THE APPARITION OF COMET LILLER 1988a

By: Don E. Machholz, A.L.P.O. Comets Recorder

ABSTRACT

We report here on the passage of Comet Liller, 1988a, covering its discovery, orbit, observing conditions, magnitude, coma size, and tail length. The majority of the data used with this report was submitted by A.L.P.O. members.

DISCOVERY

William Liller of Vina del Mar, Chile, discovered this comet on photographs taken on Sunday evening (local time), 1988 JAN 11.065 U.T. [1] He reported the comet to be at Right Ascension 23h 50.9m, Declination -28° 18' (1950.0 coordinates), which placed it in the evening sky. His early brightness estimate was that the comet was at magnitude +13, but later estimates placed it nearer magnitude +10.0. At discovery, it was about 4-5 arc-minutes in size, diffuse with a condensation. The comet was moving due north at 0°.7 per day.

Liller was participating in the PROBLICOM program organized by Ben Mayer in the late 1970's. The comet was found on two 2-minute exposures that were taken 30 minutes apart on 2415 film through a 20-cm. (8-in.) Schmidt. This was Liller's first comet discovery, but he has also discovered several novae.

This was the first comet discovery of 1988, and the third comet found by amateur-type photographic equipment in three months. During this time there were several other bright comets in the heavens, including Comets Bradfield, Furuyama, and Borrelly.

Could the comet have been found sooner? Probably not. It had been brightening at 1.0 magnitude per month and was moving north at 4° per week. For northern-hemisphere comet hunters this would be a difficult discovery—as late as one month before discovery the comet would have been very low on the southwest horizon during evening astronomical twilight. It would have been a faint magnitude +11.0. Over the next month the comet's discovery chances increased somewhat, but moonlight interfered. One night after it was discovered, I unknowingly swept over it, but it was only a few degrees above my southwestern horizon at the time.

For comet hunters in the Southern Hemisphere, astronomical twilight occurred later in the day, with the comet circumpolar until early December. Here again, the comet's faintness would have made discovery difficult.

ORBIT

In less than three days, an early orbit was issued by the Central Bureau for Astronomical Telegrams. Because it was based on semi-accurate positions, refinement was necessary as more astrometric measures became available. A final orbit, computed by Dan Green, appeared in *Minor Planet Circular 13459*, with the following elements:

Time of Perihelion . 1988 MAR 31.11442 E.T.
Distance at Perihelion ..... 0.8413332 A.U.
Argument of Perihelion ..... 057°.38362
Longitude of Ascending Node ..... 030°.81800
Inclination to Ecliptic ..... 073°.31712
Eccentricity 0.9965647

[Note: E.T. stands for Ephemeris Time, then about 56 seconds ahead of Universal Time. A.U. means Astronomical Units, the Earth's mean distance from the Sun. Ed.]

Comet Liller's orbit is shown schematically in *Figure 21*, below.

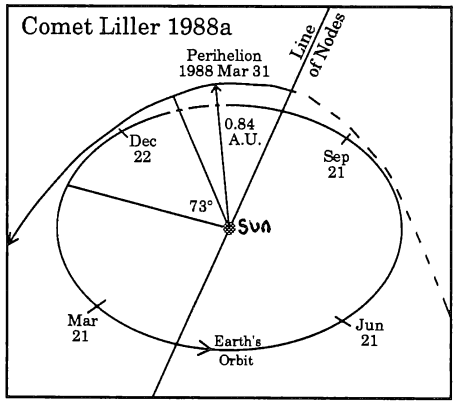

Figure 21. Sketch of orbit of Comet Liller (1988a) in relation to the Earth's orbit, with selected dates indicated.

The shape of the orbit is very close to that of a parabola, with an orbital period of 3880 years. At its most distant point [*aphelion*] it is about 250 A.U. from the Sun. However, at perihelion the comet traveled at 28 miles per second.

The comet-Earth distance at discovery was 1.88 A.U., lessening to a minimum of 1.22 A.U. in mid-May, 1988. The comet-Sun distance was 1.64 A.U. at discovery, decreasing to its perihelion distance of 0.84 A.U. on March 31. The comet, with a high inclination, crossed the ecliptic passing northward on 1988 FEB 21, when it was 1.82 A.U. from the Earth and 1.10 A.U. from the Sun. The perihelion point was well north of the ecliptic; then

the comet remained above the Earth's orbital plane until 1988 DEC 01, at more than 3.6 A.U. from both the Earth and the Sun.

