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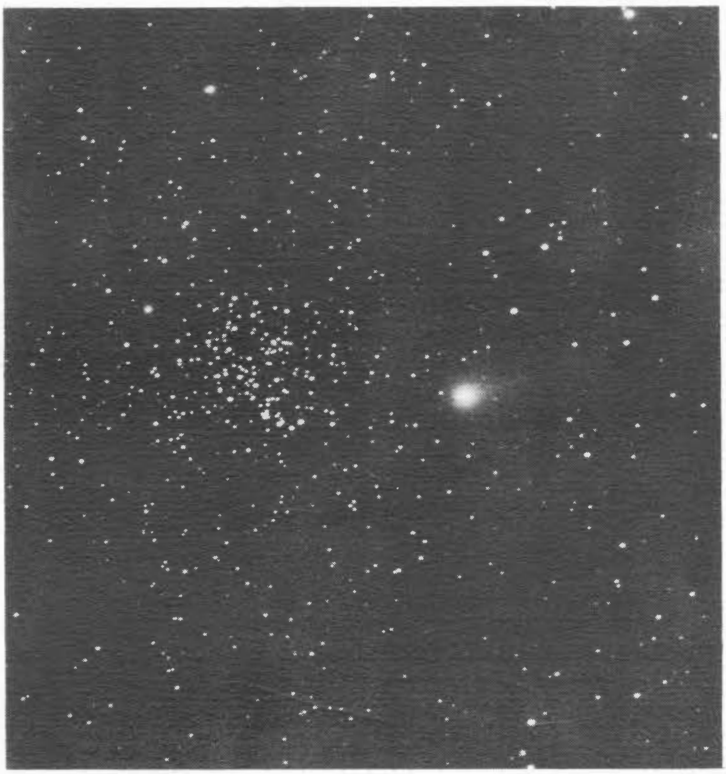

Photograph of Comet Fujikawa 1969d approaching the open cluster M67. Taken by Mrs. Ginger LeGendre of Phoenix, Arizona on September 16, 1969 at 11 hrs., 30 mins., Universal Time. She made an 8-minute exposure on Tri-X loaded in a cooled emulsion camera mounted at the Newtonian focus of her homemade 10-inch f/7 reflector. North at top. Comet of 8th magnitude on this date. Tail extends westward for about 10 minutes of arc. Film developed in D-19.

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

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

ASSOCIATION OF LUNAR & PLANETARY OBSERVERS
ALPO

Founded In 1947

IN THIS ISSUE

THE A.L.P.O. LUNAR SECTION ARISTARCHUS-HERODOTUS MAPPING PROJECT: FINAL REPORT

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

I. Introduction

A. History and Purpose

In late 1962, following a reorganization, the A.L.P.O. Lunar Section began a new long-term project--the detailed topographic mapping of selected lunar regions.[1] Because of the variety of formations of interest to amateur and professional selenographers in its relatively small area, the Aristarchus-Herodotus Region (AHR) was chosen as the first such "selected area."

During 1962-65, Mr. Patrick S. McIntosh, as an A.L.P.O. Lunar Recorder, was in charge of the Aristarchus-Herodotus Mapping Project (hereafter referred to as the "AHR Project"). During his Recordership, Mr. McIntosh stimulated considerable interest among A.L.P.O. lunarians, and compiled an outline chart of the region to enter observations upon. A large number of visual and photographic observations were received, allowing Mr. McIntosh to compile, in 1964, a "Provisional Master Chart" of the AHR on the orthographic projection.[2]

In 1965 the AHR Project was transferred to the present writer, who has been responsible for the Project from then to the present. Much of the basic material for the AHR Project had already been gathered by McIntosh, but time conflicts and the influx of a large amount of new observational material have prevented the publication of this final report until now.

Throughout this report, unless otherwise stated, the lunar cardinal directions--North, South, East, and West--are referred to in accordance with the IAU System.

The chronology of the A.L.P.O. AHR Project, in outline, is as follows (M = McIntosh; W = Westfall):

1. Selection of Study Area (M, W).
2. Preparation of Outline Chart on 1/500,000 scale (W, revised and reissued by M).
3. Collection and analysis of A.L.P.O. observations (M).
4. Compilation of Provisional Master Chart on 1/500,000 (M).
5. Preparation of AHR Bibliography (W, Appendix B of this report).
6. Revision of Provisional Master Chart (1/250,000) from additional A.L.P.O. observations and non-A.L.P.O. source material (W).
7. Transformation of Revised Master Chart from Orthographic to Albers Equivalent Conic Projection on 1/250,000 (W).
8. Construction of relief model (1/250,000) based on A.L.P.O. data and professional photographs (W).
9. Compilation of topographic contour map based on relief model, 1/250,000, 250-meter contours (W).
10. Revision of contour map based on A.L.P.O. observations and non-A.L.P.O. sources (W).
11. Final revision of contour map based on Lunar Orbiter-IV and -V photographs (W).
12. Parallel to the steps above, measurements of positions, altitudes, and slopes in the AHR (M, W).
13. Preparation of this Final Report with topographic map published at 1/500,000 scale (W).

There were three purposes to the A.L.P.O. Selected Areas Mapping Program: first, to make accurate, large-scale topographic maps of lunar regions of unusual interest; second, to construct maps as accurate representations of lunar regions at particular dates in order to serve as bases for comparison with future observations of suspected lunar changes and transient phenomena; and third, to determine the possible degree of lunar detail and topographic and positional accuracy attainable for a coöperative amateur observing project.

