CHAPTER 8

The Year of 360 Days

PRIOR to the last series of cataclysms, when, as we assume, the globe spun on an axis pointed in a different direction in space, with its poles at a different location, on a different orbit, the year could not have been the same as it has been since.

Numerous evidences are preserved which prove that prior to the year of 365¼ days, the year was only 360 days long. Nor was that year of 360 days primordial; it was a transitional form between a year of still fewer days and the present year.

In the period of time between the last of the series of catastrophes of the fifteenth century and the first in the series of catastrophes of the eighth century, the duration of a seasonal revolution appears to have been 360 days.[1]

In order to substantiate my statement, I invite the reader on a world-wide journey. We start in India.

The texts of the *Veda* period know a year of only 360 days. "All Veda texts speak uniformly and exclusively of a year of 360 days. Passages in which this length of the year is directly stated are found in all the Brahmanas." [2] "It is striking that the Vedas nowhere mention an intercalary period, and while repeatedly stating that the year

[1] W. Whiston, in *New Theory of the Earth* (1696), expressed his belief that before the Deluge the year was composed of 360 days. He found references in classic authors to a year of 360 days, and as he recognized only one major catastrophe, the Deluge, he related these references to the antediluvian era.

[2] Thibaut, "Astronomie, Astrologie und Mathematik," *Grundriss der indo-arischen Philologie und Alterthumskunde* (1899), III, 7.

consists of 360 days, nowhere refer to the five or six days that actually are a part of the solar year." [3]

This Hindu year of 360 days is divided into twelve months of thirty days each.[4] The texts describe the moon as crescent for fifteen days and waning for another fifteen days; they also say that the sun moved for six months or 180 days to the north and for the same number of days to the south.

The perplexity of scholars at such data in the Brahmanic literature is expressed in the following sentence: "That these are not conventional inexact data, but definitely wrong notions, is shown by the passage in *Nidana-Sutra*, which says that the sun remains 13⅝ days in each of the 27 *Naksatras*, and thus the actual solar year is calculated as 360 days long." "Fifteen days are assigned to each half-moon period; that this is too much is nowhere admitted." [5]

In their astronomical works, the Brahmans used very ingenious geometric methods, and their failure to discern that the year of 360 days was 5¼ days too short seemed baffling. In ten years such a mistake accumulates to fifty-two days. The author whom I quoted last was forced to conclude that the Brahmans had a "wholly confused notion of the true length of the year." Only in a later period, he said, were the Hindus able to deal with such obvious facts. To the same effect wrote another German author: "The fact that a long period of time was necessary to arrive at the formulation of the 365-day year is proved by the existence of the old Hindu 360-day Savana-year and of other forms which appear in the Veda literature." [6]

Here is a passage from the *Aryabhatiya*, an old Indian work on mathematics and astronomy: "A year consists of twelve months. A month consists of 30 days. A day consists of 60 nadis. A nadi consists of 60 vinadikas." [7]

A month of thirty days and a year of 360 days formed the basis of early Hindu chronology used in historical computations.

[3] *Ibid.* [4] *Ibid.* [5] *Ibid.*

[6] F. K. Ginzel, "Chronologie," *Encyklopädie der mathematischen Wissenschaften* (1904-1935), Vol. VI.

[7] *The Aryabhatiya of Aryabhatta*, an ancient Indian work on mathematics and astronomy (transl. W. E. Clark, 1930), Chap. 3, "Kalakriya or the Reckoning of Time," p. 51.

The Brahmans were aware that the length of the year, of the month, and of the day changed with every new world age. The following is a passage from *Surya-siddhanta,* a classic of Hindu astronomy. After an introduction, it proceeds: "Only by reason of the revolution of the ages, there is here a difference of times." [8] The translator of this ancient manual supplied an annotation to these words: "According to the commentary, the meaning of these last verses is that in successive Great Ages . . . there were slight differences in the motion of the heavenly bodies." Explaining the term *bija,* which means a correction of time in every new age, the book of *Surya* says that "time is the destroyer of the worlds."

The sacerdotal year, like the secular year of the calendar, consisted of 360 days composing twelve lunar months of thirty days each. From approximately the seventh pre-Christian century on, the year of the Hindus became 365¼ days long, but for temple purposes the old year of 360 days was also observed, and this year is called *savana.*

When the Hindu calendar acquired a year of 365¼ days and a lunar month of twenty-nine and a half days, the older system was not discarded. "The natural month, containing about twenty-nine and a half days mean solar time, is then divided into thirty lunar days (*tithi*), and this division, although of so unnatural and arbitrary a character, the lunar days beginning and ending at any moment of the natural day and night, is, to the Hindu, of the most prominent practical importance, since by it are regulated the performances of many religious ceremonies, and upon it depend the chief considerations of propitious and unpropitious times, and the like." [9]

The double system was the imposition of a new time measure upon the old.

The ancient Persian year was composed of 360 days or twelve months of thirty days each. In the seventh century five *Gatha* days were added to the calendar.[10]

[8] *Surya-siddhanta: A Text Book of Hindu Astronomy* (transl. Ebenezer Burgess, 1860).

[9] *Ibid.,* comment by Burgess in note to p. 7.

[10] "Twelve months . . . of thirty days each . . . and the five Gatha-days at

In the *Bundahis*, a sacred book of the Persians, the 180 successive appearances of the sun from the winter solstice to the summer solstice and from the summer solstice to the next winter solstice are described in these words: "There are a hundred and eighty apertures [*rogin*] in the east, and a hundred and eighty in the west . . . and the sun, every day, comes in through an aperture, and goes out through an aperture. . . . It comes back to Varak, in three hundred and sixty days and five Gatha days." [11]

Gatha days are "five supplementary days added to the last of the twelve months of thirty days each, to complete the year; for these days no additional apertures are provided. . . . This arrangement seems to indicate that the idea of the apertures is older than the rectification of the calendar which added the five Gatha days to an original year of 360 days." [12]

The old Babylonian year was composed of 360 days.[13] The astronomical tablets from the period antedating the Neo-Babylonian Empire compute the year at so many days, without mention of additional days. That the ancient Babylonian year had only 360 days was known before the cuneiform script was deciphered: Ctesias wrote that the walls of Babylon were 360 furlongs in compass, "as many as there had been days in the year." [14]

The zodiac of the Babylonians was divided into thirty-six decans, a decan being the space the sun covered in relation to fixed stars during a ten-day period. "However, the 36 decans with their decades require a year of only 360 days." [15] To explain this apparently arbitrary length of the zodiacal path, the following conjecture was made: "At first the astronomers of Babylon recognized a year of 360 days,

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the end of the year." "The Book of Denkart," in H. S. Nyberg, *Texte zum mazdayasnischen Kalender* (Uppsala, 1934), p. 9.

[11] *Bundahis* (transl. West), Chap. V.

[12] Note by West on p. 24 of his translation of the *Bundahis*.

[13] A. Jeremias, *Das Alter der babylonischen Astronomie* (2nd ed., 1909), pp. 58 ff.

[14] *The Fragments of the Persika of Ktesias* (Ctesiae Persica), ed. J. Gilmore (1888), p. 38; Diodorus ii. 7.

[15] W. Gundel, *Dekane und Dekansternbilder* (1936), p. 253.

and the division of a circle into 360 degrees must have indicated the path traversed by the sun each day in its assumed circling of the earth." [16] This left over five degrees of the zodiac unaccounted for.

