A.L.P.O. COMETS SECTION REPORT: COMET IKEYA 1964f

By: Dennis Milon, A.L.P.O. Comets Recorder

In the summer of 1964, while observers were tracking Comet Tomita-Gerber-Honda in the evening sky (see Str. A., Vol. 18, Nos. 11-12, Nov.-Dec. 1964, pages 220-222), a second comet was discovered in the morning sky, in Taurus. The amateur astronomer Kaoru Ikeya had discovered his second comet in the morning sky of July 3rd. For an interesting story about Kaoru Ikeya readers are referred to Time magazine:"$20 telescope makes good" in the Jan. 25, 1963 issue, page 39. Mr. Ikeya's first comet was 1963a, which became a naked eye comet in February, 1963. Comet 1964f also became a naked eye object as A.L.P.O. members tracked it southeastward toward the dawn in July and August, 1964. At its reappearance in the evening sky in late August, Ikeya was very difficult to observe as it travelled south at only 15 degrees or less above the horizon as twilight ended.

Observations of Comet Ikeya were received from the following A.L.P.O. members:

John Bortle	Mt. Vernon, New York	10X50 binoculars, 5-inch refr.
Darrell Conger	Elizabeth, West Virginia	7X50's, 2.4-inch refr.
Michael McCants	Houston, Texas	8-inch refl.
Alan McClure	Los Angeles, California	Various cameras, binoculars.
Dennis Milon	Tucson, Arizona	7X35's, 7-inch astrograph
Rodney Norden	Norfolk, Virginia	8-inch refl.
Gordon Solberg	Las Cruces, New Mexico	8X30's.
Fred Wyburn	Red Bluff, California	4-inch refr.
James Young	Wrightwood, California	6-inch focal length camera, 16-inch refl.

Orbit Description

Comets Section member Michael McCants used an IBM computer to calculate the orbit, and two computed orbits were distributed to observers. The second of these can be found on Harvard Announcement Card 1658 and on I.A.U. Circular 1870. Jim Low, coordinator of the Comet and Nova Section of the Royal Astronomical Society of Canada, sent copies of McCants' orbit to members of the R.A.S.C.

It is worth mentioning that A.L.P.O. members can now obtain news of comet discoveries and positions from the A.L.P.O. Comets Recorder. For learning of new comets announced by I.A.U. telegrams, send a supply of self-addressed airmail cards. To obtain ephemerides, usually computed by McCants within 2 weeks of a discovery, send some stamped, self-addressed legal size envelopes. I can also phone or telegraph collect to observers.

The elements show that Comet Ikeya 1964f is in retrograde motion, opposite to the direction of revolution of the planets. Retrograde motion is determined from the fact that the inclination is greater than 90°. Ikeya's inclination is 172°, inclined only 8° to the ecliptic. Closest approach to the sun was on August 1st at 0.8 of an astronomical unit -- about 74 million miles. Thus the comet did not get close enough to the sun to develop an exceptional tail. It was closest to the earth on August 13th at about 18 million miles. However, it was then nearly directly between the earth and the sun (the comet-earth-sun angle was 31°), and no A.L.P.O. observations were reported to the Recorder. The great value of southern hemisphere observations becomes apparent here -- Dr. S. Archer observed from Wollongong, Australia on August 15th and reported in I.A.U. Circular 1876 that Ikeya was magnitude 2.8 with a tail 4½ degrees long in an 8X54 refractor! The brightest report from the A.L.P.O. was 4th magnitude and recorded a tail less than half as long as what Archer saw.

Parabolic Elements for Comet Ikeya 1964f Computed by Michael McCants

Coordinates 1950.0	
Time of perihelion:	August 1.2234, 1964 U.T.
Argument of perihelion:	290°.762
Ascending node:	269°.255
Inclination	171°.914
Perihelion distance	0.82188 astronomical units.

A parabolic orbit provides a good fit for a comet's motion when it is near the sun. As observations over a long period of time become available, an elliptical orbit can usually be calculated. On Harvard Card 1675 Dr. Cunningham reports elements for an ellipse with a period of 363 years for Comet Ikeya.

