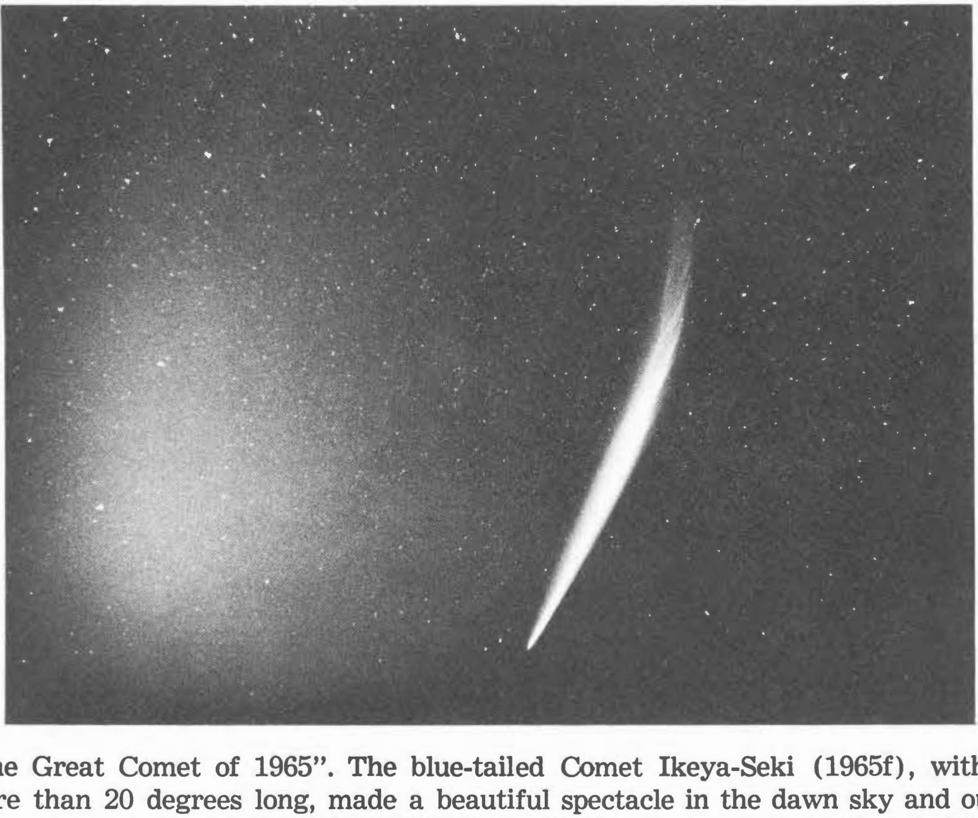
The Strolling Astronomer

The Journal Of
The Association Of Lunar
And Planetary Observers

Volume 19, Numbers 3 - 4

March - April, 1965
Published December, 1965



"The Great Comet of 1965". The blue-tailed Comet Ikeya-Seki (1965f), with a tail more than 20 degrees long, made a beautiful spectacle in the dawn sky and outshone the adjacent cone of the Zodiacal Light to its left. Photograph by Dennis Milon and Steve Larson on October 30, 1965 at 12 hrs., 15 mins., Universal Time. Location at altitude of 7000 feet near Tucson. Exposure 1 min., 45 secs. Used a 50 mm. lens on a Miranda camera with Tri X film, developed for 12 mins. in DK 60 a.

THE STROLLING ASTRONOMER

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ASSOCIATION OF LUNAR & PLANETARY OBSERVERS
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IN THIS ISSUE

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 $7\frac{1}{2}'$ 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,

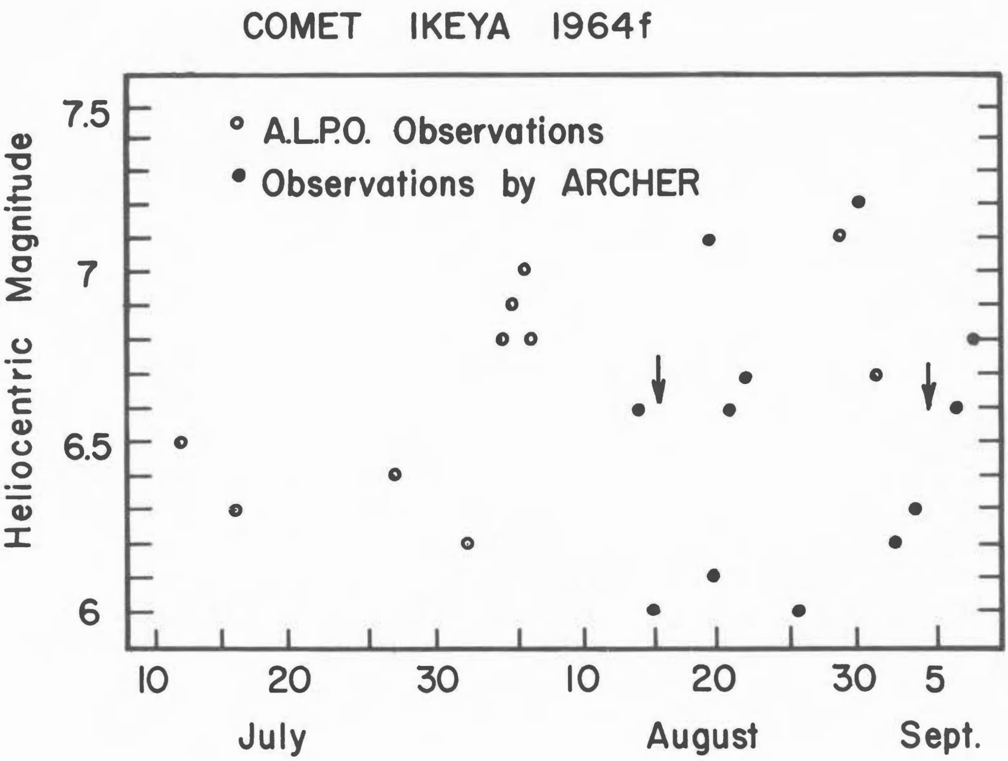

FIGURE 1. Plot of heliocentric magnitude against date (U.T.) for Comet Ikeya 1964f. The brightenings indicated by arrows on August 15 and September 1-4, 1964 are discussed in the text. Graph constructed by Steve Larson.

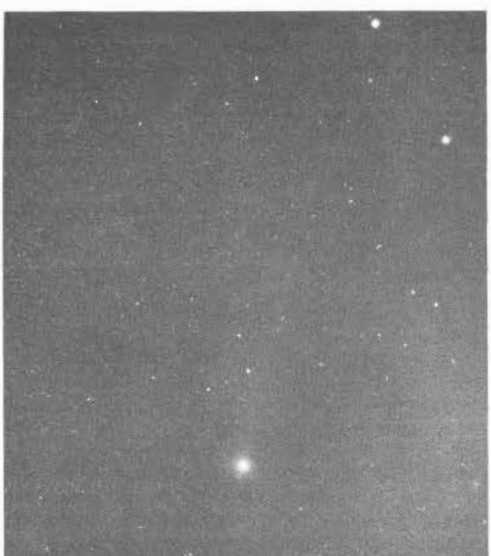

FIGURE 2. Photograph of Comet Ikeya 1964f on July 27.45880, 1964 U.T. Taken by Dennis Milon with a 7-inch f/7 astrograph at the Steward Observatory of the University of Arizona, Tucson. The visual magnitude was 5.5 in 7X35's. This photograph is a short exposure for position on 103aO blue sensitive plates.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

star A 4 comet 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.

HIGH RESOLUTION LUNAR AND PLANETARY PHOTOGRAPHY

By: Thomas Osypowski and Thomas Pope

(Paper read at the Thirteenth A.L.P.O. Convention at Milwaukee, Wisconsin, July 4, 1965.)

We are all familiar with the fact that visual observations through a medium-sized telescope generally reveal much more detail than can be clearly photographed. Numerous factors contribute to this loss of quality when film is substituted for the human eye -- yet it nevertheless is possible, with a careful technique and ideal conditions, to capture photographically a considerable amount of lunar and planetary detail. In this paper the authors would like to explore some of the problems connected with such telescopic photography, and perhaps suggest a few field-tested techniques which they have found workable and effective.

What are some of the requirements of high quality lunar and planetary photography? What is needed to photograph detail approaching the theoretical limit of a moderate size (8-12 inch) telescope? The requirements can be reduced to these five essentials:

1. Very good seeing
2. High quality optics
3. Precise focus
4. Accurate guiding
5. Proper film/f-ratio combination.

Very Good Seeing

Astronomical "seeing" is the one controlling, and at the same time, largely uncontrollable factor in high resolution astronomical photography. That is, good seeing is necessary for good pictures; but there isn't much one can do about obtaining that requisite good seeing. True, the observer can do his share of bringing the air to a temperature equilibrium by insulating his metal tube, or by using a non-radiating tube material, by allowing sufficient time for the whole instrument to "cool down" and for the air in the observatory dome to equalize with the air outside. But when even the stars near the zenith are twinkling boldly -- a sure sign of upper air temperatures differences -- then there is not much that can be done but wait it out.

As a rule, if resolution-limited detail cannot be observed visually, it certainly will not be photographed. And most of the time, even if it can be glimpsed it probably still will not all be captured on film. Really perfect seeing for astronomical photography is an extreme rarity -- at least near Milwaukee!

High Quality Optics

The telescope should be of the highest quality optically. A mediocre mirror or objective will scatter light, thus blurring out fine detail and reducing image contrast, and will also react more sensitively to the effects of variable seeing. In our program, we have been making use of the fine 12½" Newtonian reflector located at the Observatory of the Milwaukee Astronomical Society. The well-corrected f/9 primary mirror (from the Cave Optical Company), combined with a minimal 1.75" diagonal, affords excellent definition and image contrast on nights of fine seeing.