The old Babylonian year consisted of twelve months of thirty days each, the months being computed from the time of the appearance of the new moon. As the period between one new moon and another is about twenty-nine and a half days, students of the Babylonian calendar face the perplexity with which we are already familiar in other countries. "Months of thirty days began with the light of the new moon. How agreement with astronomical reality was effected, we do not know. The practice of an intercalary period is not yet known." [17] It appears that in the seventh century five days were added to the Babylonian calendar; they were regarded as unpropitious, and people had a superstitious awe of them.

The Assyrian year consisted of 360 days; a decade was called a *sarus;* a *sarus* consisted of 3,600 days.[18]

"The Assyrians, like the Babylonians, had a year composed of lunar months, and it seems that the object of astrological reports which relate to the appearance of the moon and sun was to help to determine and foretell the length of the lunar month. If this be so, the year in common use throughout Assyria must have been lunar. The calendar assigns to each month thirty full days; the lunar month is, however, little more than twenty-nine and a half days." [19] "It would hardly be possible for the calendar month and the lunar month to correspond so exactly at the end of the year." [20]

Assyrian documents refer to months of thirty days only, and count such months *from crescent to crescent.*[21] Again, as in other countries,

[16] Cantor, *Vorlesungen über Geschichte der Mathematik,* I, 92.

[17] "Sin" in Roscher, *Lexikon der griech. und röm. Mythologie,* Col. 892.

[18] Georgius Syncellus, ed. Jacob Goar (Paris, 1652), pp. 17, 32.

[19] R. C. Thompson, *The Reports of the Magicians and Astrologers of Nineveh and Babylon in the British Museum,* II (1900), xix.

[20] *Ibid.,* p. xx.

[21] Langdon and Fotheringham, *The Venus Tablets of Ammizaduga,* pp. 45-46; C. H. W. Johns, *Assyrian Deeds and Documents,* IV (1923), 333; J. Kohler and A. Ungnad, *Assyrische Rechtsurkunden* (1913) 258, 3; 263, 5; 649, 5.

it is explicitly the *lunar month* that is computed by the Assyrian astronomers as equal to thirty days. How could the Assyrian astronomers have adjusted the length of the lunar months to the revolutions of the moon, modern scholars ask themselves, and how could the observations reported to the royal palace by the astronomers have been so consistently erroneous?

The month of the Israelites, from the fifteenth to the eighth century before the present era, was equal to thirty days, and twelve months comprised a year; there is no mention of months shorter than thirty days, nor of a year longer than twelve months. That the month was composed of thirty days is evidenced by Deuteronomy 34 : 8 and 21 : 13, and Numbers 20 : 29, where mourning for the dead is ordered for "a full month," and is carried on for thirty days. The story of the Flood, as given in Genesis, reckons in months of thirty days; it says that one hundred and fifty days passed between the seventeenth day of the second month and the seventeenth day of the seventh month.[22] The composition of this text apparently dates from the time between the Exodus and the upheaval of the days of Uzziah.[23]

The Hebrews observed lunar months. This is attested to by the fact that the new-moon festivals were of great importance in the days of Judges and Kings.[24] "The new moon festival anciently stood at least on a level with that of the Sabbath." [25] As these (lunar) months were thirty days long, with no months of twenty-nine days in between, and as the year was composed of twelve such months, with no additional days or intercalated months, the Bible exegetes could find no way of reconciling the three figures: 354 days, or twelve lunar months of twenty-nine and a half days each; 360 days, or a multiplex of twelve times thirty; and 365¼ days, the present length of the year.

[22] Genesis 7 : 11 and 24; 8 : 4.

[23] The other variant of the story of the Flood (Genesis 7 : 17; 8 : 6) has the Deluge lasting 40 days instead of 150.

[24] I Samuel 20 : 5-6; II Kings 4 : 23; Amos 8 : 5; Isaiah 1 : 13; Hosea 2 : 11; Ezekiel 46 : 1, 3.

In the Bible the month is called *hodesh*, or "the new (moon)," which testifies to a lunation of thirty days.

[25] J. Wellhausen, *Prolegomena to the History of Israel* (1885), p. 113.

The Egyptian year was composed of 360 days before it became 365 by the addition of five days. The calendar of the Ebers Papyrus, a document of the New Kingdom, has a year of twelve months of thirty days each.[26]

In the ninth year of King Ptolemy Euergetes, or –238, a reform party among the Egyptian priests met at Canopus and drew up a decree; in 1866 it was discovered at Tanis in the Delta, inscribed on a tablet. The purpose of the decree was to harmonize the calendar with the seasons "according to the present arrangement of the world," as the text states. One day was ordered to be added every four years to the "three hundred and sixty days, and to the five days which were afterwards ordered to be added." [27]

The authors of the decree did not specify the particular date on which the five days were added to the 360 days, but they do say clearly that such a reform was instituted on some date after the period when the year was only 360 days long.

On a previous page I referred to the fact that the calendar of 360 days was introduced in Egypt only after the close of the Middle Kingdom, in the days of the Hyksos. The five epigomena must have been added to the 360 days subsequent to the end of the Eighteenth Dynasty. We have no mention of "five days" in all the numerous inscriptions of the Eighteenth Dynasty; the epigomena or, as the Egyptians called them, "the five days which are above the year," [28] are known from the documents of the seventh and following centuries. The pharaohs of the late dynasties used to write: "The year and the five days." The last day of the year was celebrated, not on the last of the epigomena, but on the thirtieth of Mesori, the twelfth month.[29]

In the fifth century Herodotus wrote: "The Egyptians, reckoning thirty days to each of the twelve months, add five days in every ye

[26] Cf. G. Legge in *Recueil de travaux relatifs à la philologie et à l'archéolog égyptiennes et assyriennes* (La Mission française du Caire, 1909).

[27] S. Sharpe, *The Decree of Canopus* (1870).

[28] E. Meyer, "Agyptische Chronologie," *Philos. und hist. Abhandlungen der Preuss. Akademie der Wissenschaften* (1904), p. 8.

[29] *Ibid.*

over and above the number, and so the completed circle of seasons is made to agree with the calendar." [30]

The *Book of Sothis,* erroneously ascribed to the Egyptian priest Manetho,[31] and Georgius Syncellus, the Byzantine chronologist,[32] maintain that originally the additional five days did not follow the 360 days of the calendar, but were introduced at a later date,[33] which is corroborated by the text of the Canopus Decree.

That the introduction of epigomena was not the result of progress in astronomical knowledge, but was caused by an actual change in the planetary movements, is implied in the Canopus Decree, for it refers to "the amendment of the faults of the heaven." In his *Isis and Osiris* [34] Plutarch describes by means of an allegory the change in the length of the year: "Hermes playing at draughts with the moon, won from her the seventieth part of each of her periods of illumination, and from all the winnings he composed five days, and intercalated them as an addition to the 360 days." Plutarch informs us also that one of these epigomena days was regarded as inauspicious; no business was transacted on that day, and even kings "would not attend to their bodies until nightfall."

The new-moon festivals were very important in the days of the Eighteenth Dynasty. On all the numerous inscriptions of that period, wherever the months are mentioned, they are reckoned as thirty days long. The fact that the new-moon festivals were observed at thirty-day intervals implies that the lunar month was of that duration.

