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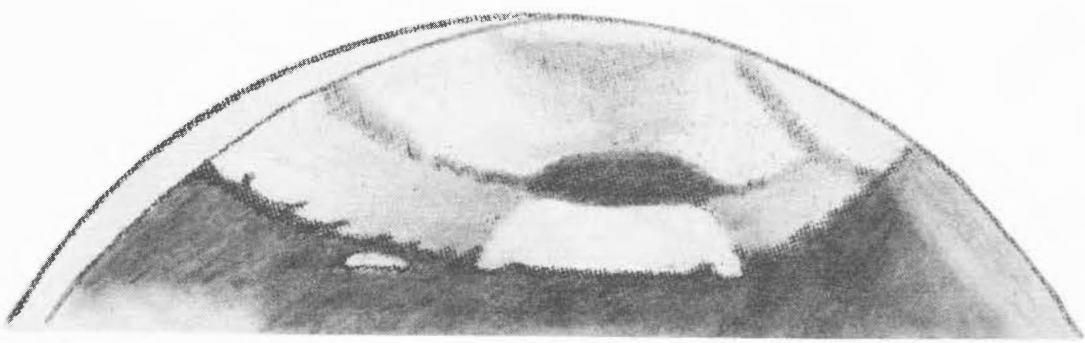

The South Polar Cap of Mars with an oblong dark marking and bright spot. Drawn by Charles F. Capen, ALPO Mars Recorder, on July 4, 1971 at 10 hrs., 10 mins., Universal Time. 12-inch Clark refractor, 490X. Wratten Filters 23A, 57, 38A, and 30. C.M. 167 degrees. Mr. Capen's article on pages 41-44 will help guide your current studies of Mars, closer to the earth this month than it has been since 1924.

THE STROLLING ASTRONOMER
Box 3AZ
University Park, New Mexico
88001

Residence telephone 524-2786 (Area Code 505)
in Las Cruces, New Mexico

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ALPO

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OBSERVING MARS III - THE ALPO 1971 OBSERVING PROGRAM

By: C. F. Capen, A.L.P.O. Mars Recorder

In 1971 the planet Mars will undoubtedly have its greatest popularity of this century because of its close approach to the Earth and the timely news publicity of the two Mariner-Orbiter space missions. Today, there are many more scientists engaged in space research and more amateur astronomers who possess moderate aperture telescopes than during the last very favorable approach in 1956. Everyone, from the man in the street to the professional scientist, will be looking up to Mars in an effort to satisfy a long enduring hunger - that of human curiosity. The ALPO Mars Section observing register is approximately 50% greater today than it has been in a decade.

Observational data consist of visual drawings and notes, visual photometry (intensity estimates on the de Vaucouleurs scale where 0 = polar cap brightness, 2 = desert mean brightness, and 10 = night sky)[1], black and white multi-color photography, color film photography, and micrometry. Of most importance to the apparition analysis are full disk drawings and limited regional maps of selected areas of interest made from overlays on base maps. Related visual reports of polar region activity, atmospheric phenomena, whitened areas, and the appearance of surface features accompany the drawings on the same form. The ALPO Mars kit contains a plain grid map of Mars that is used to indicate observed cloud and frost positions and to show surface feature changes. When a full map is received by a Recorder, a new one is returned to the observer.

The Mars charts which are most common and are suggested for use by ALPO students of Mars are: the 1954 ALPO Map of Mars (Avigliano) for nomenclature, the IAU 1941-52 Map of Mars (Mottoni) for official names and comparison, a Map of Mars 1907-1956 (Ebisawa), excellent for fine details and classical names, a Photovisual Chart of Mars 1958 (Focas) for comparison and positions, a 1967 Photovisual Chart of Mars (Capen) for comparison and positions, and the New Lowell Observatory Mars-1969 Map (Inge, Capen, Martin, and Faure) for current accurate comparison, positions, and traditional nomenclature and IAU nomenclature. When reference is made to names or to features on different Mars charts other than those above, the chart identification and areographer's name should be stated in the reports, e.g. (1887 Schiaparelli). The Antoniadi 1929 and Maggini 1939 Mars charts are also good for reference but are out of print. P. Lowell's 1895 to 1905 maps are of historical and comparison value, but a somewhat different nomenclature is employed from the Schiaparelli-Antoniadi traditional one.

Members of the ALPO can provide valuable observational data to the scientific community. The two Mariner-Orbiter spacecrafts will blastoff for Mars in May, and if all goes well, will arrive in the vicinity of Mars in November, 1971, and begin their 90-day orbiting missions.* Consequently, post-opposition observational information about atmospheric phenomena and surface aspects will be very much needed. Martian conditions determined in October can be extrapolated to predict conditions for the critical encounter periods. It is planned to communicate daily the ALPO observations to the Mariner Mission team leaders.

A systematic and planned observing schedule is the most useful to the ALPO Observing Program and the most rewarding to the individual observer. The observer should select the Martian phenomena of especial interest to him and restrict his systematic observations to these chosen areas of study. Do not try to do too much during each observing period. The individual Martian phenomena that are available for study by most amateur astronomers follow.

Observational Possibilities

From a study of the recorded 1969 and 1956 data it is possible to predict certain seasonal phenomena that may occur on the Martian disk.

Polar Regions. The southward axial tilt will not prevent observations of the reappearance of autumn arctic hazes in April TD (terrestrial date) and the formation of the north polar hood (NPH) some time in May TD. Observation of the formation of the new North Polar Cap will probably not be possible.

Regression measurements of the shrinking spring-summer South Cap (SPC) can be made

*As of this date, May 18, 1971, the first of these space vehicles failed to achieve orbit.

as soon as the cap appears from beneath the dissipating South Polar Haze from May, 1971 to January, 1972. Estimates of the diameter of the SPC can be made by comparing its width to the planetary diameter or to gross, dark surface features. Micrometer measurements of the SPC diameter can be related to the subtended angle at the center of the disk (areocentric) and can be converted to the latitude ϕ of the cap edge by the equation $\cos \phi = \frac{\text{cap dia.}}{\text{planet dia.}}$ Intensity estimates of the surface contiguous to the cap edge should be made during the rapid retreat phase, and a watch should be carried on for bright patches on the SPC periphery and for dark crevasses which split the SPC into sections. In 1956 bright patches, that later became white remnants, were located at 03° and 23° long., -70° lat.; and several dark crevasses developed across the SPC in Martian November, 218° L_s to 220° L_s (areocentric longitude of sun, chosen to be 0° at vernal equinox of north hemisphere).

When the SPC retreats past the 73° latitude circle during early August TD a bright projection will be left at 280° long., -73° lat. known as the Mts.-of-Mitchel. Theoretical studies of carbon dioxide deposition indicate that they should be called Mitchel Depressio, whereas the Mariner '69 TV photos show ridges or cloud banks in the vicinity. The Mts.-of-Mitchel should become detached from the south cap in about early September and should survive as an isolated white patch for about 7 to 10 days. The exact times when they first make their appearance on the cap edge, the time when they become detached entities, and the times when they completely disappear are important information for the theorist.

There has been considerable controversy regarding the possible complete disappearance of the South Cap remnant. It will be of interest to learn if the late summer SPC remnant is seen to disappear during this 1971 apparition. Perhaps ALPO observers can settle this question. Blue, blue-green, green, orange, and red filters are the recommended observing aids.

Atmospheric Phenomena. The study of cloud aerosols, their statistical occurrence, and their motion in the atmosphere of Mars have assumed increasing importance during the last decade. The seasonal occurrence of clouds is statistically coupled with the sublimation and condensation of the material of the polar caps. Knowledge of the windy seasons and areas on Mars is important to the spacecraft engineer who desires to land safely a scientific package. Further, the ability of predicting diurnal aerosol obscurations of surface features is important to the astrogeologist.

Cloud activity should be high at the beginning of the 1971 apparition. Seasonal clouds should be present along the southern border of the Syrtis Major and over the Candor-Tharsis and Amazonis Deserts from January through April, 1971. Equatorial cloud bands and evening terminator clouds will also possibly be present during this early period in the apparition. Limb brightenings should increase and local cloud activity will probably shift from the northern hemisphere to the southern during mid-apparition: July, August, and September. Violet (W47), blue (W38A), and blue-green (W64) color filters show the aerosols best.

The normal appearance of Mars in violet light is a featureless disk with occasional bright spots. At unpredictable times the violet opacity will seem to clear, and the contrasts of surface features will be seen in violet light. Observations of this interesting blue-clearing phenomenon can be acquired in average seeing, using a violet W47 filter.

As a result of a thorough study of historical yellow clouds from 1878-1939, the Great Yellow Cloud of 1956, and the yellow-white cloud of 1969, it was possible to predict the occurrence of yellow clouds on Mars in 1971.[2] It is possible that a bright yellow-white cloud may develop over the Hellespontus-Noachis area or the Pyrrhae R.-Erythraeum M. when the thermal equator (subsolar point) reaches a southern latitude of -23° and when Mars is near perihelion. Refer to Fig. 36 on page 37 of Str. A., Vol 23, Nos. 1-2, the critical dates being Sept. 5-30. If a bright cloud develops and then becomes a vast disturbance in the southern hemisphere, the physical conditions associated with it could furnish a test between the insolation hypothesis versus the solar-flare protons hypothesis. A vast dust storm could interfere with post-opposition earth-based observations as well as with the first Mariner-orbiter '71 spacecraft mission (but see footnote on page 41).

White Areas. Knowledge of whitened areas is of particular importance to the astrobiologist in search of Martian life. The white material is thought to be associated with the Martian surface, such as frost or ground ice-fog. The occurrence of whitening versus the Martian season needs much study; however, during Martian southern hemisphere spring-summer several discrete areas should show activity: Chryse (long. 32°, lat. +08°), Can-

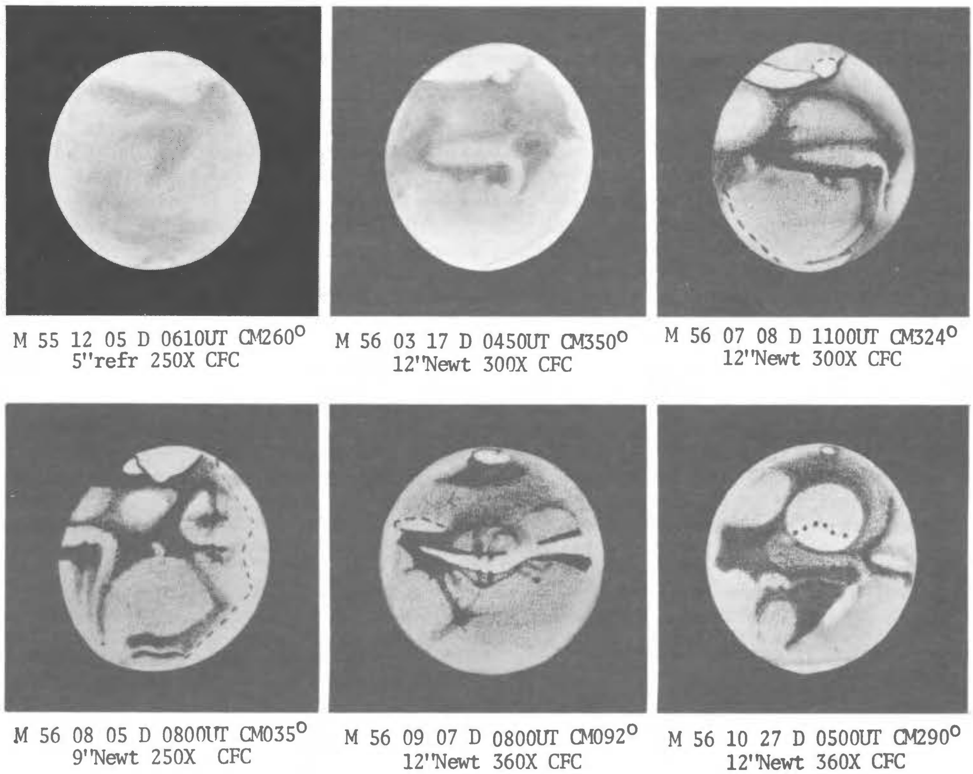

Fig. 1. These 1956 apparition drawings of Mars show the retreat of the South Polar Cap and the aspects of the surface features.

Figure 1. Six representative drawings of Mars by C. F. Capen during the 1956 apparition. The retreat of the South Polar Cap and aspects of some of the surface features are shown. Similar appearances may be expected during the current 1971 apparition.

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dor (long. 75°, lat. +05°), Nix Lux (110°, -07°) in Tharis, Nix Olympica (132°, +21°) in Amazonis, Hellas (295°, -50°), Ausonia Australis (250°, -40°), Nymphaeum (300°, +10°), Isidis-Neith R. (275, +28°), Deucalionis R. (350°, -11°), Edom (345°, -04°), Aram (12°, -05°), Sinai (65°, -23°), Thaumasia (75°, -35°), Aeolis (212°, -10°)?, and Elysium (215°, +25°). Specular reflections are possible from the southern whitened areas when the subsolar and subearth points are close together around July 20 and November 17, 1971 TD. Yellow-green (W57 or 58) and yellow-orange (W21 and 23A) light reveal this type of activity.

Surface Features. The light and dark surface features tend to change their albedo (brightness) and color contrast diurnally and more slowly with the seasons. There are also long term changes that are recorded from apparition to apparition known as secular changes.

Some regions that display seasonal changes are: Syrtis Major-Aeria (long. 300°, lat. +10°), Pandorae Fr. (345°, -25°), Nilokeras-Lunae L. (60°, + 25°)?, Candor-Tharsis (90°, +10°), Elysium-Trivium Charontis (210°, +22°), Mare Australe (340°, -65°), and Aonius Sinus (105°, -47°). Areas that are currently under secular change are: Nodus Laocoöntis-Amenthes (245°, +10°), Nepenthes-Thoth (268°, +08°), Thoana Palus (256°, +35°), Moeris L.-Pallas (270°, +08°), Antigones Fons-Astaboras complex (298°, +22°), Margaritifer S.-Hydrae S. (30°, -02°), Solis L. area (85°, -35°), Nilokeras-Lunae L. (60°, +25°)?, and Acidalius Fons-Tempes C. (60°,+58°). Surface feature sketches, relative intensity estimates, (high, medium, low contrast), or quality intensity estimates (0-10 scale) can be reported on the surface variations. Surface feature aspects are important to the Mariner-orbiter Mission '71 scientific investigators and for the production of a 1971 Mars chart. Yellow (W15, W21), orange (W23A), and red (W25) filters penetrate the atmospheric hazes and increase the contrast of surface features.

The current aspects of the Martian disk, such as the apparent diameter, axial tilt, subearth and subsolar points, and seasonal dates were discussed in "Observing Mars II" in the J.A.L.P.O.[3] Similar aspects and appearances of the Martian disk can be found in 1956 observations. Six drawings obtained with a 5-inch refractor, a 9-inch Newtonian reflector, and a 12-inch Newtonian have been selected from the equivalent (in Martian seasons) 1956 apparition for reference as shown in Fig. 1.

References

1. Vaucouleurs, G. de; Physics of the Planet Mars, Macmillan, N. Y., 1954, pp. 314-325.

2. Capen, C. F.; "Martian Yellow Clouds - Past and Future," Sky and Telescope, Vol. 41, No. 2, Feb., 1971..

3. Capen, C. F.: "Observing Mars II - Everything You Want to Know About Mars in 1971 - But Do Not Have Time to Ask," J.A.L.P.O., Vol. 23, Nos. 1-2, May, 1971.

THE 1967-68 AND 1968-69 APPARITIONS OF SATURN

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

General Introduction

Due to the relatively small number of observations of Saturn that were contributed to the Section during the 1967-68 and 1968-69 apparitions, it has been necessary for the Recorder to combine reports for the two periods.