When Comet Liller was found, it was 60° from the Sun in the evening sky. As the comet moved north its elongation decreased, dropping to 24° by mid-March. Then, the elongation slowly increased as the comet entered the morning sky in early April, where it remained for four weeks. Due to the comet's apparent close proximity to the Sun, there was only one reported A.L.P.O. observation of it during the months of February and March, 1988.

When discovered, Comet Liller was in the constellation Sculptor, and it remained in barren sky until it entered the northern Milky Way in mid-April. On April 19, the comet passed 3° from the planetary nebula M76, and in late May it was within 5° of the galaxies M81 and M82. As it dimmed through July and August, it passed many of the galaxies in the Coma Berenices-Virgo region. A photograph of Comet Liller as it appeared in mid-May appears to the lower left as *Figure 22*.

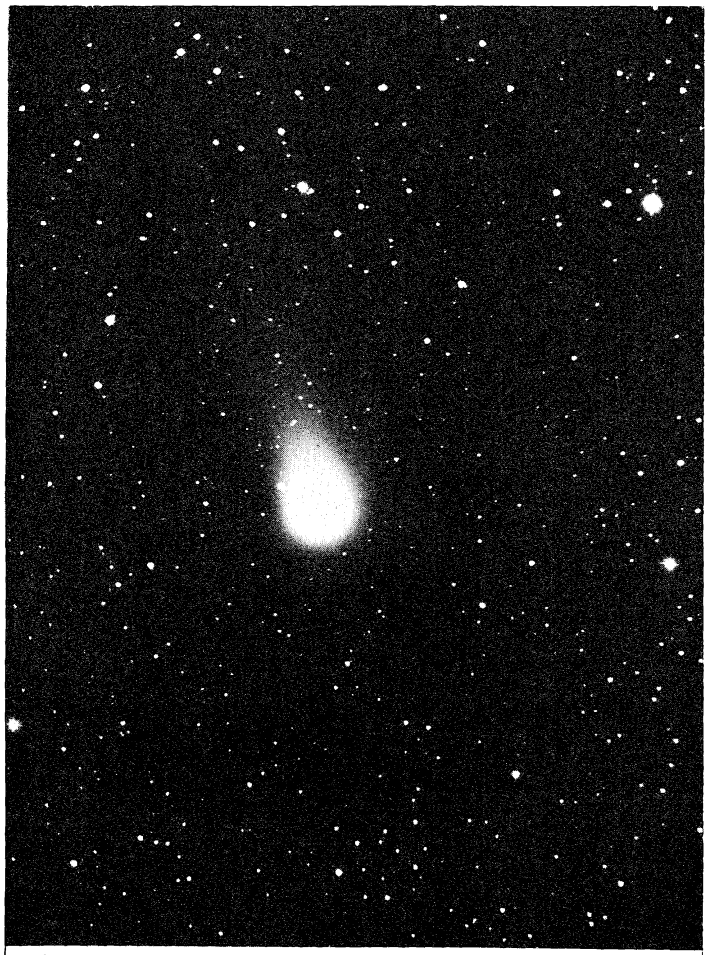

Figure 22. Photograph of Comet Liller 1988a by Chris Schur on 1988 MAY 15, 04h 45m-05h 05m U.T. 20-minute exposure on hypered Kodak TP2415 Film, with a 16-inch (41-cm.) f/4.4 reflector. North is at upper right and the field shown is about 66 arc-minutes by 41 arc-minutes .Note the faint tail extending to the upper left.

MAGNITUDE

Comet Liller was near magnitude +10.0 when it was discovered. It brightened to magnitude +5.0 in early April, and remained that bright for the next six weeks. By August it had dimmed to twelfth magnitude. This comet was not so well observed by A.L.P.O. members as were Comet Bradfield (1987s) and Periodic Comet Tempel 2. In order to compute Comet Liller's absolute magnitude, a larger pool of observations was needed. To achieve this, Gary Kronk utilized both I.A.U. (International Astronomical Union) and A.L.P.O. magnitude estimates. Two of his graphs appear as *Figures 23* and *24* on page 175. *Figure 23* shows the apparent magnitude, corrected for aperture effects, versus the date of observation. Note that the comet was brightest after perihelion (1988 MAR 31).

