## No. 82 THE LEONID METEOR SHOWER OF NOVEMBER 17, 1966

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### 1. *The Observations*

On November 17, 1966, a team of observers, led by Dennis Milon of LPL, observed the Leonid meteor shower from Kitt Peak National Observatory. Accurate counts and magnitude estimates of meteors for various regions of the sky were made, and the results have been sent to Dr. Peter M. Millman of the National Research Council of Canada in Ottawa for incorporation into a more comprehensive report.

The first hour of observing, from $8^h30^m$ UT (1:30 a.m. MST) to $9^h30^m$ UT, produced a count of only 33 Leonids per hr. However, during the course of the second hour, $9^h50^m$ to $10^h50^m$ UT, 192 Leonids were recorded by a single observer. At $11^h10^m$, the rate was at least 30 per min and increasing rapidly; at $11^h54^m$, the rate was 40 per sec. This rate persisted about 20 min and then dropped back to 30 per min at $12^h40^m$ UT.

I photographed continually after $11^h00^m$ UT with a Pentax camera at f/2 and obtained 18 useful frames on 35 mm Tri-X film. The film was developed in D-19 for 12 min. The highest recorded rate was one meteor per sec per frame on a frame exposed for 43 sec.

### 2. *Visual Rate versus Photographic Rate*

No magnitude estimates were made during the period of photography because of the high count rates. However, a limiting magnitude for photographs was determined during the Geminid shower, December 13, 1966, when third-magnitude meteors were recorded on two frames. The exposures were on the order of four to five times longer on the Geminid frames, however, than on the Leonid frames. Therefore, the fog level of the Geminid photographs is considerably greater than that of the Leonid, and this may have prevented the recording of fainter Geminids. In any case, third-magnitude meteors on the Geminid frames match the appearance of faint meteors on the Leonid frames. The relative velocity of Leonid meteors is about twice that of Geminids, being 72 and 35 km per sec, respectively (McKinley 1961, p. 147). Thus, for the same angular distance from the radiant, a Geminid has twice the exposure of a corresponding Leonid. The faintest recorded Leonid would thus be about 2.5 mag, that is, 0.7 mag brighter than the matching Geminid (estimates being made to only 0.5 mag).

The dimensions of a single observer's visual field were found by looking straight at a star and noting which second-magnitude stars could be seen at the very edge of the field. Second magnitude was chosen as representative of the average Leonid meteor. I rotated my head back and forth so that the star would appear, by virtue of the motion, to resemble a meteor. A vertical distance of 100 deg and horizontal distance of 120 deg was found for the dimensions of an ellipse approximating the field of vision. The area of this ellipse is about 9500 sq deg.

The highest photographic rate, one meteor per sec per frame, can be converted to a visual rate. The ratio of the observer's field to that of the camera is 9500/950 = 10, that is, the eye — assuming it has the same sensitivity as the camera — would see 10 times the number of meteors. Actually, the eye is about twice as sensitive as the camera and thus would see about 20 meteors per sec. This has been confirmed by our results which were compiled by Dr. Millman. The peak visual rate estimated from the photographic rate is therefore 70,000 per hr.

Since the radiant was not more than about 23 deg from the zenith during the intense shower, altitude corrections are never more than 15 percent, according to the equation

$$R_o = R_z \sin (a + l),$$

where $R_o$ is the observed rate, $R_z$ the zenith rate, $a$ the radiant altitude, and $l$ the path length near the horizon, about 6 deg (cf. Prentice 1953).

### 3. *The Width of the Swarm*

Figure 1 shows the time distribution of meteor counts. This graph shows that the pronounced peak in the flux occurred between $11^h30^m$ and $12^h30^m$ UT. The rate at the edge of these limits is 100 per min. The inclination, $i$, of the orbital plane of the Leonids is 163 deg (McKinley 1961, p. 151). The well-defined width of the swarm is therefore

$$tV \sin i = 3.2 \times 10^4 \text{ km},$$

about 2.5 times the earth's diameter, where $t$ is the time width of the maximum, and $V$, the earth's orbital velocity. This result is comparable to the value $1 \times 10^5$ for the Giacobinid shower found from data for three different years by Davies and Lovell (1955). However, that shower had a weak component corresponding to diameter $3 \times 10^5$ km, not found for the Leonids.

