ASTRONOMY

Impressive Stellar Display

Brilliant winter constellations shining on December evenings include Orion, Canis Major and Taurus. The planets Jupiter and Saturn are visible early, James Stokley reports.

➤ WITH THE ARRIVAL of December the brilliant constellations of the winter evening are now in full view. Orion and his neighbors, which occupy a region of the sky that has more bright stars than any other area of similar size, shine in the southeast, as shown on the accompanying maps.

These depict the heavens as they look about 10 p.m., your own kind of standard time, at the first of December, an hour earlier at the middle of the month and two hours earlier at the end.

A good place to start is with the three stars in a row (now nearly vertical) that form the belt of the warrior, which is the way that Orion was pictured on the old star maps. These stars are high in the southeast. To the left, and a little higher, is Betelgeuse, while brilliant Rigel is to the right and below the belt.

Directly below Orion is Lepus, the hare, a relatively faint group, but to the left of this creature is Canis Major, the great dog, with the star called Sirius. It is also known as the dog star, and is the brightest star that we can see in the nighttime sky. Even though its present low altitude causes considerable reduction in its light on account of absorption in the atmosphere, Sirius still shines with great splendor.

Canis Minor Stands in the East

Over toward the east, a little higher than Sirius, is Procyon in Canis Minor, the little dog. And above this group is the constellation of Gemini, the twins, in which are two bright stars, Castor and Pollux. (These appear on the map of the northern sky.)

Above Orion is Taurus, the bull, with the bright star Aldebaran (red in color) marking the animal's eye. To the left of Taurus (also on the northern sky map) is Auriga, the charioteer, with Capella as the brightest star.

Low in the northwest is Vega, about all that is now visible of the constellation of Lyra, the lyre. Vega is of the first magnitude—the brightest—but its low altitude causes a diminution of its light, as with Sirius. Similarly dimmed is Deneb, in Cygnus, the swan, which is above Vega.

Directly north, about half way from the horizon to the zenith, is Polaris, the pole star, which is part of Ursa Minor, the little bear. Ursa Major, the big bear, is a little lower and to the right, in a poor position, as it always is at this time of year. But higher than Polaris, and toward the left, you can see Cassiopeia, the queen, whose five main stars now form a letter M.

Andromeda, who was Cassiopeia's daughter according to mythology, is above her mother. Directly overhead stands Perseus, the champion, who rescued the princess when she was chained to a rock and a sea monster was about to devour her. The star marked Algol is not notable for its brightness, but because it is a famous variable star. Every 2 days 21 hours, approximately, it fades to about a third of its normal brightness, taking about five hours to dim and about five more to return to its original state. Actually, there are two stars, one dark, which regularly passes in front of its bright companion and partially eclipses it.

No planet is visible in December at the times for which the maps are drawn, but earlier in the evening—until about three hours after sunset—Jupiter shines brightly in the southwestern sky. It is in the constellation of Capricornus, the horned goat. This is next to Aquarius, the water carrier, which does appear, low in the west. Saturn, considerably fainter, is lower and farther to the right. It sets about half an hour earlier.

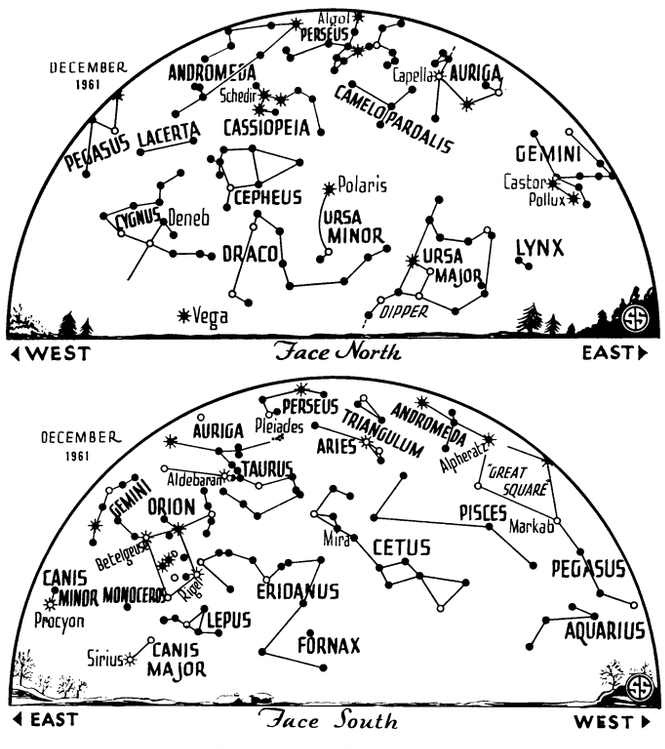
On Thursday, Dec. 21, at 9:20 p.m. EST (8:20 CST, 7:20 MST and 6:20 PST), the sun reaches its farthest south for the year. At this moment it will be directly over the Tropic of Capricorn, above a point near the city of Rockhampton, on the northeast coast of Australia. In the Northern Hemisphere this is the winter solstice, marking the generally recognized beginning of winter. But in Australia and other countries of the Southern Hemisphere it is the beginning of summer.

