

Maya Cycles of Time

Introduction: [John Lloyd Stephens](#) and [Fredrick Catherwood](#) brought the ancient Maya to world attention in 1841 with their illustrated volumes entitled *Incidents of Travels in Central America, Chiapas and Yucatan*.






Figure 1: Labna from Catherwood's *Views of Ancient Monuments in Central America* (1844)

For some time after, though, much about this lost civilization remained shrouded in mystery. A Spanish colonial Franciscan priest, [Fray Diego de Landa](#) had come very close to annihilating the civilization in an effort to wipe out practices he viewed as relapses into paganism. He burned every Mayan book he could find. Only four of the written records of Maya heritage survived the flames of de Landa's infamous 1562 *auto da fe*



Figure 2: *de Landa*, Government Palace, Merida, Mexico

To atone, de Landa published *Relacion de las cosas de Yucatan* in 1566, reconstructing as much as he could of the lost heritage. Ironically, that source, written in Spanish, was a key to deciphering Mayan glyphs in later years.

Number system: The Maya left evidence of a highly developed understanding of arithmetic, calendrics and astronomy, which was certainly as sophisticated as contemporary civilizations elsewhere in the world. By the end of the *Late Preclassic* Maya time period (400BCE-100CE), they were using a positional number system which employed only three symbols:  representing 0,  for 1 and  for five. The numbers 1 to 19 inclusive appeared as:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
•	••	•••	••••	—	—•	—••	—•••	—••••	==	—•	—••	—•••	—••••	===	—•	—••	—•••	—••••

Numbers larger than 19 were written vertically, employing a vigesimal (base 20) system.

$43 = 2 \cdot 20 + 3$	$354 = 17 \cdot 20 + 14$	$220 = 11 \cdot 20 + 0$
••	—••	—•
•••	—•••	•





















The concept of a zero placeholder first occurred among the Olmec, the mother of all Mesoamerican civilizations. By contrast, an ancient Middle Eastern civilization, the [Babylonians](#) employed two symbols in a sexagesimal (base 60) system. Without a zero placeholder, though, they did not have the means to make a distinction, the way we do, between numbers such as 6 and 60. They used, instead, the relative size and spacing of symbols as well as the context to deal with such ambiguities.

The Maya used a modified vigesimal number system, in which the value of the third place was 360 instead of 400, for calendric purposes.

<p>Vigesimal</p> $1872 = 4 \cdot 400 + 13 \cdot 20 + 12$ <div style="display: flex; justify-content: center; gap: 20px;"> <div style="text-align: center;"> <p>⋯</p> <p>≡</p> <p>≡</p> </div> <div style="text-align: center;"> <p>—</p> <p>⋯</p> <p>≡</p> </div> </div>	<p>Quasi-vigesimal</p> $1872 = 5 \cdot 360 + 3 \cdot 20 + 12$
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Some authors claim that the Maya employed a pure vigesimal system for non-calendric purposes, however all extant evidence of large numbers relates to the calendar.

Calendrics: Like all Mesoamerican cultures, the Maya employed a 260-day year called the *Tzolkin* or sacred almanac. Dates consisted of pairings of two cycles, one cycle of 13 day numbers with another of 20 day names.




















Tzolkin Day Names and Glyphs									
Ahau	Imix	Ik	Akbal	Kan	Chicchan	Cimi	Manik	Lamat	Muluc
									
Oc	Chuen	Eb	Ben	Ix	Men	Cib	Caban	Etz'nab	Cauac
									

In this almanac, the day 1 Imix is followed by 2 Ik, 3 Akbal and so on, passing through 260 unique pairs of day numbers and names illustrated by interlocking wheels.




Figure 3: Tzolkin Calendar

The Maya also used the standard Mesoamerican 365-day *haab*, or vague year composed of eighteen months of 20 days, numbered zero through nineteen, and closing with the 5-day month of Uayeb.