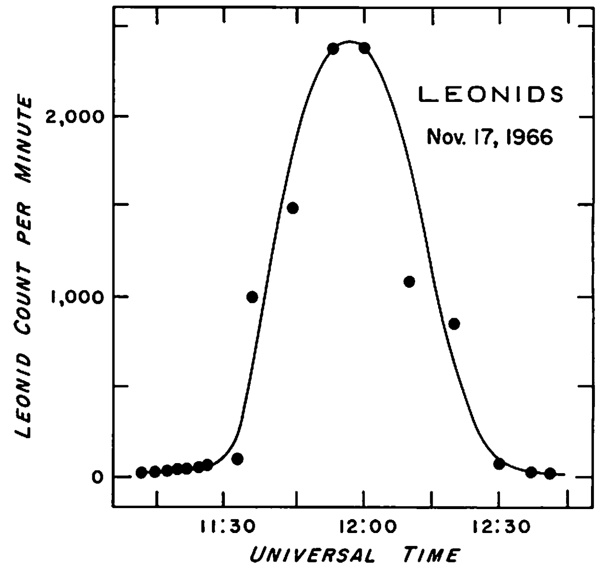


*Fig. 1* Count rate as a function of time.

### 4. *The Photographs*

Figures 2–6 are examples of photographs obtained during the peak of the shower, $11^h30^m$–$12^h30^m$ UT.

## REFERENCES

Davies, J. G., and Lovell, A. C. B. 1955, *M. N.*, 115, 23.

McKinley, D. W. R. 1961, *Meteor Science and Engineering* (New York: McGraw-Hill, Inc.).

Prentice, J. P. M. 1953, *J. Brit. Astr. Assoc.*, 63, 175.