Figure 24 shows Comet Liller's absolute magnitude as a function of the date. The absolute magnitude of a comet is its magnitude if it were simultaneously 1.0 A.U. from both the Earth and the Sun. Because a comet is hardly ever at such a position, we use the following formula to calculate magnitude:

$$m = Ho + 5 \log D + 2.5\, n \log R,$$

where: m = apparent magnitude; Ho = absolute magnitude; D = comet-Earth distance (A.U).; R = comet-Sun distance (A.U.); and n = a constant equal to the rate of brightness change as the comet-Sun distance changes.

For Comet Liller, Kronk calculated an absolute magnitude of +5.61±0.06, and an n-value of +3.7. This absolute magnitude is about one magnitude brighter than for the average comet, while

the n-value is about average. Kronk also discovered that there might have been a brightening in February and March, but more observations are needed to analyze this possibility.

COMA SIZE

The next physical parameter, graphed on *Figure 25* below, is the diameter of the coma,

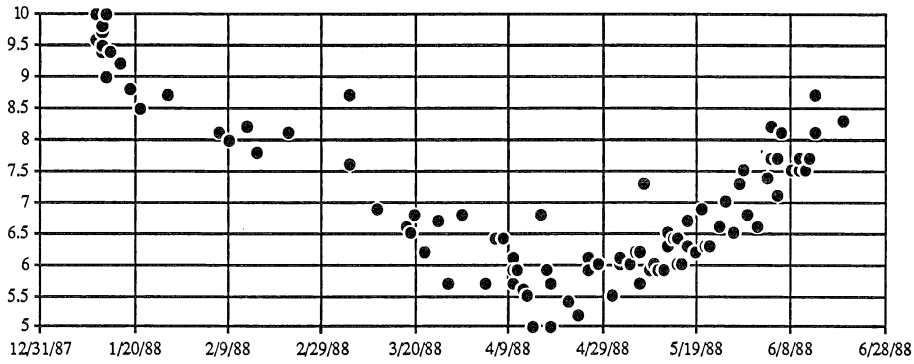

Figure 23. Apparent magnitude of Comet Liller 1988a as a function of date of observation.

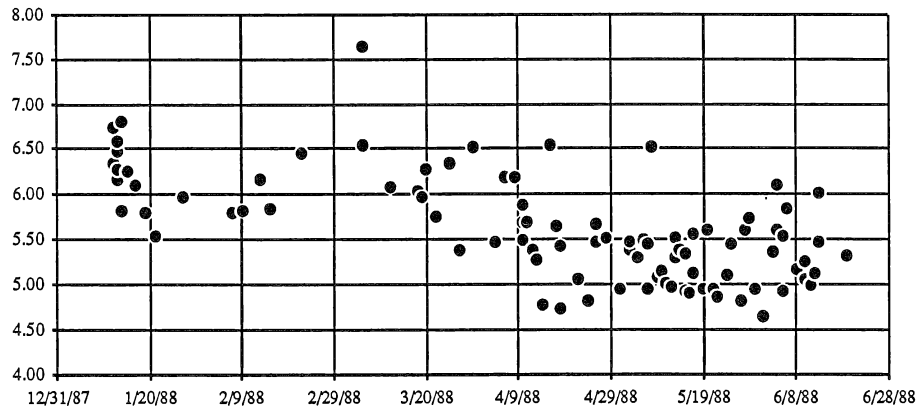

Figure 24. Absolute magnitude of Comet Liller 1988a as a function of date of observation.

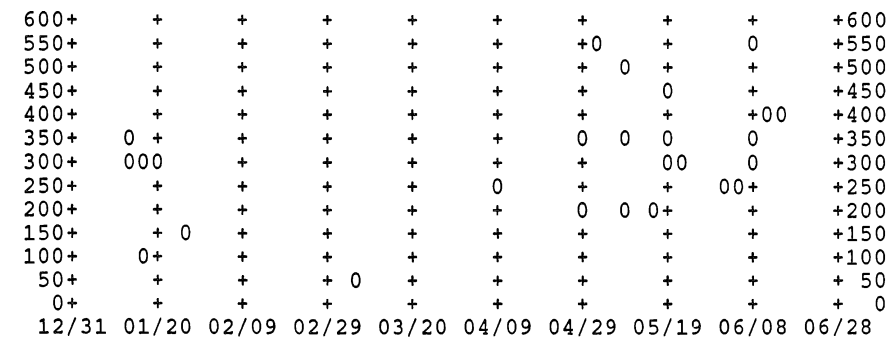

Figure 25. Coma Diameter of Comet Liller (1988a) as a function of date of observation. The diameter, shown by the vertical scale, is in units of thousands of kilometers.

