculation of Adhika Jyestha in B.C. 483.

Explanation.	B. C. year.	Tithi.	Vâra.	☾'s anom.	☉'s anom.
At Meshâdi	483	26·594	3·262	236°·93	280°·6
Tab. 13, increase for Mithuna..	..	63·347	6·356	94·60	61·5
Mithuna S. begins	..	89·941	2·618	331·53	342·1
Complement	..	0·059	·058	0·75	0·1
3rd New Moon		90	2·676	332·28	342·2
Tab. 6, Arg. 342°·2, ☉'s Eqn.	..	..	+·056	+0·67	+·056
Tab. 7, Arg. 332°·95, ☾'s Eqn.	..	..	—·204	332·95	× 12
Time of 3rd New Moon	..	..	2·528		= +·67

It is quite obvious from the above figures that the Mithuna (3rd) Sankrânti occurred at 2·618 and that the third New Moon (Amânta) fell on the same day at 2·528, *i.e.* (2·618 — 2·528) = 0·09 day, or 5·4 ghatis before the beginning of Mithuna.

Deducting 0·09 day from the period of the Vrishabha Sankrânti (*vide* Table 13) which is 31·42 days, we get 31·33 days, which exceeds the duration of the longest lunar month, 29·81. (*See* Note to Section 70.) Consequently no Sankrânti did occur between the 2nd and the 3rd New Moon; and the month Jyestha was undoubtedly adhika in B. C. 483.

99. Problem.—To calculate the English date on which the Sun attains a given tropical longitude.

Example.—Required the English date of the Summer Solstice in B. C. 483, on which the Buddhist holiday of *Vassa* was held.

The Summer Solstice occurs at the moment, when the Sun's tropical longitude is exactly 90°. But our Hindu year being sidereal we have been all along working with the sidereal longitudes, without ever feeling the need for tropical longitudes. So we must have now some link for connecting the sidereal and tropical longitudes. This is furnished by the precession of the

Vernal equinox called the Ayanâmshas. In other words, the Ayanâmshas are the tropical longitude of the first point of Ashvini. (Section 54.)

Table 3 contains the Ayanâmshas. They are meant to be applied to the sidereal longitudes for converting them into the tropical ones. But in the above example we have to do the opposite. They must, therefore, be applied to the tropicol longitudes, with their sign changed, to get the sidereal ones.

From Tables 3 and 4 we obtain — 16°·48 of precession or Ayanânashas for B. C. 483. These applied with the sign changed to 90° give 106°·48 for the Sun's sidereal longitude at the moment of the Summer Solstice in B. C. 483.

The problem then comes to this—To find the English date in B. C. 483 on which the Sun's true sidereal longitude was 106°·48—This is solved in the following manner, remembering that the mean longitude (sidereal) of the Sun at the moment of Mesha-Sankrânti is always 357°·86, owing to his apogee being considered fixed. (See Secs. 190 and 192.)

Date of Summer Solstice in B. C. 483.

Explanation.	B. C. year.	☉'s longi-tude (8)	☉'s anom.	Date (9)	Tithi Tab. 18
				days.	
At Meshâdi, Example Sec. 97..	483	357°·9	280°·6	M 10·26	26·6
Table 5, Col. (8), (9) motion ..	..	100·0	100·0	101·50	103·0
Do. do. do. ..	..	8·0	8·0	8·10	8·1
Do. do. do. ..	..	0·6	0·6	0·60	0·6
Mean longitude	..	106·5	29·2	120·46	138·3
Table 31, Arg. 29°·2, ☉'s eqn.	—1°·0	chang-ed. to	+1°·0		
Do. 30°·2, ☉'s eqn.	—1°·1	,,	30·2	+1·10	0·0
Total days from March 0				121·56	138·3
Table 11, days from March 0 to June 0 ..			..	92·00	120·0
Date of the Solstice B. C. 483 June ..			Old Style	29·56	18·3
By D. B. Pillai's calculation, Chro. page 5 ..			..	29·59	Sec. 152e

The reason of adding the Sun's equation of centre to the anomaly with its sign changed is to account for the change in the Sun's equation, which influences the time of the Sun's attaining the required true longitude.

Note.—In the Old Style the Solstices recede on the dates as the years advance. To stop the recess is the main object of the New Style, which has, since its adoption, fixed 21st June as the day of the Summer Solstice. Before the reformation in the Calendar of Julius Cæsar, it was 25th June.

100. The later Sûrya Siddhânta has been the *Almagest* of India for the last 15 centuries, and has been acknowledged as authority in matters astronomical. Almost all the subsequent works on astronomy have been more or less based on it and it is much venerated in India as being a direct revelation from the Sun. (*Vide* Sec. 207.) As all the past civil and religious transactions have been guided by the Panchângas conforming to it, it is absolutely necessary for the Epigraphist to use them as searchlight in his difficult work of verifying and fixing the dates of ancient events.

But it would be *unreasonable* to adhere to it in future when the great discoveries, the accurate observations, and the refined methods of calculation of modern European astronomers are available to us. We must venerate and admire it as an ancient relic, testifying to the high degree of excellence attained by the ancients under very adverse circumstances. [*Vide* Chap. XVII, Note 15, (d).]

Already Panchângas based on the Nautical Almanac have gained considerable popularity among the educated men for their perfect agreement with the easily observable phenomena, such as the eclipses and conjunctions of planets. But however accurate the calculations of the Nautical Almanac may be, it would be *unwise* to remain permanently dependent on it, as it is in itself an annual publication. We must have our own works on astronomy, prepared in the light of modern researches and discoveries.

The last Indian Astronomer worthy of the name was *Ganesh Daivajna* who wrote his famous *Grahalâghava* in the year A.D. 1520, *i.e.*, exactly four centuries ago. He has united in his book both accuracy and ease, the most desirable qualifications of a *Karana*, to such a degree that no one has since been able to surpass him. He has well maintained the respectable position conferred on him by posterity.

But unfortunately he lived in an age, long before the dawn of modern Astronomy. The Copernican Solar System, Kepler's laws, Newton's law of gravitation, the invention of the telescope, the theory of perturbations developed by Lagrange and Laplace, the lunar theory perfected by Hansen, Delaunay and Newcomb, the discovery of the new planet Neptune from the perturbations of Uranus, by Leverrier and Adams, these are the triumphs of Modern Astronomy which were not even dreamt of in his time.

The present author thinks that it would not be considered out of place to mention here, that he has done his best to fill up the gap of these four centuries by securing, for his country-men, the benefit of the later Western discoveries. He has composed in A.D. 1898 works in Sanskrit called *Jotirganitam, Ketaki and Vaijayanti*, in which he has based his calculations on the elements and constants determined by Leverrier, Hansen and Newcomb. But almost all the tables in his *Jyotirganitam* had to be reconstructed so as to suit the Hindu method of calculation. He has composed 7 other works in Sanskrit and Marathi on such subjects as the problem of two bodies, the theory of elliptic motion, the path of the Moon's penumbra on the surface of the Earth, the star atlas and the like. The example of a tithi worked out in the next Section will, it is hoped, testify to the accuracy accomplished in his Jyotirganitam.

101. Problem.—To calculate the ending moment of a tithi from the corrected elements of Sûrya Siddhânta so as to agree, within a few palas, with that obtained directly from the Nautical Almanac.

Method.—Calculate the mean ending moment of the given tithi T, according to Sections 77, 78 and 79.

Add to the elements of Vâra, the English date, and the Moon's anomaly, the following *constants* of correction, *viz.*, + 0·014, + 0·014 and + 3°·33 respectively. These constants will serve for the next one or two centuries. The Sun's anomaly requires no correction whatever.

102. Then, as before, enter Table 6 with the Sun's anomaly, take out the Sun's equation, and write it below the Vâra and the date of the mean tithi T.

Multiply the Sun's equation by 12, and add the product in degrees to the Moon's anomaly. Deduct from this corrected anomaly of the Moon, the product of the monthly tithi by twelve, *i.e.*, 12° × monthly tithi (see the definition in Section 86) and the remainder will be the vertical argument of Table 12. The monthly tithi itself should be taken for its horizontal argument.

Table 12 is an instance of double entry. When the monthly tithi lies at the top, we should enter the Table with the vertical argument commencing at the left-hand top-corner, and take out the Moon's equation with the left hand sign attached to it. But when the monthly tithi lies at the bottom, we should enter it at the right hand bottom-corner, and take out the equation with the right hand sign attached to it, as is done in the next example.

103. Example.—We will calculate the ending moment of Nija Shrâvan Krishna Ṣhasṭhi 6, of Shaka year 1831. The difference between the ancient and modern tithis is greatest about the 9th and 21st monthly tithis for a given Sun's position from the Moon's apogee. Here the monthly tithi is the 21st.

Type of Calculation.

Explanation.	Shaka year.	A.D. year.	Tithi.	Vâra.	A.D. date.	☾'s anom.	☉'s anom.
Tab. 3	1822	1900	13·027	5·620	A.12·620	7°·39	280°·6
,, 4	8	8	28·518	3·070	3·070	16·76	0·0
,, 4	1	1	11·065	1·259	0·259	92·09	0·0
At Meshâdi ..	1831	1909	22·610	2·949	12·949	116·25	280·6
Complement ..	..	..	·390	·384	·384	4·99	·4
S. Completed tithi ..			23	3·333	13 333	121 24	281 0
Tab. 5, Arg. R 148 ..			100	0·435	98·435	206·10	97·0
			40	4·374	39·374	154·40	38·8
			8	0·875	7·875	102·90	7·8
T. mean tithi Shrâ. 21 ..			171	2·017	159·017	224·64	64·6
Correction Sec. 101			..	+·014	+·014	+3·33	0·0
Jyotirganita Shrâ. 21 ..			171	2·031	159·031	227·97	64·6
Tab .6, Arg. 64°·6 ☉'s Eqn. ..				— 161	—·161	—1 93	—0 161
						226 04	×12
21 × 12° = 252° ☾—☉				..	..	—252 00	=—1 93
Tab. 12, Arg. 334° ☾'s Eqn. ..				—·495	— 495	334 04	..
True tithi ends ..				1 375	158 375	..	..
Tab. 11, April 0 to Sept. 0				days	153	..	..
Sept. 5, Sunday. True tithi ends at				..	5 375	=22 gh.	30 pa.
By N. Almanac				..	5 367	=22 gh.	2 pa.
By D. B. Pillai				..	5·403	=24 gh.	12 pa.

Note.—The reader will note that the method of Jyotirganita is direct and not hampered by successive approximations.

The ending moment of the tithi comes to 22 gh. and 2 pa. when worked out with the data of Nautical Almanac, using the method of Interpolation.

Our Table 12 is taken from our Jyotirganitam. It is formed by the combination of the Variation, Evection, the equation of centre of the Moon, and a few minor inequalities depending upon the combinations of the different multiples of the Moon's anomaly and elongation.

104. *Karaṇas.*—The Karaṇas (Section 25) are the halves of the tithis. So there are 60 Karaṇas in a Lunar month. Their number is made up by the repetition of the 7 Karaṇas eight times in a lunar month, beginning with the second half of the Shukla pratipadâ which is called *Bava*, and ending with the first half of the Krishna Chaturdashi which is called *Bhadrâ* or *Visti*. The remaining four Karaṇas are immovable. See the Appendix.

Their calculation.—The ending times of the Karaṇas, which are assigned to the second halves of each tithi, coincide with those of the tithis themselves and therefore there is no need for their calculation. The ending times of the first halves or Karaṇas of tithis are got by adding the Vâra, ghatis, and palas of two consecutive tithis successively, and dividing the sums by two.

In a Panchânga the ending time of that Karaṇa alone is shown. which is current at sunrise.

CALCULATION OF TITHIS

According to the Arya and Brahma Siddhantas

(*Special Tables* 14 *and* 16 *to be used.*)

105. These two Siddhântas have been in use only since the beginning of the 4th century of the Shaka Era. As their constants are almost identical with those of the Sûrya Siddhânta (*vide* Table 37), it is not considered advisable to prepare all the foregoing tables for each of them, except the table of elements for the centuries. We have therefore prepared Tables 14 and 16 to be substituted for Table 3 of the Sûrya Siddhânta in the calculation of the tithis, etc., and Tables 15 and 17 to be substituted for Table 13 in the calculation of Sankrântis, according to the Ârya and Brahma Siddhântas respectively. The rest of the Tables 4-10 are to be used as before.

The Siddhânta Shirômaṇi of Bhâskarâchârya has, we believe, never been used as a basis of Panchângas. It occupies the highest place among theoretical works and is often quoted as authority on points of theory only. His *Karaṇa-Kutûhala* has been thrown into back ground by the Grahalâghava of Ganesha. So it is of little use to prepare tables based on the constants of Shirômaṇi. Bhâskarâchârya was an admirer and follower of Brahmagupta.

106. As a model we shall calculate below, the ending moment of the famous tithi, Ashâḍha Shukla 12, of Shaka year 406 or A.D. 484 by making use of the elements of the two Sjddhânats.

According to the Arya Siddhânta

Ashâḍha Shukla 12, *Shaka* 406.

Tables.	Shaka.	A.D.	Tithi.	Vâra.	A.D. March.	☾'s anom.	☉'s anom.
	Year.	Year.	..	Days.	Days.	Degrees.	Degrees.
14 ..	422	500	2·283	0·361	18·361	309·13	280·0
4 ..	—16	—16	—27·037	—6·140	—0·140	—33·51	0·0
At Meshâdi.	406	484	5·246	1·221	18·221	275·62	280·0
Complement	..	..	·754	·742	·742	9·65	0·7
..	S	..	6	1·963	18·963	285·27	280·7
5 ..	R.	..	90	4·592	88·592	77·50	87·3
			6	5·906	5·906	77·20	5·8
..	T.	..	102	5·461	113·461	79·97	13·8
6 Arg. 14° Sun's eqn. ..				—·043	—0·043	—0·52	—·043
7 Arg. 79°5, ☾'S eqn. ..				+·412	+·412	79·45	×12=
40 .. Thurs. 49 gh. 48 pa...				5·830	113·830	June 21	—0·52
See infra.							

According to the Brahma Siddhânta

Ashadha Shukla 12, *Shaka* 406.

Tables.	Shaka.	A.D.	Tithi.	Vâra.	A.D. March.	☾'s anom.	☉'s anom.
	Year.	Year.	..	Days.	Days.	Degrees.	Degrees.
16 ..	422	500	1 357	6·461	17·461	296·62	280·6
4 ..	—16	—16	—27 037	—6·140	—·140	—33·51	—0·0
At Meshâdi.	406	484	4·320	0·321	17·321	263 11	280·6
Complement	..	..	·680	·670	·670	8·71	·7
	S,	..	5	0·991	17·991	271·82	281·3
	R.		90	4·592	88·592	77·50	87·3
			7	6·890	6 890	90·06	6·8
..	T,	..	102	5·473	113·473	79·32	15·4
6 Arg· 15°·4, ☉'s eqn. ..				—·047	—·047	—·56	— 047
7 Arg· 78° 8, ☾'s eqn. ..				+·411	+·411	78·76	×12=
40 .. Thurs. 50 gh. 13 pa.=				5·837	113·837	June 21	— 56
11 March 0 to June 0 days ..					92·		
					21·		

Note.—The ending times calculated by Diwan Bahadur L. D. Swami Kannu Pillai are exactly the same as the above ones.

107. The Ekadashi Fast.—The Mâdhvas and Vaishṇavas in the Karṇâtaka are strictly enjoined by their Spiritual Gurus to follow the Ârya Siddhânta in the observance of the fortnightly Fast of Ekâdashi. This partiality for the Ârya Siddhânta is probably due to the fact that both Aryabhatta and Shri Madhvâchârya were natives of Malayâlam.

But the elements of the Ârya Siddhânta not being accurate enough (compare Tables 3 and 14), the Ârya Siddhânta Tithi ends at present (A.D. 1920) 3 gh. 50 pa. later than the Sûrya Siddhânta Tithi. For this reason the Sûrya Siddhânta Panchângas have been in general use throughout the Karṇâtaka, and the Ârya Siddhânta Panchânga is nowhere followed except at Udipi, which is the Holy place of Madhvism in South Canara.

The day being supposed to begin with the 56th ghati for religious purposes, there is the possibility of the Ârya Siddhânta Ekâdashi being contaminated by the touch of the Dashami, when the Sûrya Siddhânta Dashami ends at about 52 ghatis. This is the occasion for the most scrupulous care in the calculation of the ending moments of the three tithis, beginning with the Dashami, exclusively with the Ârya Siddhânta elements. This is generally done with the help of the Karaṇaprakâsha. But in obedience to the precept of Vidyâdhisha Muni the Rekhântara correction must be omitted in the calculation of the Sâvana Time.

Example.—We shall calculate Pausha Krishna 12 of Shaka year 1841 for the latitude of Bijapur, *viz.*, 17° North. This was the occasion of a protracted, *i.e.*, Atiriktâ Ekâdashi, when the fast lasted 2 days & produced a general agitation among the Mâdhvas.

Pausha Krishna 12, *Shaka year* 1841.

Explanation.	Shaka.	Tithi.	Vâra.	☾'s anom.	☉'s anom.
Tab. 14 Ârya ..	1822	12·855	5·514	7°·73	280°·00
4 ..	16	27·037	6·140	33·51	0·00
4 ..	3	3·194	3·776	276·28	0·00
At Meshâdi	1841	13·086	1·430	317·52	280·00
Complement	..	·914	·900	11·70	0·90
S.	..	14	2·330	329·22	280·90
Tab. 5	R. {	200	0·871	52·11	194·03
		80	1·748	308·84	77·61
		3	2·953	38·58	2·91
T, Pausha ..	vadi 12	297	0·902	8·75	195·45
Tab. 6, Arg.	195°·4	☉'s eqn.	+·048	+0·58	+·048
Tab. 7, Arg.	9°·3	☾'s eqn.	+·075	9·33 ×12	=·58
The tithi ends (U. M. T.) ..	..	Sunday	1·025	=1 gh.	30 pa.

We must now calculate the corrections to be applied to the above meantime to reduce it to the duration from Bijapur Sunrise by Section 182. The equinoxial shadow for 17° is 3·7 by Table 34.

We first calculate the Sun's tropical longitude by Section 173.

Sun's anomaly, in the above example	195°·45
,, apogee	77·26
,, equation	0·05
The precession Tabs. 3, 4	22·83
Tropical longitude of Sun	295·59

Then we obtain from Table 33—	gh. p.
Arg. 195°·45, Bhujântar	—0 5
Arg. 295·59 gives —18·33pa. —18·33 × 3·7 shadow = Chara	—1 6
Meantime of ending moment	1 30
Time from Bijapur Sunrise	0 19

The result shows that, Dwâdashi ending 19 palas after the Sunrise, the Ekâdashi was *Atiriktâ*, so that the fast had to be observed for two days.

CHAPTER X

THE SOLAR CALENDAR

Sankrantis, Adhika and Kshaya Months, and Solar dates

(*According to the Sûrya Siddhânta.*)

108. The Sankrantis.—When the tithi Shuddhi and the Vâra, specially called *Abdapa*, at the moment of Meshâdi for any given year is obtained by Section 77, the mean tithi and Vâra of the remaining Sankrântis are obtained by adding to them the increase upto the beginning of each Sankrânti given in Table 13. This is exemplified in the calculation of the Adhika months.

Adhika Months.—Calculate the elements for the Meshâdi of the given year by Section 77. Refer the tithi-Shuddhi to Section 69 and find out the probable Adhika month.

Refer the probable adhika month to Section 70 and find out the preceding and the connected Sankrântis of the probable adhika month.

Write the elements of Meshâdi in two places and add to them separately, as given in Table 13, the increments upto the beginning of the preceding and current Sankrântis.

Then calculate by Sections 78, 79, 80, the ending moment of the nearest Amânta, *i.e.*, the New Moon, using Table 5, and negative complement where necessary.

Thus you get the ending moments of two consecutive Sankrântis and Amântas.

Write these four results in the order of their occurrence. If the Amântas lie between the Sankrântis, then the assumed month is adhika *de facto*. If not, the preceding or the following month should be treated as above.

In the determination of a Kshaya month, a series of consecutive Amântas and Sankrântis, beginning with Kârtika, must be calculated and arranged in the order of their occurrence, before it is possible to determine the Adhika and Kshaya months by the Definitions of Section 68.

Fortunately the Kshaya months are of very rare occurrence.

Example.—Calculate the Adhika Shrâvana of Shaka year 1831. See Ex. Sec. 82. We must calculate the Karka and Sinha Sankrantis here.

Time of Karka Sankrânti and 4th Amânta.

Explanation.	Shaka.	Tithi.	Vâra.	☾'s anom.	☉'s anom.
				°	°
At Meshâdi	1831	*22·630	2·949	116·49	280·60
Tab. 13, Karka motion ..	..	95·494	3·000	148·10	92·90
Karka Sankrânti, time of ..	..	118·124	5·949	264·49	13·50
Complement	..	·876	·862	11·20	·86
		119·	6·011	275·69	14·36
Tab. 5, R.	..	1·	·984	12·86	0·97
		120	6·995	288·55	15·33
Tab. 6, Arg.15·3, ☉'s equation	..	..	—·047		
Tab. 7, 288·5 ☾'s equation	..	..	—·403		
Time of 4th Amânta ..	..	..	6·545		

* The correct number for tithi is 22·610. See example of Section 82.

Time of Sinha Sankrâṇti and 5th Amânta.

Explanation.	Shaka.	Tithi.	Vâra.	☾'s anom.	☉'s anom.
At Meshâdi	1831	*22·630	2·949	116·39	280·60
Tab. 13, Sinha.. ..	..	127·470	6·476	199·30	123·70
Sinha Sankrânti, time of ..	..	150·100	2·425	315·69	44·30
		—·100	—·100	—1 30	— 10
		150	2 325	314 39	44·20
Tab. 6, Arg. 44, ☉'s equation		.. ..	—·135		
Tab. 7, Arg. 314 ☾'s equation		.. ..	—·316		
Time of 5th Amanta..		..	1·874		

ORDER OF OCCURRENCE

Karka Sankrânti ..	Thursday	.. 5·949	Âṣhâḍha.
4th Amânta ..	Friday	.. 6·545	Adhika
5th Amânta ..	Sunday	.. 1·874	Shrâvana.
Sinha Sankrâṇti ..	Monday	.. 2·425	Nija Shrâvana

Note.—The Shrâvana is adhika, there being no Sankrâṇti between the 4th and 5th Amântas.

The Solar Calendar

109. *Explanation.*—The present Indian solar calendar is in principle the same as the Christian calendar, both depending on the period of the Sun's revolution, which is sidereal in the former and tropical in the latter.

The duration of a month in the former is the time which the Sun takes to go over each sign or Râshi, and consists of fractional and integral days; while that of the months in the latter is arbitrary, and consists of entire days which facilitate the calculation.

The Indian solar calendar, compared with the Luni-Solar is very simple; and probably it is on this account that it has been

* The correct number for tithi is 22.610. See example of Section 82.

adopted by our brethren dwelling in the eastern and southern maritime provinces. Undisturbed by adhika months, its dates are more in harmony with the seasons. As the days begin at Sunrise invariably, there is not much ado about the fixing of the socio-religious holidays. But the luni-solar calendar, notwithstanding its inconveniences, is more phenomenal and attractive Coming from the north and west, it has pushed the solar calendar towards the southern and eastern shores, and has forced its way to the sea between Vizagapattana and the mouths of the Krishṇâ.

110. The Indian solar months and dates may be classified under two heads, *viz.*, *The Bengal-Orissa* and the *Tamil-Malayâlam.* The former class exclusively follows the Sûrya Siddhânta and the latter the Ârya Siddhânta. In the first class, the dates are quoted in the Bengali San and Vilâyati eras ; while in the latter class they are cited in Kaliyuga, Shaka or Kollam eras.

111. The following is a list of *Solar Months* with their concurrent Râshis :—

No.	Râshis.	Bengal-Orissa S. months.	Tamil S. months.	Malayâlam S. months.
1	Mesha ..	Vaishâkha ..	Chittirai ..	Medam.
2	Vrisha ..	Jyestha ..	Vaikasi ..	Edawam.
3	Mithuna ..	Âshâdha ..	Ani ..	Mithunam.
4	Karka ..	Shrâvana ..	Adi ..	Karkâtagam.
5	Sinha ..	Bhâdrapada ..	Avani ..	Chingam.
6	Kanyâ ..	Âshvina ..	Purattasi ..	Kanni.
7	Tulâ ..	Kârtika ..	Aipasi ..	Tulam.
8	Vrishchika ..	Mârgashirsha	Kartikai ..	Vrischikam.
9	Dhanu ..	Pausha ..	Margali ..	Dhanu.
10	Makara ..	Mâgha ..	Tai ..	Makaram
11	Kumbha ..	Phâlguna ..	Masi ..	Kumbham.
12	Mîna ..	Chaitra ..	Panguni ..	Meenam.

THE BENGAL ORISSA SOLAR DATES

(In the calculation use Tables 3, 4, 13.)

112. The object of this, as well as of the next, section is to enable the student to convert any Indian Solar date into its corresponding Christian date.

Method.—If the citation of the date contains the year of the Bengal San, it must be changed into the corresponding A.D. year by adding to it 593 years. (Table 1.)

With the A.D. year as argument, take down from Table 3 the 2nd and 3rd elements of the required century, and add to them their increase for odd years given in Table 4, and add them up, taking care to cast out thirties from the Tithi-shuddhi when it exceeds thirty.

Below the sums write the increase up to the given Sankrâṇti or month, as given in Table 13, and sum them up. Thus we get the elements for the moment when the Sun enters the given sign or Sankrâṇti. Here we should pause a little and determine the English date on the first day of the Sankrâṇti according to the following *Bengal usage.*

(*a*) If the decimal fraction of the Vâra of the Sankrâṇti be less than 0·750, add its complement to the Vâra as well as to the English date. But if the fraction exceeds 0·750, increase the complement by unity before adding up. The sums will show the weekday and the English date current on the *first day* of the Bengal solar month.

Then add the remaining days of the solar month to the Vâra and the date, and determine the English month and date with the help of Table 11.

(*b*) **The Orissa Usage.**—In the case of Orissa where the Amâli and Vilayati eras are used, the decimal fraction of the Vâra of the Sankrânti should always be deducted from the Vâra.

Example.—Find out the A.D. year, month and date corresponding to the Bengal San 1317, Solar Mâgha, 28th date. Here 1317 + 593 = A.D. 1910.

Explanation.	A.D.	Vâra.	A.D. date.
Tab. 3 ..	1900	4·620	A.12·620
„ 4 ..	8	3·070	0·070
„ 4 ..	2	2·517	·517
Meshâdi	1910	3·207	A.13·207
Tab. 13, Mâgha, ...	..	2·637	275·637
Fraction ·844 exceeds ·750	..	5·844	288·844
Therefore add complement + 1	..	1 156	1 156
On Mâgha 1		0 000	290·
Add 27 to date and 6 to Vâra	..	6 000	27·
On Mâgha 28	..	6	317·
Tab. 11, April 0, to February 0, ..	..	..	—306·
Eng. date, Friday .. ..11th February 1910		..	11

Note.—According to the usage of Orissa, the date would be 9th February.

The Tâmil-Malayâlam Solar Dates

(In the calculation use Tables 14, 4 *and* 15.)

113. The method of calculation is precisely the same as that of the preceding section. Only we must make use of Tables 14, 4, and 15, instead of Tables 3, 4, and 13 of the Bengal-Orissa dates and attend to the following usage as regards the determination of the date of the first day of the Solar month.

The Tamil and Malabar usage.—If the decimal fraction of the Vâra at the beginning of the Sankrânti be less than ·500, the fraction should be deducted from the Vâra and the date. But if the fraction exceeds ·500, its complement should be added to Vâra and the date, to get the same *i.e.*, Vâra and date, on the first day of the solar month.

The rest of the process is the same as before.

Example.—Find out the English year, month and date, corresponding to the Kollam Andu Era year 1086 (current), Dhanu 20th. The Kollam year changes with Kanni after September 15. this case 1085 (expired) + 825 = A.D. 1910 (Table I).

Explanation.	A.D.	Vâra.	A.D. date.
Tab. 14	1900	5 514	A.12 514
,, 4	8	3 069	0 069
,, 4	2	2 517	0 517
,, 15 Dhanu	..	1 304	246 304
Fraction ·404 is less than ·500 ..	1910	5 404	259 404
∴ By Malabar usage	..	— 404	— 404
On Dhanu 1	..	5	259·
Add 19 and 5, the change in Vâra ..	..	5·	19·
20	..	3·	278·
Tab. 11, April 0 to January 0 ..	..	..	275·
Dhanu 20 = January 3rd 1911	..	Tuesday	3

The authors of the Indian Calendar state that the limiting fraction for the Malabar usage is 300. If this be the case, the 20th of Dhanu would coincide with the 4th of January 1911.

Note.—Although the determination of the first day of a solar month is not uncertain when the local usage is known, yet it would be well for the people, who use the Solar Calendar, to mention the week-day of their dates, like the Arabs, who use the lunar-Calendar months, the first day of which is decided by the actual appearance of the thin crescent. (See footnote to Section 132.)

Problem.—To convert an A.D. date into the solar one.

114. The method of solving this problem is the reverse of that of the preceding sections 112 and 113.

Change the century year of A.D. by means of Table 1 to its corresponding Bengal San or into Kollam year as the case may require.

Find the Vâra and the date for the Meshâdi of the given A.D. year by using Tables 3 and 4 in the case of the *Bengal-Orissa* dates ; and Tables 14 and 4 in the case of *Tamil-Malabar* dates. But when the date belongs to the month of January or February, the Vâra and the date for the Meshâdi of the *preceding* A.D. year should be used.

Find out by Table 11 the days elapsed from the beginning of the English month of Meshâdi, upto the given English month and date and denote them by T. Deduct from T the days of Meshâdi and call the remainder R.

Add to the date of Meshâdi the days in Table 13 or 15 under column (3), that are next to but less than R, and the sum will mark the beginning of the Solar month.

Apply to the sum the correction of usage, and determine the entire number of days on the first day of the solar month and deduct them from T, and add 1 to the remainder. The result will denote the current Solar date.

Example.—Calculate the solar date of the Bengal San corresponding to the 11th of February A.D. 1911.

Here the A.D. date being in the month of February, we should calculate the date of Meshâdi of the preceding year A.D. 1910.

We deduce from Table 1 that the year A.D. 1900 corresponds to (1900 — 593) = 1307 of the Bengal San.

Also by Table 11 the interval from April 0 to the 11th February is 317, which we denote by T. Deducting the 13 days of April in the following calculation from 317, we get 304 for R.

On referring to Table 13, we see that under column 3 the number of days next lower to 304 is 275·637, which, being added to the days 13·207 of Meshâdi, gives 288·844 days from April 0 to the beginning of the Mâgha month. Then adding 1·156 for Bengal usage we get 290 complete days for Mâgha 1.

Explanation.	B. San	A.D.	Vâra.	A.D. date.
Tab. 3	1307	1900	5·620	A.12·620
„ 4	8	8	3·070	0·070
„ 4	2	2	2·517	0·517
Meshâdi	1317	1910	4·207	A.13·207
13 Days of Mâghâdi < R, less than R	..	..	2·637	275·637
Mâghâdi	..	..	6·844	288·844
Bengal usage ..	..	..	1·156	1·156
Mâgha	1	..	1·000	290·000
Tab. 11, T.	..	..	..	317·000
	27	..	6·000	27·
Mâgha	28	date	000·0	sought.

VERIFICATION OF DATES

THE TITHI.

115. How the toil of computation can be minimised.— In the preceding Sections we have described the methods of accurate calculation which deserve to be employed in cases of exceptional importance. No epigraphist, however zealous and energetic he may be, will be found willing to undergo so much trouble in each case. A simpler and shorter method is no doubt necessary even though it be at the cost of a little accuracy, which is not always necessary in the work of verification.

This is possible if we calculate a given tithi by means of the solar elements of Table 13, using only two decimal places in the computation and the Supplementary Table 5, where necessary.

We might also dispense with the nicety of adding the Sun's equation of centre to the Moon's anomaly, the omission of which will, at the most, produce a variation of one ghati in the ending moment of the tithi.

THE NAKSHATRA

The mean value of a nakshatra current with a tithi can also be very easily derived by the following short formula.

$$5{\cdot}8 + ({\cdot}9 \times \text{tithis}) + \left(\tfrac{3}{40} \times \odot\text{'s anomaly}^{\circ}.\right)$$

116. We shall present below one or two models of working without lengthy explanations, assuming that the reader has fully mastered the theory and reasoning of the foregoing calculations. (*Vide* Secs. 94, 95.)

As a ***first example*** we shall test the accuracy and genuineness of the inscription at ***Eran*** which bears the date, Shaka year 406, Âshâdha Shukla 12, Thursday. (*Vide* Section 94.)

We should calculate here the elements for the Karka Sankranti which is allied to Âshâdha.

Explanation.	Shaka.	A.D.	Tithi.	Vâra.	A.D. date.	☾'s anom.	☉'s anom.
Tables.							
3	322	400	5·78	0·49	M.17·49	104°·2	280°·6
4	84	84	29·44	0·73	0·73	175·9	0·0
At Meshâdi ..	406	484	5·22	1·22	M.18·22	280·1	280·6
13	..	..	95·48	3·00	94·00	148·1	92·9
Karkâdi ..	..	..	100·70	4·22	112·22	68·2	13·5
Completion ..	..	..	·30	·30	·30	3·9	·3
			101·00	4·52	112·52	72·1	13·8
5		..	1·00	0·98	0·98	12·9	1·0
Ashâdha Sh. 12		..	102·00	5·50	113·50	85·0	14·8
				—0·05	—0·05		
				+·41	+0·41		
Thursday		..		5·86	113·86	51 gh.	36 pa.
11, March 0 to June 0				..	92·00		
English date ..		..			21	June	

Similarly by the preceding formula,

The Naksahtra $= 5{\cdot}8 + ({\cdot}9 \times 12) + ({\cdot}075 \times 14{\cdot}8)$

$= 5{\cdot}8 + 10{\cdot}8 + 1{\cdot}1 = 17{\cdot}7 =$ 18th or Jyesthâ.

Example 2.—Verify the date Shaka 1106 on the day of ***Shatabhishaja,*** which was the 14th tithi of the first fortnight, and ***Wednesday,*** the 26th Solar day of the month of Sinha.

This inscription is cited in ***Epigraphia Indica,*** Supplement to Vol. VII, p. 132, as quoted by D. B. Pillai, Chronology, p. 74.

Explanation.	Shaka.	A.D.	Tithi.	Vâra.	A.D. date.	☉'s anom.
Tables.						
3 ..	1122	1200	7·64	6·49	M.24·49	280·6
4 ..	—16	—16	-27·04	—6·14	—0·14	—0·0
Meshâdi	1106	1184	10·60	0·35	M.24·35	280·6
13	..	..	127·47	6·48	125·48	123·7
Sinhâdi			138·07	6·83	149·83	44·3
Tamil usage			·17	·17	0·17	·2
1 of Sinhaa			138·24	0·00	150·00	44·5
25 (by Tab. 11.) ..			25·40	4·00	25·00	25·0
26 of Sinh ..			163·64	4·00	.175·00	69·5
Complement ..			·36	·36	·36	0·4
Bhâdrapada 14			164·00	4·36	175·36	69·9
11 March 0 to August 0 ..			..	..	153·00	
The Mean tithi ..			ended	Wed.	22·36	August.

The Nakshatra $= 5·8 + 12·6 + 5·2 = 23·6$; Shatabhishaja current.

Note.—The inscription is therefore correct in all its citations.

117. The Samvatsara cycle of 60 years—Origin.—This 60 year-cycle probably had its origin in the approximate coincidence of the periods of the Jovian and Saturnian revolutions round the Sun. It is the smallest of the cosmic cycles, at the end of which all the five planets assume very nearly the same geocentric configuration as they had at its beginning, deviating on favourable occasions within six degrees one way or the other.

Use.—Formerly people remembered the name of Samvatsara of the year in which they were born, and when asked how old they were, they replied by stating the Samvatsara of their birth. The Samvatsarás were also remembered as an aid to the memory of great calamities, such as famines, floods and epidemics; for instance the great famine of *Ishwara-Samvatsara* is named after it. The cycle also coincides with the ordinary span of human life. According to the Dharma-Shâstras a pious Hindu must perform the Shânti or penance on the completion of his 60th year.

Viewed from the point of public utility it must be considered unwise to break its continuity, as is done in Northern India, by adopting in its place the *Jovian mean sign system*, which necessitates the suppression of a Samvatsara in the course of 85 years. The people of the Deccan have wisely adhered to the old custom of changing the Samvatsara regularly at the beginning of the year. At present the northern cycle has advanced over the southern by 12 Samvats on account of the suppression.

The cycle of 60 Samvatsaras seems to have been in use throughout India from remote antiquity. Aryabhatta says that he was 23 years old when 60 cycles, of 60 years from Kali-yuga, had expired, *i.e.*, in Kali 3600. This implies that the 60 year cycle has been in use without any interruption or suppression for 50 centuries. We have shown in section 153 that the Indian and the Chinese 60 year cycles had probably a common origin.

118. To calculate the Samvatsara in the 60-year cycle.—Table 19 furnishes, at a glance, the Samvatsara current with a given A.D. year, from the month of March to the end of December. If the given year be of the Shaka Era, it should be converted into that of the A.D. Era by adding 78 to it.

The name of a Samvatsara can also be found from table 19 when its index number is known.

The following three formulæ will be found useful in determining the Samvatsara independently of the Table 19.

Samvatsara = Q (Kali years + 13) ÷ 60.
= Q (Shaka years + 12) ÷ 60.
= Q (A.D. years + 54) ÷ 60.

The symbol Q is used here in a new mathematical sense. The lower stroke is supposed to signifty the remainder left after the division. In the above three formulæ the quantities within the brackets are to be divided by 60, and the remainder to be taken for the Samvatsara. For instance, the Samvatsara for Shaka year 1840 is 52 = Q (1840 + 12) ÷ 60, *viz.*, the Kâlayukta (Table 19).