Precise Focus

In order to obtain the finest detail possible in lunar and planetary photography the image must be very precisely focused, particularly when eyepiece or Barlow projection is being employed. Such projection magnifies not only the image but also the focusing error. Probably the most convenient focusing arrangement for the amateur is a 35mm. reflex camera body attached by means of extension tubes to the eyepiece holder. Cameras such as the Miranda, Exakta, and Nikin F allow the photographer to replace the ground glass with a clear glass bisected by a crosshair pattern. When both crosshair and image are sharp in the viewfinder of the camera, the telescope is focused. Cameras equipped with non-interchangeable viewfinders can be made more useful for telescopic photography by increasing the transparency of the ground glass with a light film of oil.

Naturally, the eyepiece used to enlarge and to project the image onto the film must be of the highest quality. Actually, we prefer to use movie camera lenses in place of eyepieces. Such lenses used as projectors are much sharper over a wider area than most telescope eyepieces, and they can be obtained used at fairly low prices.

When designing an adapter for the camera body, provision should be made, of course, for including the projecting lens in the optical track. Our own camera adapter is a crude but perfectly serviceable affair made of parts salvaged from an M70 telescope. It consists of two tubes which thread into each other. The first tube is machined down to 1¼" on one end to fit the rack and pinion of the telescope, and accommodates the eyepiece in the other end. The second tube threads into the first, and receives the camera body, either directly or by means of extension tubes. A small black card flicked back and forth across the slot in the second tube serves as a handy, perfectly vibrationless shutter.

Accurate Guiding

A 12½" telescope can resolve detail in the order of approximately 0.5" of arc. The westward motion of the moon and planets at the equator, however, amounts to 15" of arc in 1 second of time. Obviously, for high resolution photography, unguided exposures must be kept short -- 1/15 or 1/30 of a second. If longer exposures are needed (and they inevitably are if eyepiece projection is used), then an accurate smooth-running clockdrive is indispensable.

The moon's eastward motion of 0.5" of arc in 1 second of time creates additional problems. Unless the clockdrive can be geared down to compensate for this motion, exposures of the moon should be kept down to around 1 second if a 12½" or larger telescope is being used. Fortunately, even slow films rarely require a longer exposure than this.

It is assumed, of course, that along with the accurate guiding there is no source of vibration during the exposure. The biggest offender in this regard will probably be the shutter of the camera. To eliminate this jarring, we use a small black card, as described above, to make an exposure. The camera shutter, set on "Bulb", is opened with a cable release; any vibrations are given a few seconds to dampen out; then the black card is flicked away from the optical path for the exposure duration, then put back in place, and the camera shutter is closed.

Proper Film/F-Ratio Combination

The film chosen for astronomical photography must be capable of resolving all the detail that the telescope reveals. Film resolution is generally expressed as the number of lines/mm. which the film can just resolve. Now, the number of lines/mm. a telescope can resolve depends solely upon its effective f-ratio. (Note, we are not speaking here of angular resolution, which is a function of the objective's aperture, but rather of linear resolution at the focal plane). Thus, the Lick 120" f/5 reflector can resolve no more lines/mm. at the film plane than can an amateur's 12" f/5 telescope. (Of course, since the Lick's plate scale is ten times larger, the image will contain much more actual detail.) In general,

$$R_1 = \frac{1450}{EFL},$$

where R_1 = the resolution of the prime focus or projected image in lines/mm., and EFL = the effective f-ratio of the optical system. For example, if one is using eyepiece projection to obtain an f-ratio of f/32, then $R_i = \frac{1450}{32} = 46$ lines/mm.

Now since almost every film on the market today is claimed to be capable of resolving at least 46/lines mm., the temptation might be to select a very fast but grainy film to keep exposures to a minimum. Well, it's not quite that simple. Resolution claims for films are based on high contrast subjects like black and white test charts. The wispy, delicate festoons on Jupiter or the finest tracings on Mars can hardly be called "black-and-white". Sometimes it's more a matter of "light grey on lighter grey". In practice, then, a film with a rated resolution maybe three times or more that of the optical system should be used to attain the latter's full resolving power. Or, as an approximation,

$$R_f = \frac{4500}{EFL},$$

where R_f = the needed film resolution in lines/mm., and EFL = the effective f-ratio. Here are a few suggestions:

EFL	R_i	R_f	Recommended Films
f/20	75 l/mm	225 l/mm	Adox Dokupan, Kodak High Contrast Copy Film
f/40	35	110	Kodak Panatomic-X , Adox KB 14
f/80	18	55	Plus-X, Tri-X
f/160	9	28	Any film

The first film listed, Adox Dokupan, is actually a copy film, but with greater speed and much more controllable contrast than Kodak's copy film. It has an extremely fine grain structure and very high resolution. For instance, one of our negatives of the moon taken on Dokupan at the prime focus of the 12½" f/9 mirror reveals craters less than 2 miles in diameter. A 20X enlargement is needed to begin to see the finest detail on the negative.

In general, we've preferred using the slower speed films since their finer grain and higher contrast make for more acceptable enlargements. Developer choice is mostly a matter of personal preference. To enhance contrast in planetary photography we use D19; while with the moon, FR X-22 diluted 1-15 seems to work rather well.

Color film can be used to advantage, especially on the planets, provided that the proper film is chosen. Kodachrome II gives decidedly "greenish" images. Ektachrome-X, on the other hand, shifts rather definitely to the orange. Kodak's third medium speed film, Kodachrome-X, appears to give the "truest" colors -- at least the moon is rendered a more neutral tone than with the other two emulsions. No controlled lab tests have been made, however; and much of the above is simply the result of subjective judgment.

Proper exposure times are affected by a variety of factors, but we have this following chart as a fairly accurate guide:

Film	Gibbous Moon	Jupiter	Saturn
Dokupan	1 sec. at f32	2 sec. at f32	8 sec. at f32
KB 14	½-1 sec. at f64	2 sec. at f90	4 sec. at f64
Plus-X	¼ sec. at f90	½ sec. at f90	2 sec. at f90
Kodachrome -X	½-1 sec. at f45	4 sec. at f90	8 sec. at f64

PLANETOLOGICAL FRAGMENTS-2

By: DPC

Luminescence of the Lunar Surface and Clouds on Mercury

There is a growing body of physical evidence that the moon fluctuates in intensity by several percent. This fluctuation is in addition to the usual photometric phase function and opposition effect familiar to those acquainted with lunar photometric studies. Since the discovery several years ago of the brightness fluctuations it has been generally concluded that the materials comprising portions of the lunar surface can luminesce under the bombardment of solar corpuscles or the high-energy ultraviolet solar radiation.

Lunar luminescence has been detected photographically, photometrically, polarimetrically, and now spectroscopically by H. Spinrad. Using spectra obtained with the Dominion Astrophysical Observatory 48-inch reflector, Spinrad compared the intensity of the Frannhofer H and K lines of singly ionized calcium and showed that these absorptions are less strong in the lunar spectrum than those in the spectra of Jupiter and Mars. Since all these bodies reflect the same sunlight, the fact that the lunar lines are less dark or more "filled-in" than those in the spectra of the planets indicates that there is a contribution in these wavelengths (near 3950Å) due to the moon itself. The luminescence mechanism explains this by assuming that the materials on the moon absorb energy from other parts of the solar spectrum and re-radiate it in the wavelengths of the H and K lines.

The actual physical mechanism by which luminescence on the moon occurs is by no means well understood. It appears clear, however, that the magnitude of the brightness fluctuations and their frequency are related to solar activity. For this reason and because the moon has no atmosphere, it will be interesting to look to other similar bodies in the solar system to see if further luminescence effects may be detected. The obvious choice is Mercury, which has a marginal atmosphere, if any, and which receives almost an order of magnitude more solar radiation than does the moon.

Observations of Mercury are difficult, and it has been the vogue in recent years to discount the numerous visual observations of apparent surface obscurations observed to occur on that planet by Antoniadi, the Jarry-Desloges observers, and a host of experienced B.A.A. and A.L.P.O. observers during the last half century. In the light of the new physical evidence for luminescence of lunar regions, however, it is tempting to suggest that Mercury may also luminesce in such a way that certain dark regions would appear and disappear as the above-mentioned observers have repeatedly reported.

There has been no satisfactory extended program of photometry of Mercury owing to the difficulties of the observations and also because variations aside from those predicted by the phase function would not normally be expected. A careful program carried out during periods of solar quiescence and activity might disclose some interesting results because luminescence effects of sufficient magnitude to "cloud" a dark area on Mercury would strongly affect the photometric results. (Reference to lunar observations: Spinrad, Hyron, 1964, "Lunar Luminescence in the Near Ultraviolet", Icarus, 4, 500.)

PETAVIUS RILLES

By: T. C. McCann, Lowell Observatory

C.A. Wood's paper on the rilles within Petavius (Strolling Astronomer, Vol. 18, Nos. 1-2) has prompted this writer to submit the following comments and annotations. This work is the result of observations made in connection with the future release of Air Force LAC 98. Observations were made with the Lowell 24" Refractor (490X) and the Lowell 20" Refractor (410X) from September, 1963 thru April, 1965. Figure 3 is a compilation of all observations, the best of which occurred on May 16, 1964. Lunar directions are in the new (IAU) sense; i.e., Petavius is near the eastern limb.

Rima Petavius II is not the simple linear feature it is generally shown to be. The major segment is jointed and runs from the central mountains to the base of the inner wall to the north. Midway in its length, it divides, the eastern-most component being more sinuous and eventually branching.