or head, of the comet. This consists of the thin atmosphere that surrounds the tiny nucleus, which for most comets is unobservable and only 5 to 15 miles across. From the Earth, observers measure the angle that the round coma subtends. This value usually ranges from 1 to 10 arc-minutes for most comets; and, besides the actual coma diameter, depends upon the comet-Earth distance and the observer's eye, sky, and instrument. On *Figure 25*, we see some scatter; but the coma size appears to have been about 300,000 km. (185,000 mi.) in diameter.

TAIL LENGTH

Few observers reported a tail on Comet Liller. [Nonetheless, one was photographed; see *Figure 22* on p. 174.] The lack of visual tail sightings was most likely due to the low elongations from the Sun that were present when the comet was brightest. The comet was then near the horizon and sometimes in a twilight sky. The few measurements that were made suggest a tail length of roughly 6 million km. (3.7 million mi.).

ACKNOWLEDGEMENTS

We thank Gary Kronk for once again determining the absolute magnitude and "n" values; he also produced *Figures 23* and *24*. Chris Shur submitted the photograph in *Figure 22*. A.L.P.O. comet observers, who submitted several dozen visual observations, are listed below with their observing sites and instruments (Bi. = binoculars; Rl. = reflector; Rr. = refractor):

Clark, M. (Armadale, W. Australia; 15-cm. Rl.)
Graham, F. (East Liverpool, OH; 24-cm. Rr.)
Kronk, G. (Troy, IL; 33-cm. Rl.; 8-cm. Bi.)
Modic, R. (Richmond Heights. OH; 20-cm. Rl., 5-cm. Bi.)
Nowak, G. (Essex Junction VT; 10-cm. Bi.)
Rhea, K. (Paragould, AR; 8-cm. Rr.; 5-cm. Bi.)
Seargent, D. (The Entrance, N.S.W., Australia; 15-cm. Rl.)

REFERENCE

1. Central Bureau for Astronomical Telegrams, *International Astronomical Union Circular No. 4527*, issued January 11, 1988, by Brian Marsden.

METEORS COLUMN

By: Robert D. Lunsford, A.L.P.O. Meteors Recorder

As the new Meteors Recorder for the A.L.P.O., I look forward to the challenge of revitalizing interest in meteor observing, especially here in America. During the last several decades, interest in meteors has been high among our counterparts in Europe, Japan, and Australia. American efforts have lagged behind; not due to a lack of interest, but rather a lack of organization. Half the Earth's surface lies between the last observing site in Europe and the first sites in Australia and Japan. The Americas, with the Hawaiian Islands, are of the utmost importance to fill this gap and thus to achieve worldwide coverage of meteor showers. Several members of the American Meteor Society (A.M.S.) and the International Meteor Organization (I.M.O.) are supportive of my revitalization project. With support from these and the many local astronomy groups we can look forward to a surge of interest across America in meteor observing.

I would prefer that all our data and articles be published in the *Journal A.L.P.O.*. I realize that sometimes space will be limited, so for such times a newsletter similar to the previous *Tails and Trails* will be issued. I look forward to working with David Levy and Jim Scotti, our Assistant Meteors Recorders, and I will rely on their expertise and experience to guide me as your Recorder. Observers new to meteor work are encouraged to purchase *Observe Meteors* by David Levy and Stephen Edberg (available for $5.75 from: Astronomical League Sales, Four Klopfer Street, Pittsburgh, PA 15209 U.S.A.).

On a personal note, I have been observing meteors since the great Leonid storm of 1966. I joined the A.M.S. in 1979 and became a founding member of I.M.O. last year. I have lived in the San Diego area for the past three decades and graduated from San Diego State University in 1980 with a B.S. in Geography. I have been married now for ten years and have two children, aged 8 and 2. My main interests in astronomy besides meteors work include visual and photographic planetary and cometary studies, and visual variable-star observing for the A.A.V.S.O. [American Association of Variable Star Observers]. I use a 15-cm. (6-in.) f/15 refractor and a 41-cm. (16-in.) f/4.5 reflector for my observations.

I look forward to hearing from meteors observers all over the world. Do not hesitate to send me your ideas or criticisms. All correspondence helps the Meteors Section to cater to everyone's needs.