The 360 and 364 Day Year in Ancient Mesopotamia*

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For Jonas Greenfield, in memoriam

ABSTRACT

During the later portion of the Second Temple period in Israel, a 364 day calendar emerged to challenge the traditional lunar calendar with its regular year of 12 lunar months (approximately 354 days) and leap year of 13 lunar months (approximately 384 days).[1] Evidence from cuneiform sources suggests that this ancient Israelite 364 day year, which appears in the apocryphal books of Enoch and Jubilees, and in the writings of the Qumran community, had its origins in a Mesopotamian ideal mean lunar year of 364 days (12 lunar months = 354 days plus $\frac{1}{3}$ ideal lunar month [= 10 days]). This year length of 12 months plus 10 additional days is attested in Mesopotamia from the seventh century B.C.E. onwards, and itself represents an improvement on an ideal 360 day calendar year that dates back to the fourth millennium B.C.E.[2]

* I had the privilege of working with Professor Jonas Greenfield at the Hebrew University between the years 1986 and 1995. The present study began as a working paper on Mesopotamian astronomy and astrology for use in informal discussions between Professor Greenfield and myself on a wide range of matters of mutual interest, including 360 and 364 day calendars in Jewish sources. Later, Professor Greenfield encouraged me to write up a more formal presentation of the Mesopotamian materials for possible publication as part of a joint article. Although sorrowfully this will not now be impossible, I dedicate the present study to Professor Greenfield's memory both as a tribute to his broad academic interests and, perhaps more importantly, in remembrance of his personal wisdom, which transcended the bounds of academia.

1. The present article is a brief overview of 360 and 364 day years in Mesopotamian astronomy and astrology, intended as an aid to readers and non-readers of cuneiform script. A more detailed Assyriological exposition of these matters, with editions of cuneiform passages and further bibliographical notes, will appear in a forthcoming study by this author. Recent general studies on the subject of Mesopotamian calendars include the article on ancient Near Eastern calendars by F. Rochberg-Halton in *The Anchor Bible Dictionary* (1992), 1:810–14, and M. E. Cohen, *The Cultic Calendars of the Ancient Near East* (Bethesda: CDL Press, 1993), 3–20. The remarks below refer in general to the standard Babylonian calendar, which itself is based on earlier Sumerian precursors, particularly the Nippur calendar (see Cohen, ibid., 8–13). For Assyrian variations of this calendar, see Rochberg-Halton's article and note 5 below. For a most useful exposition of the astronomical observations and calculations utilized in ancient Near Eastern calendars, see A. Aaboe, *What Every Young Person Ought to Know about Naked-eye Astronomy* (privately circulated).

2. For a summary of the evidence for the 360 and 364 day years in ancient Israel, see J. Vanderkam, *The Anchor Bible Dictionary*, 1:818–20. Recent longer studies on the 360 and 364 day years in ancient Israel with further bibliography include S. Talmon, *The World of Qumran from Within* (Jerusalem, 1989), 163–67, and M. Albani, "Die lunaren Zyklen im 364-Tage-Festkalender von 4QMischmerot/4QS[e]," in *Forschungsstelle Judentum, Mitteilungen und Beiträge* 4, Kirchliche Hochschule Leipzig (1992). Cf. M. Albani, "Der Zodiakos in 4Q318 und die Henoch-Astronomie," *Mitteilungen und Beiträge* 7 (1993), 20–22; O. Neugebauer, *The 'Astronomical' Chapters of the Ethiopic Book of Enoch (72 to 82)* (Copenhagen, 1981), 386–416; H. Kvanvig, *The Mesopotamian Background of The Enoch Figure* (Oslo, 1983), 42–74; S. Talmon and I. Knohl, "A Calendrical Scroll from a Qumran Cave: *Mišmarot* B[a], 4Q321," in D. Wright,