Recapitulating, we find concordant data. The Canopus Decree states that at some period in the past the Egyptian year was only 360 days long, and that the five days were added at some later date; the Ebers Papyrus shows that under the Eighteenth Dynasty the calendar had a year of 360 days divided into twelve months of thirty days each; other documents of this period also testify that the lunar month

[30] Herodotus, *History,* Bk. ii. 4 (transl. A. D. Godley).

[31] See volume of Manetho in Loeb Classical Library.

[32] *Georgii Monachi Chronographia* (ed. P. Jacobi Goar, 1652), p. 123.

[33] In the days of the Hyksos King Aseth. But see the Section "Changes in the Times and the Seasons."

[34] Translated by F. C. Babbit.

had thirty days, and that a new moon was observed twelve times in a period of 360 days. The Sothis book says that this 360-day year was established under the Hyksos, who ruled after the end of the Middle Kingdom, preceding the Eighteenth Dynasty.

In the eighth or seventh century the five epigomena days were added to the year under conditions which caused them to be regarded as unpropitious.

Although the change in the number of days in the year was calculated soon after it occurred, nevertheless, for some time many nations retained a civil year of 360 days divided into twelve months of thirty days each.

Cleobulus, who was counted among the seven sages of ancient Greece, in his famous allegory represents the year as divided into twelve months of thirty days: the father is one, the sons are twelve, and each of them has thirty daughters.[35]

From the days of Thales, another of the seven sages, who could predict an eclipse, the Hellenes knew that the year consists of 365 days; Thales was regarded by them as the man who discovered the number of days in the year. As he was born in the seventh century, it is not impossible that he was one of the first among the Greeks to learn the new length of the year; it was in the beginning of that century that the year achieved its present length. A contemporary of Thales and also one of the seven sages, Solon was regarded as the first among the Greeks to find that a lunar month is less than thirty days.[36] Despite their knowledge of the correct measure of the year and the month, the Greeks, after Solon and Thales, continued to keep to the obsolete calendar, a fact for which we have the testimony of Hippocrates ("Seven years contain 360 weeks"), Xenophon, Aristotle, and Pliny.[37] The persistence of reckoning by 360 days is accounted for not only by a certain reverence for the earlier astronomical year, but also by its convenience for every computation.

[35] See Diogenes Laërtius, *Lives of Eminent Philosophers*, "Life of Thales."

[36] Proclus, *The Commentaries on the Timaeus of Plato* (1820); Diogenes Laërtius, *Lives*, "Life of Solon"; Plutarch, *Lives*, "Life of Solon."

[37] Aristotle *Historia animalium* vi. 20; Pliny, *Natural History*, xxxiv. 12 (transl. Bostock and Riley).

The ancient Romans also reckoned 360 days to the year. Plutarch wrote in his "Life of Numa" that in the time of Romulus, in the eighth century, the Romans had a year of 360 days only.[38] Various Latin authors say that the ancient month was composed of thirty days.[39]

On the other side of the ocean, the Mayan year consisted of 360 days; later five days were added, and the year was then a *tun* (360-day period) and five days; every fourth year another day was added to the year. "They did reckon them apart, and called them the days of nothing: during the which the people did not anything," wrote J. de Acosta, an early writer on America.[40]

Friar Diego de Landa, in his *Yucatan before and after the Conquest*, wrote: "They had their perfect year like ours, of 365 days and six hours, which they divided into months in two ways. In the first the months were of 30 days and were called *U* which signifies the moon, and they counted from the rising of the new moon until it disappeared." [41] The other method of reckoning, by months of twenty days' duration (*uinal hunekeh*), reflects a much older system, to which I shall return when I examine more archaic systems than that of the 360-day year. De Landa also wrote that the five supplementary days were regarded as "sinister and unlucky." They were called "days without name." [42] Although the Mexicans at the time of the conquest called a thirty-day period "a moon," they knew that the synodical moon period is 29.5209 days,[43] which is more exact than the Gregorian calendar introduced in Europe ninety years after the discovery of America. Obviously, they adhered to an old tradition dating from the time when the year had twelve months of thirty days each, 360 days in all.[44]

[38] Plutarch, *Lives*, "The Life of Numa," xviii.

[39] Cf. Geminus *Elementa astronomiae* viii; cf. also Cleomedes *De motu circulari corporum celestium* xi. 4.

[40] J. de Acosta, *The Natural and Moral Histories of the Indies*, 1880 (Historia natural y moral de las Indias, Seville, 1590).

[41] Diego de Landa, *Yucatan*, p. 59.

[42] D. G. Brinton, *The Maya Chronicles* (1882).

[43] Gates' note to De Landa, *Yucatan*, p. 59.

[44] R. C. E. Long, "Chronology—Maya," *Encyclopaedia Britannica* (14th ed.):

In ancient South America also the year consisted of 360 days, divided into twelve months.

"The Peruvian year was divided into twelve Quilla, or moons of thirty days. Five days were added at the end, called Allcacanquis." [45] Thereafter, a day was added every four years to keep the calendar correct.

We cross the Pacific Ocean and return to Asia. The calendar of the peoples of China had a year of 360 days divided into twelve months of thirty days each.[46]

A relic of the system of 360 days is the still persisting division of the sphere into 360 degrees; each degree represented the diurnal advance of the earth on its orbit, or that portion of the zodiac which was passed over from one night to the next. After 360 changes the stellar sky returned to the same position for the observer on the earth.

When the year changed from 360 to 365¼ days, the Chinese added five and a quarter days to their year, calling this additional period *Khe-ying;* they also began to divide a sphere into 365¼ degrees, adopting the new year-length not only in the calendar, but also in celestial and terrestrial geometry.[47]

Ancient Chinese time reckoning was based on a coefficient of sixty; so also in India, Mexico, and Chaldea, sixty being the universal coefficient.

The division of the year into 360 days was honored in many ways,[48]

"They [the Mayas] never used a year of 365 days in counting the distance of time from one date to another."

[45] Markham, *The Incas of Peru,* p. 117.

[46] Joseph Scaliger, *Opus de emendatione temporum,* p. 225; W. Hales, *New Analysis of Chronology* (1809-1812), I, 31; W. H. Medhurst, notes to pp. 405-406 of his translation of *The Shoo King* (Shanghai, 1846).

[47] H. Murray, J. Crawfurd, and others, *An Historical and Descriptive Account of China* (p. 235); *The Chinese Classics,* III, Pt. 2, ed. Legge (Shanghai, 1865), note to p. 21.

Cf. also Cantor, *Vorlesungen,* p. 92: "Zuerst wurde von den Astronomen Babylons das Jahr von 360 Tagen erkannt, und die Kreisteilung in 360 Grade sollte den Weg versinnlichen welchen die Sonne bei ihrem vermeintlichen Umlaufe um die Erde jeden Tag zurücklegte."

[48] C. F. Dupuis (*L'Origine de tous les cultes* [1835-1836], the English compendium being *The Origin of All Religious Worship* [1872], p. 41) gathered material on the number 360, "which is that of the days of the year without the

and, indeed, it became an incentive to progress in astronomy and geometry, so that people did not readily discard this method of reckoning when it became obsolete. They retained their "moons" of thirty days, though the lunar month in fact became shorter, and they regarded the five days as not belonging to the year.

All over the world we find that there was at some time the same calendar of 360 days, and that at some later date, about the seventh century before the present era, five days were added at the end of the year, as "days over the year," or "days of nothing."

