Calendar FAQs hrs

Q: Our calendar seems a hodge-podge. Where did it come from?
A: Our Western months are indeed a mixed up mess. They are an attempt to impose a human system where there is none. They are only weakly related to the length of an orbit of the moon, and were inherited from the ancient Romans. The only things about our calendar that are measurable and have nothing to do with human traditions is the length of the year and day.

Q: Why isn't our month exactly equal to the number of days between new moons?
A: Two reasons. 1) There are an uneven number of days in a lunar month. 2) There are about two weeks extra in a year, so a precise moon calendar doesn't line up very well with the seasons. Our months add an extra day or two, here and there, to line up the months better with the seasons.

Q: How did leap years get started?
A: When Gaius Julius Caesar was appointed Pontifex Maximus, or head priest of the pagan Romans, the year was known to be somewhere around 365 days, 6 hours long. However, such a calendar was not then in use. The Romans followed a 360 day calendar at the time, and the Pontifex had the responsibility of putting in extra days at the end of the year, a process known as *intercalation*. A few previous Pontifices, who had the responsibility of regulating the calendar in this way, had been lax in their duties. Also there was a tendency to manipulate the calendar to prevent rivals from getting elected or to achieve other political aims. The year was thus about 90 days off.

Caesar, even though he was the consummate politician and would have approved of the power to affect the elections, was tired of the alleged first day of spring happening in the middle of winter. After consulting with a knowledgeable Greek astronomer, he decreed that henceforth the year was based on a 365 day calendar and that every fourth year a day was to be added to February (oddly enough, he chose a presumably unnumbered day in between the 23rd and 24th). This extra day 6 days before the first of the next month (the Kalends) made the leap year acquire the alias "bisextile" or "two sixes." Anyway, this recipe was so very superior to what had gone before that people came to regard it as set in stone. The month of July is named after him, but not for his calendar reform.

Q: What reason was it?
A: Long after his appointment as Pontifex, his skilful political maneuvering (and the fact that he had a big army loyal to him alone) led to his becoming the Dictator of Rome. His short rule was followed by the long rule of his adopted son, the first Roman Emperor — called Augustus. Augustus, because his rule was founded in the rule of Julius Caesar, did not follow the common practice of many later emperors of blackening the name of his predecessor to make himself look good. Romans eventually changed the name of the month Quinctilis to July to honor Julius.

Q: Uh, Augustus?
A: Yep, August. He got the month Sextilis.

Q: I heard on the radio, from a character called "Astronerd," that the reason that several days were missing from the years 1752 has to do with precession of the equinoxes. What is the precession of the equinoxes?
A: It is a wobble in the rotation of the earth, caused by the Moon's pull on the aspherical bulge in the Earth's shape near the equator. The position of the North pole in the sky will change gradually, making a slow circle in the sky. It has a period of about 26 thousand years; during that time the sky will have rolled around to make Polaris the North Star once again.

Q: So how does it cause missing days?
A: It doesn't. "Astronerd" was *wrong.* It has more to do with the residual error in the calculation. The tropical year is not 365.25 days long, it is close to 365.24219 days. Slowly, this difference in the length of the year introduced a creeping error in the Julian calendar of about 1 day every 130 years. It was last rectified in the 4th century; but after the collapse of the empire it did not move and through the long medieval times, the Julian calendar had wandered out of date with the seasons about 10 days. In 1582, again after consulting astronomers, Pope Gregory XIII jumped the calendar forward by 10 days and corrected the formula to pull out the leap days in years divisible by 100 but not by 400. Thus, the year 1600 was a leap year as usual, but 1700, 1800, and 1900 were not. The year 2000 was a leap year again. The remaining error in the Gregorian calendar is one day in over 3000 years. It is interesting that the Pope, who is also known as the Pontiff, has a name and timekeeping function that antedates his religion.

Q: What about 1752?
A: Protestant England was fundamentally opposed to anything having to do with the Catholic church, and resisted even the secular appeal of an accurate calendar. Finally, bowing to economic and social pressures to conform, it converted calendars in 1752, by which time the error had advanced to eleven days. Being under the control of England at the time, we changed then, too. The Greek Orthodox church finally converted to the new timekeeping in the 20th century, and I've heard has adopted an even more accurate formula that corrects for the 3000-year error as well. The Greek Orthodox calendar supposedly has an error of 1 day per 10,000 years. Of course, the reason the Catholic and Greek Orthodox churches are interested in the calendar is related to the complicated calculation of the moveable holiday of Easter.