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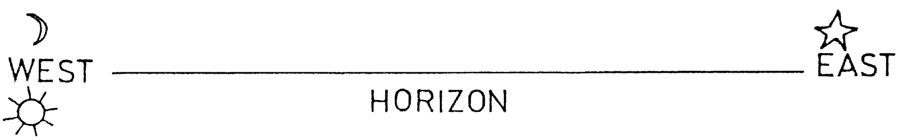
1. *Astronomical Introduction*

Ancient Mesopotamians used a lunar calendar for their civil and religious year. In the lunar calendar, months begin with the appearance of the new moon on the western horizon at sunset at the end of the first day of the month, and continue for 29 or 30 days until the last night of the old month, when the moon is not visible at all. The middle of the month is marked by the full moon rising on the eastern horizon at sunset in opposition to the setting sun; a crescent moon in the East towards dawn marks the waning days of the month; and the "Day of Disappearance,"[3] when no portion of the moon is visible, occurs at the end of the lunar month.



An ordinary lunar year consists of twelve lunar months; approximately six "hollow" 29 day months and six "full" 30 day months, totalling 354 days; i.e., $11\frac{1}{4}$ days short of an ordinary solar year of $365\frac{1}{4}$ days. In Mesopotamia, the New Year began on the first of Nisan (Month I)—according to Babylonian convention, the day of the first new moon after the Spring Equinox, which was ideally meant to occur on the 15th of Adar (Month XII).[4] The first day of the seventh month, Tishre, should there-

D. Freedman, and A. Hurvitz, eds., *Pomegranates and Golden Bells, Studies in Biblical, Jewish, and Near Eastern Ritual, Law, and Literature in Honor of Jacob Milgrom* (Winona Lake, 1995), 267–301. Note also indirect evidence for the 364 day year in Genesis 7–8 where the flood begins in the Noah's 600th year on Day 17 of Month 2 (Gen. 7:11) and ends in Noah's 601st year on Day 27 of Month 2 (Gen. 8:14), i.e., what would appear to be twelve lunar months (approximately 354 days) plus ten additional days = 364 days.

3. U_4.NU_2.AM_3 = *ūm bubbulim*, cf. *CAD* B, 298–300. In ancient Babylonia, as is still the case in Judaism, the day began at dusk so the new moon was actually sighted at the very end of the first day, i.e., on the eve of the second day. For a discussion of 29 and 30 day lunar months, and problems in determining the length of lunar months and the date of the new moon, see P. Beaulieu, "The Impact of Month-lengths on the Neo-Babylonian Cultic Calendar," *ZA* 83 (1993), 66–87.

4. For the two Mesopotamian systems for equinoxes and solstices: A Babylonian system where the equinoxes and solstices fall in Months XII, III, VI, IX, and a Neo-Assyrian period system where the date for equinoxes and solstices occurred one month later in Months I, IV, VII, X, see Excursus II below (42–44). According to both systems Nisan was the first month of the year (cf. Cohen, *The Cultic Calendars*, 14–20, for the almost universal spring New Year in ancient Mesopotamia).

fore have fallen one half-year later, ideally on the first day of Tishre (Month VII 1), the day of the first new moon after the Fall Equinox (ideally Elul 15 = VI 15). However, due to the shortfall of $11\frac{1}{4}$ days between the 354 day lunar year and the true solar year, the "first of Nisan" and "first of Tishre" slipped backwards in respect to the equinoxes and solstices at the rate of just over $\frac{1}{3}$ month each year, i.e., approximately one lunar month every three years.