Scholars who investigated the calendars of the Incas of Peru and the Mayas of Yucatan wondered at the calendar of 360 days; so did the scholars who studied the calendars of the Egyptians, Persians, Hindus, Chaldeans, Assyrians, Hebrews, Chinese, Greeks, or Romans. Most of them, while debating the problem in their own field, did not suspect that the same problem turned up in the calendar of every nation of antiquity.

Two matters appeared perplexing: a mistake of five and a quarter days in a year could certainly be traced, not only by astronomers, but even by analphabetic farmers, for in the short span of forty years—a period that a person could readily observe—the seasons would become displaced by more than two hundred days. The second perplexity concerns the length of a month. "It seems to have been a prevailing opinion among the ancients that a lunation or synodical month lasted thirty days." [49] In many documents of various peoples, it is said that the month, or the "moon," is equal to thirty days, and that the beginning of such a month coincides with the new moon.

Such declarations by ancient astronomers make it clear that there was no such thing as a conventional calendar with an admitted error;

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epigomena." He refers to the 360 gods in the "theology of Orpheus," to the 360 eons of the gnostic genii, to the 360 idols before the palace of Dairi in Japan, to 360 statues "surrounding that of Hobal," worshiped by the ancient Arabs, to the 360 genii who take possession of the soul after death, "according to the doctrine of the Christians of St. John," to the 360 temples built on the mountain of Lowham in China, and to the wall of 360 stadia "with which Semiramis surrounded the city" of Babylon. This material did not convey to its collector the idea that an astronomical year of 360 days had been the reason for the sacredness of the number 360.

[49] Medhurst, *The Shoo King*.

as a matter of fact, the existence of an international calendar in those days is extremely unlikely. After centuries of open sea lanes and international exchange of ideas, no uniform calendar for the whole world has as yet been devised: the Moslems have a lunar year, based on the movements of the moon, which is systematically adjusted every few years to the solar year by intercalation; many other creeds and peoples have systems of their own containing many vestiges of ancient systems. The reckoning of months as equal to thirty and thirty-one days is also a relic of older systems; the five supplementary days were divided among the old lunar months. But at present the almanac does not ascribe an interval of thirty days between two lunations or a period of 360 days for twelve lunations.

The reason for the universal identity of time reckoning between the fifteenth and the eighth centuries lay in the actual movement of the earth on its axis and along its orbit, and in the revolution of the moon, during that historical period. The length of a lunar revolution must have been almost exactly 30 days, and the length of the year apparently did not vary from 360 days by more than a few hours.

Then a series of catastrophes occurred that changed the axis and the orbit of the earth and the orbit of the moon, and the ancient year, after going through a period marked by disarranged seasons, settled into a "slow-moving year" (Seneca) of 365 days, 5 hours, 48 minutes, 46 seconds, a lunar month being equal to 29 days, 12 hours, 44 minutes, 2.7 seconds, mean synodical period.

Disarranged Months

As a result of repeated perturbations, the earth changed from an orbit of 360 days' duration to one of 365¼ days, the days probably not being exactly equal in both cases. The month changed from thirty to twenty-nine and a half days. These were the values at the beginning and at the end of the century of "the battle of the gods." As a result of the perturbations of this century, there were intermediary values of the year and the month. The length of the year probably ranged between 360 and 365¼ days, but the moon, being a smaller (or

weaker) body than the earth, suffered greater perturbations from the contacting body, and the intermediate values of the month could have been subjected to greater changes.

Plutarch declares that in the time of Romulus the people were "irrational and irregular in their fixing of the months," and reckoned some months at thirty-five days and some at more, "trying to keep to a year of 360 days," and that Numa, Romulus' successor, corrected the irregularities of the calendar and also changed the order of the months. This statement suggests the question: Might it not have been that during the period between consecutive catastrophes the moon receded to an orbit of thirty-five or thirty-six days' duration?

If, in the period of confusion, the moon actually changed for a while to such an orbit, it must have been an ellipse or a circle of a radius larger than before. In the latter case, each of the four moon phases must have been of nine days' duration. It is of interest, therefore, to read that in many sagas dealing with the moon, the number nine is used in measures of time.[1]

A series of scholars found that nine days was for a while a time period of many ancient peoples: the Hindus, the Persians,[2] the Babylonians,[3] the Egyptians,[4] and the Chinese.[5] In religious traditions, literature, and astrological works, seven days and nine days compete as the measure of the month's quarter.

In the time of the Homeric epics, the nine-day week became prevalent in the Greek world. The seven-day week and the nine-day

1 "The number nine occurs conspicuously in so many sagas which, for other reasons, I recognized to be moon sagas, that I am convinced that the holiness of this number has its origin in its very ancient application in time division." The author of this passage (E. Siecke, *Die Liebesgeschichte des Himmels, Untersuchungen zur indogermanischen Sagenkunde* [1892]) did not suppose a change in the nature of the lunar cycles, and also was not aware of the work of the scholar referred to in the following footnote, yet he was forced to believe that nine was connected with a time subdivision of a month.

2 A. Kaegi, "Die Neunzahl bei den Ostarien," in the volume dedicated to H. Schweizer-Sidler (1891).

3 Kugler, "Die Symbolik der Neunzahl," *Babylonische Zeitordnung*, p. 192.

4 E. Naville, *Transactions of the Society of Biblical Archaeology*, IV (1875), 1-18.

5 Roscher, *Die enneadischen und hebdomadischen Fristen und Wochen*, Vol. XXI, No. 4, of *Abhandlungen der philol.-histor. Klasse der Kgl. sächs. Ges. der Wissenschaften* (1903).

week are both found in Homer.[6] The Romans, too, retained the recollection of a time when the week had been of nine days' duration.[7]

The change from a seven-day phase to a nine-day phase is found in the traditions of the peoples of Rumania, Lithuania, and Sardinia, and among the Celts of Europe, the Mongols of Asia, and the tribes of West Africa.[8]

In order to explain this strange phenomenon in time reckoning, obviously connected with the moon, the suggestion was made that, in addition to the seventh-day phase of the moon, a nine-day phase was also observed, which is a third part of the month.[9] But this idea must be rejected, because a third part of a month of twenty-nine and a half days would more nearly be ten days and not nine.[10] Besides, the quarter-month phases are easily observable periods during which the moon increases from new moon to half moon, to full moon, and then decreases accordingly; but a nine-day period falls between these phases.

Therefore, and in view of the vast material from many peoples, we conclude that at one time during the century of perturbations, for a period between two catastrophes, the moon receded to an orbit of thirty-five to thirty-six days' duration. It remained on such an orbit for a few decades until, at the next upheaval, it was carried to an orbit of twenty-nine and a half days' duration, on which it has proceeded since then.

These "perturbed months" occurred in the second half of the eighth century, at the beginning of Roman history.[11] What is more, we have

[6] Roscher, *Die Sieben- und Neunzahl im Kultus und Mythus der Griechen, ibid.*, Vol. XXIV, No. 1 (1904): "Die beiden Arten von Fristen schon bei Homer und ebenso auch im ältesten Kultus nebeneinander vorkommen" (p. 54). "In der Zeit des älteren Epos herrschend gewordene 9-tägige Woche" (p. 73).

[7] Cf. Ovid *Metamorphoses* vii. 23 ff.; xiii. 951; xiv. 57.