The 1967-68 apparition of the planet was poorly observed, covering the period from about May 20, 1967 to March 2, 1968. Since this apparition followed the edge-on presentation of the rings to our line of sight, the value of B was not appreciable. Mean values for B during the period were between -7° and -8° during the month of July. Opposition occurred on October 2, 1967, at which time the stellar magnitude of Saturn was +0.6, and the polar diameter of the globe was 18" on the same date. Also at opposition, the major axis of the rings was 44". Most of the observations submitted during this apparition were centered around the 1967 opposition.

The 1968-69 apparition got wider participation, including the dates from about May 30, 1968 to March 15, 1969. Opposition occurred on October 15, 1968, when Saturn was again at zero stellar magnitude, and the ring inclination was much greater, with B averaging some -12°. On the date of opposition the major axis of the rings was 45", and the polar diameter of the planet was then nearly 18". As in 1967-68, the south face of the rings and the southern hemisphere of the globe were becoming easier to observe as the rings began opening up once again.

The following observers contributed observations and drawings during the two periods:

Observer	Station	Telescope	No. Nights Observed in 1967-8	No. Nights Observed in 1968-9
Beck, Inez N.	Wadsworth, Ohio	6" refl.	0	9
Benton, Julius L., Jr.	Savannah, Georgia	4" refr.	3	7
Cyrus, Charles M.	Baltimore, Md.	12.5" refl.	1	0
Delano, Kenneth J.	Taunton, Mass.	12.5" refl.	17	51
Gordon, Rodger W.	Barrington, N. J.	3.5" refl.	0	2
Haas, Walter H.	Las Cruces, N. M.	12.5" refl.	10	1
Heath, Alan W.	Nottingham, England	12" refl.	19	18
Hodgson, Richard G.	Westford, Vermont	12.5" refl.	0	8
Minton, R. B.	Mesilla Park, N. M.	8" refl.	1	0
Moser, Bill	Connellsville, Pa.	8" refl.	0	14

The Recorder would like to thank all of these observers for their meaningful contributions during both periods; and special thanks must go out to Mr. Charles Capen for his generosity in submitting a fine set of color slides to the Section, taken at Table Mountain Observatory.

The Globe

Northern Portion of the Disc. Now that greater and greater portions of the southern hemisphere of Saturn are passing into our view, there is a decreasing amount of the northern hemisphere available for investigation. As a consequence, only a few observers reported activity in the north. According to Delano, the northern hemisphere displayed some unusual variations in intensity during 1968-69, particularly the NTrZ (North Tropical Zone). This zone appeared even brighter than the EZ (Equatorial Zone), for example, on the evenings of September 19, December 8, and December 11, 1968. With the exception of the NEB (North Equatorial Belt), there was a gradual but definite increase in the brightness of the northern hemisphere of the planet as one progressed from polar areas toward the equator. All in all, observers tended to record that the north was decidedly brighter than the southern regions of the planet during both apparitions. It should be mentioned here that the 1968-69 apparition did not afford good opportunities for continuing observations of the north made in 1967-68.

North Polar Region. A considerable number of observers reported this region during 1967-68 and 1968-69; and most indications showed that it was very similar in appearance to the SPR, only a little less dark. On several occasions in 1967-68 Haas indicated the possible presence of a white northern polar cap, and during the same period he reported the diffuse NPB (North Polar Band) on a few evenings. Color estimates by the contributing observers appeared to indicate a greyish appearance for the entire area, with a slightly darker area in the extreme north, often interpreted as a darker polar cap.

North Temperate Zone. Several observers contributed observations which indicated the presence of this area, but Haas and Delano were alone in maintaining a good set of intensity estimates for the region. The reduction of these values gave ample evidence of the fact that the NTrZ was brighter than the NTeZ; and even though the STeZ (South Temperate Zone) was darker, according to intensity values, it appears that observers tended to report the NTeZ more often than the STeZ. No drawings were received that showed the presence of these regions.

North Temperate Belt. Only one report was received of this feature during either period. Haas noted its presence during 1967-68 as a rather inconspicuous region, with no color estimates being made. The southern counterpart of this belt was more easily seen, perhaps due to its darker intensity.

North Tropical Zone. Most observers recorded the zone only sporadically during 1967-68 and 1968-69, but Delano and Haas were able to obtain a few intensity values to indicate its slightly brighter appearance compared to the NTeZ in the latter apparition. Other than these isolated cases, observers failed to see the zone during either of the two apparitions, at least as far as our records indicate.

North Equatorial Belt. During 1968-69 very few observers reported it; but in the earlier period it was apparently more easily seen, even though many observers found it almost indistinguishable from the ring shadow. Haas supplied the Saturn Section with a good set of intensity estimates, as usual, for 1967-68; and these were interpreted to mean that the NEB was slightly brighter than the SEB. Perhaps this last point can show that Haas was not in error by reporting the NEB, even though it was difficult, since confusion with the ring shadow would undoubtedly have produced a seemingly darker intensity for the belt. No color estimates were received, and only a few observers submitted drawings which even gave a hint of the NEB apart from the ring shadow.

Equatorial Zone. Almost all observers saw this area with ease, reporting it as rather surpassing all other areas in brightness. The only observer to make a detailed survey of the region was apparently Haas, who noted that the EZ south of the rings was very bright, often much brighter than Ring B; and the EZ north of the rings was much duller (perhaps due to an outer ring D?). These observations were made during 1967-68, and no corroborating evidence is available. Haas also noted the elusive EB (Equatorial Band) on September 9, 1968, the only observation of this belt during either apparition that was made with any real confidence. During 1968-69 Heath and Delano made observations of the apparently variable nature of the EZ. On the evenings of Sept. 19, Dec. 8, & Dec. 11, 1968, Delano observed that the EZ was surpassed in brightness by the NTrZ. Delano also noted that the EZ was brighter during the first parts of the apparition of 1968-69 than during the last parts. Other than these reports, the bulk of the observational data indicates that the EZ was the brightest area on the globe; and Heath noted that the EZ and Ring B were of nearly equal intensity during the 1968-69 period. With respect to color estimates, Heath recorded the EZ as a distinct white or yellow color during 1967-68, also confirmed by Haas on a number of occasions during the same period. Delano noted a conspicuous orange tint on October 1, 1968. Benton and Haas reported that the color of the EZ was reddish-orange in the later apparition, being enhanced in a red filter. Beck was able to suspect the presence of a faint and rather indefinite light oval in the EZ on October 27, 1968 (see Figure 2); and Haas observed a possible white spot on November 12, 1967. Heath noticed a white spot with even less confidence on December 21, 1968. These regions of possible activity were not permanent enough to allow transits or rotation periods.

South Equatorial Belt. Most of the observers noted that the SEB was the darkest and most evident belt on the entire planet during both apparitions. In 1967-68 Haas described the dual nature of the belt, noting that the SEB_n was, on the average, darker than the SEB_s. Haas also noted the intensity of the SEB Z during the 1967-68 apparition, and during 1968-69 both Heath and Haas were in agreement about the appearance of components of the SEB. As in the earlier apparition, the SEB_n was the darker component. Heath went on to point out that perhaps, during 1968-69, the SEB Z did not really exist as such, the double nature of the belt being the result of intensity variations between regions rather than actual division into parts. Most observers agreed about the color of the belt, reporting it as a brown or a brownish-grey area during both apparitions. Delano recorded a red color on the night of September 24, 1968. Occasional condensations were detected in the belt during both apparitions, but none were definite enough for transits.

South Tropical Zone. Virtually no observers recorded this area during either period.

South Temperate Zone. Heath and Delano were the only observers to contribute observations of this zone during both periods. On November 6, 1968 Heath reported a possible disturbance of minor importance in the STeZ, but corroborating evidence is lacking. No drawings contributed to the Section showed this region.

South Temperate Belt. During 1967-68, Heath reported this region only occasionally as a thin, rather featureless grey band; and Haas was able to observe it on a few occasions during both apparitions, much the same as Heath did, noting its rather featureless appearance.

South Polar Region. Most observers reported this area as a rather uniform region, varying in intensity somewhat during each apparition. The similarity of the SPR and the NPR has already been noted, the SPR frequently having a darker tint than the NPR in 1967-68 and 1968-69. Haas detected the presence of the dark SPB (South Polar Band) on a few dates in the earlier apparition, but no observers submitted reports for this apparently obscure band in the last period. Most observers recorded the SPR as a rather diffuse and featureless area, with a distinct greyish color indicated throughout each apparition. Haas noted the SPC (South Polar Cap) during 1967-68, and Beck made a drawing on the night of December 18, 1968, which confirmed its presence during the last apparition. No other observers were able to see it in either observing period. (See Figure 3).

Southern Portions of the Disc. Since the southern hemisphere of the planet was progressively becoming more easily observable during the two apparitions, as well as the southern face of the rings themselves, observers found detail easier to notice in these areas. However, with the exception of a few bright areas in the EZ and hints of occasional condensations in the SEB, the southern regions of the planet were not appreciably active during the two periods. As pointed out in other places in this report, the south parts of Saturn tended to be darker than the north ones, on the average.

Shadow of the Rings on the Globe. Under conditions of good seeing, most observers recorded this object as being black; but a few people indicated that it seemed nearer to a dark grey than black. As a general rule, observers recorded it as a thin, dark line immediately north of the rings in 1968, crossing the globe and occasionally exhibiting a distinct curvature (Figure 4). [Shadows may look less black when the seeing is too poor or the aperture too small for their proper resolution. —Editor]

Shadow of the Globe on the Rings. Most observers noted this shadow as mostly black (0.0) and naturally variable in size during the two apparitions. Most of the intensity reports by Haas and others appeared to indicate that this shadow did not look as dark as the shadow of the rings on the globe.

On the whole, there was not a considerable amount of activity on the globe of Saturn during these two apparitions, and most observers reported only occasional detail in the belts and zones. One might be led to conclude, as a result of these findings, that Saturn was rather quiescent throughout 1967-68 and 1968-69; but a more conservative ap-

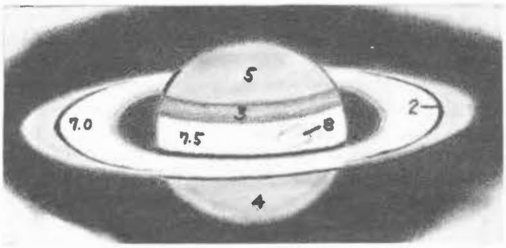

Figure 2. Drawing of Saturn by Inez N. Beck on October 27, 1968 at 4 hrs., 0 mins., U.T. 6-inch refl., 152X. Seeing 7 (scale of 0 to 10, with 10 best). Transparency 6.5 (limiting stellar magnitude). Numbers are marked on the drawing to show intensities. Note the shadow of the globe on the rings, the double South Equatorial Belt, and the indefinite brighter oval in the Equatorial Zone. South at top as in Figs. 3 & 4 also.

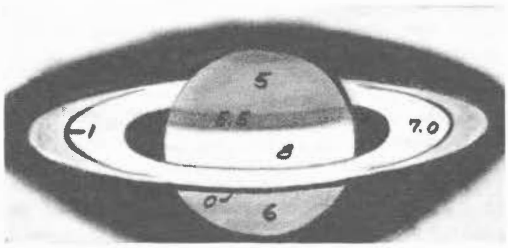

Figure 3. Drawing of Saturn by Inez N. Beck on December 18, 1968 at 1 hr., 30 mins., U.T. 6-inch refl., 152X. Seeing 7. Transparency 5. Shadow of rings on ball present just north of rings. The drawing also shows a diffuse South Polar Cap and the frequently mentioned differing intensities of the NPR and the SPR.

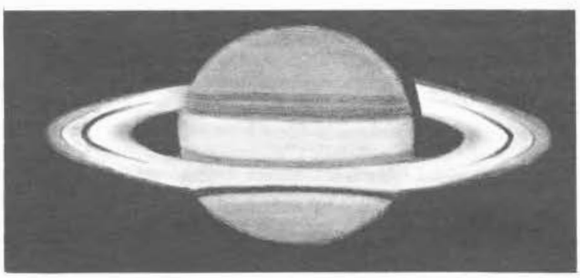

Figure 4. Drawing of Saturn by Alan W. Heath on November 4, 1968 at 21 hrs., 15 mins., U.T. 12-inch refl., 190X - 318X. Seeing very good. Note definite curvature of shadow of rings on globe. Encke's Division in Ring A, the outer ring, and other detail in rings recorded near ansae. Crape Band present on globe just south of rings.

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proach must be made. Since there was a small number of observations during either period, it would be a little presumptuous for us to assume that these observations represent a good sample for these years. Not until we can have active participation by a large number of observers in all aspects of Saturn observing throughout an apparition can we expect to place a high degree of confidence in our observed results.

TABLE I. VISUAL INTENSITY ESTIMATES OF SATURNIAN BELTS AND ZONES FOR 1967-68 AND 1968-69

Feature	Number of Observations	Mean Intensity 1967-69
Zones:		
EZ	38	7.8
NTrZ	19	6.5
NTeZ	17	6.2
STeZ	24	5.0
NPR	39	4.8
SEB Z	10	4.5
SPR	38	4.0
Belts:		
SPC	05	5.2
NTeB	02	4.6
STeB	02	4.0
EB	01	4.0
NPB	03	3.9
SPB	06	3.8
NEB	08	3.7
SEB	05	3.5

TABLE I. VISUAL INTENSITY ESTIMATES (cont.)

Feature Belts: (cont.)	Number of Observations	Mean Intensity 1967-69
SEB_s	06	3.0
SEB_n	06	2.5
Rings:		
B (inner)	14	6.1
A	14	5.3
C	10	1.5
Crape Band	07	1.5
Sh. Rings on Globe	11	0.1
Sh. Globe on Rings	09	0.3

Note: Ring B (outer third) is set as the standard for estimating intensities. The value assigned to Ring B is 8.0 and will prevail as the standard for the Section. Otherwise, our intensity scale ranges from 0 for shadows to 10 for the most brilliant features.

Saturnicentric Latitudes of Belt Edges. In light of the number of observations received in this category, it is apparent that the response to an earlier appeal made by Cragg and Goodman for observations of this kind has been poor. Haas was the only observer to submit a suitable number of latitude estimates, made by a method he invented some years back. The method in use by Haas is apparently a very good one when the observer does not possess a filar micrometer. The technique involves the estimating of the fraction of the polar radius subtended on the CM by the belt whose latitude is desired. After this "ratio" is established, the proper formulas can be applied to compute the latitude, provided that the tilt B is known. This method is good because it allows the observer to make a large number of visual estimates at the telescope in one evening. An inherent problem that is encountered when one tries to measure a set of photographs is the error introduced by the difference between the visual and the photographic limbs. Also, selection of the proper photograph can present problems. Should we select only those photographs which "look nice", or should we adopt a more objective approach? When it comes to measuring drawings, problems arise from systematic errors by the individual and from his own drawing technique. It is evident, therefore, that all of these methods present certain specific inconsistencies, but one that is most versatile is to be desired. The writer personally feels that the method in use by Haas is very effective and should be used by more observers; plans are in the making for adopting this method as the standard one to be used by the Saturn Section. In any case, what is really needed is a large mass of observations made by all methods in order that a suitable comparison can be made. Perhaps then we can be more confident in selecting our most useful method; and after these examinations are made, we will know which results to trust. Of course, measurements made by a micrometer are most valuable; but these are not always available. All in all, what is badly needed now is wider participation by observers in this category of observations, regardless of the method employed.

Estimates of belt latitudes have been made by Haas throughout 1967-68 and on one occasion in 1968-69. He was the only observer to contribute these results, and as a consequence it would be most difficult for us to try to assume too much. Presented here, for what it is worth, are the mean values of Saturnicentric latitudes for belt edges for both periods.