CHAPTER XI

The Jovian mean-sign cycle of 60 Samvats used in Northern India

119. Probable Origin.—The mean sign cycle of Jupiter alluded to in the Sûrya Siddhânta appears to belong to the period of Samhitâs which preceded, by many centuries, the introduction of the Siddhântas, in India. But its re-introduction into usage on the new basis of exact calculation appears to be comparatively later. This can be inferred from the fact that its commencement is quite abrupt in the list of Samvatsaras, as it begins with *Vijaya*, the 27th Samvatsara. The choice of the first year Vijaya appears to be deliberate, as it is meant to impress the minds of the followers with its meaning of *sure Victory*. Bhâskarâchârya defines the mean sign Samvatsara in the following manner :—

बृहस्पतेर्मध्यमराशिभोगं संवत्सरं सांहितिका वदन्ति ॥

Here the word Sâmhitika appears to be used with the special object of pointing to its origin, as much as to say that the introduction of the mean sign system originated with the authors of Samhitâs and not with an astronomer. In our opinion the Jovian mean-sign cycle serves no useful purpose, but on the contrary it creates confusion and ambiguity in chronology, not only by its two-fold-practices of being current either at the beginning of the year or at the date but also by the occasional suppression of years. One should like to see it replaced by its elder Deccan sister. (*Vide* Sec. 117.)

Problem.—To find the Samvat current at Meshadi

(*First Practice.*)

120. The problem can be solved by the help of the following formula :—

Samvat = 18·005 + 1·0117 (A.D. years — 831.)

Example.—Find the Samvat, current at the Meshâdi, of A.D. 1515.

Putting the year 1515 in its place in the above formula and solving it, we get—

Samvat = 18·005 + 1·0117 (1515—831).
= 18·005 + 1·0117 × 684.
= 50·008 = The Subhânu in the list of Sec. 122.

But this same result can be obtained by mere addition by means of Table 20, which we have borrowed from D. B. Pillai's Chronology. The theory of its construction will be found explained in Sec. 121.

Rule.—From Table 20, part A, take down the element for the century of A.D. era; add to it the increase for odd years from part B, and cast out sixties from the sum. Refer the integers of the remainder to the list in Sec. 122, and you will get the name of the Samvat current at Meshâdi.

Example.—Find out the Samvat current at the Mesha Sankrânti of A.D. years 1514 and 1515.

EXPLANATION.	A.D.	SAMVAT.
Tab. 20, part A, Samvat for ..	1500	34·832
„ B, increase for ..	10	10·117
„ B, increase for ..	4	4·047
48, Vrisha at Meshâdi of	1514	48·996
B, increase for ..	1	1·012
50, Subhânu, at Meshâdi of ..	1515	50·008

The Samvats for the A.D. years 1514 and 1515 are Vrisha and Subhânu respectively. The Samvat 49, Chitrabhânu, having no touch with either, is suppressed like the Kshaya tithi or the Kshaya month. This example illustrates the occasion when, and the reason why, it is necessary to *suppress* a Samvat.

121. We will now give the theory of Table 20, which is prepared by mere continuous summation.

Theory.—The length of a Samvat is the mean period in which Jupiter finishes one sign or 30 degrees. It is therefore equal to one-twelfth of its mean periodic time, and is 361·0267 days. It is shorter than the sidereal year by 4·232 days. The result of this defect is that in 85·308 years there occur 86·308 Samvats. This superfluous Samvat is therefore to be suppressed like the tithi (Sec. 35).

In one year the increase in the Samvat amounts to $4 \cdot 232 \div 361 \cdot 0267 = 0 \cdot 0117$, consequently,

$$1 \text{ year} = 1 \cdot 0117 \text{ Samvats.}$$

$$100 \text{ years} = 101 \cdot 17 \text{ Samvats} = 1 \text{ cycle} + 41 \cdot 17 \text{ Samvats.}$$

The mean longitude of Jupiter according to the Sûrya Siddhânta with its Bîja for A.D. 78, was 3216 signs $5^\circ\ 49' 4'' = 3216 \cdot 1943$. Omitting cycles of sixty Samvats there remain $36 \cdot 1943$ Samvats.

The increase for 22 years at the rate of 1.0117, is 22.2574. Adding $36 \cdot 1943 + 22 \cdot 2574$ we get $58 \cdot 4517$ Samvats for A.D. year 100. (*Vide* Table 20.)

The reader will see that by the values of the yearly and century increments of the Samvats shown above, the A and B parts of Table 20 can be prepared for successive centuries and years by mere addition.

122. List of Samvats used in Northern India.—

0 Vijaya.	21 Ânanda.	42 Yuva.
1 Jaya.	22 Râkshasa.	43 Dhâtri.
2 Manmatha.	23 Nala.	44 Ishwara.
3 Durmukha.	24 Pingala.	45 Bahudhânya.
4 Hemalambi.	25 Kâlayukta.	46 Pramâthi.
5 Vilambi.	26 Siddhârthi.	47 Vikrama.
6 Vikâri.	27 Raudra	48 Vrisha.
7 Shârvari.	28 Durmati.	49 Chitrabhânu.
8 Plava.	29 Dundubhi.	50 Subhânu.
9 Shubhakrit.	30 Rudhirodgâri.	51 Târana.
10 Shobhana.	31 Raktâkshi.	52 Pârthiva.
11 Krodhi.	32 Krodhana.	53 Vyaya.
12 Vishwâvasu.	33 Kshaya.	54 Sarvajit.
13 Parâbhava.	34 Prabhava.	55 Sarvadhâri.
14 Plavanga.	35 Vibhava.	56 Virodhi.
15 Kîlaka.	36 Shukla.	57 Vikriti.
16 Saumya.	37 Pramoda.	58 Khara.
17 Sâdhârana.	38 Prajâpati.	59 Nandana.
18 Virodhakrit.	39 Angira.	60 Vijaya.
19 Paridhâvi.	40 Shrimukha.	
20 Pramâdi.	41 Bhâva.	

Note.—The names in this list have been purposely set back one place, in order that they may denote, at a glance, the year current.

Samvat expired at Date Cited
(*Second Practice.*)

123. In Northern India there is a second practice or mode of citing the Samvat which is expired, not at the beginning of the year, but at the date cited. This mode is more reasonable than the first, because it requires *no suppression* of a Samvat This shows that thinkers, soon after the innovation, realized the inconvenience and confusion arising out of the suppression. They must have, therefore, followed this second mode in preference to the first. But after all, it was a bad innovation of a Sâmhitika meddling with the 60 year-cycle of Samvatsaras, which had been turning slowly and without jerks for many centuries. The people of the Deccan were, however, shrewd enough not to be lured by it.

Rule.—When the first trial by Sec. 120 fails to produce the cited Samvat, we should calculate the interval from Meshâdi to the date cited either in tithis or in days. Then we should divide the interval in tithis by 367, or that in days by 361, and add the quotient to the Samvat of the Meshâdi. The result must agree with the citation. Otherwise the citation may be considered to be faulty.

Example.—Verify the following date of a Sanskrit Manuscript given by its author as " Shaka year 1396, Shubhakrit, Kartika Shukla 9, Wednesday."

Shaka 1396 *concurs with A.D.* 1474 *from the Meshâdi.*

Explanation.	Shaka.	Tithi.	A.D.	Samvat.	Vâra.
Tab. 20 A ..	..	..	1400	53·662	..
,, B ..	..	..	70	10·819	..
,, B ..	..	..	4	4·047	..
3	1322	0·610	..	..	6·242
4	72	16·667	..	..	6·630
4	2	22·130	..	..	2·517
At Meshâdi	1396	9·407	1474	8·528	1·389
Tithi given T	..	219·000			
Interval in tithis	Tab. 5	209·593	÷ 367 =	0·571	3 235
Samvat	Shubha	krit	at date	9 099	4 624

Here the Samvat obtained for Meshâdi is 8·528, *i.e.*, Plava (by the list in Sec. 122). This does not agree with the author's citation. So we obtained the interval between the Meshâdi and Kârtika Shukla 9, which is 209·593 tithis. These divided by 367 give the quotient 0·571, which, when added to 8·528, amount to 9·099. The integer 9 when referred to the list in Section 122 indicates the Samvat Shubhakrit, which fully corroborates the author's citation made according to the second practice. The week day was also Wednesday. Table 5 yields 3·235 as increase in Vara for Arg. 209·513.

124. Name of the year in the 12 year Sub-cycle, as given in South India and Malayâlam.—There are two more practices of naming a year in Malabar and Travancore. Their cycle is of 12 years, and is based on the same principle. No separate calculation is, therefore, necessary, this cycle being itself a sub-cycle of the larger one.

In the *third practice* the year is named after the name of the sign obtained as remainder, after dividing the number of the Samvats by 12. According to this rule, the year Shaka 1396, cited in the preceding section, receives the name Makara, Jupiter being then in the tenth sign (9.099).

This resembles the practice in the *Sankalpa* (*vide* sec. 74), according to which one might say *Makarasthite Devagurau.* But in the Sankalpa the position of Jupiter is geocentric, and not the mean heliocentric as calculated above. The difference, however, between the two positions of Jupiter never exceeds half a sign.

125. The fourth practice.—In this the names of signs are replaced by the names of those lunar months, which derive their names from the nakshatras contained in those signs. The year is called Kârtika when Jupiter is in Mesha or the first sign, and Mârga-Shîrsha, when in Vrishabha or the second sign and so on with the prefix *Mahâ* to distinguish them from the ordinary lunar months.

In the preceding example the year 1396 was, according to the fourth practice of naming, Mahâ-Shrâvana. There is a good reason for this peculiar nomenclature. For, Jupiter occupying the sign Makara rises and sets throughout the year called Mahâ-Shrâvana along with the nakshatra Shravana (the bright star Altair, Alpha Aquila. *Vide* Fig. 1). Thus Jupiter is made to act like a hand in a clock, pointing to the Jovian years recorded on the sky-dial.

Example.—Let us verify the date of the following Malabar inscription by means of the mean position of Jupiter quoted in it. " Kollam 389, Jupiter in Kumbha, and the Sun 18 days old in Mîna."

Kollam 389 is (389 + 825) = 1214 as A.D.

The days from Meshâdi to Mîna 18, are by Table 15 335 + 18 = 353.

Table 20	Samvat
Part A, for A.D. 1200	31·322
,, B, increase for 10 years	10·117
,, B ,, 4 ,, ...	4·047
353 ÷ 361 = increase for days 353	0·978
Signs at date	46·464
Signs of three 12 year cycles ..	36·000
Jupiter in the eleventh sign	10·464
By D. B. Pillai's calculation	10·463

126. Ambiguous cases arising out of imperfect citations.—Just as an A.D. date, in a period after the change of style, becomes ambiguous if the country or the style be not mentioned, so citations about Samvatsaras, months, tithis are not sufficient for the determination of a date. Details about the era ; whether northern or southern ; whether the Samvat is current at the Meshâdi or at date ; whether the year is expired or current ; whether Chaitrâdi or Kârtikâdi ; whether the month is Amânta or Purnimânta ; whether the solar date belongs to the Bengal-Orissa class or to the Tamil-Malayalam class ; and finally whether the date is derived from the Sûrya Siddhânta or the Arya Siddhânta ; details like these must be clearly and fully made out before commencing the calculation. These are the uncertainties that often beset the work of an epigraphist. When he is confronted with ambiguities and discrepancies like these, he must try every alternative before pronouncing any date as incorrect or impossible.

D. B. Pillai in his chronology, p. 64, cites an amusing case, apparently unaccountable, in connection with the solar date of the birth of a Tamil gentleman born at Belgaum in the Bombay Presidency. The date of birth in his horoscope was —

" A. D. 1856, June 28, Ani 16 "

while in all the Tamil panchângams the English date corresponded to Ani 17. This apparent paradox baffled all conjectures, till it was explained by the fact that the Tamil astrologer, who cast the horoscope at Belgaum, did not know that the panchângam which he used at Belgaum was calculated according to the Sûrya Siddhânta, and not the Arya Siddhânta as he believed. The difference was due to the difference in the times of Sankrântis that changed the first day of the Ani month and subsequent dates by one and the same Tamil usage, sec. 113. This will be shown below :—

Surya S.°	A.D.	Date.	Ayra S.°	A.D.	Date.
ab. 3	1800	A.10 745	Tab. 14	1800	A.10 646
4	56	0 490	4	56	0 490
13 Mithuna ..	..	62 356	15 Ani ..	..	62·326
	1856			1856	
Fraction greater than ·500..		73·591	Less than ·500 ..		73·462
Tamil usage		+·409	Tamil usage ..		—·462
Days from April 0 ..		74·	From April 0		73
Tab. 11, to June 0 ..		61	Tab. 11, to June 0 ..		61
Ani 1 .. ..June ..		13	Ani 1 .. .. June..		12
15		15	16		16
Ani 16 .. ..June ..		28	Ani 17 .. .. June ..		28

Retrospect.—Here we come to the end of our main object, *viz.*, the treatment of the mathematical part of Indian chronology.

We have done our best to render the subject clear both from the practical and the theoretical points of view. But as no knowledge is rendered thorough and interesting without analogy and contrast, we wish to acquaint our readers with the chronologies of other nations both modern and ancient.

A short allegory.—Time is Nature's ever increasing wealth and a free gift. She bestows this favour without grudge or partiality on all nations and individuals, both civilized and barbarous. Chronology is the system of keeping the account of the receipts of these gifts of Nature, and History and Biography are the accounts of the daily and yearly debits. The Calendars are the day-books devoted to the entries of receipts only. The days, months, years and cycles are the coins and currency notes signifying the gifts of Nature, which are made on the condition that they are to be debited the moment they are received and the balance to be nil every moment.

End of Part I

CHAPTER XII

127. The Musulman Calendar.—The Calendar of the Musulmans is cyclic-lunar. Their Era, which is called the *Hijra,* commences on Friday, the 16th July 622 A.D., and corresponds to the Hindu date Shrâvana Shukla 1, Shaka year 544. It commemorates the year of their Prophet's flight from Mecca, which took place two months later in September in the month Rabi-ul-awwal.

The natural unit of time common to the Musulman and the Christian calendars is the *mean solar day*; while that common to the Musulman and the Hindu calendars is the *mean lunar month*.

128. The length of their lunar month is 29 days, 12 hours and 44 minutes exactly. They are, therefore, made to consist of 30 and 29 days alternately, as shown in the subjoined table, making in all 354 days for an ordinary lunar year. and 355 days for a leap year.

Months.	Days.	Months.	Days.
1. Muharram	30	7. Rajab	30
2. Safar	29	8. Shâbân	29
3. Rabi-ul-awwal	30	9. Ramzân ..	30
4. Rabi-ul-âkhir or Rabi us-sani.	29	10. Shawwâl	29
5. Jumâdalâwal	30	11. Zilkâd	30
6. Jumâdalâkhir	29	12. Zilhijja	29
		Do. (In a leap year)..	30

129. The cycle of 30 years.—The outstanding 44 minutes, which amount to 11 days in 30 years, are distributed over the 11 years of the cycle of 30 years in the following order, 2nd, 5th, 7th, 10th, 13th, 16th, 18th, 21st, 24th, 26th and 29th. This order of *leap years*, as they may be called by analogy, is adopted at Constantinople. They are so chosen that by the addition of the leap day to the last date of Zilhijja, the time of the mean visibility of the Crescent occurs always within 12 hours either before or after the sunset of the new year's day.

In some countries, the years 8th, 19th, and 27th are considered as leap, instead of the 7th, 18th and 26th. But this change breaks the desirable condition of 12 hours and so deserves to be abandoned.

130. The beginning of the day, month and year.—Among the Musulmans the day is reckoned from sunset to sunset. The Moon is liked and respected more than the Sun. This may probably be due to the fierce glare and the intolerable heat of the latter in the sandy deserts of Arabia.

The month begins on the evening following the New Moon on which the faint and slender crescent is visible for the first time. This rule, though applicable in theory to all the months alike, is practically observed in the determination of the first date of the Muharram and Ramzân months. Our readers might have seen with what religious fervour the Musulmans watch from high places, on such occasions, the first appearance of the Moon's crescent and how joyfully they salaam each other at her first appearance.

131. The earliest possibility of the appearance of the crescent Moon.—In India this can be determined roughly with the aid of the Hindu Panchânga. If the first tithi ends before the 25th ghati, the appearance of the crescent is certain. If the tithi ends between the 25th and 35th ghatis, the appearance is doubtful; and after the 35th ghati, it is impossible. The appearance is determined better by the method of *Kâlâmshas*, *i.e.*, by calculating the interval between the settings of the Sun and the Moon. In India the appearance is sure to come off if the Moon sets 50 minutes or more after sunset. But after all, the calculations are of little use if the sky be not clear.

132. Owing to this source of uncertainty the dates, as given in the printed calendars, are often at variance with those determined by actual observation. To avoid the confusion the Arabs* always annex the week days to their dates.

Note.—The Crescent is generally seen for the first time on the second day after the New Moon; hence the following approximate equations:

* Dans la practique les jours comptes par les Arabes et les autres peuples qui suivent the calendrier Musulman ne sont pas toujours bien de accord avec les jours marques dans les calendriers imprimes. Cela vient de ce que les peuples ne comptent pour le premier jour de mois que le jour même où le croisant de la nouvelle lune devient visible pour eux, ce qui n'a lieu que le 2e jour environ aprês la conjonction de Soleil et de la Lune; mais cet inconvenient disparait par la soin qu'ils ont de joindre á leur date le nom de jour de la semaine, ce qui permet toujours de ramener a sa veritable place le jour 'quils ont voulu indiquer.—(Annuaire pour l'an 1919, page 122.)

Monthly tithi = Hijri Tarikh + 2...... ......(*a*)
Hijri Tarikh = Monthly tithi — 2..............(*b*)

Spread as they are from Morocco in the west to the Malay Peninsula in the east, the Musulmans trust only to the testimony of their own eyes, and decide the first day of Muharram and Ramzân for themselves. This is the reason why the Taboot day is sometimes celebrated on different days in different localities in India.

To calculate the Christian date corresponding to a given Hijri one.

(TABLE 21.)

133. Method.—Deduct 1 from the number of the Hijri year and divide the remaining years by 30. The quotient and the remainder will respectively be the *cycles* and the *odd years* expired.

(*a*) From Table 21, parts B and C, given under the Christian Era, take down the increase for the cycles, years, months and days, and add them. If the days in the sum exceed 365, divide them by 365, keep the remainder in the column for days and add the quotient to the years.

(*b*) Divide the A.D. years thus obtained by 4, and deduct the integral quotient from the days as a correction due to leap years.

(*c*) Add to the remainder the elements for the epoch in Part A. The sum will represent the years, days and week days according to the *Old Style*.

(*d*) Add 11, 12, 13, 13, 14 and 15 days for the 17th, 18th, 19th, 20th, 21st and 22nd centuries respectively. The result will be the year and days according to the *New Style*.

Example.—Required the A.D. year, month and date corresponding to the Hijri year 1337, Ramzan 1.

Here 1337 — 1 = 1336 are the years elapsed, and dividing 1336 by 30 we get 44 cycles and 16 years.

Type of calculation.

	Explanation.	Christian Era.		
	Part, Table 21.	Years.	Days.	Vâra.
(*a*)	B. Increase for 40 cycles	1165	15	4
	„ „ 4 „	116	184	6
	C. „ 16 years	15	195	0
	D. Muharram 1 to Ramzan 1	..	236	5
		1296	630	15
	(630*d*. = 1*y* 265 days) .. .. Total ..	1297	265	1
(*b*)	Deduct leap days, 1297 ÷ 4 = ...	..	—324	..
	Total interval in Julian years and days ..	1296	306	1
(*c*)	A ; Epochal elements	622	196	6
	Sum ; date in old style..	1919	137	0
(*d*)	Add for the 19th century	..	13	..
	Sum ; date in new style	1919	150	0
	Days—January 1 to April 30 (by Table (*b*) of Sec. 145).	..	—119	..
	Result, 1919 May 31st, Saturday	1919	31	0

To calculate the Hijri date corresponding to a given Christian date

134. Method.—(*a*) Deduct 621 from the given A.D. year, multiply the remainder by 365, and set down the product.

(*b*) Divide the remainder by 4, take the integral quotient and write it below the product.

(*c*) Also count the number of days from the beginning of the A.D. year, not omitting the leap day of February if it intervenes ; or use the table (B) in Sec. 145.

(*d*) Add up the numbers indicated by (*a*), (*b*) and (*c*), and deduct 561 days from the sum.

(*e*) Then if the A.D. year be of the New Style, deduct 11, 12, 13, 13 and 14 days for the 17th, 18th, 19th, 20th, and the 21st centuries respectively, and call the remainder G. But if the year be of the Old Style, nothing is to be deducted. Thus G will be the number of days elapsed since the beginning of the Hijri Era, which we must now convert into Hijri years, months and days.

(*f*) From G deduct successively the highest possible number of days, given in the columns headed Hijri Era, in parts B, C, and D of Table 21. Write down at the same time, their respective equivalents in Hijri years and months. The last remainder will be the day of the month.

(*g*) Lastly, add 1 to the number of years in order to change them into current year according to the Hijri Era.

(*h*) The week day = Q $(G + 6) \div 7$

Example.—Calculate the Hijri date corresponding to the 31st of May 1919. New Style.

In this instance 1919 — 621 = 1298 are the intervening years.

		Days.
(*a*)	1298×365	473,770
(*b*)	$1298 \div 4$ = leap days	324
(*c*)	January 1 to end of May 31	150
	Sum ..	474,244
(*d*)	deduct the constant	— 561
(*e*)	days to be suppressed for 19th century (New Style)	—13
	G	473,670
(*f*)	Deduct B 1200 years ..	— 425,240
		48,430
	,, B 120 ,, ..	—42,524
		5,906
	,, C 16 ,, ...	— 5,670
		236
	,, D Muharram to end of Shâbân	235
(*g*)	Add 1 year current 1337 — Ramzan	1

Result.—The corresponding date was Ramzan 1, 1337 the year of the Hijri Era.

The week day = Q $(473670 + 6) \div 7 = 0$ = Saturday.

3 1 *

135. Mutual conversion of the Shaka and Hijri dates.—Students of the Mughal and Maratha periods of Indian History often require to know the corresponding dates of these two Eras. Table 22 is specially prepared for their use. It shows at a glance the number of the Hijri month concurrent with the Chaitra of Shaka years 1369-2049.

The Shaka years omitted in the table should be understood to begin with the Hijri month of the number attached to the preceding year. For instance, the omitted Shaka year 1370 begins with the Hijri month 1, *i.e.*, Muharram; the years 1372, 1373 begin with the Hijri month 2, *i.e.*, Safar and so on.

Problem.—To find the fractional number of Hijri year corresponding to the Meshâdi of the given Shaka year.

This can be solved by the following formula:—

$$H = S - 518 + \frac{S - 1368}{32 \cdot 54}$$

Here H stands for the Hijri year, and S for the Shaka year. The sign = means 'concurs with.'

Example.—What fractional Hijri year, which begins with Muharram, corresponds to the moment of the Meshâdi of the Shaka year 1841. Here putting the Shaka year 1841 in the above formula and solving it, we get,

$$H = 1841 - 518 + \frac{1841 - 1368}{32 \cdot 54} = 1337 \cdot 54;$$

= 1337 years and 6·5 months completed, at the moment of the Meshâdi.

This shows that the 7th month Rajab was running, or was synchronous with the Chaitra of Shaka year 1841.

This fact is also confirmed by Table 22.

Now if it be desired to know what month of the Shaka year 1841 concurred with the Ramzân of the Hijri year 1337, we might show it thus—

Shaka.				Hijri.	
yr.	m.			yr.	m.
1841	1	concurs with	.. ..	1337	7
	2	add to each	.. ..		2
1841	3	Jyestha	=	1337	9 Ramzân.

136. Problem 2.—Conversely to find the fractional number of the Shaka year corresponding to the New Moon of Muharram of the Hijri year.

This can be solved by the following formula.

$$S = H + 518 - \frac{H - 850}{33 \cdot 54}$$

Example.—Suppose it is desired to know the Shaka year corresponding to the beginning of the Hijri year 1337.

Proceeding as before—

$$S = 1337 + 518 - \frac{1337 - 850}{33 \cdot 54} = 1840 \cdot 50$$

= 1840 Shaka year and 6 months which had elapsed at the beginning of Muharram.

If we want to know what Hijri month was running with the Shaka month Jyestha,

Shaka.				Hijri.	
yr.	m.			yr.	m.
1840	7	concurs with	.. ..	1337	1
	8	add to each	.. ..		8
1841	3	Jyestha	=	1337	9 Ramzân.

Note.—It may be noted that the above two formulæ are formed on the principle of *mean* intercalation ; while the concurrence shown in Table 22 is based on the actual calculation of the intercalary months. This difference may occasionally produce a difference of a month, which can be corrected with the help of Table 2 or 22.

137. The Arabic San or Sursan.—The state papers and documents of the Maratha Period of Indian History always bear the years, months and dates of the Arabic San, coupled with Shaka months and tithis.

The following formulæ show the relation between the Arabic, the Shaka and the Christian years.

(*a*) Fasali year = Arabic year + 9
(*b*) Shaka year = Arabic year + 521-522
(*c*) A.D. year = Arabic year + 599-600
(*d*) Arabic year = Shaka year — 522-521
(*e*) Arabic year = A.D. year — 600-599
(*f*) Shaka year = A.D. year — 79-78

Note.—We get two consecutive years from the above formulæ. Of these the first concurs with the beginning, and the second with the end of the given year in the second column.

The Arabic San is Solar and, like the Fasali year, begins at the moment when the Sun enters the Hindu *Mriga Nakshatra.* It is on this account sometimes called the *Mriga Sal.* Strange enough it has no months of its own, and the defect is made up by the Lunar Hijri months current at date.

Two formulæ must therefore be combined, one for the year and the other for the month.

138. Problem.—Given any Shaka year, to calculate the Arabic year and the Hijri month current at the moment of Mrigâdi, which occurs in the Hindu month of Jyestha.

(*e*) Arabic year = Shaka year – 522-521.

(*H*) Hijri month = The fraction of $\left(\frac{\text{Shaka years—1493}}{32 \cdot 54.}\right) \times 12$

Example 1.—Find the Arabic year and Hijri month and date at the moment of Mrigâdi in Shaka year 1842.

As the Arabic year which began with Mrigâdi of the Shaka year 1842 was the latter one, we must make use of the latter number 521 in Formula (*e*).

The required Arabic year is $1842 - 521 = 1321$.

And by formula (H) of § 138.

$$\frac{1842 - 1493}{32 \cdot 54} = 10 \cdot 725 \text{ of which—}$$

the fraction $\cdot 725 \times 12 = 8 \cdot 7$ months (Hijri).
= 8 months, 21 tithis.

By Sec. 132, Formula (*b*) = 8 months, 19 tarikhas.
= 9th month Ramzân.
current at Mrigâdi.

Ans.—Arabic San 1321, Ramzân 19th tarikha.

139. The Arabic notation of years.—The Arabic years are often expressed in words, and very seldom in figures. The following words express the numerals which precede them ;—

1	Ihide	8	Sammân	60	Sectain
2	Isanné	9	Tissâ	70	Sabbain.
3	Sallâs	10	Ashar.	80	Sammâneen.
4	Arbâ	20	Ashareen	90	Tissain.
5	Khamas	30	Sallaseen	100	Mayyâ.
6	Seet	40	Arbain	200	Mayyâtain
7	Sabbâ	50	Khamsain	1000	Alaf.

Example 2.—Find the tithi, month and year of the Shaka Era corresponding to 14th tarikh of Rabi-ul-awwal of the Arabic or Sursan year Sallâseen, Mayyâ, and Alaf = 30 + 100 + 1000 = 1130. (Given in Art. 44, Part VI, Materials for the History of the Marathas by Râjwade.)

Arabic year 1130 + 521 = 1651 Shaka, (Sec. 137)

On referring the Shaka year 1651 to Table 22 we find that the Chaitra corresponds to Ramzân the 9th, so that when counted from the Muharram of the preceding year, Rabi-ul-awwal is the 15th month, and the 14th tarikh corresponds to the 16th tithi.

Deducting 9 from these lunar months, we get 6 months and 16 tithis, and counting from Chaitra Shukla 1, we come to Ashvin Krishna 1 of the Shaka year 1651, which is the tithi sought.

Example 3.—Find the Christian date, month and year corresponding to Jilkad 1 of the Arabic year Sammân, Sabbain Mayyâ, and Alaf = 8 + 70 + 100 + 1000 = 1178. (Given in Art. 159 of letters, etc., collected in the Kâvyetihâs Sangraha.)

Arabic year 1178 + 599 = 1777 A.D. (Section 137) 1178 + 521 = 1699 Shaka. (Sec. 137.)

On referring the Shaka year 1699 to Table 22 we find that the 3rd month Rabi-ul-awwal concurs with the Chaitra. Deducting the 3rd month from Jilkad the 11th, we get 8 months and 1 + 2 = 3 tithis or 243 tithis in all. Counting from Chaitra Shukla 1, we arrive at Mârgashirsha 3. We may now calculate the English date corresponding to Mârgashirsha 3 of Shaka year 1699 according to Sections (77—81).

Or we may calculate the approximate English date with Table 23, as shown below—

Explanation.	Shaka.	A.D.	Tithi.	Date.	Vâra.
Table 23	1698	1776	21·0	Ap. 9·5	3·5
Table 23 bottom figures ..	1	1	11·1	0·3	1·3
At Meshâdi..	1699	1777	2·1	9·8	4·8
Table 5 complement of 243 ..	..	..	240·9	237·2	6·2
Mârgashir 3	..	..	243·0	247·0	4·0
Tab. 11, April 0 to December 0 ..	..	..	..	244·0	..
Result, Wednesday	1699	1777	Dec.	3·0	4·0

CHAPTER XIII

THE CHRISTIAN CALENDAR

140. History of the Calendar.—We take the following description from " Outlines of Astronomy " by J. F. W. Herschel :— The history of the calendar, with reference to chronology or to the calculations of ancient observations, may be compared to that of a clock, going regularly when left to itself, but sometimes forgotten to be wound up, and when wound, sometimes set forward, sometimes backward, either to serve particular purposes and private interests, or to rectify blunders in setting. Such at least appears to have been the case with the *Roman Calendar*, in which our own originates, from the time of Numa to that of Julius Cæsar when the Lunar year of 13 months, or 355 days was augmented at pleasure to correspond to the solar, by which the seasons are determined, by the arbitrary intercalation of the priests, and the usurpations of the decemvirs and the magistrates, till the confusion became inextricable. To Julius Cæsar, assisted by Sosigenes, an eminent Alexandrian astronomer and mathematician, we own the neat contrivance of the two years of 365 and 366 days and the insertion of one bissextile after three common years. This important change took place in the 45th year before Christ, which he ordered to commence on the 1st of January, being the day of the New Moon immediately following the winter solstice of the year before. We may judge of the state into which the reckoning of time had fallen, by the fact, that to introduce the new system it was necessary to enact that the previous year 46 B. C. should consist of 445 days, a circumstance which obtained for it the epithet of "*the year of confusion.*"

(*a*) But the real length of the tropical year is 365·24224 days and the yearly excess of about ·00776 day amounted, during the next four centuries, to three days. Consequently the equinox had retrograded from the 25th to the 21st of March. At the *Council of Nice* in A.D. 325, it was enacted that the 21st of March should, in future, be the day of the *vernal equinox*, but no remedy was suggested to check the ever accumulating error. During the Popedom of Gregory XIII, the equinoxial day, owing to the unchecked excess, actually fell on the 11th of March, which was quite against the enactment of the Council of Nice. The amount of the annual error being then correctly ascertained to be about three days in four centuries, Pope Gregory XIII ordered that the 4th of October 1582 should be followed by the 15th of October and not by the 5th. Consequently the equinox again fell on the 21st of March in A.D. 1583. But the year 1582 consisted of 355 days only.

(*b*) In order to secure the perpetual concurrence of the Vernal Equinox and the 21st of March, the Pope further enacted that the century years, that were not divisible by 400 without a remainder, should be considered as ordinary years, although they were divisible by 4. Thus the century year 1600 is a leap year, but the years 1700, 1800 and 1900 are not leap, *i.e.*, the number of days of February in these years is 28. The year 2000 will be a leap year and the years 2100, 2200 and 2300 will be again ordinary years consisting of 365 days.

This change is called the *New* or the *Gregorian Style*, as distinguished from the Old or the Julian Style. The New Style was at once adopted in all the Catholic countries. But England hesitated till the year 1752 A.D. and finally adopted it by an Act of Parliament. The 2nd day of September 1752 was the last day of the Old Style in England, and the first day of the New Style was the 14th instead of the 3rd, 11 nominal days being struck out.

(*c*) The same legislative enactment which established the Gregorian year in England in 1752 shortened the preceding year 1751 by a full quarter. Previous to that time the year was held to begin with the 25th March, and the year A.D. 1751 did so accordingly; but that year was not suffered to run out, but was supplanted on the 1st January by the year 1752, which (as well as every subsequent year), it was enacted, should commence on that day, so that the English year 1751 was in effect an "*annus confusionis*" and consisted of only 282 days."

Russia was the only country in Europe in which the Old Style was adhered to, and (three secular years having elapsed) the difference between the European and Russian dates amounts to 13 days at present (A.D. 1920). But the Russian republic has now given up the Old Style.

The change of calendar, in England, met with much popular opposition. The day-labourers complained that they were unjustly deprived of their wages for eleven days and the young ladies murmured that they were made older by the change.

141. Astronomers are justly opposed to such sudden and abrupt changes in the calendar. Simon Newcomb says in his Popular Astronomy "the length of the mean Gregorian year is 365d 5h 49m 12s, while that of the tropical year, according to the best astronomical determination, is 365d 5h 48m 46s. The former is, therefore, still 26s too long, an error which will not amount to an entire day for more than 3,000 years. If there were any object in having the calendar and the astronomical year in exact coincidence, the Gregorian year would be accurate enough for all practical purposes during many centuries. In fact, however, it is difficult to show what practical object is to be attained by seeking for any such coincidence. It is important that summer and winter, seed time and harvest, shall occur at the same time of the year through several successive generations; but it is not of the slightest importance that they should occur at the same time now that they did 5,000 years ago, nor would it cause any difficulty to our descendants of 5,000 years hence if the equinox should occur in the middle of February, as would be the case, should the Julian Calendar have been continued.

The change of calendar met with much popular opposition, and it may hereafter be conceded that in this instance the commonsense of the people was more nearly right than the wisdom of the learned. An additional complication was introduced into the reckoning of time without any other real object than that of making Easter come at the right time."

142. The interval in days elapsed.—The chief object of chronology is the calculation of the exact number of days, that have elapsed since the Epoch of an era, or between any two given dates separated by a long interval. The Musulman calendar is better suited for this purpose. It is not liable to any uncertainty excepting the one due to the first visibility of the crescent moon after the New Moon. The error due to this cause would never amount to more than a single day, and can be easily corrected by the week-day if available. (*Vide* footnote to Sec. 132.)

Next to it in the matter of convenience are the Indian luni-solar and solar calendars. But the former is liable to an uncertainty of a full month when the mean intercalary month is made use of in the calculation. The solar calendar is the best as it is based on the number of days in a sidereal year, and is not hampered by the Adhika and Kshaya months. Yet the solar dates are sometimes rendered doubtful by the different usages in different parts of India as regards the determination of the first day of a month. *Vide* Sections 112, 113 and 126.

143. The Julian Period.—To avoid confusion in chronology the astronomers and chronologists have invented and adopted a new cycle of 7980 Julian years called *The Julian Period.* It has been found so useful that the most competent authorities have declared that, through its employment, light and order were first introduced into chronology. It was invented or revived by Joseph Scaliger, who is said to have received it from the Greeks of Constantinople. The first current year of the Julian period was 4713 B.C., and the noon of the 1st of January of this year, for the meridian of Alexandria, is the chronological epoch to which all historical eras are most readily and intelligibly referred, by computing the number of integer days intervening between that epoch and the noon (for Alexandria) of the day. The meridian of Alexandria is chosen as that to which Ptolemy refers the commencement of the era of Nabonassar, the basis of all his calculations. The number 7980 is obtained by the multiplication of the numbers 28, 19, and 15, which are severally the Julian years in the Solar, the Metonic, and the Indictional cycles. This cycle consists of years and days only, and resembles the smaller cycles of the Grahalâghava and Ketaki, which consist of 4016 and 6940 days respectively.

144. The leap year how determined.—To determine whether a given Christian year is leap or not, proceed thus—

OLD STYLE

B. C. years.—Deduct 1, divide by 4 and if no remainder be left, it is a leap year.

A. D. years.—In England the Old Style had been in use upto the date, September 2 (inclusive), 1752 A.D. So the A.D.

years preceding this date are leap, when they are divisible by 4 without remainder.

NEW STYLE

A. D. years.—The New Style came into force after the above date. It is exactly the same as the Old one, differing from it by a single exception, which is that century years which are not divisible by 400, although divisible by 4 without a remainder, are not leap years but common years, *i.e.*, the days of February in them are 28. For instance the years 1700, 1800, 1900, 2100 are common years.

Note.—A counter correction to this rule is proposed. It is that years divisible by 4000 ought to be considered as common years.

		Days.
Because 4000 tropical years contain, according to Newcomb 365·2422* ×4000		=1460969
„ Gregorian Reformation—		
365 × 4000 = 1460000		
Leap days	970	
		=1460970
Excess in 4000 years		1

But the time for this correction will come in A.D. 5752. So we need not think of it for the present.