[8] Roscher, *Die Sieben- und Neunzahl.* [9] Roscher, *Fristen und Wochen.*

[10] The sidereal month, or the period of time during which the moon completes a revolution in relation to the fixed stars is 27 days, 7 hours, 43 minutes. But the phases of the moon change according to the synodical month of 29 days, 12 hours, 44 minutes; after a synodical month the moon returns to the same position in relation to the sun as viewed from the earth.

[11] It was probably these changes that caused the gods in *The Clouds* of Aristophanes to accuse the moon of having brought disorder in the calendar and in the cult. Aristophanes, *The Clouds* ll. 615 ff.

actual dates like "the 33rd day of the month," cited in the Babylonian tablets of that period.[12]

Thus the month which was equal to thirty days changed to thirty-six and then to twenty-nine and a half days. The last change was simultaneous with the change of the terrestrial orbit to one of 365¼ days' duration.

Years of Ten Months

When the month was about thirty-six days and the year between 360 and 365¼ days, the year must have been composed of only ten months. This was the case.

According to many classical authors, in the days of Romulus the year consisted of ten months, and in the time of Numa, his successor, two months were added: January and February. Ovid writes: "When the founder of the city [Rome] was setting the calendar in order, he ordained that there should be twice five months in his year. . . . He gave his laws to regulate the year. The month of Mars was the first, and that of Venus the second. . . . But Numa overlooked not Janus and the ancestral shades [February] and so to the ancient months he prefixed two." [1]

Geminus, a Greek astronomer of the first century before the present era, says similarly that it was Romulus who (in the eighth century) established the year of ten months.[2] Aulus Gellius, a second century author, writes in his *Attic Nights:* "The year was composed not of twelve months, but of ten." [3] Plutarch remarks that in his day there was a belief that the Romans, in the time of Romulus, computed the year "not in twelve months, but in ten, by adding more than thirty days to some of the months." [4] At the beginning of Numa's reign the ten-month year was still the official one.[5] "March was considered the first month until the reign of Numa, the full year before

[12] Kugler, *Babylonische Zeitordnung*, p. 191, note.

[1] Ovid *Fasti* i. 27 ff.

[2] Geminus, "Introduction aux phénomènes" in Petau, *Uranologion* (1630).

[3] Aulus Gellius *Noctes Atticae* iii. 16. [4] Plutarch, *The Roman Questions*, xix.

[5] Eutropius *Brevarium rerum romanorum* i. 3 says: "Numa Pompilius divided the year into ten months." This must refer to the beginning of Numa's reign, when the calendar of Romulus was still valid.

that time containing ten months," wrote Procopius of Caesarea, who lived in the closing years of the Roman Empire.[6] The fact that, in Romulus' time, the first month was named in honor of Mars and the second in honor of Venus shows the importance of these two deities in that period of history. July was named Quintilis (the fifth). The difference of two months still survives in the names September, October, November, and December, which denote the seventh, eighth, ninth, and tenth months, but according to present-day reckoning they are the ninth, tenth, eleventh, and twelfth months, respectively.

Not only was the year divided into fewer than twelve months, but also the zodiac, or the path of the sun and the moon across the firmament, at present consisting of twelve signs, at one time had eleven and at another time ten signs. A zodiac of fewer than twelve signs was employed by the astrologers of Babylonia, ancient Greece, and other countries.[7] A Jewish song in the Aramaic language which is included in the Seder Service refers to eleven constellations of the Zodiac.

The calendars of the primitive peoples disclose their early origin by the fact that many of them are composed of ten months, and some of eleven months. If the time of the lunar revolution was thirty-five days and some hours, the year was something over ten months long.

The Yurak Samoyeds reckon eleven months to the year.[8] The natives of Formosa, too, have a year of eleven months.[9] The year of the Kamchadals is made up of ten months, "one of which is said to be as long as three."[10] The inhabitants of the Kingsmill Islands in the Pacific, also called the Gilbert Islands, near the equator, use a ten-month period for their year.[11] In the Marquesas (in Polynesia

[6] Procopius of Caesarea, *History of the Wars*, Bk. V, "The Gothic War" (transl. H. B. Dewing, 1919), Sec. 31.

[7] Boll, *Sternglaube und Sterndeutung*, p. 92; A. del Mar, *The Worship of Augustus Caesar*, pp. 6, 11, with references to Ovid, Virgil, Pliny, Servius, and Hyginus.

[8] M. P. Nilsson, *Primitive Time-Reckoning* (1920), p. 89.

[9] A. Wirth, "The Aborigines of Formosa," *The American Anthropologist*, 1897.

[10] A. Schiefner, *Bulletin de l'Académie de St. Petersbourg, Hist.-phil. Cl.*, XIV (1857), 198, 201 f.

[11] H. Hale, *Ethnography and Philology: U.S. Exploring Expedition, 1838-42*, VI (1846), 106, 170.

south of the equator) ten months form a year (*tau* or *puni*), but the actual year of 365 days is also known.[12]

The Toradja of the Dutch East Indies compute time in moon-months. Each year, however, a period of two or three months is not brought into the computation at all, and is omitted in time reckoning.[13]

The Chams of Indo-China have a calendar of only ten months to the year.[14] The natives in some islands of the Indian Ocean also observe ten months to the year.[15]

The aborigines of New Zealand do not count two months in the year. "These two months are not in the calendar: they do not reckon them; nor are they in any way accounted for." [16]

"Among the Yoruba of South Nigeria the three months—February, March, April—are generally given no specific name." [17]

These calendars of primitive peoples are similar to the old Roman calendar. They were not invented in disregard of the solar year ("Years with less than twelve months are to us the strangest of phenomena" [18]); their fault is that they are more constant than the revolution of the earth on her orbit around the sun. The work of adapting the old systems to a new order is still evident in the systems of the aborigines of Kamchatka, South Nigeria, the Dutch East Indies, and New Zealand. Instead of introducing two additional months, as in the reform of Numa, one of the months is extended to triple its length, or a period equivalent to two months is not counted at all in the calendric system.

The abundance of proofs of the existence of a ten-month year is even embarrassing. Since the period when the year was composed of ten months of thirty-five to thirty-six days each was short, how could this ten-month year leave so many vestiges in the calendar systems all over the world? The answer to this question will become simple when we shall find that this was the second time in the history of the

[12] G. Mathias, *Lettres sur les Isles Marquises* (1843), 211.

[13] N. Adriani and A. C. Kruijt, *De Bare'e-sprekende Toradja's* (1912-1914), II, 264.

[14] Frazer, *Ovid's Fasti* (1931), p. 386. [15] *Ibid.*

[16] W. Yate (English missionary in the early part of the nineteenth century), quoted in Frazer, *Ovid's Fasti*, p. 386.

[17] *Ibid.* [18] Nilsson, *Primitive Time-Reckoning*, p. 89.

world that the year was composed of ten months. In a much earlier age, when the year was of an entirely different length, one revolution of the earth was also equal in time to ten revolutions of the moon. We shall trace this period in history in a succeeding volume of this work.

The Reforming of the Calendar

In the middle of the eighth century the calendar then in use became obsolete. From the year –747 until the last of the catastrophes on the twenty-third of March, –687, the solar and lunar movements changed repeatedly, necessitating adjustments of the calendar. Reforms undertaken during this time soon became obsolete in their turn, and were replaced by new ones; only after the last catastrophe of –687, when the present world order was established, did the calendar become permanent.

