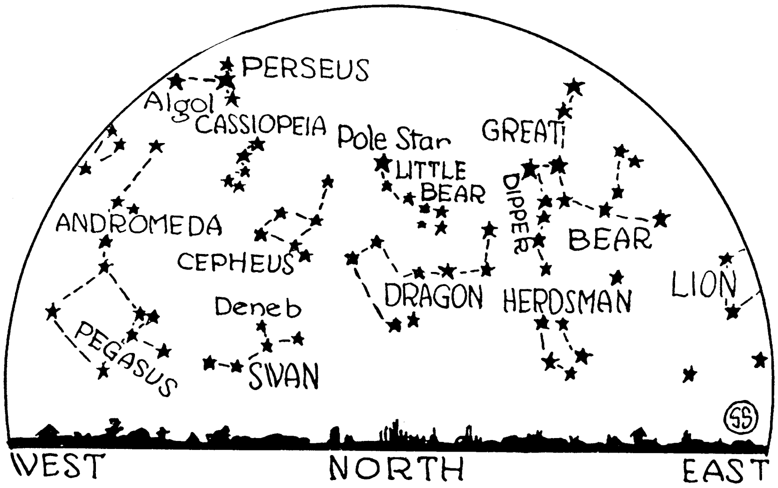
Brightest Stars Now in Evening Sky

Astronomy

By James Stokley



Hold these maps in front of you and face north or south. The upper or lower one will then show the stars of the February evening sky.

IF you want to see bright stars, this is the time of year to look at evening skies. Of the ten brightest stars that you can see from the United States, seven are now visible in the evening, in and around the constellation of Orion. They form a ring of six brilliant stars, with the seventh near the center.

In the southern sky, these February evenings, you can easily find a row of three stars, which form the belt of the heavenly warrior, Orion. They are not included among the brightest ten, but they form a convenient guidepost to them. Above and to the east of the belt you will see a brilliant star, Betelgeuse. According to Webster, it is pronounced bet elguz, the first syllable as in "bet", meaning a wager; the second similar to the last syllable of "single" and the "u" in the last the same as in "urn." But you do not need to be surprised if you attend a meeting of astronomers and hear a pronunciation ranging from "beh tell' jew-eez" to "beetle-juice."

Its spelling, too, varies widely, as the last syllable may be spelled "-guese," "-guex" or "-gueze." In fact, many astronomers pronounce the word "alpha Orionis," because this is the really proper way of designating the star, and is subject to fewer variations.

To the southwest of Orion's belt is Rigel, or beta Orionis. To the northwest of Betelgeuse is alpha Tauri, or Aldebaran, to use its common name. This star is red in color, and represents the eye of the bull, Taurus.

This month Taurus is further decorated by the presence of the planet Jupiter, to the north of Aldebaran. Because of its steady light and brilliance superior to any star in the sky, you can easily identify it. Jupiter, of course, is a planet, a member of our own solar system of bodies, that, like the earth, travel in orbits around the sun.

Almost over your head in early February evenings is Capella, in Auriga, the charioteer, about which we shall say more a little later. To the southeast of Capella, and northeast of Betelgeuse, is Pollux, the brighter of the two twins, Gemini. South of Pollux is Procyon, in Canis Minor, the little dog, while still farther south is the brightest of all the stars in the sky, Sirius, the "dog star," in Canis Major, the great dog. In no other part of the sky can so many brilliant stars be seen as in this circle around Orion.

Capella, in Auriga, is the third brightest star visible from 40° north latitude, approximately that of a large part of the United States. Vega, in Lyra, which is not visible this month, is the second brightest. From the extreme southernmost parts of the United States, however, there can be seen a third star that exceeds Capella in brightness. It is Canopus, in the constellation Carina. If you happen to be wintering in Florida or southern California this month, you can see Canopus in the early morning, low in the southern sky.

But though Capella, to the unaided eye, looks like a mere point of light, and though no present or projected telescope, however powerful, will reveal the globe of the star, astronomers have learned many of its secrets. In Prof. A. S. Eddington's famous book, "The Internal Constitution of the Stars," this distinguished astronomer of Cambridge University devotes four pages to listing various facts about Capella. The Astronomical Society of the Pacific, with headquarters in San Francisco, has just issued a leaflet devoted entirely to this star. It was prepared by Dr. Paul W. Merrill, of the Mt. Wilson Observatory, who has himself contributed much of the information.

To the unaided eye, to the same eye looking through a great telescope, or even to the sensitive surface of the photographic plate, Capella looks like a single star. But in 1899 two astronomers, on opposite sides of the Atlantic, found that Capella is not what it seems. Dr. W. W. Campbell, now president of the University of California and director of the Lick Observatory, observed it with the spectroscope. So did Dr. H. F. Newall, at Cambridge University in England.

Identifying the elements of which a distant star consists is not the only work that a spectroscope does for the astronomer. When the light is analyzed and the dark lines of the spectrum appear, they are sometimes displaced towards one end. There are various causes for such a displacement, but the most usual is a motion of the star towards or from the earth—what astronomers refer to as "radial motion," because it is along a radius extending from the earth as a center. It is due to the "Doppler-Fizeau effect."