145. The interval in years and days.—In the chronological order of years the year zero is wanting. The year immediately preceding A.D. 1 is B.C.1. This is mathematically wrong. In finding the interval in years between the B. C. and A.D. years it is therefore necessary to lessen the number of B. C. years by 1. For instance, the number of the Julian years elapsed in A.D. 1919 is 4712 + 1919 = 6631. When both the years are of the same denomination, no deduction is necessary. See the following example.

* The accurate length is 365. 242 198 79 or 365 d. 5 h. 48 m. 45. 985 s. with a diminution of 0·53 s. per century.

To calculate the number of days elapsed since the Julian epoch, corresponding to any given date, old style.

Find the number of the Julian years (J. P.) elapsed as above and multiply them by 365.

Add to these the leap days obtained by adding 3 to the Julian years elapsed and dividing them by 4.

Add also the number of days intervening between January 1 and the given date from Table (B) on p. 100.

Example.—Find the interval in days between the commencement of the Julian Period, and that of the Kali-yuga, February 18, 3102 B.C.

Here the years elapsed are 4713 — 3102 = 1611,

	Days elapsed.
1611 × 365	588015
(1611 + 3) ÷ 4 = leap days	403
Days elapsed, Jan. 1 to Feb. 18, Tab. (*B*).	48
At the Epoch of the Kali-yuga	588466

To find the same for any given date of the *New Style*, proceed as above, considering the date as a Julian date. Then from the resulting days, subtract as follows :—

	Days.
For any date (N.S.) before March 1, A.D. 1700 ..	10
After Feb. 28, 1700 and before March 1, A.D. 1800	11
„ 1800 „ „ 1900	12
„ 1900 „ „ 2100	13

Examples 2 and 3.—Find the number of days elapsed of the Julian Period on Sept. 1st, B.C. 1193, and April 3, A.D. 1878, which are the Epochs of the Aryan and Ketaki Eras.

Here the years elapsed are 4713 — 1193 = 3520, and 4712 + 1878 = 6590 upto the two Epochs respectively.

Example 2

	Days elapsed.
3520 x 365..	1284800
(3520 + 3) ÷ 4 = leap days	880
Jan. 1st to Sept. 1st, Table (B). p. 100 ..	244
Epoch of the Aryan Era	1285924

Example 3

6590 x 365 = ...	2405350
(6590 + 3) ÷ 4 = leap days	1,648
Jan. 1st to April 3rd, Table (B) p. 100 ..	92
	2407090
Correction for New style	— 12
At the Epoch of Ketaki, see next page ..	2407078

To find the week-day of any Julian date.—Add 2 to the number of the days elapsed, and divide the sum by 7, and count the remaining days from Sunday as one. The result will be the week-day.

In the above example adding 2 to 2407078 and dividing 2407080 by 7 we get 4 as remainder, and counting from Sunday we get Wednesday for the Epoch of Ketaki.

By following the same course we get Friday for the Epoch of the Kali-yuga.

Intervals in days between the commencement of the Julian Period, and that of some other remarkable chronological and astronomical Epochs.

TABLE (A)

of important Epochs partially derived from J. F. W. Herschel's " Outlines of Astronomy."

Names of Eras and Epochs.	First day of Era.	Chronology B. C.	Julian Period years.	Interval in days elapsed.
Julian Period	January 1 ..	4713	1	..
Kaliyugae (Era of the Deluge)	February 18 ..	3102	1612	588 466
Epoch of Aryan Era* ..	September 1 ..	1193	3521	1285924
Olympiads	July 1 ..	776	3938	1438171
Era of Nabonassar ..	February 26 ..	747	3967	1448638
Eclipse of Thales	May 28 ..	585	4129	1507900
Metonic Cycle ..	July 15 ..	432	4282	1563831
Julian Reformation ..	January 1 ..	B.C. 45	4669	1704987
Dionysian Era	January 1 ..	A. D. 1	4714	1721424
Hejira (New Moon) ..	July 15 ..	622	5335	1948439
Era of Yezdgird	June 16 ..	632	5345	1952063
Last day of old style ..	September 2 ..	1752	6465	2361221
Epoch of Ketaki*	April 3 ..	1878	6591	2407078

* See page 99.

TABLE (B).

Days elapsed from Jan. 1st to the 1st of each month.

Months.	In a common year.	In a leap year.	Months.	In a common year.	In a leap year.
January 1 ..	..	..	July 1 ..	181	182
February 1 ..	31	31	August 1 ..	212	213
March 1 ..	59	60	September 1 ..	243	244
April 1 ..	90	91	October 1 ..	273	274
May 1	120	121	November 1 ..	304	305
June 1	151	152	December 1 ..	334	335

146. Perpetual Almanac for the European Calendar. — The perpetual Almanac enables us to find the week-day or Vâra of any English date. In fact it is a means of testing the accuracy of a date by casting out sevens in the same manner as we test the accuracy of a product by casting out nines. It is given in several forms, but here we have adopted that in which it is given by D. B. Pillai in his Chronology, for the sake of its great simplicity. See table 24.

147. The Index-numbers.—The numbers in heavy type printed at the tops of the columns of centuries, years, and months in Table 24 may be called the *Index numbers.* They are common to all the numbers of years and months shown in the column below them. The index-number for the days of a month is the remainder left after dividing them by 7.

148. To compute the week day of a given Christian date stated in A.D. years.

Rule.—All that we have to do is to add up the Index-numbers of the four component elements of time, *viz.*, the century, year, month and date of the given day as shown in Table 24, and to cast out sevens from the total if it exceed 7. The remaining Index-number will show the week-day beginning with Sunday as 1.

Example.—Required the week-day on June 10, 1858.

By Sec. 144, the year 1858 is not leap.

				Index
Table 24, the Index of A.D.	1800	century	..	4
,, ,, ,,	58	years	..	2
,, ,, ,,	C	June	..	3
,, ,, ,,	10	days	..	3
		The required week-day is Thursday		5

149. Rule in the case of B. C. years.—In calculating the week-day of a B. C. date, the given B. C. year should be deducted from the last preceding century and the remainder should be used as odd year.

Add to the Index of the last preceding century, the Index of the odd year thus found, and that of the month and of the date as before.

Example.—Required the week-day of 18, February 3102 B.C., which was the first day of Kaliyuga.

By Sec. 144 : Q(3102 — 1) ÷ 4 = 1. It is therefore a common year.

	Index
Table 24, Index of B. C. 3201 .. .. (the last preceding century)	3
(3201 — 3102) = 99 odd years	4
February in ordinary year	2
18 days of month	4
The Kaliyuga began on Friday	6

150. Theory of the formation of the perpetual calendar.—A century consists of 36525 days or 5218 weeks minus one day. This is the reason why the B. C. centuries advance and the A. D. centuries recede along the Index numbers.

An odd year, when not leap, consists of 52 weeks plus one day. This fact explains why the odd common years advance along the Index numbers.

As the first year A.D. and the first date of January began at the same moment on Saturday, the Index of which is zero (0), the zero date of January, *i.e.*, December 31, must have 6 for its Index.

NOTES ON WEEK-DAYS

Use.—The cycle of week-days, like the decimal notation, has been adopted by every civilized nation. It is to the illiterate what the cycle of Samvatsaras is to the educated. A day is too short and a month is too long for common people to count and remember. The market-days, the payment of wages to the day-labourers, the recovery of interest for small money-lending business, the periods of the prescription of medicine, and similar short terms and engagements, are most conveniently regulated by means of the weeks.

The week is a little calendar solely dependent on human memory, and incapable of being determined from observation of the heavens.

The origin of the week-days.—The origin must be ascribed rather to the astrologers than to the astronomers. For the order is governed by the supposition, or rather superstition, that each of the 24 hours of the day is ruled by the planets by turns, according to the descending order of their Periodic times, *viz.*, Saturn, Jupiter, Mars, the Sun, Venus, Mercury and the Moon, when written so as to complete a circle. It is plain then to see that if Saturn should preside over the first hour of a day, it will preside again over the 8th; 15th and 22nd hour, and then it will be the Sun's turn, occupying the third place in the cycle from Saturn to preside over the 25th, or the first hour of the second day, and the Moon's turn to preside will be on the first hour of the third day and so on.

The Sûrya Siddhânta briefly explains the above theory of the week-days in the following verse.

मन्दादधः क्रमेणस्युश्चतुर्था दिवसाधिपाः ॥ ७८ ॥
होरेशाः सूर्यतनयादधोऽधः क्रमशस्तथा ॥ ७९ ॥
(भूगोलाध्याय १२)

Meaning--From Saturn downwards every fourth in the (cyclic) order is the lord of the day. From Saturn downwards in due succession they are each the lords of the hours.

CHAPTER XIV

BRIEF NOTICES OF OTHER LUNI-SOLAR AND SOLAR CALENDARS

(1) The Vedic Calendar

151. The vedic Calendar is one of the most ancient, being compiled in the fourteenth century Before Christ. Each Veda had its own Jyotisha. The Rigveda Jyotisha consists of 36 verses and the Yâjusha Jyotisha of 43, of which 30 verses are common to both. Most of them are very unintelligible. Messrs. J. B. Modak, S. B. Dixit, B. G. Tilaka, Bârhaspatya and others have tried to interpret them in their own way. But there are still a few verses which have baffled all their attempts at explanation.

(*a*) Its primary object was to announce to the village cultivators the progress of the seasons, and the fortnightly and other sacrifices were but a means to gain this chief object. The Agnithôtris, who were much esteemed and amply provided with corn and other necessaries, kept up a regular watch over the movements of the sun, observing the Equinoxial and Solsticial days every year.

By this course the Agnihôtris soon came to know that the seasons happened regularly with respect to lunar months in the course of 5 years. Thus the Aryan Agnihôtris established the five-year cycle, which contained 60 solar months, 62 lunar months 67 lunar revolutions, 1830 solar days, and 1860 tithis. They were also clever enough to mark that the Sun and the Moon turned towards the north after reaching the Dhanishthâ Nakshatra (Alpha Delphini).

(*b*) The first year of the opening cycle began with the New Moon which fell on the day of the winter Solstice. The chief object of the calculations was to determine the lunar tithis and months, on which the bi-monthly seasons, the Equinoxes and the Solstices recurred in each of the five years; and as a course preparatory to determine the days (tithis) of the above phenomena, it was necessary to calculate at first the position of the Sun accurately with respect to the Nakshatra-Divisions for each of the 124 New and Full moon days in the cycle. This is the same method of calculation which is followed in the preparation of the Nautical Almanacs, in which the positions of the Sun and the planets are calculated first, and the table of phenomena calculated with them is placed at the end.

The motions being mean, Mr. S. B. Dixit has embodied the preparatory course at pages 77 and 78 of his Marathi History of Astronomy, and the phenomena are stated at pages 91 and 75 as described in the Garga Samhitâ.

(*c*) In fact this little cycle of 5 years was far from being perfect. For the defect of the lunar year as compared with the solar year is 11 tithis, which amount to 55 tithis at the end of the fifth year. By intercalating two lunar months we intercalate 5 tithis more than what is required. In other words, we add unnecessarily one tithi per annum; and unless there is a provision to get rid of this excess the cycle must become useless after 30 years.

But as we meet with references and allusions made about the cycle in the Mahâbhârata, and its use in the Pitâmaha Siddhânta which was in use in A.D. 80, there must have been a proviso for the removal of the undesirable excess in intercalation when it amounted to a whole month in 30 years, by omitting the 12th intercalary month. But unfortunately the verse containing the correction has somehow disappeared along with others from the text of the Vedânga. We can, however, infer the existence of such a proviso in the following definition of the Âdiyuga, *i.e.*, the first cycle which fulfilled the original conditions of the Epoch after every 30 years.

स्वराक्रमेते सोमार्कौ यदा साकं सवासवौ ।
स्यात् तदाऽऽदियुगं माघस्तपः शुक्लोऽयनं ह्युदक् ॥

(*d*) The presence of this correction is clearly traceable in the following verses in the Mahâbhârata :—

तेषां कालातिरेकेण ज्योतिषां च व्यतिक्रमात्
पंचमे पंचमे वर्षे द्वौ मासावुपजायतः ॥ ३ ॥
एषामभ्यधिका मासाः पंच च द्वादश क्षपाः
त्रयोदशानां वर्षाणामिति मे वर्तते मतिः ॥ ४ ॥
पूर्वेद्युरेव निर्वृत्तास्ततो बीभत्सुरागतः
विराटपर्व अध्याय ५२.

Here the word क्षपाः is irrelevant to and irreconcilable with the meaning intended by the speaker Bhîshma. There is no question at all about the nights. I think that the word क्षपाः was originally क्षयाः,* but was mistaken by the scribe; for we

* A copy (No. 472, Vishrama I, foll. 83) in Bhandarkar Research Institute actually reads —°पंचच द्वादश क्षयाः ॥ अ.४७ ॥ This copy makes full distinction between य and प.

often meet with instances of प mistaken for य. Also द्वादश seems to be used for त्रयोदश for the exigency of metre. With this emendation the above verses state with astronomical accuracy that 13 solar years (s) are equal to 13 lunar years (l), plus 5 intercalary months, minus 13 tithis. This can be stated algebraically—

$$\begin{aligned} 13\ s &= 13\ l + 5 \text{ months} - 13 \text{ tithis.} \\ \therefore\ 30\ s &= 30\ l + 12 \text{ months} - 30 \text{ tithis, nearly.} \\ &= 30\ l + 11 \text{ months.} \end{aligned}$$

(*e*) The above demonstration clearly shows that the rule of omitting or suppressing every 12th intercalary month, must have been in practice in the time of the Mahâbhârata. This resembles the Gregorian rule in connection with the omission of leap days. We sometimes meet with allusions to kshaya months in the age of cyclic calculations. In such cases the kshaya months must be no other than the omitted intercalary months.

The above rule can be also deduced from astronomical data.

$$\begin{aligned} s &= 371 \cdot 05 \text{ tithis, (page } \mathbf{210}\text{).} \\ \text{or } s &= (360 + 12 - 1 + 0 \cdot 05) \text{ tithis.} \\ \therefore\ 30\ s &= 30\ (360 + 12 - 1 + 0 \cdot 05) \text{ tithis.} \\ &= 30\ l + 12 \text{ months} - 1 \text{ month} + 1 \cdot 5 \text{ tithis.} \\ \therefore\ 600\ s &= 600\ l + 20\ l - 20 \text{ months} + 1 \text{ month,} \\ &= 600\ l + 221 \text{ intercalary months.} \end{aligned}$$

So I suggest that the following two verses composed by me may be read, in place of the missing ones, immediately after the 37th verse of the Yâjus-Jyotisha, beginning with 'यदर्धं दिनभागानां सदा पर्वणि पर्वणि.' By this means the Vedânga Jyotisha Cycle can be used for sacrificial purposes even at the present day, if its epoch is known, which is probably B.C. 1440 = 1193 + 247 (*vide* sec. 152).

विहाय युगषट्कान्ते ६ प्राप्तं माघं मलिम्लुचम्
प्रारभेत सदाऽऽद्यानि युगानि च पुनः पुनः ॥ ३८ ॥
न हेयः षट्शताब्दीयो ६०० माघमासोऽधिकस्तु यः
एवमादियुगारंभो योग्यकाले सदा भवेत् ॥ ३९ ॥

(*f*) We shall finish this brief notice of the Vedânga Jyotisha by mentioning the fact that it has rendered the greatest service to the cause of *Indian antiquity* by recording the position of the Solsticial points in its time. This has led to the fixing of its date as **1400** B.C, and also of other dates of the Vedic literature relatively to it.

Professors Max-Muller, Whitney and others have in vain tried to reduce this impregnable stronghold of Indian Antiquity (*vide* Max-Muller's preface to the 4th volume of his Rigveda Samhitâ).

(*g*) It appears that the sage by name Lagadha was the original author of a small tract on the Vedic calendar and that the Vedânga Jyotisha was simply an adaptation of it as the following opening verse clearly shows :—

प्रणम्य शिरसा कालं अभिवाद्य सरस्वतीम्
कालज्ञानं प्रवक्ष्यामि लगधस्य महात्मनः ॥

The title कालज्ञान literally means knowledge of time, the same as the French title 'Connaissance des temps.' This shows how true ideas concur although the thinking minds may be separated by thousands of years.

Calculations made on the basis of the greatest length of the day, stated by Lagadha, show that he lived in latitude 35 degrees North, probably in Cashmere.

(2) The ancient Indian or Aryan Calendar

(*In use from* 1193 *B.C. to* 291 *A.D.*)

152. To me it had been a great puzzle to understand how the ancient Indian kings could have managed their state affairs for centuries without a well-regulated calendar and an era for its basis, until I saw the following table given by John Bentley in his Historical View of the Indian Astronomy. Being given in a rudimentary form and without any directions regarding its use, the table has hitherto failed to attract the attention of scholars.

But I found it fully practicable and, therefore, thought it worth while to recalculate it with a view to detect errors in it and to amplify it by placing alongside other concurrent Indian eras.

Table showing the Ancient Aryan Tropical Solar Calendar

Cycles	Christian Chronology.		Aryan Chronology.				Siddhântic Chronology.	
	B.C.	Mon, Date, Day	Year.	Month solar.	Sun.	Spica.	Kali.	Shaka, Mon, tithi lunar.
				long.	long	long		
1	1193	Sept. 1, Thurs. 1285924 J. P.	0	Âsvin ☾ 222°	150°	160°	1909	—1270 Bhad. 6.
2	946	Oct. 1, Satur. 1376170 J. P.	247	Kârtik ☾ 252°	180	$163\frac{1}{3}$	2156	—1023 Âsvin. 6.
3	699	Oct. 29, Sun. 1466415 J. P.	494	Mârga. ☾ 282°	210	$166\frac{2}{3}$	2403	—776 Kârtik. 6.
4	452	Nov. 27, Tues. 1556661 J. P.	741	Paush. ☾ 312°	240	170	2650	—529 Mârg. 6.
5	205	Dec. 25, Wed. 1646906 J. P.	988	Mâgha ☾ 342°	270	$173\frac{1}{3}$	2897	—282 Paush. 6.
	A.D.							
6	44	Jan. 24, Fri. 1737152 J. P.	1235	Phâlg. ☾ 12°	300	$176\frac{2}{3}$	3145	—34 Mâgh. 6.
7	291	Feb. 21, Satur. 1827397 J. P.	1482	Chaitr. ☾ 42°	330	180	3392	+213 Phâlg. 6. ended at 56 gh.

Note.—J. P.=Days of the Julian Period expired at Sunrise.

(*a*) The opening tithi of the 1st cycle was called Âdikalpa shasthi; that of the 2nd, Guha shasthi; that of the 3rd, Mitra saptami, which we at present call Ratha Saptami.

The following are the ancient constants and elements with which the above table is computed. In a cycle :—

Sun's. tropical revolutions.	$247\frac{1}{12}$	Mean solar days ..	90245·5
Moon's do. ..	$3303\frac{1}{12}$	Lunar tithis ..	91680·0
solar months ..	2965	Precession seconds ..	12000·0
Lunar months ..	3056	Tithis in a solar month	30·9205
Intercalary months ..	91	Days do. do.	30·4368

The following ancient values are obtained from the preceding elements for comparison with the modern ones :—

	Ancient.				Modern.			
Length of—	Days	H.	M.	S.	Days	H.	M.	S.
Tropical year ..	365	5	50	10	365	5	48	46
Sidereal year ..	365	6	9	53	365	6	9	9
Lunar month ..	29	12	44	3	29	12	44	3
Moon's revolution ..	27	7	43	5	27	7	43	5

	Days.	Days.
247 $\frac{1}{12}$ tropical years ..	90245·5	90245·26
3303$\frac{1}{12}$—Moon's trop. revolu.	90245·5	90245·723
Yearly precession ..	48″·567	50″·236

(*b*) This Aryan cycle of 247$\frac{1}{12}$ tropical years is really a happy combination of the lunar, solar, and sidereal systems. It contains 13 metonic cycles and one month. Each new cycle begins invariably on the 7th tithi of the month next to that with which the preceding cycle has begun. The precession of the equinoxes in one cycle amounts exactly to a quarter of a Nakshatra, and the 7th cycle begins in the year A.D. 291, in which the tropical longitude of the brilliant and conspicuous star Spica (Chitrâ) was exactly 180 degrees, as mentioned in the old Surya S°, quoted in the Pancha Siddhântikâ. [*Vide* sec. 200 (*a*).]

It completely fills up the hitherto supposed chronological gap of fifteen centuries, separating the Vedânga and the Siddhânta periods. This calendar must have been in general use while the five-year Vedic calendar was used only for sacrificial ceremonies. But the cycle was not destined to run for ever. It appears probable that soon after the star Spica had coincided with the autumnal equinox, the Babylonian astronomy appeared in India and threw into the background the ancient Indian chronology. Learned men were willing to adopt it but the orthodox, as was natural, strongly opposed it. Thus the Romaka and Paulish works commented on by Lâtadeva were rejected as being श्रुतिबाह्य *i.e.*, opposed to the scriptures. The efforts of Shrishena and Vijayanandi shared the same fate.

(*c*) At last Âryanâtha* or his predecessor or some unknown contemporary astronomer realised, it appears, the necessity of gratifying the orthodox in the manner of children crying for the Moon. He adopted in his Siddhânta the era of Kaliyuga and its colossal multiples, the Mahâyugas and the Kalpa. Computing backward with the correct mean motions of the Sun and the moon from the Kali year 3600, he arrived at *Shukla saptami*, as the tithi of Mesha Sankrânti in the zero year of the Kaliyuga. This result was very disappointing to him. For he wanted an Amâvâsya or New Moon day to gratify the orthodox by presenting them with a general conjunction of the Sun, the Moon and the planets. Undaunted by the adverse result he made no scruple to carry back the origin of longitude itself, seven degrees, in order to show to the orthodox that the Mesha Sankrânti did fall on the New Moon day according to their expectations. To prevent this artifice from being detected, it became necessary to distribute this increase of 7 days over 3600 years. He accordingly raised the length of the sidereal year given in the foregoing table 365 days, 6h, 9m, 53s. = 365 days, 15gh., 24pa., 42 vip. to 365 days 15 gh., 31 pa. 30 vip. Thus the vitiated sidereal year was introduced for the first time, and was implicitly followed by the subsequent astronomers without the least suspicion. The equinox had receded three degrees behind Chitrâ in Shaka 421, and the arbitrary putting back of the starting point by seven (7) degrees raised the error to ten (10) degrees or days in the Zero year of the Kaliyuga. This minus error of 10 days, or 36000 palas, is made good at the annual rate of 7 palas in about Kali 5000 years. So now A.D. 1920 is the proper time for rejecting the vitiated year, and for replacing it by its modern correct value 365d. 15gh. 23p. adopting the time-honoured starting point opposite to the star Chitrâ (Alpha Virginis).

The liberties taken by Âryanâtha with the positions of the planets in bringing about a perfect conjunction on the 17-18 of February 3102 B.C. are really appalling. He has added empirically $+35°$, $+33°$, $+12°$ $-17°$, $+20°$ to the longitudes of the planets beginning with Mercury, with corresponding changes in their mean motions, and has intentionally observed silence in the matter

* The supposed author of the original Surya S° Aryabhatta was probably his pupil at Kusumapura. For he says—आर्यभटास्त्विह निगदति कुसुमपुरेऽभ्यर्जितं ज्ञानम् ।

of the latitudes and longitudes of the yoga-târas probably for fear of his artifice being detected from their observations.

We shall now demonstrate below by making use of the data of our Jyotirganita, how the sidereal year of the ancient Aryans was changed into that of the Surya Siddhânta :—

Explanation.	In Kali.	Abdapa or Vara.	Tithi-Shuddhi.
Time of the Sun's arrival— At the Equinox of Shaka 213, Jyo. p. 64 In shaka year 1800.. .. Spica—180°	Year. 4979	v. gh. pa. 6 9 28	9·82
Table 10, Change in years ..	4000	6 29 52	29·66
„ ..	900	3 44 13	26·17
„ ..	70	3 56 46	24·37
„ ..	9	4 18 26	9·56
Deduct from the top line the sum ..	4979	4 29 17	29·76
At Equinox of Shaka 213, Spica — 180°.	0	1 40 11	10·06
Change for precession .. .. — 3°.	·	—3 2 43	—3·10
At Equinox of Shaka 421, Spica — 183°.	0	5 37 28	6·96
Arbitrary Set-back for New Moon — 6°·74		—6 48 12	—6·96
At Arbitrary starting point, Spica —189°·74	0	5 49 16	30·00

This arbitrary set-back of 6 days 48 gh. 12 palas made in the Abdapa, for the sake of the New Moon of the preceding 3600 years, amounts to 6 pa. 48 vipalas per year, and consequently,

	days	gh.	pa.	vip.
The Âryan year (adopted by Ptolemy through the Chaldeans)	365	15	24	42
Arbitrary increase	+	°	6	48
The Sûrya Siddhânta year	365	15	31	30

(*d*) **Use.**—This ancient Indian civil calendar being cyclic is fixed, and does not stand in need of annual calculations. Being also solar, it is free from the uncertainty of the intercalary months. In practical use it can be used as a safe guide in the determination of the dates of ancient events. As an instance of this we have determined in Section 201 the date of the Mahâbhârata and the Bhagavadgîtâ within very close and precise limits.

(*e*) Though entirely solar in character, the table also affords means of calculating the tithi and the nakshatra on a given day. They can be calculated by means of the following formulæ.

$$\text{Tithi} = 6 + 0 \cdot 920742\ \text{M}.$$

Where M is the period, in solar months, expired between the beginning of the cycle in which the given date is included, and the end of the given solar month.

Example 1.—Required the tithi on the day of the summer Solstice in B.C. 483. This day marks the end of the third solar month.

The given date lies in the 3rd cycle ; therefore

$$\begin{aligned} \text{M} &= (699 \text{ years} - 7 \text{ months}) - (483 \text{ years} - 3 \text{ months}). \\ &= (698 \text{ years} + 5 \text{ months}) - (482 \text{ years} + 9 \text{ months}). \\ &= (215 \text{ years} + 8 \text{ months}) = 2588 \text{ solar months.} \end{aligned}$$

And the required

$$\text{Tithi} = 6 + (0 \cdot 920742 \times 2588) = 18 \cdot 88 = 19 \text{ nearly.}$$

This means that the festival Vâssa of the Buddhists or the 'Fete de Soleil' of the French astronomers was held in B.C. 483 on the Sankashti-day. (*Vide* Sec. 99), where this same tithi is 18·3 as worked by the Surya Siddhânta elements.

The Nakshatra (N) can similarly be obtained by the following formula—

$$\text{N} = 13 \cdot 5 + (0.9 \times \text{tithi}) + \tfrac{3}{40}\,(\text{Sun}^\circ - \text{Spica}^\circ).$$

On the day of the summer Solstice in B.C. 483, for example,

$$\begin{aligned} \text{N} &= 13 \cdot 5 + (0 \cdot 9 \times 19) + \tfrac{3}{40}\,(90^\circ - 170^\circ), \\ &= 13 \cdot 5 + 17 + 21 = 51 \cdot 5 = \text{Pûrvâ Bhâdrapadâ}. \end{aligned}$$

Note. — In order that the solar months may coincide with the English calendar months without affecting the years, it is safer to add 90 degrees to the Sun's longitude in col. 6 of the table, and then to divide the sum by 30^0. The quotient will correctly express the calendar months. Or solar months may be counted from April as one.

Example 2.—Find the tithi on which the era of Nabonassar commenced, it being known that the years in it begin when the Sun's longitude is 330 degrees. It commenced on February

26, 747 B. C. in the second cycle, which began with the Sun's longitude 180°. We must take it as 270° and the solar month as the 9th for the above reason.

As before,

$$\begin{aligned} M &= (946\text{ y} - 9\text{ m}) - (747\text{ y} - 2\text{ m}). \\ &= (945\text{ y} + 3\text{ m}) - (746\text{ y} + 10\text{ m}). \\ &= (198\text{ y} + 5\text{ m}) = 2381 \text{ solar months.} \end{aligned}$$

And the required

Tithi $= 6 + (\cdot 92 \times 2381) = 6 \cdot 52$, Saptami.

(*f*) *Important note.*—This calculation discloses the important fact that the Chaldean and the Egyptian Era of Nabonassar and the Indian Aryan Era began on a Saptami. Not only this but even the length of the sidereal year is the same in both the Eras. This cannot be accidental, and as the Indian Era precedes the Chaldean Era by more than four centuries, the Chaldeans must have in all probability borrowed from the Indian Aryans their Era and Chronology. After making use of it as a basis for their astronomical pursuits the Chaldeans have returned the debt to us in the form of their astronomy. Though it is not proper to indulge in mere speculations, yet I cannot forbear saying that an important truth lies hidden in the word Chaldean, for it seems closely allied to the Sanskrit word कालद. Nay the Chaldeans themselves seem to have been a colony of the Indian Aryans calling themselves Caldais, *i.e.*, Time-givers or Chronologers. There is historical evidence to show (see Chambers' Ancient History) that the Chaldeans, though much respected for their learning, were looked upon as foreigners in Mesopotamia. They might also have carried with them from India the memory (स्मृति) of the general conjunction of the planets that took place in B. C. 3102, and of the imaginary vast cyclic periods of 432000 years (*vide* Sec. 209).

(*g*) On page 273 of 'Histoire Abrégée de L' Astronomie par E. Lebon, 1899" we read the following description about the Chaldeans: " Les Chaldéens ont précédé toutes les autres nations pour les observations astronomiques. D'apres Diodore de Sicile, ils comptaient 432000 années d' observations astronomiques que

Berose reduit à 150000 ! Ces nombres sont de nulle valeur en histoire ; cependent ils montrent la grande antiquité de ces observations. La date terminale de la Chaldée 538 av. J-C., est l'annêe de la prise de Babylone par Cyrus."

Mr. R. Shama ShastriofMysore has very ably proved in his Gavâmayana the relation between the Vedic word नराशंसस्वर (Narâshamsaswara) representing 432000 syllables, and the Chaldean words nerus, sosus and sarus for the cycles of 600, 60 and 3600 years respectively. His book contains reliable and very interesting information regarding the dim antiquity of the Vedic times.

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(3) THE CHINESE CALENDAR

153. The Chinese calendar is luni-solar, the months being lunar and the years tropical. It is not based on any cycle but is computed like ours by means of the true positions of the Sun and the Moon. Their era commences in the year B. C. 2637, and is reckoned in cycles of 60 years like our Deccan Samvatsara-Chakra. In the year A. D. 1919, seventy-five of such cycles had elapsed, and the 56th year of the seventy-sixth cycle was current. The samvatsara in the Deccan in A. D. 1919 was the 53rd, called Siddhârthi. This near approach of the numbers of the years in the cycle, suggests the probability of a common origin of the Indian and Chinese chronology at some remote time.

The year begins in that lunar month in which the Sun's tropical longitude is 330°. At present the first month concurs with the Hindu lunar month of Mâgha. The months are indicated by the ordinal numbers like the Hindu Tithis, and not by the sidereal names like Chaitra, Vaishâkha, etc. The Adhika or the intercalary month bears the same number as that of the proper one. Their week days are 60, and have the same names as the years have in the 60-year cycle. The day begins at midnight, and is divided into 12 equal parts. Their almanacs are prepared from tables constructed in the year A. D. 1644 by Imperial order. But since the establishment of the Chinese Republic, changes consistent with the calculations of the French Connaissance des Temps are said to have been introduced into them.

THE SAYANAVADIS

Note.—The Chinese Calendar is a true Sâyana Calendar. The Indian Sâyanavâdis should, if they like, adopt it and stop in future their advocacy for giving the sidereal names to their lunar months and to their tropical 27 divisions of the Ecliptic. Seeing that the 12 zodiacal constellations no longer coincide with the 12 signs, European astronomers have long since abandoned the custom of stating the longitudes in signs, and have adopted in its place that of mentioning them in degrees (0 — 360). The constellations are only shown with vague boundaries in their star-atlases and are used in giving names to fixed stars.

The 27 nakshatras are the pure Indian zodiacal constellations used long before the adoption of the Assyrian 12 constellations. To name after them the 27 moveable (tropical) divisions of the ecliptic from the vernal equinox is, not only inconsistent, but productive of great confusion in future ages. There is no objection if the Sâyanavâdis name their 27 divisions by the ordinal numbers just as the Chinese do their months. The word Sâyan-Nakshatra is in itself ludicrously inconsistent, as it literally means a moving-stationary division. Modern astronomers have, it appears, omitted the old word 'sign' in their tables in order to avoid this very objection.

(4) THE JEWISH CALENDAR

154. The calendar of the Jews is luni-solar and is regulated by a cycle of 19 years, called the Metonic cycle. Its months are lunar. The year contains 12 lunar months when it is common, and 13 months when embolismic. The years 3rd, 6th, 8th, 11th, 14th, 17th and the 19th in the cycle are embolismic or adhika. The order is nearly the same as that of the adhika years in Table 2. Deduct 1 from the years given in line 1 of it, and you obtain the above figures. But there can arise no Kshaya months in a cyclic reckoning. It is produced only when the names of Lunar months are determined with reference to the Solar months. (Sec. 65.)

155. The names of months are of Assyrian origin. These are—1 Tisseri, 2 Heswan, 3 Kisler, 4 Tibeth, 5 Schebat, 6 Adar, 7 Ve'adar (adhika), 8 Nissan, 9 Iyar, 10 Sewan, 11 Tamouz, 12 Ab, and 13 Elloul.

Like the Vedâng Jyotisha the intercalary month Ve'adar is placed in the middle of the embolismic year. The first month usually concurs with the Hindu Âshvina. The day begins at sunset as in the Musulman calendar. The year is not permitted to begin on a Wednesday, Friday or Sunday, but on the day following, as they are considered unlucky.

The Jewish Calendar was recast into its present form in the fourth century A. D.

(5) THE ECCLESIASTICAL OR CHURCH CALENDAR

156. Easter is the only religious festival, says Prof. Newcomb, which in Christian countries depends directly upon the motion of the Moon. The rule for determining Easter is that it is the Sunday following the first full Moon, which occurs on or after the 21st of March. The Church calculations of Easter Sunday are, however, founded upon very old tables of the Moon, so that if we fix it by the actual positions of the Moon, we should often find the Calendar feast a week in error.

" The natural units of time,"says C. A. Young in his Manual of Astronomy, " are the day, month, and year. The day is too short for convenience in dealing with considerable periods, such as the life of man for instance, and the same is true even of the month; so that for all chronological purposes the tropical-year—the year of the seasons—has always been employed. At the same time, so many religious ideas and observations have been connected with the changes of the Moon that, there was a long constant struggle to reconcile the month with the year. Since the two are incommensurable, no really satisfactory solution is possible, and the modern calendar of civilized nations entirely disregards the Moon."

Use of the Golden number and of the Dominical letter

The Golden number and the Epact at the beginning of a year are useful in fixing the date of the Paschal full moon, and the Dominical letter serves to show the Sunday dates. The French

Annuaire for A. D. 1919 contains two tables which give the Easter days from A. D. 1600 to 2200, both according to the Old and the New Styles.

157. Easter can be calculated by means of our tables also. At present the Meshâdi occurs on the 12th of April. So the Easter full moon occurs between March (21—31) when the tithi-Shuddhi lies between 27 and 7, and between April (1—20) when it lies between 7 and 27. The date of Meshâdi increases by 1 in 60 years, so the limits of the tithi-Shuddhi will have to be raised by one, when the Meshâdi will occur on the 13th of April.

Rule.—Calculate the mean elements for the Meshâdi of the given A. D. year according to Sec. 77 and complete the tithi-Shuddhi or Epact, as it is called, by Sec. 78. Then deduct algebraically the completed tithi from 15; find out from Table 5 the motions of the elements for the remaining tithis, and add them, according to the sign of the remaining tithis, to the elements of the Epact.

Calculate the ending moment by Sec. 79-81. Then the date of the Sunday, next to the full-moon will be that of *Easter-Sunday* and the preceding Friday will be Good-Friday. If the full-moon falls on a Sunday, Easter day is the Sunday after.

Example.—Determine the date and the week-day of the Easter full moon in A. D. 1920.

Type of Calculation for Easter day.

Explanation.	A.D.	Tithi.	Vâra.	Date.	☾'s anom.	☉'s. anom.
Tab. 3	1900	13·027	5·620	A.12·620	7°·4	280°·6
,, 4	20	11·297	4·175	0·175	41·9	0·0
At Meshâdi ..	1920	24·324	2·795	A.12·795	49·3	280·6
Complement ..	..	0·676	0·666	0·666	8·7	0·7
S	..	25·	3·461	A.13·461	58·0	281·3
Tab. 5 R ..	minus	10·	2·844	9·844	128·6	9·7
T		15	0·617	A. 3·617	289·4	271·6

Here Easter Full-Moon falls on Saturday the 3rd of April. Easter, therefore, occurred on the 4th of April 1920.

(6) THE COPTIC CALENDAR OF EGYPT

158. This calendar is used in parts of Egypt and Ethiopia. Like the calendar of the Parsis, the year consists of 12 months, each containing 30 days, with 5 intercalary days called *Epagomenes* added at the end of the twelfth month. After three such years of 365 days in succession the fourth year has 6 epagomen days added at the end. Thus it will be seen that the length of the Coptic year and the intercalation are the same as in the Julian Calendar.

The intercalary or leap years of the Coptic calendar are those next preceding the Julian bissextile years. See Sec. 144 Old style.

The era followed is that of the Diocletian or of the Martyrs, the origin of which is fixed on Friday, 29th August, 284 A. D.

Concordance of the Julian and Gregorian dates with the first day of each Coptic month in a common year (1637).