Belt or Feature	Total Number of Estimates		Saturnicentric Latitudes (Mean)	
	1967-68	1968-69	1967-68	1968-69
Center NEB	2	1	+ 8.2°	+23.3°
S Edge NEB	6	0	+ 7.6°	----
N Edge NEB	6	0	+ 9.5°	----
N Edge SEB_n	10	1	-15.3°	-16.5°
S Edge SEB_n	7	1	-19.0°	-18.7°
N Edge SEB_s	7	1	-20.8°	-21.8°
S Edge SEB_s	10	1	-24.3°	-24.6°
N Edge SPB	5	0	-60.1°	----
S Edge NPB	3	0	+48.6°	----
Center EB	0	1	----	-11.3°
Center STeB	1	0	-35.7°	----
Center NTeB	1	0	+16.9°	----

The Rings

Ring B. Most of the intensity estimates made of the rings were based upon the scale adopted by Goodman some years ago, whereby the outer third of Ring B was to have a value of 8.0 and every other part of the rings was to be visually estimated relative to that standard. During most of 1967-68 and 1968-69, Ring B was recorded as being the brightest part of the ring system, with perhaps only one exception when Delano reported Ring A to be actually brighter than Ring B on September 19, 1968. Benton, Haas, and Heath recorded a definite gradation in intensity from the outer third of B toward the inner edge. All observers tended to agree that the color of the ring was white, with the inner parts pale grey. Heath also noted that Ring B was appreciably duller during January and February of 1969 than during earlier parts of the 1968-9 apparition.

Ring A. Throughout both apparitions Ring A was distinctly darker than Ring B, but Delano and Haas occasionally reported that at times Ring A was brighter than Ring B. This was quite rare, however; and most reports stated that the two rings were either equal in brightness or that A was darker than B. The majority of observers noted that Ring A was white to greyish in color during each apparition.

Ring C. The "Crape Ring" was reported by most observers as being quite difficult to detect off the globe, but virtually all of the observers recorded it in front of the disc. Haas and Heath both indicated that the ring was a very dull grey during both periods.

Ring D. The suspected ring external to Ring A was not observed during these apparitions by observers who submitted observations to the Section.

Intensity Minima in the Rings. All observers reported Cassini's Division (B10 or A0), but only a few observations were received which indicated that the same division could be seen completely around the rings. As a result, most observations were of Cassini's Division near the ansae. Heath and Haas recorded the division as being quite black at times of good seeing. Encke's Division was noted off and on by Heath during October and November, 1967, each observation being made at times of excellent seeing. Haas also reported Encke's Division near the ansae throughout both apparitions. Haas noticed with difficulty "Division" B2 on several evenings during 1967-68, but his was the only report by any observer of this intensity minimum.

Bicolored Aspects of the Rings. During 1967-68 Haas was the only observer to notice any pronounced effect. Haas recorded that the W arm and the E arm of the rings were of equal brightness with no filter, but in the Wratten #25 (red) filter the W arm was sometimes reported to be brighter than the E arm. In the Wratten #47 (blue) filter the W arm was also brighter than the E arm, with the possible exception of an observation made on July 31, 1967. On this morning Haas noted that the E arm was slightly brighter than the W arm in the #47 filter; but a few minutes later the W arm with the same filter was detected as being brighter than the E arm, casting doubt on the first observation. Using similar techniques, Heath noticed that the W arm was also brighter than the E arm in blue filters in 1968-69. Future observations of this type are very much desired by the Saturn Section, and observers are encouraged to participate in this project. A summary of observations made by Haas is listed below.

Date	Wratten #25 (red)	Wratten #47 (blue)	No Filter
1967, May 16, 11:15-11:22 UT	W & E Same	W brighter	W & E Same
July 31, 10:34-10:42 UT	W brighter	E brighter	W & E Same
July 31, 10:50 UT	W brighter	W brighter	W & E Same
Sept. 9, 8:14-8:19 UT	W brighter	W & E Same	W & E Same
Oct. 21, 3:20-3:45 UT	W & E Same	W brighter	W & E Same
Oct. 22, 4:44-4:48 UT	W & E Same	W brighter	W & E Same
Oct. 28, 3:55-4:05 UT	W & E Same	W brighter	W & E Same
Nov. 12, 4:49-4:55 UT	W & E Same	W & E Same	W & E Same
Dec. 3, 2:30-2:35 UT	W & E Same	W brighter	W & E Same
1968, Feb. 5, 3:00-3:05 UT	W & E Same	W brighter	W & E Same

The Satellites of Saturn

Few observers devoted time to observations of Saturn's satellites during either apparition, but Kenneth Delano made several observations of them in 1967-68 and a very extensive set of color observations and visual magnitude estimates during 1968-69.

During 1967-68, Delano recorded that Tethys varied between visual magnitudes 10.1

and 12.0 (1.9 magnitudes), Dione varied between 10.3 and 10.8 (0.5 magnitudes), Rhea varied from 9.6 to 10.5 (0.9 magnitudes), and Titan fluctuated between 8.0 and 9.0 (1.0 magnitude). More detailed studies during 1968-69 gave interesting results. On October 17, 1968, Delano noted that the magnitude of Titan was 9.2, and the satellite displayed a distinct reddish color in comparison to Rhea and Iapetus with a blue filter (W48). With a red filter (W25) Titan was redder by about 0.7 magnitudes. Dione, on December 11, 1968, was at magnitude 10.4; and it then displayed a very blue color in comparison to the other satellites and the globe of Saturn, with and without filters. On the following night, Titan was observed again; and it was noted by Delano to exhibit a red color in relation to Rhea and to a comparison star in the immediate vicinity.

During 1968-69, using his 12.5" reflector and a 16 mm. Erfle eyepiece (150X), Delano made a series of very important magnitude estimates with the objective of detecting variations in magnitude for Tethys, Dione, Rhea, Titan, and Iapetus. Assuming Titan to be relatively stable at magnitude 8.4, the other satellites had their magnitude estimated by intercomparison to that of Titan. In the following summary there are presented the average magnitudes of the satellites for the period from September 15, 1968 to February 16, 1969.

Satellite	No. of Observations	Average Magnitude
Titan	56	8.39
Tethys	42	10.61
Dione	50	10.57
Rhea	53	9.92
Iapetus	56	9.75

From the above summary it is easy to see that Tethys and Dione, apart from variations, averaged about the same magnitude. Iapetus, at magnitude 9.75, was some 0.2 magnitudes brighter than Rhea on the average. When the satellites were plotted by Delano on a graph, satellite's observed magnitude vs. orbital position (generally expressed in terms of hours or days of elapsed time since the last eastern elongation), some interesting results were obtained. Tethys appeared to be at least one full magnitude brighter at east and west elongations than at conjunctions, in accordance with what has been predicted by other observers in the past. Delano noted also that Dione, Titan, and Rhea exhibited similar magnitude increases at elongations over observed magnitudes at conjunctions. Apparently, the brightness of Saturn and its rings plays some role in accounting for the seemingly fainter magnitudes at conjunctions. In any case, Delano found that all four satellites displayed magnitude variations of almost one magnitude apparently independent of their proximity or remoteness from the globe of the planet. In accordance with the above, Tethys at virtually every point in its orbit exhibited variations from 0.3 to 1.1 magnitudes. The most obvious variations occurred during the period beginning 6 hours after greatest western elongation and lasting to eastern elongation.

Dione appeared to vary at almost every point in its orbit by 0.3 to 0.9 magnitudes; and Rhea varied similarly by 0.3 to 0.8 magnitudes along its orbit, with perhaps an average of 0.25 magnitudes fainter at inferior conjunction than at superior conjunction. Titan varied along its orbit by 0.2 to 0.4 magnitudes; but if we include in the sample two estimates made near conjunction, of 9.0 and 9.2 magnitude, then the variation increases at conjunctions by 0.6 to 0.8 magnitudes. Iapetus fluctuated between 9.0 and 10.4 magnitudes, at western and eastern elongations respectively, exhibiting its most marked increase in brightness shortly after inferior conjunction. It presents its most obvious decrease in brightness some one or two weeks after greatest western elongation.

Other observers tended to confirm these observations by Delano in 1968-69, namely Richard G. Hodgson, who observed the satellites between October 19, 1968 and February 17, 1969. Otherwise, only a few observers even noted the presence of the satellites so that it would appear obvious that more work on them is needed.

General Conclusions

As one can see, and from what has already been stated earlier in this report, there was very little activity indicated on Saturn during either 1967-68 or 1968-69. To reiterate, however, much of this apparent inactivity on Saturn is probably due to the neglect that the planet has been receiving over the past years. To continue with a suitable and worthwhile program of research, we must obtain many more excellent observations, as those outlined in this report can illustrate. As of March 15, 1971, the Saturn Section has undergone extensive revision and reorganization; and the writer feels that observers should feel free to submit their own suggestions and comments in regard to what they want from the Section and to how it can better serve them. Perhaps for the more recent years, and for years to come, we can establish a fine survey of the planet from apparition to apparition. Much work is left to be done on the Ringed Planet; and it will be up to dedicated observers, like those who contributed faithfully to the Section for this report, to determine the fate of Saturn studies.

A DARK HALOED CRATERS PROGRAM

By: Kenneth J. Delano, A.L.P.O. Lunar Recorder

A new lunar program is being initiated, the aims of which are to discover and to confirm the existence of craters having dark halos around them. From photographs and observational reports submitted by ALPO members, a study will be made to determine the distribution patterns of dark haloed craters (abbreviated DHCs) on the Moon. The program will attempt to determine how the visibility of DHCs changes in accordance with the sun's elevation. Among the more easily recognized DHCs, the best known are the craterlets located in the middle of the famous very dark spots on the floor of Crater Alphonsus. These black spots within Alphonsus are particularly striking under a high sun.

Preparatory to the announcement of the DHC Program, much time was spent by Harry Jamieson and Chris Vaucher, as well as myself, in carefully examining The Orthographic Atlas of the Moon, Kuiper's Photographic Lunar Atlas, Kopal's Photographic Atlas of the Moon, and Alter's Lunar Atlas. As a result, there appeared to be sufficient photographic evidence to cite 33 craters as definitely being DHCs. This list of 33 is given here in a table entitled "Dark Haloed Craters Evident in Photographs." They are numbered serially and are identified by their xi and eta coördinates, which appear in the first column of the table. After the longitude and latitude columns, the diameters of the crater and of the dark halo of each listed object are given in kilometers. Where uncertainty exists concerning the size of a dark halo, the smallest and the largest likely diameters are given.

In the list of 33 DHCs, the ones numbered 4 and 5, 10 and 11, 18 and 20, and 22, 23, and 24 are so close together that their dark halos overlap, thus giving the appearance of elongated dark spots at those four locations. The DHCs numbered 16 to 24 are within Alphonsus. The 9th to the 14th craters in the list were found on Apollo photographs of the Triesnecker area, although their dark halos are not evident in the Apollo prints. These DHCs west of Crater Triesnecker demonstrates very well how space photography complements rather than supplants Earth-based observations.

It should be noted that most of the 33 listed DHCs have halos with diameters 2 to 4 times greater than the diameters of the craters themselves. A craterlet near Triesnecker and one in Alphonsus have the largest halos in relation to crater size: their halos have diameters 8 times greater than that of the central crater. Since the 33 photographically confirmed DHCs are offered as typical examples of the lunar features to be studied by the DHC Program, a crater located in a spot more than 10 times larger in diameter than itself will be considered to be not a DHC, but instead merely a crater situated in a dark area according to the laws of random distribution.

A clear distinction must be made from the beginning between a DHC and a crater that just happens by chance to be in a local dark spot. Few, if any, genuine DHCs are likely to be mistakenly omitted from a catalogue of DHCs by adhering to a 10 to 1 criterion. Also, by keeping to that criterion, it will be possible to maintain with greater confidence that all the craters to be entered into a catalog of confirmed DHCs are the point of origin of the dark material surrounding them. However, it should be pointed out that the combined diameters of two adjacent dark halos, both 9 times the diameter of their 1-kilometer (for example) central craters, may appear as one elongated dark spot measuring 9 kms. by perhaps 13 to 16 kms. The large dark spot would be catalogued as two DHCs whose halos coalesce; and their listed diameters would represent the width, not the length, of the elongated dark spot formed by the two. Indeed, a somewhat L-shaped dark spot lying at the base of the west (IAU) wall of Alphonsus is the result of the overlapping of two 8-kilometer halos and one 6-kilometer halo.

In addition to the 33 DHCs listed here, the examination of lunar photographs has turned up about 60 other possible DHCs, for which there is some question as to whether a distinct dark halo exists or whether there is a craterlet in a round dark spot. Telescopic observations will be necessary to clear up the uncertainties and to discover additional DHCs. Lunar Orbiter and Apollo photographs will have to be employed to detect the smallest of craters in the middle of some dark spots, but telescopic observations can reveal the dark halos of such small craterlets which spacecraft photographs fail to show because of insufficient contrast or improper solar illumination.

The observation form published here is designed for giving a complete report on DHCs and is largely self explanatory; and it is to be used for recording observations of confirmed, suspected, and newly discovered DHCs. The two blanks in the upper right corner are for filing purposes. Here are put the xi and eta coördinates of the DHC as well as the colongitude at the time of the observation. The observing station is noted only if it differs from the mailing address. A person who uses an atlas giving xi and eta coördinates need not fill in the longitude and latitude blanks, but it is recommended that he note the general area in which the DHC is located (e.g., "in Alphonsus," or "west of Triesnecker") because thereby any inadvertent typographical error in recording the xi and eta coördinates will be more readily discovered. Users of atlases employing lines of longitude and latitude are asked to make use of those coördinates when reporting newly suspected DHCs, but to write in also the xi and eta coördinates of those DHCs that are contained in the lists of certain and probable DHCs which will be sent to all participants.

In giving the diameters of the craters and halos, it is sufficient to do so in terms of kilometers or miles, although kilometers are preferable. Estimates of diameters can be made by using mileage or kilometer scales found on some atlases, or by making comparisons with lunar features of known size.

Intensity estimates are to be recorded on a scale of 0 to 10, with 0 equal to black shadows, 5 equal to the average darkness of the lunar maria, and 10 equal to the most brilliant features of the Moon. Estimates are to be made of both the dark halo and its immediate surroundings, giving the intensity value of the dark halo first, followed by that of its surroundings. Thus a halo a little darker than the average mare material in a moderately bright surrounding would be recorded as 4/8.

On the reporting form, under "Comments," the alignment of the major axis of an elliptical dark halo should be given as, for example, a northeast-southwest orientation. If the dark halo is neither circular nor elliptical, a drawing of it should be made. A drawing should also be given to illustrate the position of an off-center crater in the halo. Indicate the position of lunar north in all sketches.

Once an observer has made out a full report of a particular DHC, as called for in this detailed reporting form, it will not be necessary for him to make out another complete report if, on a subsequent night, the DHC appears exactly the same, except for its intensity. Only if the existence of a crater or the size or shape of the dark halo is in dispute among participating observers would it be desirable to submit a detailed report of an observation which is identical to the first one of the object, but made at a later date.

An important part of the DHC Program will be the determination of how the intensity of dark halos varies with the sun's changing altitude. For this particular purpose a different and shorter reporting form is to be used. A separate form will be used for each DHC, but in this second type of form there will be space for 21 observations of a particular DHC since the only desired information about the DHC will be its changing visibility and intensity. (The long form is to be used in reporting other details about DHCs.) However, if a DHC appears to vary not only in intensity but also in size or shape, such changes can be noted on the back of the short form.

The DHC Program is one to which the owners of small telescopes can make important contributions. Although some of the central craterlets will be detectable only in larger telescopes, most of the dark halos can be found with telescopes of small aperture. By observing specific dark halos 10 to 20 times (evenly spread over a 2- to 4-month period) and recording the observations on the proper reporting form, it should be possible to determine: (1) How early in the lunar morning does the dark halo appear? (2) At what colongitude is the dark halo most conspicuous? and (3) How late in the lunar afternoon is the dark halo still recognizable? Most halos appear to be most prominent around lunar noon; but unlike those within Alphonsus, many are not visible close to lunar sunrise and sunset.

