

# Enigma of the Ashen Light

*Help astronomers solve this enduring mystery of Venus.*

**FOR MORE THAN** three centuries, many telescopic observers have reported a faint glow emanating from the nightside of Venus. One of the oldest unsolved riddles in planetary astronomy, the so-called *ashen light*, is puzzling because this cloud-shrouded planet has no satellite capable of reflecting sunlight to illuminate its nightside the way that sunlight reflected by Earth produces the appearance of “the old Moon in the new Moon’s arms.”

There is a common link, however, between earthshine on the Moon and the ashen light of Venus. They are both phase-dependent and only become conspicuous at large phase angles. The ashen light is seldom reported when Venus is more than 30% illuminated and is usually seen only when the crescent phase is viewed against a dark-sky background. At such times Venus must be viewed at a rather modest altitude above the horizon, so image quality is almost invariably impaired by atmospheric turbulence.

Although some observers have described the color of the ashen light as purple, blue, and even green, reports of a warm, ruddy hue are far more common. Visual perceptions of the color of faint light sources are notoriously unreliable. A pronounced shift in the sensitivity of the dark-adapted eye toward the blue end of the spectrum, known as the *Purkinje effect*, causes a faint source of red light (such as the glowing ember of a distant cigarette) to be perceived as green. Most observations of the ashen light using color filters suggest that it really is brightest in the red region of the spectrum.

Many authorities dismiss the ashen light as an optical illusion. Skeptics find it hard to believe that the phenomenon has not been recorded in images or spectrograms obtained with large Earth-based telescopes, let alone by the various spacecraft that have orbited Venus.

It cannot be denied that the human eye–brain combination has an insidious tendency to fill in or complete the figure of a crescent. Prospective observers of the ashen light have been strongly encouraged to eliminate this visual cue by hiding the crescent behind an occulting bar inserted at the focal plane of an eyepiece. Malleable 15-amp fuse wire is the ideal material for constructing such a device because it’s easy to form a semicircular kink that matches the curve of the planet’s terminator.

Your telescope can also be a source of deception. The dazzling brilliance of Venus’s sunlit crescent severely taxes the color correction of achromatic refractors. The French astronomer André Danjon cautioned that the purple halo of chromatic aberration can convincingly mimic the appearance of the ashen light. Nor are reflectors immune. Light diffracted by the spider supports of the secondary mirror of a Newtonian or Cassegrain reflector can also produce the appearance of a glow on the planet’s nightside.

Veteran Venus observers such as Richard Baum have characterized the ashen light as “a rare phenomenon, seen with difficulty and even then uncertainly.” An exhaustive review of the British Astronomical Association’s observational archives, which span more than a century, has led Richard McKim, director of the British Astronomical Association’s Mercury and Venus Section, to conclude that the phenomenon is real but only appears sporadically:

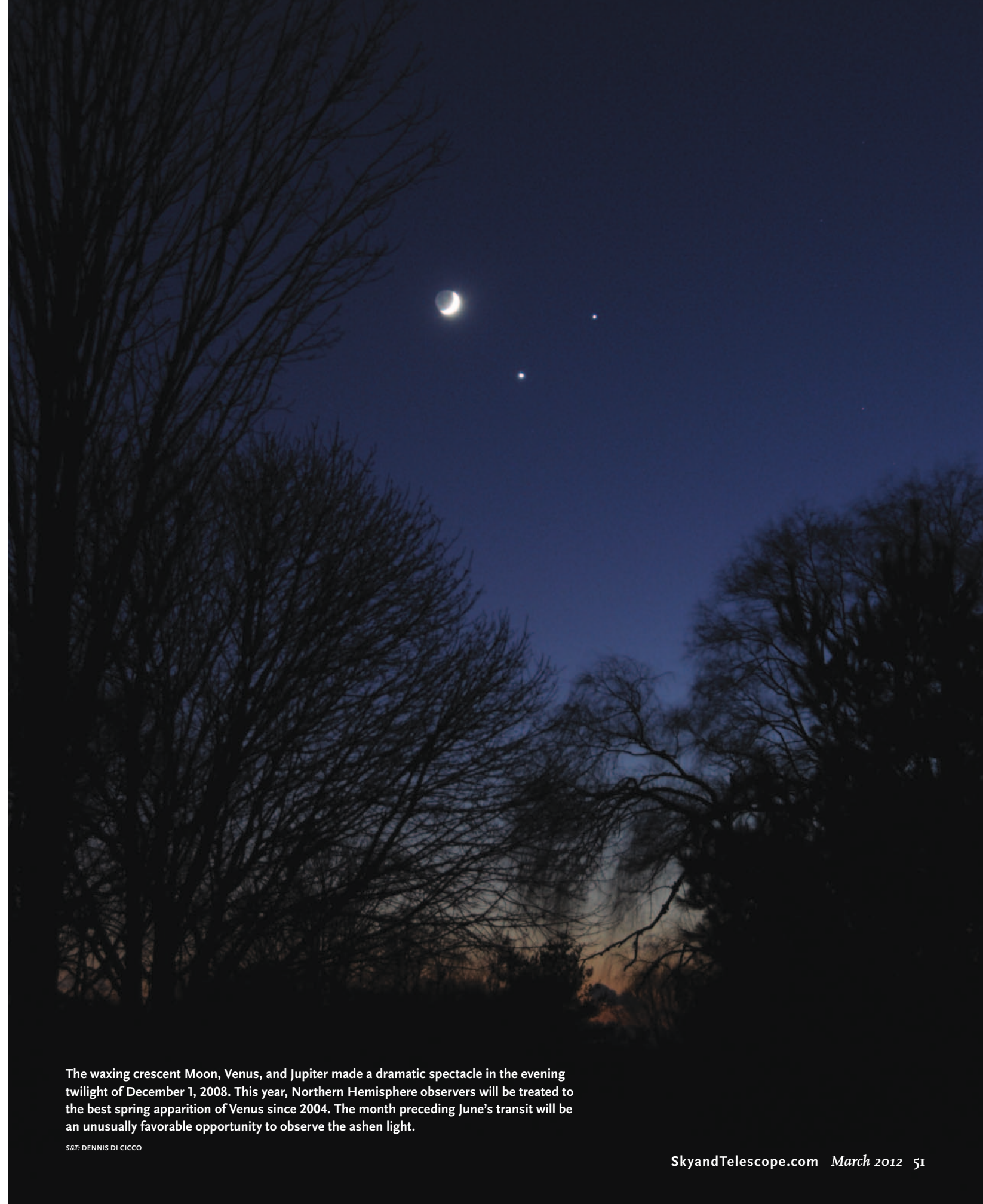
*Sometimes the ashen light is visible for many days in succession, as in 1940, 1953, 1956, and 1957. At other times, despite excellent observing conditions, it remains elusive... Its visibility must therefore depend upon conditions in the Venusian atmosphere rather than upon the altitude of Venus in terrestrial skies.*

Although most accounts of the ashen light describe a uniform, structureless glow, some observers have remarked on its patchy or mottled appearance. In 1949 three experienced observers in the United States independently reported that only one-third of “the dark face glowed over an area in the form of a biconvex lens, with



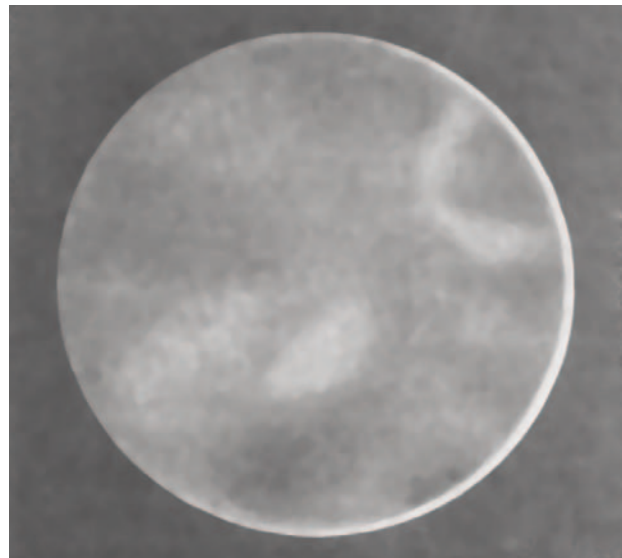
The appearance of the ashen light of Venus is frequently compared to earthshine on the crescent Moon. The apparent surface brightness of the sunlit lunar crescent is about 2,500 times greater than the earthlit portion of the Moon. The intensity of sunlight reflected by the cloud canopy of Venus is about 60 times stronger than the reflected light of the crescent Moon, producing intense glare that makes observing the planet’s adjacent night-side extremely challenging.

