

Photographic and Visual Studies of the July 30, 1981 Total Solar Eclipse from 37,000 Feet

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Introduction

Photographing an eclipse from an aircraft creates distinct advantages and disadvantages relative to ground-based observations. Among the disadvantages are the unavoidable vibrations and motions of the aircraft, a very restrictive view of the sky, and having to observe through a multi-layer reflection prone plexiglass window.

However, observing from a high altitude aircraft practically eliminates interference from clouds and haze. The sun was only about 3° above a sea-level horizon when the moon's umbra swept over the Moonshadow aircraft. From the aircraft's altitude of 37,000 feet the sun was approximately 6° above the apparent horizon, well above any interfering weather. The many clouds seen dotting the Pacific far below would have made ship-based observations difficult if not impossible. The low altitude of the sun combined with the height of the aircraft also provided a dramatic view of the rapidly moving umbral cone.

Visual Impressions

Visually the eclipse was an awesome experience. Approximately an hour before totality, first contact was observed as the moon began to cover the solar disk, starting at the four o'clock position. The partial phases were observed through aluminized mylar plastic.

As totality approached, the sky began to grow noticeably darker. Around 7:12 p.m., Hawaiian time, the sun was a brilliant wire-thin crescent above the cloud speckled Pacific, 37,000 feet below. Suddenly the lunar umbra appeared, rushing toward the aircraft across the ocean like a curtain of darkness. The solar crescent thinned into a brilliant "diamond ring" at the one o'clock position, heralding the appearance of the corona.

At 7:13 p.m. the sun was completely covered by the moon. During the brief 17-second totality the prominent umbral cone was visible moving rapidly from right to left, the clouds below tinted an eerie salmon hue with chromospheric hydrogen-alpha emission.

To the eye, the corona appeared small with much fine structure, and somewhat blue in color. Photographically, the corona was much larger.

Totality ended with a second diamond ring at the four o'clock position. The proximity of the first and second diamond rings indicated that the aircraft was not in the exact center of the umbral track. At the center of the track the diamond rings would have been 180 degrees apart. An observer located at the edge of the track would have observed but one prolonged diamond ring.

The duration of the diamond rings was extended as observed from the Moonshadow aircraft, lasting for approximately 20 seconds each. Due to the high altitude, the bright inner corona was visible during the diamond ring phases, as well as during totality.

No shadow bands were visually detected on any part of the aircraft immediately before or after totality. Movie footage taken of the right wing by Joyce Hulst also failed to show any shadow bands. About 15 minutes after totality, distinct ripples were seen for about 3 seconds, moving away from the fuselage on the right wing. By this time the aircraft was at a lower altitude, and had turned so that the sun was on the left, casting a shadow of the fuselage on the right wing. The ripples appeared beyond the fuselage shadow, parallel to the shadow, and moved with a velocity of at least 2 or 3 meters per second toward the wing tip.

The ripples were certainly not shadow bands in the usual sense as they occurred too long after totality. Shadow bands are usually seen a minute or two before and after totality, and are most likely atmospheric density waves projected upon the landscape by the thin solar crescent. The solar crescent is normally too large to project shadow bands 15 minutes after totality. The sun in this case was very near the apparent horizon and seen through a great thickness of atmosphere. The observed ripples could have been due to atmospheric turbulence or diffraction as the sun was occulted by a cloud. At least one other observer has reported phenomena similar to shadow bands during a normal sunset (1).

Photographic Results

Figures 1, 2, and 3 were taken with a Nikkormat Ftn camera and a 50mm lens. The original exposures were made on Ektachrome 400 slide film, using a time of 1/250 second and a focal ratio of $f/2$. These photographs were printed from black and white internegatives, which were made from the original slides.

Figure 1 shows the initial diamond ring at the start of totality. The edge of the umbral core is visible at the lower right. Totality began at approximately 7:13 pm July 30, 1981, Hawaiian time.



