Counting Lunar Phase Cycles in Mesoamerica

51

Stanisław Iwaniszewski

Contents

Abstract

Though ancient Mesoamericans did not develop formal lunar calendars, they nevertheless timed diverse agricultural activities with the lunar phases. Only the Classic Period Maya created a complex system of recording the lunar cycles, called the Lunar Series, attached to various mythological or historical narratives. It is probable that the structure of the Lunar Series was used to make eclipse predictions.

Introduction

There can be no doubt that like most other peoples, ancient Mesoamericans paid attention to various lunar phenomena. The cyclical changes in the appearance of the Moon were incorporated into a dualistic system of complementary oppositions in which the phases of the waxing moon and waning moon were interrelated with the periods of agricultural planting and harvesting. As current ethnographic research shows, the idea that the Moon affects the growth of plants is widely disseminated

S. Iwaniszewski
División de Posgrado, Escuela Nacional de Antropología e Historia, Tlalpan, México, D.F., Mexico

Państwowe Muzeum Archeologiczne, Warszawa, Poland
e-mail: siwanisz@yahoo.com

C.L.N. Ruggles (ed.), *Handbook of Archaeoastronomy and Ethnoastronomy*,
DOI 10.1007/978-1-4614-6141-8_54,

among the Mesoamerican farmers (Iwaniszewski 2007). Though the dates of the solar and divinatory calendars are consulted for specific agricultural activities, they still had to be aligned upon the proper lunar phase (Gossen 1974, p. 224). In most cases, the lunar month is divided into two parts and correlated with important farming activities: planting by the waxing moon and cropping by the waning moon.

As far as we know, the Mesoamericans did not develop a formal lunar calendar. Though in modern Mesoamerican languages, the terms for moon and month are the same, it is difficult to find traces of a formal lunar calendar. When first Spaniards arrived at Yucatán, they noticed the Maya utilized two ways to count the time:

> They divide it [the year] into two kinds of months, the one kind of thirty days and called *u*, which means "moon", and they counted it from the time at which the new moon appeared until it no longer appears. They had the other kind of months of twenty days and they called these *winal jun ekek*. . ..(de Landa 1941, pp. 133–134).

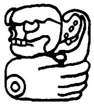
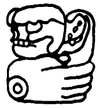
The 365-day Maya *haab*ꞌ, year, consisted of 18 periods of 20 days each to which 5 days were added. The 20-day units were known as *winal jun ek*ꞌ*ek*, (*winal* "the old month of 20 days", *jun*, "one, once", and *ek*ꞌ*ek* with meaning unknown), and not connected to the lunar phases. The lunar month is called *u*ꞌ or *uh*, meaning simply "moon" in Yukatekan Maya and, according to Landa's account, describes the period that begins with the first visibility of the lunar crescent and lasts until the day of its disappearance. We do not know if the term *uh* is used in the sense of lunation, or whether it describes only the period of the moon's visibility.

The Structure of the Maya Lunar Series

The Classic Maya incorporated the lunar cycle to the Long Count in the form of the Lunar Series. The Long Count recorded the days elapsed from an arbitrary or mythological zero point fixed on the month of August of 3114 BC. The date expressed in the Long Count is usually followed by the 260-day divinatory cycle and the 365-day *haab*ꞌ calendar. We find the Lunar Series on Maya monuments from the fourth century on, suggesting they were added to meet the political and ritual requirements of the Maya ruling elites.

The invention of the Lunar Series means the development of the more abstract and less season-dependent system of time-reckoning. First, the Lunar Series represent a continuous lunar count, consisting of standard 29-day and 30-day units, a rough correspondence with hollow and full lunar months known from the Old World lunar calendars. Thus, the simple counting of days from the first appearance up to 29 or 30 is already an abstract method, independent from actual observations of the moon. Second, the moons were arranged in a series of lunar months, forming a regular and easily predictable sequence providing strings alternating 30-day and 29-day units. Since the mean synodic month is little over 29.5 days, this method establishes the fixed relationship between the observed and calculated lunations, so discrepancies could have been easily predicted. Third, with the invention of the Long Count, all earlier seasonal cycles were abandoned and substituted for a more universal system. Any position in the

Table 51.1 Hypothetical semesters patronized by three Glyph C head variants: s – skull, f – young female, j – male or jaguar god. Two alternative sequences are displayed (starting either with a 30-day or a 29-day Glyph A)