Some of the clay tablets of Nineveh found in the royal library of that city [1] contain astronomical observations made during the period before the present order in the planetary system was established. One tablet fixes the day of the vernal equinox as the sixth of Nisan: "On the sixth of the month Nisan, the day and night are equal." But another tablet places the equinox on the fifteenth of Nisan. "We cannot explain the difference," wrote a scholar.[2] Judging by the accurate methods employed and the precision achieved in their observations, the stargazers of Nineveh would not have erred by nine days.

In the astronomical tablets of Nineveh "three systems of planets" are extensively represented; single planets are followed in all their movements in three different schedules. For the movements of the moon there are two different systems.[3] Each of these systems is carried out down to the smallest detail, but only the last system of the planets and of the moon conforms to the present world order.

According to Tablet No. 93, the perihelion, or the point on the earth's orbit that is nearest the sun, is defined as the twentieth degree

[1] The palace of Nineveh was the residence of Sargon II, Sennacherib, Esarhaddon, and Assurbanipal.

[2] J. Menant, *La Bibliothèque du palais de Ninive* (1880), p. 100.

[3] Kugler, *Die babylonische Mondrechnung: Zwei Systeme der Chaldäer über den Lauf des Mondes und der Sonne*, pp. 207-209.

of the sign of the zodiac called the Archer; at aphelion, when the earth is farthest from the sun, the sun is said to be at the twentieth degree of Gemini. Accordingly, these points are designated as stations of the fastest and slowest solar motion. "But the real position of the apsides decidedly contradicts these statements." [4] Another tablet, No. 272, seventy years younger than the first, gives very different data for the perihelion and aphelion, and scholars wonder at this.

All the numerous data on solar movements in one of the systems lead to one and the same conclusion. "The solstitial and equinoctial points of the ecliptic lay 6° too far to the east." [5]

"The distances traveled by the moon on the Chaldean ecliptic from one new moon to the next are, according to Tablet No. 272, on the average 3° 14′ too great." [6] This means that during a lunar month the moon moved a greater distance in relation to the fixed stars than present observation shows.

In Tablet No. 32, the movement of the sun along the zodiac is precisely calculated in degrees, and the station of the sun at the beginning of each lunar month is determined exactly; but it is "a perplexing presentation of the ununiform movement of the sun. The question is insistent: Why is it that the Babylonians formulated the nonuniformity of the solar movement precisely in this way?" [7]

As the various systems recorded in the astronomical tablets of Nineveh show, the world order changed repeatedly in the course of a single century. Hence, the Chaldean astronomers had the task of repeatedly readjusting the calendar. "From certain passages in the astrological tablets it is easy to see that the calculation of times and seasons was one of the chief duties of the astrologers in Mesopotamia." [8] The scholars ask: How could those men, employed for that very purpose, have made the egregious mistakes recorded in the tablets, and carried these mistakes over into systems in which the movements of the sun, the moon, and the five planets were recorded with repetitions at regular intervals, these movements and intervals being consistently different from those of the present celestial order?

[4] *Ibid.*, p. 90. [5] *Ibid.*, p. 72. [6] *Ibid.*, p. 90. [7] *Ibid.*, p. 67

[8] R. C. Thompson, *The Reports of the Magicians and Astrologers of Nineveh and Babylon*, II, xviii.

How could the stargazers who composed the earlier tablets be so careless as to maintain that the year is 360 days long, a mistake that in six years accumulates to a full month of divergence; or how could the astronomers of the royal observatories announce to the king the movements of the moon and its phases on wrong dates, though a child can tell when the moon is new,[9] and then record all this in very scholarly tablets requiring advanced mathematical knowledge? [10] Hence scholars speak of "enigmatic mistakes." [11]

However, it appears to us that the tablets with their changing astronomical systems reflect the changing order of the world and consequent attempts to adjust the calendar to the changes.

When the cataclysm of the 23rd of March, –687 brought about another disturbance in the length of the year and the month, the new standards remained uncertain until they could be calculated anew in a series of investigations.

From the time of that catastrophe until about the year –669 or –667, no New Year festivals were observed at Babylon.[12] "Eight years under Sennacherib, twelve years under Esarhaddon: for twenty years . . . the New Year's festival was omitted," says an ancient chronicle on a clay tablet.[13] According to cuneiform inscriptions, in the days of Sargon II a new world age began, and in the days of his son Sennacherib another world age.[14] In the days of Assurbanipal, son of Esarhaddon, son of Sennacherib, the planetary movements, the precession of the equinoxes, and the periodic returns of the eclipses were recalculated, and these new tablets, together with the older ones or copies of the older ones, were stored in the palace library at Nineveh.

[9] "The class of magicians who calculated the length of the months and published information concerning them formed a very important section of the Babylonian and Assyrian priesthood." *Ibid.*, p. xxiii.

[10] C. Bezold, "Astronomie, Himmelschau und Astrallehre bei den Babyloniern," in *Sitzungsberichte der Heidelberger Akademie der Wissenschaften, philos.-histor. Klasse,* 1911, expresses the opinion that before the sixth century the Babylonians were unaware of the relative lengths of the solar year and 12 lunar months. See also Gundel, *Dekane und Dekansternbilder,* p. 379.

[11] Kugler, *Die Mondrechnung,* p. 90.

[12] S. Smith, *Babylonian Historical Texts,* p. 22. [13] *Ibid.*, p. 25.

[14] A. Jeremias, *Der alte Orient und die ägyptische Religion* (1907), p. 17; Winckler, *Forschungen,* III, 300.

The tablets from Nineveh provide the best possible opportunity to learn how the order of the world changed in the eighth and seventh centuries.

Repeated changes in the course of the sun across the firmament led the astronomers of Babylonia to distinguish three paths of the sun: the Anu path, the Enlil path, and the Ea path. These three paths created much difficulty for the writers on Babylonian astronomy, and many explanations were offered and as many rejected.[15] The Anu, Enlil, and Ea paths of the planets across the sky appear to denote the successive ecliptics in various world ages. Like the sun, the planets in different times moved along the Anu, Enlil, and Ea paths.

In the Talmud[16] a number of scattered passages deal with a calendric change made by Hezekiah. The Talmud was written about a thousand years after Hezekiah, and not all details of the reform are preserved; it states that Hezekiah doubled the month of Nisan.

In later times, in order to adjust the lunar year to the solar year, an intercalary month was added every few years by doubling the last month of the year, Adar. This system of an intercalary Adar is preserved in the Hebrew calendar to this day.

The rabbis wondered why Hezekiah added another Nisan (the first month). The story is told in the Scriptures that Hezekiah, instead of celebrating Passover in the first month, put off the feast to the second month.[17] The Talmud explains that it was not the second month, but an additional Nisan.

It must be noted that in Judea in the days of Hezekiah the months were not called by Babylonian names, and therefore the situation should be stated as follows: Hezekiah, after the death of Ahaz, and before the second invasion of Sennacherib, added a month and postponed the feast of Passover. According to the Talmud this was done to make the lunar year correspond more closely to the solar year. As

[15] Bezold, *Zenit und Aequatorialgestirne am babylonischen Fixsternhimmel* (1913), p. 6; M. Jastrow, *The Civilization of Babylonia and Assyria* (1915), p. 261.

[16] Tractate Berakhot 10b; Pesahim 56a; other sources in Ginzberg, *Legends*, VI, 369.