FIGURE 1. *The initial diamond ring just before totality at 7:13 pm Hawaiian time. The edge of the umbral cone is visible at the lower right.*



FIGURE 2. *Totality. As in Figure 1, the edge of the umbral cone is visible at the lower right.*



FIGURE 3. *The end of totality as the umbra moves off to the upper left. Clouds over the Pacific 37,000 feet below are tinted an eerie salmon hue by chromospheric hydrogen-alpha light. The right wing of the aircraft is visible at the lower right.*



FIGURE 4. *The first diamond ring. A Cibachrome print made from the Super 8 movie taken with the Nikon R-8 on Ektachrome 160 film.*

Totality is shown in Figure 2. Again the edge of the umbral cone is visible at the lower right.

The dramatic end of totality is shown in Figure 3, taken approximately 17 seconds after Figure 1. The umbral cone is moving off to the upper left. Chromospheric hydrogen-alpha light at the edge of the umbra tinted the clouds 37,000 feet below an eerie salmon hue. The white splotches seen in Figures 1 and 3 are unavoidable reflections caused by the plexiglas window of the aircraft.

Figures 4 and 5 show the first and second diamond rings. These Cibachrome



FIGURE 5. *The second diamond ring. A Cibachrome print from the Super 8 movie. The authors saw approximately 17 seconds of totality between the end of the first diamond ring and the start of the second.*

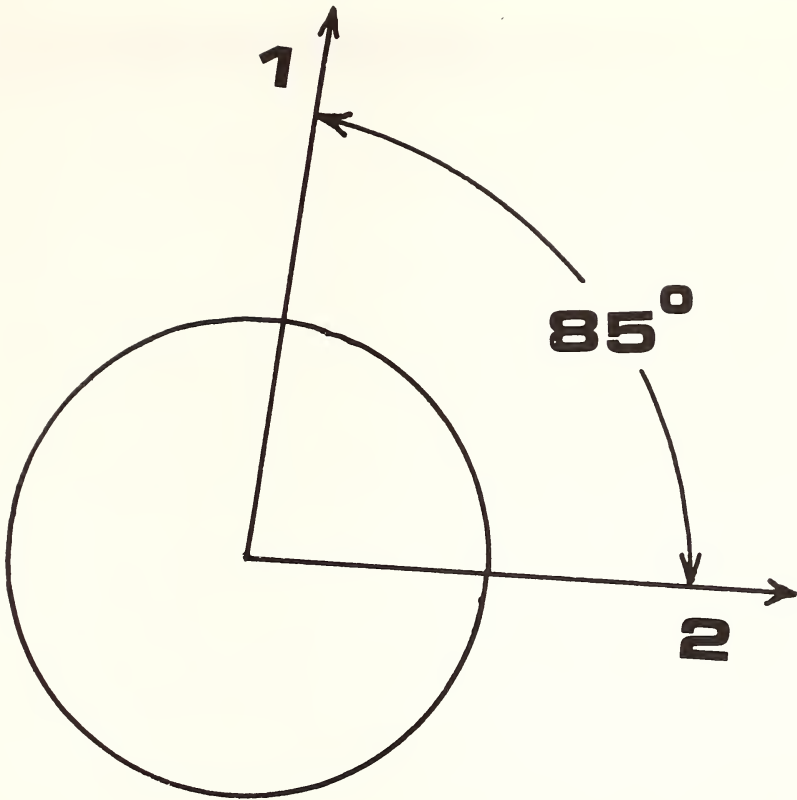


FIGURE 6. *The angle between the diamond rings illustrated. Arrows 1 and 2 show the positions of the 1st and 2nd diamond rings, respectively.*

prints were made from a Super-8 movie taken with a Nikon R-8 camera on Ektachrome 160 film.

Figure 6 illustrates that the angle between the diamond rings was approximately 85 degrees, indicating that the aircraft was not centrally located in the umbral track during the eclipse.

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Literature Cited

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