I. INTRODUCTORY

(i) Evolution of Chronology in Ancient India

It is known from references in the Vedic literature that Indian Chronology in its primary stage has been in existence since more than 2000 years before the Christian Era. The earliest traces of Indian chronology belong to the Vedic period. A method of distributing time into various periods such as days, fortnights, months and years, was adopted for the purposes of civil life. People had the primary knowledge about days, lunar months and luni-solar years from the very beginning of the Vedic age and these divisions of time are intimately connected with the affairs of the people.

From the period of Rgveda people were knowing convenient parts of time - days, months and years. The months were lunar but the years were luni-solar. Twelve lunar months, coincided into a solar year containing 365\(\frac{1}{4}\) days, formed a luni-solar year. At one place in Rgveda an intercalary month is mentioned. From this it follows that an intercalary month was added to preserve the correspondence between a whole solar year and the twelve lunations. From the mention of the word Vasara

1. Shivanath zarakhandi; Bhāratīya Jyotīṣa; pp.40,43
2. Vedamaso dhrtavrato dvādasa prajāvatah/ vedaḥ ya
   upajāyate, RKS. 1,25,8
in Rksamhita, it is certain that the term was used in the
general sense of a day. A day was divided into five parts
like Pratig, Sangava, Madhyahna, Aparahna and Sayam.
References to Nakshatras are also found in Rgveda.

Seers also had knowledge of eclipses. There is a refer-
ence to a solar eclipse at one place in Rksamhita.

In some of the samhitas there are further
references to intercalations and nakshatras. The earli-
est mention of the word Rtu is seen in the Taittiriyya
Samhita. The names of the months are seen at one place.
The two systems of Purimanta months (months ending with
Purimīma) and Amanta months, (months ending with Amavasya),
were in existence during this time. Twelve months
are expressed in their old names. References to the
solstices are found for the first time in these
samhitas. The solar day, the solar year and the lunar
month were put into use, but weekdays still did not
enter into practical use during this period. During the
whole Vedic period the year commenced with the Madhu

3. Rk. Sa. 8,6,30  4. Taittiriyya Brahmana, 1,5,3
5. Rk. Sa. 10,85,2; Rk. Sa; 10,85,13.
6. Rk. Sa. 5,40
7. Tai. Sa; 4,4,11; 114,14, Vaisanīya, 7,30; 22,30,31
8. Tai. Sa; 4,4,10; Atharva Samhīta 19,7
11. Tai. Sa; 1,6,7; 7,5,6,1.  12. Ibid; 4,4,11; Vaisanīya sa,
  7,30; 22,31
13. Tai. Sa; 6,5,3.
month of the Spring season

In the Brahmanical literature, we come across more and more astronomical terms, which help us to understand detailed chronology. For the first time there is a mention of the two fortnights of the month, Purva and Apara. From the context the Purva (former) seems to denote the bright fortnight, while the Apara (later) seems to stand for the dark fortnight. The word Tithi is mentioned with reference to the rising and setting of the moon. Purnima and Amavasya were called the parvas. Divisions of the day are given in some of the Brahmanas. Muhurtas are also mentioned in the Taittiriya Bràhmana. The further divisions of the Muhurtas into pratimuhurtas were also determined.

During the time of Vedanga Jyotisa, the calendar followed the mean system. The months were lunar and they contained thirty days each. A month was generally divided into thirty parts and one part

14 Shivanatha zarkhandi; Bharatiya Jyotisa; p. 92
15 Taittiriya Bràhmana; 2,2,3,1; 3,10,4,1
16 Shivanath zarkhandi; Bharatiya Jyotisa; p. 60
17 Ibid; p. 63. 18. Tai.Brà;3,12,9,1; Satapatha Brà;2,4,2,8
19. Tai. Brà; 3,10,9; 3,10,1; 3,10,1,1,2; 3,10,1,2; 3,10,1,3
20 Ibid; 3,10,9,9; 3,10,1,4
21 Br. Gorakhanath; Bharatiya Jyotişakā Itihās; p.43
was called a tithi.\(^{22}\)

