Mountain Skies

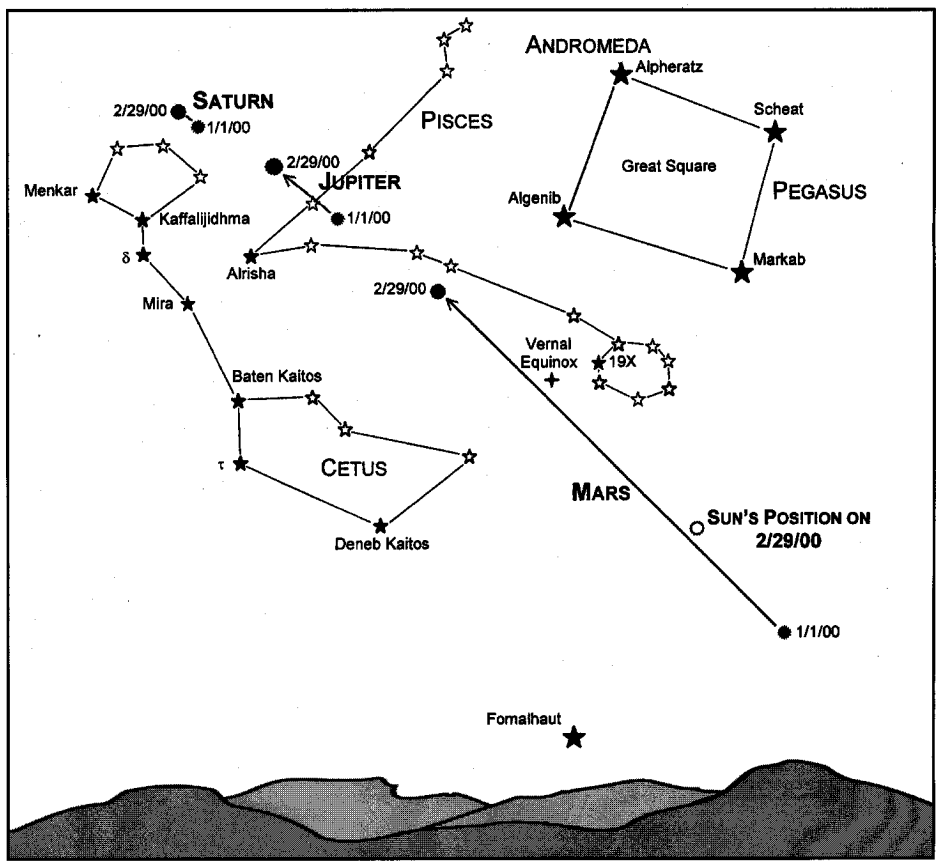
January and February 2000

As the new year arrives and the revelers in Times Square celebrate the plunge of the lighted sphere, Jupiter and Saturn will hang in the southwestern sky, silent witnesses to the celebrations. They will be separated by 15° in the sky, and bright enough to be visible even from the roofs of New York City. Jupiter will set at 1:15 a.m., Saturn at 2:30. At 4:30 a.m., Venus will rise in the east to light the path of the last of the revelers wending their ways home.

The night sky is one of the gifts of mid-winter. The first day of Y2K will darken early into night in the northern latitudes of the Adirondacks. Even those who go early to bed thus have opportunity to observe the sky.

This new year's evening sky glitters in its richness. In the west, Mars hangs above the horizon as it has for months, 20° above the horizon at 6 p.m. As it has lingered, it has been moving steadily through the constellations and will reside in Aquarius throughout January, finally moving into Pisces on February 2, Groundhog Day. Though now February 2 is noted for the ability of Punxsutawney Phil to see his shadow (and have it dutifully reported at <www.groundhog.org>), the origin of this ritual lies in the recognition of Candlemas, of which a Scottish couplet says, "If Candlemas Day is bright and clear, there'll be two winters in the year." The folks of Punxsutawney took this to heart in the early 1880s and went in search of their now-famous groundhog.

The astronomical significance of this day is that it is the mid-point of the winter, halfway between the winter solstice and the vernal equinox. This is also called the first "cross quarter" day of the year. Other cross quarter days are May 1, August 2 and November 1. The Celts celebrated the beginnings and endings of their seasons on the cross quarter days; if you would like to end winter early, you can celebrate Imbolc (IMM-ulk), the first day of Celtic spring on February 2!



Big Fish

As Mars moves into Pisces, it joins Jupiter on the far eastern edge of that constellation. These two planets separated by 35° thus show the great extent of Pisces and make this an excellent opportunity to pick out the faint constellation that now harbors the vernal equinox. Pisces means the fishes, and the illustration of the constellation shows two fish tied together by a rope around their tails. The larger fish is associated with the *Circlet of Pisces* just south of, or below, the Great Square. The rope extends to the east where it ends at Alrisha (al-REE-sha), which translates from Arabic as "The Robes." The motion of Mars from January 1 to February 29 is shown on the diagram. The position of Mars on February 11 is quite close to the vernal equinox, where the sun will be when spring begins on the Roman calendar.

Jupiter slowly closes in on Saturn through January. The ringed world is 12.5° east of Jupiter in Aries by early February. The paths of these giants are also shown on the diagram and are markedly shorter than Mars' due to their much slower motion. The differences in their speeds are due to their distances from us and from the sun. The outer planets move more slowly in their orbits because the gravitational force of the sun is reduced by the distance. The next time that Jupiter and Saturn will align in our sky will be in December of 2020, when they will be separated by a bit more than half a degree . . . a spectacular sight to look forward to.

