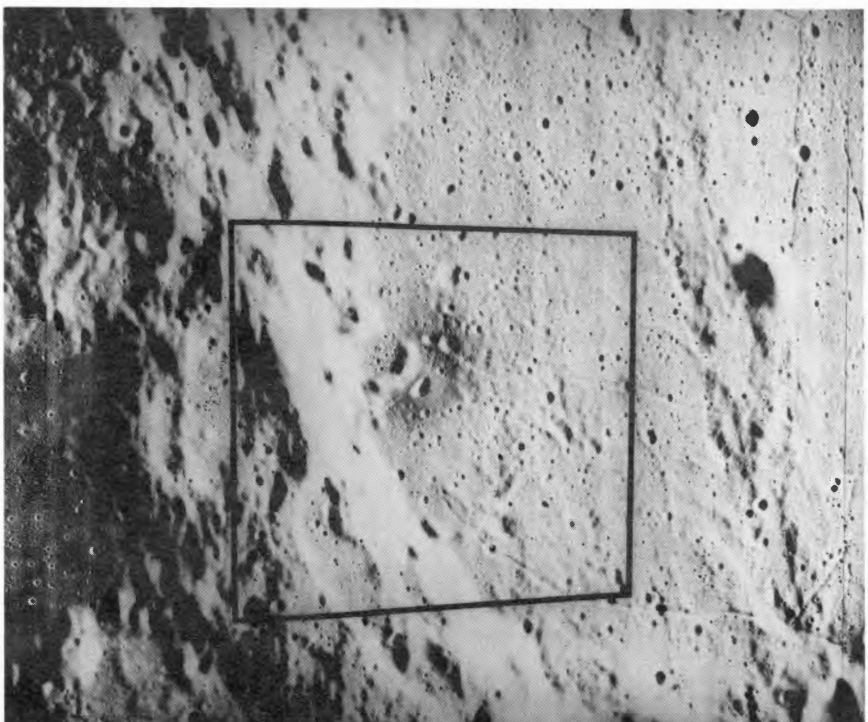
The Journal Of The Association Of Lunar And Planetary Observers

The Strolling Astronomer

Volume 25, Numbers 5-6 **Published March, 1975**



Four of the Dark-Haloed Lunar Craters in Alphonsus as shown on NASA Photograph 67-H-1423. Three of them are close together in the upper central part of the enclosed quadrilateral, and the fourth is near the right edge of this enclosure. Note the elongated shapes of the Dark-Haloed Craters, their interaction with lunar rills, and the diffuse halo boundaries. Taken by Lunar Orbiter V on August 14, 1967 at 22 hrs., 3 mins., Universal Time, colongitude=22°.1. See article by Mr. Alain Porter on page 120 *et seq.*

THE STROLLING ASTRONOMER
Box 3AZ
University Park, New Mexico
88003

Residence telephone 522-4213 (Area Code 505)
in Las Cruces, New Mexico

ASSOCIATION OF LUNAR & PLANETARY OBSERVERS
ALPO

Founded In 1947

IN THIS ISSUE

ABC Print—Las Cruces

OBSERVING LUNAR ECLIPSES

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

Introduction.--No two lunar eclipses are identical, and the amateur can contribute observations of them which give valuable information about the Earth's atmosphere and also about the Moon's surface. A variety of instruments may be used, ranging from the unaided eye to a large telescope; and a number of separate projects are possible, preferably carried out by means of a prearranged schedule. Indeed, an individual observer should restrict himself to carrying out thoroughly just one or two of the programs described below; there is obviously scope for team projects. The "ALPO Lunar Eclipse Observation Form," available from the writer, should be used to record observations.

General Observations.--The naked eye, binoculars, or a telescope may be used to survey the Moon during partial and total phases. Written notes and sketches should describe the following phenomena:

Visibility, color and tone of penumbra.
Sharpness and possible ellipticity of edge of umbra.
Color and tone of umbra.
Zonal or time variations of tone or color in umbra.
Visibility of features within the umbra.
Estimations of the eclipse luminosity (at mid-totality) according to the 5-value Danjon Scale:

L = 0 Very dark eclipse; Moon almost invisible, especially at mid-totality.

L = 1 Dark eclipse; gray or brownish coloration, details distinguishable only with difficulty.

L = 2 Deep red or rust-colored eclipse, with a very dark central part in the shadow and the outer edge of the umbra relatively bright.

L = 3 Brick-red eclipse, usually with a bright or yellow rim to the shadow.

L = 4 Very bright copper-red or orange eclipse, with a bluish, very bright shadow rim.

Photometry.--The Moon's apparent magnitude (M) should be estimated at frequent intervals during the course of an eclipse, especially during totality. In each of the three methods described below, the image of the Moon is compared with that of a star or planet. Each method differs in the manner by which the images of the Moon and the comparison object are made comparable in apparent size and brightness. Because the Moon's brightness often varies by a factor of 100,000 or more during a total eclipse, no single method can be used for all phases of an eclipse. In order to achieve standardized results, one may assume that the visual magnitude of the uneclipsed Full Moon is - 12.7.

If magnitude estimation is to be accurate, one must take account of the unequal dimming (extinction) of the Moon and the comparison object due to the Earth's atmosphere. The value of this correction (E) is given by Figure 1. To use this graph, take the vertical axis as the altitude of the higher of the two objects, and the horizontal axis as the altitude of the lower object. If the Moon is the higher object, add E; if the Moon is the lower, subtract E. Even when using this correction, we are more accurate if the Moon and the comparison object are at approximately equal altitudes. Altitudes may be measured by sighting on the straight edge of a protractor, with a plumb bob suspended from the center mark. They may also be computed later from the time of an observation.

Three methods of lunar magnitude estimation may be used:

1. If you are nearsighted, remove your glasses and compare the out-of-focus image of the Moon with that of a star or planet of known visual magnitude (m) which appears equally bright. The Moon's magnitude (M) is:

$M = m \pm E$, with the plus or minus sign chosen as described above.

This method is suited to the total and near-total phases of an eclipse (i.e., M *ca.*-1.5 to +2).

2. Using reversed binoculars or a small telescope, compare the reduced lunar image with a star or planet viewed by the naked eye. If the normal magnification is P, the Moon's magnitude is given by:

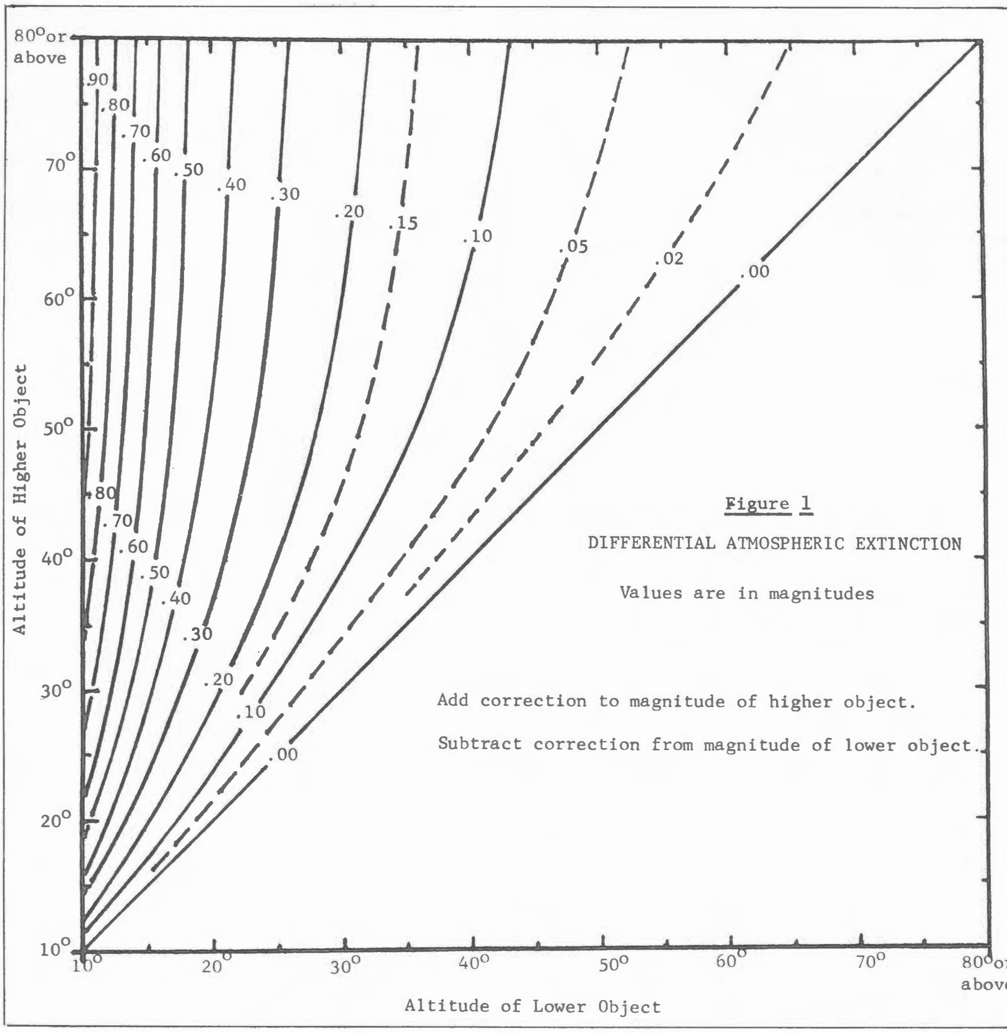


Figure 1

DIFFERENTIAL ATMOSPHERIC EXTINCTION

Values are in magnitudes

$$M = m - (5 \log P + 0.2) \pm E.$$

The constant, 0.2, assumes a 0.2-magnitude loss of light in the instrument. Assuming this value, the magnitude reduction, depending on magnification, is:

6X . . . 4.09 Mag.	12X . . . 5.59 Mag.
7X . . . 4.43	16X . . . 6.22
8X 4.72	20X . . . 6.71
10X . . . 5.20	

This method is suited to the umbral and total phases of an eclipse (i.e., M *ca.* -6 to +1).

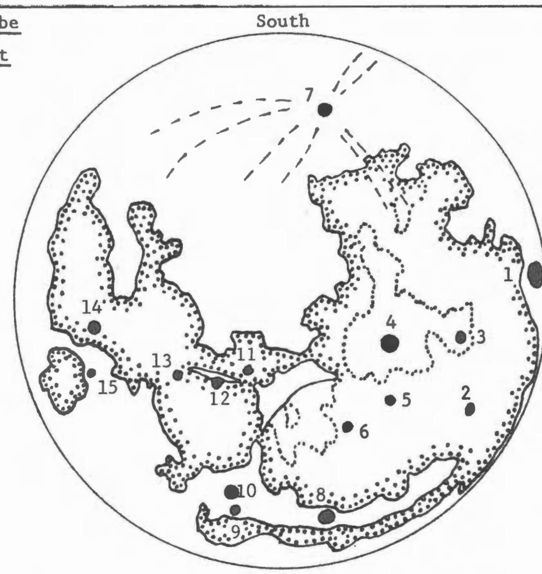
3. A convex reflector (convex mirror, ball bearing or Christmas tree ball) is used to create a reduced, virtual, lunar image. This image becomes fainter the farther the eye is moved back from it so that, for a given eye-image distance, R (in inches or centimeters), the Moon's apparent brightness matches that of a comparison object. The Moon's magnitude is then given by:

$$M = m + K - 5 \log R \pm E.$$

The constant, K, is found by observing the Full Moon immediately before and/or after the eclipse, when its magnitude is known (-12.7). It is convenient to view the comparison object's image in a plane mirror placed beside the convex reflector so that the two images are viewed side-by-side. In such a case, the constant K must also be found when using the plane mirror.

Figure 2. Craters to be Used for Umbral Contact Timings.

Key: 1. Grimaldi
2. Aristarchus
3. Kepler
4. Copernicus
5. Pytheas
6. Timocharis
7. Tycho
8. Plato
9. Aristoteles
10. Eudoxus
11. Manilius
12. Menelaus
13. Plinius
14. Taruntius
15. Proclus



This method is usable during the penumbral stages and, given a sufficiently large radius of curvature for the reflector, may also be used for the brighter umbral stages of an eclipse (i.e., M = -12.7 to *ca.* -4).

Contact and Crater Timings.--Eclipse timings furnish information on the Earth's upper atmosphere, if accurate to ± 0.1 minute (e.g., with WWV time signals), and with a low-power telescope (i.e., 20X - 80X). Umbral contacts I-IV may be timed, but are subject to systematic errors. For this reason, more useful timings are made of umbral contacts (ingress and egress) of 15 selected craters, shown on the map in Figure 2. Instead of estimating the time for the center of a crater, average the two times when the umbral edge first touches the crater and when it reaches the crater's other side. Such crater timings should be mailed to Sky and Telescope (address given on form) for reduction.

Lunar Changes.--Many lunarians feel that lunar eclipses are especially favorable times to observe unusual lunar events, for example changes in brightnesses, shapes and definitions of dark and light patches. Such areas should be watched (and preferably photographed; see below) just before and just after the eclipse and, if possible, during totality. Some features of special interest are:

Alphonsus--central peak, dark patches on floor.
Aristarchus & area--wall bands, "red glow" areas.
Atlas--dark areas on floor.
Conon--white area on floor.
Eratosthenes--dark areas on floor & walls.
Grimaldi--tone of floor & bright spots on E & NE (East in IAU sense).
Linné--nimbus
Messier & Pickering--relative shapes, sizes and tones.
Plato--light spots on floor.
Riccioli--dark area on floor.
Stöfler--dark areas on floor.

Photography.--Realistic lunar eclipse photography is difficult because of the dimness of the Moon during totality and because of the extreme variation in brightness during an eclipse. A clock-driven telescope of focal length 36 - 100 inches (to fit the Moon into a 35mm frame) is ideal, operating at f/8 or faster. General views of the partial phases of an eclipse can be taken with such an instrument, although a lunar clock rate (preferably aided by guiding in declination) is recommended for views of totality. Deviations of the umbral outline from circularity, and the tone and color of the umbra may thus be recorded on film.

"Fast" films are desirable, developed for high contrast if black-and-white (e.g., Plus-X or Tri-X, "pushed" with D-76 or DK-50; spectroscopic films with D-19). High-speed Ektachrome is probably the most suitable easily-available color film for lunar eclipses, although interesting results might be obtained with Ektachrome Infrared. Reciprocity failure should be considered when choosing a film for photography of totality.

It is difficult to set rules about the correct exposure for lunar eclipses, particularly for the umbra, which varies in darkness between eclipses. Table 1 gives suggested exposure times, for an f/8 instrument and ASA 160 film, modified from a table by Frederick Veio. Bracketing should be done to insure correct exposure.

Table 1. Suggested Exposures for Lunar Eclipses (f/8, ASA 160)[a]

Partial Phases

Uneclipsed Full Moon	1/1000 sec.
Moon deep in Penumbra	1/250
Moon 1/10 - 1/2 in Umbra	1/15
Moon 1/2 - 3/4 in Umbra	
Portion in Penumbra	1/15
Portion in Umbra	2[b]
Moon 3/4 in Umbra to Totality . .	3[b]

Totality

(Exposure Times in Seconds)	Eclipse Luminosity L=0	L=1	L=2	L=3	L=4
Beginning or End of Totality	500[d]	125[d]	35	10	2.5
10 min. After Totality Begins or 10 min. Before Totality Ends .	1000[d]	250[d]	70[c]	20	5
Mid-Eclipse	2000[d]	500[d]	140[d]	40	10

[a]For other f-ratios or film speeds, see formula in "Lunar Photography" chapter of forthcoming Lunar Observer's Manual.
[b]Depending on luminosity (L) of eclipse.
[c]Lunar clock drive rate required (maximum motion 30").
[d]Guiding in declination required (maximum motion 30").

A somewhat different project is the high-resolution photography of selected lunar features for possible eclipse-induced tonal changes or LTP's. High-contrast black-and-white or colored photographs of a feature immediately before and immediately after an eclipse are suitable for this purpose. Particularly challanging are such views taken during totality; this requires a fairly large, "fast" instrument (e.g., 10-16 inches, f/6 - f/8), "fast" film, a relatively bright eclipse, and accurate guiding.

Forthcoming Lunar Eclipses.--The lunar eclipses listed below will be at least partly visible from the United States in 1975 - 1983. Their magnitudes (1.0 and greater are total) are given in parentheses.

May 25, 1975 (1.4)	July 17, 1981 (0.6)
Nov. 18, 1975 (1.1)*	July 6, 1982 (1.7)
Apr. 4, 1977 (0.2)	Dec. 30, 1982 (1.2)
Sep. 6, 1979 (1.1)*	June 25, 1983 (0.3)

*Only partly visible from the United States.

THE LUNAR ECLIPSE OF MAY 25, 1975

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

On the night of May 24-25, 1975, there will occur the first total lunar eclipse well visible for American observers since January, 1972. Given clear skies, observers throughout the United States should be able to see the entire eclipse, unless they are located in the Northwest, where the Moon will not yet have risen for the early penumbral stages.

The Moon, at 20°6 South declination, will be fairly low in the sky for this eclipse, which will be of magnitude 1.43 (1.00 or above is a total eclipse). The table below gives the Universal and Local Times predicted for penumbral and umbral contacts.

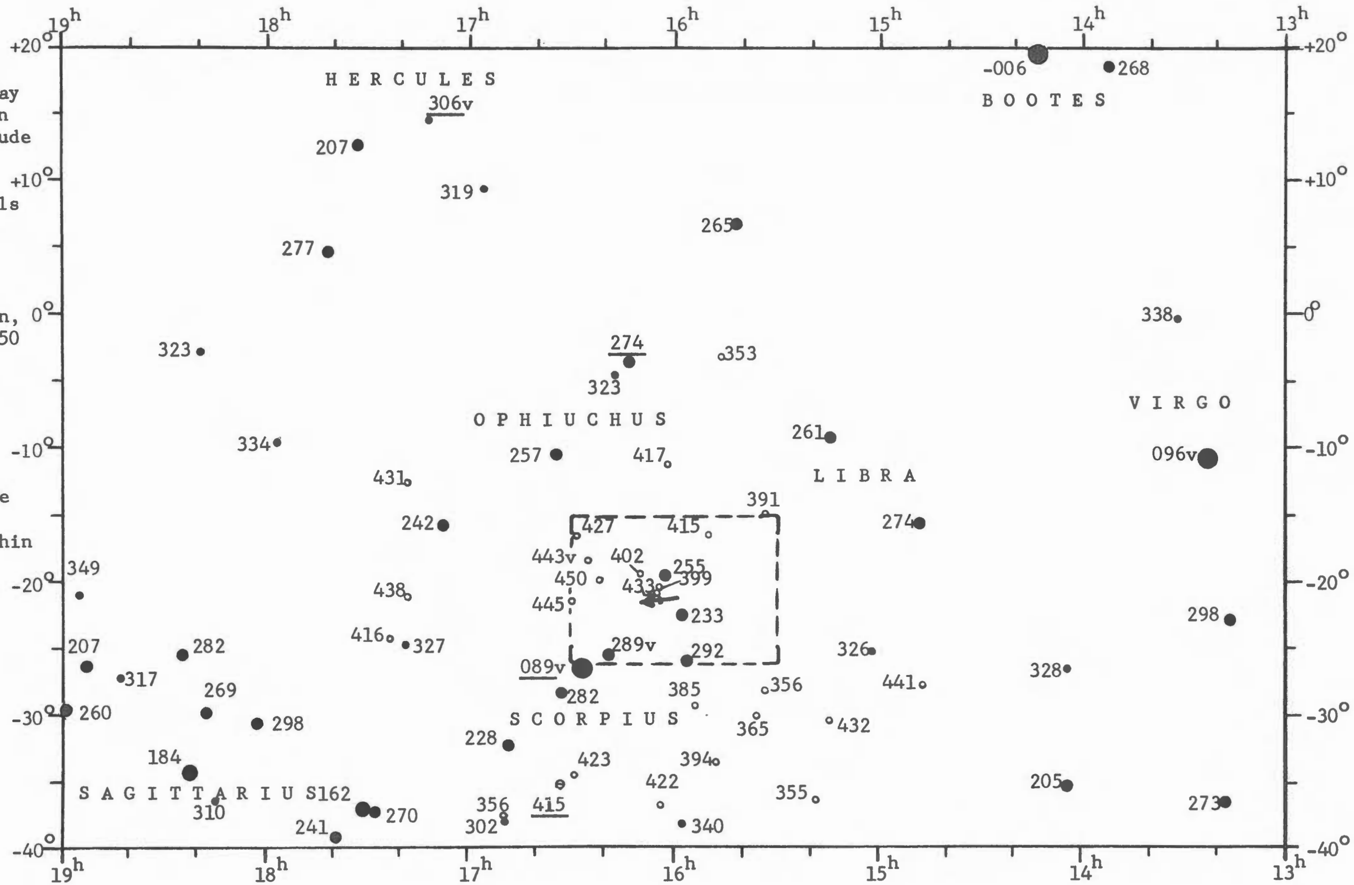
[Text continued on Page 93.]

Figure 3.--Map of the vicinity of the Moon during the total lunar eclipse of May 25, 1975, intended for use in estimating the Moon's magnitude changes during the eclipse. Stellar visual magnitudes are expressed without decimals (e.g., 265 indicates +2.65), based on the <u>Arizona-Tonantzintla Catalog</u>. The limiting magnitude is +3.50, except within 20° of the Moon, where it is +4.50. Epoch 1950 coordinates are used. The path of the Moon during the eclipse is shown by a short arrow; it is accurately placed for latitude 40°N, longitude 90°W, but is approximately correct for the rest of the United States. The portion of the chart within the dashed outline is shown at larger scale on Figure 4.