The Dark Haloed Craters Program will be seeking information on the variable intensities of all reported DHCs, and observers will be encouraged to report every DHC observation. However, to insure that all DHCs will be thoroughly observed and reported, participating observers will each be assigned about 8 confirmed DHCs to observe enough times to determine when the halo first and last appears and when it is most conspicuous. When each participant's dark halo project is completed, another 8 will be assigned to him until all of the confirmed dark halos have been similarly observed for changing intensity

Dark Haloed Craters Evident in Photographs

	DHC (xi-eta)	Longitude	Latitude	Diameter of Crater	Diameter of halo
1)	+838-355	+63°38'	-20°48'	8 kms.	15 kms.
2)	+486-248	+30 04	-14 22	4½	15
3)	+481-237	+29 40	-13 42	2	8
4)	+412+709	+35 45	+45 07	4	10
5)	+407+708	+35 10	+45 05	2	10
6)	+392+707	+33 40	+45 02	4	12 to 15
7)	+353+017	+20 38	+01 00	3	10
8)	+127+248	+07 32	+14 22	1½	6
9)	+050+071	+02 54	+04 08	1	7
10)	+041+069	+02 32	+03 52	½	3½
11)	+037+073	+02 13	+04 03	½	4
12)	+037+078	+02 04	+04 28	½	2
13)	+034+082	+01 52	+04 38	1	3
14)	+033+076	+01 52	+04 20	2	3 to 5
15)	-013+565	-01 55	+34 28	3	10 to 14
16)	-025-235	-02 41	-13 18	1	8
17)	-027-223	-01 37	-12 52	3	10
18)	-028-217	-01 42	-13 14	2	7
19)	-032-248	-01 50	-14 22	3½	11
20)	-033-216	-01 55	-12 33	2	7
21)	-057-238	-03 21	-12 47	1	5
22)	-069-235	-04 03	-13 40	2	8
23)	-070-234	-04 07	-13 38	1	6
24)	-071-237	-04 11	-13 43	2	8
25)	-156-353	-09 33	-20 42	4	11 to 15
26)	-180+299	-10 52	+17 30	4	7
27)	-264+311	-16 08	+18 13	1½	6
28)	-293+219	-17 32	+12 41	1	6
29)	-312+120	-18 15	+06 53	4½	15
30)	-348+218	-20 28	+12 28	2½	8 to 10
31)	-398+083	-23 38	+01 45	1	4½
32)	-409+052	-24 33	+02 59	2	7 to 12
33)	-457+078	-27 39	+04 30	2½	5 to 7

The craters listed here were found by Lunar Recorders Delano, Jamieson, and Vaucher in a protracted examination of several photographic lunar atlases. The table and these presumably typical Dark Haloed Craters are discussed by Reverend Delano in his accompanying text.

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by some one or another of the participating observers. The observers' reports and the results of their studies of the dark halos will be appearing in the "Lunar Notes" section of The Strolling Astronomer.

Everyone interested in discovering, confirming, describing, and monitoring DHCs should write to me and will receive, in reply, a list of the 33 photographically identified DHCs, a list of about 60 unconfirmed DHCs, and a supply of the two different kinds of reporting forms described above. Here is a chance to make an important contribution to lunar science regardless of what size telescope you have. Lunar spacecraft photographs usually fail to show the dark halos because the exposures were not suitable to bring out the contrast of the halo with its surroundings. Moreover, there has not been, and probably will not be in the foreseeable future, sufficient photographs taken under varying solar illuminations to duplicate the ALPO Dark Haloed Craters Program.

Postscript by Editor on Lunar Section Projects. We thank Mr. Delano for this description of a new lunar program and cordially urge all interested readers to correspond with him and to participate actively in this program. We have not thought it necessary to publish here the "short form" described near the middle of page 52.

ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS DHC -312 +120

Observations of Dark Haloed Craters on the Moon Col. 65°.1

Date (U.T.) MARCH 10, 1971 Time (U.T.) 01:15

Colongitude 65.1°

Seeing (0 to 10, 10 best) 3 Transparency (limiting stellar magnitude) ~~(0 to 5, 5 best)~~ 5

Telescope 12½" REFL. Magnification 300X

Observer KENNETH J. DELANO

Mailing address 22 INGELL ST.

TAUNTON, MASS. 02780

Observing station FALL RIVER, MASS.

Position of the dark haloed crater:

xi	eta	Long.	Lat.	General area
-312	+120	-18°15'	+06°53'	S. of COPERNICUS

The Lunar Atlas used ORTHOGRAPHIC LUNAR ATLAS and LUNAR ATLAS CHARTS (LAC)

The appearance of the dark haloed crater: The crater was (✓) definitely seen
( ) only suspected
( ) not seen.

The diameter of the crater was 4½ kilometers, or ___ miles.

The crater was (✓) central, ( ) off center.

The appearance of the dark halo: The dark halo was (✓) definitely seen
( ) only suspected
( ) not seen.

the dark halo was (✓) circular
( ) elliptical
( ) other (describe)

The diameter of the dark halo was 15 kilometers, or ___ miles.

Relative intensity of the dark halo 4/7

Comments and drawing:
(use back if necessary)

Figure 5. Sample "long form" used in reporting observations in the Dark Haloed Craters Program of the ALPO Lunar Section. A representative observation has been entered on the form, which is further described in the accompanying text by Reverend Delano. Interested lunar observers can obtain copies of this form from Reverend Delano.

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We announced in our previous issue the termination of the Lunar Dome Survey, long directed by Kenneth Delano. It was pleasant to hear many objections to this decision from our members. The Lunar Dome Survey is accordingly being revived under the leadership of Lunar Recorder Harry Jamieson.

BOOK REVIEWS

Lunar Planning Chart Series, Edition 1, July, 1969, U.S.A.F. Aeronautical Chart and Information Center. Price 50 cents per chart.

Reviewed by Brian R. Webb, ALPO Lunar Section

The four lunar charts which comprise this series offer complete overlapping coverage of the lunar equator. Although the northern and southern limits of coverage amount to 25 degrees of lunar latitude, the chart set is worthy of mention. The serious amateur will not only benefit from the scale of 1:2,500,000, but also from the I.A.U. nomenclature, which is as recent as 1964. Only the tonal variations of the lunar surface which have been previously identified are indicated. The smallest features indicated are in the order of about 0.75 statute miles. Each chart contains correctional information for accurate measurement of features in the higher lunar latitudes, which are partially corrected for foreshortening. Lineaments for locating latitude and longitude are placed every 10 degrees.

Chart	Longitude Coverage
LOC1	140° W. to 50° W.
LOC2	50° W. to 50° E.
LOC3	40° E. to 130° E.
LOC4	140° E. to 130° W.

The maps may be obtained from the United States Air Force Aeronautical Chart and Information Center, St. Louis, Missouri 63118. It may be worth mentioning that a similar chart set with coverage up to 40 degrees of latitude may be available in June or July, 1971 from the same source.

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Nine Planets, by Alan E. Nourse. Published by Harper and Row, New York, N. Y., 1970. Price $8.95.

Reviewed by Mike Rogers

The remaining Apollo flights make a study of the Solar System especially pertinent and interesting. Some pressing questions beg answers as we start expanding into the Universe. Is there life on the other planets? Will mineral wealth on the planets make spaceflight economically feasible? Can Man survive spaceflight? Can Man survive without spaceflight? Perhaps most important, why forge into spaceflight at all? In this book, Nine Planets, Alan E. Nourse replies to these queries while presenting a description of each of the eight principal planets (other than the earth) and our moon.

The first chapter, "The Threshold of Space", describes some of the needs and problems of exploring the Solar System as well as explaining some basic astronomical principles, such as the universality of natural laws. "The Sun and Its Planets" deals with the physical characteristics of our Solar System. Mr. Nourse describes some basic facts about the sun and the planets, and discusses such topics as the biological limitations of spaceflight and the motives for exploring space. In "Mercury" the author brings out some interesting information about the closest known planet to the sun. The difficulty in observing it, the search for the supposed planet Vulcan, the incredible contrasts on Mercury's surface, and the question of life on the planet are discussed. In addition, the author probes some conventional topics such as the problem of Mercury's rotation, and its value as a solar observation station. In "Venus", the question of the rotation of the planet, its albedo, the oxygen content of its atmosphere, the question of life, and the new data from unmanned probes show the planet to be one with enigmatic characteristics. An extra long chapter discusses the frustrating Red Planet, Mars. Mr. Nourse first carefully knocks down the assumption that Mars is the earth's twin and then goes on to describe the planet as observed with infrared and ultraviolet rays.

After passing lightly over the asteroids, we find Jupiter, Saturn, Uranus, and Neptune lumped together into one chapter. The author discusses the multiple star theory of the formation of these planets as well as the problem of identifying and contacting truly "alien" life.

In one of the most interesting chapters, "Pluto and the Outer Reaches", Mr. Nourse discusses Pluto's incredible gravitation, the search for a trans-Plutonian planet, and faults in the Bode-Titius progression. Concluding the book are appendices of comparative planet statistics and a glossary, and included throughout the book are some 12 pages of fine paintings by artist Mel Hunter.

At first glance, Nine Planets appears to be just another adequately but unspectacularly written introduction to the sky. However, it is one of the most provocatively and intelligently written books to appear in recent years. By describing just how little we know about the Solar System, Alan E. Nourse makes a convincing case for further financing of our space program. So intriguing are the questions brought up by this book that, if it were read by all astronomers, it would probably bring a veritable flood of eager new planetary observers.

Postscript by Editor. It is not my wish to appear to be a reviewer of reviews. We are much indebted to Mr. Rogers and others who make this service to our readers possible. However, it should be pointed out that Mr. Nourse's 1970 book is a revision of one he published about 10 years ago with the same title, and the statements about the rotations of Mercury and Venus in the review above would raise questions about the completeness of the updating of the text - admittedly a tedious and also herculean task during the present rapid advances in planetary astronomy.

ARMAND N. SPITZ, 1904-1971

All friends of Dr. Armand N. Spitz were much saddened to learn of his death at Fairfax, Virginia on April 14, 1971. Few men have inspired so much love and respect in those who knew them, and probably no one else has done as much to bring the stars to the man in the street.

He was born at Philadelphia in 1904 and attended the University of Pennsylvania and the University of Cincinnati. He was awarded a Doctor of Science Degree by Otterbein University in 1956. He developed an early interest in scientific writing and publishing. He was on the staff of the Franklin Institute in Philadelphia from 1936 to 1955 and at various times was editor of The Institute News, head of their Meteorology Department, lecturer in the Fels Planetarium, and Assistant Director of Public Relations. From 1941 to 1946 he pioneered the development of television education in Philadelphia.

It was during this period that he became deeply interested - say rather, dedicated - to the concept of a modestly priced planetarium for popular education in astronomy. He organized Spitz Laboratories in 1949, with headquarters at Yorklyn, Delaware (now at Chadds Ford, Penn.). As we all know, the company grew most remarkably; and today there are hundreds of Spitz Planetaria in public schools, colleges, and museums. More sophisticated models serve, for example, the Air Force Academy near Colorado Springs.

In 1956 Armand Spitz became "Mr. Moonwatch", with the job of coördinating visual observations of artificial satellites by teams of volunteer observers for the Smithsonian Astrophysical Observatory. The first launching in October, 1957 was a little sooner than expected! For some years Moonwatch results, instrumentation, and techniques formed a large slice of the program at meetings of amateur astronomers; and Armand's own talks at Astronomical League National Conventions were invariably both delightful and instructive.

In 1958 he married Grace Scholz, an officer and leader of the Astronomical League in its early years. They were Sunday hosts to a League bus tour during the 1960 Convention at Haverford College; and the Spitz Laboratories then unveiled a new A-3-P Projector. In 1962 he became President of Astro Murals, Incorporated, distributors of enlarged photographs of celestial objects taken with observatory telescopes.

In the summer of 1966 Armand suffered a stroke and was thereafter a prisoner of his paralysis, chiefly attended to by his wife Grace. Yet he continued to read extensively, to work on his writing as he could, and to watch rare events, such as the 1970 total solar eclipse. Those privileged to receive Grace's annual Christmas messages found in their factual descriptions inspiring examples of Armand's remarkable cheerfulness and indomitable spirit.

He was a fellow of the American Association for the Advancement of Science, an honorary member of the Astronomical League and the National Capital Amateurs, and a member of the American Association of Museums, the Fibonacci Association, and the Middle East Planetarium Society, among others. His honors included a silver medal in astronomy from the Astronomical Society of Mexico, a gold medal from La Salle College, Havana, Cuba in 1955, and the Astronomical League Award. He authored the books The Pinpoint Planetarium, A Start in Meteorology, and Dictionary of Astronomy and Astronautics and many magazine articles.

As usual, this formal factual recitation tells the reader little of the warmth and personality of the man. The editor of this journal first met Armand Spitz in Philadelphia

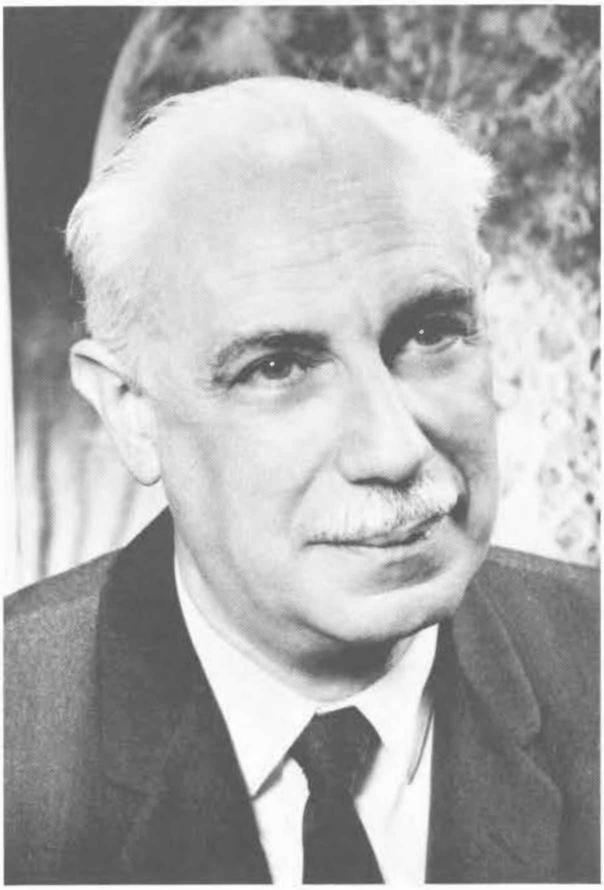

Figure 6. Dr. Armand N. Spitz, planetarium manufacturer, astronomy popularizer, and leader of amateur astronomers. Photograph supplied by Grace C. Scholz Spitz.

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in or near 1942. His chief recollection is of the man's scholarly knowledge of Greek and of his pleasure in sharing it with a well-known professional baseball player of that period. There were other meetings over the years, the longest of them in the editor's home when Armand was on a national tour to help coördinate Moonwatch team efforts. Moonwatch instrumentation was being discussed, and he made everyone to whom he talked know that his opinion was sought and was valued. It is typical that in his last letter to the editor, Armand was concerned about the proper defense of an amateur observer of an apparent rare event on the moon whom he felt to have been shabbily treated by the astronomical profession.

Those who love the stars now and those who will learn to love the sky in future generations owe a debt of gratitude to a remarkable man, Armand Spitz.

ERATOSTHENES FROM SUNRISE TO SUNSET

By: Harry D. Jamieson, A.L.P.O. Lunar Recorder

The crater Eratosthenes has always been something of an oddity to lunar researchers. Unlike its somewhat larger but otherwise similar neighbor Copernicus, for instance, it does not brighten as the sun rises higher over it, but instead becomes steadily more difficult to locate as local noon approaches. The reasons for this are unknown, but it may be significant that Eratosthenes possesses a number of dark radial bands and spots which Copernicus is for the most part free of. Let us, then, examine these features through the eyes of a skilled observer to see how they behave during the course of a lunar day.