During the AHR Project three important events occurred in the history of selenography and modified the goals of the A.L.P.O. Selected Areas Program.

First, the United States Air Force, Aeronautical Chart and Information Center, completed mapping most of the lunar nearside at a scale of 1/1,000,000 (i.e., half the scale of the projected A.L.P.O. Selected Areas Maps) and most of the equatorial zone of the nearside at a 1/500,000 scale. Positional and topographic accuracy in this series (LAC and AIC) is quite good, and the charts near the center of the disc employ contour lines so that the need for amateur-produced topographic maps is now lessened except, perhaps, in a few areas of particular interest to amateur observers.

Second, in 1966-67 a series of five Lunar Orbiter space probes photographed the lunar surface from distances as close as 30 kms. Orbiter-IV photographed almost all the nearside with resolution of the order of 80 meters, and most of the farside at lesser resolution. Orbiter-V took numerous high-resolution photographs (ca. 3 meters) of some features of special scientific interest, including Aristarchus and Schroeter's Valley. These photographs showed features far smaller than any visible from Earth and, to some extent, made further earthbased lunar topographic studies superfluous (with the important exception that terrestrial observers have the advantage of observing features over long periods of time and under differing solar illuminations).

Finally, on October 30, 1963, James A. Greenacre and Edward Barr observed three areas of reddish or pinkish glows, by good fortune all within the AHR.[3] Such unusual phenomena within the AHR have been reported from 1650 to the present (e.g., in 1961 N. A. Kozyrev photographed unusual spectra in the AHR). Thus, this particular lunar region is now of unique interest, and a detailed topographic map should be of considerable use in the observation and interpretation of further "Lunar Transient Phenomena" there.

In view of these recent developments, it does not appear worthwhile to continue the Selected Areas Mapping Program in its original form, although a promising program of observation of selected areas particularly for lunar changes and transient phenomena is in progress.

Nonetheless, it is felt that the publication of this report on the Aristarchus-Herodotus Region will be of definite use to lunar observers because of the great interest amateur and professional selenographers have in this area, especially as regards unusual lunar phenomena. Hopefully, the intensive observation of this area now going on will result in revisions to the A.L.P.O. AHR map and perhaps eventually will allow the correlation of such unusual phenomena as the "red glows" and tonal changes (e.g., the famous Aristarchus "Bands") with particular topographic features.

B. Acknowledgments

Although the AHR Project itself has continued for some six years, in large part it derives from published lunar observations dating as far back as the beginning of the last century, resting on the efforts of those who observed the moon with dedication even when most astronomers called the moon a "dead world."

During the course of this study, a number of persons, both within and outside the A.L.P.O., have given valuable aid. Top on the list must come Patrick S. McIntosh, who saw this project through its earliest and most difficult stages. Other A.L.P.O. staff members have helped far beyond the call of duty--Walter H. Haas, as Director of the A.L.P.O., and the following Lunar Recorders: Harry D. Jamieson, Kenneth J. Delano, José Olivarez, Charles L. Ricker, and Clark R. Chapman. An A.L.P.O. member, Dr. Lincoln E. Bragg, computer-programmed and calculated the relative altitudes and horizontal positions for the final map. In addition to making personal observations, Lyle T. Johnson kindly allowed this writer to observe the AHR with his 16-inch "Johnsonian" reflector on many occasions. A veteran A.L.P.O. lunar observer, Dr. James C. Bartlett, Jr., gave access to his extensive observational files and furnished much helpful advice. The A.L.P.O. members who contributed the necessary observational "input" are listed in the following section.

Two others were kind enough to furnish the writer with some very useful advice: Mr. Chesley Bonnestell, in the construction of the AHR model, and Mrs. Winifred S. Cameron, in regard to the numerous Lunar Transient Phenomena observed in the study area.

II. Observing Program

A. Visual Observations

The great bulk of the data for the initial compilation of the AHR Map came from the visual observations of a relatively small number of A.L.P.O. members. In addition to observing the AHR expressly for this project, several members allowed the use of earlier, unpublished drawings from their files. The dates of all such observations range from September 10, 1954, to March 25, 1967, instruments employed ranging from 3 to 20 inches in aperture. These participating observers are listed below in Table 1.

Table 1. Participating Observers.

Observer	Number of Visual Observations	Observer	Number of Visual Observations
Larry J. Anthenien	1	Adolfo Lecuona	2
James C. Bartlett, Jr.	6	Daniel Louderback	2
Orville Brettman	4	Patrick S. McIntosh	13
Phillip Budine	1	José Olivarez	2
Kenneth J. Delano	19	Charles L. Ricker	7
Jean Dragesco	2	George W. Rippen	2
Frederico L. Funari	1	Kenneth Schneller	4
Harry D. Jamieson	18	William A. Snyder	3
Lyle T. Johnson	1	John E. Westfall	22
		TOTAL	110

It is interesting to mention the apertures employed by A.L.P.O. observers for this long-term project, which are distributed as follows:

Table 2. Apertures Employed.