Magnitude Key:

- +3.51 - 4.50
- +3.00 - 3.50
- +2.00 - 2.99
- +1.00 - 1.99
- -0.06 - +0.96

("v" indicates a variable; underlines represent class M stars)



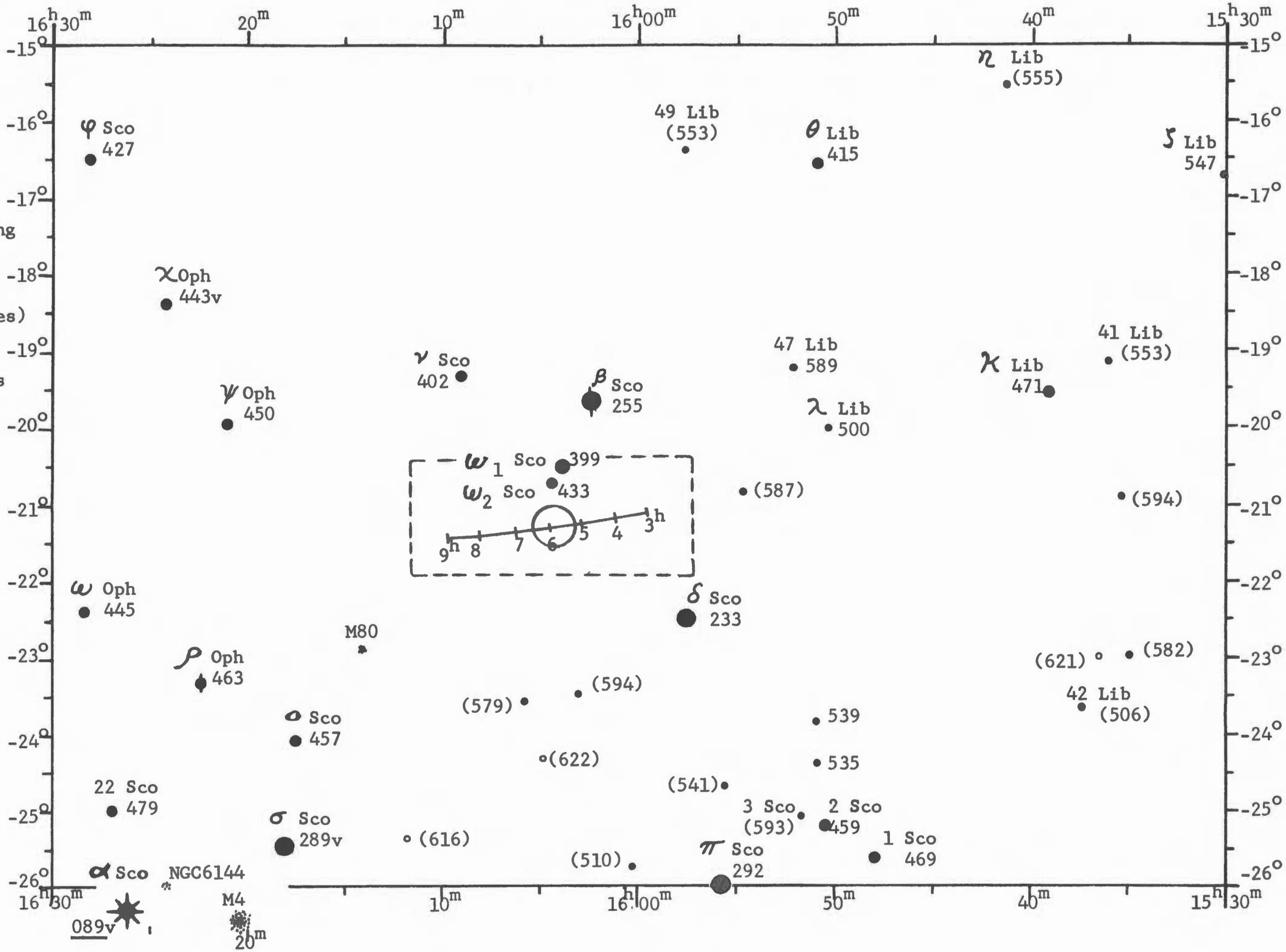


Figure 4.--The immediate surroundings of the Moon during the May 25, 1975, eclipse, intended for star identification (both visual and photographic; the area covered approximates a 35mm frame taken with a 135mm telephoto lens). The limiting magnitude is +6.25; visual magnitudes are based either on the Arizona-Tonantzintla Catalog, or (if in parentheses) on the Atlas Coeli Catalog. Epoch 1950 coordinates are used. The path of the Moon's center, at 1-hour intervals from 3^h-9^h U.T., is shown for a station at 40°N/90°W, and the outline of the moon, to scale, is shown for mid-eclipse. The portion of this chart within the dashed outline is shown at larger scale in Figures 5 and 6.

Magnitude Key:

- +6.00-6.22
- +5.00-5.99
- +4.00-4.99
- +3.00-3.99
- +2.55-2.99
- +0.89v (class M)
- Double Star
- v Variable Star

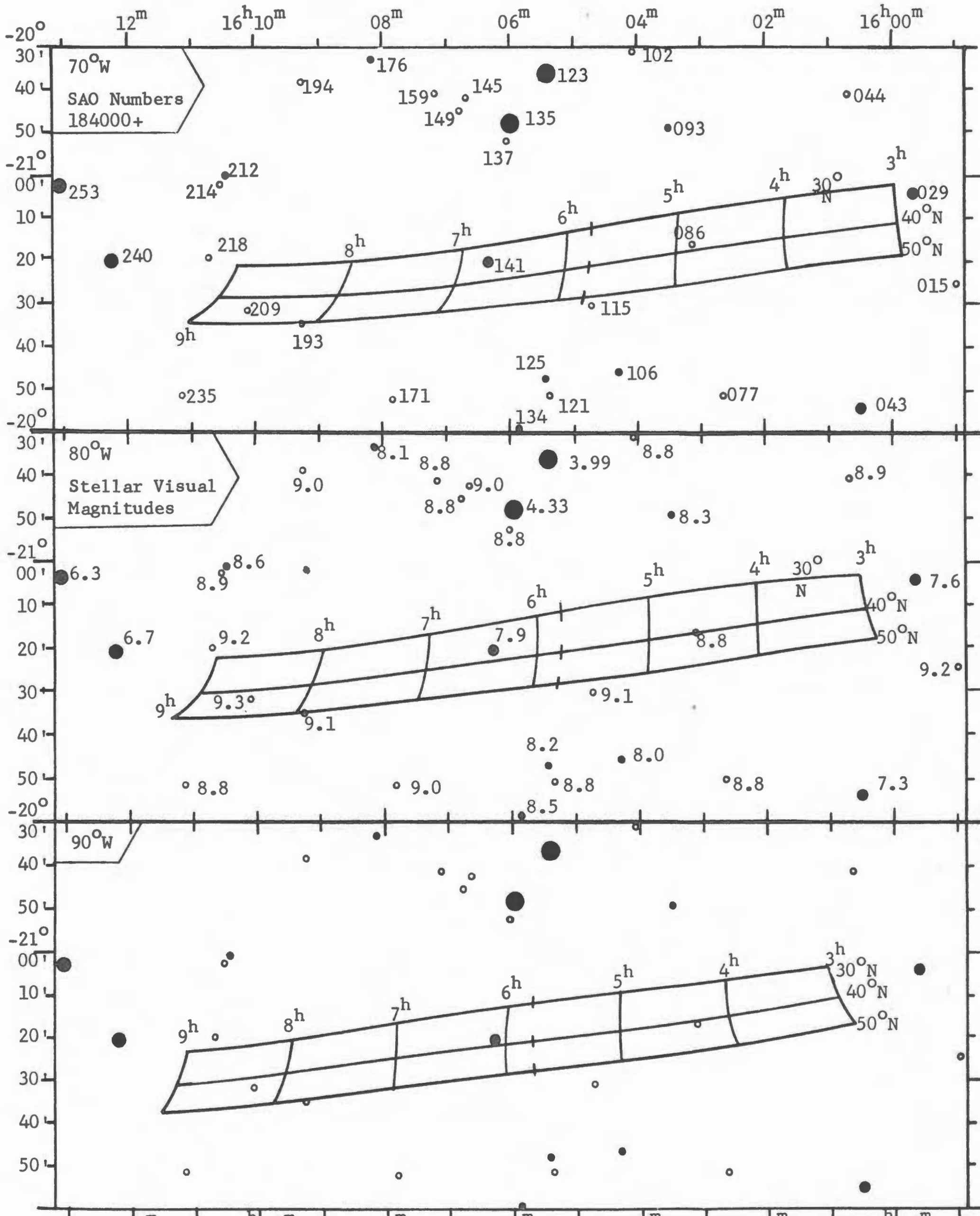


Figure 5. --Three views of the apparent path of the Moon's center during the May 25, 1975, total eclipse, intended for star identification and the planning of occultation observations. Each view represents a particular longitude (70°W, 80°W, 90°W) and shows the Moon's path, at 1-hour intervals, for 10° intervals of latitude (30°N, 40°N, 50°N). Short ticks show the Moon's position at mid-eclipse. Stellar positions (converted to 1975.395 coordinates) and visual magnitudes are based on the <u>SAO Catalog</u>, with limiting magnitude about +9.3. The top view (for 70°W) gives the abbreviated SAO identification for each star (for the full identification, add 184000), while the center view (for 80°W) gives the SAO stellar visual magnitude (except for magnitudes 3.99 and 4.33, which are based on the <u>Arizona-Tonantzintla Catalog</u>). For further data, see Figure 6.

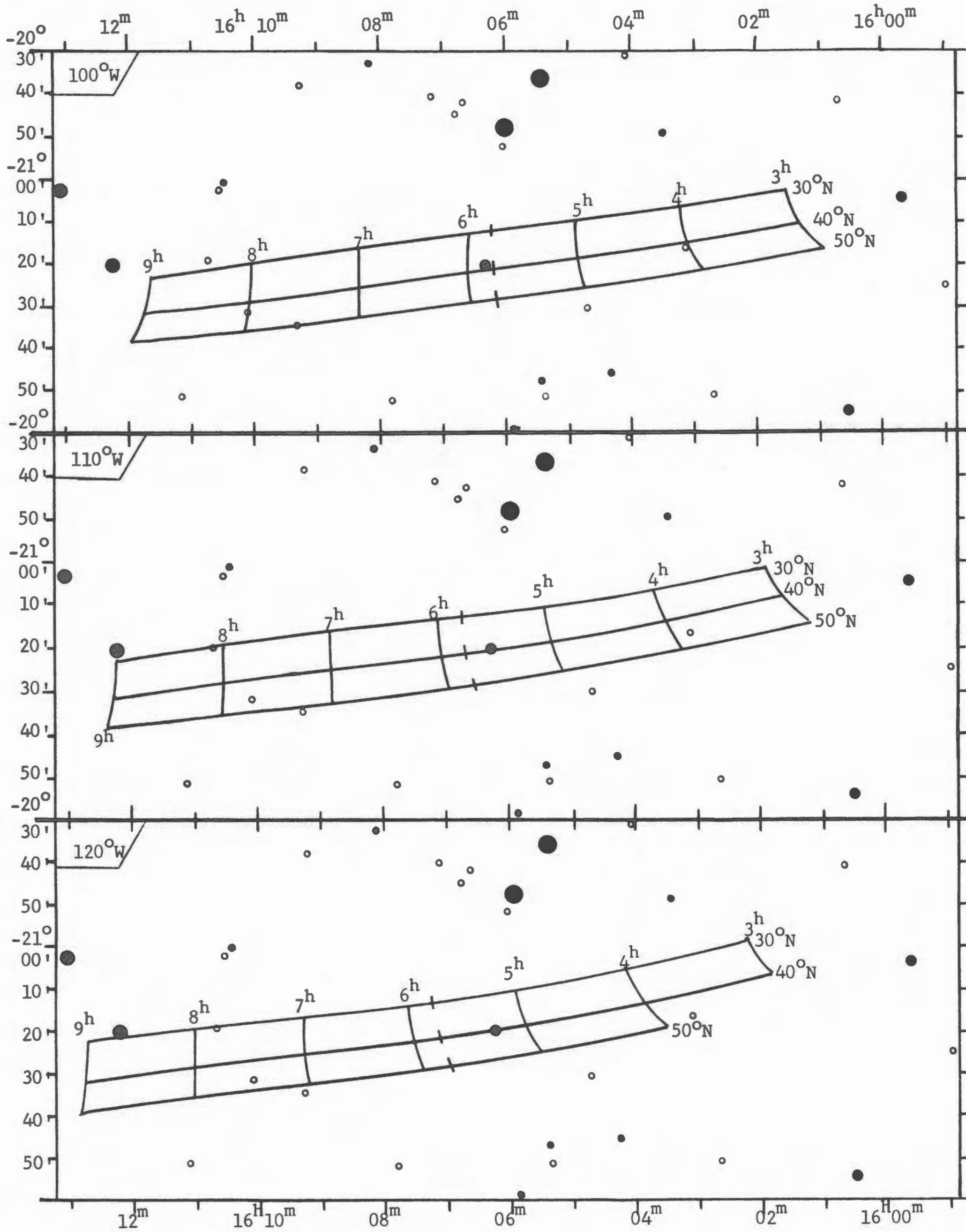


Figure 6.--Three views of the apparent path of the Moon's center during the May 25, 1975, total eclipse, for longitudes 100°W, 110°W, and 120°W. Other data are the same as in Figure 5. Note that SAO 184141 (Mag. 7.9) will be occulted during or near totality for all United States stations (see also Figure 5). For some western stations, the Moon will be near or below the horizon at the beginning of the eclipse.

Magnitude Key

- 8.7 - 9.3
- 8.0 - 8.6
- 7.3 - 7.9
- 6.3 & 6.7
- 3.99 & 4.33

Moon to Scale

Phase	U.T.	--- / EDT	EST / CDT	CST / MDT	MST / PDT	PST / ---	
Moon enters penumbra	02:58.5	10:58.5	09:58.5	08:58.5	07:58.5	06:58.5	
Moon enters umbra[a]	04:00.0	12:00.0	11:00.0	10:00.0	09:00.0	08:00.0	
Total eclipse begins[b]	05:03.4	01:03.4	12:03.4	11:03.4	10:03.4	09:03.4	
Middle of the eclipse	05:48.0	01:48.0	12:48.0	11:48.0	10:48.0	09:48.0	
Total eclipse ends[c]	06:32.5	02:32.5	01:32.5	12:32.5	11:32.5	10:32.5	
Moon leaves umbra[d]	07:35.9	03:35.9	02:35.9	01:35.9	12:35.9	11:35.9	P.M. MAY 24
Moon leaves penumbra	08:37.5	04:37.5	03:37.5	02:37.5	01:37.5	12:37.5	A.M. MAY 25

[a]First Contact (PA 109°). [b]Second Contact. [c]Third Contact.

[d]Fourth Contact (PA 262°).

Almost any observer, with almost any instrument, should be able to make useful observations of this eclipse. Details on making general observations, lunar magnitude estimates, crater and contact timings, searches for lunar changes, and photographs are given in the preceding article, "Observing Lunar Eclipses," which supplies instructions intended for any lunar eclipse. Observations should be sent to Prof. Walter H. Haas, and reported on an "ALPO Lunar Eclipse Observation Form," obtainable from this writer by sending him a stamped, self-addressed envelope.

Figure 3 is a small-scale star map of the vicinity of the Moon for this particular eclipse; the stellar magnitudes given can be used to estimate changes in the Moon's apparent magnitude during the eclipse. As this figure shows, the Moon will then lie in northern Scorpius, in a fairly rich star field not far from the Milky Way. The area near the Moon is shown on a larger scale in Figure 4. Those observers interested, and equipped to do so, should be able to obtain quite striking photographs of the eclipsed Moon against this star field (the area of Figure 4 is approximately that of a 35mm frame exposed with a 135mm telephoto lens); note that three globular clusters (M4, M80 and NGC 6144) lie within this field.

Not discussed in the preceding article is the observation of lunar occultations. Because of the dimness of the eclipsed Moon, one should be able to observe occultations of stars fainter than those normally so observed, particularly during totality. Persons attempting occultation timings should strive for an accuracy of ± 0.s1 (i.e., employing an accurate time source, such as WWV), should know the latitude and longitude of their observing site to ± 1 second of arc (i.e., as measured from a large-scale topographic map), and should report their timings (with the star identified) to:

H.M. Nautical Almanac Office
Royal Greenwich Observatory
Herstmonceux Castle
Sussex, England

From anywhere in the United States, several stellar occultations (of stars of visual magnitude + 9.3 or brighter) should occur during the eclipse. In particular, SAO 184141 (visual magnitude + 7.9) will be occulted near or during totality for all U.S. stations. Interested observers should consult Sky and Telescope magazine, which may give more detailed occultation predictions and instructions, prior to the eclipse.

As an aid to star identification and to planning occultation timings, refer to Figures 5 and 6, which are large-scale plots of the Moon's apparent path during the eclipse. The apparent position of the Moon's center is shown at one-hour intervals for 10° latitude and longitude intervals throughout the contiguous United States. As in Figures 3 and 4, these charts are oriented with North at the top.

COMA DIAMETER OF COMETS - I*

By: Charles S. Morris, A.L.P.O. Comets Section

This is the first in a series of papers which will deal with the coma diameter of several major comets. In this first paper the coma diameter of Comet Tago-Sato-Kosaka 1969 IX (1969g) will be discussed. Later papers will deal with the coma diameters of Comet Bennett 1970 II (1969i), Comet Abe 1970 XV (1970g) and Comet Kohoutek 1973f. Finally, there will be a paper in which the results obtained for these different comets will be compared.

Selection of Observations

The worst problem encountered in this study was the fact that in general a comet will *appear* to be larger in smaller instruments. Binoculars estimates of coma size usually give the largest diameters. In some cases, this effect and/or poor observing conditions resulted in a very large range of coma diameter estimates. Thus, in order to secure a homogeneous set of data it was necessary to eliminate those observations which were not consistent with the majority of estimates obtained. It must be admitted that this method of selecting observations is somewhat subjective. In general, however, there was a distinct gap between the observations which were selected for reduction and those estimates which were eliminated.

Reduction of the Observations

The observed coma diameters, which were given in minutes of arc, were converted to kilometers by using the following relation:

$$d = 43{,}633\Delta\theta$$

where d is the coma diameter in kilometers, Δ is the geocentric distance of the comet in A.U. and θ is the observed diameter of the comet coma in minutes of arc. The constant has the units of kilometers - minutes of arc^{-1}-A.U.^{-1}.

The Coma Diameter of Comet Tago-Sato-Kosaka 1969 IX (1969g)

A total of 73 observations made by 23 observers were selected for reduction. The observers and their 1969-1970 observing locations are listed in Table I.

The values of r, the comet's heliocentric distance, and Δ, the comet's geocentric distance, were computed using the following orbital elements (Marsden, B. G., Catalog of Cometary Orbits, 1972):

T = 1969, December 21.2677	ω = 267°8274
e = 0.999916	Ω = 100.9628
q = 0.472638	i = 75.8198

The computed values of Δ were used with the equation given above to convert the coma diameter estimates to kilometers. Table II lists the observations along with the resulting coma diameter given in kilometers and the values of r. Table III lists the average values of the coma diameter and r which were used to construct Figure 7, a graph of coma diameter (kilometers) vs. r.

Conclusions

As can be seen in Figure 7, very little can be determined about the variation of the coma diameter before perihelion. It appears probable, however, that the maximum coma size before perihelion was smaller than the maximum size after perihelion.

Several important conclusions can be drawn from Figure 7 concerning the post-perihelion variation of the coma diameter. First, however, the effect of the Moon was removed. At one data point the observed coma diameter was decreased by a factor of two as a result of interference by moonlight. This variation in the coma diameter is obviously not intrinsic to the comet.

The most important conclusion which can be drawn concerning the *intrinsic* variation of the coma diameter is the fact that after perihelion the coma

*Contributed by Dennis Milon, A.L.P.O. Comets Recorder.

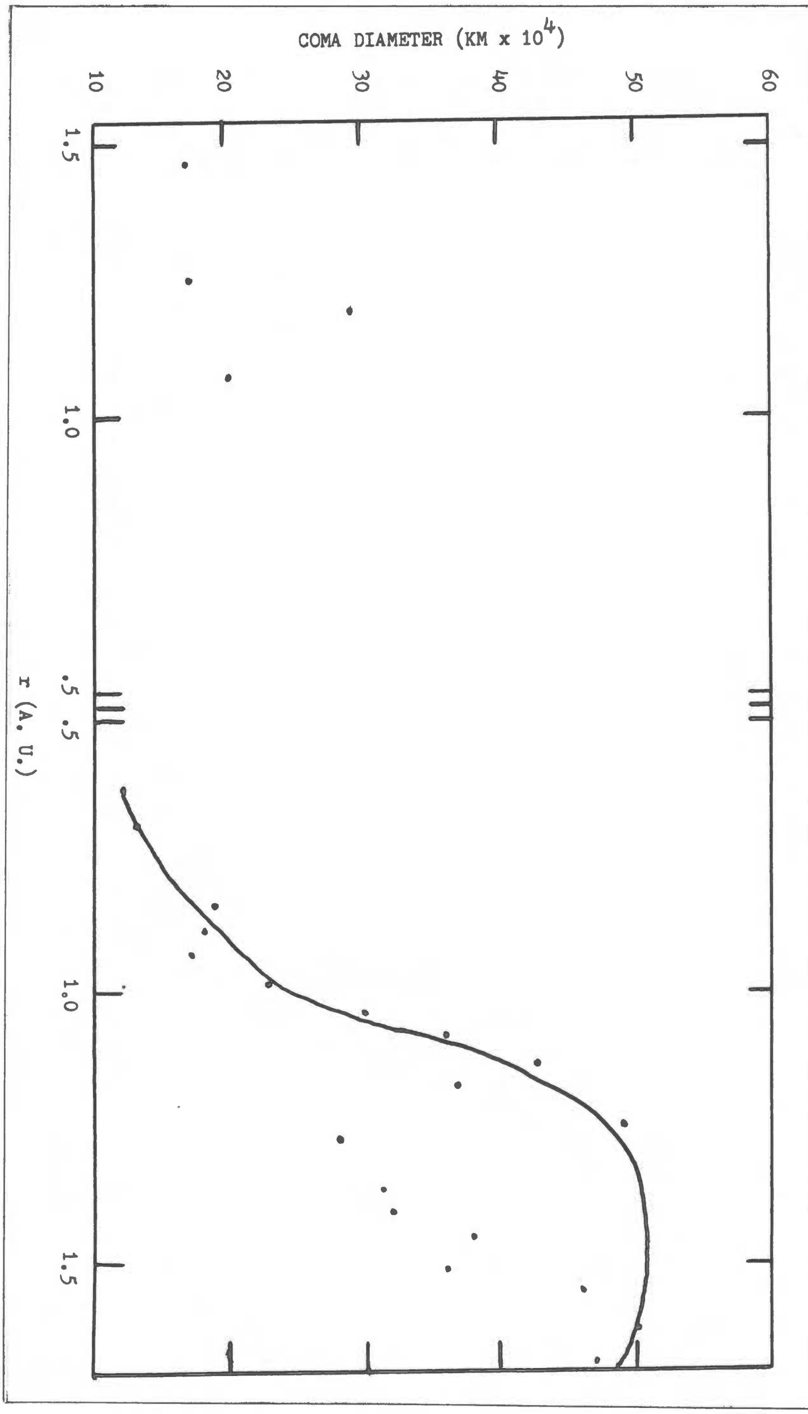


Figure 7. A graph of the coma diameter in kms. of Comet Tago-Sato-Kosaka 1969 IX (1969g) against the heliocentric distance r in Astronomical Units. The values plotted are listed in Table III. The freehand curve is an attempt by the author to illustrate the probable true variation of the coma diameter, ignoring the effects of moonlight. The points in the upper part of the graph (no curve) represent observations before perihelion passage; those in the lower part of the graph represent observations after perihelion.

diameter increased rapidly from a diameter of 1.2 x 10^5 kilometers to about 5.0 x 10^5 kilometers. This increase in coma size is similar to the increase experienced by Comet Ikeya-Seki 1965 VIII (Milon, D., J.A.L.P.O., Vol. 21, Nos. 11-12, pp. 201-205) and is in agreement with the theoretical development of the coma as outlined by Sekanina (Bulletin of the Astronomical Institutes of Czechoslovakia, Vol. 12, No. 1, 1961).