S&T: SEAN WALKER



The waxing crescent Moon, Venus, and Jupiter made a dramatic spectacle in the evening twilight of December 1, 2008. This year, Northern Hemisphere observers will be treated to the best spring apparition of Venus since 2004. The month preceding June’s transit will be an unusually favorable opportunity to observe the ashen light.

S&T: DENNIS DI CICCO



The ashen light is often described as a uniform glow emanating from the nightside of Venus. However, many observers have reported an irregular, dappled appearance similar to this 1932 drawing by Robert Cheveau.

one surface along the terminator and the other some way within the dark limb.” Several observers at widely separated locations in Britain independently reported that the ashen light was unusually conspicuous on the evening of March 17, 1953. One commented on its “slightly brownish, mottled” aspect, while another was struck by the “filmy, granular look” of a “coppery” glow that he suspected might be caused by “a confusion of tiny bright spots.” Others have described wavy arcs of light and random scatterings of bright dots. These reports of structure are difficult to reconcile with the notion that the ashen light is invariably an optical illusion.

If the ashen light is a real but transient phenomenon, what mechanism could produce it? Prior to 1962 the glow of intense auroral displays seemed to be the most plausible explanation. Terrestrial auroral displays occur when charged particles emitted by the Sun are captured by the

Earth’s magnetic field and interact with rarefied gases high in the atmosphere. It was widely suggested that the closer proximity of Venus to the Sun would subject it to almost twice the flux of solar corpuscular radiation, but in 1962 the Mariner 2 spacecraft revealed that Venus lacks an appreciable magnetic field. In any event, there doesn’t appear to be any correlation between the reports of the ashen light and the level of solar activity or solar-wind events.

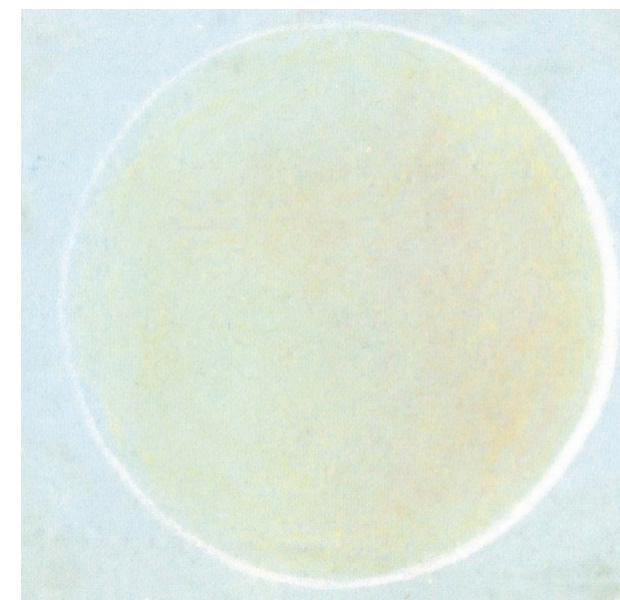
Others have suggested that the ashen light might be an analog of the terrestrial airglow or permanent aurora that occurs at extremely high altitudes in Earth’s atmosphere. This phenomenon occurs when atoms ionized by solar radiation during the day slowly release radiant energy throughout the night as they return to their ground states. Instruments aboard the Russian Venera 9 and Venera 10 orbiters detected a glow in the visible region of the spectrum on the nightside of Venus emitted when single atoms of oxygen recombine to form diatomic molecules of oxygen. Although this oxygen airglow fluctuates in brightness by a factor of three, it has been estimated that even at its brightest it is about 40 times too faint to be visible through a telescope of modest aperture.