Rima Petavius V begins near the small hill south of the central mountains. Observations on May 16, 1964 gave evidence that this rille

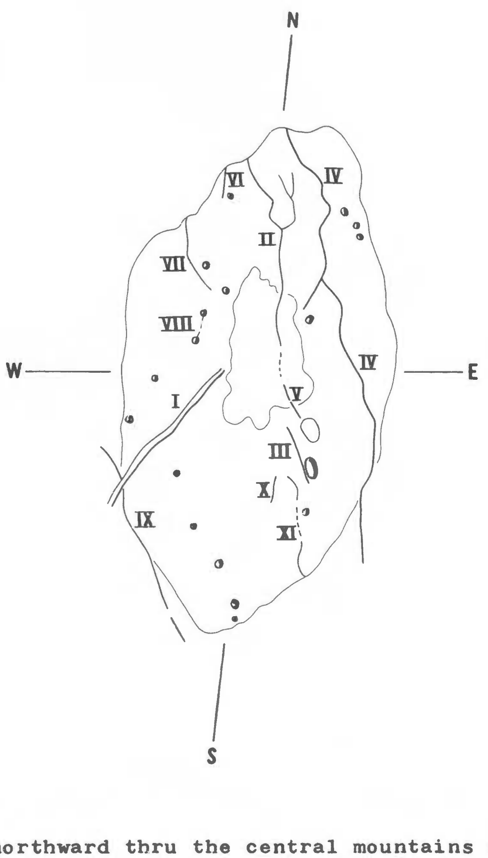

FIGURE 3. Compilation of observations of Petavius rilles by T.C. McCann and others. See his adjoining article. Note lunar directions marked (IAU sense). Best observation on May 16, 1964, $3^h 0^m$ - $4^h 30^m$, U.T., 20-inch refractor, 410X, seeing 5-7, transparency 8 (5 on A.L.P.O. scale?), colongitude 324°.2, libration in longitude +5°.4, libration in latitude -2°.5. No attempt here to show all detail other than rilles on floor and walls of Petavius. Sketch here shown by T. Dungan.

travels northward thru the central mountains and joins Rima Petavius II. In conversation with Patrick Moore (May 21, 1964) he admitted the likelihood of such a connection, but had never confirmed it.

Rima Petavius III parallels V and is peculiar in that it appears to possess a raised eastern rim.

Rima Petavius IV extends from the base of the inner north rim and winds its way in a long arc to the central mountains. Another rille (also labelled IV) joins it to the east of the mountains. This latter rille continues southward to the rim, and follows the contact of wall and floor for a short distance and then continues up the southern flank of the crater inner wall.

Rilles numbered VI, VII, VIII, X, and XI in Figure 3 are the results of visual observations. Rille VI is a delicate, straight rille of little extent. Rille VII runs from the base of the rim in a slow arc toward the central mountain. Rille VIII joins two smaller crater pits. Rille X is a short segment and follows some low mounds on the floor of Petavius. Rille XI parallels III for a short distance. A second segment (also labelled XI) runs from the crater floor into the inner south wall of the crater. Additional observations and/or high resolution photography may yield a connection between these two segments of XI.

Rille IX is a strong crater chain-rille system, which begins near the prominent crater on the southern rim of Petavius. It runs obliquely down the inner wall onto the floor and follows the floor and rim joint as far as Rima Petavius I. It continues north of I where it again travels obliquely up the flank of the inner rim.

A COMET ORBIT MODEL

By: Steve Larson

After a comet is discovered and the orbital elements are known, it is helpful to be able to visualize the comet's orbit in space. It is then easy to tell where the comet will be in relation to the earth on any given date. One way to achieve this would be to draw an orbit diagram. Doing so is not easy, however, because the right perspective is difficult to obtain. Another way would be to draw two figures: (1) the comet's orbit projected on the plane of the earth's orbit; and (2) the earth's orbit projected on the plane of the comet's orbit. A third way, the construction of a model, is the easiest and most useful.

In making a model one can immediately visualize the relationship between the earth and the comet, and by photographing the model in the right orientation the effect of the orbit diagram is achieved. When one makes a model, the following elements of an orbit must be known:

- T - time of perihelion passage.
- ω - angle between the ascending node and the point pf perihelion with the sun at the vertex, measured in the plane of the comet's orbit and in the direction of the comet's motion.
- Ω - the celestial longitude of the ascending node, measured from the vernal equinox and along the ecliptic.
- i - inclination of the plane of the comet's orbit to the ecliptic; it is always less than 90 degrees unless the comet is in retrograde motion.
- e - eccentricity of the orbit.
- q - the comet's distance from the sun at perihelion.

In addition to these elements, the distance from the earth, or the sun, at a given time is also required.

This information can usually be found in the IAU Circulars and through correspondence with the A.L.P.O. Comets Section.

Construction of the Model

To start the construction of the model, a circular piece of cardboard is used to represent the plane of the earth's orbit (Fig. 4). The position of the sun is at the center of the disc, and the earth's orbit

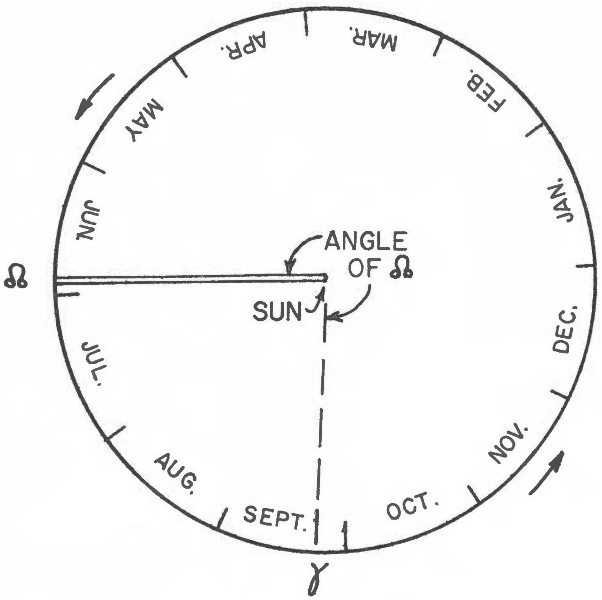

FIGURE 4. Plane of the earth's orbit from the top,or north. The earth travels counter-clockwise as indicated by the arrows. The slot between the sun and the ascending node is the place where the comet's orbital plane cuts the earth's orbital plane. See also text of Mr.Larson's article.

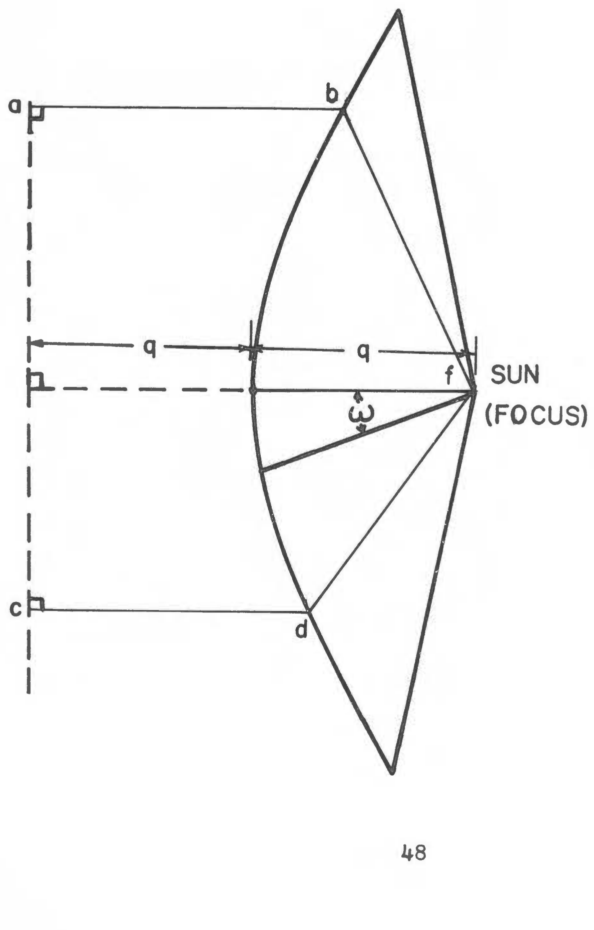

FIGURE 5. Plane of the comet's orbit. The parabola (the comet's orbit) is the locus of points equidistant from the dotted line (directrix) and the sun. Thus ab=bf and cd=df. The bottom side of the angle ω is the line where the plane of the earth's orbit intersects the comet's orbital plane. See also text.

is along the edge. Looking down on the disc, one has north up, while the earth travels to the right, or counter-clockwise, in its orbit. The edge is then divided into twelve equal parts representing the months. The vernal equinox is marked on the position of September 22, and the ascending node (Ω) is measured in the direction of the earth's travel. A slot is cut from this point to the center of the disc. In the case of Comet Everhart where Ω is 279°43', the slot is a little more than 3/4 of the way around the circle. The plane of the comet's orbit will later slide into this slot.

On another piece of cardboard representing the plane of the comet's orbit (Fig. 5), a point is placed in a position to represent the sun. A second point is marked at the distance of the comet from the sun at perihelion (q) using the radius of the earth's orbit disc as one Astronomical Unit. For example, q for Comet Everhart is 1.26 A.U. or 1.26 times the radius of the earth's orbit disc. A line is drawn between the sun and perihelion. Using it as one side of the angle ω with the sun at the vertex, the other side is drawn. This other side is the intersection of the two planes. The shape of the comet's orbit is then determined by its eccentricity (e). If $e<1$, the orbit will be an ellipse with the sun at one focus. This kind of orbit is characteristic of periodical comets and asteroids. If $e \sim 1$, the orbit plane is almost parabolic, and the orbit is drawn with the sun as the focus. Most newly discovered comets have assumed eccentricities of 1 so that for our purposes a parabola is drawn for the orbit of the new comet. A parabola is defined as the locus of points equidistant from the focus (the sun) and a line called the directrix. The directrix is twice the perihelion distance from the focus and is perpendicular to the line joining the sun and the point of perihelion, where the distance of a perpendicular line from the directrix to a point on the parabola is equal to the distance from that point to the focus (the sun). When $e > 1$, the orbit is hyperbolic. However, this value is never encountered since comets with hyperbolic orbits are not permanent members of the solar system and have not been certainly observed. The orbit of Comet Everhart, which has an eccentricity of 0.968, has e close enough to 1 to be considered parabolic.

The cardboard with the comet's orbit is now inserted into the slot in the cardboard for earth's orbit with the correct side of angle ω coinciding with the earth's orbit. Next a small piece of cardboard is cut with the angle of inclination (i), which acts as a support to orient the two planes. The addition of more supports will give better rigidity. The actual position of the comet along its orbit can be found by knowing the direction of travel and the distance from the sun, or from the earth, at a known date. On a separate piece of paper measure the distance of the comet from the earth, or the sun, using the scale of the model. Then, once we find that distance to the orbit on the model, the position of the comet on that date is known. Knowing the date and position of perihelion and the other position just found, we can extrapolate the position at any other date.

