



Enter the Twilight Zone

Enjoy dawn and dusk riches during the summer solstice.

Dusk and dawn. Gloaming. Blue Hour. Eventide. All refer to twilight, that colorful and contemplative time after sunset and before sunrise. Light scattered off particles and dust in the air bathes the landscape in a soft, mellow light. I've always enjoyed the transition that dusk provides, especially in summertime when the end of the day brings relief from the heat. Dawn has a different feel. It's an awakening to the fresh possibilities that come with a new day.

But twilight can have a downside, too. Around the summer solstice — which this year occurs on June 20th at 11:32 p.m. EDT — skywatchers at mid-northern latitudes typically experience late sunsets, two hours or more of evening twilight, and very little true darkness. That puts a big crimp in the time available for spending at the telescope, not to mention how late nights can affect your attentiveness at work the next day.

The crescent Moon and Mercury adorned evening twilight last January when this photo was captured. The sky near the horizon appears much redder than higher up because we view through much more atmosphere, which scatters blue light, leaving only orange and red hues.

The circumstances aren't so bad in the southern states where twilight is shorter, but in the northern U.S. and southern Canada it lingers an additional hour and kicks in again 2½ hours before sunrise. That makes for a short night. So why not spend an evening observing the twilight sky at dusk for its own charms?

Let's start by looking at the three types of morning and evening twilight: *civil*, *nautical*, and *astronomical*. Civil twilight begins at sunset and ends when the center of the Sun is 6° below the horizon. During this period, you can still easily see your way around and recognize faces and landmarks.

Scattered light from the setting Sun

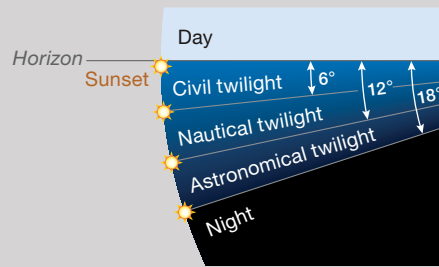
colors the western horizon bright yellow at first, which deepens to orange and orange-red as the minutes pass. If mid- to high-level clouds are present, they catch the Sun's final reddened rays and glow vividly against the deepening blue sky. Watch for the purple light some 20° to 30° above the western horizon about 15 to 20 minutes after sunset. The effect is caused by sunlight scattered by dust and aerosols in the lower stratosphere mingling with the reds of the troposphere. Extra material injected into the air by volcanic eruptions and dust storms can intensify the phenomenon. Civil twilight is also the best time to spot the Earth's shadow rising in the eastern sky, opposite the

sunset position. The shadow appears as a purple-gray band about 5° wide, fringed by a diffuse, pink glow. Known as the Belt of Venus, it's caused by red-dened sunlight scattering off dust high in the atmosphere.

Nautical twilight covers the interval when the center of the Sun is between 6° and 12° below the horizon. During this time, sailors can still discern the horizon and make reliable readings of star positions at sea with a sextant. On terra firma, the brighter stars and constellations are visible, and most outdoor activities require artificial lighting.

The general public would consider the end of nautical twilight “night” — but not astronomers. For them, true night only arrives at the end of astronomical twilight, when the center of the solar disk has dipped 18° below the horizon. With all trace of twilight gone, observers far from city lights can seek the faintest deep-sky objects and comets. Of course, the night sky is never truly dark. Starlight, airglow, aurorae, and zodiacal light continue to provide feeble illumination, making it possible to see your hand silhouetted against the sky even from the darkest locations on Earth.

Nights around the solstice offer only a brief voyage into darkness before our craft arrives at dawn's shore, where each stage of twilight plays out in reverse before the Sun peeps over the horizon. How long twilight lasts depends on how quickly the Sun drops below the



▲ **DAY TO NIGHT** Twilight has three phases, each defined by the Sun's position relative to the horizon. The sky is only fully dark when the Sun's center lies 18° below the horizon at the end of astronomical twilight (evening) or before the start of astronomical twilight (morning).

horizon, which varies according to the season and your latitude. Dusk and dawn zip by in about 70 minutes at the equator, where the solar disk quickly drops to -18° . Northern visitors to the tropics are often shocked at how quickly darkness falls.

Not surprisingly, twilight lingers longest at the poles, where the Sun's path is nearly parallel to the horizon around the equinoxes. All of us have heard of the Land of the Midnight Sun, where daylight lingers continuously during the summer solstice for locations north of the Arctic Circle. However, you might be surprised to learn that if you live north of 48.5° the Sun's center never dips to -18° on the June solstice. As most Canadian stargazers are keenly aware, at least a trace of twilight lingers in the northern sky all night long.

The Sun's declination varies during the year from 23.5° north of the celestial equator on the summer solstice, to 23.5° south on the first day of winter. Near the equator, the Sun's path is almost perpendicular to the eastern and western horizons all year long. However, at mid-Northern latitudes in summer, the Sun intersects the horizon at a much shallower angle. That means the Earth has to spin longer for the Sun to sink to the requisite -18° , increasing twilight's duration by an hour or more.

June is, of course, the month of the summer solstice and brings a bounty of eventide. Use the time to relish the progression of colors and emerging stars as our planet languorously unfurls its shadow across the sky.**



▲ **FADING LIGHT** The blue-gray band of Earth's shadow rises in the eastern sky beneath the rosy-hued Belt of Venus. Both features lie opposite the setting Sun and remain visible for 20 to 25 minutes after sunset.