Haab Month Names and Glyphs									
Pop	Uo	Zip	Zoltz	Tzek	Xul	Yaxk'in	Mol	Ch'en	Yax
									
Zak	Ceh	Mac	K'ank'in	Maun	Pax	K'ayab	Cumku	Uayeb	
									

The haab roughly approximates a [solar year](#) and the Maya recorded an accurate account of the discrepancy. Great observers of the cycles of time, they noted that a 365-day year precessed through all the seasons twice in 1,101,600 days (a number that will become significant later). Thus, the true length of a year, n , satisfies $\frac{1101600}{365} = \frac{1101600}{n} + 2$ or 365.242036 days, which is slightly more accurate than our [Gregorian calendar](#).

A *Calendar Round* combined the 260-day sacred almanac and 365-day haab year in ancient Mesoamerica. As the least common multiple of 260 and 365 is 52·365, the Calendar Round was comprised of 52 haab years. Thus a typical Calendar Round date referenced both the almanac and haab positions. For example, the date 11 Akbal 16 Ceh

would look like  in Mayan glyphs with the number glyphs rotated from horizontal to vertical. Below find a graphic of the Calendar Round.

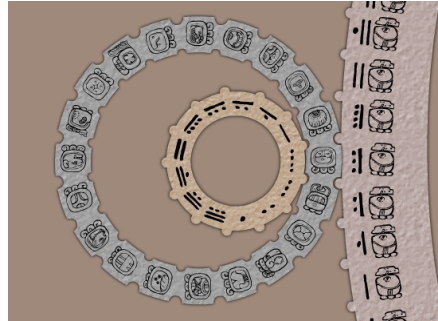







Figure 4: [Interactive Calendar Round](#)

Only four of the twenty sacred almanac day names could possibly align with the first position of any month of the 365-day haab year. This is because the sequence of 20 distinct day names and 20-day months align exactly save for the final 5-day month of Uayeb. This misalignment shifts the day name of the start of each successive year by 5. Thus, in any given year, each haab month begins on the same sacred calendar day. Then in the subsequent year, each month begins 5 days later. In Classic times these were the days named Akbal, Lamat, Ben and Etz'nab and known as *year-bearers*. By the time of the Spanish Conquest, the year-bearers had inexplicably been shifted forward by one day. In any case, the four year-bearer day names together with the day numbers 1-13 made up the 52 distinct sacred almanac days beginning each month of a 365-day haab year of a Calendar Round.

Long Count: The Maya carried on the practice of using time periods longer than the 18,980-day Calendar Round believed to be developed by the Olmec. For the Maya, the basic unit of time, a day was called a kin. At a second order, 20 kins made up a uinal. In a vigesimal system the third order would be 20 uinals but, instead, 18 uinals made up a tun. Thus a tun was 360 kin (days). Time keeping units then returned to factors of 20 moving up to each successive level. In this way the Maya recorded references to

vast spans of time in their effort to tie, really justify, current events with the past history and folk law.

The table below shows the five levels used to record significant dates in the Maya *Classic Era* (200-900CE).

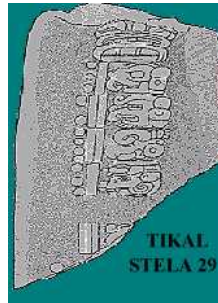
Maya Time Periods with Glyphs				
Kin 1 day	Uinal 20 Kin	Tun 360 Kin	Katun 7,200 Kin	Baktun 144,000 Kin
				

The Maya are often credited as the first people to establish a chronological record of dates beginning with a fixed day in the distant past from which to number each day uniquely. They identified the beginning of recorded time as the date when they believed the world came to an end and was recreated afresh. They believed this occurred at the close of a great cycle of 13 baktuns (1,872,000 Kins). Thus their “chronological count”, called the Long Count, is really another cycle, this one of 5,128 years. The end of the current great cycle is approaching soon, due on the [Winter Solstice](#), December 21, 2012.