A photograph of the completed model for Comet Everhart (1964h) has already been published in The Strolling Astronomer, Vol. 19, Nos. 1-2, Figure 3 on pg. 4, to which readers are referred. Such models help the observer visualize the position and motion of the comet in space. Their accuracy is limited only by the scale and the amount of data given.

ADDITIONS TO THE A.L.P.O. LUNAR PHOTOGRAPH LIBRARY--III

By: John E. Westfall, A.L.P.O. Lunar Recorder

In recent months the A.L.P.O. Lunar Section has received numerous additional lunar photographs from several sources (including some generous and competent A.L.P.O. members). These new photographs are now available to A.L.P.O. members on the same basis as earlier photographs in the Lunar Photograph Library. Your Lunar Photograph Library now has a total of 153 lunar photographs, many of excellent quality; and it has been surprising how few members have taken advantage of the library's loan service. It is hoped that this supplementary list will help remind members that this research source continues to be available to them.

The new Lunar Library Photographs are listed below, grouoed by their source. All enlargements are 8 X 10 inches. Directions are in accordance with the I.A.U. system.

Photographs Taken by A.L.P.O. Members

Source: Patrick S. McIntosh (PSM-#) (6-in. Refl., #2-9 incl.; 12-in. coelostat, #1, 10)

Code Number	Area Covered	Date & Time (U.T.)	Colong.	Approx. Scale*
PSM-1	Pico-Piton-Cass.	28 Aug. 1964, 02:56	012°.7	1/450,000
PSM-2	M. Fecud.-Nect.	21 Nov. 1964, 04:--	111.-	4M
PSM-3	M. Cris. & vicin.	21 Nov. 1964, 04:--	111.-	4M
PSM-4	Eastern Maria	21 Nov. 1964, 04:--	111.-	9M
PSM-5	Quadrant IV	11 Dec. 1964, 01:39	353.2	10M
PSM-6	O. Procellarum	17 Dec. 1964, 03:25	066.9	9M
PSM-7	Tycho-Sirsalis	17 Dec. 1964, 03:35	067.0	10M
PSM-8	O. Procellarum	17 Dec. 1964, 03:43	067.1	6M
PSM-9	N.M. Imb.-N. limb	17 Dec. 1964, 03:45	067.1	6M
PSM-10	Aristarchus	5 May 1963, 05:38	049.0	1.3M

Source: Thomas Osypowski and Thomas Pope (OSY-#) (12½-in. Refl.)

Code Number	Area Covered	Date & Time (U.T.)	Colong.	Approx. Scale*
OSY-1	Ptol.-Alphonsus	29 Aug. 1964, 10:15	170°.2	2.7M
OSY-2	Tycho-Hellplain	29 Aug. 1964, 10:10	170.2	2.7M
OSY-3	Clavius-Tycho	28 Sep. 1964, 10:00	176.1	2.3M
OSY-4	Hyg. Clft.-Tries.	29 Aug. 1964, 10:20	170.2	1.8M
OSY-5	Copernicus Reg.	29 Sep. 1964, 10:00	188.3	2.1M
OSY-6	Plato & Alps	29 Aug. 1964, 10:20	170.2	1.8M

Source: Kenneth Schneller (KS-#) 8-in. Refl.)

Code Number	Area Covered	Date & Time (U.T.)	Colong.	Approx. Scale*
KS-1	Sacrob.-Jacobi	30 May 1963, 02:30	352°.7	4M
KS-2	Theop.-Hipparch.	30 May 1963, 02:32	352.7	4M
KS-3	NE M. Imb.-M. Frig.	14 Nov.1964, 03:25	025.6	4½M
KS-4	Copern.-Carpath.	13 Mar.1965, 04:16	033.5	3.1M

Additional Table Mountain Observatory Photographs (16-in Refl.)

Code Number	Area Covered	Date & Time (U.T.)	Colong.	Approx. Scale*
714a**	Mare Tranquill.	2 Mar. 1963, 02:47	347°.4	5.5M
714b**	Mare Tranquill.	2 Mar. 1963, 02:47	347.4	5.5M
714c**	Mare Serenitatis	2 Mar. 1963, 02:47	347.4	5.5M
2455a	Mare Tranquill.	27 Apr. 1964, 07:30	094.-	3.8M
2455b	M.Humorum-Nubium	27 Apr. 1964, 07:30	094.-	3.8M
2455c	Mare Fecunditatis	27 Apr. 1964, 07:30	094.-	3.8M
2455d	Coper.-Kepl.-Arist.	27 Apr. 1964, 07:30	094.-	3.8M
2455e	Mare Cognitum	27 Apr. 1964, 07:30	094.-	3.8M
2455f	Theop.-SW M.Tran.	27 Apr. 1964, 07:30	094.-	3.8M

Code Number	Area Covered	Date & Time (U.T.)	Colong.	Approx. Scale*
2925a	Plato area	29 Aug. 1964, 10:53	170°.5	3M
2925b	E. Mare Imbrium	29 Aug. 1964, 10:53	170.5	3M
2925c	S. Medii-M. Vap.	29 Aug. 1964, 10:53	170.5	3M
2925d	Ptol.-Alph.-Regio	29 Aug. 1964, 10:53	170.5	3M
2926a	Alpine Valley	29 Aug. 1964, 10:57	170.6	1/650,000
2926b	Straight Wall	29 Aug. 1964, 10:57	170.6	1/650,000
2926c	Albategnius	29 Aug. 1964, 10:57	170.6	1/650,000

NASA Ranger Series

Ranger VIII (Colong. 140°.4 - 140°.5)

Code Number 65-H-	U.T.: 1965 20 Feb. 9^h+	Area Photographed	Approximate Scale
188	51^m	Delambre Region	1/600,000 NS; 1/730,000 EW
189	54	Rilles SE of Sab.	1/360,000 NS; 1/450,000 EW
190	55^m 23^s	Sabine & Ritter	1/570,000 NS; 1/610,000 EW
191	56 52	3 Elong. Depress.	1/72,000 NS; 1/95,000 EW
192	57 13	Ireg. Clstr. Deprs.	1/38,000 NS; 1/51,000 EW
193	57 33	Area of Impact Pt.	1/4700 NS; 1/5900 EW
194	57 36	Area of Impact Pt.	Approx. 1/8300
195	57 38	Area of Impact Pt.	1/680 NS; 1/800 EW

Ranger IX (Colong. 172°.1 - 172°.2)

Code Number 65-H-	U.T.: 1965 24 Mar., 14^h+	Area Photographed	Approximate Scale
488A***			
UL	5^m 18^s	Alph.-Davy-Alpet.	2.4M
UR	6 45	Alphonsus	1.27M
LL	7 16	Alphonsus-Interior	1/870,000
LR	7 36	Alph.-Cent. Inter.	1/595,000
488B***			
UL	7 46	Alph.-N.Cent. Int.	1/450,000
UR	7 57	Clefts in NE Alph.	1/320,000
LL	8 12	Area of Impact Pt.	1/110,000
LR	8 17	Area of Impact Pt.	1/40,000
525	(13^h) 59^m 02^s	Ptol.-Alph.-Albat.	1.04M NS; 1.11M EW
526	7 03	Alph.-NE Interior	1/155,000
527	8 15	Area of Impact Pt.	1/11,700
528	8 20	Area of Impact Pt.	Approx. 1/500
529	5 30	Alph.-Davy-Alpet.	1/940,000
530	8 17	Area of Impact Pt.	1/16,500
531	8 12	Area of Impact Pt.	1/46,000
532	7 41	Alph. C.P.-NE Int.	1/216,000
534	8 20	Area of Impact Pt.	Approx. 1/820
535	8 20	Area of Impact Pt.	Approx. 1/800
536	(13^h) 50^m	Ptol.-Alph.-Hippar.	2.0M NS; 2.3M EW

* 4M is a scale of 1/4,000,000, etc.

** Color Photographs.

*** 65-H-488AB each contain four partial-scan photographs:
UL = Upper Left, UR = Upper Right, LL = Lower Left, LR = Lower Right.

Footnote by Editor. We can only underscore Mr. Westfall's implied wishes for a considerably more intensive use of our Lunar Photograph Library. After all, this facility serves a useful purpose only to the extent that it is used. Surely we have many members capable of carrying on research projects in which these photographs can be extremely helpful.

ADDITIONS TO THE A.L.P.O. LUNAR PHOTOGRAPH LIBRARY--IV:

MARINER IV MARS PHOTOGRAPHS

By: John E. Westfall, A.L.P.O. Lunar Recorder

N.A.S.A. has made available to the A.L.P.O. 8-by-10 prints of all twenty-two Mariner IV Mars Probe photographs. In spite of a paradox in nomenclature, both Mr. Brasch, the A.L.P.O. Mars Recorder, and the writer feel that the A.L.P.O. membership would be best served by making these prints available to them through the A.L.P.O. Lunar Photograph Library. The Mariner IV Mars photographs are thus available on the same basis as are the Library's lunar photographs.

Figure 6 is an index map, on the Mercator projection, showing the portion of the Martian surface covered by each photograph. The approximate limb (as seen from the Mars Probe) and the terminator are indicated. The small circle-dot symbol represents the subsolar point (i.e., point on Mars at which the sun was overhead at the time of photography); shadows, naturally, will fall directly away from this point. At about the average time of exposure (1965, July 15, $00^h 30^m$ U.T.) the areographic latitude and longitude of this point were 14°.7 N. and 209°.5 W. (150°.5 E.) respectively.

Figure 7 is Mariner IV photograph number fourteen, one of the more detailed of the series. This frame shows some of the surprising lunatype craters, these being ones in northeastern Phaethontis. North, and the sun, are toward the top of the photograph, so that objects cast shadows toward the bottom (orientation instructions are given on the back of each photograph). The lightish areas, particularly prominent in the upper right and lower center, may be frost areas. The altitude of the sun above this area's horizon is 30 degrees.