Group I: starts with a 30-day lunar month			Group II: starts with a 29-day lunar month		
					
1Cs 30	1Cf 30	1Cj 30	1Cs 29	1Cf 29	1Cj 29
2Cs 29	2Cf 29	2Cj 29	2Cs 30	2Cf 30	2Cj 30
3Cs 30	3Cf 30	3Cj 30	3Cs 29	3Cf 29	3Cj 29
4Cs 29	4Cf 29	4Cj 29	4Cs 30	4Cf 30	4Cj 30
5Cs 30	5Cf 30	5Cj 30	5Cs 29	5Cf 29	5Cj 29
6Cs 29	6Cf 29	6Cj 29	6Cs 30	6Cf 30	6Cj 30
177 days	177 days	177 days	177 days	177 days	177 days
18 months = 531 days			18 months = 531 days		
18 lunations × 29.5305889 days = 531.5505 days					

Long Count is recorded by cycles of various magnitudes; therefore, we cannot study the lunar cycle in relation to the length of the year, either calendar or astronomical one.

The Lunar Series glyphs inform about the cycle of the Moon's phases: the age of the current lunar month, the number of completed moons grouped in a series of subsets consisting of 6 and 18 differentiated lunar months, and the statement establishing the standard length of the current lunar month of either 29 or 30 days. This information is represented by hieroglyphic signs, called by epigraphers Glyphs A, B, C, D, E, and X. This may be roughly translated like

"'x' (days after the Moon) arrived, it is the (1st to 6th) Moon under the patronage of (S,F or J God) the one that is bound; Glyph X is/was his sacred/young name, of this 29 or 30-day (moon)".

Glyph C is composed of two variable elements: the numerical coefficients varying from 1 to 6 and three variable head variants: a skull (s), a female (f) and a male jaguar deity head (j) (compare in Aldana 2006). During the Classic period, the sequence of Glyph C head variants was fixed and followed the order: a skull, a female head, and a male or jaguar head (see Table 51.1). It may be observed that Glyph A (defining whether the moon is 29 or 30 days long) combined with Glyph C (3 × 6 moons) provides, at least in theory, as much as 36 differentiated lunar months (see Table 51.1).

The earliest known uses of Glyphs D and/or E (Moon Age) and Glyphs C (Moon Number) are from Uaxactun (Stela 18 at 8.16.0.0.0, or AD 357), of Glyph A (Moon Length) from Río Azul (Tomb 1 at 8.19.1.9.12, or AD 417), of Glyph X – from Copán (Stela 63 at 9.0.0.0.0, or AD 435), of Glyph B – from Balakbal (Stela 5 at 9.7.1.6.0, or AD 575). The earliest known Maya lunar count record is from the Seattle stela with a hypothetical Glyph C variant (at 8.8.0.7.0, or AD 199).

For a long time, the Lunar Series have been believed to never occur alone, they were always attached to the dates expressed by the Long Count system. The recent discovery of a lunar table in Xultun, Petén, Guatemala, shows that the Classic Maya skywatchers developed methods of regularly inserting a 30-day month.

The Xultun Lunar Table

The regular distribution of 29-day and 30-day lunar months produces a growing discrepancy between observed and computed moons, so the Maya should have added an extra 30-day lunation, instead of that of 29-days. This would mean the abandonment of the regular and symmetrical sequence of alternating 30-day and 29-day units, however, any addition of an extra 30-day lunar month breaks up with the symmetry, as it allows for the occurrence of two consecutive 30-day moons. The placement of two consecutive 30-day months implies shifts of posterior months from even to odd and from odd to even numbered months. Various scholars attempted to reconstruct the Maya intercalary methods, but without much success. On the other hand, on several occasions, the Dresden Codex Eclipse table records the series of 6 moons equal 178 days or of 5 moons equaling 148 days, implying that such intercalations were made (since $4 \times 30 + 2 \times 29 = 178$ days, and $3 \times 30 + 2 \times 29 = 148$ days).

The recent publication of the mural painting motifs displayed on the wall found in the house of *aj k'in*, "priest-astronomer" who lived in Xultun, Peten, Guatemala, during the first half of the ninth century (Saturno et al. 2012), throws new light on the methods used by the Classic Maya scribes to perform lunar computations. The panel records the count of 162 lunar months, arranged in 27 columns of 6 moons each ($27 \times 6 = 162$), each topped by one of the three head variants of Glyph C, and below recording a cumulative count of days, recorded in a customary dot-and-bar format, increasing from left to right.