Necessarily an intercalary month was added as a result of the luni-solar year. The names of the twenty-seven nakṣatras were popular at that time.\(^{23}\) The words Saḥvatsara, Varga and Abda were used in the sense of the year.\(^{24}\) For the computation of seasons solar months also were involved.\(^{25}\) Months were generally Amanta\(^{26}\). With a reference to the solar and lunar months, the intercalations were introduced. The inferences to the karanas are seen for the first time in Vedaṅga Jyotisa\(^{27}\). In the Atharva Jyotisa there occur references to the seven planets\(^{28}\) in the order in which they are associated with the weekdays at present. This enumeration and sequence may imply that they are here mentioned in relation to weekdays\(^{29}\) but they are here associated with the karanas of day time\(^{30}\).

\(^{22}\) To adjust the phase of the moon a tithi was occasionally dropped.
\(^{23}\) Sata. Brāh. 2,1,2,11; Tai. Brāh. 1,5,1
\(^{24}\) BJ; p. 137
\(^{25}\) Ibid; p. 138
\(^{26}\) Ibid; p. 139
\(^{27}\) Atharvaṇa-Jyotisam; 3,7,12
\(^{28}\) Atharvana-Jyotisam; 3,8,1
\(^{29}\) BJ; p. 141
\(^{30}\) Poona Orientalist; XII; 1 to 4; pp. 64 ff.
Kalpasūtra works contain several references to chronology. The names of the twelve months are given according to the old system\textsuperscript{31}. At one place in Srautasūtra there is a reference to seasons\textsuperscript{32}. The seasons commenced with the Spring. The word tīthi is not mentioned anywhere, but there occurs mention of certain particular tīthis\textsuperscript{33}. Some detailed information of nakṣatras is gathered from the references to the different nakṣatras\textsuperscript{34}. In Pāraskarasūtra, we get some information about the nakṣatras\textsuperscript{35} but the Pāraskarasūtra as well as the Āṣvamedhayānasūtra contains no reference to intercalations, tīthis, week-days, yogas and karaṇas. In one of the Sūtras\textsuperscript{36}, the names of the Rāsīs are given exceptionally.

Further in the third Vedaṅga Nirukta, the divisional terms of time such as Muhūrtas and Kṣanas are introduced\textsuperscript{37}. Nirukta contains references to days, nights, fortnights, solstices etc.\textsuperscript{38}

\begin{itemize}
  \item[31] Srautasūtra; 4, 12
  \item[32] Ibid; 4, 12
  \item[33] Grhyasūtra, 2, 3, \textsuperscript{i} 2, 4, \textsuperscript{i} 3, \textsuperscript{i} 5
  \item[34] Srautasūtra, 2, 1; Grhyasūtra; 2, 10, 3, 1, 4, 1, 1, 14
  \item[35] Pāraskarasūtra, 2, 16
  \item[36] ‘Ningmayoromevsaabhayorvasantaḥ... Bodhāyanasūtra, Shivanath zarkhandi, BJ., p. 144
  \item[37] Nirukta, 2, 25.
  \item[38] Ibid; 14, 9
\end{itemize}
As for references given in Panini's Grammar, the word *Saṃvatsara* in the sense of a year mentioned in the Vedic literature is also seen here in the same sense\(^39\). The names of the months are given as *Caitrādi*\(^40\). At one place the word *Muhūrta* is given\(^41\). Though there is not a single reference to *tithi*, it does not necessarily follow that this word in its original sense was not familiar at that time. Some names of the nakṣatras have been found in the grammar of Panini\(^42\).

In the Śaṁti literature occur a number of astronomical terms. In the *Yājñavalkya Śaṁti*, nine planets are enumerated\(^43\). The sequence of the first seven of them corresponds to that of the week-days. But from this sequence it is difficult to ascertain whether the planets are, here, represented in association with the Karanas of earlier times or the corresponding week-days of later times.