Below is a listing of the twenty-two Mariner IV photographs, with some abbreviated information. More complete information is given on the back of each photograph. Semitechnical analyses of the Mariner IV photographs are found in the references at the end of this paper.[1,2,3]

Mariner-IV Photographs

Code Number 65H- + (frame No.)	U.T.: 1965 15 July 00^h+	Area Coverage Lat./Long.	Area Coverage Description	Approx. Scale*	Filter
1226 (1)	18^m 33^s	35°N/172°E	Phlegra	var., 8.4 M along limb	Orange
1227 (2)	19 21	27N/174E	NE of Trivium Charontis	5.5M NS 3.0M EW	Green
1228 (3)	20 57	13N/177E	SE of Trivium Charontis	3.3M NS 2.4M EW	Green
1229 (4)	21 45	07N/179E	Mesogaea	2.7M NS 2.2M EW	Orange
1230 (5)	23 21	02S/181E	E Zephyria	2.1M NS 1.9M EW	Orange
1231 (6)	24 09	06S/183E	E Zephyria	2.1M NS 2.1M EW	Green
1232 (7)	25 45	13S/186E	SE Zephyria	1.9M NS 1.9M EW	Green
1233 (8)	26 33	16S/187E	Zephyria-M. Sirenum	1.7M NS 1.9M EW	Orange

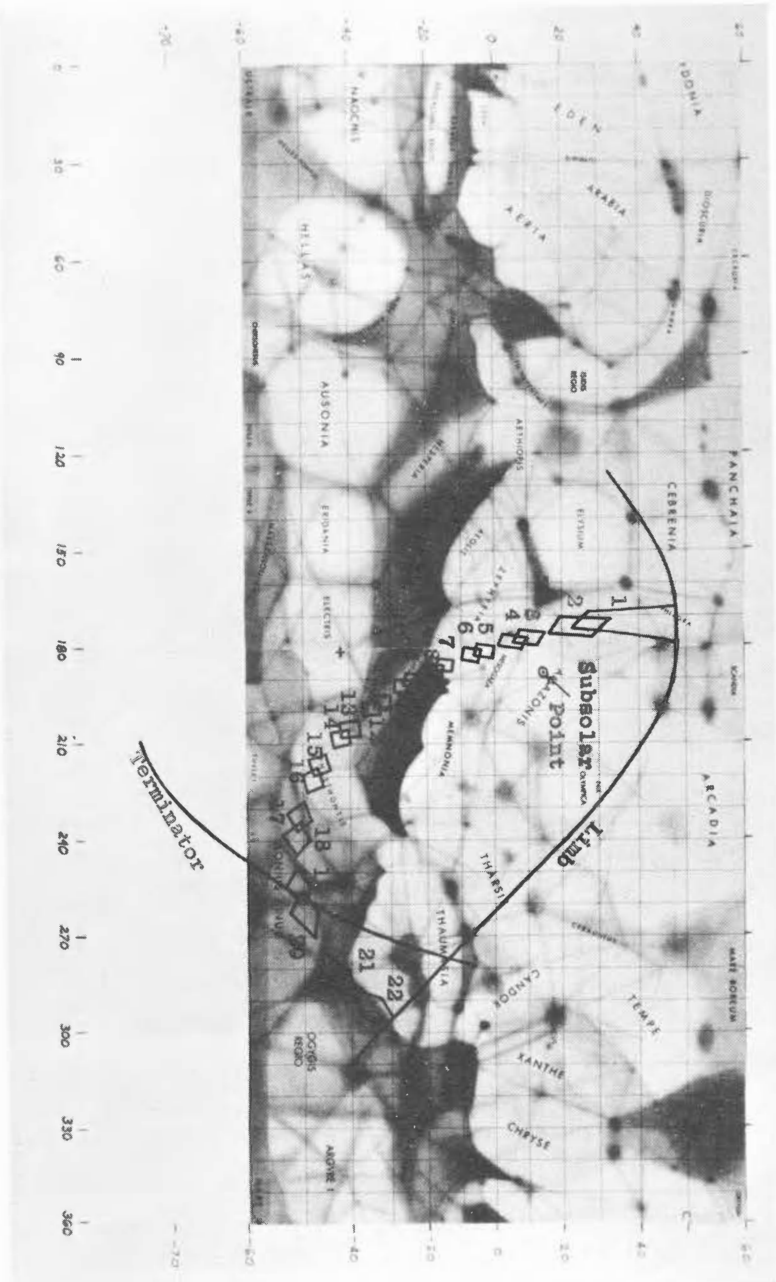

FIGURE 6. Mercator projection map of Mars showing the Mariner IV trace, the areas photographed in the 22 frames, the terminator, the limb seen by the spacecraft, and the subsolar point. This map supplied by N.A.S.A. North at right.

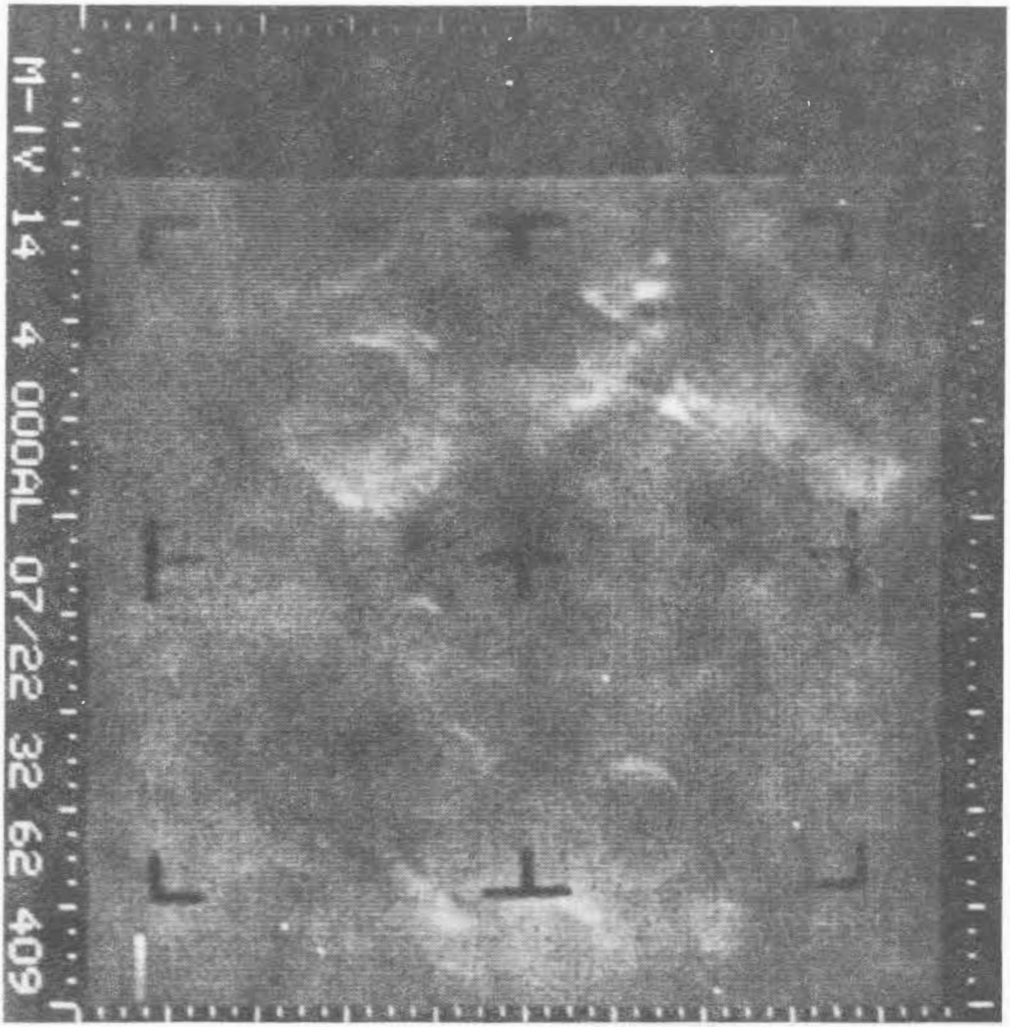

FIGURE 7. Mariner IV photograph 65-H-1239 (picture number 14). North at top. Taken at $0^h\ 33^m\ 45^s$, U.T., July 15, 1965, slant range 7600 miles. Area covered 170 miles east-west, 140 miles north-south, located at latitude 41°S., longitude 208°E. Sun's angular elevation 30 degrees. Green filter. Given to the A.L.P.O. by N.A.S.A. See also text.

Code Number 65H- + (frame no.)	U.T.: 1965 15 July 00^h+	Area Coverage Lat./Long.	Area Coverage Description	Approx. Scale*	Filter
1234 (9)	$28^m\ 09^s$	23°S/191°E	N. Sirenum	1.6M NS 1.7M EW	Orange
1235 (10)	28 57	26S/192E	Atlantis	1.6M NS 1.8M EW	Green
1236 (11)	30 33	31S/197E	Atlantis	1.6M NS 1.9M EW	Green

Code Number 65H- + (frame no.)	U.T.: 1965 15 July 00^h +	Area Coverage Lat./Long.	Area Coverage Description	Approx. Scale*	Filter
1237 (12)	31^m 21^s	34°S/199°E	M. Cimmerium	1.6M NS 1.9M EW	Orange
1238 (13)	32 57	39S/205E	M. Cimmerium-Phaethontis	1.5M NS 1.9M EW	Orange
1239 (14)	33 45	41S/208E	SW Phaethontis	1.5M NS 1.7M EW	Green
1240 (15)	35 21	45S/216E	Phaethontis	1.5M NS 2.0M EW	Green
1241 (16)	36 09	47S/221E	Phaethontis	1.5M NS 2.0M EW	Orange
1242 (17)	37 45	50S/232E	Aonius Sinus	1.5M NW-SE 2.2M NE-SW	Orange
1243 (18)	38 33	51S/238E	Aonius Sinus	1.5M NW-SE 2.3M NE-SW	Green
1244 (19)	40 09	51S/253E	Aonius Sinus-Terminator	1.6M NW-SE 2.6M NE-SW	Green
1245** (20)	-- --	----	----	----	----
1246** (21)	-- --	----	----	----	----
1247** (22)	-- --	----	----	----	----

* eg., 1.6M NS = 1/1,600,000 North-South
1.9M EW = 1/1,900,000 East-West, etc.

** These three photographs show the night side of Mars. Since no detail is visible, no data are given.

References

[1] Anon., "Special Supplement: Mariner 4 Photographs of Mars". Sky and Telescope, 30, 3 (Sept., 1965), 155-161.