The Observations

After the first A.L.P.O. sighting by McClure on July 7th, the comet was observed visually and photographically up to the first week in August. Then it disappeared into the morning twilight until the end of August, when a sighting was made by McCants and others in the evening. Only nine A.L.P.O. members reported observations of Ikeya, and only two of these obtained photos. The moon was at Last Quarter on August 1st and began to interfere with comet observations as it moved closer to Ikeya in the morning sky. Naked eye observations were made about two weeks before this time on July 19th by Jim Young from JPL's Table Mountain Observatory near Los Angeles. The comet was then about 20° above the horizon at 4 A.M. local time. Its distance from the earth was 32.5 million miles.

Visual magnitude estimates, using out of focus images, are listed in the following table. They have been corrected to a standard aperture of 2.67 inches.

Comet Ikeya -- Visual magnitude estimates

Universal Time			Observed Magnitude	Corrected Magnitude	Heliocentric Magnitude
July 12.49	Shayler	8-inch refl.	7	6.1	5.5
July 12.46	Milon	7-inch refr.	7.8	7.1	6.5
July 16.47	Milon	7-inch refr.	7.3	6.6	6.3
July 27.46	Milon	7X35 binoculars	5.5	5.7	6.4
	2° tail in photo with 7-inch.				
Aug. 2 43	Solberg	8X30's. Coma 10'.	4.4	4.7	6.3
Aug. 4.33	Bortle	10X50's	4.7	4.8	6.8
	Tail 30', P.A. 259°, coma 8', degree of condensation 5.				
Aug. 4.4	Solberg	8X30's. Coma 20'.	4.3	4.6	6.6
Aug. 5.34	Bortle	10X50's	4.6	4.7	6.9
	Coma 7½' in 5", degree of condensation 6.				
Aug. 6.34	Bortle	10X50	4.4	4.5	7.0
	Coma 9' in 5", degree of condensation 4.				
Aug. 6.46	Milon	7X35	4.1	4.3	6.8
Aug. 28.04	McCants	8-inch refl.	7.3	6.4	7.2
Sept. 1.06	Conger	7X50's.Coma 15' to 20'	6.2	6.3	6.7

New members may be interested in the procedure of making visual magnitude estimates of comets. The smallest optical aid possible should be used, beginning with the unaided eye. Binoculars are particularly suitable since they have the wide field of view that makes it possible to look at comparison stars and a fairly bright comet at the same time. To estimate the stellar magnitude: 1) Put the image out of focus . 2) Locate a star slightly brighter and a star slightly fainter than the comet, preferably ones near the comet. 3) Estimate the brightness of the comet in terms of tenths between the two stars. Make several estimates using different stars for improved accuracy. One estimate might be, for example,