In lunar calendars without intercalation, such as the modern Islamic calendar, this shortfall of approximately $11\frac{1}{4}$ days per year is ignored, so the lunar months fall back through the seasons of the solar year over a $32\frac{1}{2}$ year cycle. As a result, in Islam for instance, holidays such as Ramadan occur in different seasons in different years. Ancient Mesopotamians, like the Jews, celebrated seasonal-agricultural holidays, and so could not allow the dates of their holidays to wander over the seasons of the year.[5] Thus, ancient Mesopotamians declared a leap-year approximately every third year to keep the lunar months in their proper seasons. In leap-years, an extra lunar month was added, almost always as intercalary months XII^2 or VI^2 (Second Adar or Second Elul), allowing for the first of Nisan and Tishre (Months I, VII) to return to the eve of the first new moon after the equinoxes (according to the Babylonian system).[6] Thus, the ancient Mesopotamian civil and religious calendar was built, in principle at least, around an ideal three year cycle of 37 lunar months consisting of two regular years of 12 lunar-months (approximately 354 days) and a leap-year of 13 lunar-months (approximately 384 days).[7]

2. *The 360 Day Ideal Stellar Year*

The lunar calendar with its year of 354/384 days is ideal for determining the length of months, and the days of the month, since a quick glance at the phase of the moon at night indicates which day of the month it is. However, lunar-calendars are unsuitable for determining annual events due to the shortfall of approximately $11\frac{1}{4}$ days between the lunar and solar year in regular years, or the excess of approximately 19 days in leap-years. Using a solar calendar, of course, would have eliminated these difficulties, but the sun is too bright to be observed except at sunrise and sunset, and variations in solar movement and position are not perceptible to the naked eye from one day to the next. A true stellar calendar eliminates the shortcomings of both the

5. A twelve-month lunar calendar without intercalation was used in Assyria until the time of Tiglath-Pileser I (1114–1076) when the Assyrians adopted the Babylonian calendar (see Cohen, *The Cultic Calendars*, 299–301). The date of this calendrical switch may be connected with the presence of the Babylonian astronomical-calendrical work 'Astrolabe B' (*KAV* 218) among tablets at Assur dating to the reigns of Tiglath-Pileser I and his father Assur-reš-iši. For a now outdated edition of 'Astrolabe B', see E. Weidner, *Handbuch der Babylonischen Astronomie* (Leipzig, 1915), 62–102; and more recently B. van der Waerden, *Science Awakening II, The Birth of Astronomy* (Leiden, 1974), 64–67; W. Horowitz, *Mesopotamian Cosmic Geography* (Eisenbrauns; in press). A new edition of 'Astrolabes' by W. Horowitz will appear in the *AfO* Beiheft Series.

6. The last new moon before the equinox according to the Neo-Assyrian period system. For months other than Adar and Elul as intercalary months, see Cohen, *The Cultic Calendars*, 5 no. 2. For intercalary Nisan (Month I^2), see *CAD* N/2 266b).

7. In actuality seven leap months are needed every 19 lunar years in order to keep the lunar and solar years in step; Rochberg-Halton, *The Anchor Bible Dictionary*, 810–11.

solar and lunar calendars. It is much easier to monitor the movement of the stars at night than the apparent motion of the sun during the day, and the pattern of stellar movement in the sky repeats itself at annual intervals.[8]

Yet, stellar calendars do not provide an immediate means for dividing the year into months, such as by means of the phases of the moon. One method for determining months in a stellar calendar is to identify the sequence of new moons (first days of lunar months) with a sequence of first-risings of selected stars. First-risings (heliacal-risings) of stars occur at annual intervals on the eastern horizon just before dawn. Thus, first-risings of stars at the start of lunar months would be observed ideally along the eastern horizon just before dawn on the first of the month. New Year's Day (the first of Nisan), if the lunar and stellar calendars were in step, would have been marked first by the heliacal rising of the star(s) of the New Year on the eastern horizon just before sunrise, and then later, at dusk, by the appearance of the first crescent new moon after the Spring Equinox.