[2] Leighton, Robert B. et al. "Mariner IV Photography of Mars: Initial Results". Science, 149 (3684, 6 Aug., 1965), 627-630.

[3] N.A.S.A. News. News Conference on Initial Scientific Interpretation of Mariner IV Photography. Washington, DC., released 29 July, 1965. pp. 1-34.

INDEX OF VOLUME 18 (1964) OF THE STROLLING ASTRONOMER

By: Dale P. Cruikshank and William K. Hartmann

Subject Index (references are to pages)

Author Index

A.L.P.O. COMETS SECTION

PRELIMINARY REPORT ON COMET IKEYA-SEKI 1965f

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

The excitement of a daytime comet enthused amateur comet observers as Comet Ikeya-Seki rounded the sun on Oct. 21, 1965 U.T. For the Comets Section members who had watched it faithfully at nearly every dawn since its September 18th discovery, the thrill of observing a comet within 2 degrees of the sun seemed the climax. However, within 5 days after perihelion passage a beautifully structured tail appeared in the dawn sky, and eventually stretched to over 25 degrees. In the week beginning on Oct. 25th the yellow head was overshadowed by the immense tail -- it was so large that the naked eye view was perhaps the most impressive, with the curving tail (of a decidedly blue tint visually) set next to the more familiar Zodiacal Light cone. Binoculars showed spiraling tail features which were easy to photograph with ordinary hand cameras, even without a clock drive.

We present in this report some of the sketches and photographs that have been received by the Comets Recorder up to the middle of November, 1965. Detailed analysis will appear in subsequent reports after all observers have sent in their records. Thanks go to the following A.L.P.O. members for their correspondence with the Recorder about what Brian Marsden has called "The Great Comet of 1965":

Gordon Solberg	Chick Capen	William Grady
R. B. Minton	Steve Larson	Herb Roth
Walter Haas	Rev. Leo Boethin	Raymond Rea
John Bortle	Ken Thomson	Bill Roberts
David Meisel	Ken Steinmetz	Bill Cahill
Rev. Kenneth Delano	Mike McCants	Bob Shayler
Elmer Reese	Alan McClure	Karl Simmons
Tom Pope	Alika Herring	Leif Robinson
James Young	Russ Maag	Carl Anderson
Craig Johnson	J. Russell Smith	

Beginning as a diffuse and tail-less object of 8th magnitude (Figure 8), by Sept. 26th and later the comet had a faint tail that was naturally better seen on long exposure photos (Figure 9). By Oct. 2nd a $1\frac{1}{2}^{\circ}$ tail was visible in a 6-inch from the mountains. At this time the 5th magnitude comet was seen as strongly bluish by most observers. We have on hand a fine series of magnitude estimates which agree quite well - attesting to the skill of observers such as Minton, Solberg, Reese, and Johnson. Reports of the degree of coma condensation indicate that the appearance varied from diffuse to stellar and back again.

At the end of the first week of October Comet Ikeya-Seki was visible to the naked eye. On Oct. 6th Craig L. Johnson, Boulder, Colorado, observed the following: "First identified at about 11:30 U.T. with 7X50 binoculars, this sharply condensed object had earlier been mistaken for a star.

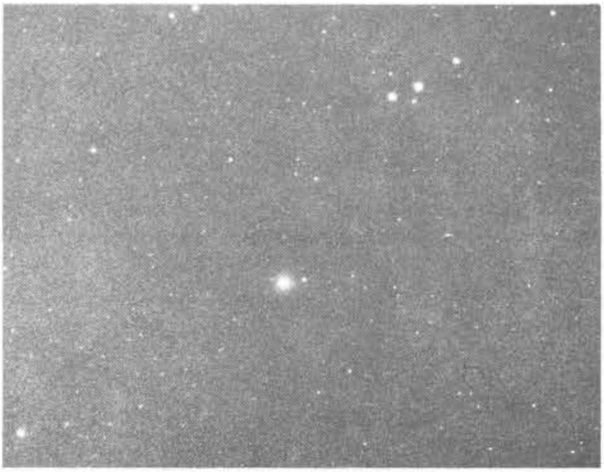

FIGURE 8. Early photograph of Comet Ikeya-Seki 1965f by Dennis Milon on September 22.5, 1965, U.T. 7-inch F7 Astrograph. Integrated visual magnitude in 7-inch was 7.7. No tail.

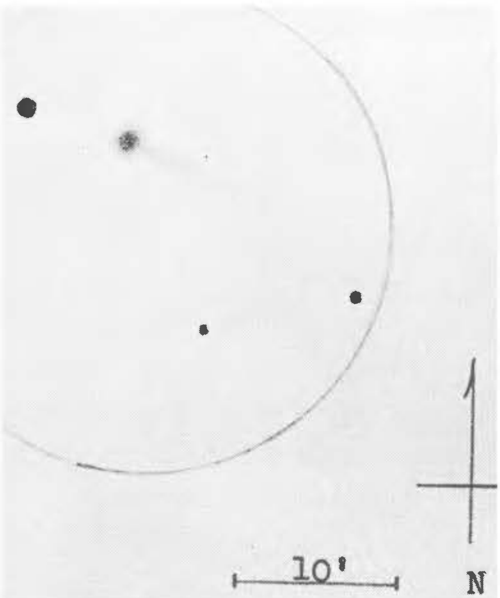

FIGURE 9. Drawing of Comet Ikeya-Seki 1965f by John E. Bortle, Mount Vernon, New York on October 2,1965 at 9^h 30^m, U.T. 5-inch refractor, 75X. Tail 6' to 7' long at position angle 261 degrees. Coma about $2\frac{1}{2}'$ in diameter. Nearly stellar nucleus of magnitude 9.1. The indicated scale and directions in the sky here shown by Mr. Bortle add to the value of such observations.

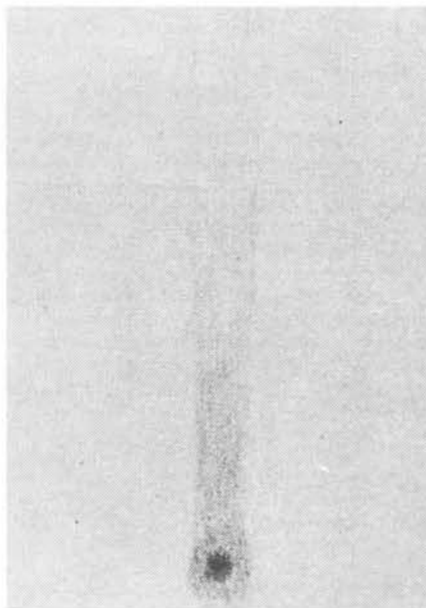

FIGURE 10. Drawing of Comet Ikeya-Seki 1965f by R. B. Minton, El Paso, Texas on October 8,1965 at 11^h 45^m, U.T. 4-inch reflector, 90X. Coma 2' in diameter. Tail $\frac{1}{2}$ degree long and at position angle 270 degrees.

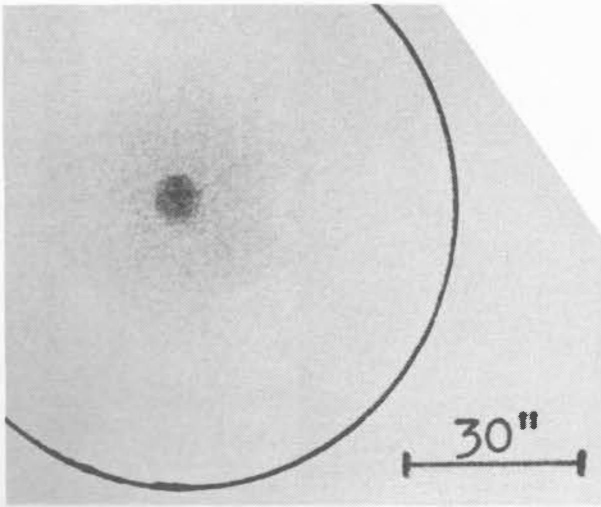

FIGURE 11. Drawing of Comet Ikeya-Seki 1965f by John E. Bortle on October 13, 1965 at $10^h 20^m$, U.T. (bright twilight). Coma condensation 7" to 10". Total magnitude about 3. The observer writes: "The nucleus was perfectly spherical and of the purest and most intense white". 5-inch refractor, 72X.

As it rose higher, a faint tail became evident, with a length of approximately 3/4 degree and brighter edges than center. A faint but definite coma was seen with a diameter of 4' or 5'. The relatively bright nucleus appeared only slightly larger than a star in the 7X50's. The magnitude was 4.9 by comparison with stars (50 mm. aperture), and the comet was faintly glimpsed in the dawn glow with the naked eye".

October 8 was the last day to observe for about two weeks without interference from moonlight. Dr. Van Biesbroeck and Dennis Milon saw a 3° tail (5.4 million miles long) in 7X35's that morning. See also Figure 10. As usual, those who were able to get away from city lights, and perhaps even to high mountains, had a better show.

Sketches by R. B. Minton and John Bortle show the appearance of the coma in mid-October (Figure 11). No blue color was noted in the tail at this time. However, Rev. Leo Boethin in the Philippines saw a yellow color in the tail with his 3-inch refractor on Oct. 12th. He made one of the last observations before perihelion in broad daylight on Oct. 15th, when he saw a tail making an angle of 15 degrees with the horizon.

Closest approach to the sun was predicted for Wednesday evening, Oct. 21st U.T. The comet brightened dramatically during the day, and many saw it with the naked eye (Figure 12). Changing detail could be seen in the coma by those who watched with telescopes through the day. David Meisel estimated the magnitude at -6.7 with the naked eye from Flagstaff, even brighter in yellow light. Meisel saw a tail of 2¼ degrees. Alan McClure in Los Angeles suspected an orange tint with a Questar after he blocked off the sun with a telephone pole.

After more daylight observations on Oct. 21st, our next report is by Craig Johnson, who saw the comet at first magnitude on Oct. 24th.