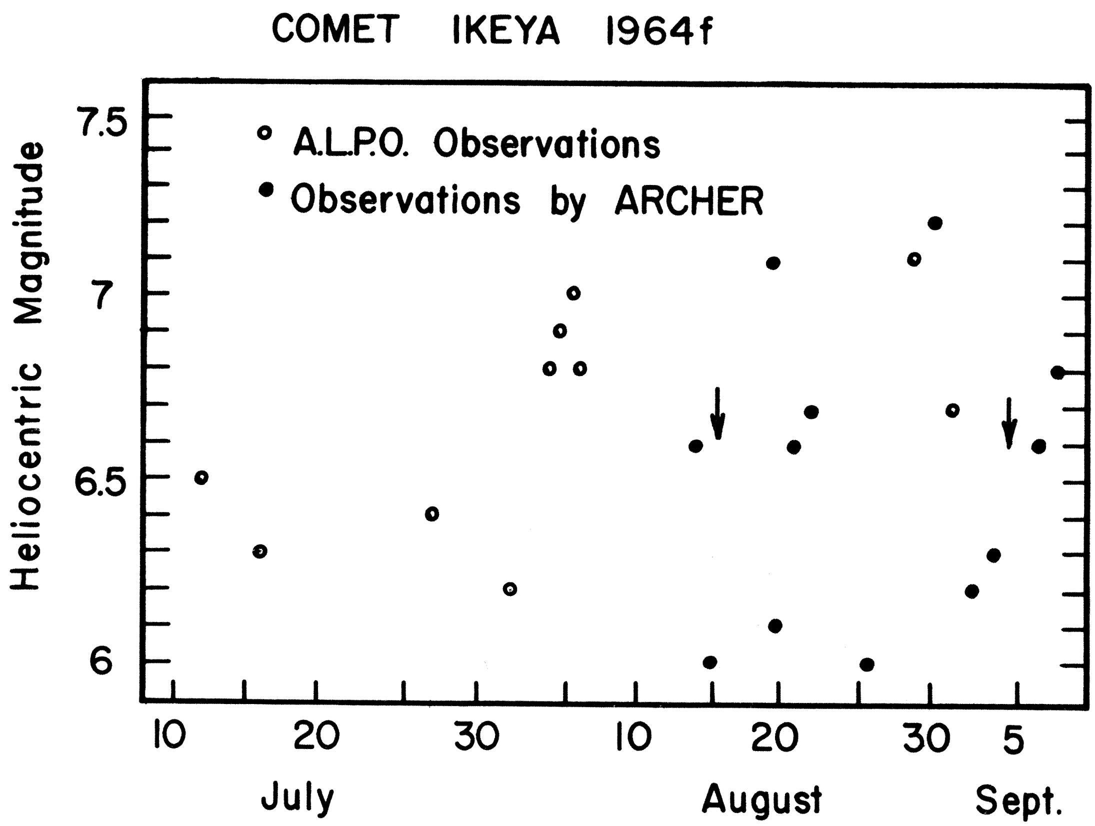

FIGURE 1. Plot of heliocentric magnitude against date (U.T.) for Comet Ikeya 1964f. The brightenings indicated by arrows on August 15 and September 1-4, 1964 are discussed in the text. Graph constructed by Steve Larson.

FIGURE 2. Photograph of Comet Ikeya 1964f on July 27.45880, 1964 U.T. Taken by Dennis Milon with a 7-inch f/7 astrograph at the Steward Observatory of the University of Arizona, Tucson. The visual magnitude was 5.5 in 7X35's. This photograph is a short exposure for position on 103aO blue sensitive plates. Dr. Van Biesbroeck measured the position as R.A. $4^h\ 42^m\ 50^s.43$, Dec. + $12°54'\ 18''.1$. The tail shown is about 2 degrees long (may be partially lost in reproduction). North is to the left.

star A 4comet 6 star B. 4) Find the magnitudes of the comparison stars in a catalog, or send their identification to the Comets Recorder.

Although the magnitude of Ikeya varied by several magnitudes, this was almost entirely due to its changing distance with respect to the earth (Δ). As shown in the table below, the distance from the sun (r) was always around 0.8 A.U. during the A.L.P.O. observation period (July 7 to Sept. 1).

U.T. Date	r in A.U.'s	Δ
July 4, 1964	0.98	1.57 A.U.'s.
July 14	.89	1.23
July 24	.84	.84
August 3	.82	.45
August 13	.85	.20
August 23	.92	.50
September 2	1.01	.89
September 12	1.12	1.27

Since there was little chance for variation in magnitude with respect to r, changes caused by solar activity should be more obvious. Therefore, in Figure 1 the heliocentric magnitude has been plotted against time, rather than against log r. The heliocentric magnitude is obtained as the standard-aperture corrected magnitude minus 5 logΔ; it allows the comet's magnitude changes to be studied with the effect of the varying distance from the earth removed. A plot of heliocentric magnitude versus log r would enable us to determine the comet's photometric formula, from which useful data can be obtained for the comparison of different comets. The graph of magnitudes in Figure 1 also includes observations by Archer in Australia as given on I.A.U. Circulars 1876 and 1872.

Using the magnitude estimates on the graph from July 12th to September 8th, Michael McCants has investigated possible correlations between brightness changes of the comet and solar activity. There was a brightening from Sept. 1st to Sept. 4th and a noticeable increase in sunspots 7 days later: on Sept. 8th there were 20; over Sept. 9-14, an average of 12; over Sept. 15-29, none. This 7-day lag would allow the sun to rotate the necessary 70 degrees or so in pointing the activity (possibly ultraviolet emission, x ray emission, or corpuscular emission from solar flares) from the comet's direction to that of the earth. In addition, the brightening on August 15th might be connected with a sunspot average of 31 between August 13 and 16, 1964.

Patrick McIntosh, then at Sacramento Peak Observatory, Sunspot, New Mexico, wrote the following about possible correlations: "The August 15th brightness increase coincided with the maximum development of two healthy sunspot groups. However, neither region produced flares larger than 1- (on a scale of 1-, 1, 2, 3, 3+, in order of increasing size and brightness), and these were very few and very small. Near the Sept. 1-4 dates a very small sunspot group formed, but was accompanied by only a few small subflares. However it occurred in one of the same regions as was well developed on August 15th. I would consider this evidence as doubtful for a correlation between solar activity and comets."