If you have ever stood on the platform of a railroad station as an express train rushed past with the locomotive bell ringing, you have probably observed a familiar example of this effect. As the bell approaches it sounds shriller than it does when receding. The shrillness, or pitch, of the sound of a bell depends on the distance between the sound waves that reach the ear. The closer they are, or the shorter the wave length, the more shrill the bell sounds. If the bell emitting the sound waves is rapidly approaching you, the sound waves are jammed closer together than if the bell is standing still, and so it seems to have a higher pitch than normally. When it is rapidly receding, the waves are spread out and then the bell seems to ring with a deeper note.

Since light behaves, for all ordinary purposes, as if it were due to waves, an exactly similar effect is observed. Light from a star approaching the earth is "shriller," or bluer, than light from a star that is stationary with respect to the earth. If the star is receding, it is redder. There are no sharp divisions in the spectrum between the different colors and their displacements cannot be observed, but the sharp dark lines revealed by the spectroscope are different. They can be measured accurately on spectrum photographs. In taking such a spectrum photograph, the spectrum of the star is first recorded. Then, through the same instrument and on the same plate is recorded the spectrum of light from an electric arc of iron or titanium. This produces a series of lines alongside the star spectrum which serves as a standard from which to measure the displacements of the star lines. If the latter then prove to be nearer the red end of the spectrum than the corresponding comparison lines, the astronomer knows that the star is approaching the earth. The speed is indicated by the amount of the displacement.

Studying the spectrum of Capella, Dr. Campbell and Dr. Newall found that the lines varied over a period of about 104 days. The lines would appear as in an ordinary star, then they would double, only to become single again. The only satisfactory explanation of this behavior is that the star is double with the two components revolving around each other. When both members of the pair are on a line with the earth, they are neither approaching nor receding, and their lines coincide. Twenty-six days later they are side by side; then one is moving rapidly towards us, while the other is going away. At this time the lines from the latter are displaced to the red end of the spectrum, while those from the former are shifted to the blue. Therefore, the lines are doubled. After 26 days more the stars are in line and the spectral lines again coincide.

But this is not the only source of our knowledge of Capella. With the interferometer that was used with the 100-inch telescope at Mt. Wilson to measure the first diameter of a star, the actual separate members of the Capella pair were observed. This instrument depends on the fact that the waves in two beams of light, from nearby objects, may be made to "interfere," and produce a series of light and dark bands. Measurement of these bands reveals the separation of the two light sources. The instrument was originally invented by Dr. A. A. Michelson, and modified by Dr. J. A. Anderson for use on the Mt. Wilson telescope. With this instrument, it was found that the angle between the two stars in Capella, when fully separated, is a twentieth of a second of arc. This is the angle that would be made by two points an inch apart and 65 miles from you —too small to be seen directly with any telescope, but not too small to be revealed by the interferometer.

From the observations with the spectroscope, the actual distance separating the two stars was calculated, and found to be 7,866,400,000 miles. With the angle known, and the actual distance between them, it is easy to figure out how far away they are, and this proved to be 52 light years, or 52 times six million million miles! With their distance known, their intrinsic brightness, or "candlepower" was calculated and it turned out that one of them is 110 times and the other 48 times as bright as the sun.

From the known laws of the behavior of glowing bodies, their diameter was estimated at 13.7 and 7 times that of the sun. Study of their motions around each other gives data from which to figure their mass, and the curious fact was found that in this respect they are much more nearly like the sun. The more massive has only 4.2 and the other 3.3 times the sun's mass. As this is spread out over so much more space, they must be exceedingly diffuse. The larger star is about one-four-hundredth as dense as water, not as much as twice that of ordinary air, while the other is only about ten times as dense. This places them in the class of giant stars, while our sun is a dwarf.

Summarizing our knowledge of Capella, Dr. Merrill has this to say:

"Speaking broadly, it is a sun, but it differs markedly from the beneficent ruler of our solar system in many important particulars. To recapitulate briefly, it is a double giant, while our sun is a single dwarf. Both objects are probably typical examples of large classes of similar bodies, unique only in being especially well known to terrestrial observers."

If you look to the southeast of Capella this evening you will see another famous double star. Castor, the fainter of the two Twins, Gemini, and to the northwest of Pollux, is revealed by even a moderate sized telescope as a double star, with two components, one of the second and the other of the third magnitude. They are about 6 seconds apart—120 times as far as the parts of Capella. Being farther apart, they move more slowly, and take about 300 years to make one revolution about each other. But the spectroscope reveals an otherwise unsuspected fact about them. With it, astronomers have shown that each component is itself a spectroscopic binary, like Capella. Even this is not all. About 73 seconds from the center is a faint star that is also part of the system. It also is a spectroscopic binary, so Castor, that you see as single with your unaided eye, consists in reality of six separate orbs, all revolving around each other in a most complicated fashion.

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