In the passage pertaining to *Sraddhakāla*, given in the *Yājñavalkya Śaṁti*, there occurs the word *Vṛddhi*, but it cannot be ascertained whether the word

\(^{39}\) Panini's Grammar, 5,1,88, 7,3,16  
\(^{40}\) Ibid., 4,2,21  
\(^{41}\) Ibid., 3, 3, 9  
\(^{42}\) Ibid., 3, 1, 116  
\(^{43}\) Yājñavalkya Śaṁti, Acārādhyaya, Verse No.296.
here denotes the particular yoga of that name. Probably it conveys the general sense of increase. Nakṣatras, Muhūrtas and tithis have also been mentioned. Thus in the Śārīti literature literature we come across many astronomical terms.

In the Mahābhārata references to technical terms of chronology are found to a large extent. The references indicate that the people of those times were aware of nakṣatras, seasons, solstices, lunar as well as solar months and tithis. The months were both Pūrṇimanta and Amanta. The days were divided into Kāṣṭhas, Kaṭas, Muhūrtas, Lavas and Kaṇās. Sometimes names of nakṣatras are found. At one place the word Vāra occurs, but it is here used in the general sense of a day (not in the sense of a week-day).

Yogas, Kaṇās and Rasis are not mentioned at any place in the Mahābhārata. Descriptions of solar and lunar eclipses are found at many places.

44 BJ., p. 151  
45 Yaśāvalkya Śārīti, 1, 180, 1 1, 3, 2  
46 Mahābhārata, Adiparva, Adhyāya 71, 34, 44, 2  
47 Ibid., 83, 7 182, 16 48, Ibid., 84, 96  
49 Ibid., 160, 7  
50 Ibid., 49, 28; 1 21, 48  
51 Ibid., 160, 7  
52 BJ., p. 161
Among the sources mentioned above, the *Vedānga Jyotisa* alone was a regular treatise on Jyotisa, all the other sources containing only incidental references to terms and topics of Jyotisa. To these references may be added references to early astronomers that flourished prior to the period of scientific Jyotisa in India.

Vṛddha Garga is the earliest among them. In the *Mahābhārata* (in its present form) he had already come to be regarded as the oldest astronomer. He is dated earlier than Lagadha, the author of *Yajusā Jyotisa*. Then come Garga and Parāśara. In the absence of their works (which are now extinct), it is not possible to get any concrete idea of their contribution to Jyotisa.

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54 His name is found in *Mahābhārata* in two places. 

55 Cultural Heritage of India, Vol. III. p. 348

56 Names of some other astronomers occur in *Bhattopala's commentary on Brhat saṁhitā*, but their periods cannot be fixed definitely.
Among the extant works on Jyotisa, the Aryabhatiya comes next to the Vedanga Jyotisa. But from the Pancasiddhantika by Varahamihira who was a junior contemporary of Aryabhatta I, we learn that five different systems (Siddhantras) were already prevalent before his time. These Siddhantras treated by Varahamihira are as follows: - Paulisa, Romaka, Vasistha, Saura and Paitamaha.57

The scientific Indian astronomy is said to commence with Aryabhatta I, whose work is known as Anyabhatiya. The work is dated s.e. 421, (499 A.D.). It represents a scientific treatment of the subject, established by some original contribution of the author58.

After Aryabhatta I came Varahamihira who flourished in about s.e. 427 (505 A.D.). He has contributed several works to Jyotisa - Pancasiddhantika, Vivakhapajala, Bhajjatakā, Lechusjatakā, Yatra and Bhratsadhita59. The contents of his Pancasiddhantika are already given above. The other works are rather of astronomical character, and contain no data pertaining to chronology.

57 Varahamihira treats the Surya siddhanta in detail and other siddhantas in brief. The extant works on the five siddhantas that are distinct from the old siddhantas treated by Varahamihira are of latter origin comparatively.