The maximum coma diameter attained by Comet Tago-Sato-Kosaka was somewhat greater than 5.0 x 10^5 kilometers. This value indicates that this comet was extremely large.* The maximum coma size occurred at about 1.5 A.U., which is

*This size is not unusually large for bright comets, however.

typical for comets.

Finally, magnitude estimates indicate that there was a flare of about one stellar magnitude in the brightness of the comet between February 8 and February 11, 1970. From the results obtained in this study, no definite correlation could be found between this flare and the size of the coma.

Table I. List of Observers with Their Stations and Instruments

John E. Bortle, Mount Vernon, New York	10X50, 7X50, 4" refr.
Rev. Leo Boethin, Abra, Phillipines	15X80
Darrell Conger, Elizabeth, West Virginia	2.4" refr.
Rev. Kenneth Delanc, Fall River, Massachusetts	10X40
Jerome Green, Switzerland, Florida	2.4" refr.
Daniel H. Harris, Kitt Peak, Arizona	7X50
Walter Scott Houston, Haddam, Connecticut	15X65, eye, 4" refr.
Albert Jones, Nelson, New Zealand	12.5" refl.
Merve Jones, Maryborough, Queensland, Australia	8" refl.
Randy Lambert, Mesquite, Texas	6" refl.
Rainer Lukas, Berlin, West Germany	20X70
Michael McCants, Austin, Texas	10" refl.
Tom Middlebrook, Nacogdoches, Texas	8" refl.
Martin P. Miller, Orosi, California	6" refl.
Dennis Milon, Harvard, Massachusetts	6" refr.
R. B. Minton, Tucson, Arizona	6" refl.
Thomas O'Hara, Fullerton, California	2.4" refr.
Logan Rimes, Offutt AFB, Nebraska	12.5" refl.
Karl Simmons, Jacksonville, Florida	8" refl., 12.5" refl.
Horace Smith, Willimantic, Connecticut	7X35, 6" refl.
Richard Sweetsir, Jacksonville, Florida	10X50
Thomas Williams, Darien, Connecticut	7X50
Wayne Wooten, De Funiak Springs, Florida	6" refl.

Table II. A.L.P.O. Observations of Coma Diameter

Date (UT)	Observer	Instrument	Observed Coma Diameter	Coma Diameter (km x 10^5)	r
1969, Oct. 15.99	Milon	6" refr.	2'	1.7	1.473
29.35	Jones, A.	12.5" refl.	2'	1.7	1.248
Nov. 1.04	McCants	10" refl.(?)	3-4'	2.9	1.201
8.00	Simmons	8" refl.	2.5'	2.0	1.080
1970, Jan. 5.41	Jones, M.	8" refl.	4'	1.1	.601
6.44	Jones, M.	8" refl.	5'	1.3	.617
7.24	Jones, M.	8" refl.	5'	1.3	.628
10.44	Jones, M.	8" refl.	6'	1.3	.678
11.42	Jones, M.	8" refl.	7'	1.5	.694
12.42	Jones, M.	8" refl.	7'	1.4	.711
18.08	McCants	10" refl.	12'	2.0	.807
20.00	Wooten	6" refl.	10'	1.7	.841
20.00	Smith	7X35	15'	2.5	.841
20.02	Bortle	7X50	8'	1.3	.841
20.10	Minton	6" refl.	11.5'(P.E.P.)	1.9	.843
21.03	Lambert	6" refl.	10'	1.7	.859
21.95	Smith	7X35	12'	2.0	.876
21.98	Houston	15X65	16'	2.7	.877
22.01	Bortle	7X50	8'	1.3	.877
22.96	Smith	6" refl.	10'	1.7	.893
22.98	Bortle	7X50	9-10'	1.6	.894
23.03	Simmons	12.5" refl.	8'	1.4	.895
24.03	Lambert	6" refl.	8'	1.4	.912
24.06	Middlebrook	8" refl.	10'	1.7	.913
24.97	Smith	6" refl.	14'	2.5	.930

Date (UT)		Observer	Instrument	Observed Coma Diameter	Coma Diamter (km x 10^5)	r
1970, Jan.	25.03	Sweetsir	2.4" refr.	8'	1.4	.930
	25.10	Miller	6" refl.	10'	1.8	.932
	26.00	Green	2.4" refr.	8.5'	1.6	.947
	26.04	Lambert	6" refl.	9'	1.6	.947
	26.05	Sweetsir	10X50	8'	1.5	.947
	26.11	Miller	6" refl.	11'	2.0	.948
	27.10	Miller	6" refl.	14'	2.7	.967
	27.12	Minton	6" refl.	10.5'(P.E.P.)	2.0	.967
	27.18	Harris	7X50	10'	1.9	.969
	28.17	Miller	6" refl.	12'	2.4	.986
	29.12	Sweetsir	10X50	12'	2.5	1.002
	30.02	Simmons	8" refl.	10'	2.1	1.018
	30.09	Middlebrook	8" refl.	10'	2.1	1.020
	30.09	O'Hara	2.4" refr.	11.7'	2.5	1.020
	31.02	Bortle	10X50	12'	2.6	1.036
	31.97	Houston	15X65	17'	3.9	1.053
Feb.	1.01	Conger	2.4" refr.	12-15'	3.1	1.053
	1.12	Rimes	12.5" refl.	20'	4.6	1.055
	1.97	Houston	naked eye	20'	4.8	1.071
	2.00	Bortle	10X50	12'	2.9	1.071
	3.10	Miller	6" refl.	12'	3.0	1.090
	4.99	Houston	4" refr.	16'	4.3	1.123
	4.99	Bortle	10X50	10-12'	3.0	1.123
	5.14	Rimes	12.5" refl.	15-20'	4.8	1.125
	5.52	Lukas	20X70	15'	5.0	1.149
	7.04	Conger	2.4" refr.	12'	3.5	1.159
	7.97	Williams	7X50	10.3'	3.1	1.175
	8.01	Bortle	10X50	13'	4.0	1.176
	8.02	Delano	10X40	10'	3.0	1.176
	8.51	Boethin	15X80	16'	5.0	1.184
	10.56	Boethin	15X80	15'	4.9	1.220
	11.56	Boethin	15X80	14'	4.9	1.237
	13.01	Bortle	10X50	7'	2.5	1.262
	13.04	Conger	7X50	8-10'	3.3	1.262
	14.04	Bortle	10X50	7'	2.6	1.280
	18.01	Bortle	10X50	8'	3.4	1.347
	20.05	Bortle	4" refr.	6'	3.1	1.382
	21.02	Bortle	10X50	7'	3.2	1.397
	24.02	Boethin	15X80	8'	4.0	1.447
	24.02	Conger	2.4" refr.	6'	3.0	1.447
	24.06	Williams	7X50	9.3'	4.6	1.448
	24.51	Boethin	15X80	10'	5.0	1.455
	25.07	Conger	2.4" refr.	5'	2.5	1.465
	27.10	Conger	2.4" refr.	5'	2.7	1.499
	28.54	Boethin	15X80	8'	4.4	1.522
Mar.	2.56	Boethin	15X80	8'	4.6	1.553
	6.52	Boethin	15X80	8'	5.0	1.619
	10.50	Boethin	15X80	7'	4.7	1.683

(P.E.P.) - Photoelectric observation

Table III. Comet Tago-Sato-Kosaka 1969 IX - Normal Places

$\bar{r}$ (AU)	Average Coma Diameter (km x 10^5)	Number of Observations
1.47	1.7	1
1.25	1.7	1
1.20	2.9	1
1.08	2.0	1
.62	1.2	3

Table III. Comet Tago-Sato-Kosaka 1969 IX - Normal Places. (cont.)

$\bar{r}$ (AU)	Average Coma Diameter (km x 10^5)	Number of Observations
.69	1.4	3
.83	1.9	5
.88	1.8	7
.93	1.7	9
.98	2.3	5
1.04	3.0	7
1.08	3.6	3
1.13	4.3	4
1.17	3.7	5
1.24	4.9	2
1.27	2.8	3
1.36	3.1	2
1.40	3.2	1
1.45	3.8	5
1.51	3.6	2
1.55	4.6	1
1.62	5.0	1
1.68	4.7	1

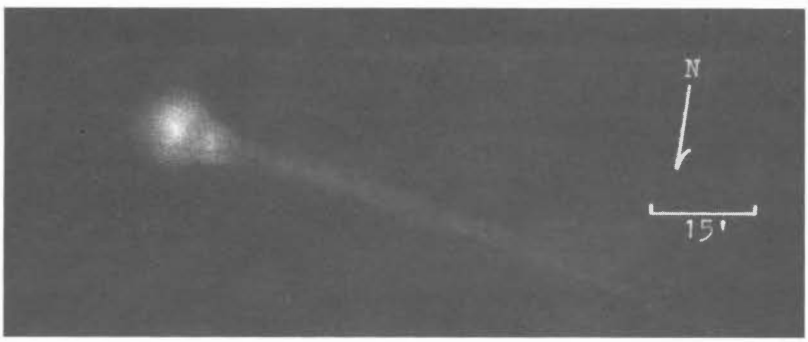


Figure 8. Drawing of Comet Tago-Sato-Kosaka 1969g by John E. Bortle at Mount Vernon, New York on January 31.03, 1970, U.T., 6-inch reflector. Note the possible condensation behind the nucleus. In 10X50 binoculars Mr. Bortle estimated the coma to be 12 minutes of arc in diameter. The use of the scale and the arrow for orientation are highly recommended on drawings.

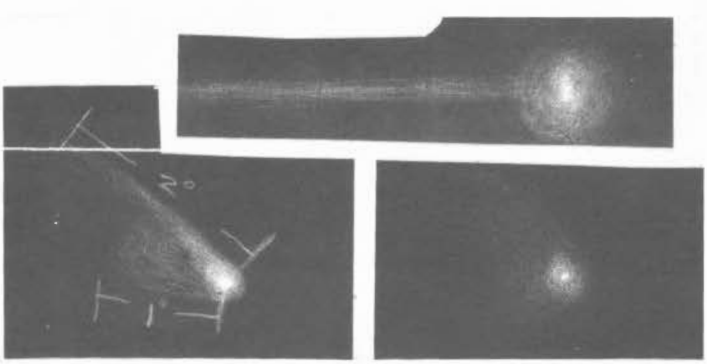


Figure 9. Three drawings of Comet Tago-Sato-Kosaka 1969g by Logan Rimes at Offutt AFB, Nebraska, with a 12.5-inch reflector. Top: January 27.04, 1970, U.T. Coma 30 minutes across, tail 3.3 degrees long. Lower left: February 1.12, U.T. Coma 20 minutes across but tail had additional plume one degree long. Lower right: February 5.14, coma fan-shaped with a stellar nucleus.

Figure 10. Photograph by Dennis Milon of R.B. Minton using his 6-inch, f/5 reflector in Tucson, Arizona. He employs a photoelectric photometer to determine the diameter and stellar magnitude of comets, such as 1969g. Instructions for building this photometer for \$50 to \$100 were given in <u>JALPO</u>, Vol. 24, Nos. 1-2, pp. 14-18.

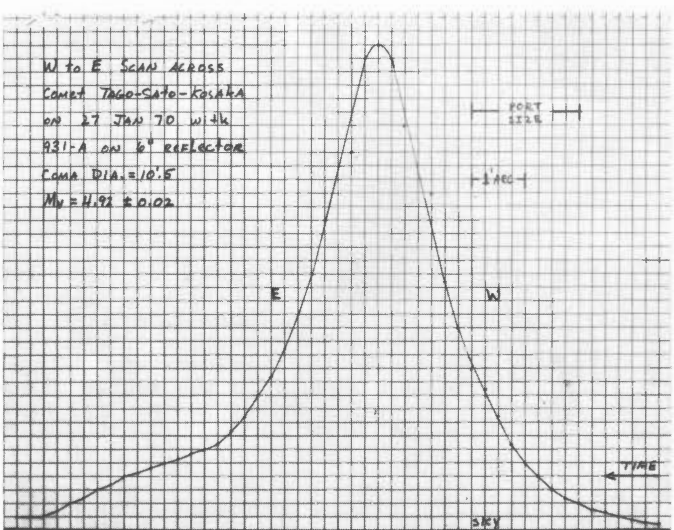


Figure 11. Sample photoelectric measurement by Mr. R.B. Minton of diameter and magnitude of Comet Tago-Sato-Kosaka 1969g on January 27.12, 1970, Universal Time. The round coma was trailed across the two-minutes-of-arc port of the photoelectric photometer, giving a coma diameter of 10.5 minutes of arc or more than 300,000 miles.

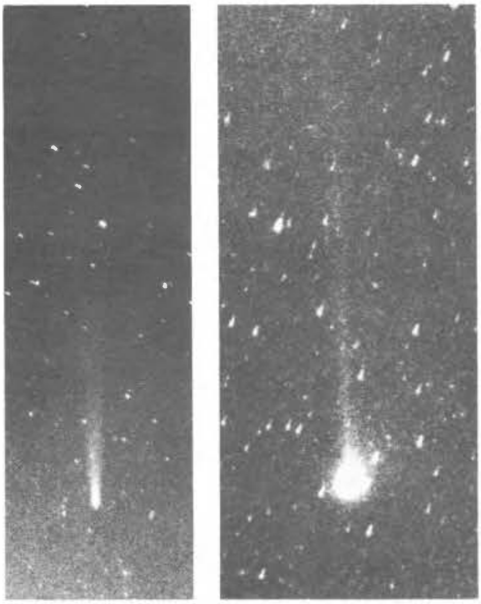


Figure 12. Two photographs showing change in tail of Comet 1969g from broad to narrow. Left view on January 8.41, 1970, U.T., by Merve Jones with a Retinette camera and Plus-X film exposed for three minutes. Right photograph on January 27.04, 1970, U.T., by Karl Simmons, Tri-X film and a five-minute exposure, giving a tail two degrees long.

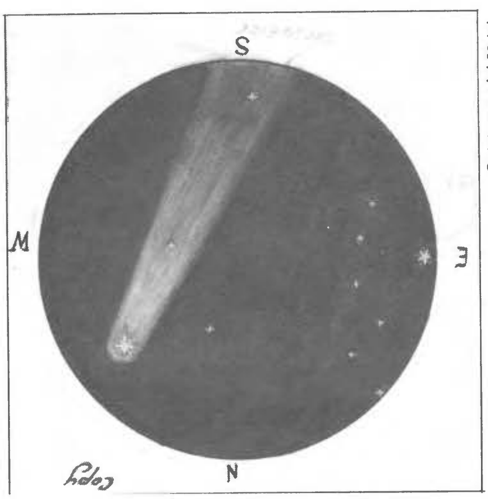


Figure 13. Drawing of Comet Tago-Sato-Kosaka 1969g by M. V. Jones on December 29, 1969 at $9^h\ 50^m$, U.T. 20-cm. reflector, 40X, field diameter 58' 15". Comet at right ascension $19^h\ 24^m.9$, declination -53° 00' (1950 coördinates).

Figure 14. Photograph of Comet 1969g on January 27.15, 1970, U.T., by Ginger Le Gendre, Phoenix, Arizona. She guided on the comet for 20 minutes with a 4-inch refractor while Super Panchro Press film was exposed in a cold camera on her 10-inch f/7 Newtonian reflector.

Figure 15. In December, 1969 and early January, 1970 Comet 1969g was only observable from the Southern Hemisphere; and veteran observers such as Vic Matchett, Albert Jones and Mervyn V. Jones reported to the A.L.P.O. Comets Section as the comet became a naked-eye object. The photograph shows Mervyn V. Jones of Maryborough, Queensland, Australia, who discovered Comet Mitchell-Jones-Gerber 1967f while sweeping in the evening sky with binoculars. Note his refractor and an 8-inch f/5 Newtonian in a run-off shed.

Figure 16. Another observer of Comet Tago-Sato-Kosaka, namely the experienced comet watcher Reverend Leo Boethin, Bangued, Abra, Phillipines. He observed the comet with 15X80 binoculars and also uses the 8-inch reflector shown here.

THE 1972-73 APPARITION OF SATURN

By: Julius L. Benton, Jr., A.L.P.O. Saturn Recorder

[Concluded from J.A.L.P.O., Vol. 25, Nos. 3-4, pp. 72-79)

Note by Editor: The reader may find it helpful to review the first part of Dr. Benton's Saturn Report before reading the final part here. In particular, Figures 17 and 18 on page 77 of our preceding issue and Figure 19 on page 79 will help to clarify parts of the text. We regret that space problems forced us to publish this paper in two issues.

The Rings of Saturn

Ring B. As has been the custom for several apparitions in the past, throughout the 1972-73 period virtually all observers made visual numerical intensity estimates using the adopted standard of 8.0 for the outer third of Ring B. In general, nearly everyone who contributed observational material to the Section reported that Ring B was the brightest of the three major ring components; and it was apparent that this ring, taken as a whole, was a little brighter in 1971-72 than during the 1972-73 apparition. The writer noted that the outer portion of Ring B was always the brightest part of the ring, and it was apparent that even the inner portion of B was considerably brighter than the entire Ring A. The writer assigned a whitish coloration to the outer third of Ring B, while the inner portion was described as exhibiting a yellowish to yellowish-white hue. In addition, it was noticed that Cassini's Division (B10 or A0) could be seen completely around the ring system on most occasions, and the average numerical intensity of B10 was greater than 0.0 (black shadow). B10 appeared to be dark greyish in color for the most part, even though the quality of seeing was often quite good. Division B2*was suspected on a few occasions as well. Heath described Ring B as displaying a vivid white color in the outer portion and a light greyish tint in the inner regions. He noted as well that the brighter outer third of Ring B was clearly separated from the inner part by a distinct border, although Heath did not make any specific reference to an intensity minimum. Furthermore, the same observer noted that B10 was visible all the way around the rings; and the intensity of this division to him was frequently black, differing from the impressions of the writer just discussed. Haas recorded that Ring B was the brightest of all of the ring components, and the inner portion of Ring B was not nearly so bright as its outer third. Ring B was always considerably brighter than Ring A, and Haas described the color of Ring B as white throughout. B10 was visible to him all around the ring system with apparent ease; but the intensity of the gap was never a complete black, confirming the views of other individuals. Also, Haas detected an intensity minimum B1 (same as Benton's B2?) several times during the apparition, and reference to the table of average visual numerical intensity estimates (p. 78 of preceding issue) will serve to illustrate that this "division" was far from being black. B1 was seen best near the ansae of the ring system. Porter's results were in general agreement with the findings of others described here, although he did on occasion see B10 as a completely black feature. Additionally, Porter detected other intensity minima in Ring B, denoting them as B3 and B8; and he indicated that their intensities were always something other than black.

Ring A. On a more general note, Saturn observers concurred that the overall brightness of Ring A had remained stable throughout the 1972-73 apparition as well as since the 1971-72 period, when it was noted that Ring A had not been so bright as in previous years. Individuals were also in agreement that Ring A was at its brightest just outside B10, and that it was brighter outside A5 (Encke's Division) than inside A5. The writer described the color of Ring A as greyish-white to yellowish-grey, and it was noted that A5 could be seen only on occasions of good seeing near the ansae. The intensity of Ring A was usually quite uniform, with a possible gradation toward a higher intensity (brighter) as one moved outward in the ring. Heath reported that Ring A was, as a whole, rather dark relative to Ring B and greyish in color. He noted that the outer part of Ring A was darker than the SEB and that there was some indication that the inner portion was lighter than the outer regions. A5 (Encke's) was seen at times of better than average seeing near the ansae, and on a few evenings the division could be followed almost completely around the ring system. Porter noted that the brightness of Ring A was frequently comparable to that of the STrZ, and it was apparent that Ring A was commonly brighter inside A5 than outside this division. The color of Ring A was described by Porter as being yellowish-white to yellowish-orange. A5 was usually visible at the ansae, and on several occasions an intensity minimum denoted as A3 was suspected by the same person. Haas described Ring A as being slightly non-uniform in brightness immediately adjacent to Encke's Division; the portion of the ring to the outside of A5 was slightly brighter than the inner areas. Just outside Cassini's Division, Ring A was at its brightest, according to Haas; and taken as a whole, Ring A was comparable in intensity to the EZ, while its color was noted to be bluish-white. A5 was seen near the ansae and appeared greyish in hue.

Ring C. A relatively large number of the individuals contributing observations to the Section during 1972-73 were able to detect Ring C (or the Crape Ring) as it passed in front of the globe of Saturn, describing its color there as reddish-brown to brownish-grey. Heath, Porter,

*B2 is a positional designation for a "division" observed to be 2/10 of the way from the inner edge of Ring B to its outer edge. Similarly for B1, A5, etc.