No.	1637 Coptic months and their duration in days. 2nd common year.		1920 Julian dates and months.	1920 Gregorian dates and months.
1	Tut 1, days ..	.. 30	29 August	11 September.
2	Bobeh. 1	.. 30	28 September ..	11 October.
3	Hatur. 1	.. 30	28 October ..	10 November.
4	Koyhak. 1	.. 30	27 November ..	10 December
5	Tubeh. 1	.. 30	27 December ..	1921 9 January.
6	Amchir. 1	.. 30	1921 26 January ..	8 February.
7	Barmhat. 1 ..	.. 30	25 February ..	10 March.
8	Barmudeh. 1 ..	.. 30	27 March	9 April.
9	Bachones. 1 ..	.. 30	26 April ..	9 May.
10	Bawne. 1	.. 30	26 May	8 June.
11	Abib. 1 ..	.. 30	25 June	8 July.
12	Mesori. 1	.. 30	25 July	7 August.
..	Epagomenes ..	.. 5	24 August	6 September.
1	Tut, 1, 1638 ..	..365	29 August	11 September.

An intercalary Coptic year ends on the 29th of August instead of the 28th ; and the next Coptic common year, having to concur partly with a Julian bissextile year, ends on the 28th August of the bissextile year. The second common Coptic year again commences on the 29th August of the Julian year. The formula of Coptic Leap Year (C) is : $Q\ (C + 1) \div 4 = 0$.

The excess of the Gregorian dates over those of the Julian is at present (A. D. 1920) 13 days. It will be 14 days on the 29th date of February of the Julian calendar in A. D. 2100, and 15 days in A.D. 2200. (The above information about the Coptic calendar is derived from the French Annuaire for A. D. 1920.)

CHAPTER XV

ECLIPSES

Importance.—Eclipses, when they are mentioned in inscriptions and copper plates, are an unerring means of verifying their dates. The Hindu Scriptures affirm that the merit of a gift, made on the occasion of an eclipse, is great and permanent. It was mainly owing to this religious faith that the kings and princes of India made free grants of lands and even of villages to deserving Brahmins on the occasion of important eclipses.

159. Possibility and recurrence.—A lunar eclipse can occur only at the time of Full Moon, and a solar eclipse only at the time of New Moon, if the Sun happen to be near enough to one of the nodes of the lunar orbit (*vide* Sec. 55). The Moon is eclipsed by the earth's shadow, and the sun is eclipsed by the dark opaque body of the Moon passing like a cloud between a spectator on the earth and the sun. The interval between two successive eclipses is generally six months and sometimes a fortnight.

160. The Saros—The cycle of the eclipses is called ' *Saros*, a word probably allied to ' Saura ' by which name the celebrated Sûrya Siddhânta is sometimes cited. It was known to the ancient Chaldeans who used it to predict eclipses. It consists of 223 lunations, or 18 years and 10 or 11 days. In this interval there occur 71 eclipses of which 43 are of the sun and 28 of the moon. Though the number of the Sun's eclipses is larger, their visibility in respect to a given place on the earth is much limited by the fact that the earth's surface traversed by the moon's penumbra is much smaller than that of the earth's hemisphere. It may sometimes happen that a partial solar eclipse actually seen in the Panjab may not be seen at all in the Madras Presidency and *vice versa.*

161. Our object in including the subject of eclipses in this book is, not only to enable our readers to become acquainted with the calculation of one of the most interesting and awe-inspiring phenomena, but to show the great merit of the Sûrya Siddhânta that has turned, as it were, the two luminaries into its most obedient servants during the past 50 centuries. Besides, our readers will be able to verify doubtful cases of eclipses independently of the list supplied to them by others. (Sec. 218.) Also there are very few books in India on this subject, accessible to the English knowing readers, so that they will find this subject a good pastime to enjoy, when an eclipse is approaching.

THE ECLIPSE OF THE MOON

162. Method of calculation.—Take down from Table 3 the first 7 elements for the last preceding century of the given date, and go through all the successive steps as described in Secs. 77—80, till you obtain the ending moment of the true full moon tithi.

If the date be modern the empirical corrections of the Vâra, date, and moon's anomaly, *viz.* + 0,014 day, + 0,014 day, and + 3°·33 respectively, must also be added after the increase for odd years. (Sec. 101.)

Example.—Calculate the lunar eclipse that took place on the 15th tithi of Chaitra, Shaka year 1806, corresponding to 10th April 1884.

Note.—This eclipse is noteworthy for the fact that it was calculated with the elements of Grahalâghava and was found to be invisible at Bagalkot. Great was the surprise and chagrin of the pious and orthodox people when they beheld the moon rise with her upper border immersed in the earth's shadow, lasting over a ghati.

Type of calculation.

Tables.	A.D.	Tithi.	Vara.	Date.	☾'s An.	⊙'s An.	Râhu.
3, 24	1800	16·543	5·745	A.10·745	157°94	280°·60	70°·89
4	84	29·445	0·735	0·735	175·93	0·00	185·64
Corr.	..	..	0·014	0·014	3·33	..	..
Meshâdi ..	1884	15·988	6·494	A.11·494	337·20	280·60	256·53
Complement ..	..	—·988	—·973	—·973	—12·65	—·97	..
S, ...	..	15	5·521	A.10·521	324·55	279·63	256·53
6 Arg. ..	279·6	⊙' eq.	+·176	+·176	+2·11	=+·176	× 12 =
7, Arg. ..	326·7	☾' eq.	—·245	—·245	326·66	..	2·11
Full Moon ..		(*f*)	5·452	A.10·452	Thurs.	27 gh.	7 pal.

The above calculation shows that the Full Moon of Chaitra fell on 10th April 1884 at 27 gh. 7 palas, after the mean sunrise of Ujjain.

163. Then calculate D, which denotes the distance of the sun from the node Rahu, according to the following formula, and add 180° to it when the eclipse is a lunar one.

D = + Râhu,
+ ⊙'s anomaly,
+ ⊙'s equation × 13.
+ ☾'s equation,
+ ·02° (K—50) = Empirical correction.
K = Centuries of Kaliyuga.

Example—

D = 256°·53 = Rahu.
+ 279·63 = Sun's anomaly.
+ 2·29 = ⊙'s eqn. × 13 = +·176 × 13.
— 0·25 = ☾'s eqn.
+ 0·00 = ·02 (50—50) = Empirical correction.
+ 180·00 To be added, the eclipse being lunar.

358°·20

164. With the value of D thus obtained, we are able *to decide* from the following limits whether a lunar eclipse will happen.

Lunar ecliptic limits.

	Doubtful	Certain or	Doubtful
A lunar eclipse is			
If D is between	347°—350°	350°— 10°	10°— 13°
or D is between	167°—170°	170°—190°	190°—193°

In the above example D is 358°·20 and lies between the limits 350° — 10° of certainty. We are, therefore, able to assert that there *shall* be an eclipse of the moon on the day in question. But the question in respect of its visibility must be postponed till we calculate the times of the moon's first and last contacts with the earth's shadow. If either of these times falls that day, after sunset and before the next sunrise, the lunar eclipse is sure to be seen.

165. Next find out the values of the elements *v, a, b, l, p*, and *t* as shown below—

From Table,	With Argument		Take out,	Which is the —
25	☾'s anomaly,	..	*v*	= Moon's true daily motion.
26	*v*	..	*a*	= Sum of semi-diameters of the moon and earth's shadow
26	*v*	..	*b*	= Difference of the semi-diameters.
27	D	..	*l*	= Moon's latitude.
28	(*a*—*l*), *a*,	..	*p*	= Semi-duration of the eclipse
35	(*b*—*l*), *b*,	..	*t*	= Do. of the total phase

Note.—In a lunar eclipse *l* should always be considered plus in finding out *p* and *t* from tables 28 and 35.

Example.—Thus :—

From Table		With Argument		We get			
25 ..	..	326°·66	..	*v*	=	736′	minutes,
26 ..	..	736′	..	*a*	=	55	,,
26 ..	..	736′	..	*b*	=	24	,,
27 ..	..	358°·20	..	*l*	=	—10	,,
28 ..	..	45′ and 55′	..	*p*	=	282	palas.
35 ..	..	14′ and 24′	..	*t*	=	116	palas.

166. The time of the Full Moon is not the time of the middle of the eclipse (m). The difference between these times depends upon D, and never exceeds 26 palas or about 10 minutes which can be ignored except when great accuracy is desired, in which case it may be found out in the following manner.

Deduct D algebraically from either 180° or 360° whichever be nearer to D. Then double the difference in degrees which will be the correction (*c*) in palas to be made to (*f*), the time of Full Moon, as shewn in the preceding type of calculation.

$$\text{So, } (f + c) = (m)$$

In the above example D is 358°·20, and 360° being nearer to it, 360° — 358°·2 = + 1°·8. The double of + 1·8 is + 4 which is the correction (c) in palas. This being plus, 27 gh. 7 pa. + 4 pa. or 27 gh. 12 pa. is the time of the *middle of the eclipse.* (m)

167. The times of the *different phases* can afterwards be determined with the aid of the following formulæ.

(m — *p*) = beginning of the eclipse.
(m — *t*) = beginning of the total phase.
(m + *o*) = middle of the eclipse.
(m + *t*) = end of the total phase.
(m + *p*) = end of the eclipse.
(*a* — *l*) = magnitude of the eclipse.
(*b* — *l*) = *Khagrâsa, i.e.,* covering of the sky, or extent of shadow beyond the moon's disc.

The *magnitude* is usually expressed in digits. A digit is equal to 2·5 minutes of arc. The calculation of the different phases by the above formulæ is shown below.

Lunar Eclipse. April 10, 1884. Ujjain mean time.

Eclipse begins. m — *p*		Totality begins. m — *t*		Mid eclipse. m + *o*		Totality ends. m + *t*		Eclipse ends. m + *p*	
gh.	pa.	gh.	pa.	gh.	pa.	gh.	pa.	gh.	pa.
27	12	27	12	27	12	27	12	27	12
— 4	42	— 1	56	..	..	+ 1	56	+ 4	42
22	30	25	16	27	12	29	8	31	54

(*a* — *l*) = (55 — 10) = 45′ or 18·0 digits of magnitude.
(*b* — *l*) = (24 — 10) = 14′ or 5·6 digits of Khagrâsa.

168. The points of contact on the disc.—The first contact with shadow in a lunar eclipse takes place on the eastern border of the moon's disc, and the last contact on the western border. In the Solar eclipse the opposite of this takes place.

ANCIENT ECLIPSES

169. The most ancient lunar eclipse of 8th March B.C. 720.—This eclipse has been cited by Ptolemy as having been observed at Babylon in the latter half of the night, the magnitude being three digits. This we will calculate below, to show to the readers that the highest praise and almost religious regard paid in India to the Sûrya-Siddhânta is not undeserved. The longitude of Babylon from Ujjain is 31°·3 West or, —·09 day and the latitude 32°·5 North. The indefiniteness of the time, says Newcomb, renders the eclipse of very little value. (Researches on the motion of the Moon, page 36.) According to his calculation the time of the greatest phase at Ujjain is 3 A.M.

Model of calculation.

Explanation	B. C.	Tithi.	Vâra.	Date.	☾'s anom.	⊙'s anom.	—Rahu.
Tab. 3 ..	—801	17 98	1·98	M. 6·98	110·9	280·6	138·9
4 ..	80	15·19	2·70	0·70	167·6	0·0	108·2
4 ..	1	11·06	1·26	0·26	92·1	0·0	19·3
Chaitra ..	—720	14·23	5·94	M. 7·94	10·6	280·6	266·4
Longi. of Babylon		..	—·09	—·09	..	..	..
Meshâdi		14·23	5·85	M. 7·85	10·6	280·6	266·4
Complement ..		·77	·76	·76	9·9	0·8	0·0
Mean tithi		15·00	6·61	M. 8·61	20·5	281·4	266·4
Tab. 6 ⊙'s eq. Arg. 281°			+·17	+0·17	2·0	=(0·17	× 12)
Tab. 7 ☾'s eq. Arg. 22°			+·17	+0·17	22·5		
Mid Eclipse on			6·95	M. 8·95	Friday.	4·48	A.M.

We must first calculate the value of D by Sec. 163.

D = 266·40, Rahu.
281·40, ⊙'s anomaly.
2·21, ⊙'s eqn. × 13 = ·17 + 13,
0·17, ☾'s equation.
—0·54, ·02 (23 — 50), Empi. Corr.
180·00. The eclipse being lunar.

9·64

By Sec. 165 we find the following values of v, a, l and p.

Table 25 Arg. ☾'s anom. 22° ·5 ;	v =	730·0
26 Arg. v = 730′ ;	a =	55·2
27 Arg. D = 9°·6 ;	l =	49·0
Magnitude, = $(a - l)$ = (55′ — 49′)	=	6·2
Magnitude, in digits = 6′·2 × ·4	=	2·5
Table 28 Arg. $(a - l)$, (a)	p =	130·0
semi duration, in minutes	=	52·0

By Sec. 167, $(m - p)$ = 4h. 48 m — 52 m.
= 3h. 56 m, Ecl. begins.
$(m + p)$ = 4h. 48 + 52 m.
= 5h. 40*m*. Ecl. ends.

Example 2.—Calculate the Lunar Eclipse of September 1, B. C. 720. The magnitude was 6 digits. It was observed at Babylon, and is quoted by Ptolemy.

We shall make use of the elements of the preceding example and add to them the increase for the interval of 180 tithis from Table 5.

Prof. Newcomb estimates the middle time for Ujjain as 9 P.M.

Calculation.

Explanation.	B.C.	Tithi.	Vāra.	Date.	☾'s anom.	⊙'s anom.	Rahu.
Table	—720	15	6·61	M. 8·61	20°·5	281°·4	266°·4
5		100	0·43	98·43	206·1	97·0	5·2
5		80	1·75	78·75	308·8	77·6	4·2
Ashvin		195°	1·79	185·79	175·4	96·0	275·8
6 Arg. 96° ⊙'s eqn.			—·18	—·18	—2·2	—·18	× 12
7 Arg. 173° ☾'s eqn. ..			+ ·04	+ ·04	173·2		
			1·65	185·65			
11 September 0			..	184·00			
September 1			1·65	1·65	= 9h.	36 m.	P. M.

Here D = 275°·8 Rahu.
96·0 ⊙'s anomaly.
— 2·3 ⊙'s eqn. × 13 = ·18 × 13,
+ 0·0 ☾'s eqn.
— 0·5 ·02 (23 — 50). Empi. corr.
180·0 The eclipse being lunar.

Tab. 27 Arg. 189·0 l = — 45′·0 ☾'s latitude south.

Tab. 25 Arg. 173° ·2 ; v = 857′·0
Tab. 26 Arg. 857′ ; a = 61·2
Magnitude $(a - l)$ .. .. = 16·2 = 6·5 digits.

Thus the preceding calculations confirm Ptolemy's statements as regards the magnitude of the lunar eclipse that happened 25 centuries ago, though we cannot vouch for the times which *are themselves* not precisely stated.

THE ECLIPSE OF THE SUN

170. Method.—Calculate as before the ending moment of the true New Moon, according to Secs. 77-80 and then add the correction in time for the difference of longitude of the given place from the meridian of Ujjain.

171. Calculate D as stated in Sec. 163 and determine with it by means of the following limits, the possibility or certainty of the eclipse at least somewhere on the earth's surface.

Solar ecliptic limits.

A Solar eclipse is	Doubtful.	Certain.	Doubtful.
If D lies between	341° — 347°	347° — 13°	13 — 19°
or ,,	161 — 167	167 — 193	193 — 199

172. To be able to say definitely whether a solar eclipse will be seen at a given place, the following 12 elements are necessary. Of them the first four elements are obtainable from tables and the rest must be calculated.

Elements.

(*a*) Latitude and longitude of the place.

(*b*) Latitude of the Moon, by D (Table 27).

(*c*) Diameter of the Moon, by ☾'s anomaly (Table 25).

(*d*) Diameter of the Sun, by ☉'s anomaly (Table annexed to Sec. 174).

(*e*) The approximate ghati of the apparent or local middle (M) of the eclipse, Arg. ghati of Amânta (New-moon), Table 29.

(*f*) The sun's tropical longitude by Sec. 173.

(*g*) Sidereal time T at apparent middle of the eclipse, by Sec. 174.

(*h*) The Nati, *i.e*, the parallax in the latitude of the Moon. Table 30, Arg : T, and latitude of the place.

(*j*) The Moon's apparent latitude, which is = (Moon's latitude + Nati) = $(b + h)$.

(*k*) Sum of semi-diameters of the Sun and the Moon = $\frac{1}{2}(c + d)$.

(*l*) The Sun will be eclipsed at the given place if (*j*) is smaller than (*k*).

(*m*) The magnitude of the eclipse is equal to the remainder of $(k - j)$.

173. The tropical longitude of the Sun (*f*) at the moment of the true New Moon, can be calculated by the following formula :

(*f*) = Tropical ☉° = ☉'s anomaly.

+ 77° 3, ☉'s apogee .
+ ☾'s equation.
+ ☉'s eqn. × 13.
± Precession of equinox Tab. 3.

174. The sidereal time T, at the time of the apparent middle of the eclipse, can be calculated by dividing by 6 the degrees of the sun's tropical longitude, and adding the quotient to M, the ghati of the apparent middle of the eclipse. T is one of the arguments of Table 30 for finding out the Nati.

$$T = \frac{\text{Trop. ☉ in degrees}}{6} + M.$$

Table—Sun's diameter in minutes of arc.

Argument ☉'s anom.	0° / 360	20° / 340	40° / 320	60° / 300	80° / 280	100° / 260	120° / 240	140° / 220	160° / 200	180° / 180
☉'s diameter	31'·5	31'·5	31'·6	31'·8	31'·9	32'·1	32'·3	32'·4	32'·5	32'·6

The Total Solar Eclipse observed at Nineveh

175. Example.—We shall here calculate the great Eclipse of the Sun, observed at Nineveh on 15th June B. C. 763, in the

Hebrew month of Sivan. The latitude of Nineveh is 36°·3 North and its longitude is 31°·5 West from Ujjain, or — 0·09 day.

Model of calculation by Secs. 77—80.

Table.	B. C.	Tithi.	Vâra.	Date.	☾'s anom.	☉'s anom.	Precession.	Rahu.
3 ..	—801	17·98	1·98	M.6·98	110°·9	280°·6	-21°·7	130·9
4 ..	36	8·33	3·31	0·31	75·4	0·0	0·6	386·7
4 ..	2	22·13	2·52	0·52	184·2	0·0	0·0	38·7
	—763	18·44	0·81	M.7·81	10·5	280·6	21·1	154·3
Longi. of Nineveh		..	—·09	—·09	..	..	..	..
At Nineveh ..		18·44	0·72	M.7·72	10·5	280·6	—21·0	154·3
Compl. ..		·56	·55	·55	7·1	0·5	0·0	0·0
S		19	1·27	M.8·27	17·6	281·1	—21·1	154·3
5 R		100	0·43	98·43	206·1	97·0	0·0	5·2
5 R		1	·98	98	12·9	1·0	0°0	0·0
T Ashâdha 30 ..		120	2·68	107·58	236·6	19·1	—21·1	159·5
6 Arg. 19° ☉'s eqn. ..			—·06	—·06	—0·7	(—0·06	× 12)	= —·7
7 Arg. 236° ☾'s eqn. ..			—·33	—·33	235·9			
			2·29	107·29				
11 March 0 to June 0 ..			..	92·00				
		June	Mon.	15·29	·29 ×	60 =	17·4	ghatis.

From Table 29 Arg. 17·4 gh. we get M = 19 gh. of Mid-eclipse,

Let us first calculate D by Sec. 163, the Sun's tropical longitude by Sec. 173, and T by Sec. 174.

D = 159°·5 Rahu,

19·1 Sun's anomaly,

—0·8 Sun's eqn. × 13 = — ·06 × 13.

—0·3 Moon's eqn.

—0·5 ·02 (23 — 50) Emp. corr.

177°·0

By Secs. 173, 174.

Trop. ☉ =	19°·1	Sun's anomaly, as above.
	77·3	Sun's apogee, constant.
	— 0·8	Sun's equation × 13 = −·06 × 13.
	— 0·3	Moon's equation.
	— 21·1	Precession, Ayanâmsha. Tabs. 3, 4.
(f) =	74·6	

$$T = \frac{74 \cdot 6}{6} + 17 \cdot 4 = 29 \cdot 8 \text{ ghatis.}$$

We shall now proceed to calculate in succession all the elements from (*a*) to (*m*) described in Sec. 172.

Elements of the eclipse, at 19 ghatis at Nineveh.

(*a*) Latitude of Nineveh.. .. .. .. N.	36°·3
(*b*) ☾'s latitude, Tab. 27 Arg. D = 177 .0 .. N.	15′·1
(*c*) ☾'s diameter Tab. 25 Arg. ☾'s anom. 236 0	32′·0
(*d*) ☉'s diameter. Sec. 174 Arg. ☉'s Anom. 19°	31′·5
(*e*) Ghati of Mid-eclipse Tab. 29, Arg. M = 17·4 gh.	19 ·0
(*f*) ☉'s trop. longitude as above calculated ..	74°·9
(*g*) Sidereal time T, as above calculated .. gh.	29 ·8
(*h*) Nati, Tab. 30, Arg. T and (*a*) .. .. —	13′·3
(*j*) ☾'s apparent latitude = (*b* + *h*)	1′·8
(*k*) Sum of semi-diameters of ☉ and ☾ = ½ (*c* + *d*)	31′·7

(*l*) Here *j* is smaller than *k*. Therefore the eclipse did take place at Nineveh.

(*m*) The greatest magnitude was *k* — *j* = 30′ or 12 digits .. .. 30·0

It was a great solar eclipse. It passed centrally about 100 miles north of Nineveh. The diameter of the Moon being greater than that of the sun it was total and was, therefore, placed on record by the Assyrians of Nineveh.

The moments of first and last contact may be accurately computed by means of the author's Ketaki or Jyotirganita.

The great Solar Eclipse observed at Babylon

176. As a second Example, we will calculate below the great solar Eclipse observed at Babylon on July 31, 1063 B. C.

Longitude of Babylon from Ujjain 32°·5 W = — 0.09 day and latitude 32°.5 North (Encyclopædia Britannica, 11th Edition).

Tables.	B.C.	Tithi.	Vâra.	Date.	☾'s anom.	☉'s anom.	Prec.	-Rahu
3 ..	—1101	28·53	2·35	M4·35	202°·6	280°·6	·26°·6	91°·42
4 ..	36	8·33	3·31	0·31	75·4	0·0	+0·6	336·70
4 ..	2	22·13	2·52	0·52	184·2	0·0	+0·0	38·71
At Meshadi	—1063	28·99	1·18	M5·18	102·2	280·6	—26·0	106·83
Comple.	..	·01	·01	·01	·1	·0	·0	·00
S ..	..	29·00	1·19	M5·19	102·3	280·6	—26·0	106·83
5 .. R	..	100	0·43	98·43	206·1	97·0	0·0	5·22
		50	0·22	49·22	283·0	48·5	0·0	2·61
		1	0·98	0·98	12·9	1·0	0·0	0·05
At Ujjain T ..		180	2·82	153·82	244·3	67·1	—26·0	114·71
Longi of Babylon			—·09	—·09	0·0	0·0	0·0	0·00
At Babylon ..		..	2·73	153·73	244·3	67·1	—26·0	114·71
6 Arg. 67° ☉'s eqn.		..	—·16	—·16	—1·9	(—·16	×12=	-1·9)
7 Arg. 242° ☾'s eqn.		..	—·36	—·36	242·4			
			2·21	153·21				
11 March 0	to	July 0.	..	122·				
Date	..	July	2·21	31·21	=12·6	gh.true	new	moon.

We will now calculate M, D, Trop. ☉, and T. By Table 29 Arg. 12.6 gh. Time of Mid-eclipse M = 9·6 gh.

By Sec. 163, D = 114°·71 Rahu,
67·10 ☉'s anomaly,
— 2·08 ☉'s eqn, ×13, = — ·16 × 13
— 0·36 ☾'s eqn.
— 0·60 Emp. corr. — 0°·02 (20 — 50)

Table 27 Arg .= 178·77 ☾'s Latitude + 6'·4.

By Sec. 173 Trop. ☉ = 67·10 ☉'s anomaly,
77·30 ☉'s apogee,
— 2·08 ☉'s eqn. × 13, — 0·16 × 13,
— 0·36 ☾'s eqn.
— 26·00 Precession.

115·96 ÷ 6, we get 19·4 gh.

By Sec. 174, T = 19·4 gh. + 9·6 gh. = 29 gh.

Elements of the Solar Eclipse seen at Babylon.

(Babylon meantime.)

Monday, July 31, B. C. 1063.

(*a*)	Latitude of Babylon .. .. .. N.	32°·5
(*b*)	☾'s latitude Tab. 27 Arg. D. .. .. N.	6′·4
(*c*)	☾'s diameter, Tab. 25 Arg. ☾'s anom. 242°.4	32′·0
(*d*)	☉'s dameter, Sec. 174 Arg. ☉'s anom. 67°	31′·8
(*e*)	M. time of middle of Eclipse .. .. gh.	9·6
(*f*)	☉'s tropical longitude	116°·5
(*g*)	T. Sidereal Time at Mid-eclipse .. .. gh.	29·0
(*h*)	Nati, Tab. 30, Arg. T and Lat. 32°·5 ..	—9′·5
(*j*)	☾'s apparent latitude = $(b + h)$	— 3′·1
(*k*)	Sum of Semi-diameters of ☉ and ☾ = $\frac{1}{2}(c + d)$	—31′·9
(*l*)	$j < k$ Therefore eclipse was visible at Babylon.	
(*m*)	the magnitude was $(k - j)$ = or 28′·8 × ·4 = 11·5 digits.	28′·8

Note.—In finding the magnitude the sign of (*j*) should be considered to be plus always.

The eclipse was nearly as large as that observed at Nineveh on June 15,763 B. C. But in the present instance the central line of the Moon's shadow must have passed — 3′·1 × 70 = about 200 miles to the south of Babylon.

The diameter of the sun being smaller than that of the moon the eclipse was total on the central line.

CHAPTER XVI

Time

177. Time is simply an idea inseparably connected with the idea of motion or action. So that both being concurrent, either of them can be considered as the measure of the other. The year, month, day, hour, &c. measure, in the astronomical calculations, the motion of the heavenly bodies, and conversely the motion of the heavenly bodies such as the Sun, the Moon and the planets is used in chronological calculations to measure time.

Smaller actions or motions are employed to measure smaller divisions of time. The pulsations were employed to measure time in India long before the time of Galileo. This is shewn by the fact that the celestial Equator is called Nâdi-Mandala in all the ancient Siddhântas. Nâdi-Mandala literally means the pulsation circle. In common parlance the smallest portion of time is expressed by the phrase ' the twinkling of an eye.' On the other hand distance is often expressed by the time taken to go over it. The vast stellar distances are expressed in astronomy by light years. Light travels at the inconceivable rate of 186,000 miles per second.

178. Before the invention of clocks and watches, the ***Ghatikâpâtra***, the clepsydra and the sundial, were employed to measure time, which generally commenced at sunrise, noon, or sunset. The time obtained from them was of course rather too rough to be used in accurate observations. The invention of chronometers served to give the greatest stimulus to the progress of astronomy. But finding that chronometers were incapable of following the capricious movements of the Sun, modern astronomers have called in the help of a fictitious point called the mean sun in the Siddhântas, which is supposed to move always with uniform motion along the celestial equator. The astronomers know the exact interval by which the mean fictitious sun arrives at the meridian, either before or after the shining Sun. This interval is called the *equation of time*. It is therefore necessary to observe every day the meridian passage of the real Sun and to set the chronometers so as to show the position of the mean sun. An observatory is therefore indispensable if civil and public affairs are to be conducted in accordance with mean time. With this object in view western nations have built observatories at or near their capitals, from which correct mean time is every day wired to all the important places connected by railways and telegraphs. Lately mean time is communicated to steamers at sea by means of wireless telegraphy, it being formerly obtained by the observation of lunar distances.

179. The time hitherto shown in the Tables and calculations is the *mean solar time of Ujjain* (*U. M. T.*). The meridian that passes through the old Observatory of Ujjain is used as the origin of longitude by all the Siddhântas. Ujjain is, therefore, the Greenwich of India. Its longitude is 75°46′·1 East of Greenwich and its latitude is 23° North.

Ujjain seems to owe this honour chiefly to its central position and to the fact that it was once the capital of one of the most powerful and enlightened king called Vikrama, whose era still prevails over the greater part of Northern India. He liberally patronized arts and sciences, and invited many learned men to his court.

180. The Indian Standard Time.—It is 5 hrs. 30 m, and 27 m. in advance of the Greenwich and Ujjain mean times respectively, and 2 minutes behind the Benares time. But mean times are not to be used in the performance of Hindu religious ceremonies. All the statements of time for this must be made in the Sâvana Time (*vide* Sec. 64) which is measured from the moment of the actual sunrise at the given place. For this purpose the Ghatikâpatra is used and its immersions in water are watched and noted with little vertical lines of kumkuma on the white background of a wall. The watchman (a Joshi) is afterwards paid his fee and thanked for his trouble and is invited to dine at the festival.

181. To convert meantime of Ujjain into Sâvana time of a given place. (*Vide* Sec. 64.)

We need calculate only the two arguments, (*a*) and (*b*), to obtain the three corrections from one and the same Table 33. The latitude and the time difference of longitude from Ujjain can be obtained from maps or other sources, such as my Jyotirganita.

(*a*) The tropical longitude of the sun.

(*b*) The Sun's anomaly.

(*c*) The equinoxial shadow at a place can be obtained from Table 34, when its latitude is known.

To convert Ujjain meantime into sâvaṇa time

THERE ARE TWO CASES:

First, when the given date is Luni-Solar.

182. In the case of a luni-solar date the sun's anomaly becomes available in the course of its computation. But the sun's tropical longitude must be calculated by the formula of Sec. 173.

Method.—(*a*) From Table 33, with the sun's tropical longitude take out the palas and multiply them by the digits of the equinoxial Shadow of the place. The product will be the palas called *Chara.*

(*b*) With double the number of the Sun's tropical longitude as argument, take out from the same table the palas, and increase them by their seventh part and call them *Udayântara.*

(*c*) With the sun's anomaly as third argument, take out from the same table the palas and call them *Bhujântara.*

(*d*) *The Rekhântara* should be reckoned at 10 palas per degree of longitude measured from Ujjain, and is plus or minus according as the place lies to the east or west of the meridian of Ujjain.

(*e*) Add the above four quantities to the mean time of Ujjain according to their signs, and the sum will be the *Sâvana Time* of the occurrence of the phenomenon at the given place.

Sâvana Time = Ujjain mean time,
+ Chara.
+ Udayântara,
+ Bhujântara,
+ Rekhântara.

Example.—Calculate the Sâvana Time of the end of Ashâdha Shukla 12, Thursday, Shaka 406, at Eran. Lat. 24° N and Long. 2°53' to the East of Ujjain. The tithi ended at 51 gh. 11 pa. (U. M. T.)

This same tithi has been worked out in Sec. 94, where the Sun's anomaly is 14°·5. Table 34 gives 5·34 digits for the equinoxial shadow for latitude 24° N.

We have now to calculate only the Sun's tropical longitude by Sec. 173.

Thus—

Trop. ☉ = 14°·5 Sun's anomaly,
77·3 ,, apogee,
— 0·8 ,, Eqn. × 13 = —·046 × 13.
+ 0·4 ☾'s Equation.
— 0·6 ,, Precession for Shaka 406, Tabs. 3, 4.

90·8

With this preparation we can calculate the Sâvana time by Table 33, as follows :—

		gh.	pa.
Ujjain Mean Time		51	11·0
(Arg. 91°) for Chara ; 20·7 pal. × 5·34 = ..	+	1	50·5
(Arg. 182°) for Udayântara; — 0·65 × 8 ÷ 7 =	—	0	0·7
(Arg. 14°·5) for Bhujântara	+	0	4·8
Rekhântara + 2°·53 × 10 = ...	+	0	25·3
Sâvana time at Eran ..		53	29·9

2ndly, When the given date is Solar.

183. In the case of solar dates which are used in Bengal, Orissa, Tamil and Malayâlam provinces, the arguments of Table 33 can be obtained by the following two formulæ.

Trop. ☉ = + Longitude of Sankrânti in Tables 13, 15 or 17.
+ Date of Solar month.
+ Precession, Tables 3, 4.

Sun's anomaly = Trop. ☉, as obtained above.
+ 282°·7 = (360 – 77°·3).
— Precession, by Tables 3, 4.

Note.—The remaining procedure is exactly the same as given in Sec. 182.

184. Time of Sunrise, Noon and Sunset.—The three corrections Chara, Udayântara, and Bhujântara, calculated in Sec. 182, can also be employed in solving problems of sunrise, noon, and sunset in local time, as shown in the following formulæ.

Let C, U, and B, the initial letters, denote the three corrections in palas and, let (m) represent the factor 0·4 for changing them into minutes of time. (Sec. 64 Note.)

Formulæ.—

(*a*), Half day time $= 6\,h. + m\,C.$
(*b*), Sunrise $= 6\,h. - m\,(C + U + B).$
(*c*), Noon = Sunrise + Half day time.
(*d*), Sunset = Noon + Half day-time.
(*e*), Equation of time $= -\ m\,(U + B).$

Note.—The time of sunrise obtained by the above formula must be lessened by 2 minutes, and the time of sunset must be increased by 2 minutes for the refraction of the Sun's rays at the horizon. For greater accuracy the 2 minutes must be multiplied by the secant of the latitude of the place.

(1) When the given date is Luni-Solar

Example.—Calculate the mean local time of the above phenomena at Eran, Lat. 24 N., on Ashâdha Shukla 12, of Shaka year 406.

We make use of the corrections already computed in Section 182, *viz.*, Chara + 110 pa. ; Udayântara — 1 pa ; and Bhujântara + 25 pa.

	Local mean time.
(*a*), Half daytime	$= 6h. + \cdot 4 \times 110.$
	$= 6h.$ 44 minutes.
(*b*), Sunrise	$= 6h. - .4\,(110 - 1 + 5).$
	$= 6h. -$ 46 minutes.
	$= 5h.\ 14\,m.$ (A. M.)
(*c*), Noon	$= 5h.\ 14\,m. + 6h.\ 44m.$
	$= 11h.\ 58\,m.$ (A. M.)

(*d*), Sunset = 11*h*. 58 *m*. + 0*h*. 44*m*.
= 6*h*. 42 *m*. (P. M.)

(*e*), Equation of time = —·4 (— 1 + 5).
= — 1·6 minutes.

185. (2) When the date is Solar, we should calculate the arguments, the sun's tropical longitude and anomaly according to Sec. 183.

We shall work out an example involving the highest latitude in India given in D. B. Pillai's Chronology, page 27.

Example 2.—Find the time of sunrise at Shrînagar, Lat. 34° North, on the 4th date of the Bengal Solar month Mârgashîrsha in the Kaliyuga year 4325.

Here by Table 34, the equinoxial shadow for latitude 34° is 8·1 digits.

By Sec. 183—

Trop ⊙ = 210°·0 longitude of the sun, Tab. 13, on the first day of Mârgashirsha.

4·0	The date of Mârgasîrsha.	
11·0	Precession, Tab. 3, K. Y.	4301
0·4	„ „ 4	24
225·4		4325

's anomaly = 225°·4 ⊙'s tropical longitude,
282·7 = (360° – 77°·3),
–11·4 Precession, Tabs. 3, 4.

136·7

Tab. 33 :— Palasi

Arg. 225°·4 for Chara, (— 14·1 × 8·1) =	..	— 114·2
90·8 for Udayântara, (20·7 × 8 ÷ 7) =	..	+ 23·7
136·7 for Bhujântara	..	+ 14·2
Correction to be made to 6 hours A.M.	..	— 76·3
Correction calculated by D. B. Pillai	..	— 75·0
Correction calculated by Prof. Jacobi	...	— 74·0

By Sec. 184 eqn. (*b*), 6*h*. —·4 (— 76·3) minutes.
Sunrise = 6*h*. 30·5m. (A.M.)

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186. The Ishtakâla and Lagna.—Owing to the apparent diurnal revolution of the heavens, all the degrees of the Ecliptic rise in succession upon the horizon of every place on the earth situated within 66° of Latitude. In astrology the whole of the ecliptic is divided into 108 divisions called Navamâmshas or quarter nakshatras, each of which is presided over by a particular planet. the qualities of which are supposed to influence the actions at the place during the time which the Navamâmsha takes to rise fully above the horizon, and which usually lasts about 33 palas.

The properties of the Navamâmsha, during which a child happens to be born, are supposed to influence all its actions through life, although they are liable to modifications according to the effects of the aspects of the planets situated at different distances from the Navamâmsha. It is the pivot on which the horoscope of an individual is made to turn and consequently its knowledge, correct to within a degree at least, is essential to the astrologers.

In the performance of any important business, the time of the rising of inauspicious Navamâmshas is to be avoided as far as possible.

Hence arise the following two problems

187. Problem 1.—Given the Sun's sidereal longitude at sunrise, the auspicious degree of the Ecliptic (Lagna), and the latitude of the place, to find at what ghati of the Sâvana time (*Ishtakâla*) after sunrise, the auspicious degree of the Ecliptic will come in contact with the horizon.

Rule.—From Tables 3 and 4, take out the precessional degrees and deduct from them 22°·50 algebraically and call the difference C, which is the correction for the precesssion.

Add C to the Sun's longitude S, and to the lagna L, and call the sums (S + C) and (L + C).

From Table 36, with arguments, latitude, and (S + C), take out sidereal time in ghatis entered in the first column of the table.

Again from table 36, with arguments, latitude and (L + C) take out the sidereal time.

Deduct the former sidereal time from the latter. Then again deduct from the remainder as many Asus as there are ghatis in it ; six Asus being equal to one pala.

The result will be the *Ishtakâla* or the desired Sâvana Time.

Example.—At how many ghatis and palas after sunrise was the 165th degree of the ecliptic in touch with the horizon (lagna) on the 6th day of the Bengal Solar month Jyestha, in Kaliyuga year 4000, in Latitude 20 N., at Puri in Orissa.

Tables 3 and 4 give 6°·1 for the Ayanâmshas in Kali 4000. Therefore (6°·1 — 22°·5) = — 16°·4 = C.