Number of Visual Observations	Aperture (inches)
1	3
25	4 (including $4\frac{1}{4}$)
5	5
15	6
17	8 (including $8\frac{1}{2}$)
24	10 (including $10\frac{1}{4}$)
15	12 (including $12\frac{1}{2}$)
8	16 (including 17)
1	20
110	

Thus, the average aperture was 7.3 inches (18.5 cms.), and only 8 per cent of the observations were made with telescopes larger than $12\frac{1}{2}$ inches. Clearly, the A.L.P.O. program was at a disadvantage because of the relatively small apertures employed. The U.S.A.F. lunar charts, for example, are checked by visual observations with a 24-inch refractor, larger than any used for this study. On the other hand, the large amount of A.L.P.O. observations meant that some were made under excellent seeing conditions (8 and 9 on a scale of 10), when moderate apertures outperform large telescopes if the latter have been used during average seeing.

Ideally, the observations should have been distributed evenly over the lunation, from local sunrise to local sunset (approximate colongitudes 45°-225°). Such was far from the case; afternoon- and high-lighting observations were rare, and almost 2/3 of the observations were made within two days of local sunrise. Unfortunately, this "morning bias" applied also to the photographs (even those by OrbitersIV and V) so that the final map is certainly biased to some extent in depicting slopes of different steepnesses and directions. Figure 1 graphs the distribution of visual observations by 10° colongitude intervals.

Most observers made use of the Outline Form, although a number of detailed sketches of limited areas were made with no Form. The original Outline Form was compiled by Westfall from photographs of the AHR in the Kuiper Photographic Lunar Atlas.[4] These photographs, taken under various librations, were rectified to a central orthographic projection at scale 1/500,000 using a Zeiss Sketchmaster. Only the outlines of the major relief features were shown so that details could be added at the telescope in their correct relative locations. After some observations had been accumulated, the Outline Form was revised and reissued by

McIntosh. Figure 2 illustrates the use of the (original) form to record a typical observation, made by McIntosh on August 3, 1964.

Figure 3 shows a detailed sketch of a limited area--the SW wall of Aristarchus--made without the AHR Form by Harry D. Jamieson on December 28, 1963. Much finer detail is shown on this sketch than it would be practical to enter on the medium-scale form.

By 1965, 75 visual observations had been submitted, enough so that, using the revised Outline Form as a base, a "Provisional Master Chart" was compiled by McIntosh.[5] This map is reproduced here as Figure 4.

B. Photographic Observations.

After the Provisional Master Chart was compiled, it was revised both from later visual observations and from photographs showing the AHR. These photographs were also valuable at a later phase in the project, when a relief model was constructed on the basis of the shadow patterns shown on them. A total of 58 photographs were consulted, 27 of which were published (half-tone) reproductions, 22 were black-and-white enlargements, and 9 were color positive transparencies. The sources of the photographs studied are given in Table 3.

Table 3. Sources of Photographs Consulted.

A.L.P.O. MEMBERS		16
Lyle T. Johnson	4	
Patrick S. McIntosh	3	
John E. Westfall	9	
PROFESSIONAL OBSERVATORIES		34
Kopal atlas[6]	6	
Kuiper atlas[7]	8	
Kwasan Observatory[8]	13	
Lick Observatory[9]	2	
Table Mountain Observatory[10]	5	
LUNAR ORBITER PHOTOGRAPHS		8
Orbiter-IV[11]	2	
Orbiter-V[12]	6	

The only photographs taken specifically for the AHR Project were the 16 A.L.P.O. ones. These were valuable in showing the AHR under a low sun. Figure 5 is an example of one of these, taken by McIntosh at a colongitude of 49°.0.

Unfortunately, the photographs available showed the same colongitude bias as did the visual observations: a concentration at colongitude 45-70°. The distribution of the photographs, by 10° colongitude interval, is given in Figure 6.

III. Horizontal Control

A. Projection.

Compared to the entire lunar surface, the AHR is small in area (13,500 square kms.)--only 0.036 per cent of the whole lunar surface. Thus, there are many map projections that would have given negligible distortion over this small an area. This writer chose an Albers Equivalent Conic Projection with standard parallels at 22° and 25° North Latitude. This projection has the property that all areas are represented in their correct proportions anywhere on the map (at the published scale of 1/500,000, 1 sq. cm. on the map represents 25 sq. kms. on the moon). Theoretically, shapes are shown correctly only on the standard parallels. However, shape distortion--caused by a difference between the North-South and the East-West scales--is minimal throughout the AHR, as is shown by Table 4.

Table 4. Scale Distortion within the AHR.

	Scale in Terms of Nominal Scale (1/500,000)	
North Latitude	North - South	East - West
26°.12[a]	0.99927	1.00073

Table 4. Scale Distortion within the AHR. (Cont.)

North Latitude	Scale in Terms of Nominal Scale (1/500,000) North - South	East - West
26°00	0.99938	1.00062
25.00	1.00000	1.00000
24.00	1.00031	0.99969
23.00	1.00030	0.99970
22.00	1.00000	1.00000
21.05[b]	0.99947	1.00053

[a]Upper left (northernmost) corner, with a maximum scale deviation of 0.073 per cent.

[b]Lower right (southernmost) corner.

Projection coördinates, expressed as X and Y in centimeters at a scale of 1/250,000 (compilation scale) were computed by Dr. Lincoln E. Bragg, using the facilities of the Numerical Analysis Center of the University of Minnesota. (Dr. Bragg computed map coördinates for each integer-degree latitude-longitude intercept as well as for 6 second-order points and 35 third-order points.)