Ancient Mesopotamian astronomers used such astronomical observations as an aid in determining the appropriate time to declare leap-years and intercalate leap-months. This is demonstrated, for example, on a theoretical level in "Astrolabes," where each month of the year is marked by the rising of three stars; one star each in the central, northern, and southern portions of the sky,[9] and in practice by a seventh century letter from a court astronomer to the court of Assurbanipal:

> Let them intercalate a month. All the stars of heaven are late.
> Let Adar not pass unluckily. Let them intercalate it.[10]

Here, the court astronomer advises the intercalation of a second Adar so as to bring the sequence of stars into agreement with the lunar calendar in order to allow New Year's Day (the first of Nisan) to fall on an appropriate, and therefore favorable, day.[11]

2.1 *Historical Evidence for the 360 Day Year in Mesopotamia*

It is impossible to date the invention of the lunar calendar in ancient Mesopotamia and the Near East. The earliest direct evidence for both the Sumerian and

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8. The solar year is actually approximately 20 minutes longer than the true stellar year; the interval between the annual first-risings (heliacal risings) of fixed-stars. However, over a period of 70 years, this amounts to a discrepancy of only approximately one day, so the difference between solar and stellar calendars is barely noticeable over a single lifetime.

9. The paths of the Anu, Enlil, and Ea stars. For the practice of identifying stars with months of the year (month-stars) in 'Astrolabes', see e.g., B. van der Waerden, *Science Awakening II*, 64–67. For 'Astrolabes' in general, see n. 5.

10. See H. Hunger, *Astrological Reports to Assyrian Kings* (Helsinki, 1992) = *State Archives of Assyria* 8, 57, no. 98: rev. 8–10; cf. S. Parpola, *Letters from Assyrian Scholars to the Kings Esarhaddon and Assurbanipal Part II* = *AOAT* 5/2, 342, notes to no. 325. See *Mul-Apin* II Gap A 8–II ii 10 (H. Hunger and D. Pingree *Mul-Apin, An Astronomical Compendium in Cuneiform*, *AfO Beih.* 24 (1989), 89–94) for similar calculations for all months of the year.

11. For omens relating to 'Astrolabes' with favorable apodoses when stars rise on their assigned dates, and unfavorable apodoses when stars rise late, see 'The Assumed Tablet 51' of the *Enūma Anu Enlil* series (*BPO* 2 = E. Reiner and D. Pingree, *Enūma Anu Enlil, Tablets 50–51* [Malibu, 1981], 52–69).

Semitic calendars, those of the middle third millennium, demonstrates that these calendars already included intercalary months. Earlier indirect evidence for the lunar calendar dates to late fourth millennium southern Mesopotamia, where an archaic period economic document balances accounts over a period of 37 months, i.e., the period of the three year intercalation cycle. At approximately the same time, the earliest surviving evidence for the 360 day ideal calendar emerges as well.[12]

Both the 360 day year and the three year (37 month) cycle are present in the Ur III period a millennium later,[13] and this same 360 day year length finds explicit expression in the first half of the second millennium in two Old Babylonian period documents belonging to a certain Ur-Utu from Tell ed-Dēr, where a year from one 20th of Nisan to the next is 360 days and 360 nights long:[14]

> From the 20th of Nisan to the 20th of Nisan of the coming year, 6 times sixty days (and) 6 times sixty nights . . .

Later explicit references to the 360 day astronomical calendar in first millennium astronomical works include *Mul-Apin* I iii 35–47 which measures the time from one first-rising of the constellation "The Arrow" (Sirius) to the next as 360 days,[15] and a contemporary Neo-Assyrian treatise on divination which makes clear a connection between observations of the constellation "The Field" (Pegasus),[16] the ideal 360 day year of twelve ideal 30 day months, and New Year's Day (the first of Nisan).[17]

> Twelve are the months of the year; 360 are its days. Take the length of the new year in your hand and continuously seek out the times of the disappearance (of the moon), the expected heliacal risings of the stars, the conjunction of the New Year with "The Field," the sightings of the moon and sun in Adar and Elul, the risings and first appearances of the moon which are seen monthly.

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12. See H. J. Nissen, P. Damerow, and R. K. Englund, *Archaic Bookkeeping*, trans. P. Larsen (Chicago, 1993), 36–37.