On Dec. 21, as seen from the U.S., the sun rises far to the south of the eastern point of the horizon. Similarly, it sets well to the south of due west. Its noon-day height is the lowest of the year. Consequently it has only a short path above the horizon, and a long one below, which means that this is the shortest day of the year, and the longest night.

Knowing this, you might suppose that on the 21st the sun would rise later than any other day, and set earlier. But it does not! The earliest sunset comes from Nov. 30 to Dec. 13. Then, at 40 degrees north latitude, it sets at 4:35 p.m. if you are on the central meridian of your time zone. (That is, at 75 degrees west longitude for Eastern time, 90 degrees for Central, 105 degrees for Mountain and 120 degrees for Pacific.) To the west of these meridians, by your watch, it would be later; to the east, earlier. On Dec. 21, the sun sets at 4:38 p.m., and rises at 7:18 a.m.

The latest rising, at 7:22 a.m., comes from Dec. 30 to Jan. 11, when the sun sets from 4:43 p.m. to 4:55 p.m. In other words, the earliest sunsets come several days before the solstice, while the latest sunrises come several days later. Why?

The reason lies in the fact that the sun is not entirely satisfactory as a clock. Centuries ago, the sundial was the most common timepiece. Noon came when the sun was directly south, with the shadow of the gnomon aimed due north. But the sundial



sometimes runs fast, sometimes slow, because of the way the earth revolves around the sun. It indicates what is called apparent time. As clocks came into use, "mean" time was introduced, which is based on an average, or mean sun, that does run at the same rate throughout the year.

At the beginning of November, mean time is about 15 minutes slow compared to apparent time; that is, the sun is 15 minutes early. After that—during December—the clock gains rapidly on the sundial. In mid-February, the sun will be almost 15 minutes late. The difference between mean and apparent time is called the "equation of time"; it is the number of minutes and seconds that you must add to or subtract from the mean time indicated by the clock to get the corresponding apparent or sundial time.

On Dec. 6, approximately midway in the earliest sunset period, the equation of time is plus 9 minutes 11 seconds; on Dec. 21, plus 2 minutes 10 seconds, and on Jan. 5, approximately midway in the latest sunrise period, minus 5 minutes 6 seconds. Now let us alter the times of sunrise and sunset on these dates to give it in apparent time, and we have:

	Sunset	*Sunrise*
Dec. 6	4:44 p.m.	7:16 a.m.
21	4:40 p.m.	7:20 a.m.
Jan. 5	4:44 p.m.	7:17 a.m.

Now the latest sunrise and the earliest sunset do occur on the shortest day—the day with the least time between the sun's rising and setting.

In other words, the sun performs according to its own kind of time, not the arbitrary and artificial kind of time that man has found most convenient to regulate his activities.

Celestial Time Table for December

Dec.	EST	
5	2:02 a.m.	Algol (variable star in Perseus) at minimum brightness
7	6:52 p.m.	New moon
	10:51 p.m.	Algol at minimum
10	7:00 p.m.	Moon passes Saturn
	7:40 p.m.	Algol at minimum
11	9:00 a.m.	Moon passes Jupiter
	7:00 p.m.	Moon nearest; 228,900 miles from earth
13	early a.m.	Meteors seen radiating from constellation of Gemini
14	1:00 p.m.	Mars behind sun
	3:06 p.m.	Moon in first quarter
16	3:00 a.m.	Mercury behind sun
21	7:42 p.m.	Full moon
	9:20 p.m.	Sun farthest south; winter commences in Northern Hemisphere
25	3:46 a.m.	Algol at minimum
27	2:00 p.m.	Moon farthest; 251,500 miles from earth
28	12:35 a.m.	Algol at minimum
29	10:57 p.m.	Moon in last quarter
30	9:24 p.m.	Algol at minimum

Subtract one hour for CST, two hours for MST, and three hours for PST.
MST, and three hours for PST.

Know the Sky to Watch Satellites

These star maps showing the positions of stars and planets can help you locate satellites when they flash briefly across the sky. Familiarity with the constellations and their relative positions makes locating artificial moons much easier whenever they are visible from your area.

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