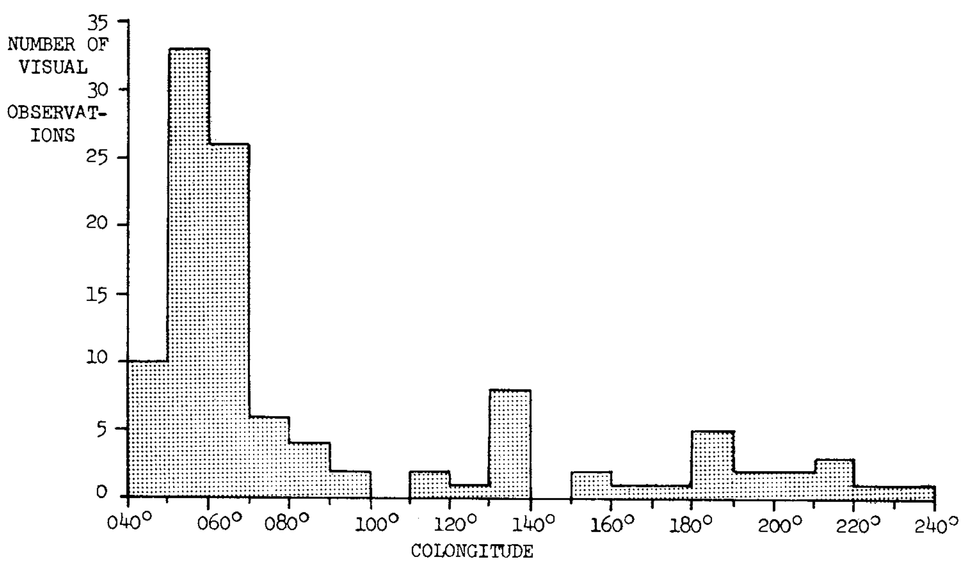

Figure 1. Colongitude distribution of A.L.P.O. visual observations of the AHR. The 110 visual observations are grouped into 10-degree intervals of colongitude. See also discussion in text.

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For these calculations, the moon was assumed to be a perfect sphere, 1738.00 kms. in radius. The writer feels that, at present, there are not sufficient data to define a more accurate "selenoid" in this region. Measures of one point (Herodotus A), however, indicate that its radius vector is 1736.91 kms. (sigma = 0.32 kms.) so that the assumed radius may be slightly too large.[13]

B. Coördinates.

The mapped positions of features were referred to six reference points (here called "second order" points), only two of which (Aristarchus F and Z) actually fell within the map margins. The positions of the six points are given in Table 5. (The position of a seventh point, Aristarchus, $\xi = -.6755, \eta = +.4019$, was not used because the large size

A.L.P.O. - LUNAR SECTION - ORTHOGRAPHIC OUTLINE CHART

ARISTARCHUS-HERODOTUS, 1:500,000

5

OBSERVER..McIntosh......... DATE.3 Aug.64. TIME.10.45.(U.T.) - 11.45 U.T.
INSTRUMENT.6 in..... MAG...... S...(0 to 10) T.5.(0 to 5) COLONG.212.9 - 213.4

NOTES (Continue on Back if Necessary):