Rising Mercury

Elusive Mercury will become visible in the western sky at dusk. It swings around the far side of the sun on January 17, then rises in the evening sky. By Candlemas it is 10° above the horizon at sunset. The waxing crescent

moon joins the planets in the eastern sky of early evening on February 6, when a very thin crescent moon will be 2° left and slightly below Mercury. On the 14th, Mercury is at its greatest eastern elongation and is easiest to see since it's at its highest position above the horizon at sunset. This is the best view of Mercury available in 2000, according to the Royal Astronomical Society of Canada (<www.rasc.ca>). The moon will be past the first quarter and in the waxing gibbous phase by then and in the southeastern sky. The string of other worlds stretching from Mercury to the moon will nicely display the plane of the solar system, the ecliptic, on the sky.

February ends on a leap day this year. Only on "00" years divisible by 400 does this occur: 1700, 1800 and 1900 were not leap years, but 1600 and 2000 are. This is to adjust our calendar to the fact that the solar year is 365.242 days long. We count 365 days most years, and add an extra day each leap year. This makes our calendar day 365.25 days long . . . a little too long! It's only about 11 minutes too long, but it moves our calendar away from its astronomical anchors one day every 130 years, so after 1300 years, the vernal equinox that the Roman calendar anchors on March 21 would fall on March 11.

This actually occurred and resulted in the creation of our Gregorian calendar. Julius Caesar introduced the 12-month calendar with leap years in 46 BCE.[1] He also added 90 days to the year 46 BCE to realign the seasons with the dates. The Venerable Bede (673-735), the English cleric who first started reckoning the years from the birth of Jesus, noticed that the vernal equinox had slipped three days from its traditional March 21. Nothing changed, however, until Christoph Calvius convinced Pope Gregory XIII to realign the dates and seasons. The Pope decreed that October 4, 1583, would be followed by October 15, 1583. By then, 1,629 years after Julius Caesar's reforms, the dates had slipped 12 days from their seasonal anchors.

It took a number of centuries for other nations to catch on to the Gregorian calendar. Most Catholic countries converted to it in the 16th century, but it took until the 18th century for the Protestant countries (including England's North American colonies, who changed with England in 1752). In 1873, Japan adopted the Gregorian calendar. Russia adopted it in 1917 . . . their Julian October Revolution happened in November on the Gregorian calendar. China accepted the calendar only in 1949.

Venus, which has been spectacular in the pre-dawn skies of autumn, continues the plunge toward the horizon begun in December. Though it gets lower toward the brightening horizon at dawn, it will remain a bright morning object through February.

Starshine

Orion and the winter hexagon are once again rising in the starry sky. In early January, Orion rises in the southeast just as the sky darkens after sunset, his belt perpendicular to the eastern horizon. To the south, Pegasus, Andromeda, Pisces and Cetus cover most of the sky. The area of Pisces and Cetus is not among the most interesting for naked-eye observers since these constellations are made up mostly of fairly faint stars, but there are some interesting stars. One is bright Fomalhaut (FOAM-a-lot, as in "if you pour beer too fast it will foam a lot," but some pronounce it FOAM-a-low) in Pisces Austrinus, the southern fish. This constellation is also called the solitary fish to distinguish it from the fishes of Pisces. Fomalhaut represents the mouth of the fish, and is best viewed in December, when it's highest in the sky in early evening. By February it will be hard to sight in the brightening dusk.

Another star of particular interest is Mira, "the wonderful" in Cetus, the Sea Monster. Mira was the first long-period variable star discovered. Its period of variation was first measured to be 11 months by Johann Holwarda of Friesland in 1638. Eleven months is actually its average period and it has dimmed below naked-eye visibility for several years at a stretch. At this writing in early November, it is slowly increasing in brightness. In late December and January it could be quite bright. By late February it will likely have dimmed so much as to be difficult to see even with binoculars. Use the diagram in the first days of the new year to try to spot this elusive but wonderful star. If it were placed where our sun is, it would stretch $\frac{2}{3}$ of the way to the orbit of Jupiter!

The variation in its brightness seems to be due to expansions and contractions signalling that the star is very close to the end of its life. Eventually, it will blow off its outer layers and the core will remain as a white dwarf star about the size of Earth, but about a million times denser than water. Actually, Mira is a binary star and the companion of the giant star is a white dwarf. The distance between the stars is about 70 times the distance from the Earth to the sun, almost twice the size of the orbit of Pluto.

Cetus also harbors one of the nearest stars, Tau Ceti (τ), a mere 11.8 light years (ly) away. It's much like our own sun, and gives an idea as to how feeble a star our sun is compared to the familiar bright stars such as those in the Great Square that range in distance from 97 ly for Alpheratz to 335 ly for Algenib.

One interesting star in Pisces is 19X Piscium (PIS-ee-um), which is a very cool star, having a surface temperature less than 3,000°F (the sun's surface temperature is about 10,000°F). As such a cool (and thus dim) star, at a distance of 767 light years, it must be a gigantic star, having a size on the order of a few hundred times the size of the Earth's orbit. If it were at the distance of, say, Tau Ceti, it would be a spectacular sight indeed.

—Aileen O'Donoghue

[1] Before the Common Era, equivalent to BC, but preferred by historians since it does not privilege Christianity in our global, multifaith, multicultural village.