13. See R. Englund, "Administrative Timekeeping in Ancient Mesopotamia," *JESHO* 31 (1988), 122–30 and cf. 130–68 for earlier periods.

14. L. De Meyer, "Deux Prières *ikribu* Du Temps D'Ammī-Ṣaduqa," in G. van Driel et al., eds., *Zikir Šumim, Assyriological Studies Presented to F. R. Kraus on the Occasion of his Seventieth Birthday* (Leiden, 1982), 274: 7–9, 16–18; 277: 11–15; cf. B. Foster, *Before The Muses* (Bethesda 1993), 153. The start of this 360 day period on the 20th of Nisan may indicate that the 360 day year, at least in the Old Babylonian period, had a solar dimension since the 20th day of the month was important to the sun-god whose name could be written with the numeral 20 [𒌋𒌋]; see W. G. Lambert, *Babylonian Wisdom Literature* (Oxford, 1960), 137: 156–58; 221; 323 n. 156; 341; and cf. R. Labat, *Un calendrier babylonien des travaux des signes et des mois* (Paris, 1965), 105, no. 40; W. Horowitz, "Two New *ziqpu*-Star Texts and Stellar Circles," *JCS* 46 (1994), 93:29; 97 notes to line 29). A solar dimension of the 360 day year is also demonstrated by *Mul-Apin* II Gap A 1–8 (Hunger-Pingree *Mul-Apin* 88–89) where the year is divided into four seasons of three (ideal) months each (90 days) that are defined by the position of the sun in relation to the paths of the stars.

15. $^{\text{mul}}$KAK.SI.SÁ; Hunger-Pingree *Mul-Apin* 53–57. For a much better $365\frac{1}{6}$ day approximation of the length of time between heliacal risings of Sirius in the late Persian Period astronomical work *BM* 36712, see A. Sachs and O. Neugebauer, "A Procedure Text Concerning Solar and Lunar Motion: BM 36712," *JCS* 10 (1956), 132, section 1.

16. $^{\text{mul}}$IKU.

17. A. Oppenheim, "A Babylonian Diviner's Manual," *JNES* 33 (1974), 200: 57–63.

This ideal 360 day astronomical year corresponded to an ancient Mesopotamian astronomical theory known from first millennium B.C.E. astronomical texts which held that the stars, sun, and moon moved along 360° circuits. According to this model, each day of the ideal astronomical year of 360 days corresponded to 1° of stellar or solar movement. This theory is made clear in *Mul-Apin* I iii 49–50 (Hunger-Pingree *Mul-Apin* 57):

> Each day the stars go in one degree from the morning into the evening.
> Each day the stars come out one degree from the evening into the morning.

This same observation is also made in the *ziqpu*-star text *BM* 38369+ ii′ 20–28 in the context of a 360° circle of *zi*[*qpu*]-stars (*kippat zi*[*qpi*] (see W. Horowitz, *JCS* 46, 92–93: 20–28).[18]

2.2 *The 360 Day Year in Mesopotamian Astrology*

In ancient Mesopotamia the experts who observed and studied the sky and compiled astronomical texts ("astronomers") were one and the same as those who observed the sky in search of omens ("astrologers"). Thus, it was natural for these experts to apply the 360 day calendar to astrology as well. When applied to astrology, the missing 30th days of "hollow" months were ignored, and leap-months were almost always assigned the same omens as their corresponding regular month (i.e., the omens for second Adar and second Elul were those for regular Adar and Elul).[19] In this way, omens could be applied to regular years and leap years alike. Thus, omens derived from the 360 day calendar would cover all eventualities even in a leap year of 13 lunar months totalling approximately 384 days.