Mrs. Inez N. Beck, the observer responsible for the drawings on pages 58 and 59, has been observing Eratosthenes on a regular basis for some years now, and has become very familiar with the crater. This familiarity, coupled with her obvious artistic talents, make her series for the month of August, 1970, ideal for this study. The letters assigned to each feature described are those shown on the small key chart given here as Figure 8.

A. This bright feature is most prominent near sunrise, after which it fades steadily until noon, when it resumes the intensity of its surroundings and becomes lost as a distinct feature.

B. Really a part of 'A', this portion of it is strange in that it is not always visible as a separate bright area. Its appearances and disappearances are apparently quite random, with one never knowing from one night to the next whether

(text continued on page 60)

ERATOSTHENES 6" REFLECTOR - INEZ N. BECK

AUG. 11, 1970 1:00 TO 1:20U.T.
S-8 TR.-5 152X 15.83 TO 16.00

AUG. 12, 1970 2:00 TO 2:20U.T.
S-7 TR.-4 152X 28.55 TO 28.72

AUG. 13, 1970 2:30 TO 2:48 U.T.
S-4-7 TR.-4 152X 41.00 TO 41.15

AUG. 16, 1970 5:05 TO 5:25 U.T.
S-6 TR.-5 152X 78.88 TO 79.05

AUG. 17, 1970 2:00 TO 2:25 U.T.
S-8 TR.-6.5 152X 89.50 TO 89.71

AUG. 18, 1970 2:30 TO 2:45 U.T.
S-9 TR.-6.5 152X 101.93 TO 102.06

AUG. 21, 1970 4:10 TO 4:25 U.T.
S-8 TR.-5 152X 139.34 TO 139.48

AUG. 22, 1970 5:00 TO 5:20 U.T.
S-7 TR.-5 152X 151.96 TO 152.13

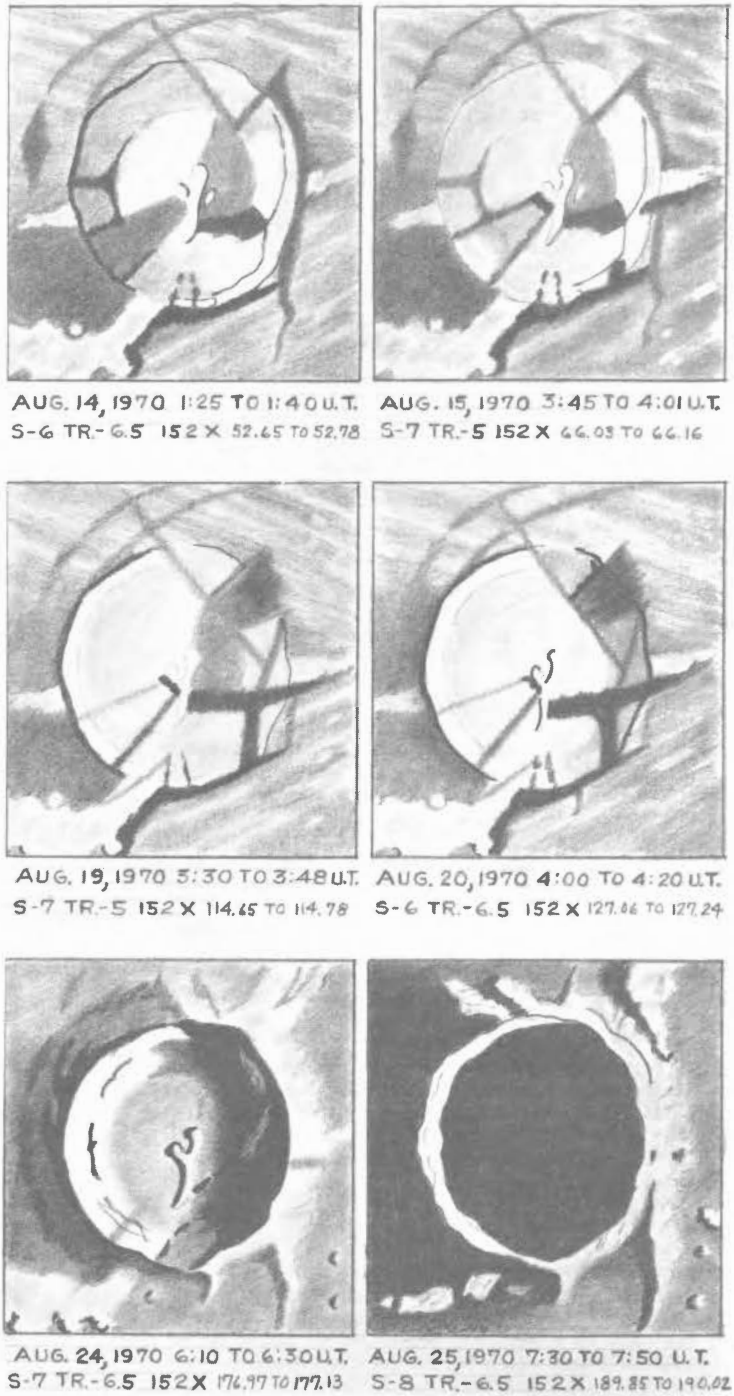

Figure 7. Series of drawings of the lunar crater Eratosthenes by Mrs. Inez N. Beck in the August, 1970 lunation. The drawings show the aspect of Eratosthenes from sunrise to sunset; only one day is missing. Lunar south at top, lunar west in IAU sense at right. The seeing (S) is expressed on a scale of 0 to 10, with 10 best. The transparency (TR) is the estimated limiting stellar magnitude. The numbers at the right end of the second line below each drawing give the colongitude of the begining and ending of the drawing. The colongitude is the lunar western longitude (IAU west) of the sunrise terminator. Approximately, colongitude is 0° at First Quarter, 90° at Full Moon, 180° at Last Quarter, and 270° at New Moon. On Eratosthenes sunrise occurs at colongitude 11°; lunar noon, at 101°; sunset, at 191°.

Mrs. Beck's laudable series of drawings invites comparison with the set obtained half a century ago by William H. Pickering with a 3-inch refractor; see his paper "Eratosthenes I, a Study for the Amateur", _Popular Astronomy_, Vol. 27, pg. 579, 1919. Files of _Popular Astronomy_ exist in many large libraries; it was long the leading non-professional American astronomical magazine.

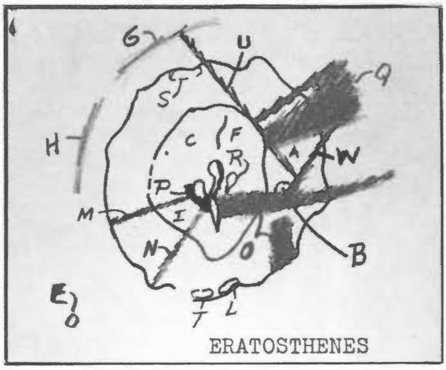

Figure 8. Key chart of lunar crater Eratosthenes to show nomenclature used in article "Eratosthenes from Sunrise to Sunset." This chart and the text may be employed to study the drawings on pages 58 and 59. Lunar north at bottom, lunar east in IAU sense at left.

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it will be seen or not. This aspect has also been confirmed by H. W. Kelsey.

C. This is the southeast quadrant (IAU directions) of the crater's floor, which maintains a fairly constant relative intensity throughout the day.

E. A bright spot, or small craterlet, near the northeast (IAU east and west) outer wall of Eratosthenes. Its intensity increases rapidly until at noon it becomes quite brilliant, after which it fades away very gradually.

F. The dusky southwest quadrant of the crater's floor. Decidedly darker than 'C' until well after noon, when it brightens somewhat and the two become comparable. The strong dark band 'O' marks its northern boundary.

G. The outer glacis of the crater's southeast wall appears to contain a system of linear or curved features which are darker than their surroundings and remain so even after the sun is quite high. Their exact nature is uncertain.

H. As for 'G'.

I. This broad dark band runs from the central peak out to and beyond the northeast walls of Erathosthenes, passing through 'E'. First noticed around mid-morning, it fades to near invisibility long before noon. The very dark bordering bands 'M' and 'N' first appear as 'I' fades, though for a very short time all three features may be seen together.

K. The central mountain range is never very bright, though always apparent. At times, under excellent seeing, bright spots can be seen on the summits.

L. This feature and 'T' appear to be small bright spots which may be craterlets on the northern wall of Eratosthenes. First noticed near mid-morning, they appear to follow the pattern typical of such features by brightening as the sun rises higher and fading shortly before shadow from the crater's western wall engulfs them.

M. Features 'M' and 'N' are the two very dark and conspicuous dark bands that border 'I'. Both bands develop as 'I' fades, reaching their full extent and darkness shortly after mid-morning. As the lunation progresses, 'M' gradually begins to fade itself until at noon it is a full intensity unit lighter than 'N', and by mid-afternoon is gone altogether. Feature 'N', on the other hand, remains visible until nearly sunset.

N. As for 'M'.

O. This band system located in the northwest quadrant of the crater begins to form early in the day, becoming very dark and broad quite early and staying that way until finally engulfed in shadow late in the afternoon. By mid-morning, an extension forms which lengthens the band in a westerly direction by about twice its former length. Another extension forms which starts at the northern wall and over a period of time reaches the main band; both bands last the rest of the lunar day.

Q. This feature makes its first appearance by mid-morning as a light narrow band running up the southwest wall, broadening before lunar noon into a fan-shaped dark area extending beyond the wall. It remains visible until engulfed by evening shadow.

R. An unusual feature which does not always act the same from lunation to lunation. Often it is seen as a bright spot just west of the central mountain range, but on occasion it has been recorded as a dark spot or has not been seen at all; and present feelings are that it might be a ridge.

S. A medium to large bright spot seen intermittently after lunar noon.

T. As for 'L'.

U. This band first begins to develop early in the lunar day as a part of 'G', after which it grows in a northwesterly direction, joining 'Q' by mid-morning and 'W' by noon. It remains at its fullest extent until late evening shadow begins to engulf it.

W. This band runs from 'O' in a southwesterly direction and merges with 'Q', and is visible from late morning until engulfed in evening shadow.

While this survey of some of the most interesting features in and around Eratosthenes can in no way be considered complete or exhaustive, this writer hopes that it has shown that this crater is worthy of additional study. Mrs. Beck's efforts have spanned a number of years, and her work must be considered an important contribution to our knowledge of the crater. However, the apparently ever-changing aspect of this crater requires a long-range study made over an even longer period of time and with larger apertures. Mrs. Beck's valuable work points the way.

THE LUNAR AND PLANETARY TRAINING PROGRAM

By: Charles L. Ricker, A.L.P.O. Lunar and Planetary Training Program Recorder

As of this date (June 15, 1971) there have been 94 requests for information concerning our training program. Actual observations have been received from the following members who are still participating:

Steven Lloyd	John Friscia	Vincent Foster
Gary Gendron	Peter Reinert	Andy Blackburn
Tom Mullen	Lt. F. R. Wooldridge	Charles Roberts
	Dean Mamalakis	

In addition to the above, the following observers have demonstrated to our satisfaction that they are now capable of participating in regular ALPO programs, and are hereby endorsed by the Training Section.

Michael Fornarucci	B. Gomes Casseres	Lothar Stadler
Richard Wessling	André LaClair	

All of the above members are to be congratulated for showing enough interest to wish to learn the correct methods of making and submitting observations. This is enough of a positive response to indicate that the training program fills a need and that many members feel that they can use some training. It is hoped that the inquirers who did not send in observations at least studied the information sheet, and tried some observations on their own.

The method presently being used in the program is to provide prospective trainees with an information sheet which describes basic techniques which are common to all ALPO programs, such as the use of seeing and transparency scales, color filters, the correct application of Universal Time, etc. Along with the information sheet are provided some special observing forms, which contain some planetary blanks and several lunar formation outlines. It is hoped, of course, that the member will make some observations, and send them in for advice and comment.

There is no prescribed number of observations which a member must make in order to complete the program. This is entirely dependent upon the member's own interest and development. We are avoiding a rigid, inflexible program; for we recognize that we are working with volunteers, and our only desire is to make it possible for some of you who are members of the ALPO but never submit observations to begin doing so. You will thereby find that membership is vastly more enjoyable and interesting if you are actually participating in our programs.

The ALPO has provided the organization, publication, regular programs, and a Training Program, all of which is done by volunteers who, like you, pursue their hobby on their own time and resources. The rest is up to you. Amateur Astronomy can be a fascinating life-time hobby if one is prepared to take an active part.

LUNAR NOTES

By: Charles L. Ricker, Harry D. Jamieson, and John E. Westfall, A.L.P.O. Lunar Recorders

ALPO Lunar Programs and Staff (Charles L. Ricker)

In the last issue of this *Journal*, an article appeared by Harry Jamieson (pp. 31-32), which outlined the prospects and programs of the Lunar Section. Since this article appeared, there have been further changes, which we feel will lay the foundation for a stronger and more flexible Section.

The many recent changes in the Lunar Section are largely a result of a resurgence in interest among the membership in lunar studies, and at last, a realization that serious lunar studies are still possible despite the fantastic advances in Solar System Science in recent years. As expected by many of us, the advances have solved many problems; but many others have not been solved, and many new ones have arisen. It is, in fact, because of the many problems still awaiting investigation that the ALPO has found it necessary to add an unprecedented number of Lunar Recorders. It must be remembered that each one of hundreds of lunar formations displays more telescopic detail than any of the planets. It can thus be seen that a thorough study of the Moon cannot possibly be supervised by one or two Recorders as with the planets.

Our official programs have been selected as being those most in need of study by amateurs, using normal observational methods; and any prospective lunar student should participate in these programs as time allows. We also realize, though, that some of you would like to undertake studies other than those which are covered by our programs; and it is for this reason that we shall also welcome all observations or reports on individual programs, and such reports or observations will appear in these pages if the material is deemed to be of sufficient importance or general interest.

The following changes in programs and staff members have recently occurred:

1. We are very pleased to announce that Mrs. Winifred Cameron has accepted an appointment as Lunar Recorder in order to coördinate and strengthen the ALPO program in the very important study of Lunar Transient Phenomena (TLP). Mrs. Cameron's previous lunar researches, particularly in the field of TLP, are world known; and we are indeed fortunate to have her on our staff.

2. Due to considerable consternation upon the announcement that the Lunar Dome Survey had been dropped among a number of members, Harry Jamieson, the founder of that program, has consented to reactivate it. This is welcome news since the study of lunar domes is one of the important problems in lunar science today.

3. Charles L. Ricker has rejoined the staff to coördinate the activities of the A.L.P.O. Lunar Section as a whole, and to edit "Lunar Notes". Any observations of a general nature which are not covered by our various official programs should be sent to Mr. Ricker.

Summarizing, then, the present organization of the Lunar Section:

1. John Westfall - The ALPO Lunar Photograph Library.
2. Charles L. Ricker - Edit "Lunar Notes", and coördinate Section activities.
3. Kenneth Delano - The Dark Haloed Craters Program.
4. Harry Jamieson - The Bright and Banded Craters, and Lunar Dome Survey.
5. Julius Benton - The Selected Areas Program.
6. Christopher Vaucher - Mr. Benton's assistant.
7. Mrs. Winifred Cameron - Lunar Transient Phenomena.

It is hoped that the above organization and programs will accomodate anyone who is interested in lunar studies. If you have never done any lunar observing, the ALPO also has a training program where you can gain some necessary experience (see pg. 61).

Strange Object on the Mare Imbrium (Harry D. Jamieson)

Mrs. Inez N. Beck draws our attention to an observation made by her of an object in the center of a triangle formed by Piazzi Smyth, Kirch, and Pico (Figure 9). When this object was first seen, it was strongly suspected of being a dome and was recorded as such.

