The Ashen Light of Venus

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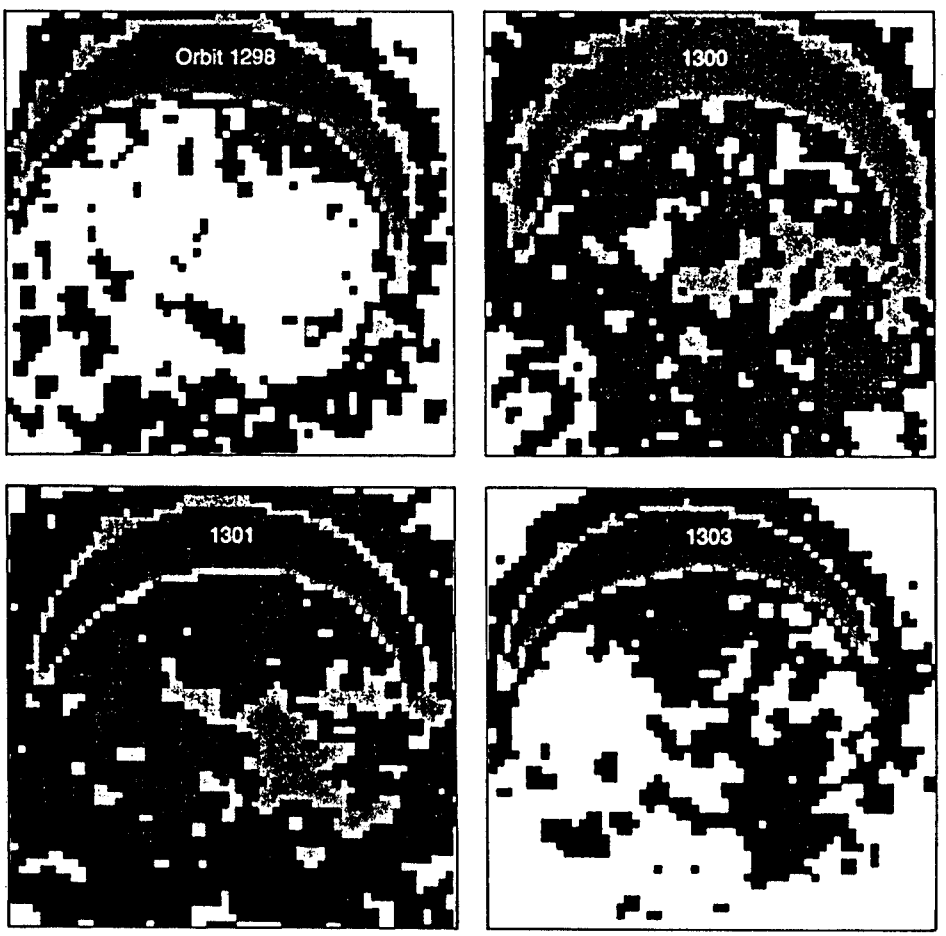
FOR MORE THAN three centuries observers have claimed that the nighttime side of Venus occasionally glows dimly. Similar to earthshine on the Moon, though generally not as bright, the ashen light is one of the oldest unsolved puzzles in planetary astronomy — it's as enigmatic as Jupiter's Great Red Spot, water on Mars, or the search for a tenth planet.

Giovanni Riccioli first noted the phenomenon in 1643, and many have seen it since, including the venerable observers William Herschel and Johannes Schröter. Members of the British Astronomical Association (BAA) frequently reported ashen glows during Venus' evening apparitions in 1956 and 1957-58, which coincided with a sunspot maximum. However, they didn't notice it during the subsequent morning apparitions, and few sightings of it occurred at the next solar maximum.

Not everyone accepts the reality of ashen light, but there are a few observations on record made by professional astronomers. In 1954 Nikolai A. Kozyrev of the Crimean Observatory in the Soviet Union detected many emission bands in the spectrum of Venus' night side, two of which he believed could be related to the phenomenon. Four years later Gordon Newkirk, Jr., of the High Altitude Observatory in Climax, Colorado, found similar spectral features. And in 1969 Joel Levine of NASA's Goddard Institute for Space Studies (GISS) reported a correlation between ashen-light sightings and auroral activity at Earth, suggesting that Venus' night glow could occur when energetic solar particles bombard the planet's upper atmosphere.