59 BJ p. 296.
Then appear Srisena and Visnacandra, who were predecessors of Brahmagupta. Their works are not available today.

The next astronomer is Brahmagupta. He wrote his Brāhma-sphuṭa Siddhānta in S.E. 550 (A.C. 628) and Khandakhadyaka in S.E. 587 (A.C. 665). The former work is also known as Brahmasiddhanta. Therein he seems to have improved upon Āryabhatiya. In Khandakhadyaka he has treated several topics of chronology. Both his works were translated into Arabic. His methods etc. have been accepted by all the subsequent famous astronomers like Bhāskarācārya (A.C. 1150) as also by the new reedictions of the Siddhantas (modern) which are held as revelations.

Lalla comes after Brahmagupta. There are different views about his date. Dr. Kern and Janardan Balaji Modak put him in S.E. 420 (A.C. 498) and Sudhaker Drivedi holds that he lived in S.E. 421 (A.C. 499), while Sh. B. Dixit dates him round about S.E. 560 (A.C. 638).

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2. Brahmagupta's date is 550 S.E. (BJ; PP 299-300).
3. BJ. pp. 300 ff.
5. Alberuni translated the works of Brahmagupta into Arabic (BJ; p. 301).
His famous work on Jyotisa is Dhivrddhidatantra. He wrote a Muhūrtagrantha named Ratnakosa. Padmanābha, mentioned by Bhaskaracarya, is put by Colebrooke earlier than Sridhara (dated not later than S.E. 775 (A.C. 853) i.e. not earlier than S.E. 775 (A.C. 853). Sridhara (not later than A.C. 853) wrote a book on Pañiganita, which is named Trisātikā.

Then appears Mahāvīra, the author of Sarasākṛghra. He is dated about S.E. 775 (A.C. 853). Then comes Balabhadrā (S.E. 800 = A.C. 878). Vittesvara wrote his work Karanāsāra in S.E. 821 (A.C. 899). He was followed by Muñjāla (S.E. 854 = A.C. 932). His work Lañhumāṇasa remained popular as late as 1500 S.E. (A.C. 1578). Aryabhata II, the author of Laghu Aryan- siddhanta, is dated circa S.E. 875 (A.C. 953).

67 Ibid., p. 316
68 Ibid., p. 316
69 According to Alberuni, Balabhadrā wrote each book on Ganita, Smāhitā and Jātaka and made commentaries on Khaṇḍakāhyā and Brahmajātaka (EJ., p. 318)
70 Op. Cit., p. 318
71 Colebrooke determined the dates of some astronomers according to the astronomy of Vījai, in which he wrote about Muñjāla's date of S.E. 854 (A.C. 932) (Colebrooke's Essary, p. 461; B.F. 319)
72 EJ., pp. 321, f.
Next comes Cāturveda Prthūdakaswami. Then Bhatotpala (circa S.E. 399-467) wrote commentaries on the works of Varahamihira, such as śatrā, Bhajjātaka, Laghujātaka and Bhatsamhitā. Karanatilaka was written by Vijayanandi in S.E. 888 (A.C. 966). Then Bhanubhaṭṭa Bhāṇarju (circa S.E. 900-978) wrote a work entitiled Rasayanatāntra.

Śripati lived in circa S.E. 961 (A.C. 1039). He wrote two Jātakagranthas named Siddhāntasekhara and Dhikotidakarana, one Muhūrtagrantha Ratnamāla and a Jātakagrantha Jātakapadhati. In his work Dhikotidakarana he discussed the topics of solar and lunar eclipses.

Varuna (circa S.E. 962-1040 A.C.) wrote a commentary on Khandakhādyas of Brahmagupta. Rajamargaṇḍa has been Bhāskaracārya mentioned him at many places. From the reference of his name in the commentary on Khandakhādya by Varuna he seems to have flourished sometime before S.E. 962 (A.C. 1040) (Bj., p. 325).