Comet photographers now had an impressive sight to catch on film. R. B. Minton of El Paso, Texas, made some of the best photos sent to the Comets Recorder. See Figures 13, 14, and 15. He describes his camera equipment as follows: "The mount has no drive or slow motions -- I push down on one end of the board to guide. For all of these photos I was set up about 15 miles east of El Paso in a dark part of the desert. As you can tell from the prints, I use an old 8X10 portrait camera mounted beside a Moonwatch 20 X 120 apogee telescope for guiding. The camera lens is an f/5 15-inch focal length Cooke triplet bought from Edmunds. It is stopped down to f/7 to improve image quality. The lenses are

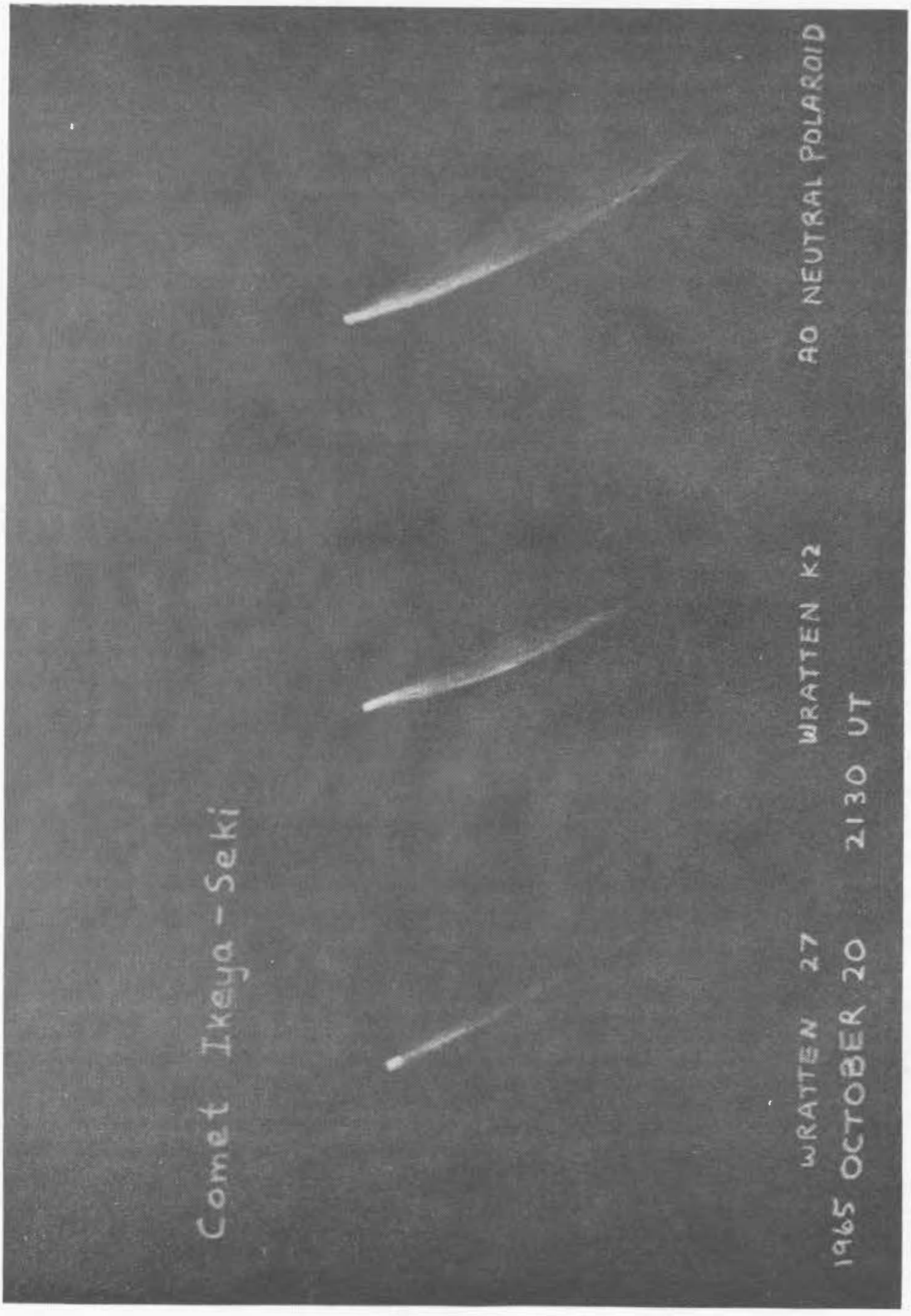

FIGURE 12. Daylight sketches with naked eye of Comet Ikeya-Seki 1965f by David Meisel from Flagstaff, Arizona. Made on October 20, 1965 at $21^h\ 30^m$, U.T. Note how the brighter leading edge of the tail was brighter in yellow light (Wratten K2) than in red (Wratten 27).

chipped seconds, and I had to space and mount them myself -- you don't get much for $12. I use 8 X 10 Tri-X developed 40 minutes in concentrated D76 at 72 degrees. No, none have turned black yet".

The bright streaks cutting diagonally across the end of the tail shown in Figures 13, 14, and 15 could be seen in binoculars; and the brighter edges of the tail-end added to the tube-like appearance. Many observers noted the lack of fine filamentary structure near the head. Instead, there was a bright inner core surrounded by a fainter sheath. At about the point where the spiral structure began there was a portion of tail on the south side which pointed straight away from the sun. See Figures 13, 14, 15, and 17. This was presumably the gas tail, forced directly away from the sun, while the dust tail still lagged behind from the million mile per hour sweep around the sun. On October 28th and 30th R. B. Minton photographed a diffuse anti-tail. It was confirmed bv Milon and Thomson on Nov. 2nd, when Ken Thomson described it as brash-shaped.

Steve Larson of Tucson, Arizona, took plates with the Steward Observatory Astrograph on Oct. 27th and 28th. He writes: "After 30 minutes of fruitless search over the bright lights of Tucson, the great tail was seen like a searchlight from the horizon, reminiscent of the old etchings seen in astronomy books of the last century. After recovering from the awesome beauty, I ran to the telescope and took 3 exposures. The plate scale is one degree per inch, and three 8 X 10 plates were needed to include the entire comet with some overlap.

"On a set taken the next morning, Oct. 28th, the same detail in the end of the tail was recorded.

"To increase the contrast the plates were traced on drawing paper. Comparing the two dates, there was very little change in the spiral structure, but the long mid-section stretched out. The detail in the end of the tail moved 1.56 degrees relative to the head between Oct. 27th and 28th. Thus the comet increased in length by 1½ degrees or 2½ million miles between the two dates."

Gordon Solberg has done a preliminary analysis from his measurements of photos by himself, Bradford Smith, and Tom Pope at the Research Center of New Mexico State University. He reports: "The ray farthest from the head was emitted Oct. 22.9, and the ray nearest the head was emitted Oct. 23.9. The south edge of the tail had a velocity of 74.8 kilometers per second (relative to the head), and the north edge 61.0 kms./sec. Oddly enough, the end of the tail seems to have been emitted before Oct. 20, although it appears unlikely that the tail could have followed the coma around the sun near perihelion without being blown away."

With moonlight again interfering on Nov. 6th, photographic studies of the tail were hampered. Of equal interest at this point were reports of a break-up of the nucleus. According to IAU Circular 1937 this was first observed on Nov. 4th. Rev. Kenneth Delano of New Bedford, Mass., on Nov. 15th described an inner coma 70 seconds in diameter (compared to Jupiter in a 3½" Questar) containing " ... hints of two nuclei of nearly equal brightness". On the same date John Bortle commented: "Even the binoculars showed there was something wrong with the head, and the 5-inch was just able to show it was divided into two comas about one minute of arc apart." So it appears that,notwithstanding the spectacles of daylight visibility and a 25 degree tail, Comet Ikeya-Seki may still have some new surprises in store for observers.

BOOK REVIEWS

1966 Celestial Calendar and Handbook, by Charles F. Johnson, Jr., published by Charles F. Johnson, Jr., 48 Roberts Street, Watertown, Conn. $1.00 postpaid in U.S.A., Canada, and Mexico.

FIGURE 13. Photograph of Comet Ikeya-Seki 1965f by R.B. Minton on October 30, 1965. 10-minute exposure beginning at 11:55, U.T. F7 15-inch F.L. Cooke Triplet. Tri X film. See text for camera details.

FIGURE 14. Another photograph of Comet Ikeya-Seki 1965f by R. B. Minton. Taken on October 31, 1965, 15-minute exposure, 11:50 - 12:05, U.T. Same camera and film as for Figure 13. Note spiral detail, bright inner core of tail, and fainter surrounding sheath.

FIGURE 15 (left). A third photograph of Comet Ikeya-Seki 1965f by R. B. Minton. Taken on November 5, 1965, 10-minute exposure beginning at 11:55, U.T. Same camera and film as for Figure 13. Notice the fading of the tail compared to the October 30 and 31 photographs.

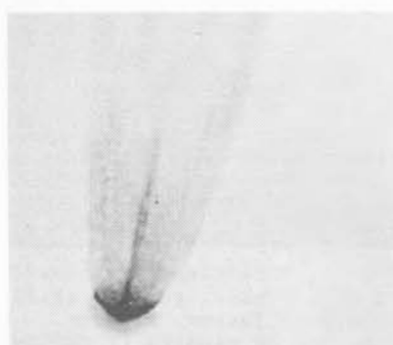

FIGURE 16. Sketch of detail in head of Comet Ikeya-Seki 1965f by Alika K. Herring. 12.5-inch reflector, 75X. Observed at Mauna Kea, Hawaii. October 25, 1965, $15^h 40^m$, U.T.

FIGURE 17. Photograph of Comet Ikeya-Seki 1965f by Ken Thomson, November 2, 1965, 3-minute exposure from 12:20 to 12:23, U.T. Observed from Catalina Mountains near Tucson, Arizona. Used F3.5, 75mm. lens and Tri X film. Developed for 10 minutes in DK 60a. Note the narrowing of the main tail at the point where the straight gas tail appears (see also text on pg. 66).

Reviewed by J. Russell Smith

Here's a 32-page booklet which is now in its second year of publication. The 1965 issue was used and praised by observers all over the country. The 1966 edition has been enlarged to include several items of general interest which were not in the 1965 edition. These listings include information on variable stars, meteor showers, elongations and conjunctions of Titan, the largest satellite of Saturn, and finding charts for Uranus and Neptune as well as for the asteroids Ceres and Pallas.