Table 13 yields (30° + 5°) = 35° for the longitude of the Sun on the 6th day of Jyestha.

	Sun.	Lagna.
Longitudes of	35°·0	165°·0
Precessional correction C ..	— 16·4	— 16·4
Arg. of Tab. 36 ..	18·6	148·6

Sidereal time of rising of—

	Sun.		Lagna.	
	gh.	pa.	gh.	pa.
Table 36, Arg. Lat. 20° and 18°·6 ..	5	30	0	0
Table 36, Arg. Lat. 20° and 148·6 ..	..	..	28	25
Deduct	5	30	5	30
Duration in sidereal time	0	0	22	55
Deduct 23 asus = 4 palas			—	4
Result — The Sâvana time when 165°·0 was Lagna ..			22	51
By D. B. Pillai's Chronology, page 30			22	52

188. Problem 2.—Given the Sun's longitude, the Ishtakâla or Sâvana time and the latitude of the place, to calculate the Lagna or the rising degree of the Ecliptic.

Rule.—Calculate the Sun's sidereal time of rising as in problem 1. Add to this the Ishtakâla and as many Asus as there are ghatis in it.

With this sum as argument of Table 36, and under the given latitude in it, calculate the Lagna, and add C to it with its sign reversed. The result will be the *Lagna* sought.

Example 2.—What degree of the Ecliptic was Lagna or rising at the same place and date at the end of the 20th ghati ?

The sidereal time at sunrise is in the above example 5 gh. 30 pa. This increased by the Ishtakâla, 20 gh., and as many asus (20 = 3 palas), amounts to 25 gh. 33 pa. as the sidereal time, which is the Vertical Argument of Table 36. Opposite to this and under 20° of latitude we get for Lagna 132°·5. Adding to this C with its sign reversed, *viz.*, 16°·4, we get for the Lagna or the rising degree of the Ecliptic 148°·9.

Type of calculation.	gh.	pa.
Sidereal time at sunrise, as before	5	30
Add the Ishtakâla, 20 gh.	20	0
Add 20 asus = 3 palas	0	3
Sidereal time at 20 gh. Sâvana time	25	33
	Lagna.	
Tab. 36 Arg. 25 gh. 33 pa. and 20° lat.	132°·5	
Add C,—16°·4 with its sign changed	+16·4	
Result :—The Lagna at 20 gh.	148·9	
Result reached by D. B. Pillai and Prof. Jacobi ..	149·0	

CHAPTER XVII

MISCELLANEOUS NOTES

In this chapter we mean to add, for advanced readers, a few notes on questions relating to theory, explanation, comment and antiquary.

Note 1

189. The beginning of Kaliyuga.—According to the Sûrya Siddhânta, the Kaliyuga, which is a cycle of 432000 years, commenced at mid-night of Lankâ on Thursday, the 17·75th of February 3102 B. C. This means that the first point of Ashvini on the Ecliptic, the mean sun, and the mean moon, reached simultaneously the lower meridian of *Lankâ*, an imaginary spot on the Equator on the meridian of Ujjain. The Siddhânta further states that at this moment the longitudes of the apogees of the Sun and the Moon were 77°·26 and 90° respectively.

190. But as the functions of civil life depend upon the true positions of the sun, the *almanac-makers* seem to have rejected the mean zero moment of the zero year of the Kaliyuga, and to have adopted in its place, for convenience's sake, that moment for zero, at which the centre of the *true sun* arrived at the first point of Ashvini usually called Ashvinyâdi.

This *True Epoch* of chronology, when calculated with the elements of the Sûrya-Siddhânta, precedes the midnight of Lankâ by 2·1707 days. It, therefore, occurred on the 17·75 — 2·1707 = 15·5793th day of February, 3102 B. C. At this moment the mean longitude of the Sun was 357°·862 and the equation of its centre was + 2°·138.

191. The Ahargana or the days elapsed from the *Mean Epoch* of Kaliyuga, *i.e.*, from 17·75th of February, 3102 B. C., is often required in the planetary computations of the Sûrya-Siddhânta. It is easily obtained by multiplying the days of the Solar year 365·258756484 by the number of years elapsed upto the Meshâdi of any given year, and deducting from the product the constant number, 2·1707 days. This constant number is called *Shodhya*, meaning a subtrahend. It has no application in chronology.

Note 2

192. Transformation of the chronological elements into Astronomical ones.—This is sometimes necessary for the purpose of comparison with the latter, when available from an independent source. The transformation can be easily effected by means of the following formulæ.

The apogee of the Sun is supposed to be motionless. Its longitude is, therefore, always $77^\circ{\cdot}26$ from the first point of Ashivni.

Let S, M, A and N denote the mean longitudes of the Sun, the Moon, the Moon's Apogee and Node (Râhu).

Then—

S = $77^\circ{\cdot}26$ + Sun's anomaly.
M = S + (tithi × 12°).
A = M — Moon's anomaly.
N = $77^\circ{\cdot}26$ — (Râhu) .. given in Table 3.

Example.—We shall calculate the values of S, M, A and N for the moment of the true epoch of Kaliyuga, the year of Table 3.

Putting the chronological elements in their proper places in the preceding formulæ and solving them, we have—

S = $77^\circ{\cdot}26 + 280^\circ{\cdot}60 = 357^\circ{\cdot}86$ .. ☉'s longitude.
M = $357{\cdot}86 + (27{\cdot}795 \times 12^\circ) = 331^\circ{\cdot}40$ ☾'s longitude.
A = $331{\cdot}40 - 241{\cdot}57 = 89{\cdot}83$ .. ☾'s apogee.
N = $77{\cdot}26 - 235{\cdot}18 = 202{\cdot}08$ .. ☾'s node.

NOTE 3.

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193. Method of testing the accuracy of the consecutive and equidistant *mean elements* given in Tables 3, 4, 5, 14, 16, 18, 20 and 23, and of finding out a new one, that is not given in them. The elements affected by Bija or by abrupt changes due to the introduction of the Gregorian Style are exceptions. The accuracy of the figures of the remaining tables, which are mostly sine-functions, may be examined by taking their first and second differences which ought to rise or fall uniformly without a hitch, if they are correct.

If A, B, C, be any consecutive and equidistant mean quantities, then they must satisfy the following equations :—

$$2\,B = A + C.$$
$$A = 2\,B - C.$$
$$C = 2\,B - A.$$

Example 1. — Suppose we want to test the accuracy of Samvat 36·112 for Kali-year 3001, given in Table 20, Part A, we should proceed thus :—

Kali.		Samvat.	2 B.	A + C.
3001	A	36·112	39·622	36·112
3301	B	39·622	39·622	43·132
3601	C	43·132	19·244 =	19·244

Here the first equation is satisfied. Therefore the quantity 36·112 is correct.

Example 2. — Suppose we want to know the Samvat for Kali-year 2601 which is not given in Table 20. We can obtain it in the following way :—

Kali-Yuga.			Samvat.
2601	A		unknown
3201	B	=	58·452
3801	C	=	5·472

$$A = 2\,B - C = 56{\cdot}904 - 5{\cdot}472 = 51{\cdot}432, \text{ Ans.}$$

Example 3.—Suppose we intend to examine the accuracy of the figures in the 2nd column of Table 6 which vary as the sine of the sun's anomaly. We should do it thus :—

Argument— ..			6		12°		18°		24		30°		36°
Figures— ..	0	,	19	,		,	56	,	74	,	90	,	106.
1st diff. ..	,	19	,	19	,	18		18		16		16	
2nd diff. ..	,		0	,	1	,	0	,	2	,	0		

Here the first differences decrease pretty uniformly. But as we have omitted the fourth decimals, the hitch in the 2nd differences is unavoidable, and being too small, may be overlooked. The figures are therefore accurate enough. The last decimals are generally in error not exceeding half a unit for the same reason.

NOTE 4.

194. The Theory of the necessity of adding the Sun's equation in arc to the Moon's anomaly before obtaining her equation in time from Table 7 (*vide* Section 80, para. 3) must be explained.

In calculating the effect of the Sun's equation on the ending moment of a tithi as given in Table 6, we ought to have employed the Moon's true daily motion (t) as one of the components of the divisor (*vide* example in Sec. 196). But the Moon's true daily motion being indeterminate at the time of preparing Table 6, we were obliged to use her mean daily motion (m) = 791′ in place of (t).

This must entail some error (E) which must be determined and compensated for at the time of calculating the moon's equation in time, when, of course, her anomaly is definitely known.

It is obvious then that the error (E) in time must be equal to the difference between the quotients obtained by dividing the Sun's equation in arc (S) by (m) and (t) separately. It is therefore expressible by—

$$E = \left(\frac{S}{m} - \frac{S}{t}\right) = \left(\frac{S\,(t - m)}{m.t}\right)$$

But ($t - m$) is equal to the increment of the moon's equation of centre in one day. Denoting it, therefore, by D we have,

$$E = \frac{S.D.}{m.t.}$$

Now suppose it is required to find the increase E′ in the Moon's equation in time for the increase N in any two consecutive tabulated values of moon's anomaly in Table 7. For this purpose we must first multiply N by the fraction D/m in order to get the increase in arc in the Moon's equation of centre, and then divide the product by t to get its value in time. Consequently,

$$E' = \frac{N.\ D.}{m.t.}$$

These two formulæ are similar and can, therefore, be combined to obtain the two values by a single effort. Thus—

$$E + E' = \frac{(S + N)\,D}{m.t.} \qquad \text{Q. E. D.}$$

195. The *variation* in the daily motion of the sun being too small, *viz.*, about 2′, it can be ignored and the sun's mean daily motion 59′ can be used as a constant in the divisor in calculating the equations in time of the sun and the moon. The addition of the moon's equation to the Sun's anomaly, though required by the above theory, is practically of no value. For the moon's equation in time (See Table 7) amounts at its maximum to less than half a day, during which time the sun's equation of centre in arc can vary, at the most, only by one minute of arc or by five palas which are practically negligible.

196. We shall *illustrate* the foregoing theory by a numerical example, worked out according to the method of the Indian Jyotishis. For this purpose we select the example worked out in Sec. 82, and take from it the anomalies of the moon and the sun which are 341°·1 and 236°·2 respectively. With these arguments, we obtain from Tables 32 and 31 their equations of centre, + 98′·1 and 108′·6, respectively. Also Table 25 gives 729′ for the moon's true daily motion for that day; and we may assume 59′ for the sun's motion.

The usual Indian method of calculating the correction to the ending moment of a tithi, due to the equations of centre which they call *Parâkhya Samskâra*, can be easily understood from the following working :—

☾'s eqn. ☉'s eqn.		☾'s		☉'s		Total.
$\dfrac{(-98'\cdot1+108'\cdot6)}{(729'-59')}$	$=$	$-\cdot147\ d.$	$+$	$\cdot162\ d.$	$=$	$+\ \cdot015\ d.$
While we get, from Tables 7, 6,		$-\cdot133\ d.$	$+$	$\cdot149\ d.$	$=$	$+\ \cdot016\ d.$

The Sun's equation $+\cdot149\ d.$ obtained from Table 6 by employing the moon's mean daily motion 791′ is, as it ought to be, less by about $\cdot013\ d.$ than $\cdot162\ d.$ obtained by employing the true motion 729′. To make up this deficiency, theory tells us that we should add $108'\cdot6 = 1^\circ\cdot80$ to the moon's anomaly $341^\circ\cdot0$ (See Type of calculation under Sec. 82) and that with the argument $342^\circ\cdot8$ we should find from table 7 the moon's equation $-\cdot133\ d.$ which is equal to $-\cdot147\ d. + \cdot013\ d. = -\cdot134$ day. The totals, in both the cases being identical, clearly prove the compensation.

NOTE 5

197. The Theory of the calculation of the interval passing between the mean sunrise at Ujjain and the actual sunrise at a given place (*vide* Sec. 182) is based on the following four assumptions, *viz.*, that (1) the Sun moves with its mean motion, (2) in the Celestial Equator, and that (3) all the towns on the earth have neither longitudes, (4) nor latitudes ; but are crowded together as in an ant-hill in the central point of Lanka on the Equator. As none of these assumptions is real, corrections must be made for each individual assumption to the extent of its deviation.

The first assumption is corrected by the *Bhujântara*, *i.e.*, the equation of the Sun's centre ; the second is corrected by the *Udayântara*, *i.e.*, the Right Ascensional difference due to the obliquity of the Ecliptic. The third is corrected by the *Rekhântara* or longitude ; and the fourth by *Chara* which is equal to the excess or defect of the semi-diurnal duration as compared with 6 hours.

NOTE 6

198. Tables.—Table 2 (parts I and II) of the Adhkika and Kshaya months, originally computed by Prof. Kero Laxman Chhatre, is copied from a magazine published in Bombay by the *Djnânaprasâraka-Mandali* in 1851. It is corrected in a few cases by Messrs. Sewell and Dixit, and D. B. Pillai.

Tables 19, 20 and 24 have been adopted from D. B. Pillai's Chronology. Table 19 is too simple. D. B. Pillai has not taken the trouble to explain the construction of Tables 20 and 24, a defect which has been made good here with a full explanation. (*Vide* Secs. 121 and 150.) At the very outset in Chapter XI we have in Sec. 120 furnished a formula to which Table 20 may be considered as auxiliary.

The rest of the tables are either specially prepared for this book, or are derived from the author's own treatises.

Tables of increase of elements for odd years and tithis of the Ârya and Brahma Siddhântas are not given, the occasion for their use being rare. Those given for the Sûrya Sidhânta can be used in their place without appreciable error, as can be seen from the examples worked in Sec. 106, and also from Table 37 of the Constants at the end.

The longitude of (Râhu), as given in Col. 7 of Table 3, is the supplement of the distance of the Moon's Node from the Sun's apogee. It is derived from the author's Marathi Grahaganita.

NOTE 7

199. Bija or Empirical correction.—It is an Indian Astronomical maxim that the mean positions, after long intervals, require empirical correction. '*Yugânâm parivartena Kâlabhedotra, Kevalam*' says the Sûrya Siddhânta. By 'Kâlabheda' is meant the empirical correction that is not capable of being explained by theory but by a change in the mean motions or by considering it as an arbitrary constant.

Makaranda, Lalla and Râjamrigânka have respectively suggested empirical corrections to the Sûrya, Ârya and Brahma Siddhântas.

(*a*) The revolutions of Jupiter in a Mahâ Yuga, when corrected for the Bîja proposed by Makaranda, come to 364212 ; while those according to Sûrya Siddhânta are 364220.

(*b*) The Bîja correction to be made to the Moon's anomaly in A. D. 1600 is $+ 1^\circ{\cdot}56$ according to Ganesh Daivajna. This same correction amounts to $+ 1^\circ{\cdot}70$ when calculated by Bürg's Lunar Tables.

(*c*) The Bîja corrections which must be made to the mean elements of the Sûrya Siddhânta so that they may agree with the mean elements of the Nautical Almanac are, in the case of tithis—

$+$ 0·014 day to vâra,
$+$ 0·014 day to English date,
$+$ 3·330 degrees to the moon's anomaly.

These will serve as empirical corrections for a period of one or two centuries in future.

NOTE 8

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200. The First point of Ashvini.—Unfortunately there is no bright and unmistakable star near the Ecliptic, either in or near the first point of the first sidereal division of the Hindus, called Ashvini, worthy of being referred to as the origin of all the sidereal longitudes. Luckily, however, there lies in the opposite direction and near the Ecliptic the single and brilliant star Chitrâ (Spica), the cynosure of all the ancient astronomers. The Indian astronomers deserve, therefore, high praise for their decision to fix the origin of longitudes at a point diametrically opposite to Chitrâ which is of Vedic renown. As there are two equinoxial points in the Ecliptic diametrically opposite to each other, the Ayanâmshas determined with reference to either of them must be equally correct.

I shall now show that the general consensus of opinions is in favour of the choice of Chitrâ, by quotations both from the works of ancient and modern astronomers and scholars in India.

(*a*) The most ancient and famous Indian astronomer (वराहमिहिर) Varâhamihira, (A. D. 505), has given in his Pancha-Siddhântika (पंचसिद्धांतिका) the following verse, while stating the latitudes and longitudes of only such stars as could be seen occulted by the moon.

पित्र्यस्य स्वक्षेत्रे षष्ठे चांशे समायोगः ॥ (अ. १४. श्लो. ३६)

चित्रार्धाग्रमभागे दक्षिणतः संस्थिते त्रिभिर्हस्तैः ॥ (अ. १४ श्लो. ३७)

This important verse was recently brought to my notice by my friend Mr. N. V. Kolhatkar, B.A., Head Master, Training School, Alibag.

The meaning of the verse is plain enough. Herein Varâhamihira states the positions or the longitudes of the moon, when she occults the stars Regulus (मघा) , and Spica (चित्रा), or in other words, he states the longitudes of the two stars. The moon, he says, occults Regulus when she arrives at the sixth degree of the Pitrya-nakshatra-division, and she occults Spica when she arrives at the middle point of the Chitra-nakshatra-division, and has three cubits of south latitude, a cubit being equal to 54′·4.

Now the Pitrya division begins at the 120° of longitude, consequently the longitude of Regulus must be 126°. Chitrâ being the 14th division, the longitude of Spica which corresponds to its middle point, must be exactly 180°. Both these longitudes agree in fixing the same first point of Ashvini which is diametrically opposite to the star Spica and is about 43′ to the east of the star called mu Piscium. The 6th cycle ends in A. D. 291, (Sec. 152) when the tropical longitude of Spica was 180°, and the tropical system came to an end giving place to the sidereal.

(*b*) In respect of the 14th chapter wherein Varâhamihira has given the above verse, Dr. Thibaut asks in his introduction, p. 41: " Why Varâhamihira should have confined himself to stating the longitudes and latitudes of seven junction-stars only, remains unaccounted for. Possibly the manuscripts are defective just at that place."

The question is not so difficult as Dr. Thibaut thinks it to be. Varâhmihira wanted to give a list of such bright stars, the occultation of which by the moon could be seen by the naked eye. For this reason he has omitted all the stars whose latitudes exceeded five degrees and also smaller stars of the third magnitude and below, which disappear on the approach of the moon. The bright star Jyesthâ seems to be omitted as lying on the border of the zone of occultation. The stars Pushya and Âshleshâ given in the list must be, as their latitudes show, different from those given in the later lists of Yoga-târâs. It being a list of occultation stars Varâhamihira is justified in selecting the 7 stars only. I have done the same in my Jyotirganita, page 325.

In another place (Introduction, p. 40) Dr. Thibaut says ' . . . a few remarks may be added about what Varâhamihira states in XIV, (33-38), about the longitudes and latitudes of certain stars. What authority he follows therein we are unable to say."

The answer to this question is given by Varâhamihira himself fourteen centuries ago in the following verse in his बृहत्संहिता edited by Dr. Kern.

युद्धं यथा यदा वा भविष्यदादिश्यते त्रिकालज्ञैः

तद्विज्ञानं करणे मया कृतं सूर्यसिद्धांतात् ॥ (अ. १७. श्लो. १.)

भटोत्पलः—मया करणे पंचसिद्धांतिकायां सूर्यसिद्धांतादानीय कृतमिति ।

Here by Karaṇa is meant पंचसिद्धांतिका and the Sûrya Siddhânta is the original or the old one and not the new or the later one which is now available. The above queries of Dr. Thibaut were brought to notice by my son D. V. Ketkar, B.A., and the explanations given were also suggested by him.

It should be noted that the words युद्ध and समायोग mean the occultation or a near appulse or approach of two heavenly bodies. The Sanskrit word योगतारा should I think be rendered by ' Conjunction star ' and not by ' Junction star,' as Dr. Thibaut has rendered it in his Introduction to पंचसिद्धांतिका.

(c) The old siddhântas such as the Sûrya S°, the Sôma S°, the Brahma S° and the Vriddha-Vasistha S°, have all assigned 180° for the longitude of the star Chitrâ.

The modern astronomers, Mishra Nandrâmji (Shaka 1665) Jyotishroy Kevalarâmji (Shaka 1651) of Jaipur, and Chandra Shekhar Sinha of Cuttock, who were also skilful observers have adopted, in their works, the Ayanâmshâs, determined from the observations of the distance of the star Chitra from the Autumnal Equinox.

(d) Great scholars like Mahâmahopâdhyâya Sudhâkara Dwivedi of Benares, Shriyuta Lâlachândra Sharmâ of Jaipur, and the late A. R. Râjarâja Varmâ, M.A., Principal, Sanskrit College, Trivendrum, have in their pamphlets strongly supported the course of fixing the first point of Aśhvini situated at 180° from the bright star Chitrâ.

(e) Sir William Jones, in Vol. IV of his works, says : " The Lunar year of 360 days (tithis) is apparently more ancient than the solar, and began, as we may infer from a verse in the Matsya Purâṇa, with the month of Âshvina, so called because the moon was at the full, when that name was imposed on the first lunar station of the Hindoo Ecliptic, the origin of which, being diametrically opposite to the bright star Chitrâ (*i.e.*, Spica), may be ascertained on our sphere with exactness."

(f) Mr. Davis was a civil servant of the East India Company in A. D. 1790 at Bhâgalpore. In one of his papers published in the second and third volumes of the " Asiatic Researches," Bengal, he says about the Hindoo Ecliptic, " Its origin is considered as distant 180° in longitude from Spica, a star which seems to have been of great use in regulating their astronomy, and to which the Hindoo tables of the best authority agree in assigning six signs of longitude, counting from the beginning of Aśvini, their first nakshatra."

(g) M. P. Khareghat, Esq., I.C.S. (now retired), says in his article on the Interpretation of certain passages in the Panch-Siddhântikâ of Varâhamihira, published in Vol. XIX, of the Journal of the Bombay Branch of the Royal Asiatic Society, A.D. 1895, on page 134:—" The Epoch of the Pitâmaha Siddhânta is the second year of the Shaka Era Mâgha Sukla 1, when the Sun and Moon were in conjunction at sunrise in the beginning of Dhanisthâ. The data are correct, for on Tuesday, 11th January 80, A.D., the sun and moon were in conjunction in Dhanisthâ in the morning. But the conjunction took place not in the beginning of the nakshatra, as now understood, but very near the true longitude of the star Dhanisthâ (Alpha Delphini). The sun was then in the 21st degree from the winter solstice of that year, and in the 27th degree of Capricornus of the moveable Hindu Zodiac ; the true longitude of the star is also in the 27th degree of Capricornus. This is extremely important as fixing the true position of the Hindu Zodiac before the introduction of the Babylonian system of signs ; Asvini, according to this system, must have commenced three degrees more to the east than it does now."

(*h*) From all the above opinions it is clearly manifest that the first point of Asvini was fixed diametrically opposite to the star Chitrâ, and that its epoch was Shaka year 213 or A.D. 291, (p. 108). Should the reader desire the authority of an Indian observer it is afforded by the above Pitâmaha Siddhântâ, the oldest of all. According to this Siddhânta the longitude of the Star Dhanistha was 291 degrees in Shaka year 2. Of course the longitude of Chitrâ must in that year be (291 — 114) = 177 degrees. From these facts we deduce by means of the precessional motion the Shaka year to be (2 + 210) = 212 when the longitude of Chitrâ was (177 + 3) = 180 degrees.

REFORMATION OF THE HINDU CALENDAR

(*i*) From what has been stated in Sec. 152 the reader will be convinced that the star spica was the main Bench-Mark of the Sidotropical system of the Aryan Chronology from B. C. 1193 to A. D. 291. In the latter year its longitude was exactly 180°, and on this account the year A. D. 291 was considered as a proper epoch for the commencement of a purely sidereal system of Chronology. But the movement seems to have been opposed by the orthodox,* till at last Âryanâtha succeeded in overcoming

* The Libration of the Equinoxes was a subsequent invention calculated to pacify the just fears of the orthodox that the Vernal Equinox would go far away from the month of Chaitra.

their opposition [*vide* Sec. 152 (*c*)], by archly adopting for the counter-point of Chitrâ, a slowly moving point about 10 degrees west of it, and an erroneous sidereal year about 7 palâs in excess of that of the ancient Âryans. We must, therefore, correct these two radical errors if we mean to carry out a thorough reform.

As regards the starting point, the reform will not be a startling one. Because the Epoch of the Meshâdi of the Surya S.° for Shaka year 1844, as calculated by sec. 77, falls on April 13·312, and the true longitude of the Sun for the same Epoch, as calculated from Ketaki (2 cyc. 2200 days), is found to be $359^{\circ}{\cdot}88$. So the distance between the Chitrâ counter-point and the moving starting point which was 10 degrees in the beginning of Kaliyuga, is at present reduced to — 7′ minutes only. So also the substitution of the real sidereal year for the erroneous one will secure the fixity of the starting point for all time to come.

We have announced these fundamental reforms in the introductory part of our Ketaki in the following verses :—

सौरे चित्राभभोगो भगणदलमिति १८०° स्पष्टमुक्तं मयेन
तस्मात् तत्तारकाया अपमविषुवयोर्वृत्तयोर्वै द्वितीयात् ।
संपातात् क्रांतिवृत्ते प्रणमितविवरेणायनांशैश्च भाव्यम्
तत्खाभ्राष्टेंदु (१८००) शाके यमनयनलवं २२° नंदलिप्तं ९′ किलासीत् ॥
सौरोक्तं शरदः प्रमाणमधुना सार्धैः पलैरष्टभिः
सत्याद्दीर्घतरं हि वेधनिपुणैः प्रत्यक्षतो लक्ष्यते ।
चक्रुः प्राक् किल वर्तमानघटनां दृष्ट्वा मुहुः सूरयः
शुद्धिं तद्वदिहापि वेधजशरद्दैर्घ्ये मया स्वीकृतम् ॥४॥

SPREAD OF THE REFORMED KETAKI CALENDAR

We have been publishing our Ketaki Panchânga containing these and other reforms for the last 25 years, and similar Panchângas calculated on the basis of our Ketaki, Vaijayanti and Graha-ganita, are annually being published in different parts and languages of India, as at Puttur in South Canara, at Belgaum in Mahârâstra, at Elichpur in the Berars, and at Mathura in Upper India.

Learned men like Pt. Madan-Mohan Mâlaviya, M.A., of Allahabad, and Prof. Jogesh Chandra Ray, M.A., of Bankura (Bengal), are at present earnestly considering the pressing need of the calendar reform, and the necessity of erecting and conducting suitable observatories for testing the accuracy of Calendars by direct observations. It is to be hoped that sound counsels will ultimately prevail with them and that they will succeed in the near future in their commendable desire.

NOTE 9

201. The date of the Mahâbhârata and Bhagavadgitâ, B. C. 470.—The late Mr. K. T. Telang has, in his learned introduction to the translation of the Bhagvadgîtâ, (part of the Series of the Sacred Books of the East, Vol. VIII), attempted and almost succeeded in solving this important problem. Beginning from Shankarâchârya (8th century A. D.) he has, by means of references and allusions, skilfully traced his way up, step by step, through the books of Bâna, Kâlidâs, Panchatantra, Âpastamba, Patanjali, Baudhâyana, and Pânini (4th century B. C.) and laid down his conclusion in the following words on page 34: "We may, I think, lay it down as more than probable, that the latest date, in which the Gîtâ can have been composed, must be earlier than the third century B. C., though it is at present impossible to say how much earlier."

(*a*) Mr. B. G. Tilak has made use of this same method in his Marathi Gîtâ Rahasya (p. 557). He has ultimately expressed his opinion that the date of the Mahâbhârata cannot be carried more than 500 years before the Shaka Era. Thus both Messrs. Telang and Tilak assign the 4th century B. C. for the date of the Gîta. However, these methods are indirect and yield negative and often vague results. I have, however, caught hold of a chronological allusion made in the Bhagavadgitâ, and making use of a contemporary historical event described in the Mahâbhârata, and also of the tables of the Ancient Aryan Chronology, have, I believe, completely and definitely solved the problem.

(*b*) In identifying himself with the first, foremost, and the best of each kind of things the Divine Shrikrishna says in the Bhagavadgîtâ, X. 35.

मासानां मार्गशीर्षोऽहं ऋतूनां कुसुमाकरः ।

This means that he is the Mârgashîrsha of the months and the spring of the seasons, while it implies that Mârgashîrsha was the first month at the time when the Gîta was composed. On referring to the table of Sec. 152, we find that in the third cycle (B. C. 699 — 452) the years began with मार्गशीर्ष. Therefore the age of the Gîta must be placed somewhere in the third cycle. Now if we take into consideration the mention in the Mahâbhârata about the Buddhist Edukas which were edifices built over the dead relics of Buddha, such as his hair or tooth, we shall be able to draw the limits of the age still closer. The mention is made in the following terms :

एडुकचिह्ना पृथिवी न देवगृहभूषिता ॥ वनपर्व १९०, ६८.

(*c*) This means that the land was covered, not with the temples of gods, but with the Edukas. But as Edukas must have been built after the death of Buddha, which event is generally admitted to have taken place in the year B. C. 483, we can conclude, without fear of contradiction, that both the works were composed sometime between B. C. 483 and B. C. 452. But if we want a single year of the composition, which cannot be the case as the composition should have taken up many years, we can put it down as the year B. C. 470, which is half way between the two extremes.

(*d*) Moreover, the truth of the above date is confirmed by the following astronomical allusion made in the Mahâbhârata.

चकारान्यं च लोकं वै क्रुद्धो नक्षत्रसंपदा

प्रतिश्रवणपूर्वाणि नक्षत्राणि चकार यः ॥ १ ॥ (आदिपर्व अ. ७१)

The purport is that the Rajarshi Vishvâmitra, being angry, created quite a new world and enforced in it the new system of counting the nakshatras from Shravaṇa. This can be explained thus :—In the time of the Vedânga Jyotisha B. C. 1400, the nakshatras were counted from Dhanisthâ as the first one. But nine centuries having elapsed since that time (1400 — 900 = 500), the winter solsticial colure had retrograded through one complete nakshatra-space during the interval, and consequently it was necessary to introduce by a royal mandate the new custom of counting from Shravana. This is one out of many instances of the manner how pure truths are often disguised in the purânic myths of India, in order to perpetuate them in peoples' memory. The legends about Sagara, Bhagiratha and Agastya disclose, when properly considered, important facts in regard to the vast changes in the Earth's surface. The reader may refer for information to my paper read before the First Oriental Conference held at Poona in A. D. 1919, and recently published in Vol. II of its transactions in A.D. 1923.

NOTE 10

202. Largeteau's Method.—The principle of expressing the arguments of inequalities in days of their periods is called Largeteau's Method. It appeared first in 1846 as an addition to the French Connaissance des Temps. Its great merit lies in that it saves completely the time and trouble of computing the arguments. This is very desirable when the number of arguments is unusually large. The arguments when once computed for any date are, by this method, at once changed into those for any other date by simply adding to them all the same number of the intervening days. For this reason the method has been adopted by Hansen and Delaunay in their lunar tables which contain respectively 52 and 76 inequalities of the Moon's longitude alone. Prof. E. W. Brown has also recently done the same in his lunar tables.

(*a*) But the case of Indian Chronology, in which only two inequalities are involved, differs much from that of the Lunar theory, in which there arises no necessity of retransforming the periods of arguments into spaces or arcs. In Indian Chronology the way to Nakshatra and Yoga lies through the Sun's anomaly (See Sec. 92) which when expressed in days, as is done by D. B. Pillai, renders the passage very difficult and the explanations unintelligible. For instance the reader might refer to D. B. Pillai's Chronology, Chapter XXVIII.

(*b*) The method of successive approximations employed by Messrs. Sewell and Dixit in their Indian Calendar is also objectionable, on account of its being very tiresome to the computer. Mr. Pillai has, however, the credit of securing both ease and accuracy of computation by voluntarily and generously undergoing himself, once for all, all the worry of successive approximations by vastly extending the tables. See his table IX extending over twelve pages.

NOTE 11

The Gavâmayana Sacrifices

203. The Earliest efforts of the Aryans for Chronology.—The correct knowledge of time being considered of vital importance in spiritual and religious matters, the duty of keeping correct account of time was entrusted to the *Priests*, who were called the Grâma-purohitas. For this purpose they instituted daily, yearly, quadrennial and Epoch-making sacrifices in which not only the gentry but even kings took part. It appears from the Purâna-Nirîkshana of the late Mr. T. G. Kale and from the Gavâmayana of Pandit R. Shâmashâstri of Mysore, that about the time of the Shatapatha Brâhmana (B.C. 3100) an era was started by the Aryans, in which the priests kept up the count of time by celebrating the Gavâmayanas or the leap-year sacrifices every fourth year. There is preserved, says R. Shâmshâstri, a record, called Brihadukta, of 460 such sacrifices. The era thus lasted 1840 years and ended in about (3100 — 1840) = 1260 B.C., giving place to Vedânga Jyotisha, and to the grand cyclic era of the Aryans. (*Vide* Sec. 152). The years were called in due order Kali, Dwâpara, Tretâ and Krita in succession as the following verse implies :—

कलिः शयानो भवति संजिहानस्तु द्वापरः
उत्तिष्ठन् त्रेता भवति चरन् संपद्यते कृतम् ॥

Note.—The order of years in this is direct and not reversed, like that of the later unwieldy Yugas.

This verse mentions that Kali or the first year begins at sunset, the Dwâpara at midnight, the Tretâ at sunrise, and the Krita at Noon. Instead of adding one day at the end of the fourth year, the original practice seems to commence each year 6 hours later than the preceding.

The similarity in sound of words for the intercalary days used in India, Persia, and Egypt, *viz.*, Gavâmayana, Gambar and Epagomen is very striking and suggestive.

The Indian Chronology can be briefly divided into 3 great periods.

B. C. 3100 to 1200 B. C. The Gavâmayana Period.
B. C. 1200 to 300 A. D. The Grand Cyclic Period.
A. D. 300 to 1900 A. D. The Siddhânta Period.

Or still better into two divisions, *viz.*, the pre-Chitra and the post-Chitra periods, which are separated by the year A. D. 291.

NOTE 12

204. Assyria, the land of Astrology and Astronomy.— The reference to Asurâs in the Shatapatha-Brâhmana (Khanda VI, 1, 4) as being more advanced in their knowledge of the seasons is a proof of their civilization being at least as ancient as that of the Aryans, whom they soon left far behind in arts and sciences. The Assyrians assisted by the Chaldeans founded mighty empires, built great cities and established astronomical observatories at their capitals, so that at present Assyriology forms an important branch of Antiquarian research.

The Assyrian Empire was at the height of its glory in the reign of Shalmanesar, B. C. 851. Ptolemy of Alexandria has based his calculations in his Almagest on the Assyrian Era of Nabonassar, which commenced on the 26th of February, B. C. 747. (*Vide* Sec. 152, Ex. 2.) Berosus, the historian, told Alexander the Great that 10 kings ruled before the Deluge for 432000 years, *i.e.*, for 120 Saroi, each of 3600 years.

Although the statement is apparently impossible (*Vide* Sec. 210 (*c*.) yet the number 432000 is very important as it is exactly equal to the years of Kaliyuga. There were royal observatories at *Ur* and *Chaldai* and the Royal astronomers had to submit their reports about their observations twice a month. They used the gnomon and astrolabe in their observations. They marked the Signs of the Zodiac about B. C. 2200. The cycle of the eclipses was known to them, and the week of 7 days was also in use. They had cycles of 600, 60, and 3600 years called respectively Neras, Sossus and Sarus. (Encyclopædia Britannica, ninth edition.)

205. Under such a state of civilized polity and imperial patronage and encouragement to Astronomy, it would be unjust to deny to the Assyrian Astronomers the honour of being the first to compile an original work on mathematical astronomy, based on eccentric theory. The countries included in the Assyrian Empire, have even in later years, produced the best observing astronomers. Among them may be mentioned, Al-Mamun, Thebit, Albateni, Alhassan and Ulugbeg. (Fig. 4.)

NOTE 13

206. **Gradual spread of the Assyrian Astronomy**.—It is quite natural for the Western scholars to be partial to their brethren the Greeks. They allege, without any strong and indisputable evidence, that the Hindus must have borrowed their astronomy from the Greeks. On the other hand they admit that the Hindu astronomy is much superior to the Greek in several details, and contains proofs of original and independent development. Had I got a copy of Ptolemy's Syntaxis or of its translation called the Almagest, I could have discussed and decided this question much bettei than I can at present, with the second hand and limited information picked up from encyclopædias and other books of reference.

If at all the Hindus have borrowed from the Greeks any science if we can use the word, it is the Astrology which is now discarded as groundless by astronomers and scientists, and which they (the

Greeks) themselves had borrowed from the Chaldeans. The Hindus frankly acknowledge this fact. Varâhmihira quotes in his Brihatsamhitâ

म्लेंच्छा हि यवनास्तेषु सम्यक्शास्त्रमिदं स्थितम् ।
ऋषिवत्तेऽपि पूज्यंते किं पुनर्दैवविद्द्विजाः ॥ (गर्गसंहिता ।)

After calmly considering all the facts and possibilities connected with this question, it appears most likely to me, that both the Greeks and the Hindus must have borrowed their knowledge of Astronomy directly from the Assyrian astronomers of Babylon, at different periods of its development. By this supposition we can account for and reconcile the agreements and differences of the two schools of astronomy, so remarkable for the likeness of their terminology* and progress.

Small Assyrian astronomical tracts on which the Romaka, Pulisha and Saura Siddhântas were based, seem to have reached India, as noticed before, about the second or the third century A. D. Similar compendiums might have been carried from Babylon in the time of Hipparchus, or a century or two later in the time of Ptolemy, 150 A. D., as the map (Fig. 4) shows, to Egypt, Greece and the civilized countries on the borders of the Assyrian Empire.

It is a curious fact that, almost all the astronomical works in India have used the Shaka Era as the basis of their computation. This suggests that the Assyrian astronomical tracts might have first entered India by the route of the Persian Gulf, through the Deccan, with the Shaka invaders, who established themselves as kings at Paithan on the Godavari.

The Mahomedan conquerors of Egypt carried with them Ptolemy's Almagest to Spain in A.D. 1100, whence it was gradually adapted to the European mode of calculations.