Shivanath zarkhandi; Bj., p. 327

Ibid; p. 329

According to Sudhākara Drivadi he also wrote two Muhūrtagranthas, named Ratnavali and Ratnasara (Bj., p. 330)

Though this work is not famous for the present there are two chapters on solar and lunar eclipses (Bj., p. 330)
written by Bhōjarāja in S.E. 964 (A.C. 1042).

Karana-kamalamārtanda is a Kanaṇagrāntha written by 
Dasabala (S.E. 980 = 1058 A.C.). This work contains 
chapters on solar and lunar eclipses, tithiśuddhis etc.

Karana-prakāsa was written by Brahma-deva on the basis 
of the work of Aryabhata I, in S.E. 1014 (A.C. 1092). In 
this work he devotes a chapter to eclipses. 78

Satānanda wrote a Karanagrāntha 
Bhasvatikāraṇa in S.E. 1021 (A.C. 1099). He wrote this 
work on the basis of Sūrya Siddhānta by Varāhamihira. 79

In one of the Adhikāras he deals with eclipses. 80

Mahēśvara contributed his works round about S.E. 1030-40 
(A.C. 1108-1118). From the reference of an inscription 
of his great-grandson Anantadeva, it follows that he wrote 
a Karanagrāntha Sekhara, a commentary on Laghu-jātaka 
and a Muhūrtā grantha Yṛttasata. 81 Somesvara III wrote 
Abhilāsitarthasamānpa in which some topics of 
Jyotiga have been discussed. 82

78 Shivanath Zarkhandi; BJ 336
79 Ibid; p. 338
81 Op. cit; p. 341
82 BJ 334; 2
Then comes Bhāskarācārya, a great astronomer of India. Two works on mathematical Jyotīṣa were written by him. Siddhānta-śiromani and Karanakutuhala were written by him. This Siddhānta-śiromani is dated S.E. 1072 (A.C. 1150). His Karanakutuhala includes Adhikāras on solar and lunar eclipses. He is also known to have written a work named Bhāskaravivahapatala.

Vāvilālekoocanna (S.E. 1220 = A.C. 1298) of the Tailangana region wrote a Karanagrantha. Lastly, Kesava, a famous astronomer composed Vivahavandavanam on which Ganesadaivajña, wrote a commentary. According to Ganesadaivajña Kesava also wrote Karanaksanāthra. He is dated circa S.E. 1165 (A.C. 1243).

A number of other works were contributed to Jyotīṣa by several later authors like Kesava II (S.E. 1418 = A.C. 1496) and Ganesadaivajña (S.E. 1442 = A.C. 1520), but their period falls subsequent to the lower limit of the period of our subject.

83 Ibid., p. 342
84 Ibid., p. 349
85 Ibid., p. 351
86 Ibid., p. 351
87 Ibid., p. 352
88 Ibid., p. 357
89 Ibid., p. 360

Madhava, a commentator of Ratnamalā and other authors refer to a Muhūrtagrantha entitled Bhāskarayavahāra. The title of the work implies that it would have been written by Bhāskaracārya (Ibid., p. 351).
(ii) Sources of investigation into the Chronological systems in ancient Gujarat:

Among the sources of information about the chronological systems in ancient Gujarat, we find no regular work on Jyotisa, containing the terms and topics of chronology. All the other sources contain only incidental references to the chronological systems. So it is essential to collect and examine the data from incidental references in inscriptions and literature.

The epigraphic records bearing dates consist of stone inscriptions, copper-plate inscriptions, image inscriptions, earthenware inscriptions and coin legends. They record dates about various events such as the construction of temples, forts, step-wells etc.

1 Varahamihira, the author of *Pancasiddhāntikā* was the inhabitant of Ujjain and Brahmagupta, a famous astronomer and the writer of *Khandakhādyaka* lived in Bhilūmāla (Bhinmal). Both these places though intimately connected with Gujarat lay outside the region of Gujarat in the modern sense of the term. Hence their works are not here regarded as pertaining to Gujarat.