The heart of the booklet is the calendar section and the charts for the four largest satellites of Jupiter. The calendar section simply gives a calendar page for each month and lists on the calendar (for certain dates) important astronomical events. For example, March 4, 1966 lists Mercury at greatest elongation east (18°) at $23^h\ 00^m$ E.S.T. The charts for the satellites of Jupiter give the daily configurations of Satellites I - IV. Some of the other informative charts are on the brightest stars, double and multiple stars, clusters, nebulae, and galaxies. On page 2 one finds a small map of the moon, and on the inside of the back cover there is a key map of Jupiter's belts and zones which is quite useful for the Jupiter observers. The back cover contains a list of major societies, journals, and planetariums.

The booklet is a useful volume to have around the telescope, and is well worth the "buck".

Astronomy Highlights. Natural History Press, New York, 1964. 50¢/booklet.

Reviewed by José Olivarez

Astronomy Highlights is a boxed series of eight richly illustrated booklets which present fascinating topics of modern astronomy for the general reader. The booklets were indeed written by lecturers of the Hayden Planetarium of the American Museum of Natural History. Each booklet is a thirty-two page work. In these thirty-two pages, the principles of today's astronomy highlights are simply and accurately described. The astronomy highlights were appropriately picked to be the man in space program, space age astronomy, the Apollo project and the moon, the sun, the planets, the stars, time, and the probes in search for the design of the universe. The booklets are all well illustrated with photographs taken by major observatories and with excellent line drawings and graphs which help simplify otherwise hard-to-grasp points.

Errors and omissions are few and occur mainly in the booklet, Design of the Universe. On page 22 of this booklet, the author makes the following statement: "Clouds of hydrogen that drift through space cannot be detected unless they are excited by a nearby hot star. When they are excited, they radiate energy in a very definite radio wavelength." The second statement is certainly erroneous! What the author must have had in mind are the neutral hydrogen clouds (H-I) that are detected by radio telescopes because of their inherent radiation in the 21 cm. line of the radio spectrum. These H-I clouds do not require external excitation to emit in the radio regions.

This boxed series of booklets will educate the general reader rather fully on the aspects of today's astronomy and help the beginning amateur astronomer to realize the majestic aspects of the universe that he will learn to love so well.

ANNOUNCEMENTS

1966 A.L.P.O. Convention to be at Tucson. In accord with the expressed wishes of the large majority of those who replied to a circular letter on the subject sent to some dozens of our most active members, it has been decided to hold the 1966 Convention of the A.L.P.O. at Tucson, Arizona. We thank all those who helped by expressing their opinion. The dates of the meeting and other details will be announced in future issues as plans develope. Readers interested in pre-Convention information and pre-registration should write to: C.A. Wood, 1304 East 7th, Tucson, Arizona 85719.

Thank-You Note. We were pleased to note the following sentences in a letter from Mr. Carl Anderson of Manchester, New Hampshire: "Incidentally, I have found both Dale Cruikshank and Dennis Milon to be very prompt and helpful in responding to any request I have made. It seems to me this is very important in such activity, and I wanted to pass along my appreciation."

Adult Study Course in Astronomy. Miss Grace A. Fox of Fort Dodge, Iowa is already well known to those who have attended A.L.P.O. Conventions in recent years for her regular presence and contagious enthusiasm. Friends of Miss Fox will be interested in knowing that she has taught a 12-week adult evening course in astronomy at the Fort Dodge Community College. There were nine students from several different professions. The course included sessions with a telescope and library reading assignments. A second course will begin in January. We congratulate Miss Fox upon providing a needed service, adult education in astronomy in our Space Age.

No Planetary Occultations in 1966. Dr. Gordon E. Taylor of H.M. Nautical Almanac Office at Herstmonceux Castle tells us that we shall have no occultations of stars by planets next year. Dr. Taylor has graciously been sending us information on such phenomena for a number of years.

LUNAR, PLANETARY, AND COMETARY PROSPECTS, JANUARY - FEBRUARY, 1966

By: Walter H. Haas

Comets Notes. Dennis Milon has given us these notes: "Comet Ikeya-Seki is running about 0.8 magnitudes fainter than McCants' predictions on pg. 36 of Str. A., Vol. 19, Nos. 1-2, judging from early November observations.

"Comet Alcock 1965h has not been reported visually by A.L.P.O. members. Searches with 12.5-inch reflectors by Alika Herring and Walter Haas were unsuccessful. The comet was not found on photographs taken with a 7" F7 astrograph on October 23 and 24, 1965 by Dennis Milon".

Michael McCants has forwarded the following revised ephemeris based on Dr. Cunningham's elements:

Date 1965	Right Ascension	Declination	r	Δ	Comet-Earth-Sun Angle	Stellar Magnitude
Dec. 16	$9^h\ 1^m.20$	-38 47!9	1.599	1.087	100°.9	8.3
Dec. 26	8 6.15	-38 32.1	1.785	1.155	112.9	9.0
1966						
Jan. 5	7 17.17	-36 2.6	1.962	1.263	121.1	9.6
Jan. 15	6 40.86	-32 12.8	2.130	1.414	124.3	10.2
Jan. 25	6 15.85	-28 1.0	2.293	1.602	123.0	10.7
Feb. 4	6 0.22	-23 58.1	2.456	1.825	118.7	11.3
Feb. 14	5 50.69	-20 23.3	2.608	2.065	112.5	11.9
Feb. 24	5 46.54	-17 15.5	2.770	2.334	105.6	12.4

As usual, r is the distance from the sun in astronomical units; and Δ is the distance from the earth in the same units. Substantial variations from the predicted stellar magnitudes may occur, and it is hoped that readers with large enough telescopes will keep watching this famous comet.

Mercury. The innermost planet will be at greatest elongation west on December 21, 1965, at superior conjunction on February 6, and at greatest elongation east on March 5. It will hence be observable in the morning sky in late December and early January, though not particularly well placed relative to the horizon for northern hemisphere observers. For such observers the February-March evening apparition will be the most favorable one of the year. Because the question of the rotation of Mercury is now wide open after it had long been supposed to be synchronous with the revolution around the sun and because reliable optical evidence on this matter would be valuable, we again urge interested members to make a close study of Mercury from this point of view. The method must consist of carefully recording day after day the positions of any features seen relative to the terminator. The Editor would opine that three to five days, granted good enough viewing, should make very clear the distinction between 59-day and 88-day rotations.

Venus. This planet is in inferior conjunction with the sun on January 26, after which it passes over to the morning sky. It will pass more than six and one-half degrees north of the center of the sun, making the event a favorable one for northern hemisphere observers. As usual when Venus is a narrow crescent, observers can look for the curious very faint illumination of the dark hemisphere of the planet which is often then recorded and can report the amount of the extension of the horns of the crescent by the atmosphere of Venus. Color filters of known transmissions can be used in such observations, and also in more general studies of the aspect of the planet; but caution must be exercised in distinguishing between effects due to the filter and effects due merely to the lessened brightness of the image.

Mars is so distant as to be effectively unobservable, though conjunction with the sun does not occur until April 29, 1966.

Jupiter. Being at opposition on December 18, 1965, the Giant Planet will be excellently placed in the evening sky during January and February. Its declination of about +23 degrees will bring it high above the horizon for northern hemisphere observers. Amateur planetary observers can hardly find a better program than the systematic recording of central meridian transits of Jovian surface features. Dr. Charles H. Giffen's article on pages 29-34 of our last issue (Vol. 19, Nos. 1-2) will provide excellent guidance for this kind of study. At last reports the famous Red Spot was still near longitude 25 degrees (System II).

Figure 18 ought to be of interest to many of our readers, and observers favored by both moderate apertures (say 12 inches and above) and good seeing may enjoy drawing the discs of the four large satellites. Contrary to what many have chosen to conclude, we have never encouraged such studies with very small apertures.

Saturn. The Ringed Planet will be in conjunction with the sun on March 10. It will hence be well placed in the early evening during January but will be rather hard to observe during February. The rings will be but slightly opened; in mid-January they are tilted only 4 degrees to the earth and only 2 degrees to the sun. Observers should begin to prepare for the triple edgewise presentation of the rings in 1966. For doing so we recommend a close study of Joel W. Goodman's article "The Edgewise Presentation of Saturn's Rings" in Sky and Telescope for September, 1965, pp.128 - 131. (Dr. Goodman was formerly the A.L.P.O. Saturn Recorder.)

Moon. Those interested in "lunar transient phenomena" might note that Alphonsus is illuminated from December 30 to January 14 and from January 29 to February 13. The Aristarchus-Herodotus region is in sunlight from Jan. 3 to 18 and from Feb. 2 to 17. The moon is in perigee on January 8 and February 5, in apogee on January 23 and February 19. Searches might be more intense near these dates since good evidence exists that "lunar transient phenomena" are more frequent near perigee and apogee.

Uranus will reach opposition on March 8 and will be well placed in the morning sky during January and February. On February 1 its position is right ascension 11 hrs., 21 mins., declination + 5 degrees. The diagram of the satellite orbits on pg. 372 of the 1966 A.E.N.A. shows that these are now nearly edgewise and that the Uranian satellites undergo during each revolution occultations behind their primary while the satellites (and their shadows?) also transit the face or Uranus.

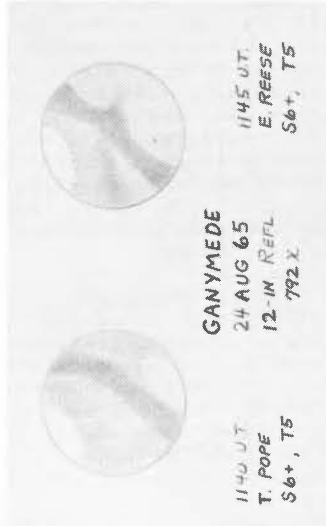

FIGURE 18. Comparative drawings of Ganymede (Jupiter III) by staff members of Research Center, New Mexico State University. The agreement between these independent drawings is remarkably good. South at left.

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