NOTE 14

207. Babylon was the home of Mayâsura.—It is quite natural that one should desire to know the place where Mayâsura,

* Thus the words *hora*, *kendra*, and *lipta*, which are made the topic of a hot discussion, lose their importance. They are neither Sanskrit nor Greek, but Chaldean.

Byzantium, Alexandria, Ujjain, Paithan.

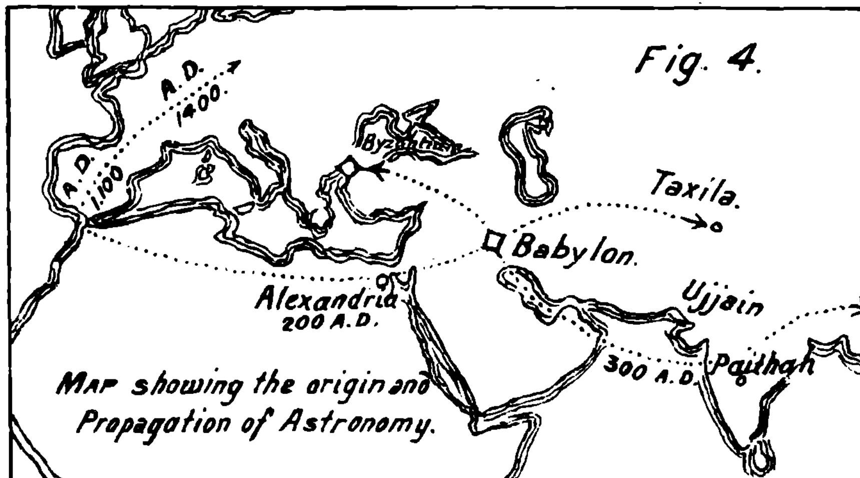

Fig. 4.

the Assyrian author of so eminent a work as Sûrya-Siddhânta, lived. In the sequel we hope to answer this question most conclusively by direct evidence from the Shâkalyôkta-Brahma-Siddhânta and by the indirect evidence of the Sûrya-Siddhânta itself.

The first eight verses of the Sûrya-Siddhânta describe in the Purânic style how Mayâsura, intent upon acquiring the sacred knowledge of Astronomy, practised the most difficult penance to please the Sun, and how the Sun himself, being pleased, gave him the knowledge about the movement of the planets.

The following are the verses—The dialogue is mentioned as having taken place when the Krita-Yuga was nearing its end.

अल्पावशिष्टे तु कृते मयनामा महासुरः ।
आराधयन् विवस्वंतं तपस्तेपे सुदुश्चरम् ॥
तोषितस्तपसा तेन प्रीतस्तस्मै वरार्थिने
ग्रहाणां चरितं प्रादान्मयाय सविता स्वयम् ॥

208. The following verse, mentioning the place where the dialogue between the sun and Maya took place, occurs in the Shâkalyokta-Brahma-Siddhânta, Adhyâya 1. verse 168.

भूमिकक्षाद्वादशांशे लंकायाः प्राक् च शाल्मले ।
मयाय प्रथमे प्रश्ने सूर्यवाक्यमिदं भवेत् ॥

The meaning of this verse is that the sun replied to the first question of Maya at *Shâlmala*, probably connected with Shalmanesar, from which the longitude of Lanka is equal to one twelfth of the Earth's circumference, (*i.e.*, 30 degrees) eastwards. The city of Shâlmala can, therefore, be no other than Babylon, from which the Longitude of Lanka (Ujjain) is according to modern determination 31 15′ East. The Arabs still call Babylon Sham.

The longitude is here stated according to the Tûlânsha system, which was peculiar to the Chaldeans and Assyrians and it is therefore an additional evidence of the Sûrya Siddhânta being Assyrian.

In this system the directions of longitudes and latitudes are stated in a sense opposed to that adopted by us. They are the directions from a place towards the first meridian and the Equator. Accordingly Ganesh Daivjna calls all Indian latitudes as southern. ' यमाशाः पलांशाः '

Tândava Krishnâchârya, who in his Panchânga for Shaka year 1835 has given the longitude of Vizâgapattana from Ujjain as 7° 35′ 30″ West according to the Tûlânsha System, quotes in support of it the following verse from the Siddhânta Tatvaviveka of Kamalâkara.

पश्चिमे रोमकाख्याच्च द्विद्वि (२२) भागैः पुरं किल ।
खाल्दत्ताभिधं चास्ति व्यक्षस्थं तद्गतं किल ॥ १७२

मेरुद्वयस्थानसक्तं रेखावृत्तं च यत् ततः ।
स्वदेशावधि तूलांशाः स्पष्टभूपरिधौ स्वकाः ॥ १७३

209. Here we meet with a clear allusion in Sanskrit to the town Caldai of the Chaldeans as Châladatta. "They were also called the Caldai from the name of the place whence they were supposed to have come originally. The Caldai or Chaldeans are first met with in the 9th century B. C. as a small tribe on the Persian Gulf whence they moved northward, probably taking part in the invasion led successfully by Shalmanesar against the Babylonians in 854 B. C." (*Vide* Encl. Britannica Edi. 9, page 136).

This shows the probable connection between the Era of Nabonassar and the Aryan Era as suggested by us. (*Vide* Sec. 152 *f*.) The Encyclopædia also mentions that Tiglath Pileser I, captured Babylon in 1130 B. C. and carried his arms into India. The Aryan Era had been begun in 1193 B. C. and Tiglath Pileser being convinced of its excellence, might have invited the Aryan colony of Chronologers or Caldais to go along with him and settle down on the coast of the Persian Gulf in his dominion.

NOTE 15

210. Additional evidence in support of the theory of the Assyrian origin of the Sûrya Siddhânta.

(*a*) The Sûrya Siddhânta is often quoted in our old works as Saura, for instance Saura-Mâna, Saura-Bhâshya. It must have been its original Assyrian name. The Arabic Sur-San which begins with the entry of the Sun into the Mriga Nakshatra, calculated according to the Sûrya Siddhânta, suggests the same conclusion. The cycle of the eclipses called *Saros*, which was undoubtedly known to the Chaldeans, may be traced to the original name Saura.

(*b*) The Shadashîtimukha holidays described in Sûrya S° are said to be of Chaldean origin. They commence with the entry of the Sun in the sign Libra for which they had peculiar predilection.

(*c*) The most significant number of the Kaliyuga years, 432000, found in the Assyrian works is an indisputable evidence. The seemingly absurd mention in them, that 10 kings ruled before the deluge at the rate of 43200 years each, can be explained just as we do by giving fictitious names of kings to each of the mighty periods called *Manwantaras*. In the language of the Assyrians, we might say that six Manus, *viz.*, Swâyambhuva, Swârochiṣh, Uttama, Tâmasa, Raivata, Châkshus, have reigned during the past 1972944000 years, and that the present king Vaivasvata has been ruling since the beginning of the Kaliyuga. In our Sankalpa we daily repeat " Vaivasvata-Manvantare " without any idea of ridicule. The number of Kali-yuga years 4,32,000 appears to be of Indian origin and might have been carried with them by the Chaldeans in their migration to the shores of the Persian Gulf.

(*d*) Lastly, the most convincing evidence in support of the theory is the complete and astonishing agreement between the times of the Eclipses actually observed during the Assyrian ascendancy, and the times calculated exclusively with the elements of the Sûrya-Siddhânta (that of the moon's node being excepted) without any correction due to the secular acceleration of the moon's mean motion. Had the elements of the Sûrya Siddhânta been derived from much later observations, there could have been no such agreement.

(*e*) We may further suggest that the Sûrya-Siddhânta elements and inequalities (*vide* Sec. 40), being most accurately determined twenty-five centuries ago, are better fitted to be employed in the calculation of the *ancient eclipses* than the modern ones, in which the co-efficient of the moon's acceleration is still somewhat empirical. Theory gives for it 6″·0 per century, while the observations assign 8″·0. (Tables de la lune, fondées sur la theorie de Delaunay par Radau.)

Note 16

211. Bid, the residence of Bhâskarâcharya.—It is regrettable that the question about the place of residence of so eminent an astronomer as Bhâṣkarâchârya should remain so long unsettled. It has been wrongly identified with Bijapur, Beedar and Patan by scholars like Sudhâkara, and S. B. Dixit.

The colophon at the end of Golâdhyâya says: :—

आसीत्सह्यकुलाचलाश्रितपुरे त्रैविद्यविद्वज्जने ।
नानासज्जनधाम्नि विज्जलविडे शांडिल्य गोत्रो द्विजः ॥
श्रौतस्मार्तविचारसारचतुरो निःशेषविद्यानिधिः ।
साधूनामवधिर्महेश्वरकृती दैवज्ञचूडामणिः ॥

Mr. S. B. Dixit appears to be influenced by the apparent impossibility that Bîd, which is about 200 miles to the east of the Sahyâdri range, can be said to be in its neighbourhood. On the other hand Bhâskara was no simpleton to speak so loosely and wrongly about the geographical position of his own residence.

The discrepancy is merely apparent and not real. It is due to the failure on the part of Mr. Dixit to mark the broad distinction between the meanings of the words *Achala* and *Kulâchala*. The former is applied to a single range and the latter to the whole family inclusive of the off-shoots emanating from the principal range. Bhâskara seems to have specially used the word Kulâchala to signify that Bîd was situated in the neighbourhood of an off-shoot or branch of Sahyâdri, and so he leaves no ground for misunderstanding him. The readers will please see on a map that Sahyâdri sends out a lengthy off-shoot eastwards near Deolali in the Nasik District. It runs 200 miles parallel to the Godâvari as far off as Beedar and passes on its way near Bîd, which is situated in the Nizam's territory on the meridian of Ujjain at 19° Latitude.

212. By *Bîjjala-Bid* is meant that Bîd belonged to Bijjala, who was a vassal prince of the Western Châlukya king Tailapa II., in A. D. 1150, (see Dr. Bhandarkar's early History of the Deccan, page 90), which is also the date of the Siddhânta Siromani. Munîshvara, the commentator of his works, tells us that Bîd was situated not far from the Godâvari. Bijapur, therefore, cannot be the residence of Bhâskara as guessed by Pt. Sudhâkara of Benâres in his Gaṇaka-tarangini. Nor was he a Karnâtaka Brâhmin as he uses the Sanskritized pure Marathi word *Pâti*, meaning a board sprinkled with fine red dust on which formerly arithmetical calculations were made. But he also uses the word *Kuttaka* for the method of solving indeterminate equations. Kuttaka is derived from the Kanarese root 'Kuttu' meaning to pound or pulverize. This opens a new problem for research, *viz.*, whether Algebra had its origin in Karnâtaka. There is some ground to believe that Shrîdhara and Padmanâbha, whom he mentions as renowned Algebraists, must have lived either in Karnâtaka or in Kalinga, the modern Telugu Districts. Aryabhatta (A.D. 476), the first of the known Indian Algebraists, was a native of South Canara or Malabar where his Siddhânta is still used. His commentator Paramâdishvara uses the word Kuttâkâra in his 'Bhata Dîpikâ': '*Iti dvividhah Kuttâkârah niragrassâgrascheti*,' page 47, Aryabhatiya, edited by Dr. H. Kern. Leiden. A. D. 1874.

CHAPTER XVIII

BIBLIOGRAPHY

213. Early chronologists.—In the early half of the eighteenth century, Beschi the famous Tamil Scholar and Jesuit missionary in Madura, and Walther, a Tranquebar missionary, are said to have published in Latin the accounts of the Indian system of chronology. But it was not until the beginning of the nineteenth century that systematic attempts were made for the compilation of books based on the correct principles and data of the Hindu Siddhântas.

214. Kâla-Sankalita.—Under the auspices of the Board of Superintendence of the College of Fort St. George, Lieut.-Col. John Warren published under the above title a big quarto Volume of over 400 pages on Indian Chronology. The date of its dedication is 26th February 1825. Assisted by Adi Shesha Brahmin, he has incorporated into it the tables of one Vavilal Couchinna, a Telugu author, and has closely followed the Sûrya Siddhânta and the Era of Kali-Yuga. It contains rules, examples and tables for the computations of tithis, nakshatras and the positions of the planets.

There appears in the Miscellanea of the Indian Antiquary for January 1891 an able article entitled 'Examination of some errors in Warren's Kâla-Sankalita' contributed by Mr. Shankar B. Dixit of Poona.

215. Graha-sâdhanâchin-Koshtaken.—Under this title Prof. Kero Laxuman Chhatre of the Deccan College, Poona, published in Marathi, in A. D. 1860, his lunar and planetary tables based on those of Bürg, Delambre, and Rev. Vince. The book begins with chronological rules and tables which are absolutely necessary for the calculation of the Ahargaṇa corresponding to the given tithi of a luni-solar calendar. With the help of these tables, Mr. Dixit published in the Indian Antiquary for April 1887 his article on '*The method of calculating the week-days of the Hindu tithis and the corresponding English dates.*'

Prof. Chhatre deserves great praise for being the first to undertake the calculation of all the Adhika and Kshaya months from Shaka year zero to the year 2105. 'They have been,' says D. B. Pillai, 'copied freely by General Cunningham in his Indian Eras and by Mr. Patel in his Chronology without any check.'

216. South Indian Chronological Tables.—These were edited by W. S. Krishnaswami Naidu and Dr. Robert Sewell, M.C.S., Madras. They have been reviewed by Mr. S. B. Dixit in the Indian Antiquary for October 1890.

217. Dr. Herman Jacobi, Ph.D.—He has contributed a number of learned articles and tables on Indian Chronology to Epigraphia Indica and to Indian Antiquary, A. D. 1888. He has invented a new and easy method of calculating English dates corresponding to the given Indian dates and *vice versa*. As he has made use of mean motions, the first results are only approximate ; and the second ones require much labour.

218. The Indian Calendar.—This has been edited under the joint authorship of Messrs. Sewell and Dixit. It covers a period of 16 centuries, A. D. 300—1900. It gives for each year the elements of computation for the beginning of the solar as well as of the lunar years. But these elements are not of much use as the book contains no means of ready reckoning like that of Mr. Pillai. The insistence of the method of successive approximation in the calculation of tithis has, unfortunately, a deterrent effect on computers who are at times required to repeat the approximations ten or fifteen times in order to obtain the correct result.

It contains an extensive and very useful table or Jantri of the Hijari and Christian dates ; and another one supplied by Dr. Schram of Vienna, containing the dates of all the Solar eclipses visible in India, with elements for their computation for a given locality.

The letter-press and the foot-notes contain very useful information and explanations relating to chronological questions.

219. The Indian Chronology.—It is compiled by Diwan Bahadur S. K. Pillai of Madras (A. D. 1911). Of all the books written on Indian Chronology this is the best in point of ease and accuracy. The elements are given for every new moon of the past twenty centuries, so that with the help of the eye-table, the ending moment of any tithi can be obtained correct within a few palas. But the calculation of B. C. dates is not so easy.

220. The Jantries.—These are ephemerides of concurrent dates of two or more eras, included within some historical periods.

The Peshwa Period.—The late Mr. B. P. Modak, professor at the Rajarâm College of Kolhapur, has published (A. D. 1889) a very useful Jantri of the simultaneous dates. It has greatly facilitated the work of historical research of the Peshwa Period, as it contains full details regarding the dates of the Shâlivâhana, Vikrama, Râja Shaka, Sursan, Fasli, Hijri and the Christian Eras, for Shaka years (1650—1811) or for A. D. year (1728—1889).

The Maratha Period.—My friend, Mr. G. S. Khare, retired Hon. Assistant Engineer, has recently (A. D. 1920), presented to the Bhârat Itihâsa Samshôdhaka Mandala of Poona a hundred-and-fifty-year Ephemeris, similar in its details to the above Jantri, for the Shaka years (1500—1649) or for the A. D. years (1578—1727), *i.e.*, from fifty years before the birth of Shivâji to the death of the first Peshwa Bâlâji Vishvanâth. Mr. Khare could not avail himself of old manuscript almanacs of such distant dates. He has undertaken and ably carried out in his old age the most fatiguing work with no other desire than to serve his country.

In his calculation of the five *angas* he has made use of the Tables of Tithi Chintâmani of Ganesha Daivajna.

[END OF PART II AND OF THE BOOK.]

TABLES

To be used in calculations.

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TABLE 1

Summary of Eras

Vide Secs. 2 to 4

No.	Era and kind of year.	Began in.	Calendar.	Year begins with.	Where or by whom is used.
		B. C.			
1	Julian Era, Cur. Trop.	—4713 Jan.	Solar.	January 1 ..	Astronomers.
2	Jewish Era, Cur. Sid.	—3761 Sep.	L. S.	Tesseri 1 ..	The Jews.
3	Kaliyuga, exp. Sid.	—3102 Feb.	L. S.	Chaitra Shukla.	The Hindus.
4	Chinese, Cur. Trop.	—2637 Feb.	L. S.	No. 1 Shukla.	The Chinese.
5	Saptarshi, Cur. Sid.	—3076 Apr.	L. S.	Chaitra Shukla.	Cashmere.
6	Vikrama, Exp. Sid.	—58 Nov.	L. S.	Kârtika Shukla.	Gujaratha.
7	Vikrama, Exp. Sid.	—58 Apr.	L. S.	Chaitra Krishna.	Northern India.
		A. D.			
8	Christian, Cur. Trop.	+ 1 Jan.	Solar.	January 1 ..	The Christians.
9	Shaka Era, Exp. Sid.	+ 78 Apr.	L. S.	Chaitra Shukla.	The Deccan.
10	Chedi, Cur. Sid.	+ 247 Oct.	L. S.	Âshvin Krishna.	Not in use.
11	Vallabhi, Cur. Sid.	+ 318 Nov.	L. S.	Kârtika Shukla.	Kathiawar. A. D. 400-1300.
12	Gupta, Era, Cur. Sid.	+ 319 Apr.	L. S.	Chaitra Krishna.	Central India. A. D. 400-700.

Abbreviations.—Cur. = Current ; Sid. = Sidereal ; Trop. = tropical ; Exp. = expired.

Note.—Years that begin with Shukla-paksha are Amânta and those that begin with Krishna-paksha are Purnimânta.

The centuries of the Saptarshi Era are generally omitted as if it were a cycle of 100 years.

TABLE 1—(*contd.*)

SUMMARY OF ERAS

No.	Era and kind of year.	Began in.	Calendar.	Year begins with.	Where or by whom used.
		A. D.			
13	Vilayati, Cur. Sid...	+ 592 Sep.	Solar.	Kanyâ 1 ..	Orissa.
14	Amali, Cur. Sid. ..	+ 592 Oct.	L. S.	Bhâdra, Shu. 12.	Orissa.
15	Bengal San, Cur. Sid.	+ 593 Apr.	Solar.	Vaishâkha 1 .	Bengal, Assam.
16	Magi San, Cur. Sid.	+ 638 Apr.	Solar.	Do.	Chitagong.
17	Deccan Fasali, Cur. Sid.	+ 591 June	Solar.	Mrigâdi ..	Revenue accounts
18	Sûrsan or Arabic San, Cur. Sid.	+ 599 June	Solar.	Mrigâdi ..	Was in use during Mahratha Supremacy.
19	Harsh-Kâla, Cur. Sid.	+ 606 Nov.	..		Nepal. Not in use now.
20	Hijri San, Cur. Lunar.	+ 622 July	Lunar	Muharam 1..	The Musulmans.
21	Kollam Era, Cur. Sid.	+ 825 Sep.	Solar.	Kannyâ 1 ..	North Malabâr.
	Do. do. ..	Do.	Do.	Sinha 1 ..	South Malabâr Kochin, Travancore.
22	Newâr, Exp. Sid. ..	+ 879 Nov.	L. S.	Kârtika Shukla 1.	Nepal 878 to 1768 A. D.
23	Chalukya, Exp. Sid.	+1076 Apr.	L. S.	Chaitra Shukla 1.	Deccan. A. D. 1079-1162.
24	Laxman Sen, Exp. Sid.	+1118 or +1108 Nov.	L. S.	Kârtika Shukla 1.	Tirhut, Mithilâ with Shaka, Vikrama.
25	Râja Shaka, Cur. Sid.	+1673 June	L. S.	Jyestha Shu. 13.	Dates from Shivaji's coronation.
26	Coptic, Cur. Trop...	+ 284	Solar.	August 29 ..	In some part of Egypt.

TABLE 2.
The Adhika and Kshaya months.
(PART I.)

Calculated on the basis of the Sûrya-Siddhânta by Prof. Kero Laxuman Chhatre.

The Intercalary or Adhika months with their Shaka years.													
Shrâ.	1	Jye.	4	Cha.	7	Shrâ.	9	Dha.	12	Vai.	15	Bhâ.	17
	20		23		26		28		31		34		36
	39		42		*45		47		50		53		55
	58		61		*64		66	Jye.	69		72		74
Dha.	77		80	Ash.	82		85		88		91		93
	96		99		101		104		107		110		112
	115		118		120		123		126	Cha.	129	Shr.	132
	134		137		139		142		145		148		150
	153	Vai.	156	Bhâ.	158		161		164		167		169
	172		175		177		180		183		*186		188
	191		194		196		199		202		*205		207
Jye.	210		213		215	Dha.	218		221	Âsh.	223		226
	229		232		234		237		240		242		245
	248		251		253		256		259		261		264
	267	Cha.	270	Shr.	272		275		278		280	Dha.	283
	286	Phâ.	288		291		294	Vai.	297	Bhâ.	299		302
	305		307		310		313		316		318		321
	324	Cha.	327*		329		332		335		337		340
	343		*346		348	Jye.	351		354		356		359
	362	Bhâ.	364		367		370		373		375		378
	381		383		386		389		392		394		397
	400	Âsh.	402		405		408	Cha.	411*		413		416
	419		421	Dha.	424		427	Pha.	429*	Shr.	432		435
Vai.	438	Bhâ.	440		443		446		*448		451		454
	457		459		462		465		*467		470		473
	476		478		481		484		*486		489	Jye.	492
	495		497		500	Vai.	503	Bhâ.	505		508		511
	514		516		519		522		524		527		530
	*533		535		538		543		543		546		549
Cha.	*552		554		557		560		562	Dha.	565		568
Kâr.	570	Shr.	573		576		579		581		584		587
	589		592		595	Cha.	598		600		603		606
Âsh.	608		611		614		617		619		622		625
	627		630	Jye.	633		636	Shr.	638		641	Vai.	644
Bhâ.	646		649		652		655		657		660		663
	665		668		671		*674		676		679		682
	684		687		690		*693		695		698		701

Note.—The years marked with an asterisk are preceded by a Kshaya month. Dha = Âshâdha. Âsh. = Ashvina.

TABLE 2—(*contd.*)

(PART I)—*continued.*

(*Based on the Sûrya-Siddhânta.*)

Adhika months with the years of Shaka Era.						
Bhâ. 703	Dha. 706	Jye. 709	Âsh. 711	Sh. 714	Dha. 717	Vai. 720
722	725	728	730	733	736	739
741	744	747	749	752	755	Cha. 758
Shr. 760	763	766	768	771	774	777
779	782	Vai. 785	Bhâ. 787	790	Jye. 793	796
798	801	804	806	809	812	*815
817	820	823	825	828	831	*834
836	839	842	844	Dha. 847	850	Âsh. 852
855	858	861	863	866	869	871
874	Jye. 877	880	882	885	888	890
893	896	Cha. 899	Shr. 901	904	907	909
912	915	918	920	923	Vai. 926	Bhâ. 928
931	934	937	939	942	945	947
950	953	956	958	961	964	966
969	972	*975	977	Jye. 980	983	985
Dha. 988	991	Âsh. 993	996	999	1002	1004
1007	1010	1012	1015	1018	1021	1023
1026	1029	1031	1034	1037	Cha. 1040	1042
1045	1048	.1050	Dha. 1053	1056	1059	Shr. 1061
1064	Vai. 1067	Bhâ. 1069	1072	1075	1078	1080
1083	1086	1088	Shr. 1091	1094	1097	1099
1102	1105	1107	1110	1113	*1116	1118
1121	1124	1126	Dha. 1129	1132	Âsh. 1134	1137
Jye. 1140	1143	1145	1148	1151	1153	1156
1159	1162	1164	1167	1170	1172	1175
1178	Cha. 1181*	1183	1186	1189	1191	Dha. 1194
1197	Pha. 1199*	Shr. 1202	1205	Vai. 1208	Bhâ. 1210	1213
1216	*1218	1221	1224	1227	1229	1232
1235	*1237	1240	1243	1246	1248	1251
1254	*1256	1259	1262	1265	1267	1270
Vai. 1273	Bhâ. 1275	1278	Jye. 1281	1284	1286	1289
1292	1294	1297	1300	*1303	1305	1308
Jye. 1311	1313	1316	1319	Cha. 1322*	1324	1327
Vai. 1330	1332	Dha. 1335	1338	Kâr. 1340	Shr. 1343	1346
1349	1351	1354	1357	1359	1362	1365
1368	1370	1373	1376	1378	1381	1384
Cha. 1387	1389	1392	1395	Ph. 1397*	1400	1403

TABLE 2—(*contd.*)

(PART I)—*continued.*

(*Based on the Sûrya-Siddhânta.*)

Adhika Months with the years of Shaka Era.						
Cha. 1406	Shr. 1408	Dha.1411	Vai. 1414	Bh. 1416	Sh. 1419	Jye. 1422
1425	1427	1430	1433	1435	1438	1441
Vai. 1444*	Bhâ.1446	1449	1452	1454	1457	1460
Cha. 1463*	Shr. 1465	1468	1471	1473	Dha.1476	1479
Âsh. 1481	1484	1487	1490	1492	1495	1498
1500	1503	1506	1509	1511	1514	1517
1519	1522	1525	Cha.1528	1530	1533	1536
1538	1541	1544	1547	Shr. 1549	1552	Vai. 1555
Bhâ. 1557	1560	Jye. 1563	1566	1568	1571	1574
1576	1579	1582	1585	1587	1590	1593
1595	1598	1601	1604*	1606	1609	1612
1614	Dha.1617	1620	Âsh.1622	1625	Jye. 1628	1631
1633	1636	1639	1641	1644	Dha.1647	1650
1652	1655	1658	1660	1663	1666	Cha.1669
1671	1674	1677	1679	1682	Jye. 1685	1688
Shr. 1690	1693	Vai. 1696	Bhâ.1698	1701	1704	1707
1709	1712	1715	1717	1720	1723	1726
1728	1731	1734	1736	1739	1742	1745*
1747	1750	1753	1755	Dha.1758	1761	As. 1763
1766	Jye. 1769	1772	1774	1777	1780	1782
1785	1788	1791	1793	1796	1799	1801
1804	1807	Cha.1810	1812	1815	1818	1820
1823	1826	1829	Shr. 1831	1834	Vai. 1837	Bhâ.1839
1842	1845	1848	1850	1853	1856	1858
1861	1864	1867	1869	1872	1875	1877
1880	1883	1886*	1888	1891	1894	1896
Dha.1899	1902	Ph. 1904	1907	Jye. 1910	1913	1915
1918	1921	Âsh.1923	1926	1929	1932	1934
1937	1940	1942	1945	1948	Cha.1951*	1953
1956	1959	1961	Dha.1964	1967	Ph. 1969*	Shr. 1972
1975	Vai. 1978	Bhâ.1980	1983	1986	1988	1991
1994	1997	1999	2002	2005	2007*	2010
2013	2016	2018	2021	2024	2026*	2029
2032	2035	2037	2040	Vai. 2043	2045*	2048
Jye. 2051	2054	2056	2059	Jye. 2062	Bhâ.2064	2067
2070	2073	2075	2078	Vai. 2081	2083	2086
2089	2092	2094	2097	2100	2102	Dha.2105

TABLE 2—(*contd.*)

(PART II.)

(*Based on the Sûrya-Siddhânta.*)

Kshaya or suppressed months in Shaka years with the Adhika months preceding them.

Adhika.	Kshaya.	Adhika.	Kshaya.	Adhika.	Kshaya.
Âsh. 44	Kâr. 44	Âsh. 551	Pau. 551	Kâr. 1321	Pau. 1321
Âsh. 63	Mârg. 63	Kâr. 673	Mâr. 673	Âsh. 1397	Mâr. 1397
Kâr. 185	Mâr. 185	Âsh. 692	Pau. 692	Kâr. 1443	Mâr. 1443
Âsh. 204	Mâr. 204	Kâr. 814	Mâr. 814	Âsh 1462	Pau. 1462
Kâr. 326	Mâr. 326	Âsh. 833	Pau. 833	Âsh. 1603	Pau. 1603
Âsh. 345	Pau. 345	Âsh. 974	Pau. 974	Âsh. 1744	Pau. 1744
Kâr. 410	Pau. 410	Âsh. 1115	Pau. 1115	Âsh. 1885	Pau. 1885
Kâr. 429	Mâr. 429	Kâr. 1180	Pau. 1180	Âsh. 1904	Mâr. 1904
Kâr. 448	Pau. 448	Kâr. 1199	Pau. 1199	Kâr. 1950	Mâr. 1950
Kâr. 467	Pau. 467	Mâr. 1218	Pau. 1218	Mâr. 1969	Pau. 1969
Âsh. 486	Pau. 486	Kâr. 1237	Mâr. 1237	Kâr. 2007	Mâr. 2007
Kâr. 532	Mâr. 532	Âsh. 1256	Pau. 1256	Âsh. 2026	Pau. 2026
—	—	Kâr. 1302	Mâr. 1302	Âsh. 2045	Pau. 2045

TABLE 3

(*Based on the Sûrya-Siddhânta*).

Chronological elements for the Meshâdi of each century of Kaliyuga.

Kali yuga. Era	Shaka Era B. S.	Christian Era. B. C.	Tithi Shuddhi. (1)	Vâra (2)	Christian Months & Date. (3)	Moon's Anomaly. (4)	Sun's Anomaly. (5)	Precession Ayanâmsh (6)	Râhu. (7)
Year.	Year.	Year.	Tithi.	Vāra.	Days.	°	280°	°	°
0	3179	3102	27·795	3·579	F.15·579	241·57	·60	–59·30	235·18
1	3178	3101	8·860	4·838	15·838	333·77	·60	59·32	254·54
101	3078	3001	5·343	4·714	16·714	183·18	·60	57·73	30·39
201	2978	2901	1·827	4·589	17·589	32·63	·60	56·06	166·23
301	2878	2801	28·310	4·465	18·465	242·07	·60	54·39	302·08
401	2778	2701	24·793	4·341	19·341	91·51	·60	–52·82	77·92
501	2678	2601	21·277	4·216	20·216	300·95	·60	51·15	213·76
601	2578	2501	17·760	4·092	21·092	150·39	·60	49·48	349·61
701	2478	2401	14·243	3·968	21·968	359·83	·60	47·91	125·45
801	2378	2301	10·727	3·843	22·843	209·28	·60	46·24	261·29
901	2278	2201	7·210	3·719	23·719	58·72	·60	–44·57	37·14
1001	2178	2101	3·693	3·594	F.24·594	268·16	·60	43·00	172·98
1101	2078	2001	0·177	3·470	25·470	117·60	·60	41·33	308·83
1201	1978	1901	26·660	3·346	26·346	327·04	·60	39·66	84·67
1301	1878	1801	23·144	3·221	27·221	176·48	·60	38·09	220·61
1401	1778	1701	19·627	3·097	28·097	25·93	·60	–36·42	356·36
1501	1678	1601	16·110	2·973	28·973	235·37	·60	34·75	132·20
1601	1578	1501	12·593	2·848	F.29·848	84·81	·60	33·18	268·04
1701	1478	1401	9·077	2·724	M. 1·724	294·25	·60	31·51	43·89
1801	1378	1301	5·560	2·600	2·600	143·69	60	29·84	179·73
1901	1278	1201	2·043	2·475	3·475	353·13	·60	–28·27	315 58
2001	1178	1101	28·527	2·351	4·351	202·58	·60	26·60	91 42
2101	1078	1001	25·010	2·227	5·227	52·02	·60	24·93	227 26
2201	978	901	21·493	2·102	6·102	261·46	·60	23·36	3·11
2301	878	801	17·977	1·978	6·978	110·90	·69	21·69	138·95
2401	778	701	14·460	1·854	7·854	320·34	·60	–20·02	274·79
2501	678	601	10·993	1·729	M. 8·729	169·78	·60	–18·45	50·64

TABLE 3.—*contd.*

(*Based on the Sûrya-Siddhânta*)—*contd.*

Chronological elements for the Meshâdi of each century of Kaliyuga.

Kali yuga Era.	Saka Era. B. S.	Christian Era. B. C.	Tithi Shuddhi. (1)	Vâra Week days. (2)	Christian Months & Date (3)	Moon's Anomaly. (4)	Sun's Anomaly. (5)	Precession Ayanamsh. (6)	Râhu. (7)
Year.	Year.	Year.	Tithi.	Vâra.	M. Days.	°	280°	°	°
2601	578	501	7·427	1·605	M. 9·605	19·23	·60	–16·78	186·48
2701	478	401	3·910	1·481	10·481	228·67	·60	15·11	322·33
2801	378	301	0·393	1·356	11·356	78·11	·60	13·54	98·17
2901	278	201	26·877	1·282	12·282	287·55	·60	–11·87	234·01
3001	178	101	23·360	1·107	13·107	136·99	·60	10·20	9·86
3101	B.78	B.C. 1	19·843	0·983	13·983	346·43	·60	8·63	145·70
3201	A.22	A.100	16·327	0·859	14·859	195·87	·60	6·96	281·55
3301	122	200	12·810	0·734	15·734	45·32	·60	5·29	57·39
3401	222	300	9·293	0·610	16·610	254·76	·60	–3·72	193·23
3501	322	400	5·777	0·486	17·486	104·20	·60	2·05	329·08
3601	422	500	2·260	0·361	18·361	313·64	·60	–0·38	104·92
3701	522	600	28·743	0·237	19·237	163·08	·60	+1·19	240·76
3801	622	700	25·227	0·113	20·113	12·53	·60	2·86	16·61
3901	722	800	21·710	6·988	20·988	221·97	·60	+4·53	152·45
4001	822	900	18·193	6·864	21·864	71·41	·60	6·10	288·30
4101	922	1000	14·677	6·740	22·740	280·85	·60	7·77	64·14
4201	1022	1100	11·160	6·615	23·615	130·29	·60	9·44	199·98
4301	1122	1200	7·643	6·491	24·491	339·73	·60	11·01	335·83
4401	1222	1300	4·127	6·367	25·367	189·18	·60	+12·68	111·67
4501	1322	1400	0·610	6·242	26·242	38·62	·60	14·35	247·51
4601	1422	1500	27·093	6·118	27·118	248·06	·60	15·92	23·36
4701	1522	1600	23·577	5·993	27·993	99·06	·60	17·59	159·20
4801	1622	1700	20·060	5·869	M28·869	308·50	·60	19·26	295·05
4901	1722	1800	16·543	5·745	A.10·745	157·94	·60	+20·83	70·89
5001	1822	1900	13·027	5·620	A.12·620	7·39	·60	22·50	206·73
5101	1922	2000	9·510	5·496	A.13·496	216·82	·60	24·13	342·58
5201	2022	2100	5·993	5·372	A.15·372	66·26	·60	+25·76	118·42

Note.—Column (7) contains supplement of the moon's node *plus* 77°26.

TABLE 4

(*Sûrya-Siddhânta.*)

Increase of Elements in years.

Years.	Tithi. (1)	Vâra. (2)	A.D. day. (3)	Moon's anomaly. (4)	Sun's anomaly. (5)	Precession Ayana. (6)	Râhu. (7)
Com.				°	°	°	°
1	11·065	1·259	·259	92·09	0·00	0·02	19·35
2	22·130	2·517	·517	184·19	0·00	·03	38·71
3	3·194	3·776	·776	276·28	0·00	·05	58·06
Leap.							
4	14·259	5·035	·035	8·38	0·00	·07	77·41
8	28·518	3·070	·070	16·76	0·00	·13	154·82
12	12·778	1·105	·105	25·13	0·00	·20	232·23
16	27·037	6·140	·140	33·51	0·00	·27	309·65
20	11·297	4·175	·175	41·89	0·00	·33	27·06
24	25·556	2·210	·210	50·27	0·00	·40	104·47
28	9·815	0·245	·245	58·64	0·00	·47	181·88
32	24·074	5·280	·280	67·02	0·00	·53	259·29
36	8·334	3·315	·315	75·40	0·00	60	336·70
40	22·593	1·350	350	83·78	0·00	67	54·11
44	6·852	6·385	385	92·15	0·00	73	131·53
48	21·112	4·420	420	100·53	0·00	80	208·94
52	5·371	2·445	·445	108·91	0·00	87	286·35
56	19·630	0·490	·490	117·29	0·00	93	3·76
60	3·890	5·525	·525	125·66	0·00	1·00	81·17
64	18·149	3·560	·560	134·04	0·00	1·07	158·58
68	2·408	1·595	·595	142·42	0·00	1·13	236·00
72	16·667	6·630	·630	150·80	0·00	1·20	313·41
76	0·927	4·665	·665	159·17	0·00	1·27	30·82
80	15·186	2·701	·701	167·55	0·00	1·33	108·23
84	29·445	0·735	·735	175·93	0·00	1·40	185·64
88	13·705	5·771	·771	184·31	0·00	1·47	263·05
92	27·964	3·806	·806	192·68	0·00	1·53	340·46
96	12·223	1·841	·841	201·06	0·00	1·60	57·88

TABLE 5

(Sûrya Siddhânta.)

Increase of Elements in the interval of Tithis.