Haas, and the writer together reported Ring C off the globe of the planet as a dark greyish inner border to Ring B throughout the 1972-73 apparition.

Ring D. The supposed ring exterior to Ring A was not reported by any of the observers who participated in Saturn studies studies during 1972-73.

White Spot on the Rings. Heath indicated that a Terby White Spot was seen where Ring B adjoined the shadow of the globe on the rings, and he described it as a roughly triangular feature of a size that was approximately equal to the apparent size of the Saturnian satellite Titan. The intensity of this feature was often equal to that of Ring B. Heath found that the Terby White Spot was associated entirely with the outer third of Ring B and did not involve the inner portion of the ring at all. The writer suspected a possible whitish spot on one or two evenings, although nothing at all was certain. Haas also reported a Terby White Spot of a brightness which was usually equal to or slightly greater than that of the inner portion of Ring B. On April 23, 1973, Haas noted that the brilliance of this spot exceeded that of the outer third of Ring B (intensity estimated to be 8.5 on the standard scale). Most authorities agree that ordinary limb-darkening is not sufficient to produce such an effect, which appears to be largely due to a contrast phenomenon involving the very bright Ring B and the exceedingly dark shadow of the globe on the rings.

Bicolored Aspect of the Rings. On 1972, November 5, Haas reported that the west and east arms of the Saturnian ring system (directions refer to those in the sky and are not in the IAU sense) were of equal brilliance when using a W25 (red) filter and without a filter (integrated light); however, the western arm (preceding) of the rings was suspected visually to be slightly brighter than the eastern counterpart with a W47 (blue) filter. This observation was carried out under average seeing and transparency conditions, using a 6" reflector from 05:01 to 05:10, U.T. Independently, Sherrod took several photographs of Saturn on the same date around 09:12 U.T., using a 10" reflector under good conditions. Upon examination of the developed plates, Sherrod noticed that the west ansa was a little brighter than the east ansa, possibly confirming the visual impressions of Haas earlier on the same date. Sherrod obtained an additional photograph using the same instrument on 1972, November 7; and this effect was noted again, the west ansa showing up to be the brighter by a small fraction. Furthermore, Haas detected another brightness difference between the ansae on November 12, the west ansa appearing brighter than the east ansa when using a W47 filter; the east ansa, in addition, was brighter than the west ansa when viewed with a W25 (red) filter. On 1973, January 14, Hull took a photograph which clearly illustrated that the west ansa was brighter than the east ansa on that date. On 1973, April 23 and 29, and on May 8, similar brightness inequalitites between the west and east ansae were noted, the east ansa being brighter than the west one with a W47 filter. On May 12, the west ansa was the brigher of the two in a W47 filter. It would perhaps be very interesting at this point to speculate somewhat upon these virtually simultaneous observations; however, the writer will defer comment until additional confirmational evidence is obtained in subsequent apparitions in greater quantity. Nonetheless, such observational evidence is of tremendous value, particularly with regard to the curious phenomenon we are concerned with at present. Individuals are reminded to attempt to secure a lengthy series of simultaneous observations similar in nature to those described here. In order that the number of variables is reduced and so that continuity can be established among the data, it is important that observing programs such as these be planned very carefully and well in advance. A detailed discussion of how to prepare and carry out simultaneous studies of Saturn can be found in the new observing guide mentioned much earlier in this report. In any case, one cannot help but wonder just how much of a role differential refraction plays in this phenomenon, which has been reported rather frequently over the past several years. Differential refraction, obviously, would be greatest when Saturn is near the horizon, and much less when the planet is higher in the sky. Observing programs, consequently, should be planned so that the overall study may include an investigation of such influencing factors.

The Satellites of Saturn

Unfortunately, only a minimal amount of observational material was submitted with respect to visual magnitude estimates of Saturn's brighter satellites. As a result, it was impossible to perform a suitable analysis on the very sparse data. Observers are encouraged to take a greater interest in the study of the satellites of Saturn in coming apparitions.

Concluding Remarks

As can be seen from the preceding report, a fairly large number of observers took part in the observing programs conducted by the Saturn Section during 1972-73. Even though an increased response among observers is most encouraging, there still remains a great deal of work which can be done in other areas of Saturn studies (see Journal of the A.L.P.O., Vol. 24, Nos. 7-8, p. 147). Those individuals not acquainted with the variety of programs conducted by the Saturn Section should refer to the book: An Amateur's Guide to Visual Observations of the Planet Saturn. This new book is available from the Recorder at a cost of $4.50, which includes a set of observing forms, etc. This new book is not a re-written version of the former Saturn Handbook; it is a more detailed study of the programs of the Saturn Section with emphasis on observation and analysis of results. In addition, the Recorder stands ready to help any individual initiate his own research programs on Saturn; and interested persons are cordially invited to write for details.

THE 1972 APPARITION OF JUPITER*

By: Paul K. Mackal, A.L.P.O. Jupiter Recorder

Jupiter was well observed throughout 1972, both before and after opposition, which was on June 24, 1972. Conjunction with the Sun, following opposition, was on January 10, 1973. Conjunction with the Sun, preceding opposition, was on December 10, 1971.

The observers for 1972 included: (1) P. W. Budine of Walton, N.Y., 7 observations; (2) C. F. Capen of Flagstaff, Ariz. (& Lowell Observatory), 4 observations; (3) L. M. Carlino of Buffalo, N.Y., 2 observations; (4) R. Doel of Willingboro, N.J., 14 observations; (5) M. Fornarucci of Garfield, N.J., 3 observations; (6) R. Gordon of Nazareth, Pa., 1 observation; (7) T. Hasebe of Nagoya-shi, Japan, 8 observations; (8) A. Heath (B.A.A.) of Nottingham, U.K., 21 observations; (9) S. Hockstein of Bronx, N.Y., 8 observations; (10) B. Jones of Levittown, Pa., 22 observations; (11) K. Krisciunas of Naperville, Ill., 13 observations; (12) F. des Lauriers of Plaistow, N.H., 7 observations; (13) R. Lima of Jacksonville, Fla., 1 observation; (14) P. K. Mackal of Mequon, Wis., 6 observations; (15) G. Manchester of Cupertino, Calif., 18 observations; (16) G. Manning of Bronx, N.Y., 17 observations; (17) M. Morrow of Ewa Beach, Hawaii, 1 observation; (18) T. Mulligan of Jamaica, N.Y., 2 observations; (19) T. Osawa of Nara, Japan, 4 observations; (20) M. Otis of Aberdeen, S.D., 5 observations; (21) P. Pastore of Massapequa, N.Y., 7 observations; (22) P. Reinert of Norristown, Pa., 3 observations; (23) T. Ross of Milwaukee, Wis., 2 observations; (24) C. Sherrod of North Little Rock, Ark., 5 observations; (25) Dr. N. Travnick of Minas, Brazil (at Flammarion Observatory), 9 observations; (26) J. P. Vitous of Gays Mills, Wis., 7 observations; (27) R. Wessling of Milford, Ohio, 4 observations; (28) J. West of College Station, Texas, 1 observation.

The total number of observations received was 202. Most of these were made after rather than before opposition. July and August were well covered with a total of 55 observations.

I. Qualitative Changes of the Northern Hemisphere of Jupiter.

North Polar Region: It was definitely gray prior to opposition in most longitudes according to R. Doel. During March and April, 1972, the NNNTB enclosed it all about. A dark spot was seen in the NNNTB by Mr. Hasebe on May 18, its following end near 305°II. On May 27 Doel spotted a white marking at 242°II. Doel also saw a NPR haze at 245°II on May 29. In June, Hasebe, Ross, Doel and Dr. Travnick observed a complete cessation of NPR and NNNTB activity. On July 1 and 4 the NNNTB was faint to Mackal and Dr. Travnick at 12°II. The belt was fragmentary throughout the remaining days of July, according to Budine, Doel, Hasebe, Mackal, Ross and Vitous. Vitous perceived warm color on July 19 in the northern hemisphere at 140°II. A preceding end of the NNNTB was seen by Wessling on July 21 at about 80°II. By July 31 the belt was definitely missing over large stretches of the planet, according to Heath, Mackal, and Vitous. Budine, Doel and Dr. Travnick did observe the belt in the Red Spot longitudes, however. A white oval in the NPR at 20°II on July 23 was seen by Doel. By July 31 a photograph by Sherrod showed no indication of the NNNTB in the Red Spot longitudes. This absence was also observed visually by Vitous on August 4 at 15°II. The NPR remained gray for the rest of the 1972 apparition. The NNNTB was reobserved at 46°II by Hasebe and at 279°II by Doel on August 6 (a preceding end and a following end respectively). On August 17 Hasebe noticed the belt at 198°II, and on August 20 Doel confirmed the belt at 198°II. White hazes were seen by Doel and Hasebe on August 6 at 285°II and on August 9 at 286°II, respectively.

North North Temperate Zone and North North Temperate Belt: On April 1 Budine saw the preceding end of the NNTB at 221°II. A hazy NNTeZ and a completely visible NNTB were noticed by Hasebe on May 18 at 236°II. The following end of this hazy zone was seen near the RS longitude by Doel on March 11. The NNTB was confirmed by Doel on May 27 at 242°II and on May 29 at 255°II. The hazy NNTeZ was again seen on June 10 by Hasebe at 103°II. On June 28 Doel noted the preceding end of the NNTB at about 190°II. Hasebe picked up a faint belt on the same date at 271°II. This belt was also seen by Doel on July 5 at 221°II. On July 7 Doel noted the p. e. of the NNTB at 184°II. (He also saw a f. e. at 164°II.) By July 14 Doel noted the f. e. of the NNTB at 137°II. Budine perceived a strong belt on July 18 at 357°II. A few hours later Hasebe confirmed this impression at 21°II. By July 23 this activity was no longer visible to Doel at 14°II. Its absence was confirmed by R. Wessling at 8°II on the same date. Throughout July the NNTB was not seen by Mackal, though Dr. Travnick picked it up in the RS longitudes. A confirmation was made on July 28 by Budine at 3°II, and a reobservation was made on July 29 by Dr. Travnick at 161°II. On August 6 Doel observed a gray NNTB at 279°II. On August 11 Budine observed the NNTB at 13°II. At 89°II Doel noticed festoon activity in the NNTeZ on August 14 but did not record the NNTB. On August 15 Hasebe still observed the NNTB, however, at 217°II. Doel confirmed it on August 20 at 198°II. By August 31 the belt was certainly missing at 56°II, while the NNTeZ exhibited festoon and bright oval activity. This state of affairs persisted, and on September 9 Doel perceived the same conditions at 334°II. On October 15 Doel caught similar conditions in the original longitude at 58°II.

North Temperate Zone, North Temperate Belt, and North Tropical Zone: The NTeZ was fairly bright and clear of any activity throughout the apparition, while the NTB was dark, stable,

*There is an addendum to this article on page 119.

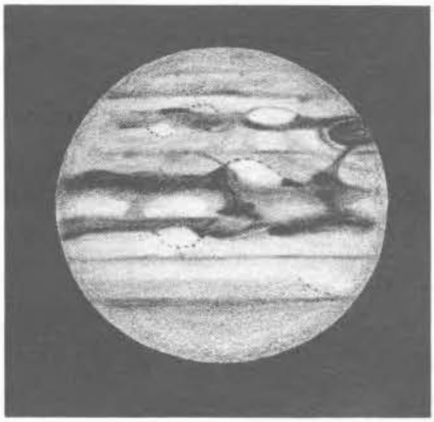


Fig. 17. Ron Doel. March 11, 1972; 10:00 UT; 240°I, 315°II; 8-inch reflec., 160x; Seeing 6, Trans. 4. Notice the Olivarez effect.

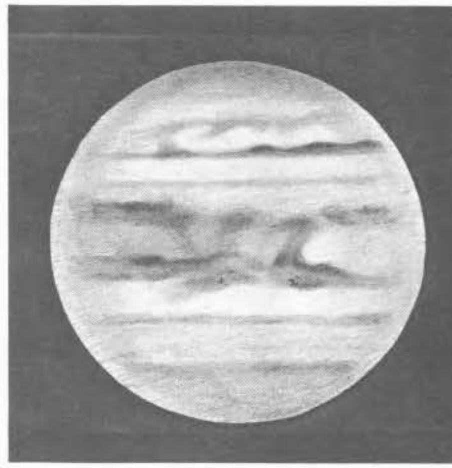


Fig. 18. Toshihiko Osawa. April 28, 1972; 18:20 UT; 205°I, 270°II; 8-inch reflec., 222x; Seeing 5, Trans. 4. Notice a large festoon connecting both equatorial belts.

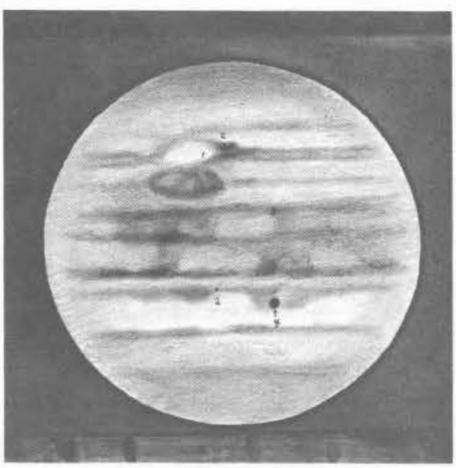


Fig. 19. Toshihiko Osawa. May 6, 1972; 17:56 UT; 14°I, 19°II; 8-inch reflec., 286x; Seeing 5, Trans. 4. DE in conjunction with the RS.

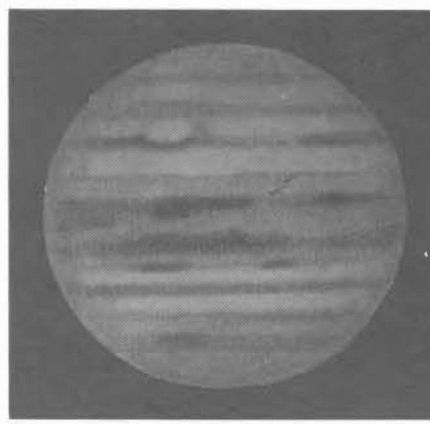


Fig. 20. Mr. Hasebe. May 17, 1972; 18:00 UT; 315°I, 236°II; 6-inch reflec., ----; Seeing 6, Trans. 3.

and active from time to time. As the NNNTB remained very dark, so did the NTB, unlike the NNTB, which subsided and then revived somewhat. The NTrZ was as bright or brighter than the NTeZ.

First signs of activity in the NTB were seen by Doel on May 27 at 242°II. This included dark spots and gaps or faint sections alternating with the dark spots. It was reobserved by Doel on May 29 at 255°II. On June 1 a fuzzy appearance was seen by Otis at 328°II and tended to confirm Doel's observations. A dusky NTeZ was noticed on June 10 by Hasebe at 103°II; it was seen again on June 28 by Doel at 206°II, but not on the same date at 271°II, according to Hasebe. The NTB was very uniform and stable, according to Doel and Hasebe, throughout late June. On July 1 Mackal also saw a stable belt at 12°II. The belt was brown. The belt did appear grayish to Doel, however, on July 5 at 221°II. A faint NTB was seen by Mackal on July 6 at 60°II. By July 7 Doel observed two components of the NTB (north and south) at 164°II. A somewhat darker NTB was noted by Mackal on July 10 at 265°II. It appeared one belt to him with a darker north edge. A dusky NTeZ was seen by Doel on July 14 at 137°II,

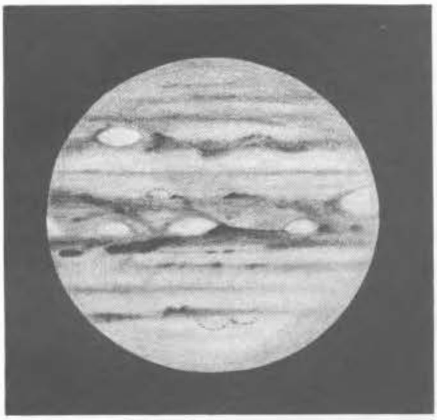


Fig. 21. Ron Doel. May 27, 1972; 6:30 UT; 34°I, 242°II; 8-inch reflec., 150x; Seeing 7, Trans. 5. Note large white oval on limb in SEBZ.

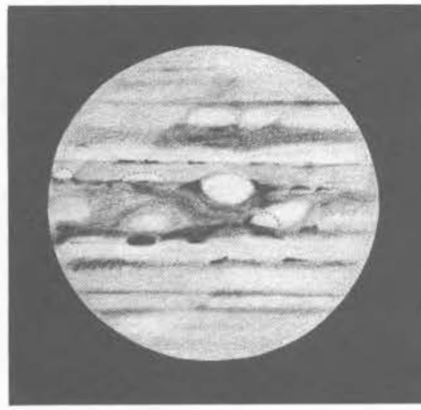


Fig. 22. Ron Doel. May 29, 1972; 8:30 UT; 63°I, 255°II; 8-inch reflec., 150x; Seeing 7, Trans. 5. Note large white oval on CM in SEBZ.

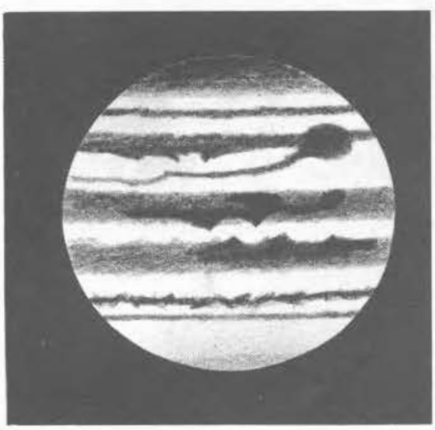


Fig. 23. Mike Otis. June 1, 1972; 7:55 UT; 153°I, 328°II; 8-inch reflec., 160x; Seeing 7, Trans. 2. SEBs connected to p. e. of RS.

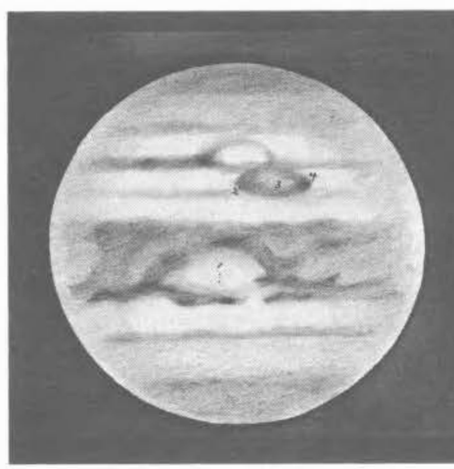


Fig. 24. Toshihiko Osawa. June 9, 1972; 15:05 UT; 242°I, 348°II; 8-inch reflec., 222x; Seeing 4, Trans. 4. Note bright white oval on CM in EZ.

plus a p. e. of a dusky NTrZ at 130°II. Vitous indicated that this was a reddish haze on July 16 at 90°II. No such haze was seen by Budine on July 18 at 357°II. Hasebe saw white ovals in the two zones on July 18 at 21°II, however. On july 19 Vitous saw the reddish cast in the area at 140°II. A festoon between the NTB and the N.E.B.$_n$ was seen by Wessling on July 21 at 83°II. The south side of the NTB erupted in late July, and the belt then looked even more uniform and stable than it had been. According to all observers, this state of affairs persisted through August 6. The color of the two zones returned to white in August at 268°II, according to Vitous. They were not quite so bright then as they had been, according to Heath. On August 14 Doel noted white spot activity in the NTeZ at 89°II and a festoon bridging the NTrZ at 109°II. On August 20 Doel noted a f. e. of a dusky patch in the zone at 198°II plus two columns at 198°II and 218°II. An orangeish cast over both zones was seen by Vitous on August 30 at 304°II. On August 31 Doel confirmed this impression at 56°II. Doel also noticed a large white oval in the NTB at 56°II. On September 6 Hasebe saw a stable NTB at 286°II. A dark p. e. of the NTB was noted by Doel on September 9 at 350°II. A gray appearance to the belt was seen by Doel on October 15 at 58°II.

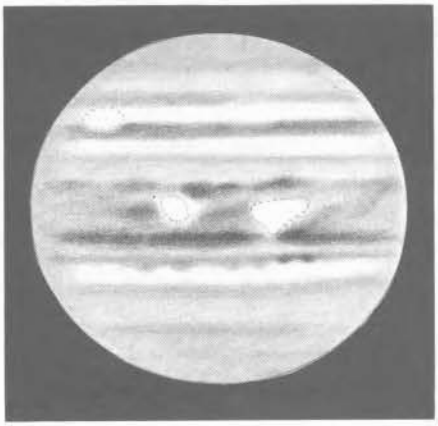


Fig. 25. Mr. Hasebe. June 10, 1972; 14:06 UT; 04°I, 103°II; 6-inch reflec., ----; Seeing 6, Trans. 2. Notice FA near limb. Dark N.E.B.s. Faint SEBZ.

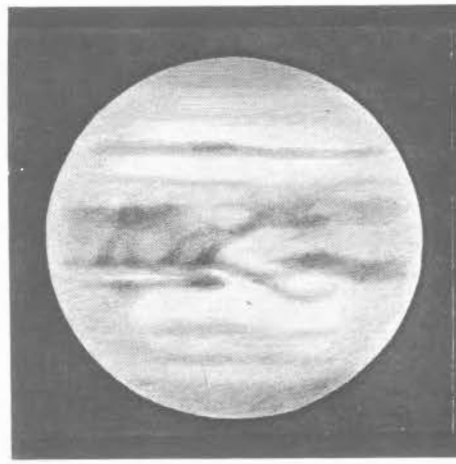


Fig. 26. Toshihiko Osawa. June 10, 1972; 15:10 UT; 43°I, 142°II; 8-inch reflec., 222x; Seeing 4, Trans. 3. Notice NEB activity.

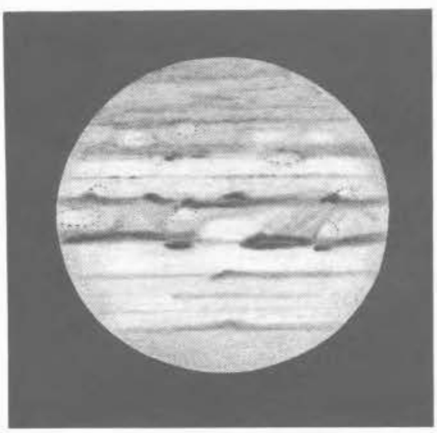


Fig. 27. Ron Doel. June 28, 1972; 1:50 UT; 240°I, 206°II; 4.25-inch reflec., 135x; Seeing 9, Trans. 3. Notice STeZ activity.