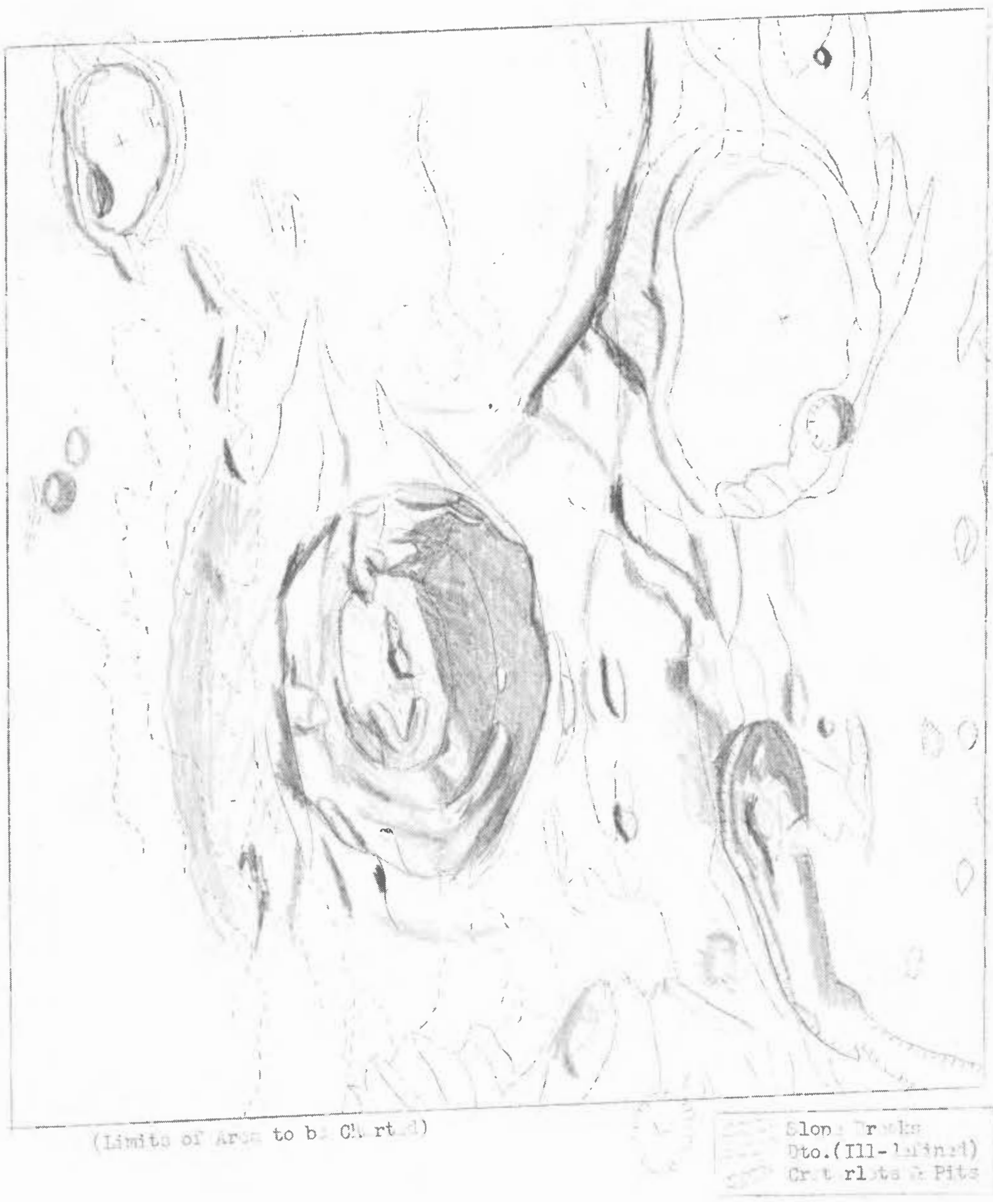

Figure 2. Sample A.L.P.O. visual observation submitted on the AHR Observing Form. This sketch was prepared by Patrick S. McIntosh on August 3, 1964, using a 6-inch reflector. Other pertinent data are entered on the top of the Form. South at top of drawing, West (in IAU sense) at right.

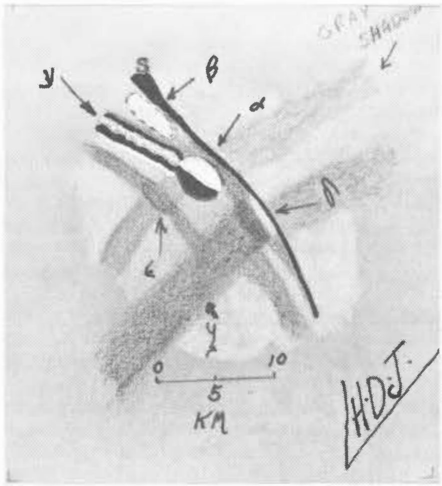

Figure 3. One of a number of detailed observations of restricted regions within the AHR; this one shows the SW wall rim of Aristarchus. This sketch, accompanied by two pages of notes, was prepared by Harry D. Jamieson on December 28, 1963, 02:39-02:55 U.T., using a 10-inch reflector at 313X and 660X. Colong. = 58°.5, S = 4-6, T = +5.5. Greek letters shown are references to the written notes. South at top.

of this feature made accurate location of the measured point impossible.)

Table 5. Second-Order Positions In or Near the AHR.[14]

Reference	Designation	Rectangular Coördinates		Angular Coördinates		Map Coördinates[b] (cms.)	
		ξ	η	Long.	Lat.	X	Y
		-	+	-	+	-	+
26376[a]	Aristarchus F	.6741	.3688	46°.487	21°.642	515.30	1537.35
26454	Aristarchus B	.6531	.4423	46.736	26.251	500.09	1483.45
26456	Aristarchus C	.6515	.4682	47.502	27.918	501.44	1461.67
26463	Aristarchus A	.6664	.4365	47.790	25.881	512.41	1483.97
26473[a]	Aristarchus Z	.6754	.4300	48.425	25.468	520.63	1486.45
27336	Herodotus A	.7335	.3664	52.029	21.494	574.80	1518.02

[a]Within AHR map margin. [b]At 1/250,000 scale.

It is difficult to assess the accuracy of the positions above. The writer knows of only one applicable measure that is both more recent and probably more accurate than the value in Table 5; this gives the position of Herodotus A as 21°.529 N, 52°.030 W.[15] As the stated standard deviation of the last measure is small (± 0.°016 in longitude and ± 0°.002 in latitude), it is possible that most positions in Table 5 are uncertain by the order of ± 0°.03-0°.04 selenocentric (about 1 km. on the moon's surface, or 2 mms. on the published map). The projection (map) coördinates of these control points were approximately corrected for the effect of relief displacement (based on the elevations as shown on the LAC's).

Besides the six second-order points, the writer measured the x-y coördinates of 35 additional points (called "third order" points) from an enlargement of Table Mountain Observatory photograph No. 1689. Dr. Bragg computed the latitudes and longitudes and projection coördinates of these additional points because it was then intended that they (plus the two second-order points in the AHR) would form the framework for positioning of detail within the map. After the Orbiter missions, it was found that these secondary positions could be obtained much more accurately from an enlargement of Orbiter-IV high-resolution frame No. 150.