Tithis. (1)	Vâra. (2)	Days. (3)	☾'s anomaly. (4)	☉'s anomaly. (5)	Pre-ces. (6)	Râhu (7)	Sun's Motion. deg. (8)	Days. (9)
			°	°	°	°	°	°
1	0·984	0·984	12·86	0·97	0·0	0·05	1	1·0
2	1·969	1·969	25·72	1·94	0·0	0·10	2	2·0
3	2·953	2·953	38·58	2·91	0·0	0·15	3	3·0
4	3·937	3·937	51·44	3·88	0·0	0·21	4	4·6
5	4·922	4·922	64·30	4·85	0·0	0·26	5	5·1
6	5·906	5·906	77·16	5·82	0 0	0·31	6	6·1
7	6·890	6·890	90·02	6·79	0 0	0·36	7	7·1
8	0·875	7·875	102·88	7·76	0·0	0·42	8	8·1
9	1·859	8·859	115·74	8·73	0·0	0·47	9	9·1
10	2·844	9·844	128·61	9·70	0·0	0·52	10	10·1
20	5·687	19·687	257 21	19·40	0·0	1·04	20	20·3
30	1·531	29·531	25·82	29·11	0·0	1·57	30	30·4
40	4·374	39·374	154·42	38·81	0·0	2·09	40	40·6
50	0·218	49·218	283·03	48·51	0·0	2·61	50	50·7
60	3·061	59·061	51·63	58·21	0·0	3·13	60	60·9
70	5·905	68·905	180·24	67·91	0·0	3·65	70	71·0
80	1·748	78·748	308·84	77·61	0·0	4·18	80	81·1
90	4·592	88·592	77·45	87·32	0·0	4·70	90	91·3
100	0·435	98·435	206·06	97·02	0·0	5·22	100	101·5
200	0·871	196·871	52·11	194 03	0 0	10·44	200	202·9
300	1·306	295·306	258·17	291·05	0·0	15·66	300	304·4

TABLE 6

Sun's Equation in fractions of a day—For **Tithis.**

Argument = Sun's Anomaly.

Arg	0°	30°	60°	90°	120°	150°	Arg.
Deg.	Day.	Day.	Day.	Day.	Day.	Day.	Deg.
0	·000	·090	·155	·178	·155	·090	30
1	·003	·093	·156	·178	·153	·087	29
2	·006	·095	·158	·178	·152	·085	28
3	·010	·098	·159	·178	·150	·082	27
4	·013	·101	·160	·177	·148	·079	26
5	·016	·104	·161	·177	·147	·077	25
6	·019	·106	·163	·177	·145	·074	24
7	·022	·108	·164	·176	·143	·071	23
8	·025	·111	·165	·176	·141	·068	22
9	·029	·113	·167	·176	·139	·065	21
10	·032	·115	·168	·176	·137	·062	20
11	·035	·118	·169	·175	·135	·059	19
12	·038	·120	·170	·175	·133	·056	18
13	·041	·122	·171	·175	·131	·053	17
14	·044	·124	·172	·174	·129	·050	16
15	·047	·127	·173	·173	·127	·047	15
16	·050	·129	·174	·172	·124	·044	14
17	·053	·131	·175	·171	·122	·041	13
18	·056	·133	·175	·170	·120	·038	12
19	·059	·135	·175	·169	·118	·035	11
20	·062	·137	·176	·168	·115	·032	10
21	·065	·139	·176	·166	·113	·029	9
22	·068	·141	·176	·165	·111	·025	8
23	·071	·143	·176	·164	·108	·022	7
24	·074	·145	·177	·163	·106	·019	6
25	·077	·147	·177	·161	·104	·016	5
26	·079	·148	·177	·160	·101	·013	4
27	·082	·150	·178	·159	·098	·010	3
28	·085	·152	·178	·158	·095	·006	2
29	·087	·153	·178	·156	·093	·003	1
30	·090	·155	·178	·155	·090	·000	0
	+ 330	+ 300	+ 270	+ 240	+ 210	+ 180	

TABLE 7

Moon's Equation for Tithis.

Argument = Moon's Anomaly.

Arg	0° +	30° +	60° +	90° +	120° +	150° +	Arg.
Deg.	Day.	Day.	Day.	Day.	Day.	Day.	Deg.
0	·000	·225	·374	·412	·343	·193	30
1	·008	·231	·377	·412	·339	·187	29
2	·016	·237	·380	·411	·335	·181	28
3	·024	·244	·383	·410	·332	·175	27
4	·032	·250	·385	·409	·328	·168	26
5	·040	·256	·388	·408	·323	·162	25
6	·048	·262	·391	·406	·318	·156	24
7	·056	·268	·393	·405	·314	·150	23
8	·064	·273	·395	·404	·309	·144	22
9	072	279	397	402	304	138	21
10	079	285	399	400	300	131	20
11	·087	290	·401	·398	·295	·125	19
12	·095	·296	·403	·396	·290	·119	18
13	·102	·301	·404	·394	·285	·113	17
14	·110	·306	·406	·392	·280	·106	16
15	·117	·311	·407	·390	·275	·100	15
16	·125	317	408	·388	270	·093	14
17	·132	·322	·409	·385	·263	·087	13
18	·140	·327	·411	·382	·260	·080	12
19	·147	·331	·412	·380	·255	·073	11
20	·155	·336	·413	·377	·250	·067	10
21	·162	·340	·413	·374	·245	·060	9
22	·169	·344	·413	·371	·239	·053	8
23	·176	·348	·414	·367	·234	046	7
24	·184	·353	·414	·364	·228	·040	6
25	·191	·356	·414	361	·222	·033	5
26	·198	·360	·414	·357	·217	·027	4
27	·204	·363	·414	·354	·211	020	3
28	·211	·367	·413	·351	·205	·013	2
29	·218	·370	·413	·347	·199	·006	1
30	·225	·374	·412	·343	·193	·000	0
	—	—	—	—	—	—	
	330	300	270	240	210	180	

TABLE 8

Moon's Equation for Nakshatras.

Arg. = Moon's Anomaly.

Arg.	0° +	30° +	60° +	90° +	120° +	150° +	Arg.
Deg.	Day.	Day.	Day.	Day.	Day.	Day.	Deg.
0	·000	·208	·346	·382	·317	·178	30
1	·007	·214	·349	·381	·313	·173	29
2	·015	·220	·352	·380	·309	·167	28
3	·022	·226	·355	·379	·306	·162	27
4	·029	·231	·358	·378	·302	·156	26
5	·036	·237	·360	·377	·298	·151	25
6	·044	·243	·362	·376	·294	·145	24
7	·051	·248	·364	·375	·290	·139	23
8	·059	·353	·366	·373	·286	·133	22
9	·066	·358	·368	·372	·282	·127	21
10	·073	·364	·370	·371	·277	·122	20
11	·080	·369	·372	·369	·273	·116	19
12	·088	·374	·373	·367	·269	·110	18
13	·095	·379	·375	·365	·264	·104	17
14	·102	·383	·376	·363	·260	·098	16
15	·109	·388	·377	·361	·255	·092	15
16	·116	·393	·378	·359	·250	·086	14
17	·123	·398	·379	·357	·245	·080	13
18	·130	·302	·380	·354	·241	·074	12
19	·137	·306	·381	·351	·236	·068	11
20	·143	·310	·381	·349	·231	·062	10
21	·150	·314	·382	·346	·226	·056	9
22	·157	·318	·382	·343	·221	·049	8
23	·163	·322	·383	·340	·216	·043	7
24	·170	·326	·383	·337	·211	·037	6
25	·176	·329	·383	·334	·206	·031	5
26	·183	·333	·383	·330	·200	·025	4
27	·189	·336	·383	·327	·195	·019	3
28	·195	·339	·383	·324	·189	·012	2
29	·201	·343	·382	·320	·184	·006	1
30	·208	·346	·382	·317	·178	·000	0
	— 330	— 300	— 270	— 240	— 210	— 180	

TABLE 9

Sun's Equation for **Yogas.** Arg = ☉'s Anomaly.

Arg.	0° +	30° +	60° +	90° +	120° +	150° +	Arg.
Deg.	Day.	Day.	Day.	Day.	Day.	Day.	Deg.
0	·000	·077	·131	·153	·131	·077	30
6	·017	·091	·140	·152	·124	·064	24
12	·033	·103	·146	·150	·114	·048	18
18	·048	·114	·150	·146	·103	·033	12
24	·064	·124	·152	·140	·091	·017	6
30	·077	·131	·153	·131	·077	·000	0
	—	—	—	—	—	—	
	330	300	270	240	210	150	

TABLE 10

Moon's Equation for **Yogas.** Arg. = ☾'s Anomaly.

Arg.	0° +	30° +	60° +	90° +	120° +	150° +	Arg.
Deg.	Day.	Day.	Day.	Day.	Day.	Day.	Deg.
0	·000	·190	·319	·355	·295	·166	30
6	·042	·222	·334	·350	·274	·135	24
12	·080	·251	·347	·341	·251	·102	18
18	·119	·277	·355	·329	·223	·069	12
24	·155	·300	·356	·313	·197	·036	6
30	·190	·319	·355	·295	·166	·000	0
	—	—	—	—	—	—	
	330	300	270	240	210	180	

Table 11

Days elapsed from March 0, and April 0.

To	From March 0.	From April 0.	To	From March 0.	From April 0.
April 0 ..	31	0	October 0..	214	183
May 0 ..	61	30	November 0..	245	214
June 0 ..	92	61	December 0..	275	244
July 0 ..	122	91	January 0..	306	275
August 0 ..	153	122	February 0..	337	306
September 0 ..	184	153	March 0..	365	334
			In leap year ..	366	335

TABLE 12

Moon's Modern Equation of Centre for Tithis,

Horizontal Arg : = The Monthly Tithi.

Vert. Arg : =Moon's Anomaly —(12 × monthly Tithis).

Vert Arg.	Entry			The Monthly Tithis.					
	30	1	2	3	4	5	6	7	
°	Day.	Day.	Day.	Day.	Day.	Day.	Day.	Day.	°
0	+·000—	+·115—	+·231—	+·335—	+·431—	+·512—	+·576—	+·617—	360
12	·092	·201	·306	·399	·478	·543	·587	·609	348
24	·178	·276	·366	·441	·501	·545	·571	·575	336
36	·254	·335	·405	·460	·499	·523	·529	·516	324
48	·318	·378	·425	·455	·453	·474	·463	·433	312
60	·365	·400	·422	·429	·484	·406	·376	·335	300
72	·394	·402	·399	·376	·353	·318	·273	·221	288
84	·405	·402	·357	·318	·269	·215	·159	+·098—	276
96	·398	·356	·303	·239	·173	+·104—	+·037—	—·029+	264
108	·375	·308	·231	·149	+·067—	—·014+	—·089+	·157	252
120	·336	·248	·151	+·053—	—·043+	·132	·214	·281	240
132	·285	·179	+·065—	—·046+	·152	·243	·327	·391	228
144	·222	·102	—·023+	·144	·256	·353	·430	·487	216
156	·154	+·022—	·110	·238	·352	·447	·518	·566	204
168	+·078—	—·060+	·198	·325	·435	·523	·584	·615	192
180	·000	·141	·276	·399	·503	·580	·628	·639	180
192	—·078+	·215	·347	·461	·552	·616	·643	·638	168
204	·155	·285	·405	·506	·580	·624	·632	·607	156
216	·226	·343	·499	·524	·585	·605	·594	·550	144
228	·291	·391	·476	·536	·567	·566	·530	·468	132
240	·344	·424	·485	·519	·526	·501	·445	·365	120
252	·384	·440	·474	·484	·464	·415	·341	·247	108
264	·408	·438	·475	·426	·381	·312	·222	—·118+	96
276	·415	·414	·396	·351	·284	·196	—·095+	+·015—	84
288	·403	·376	·330	·262	·175	—·073+	+·037—	·146	72
300	·372	·319	·248	·160	—·058+	+·051—	·163	·271	60
312	·323	·248	·157	—·052+	+·058—	·173	·283	·383	48
324	·257	·164	—·057+	+·055—	·170	·283	·389	·477	36
336	·179	—·071+	+·043—	·160	·273	·381	·475	·549	24
348	·093	+·023—	·142	·255	·362	·468	·538	·595	12
360	—·000+	+·115—	+·231—	+·335—	+·431—	+·512—	+·576—	+·617—	0
	30	29	28	27	26	25	24	23	Vert Arg.
				The monthly Tithis.				Entry.	

Each Equation-figure has two signs. The sign lying on the side of the vertical argument of entry to be adopted.

TABLE 12—(*contd.*)

Moon's Modern Equation of Centre for Tithis.

Horizontal Arg : = The Monthly Tithi.

Vert. Arg : = Moon's Anomaly —(12×Monthly Tithis).

Vert Arg.	Entry. The Monthly Tithis. 8	9	10	11	12	13	14	15	
°	Day.	Day.	Day.	Day.	Day.	Day.	Day.	Day.	°
0	+·630—	+·612—	+·565—	+·489—	+·390—	+·272—	+·140—	—·000+	360
12	·604	·571	·510	·425	·318	·196	+·062—	·078	348
24	·654	·508	·438	·346	·236	·112	—·019+	·154	336
36	·481	·425	·348	·254	·145	+·025—	·100	·226	324
48	·388	·325	·246	·154	+·048—	—·064+	·178	·290	312
60	·281	·215	·135	+·045—	—·050+	·151	·249	·343	300
72	·161	+·093—	+·017—	— 063+	·147	·231	·311	·384	288
84	+·034—	—·035+	—·100+	·168	·238	·303	·361	·409	276
96	— 093+	·155	·210	·267	·319	·363	·396	·417	264
108	·218	·271	·316	·355	·383	·406	·412	·405	252
120	·335	·376	·406	·426	·434	·427	·409	·378	240
132	·437	·465	·478	·476	·459	·429	·385	·326	228
144	·522	·534	·527	·498	·465	·410	·341	·260	216
156	·583	·577	·551	·506	·445	·368	·279	·181	204
168	·618	·595	·548	·481	·401	·307	·204	—·092+	192
180	·627	·582	·516	·432	·336	·229	·116	·000	180
192	·603	·542	·459	·361	·253	·139	—·023+	+·092—	168
204	·554	·475	·380	·272	·155	—·042+	+·072—	·179	156
216	·479	·387	·281	·167	—·052+	+·060—	·163	·257	144
228	·381	·278	·167	—·054+	+·055—	·157	·245	·321	132
240	·267	·168	—·046+	+·062—	·162	·247	·316	·367	120
252	·141	—·031+	+·079—	·177	·260	·326	·371	·396	108
264	—·009+	+·100—	·200	·284	·347	·389	·407	·406	96
276	+·125—	·226	·312	·377	·419	·435	·427	·398	84
288	·250	·342	·412	455	472	·462	·427	·374	72
300	·366	·442	·492	·515	·506	·471	·413	·335	60
312	·465	·524	·554	·552	·521	·462	·381	·288	48
324	·544	·583	·592	·568	·515	·435	·336	·222	36
336	·599	·618	·608	·563	·490	·394	·279	·152	24
348	·627	·628	·597	·536	·447	·338	·213	·078	12
360	+·630—	+·612—	+·565—	+·489—	+·390—	+·272—	+·140—	+·000—	0
	22	21	20	19	18	17	16	15	Vert Arg.
	The Monthly Tithis.							Entry.	

Vide remarks made at the bottom of the preceding page.

TABLE 13

(Based on the Surya-Siddhanta).

To be used in the calculation of the Sankrântis, and of the Solar Months of Bengal and Orissa.

Râshis or Sankrântis and Lunar Months.	Bengal Solar months.	Days in Solar months.	Increase of Elements from Mesha Sankrânti to the beginning of each succeeding Sankrânti.					
			☉'s long	Tithi. (1)	Vâra. (2)	Days. (3)	☾'s anom. (4)	☉'s anom. (5)
Mesha. Chai.	Vaishâkh ..	30·935	0°	0·000	0·000	0·000	0°·0	·0°0
Vrisha. Vai.	Jyestha ..	31·420	30	31·426	2·935	30·935	44·0	30·5
Mithuna. Jye.	Ashâdh ..	31·645	60	63·347	6·356	62·356	94·6	61·5
Karka. Asha.	Shrâvan ..	31·475	90	95·494	3·000	94·000	148·1	92·9
Sinha. Shrâ.	Bhâdrapada	31·019	120	127·471	6·476	125·476	199·3	123·7
Kanyâ. Bhâ.	Ashwin ..	30·441	150	158·981	2·494	156·494	244·6	154·3
Tula. Ashw.	Kârtika ..	29·893	180	189·907	4·936	186·936	282·2	184·4
Vrischika Kâr.	Mârgashirsh	29·490	210	220·276	6·829	216·829	312·8	213·9
Dhanu. Mârg.	Pausha ..	29·318	240	250·234	1·319	246·319	338·1	242·9
Makara. Paush.	Mâgha ..	29·448	270	280·018	2·637	275·637	1·7	271·9
Kumbha. Mâgh.	Phâlguna ..	29·820	300	309·935	4·085	305·085	26·5	300·9
Mina. Phâl.	Chaitra ..	30·353	330	339·720	5·905	334·905	56·1	330·0
Mesha. Chai.	Vaishâkh ..	30 935	360	371·065	1·259	365·259	92·1	0·0

Note.—This Table as well as tables 15 and 17 enable us to find approximately, the Sun's longitude for any date of a Solar month. For an example *vide* Sections 183 and 185. In rough calculation days and degrees might be interchanged. But recourse should be had, where accuracy is desired, to proportional parts.

TABLE 14

(Based on the Arya Siddhanta.)

Elements for the Meshadi of Kaliyuga Centuries.

3601—5101.

Kali years.	Shaka years.	Kol-lam years.	A.D. years.	Tithi. (1)	Vâra. (2)	A.D. month date. (3)	☾'s anom. (4)	☉'s anom. (5)
3601	422	— 325	500	2·283	0·361	M18·361	309·13	280··0
3701	522	225	600	28·753	0·229	19·229	159·03	280·0
3801	622	125	700	25·222	0·097	20·097	8·93	280·0
3901	722	— 25	800	21·691	6·965	20·965	218·83	280·0
4001	822	+ 75	900	18·161	6·833	21·833	68·73	280·0
4101	922	175	1000	14·630	6·701	22·701	278·63	280·0
4201	1022	275	1100	11·100	6·569	23·569	128·53	280·0
4301	1122	375	1200	7·569	6·437	24·437	338·43	280·0
4401	1222	475	1300	4·039	6·306	25·306	188·33	280·0
4501	1322	575	1400	0·508	6·174	26·174	38·23	280·0
4601	1422	675	1500	26·977	6·042	27·042	248·13	280·0
4701	1522	775	1600	23·447	5·910	27·910	98·03	280·0
4801	1622	875	1700	19·916	5·778	28·778	307·93	280·0
4901	1722	975	1800	16·386	5·646	A.10·646	157·83	280·0
5001	1822	1075	1900	12·855	5·514	12·514	7·73	280·0
5101	1922	+1175	2000	9·325	5·382	13·382	217·63	280·0

Note.—The Ârya Siddhânta is at present used in Malabâr, Cochin, Travancore, the Tamil Districts and part of South Canara.

TABLE 15

(Based on the Arya Siddhânta.)

To be used in the calculation of the Sankrântis and of the Solar Months in Tamil and Malabar districts.

Increase of Elements from the moment of Mesha Sankrânti to each of the subsequent Sankrantis.

Tamil Solar months.	⊙'s longi.	Malabâr Solar months.	Tithi. (1)	Vâra. (2)	Days. (3)	☾'s ano. (4)	⊙'s ano. (5)
						°	°
1. Chittirai ..	0°	1. Medam	0·000	0·000	0·000	0·0	0·0
2. Vaikasi	30	2. Edawam ..	31·416	2·925	30·925	44·0	30·5
3. Ani	60	3. Mithunam ..	63·317	6·326	62·326	95·2	61·5
4. Adi	90	4. Karkatagam ..	95·428	2·933	93·933	147·3	92·9
5. Avani	120	5. Chingam ..	127·397	6·401	125·401	198·4	123·7
6. Purattasi ..	150	6. Kanni	158·923	2·436	156·436	243·2	154·3
7. Aipasi	180	7. Tulam	189·863	4·892	186·892	281·4	184·4
8. Kartikai.. ..	210	8. Vrichikum ..	220·243	6·796	216·796	312·4	213·9
9. Margali	240	9. Dhanus	250·219	1·304	246·304	337·9	242·9
10. Tai	270	10. Magaram ..	280·036	2·655	275·655	2·0	271·9
11. Masi	300	11. Kumbham ..	309·962	4·112	305·112	26·9	300·9
12. Panguni ..	330	12. Meenam ..	339·735	5·920	334·920	56·3	330·0
1. Chittirai ..	0	1. Medam	371·065	1·259	365·259	92·1	0·0

See note below Table 13.

TABLE 16

(Based on the Brahma Siddhânta.)

Elements for the Meshâdi of Kaliyuga Centuries.

3601—5101.

Kali years.	Shaka years.	A.D. years.	Tithi. (1)	Vâra. (2)	A.D. months. (3)	☾'s anom. (4)	⊙'s anom. (5)
3601	422	500	1·357	6·461	Mr. 17·461	296°·62	280°
3701	522	600	27·816	6·304	18·304	146·58	280
3801	622	700	24·275	6·148	19·148	356·53	280
3901	722	800	20·735	5·992	19·992	206·49	280
4001	822	900	17·194	5·836	20·836	56·44	280
4101	922	1000	13·653	5·679	21·679	266·40	280
4201	1022	1100	10·112	5·523	22·523	116·35	280
4301	1122	1200	6·571	5·367	23·367	326·31	280
4401	1222	1300	3·031	5·211	24·211	176·27	280
4501	1322	1400	29·490	5·054	25·054	26·22	280
4601	1422	1500	25·949	4·898	25·898	236·18	280
4701	1522	1600	22·408	4·742	26·742	86·13	280
4801	1622	1700	18·868	4·585	27·585	296·09	280
4901	1722	1800	15·327	4·429	Ap. 9·429	146·04	280
5001	1822	1900	11·787	4·273	11·273	356·00	280
5101	1922	2000	9·246	4·117	12·117	205·96	280

***Note.*—The Brahma Siddhanta is used in Gujarath and Rajaputana.**

TABLE 17

(*Based on the Brahma Siddhânta.*)

To be used in the calculation of Sankrantis in Gujaratha and Rajaputana.

Names of Sankantis.	Months.	Increase of elements from Mesha Sankranti to each of the succeeding ones.					
		☉'s Long.	Tithi. (1)	Vara. (2)	Days. (3)	☾'s anom. (4)	☉'s anom. (5)
Mesha ..	Chaitra ..	0°	0·000	0·000	0·000	00°·0	00°·0
Vrisha ..	Vaishâ ..	30	31·423	2·932	30·932	44·0	30·5
Mithuna ..	Jyestha ..	60	63·336	6·346	62·346	95·5	61·5
Karka ..	Ashâdha ..	90	95·464	2·968	93·968	147·7	92·6
Sinha ..	Shrâvan ..	120	127·443	6·447	125·447	198·9	123·6
Kanyâ ..	Bhâdra ..	150	158·974	2·487	156·487	244·5	154·2
Tula ..	Ashvin ..	180	189·912	4·941	186·941	282·4	184·2
Vrischika ..	Kârtika ..	210	220·284	6·837	216·837	313·0	213·7
Dhanu ..	Mârga ..	240	250·213	1·298	246·298	337·9	242·7
Makara ..	Pausha ..	270	280·043	2·672	275·672	2·2	271·7
Kumbha ·	Mâgha ..	300	309·968	4·118	305·118	26·9	300·7
Mîna ..	Phâlguna ..	330	339·738	5·923	334·923	56·3	330·0
Mesha ..	Chairta ..	360	371·065	1·258	365·258	92·1	360.0

See note below Table 13.

TABLE 18

Motion in the interval of Nakshatras and Yogas.

Nak R.	Vâra.	Days.	☾'s anom.	yog. R.	Vâra.	Days.	☾'s anom.	☉'s anom.
			°				°	°
1	1·012	1·012	13·22	1	0·941	0·941	12·30	0·93
2	2·023	2·023	26·44	2	1·883	1·883	24·60	1·86
3	3·036	3·036	39·66	3	2·824	2·824	36·90	2·78
4	4·048	4·408	52·88	4	3·766	3·766	49·20	3·71
5	5·059	5·059	66·10	5	4·707	4·707	61·50	4·64
6	6·071	6·071	79·32	6	5·649	5·649	73·80	5·57
7	0·083	7·083	92·54	7	6·590	6·590	86·10	6·50
8	1·095	8·095	105·76	8	0·532	7·532	98·40	7·42
9	2·107	9·107	118·98	9	1·473	8·473	110·70	8·35
10	3·119	10·119	132·20	10	2·415	9·415	123·00	9·28
20	6·238	20·238	264·41	20	4·830	18·430	146·00	18·56

Motion of the Elements for days.

Days.	Tithis.	Vâra.	☾'s anom.	☉'s anom.	☾'s node.
			°	°	°
1	1·015869	1	13·065	0·986	0·053
2	2·031738	2	26·130	1·971	·106
3	3·047607	3	39·195	2·957	·159
4	4·063476	4	52·260	3·942	·212
5	5·079345	5	65·325	4·928	·265
6	6·095214	6	78·390	5·915	·318
7	7·111083	0	91·455	6·899	·371
8	8·126952	1	104·520	7·855	·424
9	9·142821	2	117·585	8·870	·477
10	10·158690	3	130·650	9·856	0·530
20	20·317380	6	261·300	19·710	1·060

Note.—The Sun's apogee being considered fixed, the motion of the sun's anomaly may be taken for that of the mean sun.

TABLE 19

The Deccan Samvatsaras and the A. D. years concurring with them.

The month of Chaitra generally concurs with April.

Centuries.	10—11	11	12	12	13	13—14	14	15	15	16	16—17	17	18	18	19
Samvatsars.	yr	yr	yr	yr	yr	yr	yr	yr	yr	yr	yr	yr	yr	yr	yr
1. Prabhava ..	87	47	07	67	27	87	47	07	67	27	87	47	07	67	27
2. Vibhava ..	88	48	08	63	28	88	48	08	68	28	88	48	08	68	28
3. Shukla ..	89	49	09	69	29	89	49	09	69	29	89	49	09	69	29
4. Pramoda ..	90	50	10	70	30	90	50	10	70	30	90	50	10	70	30
5. Prajâpati ..	91	51	11	71	31	91	51	11	71	31	91	51	11	71	31
6. Angiras	92	52	12	72	32	92	52	12	72	32	92	52	12	72	32
7. Shrimukha	93	53	13	73	33	93	53	13	73	33	93	53	13	73	33
8. Bhâva	94	54	14	74	34	94	54	14	74	34	93	54	14	74	34
9 .Yuva	95	55	15	75	35	95	55	15	75	35	95	55	15	75	35
10. Dhâtri	96	56	16	76	36	96	56	16	76	36	96	56	16	76	36
11. Ishwara	97	57	17	77	37	97	57	17	77	37	97	57	17	77	37
12. Bahudhânya	98	58	18	78	38	98	58	18	78	38	98	58	18	78	38
13. Pramâthi	99	59	19	79	39	99	59	19	79	39	99	59	19	79	39
14. Vikama ..	00	60	20	80	40	00	60	20	80	40	00	60	20	80	40
15. Vrisha ..	01	61	21	81	41	01	61	21	81	41	01	61	21	81	41
16. Chitrabhânu	02	62	22	82	42	02	62	22	82	42	02	62	22	82	42
17. Subhânu	03	63	23	83	43	03	63	23	83	43	03	63	23	83	43
18. Târana	04	64	24	84	44	04	64	24	84	44	04	64	24	84	44
19. Pârthiva	05	65	25	85	45	05	65	25	85	45	05	65	25	85	45
20. Vyaya	06	66	26	86	46	06	66	26	86	46	04	66	26	86	46
21. Sarvajit	07	67	27	87	47	07	67	27	87	47	07	67	27	87	47
22. Sarvadhâri	08	68	28	88	48	08	68	28	88	48	08	68	28	88	48
23. Virodhi ..	09	69	29	89	49	09	69	29	89	49	09	69	28	89	49
24. Vikriti ..	10	70	30	90	50	10	70	30	90	50	10	70	30	90	50
25. Khara ..	11	71	31	91	51	11	71	31	91	51	11	71	31	91	51
26. Nandana ..	12	72	32	92	52	12	72	32	92	52	12	72	32	92	52
27. Vijaya ..	13	73	33	93	53	13	73	33	93	53	13	73	33	93	53
28. Jaya	14	74	34	94	54	14	74	34	94	54	14	74	34	94	54
29. Manmatha	15	75	35	95	55	15	75	35	95	55	15	75	35	95	55
30. Durmukha	16	76	36	96	56	16	76	36	96	56	16	76	36	96	56

To find the Samvatsara for a Shaka year add 78 to it and use the sum as argument of this table.

TABLE 19—(*contd.*)

The Deccan Samvatsaras and the A. D. years concurring with them.

Years less than 1100 must be increased by multiples of 300 and brought within the limits of this table.

The month Chaitra generally concurs with April.

Centuries.	11	11—12	12	12—13	13	14	14—15	15	15—16	16	17	17—18	18	18—19	19
Samvatsaras	yr	yr	yr	yr	yr	yr	yr	yr	yr	yr	yr	yr	yr	yr	yr
31. Hemalambi	17	77	37	97	57	17	77	37	97	57	17	77	37	97	57
32. Vilambi	18	78	38	98	58	18	78	38	98	58	18	78	38	98	58
33. Vikari..	19	79	39	99	59	19	79	39	99	59	19	79	39	99	59
34. Shârvari	20	80	40	00	60	20	80	40	00	60	20	80	40	00	60
35. Plava	21	81	41	01	61	21	81	41	01	61	21	81	41	01	61
36. Shubhakrit	22	82	42	02	62	22	82	42	02	62	22	82	42	02	62
37. Shobhan	23	83	43	03	63	23	83	43	03	63	23	83	43	03	63
38. Krodhi	24	84	44	04	64	24	84	44	04	64	24	84	44	04	64
39. Vishvâvasu	25	85	45	05	65	25	85	45	05	65	25	85	45	05	65
40. Parâbhava	26	86	46	06	66	26	86	46	06	66	26	86	46	06	66
41. Plavanga	27	87	47	07	67	27	87	47	07	67	27	87	47	07	67
42. Kîlaka	28	88	48	08	68	28	88	48	08	68	28	88	48	08	68
43. Saumya	29	89	49	09	69	29	89	49	09	69	29	89	49	09	69
44. Sadhârana	30	90	50	10	70	30	90	50	10	70	30	90	50	10	70
45. Virodhakrit	31	91	51	11	71	31	91	51	11	71	31	91	51	11	71
46. Paridhâvi ..	32	92	52	12	72	32	92	52	12	72	32	92	52	12	72
47. Pramâdi ..	33	93	53	13	73	33	93	53	13	73	33	93	53	13	73
48. Ânanda ..	34	94	54	14	74	34	94	54	14	74	34	94	54	14	74
49. Râkshasa ..	35	95	55	15	75	35	95	55	15	75	35	95	55	15	75
50. Nala	36	96	56	16	76	36	96	56	16	76	36	96	56	16	76
51. Pingala	37	97	57	17	77	37	97	57	17	77	37	97	57	17	77
52. Kâlayukta	38	98	58	18	78	38	98	58	18	78	38	98	58	18	78
53. Siddhârthi	39	99	59	19	79	39	99	59	19	79	39	99	59	19	79
54. Raudra ..	40	00	60	20	80	40	00	60	20	80	40	00	60	20	80
55. Durmati ..	41	01	61	21	81	41	01	61	21	81	41	01	61	21	81
56. Dundubhi	42	02	62	22	82	42	02	62	22	82	42	02	62	22	82
57. Rudhirodgari ..	43	03	63	23	83	43	03	63	23	83	43	03	63	23	83
58. Raktâkshi	44	04	64	24	84	44	04	64	24	84	44	04	64	24	84
59. Krodhana	45	05	65	25	85	45	05	65	25	85	45	05	65	25	85
60. Kshaya	46	06	66	26	86	46	06	66	26	86	46	06	66	26	86

TABLE 20

The Jovian mean sign Samvats used in Northern India.

PART A.

Elements of Samvats for the Meshâdi of each Century.

Kaliyu.	Vikram.	A. D.	Samvat.	Kaliyu.	Vikram.	A. D.	Samvat.
3001	—43	—101	36·112	4101	1057	1000	8·982
3101	+57	—1	17·282	4201	1157	1100	50·152
3201	157	+100	58·452	4301	1257	1200	31·322
3301	257	200	39·622	4401	1357	1300	12·492
3401	357	300	20·792	4501	1457	1400	53·662
3501	457	400	1·962	4601	1557	1500	34·832
3601	557	500	43·132	4701	1657	1600	15·992
3701	657	600	24·302	4801	1757	1700	57·172
3801	757	700	5·472	4901	1857	1800	38·342
3901	857	800	46·642	5001	1957	1900	19·512
4001	+957	+900	27·812	5101	2057	2000	0·682

PART B.

Increase for odd years.

Year.	Samvat.	Year.	Samvat.	Year.	Samvat.	Year.	Samvat.
1	1·012	6	6·070	10	10·127	60	0·702
2	2·023	7	7·082	20	20·234	70	10·819
3	3·035	8	8·094	30	30·351	80	20·936
4	4·047	9	9·105	40	40·468	90	31·053
5	5·058	10	10·127	50	50·585	100	41·170

TABLE 21

PART A.

Elements of the Musulman Calendar.

At commencement of.	Hijri Era Current.			Christian Era Current.		
Hijri Era.	Cycle.	Year.	Day.	Years.	Days.	Vâra.
	1	1	1	622	196	6.
PART B. Increase of Elements for Cycles.						
Cycles	1	30	10631	29	46	5
	2	60	21262	58	92	3
	3	90	31893	87	138	1
	4	120	42524	116	184	6
	5	150	53155	145	230	4
	6	180	63786	174	276	2
	7	210	74417	203	322	0
	8	240	85048	233	3	5
	9	270	95579	262	49	3
	10	300	106310	291	95	1
	20	600	212620	582	190	2
	30	900	318930	873	285	3
	40	1200	425240	1165	15	4
	50	1500	531550	1456	110	5
	100	3000	1063100	2916	220	3

TABLE 21

Part C.

Increase of Elements for odd years.

Hijri Era.		Christian Era.			Hijri Era.		Christian Era.		
Years.	Days.	Years.	Days.	Vâra.	Years.	Days.	Years.	Days.	Vâra.
1	354	0	354	4	16*	5670	15	195	0
2*	709	1	344	2	17	6024	16	184	4
3	1063	2	333	6	18*	6379	17	174	2
4	1417	3	322	3	19	6733	18	163	6
5*	1772	4	312	1	20	7087	19	152	3
6	2626	5	301	5	21*	7442	20	142	1
7*	2481	6	291	3	22	7796	21	131	5
8	2835	7	280	0	23	8150	22	120	2
9	3289	8	269	4	24*	8505	23	110	0
10*	3544	9	259	2	25	8859	24	99	4
11	3898	10	248	6	26*	9214	25	89	2
12	4252	11	237	3	27	9568	26	78	6
13*	4607	12	227	1	28	9922	27	67	3
14	4961	13	216	5	29*	10277	28	57	1
15	5315	14	205	2	30	10631	29	46	5

Part D.

Increase of Days to the end of each month.

To the end of—	Days.	Vâra.	To the end of—	Days.	Vâra.
1 Muharram ..	29	1	1 January ..	30	2
2 Safar	58	2	2 February ..	58	2
3 Rabi-ul-awwal ..	88	4	3 March.. ..	89	5
4 Rabi-ul-akhir ..	117	5	4 April	119	0
5 Jumadalawal ..	147	0	5 May	150	3
6 Jumadalakhir ..	176	1	6 June	180	5
7 Rajab	206	3	7 July	211	1
8 Shaban	235	4	9 August ..	242	4
9 Ramjan ..	265	6	9 September ..	272	6
10 Shawwal ..	294	0	10 October ..	303	2
11 Zil-Kad	323	1	11 November ..	333	4
12 Zil-Hijja ..	353	3	12 December ..	364	0

N. B.—Years marked with asterisk are Hijri Leap years.

TABLE 22

Showing the number of Hijri Month concurring with the Chaitra of the Shaka years.

Shak.	H.	Shak.	H.	Shak.	H.	Shak.	H.	Shak.	H.	Shak.	H.	Shak.	H.
1369	1	1371	2	1374	3	1377	4	1379	5	1382	6	1385	7
1388	8	1390	9	1393	10	1396	11	1398	12	1401	1	1404	2
1407	3	1409	4	1412	5	1415	6	1417	7	1420	8	1423	9
1426	10	1428	11	1431	12	1434	1	1436	2	1439	3	1442	4
1445	5	1447	6	1450	7	1453	8	1455	9	1458	10	1461	11
1464	12	1466	1	1469	2	1472	3	1474	4	1477	5	1480	6
1482	7	1485	8	1488	9	1491	10	1493	11	1496	12	1499	1
1501	2	1504	3	1507	4	1510	5	1512	6	1515	7	1518	8
1520	9	1523	10	1526	11	1529	12	1531	1	1534	2	1537	3
1539	4	1542	5	1545	6	1548	7	1550	8	1553	9	1556	10
1558	11	1561	12	1564	1	1567	2	1569	3	1572	4	1575	5
1577	6	1580	7	1583	8	1586	9	1588	10	1591	11	1594	12
1596	1	1599	2	1602	3	1605	4	1607	5	1610	6	1613	7
1615	8	1618	9	1621	10	1623	11	1626	12	1629	1	1632	2
1634	3	1637	4	1640	5	1642	6	1645	7	1648	8	1651	9
1653	10	1656	11	1659	12	1661	1	1664	2	1667	3	1670	4
1672	5	1675	6	1678	7	1680	8	1683	9	1686	10	1689	11
1691	12	1694	1	1697	2	1699	3	1702	4	1705	5	1708	6
1710	7	1713	8	1716	9	1718	10	1721	11	1724	12	1726	1
1729	2	1732	3	1735	4	1737	5	1740	6	1743	7	1746	8
1748	9	1751	10	1753	11	1756	12	1759	1	1762	2	1764	3
1767	4	1770	5	1773	6	1775	7	1778	8	1781	9	1783	10
1786	11	1789	12	1792	1	1794	2	1797	3	1800	4	1802	5
1805	6	1808	7	1811	8	1813	9	1816	10	1819	11	1821	12
1824	1	1827	2	1830	3	1832	4	1835	5	1838	6	1840	7
1843	8	1846	9	1849	10	1851	11	1854	12	1857	1	1859	2
1862	3	1865	4	1868	5	1870	6	1873	7	1876	8	1878	9
1881	10	1884	11	1887	12	1889	1	1892	2	1895	3	1897	4
1900	5	1903	6	1905	7	1908	8	1911	9	1914	10	1916	11
1919	12	1922	1	1924	2	1927	3	1930	4	1933	5	1935	6
1938	7	1941	8	1943	9	1946	10	1949	11	1952	12	1954	1
1957	2	1960	3	1962	4	1965	5	1968	6	1970	7	1973	8
1976	9	1979	10	1981	11	1984	12	1987	1	1989	2	1992	3
1995	4	1998	5	2000	6	2003	7	2006	8	2008	9	2011	10
2014	11	2017	12	2019	1	2022	2	2025	3	2027	4	2030	5
2033	6	2036	7	2038	8	2041	9	2044	10	2046	11	2049	12

TABLE 23

Elements of Tithi-Suddhi, A.D. month and date.