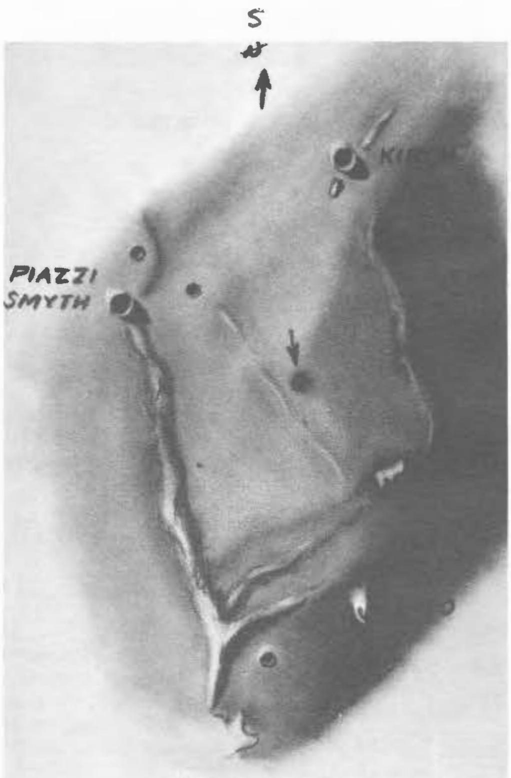

Figure 9. Drawing of curious dome-like object on Mare Imbrium by Mrs. Inez Beck on June 4, 1968 at 2^h45^m, U. T. 6-inch refl., 350X. Seeing 7 (good), transparency 5. The arrow points to the suspected dome, which later could not be recovered. Colongitude 6°5. See accompanying text by Lunar Recorder Harry Jamieson. South at top, east (IAU sense) at left.

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It certainly had a dome's classic appearance to the observer. However, since this first observation the object has not again been seen, and here is where the mystery lies. We have a well-qualified observer reporting what was at the time an obvious feature to her, only to have it never seen since. There have certainly been a number of cases like this in the history of lunar research, and this writer for one would like to see this particular one cleared up.

As can be seen from the drawing, the sun was very low over the area when the feature was observed. Could it be that only a very special set of lighting circumstances will make the feature observable again? To test this theory, it might be best if observers looking for the object concentrate their efforts on the Universal Time dates given below when the illumination will be very close to what it was when Mrs. Beck made her observation.

Date	Time
1971, August 29	3^h20^m, U.T.
October 27	4 20
December 25	8 45

Reports - both positive and negative - would be most welcomed by this writer. Try to observe within an hour or two of the listed times.

Note by Editor. Mrs. Beck's observation was made when the sun's selenographic colongitude was 6°5 and its seleonographic latitude was +1°3. On the three suggested dates and times the colongitude will be the same as when she observed; but the latitude will differ, being indeed negative. If a very close similarity to the original conditions of illumination and perspective is critical to the recovery of the suspected dome, then it may be well to mention that at the time of the June 4, 1968 observation the earth had a selenographic longitude of -7°3 and a selenographic latitude of -3°5.

While mysteries of this kind are numerous in the history of amateur lunar observations, it would be gratifying if the ALPO Lunar Section could make a concerted effort which would clear up this one.

Additions to the A.L.P.O. Lunar Photograph Library: Amateur and Apollo-11, -12, and -13 Photographs (John E. Westfall)

Introduction

The A.L.P.O. Lunar Photograph Library was originated in 1964 and now contains over 700 lunar photographs taken by amateurs, professionals, astronauts, and space probes. A catalog, complete through 1967, is available, for 35 cents in stamps, from the Librarian: Dr. John E. Westfall, Department of Geography, San Francisco State College, 1600 Holloway

Avenue, San Francisco, California 94132.

Any A.L.P.O. member may borrow photographs if he writes the Librarian and:

1. Describes the photographs by catalog number or by lunar area.
2. Describes the use he intends to put the photographs to.
3. Includes 35 cents in stamps to cover postage.

Photographs are due back six weeks after the Librarian mails them to the borrower. A six-week renewal is allowed, if requested in writing in advance of the due date and if no other requests are outstanding. Borrowers should return photographs unmarked and unfolded, in manila envelopes reinforced by cardboard.

Amateur Photographs

Three 8 x 10-inch lunar photographs have been received from Mr. Orville Brettman, one of which (OB-2) is reproduced here as Figure 10. For these photographs, Mr. Brettman used a 16-inch reflector at its Cassegrain focus (f/20). The "Approximate Scale" column refers to the unforeshortened scale (parallel to limb); e.g., "4.4M" = 1/4,400,000.

Code No.	Area Covered	Date & Time (U.T.)	Colong.	Scale (Approx.)
OB-1	M. Crisium-Cleomedes	1971, Mar. 30, 01:08	308°9	4.4M
OB-2	M. Crisium-Cleomedes	1971, Mar. 30, 01:09	308.9	4.4M
OB-3	Cleomedes-Messala-Endymion	1971, Mar. 30, 01:10	308.9	4.3M

Other advanced amateurs are invited to contribute their lunar photographs to our Lunar Photograph Library (8 x 10-inch prints are preferred).

Apollo-11, -12, and -13 Photographs

The 81 photographs listed below were taken by the Apollo astronauts on the famous Apollo-11, -12, and -13 missions. All these photographs are in the form of 8 x 10-inch black and white prints, reproduced from 70mm. film.

Apollo-11 made the first lunar landing, in SW* Mare Tranquillitatis (0°67 N/23°49 E) in July, 1969. Apollo-12 made the second lunar landing, in SE Oceanus Procellarum (2°94 S/ 23°45 W) in November, 1969. Apollo-13 did not land, but circumnavigated the moon in April, 1970.

The columns in the photograph listing are as follows:

1. Code Number--The identifying number assigned by NASA to each frame and also used by the A.L.P.O. Lunar Photograph Library.
2. Format--General orientation of the photograph; VERT means a near-vertical view; L-OBL, a low-oblique view (horizon not visible); H-OBL, a high-oblique view (horizon visible). When known, the tilt of the camera axis to the vertical is given below the general orientation.
3. Sun Angle--Solar illumination on the portion of the moon shown, in terms of low, medium, or high solar altitude. When known and relevant, the altitude of the sun is given in degrees.
4. Description--Prominent formations shown, with the approximate latitude and longitude of the center of the portion of the moon shown in the photograph. In near-vertical views, the scale is also given.

Apollo-11 (20 photographs)

Code Number	Format	Sun Angle	Description
AS11-			
37-5437	H-OBL 60-65°	Low	S M. Tranquillitatis-Maskelyne, Moltke. (0°2 N/24°5 E).
37-5447	VERT 5-10°	Low	S M. Tranquillitatis-Sabine D, Moltke, Hypatia I Rille. CSM visible. (0°5 N/23°5 E). Reversed. 1/390,000.

*The I.A.U. direction system is used throughout this report, where Mare Crisium is in the lunar eastern hemisphere and Oceanus Procellarum is in the western.

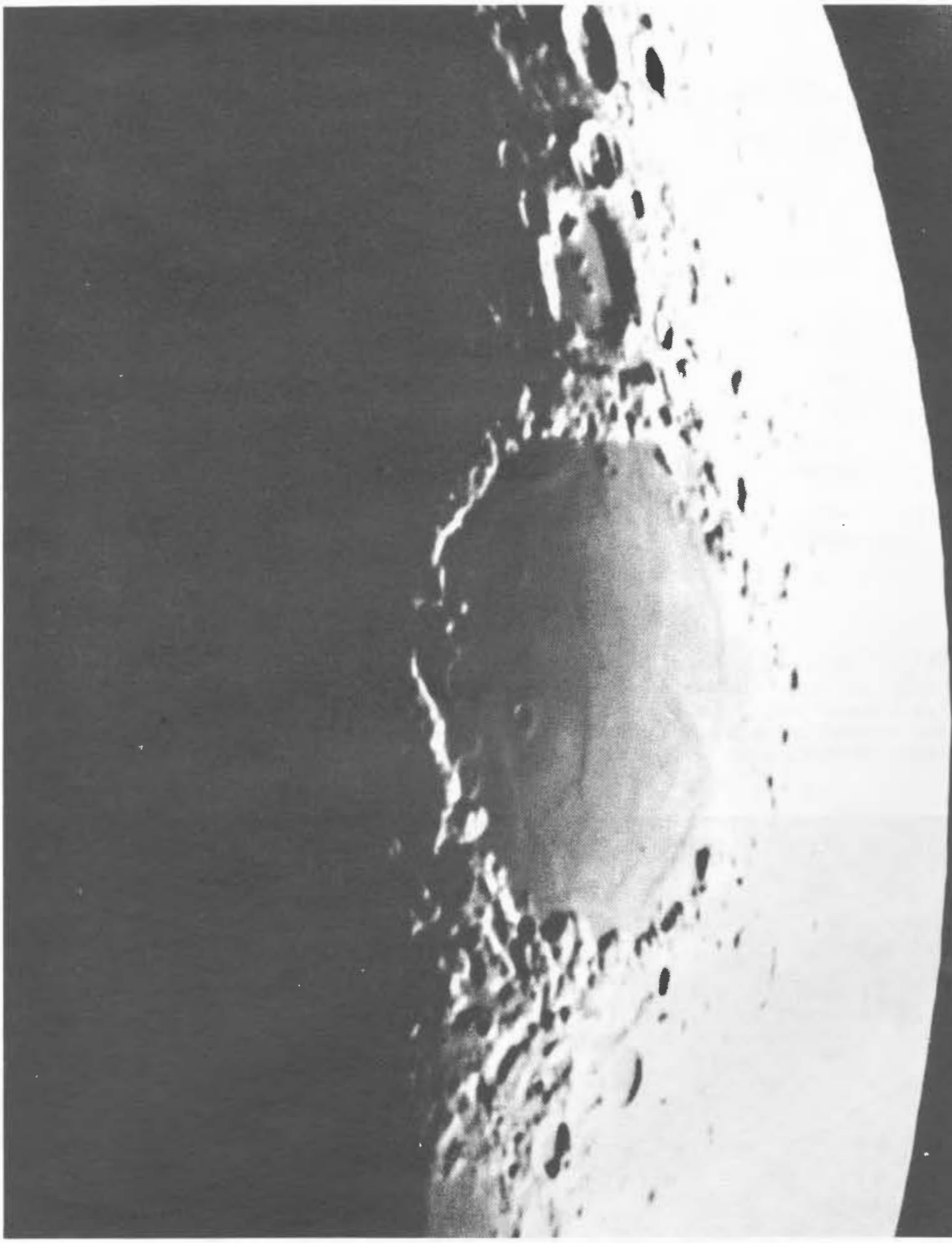

Figure 10. Mare Crisium and the 130-km. crater Cleomedes above it, as photographed by Mr. Orville Brettman with a 16-inch reflector on March 30, 1971, Colong. = 308°9. North at top; A.L.P.O. Lunar Photograph Library photograph OB-2.

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Apollo-11 (cont.)

Code Number AS11-	Format	Sun Angle	Description
37-5448	VERT 5-10°	Low	SW M. Tranquillitatis-Schmidt. CSM visible. (0°5 N/ 18°5 E). 1/390,000.
38-5602	L-OBL 35-45°	Medium	Messier A. (2° S/46°5 E).

Code Number AS11-	Format	Sun Angle	Description
38-5606	L-OBL 55-60°	Low	Horrocks, Hipparchus N. (4° S/5° E).
38-5608	L-OBL 55-60°	Low	Hipparchus X, JA, J. (7° S/4° E).
38-5654	-----	Low-High	Whole-disk. (Centered near 5° N/60° E). 1/23,000,000.
41-6122	H-OBL 65-70°	Low	Sabine, Ritter, Schmidt. (1° N/18° E).
41-6128	H-OBL 65-70°	Low	Lade A area. (0°.5 N/12° E).
42-6212	H-OBL 60-65°	Medium	Condorcet-SE M. Crisium. (12°.5 N/70° E).
42-6223	H-OBL 55-60°	Medium	W M. Crisium-Picard, Peirce. (10° N/56° E).

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Figure 11. Apollo-11 photograph AS11-42-6237. This view looks south over western Mare Nectaris. The large shadow-filled crater near center is Theophilus, 103 kms. in diameter and 7,000 meters deep. East (left) of Theophilus is Maedler. The Altai Mountains are on the horizon, while the nose of the command module appears on the right. Note the many secondary craters and low ridges brought out by the low morning sun.

Apollo-11 (cont.)

Code Number AS11-	Format	Sun Angle	Description
42-6225	H-OBL 55-60°	Medium	P. Somnii-da Vinci, Glaisher. (5° N/48°5 E).
42-6226	H-OBL 50-55°	Medium	Taruntius, Secchi. (5°5 N/47°5 E).
42-6234	L-OBL	Low	SE M. Tranquillitatis-Isidorus D, Lubbock N. (0°5 S/-37° E).
42-6235	H-OBL 70-75°	Low	M. Nectaris-Fracastorius, Maedler, Isidorus. (11° S/32° E).
42-6237	H-OBL 60-65°	Low	Theophilus, Maedler, Beaumont. (10° S/28° E). Published here as Figure 11.
42-6239	L-OBL 45-50°	Low	SE M. Tranquillitatis-Maskelyne area. (2°5 N/29° E).
42-6240	L-OBL 45-50°	Low	Torricelli, Torricelli C. (3° S/27°5 E). Reversed.
42-6305	L-OBL	Medium	Messier, Messier A. (1°5 S/47°5 E).
44-6665	-----	Low-High	Whole-disk. (Centered near 10° N/65° E). 1/22,000,000.

Apollo-11: Overlapping Pairs

AS11-37-5437/42-6239	38-5602/42-6305	42-6225/42-6226
37-5437/42-6240	41-6122/41-6128	42-6235/42-6237
37-5448/41-6122	42-6223/42-6225	42-6239/42-6240

(to be concluded in next issue)

MARS 1969 - THE NORTH POLAR REGION - ALPO REPORT II

By: C. F. Capen and T. R. Cave, A.L.P.O. Mars Recorders

A.L.P.O. Observations

The members of the ALPO Mars Section initiated observations of the planet Mars on August 31, 1968 and terminated them on January 31, 1970. The ever-changing seasonal aspects of the polar regions were examined during the mid-spring, summer, autumn, and first half of the winter season of the northern hemisphere. The extent of the Martian apparition observed covered 279 heliocentric degrees from the areocentric longitudes of $L_s = 35°$ to $L_s = 314°$, which leaves only 81 heliocentric degrees of the Martian year not observed - certainly, an exploration of another world to be commended. The complete observational coverage is shown in Figure 12. The north polar region (NPR) was well observed from September, 1968 to October, 1969 when the apparent planetary disk diameter was sufficient; and the Martian North Pole was tilted toward the Earth until mid-September, 1969. The axial tilt is synonymous to the apparent declination of the Earth D_e as viewed areocentrically, which is also the Martian latitude of the sub-earth point. Refer to Figure 13, Graphic Aspects of Sub-earth and Sub-solar Points for Mars, Ref. 1.

The north polar region data were obtained from 23 individual ALPO observers. The Mars Section members who were chiefly interested in the North Polar Cap (NPC) and who systematically recorded the aspects of the NPR were: J. Bartlett, C. and V. Capen, E. Cross, A. Heath, H. Heuseler, J. Mitchell, T. Osawa, R. Rhoads, B. Salmon, H. Smith, and W. Wooten.

Introduction

The 24°9 inclination of the axis of Mars causes the polar caps to fluctuate in an annual seasonal cycle. The composition of the white substance of the Martian polar caps has been a subject of much speculation and heated controversy ever since W. Herschel first noted their seasonal behavior and compared them to ice-water caps of the Earth. It was J. Stoney in 1897 who first stated that the white caps could be composed of CO_2 crystals.