This false-color sequence of measurements by the Pioneer Venus Orbiter (PVO) shows the appearance of Venus during June 25-30, 1982. The wavelength is 1304 angstroms (far-ultraviolet), and the planet's sunlit crescent is at top. The dark nighttime portion of the disk recorded during orbit 1298 brightens dramatically (orbits 1300 and 1301) and then returns to normal (orbit 1303). These emissions suggest that ions or electrons, perhaps from solar-flare activity, bombard the uppermost regions of the atmosphere and create aurora-like effects, which could be related to the ashen light. Unlike this ultraviolet display, the ashen light is observed at visible wavelengths and must be many times brighter to be observed from Earth. Courtesy the authors.

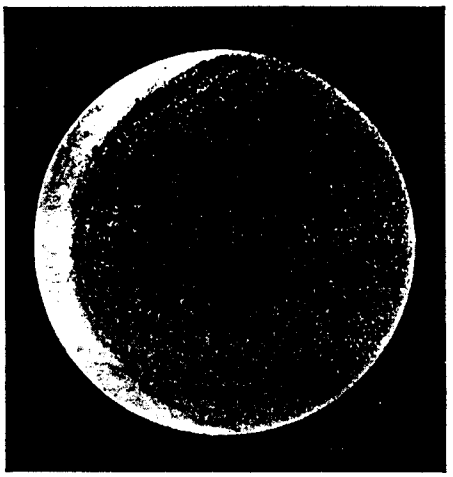
While dozens of spacecraft have visited Venus in the last quarter century, none have been equipped to make a definitive study of the ashen-light phenomenon. For example, in June, 1985, the Soviet Union's Vega spacecraft dropped a pair of balloons, equipped with instruments, into the nighttime atmosphere of Venus. One of the detectors was a light-sensing diode, designed to search for lightning. However, because the balloons remained in the planet's thickest cloud deck at all times (as planned), they were hardly in the best location to detect faint glows higher in the atmosphere.

Current theories on the source of ashen light fall into three main categories: observers' imagination, auroral effects at Venus, and lightning in the atmosphere of Venus (a controversial issue in itself).

THE 1988 OBSERVING CAMPAIGN

A program to resolve the long-standing mystery of the ashen light has never been mounted. Therefore, we have undertaken such an observing campaign and encourage all amateur and professional astronomers to participate. The program will require a combination of optical observations made by astronomers worldwide and comprehensive measurements of solar and planetary conditions by the instruments aboard NASA's Pioneer Venus Orbiter (PVO) spacecraft.

The PVO has monitored Venus from a nearly polar orbit since December, 1978. It rounds the planet in about one Earth day, currently with minimum and maximum altitudes of 1,200 and 39,000 miles.



The ashen light of Venus — the planet's controversial nighttime sheen. Early speculations on its origin ranged from phosphorescent oceans to agricultural burning or artificial illumination by the inhabitants of Venus. Contemporary theories focus on lightning or aurora-like sources in the atmosphere of Venus. Patrick Moore of England made this drawing of the ashen light on May 27, 1980 with a 15-inch reflector at 72x to 300x. About 18 hours later, instruments aboard the PVO spacecraft detected an interplanetary shock wave, caused by a solar disturbance. These two observations inspired John Phillips to start an ashen-light observing campaign. South is up.

On board are instruments designed to observe the planet's atmosphere, the interplanetary environment, and the solar-planetary interaction. Despite their age, the spacecraft and most of its instruments continue to operate well.

The PVO also carries two instruments that are possibly capable of observing the ashen light directly. Its ultraviolet spectrometer (UVS) has already detected airglow above Venus and possible auroral effects, but these occur at far-ultraviolet wavelengths and are not observable from Earth (see facing page). Also on board is a photopolarimeter with two wavelength channels in the ultraviolet, one in visible light (5500 angstroms), and one in the near-infrared.