Mayanists recognize that early Mesoamerican astronomers may have created the Long Count by targeting this particular end date. It is a date that has special meaning in Maya cosmology and perhaps, not coincidentally, also related to the movement of equinoxes relative to other heavenly bodies. After all, the [precession of the equinoxes](#) was known to many ancient Old World cultures like the Egyptians and Greeks. In 2012 there will be a unique conjunction of the winter solstice sun with the crossing point of the [Galactic Equator](#) and the [ecliptic](#).

A Mayan date begins with a Long Count which consists of number and time period symbols arranged vertically in carvings, called stela, and codex (book) writing. Below find a picture of Tikal Stela 29 recording the long count date 8 baktun 12 katun 14 tun 15

uinal 0 kin. Mayanists replace this with a kind of decimal representation, called the *Goodman notation*, 8.12.14.15.0, probably corresponding to July 8, 292.



The beginning of the current great cycle was written as 13.0.0.0.0 4 Ahau 8 Cumku (instead of 0.0.0.0.0.). See this date on the sketch of Quirigua Stela C below.



Figure 5 sketch of Quirigua Stela C

The 13 refers to the number of baktuns and each successive 0 refers to katun, tun, uinal and kin values respectively. The Ahau and Cumku numbers correspond to the sacred almanac and haab dates.



Figure 6: The Dresden Codex

During the Classic Period the Maya placed their lunar series glyphs between those of the Tzolkin and Haab dates. They demonstrated a clear grasp of the moon's changing appearance in the sky. They found that 4,400 days equaled 149 moons, corresponding to a lunation value of 29.53020 days. In the [Dresden Codex](#) they laid out the number of days between 405 consecutive lunations, cleverly interpolating lengths of 29 and 30 so that the actual discrepancy in the appearance of a new moon is no more than one day.



Figure 7: pages from the Dresden Codex

Returning to the Maya computation of the length of a solar year and the significance of 1,101,600 days, the Maya observed that in the year 7.13.0.0.0, Midwinter day occurred on 0 Yaxkin for the second time since the recreation of the world in year 13.0.0.0.0. This is 1,101,600 days after the zero'th, which they denote as 13 baktun, back in 3114 B.C.E.

Later Dating Schemes: In the Late Classic era, Long Count dating passed out of use in favor of an abbreviated system for commemorating the end of a katun or 7,200 day period. A Long Count katun ending date of 9.16.0.0.0.2 Ahau 13 Tzec was reduced to Katun 16 2 Ahau 13 Tzec. The loss of specificity is not as great as it seems because of the redundancy inherent in their dating system. A given *Period Ending Date* is exact within a cycle of nearly 19,000 years, a time period well in excess of the 13 baktun *Great Cycle* of 5,128 years.

Unfortunately, by the Late Post Classic (900-1500) era, well before the arrival of the Spanish, another abbreviation for katun endings reduced the accuracy to within the much smaller period of 260 years. This method, dubbed the Short Count, suppressed all katun ending references except the sacred almanac day. The katun ending date above, 9.16.0.0.2 Ahau 13 Tzec, was reduced to Katun 2 Ahau! It is indistinguishable from 10.9.0.0.2 Ahau 13 Mac, some 256 Gregorian years later.

The table below shows how a particular date might appear. Note the variation in codex and stelae glyph style. There is significant variation in styles among various archeological sites and even on the same site at different times. This makes general decipherment particularly challenging.

9.16.0.0.2 Ahau 13 Tzec			
Long Count: Codex	Long Count: Stelae	Period Ending	Short Count
	** lunar **		
	** glyphs **		
	** **		

Katuns must end on an Ahau day because the first katun did and each Ahau day reoccurs every 20 days. The 13 day numbers, however, are not sequential for katun endings. The length of a katun in days, 7,200 (mod 13) is 11 or -2. Thus successive katun ending Ahau days are 13 Ahau, 11 Ahau, ...1 Ahau, 12 Ahau, 10 Ahau, ... These dates, arranged in a wheel constituted the prevailing calendar at the time of the Spanish Conquest. Below is de Landa's version of the Maya calendar.

Related Readings

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