[17] II Chronicles 30.

we shall see, there appears to be some similarity between this action and that by Numa at about the same time.

What permanent changes Hezekiah introduced in the calendar is not stated, but it is apparent that at that time calendar reckoning became a complicated matter. As Moses in his day "could not understand how to compute the calendar until God showed him the movements of the moon plainly," so in the days of Hezekiah the determination of the month and of the year became a matter, not of calculation, but of direct observation, and could not be performed much in advance. Isaiah called the astrologers "the monthly prognosticators." [18]

As we have already said, there is in the Talmud [19] the information that the Temple of Solomon was built so that on the equinoctial days of the year the direction of the rays of the rising sun could be tested. A gold plate or disc was affixed to the eastern gate; through it the rays of the rising sun fell into the heart of the Temple. The Festival of the Tabernacle (Sukkoth) "was originally an equinoctial festival as Exodus 23 : 16 and 34 : 22 state explicitly, celebrated during the last seven days of the year, and immediately preceding the New Year's Day, the day of the fall equinox, upon the tenth of the seventh month." [20] In other words, New Year's Day, or the day of the autumnal equinox, was observed on the tenth day of the seventh month, the day when the sun rose exactly in the east and set exactly in the west, the Day of Atonement falling on the same day.[21] Thereafter, the day of the New Year was moved back to the first day of the seventh month. We may note that not only on the Jewish calendar, but also according to the Babylonian tablets, the equinoctial dates were displaced by nine days: one tablet says that in the spring day and night are equal on the fifteenth of the month Nisan; another tablet says that it takes place on the sixth of the same month. This indicates that the change

[18] Isaiah 47 : 13.

[19] Talmudic references may be found in the article cited in the following footnote.

[20] Morgenstern, "The Gates of Righteousness," *Hebrew Union College Annual*, VI (1929), p. 31.

[21] Morgenstern says: "Upon the tenth of the seventh month ancient Israel celebrated originally, not the Day of Atonement, but the New Year's day." *Ibid.*, p. 37.

in the calendar of the feasts observed in Jerusalem followed astronomical changes.

The eastern gate of the Temple of Jerusalem was no longer correctly oriented after the cardinal points had become displaced. On his accession to the throne following the death of Ahaz, Hezekiah "inaugurated a sweeping religious reformation." [22] II Chronicles 29 : 3 ff. says: "He in the first year of his reign, in the first month, opened the doors of the house of the Lord, and repaired them." Apparently the natural changes in terrestrial rotation which took place in the days of Uzziah and again on the day of the burial of Ahaz, necessitated a reform. Hezekiah therefore gathered the priests "into the east street" and spoke to them, saying that "our fathers have trespassed" and "have shut up the doors of the porch."

In the pre-Exilic period it was held "to be of imperative necessity that on two days of the year the sun shone directly through the eastern gate," and "through all the eastern gates of the Temple arranged in line, directly into the very heart of the Temple proper." [23] The eastern gate, also called "sun gate," served not only to check on the equinoxes, when the sun rises exactly in the east, but on the solstices as well: a device on the eastern gate was designed to reflect the first rays of the sun on the summer and winter solstices, when the sun rises in the southeast and the northeast, respectively. According to Talmudic authorities, the early prophets experienced much difficulty in making this arrangement work.[24]

From biblical times vestiges of three calendar systems remain,[25] and this assumes a special interest in view of the fact we noted some pages back, namely, that the tablets from Nineveh record three different systems of solar and planetary movements, each of which is complete in itself and differs from the others at every point.

It appears that the adjustment of the calendar, following the initiation of the new world order in the days of Hezekiah, was a long and tedious process. As late as one hundred years after Hezekiah,

[22] *Ibid.*, p. 33. [23] *Ibid.*, pp. 17, 31.

[24] The Jerusalem Talmud, Tractate Erubin 22c.

[25] Morgenstern, "The Three Calendars of Ancient Israel," *Hebrew Union College Annual*, I (1924), 13-78.

during the Babylonian exile, in the days of Solon and Thales, Jeremiah, Baruch, and Ezekiel drew up the calendar from year to year.[26]

When the Jews returned from the Babylonian exile, they brought with them their present calendar, in which the months are called by Assyro-Babylonian names.

"For as the new heavens and the new earth, which I will [do] make, shall remain before me, saith the Lord, so shall your seed and your name remain," reads the closing chapter of the Book of Isaiah. All flesh will come to worship the Lord "from one new moon to another, and from one sabbath to another." The "new heavens" means a sky with constellations or luminaries in new places. The prophet promises that the new sky will be everlasting and that the months will keep forever their established order.

Daniel, the Jewish sage at the court of Nebuchadnezzar, king of the Exile, when blessing the Lord, said to the king: "He changeth the times and the seasons." [27] This is a remarkable sentence which is also preserved in many Jewish prayers. By the change of seasons or "appointed dates" (*moadim*) is meant an alteration in the order of nature, with shifting of solstitial and equinoctial dates and the festivals connected with them. "The change of times" could refer not only to the last change, but to the previous ones also, and it was "the change of the times and the seasons" that was followed by calendar reforms.

The old Hindu astronomical observations offer a set of calculations different from those of the present day. "What is extraordinary are the durations assigned to the synodical revolutions. . . . To meet in Hindu astronomy with a set of numerical quantities widely differing from those generally accepted is indeed so startling that one at first feels strongly inclined to doubt of the soundness of the text. . . . Moreover, each figure is given twice over." [28]

In the astronomical work of Varaha Mihira, the recorded synodical revolutions of the planets, which are easy to calculate against the

[26] The Jerusalem Talmud, Tractate Sanhedrin I, 19a. [27] Daniel 2 : 21.
[28] G. Thibaut, p. xlvii of his translation of the *Panchasiddhantika,* the astronomical work of Varaha Mihira (Benares, 1889).

background of the fixed stars, are about five days too short for Saturn, over five days too short for Jupiter, eleven days too short for Mars, eight or nine days too short for Venus, less than two days too short for Mercury. In a solar system in which the earth revolves around the sun in 360 days, the synodical periods of Jupiter and Saturn would be about five days shorter than they are at present, and that of Mercury less than two days shorter. But Mars and Venus of the synodical table of Varaha Mihira must have had orbits different from their present ones, even if the terrestrial year was only 360 days.

Calendric changes in India were effected in the seventh century: at that time, as in China also, the ten-month year was supplanted by a twelve-month year.[29]

In the eighth century a calendar reform was made in Egypt. We have already referred to a cataclysm during the reign of the Pharaoh Osorkon II of the Libyan Dynasty; another disturbance of a cosmic nature took place a few decades later, still in the time of the Libyan Dynasty.

In the fifteenth year of the reign of Sosenk III "there occurred a remarkable prodigy of uncertain nature, but in some way connected with the moon." [30] The contemporaneous document written by the royal son, the high priest Osorkon, reads: "In the year 15, fourth month of the third season, 25th day, under the majesty of his august father, the divine ruler of Thebes, before heaven devoured (*or:* not devoured) the moon, great wrath arose in this land." [31] Soon thereafter Osorkon "introduced a new calendar of offerings." [32] The mutilated condition of the inscription makes it impossible to determine the exact nature of the calendric reform.[33]

It appears that the same or a similar disturbance in the movement of the moon is the subject of an Assyrian inscription, which speaks

[29] A. del Mar, *The Worship of Augustus Caesar*, p. 4.