Description of the Comet

Ikeya's first observation on July 3rd was of an 8th magnitude object with a central condensation. After being notified by the Comets Recorder, Jim Young photographed a 15' tail on July 9th (the photo was published in Sky and Telescope, Vol. XXVIII, Sept. 1964, p. 178) and also observed a tail visually with a 16-inch reflector. Milon also saw a 15' tail with a 7-inch on July 12th. He photographed a 2 degree tail (about 1.9 million miles) on July 27th. Observers may want to use the following formulas to calculate tail lengths of comets. They were supplied by Mike McCants.

An observed tail of 1 degree at a distance Δ is equal to .017 times Δ in A.U.'s. if normal to the line of sight. The true length L may in general be found from the following formula:

$$L = \frac{\text{observed length in degrees} \times .017 \times \Delta}{\sqrt{1 - \frac{(r^2 + \Delta^2 - 1)^2}{(2 r \Delta)^2}}}$$

This formula was developed with the use of the Law of Cosines of Plane Trigonometry. It assumes that the tail of the comet is directed radially away from the sun in the plane defined by the sun, the earth, and the comet.

Fred Wyburn saw a 1½ degree tail on August 1st with his 4-inch refractor. John Bortle observed Comet Ikeya on August 4th. He gave the following description, using 10X50 binoculars when the comet was 18 degrees above the horizon: "The coma has a diameter of 8' and brightens rapidly after the outer 2' to form a nuclear condensation. It is similar in appearance to a globular cluster imbedded in a round nebula. The tail is very faint, but 30' to 45' is visible. It is narrow (3'-4' wide) and straight."

In a 5-inch Bortle estimated a medium degree of coma condensation of 5, 6, and 4 (on a scale of 0 = diffuse to 9 = sharply condensed) on Aug. 4, 5, and 6 respectively. However, using the greater resolving power of his 8-inch reflector at 50X and 200X, Rodney Norden noted " a star-like nucleus surrounded by a slightly elliptical coma" on August 5th.

The last Comets Section observation before the comet passed into the evening sky was by Milon on August 6th when Ikeya was only 12 degrees above the horizon. As referred to previously, Archer in Australia watched this comet grow in brightness and length while it was inaccessible to A.L.P.O. observers.

Several A.L.P.O. members observed Ikeya after its reappearance in the evening sky. On August 28th both Comets Ikeya and Everhart were visible at a star party held on the grounds of Chamberlain Observatory during the Nationwide Amateur Astronomers Convention in Denver. At this time Mike McCants made a magnitude estimate of 7.3 with the 8-inch reflector of Houston's Lamar Astronomy Club. The final A.L.P.O. magnitude estimate was by Darrell Conger who estimated it as 6.2 in 7X50's on September 1st. The comet was then difficult to observe at only 12 degrees above the horizon, and no tail was seen. Ikeya continued to trace a path southeast, close to the horizon. The difficulty of making accurate observations on such a low object did not encourage further observations.

Thus we conclude that Ikeya's second comet discovery did not put on as spectacular a display as his comet of 1963. Comet 1963a had a tail of 8 degrees in binoculars, which represented 13 million miles, while 1964f was seen with a tail of only 1½ degrees -- less than 2 million miles. In Feb., 1963 Comey Ikeya got up to a magnitude of 3.5 and had a strongly bluish coma and a tail with filaments.

As a footnote to this article and other Comets Section Reports I would like to acknowledge the valued assistance of Dr. George Van Biesbroeck of the Lunar and Planetary Laboratory in Tucson. We are indeed fortunate in having the counsel of one of the most experienced comet observers.

Foreword by Editor. The truly excellent lunar photographs by Messrs. Thomas Osypowski and Thomas Pope published recently in this journal should add interest to the following article. Readers might like to refer to their photographs in Vol. 18, Nos. 9-10, pp. 193 and 194. Prints of these photographs and others by Osypowski and Pope are available in the A.L.P.O. Lunar Photograph Library. Lunar and planetary photographers among our members should find several worthwhile ideas in the following article.