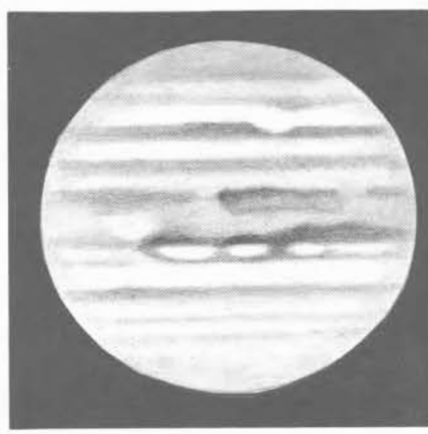


Fig. 28. Mr. Hasebe. June 28, 1972; 13:34 UT; 309°I, 271°II; 6-inch reflec., ----; Seeing 4, Trans. 3. Notice NEB activity.

2. Qualitative Changes of the Larger Belts of Jupiter.

North Tropical Zone Band, North Equatorial Belt, and North Equatorial Zone: The NEB was again active in 1972 as it had been in 1971, and about late June some swarthy segments began to appear. On March 11 the belt was double beginning at 314°II and single past 320°II, according to Doel. Large white ovals were also visible to Doel in the EZ_n (and the NTrZ) at 240°I. By April 1 Budine caught more large white ovals in the two zones as well as in the NEB itself (221°II, 306°I). By May 6 Capen observed a rather nodulated $N.E.B._n$ in green light at 97°II. This active $N.E.B._n$ splitting off from the NEB was also observed by Hasebe on May 18 at 236°II and by Doel on May 27 at 242°II. Doel also saw a bright white oval with its f.e. at 334°I in the $E.Z._n$. A prominent region followed it. More activity was seen by Doel again on May 29 at 255°II and 63°I--elongated spots, very dark in the fragmented $N.E.B._n$ and festoon activity alternating with bright white ovals in the $E.Z._n$. A dark $N.E.B._s$ was noticed by Hasebe on June 10 at 4°I, plus a nodulated $N.E.B._n$ at 103°II. These impressions were confirmed on color

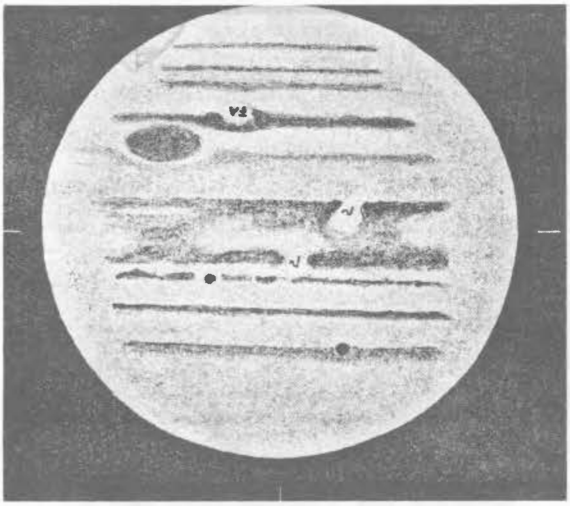


Fig. 29. Nelson Travnick. June 29, 1972; 1:15 UT; 16.5°I, 335°II; 6-inch refrac., 280x; Seeing, good; Trans., good. [p. and f. limb reversed in refractor.] FA just past conjunction with RS.

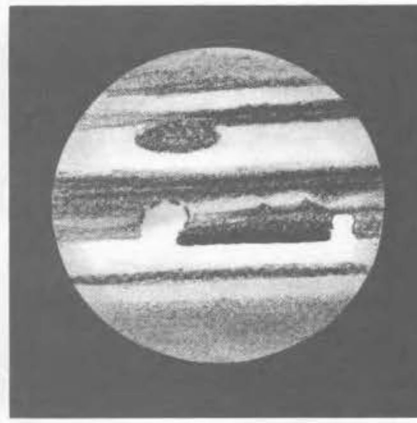


Fig. 30. Paul Mackal. July 1, 1972; 3:55 UT; 70°I, 12°II; 6-inch reflec., 141x; Seeing 4, Trans. 6. Note dark N.E.B.n and double STB.

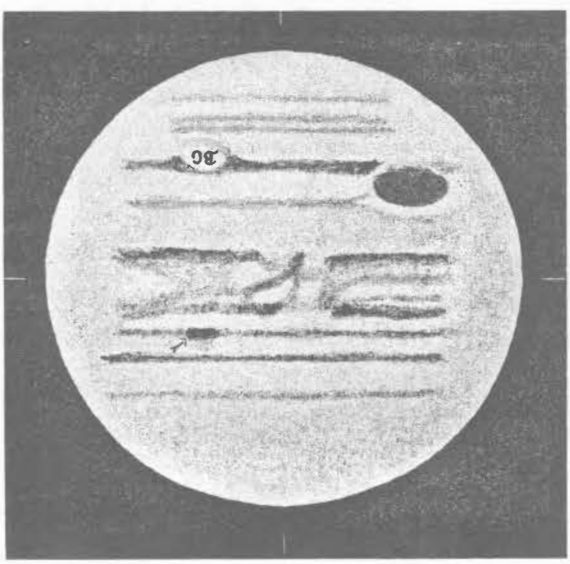


Fig. 31. Nelson Travnick. July 4, 1972; 2:05 UT; 117°I, 37°II. 6-inch refrac., 240x; Seeing, good; Trans., very good. BC approaching conjunction with RS. [p. and f. limbs reversed in refractor.]

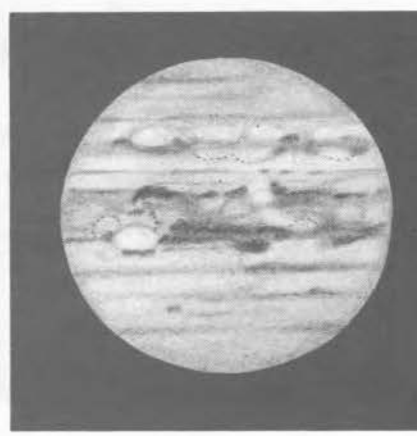


Fig. 32. Ron Doel. July 5, 1972; 3:00 UT; 309°I, 221°II; 8-inch reflec., 150x; Seeing 8, Trans. 4. Note NEB and EZ activity. A blue filter was used to make the drawing. It was a Wrattan 80-C.

slides made by Ross on June 17 (150°I, 198°II) using the Milwaukee Astronomical Society 12.5-inch reflector. Clearly, the N.E.B.$_s$ and the N.E.B.$_n$ were erupting once again!

Throughout the rest of June and during July and August the NEB continued to be agitated, appeared to get even darker, and exhibited a great amount of morphological transformation, including changes in coloration.

A bright NTrZ was seen on June 28 by Doel at 206°II, with a white oval (center) at 240°I in the E.Z.$_n$. The p.e. of the NEB eruption was seen by Hasebe at 256°II (or 294°I) on June 28, the NEB being much weaker in the preceding direction as compared to the following direction. The observation was also confirmed by Doel. The first brilliant white oval forming a distinct

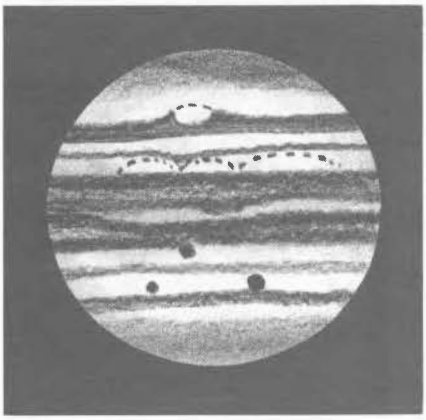


Fig. 33. Paul Mackal. July 6, 1972; 4:20 UT; 155°I, 60°II; 6-inch reflec., 141x; Seeing 5, Trans. 4. Note BC just past CM. J-III darker than usual. [J-II and J-III shadows also on disc.] Also noticed by T. E. Smart of Canada.

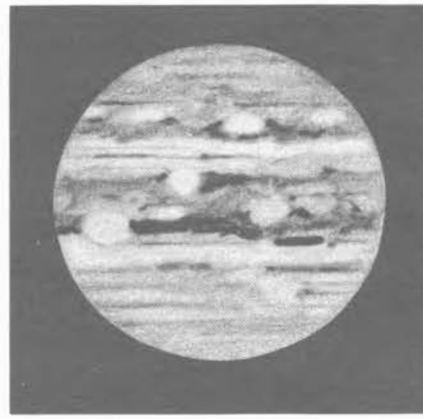


Fig. 34. Ron Doel. July 7, 1972; 3:05 UT; 268°I, 164°II; 8-inch reflec., 160x; Seeing 10, Trans. 4. Notice NPR activity, Olivarez effect in the NEB, white spot in SEB past CM, and DE.

Fig. 35. Paul Mackal. July 10, 1972; 3:20 UT; 31°I, 265°II; 6-inch reflec., 141x & 423x; Seeing 6, Trans. 3. Note EB bar, NEB white spot, and STeZ activity.

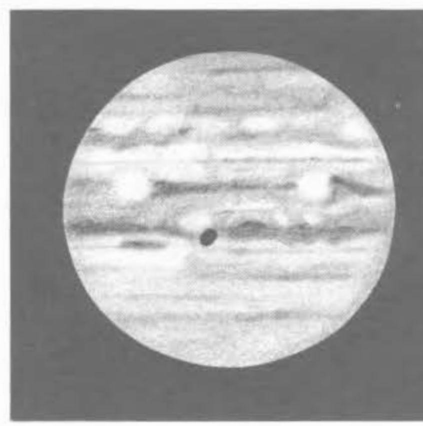


Fig. 36. Ron Doel. July 14, 1972; 3:05 UT; 294°I, 137°II; 8-inch reflec., 160x; Seeing 7, Trans. 4. Notice STrZ activity. [J-I shadow on disk.]

gap in the N.E.B.$_n$ was seen by Travnick on June 29 at 335°II. A dark N.E.B.$_n$ subtended the region from 5°-35°II on July 1, according to Mackal. This was an area of eruption. It corresponded with a System I longitude of 70°. Another such region was seen by Doel on July 5 from 205°-230°II (or from 293°-313°I) but this time in the N.E.B.$_s$. In both instances white ovals preceded the erupted areas, very excellent examples of the Olivarez effect (the tendency for extremely dark segments to be flanked by extremely brilliant spots, or for extremely bright stretches to be flanked by extremely dark spots). A July 6 observation of Mackal's indicated that the NEB remained double at 60°II (155°I), even though active in this region.

The real eruption was thus underway by early July, and the NEB as a whole was reviving to a very conspicuous level. A third eruption region was observed by Doel on July 7 from 142°II-172°II (or from 248°-270°I), again preceded by a very large bright white oval. The exact similarity of all three of these regions was certainly remarkable. EZ activity also increased noticeably concurrently with the NEB eruption, and was most likely an epi-phenomenon,

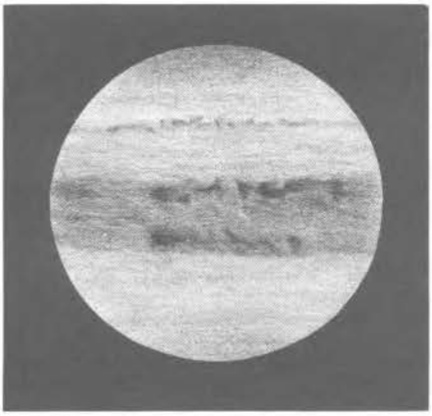


Fig. 37. Joseph Vitous. July 16, 1972; 262°I, 90°II; 8-inch reflec., 384x; Seeing 7, Trans. 5. [Drawn from photograph.]

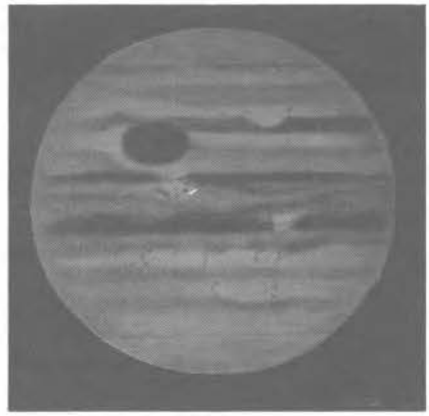


Fig. 38. Mr. Hasebe. July 18, 1972; 13:04 UT; 211°I, 21°II; 6-inch reflec., ----; Seeing 8, Trans. 3. BC approaching RS.

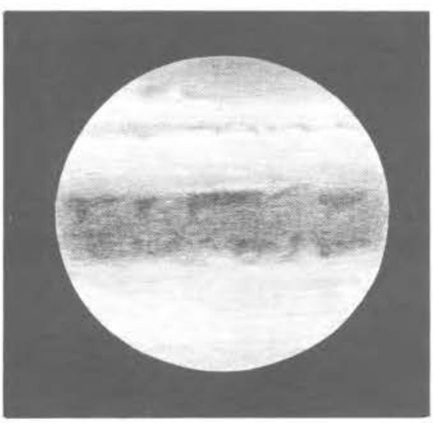


Fig. 39. Joseph Vitous. July 19, 1972; 2:18 UT; 335°I, 140°II; 8-inch reflec., 384x; Seeing 6, Trans. 5. [Drawn from a photograph.]

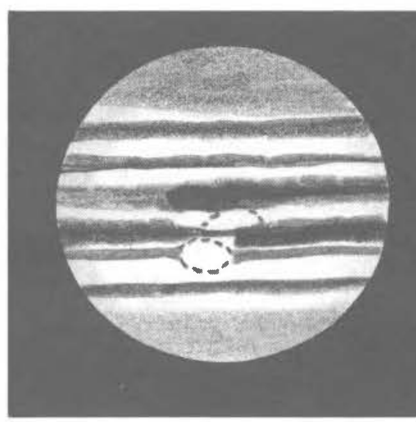


Fig. 40. Paul Mackal. July 22, 1972; 3:47 UT; 143°I, 285°II; 6-inch reflec., 212x; Seeing 7, Trans. 4. Notice dark eruption in S.E.B.n on CM.

though Mackal observed an EB segment on July 10, its p.e. at about 31°I. The f.e. of a very dark N.E.B.$_n$ was seen by Mackal on the same date at 270°II. This was the extended portion of the second eruption area, first noted by Doel on July 5 but possibly already present before that time. By July 14 Doel noted much color in the NEB and the E.Z.$_n$ at 137°II (294°I). The zone was orange, and the belt was dark brown. On July 16 Vitous confirmed this impression of Doel's concerning the warm colors in the N.E.B. and E.Z.$_n$ at 98°II (262°I). At this time Heath recorded the intensity of NEB condensations to be a half step darker than the surrounding belt. Hasebe observed eruption area one on July 18 at 21°II (211°I) with a f.e. at about 33°II flanked by a very bright white oval. He also saw white ovals in the NTrZ. Vitous confirmed the bright colors on July 19 at 140°II (335°I). A fourth eruption patch was seen by Mackal in the N.E.B.$_s$ on July 22 with its p.e. at 143°I (285°II). E.Z.$_n$ activity was observed by Doel on July 23 at 239°I near eruption area one and was also seen by Wessling. The p.e. of eruption one was placed at 236°I on July 25 by Mackal. Both the components of the NEB were fused together into one single belt preceded by a bright white oval with a f.e. at 235°I.

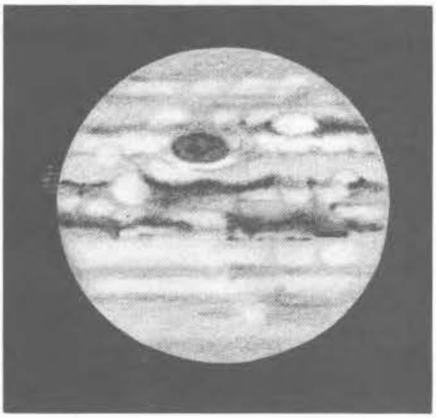


Fig. 41. Ron Doel. July 23, 1972; 2:05 UT; 239°I, 14°II; 8-inch reflec., 160x; Seeing 7, Trans. 4. Note faint SEBZ, RSH, and white spot on S.E.B.s. Note STeZ and SSTeZ activity. Note BC.

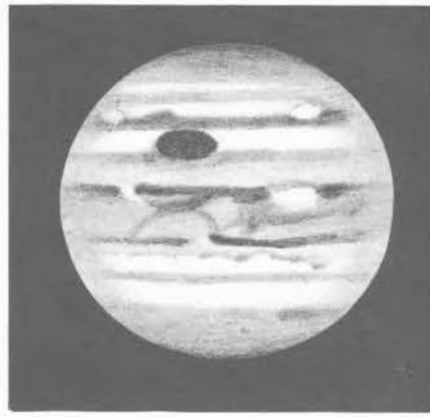


Fig. 42. Dick Wessling. July 23, 1972; c.2:00 UT; 233°I, 08°II; 12.5-inch reflec., 211x; Seeing 5, Trans. 3. Cf. fig. 41. [Simultaneous observation.]

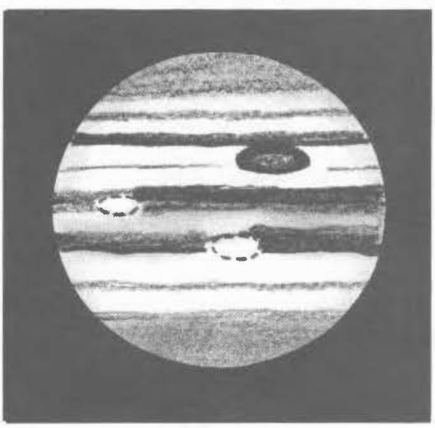


Fig. 43. Paul Mackal. July 25, 1972; 3:00 UT; 228°I, 348°II; 6-inch reflec., 141x; Seeing 5, Trans. 6. Note the dusky EZ and bright zones near RS. RS also ringed.

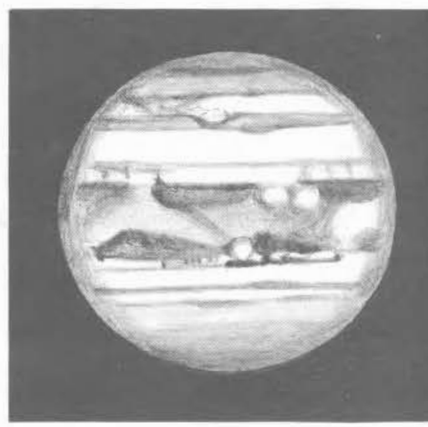


Fig. 44. Larry Carlino. July 29, 1972; 1:30 UT; 85°I, 174° II; 10-inch reflec., 152x & 216x; Seeing 5, Trans. 4.

Vitous on July 31 noted a fifth eruption area in the N.E.B.$_{c}$ with its p.e. at 123°II (48°I) and preceded also by a white oval!

From August onward the NEB tended to be one belt, passing from its double aspect (associated with inactivity) to its single aspect (associated with activity), the usual aftermath of an NEB eruption. This 1972 eruption was certainly a very violent one entailing five distinct points of activity. The NTrZBd was visible in August in most longitudes. Mackal and Vitous were first to notice its presence (July 25 at 13°II and August 4). Hasebe saw it on August 4 at 46°II. An extended eruption area preceding the fifth eruption region was seen by Doel on August 14 flanked by a white oval and a gap in the N.E.B.$_{s}$ with its f.e. at 99°II (122°I). The NTrZBd was seen by Wessling on August 16 at 359°II. It is not at all clear where or how this extra band may have developed. Consequently, we do not know if the band should be considered as an extra NEB component or as an independent current. Hasebe's impressions of it were of an NEB component (see Figures 52 and 54). However, on August 20 Doel observed three components at 198°II (276°I), opting for the NTrZBd thesis (see Figure 55).

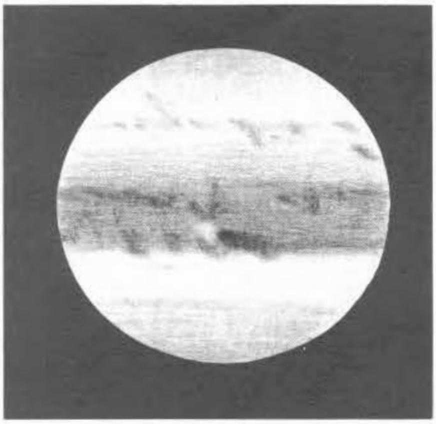


Fig. 45. Joseph Vitous. July 31, 1972; 1:42 UT; 48°I, 123° II; 8-inch reflec., 384x; Seeing 5, Trans. 4. [Drawn from photograph.]

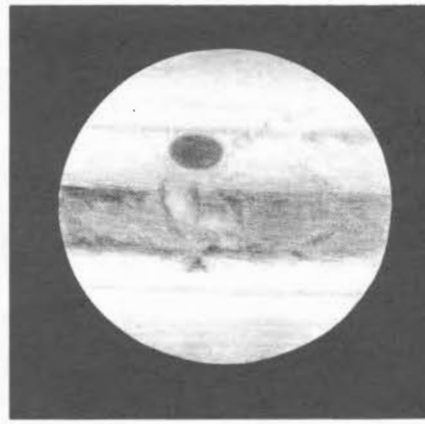


Fig. 46. Joseph Vitous. August 4, 1972; 1:58 UT; 330°I, 13°II; 8-inch reflec., 384x; Seeing 4, Trans. 5. [Drawn from a photograph.]

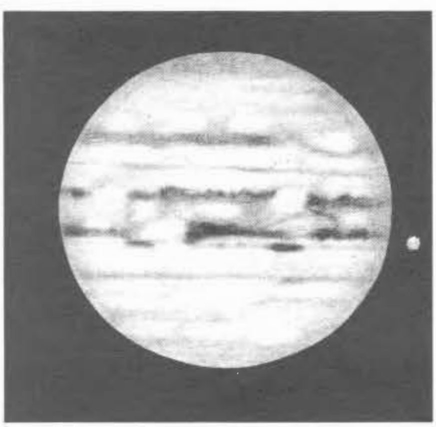


Fig. 47. Ron Doel. August 6, 1972; 1:00 UT; 250°I, 279°II; 8-inch reflec., 160x; Seeing 5, Trans. 5. [J. I near limb of Jupiter.]

