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◀ Venus's vast nightside presents a virtually untapped resource for observers watching for impactors burning up in the planet's dense atmosphere.

Hunting for Venusian Fireballs

Is it possible to see meteors on the nightside of our sister planet?

For well over a century, visual observers have reported transient flashes of light on the Moon's nightside and within the shadowed portion of lunar craters. These fleeting points of light were widely regarded as meteoroid impacts, but it wasn't until 1999 that they were first conclusively recorded using sensitive black-and-white video cameras paired with surprisingly small telescopes. Free software that automatically scans lunar videos to detect these flashes soon followed, eliminating the tedious task of examining hours of video recordings frame by frame. Since then, a network of amateur and professional astronomers who keep watch on the Moon's nightside has documented hundreds of impact flashes. The valuable data amassed by this collaborative effort shed light on both the size and nature of the meteoroid population and help to assess the hazards posed to crewed and robotic spacecraft.

The Moon is an essentially airless body, so meteoroids strike its surface with undiminished velocities as high as 70 kilometers (43 miles) per second. When a meteoroid smacks into the lunar surface, the lion's share of the impactor's kinetic energy excavates a crater or is converted into heat. Only a minuscule fraction (recent models suggest as little as 0.2%) is transformed into visible light to produce a flash that appears at the point of impact. A piece of cosmic debris the size of a beach ball traveling at 25 km/s delivers the explosive equivalent of 5 tons of TNT, but to an earthbound observer the flash it produces looks only as bright as a fourth-magnitude star.

The nightside of a 5-day-old (24%-illuminated) crescent Moon provides almost 14.3 million square km of surface area to monitor for impacts. When Venus presents a similar phase, the visible area of its nightside is about 12 times larger than the Moon's. The apparent angular size of Venus varies from about 30″ when its crescent is 40% sunlit to about 40″ when it is 20% sunlit, so a magnification of 200× makes the planet appear about four times larger than the Moon as seen with the naked eye.

Unlike the Moon, Venus has a deep, dense atmosphere. When meteoroids enter the tenuous outer reaches of Earth's atmosphere, they begin to glow at altitudes of 80 to 120 km, producing a meteor's incandescent streak of light. Due to Venus's massive, distended atmosphere, calculations suggest Venusian meteors should start to burn up at altitudes of 250 to 300 km — far above the planet's thick blanket of clouds, which extends to an altitude of 65 km. So, a telescopic observer has an excellent vantage point. The almost subliminal flash of a lunar impact usually lasts only 10 to 100 milliseconds, but the light bolides emit in the atmosphere of Venus should be of considerably longer duration — they streak through the atmosphere as they burn up, rather than smashing into the surface as we see on the Moon.

In 2009, astronomer Brian Cudnik of Prairie View A&M University in Texas suggested that Venus "presents the best opportunity after the Moon to spot impacts on another world," yet our sister planet is sorely neglected in this regard despite its relatively close proximity and our ability to see its nightside.

In 1995, University of Western

SEAN WALKER

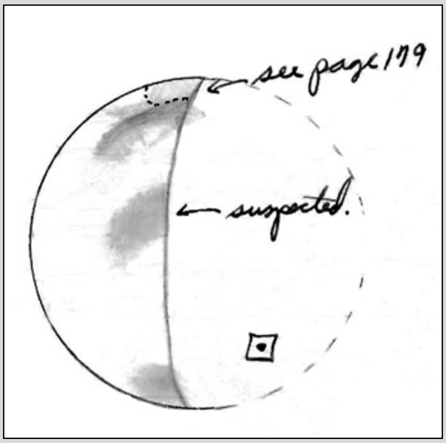
Ontario astronomers Martin Beech and Peter Brown suggested that fireballs on the nightside of Venus bright enough to be seen through amateur telescopes ought to occur once every three to four days — an estimate based on the assumption that Venus encounters fireball-producing meteoroids with the same frequency that Earth does.

Despite this prediction, I've only managed to turn up two convincing observations of Venusian fireballs. The first was made by a distinguished NASA planetary scientist, Dale Cruikshank. On July 11, 1959, when he was a 20-year-old undergraduate student, Cruikshank was observing Venus in broad daylight through the 40-inch Yerkes refractor when a sparkle caught his eye. The following note from his observing notebook accompanies the sketch of the 38%-illuminated Venusian crescent:

> *The small dot in the box on the night side of the planet marks the position of a very small, bright spot which appeared to me at 18:19 UT. It persisted only for about ¼ to ½ second and reached maximum brilliancy at the half-way point. There was no motion connected with the spot of light. At maximum brilliancy the point of light was comparable with the bright limb of the planet. I truly think that this was a real object, perhaps a meteor in the upper atmosphere of the planet or perhaps in our own, although the former appears the mostly like* [sic] *because of the absence of apparent motion of the bright spot. I watched for a recurrence but saw nothing. Most peculiar.*

When I contacted Cruikshank early last year to discuss the 1959 observation, he commented: "I have never seen anything comparable on any other planet. . . Whether or not that bright spot was an illusion (always possible), the fact that similar flashes have been recorded in CCD and other objective images of Jupiter and the Moon at least lends some credibility to the Venus flash."