3. *The 364 Day Year in Mesopotamia and Ancient Israel*

As noted above, the ancient Mesopotamian civil and religious calendar included both regular years of 12 lunar-months (approximately 354 days)[20] and leap-years of 13 lunar-months (approximately 384 days).[21] As a normal cycle of three lunar years included two regular years and one leap year, the length of a mean lunar year was

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18. The term *ziqpu*-star text refers to a group of astronomical texts examining *ziqpu*-stars: a series of stars, constellations, and constellation parts which culminated in sequence near the center of the sky when viewed from the latitude of Babylonia and Assyria. In these texts, the distances between culminations of *ziqpu*-stars are expressed in measurements of time and angular distance (degrees of arc). For the *ziqpu*-stars, *ziqpu*-star texts, and further examples of the 360 day year and 360° stellar circuits see W. Horowitz, "Two New *ziqpu*-Star Texts," 89–98, and *Mesopotamian Cosmic Geography* (in press).

19. Exceptions to this rule may be found in tablet 28 (W. Soldt, *Solar Omens of Enūma Anu Enlil: Tablets 23 [24]–29 [30]* [Istanbul, 1995], 100: 46B), and a menology that forms part of "The Assumed Tablet 51" of the *Enūma Anu Enlil* series, where regular Adar and second Adar appear separately (*BPO* 2 63 X 49 N_2 rev. 5′–8′; cf. 66 M_1 ii 6′–9′).

20. Making six full months (180 days) plus six hollow months (174 days). Compare the half year of 177 days (three full plus three hollow months) in the Book of Enoch; see Neugebauer, *The 'Astronomical' Chapters*, p. 409, chap. 78: 15–17 and cf. p. 410, chap. 79:4.

21. Making seven full months (210 days) plus six hollow months (174 days).

$12\frac{1}{3}$ lunar months; or approximately 364 days.[22] This 364 day approximation of the mean lunar year finds expression both in *Mul-Apin* II ii 11–12 (Hunger-Pingree *Mul-Apin* 94): "You proclaim a leap month (every) three years; the amount for (one) year is 10 additional days for 12 months" (i.e., 354 days + 10 days = 364 days); and in the seventh century *ziqpu*-star text *AO* 6478 // K. 9794, where an annual circuit of the *ziqpu*-stars is measured as 364° (i.e., 364 days according to the rule of 1° stellar movement equals one day).[23] Thus, in ancient Mesopotamia, by the 7th century, one finds evidence for the 364 day year in both stellar and lunar contexts.

Later, during the Persian and Hellenistic periods, the 364 day year length finds attestation in Babylonia in late copies of *Mul-Apin*;[24] the late Uruk example, *AO* 6478, of the seventh century *ziqpu*-star text *AO* 6478 // K. 9794; and the late Persian period Babylonian astronomical work *BM* 36712 where a $364\frac{1}{2}$ day period appears in a broken context.[25] Thus, the 364 day year was known in Mesopotamia not only in the seventh century before the establishment of the Jewish exilic community, but also during the time of the Second Temple. Although the exact relationship between the cuneiform astronomical materials presented above, and the 364 day year in ancient Israel remains uncertain, the cuneiform evidence places knowledge of the 364 day year in post-Nebuchadnezzar II Babylonia—a time and place where it would have been available to ancient Israel. Thus, it would appear that the Mesopotamian 364 day year is the ultimate source for the 364 day year found in the Apocrypha and Qumran texts.[26]

Excursus I: Models for Solar and Lunar Visibility

From the first half of the second millennium B.C.E. onwards Mesopotamian astronomers used mathematical models that measured the duration of 24-hour day-night

22. For the length of 12 lunar months calculated as 354 days plus a fraction of a day in late Babylonian mathematical-astronomy, see O. Neugebauer, *Astronomical Cuneiform Texts* (London, 1955), 271–72 (section 3, obv. II:7).