[30] Breasted, *Records of Egypt*, IV, Sec. 757.

[31] *Ibid.*, Sec. 764. See controversy in *Zeitschrift für ägyptische Sprache*, VI (1868).

[32] Breasted, *Records of Egypt*, IV, Sec. 756.

[33] A. Erman, *Zeitschrift für ägyptische Sprache*, XLV (1908), 1-7.

of the moon being obstructed on its way. "Day and night it was handicapped. In its august station it did not stand." Because of the duration of the phenomenon, it is concluded that "it could not mean an eclipse of the moon." [34] The reference to the moon's unwonted position also precludes such an interpretation.

At the end of the eighth or the beginning of the seventh century before the present era, the people of Rome introduced a calendar reform. In the preceding section we referred to Ovid's statement in *Fasti* concerning the reform of Romulus, who divided the year into ten months, and the reform of Numa, who "prefixed" two months. Plutarch's "Life of Numa" contains the following passage, part of which has already been quoted: "He [Numa] applied himself, also, to the adjustment of the calendar, not with exactness, and yet not altogether without careful observation. For during the reign of Romulus, they had been irrational and irregular in their fixing of the months, reckoning some at less than twenty days, some at thirty-five, and some at more; they had no idea of the inequality in the annual motions of the sun and moon, but held to the principle only, that the year should consist of three hundred and sixty days." [35]

Numa reformed the calendar, and the "correction of the inequality which he made was destined to require other and greater corrections in the future. He also changed the order of the months." [36]

Numa was a contemporary of Hezekiah.[37]

In the second half of the seventh century before the present era, the length of the new month and the new year was calculated by the Greeks.

Diogenes Laërtius regarded Thales the Milesian, one of the "seven sages of antiquity," as the man who discovered the number of days in the year and the length of the seasons. In his *Life of Thales* he wrote: "He was the first to determine the sun's course from solstice to

[34] P. Jensen, *Die Kosmologie der Babylonier*, p. 39.
[35] Plutarch, *Lives*, "The Life of Numa" (transl. B. Perrin). [36] *Ibid.*
[37] Cf. Augustine, *The City of God*, Bk. XVIII, Chap. 27.

solstice." And again: "He is said to have discovered the seasons of the year and to have divided it into 365 days." [38] He was "the first to predict eclipses of the sun and to fix the solstices." [39] Thales is said to have written two treatises, one "On the Solstice" and the other "On the Equinox," neither of which is extant.

If the natural year always was what it is now, it is very strange that this discovery should have been attributed to a sage who lived as late as the seventh century, when Egypt and Assyria were already very old kingdoms, and when the dynasty of David was in its last decades. The longest and shortest days of the year, and thus the length of the year, are easily determined by the length of the shadow. Thales is said to have been born in the first year of the thirty-fifth Olympiad or –640. The progress of culture would hardly leave to one and the same person the calculation of the days in a year, which is a simple matter, and the calculation of forthcoming eclipses, which is an advanced achievement. Similarly, the fact, as stated by Plutarch and Diogenes Laërtius, that Solon, another sage of the same period, adjusted the months to the motion of the moon after finding that the time from one new moon to another is half a day shorter than thirty days, must be understood as an adjustment of the calendar to the new order in nature. The span of time from one new moon to another is a natural time division, almost as easily observable as day and night; primitive peoples, unable to read and write, know that the period is less than thirty days.

On the other side of the globe, the people of Peru reckoned time from the day of the last cataclysm, and this method of computation was in use when the Europeans reached that country in the beginning of the sixteenth century.[40]

After the last cataclysm, the times and the seasons were computed anew. King Inti-Capac-Yupanqui ordered astronomical observations and calculations to be made, the result of which was a calendar re-

[38] Diogenes Laërtius, *Lives of Eminent Philosophers* (English transl. R. D. Hicks, 1925).

[39] *Ibid.*; see also Herodotus i. 74.

[40] Brasseur, *Manuscrit Troano*, p. 25.

form, and the year, previously of 360 days, "was changed to 365 days and 6 hours." [41]

"This Ynca appears to have been the first to order and settle ceremonies. . . . He it was who established the twelve months of the year, giving a name to each, and ordaining the ceremonies that were to be observed in each. For although his ancestors used months and years counted by the *quipus*, yet they were never previously regulated in such order until the time of this lord." [42]

"All Toltec histories mention an assembly of sages and astrologers that was convoked in the city of Huehue-Tlapallan for the purpose of working on the correction of the calendar, and the reforming of the computation of the year, which was recognized as erroneous and which had been employed until that time." [43]

Half a meridian away, across the Pacific Ocean, a calendar was introduced in Japan in –660, and the reckoning of years in that country starts from that year.

In China, the astronomer Y-hang in the year –721 announced to the Emperor Hiuen-tsong that the order of the sky and the movements of the planets had changed which made it impossible to predict eclipses; and he referred to other authorities who asserted that in the time of Tsin the planet Venus used to move 40 degrees to the south of the ecliptic and eclipse the star Sirius. Y-hang explained that the course of the planet Venus changed in the days of Tsin. [44]

All around the globe the years following –687 saw activity directed toward reforming the calendar. Between –747 and –687 the calendar was in a chaotic state, the length of the year and of the month, and probably also of the day, repeatedly changing. Before the eighth century there was a comparatively long span of time when the year

[41] F. Montesinos (fl. 1628-1639), *Memorias antiguas historiales del Perú*, II, Chap. 7.

[42] Christoval de Molina (fl. 1570 to 1584), *An Account of the Fables and Rites of the Yncas*, transl. and ed. C. R. Markham (1873), p. 10.

[43] Brasseur, *Histoire des nations civilisées du Mexique*, p. 122. Among his sources were Ixtlilxochitl, *Sumaria relación*, etc.; M. Veytia (1718-1779), *Historia antigua de México*, I (1944), Chap. 2.

[44] A. Gaubil, *Histoire de l'astronomie chinoise* (1732), pp. 73-86.

had 360 days and the lunar month consisted of almost exactly thirty days.

Neither the calendar, nor the celestial charts, nor the sundials, nor the water clocks of the time before –687 were adequate for their purpose after that year. Values subsequently established in different parts of the terrestrial globe have remained practically unchanged down to the present save for very small improvements resulting from the more precise calculations of modern times. This stability of the calendar is due to the fact that the celestial order has remained unaltered: no changes in the heavenly order were observed except for minor perturbations between the planets which have no visible effect on their motion. Thus we are lulled into the belief—which is wishful thinking—that we live in an orderly universe. In the language of a modern scientist: "Though the order of the succession of events in the heavens is often somewhat complex, it is nevertheless systematic and invariable. The running of no clock ever approached in precision the motions of the sun, the moon, and the stars. In fact, to this day clocks are corrected and regulated by comparing them with the apparent diurnal motions of the heavenly bodies. Since not merely a few but hundreds of celestial phenomena were long ago found to be perfectly orderly, it was gradually perceived that majestic order prevails universally in those regions in which, before the birth of science, capricious gods and goddesses were believed to hold domain." [45]

However, as we have learned from the records of ancient times, the order today is not the primeval order; it was established less than twenty-seven centuries ago

> when the moon was placed in orbit,
> when the silver sun was planted,
> when the Bear was firmly stationed.[46]

[45] F. R. Moulton, *The World and Man as Science Sees Them*, p. 2.
[46] *Kalevala*, Rune 3.