In most columns, the numbers of 177 days are recorded, with few occasions when the number of 178 days is written. The lunar table bases on the following sequence: 6×177, 178, 4×177, 178, 4×177, 178, 4×177, 178, 4×177, and 178 days, in total 4,784 days.

As $4 \times 177 + 178 = 886$, we can easily identify greater intervals of 886 days each, and the overall pattern of 354 +886 + 886 +886 +886 +886 days. Observe that the number of 886 days is composed of 30 lunar months where there are 16 moons of 30 days and 14 moons of 29 days ($16 \times 30 + 14 \times 29 = 886$). The appearance of an 886-day cycle indicates that one lunar day was added (intercalated). The Xultun table consists of five 886-day periods, implying that (about 2.4 years), 5 extra days were regularly added. Two columns of 177 days each, placed before the first 886-day cycle, seem to correspond a lunar year of 12 months (354 days). It may easily be deduced that the intercalation was first made during the period located between 36 and 42 moons completed, indicating that the first lunar month of the lunar table started with a 30-day moon. The mean length of a lunar month is 29.5308642 days (4,874 days: 162 lunations) – see Table 51.2.

Table 51.2 The structure of the Lunar Table at Xultun

Glyph C head variant	J	C	F	J	C	F	J	C	F	J	C	F	J	C
Tun			1	1	2	2	3	3	4	4	5	5	6	6
Winal	8	17	8	17	8	17	8	16	7	16	7	16	7	16
K'in	17	14	11	8	5	2	0	17	14	11	8	6	3	0
Sum	177	354	531	708	885	1,062	1,240	1,417	1,594	1,771	1,948	2,126	2,303	2,480
Number of added days	177	177	177	177	177	177	178	177	177	177	177	178	177	177
Cumulative moon length	177.18	354.37	531.55	708.73	885.92	1,063.10	1,240.29	1,417.47	1,594.65	1,771.84	1,949.02	2,126.20	2,303.39	2,480.87

Glyph C head variant	F	J	C	F	J	C	F	J	C	F	J	C	F
Tun	7	7	8	8	9	9	10	10	11	11	12	12	13
Winal	6	15	6	15	6	15	6	14	5	14	5	14	5
K'in	17	14	12	9	6	3	0	18	15	12	9	6	4
Sum	2,657	2,834	2,972	3,189	3,366	3,543	3,720	3,898	4,075	4,252	4,429	4,606	4,784
Number of added days	177	177	178	177	177	177	177	178	177	177	177	177	178
Cumulative moon length	2,657.75	2,834.94	3,012.12	3,189.30	3,366.49	3,543.67	3,720.85	3,898.04	4,075.22	4,252.40	4,429.59	4,606.77	4,783.95

Conclusions

It is necessary to observe that the number of 4,784 days equals two intervals of 2,392 days (= 81 moons, the lunar count used at Palenque) and that 2 × 4,784 + 2,392 = 11,960 days, the number of days recorded in the Table of Eclipses in the Dresden Codex. These coincidences seem to show that both the Lunar Series and the Eclipse Tables stem from the same organizing principles.

Cross-References

► Astronomical Deities in Ancient Mesoamerica
► Astronomy in the Dresden Codex

References

Aldana GV (2006) Lunar alliances: shedding light on conflicting classic Maya theories of hegemony. In: Bostwick TW, Bates B (ed) Viewing the sky through past and present cultures. Pueblo Grande Museum anthropological papers no 15, City of Phoenix Parks and Recreation Department, Phoenix, pp 237–258

Gossen GH (1974) A Chamula solar calendar board from Chiapas, Mexico. In: Hammond N (ed) Mesoamerican archaeology: new approaches. University of Texas Press, Austin, pp 217–253

Iwaniszewski S (2007) Lunar agriculture in Mesoamerica. Mediterr Archaeol Archaeom 6(3):67–75

Landa D (1941) Relación de las cosas de Yucatán (trans and ed: Tozzer, AM). Peabody Museum papers 18. Harvard University, Cambridge MA

Saturno WA, Stuart D, Aveni AF, Rossi F (2012) Ancient Maya astronomical tables from Xultun, Guatemala. Science 336:714–717 (together with the supplementary materials)