Calendars of Ancient Greece

The 6th through 4th c. BCE was the Classical period in ancient Greece, dominated by the powerful and independent city-states of Athens, Sparta, Corinth and Thebes. Each had its own government and culture, and each used a slightly different calendar. Here we will discuss the calendar of Athens as a representative example of these.

The calendar of ancient Athens was lunisolar, but many of its features derived from the Egyptian ecclesiological calendar. It is unclear whether it was empirical or not. The year began at the summer solstice; it is suspected that this means that the first day of the year was reckoned as the day of the new Moon that followed the solstice, but this is not clear. (See pp. 196-197 for a list of names of the Athenian months from the 5th c. BCE.)

In 594 BCE, the archon Solon decreed that months would alternate 29 and 30 days in length with a 13th month intercalated in the middle of the year (after the 6th month) every other year. This corresponds to the first rational approximation to the continued fraction of the number of synodic months per tropical year (25 months in 2 years). But this approximation is poor enough that discrepancies would be noticeable in a few years.

In 520 BCE, Cleostratus of Tenedos suggested dropping the intercalated month every 8 years. This would leave $25 \times 4 - 1 = 99$ months in 8 years (another, and better, continued fraction approximation). This 8-year cycle, the **octaeteris** [Gr., from octa + etos = 8 + years], was a clear improvement, and had the added benefit that it fell in step with another important cycle in Greek culture, the 4-year cycle of the Olympic games.

Still, as more time elapsed, even this system began to drift from the schedule of the Moon's phases, losing a day-and-a-half every cycle (or a full month in 160 years): 99 months in 8 years corresponds to 12.375 months per year, more than the true number of 12.36827. Consequently, the system was occasionally "fixed" by extracalating a day every so often to preserve synchrony with the Moon's phases.

In 432 BCE, Meton and Euctemon of Athens rediscovered the 19-year intercalary cycle that had been used by the Babylonians, proposing that 7 years of the cycle contain 13 months each: these were year numbers 3, 5, 8, 11, 13, 16, 19, the so-called **golden numbers** of the calendar. (Note that these golden numbers are slightly different from those used in the Babylonian/Jewish calendar.) The remaining 12 years had 12 months each.

The Metonic cycle includes $7 \times 13 + 12 \times 12 = 235$ months in 19 years. If all these months were **full** months of 30 days each, then all 19 years would contain $235 \times 30 = 7050$ days, whereas 19 years should contain $19 \times 365.24 \approx 6940$ days. So there are $7050 - 6940 = 110$ days too many in the cycle. Since $7050 \div 110 \approx 64$, they removed every 64th day from the calendar, demoting the corresponding month to a **hollow** month of 29 days.

Observe that the Metonic calendar used yet another of the continued fraction approximations to the ratio of 12.36827 synodic months to tropical years. This approximation is far superior to the ones used to design earlier calendars: the average number of days per month differs from the true value by only

$$\frac{6940}{235} - 29.5306 = 29.5319 - 29.5306 = 0.0013 \text{ days} ,$$

or less than 2 minutes a month. Also, the average number of days per year differs from true by only

$$\frac{6940}{19} - 365.24219 = 365.26316 - 365.24219$$

$$= 0.02097 \text{ days}$$

$$= 30 \text{ minutes}$$

Even this admirable accuracy was not enough for later Greek astronomers. Around 320 BCE, Calippus of Cyzicus further reformed the calendar by establishing that one day be extracalated every fourth cycle (every $4 \times 19 = 76$ years). The resulting 76-year cycle is dubbed the **Calippic cycle**. This proposal improved the discrepancy computed above to about 11 minutes in the average length of the year.

Then, around the year 150 BCE, the noted astronomer Hipparchus of Nicea suggested yet a further improvement by extracalating another day from the calendar every 4 Calippic cycles, that is, every $4 \times 76 = 304$ years. This lowered the discrepancy in the length of the year by half, to about 6.5 minutes per year.

Months in the Athenian calendar contained three decades (10-day weeks, as in the Egyptian calendar) tied to the Moon's phases. The first decade was that of the **waxing Moon**; the days were called New Moon, 2nd day rising, 3rd day rising, …, 10th day rising. The second decade was that of the **full Moon** and the third was that of the **waning Moon**.

The days of the decade of the full Moon were named by continuing the numbering: 11, 12, …, 19. The 20th day of the month, however, began a counting down to the day of the next new Moon; it was termed the **earlier 10th** of the month. The 21st day was called the **later 10th**, and subsequent days counted down from there: 9th day of the waning Moon, then 8th, 7th, etc. The final day of the month, whether it was the 29th or the 30th, was called the day of the **Old and New Moon**.