A relatively simple method was used to obtain positions from Orbiter-IV-H-150. The map positions of the 6 second-order points were plotted on an otherwise blank sheet of paper, which was then mounted on an easel. The Orbiter frame was then projected onto the sheet, and the easel was moved and tilted until the images of the six features coincided with their plotted positions. Although this process is obviously approximate (for example, in not allowing for lunar curvature), all six points fitted quite well; and it is felt that the positional accuracy of the detail so plotted is limited mainly by the accur-

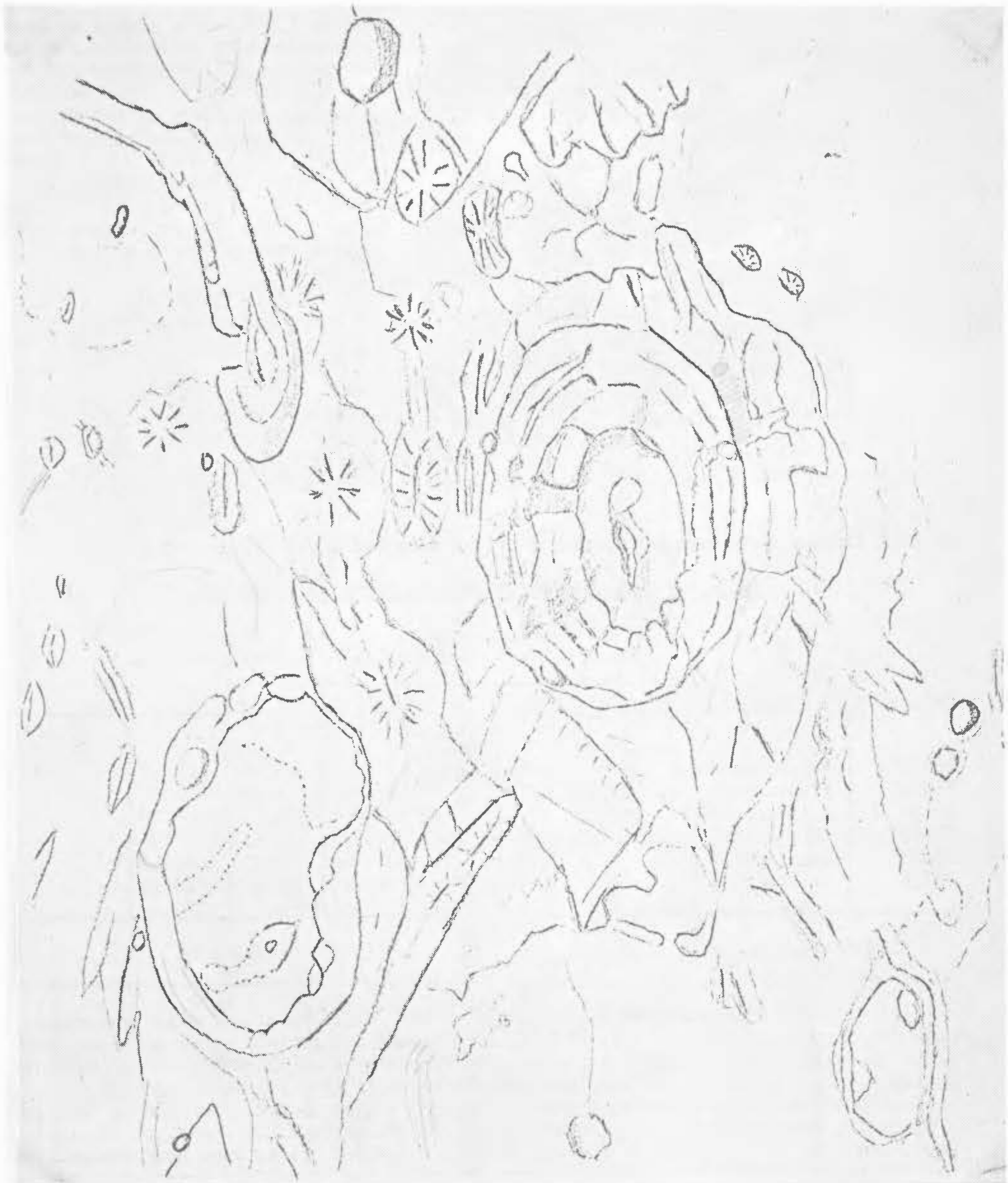

Figure 4. Provisional Master Chart of the AHR compiled in 1965 by Patrick S. McIntosh, based on 75 visual observations by A.L.P.O. members. This chart is on the Orthographic Projection, with an original scale of 1/500,000. ~~South~~ North at top.

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acy of the second-order points themselves.

Appendix A lists the X and Y projection coördinates (at 1/250,000 scale) of 32 even-degree latitude and longitude intercepts within or near the AHR.

IV. VERTICAL CONTROL

A. Relative Altitudes.

Because the AHR map depicts lunar relief by means of contour lines, a large number of altitude measures was necessary to insure the accuracy of these contours. As there is no universal reference surface (datum) for the moon, unlike mean sea level for the Earth, most lunar altitudes (being determined by measurement of the lengths of shadows) are relative altitudes. The "altitude" that is usually measured is the difference in elevation between a summit and the surface that its shadow strikes. Thus, to establish comparable elevations even over a limited area it is necessary to measure the relative elevations of a number of features at several different solar altitudes so that the shadows of these features trace out profiles of the surface. (Absolute lunar altitudes, in terms of radius vectors, have been determined by stereoscopic means; but such measures are uncertain by several hundred meters.)

