

The Calendrical History of the Vernal Equinox

As early civilizations became more complex, they began to perceive the need for formal calendars to regulate annual events, to organize the agriculture year, religious festivals and civic affairs. But almost invariably, these calendars used lunar months to demarcate the year. The passage of the months, from new moon to new moon, was very easy to observe. But, unfortunately, the length of a solar year (about 365 days) does not divide evenly into months of about 29 days. Thus with a lunar calendar there will always be days left over at the end of the year, or else the lunar year (usually 354 days) will be shorter than the solar year. In most civilizations, this discrepancy between lunar and solar calendars was a problem with festivals meant to mark annual seasons. Consequently, the priests and astronomers in charge of the calendar had to keep fiddling with it, adding extra days or months to try to keep it coordinated with the solar year. This sort of calendar, incorporating lunar months with a solar year, is called a lunisolar calendar.

The Babylonians, in the first millennium BCE, devised a calendar with twelve lunar months and added an extra leap month occasionally to keep the year on track. The Babylonian New Year began in the month called Nisannu, in the spring, determined by the Vernal Equinox. But because their lunar month began at the new moon, the date of the New Year was not the equinox but the first new moon after it. The astronomers of Babylon were considered the most knowledgeable, and other Mesopotamian nations, such as the Assyrians, followed the Babylonian calendar.

The Babylonian lunar calendar was also adopted by the Israelites, who kept the same name of the first month of the year, calling it Nisan. As in the Babylonian calendar, the month began with the new moon after the Vernal Equinox, but the calculation was complicated by the annual spring sacrifice of a lamb called Pesach, now known in English as Passover. This sacrifice, on the fifteenth day of the month, could not take place before the equinox, as the scripture dictated:

“Guard the month of spring, and make then the Pesach offering.” (Deuteronomy 16:1) Thus the priests were sometimes required to add a leap month before Nisan in order to ensure that Pesach would always take place in the spring.

Because the Christian festival known in English as Easter is based on the Pesach feast, the early Christian liturgical calendar at first followed the Jewish one in the calculation of the Paschal date. However, because the date is required to fall on a Sunday after the Vernal Equinox, the computations varied somewhat from those that calculated the date of Pesach, and this became a contentious issue among the various early Christian sects.

The early Romans used a lunar calendar in which months alternated between 29 and 30 days. It was not a precise measure and it gradually fell out of step with the seasons. This early calendar was very complicated, confusing, and inaccurate. There were at first only ten months, with many days left out at the end of the year. Later, two more months, Januarius and Februarius, were added at the end to make 355 days, with a leap month as necessary, when the Roman priests got around to adding it. In 46 BCE, Julius Caesar made a complete reform of the Roman calendar by switching its base from lunar to solar; that is, to a solar cycle of 365 days in a normal year with an additional leap-year of 366 days every fourth year. This Julian calendar was adopted throughout the Roman world. Originally, the Roman New Year began in the month of the Vernal Equinox, called Martius (i.e., March). The day on which the Vernal Equinox occurred was set at March 25th. This made the average length of a year equal to 365.25 days, which was fairly close to the actual value of 365.2422 days.

For the most part, the Christian calendar followed the Roman one, after it was reformed by Julius Caesar. The annual error of 0.0078 days accumulated over time until it became unmanageable. A second reform of the calendar was ordered by Pope Gregory XIII by a decree signed on 24 February 1582 CE. The motivation for the Gregorian reform was that the Julian calendar assumes that the time between Vernal Equinoxes is 365.25 days, when in fact it is about 11 minutes less. The error between these values was about 10 days, accumulated at the

rate of about three days every four centuries, resulting in the Vernal Equinox occurring on March 11 and moving steadily earlier in the calendar, by the time of the reform. Since the equinox was tied to the celebration of Easter, the Roman Catholic Church considered that this steady movement was undesirable. Under the new system, March 21 became the date of the Vernal Equinox. In addition to the change in the mean length of the calendar year from 365.25 days to 365.2425 days (a difference of 10.8 minutes per year), the Gregorian calendar also dealt with the past accumulated difference between these lengths. Due mostly to this discrepancy, between 325 CE (when the Roman Catholic Church thought the First Council of Nicaea had fixed the Vernal Equinox on 21 March), and the time of Gregory's edict in 1582, the Vernal Equinox had moved backward in the calendar, until it was occurring on about 11 March, 10 days earlier. The Gregorian calendar therefore began by dropping 10 calendar days, to revert to the previous date of the Vernal Equinox. Also, the year 1582 was shortened by ten days, The Gregorian calendar also modified the Julian calendar's regular cycle of leap years, years exactly divisible by four, including all centurial years, and future centennial years were not considered leap-years unless they were divisible by 400.

However, after the Roman Empire fell, the Christian churches in many places wanted to begin their new liturgical years on the dates of important religious celebrations, such as Christmas on December 25 or Lady Day on March 25, one of the Quarter Days that marked the beginning of spring, and which was originally on the Vernal Equinox. Thus for example in England, there were two New Years, one on January 1 and the other on March 25. This did not change until 1752, with the adoption of the Gregorian calendar, which is generally in use today, although some eastern Christian churches still use a Julian liturgical calendar, with the result that they celebrate Easter on a different date than those that use the Gregorian. The Gregorian calendar continues in general usage today. Eventually, its 0.0003 day annual error will accumulate and necessitate an elimination of a leap-year day circa 4915 CE.