The Athenians had a number of methods for dating years in their calendar. The easiest was a regnal system that identified the year by the name of the man who served as archon (the chief magistrate), using the tag "when X was archon". Another common scheme used the 4-year cycle of Olympic games, the first of which took place in the month after the summer solstice in the year 776 BCE. Thus, any date in the fall of the year 700 BCE, 24 years later, was said to occur in the first year of the 7th Olympiad, whereas a day in the previous spring was part of the fourth year of the 6th Olympiad.

From the beginning of the 6th c. BCE, when democratic government came to Athens, a 500-member council, or **boule**, ruled the city. Each of the 10 clans that populated the city contributed 50 men, called a **prytany** [Gr. prytanis = chief], to serve on the boule. The year was then divided into tenths, also called prytanies, of 36 or 37 days' length, during which one of these prytanies rotated into a position of administering the day-to-day affairs of the city. As a result, there was a civil **prytanic dating** scheme, used on official transcripts, that identified the date by the name of the presiding prytany, e.g., "the 33rd day in the 3rd prytany [of the year], that of the clan Erechteis".

The Celtic calendar

The Celts were a people who settled Northern Europe in the period 800 BCE to 50 CE, just before its domination by the Romans. Many Celts remained even after this time in the further reaches of the continent (Brittany in France, Ireland, and Scotland, Wales and Cornwall in Britain).

They used a lunisolar calendar of 12 months (of 29 or 30 days each), intercalating a month every $2\frac{1}{2}$ years, for a cycle of $2.5 \times 12 + 1 = 31$ months, or 62 months in 5 years. See Table 15.1, p. 201, for a list of the names of the months and their assigned lengths. Years were thus of irregular length, in a cycle of 385, 353, 385, 354, 355 days each, a total of 1832 days, which is an average number of

$$\frac{1832 \text{ days}}{62 \text{ months}} = 29.54839 \text{ days per month},$$

a little more than half-an-hour too long, and

$$\frac{1832 \text{ days}}{5 \text{ years}} = 366.4 \text{ days per year},$$

a little more than a day too long.

It is the latter inaccuracy that would be the more noticeable, as annual astronomical events would occur a day early after five years' time. Perhaps adjustments were made from time to time, extracalating a day every so often, to realign the calendar.

The 30-day months were called *matus* (auspicious), while the 29-day months were *ammatus* (unlucky). The month was divided in half, beginning at the full Moon and running for 14 days, a **bright fortnight**, then for 15 days until the next full Moon, the **dark fortnight**.

The principal Druid festivals of Beltane, Lughnasa, Samhain and Imbolg were celebrated on the cross-quarter days midway between the solstices and the equinoxes.

The Teutonic calendar

A number of Northern European tribes – including the Germans, Angles, Saxons and Vikings – used a lunisolar calendar that began the year at the winter solstice and intercalated its 13th month midway through the year in the summer.

The Angles named the first and last months of the year Giuli, from which derives the name Yule, which we now find synonymous with Christmas time.

The Icelandic calendar

Because Iceland sits just south of the Arctic circle, there are stretches of time when the Moon will never rise (near a minor standstill) or never set (near a major standstill). It makes no sense in such an environment to establish a lunar calendar. Their calendar was lunisolar, based on one the Vikings brought with them from Europe in the 10th c. CE. It was divided into two seasons called *misseri*, essentially summer and winter.

As the months cannot profitably be used to monitor the phases of the Moon, they became a secondary units of time to the 7-day week. The Icelandic calendar did include 12 months, but these were fixed at 30 days each. More importantly however, it was kept as a 52-week calendar. Consequently, the year was $52 \times 7 = 364$ days long, there being a short week of 4 epagomenal days called *aukenœtr* [Ice., additional nights]. The year always began on a Thursday at the start of the summer misseri, which included the first two days of *aukenœtr*. The last two days were part of the winter *misseri*.

After many decades using this calendar, with a year more than a day shorter than it should be, a fix was adopted: a week called *sumarauki* [Ice., extra summer] was intercalated in the middle of summer every 7th year. This gave a mean year length of 365 days, much closer to correct. In later centuries, the rate of intercalation of sumarauki was adjusted to start the year more accurately.

When Christianity came to Iceland in the 11th c., so did the Julian calendar, but the old calendar was still used for civil purposes into the 20th c.!