Thus, a complete description of an altitude determination requires three quantities--the relative elevation of the summit above the tip of its shadow, the position of the summit, and the position of the shadow tip.

Numerous lunar altitudes that fall within the AHR have been quoted in the literature, most of which derive from the measures of Johann Maedler (during the period 1832-36) and of Julius Schmidt (during circa 1853-78), although some represent more recent measures.[16] Unfortunately, previously-published altitudes usually give only one of the three required quantities listed above--the relative elevation. Summit locations are generally given only by verbal descriptions (i.e., "West wall of Aristarchus"), and shadow-tip positions are usually not given at all (although they sometimes may be computed from published data on the solar altitude and apparent shadow length--subject to the accuracy of the summit position itself). Thus, such measures, although valuable for many purposes, are almost useless in the compilation of a detailed topographic map.

Because of the unsuitability of previous altitude measures, a program of A.L.P.O. relative altitude determinations was conducted in order to provide vertical control for the AHR map.

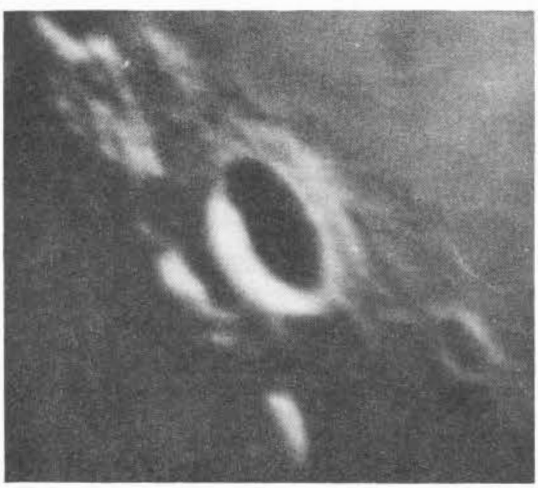

Figure 5. A sample of the photographs of the AHR contributed by A.L.P.O. members. This photograph was taken by Patrick S. McIntosh on May 5, 1963, at 05:38 U.T., with a 12-inch coelostat. Colong. = 49°.0; the sun is rising on Herodotus, and the low solar angle brings out well the low ridges in the *mare* south of Aristarchus. North at top. Some detail on the photograph may have been lost in reproduction.

Two A.L.P.O. members made a total of 174 altitude determinations for the AHR Project, using the following methods:

1. Visual estimation of shadow lengths by comparison with craters of known diameter (67 altitudes).
2. Scaling of shadow lengths from photographs--either enlargements or half-tone reproductions (104 altitudes).
3. Visual estimation of shadow lengths at time of terminator contact (3 altitudes).

Table 6 gives the sources for these altitude determinations.

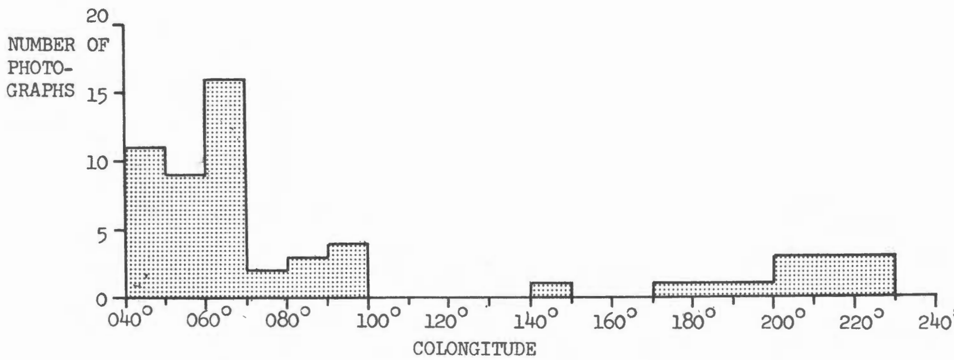

Figure 6. Colongitude distribution of photographs consulted for the AHR Project. The 58 photographs are grouped into 10-degree intervals of colongitude. There is the same strong bias toward early morning observations as in the visual data represented in Figure 1.

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Table 6. A.L.P.O. Altitude Determinations for AHR Project.

VISUAL DETERMINATIONS		70
H. D. Jamieson	67	
J. E. Westfall	3	
PHOTOGRAPHIC DETERMINATIONS		104
PLA E-3a (M191)[a] (Jamieson)	1	
OLA E-3a[b] (Jamieson)	1	
PLA F-3e (P14a)(Westfall)	25	
P. S. McIntosh, 5 May, 1963 (Westfall)	21	
PLA F-3a (Y110)(Westfall)	19	
PLA E-3b (M3)(Westfall)	37	

[a] I.e., Plate E-3a of Kuiper, Photographic Lunar Atlas.

[b] I.e., Plate E-3a of Arthur and Whitaker, Orthographic Atlas of the Moon.

Dr. Lincoln E. Bragg performed many of the necessary computations for reducing the above altitude measures.