G. Kuiper's photoelectric study in the infrared suggested that the caps were not composed of CO_2 but were probably a low-temperature H_2O snow-like deposit, Ref. 2. Spectroscopic observations of Mars detected water vapor in the atmosphere and especially in the Arctic region during maximum regression of the North Cap from 30° to 140° L_s, Refs. 3 and 4. Theoretical work by Leighton and Murray suggested that the caps may be CO_2 and H_2O in combination, Ref. 5. This idea satisfied both schools of opinion. A recent spectroscopic study of the variations in CO_2 abundance and surface pressure of Mars by E. Barker showed a strong correlation between a maximum CO_2 surface pressure and a minimum size of the North Polar Cap, and a decrease in CO_2 pressure during the re-forming phase of the North Cap, Ref. 6. The Mariner '69 spacecraft results indicated that the South Cap was chiefly composed of CO_2 with possibly a mixture of some H_2O. What a strange world we have: at one season a hemisphere has a humid atmosphere of over 50%, and during the next season the water vapor and atmospheric pressure diminish to nearly naught. Consequently, observational study of the seasonal condition of the polar caps and the polar region phenomena gives clues to the Martian climate, to the planet-wide atmospheric meteorology, and to the seasonal phenomena of apparent surface changes.

North Cap Regression 1968-1969

The north pole of Mars was tilted toward the Earth before and during the 1969 opposition period, thus allowing accurate measurements of the spring-summer regression phase of the North Polar Cap (NPC). The NPC was free of its winter haze hood at the commencement of ALPO observations in Martian April. Transient Arctic hazes were recorded by several ALPO observers during the apparition. A homogeneous set of visual micrometer measurements of the retreating spring-summer NPC was obtained by V. Capen and C. Capen.

The average latitude of the edge of the NPC, or the area covered by the white cap, at any given Martian Date can best be derived from measurement of the apparent diameter of the cap from quality photographs or from direct filar micrometer measurements at the telescope. If good seeing data are carefully analyzed, both methods are compatible within the $\pm 2°$ random observational error. Orange or red light photographs are best for diameter measures. A yellow-orange W21 or W23A filter is employed for micrometer measures in order to penetrate any Arctic haze which may be present and to control irradiation within the eye. Also, green W57 or W58 filters and a deep red W25 filter are employed prior to taking micrometer readings in order to inspect the general aspect of the cap and its peripheral boundary. The ratio between the measured North Cap diameter and the planetary disk diameter, which is independent of the apparent disk diameter, defines the latitude of the edge of the cap as well as the width of the cap in areocentric degrees. The latitude ϕ of the cap edge is found from the simple equation, $\cos \phi = AC/d$, where AC is the polar cap diameter and d is the polar diameter of the Martian disk. This ratio is internally consistent if the seeing does not change during the time between the two readings on the Martian disk and polar cap. A more thorough discussion of the methods and observing techniques is found in the biographical Refs. 7, 8, 9, and 10.

The diameter of the NPC was determined from 225 individual filar micrometer orange light measurements made on 27 selected good nights during 8 terrestrial months from September 27, 1968 (11 May Martian Date) through May 19, 1969 (1 Sept. MD). An average of all micrometer readings (n) obtained during each selected good night was made in order to reduce errors due to measurement and seeing conditions. All data were corrected for the phase effect of the "defect of illumination" and the axial tilt of the planetary disk when necessary. The eccentricity of the NPC relative to the axis of rotation is only 1 degree, which is less than the observational error, and therefore was not considered.

The results of the 1969 NPC measurements are given in Table 1, and the 1969 regression curve of the retreating NPC during the Martian spring and summer seasons is shown in Figure 16. The size of the early spring NPC appeared to have a maximum diameter of about 72°. P. Lowell obtained a normal average maximum diameter of 70°. The regression curve defined a slow, steady rate of "thaw" of about 1 degree of areocentric latitude per 29-day interval during early Martian May, increasing to about 1 degree per 7-day period by the last of May MD, and reaching a maximum of 1 degree per 2-day period in June MD. The "thawing" of the NPC started to slacken on about 26 June MD, when the cap was 26° wide on the +77° latitude parallel. Blue and blue-green light observations detected the presence of a haze patch located on the NPC periphery at 0° longitude. By 1 July MD, the regression had entirely ceased, and the NPC was observed actually to increase in diameter by about 2 or 3 aerocentric degrees in the presence of increasing Arctic hazes from 2 July to 12 July MD. Refer to the early ALPO pre-opposition drawings from M 69 01 07 to M 69 02 28 on pages 72 and 73. The regression of the NPC was resumed once again on 13 July MD at a rate of 1 degree per 7-day period. This steady rate of thawing continued throughout Martian July and until 22 August MD, after which time the small cap remnant became static on the 87°

latitude parallel with a 6° diameter.

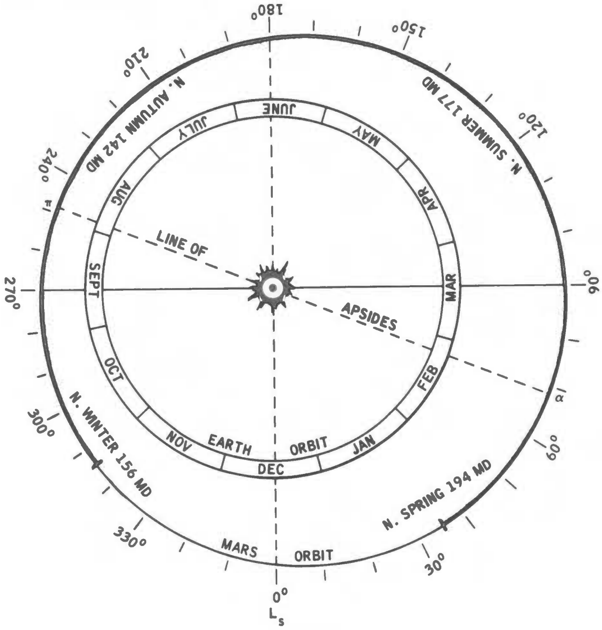


Figure 12. Plan view of orbits of Earth and Mars, showing observational coverage of Mars obtained by ALPO members in 1968-70. The orbit of Mars is indexed in 360 areocentric degrees (L_s) and is divided into seasonal quadrants. The period of ALPO observations is indicated by the heavily lined portion of Mars' orbit; it extended from L_s = 35° in northern Martian mid-spring to L_s = 314° in northern Martian mid-winter. See also text of report by Messrs. Capen and Cave.

****

The north polar region (NPR) of Mars was tilted toward the Earth during the Martian spring and summer seasons from the 1962-63 apparition through the 1969 apparition, inclusive. Consequently, considerable NPR data have been obtained in the last nine years even though the apparitions have been aphelic, Ref. 10. The next several Martian apparitions are not favorable for NPR studies. It is thus most proper here to compare and to evaluate the 1969 NPR data with similar data of the three preceding Martian years.

The NPC spring-summer regression curves for 1962-63, 1964-65, 1966-67, and 1968-69 have been prepared at the same graph scale for equal evaluation as Figs. 13, 14, 15, and 16. The aerocentric latitudes and North Polar Cap widths (diameter) are given on the sides of the graphs. The areocentric longitude of the Sun L_s and the Martian Date appear at top and bottom. Here 0° L_s = 21 March, MD, the Martian vernal equinox of the northern hemisphere. The vertical diameter of the black dot plots indicates the observational error. Table 2 compares the regression rates for similar Martian Dates.

Several conclusions regarding the NPR can be made from a study of the above data. All four NPC regression curves exhibit similar seasonal behavior. The four curves show a slowly retreating cap during Martian April and a maximum regression during May or June; the retreat of the cap is temporarily halted in late spring; and the cap becomes a small, static remnant in late northern summer. The 1969 apparition curve has a similar physical signature to those of the 1963 and 1965 curves, which indicates the normal Martian climate. The Arctic climate appeared to be abnormally cooler during the 1967 apparition.

An interesting similarity appears when the NPC regression curves are compared with the position of the subsolar point during the Martian spring, summer, and autumn seasons. Fig. 17 describes the subsolar point Ds motion in areocentric latitude vs. the Martian Date and L_s. According to the curves, the maximum regression of the NPC occurred when the Sun was near maximum northern latitude at the Martian summer solstice. When the Sun moved back toward the equator in August MD, the regression of the NPC became slow. There is no apparent seasonal lag noted, which can be explained by the tenuous atmosphere and by the lack of large bodies of water on Mars.

The cap appears temporarily to halt its retreat when Arctic hazes form over the NPR during the maximum rate of regression just prior to the summer solstice, when Mars is close to its aphelion orbital position of 68° L_s. The nature of this interesting anomalous inflection in the regression curve which usually interrupts the maximum late spring thaw phase induces speculation as to its most probable cause. Dr. Clyde Tombaugh has repeatedly observed the formation of temporary hazes over the NPC during this period, which he calls the "aphelic chill". Miyamoto et al., Kwasan Observatory, have also observed a temporary halt and a slight increase in the NPC diameter during the 1960 and 1963 apparitions (Ref.

Fig. 13. NORTH POLAR CAP PHOTOGRAPHIC REGRESSION CURVE 1962-1963

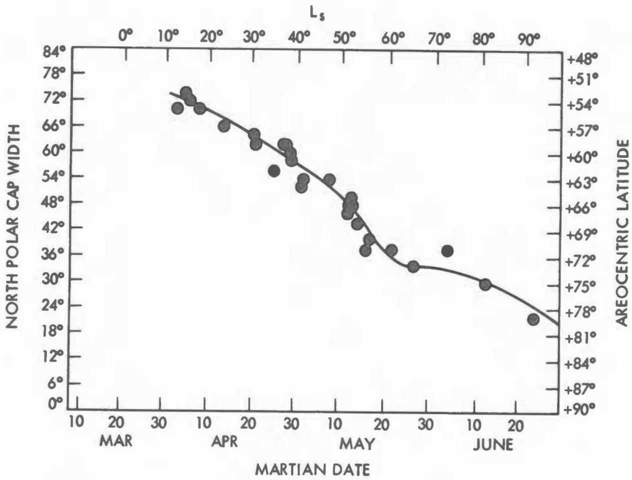
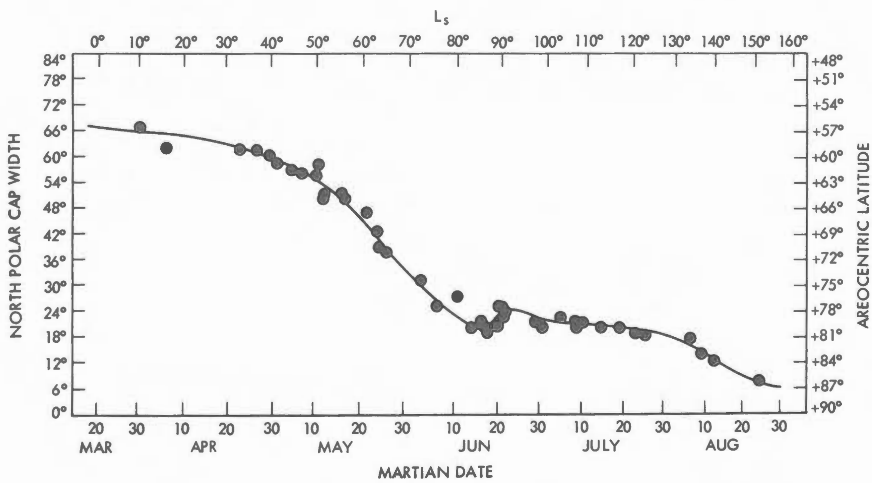


Fig. 14. NORTH POLAR CAP PHOTOGRAPHIC REGRESSION CURVE 1964-1965



11). Reporting on the ALPO 1964-65 NPC regression curve, K. Brasch found a similar occurrence of Arctic haze's covering the NPC at the summer solstice from ALPO observations, Ref. 12. The Arctic hazes take on the characteristics of a polar hood for several days, from which fresh cap deposits are possibly derived. The anomaly could possibly be explained by a change in topography at these latitudes.

The fact that a small, static NPC remnant has been observed until the return of the autumn Arctic hazes indicates that the cap never completely disappears in late summer, as possibly does the SPC. E. C. Slipher found the average NPC remnant to have a 6° diameter. The NPC measurements obtained in 1969 and 1965 showed a similar cap diameter. However, the 1967 late summer static cap had a 10° diameter. This implies that the mass of the white substance composing the NPC remnant can be variable and is dependent upon the annual climatic temperature.

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Fig. 15. NORTH POLAR CAP PHOTOGRAPHIC REGRESSION CURVE 1966-1967

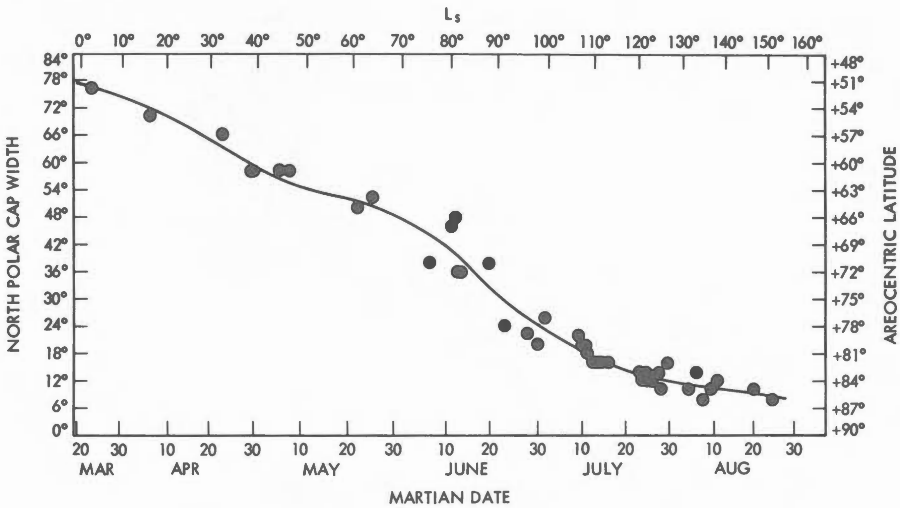
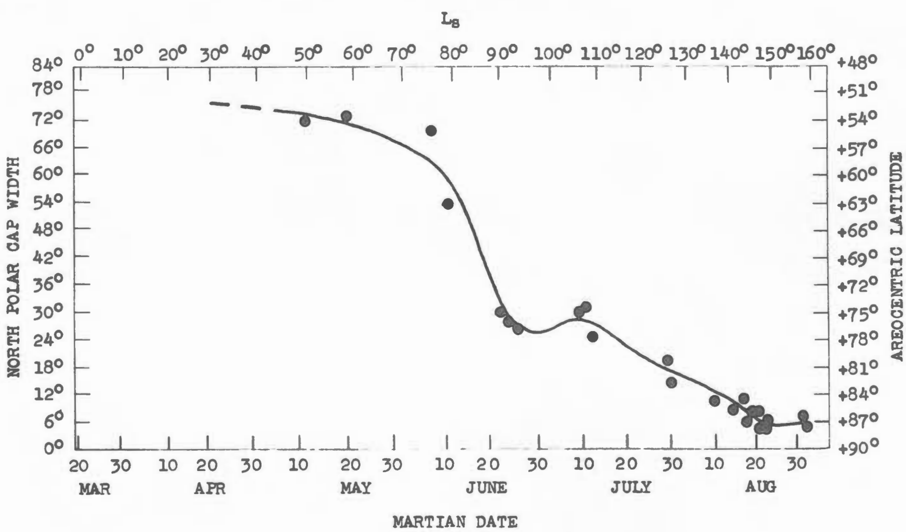