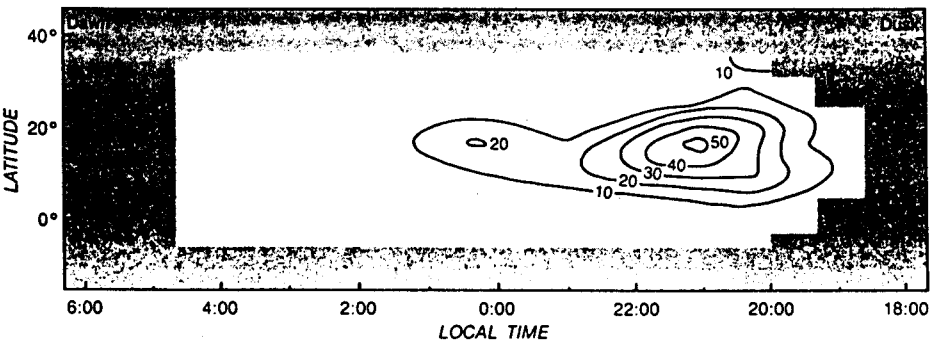
According to PVO investigators at NASA-GISS, the photopolarimeter was in fact used to search for ashen light but without success. They believe the instrument might have scanned across the planet too quickly for it to detect the faint glow, or perhaps the ashen light involves wavelengths other than those the photopolarimeter monitors.

All this underscores the need for telescopic observations. Earth-based observers should focus on features on Venus' night side, including the planet's terminator, cusps, and dark limb. The true ashen light is a faint illumination of the dark side of the planet that sometimes is localized or mottled. Other phenomena similar in appearance but not related to the ashen light (though still of interest to us) include: the night side appearing darker than the background sky; an irregular terminator, particularly around dichotomy (half phase); and an extension of the cusps at crescent phases that, in extreme cases, can completely encircle the dark disk.

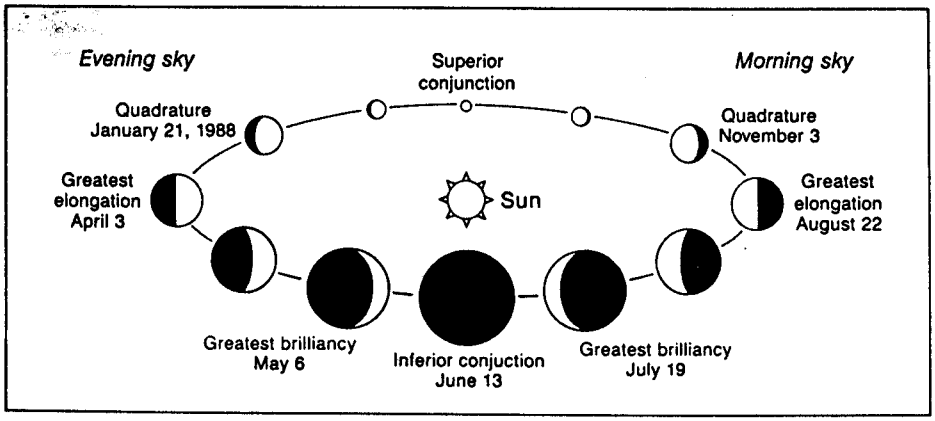
Astronomers worldwide should make as many observations of Venus as possible in 1988, reporting both positive and negative results. The organizations collecting this data have established standard scales for gauging the quality of observations and will give information to interested individuals or clubs (see the box on page 252).

For some observers poor weather conditions permit only occasional viewing. Thus for a complete record of any ashen-light sighting, we will need participants spanning as many terrestrial longitudes as possible. Large numbers of astronomers will also enhance the credibility of positive sightings.

All optical observations will be compared with the PVO measurements of electric and magnetic fields, charged particles, and ultraviolet intensity for correlations. For example, we may discover why the ashen light has almost invariably been seen when Venus is in the evening sky — showing its dusk side to us. If that trend is verified, it could provide important insight concerning the nature of the source, be it auroras or lightning. (On the other hand, we may find that the evening sightings are simply due to astronomers' sleeping habits.)



A contour map showing the areas where the PVO spacecraft has often detected bursts of electrical energy. Called "whistler waves," they may be the result of lightning, though this interpretation is controversial. The PVO recorded the bursts while at the lowest portion of its orbit, covering only a narrow range of latitude centered on 15° north. The contours near 21:00 local time and 20° north latitude indicate that the spacecraft observed electrical bursts 40 to 50 percent of the time when it transited the planetary atmosphere in this area and at this time of day. The bursts' predominance during local evening may be related to a similar clustering of ashen-light sightings made from Earth. Courtesy the authors.