Q: You still haven't answered the question about precession fully. Why shouldn't a movement in the time of spring mess up the calendar.
A: It does. But if precession didn't happen, there would still be about the same size error the *other* way. The sidereal year, which would be the same as the tropical year in the absence of precession, is 365.25636 days, so a modified Gregorian calendar in the absence of precession would have all the 100-year leap years intact. In addition, the recipe would have to inject two *extra* leap years every 300 years. In 1582, when Pope Gregory would have instituted the modern calendar, the error would have been such that people would have had to live more than a week over again or with unnamed days. By the way, we can calculate the period of precession from this difference in year lengths: 365.25636 - 365.24219 = 0.01417 days. The fraction of a Julian year is 0.000038795 [periods/year]. That inverts to 25,776 Julian years. There are corrections to this in such a chaotic system as multi-body gravitation, however, so astronomers just say it is about 26,000 years.

Q: All this seems very esoteric and theoretical. What has it go to do with anything real?
A: Besides the obvious agricultural function (you know, the *food* you put in your mouth), inaccuracies in the calendar can occasionally cost people their lives by more indirect means. During the Napoleonic wars, Russia made a pact with a German state to join armies at a certain date to destroy Napoleon. Trouble was, nobody thought to reconcile the Russian (Greek) calendar with the Gregorian and the Russians arrived over a week too late. Napoleon was able to meet the two armies the way he wanted and annihilate them.

Q: I have heard that the natives of central America had a superior calendar to the Julian, one that didn't need leap years. How did it work?
A: They needed leap years, too. There is no getting around that fraction. They had a solar calendar comprised of 18 "months" of 20 days, or 360 days. Superimposed on this was a religious calendar of 20 months of 13 days each. The two calendar intermeshed in such a way that they repeated every 52 years. The clever thing about these two rolling calendars is that there was no need to use numbers higher than 20 and you could still specify precisely every date within 52 years (you appreciate advantages like that when you don't use the decimal system). At the end of the solar year they intercalated 5 "empty days," to bring the number to 365, somewhat like the Romans did before Caesar. There is some indication that they

occasionally added 6 for a leap year. The only calendars that don't need intercalation are those that ignore the solar year.

Q: What about the week?
A: The week comes from the near East. The ancient Egyptians had a 10-day "week." The ancient Romans had an 8-day market interval. The week has little basis in astronomy. It could just as well be any value, especially as it is allowed to roll over without resetting.

Q: I heard that the year numbering is messed up because the person who counted up the years since Jesus of Nazareth's birth made a mistake. Is this true?
A: The person who established the counting system we use today was named Dionysius Exiguus (Dennis the Short, if you're curious), who lived in the time of Theodoric the Great, Ostrogothic king of Italy, around the year 500. Although the western Roman empire had officially fallen to the barbarians, it had not yet gone through the convulsion that eventually occurred when the eastern Emperor Justinian attempted to take Italy back. Hence, Dionysius had access to records that we could only dream about, and which would later be lost. He had two chores: 1) to establish the year-by-year political calendar of the Roman empire, and 2) to assign the year 1 to the year of Jesus's birth. The second task was for Dionysius the more difficult. He had to use thin and sometimes contradictory evidence to assign the birth of Jesus to a certain year. As much a we would like to have more evidence, the birth of one poor child in an odd corner of the Empire was not recorded in a wide variety of places. Perhaps he made an error in assigning the birth and perhaps he did not. Who knows?

But there are people who have lately been attacking the Dionysian dating system who are claiming that he messed up the first task. They are claiming that he made mistakes in the counting of the years in the calendar of Rome, causing a shift in the dates of Roman happenings. This is absurd. The records to which Dionysius would have had access would have made this task easy, and there is no evidence that he messed it up. In fact, there is astronomical evidence that he pinned the dates accurately on Roman events.

Q: What evidence is that?
A: In Pliny the Elder's *Natural History*, he mentions an uncommon double eclipse of the Moon and the Sun two market periods later. Pliny records this event as occurring in the third consulship of the Emperor Vespasian. In the Dionysian system, the third consulship is 71 (the first consulship was for an earlier emperor, the second in 70, after Vespasian ascended). Now, we have accurate enough models to calculate an eclipse to high accuracy. We can calculate that on March 4 71 there was a partial eclipse of the Moon and on March 20 there was a near total eclipse visible in the region of Rome. Therefore, the location of the Dionysian system against Roman political events is correct. Whether it is correct against the life of Jesus is less certain.

Q: In my reading, there are ancient dates referred to as BCE and CE. What's the difference from our old AD and BC system?
A: Much of the world does not like using a year numbering based on the Christian religion, but has to use it in order to trade with the Americas and Europe. However, it really doesn't matter where we start our years as long as we agree on the date. Thus, it has recently become more acceptable to foreign sensibilities to refer to the year as Common Era and Before Common Era. Common Era just refers to the generally accepted solar year.

Q: I have heard of calendar reformers who wish to change our way of counting days to what they claim are better methods.
A: While I agree that our calendar is a mess, there is nothing they can really do about the fact that there are an uneven number of days in the year and that the number 365 does not have many even divisors (only 5 goes in evenly). We are always going to have to intercalate days and have uneven subdivisions, that is, until the earth slows down.