The second observation I found was made on October 8, 1959, when Venus



▲ Dale Cruikshank sketched the above bright point (within the box) seen on Venus's unlit hemisphere while observing during daylight hours on July 11, 1959.

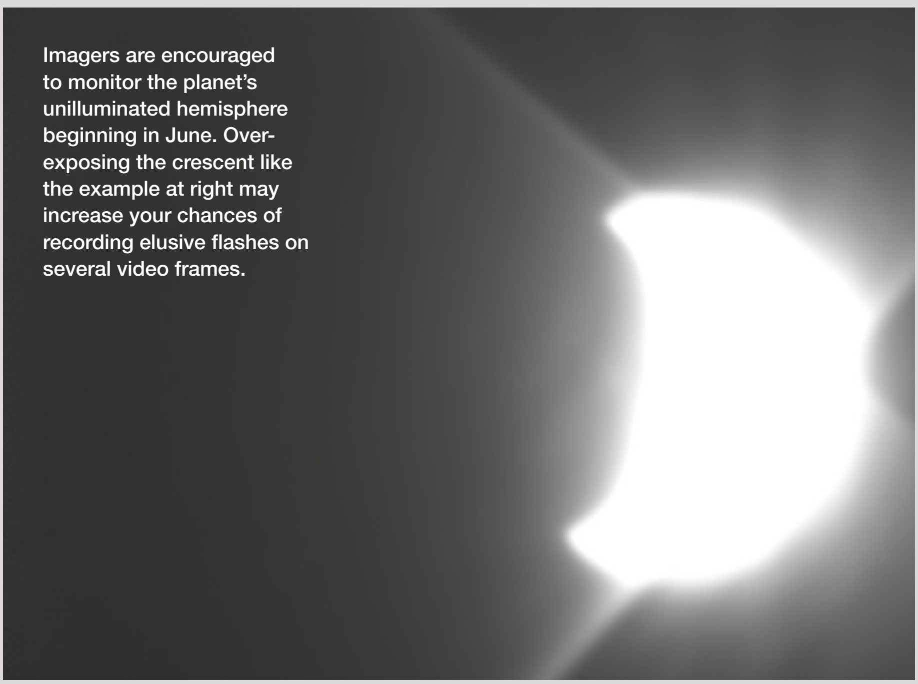
was a 28%-illuminated crescent. Using a 12-inch Newtonian at 200× to 300× in very good seeing, British observer Valdemar Firsoff saw a ". . . bright light, as though a faint star . . . on the limb about 20° beyond the point of the north cusp" on the planet's nightside. He compared it to a flare.

Is the dearth of Venusian fireball reports simply due to a failure to look for them? Amateurs could record potential impacts using many of the same tools and techniques used to record impacts on the lunar nightside. In fact, amaturs have captured 9 impact flashes on Jupiter's sunlit canopy using the same technique (*S&T:* Jan. 2022, p. 52).

For observers in the Northern Hemisphere, the late spring and early summer of 2023 present an unusually favorable opportunity for mounting a search. From 40°N latitude, Venus's 42%-illuminated crescent will stand 32° above the horizon at sunset on June 16th. By July 7th, the illuminated crescent shrinks to 27%, though the planet's altitude at sunset decreases to 22°.

Readers should take advantage of this three-week observing window to carefully monitor the Venusian nightside either visually or with video. Cruikshank's daytime sighting of a flash suggests that observing well before sunset may be worthwhile as the planet is higher above the horizon. Simultaneous video recordings by observers in widely separated locations can eliminate sources of deception such as a "point meteor" in Earth's atmosphere headed directly at an observer, sunlight glinting off a foreground satellite or orbital debris, and electronic noise that can masquerade as a flash in a video recording. Good luck!

■ Contributing Editor **TOM DOBBINS** has yet to witness an object hit a body in the solar system himself.



Imagers are encouraged to monitor the planet's unilluminated hemisphere beginning in June. Overexposing the crescent like the example at right may increase your chances of recording elusive flashes on several video frames.

OVEREXPOSED VENUS: SEAN WALKER