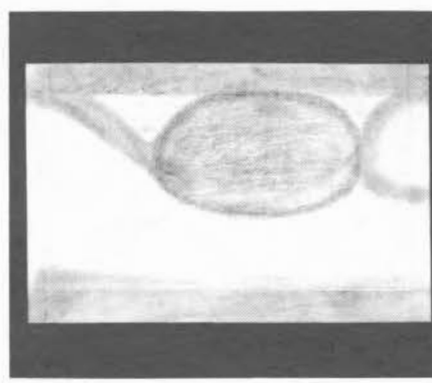


Fig. 48. Charles Capen. August 11, 1972; 11:45 to 12:05 UT; 16-inch reflec., 666x; and 6-inch reflec., 380x. "The RS had a well defined reddish border. The interior was low saturated light hues."

From July to August Heath noticed a change in the intensity (or darkness) of the NEB of one whole step. All of the five erupted regions were reobserved from August through October by Doel, Hasebe and Travnick. They appeared to be "held in place" by large white ovals flanking them on both their preceding and following sides. Like the EB Disturbance of 1969, these features looked very intense; and the term "NEB Disturbance" appears wholly appropriate in the Recorder's estimation. The evidence clearly relates the Olivarez effect to the NEB Disturbance, as well as to the SEB double Disturbance of 1971.

South Equatorial Zone, South Equatorial Belt North, South Equatorial Belt Zone, and South Equatorial Belt South: As remarkable as it may sound to the reader, the S.E.B.$_n$, as well as the N.E.B.$_n$ and the N.E.B.$_s$, erupted in 1972. Remnants of features generated by the double SEB Disturbance of 1971 were observed in March and April by Budine and Doel. A fairly dark and conspicuous S.E.B.$_n$ was seen by Capen in May. Gaps in the S.E.B.$_n$ (or white ovals, not so bright) were noticed on May 3 and on May 6. This impression was confirmed by

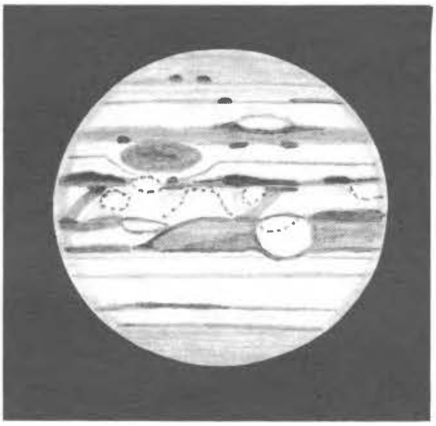


Fig. 49. Phillip Budine. August 11, 1972; 2:45 UT; 24°I, 13°II; 4-inch refrac., 167x & 214x; Seeing 8, Trans. 5.

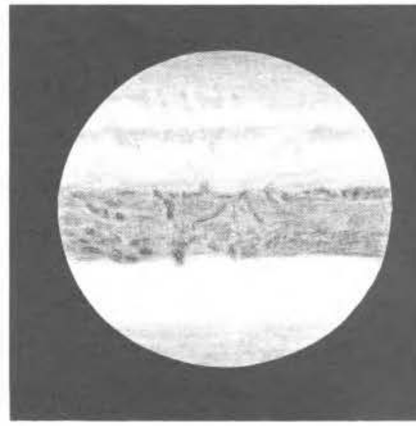


Fig. 50. Joseph Vitous. August 13, 1972; 1:30 UT; 294°I, 268°II; 8-inch reflec., 384x; Seeing 4, Trans. 4.

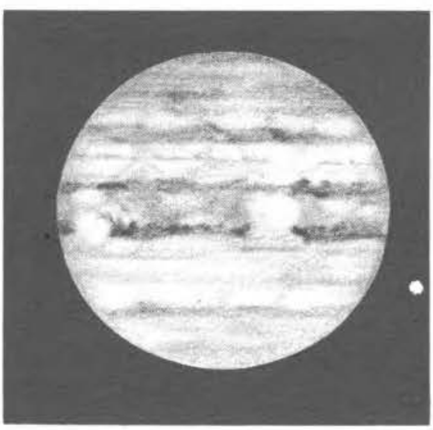


Fig. 51. Ron Doel. August 14, 1972; 2:20 UT; 122°I, 89°II; 8-inch reflec., 160x; Seeing 7, Trans. 4. [J. II approaching limb of Jupiter.]

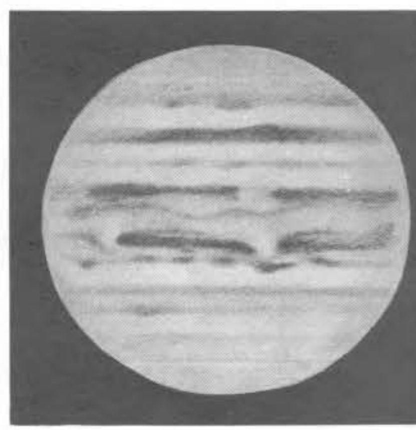


Fig. 52. Mr. Hasebe. August 15, 1972; 11:38 UT; 260°I, 217°II; 6-inch reflec., ----; Seeing 5, Trans. 2.

Hasebe on May 18 at 236°II (315°I). By May 27 Doel caught a large white oval on the limb of Jupiter squarely in the S.E.B.$_n$ latitude. The SEB Z was also dusky at 242°II. On May 29 this large white oval was located at 255°II (63°I), according to Doel. On June 1 Otis saw a distinct S.E.B.$_s$, rather more obvious than usual, at 328°II. A dusky SEB Z was seen by Hasebe at 103°II on June 10 with dark elongated segments in the S.E.B.$_n$ at 04°I. Dark triangularly notched spots on the south side of the S.E.B.$_n$ were seen by Doel on June 28 at 206°II (240°I). More activity in the S.E.B.$_n$ was seen by Hasebe on June 28 at 271°II (309°I). The S.E.B.$_n$ was erupting, but much less spectacularly than the NEB, as of July 1, according to Mackal, at 12°II (70°I). A double S.E.B.$_n$ was seen by Mackal on July 1 at the same longitude. This impression was confirmed by Doel on July 5 at 221°II (309°I). A rather dark S.E.B.$_n$ was observed, and also a faint wispy line directly south of it. A white oval was squarely placed between both belts. The SEB Z was bluish. On July 6 Mackal observed a dusky E.Z.$_s$ situated between a weak EB and a dark stable S.E.B.$_n$, at 60°II (155°I). Several white patches were seen in the SEB Z, and a rather conspicuous and undulating S.E.B.$_s$ was also seen. On July 7 Doel picked up an erupted region in the S.E.B.$_n$ at 164°II (268°I) preceded by a bright circular

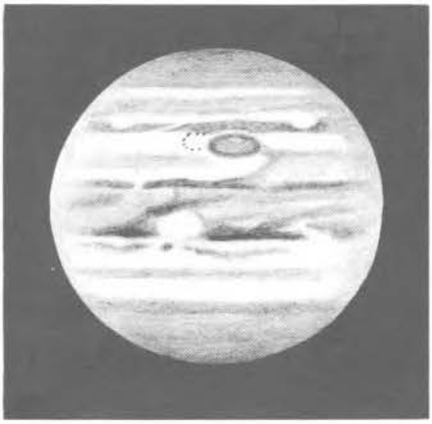


Fig. 53. Dick Wessling. August 16, 1972; 1:30 UT; 47°I, 359°II; 12.5-inch reflec., 211x & 340x; Seeing 4, Trans. 4.

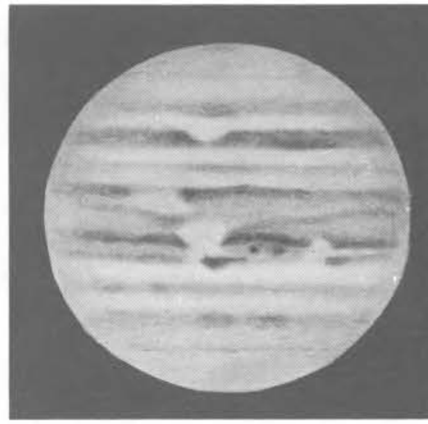


Fig. 54. Mr. Hasebe. August 17, 1972; 11:58 UT; 228°I, 169°II; 6-inch reflec., ---; Seeing 7, Trans. 2.

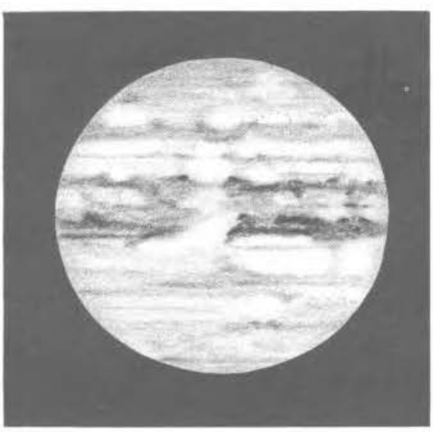


Fig. 55. Ron Doel. August 20, 1972; 0:20 UT; 276°I, 198°II; 8-inch reflec., 160x; Seeing 9, Trans. 5.

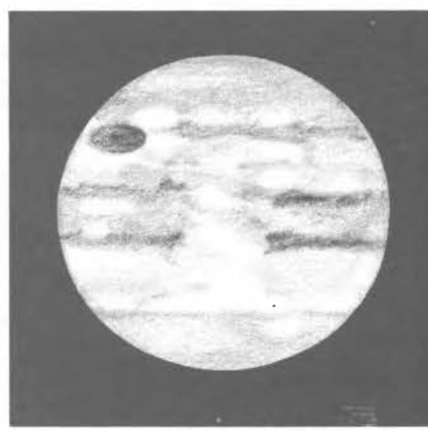


Fig. 56. Ron Doel. August 31, 1972; 0:30 UT; 218°I, 56°II; 8-inch reflec., 160x; Seeing 7, Trans. 4. BC in conjunction with RS.

white oval. A dusky SEB Z appeared to follow the disturbed region. It looked to be very warm brown in color, much like the NEB eruptions in appearance, intense (according to Heath a half step darker than the surrounding belt), and uniform, as if the two S.E.B.$_n$ components were merged together the way in which the two components of the N.E.B. finally merged.
On July 10 Mackal caught an intensely dark S.E.B.$_n$ over the entire disc of Jupiter at 265°II (31°I). The S.E.B.$_s$ was also darker in the same longitude. There was no sign of an EB other than a barge-like extended portion already mentioned in this report. The same erupted region of the S.E.B.$_n$ was reobserved by Doel on July 14 at 137°II (294°I). This time it was flanked by two white ovals, slightly-elongated, with a dusky SEB Z following the entire region. Vitous caught a dark p.e. of the S.E.B.$_n$ at 90°II (202°I) on July 16, thereby confirming Doel's observations. Budine observed activity in the S.E.B.$_n$ at 359°II (184°I) on July 18. This activity was also seen by Hasebe a little later at 21°II (211°I). An orange E.Z.$_s$ and SEB Z were seen by Vitous on July 19 at 140°II (335°I). Two bright E.Z.$_s$ ovals were seen by Wessling on July 21 at 93°II (303°I) along with a dusky SEB Z. A great second eruption in the S.E.B.$_n$ was observed by Mackal on July 22 at 285°II (143°I)--darker by far than anything else I have ever

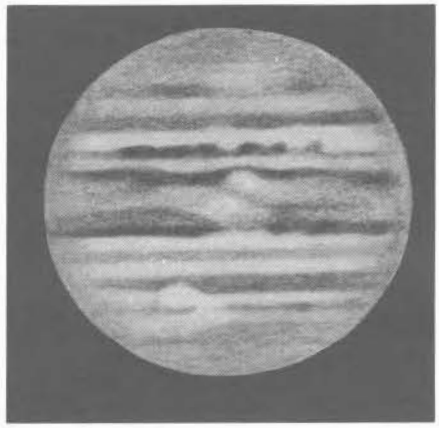


Fig. 57. Mr. Hasebe. September 6, 1972; 11:46 UT; 137°I, 286°II; 6-inch reflec., ----; Seeing 6, Trans 3. Note dark S.E.B.s.

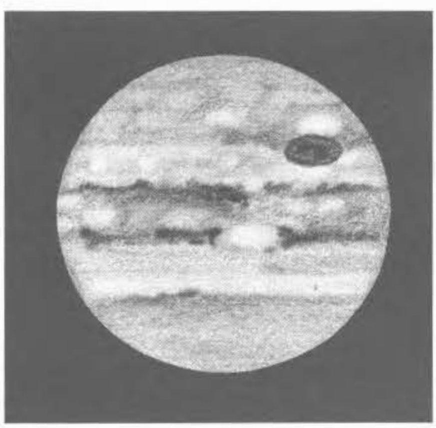


Fig. 58. Ron Doel. September 9, 1972; 0:40 UT; 204°I, 334°II; 8-inch reflec., 160x; Seeing 5, Trans. 4. BC in conjunction with RS. Large white oval in NEB.

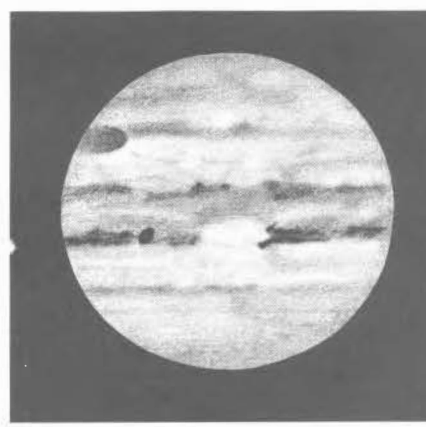


Fig. 59. Ron Doel. October 15, 1972; 22:34 UT; 204°I, 51°II; 8-inch reflec., 160x; Seeing 8, Trans. 4. Large white oval in NEB. Cf. Fig. 58. [J I. shadow on disc.]

seen since 1962. (See Figure 40.) A "break" appeared to precede the great knot of swarthy material, and this aspect was confirmed by Heath in August. On July 23 Doel reobserved the first eruption area at 14°II (239°I), as did also Wessling, who saw it for the first time. A gap in the S.E.B.$_n$ was seen by Mackal on July 23 over 299°-318°I. On July 25 Mackal observed eruption area one in the S.E.B.$_n$. It should be noted that it was located on this day at 212°I. A gap was seen by Vitous on July 31 at 123°II (48°I). A photograph by Sherrod on July 31 confirmed Doel's region and Mackal's region preceding the RS. This region was flanked by two white ovals. Vitous caught an oval on August 4 at 10°II (326°I). Doel reobserved region one at 279°II (250°I) on August 6 to be again flanked by two white ovals. On August 13 Vitous observed the S.E.B.$_s$ at 275°II. Doel observed an agitated SEB Z on August 14 at 89°II. He also saw a large E.Z.$_s$ oval at 125°I. Hasebe caught a white oval in the S.E.B.$_n$ at 265°I on August 15. On August 16 Wessling noted a dusky SEB Z from 359°II onwards. A dark part of the S.E.B.$_n$ was seen by Hasebe on August 17 at 218°I. This might be regarded as a third eruption region. The original eruption was seen by Doel on August 20 at 276°I with a white oval now situated in the SEB Z and directly preceding it. Gaps in the S.E.B.$_n$ were seen by Wessling on the same date at 346°I. On August 30 Vitous saw an orange SEB Z and $E.Z._s$ at 304°II and 100°I. Doel confirmed Hasebe's erupted region on August 31 at 218°I. The SEB Z appeared most agitated. So too was the $E.Z._s$. Mackal's observation of eruption region two was confirmed by Hasebe on September 9 at 137°I. Doel observed SEB Z activity as late as October 15, but the $E.Z._s$ had by then become much more quiet.

3. Qualitative Changes of the Southern Hemisphere of Jupiter.

The South Tropical Zone, Red Spot, and South Temperate Belt: The STrZ and the STB were alike active in March and April (March 11 at 314°II and April 1 at 221°II respectively). Both were also active on May 13 at 360°II. By May 18 the STrZ appeared less dusky and much brighter than the SEB Z, according to Hasebe, at 236°II. The STB, however, retained many features and appeared to be equally active on both edges, north and south, on May 27 at 242°II in particular, according to Doel. A very thick and dark STB was seen by Doel on May 29 from 240°II onwards. Dark notched spots rode along both the north and south edges; small elongated oblong ovals, plus white spots, were obvious by June 28 at 206°II, according to Doel. Doel noticed larger ovals in the STrZ to the north of the $S.T.B._n$ and a dark spot in the $S.T.B._s$ at 236°II on July 5. The STB looked single to Mackal on July 6 at 60°II. The STB was very dark from 164°II onward, according to Doel on July 7. On July 10 the STB was double to Mackal at 265°II. A gray column was seen by Doel on July 14 at 132°II, connecting the $S.E.B._s$ and the $S.T.B._n$. The color of the STB was brown to most observers, though grayish to Vitous. On July 18 Hasebe indicated that the RS had become less oblong and more oval-shaped, though it retained its uniformity and consistency. On July 19 Vitous drew the STrZ to be a pale blue at 140°II. Heath neither confirmed nor refuted this impression, only indicating that the STrZ was lightish. On July 22 the STB looked single to the Recorder at 285°II. On July 25 the RS was seen to be in a distinct ringed aspect by Mackal. This aspect was confirmed by Capen on August 11 (see Figure 48). The STB remained less active and less colorful for the remaining portion of August according to Doel, Hasebe and Wessling. On August 20 Doel noticed the double aspect at 198°II. Heath described the RS on August 21 as a "deep rosey pink." He placed the p.e. at 351°II and the f.e. at 8°II. Vitous observed a blue STrZ on August 30 at 304°II.

South South Temperate Belt, South South South Temperate Belt, and South Polar Region: This region was rather inconspicuous throughout the apparition. The SPR was gray to Doel and much smaller in extent, flanked on its north side by the SSTB with a weak SSSTB bisecting it on March 11 at 314°II. A white spot was seen by Budine in the SPR on April 1 at 235°II. A hint of a second SSSTB (or SSSSTB) was seen on May 27 by Doel at 242°II. A SSTeZ was seen by Otis on June 1 at 328°II and was confirmed by Hasebe, though very dusky, on June 10 at 103°II. Near opposition the SPR did look brown and a bit more active. The SSSTB was seen by Hasebe on June 28 at 27°II and by Doel at 206°II. The SPR looked faint to Mackal at 12°II on July 1. On July 6 the SSTB appeared faint or nearly missing to Mackal at 60°II. Doel showed it present but faint on July 7 at 164°II. Mackal observed large white ovals in the STeZ on July 10, situated in latitude between the STB and the SSTB, at longitude 265°II. This impression of a breakup of the zone into so many white ovals was even more obvious on July 14 to Doel at 137°II. (For historical reference, such an event took place in August, 1962.) On July 22 Mackal saw a more extended SPR at 285°II. On July 23 white ovals were seen by Doel at 14°II in both the STeZ and the SSTeZ but not at 348°II on July 25, according to Mackal. Ovals in the STeZ were seen again by Doel on August 6 at 279°II and on August 14 at 89°II. The SSTB appeared somewhat active in the longitude of the RS, according to Budine, on August 11. The STeZ appeared to become dusky to Doel in late August, September and October.

BOOK REVIEWS

The Observer's Handbook, John R. Percy, Editor. Royal Astronomical Society of Canada, 252 College Street, Toronto, M5T 1R7, Canada, 1975. 107 pages. Price #3.00, postpaid.

Reviewed by J. Russell Smith

If you are not acquainted with this Handbook, you are missing something. This useful and handy reference has been published for sixty-seven years. It contains almost everything you will need for the year. Some of the principal sections cover the following: the Sun and the planets for 1975, astronomical phenomena month by month, eclipses, elements of the Solar System, comets, meteor showers, a pronounciation list of the constellations, longitudes of the central meridians of Mars and Jupiter, Saturn and its satellites, the brightest stars, Messier's catalogue of diffuse objects, star clusters, galactic nebulae, radio sources, and external galaxies.

If you are a serious observer, you will become tied to this Handbook just as this reviewer has been for many years.

* *

Astronomy and Astrophysics Abstracts, Vol. 11, Literature 1974, Part 1. Edited by S. Böhme, U. Esser, W. Fricke, U. Güntzel-Lingner, F. Henn, D. Krahn, H. Scholl, and G. Zech.

Published for the Astronomisches Rechen-Institut by Springer-Verlag, Berlin, Heidelberg, and New York, 1974. 597 pages. Price $35.10.

Reviewed by J. Russell Smith

Astronomy and Astrophysics Abstracts is prepared under the auspices of the International Astronomical Union; and it is an excellent successor to Astronomischer Jahresbericht, which was founded in 1899. It is primarily of interest to professionals, advanced students, and persons doing research in the vast field of astronomical literature.

It records about 6300 papers covering astronomy, astrophysics, and related subjects. Readers of The Journal of the Association of Lunar and Planetary Observers, The Strolling Astronomer will find their Journal included.

If you find the book too expensive, it is possible that you might find this volume in a near-by college or university library.

The material is divided into the following basic sections: 1. applied mathematics-physics; 2. astronomical instruments and techniques; 3. Earth; 4. interstellar matter, gaseous nebulae, and planetary nebulae; 5. periodicals, proceedings, books, activities; 6. planetary system; 7. positional astronomy, celestial mechanics; 8. radio sources, quasars, pulsars, X-ray and gamma ray sources, cosmic radiation; 9. space research; 10. Sun; 11. stars; 12. stellar systems; and 13. theoretical astrophysics.

There are 81 pages of author index and 43 pages of subject index, which make the reference work easy to use. This reviewer looked for his name in the author index; and to his surprise, there it was.

* *

1975 Yearbook of Astronomy, edited by Patrick Moore. Sidgwick and Jackson Ltd., London, and W. W. Norton and Co., Inc., New York, N. Y., 1974. 221 pages. Price $8.95.