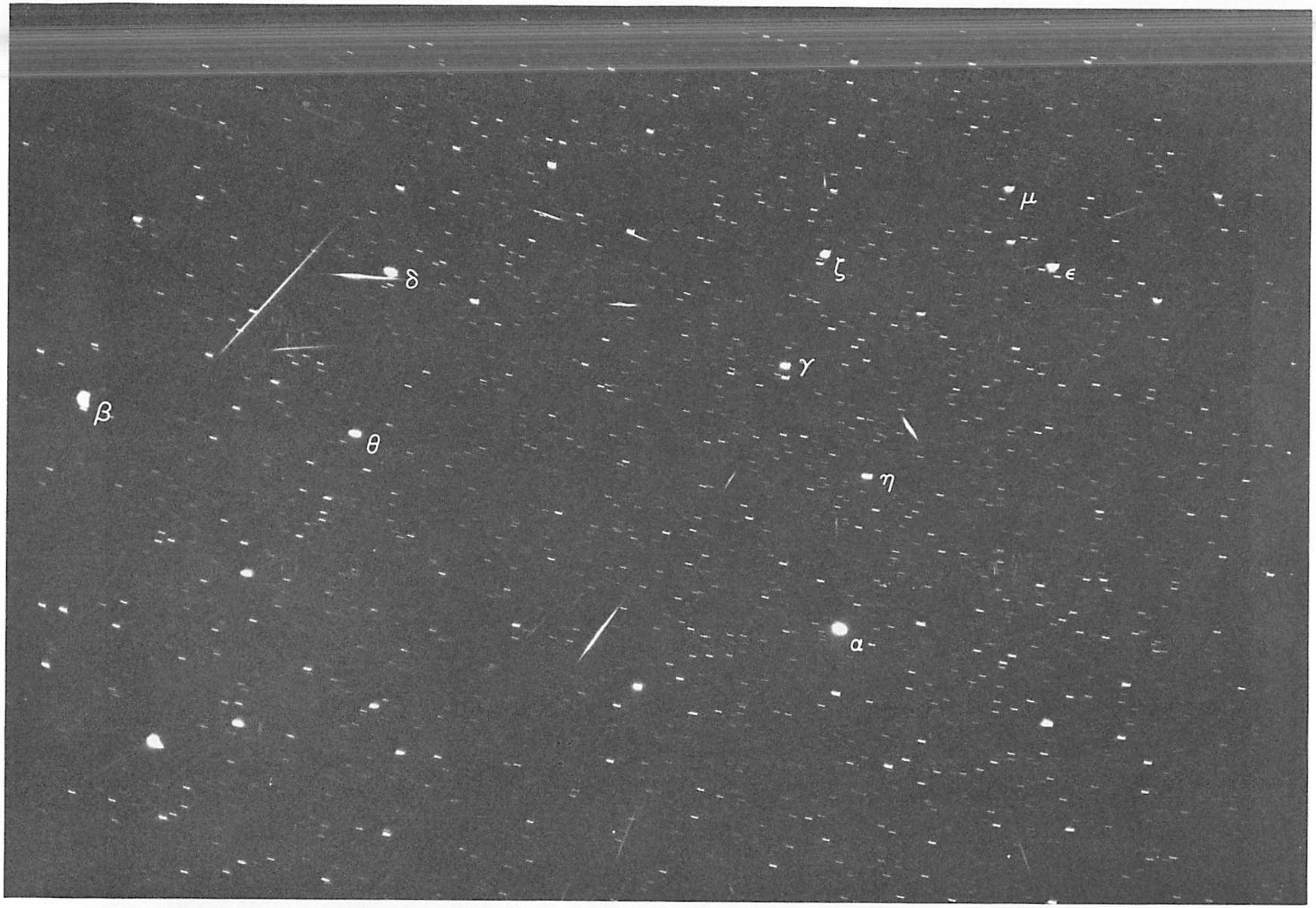


*Fig. 2* Leonid radiant showing 30 meteors, including one sporadic. Constellation Leo. Exp. 1 min 20 sec; ~ $12^h00^m$ UT. Field size, 28° × 34°.


*Fig. 3* Ursa Major showing 43 Leonids. Exp. 43 sec; ~ $12^{h}00^{m}$ UT. Field size, 28° × 34°.


*Fig. 4* Looking west. Exp. 4 min; ~ $11^h45^m$ UT. Field size, 28° × 34°.

*Fig. 5* Enlargement of Fig. 4 showing structure of bolide trail.

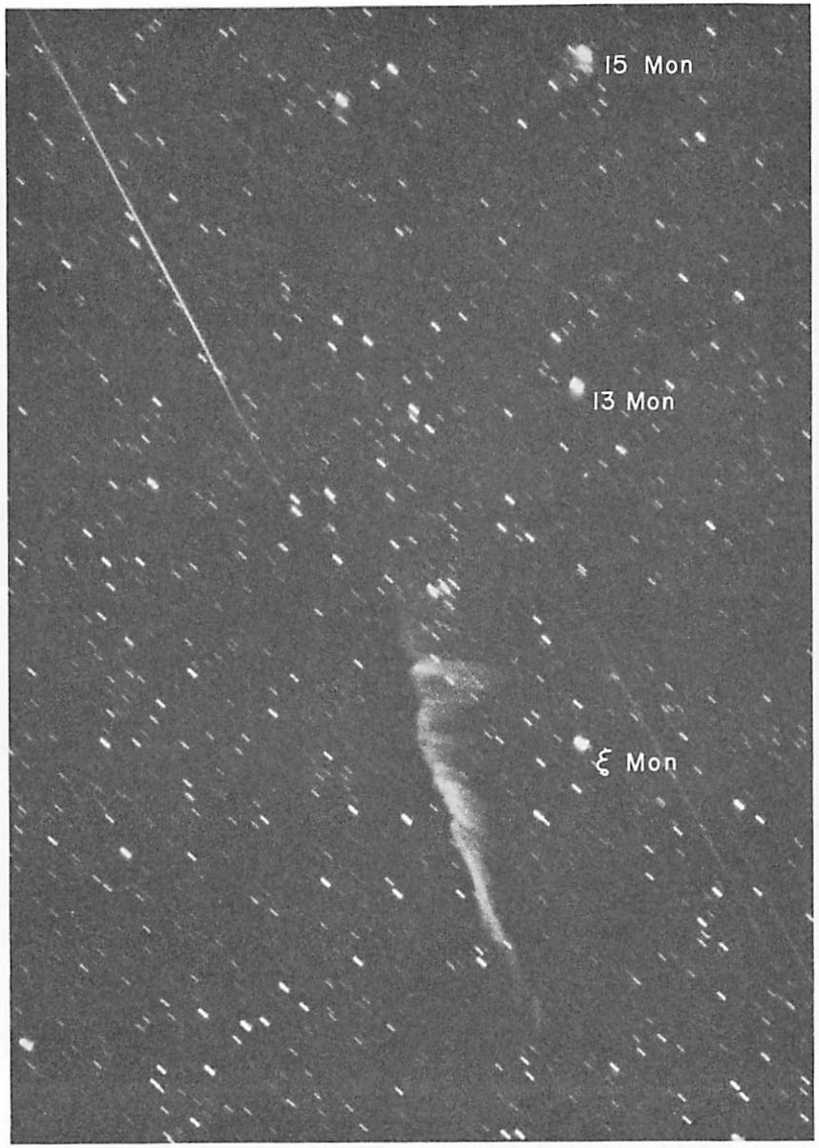


*Fig. 6* Long-enduring train of Leonid bolide. Exp. 40 sec beginning 10 sec after bolide passage; ~ $12^{h}00^{m}$ UT. Field size, 8° x 12°.