The best time to watch for Venus' ashen light is between its "quadratures" with Earth. In 1988 this period began on January 21st, when Venus had a phase of about 80° in the evening sky. The planet will achieve greatest eastern elongation on April 3rd and greatest brilliancy on May 6th. Inferior conjunction (when the entire night side of Venus faces Earth) occurs on June 13th. In the morning sky Venus reaches greatest brilliancy on July 19th, greatest western elongation on August 22nd, and quadrature on November 3rd. The next observing window won't open until Venus returns to evening quadrature in August, 1989.

OBSERVING TIPS

We anticipate that the visual observations will be made primarily by amateur astronomers, who have varying viewing experiences and equipment. Certain techniques will help optimize your efforts. For example, one observer who noticed the ashen light later found his sighting to be spurious when he used an occulting bar to block the planet's illuminated portion. Accordingly, we recommend the use of an occulting bar in your eyepiece, though it's not absolutely essential. Such a device can be fabricated by a handy do-it-yourselfer; one design is described by Alfred Curtis in the *Journal* of the BAA, Vol. 74, page 229, 1964.

We also advise using a filter that passes blue or purple light and suppresses green, such as the commonly available Wratten 38A or 47 filters. A magenta filter (Wratten 30, 31, or 32) may also help. British astronomers have had success with a violet filter (Wratten 35), which has a peak apparent response at 4430 angstroms — this one is not commonly available in a ready-to-use eyepiece format, but it can be purchased in square gels from optical supply houses. One disadvantage of viewing through such a narrow-band filter is that it prevents an observer from seeing features outside its spectral response. Therefore, when using a filter, try observing first without it and then with it.

There is admittedly a certain amount of luck required if we are to confirm and explain the ashen light. However, as we near solar maximum, and as the PVO spacecraft continues to age, it appears that the most opportune time to begin is now. If the phenomenon is auroral in nature, it would be profoundly different from other planetary auroras — for Venus does not have a magnetic field. Alternatively, if the ashen light is due to atmospheric discharges, as many observers have speculated, Venus provides our only opportunity to view lightning occurring on another planet.

John Phillips' doctoral dissertation was on the interaction of the solar wind with Venus. Christopher Russell is the principal investigator for the PVO magnetometer experiment.

Reporting and Networking

Our ashen-light campaign will involve many observers with varied experience and equipment. Therefore, it is important that each individual make consistent, thorough records of his or her observations. The following list includes the vital information needed in your observing reports:

- Date, Universal time, and location;
- Instrument type, magnification, filters, and occulting device used;
- Seeing and transparency, using the standard scales adopted by your regional organizer;
- Distribution and duration of observed emissions (or negative observations);
- Brightness of features seen, possibly while varying filter types. Standard scales of brightness, such as those adopted by regional astronomical societies, should be used;
- Presence of other phenomena, such as cusp extensions, terminator irregularities, or apparent darkness of the night side relative to the background sky;
- Drawings, photographs, and videotapes. These are particularly valuable, and observers equipped for recording in the near-ultraviolet are encouraged to do so.

The observers' network is an extremely important part of our campaign. Regional societies should provide members with observing information and recording procedures, then collect their results. Simultaneous, coordinated observations by several people would lend credibility to ashen-light sightings. Regional organizers could also initiate telephone networks to facilitate simultaneous observations. It would be particularly desirable to have many astronomers separated widely in longitude and thus viewing at different times, so as to place constraints on the duration of the phenomenon.

The following are regional astronomical organizations that have indicated an interest in participating in this campaign:

- Association of Lunar and Planetary Observers, Venus Recorder: Julius Benton, Jr., 305 Surrey Rd., Savannah, Ga. 31410
- British Astronomical Association Venus Recorder: John McCue, 69 Keithlands Ave., Norton, Stockton-on-Tees, Cleveland TS20 2QR, England
- National Association of Planetary Observers, Secretary: Geoff McNamara, P. O. Box 2, Riverwood, 2210 N.S.W., Australia
- Vereinigung der Sternfreunde e.V., Detlev Niechoy (Merkur-Venus), Bertheaustrasse 26, D-3400 Göttingen, West Germany