Reviewed by Rodger W. Gordon

Now in its 14th year, this annual Yearbook of Astronomy is very similar to its forerunners. After a brief index to previous yearbook articles, the book starts with the basic star charts and monthly events calendar. These are simple and straight-forward as are the descriptions of the monthly sky phenomena. Highlights of the sky for a particular month are given a little more in-depth coverage. The material presented here is sufficient for any beginner who has just acquired a telescope or one who wishes to probe a little further. Lists of meteor showers, asteroids, eclipses, and planetary configurations are also included, though this reviewer felt that more meteor showers could have been added.

In the second part of the book are articles by well-known British amateurs and professionals. Topics include information on the close approach of Asteroid 433-Eros, a rotating observatory, planetary nebulae, quasar redshifts, teaching astronomy in schools, a synopsis of current Jupiter research by professionals, an article on radio observations of Jupiter with some pictures of amateur radio installations, and Patrick Moore's contribution of hunting the Messier objects. Short lists of double stars, clusters, and nebulae are followed by a list of recent recommended publications and a note about the contributors.

For me, the most interesting chapter was on amateur radio observations of Jupiter since I am currently assembling equipment to pursue this aspect of Jovian observation to supplement my visual work. A very timely chapter was on the problem of teaching astronomy in the schools. It would appear that the same problems in the teaching of this subject in schools in the U.S. are also felt in the British Isles.

Although most or all of the material (or similar material) can be found in other books, it is good to have a great deal of valuable information at one's fingertips in just one volume. If there is any criticism of this book, it is probably that the amount of information covered is just enough to whet the appetite. One would wish the book to be twice as long as it is and just a little more advanced for those who have gone past the basics.

* *

The Invisible Universe-the Story of Radio Astronomy, by Gerrit L. Verschuur. Springer-Verlag Publishers, 175 Fifth Avenue, New York, N.Y., 1974. 173 pages. Price $5.90.

Reviewed by Hugh M. Johnson

This paperback is Volume 20 of the Heidelberg Science Library. The author, now at Fiske Planetarium, Boulder, was a scientist for several years at the National Radio Astronomy Observatory, Green Bank, W. Va., and Charlottesville. The book reflects both his interest in the public and his knowledge of the subject. He writes much more authoritatively than many non-astronomer authors of currently popular books on astronomy can. He has incorporated 69 appropriate and uncommon illustrations with the text. The book is not a history, as the "story" of the subtitle might imply, but is an up-to-date account of many aspects of radio astronomy. Almost journalistic brevity is forced on many pages in order to achieve wide coverage in short space. The author also takes a journalist's delight in imparting "inside" information about astronomers' astronomy: cf. remarks on "enforced secrecy," the "rat race," and "the bandwagon effect" in the preface and pp. 26, 76, 77 and 83.

The back cover claims that the book is an "informal text" for "students, from high school seniors on." However, it will not serve to teach the subject so well as to teach about the subject, enjoyably to be sure. The author does not quite surmount a very great problem of informative writing for non-professionals, namely to maintain a consistent level of assumed prior knowledge in the readers. For example, on the first few pages so little is assumed that, on page 4, the inverse-square law is circumlocutiously unnamed, but by page 18 the reader is confidently expected to swallow radian measures cold. On page 22 the author pauses to explain the Milky Way in optical terms but fails to make clear it was not stars that the pioneer radio astronomer Jansky detected in the "Milky Way." On page 26 it is implied that interstellar hydrogen was discovered, and is detectable only, by means of radio astronomy. On page 6 an optical detector is compared to a radio recorder, in the course of giving a picture of optical astronomy more appropriate to its state of techniques 30 years ago than now. Only a few outright errors occur, such as the assertion on page 45 that Venus is the only retrograde rotator in the Solar System; and there are a few quite unproved statements of fact made, such as on page 93 that "explosions of whole galaxies" are "destroying all their stars in the process." Mullard and Penticton Observatories are misprinted in their listings on page 172 (of the index).

The book will certainly give new insights into radio astronomy for the reader who is already informed about optical astronomy only. The author refreshingly succeeds in making the reader feel that he is present at the scene of action. In this respect one of the most novel chapters is 18, "How a Radio Astronomer Makes his Observations and Studies the Data." Many readers may have assumed that it was all more simple and informal. Even so, the often terrible problem of finding funds to do astronomy is not discussed, perhaps because the subject of fiscal astronomy calls for a whole book by itself.

* *

Astro Filters for Observation and Astrophotography, Second Edition, by Raymond Barbera, Charles Capen, George Carvalho, Sr., and Richard Steeg. The Optica b/c Company, 4100 MacArthur, Oakland, California, 1973. 103 pages, paperbound, $4.95.

Reviewed by J. Russell Smith

After an introduction and a few pages explaining the nature of light, the authors classify filters as to their effect on the spectrum and then as to their specific astronomical uses.

One simple formula to remember, and I quote from page 17, is as follows: "filters lighten colors like themselves and darken their compliments (opposites)."

In the section on the uses of filters, one will find a chart on filters to counteract city lights. Since most observers are faced with this problem, they should find this information helpful.

One finds many qualities of filters on the market today. However, it should be remembered that cheap gelatin filters are not the cheapest in the long run because they do not last very long. The best filters are the optical glass type.

In astrophotography, one must know the filter factor--the number of times an exposure should be increased in order to compensate for the light which is absorbed by the filter. A simple and easy way to find a filter factor is described on page 41.

In the three photographs of Jupiter, reproduced on page 51, one can readily see the advantage of tricolor separation which is usually done in the three primary colors--red, green, and blue. The blue festoons in the Equatorial Zone show readily only in the red light photograph, and the Red Spot shows readily only in the blue light photograph. In the same section one is instructed how to make color photographs from black-and-white panchromatic film. Of course, one must make three separate exposures--one through each of the color filters--red, green, and blue. This process appears impossible, but it has been used for many years.

If you are a planetary observer, Chapter 5 is for you. It discusses the use of filters in relation to their use in observing each planet as well as factors affecting definition. If you are a doubter in the use of filters, you should observe Jupiter with the reviewer's 16"

Newtonian without and with a blue filter! The photo of the quarter moon on page 80 shows how a medium yellow filter was used to increase contrast and to produce a dark sky effect.

A following section warns against looking at the Sun without the proper safeguards, and safe methods of solar observing are discussed. From page 83, I quote: "Every toy telescope we have checked supplies an eyepiece sun filter. The instructions for its use lead one to believe that such a filter is safe, but the results of the past have proven this notion not only false but disastrous." The authors place emphasis on the Herschel Wedge prism for solar observing, and the reviewer agrees since he has used one for many years.

The First Edition of this book was in 1964, and this Second Edition (1973) does not bring the filters section on observing the Sun up to date. We now have a relatively new type of Sun filter on the market today. I understand that it consists of an aluminized polyester film. It is used over the end of the tube of a reflector or over the refractor objective lens. From reports, it appears to be quite satisfactory.

Following the sections already mentioned, we find a short section on each of the following: filters and comets, filters and stars, double stars, nebulae and star fields, and filters for infrared and ultraviolet, as well as one section on filter care.

While $4.95 seems expensive for such a small volume, it is really not. This book is actually a standard reference for the beginner as well as for the advanced observer. It tells one all he needs to know about filters and their uses. The reviewer would like to see a copy in the hands of each A.L.P.O. Recorder. No doubt, it could help to standardize observing techniques and observational data.

ADDENDUM: THE 1972 APPARITION OF JUPITER

By: Paul K. Mackal, A.L.P.O. Jupiter Recorder

The following data assembled into two tables for easy reader analysis of the ranks and colors of Jupiter's belts in 1972 were kindly supplied to me by Walter Haas. The tables are prefaced by two keys, which in themselves are self-explanatory. In 1962 the Recorder embarked upon a careful study of the normality of intensity observations made by Phil Budine, Clark Chapman, and Walter Haas. At that time it was discovered that Professor Haas' estimates were usually the closest ones to the mean intensity. Hence, it is here assumed that his ranks are valid estimates, which are only affected adversely, if at all, by low seeing conditions in Las Cruces during 1972. Here "rank" is the observed relative conspicuousness of a belt, 1 for the most conspicuous belt, 2 for the second most conspicuous belt, etc.

Key 1.

Observation 1.	4/30/72.	242°II.	188°I.
Observation 2.	9/24/72.	96°II.	81°I.
Observation 3.	9/24/72.	168°II.	154°I.
Observation 4.	10/29/72.	302°II.	194°I.
Observation 5.	11/ 5/72.	245°II.	190°I.
Observation 6.	11/ 6/72.	41°II.	354°I.
Observation 7.	11/12/72.	248°II.	248°I.
Observation 8.	11/13/72.	359°II.	06°I.
Observation 9.	11/19/72.	192°II.	244°I.
Observation 10.	11/26/72.	282°II.	35°I.
Observation 11.	11/27/72.	294°II.	47°I.
Observation 12.	12/17/72.	51°II.	317°I.

Key 2.

BR.	"Brown."
Br./GR.	"Brownish-gray."
GR.	"Gray."
RD./BR.	"Red-brown."
Rd./BR.	"Reddish-brown."

Table 1.

RAW DATA

BELT	RANKS												COLOR	
	O_1	O_2	O_3	O_4	O_5	O_6	O_7	O_8	O_9	O_{10}	O_{11}	O_{12}	O_2	O_4
SEB	1	1	1	1	1	1	2	1	1	1.5	1	1	BR.	RD./BR.
NEB	1	1	1	2	2	2	1.5	2	2	2	2	2	BR.	Rd./BR.
STB	2	2	2	3	3	3	3	3	3	3	3	3	Br./GR.	--

Table 1 (Continued).

BELT	RAW DATA RANKS												COLOR	
	O_1	O_2	O_3	O_4	O_5	O_6	O_7	O_8	O_9	O_{10}	O_{11}	O_{12}	O_2	O_4
NTB	3	4	3		5								Br./GR.	--
SSTB		3	4	4	4	4		5					--	--
NNTB		6	6		7	6		4	4	4	4		--	--
SEB_s	4	5	5		6	5		6.5			5		--	--
EB			7		8								--	--

Aperture 12.5 ....6.........................12.5............... 12.5 6 inches

Table 2.

BELT	MEAN RANK	MEAN SEEING*	NUMBER OF OBSERVATIONS
SEB_n	1.125	2.12	12
NEB	1.71	2.12	12
STB	2.75	2.12	12
NTB	3.75	2.88	4
SSTB	4.00	2.58	6
NNTB	5.13	2.50	8
SEB_s	5.21	2.58	7
EB	7.50	2.75	2

*On a scale of 0 to 10, with 10 best.

Postscript. The Editor much regrets his long delay in submitting his personal observations of Jupiter in 1972 to Mr. Mackal, whom he thanks for his courtesy in presenting them in this addendum.

DARK-HALOED CRATERS: THEIR NATURE AND ORIGIN

By: Alain Porter, A.L.P.O. Lunar Section

Although dark-haloed craters are still one of the least-known features of the lunar geology, they have raised intriguing questions and have offered opportunities for answers; and a reasonable amount of work has been done with them. They have been studied for some time by the DHC program of the ALPO Lunar Section, and on occasion by Lunar Orbiter and Apollo missions. What we have so far learned about the DHCs will be summarized here in hope of generating more interest in them.

Albedo Observations

For some time now, members of the ALPO have been making observations of the intensity variations exhibited by DHCs throughout the lunar day. Unfortunately, these albedo observations have not proved to be a clean-cut line of research. Patterns are few and varied; several occur, while many other of these craters show no time-intensity relation at all. From November, 1972 to February, 1974, the author observed 17 DHCs in this fashion, confirming previous results: Nothing of importance has been brought to light. At any time in the lunar day, observations may vary by several intensity units, making suspected patterns vague and meaningless--vulnerable to observational bias and preconceived notions on the observer's part. Although about 45 DHCs have been observed in this way, only seven of them (15%) appear to show any sort of variation; and not even all of these patterns can be accepted without question.

Table of DHCs Showing Lunar Daily Albedo Variations

Crater	Observer	Variation
+490+717	FDL	Sharp rise last 1.5d, dark at noon.
+490+717	AP	Dark at local noon (see Figure 60).
+476+735	FDL	Sharp rise last 2.5d, dark at noon.
+476+735	AP	Dark at local noon.
+490-239	KJD	More conspicuous at sunrise.

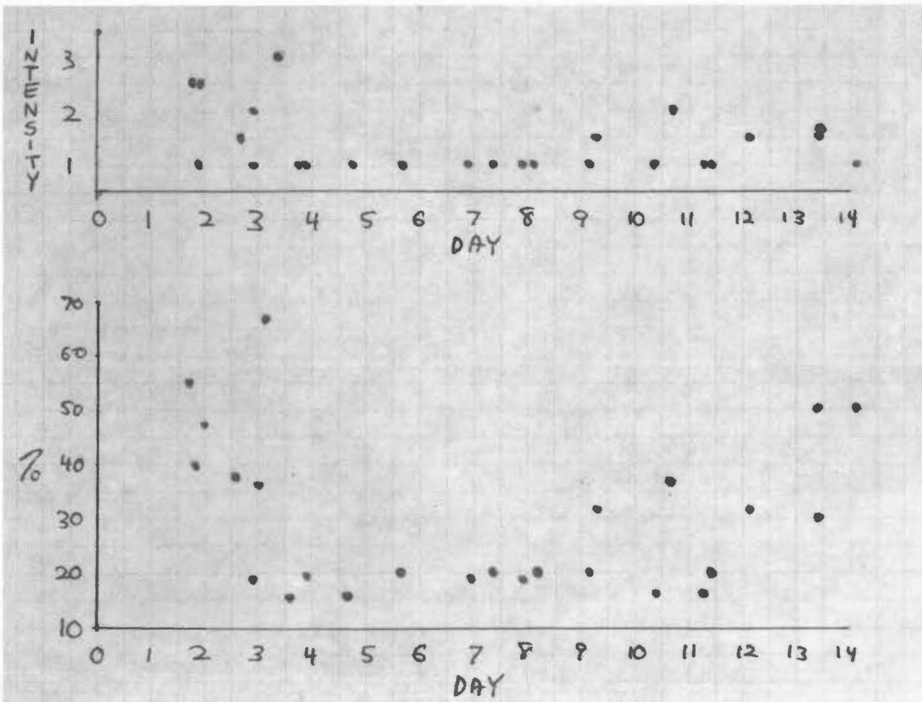


Figure 60. Observed intensity of Dark-Haloed Crater +490+717 by Alain Porter. This DHC in Atlas is one of the most conspicuous on the Moon, especially near local noon. It is undoubtedly volcanic since it is located at the intersection of several rills. There is a similar Dark-Haloed Crater in the southern part of Atlas. Upper graph: the observed intensity on a scale of zero (shadows) to ten (most brilliant lunar features) vs. terrestrial days since local lunar sunrise. Lower graph: the observed intensity of the DHC as a percentage of the observed intensity of its immediate environs vs. terrestrial days since local lunar sunrise.

The designation +490+717 means that the feature had lunar rectangular coordinates of xi=+0.490, eta=+0.717.

Table of DHCs Showing Lunar Daily Albedo Variations (cont.)

Crater	Observer	Variation
+486-248	KJD	More conspicuous at sunrise.
+481-237	KJD	More conspicuous at sunrise.
-112-538	AP	More conspicuous at sunset.
-312+120	KJD	Most conspicuous at 3-8 days.
-312+120	CP	Most conspicuous at 5-9 days.

So, due to the rarity and inconsistency of these variations, we must unfortunately lay them aside until something more definite can be learned. (For a more detailed consideration of intensity studies the reader is referred to Delano [1972].)

The Origin of the Dark-Haloed Craters

What about the origins of these objects? How were they formed? The evidence here points in different directions: volcanic and meteoritic DHCs appear to exist alongside each other, plus a few craters of mixed origin as well. Much of the evidence we have for the DHCs being volcanic is their association with other volcanic features on the Moon--particularly with domes, rills, and Lunar Transient Phenomena. Discussion of these relations follows.

DHCs and Lunar Domes. The nature and origin of the domes, although almost certainly endogenic, is still in question. Two attractive explanations are: shield volcanoes (the Apollo missions have shown lunar lava to be of an extremely low viscosity) and laccoliths. The frequency of summit craters and albedo differences on the domes would be favorable to their being volcanoes, while rough surfaces on some would appear to indicate that they are laccoliths. Most probably the two types co-exist.

In at least three cases, a DHC is found atop a dome which has been turned black. Clearly the crater has either been superimposed on the dome from above, or is related to it in origin.

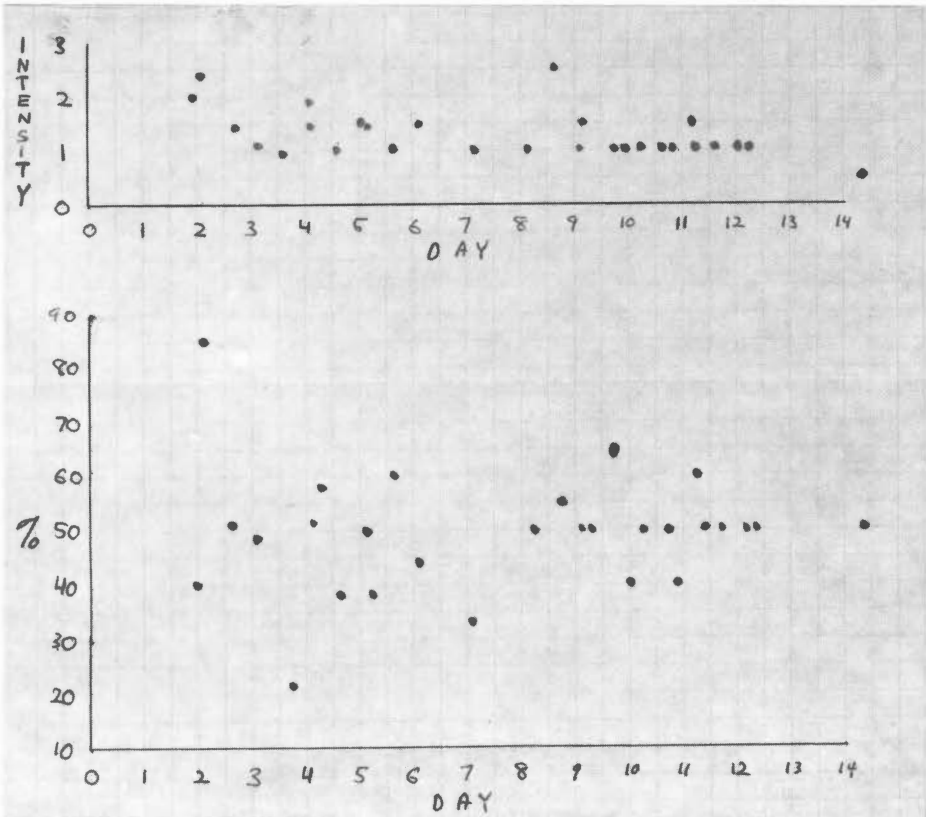


Figure 61. Observed intensity of Dark-Haloed Crater +480+814 by Alain Porter. This object is one of three DHCs in Endymion, which are most similar in their intensity variations. The two graphs are of the same kind as in Figure 60. Note that while the haloes of these objects are brighter under morning lighting, their brightness relative to their surroundings does not change. This result indicates that the variation is not restricted to the Dark-Haloed Crater.

This is the question: Is the crater, or is it not, endogenic?

A rill runs through or out of all three of the DHCs mentioned. The Apollo 15 astronauts brought back definitive geological proof that sinuous rills are collapsed lava tubes.[1] Other rills appear to be structural features. One of these three DGCs, an extremely elongated object, forms one end of the Birt rill, a sinuous one. The other two, very close to each other, lie upon one of the arcuate Menelaus rills, concentric to Mare Serenitatis. This type of relation is interesting, since the domes are usually assumed to be the products of lava eruptions, and the DHCs those of gas explosions (see text below). But less than 3 per cent of all DHCs lie on domes, and much less than one per cent of all domes lie under DHCs There are even many domes with no summit crater at all. However, there are numerous DHC-rill associations, which will be discussed next.

<u>DHCs and Lunar Rills</u>. Relations between DHCs and rills are much more common than those between DHCs and domes, and examination of several cases leaves absolutely no doubt of their genetic relationship. Such an object as the DHC on the above-mentioned Birt rill obviously cannot be the result of a meteoritic impact. Since sinuous rills are collapsed lava tubes, volcanic activity is immediately suggested.

When the surface of a basin or *mare* of radius r sags, fractures and weaknesses inside 0.73r are radial, and outside tend toward concentricity, while at 0.73r there is a maximum of stress.[2] These stresses in the interior regions are present in the form of rills, scarps, extrusions, etc.--and domes, LTP, and DHCs. Along these maximum stress lines is the perfect place for endogenic activity to rise to the surface, and that is precisely where the majority of DHCs are found. This is the case in most circular *maria*, and even in some craters, like Alphonsus (Figure 62 and front cover). Indeed, the average position of the nine exterior DHCs

---

1. Howard, *et al*, 1972,
2. Hartmann and Wood, 1971, pp. 57-58.

in this crater is 0.70r, a deviation of only .03r. Since Alphonsus is about 108 km. in diameter, this amounts to roughly only 3.5 km. difference.

It would thus appear that the lunar rills which have DHCs and the DHCs on them have a deep-seated connection, in regard to both their nature and origin. To be sure, the rill and the DHC would have different immediate causes; but the fact that a volcanic crater lies superimposed on a volcanic flow feature cannot be dismissed as coincidence.

DHCs and Lunar Transient Phenomena. One must proceed with the utmost caution in attempting to establish a relationship between the DHCs and the LTP, for the latter are one of the most controversial aspects of lunar science today. Of the many paper published on this subject, some say that LTP are definitely volcanic eruptions; others assert that they are phenomena

Figure 62. An oblique view of Dark-Haloed Craters in Alphonsus. Apollo 14 Frame 14-73-10093, courtesy of NASA and the ALPO Lunar Photograph Library. Solar altitude=38°. View centered at 12° south latitude, 2° west longitude (IAU west).

which have nothing to do with volcanism; and still others state that they do not even exist, being due to atmospheric phenomena, imperfect optics, tired eyes, and the power of suggestion. Doubtless none of these extreme views is correct--the wisdom of moderation along with more recent research would suggest that they are something "in between," for example, out-gassings, or perhaps a mixture. Of the reality of some LTP there is no doubt: Apollo seismographs have recorded moonquakes at the same time as LTP sightings.