Fig. 16. NORTH POLAR CAP MICROMETER REGRESSION CURVE 1968-1969



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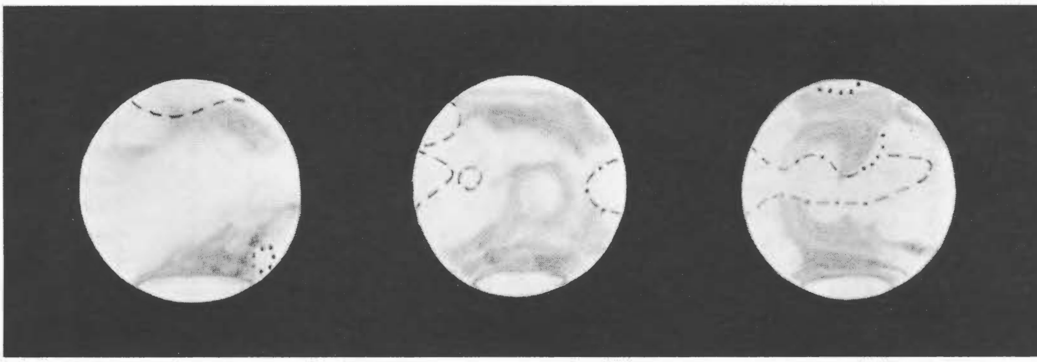
MARS - 1968-69

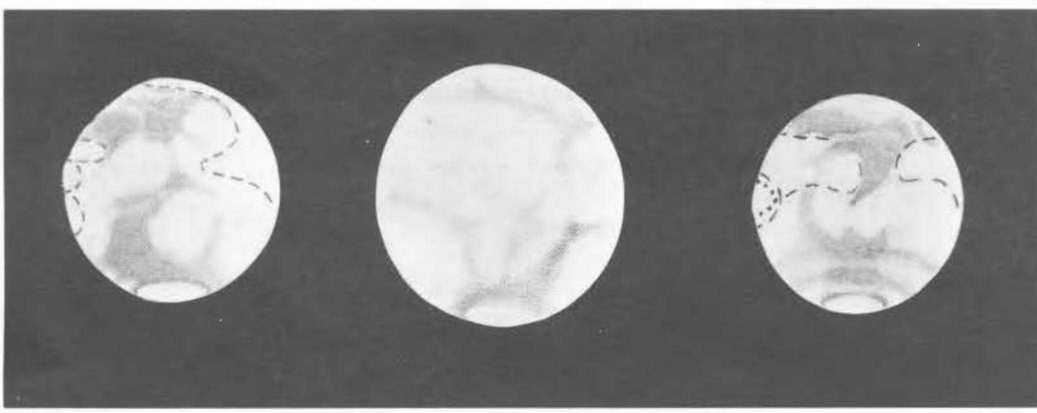
Pre-opposition drawings, August 31, 1968 - January 17, 1969



M 68 08 31 V-R 1300UT CM116° 16"CASS 360X 6"REFR 285X 29APR MD C. CAPEN

M 68 09 27 V-R&M 1215UT CM200° 16"CASS 500X 11MAY MD C.& V. CAPEN

M 68 10 28 V-R&M 1420UT CM 290° 24"CASS 780X 25MAY MD C. CAPEN



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M 68 12 04 V-R&M 1430UT CM289° 24"CASS 390X 11JUNE MD C. CAPEN

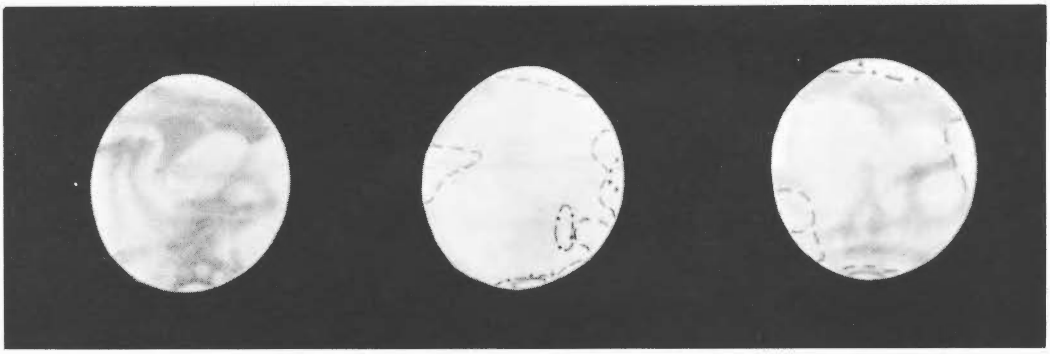
M 68 12 31 V-R & M 1403UT CM020° 24"CASS 620X 23JUNE MD C. CAPEN

M 69 01 07 V-R & M 1445UT CM 325° 24"CASS 27JUNE MD C. CAPEN

M 69 01 17 O&R 1510UT CM235° 24"CASS 395X 1JULY MD C. CAPEN

MARS - 1969

Pre-opposition drawings, February 8, 1969 - March 29, 1969



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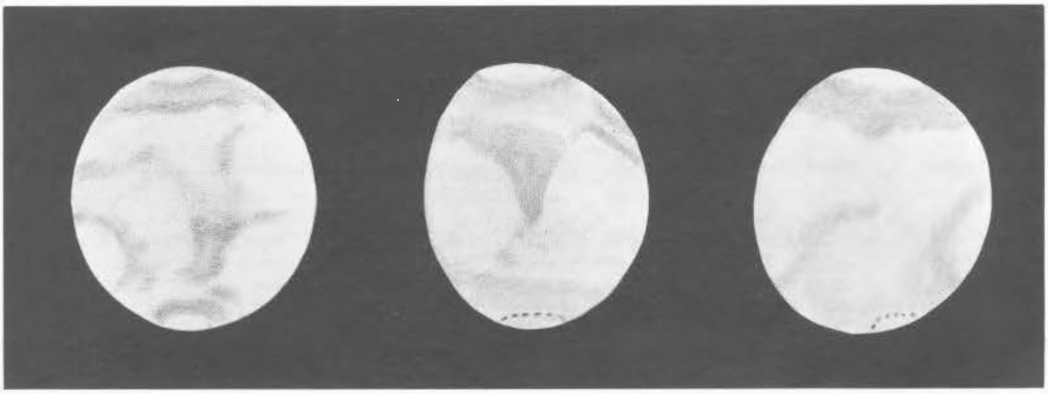
CM018° 24"CASS 825X
12JULY MD C. CAPEN

M 69 02 08 V-G 1530UT
CM028° 24"CASS 395X
12JULY MD C. CAPEN

M 69 02 28 V-R 1340UT
CM170° 16"CASS 500X
6"REFR 290X 22JULY MD
C. CAPEN



M 69 03 12 I 2010UT
CM151° 8"REFL 286X
28JULY MD T. OSAWA

M 69 03 21 B,G, & Y
1000UT CM278° 12.5"
CASS 490X 1AUG MD
J. MITCHELL

M 69 03 27 V-O 1015UT
CM227° 6"REFL 300X
4AUG MD J. MITCHELL

M 69 03 28 V-R 0920UT
CM203° 12.5"NEWT 300X
4AUG MD K. DELANO

M 69 03 29 V-O 1020UT
CM208° 12.5"CASS 490X
5AUG MD J. MITCHELL

M 69 03 29 V-R 1130UT
CM225° 82"REFL 1000X
5AUG MD C. CAPEN

SPRING-SUMMER-FALL MARTIAN SUBSOLAR POINT

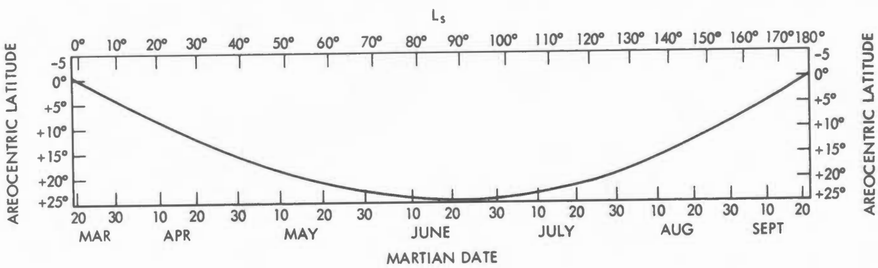


Figure 17. Graph to show the areocentric latitude of the subsolar point on Mars, or Ds, as a function of Martian Date or L_s (the heliocentric longitude of Mars so chosen as to be 0° at the vernal equinox of the northern hemisphere). The graph is drawn for the spring and summer of the northern hemisphere of Mars.

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Table 1. North Polar Cap Micrometer Regression Measurements 1968-69

Date UT 1968	Areographic latitude Ø°	Axial tilt De°	MD North hemisphere	Number Measures	Remarks
Sept. 27	+54°	+23°	11 May	9	Clearly defined North Cap.
Oct. 18	53	25	17 "	10	Clearly defined North Cap.
Nov. 22	55	24	5 June	10	Clearly defined North Cap.
Dec. 4	65	23	11	15	Clearly defined North Cap.
31	75	19	23	14	Clearly defined North Cap.
1969					
Jan. 2	76	19	24	10	Clearly defined North Cap.
6	77	18	26	15	Clearly defined North Cap.
Feb. 1	75	13	9 July	8	Clearly defined North Cap.
4	74	13	10	10	Clearly defined North Cap.
8	76	12	12	7	Arctic haze over cap.
8	78	12	12	10	Orange light cap measures.
Mar. 16	80	05	29	14	Clearly defined North Cap.
18	83	05	30	11	Clearly defined North Cap.
Apr. 8	85	03	10 Aug.	4	Clearly defined North Cap.
16	86	03	14	3	Clearly defined North Cap.
20	85	03	16	12	Clearly defined North Cap.

Table 1. (cont.)

Date UT 1969		Areographic latitude Ø°	Axial tilt De°	MD North hemisphere	Number Measures	Remarks
Apr.	21	+85°	+03°	17 Aug.	15	Clearly defined North Cap.
	22	87	03	17	4	Clearly defined North Cap.
	26	86	03	20	2	Clearly defined North Cap.
	27	86	03	20	3	Clearly defined North Cap.
	28	88	03	20	5	Clearly defined North Cap.
	29	88	03	21	4	Clearly defined North Cap.
May	1	87	03	22	2	Clearly defined North Cap.
	9	82	04	26	10	Arctic haze over cap.
	16	84	04	30	12	Arctic haze over cap.
	17	86	05	31	2	Clearly defined North Cap.
	19	87	05	1 Sept.	4	Clearly defined North Cap.

Table 2. North Cap Regression Rates 1962-1969
(Areocentric degrees per day MD)

Apparition	Early Spring	Max. Rate	Early Summer	Mid-Summer
1962-63	$1°/10^d$	$1°/3^d$	$1°/8^d$	------
1964-65	$1°/23^d$	$1°/3^d$	$1°/6^d$	$1°/30^d$
1966-67	$1°/15^d$	$1°/4^d$	$1°/10^d$	$1°/30^d$
1968-69	$1°/20^d$	$1°/2^d$	$1°/7^d$	$1°/20^d$

(to be concluded in next issue)

ANNOUNCEMENTS

Staff Changes. Two new Lunar Recorders have been added to the Lunar Section staff. One is: Mrs. Winifred S. Cameron, National Aeronautics and Space Administration, Goddard Space Flight Center, Code 641, Greenbelt, Maryland 20771. Mrs. Cameron will supervise A.L.P.O. work on Lunar Transient Phenomena, on which she has long done professional research. She has already contributed to this journal, and we heartily welcome her to our staff. Mr. Charles Ricker is returning to the Lunar Section to act as general coördinator of its different projects and to edit "Lunar Notes". The present Lunar Section staff and its projects are described by Mr. Ricker on page 62.

Sustaining Members and Sponsors. The persons in these special kinds of membership as of July 17, 1971 are listed below. Sponsors pay $25 per year; Sustaining Members, $10. The balance above the normal dues is used to help meet the general expenses of the A.L.P.O.; we deeply appreciate the generous and meaningful help of these colleagues.

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Error in Vol. 22, Nos. 11-12. Mr. Richard Hodgson has reported a correction to his article "A.L.P.O. Observations of the 1970 Mercury Transit." What Mr. Yajko observed at 13^h6^m, U.T., as given on pg. 193 was not Contact III but instead Contact IV. The footnote referring to his observation should then be deleted, and the first sentince in the next paragraph should read: "Of these five observations, the range of residuals is from -12^s to $+24^s$; the average is $+5^s$." Mr. Hodgson and the Editor express their regrets to the readers for this blunder.

Material for Saturn Observers. Mr. Julius L. Benton, the A.L.P.O. Saturn Recorder, has communicated the following announcement: "Saturn Observing Kit, price $3.00, available now. Orders will be handled promptly. The kit will include The Saturn Handbook, drawing blanks for the current 1971-2 apparition, intensity-estimate forms, a C.M. ephemeris (prepared by John Westfall), instructions for filling out the forms, and a sample observation. Order from Julius L. Benton, Jr., 735 E. 49th St., Apt. A, Savannah, Georgia 31405." The Editor has seen the Saturn Observing Kit and recommends it highly to all observers of the Ringed Planet.

Concerning the Use of International Money Orders. The Editor appreciates the mechanical difficulties which A.L.P.O. members in foreign countries must encounter in paying for their subscriptions. From the point of view of our limited volunteer staff and their limited time, he would suggest that international money orders may be the most convenient form of payment. The services of subscription agencies may sometimes be necessary, and are certainly often excellent; however, even the modest commission which we pay means that such subscriptions are carried at a loss. In addition, the correspondence with the agency which is frequently necessary and the forms which sometimes need to be filled out for the agencies take staff time away from other matters. Foreign currency, which we occasionally receive, is subject to large discounts at the local banks.

ALPO Convention at Memphis, Tennessee. Dates August 18-22, 1971. Place Southwestern College campus. Joint meeting with the Astronomical League. Professional lectures and many amateur speakers, including leading ALPO members. Commercial and amateur exhibits. ALPO Exhibit being organized by Harry Jamieson. All persons welcome. Send registration fee to William J. Busler, 441 South Reese St., Memphis, Tennessee 38111. Dormitory housing. Visits to neighboring observatories. Banquet on the Memphis Showboat. Distinctive Star Party on the same Mississippi River excursion. Featured lectures on lunar geology, balloon astronomy, amateur solar observing, etc.

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378 Broadway
Cambridgge, Massachusetts 02139

LUNAR RECORD5RS

Charles L. Ricker
403 W. Park St.
Marquette, Michigan 49855

Julius L. Benton, Jr.
735 E. 49th St., Apt. A
Savannah, Georgia 31405

Winifred S. Cameron
NASA, Goddard Space Flight Center
Code 641
Greenbelt, Maryland 20771

Kenneth J. Delano
22 Ingell St.
Taunton, Massachusetts 02780

Harry D. Jamieson
P. O. Box 30163
Middleburg Heights, Ohio 44130

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

John E. Westfall
Dept. of Geography
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San Francisco, California 94132

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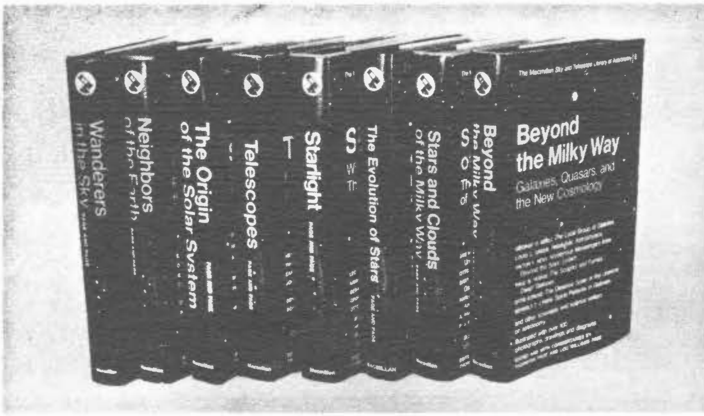

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