23. K. 9794 is from the library of Assurbanipal *AO* 6478 (*TCL* 6 21, *RA* 10:216–17) is a late Uruk copy from the Persian or Hellenistic period. For *AO* 6478//K. 9794, and the text in the context of stellar circuits, see Horowitz, "Two New *ziqpu*-Star Texts," 94–97. This 364° length of the *ziqpu*-star circuit in *AO* 6478//K. 9794 is, of course, an improvement on the 360° *ziqpu*-star circle in *BM* 38369+ (see above). For what appears to be a 364 day duration (354 + 10) in Genesis 7–8, see n. 2 above. Cf. S. Langdon, *Babylonian Menologies and the Semitic Calendars* (London, 1935), 109, for an argument that the Babylonians understood ibid. line 71 (= A. L. Oppenheim, "A Babylonian Diviner's Manual," 200: 72) to mean that the eleven days of the New Year's festival were a supplement to the lunar year that harmonized the lunar year of 354 days with the solar year of 365 days (354 + 11).

24. Note, e.g., Hunger-Pingree *Mul-Apin* 123 for the colophon to source K (*BM* 32311) which assigns this tablet to a time when Seleucus was king.

25. O. Neugebauer and A. Sachs, "A Procedure Text," 132:2′–3′ (6,4;30 = $364\frac{1}{2}$). For this text cf. n. 15 above.

26. In this context, note Professor Greenfield's contributions to the study of the survival of Babylonian astronomical/astrological traditions at Qumran in J. Greenfield and M. Sokoloff, "Astrological and Related Omen Texts in Jewish Palestinian Aramaic," *JNES* 48 (1989), 201–14; and J. Greenfield and M. Sokoloff, "An Astronomical Text from Qumran (4Q318) and Reflections of Some Zodical Names," *Revue de Qumran* 64 (1995), 507–25.

periods in units of 360.[27] At the equinoxes, day and night were each measured as 180 units, while at the solstices, 240:120 and 120:240 ratios were employed. Thus, according to this model, at the Summer Solstice, day was measured as twice as long as night. Conversely, according to this model, night was twice as long as day at the Winter Solstice.[28] Since day and night may be defined as the presence or absence of the sun above the horizon, this model seems to imply that the sun can be understood to describe a 180° arc above the horizon on the day of the equinoxes, and 240° and 120° arcs at the solstices. The moon, however, is not visible for the entire duration of the night except on the night of the full moon on the fifteenth days of lunar-months. From the first of the month through the fifteenth, the duration of the visibility of the moon increases. From the fifteenth day through the end of the month, the duration of the visibility of the moon decreases. Two surviving Mesopotamian arithmetic systems describe this lunar phenomenon; one for the night of the full moon at the equinoxes when the moon is visible for 180 units (Table I, System I), and a second for the night of the Winter Solstice when night is measured as 240 units long (Table I, System II).[29]

In both systems, the increase in the duration of the visibility of the moon in days 1–15 is identical to the decrease in visibility over days 15–29. From days 1–5, visibility of the moon doubles each day. After this, from days 6–15, the visibility of the moon increases at a set rate of 12 in System I and 16 in System II. After day 15, this process is reversed with days 16–25 marked by a decrease in visibility at the rate of 12 or 16 per day. Then, days 25–29 are marked by a decrease of one half visibility each day. In both systems, of course, on day 30, "the Day of Disappearance," the moon is not visible.

Excursus II: The Dates of The Equinoxes and Solstices

Two systems for the dates of equinoxes and solstices are evident in cuneiform texts:

I. An older Babylonian system in which the equinoxes and solstices fall in the months of Adar, Sivan, Elul, and Kislev (XII, III, VI, IX); it is attested primarily in texts from second millennium, and then reappears in the late-Babylonian period (post 539 B.C.E.).

II. A later system in which the equinoxes and solstices occur ideally one month later, on the fifteenth of Nisan, Tammuz, Tishre, and Tebet (Months I, IV, VII, X); it is attested in Neo-Assyrian period texts.