2 Earthenware Inscription of Guhasena dated (Valabhi) 4 Vaṣa year 247 (I.A., Vol.XIV, p.75)

3 The coins of only certain early dynasties bear dates, while those of the later dynasties are rare and undated.
Victories of kings, glorification of patrons and donors, grants of land, installation of images, endowments of amounts, utensils etc., and issue of coins. The early epigraphs of Gujarat date as back as the Mauryan Period, but they are dated simply in years which are found to be regnal years of the respective rulers. The subsequent dates in inscriptions are generally given in years of certain continuous eras. Though the names of the different eras are not specified in the records, they have been identifiable on the basis of comparative chronology. Many of the later records specify the eras by their particular names. A few dates are expressed in terms of corresponding years of several eras. Many of the dates consist of years, months, fortnights and lunar days. The inclusion of the weekday in some of the records dated since the 8th century, supplies a very helpful factor for determining

4. The legends on the Harappan seals found in Gujarat are here excluded, as the legends have not been legible and as the seals are assigned to protohistoric times.

5. The earliest epigraphic records of the historical period in Gujarat belong to the reign of the Mauryan king Asoka (B.C. 273-232)

6. These dates commenced from the 2nd Cent. A.D.
the system of the commencement of the year as well as the completion of the lunar month. Some dates also contain references to seasons, parvas, intercalations, eclipses, sakhramis and sometimes even Muhurthas. These particulars supply various data about the chronological systems of the respective periods.

Comparatively dates begin to appear in literary records at a very later stage. These dates are generally found to be of three types:— (1) dates of earlier events recorded in works. (2) dates of the composition of the particular works. (3) dates of the copying of manuscripts.

The known dates of the composition commence from the beginning of the 7th cen. A.C.3, while those of the copying appear from the end of the 11th cen. A.C.9. The earlier event recorded in the old literary works

Some of these dates belong to events of the near past, while some other dates refer to the events of the remote past.

9 Vide the date of S.E.531; (A.C.609) given in the Purna-leaf Ms. of Visesava's Vasantabhasya by Jinabhadraganiikshamadripana (BJ. Sandesara, Jain Agma Sthityaman Gujarat. p. 73)

9 One of the earliest known extant manuscripts copied in Gujarat seems to be that of Yogadristisamuccaya copied at Anahilapataka in V.S. 1140 (Jain Pustaka Prasasti Sangraha, P.I. p. 99)
of Gujarat is found dated since the 1st Cent. A.C.\textsuperscript{10}. The data of the dates multiply profusely in the literary records of the Caulukya period (A.C. 942 - 1304)

Like the epigraphic records, the literary records also date events either in years only or in terms of years, months, fortnights and lunar days, which are sometimes also supplemented by weekdays. These dates sometimes also contain references to intercalations, nakṣatras, yogas, lagnas, Muḥūrtas etc.

The collection and critical study of the different particulars of dates given in the old epigraphic and literary records of Gujarat throw light on the use of the different eras, different systems of the commencement of the year (such as Kartikādi Caitrādi and Āṣādhādi), those of the completion of the month (Pūrṇimanta and Amōnta) those of the intercalation of the month (mean and true), the use of the different Siddhāntas etc.

\textsuperscript{10} The Harivaṇṣa-purāṇa (A.C. 783) by Jinasendrasingha and the Mahā-vīra-rāja (A.C. 1084) by Nemiandraśārya date the (reign of) Saka king 605 years after the death of Mahāvīra i.e. in A.C. 78.

In his Vicārasṛṇi (Circa A.C. 1310) Meruṭūṅgaśūri dates the commencement of the Vikrama era counted from that of Vikrama's reign 470 years after the commencement of the Vīra era counted from Vīra's death, i.e. in 57 B.C.

The date of the composition of this work falls slightly later than the lower limit of our period.