A far more intense and even more variable oxygen airglow is emitted at a wavelength of 1.27 microns in the near-infrared. Almost a thousand times stronger than the visible-wavelength oxygen airglow, this emission has been studied with large ground-based telescopes equipped with sensitive infrared detectors. The brightest sources at this wavelength are well-defined patches measuring 1,000 to 2,000 kilometers in diameter. At the opposite end of the spectrum, sudden, dramatic brightening of Venus’s night side at far-ultraviolet wavelengths was detected on several occasions by NASA’s Pioneer Venus Orbiter during the 1980s. However, neither the near-infrared nor the far-ultraviolet emissions would be visible to the human eye, so their relationship to the ashen light is certainly questionable.

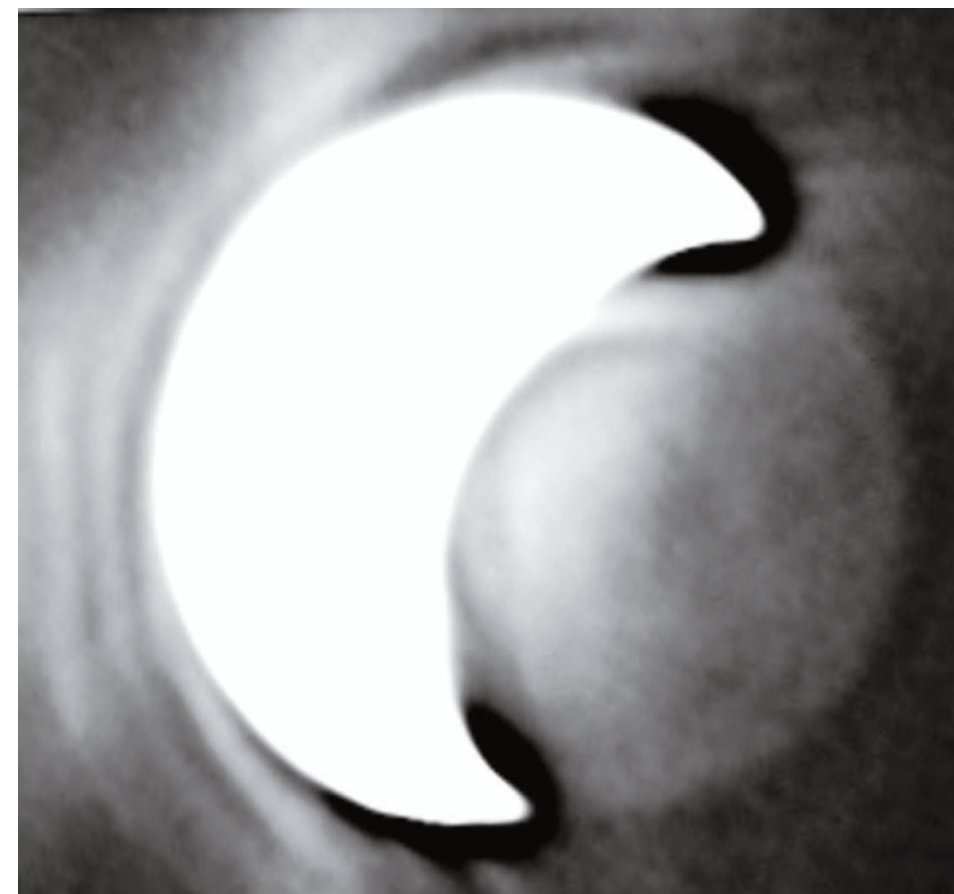
Flashes of lightning illuminating the clouds above the nightside of Venus have been proposed as an explanation for the ashen light. During the 1970s, American and Russian spacecraft recorded radio noise that was widely interpreted as evidence of lightning discharges, but definitive proof only came in 2007, when the magnetometer aboard the European Space Agency’s Venus Express Orbiter detected the short, intense electromagnetic pulses that are the characteristic signature of lightning. Gathered over a three-year period, these data suggest that lightning on Earth and Venus is similar in strength and frequency at similar altitudes. On Venus, lightning is more prevalent during the day than at night and occurs more frequently at low latitudes, where the solar energy input to the planet’s atmosphere and resulting convection are strongest. But in order to be visible from Earth as the ashen light, it has been estimated that 1,000 flashes per second would be required to illuminate the clouds on the nightside of Venus, a figure about 10 times greater than the observed frequency.