For the Meshâdi of Shaka years **from 1382—1742** or of A.D. years from 1460—1820 covering the Mogal and Marâthâ Periods.

Shaka	Tithi.	A D.	Vara.	Shaka	Tithi.	A.D.	Vara.	Shaka	Tithi	A.D.	Vara.
Years.		Date.		Years		Date.		Years		Date.	
1382	4·5	M26·8	4	1502	12·3	M27·8	1	1622	20·1	M28·9	5
86	18·7	26·8	2	06	26·5	27·9	6	26	4·3	28·9	3
90	3·0	26·8	0	10	10·8	27·9	4	30	18·6	28·9	1
94	17·3	26·9	5	14	25·1	27·9	2	34	2·8	29·0	6
98	1·5	26·9	3	18	9·3	28·0	0	38	17·1	29·0	5
1402	15·8	26·9	1	22	23·6	28·0	5	42	1·4	29·0	3
06	0·1	27·0	6	26	7·8	28·0	3	46	15·6	29·1	1
10	14·3	27·0	4	30	22·1	28·1	2	50	29·9	29·1	6
14	28·6	27·0	3	34	6·4	28·1	0	54	14·2	29·1	4
18	12·8	27·0	1	38	20·6	28·1	5	58	28·4	29·2	2
1422	27·1	M27·1	6	1542	4·9	M28·2	3	1662	12·7	M29·2	0
26	11·4	27·2	4	46	19·1	28·2	1	66	27·0	29·3	5
30	25·6	27·2	2	50	3·4	28·2	6	70	11·2	29·3	3
34	9·9	27·2	0	54	17·7	28·3	4	74	25·5	29·3	1
38	24·1	27·3	5	58	1·9	28·3	2	78	9·7	A.9·4	6
42	8·4	27·3	3	62	16·2	28·3	0	82	24·0	9·4	4
46	22·7	27·3	1	66	0·4	28·4	5	86	8·4	9·4	2
50	6·9	27·4	6	70	14·7	28·4	3	90	22·5	9·5	0
54	21·2	27·4	4	74	28·9	28·4	1	94	6·8	9·5	5
1458	5·4	27·4	2	78	13·2	28·5	6	98	21·0	9·5	3
1462	19·7	M27·5	0	1582	27·5	M28·5	4	1702	5·3	A.9·6	1
66	4·0	27·5	5	86	11·7	28·6	2	06	19·6	9·6	6
70	18·2	27·5	3	90	26·0	28·6	0	10	3·8	9·6	4
74	2·5	27·6	1	94	10·2	28·6	5	14	18·1	9·7	2
78	16·7	27·6	6	98	24·5	28·7	3	18	2·3	9·7	0
82	1·0	27·6	4	1602	8·8	28·7	1	22	16·6	10·7	5
86	15·2	27·7	2	06	23·0	28·7	6	26	0·9	10·8	3
90	29·5	27·7	0	10	7·3	28·8	4	30	15·1	10·8	1
94	13 8	27 7	5	14	21 5	28 8	2	34	29 4	10 8	5
98	28 0	27 8	3	18	5 8	28 8	0	38	13 6	10 9	3
1502	12 3	M27 8	1	1622	20 1	M28 9	5	1742	27 9	A.10 9	1
Increase		for		Single				years			
1	11 1	0 3	1	2	22·1	0 5	2	3	3 2	0 8	3

Note—The fractions of the date to be attached to the integral vâra. (Vide Section 139, **Example 3**).

TABLE 24

Perpetual Almanac for Christian Calendar.

Indexes.	1	2	3	4	5	6	0
B. C. Centuries	3001 2301 1601	3101 2401 1701	3201 2501 1801	3301 2601 1901	3401 2701 2001	3501 2801 2101	3601 2901 2201
	901 201 .	1001 301 .	1101 401 .	1201 501 .	1301 601 .	1401 701 1	1501 801 101
A. D. Centuries ..	500	400	300	200	100	.	.
(Old Style) ..	1200 .	1100 .	1000 1700	900 1600	800 1500	700 1400	600 1300
(New Style) ..	1600 2000	1900 2300	. .	1800 2200	. .	1700 2100	. .
Odd years	1 7 12	2 . 13	3 8 14	. 9 15	4 10 .	5 11 16	6 . 17
	18 . 29	19 24 30	. 25 31	20 26 .	21 27 32	22 . 33	23 28 34
	35 40 46	. 41 47	36 42 .	37 43 48	38 . 49	39 44 50	. 45 51
	. 57 63	52 58 .	53 59 64	54 . 65	55 60 66	. 61 67	56 62 .
	68 74 .	69 75 80	70 . 81	71 76 82	. 77 83	72 78 .	73 79 84
	85 91 96	86 . 97	87 92 98	. 93 99	88 94 .	89 95 .	90 . .
Months in a common year.	Aug. 0 . .	Feb. 0 Mar. 0 Nov. 0	June 0 . .	Sep. 0 Dec. 0 .	April 0 July 0 .	Jan. 0 Oct. 0 .	May 0 . .
In a leap year	Feb. 0	.	.	.	Jan. 0	.	.

TABLE 25.

Moon's true daily motion (v) and diameter (*d*) Arg :— ☾'s anomaly.

Arg. deg.	0° (v)	0° (d)	30° (v)	30° (d)	60° (v)	60° (d)	90° (v)	90° (d)	120° (v)	120° (d)	150° (v)	150° (d)	Arg. deg.
	′	′	′	′	′	′	′	′	′	′	′		′
0	722	30·0	735	30·0	757	30·5	791	31·2	824	32·0	847	32·3	30
1	723		735		758		792		825		847		29
2	723		736		759		793		826		848		28
3	723		736		760		794		827		848		27
4	723		737		761		796		827		849		26
5	724		738		762		797		828		849		25
6	724		738		763		798		829		850		24
7	724		739		764		799		830		850		23
8	725		740		765		800		831		851		22
9	725		740		766		802		832		851		21
10	725	30·0	741	30·2	767	30·8	803	31·4	833	32·0	852	32·4	20
11	726		742		768		804		833		852		19
12	726		742		769		805		834		853		18
13	726		743		770		806		835		853		17
14	727		744		771		807		836		854		16
15	727		745		773		808		836		854		15
16	728		745		774		810		837		854		14
17	728		746		775		811		838		855		13
18	728		747		776		812		839		855		12
19	729		748		777		813		839		856		11
20	729	30·0	749	30·4	778	31·0	814	31·7	840	32·2	856	32·5	10
21	730		749		779		815		841		856		9
22	730		750		781		816		841		857		8
23	731		751		782		817		842		857		7
24	731		752		783		818		843		857		6
25	732		753		784		819		843		857		5
26	732		754		785		820		844		858		4
27	733		755		787		821		845		858		3
28	733		755		788		822		845		858		2
29	734		756		889		823		846		859		1
30	735	30·0	757	30·5	791	31·2	824	32·0	847	32·3	859	32·6	0
	330°		300°		270°		240°		210°		180°		

TABLE 26

Moon's Diameter, (a), and (b); Arg:= v, (Vide Sec. 165).

Arg. v	Dia.	(a)	(b)	Arg. v	Dia.	(a)	(b)	Arg. v	Dia.	(a)	(b)
	'	'	'	'	'	'		'	'	'	'
720'	29 8	54 7	24	770	30 8	57·0	25'	820	31 8	59 5	27
730	30·0	55·2	24	780	31·0	57·6	26	830	32·0	60·0	27
740	30·2	55·6	24	790	31·2	58·0	26	840	32·2	60·4	27
750	30·4	56·1	25	800	31·4	58·6	26	850	32·4	60·9	27
760	30·6	56·6	25	810	31·6	58·9	26	860	32·6	61·4	28
770	30·8	57·0	25	820	31·8	59·5	27	870	32·8	61·8	28

TABLE 27

Moon's Latitude

Arg. =D in a solar Eclipse, Vide Sec. 163, 165.

Arg. =D + 180° in a lunar Eclipse.

Argument.	—	348°	349°	350°	351°	352°	353°	354°	355°	356°	357°	358°	359°	360°
	+	12	11	10	9	8	7	6	5	4	3	2	1	0
	+	168	169	170	171	172	173	174	175	176	177	178	179	180
	—	192	191	190	189	188	187	186	185	184	183	182	181	180
Lat.		60'.4	55'.5	50'.5	45'.4	40'.4	35'.5	30'.4	25'.3	20'.3	15'.1	10'.2	5'.1	0'

TABLE 28

Semiduration of ☾'s Eclipse. Arg.=(a) and (*a*—*l*) Sec. 165.

(Argu-) (ment) (*a*—*l*)	Argument (*a*)								
	54'	55'	56	57'	58'	59'	60'	61'	62'
'	Pal.	Pal.	Pal.	Pal.	Pal;	Pal·	Pal.	Pal.	Pal.
5	122	119	117	115	113	110	108	106	104
10	171	167	164	161	158	155	152	149	147
15	200	197	193	189	185	182	179	176	173
20	225	221	217	213	208	205	201	198	195
25	244	240	235	231	227	223	219	216	213
30	260	255	250	246	242	238	234	231	227
35	272	267	262	257	253	250	246	242	239
40	280	276	272	267	263	259	255	252	248
45	286	282	278	274	269	264	262	259	256
50	289	285	281	278	274	270	267	264	261

TABLE 29

Approximate Ghati of the middle of a Solar Eclipse.

Arg: The Ghati of New Moon.

Arg.	Mid.	Arg.	Mid.	Arg.	Mid.	Arg.	Mid.	Arg.	Mid.	Arg.	Mid.
gh.	gh.	gh.	gh.	gh.	gh.	gh.	gh.	gh.	gh.	gh.	gh.
0	56	5	1	10	6	15	15	20	24	25	29
1	57	6	2	11	8	16	17	21	25	26	30
2	58	7	3	12	9	17	19	22	26	27	31
3	59	8	4	13	11	18	21	23	27	28	32
4	60	9	5	14	13	19	22	24	28	29	33
5	1	10	6	15	15	20	24	25	29	30	34

TABLE 30

Nati or Parallax in the Moon's Latitude.

Arg:=Sidereal Time T, and the latitude of the place.

Arg. T.		Degrees of North Latitude.							
gh.	gh.	5°	10°	15°	20°	25°	30°	35°	40°
0	60	—27′	—31′	—35′	—29′	—′42	—46′	—48′	—51′
3	57	26	30	34	38	42	45	48	50
6	54	23	28	31	35	39	42	45	47
9	51	18	22	27	30	34	37	41	44
12	48	12	16	20	24	28	32	36	40
15	45	— 5	9	14	17	22	26	30	34
18	42	+2	—2	7	11	15	20	24	28
21	39	9	+4	—1	5	10	15	19	23
24	36	14	9	+4	—1	5	10	15	20
27	33	17	12	7	+3	2	7	12	17
30	30	+18	+13	+8	+3	—2	—7	—12	—17

TABLE 31

Sun's Equation of the Centre. Arg:= ⊙'s anomaly.

Arg.	0	30°	60°	90°	120°	150°	Arg.
	—	—	—	—	—	—	
Deg.	′	′	′	′	′	′	Deg.
0	0′·0	65′·6	113′·2	130′·7	113′·2	65′·6	30
1	2·8	67·5	114·3	130·7	112·0	63·6	29
2	4·7	69·5	115·4	130·7	110·8	61·6	28
3	7·0	71·4	116·4	130·6	109·6	59·6	27
4	9·3	73·3	117·5	130·4	108·3	57·6	26
5	11·6	75·1	118·5	130·2	107·0	55·5	25
6	13·9	77·0	119·4	130·0	105·7	53·5	24
7	16·2	78·8	120·3	129·8	104·4	51·4	23
8	18·5	80·6	121·2	129·5	103·0	49·3	22
9	20·8	82·4	122·0	129·1	101·6	47·2	21
10	23·0	84·1	122·8	128·7	101·1	45·0	20
11	25·3	85·9	123·6	128·3	98·6	42·9	19
12	27·5	87·5	124·3	127·9	97·1	40·7	18
13	29·8	89·2	125·0	127·4	95·6	38·6	17
14	32·0	90·8	125·7	126·8	94·0	36·4	16
15	34·2	92·5	126·3	126·3	92·5	34·2	15
16	36·4	94·0	126·8	125·7	90·8	32·0	14
17	38·6	95·6	127·4	125·0	89·2	29·8	13
18	40·7	97·1	127·9	124·3	87·5	27·5	12
19	42·9	98·6	128·3	123·6	85·9	25·3	11
20	45·0	101·1	128·7	122·8	84·1	23·0	10
21	47·2	101·6	129·1	122·0	82·4	20·8	9
22	49·3	103·0	129·5	121·2	80·6	18·5	8
23	51·4	104·4	129·8	120·3	78·8	16·2	7
24	53·5	105·7	130·0	119·4	77·0	13·9	6
25	55·5	107·0	130·2	118·5	75·1	11·6	5
26	57·6	108·3	130·4	117·5	73·3	9·3	4
27	59·6	109·6	130·6	116·4	71·4	7·0	3
28	61·6	110·8	130·7	115·4	69·5	4·7	2
29	63·6	112·0	130·7	114·3	67·5	2·3	1
30	65·6	113·2	130·7	113·2	65·6	0·0	0
	+	+	+	+	÷	÷	
Arg.	330°	300°	270°	240°	210°	180°	Arg.

TABLE 32

Moon's equation of the Centre. Arg= ☾ 's anomaly.

Arg.	0	30°	60°	90°	120°	150°	Arg.
Deg.	′	′	′	′	′	′	Deg.
0	0′·0	150′·7	260′·9	301′·7	260′·9	150′·7	30
1	5·4	155·2	263·4	301·6	258·2	146·2	29
2	10·7	159·7	266·0	301·5	254·4	141·6	28
3	16·0	164·1	268·4	301·3	252·6	137·0	27
4	21·3	168·5	270·8	300·9	249·7	132·3	26
5	26·6	172·8	273·1	300·5	246·7	127·6	25
6	31·9	177·1	275·3	300·0	243·6	122·8	24
7	37·1	181·2	277·4	299·4	240·6	118·0	23
8	42·4	185·4	279·4	298·7	237·5	113·2	22
9	47·6	189·5	281·4	297·8	234·3	108·3	21
10	52·8	193·5	283·3	297·0	230·9	103·4	20
11	58·0	197·5	285·1	296·1	227·4	98·5	19
12	63·1	201·4	286·7	295·1	223·9	93·5	18
13	68·1	205·3	288·1	293·8	220·4	88·5	17
14	73·4	209·1	289·5	292·4	216·7	83·5	16
15	78·5	212·9	291·0	291·0	212·9	78·5	15
16	83·5	216·7	292·4	289·5	209·1	73·4	14
17	88·5	220.4	293·8	288·1	205·3	68·1	13
18	93·5	223·9	295·1	286·7	201·4	63·1	12
19	98·5	227·4	296·1	285·1	197·5	58·0	11
20	103·4	230·9	297·0	283·3	193·5	52·8	10
21	108·3	234·3	297·8	281·4	189·5	47·6	9
22	113·2	237·5	298·7	279·4	185·4	42·4	8
23	118·0	240·6	299·4	277·4	181·2	37·1	7
24	122·8	243·6	300·0	275·3	177·1	31·9	6
25	127·6	246·7	300·5	273·1	172·8	26·6	5
26	132·3	249·7	300·9	270·8	168·5	21·3	4
27	137·0	252·6	301·3	268·4	164·1	16·0	3
28	141·6	255·4	301·5	266·0	159·7	10·7	2
29	146·2	258·2	301·6	263·4	155·2	5·4	1
30	150·7	260·9	301·7	260·9	150·7	0·0	0
Arg.	+ 330°	+ 300°	+ 270°	+ 240°	+ 210°	+ 180°	Arg.

TABLE 33

For Charakâla, use Arg.=Sun's Tropical longitude.

,, Udayântara, use Arg.=2 (Sun's Tropical longitude.)

,, Bhujântara, use Arg.=Sun's anomaly.

Arg.	0° +	30° +	60° +	90° +	120° +	150° +	Arg.
Deg.	Palas.	Palas.	Palas.	Palas.	Palas.	Palas.	Deg.
0	0·00	9·69	17·53	20·71	17·53	9·69	30
1	0·32	9·99	17·71	20·69	17·32	9·37	29
2	0·65	10·29	17·89	20·67	17·11	9·07	28
3	0·97	10·59	18·07	20·65	16·90	8·75	27
4	1·30	10·89	18·25	20·62	16·69	8·44	26
5	1·62	11·19	18·43	20·60	16·48	8·13	25
6	1·95	11·48	18·62	20·57	16·26	7·82	24
7	2·28	11·76	18·77	20·50	16·02	7·50	23
8	2·63	12·05	18·92	20·44	15·77	7·19	22
9	2·96	12·33	19·07	20·37	15·52	6·87	21
10	3·29	12·62	19·22	20·31	15·27	6·55	20
11	3·63	12·90	19·37	20·24	15·02	6·24	19
12	3·95	13·19	19·52	20·18	14·77	5·92	18
13	4·28	13·45	19·63	20·07	14·50	5·60	17
14	4·61	13·71	19·74	19·96	14·24	5·27	16
15	4·95	13·98	19·85	19·85	13·98	4·95	15
16	5·27	14·24	19·96	19·74	13·71	4·61	14
17	5·60	14·50	20·07	19·63	13·45	4·28	13
18	5·92	14·77	20·18	19·52	13·19	3·95	12
19	6·24	15·02	20·24	19·37	12·90	3·63	11
20	6·55	15·27	20·31	19·22	12·62	3·29	10
21	6·87	15·52	20·37	19·07	12·33	2·96	9
22	7·19	15·77	20·44	18·92	12·05	2·63	8
23	7·50	16·02	20·50	18·77	11·76	2·28	7
24	7·82	16·26	20·57	18·62	11·48	1·95	6
25	8·13	16·48	20·60	18·43	11·19	1·62	5
26	8·44	16·69	20·62	18·25	10·89	1·30	4
27	8·75	16·90	20·65	18·07	10·59	0·97	3
28	9·07	17·11	20·67	17·89	10·29	0·65	2
29	9·37	17·32	20·69	17·71	9·99	0·32	1
30	9·69	17·53	20·71	17·53	9·69	0·00	0
Arg.	— 330°	— 300°	— 270°	— 240°	— 210°	— 180°	Arg.

TABLE 34

The Equinoxial Shadow in digits

Argument=Latitude of Place.

Latitude.	Digits.	Latitude.	Digits.	Latitude.	Digits.
0°	0·00	15°	3·22	30°	6·93
1	0·21	16	3·44	31	7·21
2	0·42	17	3·67	32	7·50
3	0·63	18	3·90	33	7·79
4	0·84	19	4·13	34	8·09
5	1·05	20	4·37	35	8·40
6	1·26	21	4·61	36	8·72
7	1·47	22	4·85	37	9·04
8	1·68	23	5·09	38	9·37
9	1·90	24	5·34	39	9·72
10	2·11	25	5·59	40	10·07
11	2·33	26	5·85	41	10·43
12	2·55	27	6·11	42	10·80
13	2·77	28	6·38	43	11·19
14	2·99	29	6·65	44	11·59
15	3·22	30	6·93	45	12·00

TABLE 35

Semiduration of total phase in lunar eclipse.

Arguments=b and $(b—l)$.

(b—l)	*b*				
	24	25	26	27	28
′	Palas.	Palas.	Palas.	Palas.	Palas.
2	52	50	48	47	46
4	72	69	67	65	63
8	95	92	90	88	86
12	111	108	106	103	101
16	121	118	116	113	111
20	127	124	122	120	118
24	128	127	124	124	122
28	—	—	125	124	123

TABLE 36

Lagna and Sidereal Time.

For Lagna, Arg :=Latitude and Sidereal Time.

For Sidereral Time, Arg :=Latitude and Lagna.

Arg. Side real.	North Latitudes.							
	0°	5°	10°	15°	20°	25°	30°	35°
Ghati.	Lagna.	Lagna.	Lagna.	Lagna.	Lagna.	Lagna.	Lagna.	Lagna.
	°	°	°	°	°	°	°	°
0	337·5	337·5	337·5	337·5	337·5	337·5	337·5	337·5
1	344·0	344·0	344·0	344·9	345·2	345·8	346·5	346·9
2	350·5	351·0	351·6	352·2	352·9	353·7	354·8	356·1
3	357·0	357·7	358·6	359·5	0·5	1·7	3·2	5·0
4	3·4	4·4	5·6	6·6	8·0	9·4	11·3	13·5
5	9·7	10·9	12·1	13·5	15·1	16·9	19·0	21·6
6	15·9	17·2	18·7	20·3	22·1	24·1	26·4	29·2
7	22·0	23·5	25·1	26·8	28·8	31·1	33·5	36·4
8	27·9	29·6	31·3	33·2	35·2	37·6	40·2	43·2
9	33·8	35·5	37·5	39·4	41·5	43·9	46·6	49·6
10	39·6	41·4	43·3	45·4	47·6	50·0	52·7	55·8
11	45·3	47·2	49·2	51·2	53·5	55·9	58·6	61·6
12	50·9	52·8	54·9	57·0	59·2	61·6	64·3	67·2
13	56·5	58·4	60·5	62·6	64·8	67·2	69·8	72·6
14	62·0	64·0	66·1	68·2	70·3	72·7	75·2	77·9
15	67·5	69·5	71·5	73·6	75·7	78·0	80·8	83·1
16	73·0	75·0	77·0	79·0	81·1	83·1	85·6	88·8
17	78·5	80·5	82·4	84·4	86·4	88·5	90·8	93·1
18	84·7	86·0	87·9	89·8	91·8	93·8	95·9	98·1
19	89·1	91·5	93·4	95·2	97·0	98·9	100·9	103·0
20	95·4	97·2	98·9	100·6	102·4	104·1	106·0	107·9
21	101·2	102·9	104·5	105·9	107·7	109·4	111·0	112·8
22	107·1	108·6	110·1	111·6	113·1	114·6	116·1	117·7
23	113·0	114·5	115·9	117·2	118·5	119·8	121·2	122·6
24	119·1	120·4	121·6	122·8	124·0	125·1	126·3	127·6
25	125·3	126·4	127·5	128·5	129·5	130·4	131·5	132·5
26	131·6	132·5	133·4	134·1	135·0	135·8	136·6	137·5
27	138·0	138·7	139·4	140·0	140·6	141·2	141·8	142·5
28	144·5	144·9	145·4	145·8	146·2	146·6	147·0	147·5
29	151·0	151·2	151·4	151·6	151·9	152·1	152·3	152·5
30	157·5	157·5	157·5	157·5	157·5	157·5	157·5	157·5

TABLE 36—(*contd.*)

Lagna and Sidereal Time

For Lagna ; Arg :—Latitude and Sidereal Time.

For Sidereal Time ; Arg:—Latitude and Lagna.

Arg. Sidereal.	North Latitudes.							
	0°	5°	10°	15°	20°	25°	30°	35°
Ghati.	Lagna.	Lagna.	Lagna.	Lagna.	Lagna.	Lagna.	Lagna.	Lagna.
	°	°	°	°	°	°	°	°
30	157·5	157·5	157·5	157·5	157·5	157·5	157·5	157·5
31	164·0	163·8	163·6	163·4	163·1	162·9	162·7	162·5
32	170·5	170·1	169·7	169·2	168·8	168·4	168·0	167·5
33	177·0	176·3	175·6	175·0	174·4	173·8	173·2	172·5
34	183·4	182·5	181·6	180·9	180·0	179·2	178·4	177·5
35	189·7	188·6	187·5	186·5	185·5	184·6	183·5	182·5
36	195·9	194·6	193·4	192·2	191·0	189·9	188·7	187·4
37	202·0	200·5	199·1	197·8	196·5	195·2	193·8	192·4
38	207·9	206·4	204·9	203·4	201·9	200·4	198·9	197·3
39	213·8	212·1	210·5	209·1	207·3	205·6	204·0	202·2
40	219·6	217·8	216·1	214·4	212·6	210·9	209·0	207·1
41	225·3	223·5	221·6	219·8	218·0	216·1	214·1	211·9
42	230·9	229·0	227·1	225·2	223·2	221·2	219·1	216·9
43	236·5	234·5	232·6	230·6	228·6	226·5	224·2	221·9
44	242·0	240·0	238·0	236·0	233·9	231·7	229·4	226·9
45	247·5	245·5	243·5	241·4	239·3	237·0	234·2	231·8
46	253·0	251·0	248·9	246·8	244·7	242·3	239·8	236·8
47	258·5	256·6	254·5	252·4	250·2	247·8	245·2	242·4
48	264·1	262·2	260·1	258·0	255·8	253·4	250·7	247·2
49	269·7	267·8	265·8	263·8	261·5	259·1	256·4	253·4
50	275·4	273·6	271·7	269·6	267·4	265·0	262·3	259·8
51	281·2	279·5	277·7	275·6	273·5	271·1	268·4	265·6
52	287·1	285·4	283·7	281·8	279·8	277·4	274·8	271·4
53	293·0	291·5	289·9	288·2	286·1	284·1	281·5	278·5
54	299·1	297·8	296·3	294·7	293·0	290·9	288·6	285·1
55	305·3	304·1	302·9	301·5	300·0	298·1	296·0	293·9
56	311·6	310·7	309·6	308·4	307·1	305·6	303·7	301·0
57	318·0	317·3	316·4	315·5	314·5	313·3	311·8	310·0
58	324·5	324·0	323·4	322·8	322·1	321·2	320·2	319·0
59	331·0	330·7	330·4	330·1	329·8	329·2	328·8	328·3
60	337·5	337·5	337·5	337·5	337·5	337·5	337·5	337·5

TABLE 37

The Constants.

Elements.	Surya S°.	Arya S°.	Brahma S°.
In a Mahâyuga of 4320000 yrs.	Revolutions.	Revolutions.	Revolutions.
Days	1577 917 828	1577 917 500	1577 916 450
Suns	4 320 000	4 320 000	4 320 000
Moon's	57 753 336	57 753 336	57 753 300
Apogee of moon ..	488 203	488 219	488 106
Jupiter's ..	364 220	364 224	364 226
in a year.			
☾'s Anomaly ..	13·25 581 782	13·25 581 442	13·25 583 218
Tithis	371·06 483 333	371·06 483 333	371·06 458 333
Days	365·25 875 648	365·25 868 055	365·25 843 750
The period of the	Days.	Days.	Days.
Lunar Month ..	29·53 058 795	29·53 059 250	29·53 058 790
Anom. Month ..	27·55 459 990	27·55 460 187	27·55 454 648
Sidereal Month ..	27·32 167 416	27·32 166 848	27·32 166 733
Mean Longitude (by S. B. Dixit.)	499 March, 21·25	499 March, 21·25	499 March, 21·25
Sun	s 11 29° 58′ 37″	s 0 0° 0′ 0″	s 0 0° 51′ 45″
Sun's apogee ..	2 17 15 0	2 18 0 0	2 17 54 0
Moon	9 10 29 33	9 10 48 0	9 11 31 46
Moon's apogee ..	1 0 53 51	1 5 42 0	1 7 21 3
Greatest Equation of Centre.			
Sun's	2 10 30	2 8 55	2 10 30
Moon's	5 2 24	5 0 48	5 1 45

TABLE 38

Showing the years of other Eras, concurrent with the year A.D. 1000.

Eras.	Chaitra. Mesha. April. A.D. 1000.	Jyestha. Mithu. June A.D. 1000.	Bhâdra. Kanyâ. Sept. A.D. 1000.	Ashvin. Tula. Oct. A.D. 1000.	Kârti. Vrischika. Nov. A.D. 1000.	Year Begins with.
	Year.	Year.	Year.	Year.	Year.	Year.
1. Kali-yuga	4101	4101	4101	4101	4101	Shukla.
2. Saptarshi	*4076	4076	4076	4076	4076	Do.
3. Vikrama North ..	1057	1057	1057	1057	1057	Krishna.
4. Shaka	922	922	922	922	922	Shukla.
5. Gupta	681	681	681	681	681	Krishna.
6. Magi	362	362	362	362	362	Mesha.
7. Bengal San. ..	407	407	407	407	407	Mesha.
8. Harshakâla ..	394	394	394	394	394	Mesha.
9. Chalukya	—76	—76	—76	—76	—76	Shukla.
10. Dek. Fasali ..	409	410	410	410	410	Mrigâdi.
11. Arabi San. ..	400	401	401	401	401	Do.
12. Râja Shaka ..	—674	—673	—673	—673	—673	Shukla.
13. Coptic	716	716	717	717	717	September.
14. Amali	407	407	408	408	408	Shukla.
15. Vilayati ..	407	407	408	408	408	Kanyâ.
16. Kollam ..	175	175	176	176	176	Kanyâ.
17. Chedi Kalchuri ..	752	752	752	753	753	Krishna.
18. Jewish Era	4760	4760	4760	4761	4761	Shukla.
19. Vikrâm South ..	1056	1056	1056	1056	1057	Shukla.
20. Vallabhi.	681	681	681	681	682	Krishna.
21. Nevar	120	120	120	120	121	Krishna.
22. Laxman Sen ..	—119	—119	—119	—119	—118	Do.
.. or	—109	—109	—109	—109	—108	Do.
23. Julian ..	5713	5713	5713	5713	5713	January.
24. Chinese	3637	3637	3637	3637	3637	Magha. Sh.
25. Hijari	Vide	Sec.	(135)	Year	lunar	Muharram.

Note.—(1) The years of the above eras concurring with any given A. D. year other than 1000 can be obtained by simply correcting the above years by its defect under or excess over A. D. 1000, taking care to lessen the defect by unity in the case of the B. C. years. Vide Sec. 145.

(2) The vertical thick lines mark the change of years.

TABLE 39

Supplementary to Table 5

(Based on the Sûrya-Siddhânta).

Increase of Elements to be used in verification.

Tithi.	Vâra.	Days.	☾'s anom.	☉'s anom.	Tithi.	Vâra.	Days.	☾'s anom.	☉'s anom.
			°	°				°	°
11	3·83	10·83	141·5	10·7	21	6·67	20·67	270°0	20°4
12	4·81	11·81	154·3	11·6	22	0·66	21·66	282·9	21·3
13	5·80	12·80	167·2	12·6	23	1·64	22·64	295·8	22·3
14	6·78	13·78	180·0	13·6	24	2·62	23·62	308·6	23·3
15	0·76	14·76	192·9	14·6	25	3·61	24·61	321·5	24·2
16	1·75	15·75	205·8	15·5	26	4·59	25·59	334·4	25·2
17	2·73	16·73	218·6	16·5	27	5·58	26·58	347·2	26·2
18	3·72	17·72	231·5	17·5	28	6·56	27·56	360·1	27·2
19	4·70	18·70	244·3	18·4	29	0·55	28·55	12·9	28·1
20	5·69	19·69	257·2	19·4	30	1·53	29·53	25·8	29·1

TABLE 40

For conversion of fractions of a Day into Ghatis and Palas.

Centimes.	0	1	2	3	4	5	6	7	8	9
	g. p.	g. p.	g. p.	g. p.	g. p.	g. p.	g. p.	g. p.	g. p.	g. p.
·00	0 0	0 36	1 12	1 48	2 24	3 0	3 36	4 12	4 48	5 24
·10	6 0	6 36	7 12	7 48	8 24	9 0	9 36	10 12	10 48	11 24
·20	12 0	12 36	13 12	13 48	14 24	15 0	15 36	16 12	16 48	17 24
·30	18 0	18 36	19 12	19 48	20 24	21 0	21 36	22 12	22 48	23 24
·40	24 0	24 36	25 12	25 48	26 24	27 0	26 36	28 12	28 48	29 24
·50	30 0	30 36	31 12	31 48	32 24	33 0	33 36	34 12	34 48	35 24
·60	36 0	36 36	37 12	37 48	38 24	39 0	39 36	40 12	40 48	41 24
·70	42 0	42 36	43 12	43 48	44 24	45 0	45 36	46 12	46 48	47 24
·80	48 0	48 36	49 12	49 48	50 24	51 0	51 36	52 12	52 48	53 24
·90	54 0	54 36	55 12	55 48	56 24	57 0	57 36	58 12	58 48	59 24
For Millesimes.	0 0	0 4	0 7	0 11	0 14	0 18	0 22	0 25	0 29	0 32

***Example*:—Sec. 82. Type of Cal; 0·264 day. Of this ·26 = 15 gh. 36 p. and ·004 = 14 palas. So 0 ·264 day = 15 gh. 50 p.**

APPENDIX I.

Names of Nakshatras.

1 Âshvini. 2 Bharani. 3 Krittikâ. 4 Rôhini. 5 Mriga. 5 Ârdrâ. 7 Punarvasu. 8 Pushya. 9 Âshleshâ, 10 Maghâ. 11 Pûrvâ Phâlguni. 12 Uttarâ Phalguni. 13 Hasta. 14 Chitrâ. 15 Swâti. 16. Vishâkhâ. 17 Anurâdhâ. 18 Jyesthâ. 19 Mûla. 20 Pûrvâṣhâḍhâ. 21 Uttrarâṣhâḍhâ. 22 Shravaṇa. 23 Dhanisṭhâ. 24 Shatatârakâ. 25 Pûrvâ-Bhâdrapadâ. 26 Uttarâ-Bhâdrapadâ. 27 Revati.

Names of Yogas.

1 Viskambha. 2 Prîti. 3 Âyushamat. 4 Saubhâgya. 5 Shobhana. 6 Atiganda. 7 Sukarman. 8 Dhriti. 9 Shûla. 10 Ganda. 11 Vṛiddhi. 12 Dhruva. 13 Vyâghâta. 14 Harṣhana. 15 Vajra. 16 Siddhi. 17 Vyatipâta. 18 Varîyân. 19 Parigha. 20 Shiva. 21 Siddha. 22 Sâdhya. 23 Shubha. 24 Shukla. 25 Brahmâ. 26 Aindra. 27 Vaidhṛiti.

The Repeating Karaṇas.

Their Numbers.								Names.
2	9	16	23	30	37	44	51	Bava.
3	10	17	24	31	38	45	52	Bâlava.
4	11	18	25	32	39	46	53	Kaulava.
5	12	19	26	33	40	47	54	Taitila.
6	13	20	27	34	41	48	55	Gara.
7	14	21	28	35	42	49	56	Vaṇija.
8	15	22	29	36	43	50	57	Bhadrâ.

The Fixed Karanas.

58 Shakuni. 59 Nâga. 60 Chatushpâda.
1 Kiṇstughna,

APPENDIX II.

Note on the longitude of the star Spica.

The following two verses, which are quoted from Garga-Samhitâ by Somâkara, the commentator of Vedânga Jyotisha, clearly show the fact that the longitude of the star Spica was 180° in the ancient Hindu Zodiac. Its division into 27 equal parts, called nakshatras, was made with respect to the star *a* Delphini which was used as a starting point in the matter of sidereal division.

यदा माघस्य शुक्लस्य प्रतिपद्युत्तरायणं ।

सहोदयं श्रविष्ठाभिः सोमार्कौ प्रतिपद्यतः ॥

तदाऽत्र नभसः शुक्लसप्तम्यां दाक्षिणायनं ।

सार्पार्धे कुरुते युक्तिं चित्रायां च निशाकरे ॥

By the use of the plural word श्रविष्ठाभिः the author means the chief star of the cluster. The verses mean that when on the first day of माघशुक्ल the sun and the moon arrive together at the winter solsticial point marked by the star *a* Delphini, the next summer solstice takes place on the 7th day of the bright half of the month नभस्, the sun being then at the middle point of the division सार्पं and the moon in conjunction with the star चित्रा (Spica).

This description undoubtedly means that the distance of the star Spica from the star Alpha Delphini is equal to the mean motion of the moon in six tropical months, that is, in 182 days, 37 ghatis and 16 palas. Now the best modern tables give for the moon's motion during this period 246° 17′.2. Deducting from this the distance of *a* Delphini to the first point of Ashvini which is equal to 13° 20′ × 5=66° 40′, we get 179° 37′.2 for the longitude of Spica which in round number was said to be 180°

This result can also be arrived at independently in another way. The sidereal longitude of *a* Delphini is 13° 20′ × 22=293° 20′. Deducting from this the distance from Spica to *a* Delphini, which is by my Jyotirganita p. 232, 113° 32′.6, there remain 179° 47.′4 for the longitude of Spica which is almost 180 degrees.

The giving of names to the 27 divisions seems to have taken place about the year B. C. 2000, when the tropical longitude of the first point of the Ashvini division was 330°. The year of the Aryans and other ancient nations generally commenced when the sun's longitude was 330°. The Chinese still begin their year in that lunar month in which the sun arrives at the 330th, the degree of tropical longitude.