The Evolution of the Gregorian calendar

The mean Julian year of 365.25000 days is longer than the mean tropical year of 365.24219 by 11 minutes and 15 seconds. While not a serious error over the course of a single year, the errors mounted up over a period of centuries. Multiplied 100-fold, the error comes to 18 hours and 45 minutes over the span of a century. But the Julian calendar was in operation in Catholic Europe for nearly 16 centuries (and much longer in many other places), so the error accumulated to 10 days by the late 1500s. This means, for one, that the vernal equinox was occurring 10 days earlier than expected (on March 11 instead of on March 21).

Still, the discrepancy in the date of the equinox paled in comparison with the problem of dating the celebration of Easter Sunday. Easter is the holiest day of the Christian year, the memorial of the resurrection of Jesus Christ. The Bible tells that Jesus was crucified just outside the gates of the city of Jerusalem under Pontius Pilate, the Roman governor of Palestine, on the Friday after Passover in a year that is alternately reckoned as 30 or 33 BCE (the latter being the favored date). The following Sunday morning, his disciples reported seeing him alive; it is this event that is celebrated on Easter Sunday.
At the Ecumenical Council of Nicea in 325 CE, the bishops of Alexandria were commissioned with establishing the annual date for commemorating this feast. They decided that, like the first Easter day, the feast should be held every year on the first Sunday after the Paschal Moon [L. Pascha = Easter, from Heb., Pesach = Passover], the first full Moon to follow the vernal equinox. But the drifting of the equinox against the Julian calendar threatened to push Easter earlier and earlier into the year.

Even as early as 725 CE, the Venerable Bede, English monk and historian, recognized the calendar drift problem. But attempts to reform the calendar did not begin in earnest until the 13th c. Then a long series of suggestions, publications, and appeals to the Pope to take appropriate steps to correct the problem followed, all leading to false starts and missteps. In 1562 Pope Paul IV succeeded in getting calendar reform on the agenda of the 3rd Council of Trent, but the Council ignored the issue.
In the 1570s, Pope Gregory XIII received a proposal for a reformed calendar from Aluise Baldassar Lilio, better known as Aloysius Lilius, an astronomer and physician living in Verona. Lilius suggested that, to bring the mean calendar year closer to the mean tropical year, leap days in centurial years (those divisible by 100) should be omitted, except in those years divisible by 400. Since this proposal removes 3 leap days from the calendar every 400 years, it reduces the mean calendar year to

\[ 365.25 - \frac{3}{400} = 365.2425 \text{ days}. \]

Lilius had been consulting the Alfonsine tables, translations of astronomical star charts made by Arabic scholars in Spain, to determine the length of the tropical year. They reported that its length was

\[ 365;14,33,9,59,20,7,30 \text{ days} = 365.242546 \text{ days}, \]

so his proposal was quite on target, differing from the above measurement by only 4 seconds.
Pope Gregory named a commission to review the proposal. The commission included Aluise's brother Antonio Lilio, also a physician, and Christopher Clavius, the famous Jesuit mathematician and scientist, with Tommaso Gigli, a bishop from Calabria, in charge. In 1580, Gregory appointed the Dominican friar Ignazio Danti as papal mathematician, and an observatory was built in the Vatican in which Danti conducted experiments that showed conclusively that the equinoxes were indeed occurring on the wrong dates. Later that year, the calendar commission issued their report to Gregory, recommending adoption of Lilius' proposal.

A special plea by the King of Spain and a representative of the Eastern Church called for moving the date of the vernal equinox forward to March 21, where the Council of Nicea had said it occurred. This required the removal of 10 days from the calendar to rectify the difference. The suggestion was made to delete the days 5-14 October, as no major feasts fell during this period.

On February 24, 1582, the Pope issued the bull *Inter Gravissimas*, which called for the reform of the calendar according to the above plan. It also described revised methods for computing the date of Easter.
Catholic Europe carried out the reforms as directed, and the rest of the world eventually followed along, although it took some centuries for this to come about. Protestant countries balked, and delayed adoption of the Gregorian reforms as they did not want to be seen supporting the Pope. Ultimately, however, commerce and foreign affairs amongst the countries of Europe became problematic with both old and new calendars in effect. In 1700, the influential philosopher, mathematician and diplomat Gottfried Leibniz lobbied successfully for Prussia, Holland, Norway and Denmark to adopt the Gregorian calendar. The British Empire – and its American colonies – made the switch in 1752: for the first time there, January 1 was declared New Year’s Day (not March 25), and September 2, 1752, was followed by September 14, 1752.

Elsewhere around the world, Sweden and Finland adopted the Gregorian calendar in 1753; Japan made the switch in 1873 soon after their opening to the West; China in 1912 at the end of Imperial rule and the birth of the Chinese Republic under Sun Yat-Sen; Russia in 1918 after the Bolshevik Revolution and the establishment of the Soviet state; Persia in 1925 when Reza Shah Pahlavi took control of the country, which he would later rename Iran; and Turkey in 1926 after it became a republic under Mustafa Kemal Atatürk.
Alaska, which had been explored and settled by Russian adventurers in the 1740s, was controlled by Russia, where the Julian calendar was in effect. By this time, neighboring Canada and the United States were using the Gregorian calendar, the discrepancy between the two calendars having grown to 13 days. So when Alaska was purchased by the United States in 1867, the treaty accomplishing the sale was signed in Sitka on Friday, October 6. The document decreed that the following day would also be a Friday, October 18! The difference in these dates was just 12 days because the International Date Line was shifted westward to the Bering Straits simultaneously with the redrawing of Russia’s borders. This also explains the repeated Friday.