Previous discussions of the two systems, with further bibliography, include F. Al-Rawi and A. George, *AfO* 38/39, 60–61; A. George, *ZA* 81 (1991), 301–3 (review of Hunger-Pingree *Mul-Apin*) and, earlier, B. L. van der Waerden, "Babylonian Astronomy. III. The Earliest Astronomical Computations," *JNES* 10 (1951), 20–27. For the

27. For these systems, see now F. Al-Rawi and A. George, "Enūma Anu Enlil XIV and Other Early Astronomical Tables," *AfO* 38/39 (1991/92), 52–73.

28. For a later, more realistic, Mesopotamian model with 3/2 and 2/3 ratios for the longest day and longest night, see ibid., 59; Hunger-Pingree *Mul-Apin* 150–51.

29. See George and Al-Rawi, "Enūma Anu Enlil XIV," 55, 67–68.

TABLE 1. Lunar Visibility

Day	*Equinoxes* *System I (180 units)*	*Winter Solstice* *System II (240 units)*[30]
1	$3\frac{3}{4}$	5
2	$7\frac{1}{2}$	10
3	15	20
4	30	40
5	60	80
6	72	96
7	84	112
8	96	128
9	108	144
10	120	160
11	132	176
12	144	192
13	156	208
14	168	224
15	180	240
16	168	224
17	156	208
18	144	192
19	132	176
20	120	160
21	108	144
22	96	128
23	84	112
24	72	96
25	60	80
26	30	40
27	15	20
28	$7\frac{1}{2}$	10
29	$3\frac{3}{4}$	5
30	——	

return to the "Babylonian" 'XII, III, VI, IX'-system in the Late Babylonian period after 502 B.C.E. see J. Britton, "Scientific Astronomy in Pre-Seleucid Babylon," in H. Galter, ed., *Grazer Morgenländische Studien* 3 (1993), 66–68.

It is possible that this return to the older "Babylonian" system reflects, in some way, an intentional Neo-Babylonian period calendrical reform since the omission of an intercalation has the effect of moving the solstices and equinoxes back from Months I, IV, VII, X to Months XII, III, VI, IX; i.e., moving the Spring equinox from Nisan back to Adar, etc. According to the tables of R. Parker and W. Dubberstein, *Babylonian Chronology 626 B.C.–A.D. 75* (Providence, 1956), 27–29,[31] the Spring Equinox (March 20/21) occurs in either Adar or second Adar (Month XII, XII^2) in

30. The numbers in the original tablets are rendered according to the Mesopotamian sexagesimal system and not in base 10 as below.

31. The remarks below are preliminary, and are based solely on the tables of Parker and Dubberstein (1956) which are now out of date.

every year in the Neo-Babylonian period (Nabopolassar to Nabonidus) after 595 B.C.E. except 564.[32] In contrast, the Spring Equinox occurs in Nisan at least seven times between 626 and 600.[33]

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32. Cf. n. 33 below, and note that according to Parker and Dubberstein (1956), 27, March 20–21 fell in the month of Shevat (Month XI)[!] in 595 B.C.E. The spring equinox must fall in Nisan in years when the first of Adar (or second Adar in leap-years) occurs on or before February 18th. In such years, the first of Nisan would occur no later than March 19th (or in the case of Gregorian leap-years, with an extrapolated Feb. 29th, March 18th).

33. 624, 621, 619, 616, 608–607, 600 B.C.E. (611, March 21 = Nisan 1). Likewise, the Spring Equinox falls in either Nisan or Adar in Neo-Assyrian documents from the reigns of Esarhaddon and Assurbanipal; see Parpola, *Letters from Assyrian Scholars*, 2:360–61, and 382–83, Appendix A 2. For what may be a modern parallel to the possible Neo-Babylonian calendrical reform, compare the early Soviet Union's adoption of a modified Gregorian calendar in preference to the Julian calendar, which was used during the Czarist period. The apparent Neo-Babylonian return to the older Babylonian system following the fall of the Assyrian empire might reflect political-ideological, as well as astronomical-calendrical, considerations.