Winifred S. Cameron, of the Goddard Space Flight Center, has provided the author with a record of LTP observations in the Pierce-Picard area (see Figure 63) of Mare Crisium and has pointed out that the DHCs in Alphonsus have produced LTP several times.[3] The former have a history of LTP sightings going back over 300 years, dotted with reports by such famous astronomers as Cassini and McCord. If the LTP are volcanic outgassings, this would be tremendously significant in considering the origin of the DHCs.

Meteoritic DHCs. On examining these data, most authorities have come to the conclusion that the DHCs are a type of maar, an explosion crater. This theory is supported by the fact that the dark haloes are made up of powder and dust, not lava. (If these blankets were lava, they would display sharper demarcations than they do.) Furthermore, the DHCs are similar in size to the terrestrial maars.[4] As for the cause of the darkening, high Fe and Ti contents are the most likely agents.[5]

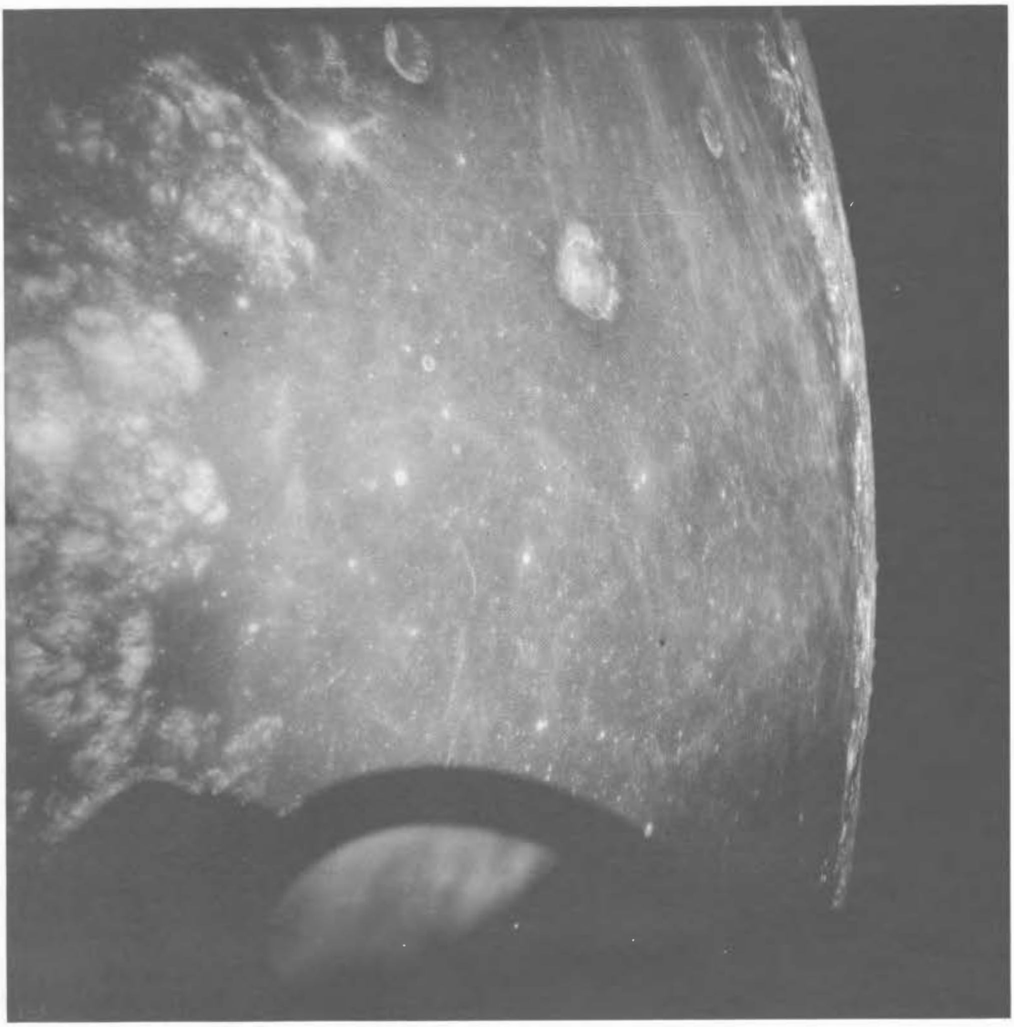


Figure 63. Apollo Frame AS 15-1500, courtesy of NASA and the ALPO Lunar Photograph Library. Centered at 14° north latitude on the Moon, 57° east longitude (IAU east). The large craters near the top edge are, from right to left, Pierce B, Pierce, Picard, and Lick D; all are Dark-Haloed Craters in the Mare Crisium.

In order that the reader may attain the proper perspective, however, it must be reiterated that there are meteoritic DHCs as well as volcanic ones. These kinds may be distinguished from each other by several methods: for example, the meteoritic DHCs have outer slopes which are concave upward, as is of course the case with any normal impact-crater. Furthermore, it would

3. Personal communication, Sep. 11, 1973.
4. Cameron, 1972, p. 163.
5. Hapke, personal communication, Nov. 27, 1974.

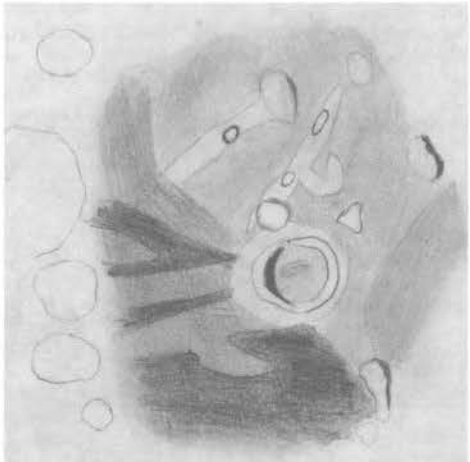


Figure 64. Drawing of lunar crater Dionysius and vicinity by Alain Porter on March 2, 1974, 1^h30^m-2^h25^m, U.T. 15-cm. reflector, 96.5X. Seeing 8 (good), transparency 3 (rather poor). Colongitude= 9°4. Dionysius is the largest known example of the puzzling dark-rayed craters. Under this morning lighting only the two eastern dark rays show. South at top, lunar east in IAU sense at left.

appear that most volcanic DHCs have dark interiors as well as haloes, and those craters produced by impact have light interiors due to brecciation and talus formation on the inner slopes. Further investigation of this latter possibility is merited. Perhaps the only sure way to tell is to examine the crater geologically, as was done with meteoritic Shorty crater on the Apollo 17 flight.

What makes these objects DHCs? Many of the exogenic objects can be found within the ray systems of large Copernican craters, and their difference in origin does not change the fact that they are rarely found very deep inside the *maria*. Why these objects have dark *ejecta*, while they are like the hundreds of other impact craters surrounding them in other ways, is uncertain. Perhaps the meteorites have landed in a pocket of previously darkened dust, but what caused such tiny pockets? The fact that they cluster around large Copernican craters suggests that these have something to do with the processes involved, but more evidence must be gathered before this opinion is confirmed or refuted.

The ALPO DHC Program

Observing dark-haloed craters is an activity which the amateur can find enjoyable and convenient even with a relatively small telescope. These craters range in size from the relatively large Picard to tiny spots which are test objects for large instruments. How conspicuous they are may also depend upon the phase of the Moon. All told, there are over 150 DHCs within the reach of a telescope of 4-5 inches in aperture. New ones are still being discovered and confirmed, and peculiar ones are being more closely studied. One might also examine the interiors of DHCs to determine the significance of their being light or dark. (Text above.) Also, these craters usually take only a few minutes to observe. DHCs are also relevant to other ALPO lunar studies. As has already been mentioned, they are often associated with domes and LTP; and several occur in craters which the Selected Areas Program has studied, such as Alphonsus or Atlas.

The program is still small, and needs more observers. Those interested should write to Rev. Kenneth J. Delano, the program Recorder, at 22 Ingell Street, Taunton, MA 02780 for further details.

Acknowledgements

Well-merited thanks go to Winifred S. Cameron, Kenneth J. Delano, Harry D. Jamieson, Christopher Vaucher, and John E. Westfall, Lunar Recorders for the ALPO. They have all provided the author with numerous sources of information to which he would not otherwise have had access.

References

Cameron, Winifred S. (1972). "Evidence for Lunar Volcanism from Lunar Probes," JALPO, V. 23, #9-10, pp. 159-69.

---- Personal Communication, September 11, 1973.

Delano, Kenneth J. The Intensities of Dark-Haloed Craters, paper read at 1972 ALPO Convention.

---- Personal Communications: 1973 Feb. 27, June 16, Aug. 19, Sep. 12, and Nov. 23, and 1974, Jan. 4.

Hapke, Bruce (1971). "Optical Properties of the Lunar Surface," Physics and Astronomy of the Moon, pp. 155-211.

---- Personal Communication: November 22, 1974.
Hartmann, William K. (1966). "Lunar Basins, Lunar Lineaments, and the Moon's Far Side," Sky and Telescope, V. 32, #3, pp. 128-31.
---- and Harris, D. H. (1968). "Lunar Volcanic Eruptions Near Aristarchus," Communications of the LPL, V. 7, #3, pp. 161-8.
---- and Wood, C.A. (1971). "Moon: Origin and Evolution of Multi-Ring Basins," The Moon, V. 3, #1, pp. 3-78.
Howard, Keith A. *et al.* (1972). "Geology of Hadley Rill," Proc. Third Lun. Sci. Conf., V. 1, pp. 1-14.
Jamieson, Harry D., Personal Communication, Aug. 31, 1973.
Kopal, Zdenek (1969). The Moon. Boston: D. Reidel.
---- and Rackham, Thomas W. (1964). "Lunar Luminescence and Solar Flares," Sky and Telescope, V. 28, #3, pp. 140-1.
Middlehurst, Barbara M. (1967). "Lunar Transient Phenomena," Icarus, V. 6, #1, pp. 140-2.
Salisbury, John W. *et al.* (1968). "DHCs on the Moon," Monthly Notices of the Royal Astronomical Society, V. 138, pp. 245-9.
Scott, David H. *et al.* (1972). Geologic Map of the Taurus-Littrow Region of the Moon.
Vaucher, Christopher. Personal Communications: Aug. 29, 1973 and Jan. 13, 1974.
Westfall, John E. Personal Communication, January 1, 1975.

IN MEMORIAM: KENNETH W. STEINMETZ

The nationally-known amateur astronomer, Kenneth W. Steinmetz of Denver, Colorado, died of cancer of the stomach on August 29, 1974. He was 54 years old.

He is certainly best known to the readers of this journal for organizing and directing the three Nationwide Amateur Astronomers' Conferences in 1959, 1964 and 1969. These are the only really national gatherings of amateur astronomers yet held in the United States. His concept was basically for a joint meeting of the Astronomical League, the Western Amateur Astronomers, the ALPO, and the American Association of Variable Star Observers, all hosted by the Denver Astronomical Society. Those who attended any or all of the three historical meetings mentioned were much impressed with the scope of his planning, the vast amount of effort so selflessly expended by him and his committees, and the carefulness and detailed work done in arranging gatherings for many hundreds of attendees--in truth, they were more impressed in proportion as they have had occasion themselves to try to arrange much more modest meetings! For these services we must all owe to Ken Steinmetz a unique debt.

Figure 65. Kenneth W. Steinmetz. Photograph taken in 1973 or 1974. Supplied by Mrs. Phyllis Steinmetz.

He was born in Longmeadow, Massachusetts in 1920 and married the former Phyllis L. Sorensen in 1943. They had three daughters. During World War II he was a telegrapher for the railroad at Tolland, Colorado. He was a board member of the Mile-Hi Church of Religious Science and a former member of the Sports Car Club of America. At the time of his death he was manager of hydronic sales for the Crane Company.

All who knew Mr. Steinmetz will join us in expressing our sympathy to his family and friends. It is a fitting tribute, and a gratifying proof that others value the work which he so ably began, that another Nationwide Amateur Astronomers' Conference is being planned at Denver for 1977.

ANNOUNCEMENTS

Partial Retirement of Charles A. Federer, Jr. Mr. Federer, the chief editor of The Sky and Sky and Telescope for the past 35 years, has recently relinquished his editorial duties. He will, however, continue to help in the preparation of the magazine and to serve as president-treasurer of the Sky Publishing Corporation. The ALPO offers its hearty congratulations on a job well done. He has rendered a unique service to professional and amateur astronomers around the world. We extend our best wishes to him in his semi-retirement.

Errors in Vol. 25, Nos. 3-4 of JALPO. Dr. Joseph Ashbrook of the Sky and Telescope staff has kindly pointed out some errors in the preceding issue of this journal. Figure 20 on page 81 is not Airy's transit circle but rather his altazimuth instrument, used at Greenwich to observe the Moon's position when it did not cross the meridian during night hours. Figure

21 on the same page is a quadrant, not a sextant. (Captain James Cook took both an astronomical quadrant and a sextant with him to Tahiti to observe the transit of Venus in 1769.) The mistakes are the fault of the Editor, who much appreciates Dr. Ashbrook's interest and help in enabling us to correct these blunders.

Change of Address for Clay Sherrod. Mr. Sherrod, the ALPO Assistant Saturn Recorder, requests that all mail be addressed to him at: P.O. Box 4145, North Little Rock, Arkansas 72116. He has been having much difficulty in receiving mail at the address formerly published on our back inside cover.

Deadline for Observing Booklet Manuscripts. Julius Benton of our staff is undertaking to write a booklet with the tenative title of "The ALPO: Organization and Observing Programs," aimed at the general membership who might be interested in an overview of the Association before they settle down into specific observing programs. All ALPO staff members are reminded that manuscripts describing the basic organization and observing programs of their Section are needed by Dr. Benton by May 1, 1975. Staff members who have not yet responded are requested to do so soon. The book should be ready by August if the May 1 deadline is met. Comments and inquiries are welcome. All manuscripts should be sent to: Julius L. Benton, Jr., Piedmont Station, Highland Point Astronomical Observatory, P.O. Box 839, Clinton, South Carolina 29325.

Riverside Telescope Makers Conference. This enjoyable and successful annual gathering will be held on May 10 and 11, 1975, from Saturday noon to Sunday noon. The new location is Camp Oaks, located east of Big Bear City, California on Highway 38 and 50 miles northeast of Riverside. Anyone interested in participating as a speaker during the conference is requested to write to Clifford Holmes, 8642 Wells, Riverside, California 92503. Speakers are much needed. There will again be a "show-and-tell," a feature becoming more popular each year. Camp Oaks is at an elevation of 7300 feet. Motel facilities are available at Big Bear City, five miles away. Persons desiring more information should write to Mr. Holmes, the Director of the Conference, at the address given above.

Organization of ALPO Saturn Section. The Recorder for Saturn is Dr. Julius Benton, and the Assistant Recorder is Mr. Clay Sherrod. Their addresses are carried on the back inside cover of this journal. All general correspondence about the Saturn Section should be directed to Dr. Benton, who will also handle all orders for specific observing manuals and forms. All observations of Saturn should be mailed to Dr. Benton. The two Recorders will divide the work of the Section, with Mr. Sherrod concentrating upon observations of the satellites of Saturn and the curious bicolored aspect of the rings. The Recorder will undertake to make copies of those observational records which are of special interest to the Assistant Recorder. Observers of Saturn are encouraged to correspond with both Recorders, according to their individual interests. The two staff members will share the direction of advanced observing programs and of certain specific observational projects described in the Saturn Handbook. Experience has underscored the wisdom of keeping all related observational data in one place.

Many of our readers must have access to zerox copying machines; and perhaps they would sometimes find it convenient to make a copy of each set of their contributed observations for each Recorder, especially if the quality of the reproduction is satisfactory for drawings.

The 1975 ALPO Convention.* This year's meeting will be a joint one with the Western Amateur Astronomers and the Amateur Astronomers of Northern California. The place will be a large motel in San Francisco. The dates are Thursday, August 7 to Sunday, August 10, 1975. We are assured that facilities will be excellent for astronomical exhibits, for special meetings of small groups, and of course, for the main paper sessions themselves. Tours have been set up to Nasa/Ames and to the Lick Observatory for a Star Party. There will be the usual banquet and several outstanding professional scientists as speakers. Panels of experts will discuss currently lively astronomical problems and will field questions from the audience, always a popular program feature.

The Editor is too well aware that the information above is incomplete for those wishing to make plans to attend. It was originally intended to mail out an informative flyer with this issue (flyer not yet received). We shall in any case plan to give needed details in our next issue. Please be patient.

ALPO participation in such gatherings in past years has been valuable chiefly for our contributions of worthwhile papers to the program and of interesting display materials. Therefore, readers able to contribute papers and/or exhibits next August are cordially invited to do so. In truth, the subject for your paper should be chosen soon. Your attendance and participation in this Convention will be greatly appreciated. Do come--learn something--and have fun!

Open Invitation to Lunar Geology Fans. One of our newest members, Mr. Robert J. Betz, 219 S. Dearborn St., Room 2118, Chicago, Illinois 60604 invites participation in some special lunar studies. The subject should in truth be extremely interesting to some of our readers.

*But see also "Late Note on 1975 ALPO Convention" on page 128.

On February 28, 1975 Mr. Betz wrote in part as follows: "My interest and investigations are concerning lunar geology by analysis of the high-resolution photography of the Moon's surface via Apollo missions and Lunar Orbiter. I work with other enthusiasts in lunar geology zeroing in on work directed toward a better understanding of lava flow epochs on both the *maria* and highland vulcanism. We are tying in technovolcanism with time datums. We are not double-dome scientists, just Moon lovers using our spare time on this fascinating work."

Late Note on 1975 ALPO Convention. Good news! We can now tell you the exact site of this meeting; it is the Golden Gateway Holiday Inn, Van Ness Avenue at California Street, San Francisco, California. We are also assured, as of March 6, 1975, that a flyer with much helpful information *will arrive* in time to be mailed out as an insert in this issue of our Journal.

Reminder about Proposed ALPO Constitution. Persons wishing to study this proposed constitution prior to its expected discussion at San Francisco next August are reminded that they can obtain a copy by writing to Dr. John E. Westfall, 2775 39th Ave., San Francisco, California 94116. They will need to provide a return, stamped, self-addressed envelope. The constitution fills 14 typed pages, and its weight is between two and three ounces.

A Thank-You to Our Secretary, J. Russell Smith. It would scarcely be proper for the Editor to let this issue go to press without expressing his special thanks to Secretary Smith for his *considerable* help in recent months. This assistance has included answering promptly many letters on a variety of subjects (e.g., career information on astronomy and advice about buying telescopes) and filling out questionnaires for book agencies and others. He has helped with good advice on a number of difficult questions relating to ALPO activities. He has made our book-review service known to a large number of book publishers, and we actually now have book reviews on hand waiting for publication. These services cost something in time, thought and money; and we are all grateful to Mr. Smith.

The Strolling Astronomer

SUBSCRIPTION RATES

Single Issue (in stock)	$ 1.50
1 Year	6.00
2 Years	10.00

SPECIAL MEMBERSHIPS

Sustaining Members	$10 per year
Sponsors	$25 per year

☆ ☆ ☆

ADVERTISING RATES

Full Page Display Ad	$40.00
Half Page Display Ad	22.50
Quarter Page Display Ad	15.00
Classsified or Listing (per col. in.)	4.00

Discount of 10% on 3-time insertion.

☆ ☆ ☆

NOTICE: In order to facilitate the reproduction of drawings in future issues readers are requested to exagerate contrasts on drawings submitted. Extremely faint marks cannot be reproduced. Outlines of planetary discs should be made dark and distinct. It is not feasible to reproduce drawings made in colors. Following these precepts will permit better reproductions.

Persons requiring prompt acknowledgement of correspondence or contributed observations from staff members are requested to furnish stamped, self-addressed envelopes.

STAFF

EDITOR

Walter H. Haas
Box 3AZ
University Park, New Mexico 88003

SECRETARY

J. Russell Smith
8930 Raven Drive
Waco, Texas 76710

LIBRARIAN

Mrs. Walter H. Haas
2225 Thomas Drive
Las Cruces, New Mexico 88001

BOOK REVIEW EDITOR

J. Russell Smith
8930 Raven Drive
Waco, Texas 76710

MERCURY RECORDER

Richard G. Hodgson
Dordt College
Sioux Center, Iowa 51250

VENUS RECORDER

Julius L. Benton, Jr.
Piedmont Station, Highland Point
Astronomical Observatory
P. O. Box 839
Clinton, South Carolina 29325

MARS RECORDER

Charles F. Capen
223 West Silver Spruce
Flagstaff, Arizona 86001

ASSISTANT MARS RECORDER

Robert B. Rhoads
8637 E. Palo Verde Avenue
Scottsdale, Arizona 85253

JUPITER RECORDERS

Paul K. Mackal
7014 W. Mequon Road
112 North
Mequon, Wisconsin 53092

Phillip W. Budine
Box 68A, R.D. 3
Walton, New York 13856

SATURN RECORDER

Julius L. Benton, Jr.
Piedmont Station, Highland Point
Astronomical Observatory
P. O. Box 839
Clinton, South Carolina 29325

ASSISTANT SATURN RECORDER

Clay Sherrod
P. O. Box 4145
North Little Rock, Arkansas 72116

REMOTE PLANETS RECORDER

James W. Young
Table Mountain Observatory
P. O. Box 367
Wrightwood, California 92397

COMETS RECORDER

Dennis Milon
378 Broadway
Cambridge, Massachusetts 02139

LUNAR RECORDERS

John E. Westfall
Dept. of Geography
San Francisco State College
1600 Holloway Ave.
San Francisco, California 94132

Winifred S. Cameron
NASA, Goddard Space Flight Center
Code 601
Greenbelt, Maryland 20771

Kenneth J. Delano
22 Ingell Street
Taunton, Massachusetts 02780

Michael Fornarucci
136 Midland Avenue
Garfield, New Jersey 07026

Christopher Vaucher
6130 S.E. Reed College Place
Portland, Oregon 97202

Roy C. Parish, Jr.
208 Birch Street
Milton, Florida 32570

LUNAR AND PLANETARY TRAINING PROGRAM

Jose Olivarez
Hutchinson Planetarium
1300 North Plum
Hutchinson, Kansas 67501

MINOR PLANETS RECORDER

Richard G. Hodgson
Dordt College
Sioux Center, Iwoa 51250