Six years ago, Fred Taylor of the Atmospheric, Oceanic, and Planetary Physics Group at Oxford University proposed a straightforward explanation for the ashen light. According to Taylor, the opacity of the cloud structures observed in recent years by Venus Express is sufficiently low that the dull red thermal glow of the planet’s surface, which bakes at an ovenlike 800°F (430°C), might occasionally penetrate the atmosphere and become dimly perceptible at visible wavelengths. Absorption and light scattering by the aerosols in Venus’s atmosphere are weak at visible and near-infrared wavelengths, allowing the dim glow of the planet’s surface to vary depending on the presence or absence of intervening clouds of greater opacity. Taylor says that “it seems not unreasonable to expect a fully dark-adjusted observer to be able to see the glow from the surface of Venus under good viewing conditions.” Descriptions by telescopic observers of the ashen light’s ruddy hue as well as its dappled appearance or the partial visibility of the nightside are certainly consistent with this notion.

Taylor’s hypothesis calls to mind an extraordinary observation of the ashen light in broad daylight made in 1962 by a pair of graduate students at the University of Arizona who went on to become two of the leading planetary scientists of their generation. Dale Cruikshank and William K. Hartmann had been observing Venus near inferior conjunction with a 12.5-inch Newtonian

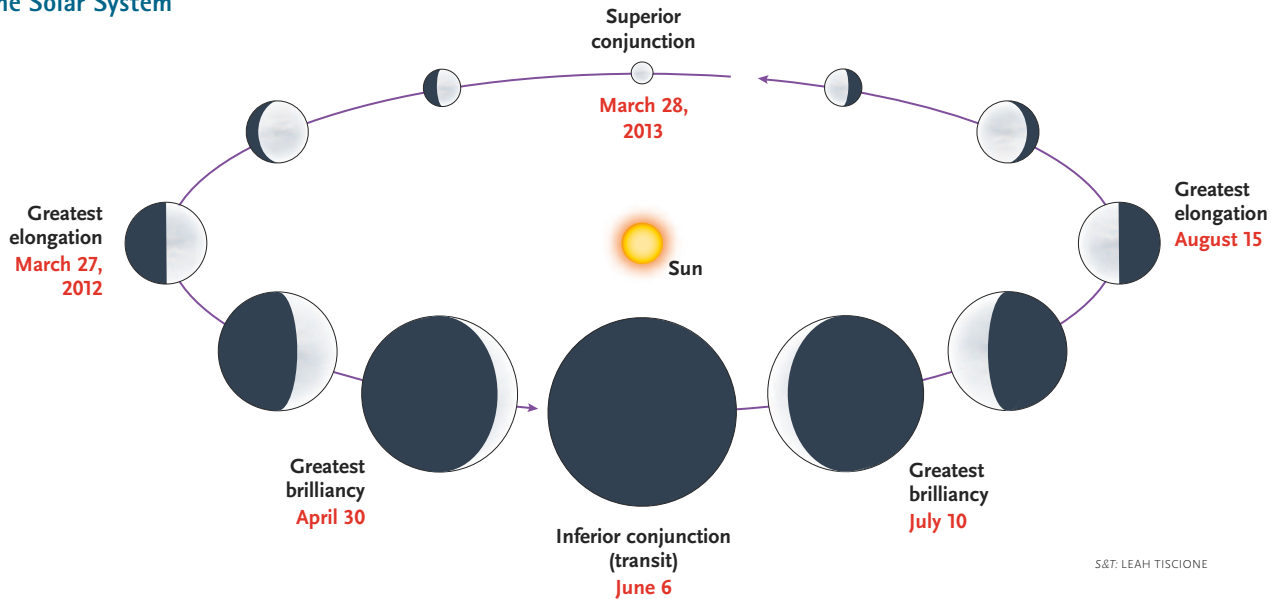


This sketch by Dale Cruikshank depicts the appearance of the nightside of Venus appearing ruddier than the background sky during a daylight observation in 1962. This intriguing observation by a seasoned observer and eminent planetary scientist lends credence to the notion that the thermal glow of the planet’s torrid surface may occasionally be visible to telescopic observers.



In May 2004, the French amateur Christophe Pellier imaged Venus at a wavelength of 1-micron in the near-infrared region of the spectrum. Although the crescent was only 19% illuminated, it appears much fatter because it was drastically overexposed in order to record the thermal emission from the planet’s nightside. Although these images bear an uncanny resemblance to descriptions of the ashen light by visual observers, the wavelength is impossible for the human eye to detect.

Diffraction spikes from secondary mirror supports in some reflecting telescopes are enhanced when superposed on the planet’s nightside. Many spurious reports of the ashen light are attributable to spider diffraction. Refractors, Maksutov-Cassegrains, and Schmidt-Cassegrains will not produce these illusory appearances.



S&amp;T: LEAH TISCIONE

For Northern Hemisphere observers, Venus will be unusually well-placed in the evening sky throughout the spring of 2012. The best opportunities to observe the ashen light will occur between late April and the middle of May.

reflector for several days. “We were quite familiar with the appearance of Venus from day to day, usually at about the same time of day,” Cruikshank recalls. “Since the ashen light sighting came unexpectedly as part of a long series of observations, we were pretty certain of its reality.” In this instance the ashen light did not appear brighter than the brilliant sky background, but was perceived as a coppery or bronze hue inside the cusps of the crescent that contrasted with the surrounding azure sky.

While the reality of the ashen light remains controversial, Cruikshank strongly encourages amateurs to continue monitoring Venus’s night hemisphere:

*We can adopt the principle that many phenomena of Venus are time-variable, and that the observations made by professional astronomers with their sensitive techniques do not cover enough of a time base to have caught the elusive ashen light. It then seems reasonable that amateurs, if suitably equipped with sensitive instruments on moderately large telescopes, can play a role in solving the mystery of the ashen light because they can devote a large amount of time to getting the observations.*

As recently as the 1980s, astronomers discovered that the clouds of Venus are partially transparent at several near-infrared wavelengths, making it possible to image deep cloud decks and even the planet’s surface. While images of the sunlit portion of Venus at a wavelength of 1 micron (1,000 nanometers) are virtually featureless because they record sunlight reflected by high-altitude clouds and hazes, images of the planet’s nightside at this wavelength record thermal emissions from the surface with surprising clarity. Venus’s appearance in this narrow spectral window broadly correlates with its topography, the cooler highlands appearing dark and the warmer valleys bright.

In 1991 a team of French astronomers using a 42-inch telescope at the Pic du Midi Observatory obtained the

first 1-micron images of the surface features of Venus. Thirteen years later French amateur Christophe Pellier managed to duplicate this feat. Using a 14-inch Schmidt-Cassegrain, a monochrome webcam, and a 1-micron infrared filter, Pellier imaged the nightside of Venus glowing right through the planet’s clouds in May 2004, when Venus appeared as a 19%-illuminated crescent. Uncertain whether his equipment would be up to the task, he was taken aback to see the thermal glow from the nightside of Venus appear on the monitor after an exposure lasting only a few seconds. Inspired by Pellier’s success, dozens of other amateurs have since captured near-infrared images of the planet’s topography (*S&T*: October 2010, page 72).

Although these images bear a striking resemblance to depictions of the ashen light by visual observers, they record Venus in a region of the spectrum that is invisible to the human eye. But they should entice imagers to monitor Venus’s nightside in visible wavelengths to record any appearance of the ashen light. The addition of an infrared-blocking filter to exclude wavelengths longer than 800 nanometers and exposures of several seconds under a dark sky should capture the phenomenon if it is present at the time.

Late this spring, Venus will be well placed in the evening sky for observers in the Northern Hemisphere. With remarkably powerful imaging capabilities now in the hands of so many amateur astronomers, the solution to one of planetary astronomy’s most enduring mysteries may finally be within our grasp. ♦

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*Although S&T contributing editor Thomas Dobbins is a skeptic when it comes to Bigfoot and the Loch Ness Monster, he became a true believer in the ashen light following his only sighting of the phenomenon 27 years ago.*