In all measures, the locations of both the summit and the shadow tip were plotted on the 1/500,000-scale Outline Form used for visual observations, which provided positions accurate enough to be used in the compilation of the final map. Jamieson's measures were of particular value because he made repeated measures of the heights of a selected group of summits at different solar altitudes, thus allowing profiles to be drawn through them.

The accuracy limits of the A.L.P.O. altitudes measures cannot be stated definitely, but most altitudes appear to be accurate to within one-half the contour interval of the AHR map (i.e., 125 meters since the contour interval is 250 meters). An accuracy of 125 meters in elevation implies the following accuracies in estimating shadow lengths, depending on the solar altitude:

Solar Altitude = 20°, shadow length accurate to 340 meters.
" " 10°, " " " to 710 meters.
" " 5°, " " " to 1,400 meters.
" " 2°, " " " to 3,600 meters.
" " 1°, " " " to 7,200 meters.

B. Slopes.

A.L.P.O. observations of the AHR under high lighting were studied in order to detect areas of unusually steep slopes by the presence of shadow under a high sun. This study was carried out in conjunction with the A.L.P.O. Lunar Section's "Steep Places Survey," conducted by Charles L. Ricker. Such a search is, of course, biased toward East or West slopes; for North or South slopes do not cast shadows at the latitude of the AHR. Ten such "steep places" (i.e., with slopes in excess of 25°) were so detected and are listed in Table 7.

Table 7. Unusually Steep Slopes within the AHR.

Description of Area	Colongitude Range for: Shadow Disappearance (West Slope)	Colongitude Range for: Shadow Appearance (East Slope)	Angle of Slope
1. Summit of E glacis of Aristarchus	------	170-72°	50° ± 1°
2. SW inner wall of Aristarchus	------	172-82	47 ± 3[a]
3. Terrace near summit of W-SW inner wall of Aristarchus	------	170-72	51 ± 1
4. E inner wall of Herodotus	079-83°	------	28 ± 2
5. W & SW inner wall of Herodotus	------	182-206	34 ± 10
6. NE inner wall of Herodotus	087-90	------	34½ ± 1
7. Valley immediately N of (6)	079-83	------	28 ± 2
8. E. inner wall of "Cobra Head"	079-83	------	28 ± 2
9. W inner wall of "Cobra Head" and W inner wall of Vallis Schroeteri (S of 25°.2 N lat.)	------	182-206	34 ± 10[b]
10. E inner wall of Vallis Schroeteri (24°.6-25°.2 N lat.)	086-90	------	35 ± 2

[a]Over 31°: Pohn, "New Measurements of Steep Lunar Slopes," p. 187.

[b]Over 32°: Ashbrook, "A Working List of Steep Places on the Moon," p. 42. This would make the slope of (8) equal to 38° ± 6°.

The existence of two areas (1 and 3) with slopes of about 50 degrees is interesting. The AHR steep places survey was conducted with moderate apertures, and an intensive search with a telescope of 10 inches aperture or more would probably reveal new, smaller areas of unusual steepness. A continuation of this observational program would also reduce the uncertainty of some of the slopes in Table 7, e.g., (5) and (9).

V. COMPILATION

A. Sources.

The sources consulted for the compilation of the final AHR map were as follows:

1. Published materials, representing a fairly exhaustive literature search through mid-1968. References consulted are listed in Appendix B. Bibliography.

2. Drawings, both ones previously published (see Appendix B) and the 110 prepared by A.L.P.O. observers for the AHR Project (see Section II.A.).

3. Earthbased photographs, including published half-tone reproductions, enlargements of Lick and Table Mountain Observatory photographs, and photographs taken by A.L.P.O. members for the AHR Project (see Section II.B.).

4. Lunar Orbiter photographs, consisting of eight frames exposed by Orbiter-IV and Orbiter-V (see Sections II.B. and V.D.). These photographs were taken when compilation was near completion so that their main use was to verify and to add to the topographic detail derived from earthbased observations.

Two of the best earthbased photographs used, both taken with the Lick Observatory 120-inch (305-cm.) reflector, are shown in Figure 7.

B. Construction of Model.

Following the collection and analysis of source material, the next step in compilation of the final map was the construction of a relief model of the AHR at 1/250,000 horizontal and vertical scales. The construction procedure, using plasticene clay, was similar to that previously used by the writer for a model of Eratosthenes,[17] and so only a brief summary need be given here.

First, a base of fiberboard was overlaid with a level layer of plasticene. Tension screws on the baseboard were used to deform it to correspond to the scale curvature of the lunar surface (695.2 cms. radius). The model was "worked" using a series of ten photographs for which the solar altitudes and azimuths at the center of the AHR had been computed for the times of exposure. These photographs and pertinent data are listed in Table 8.

Table 8. Photographs Used in Construction of AHR Relief Model.

Designation of Photograph	Solar Angular Data		
	Colongitude	Altitude	Azimuth
PSM-10[a]	048°.95	- 0°.2	090°
PLA E-3b[b]	051.79	+ 3.5	092
PLA F-3e	057.18	+ 9.0	094
TMO 1689b[c]	069.56	+19.8	098
PLA F-3a	078.83	+26.4	103
PLA F-3d	085.67	+33.7	107
PLA F-3f	172.13	+49.0	240
PLA E-3a	201.86	+23.7	258
PLA F-3c	202.80	+22.9	259
PLA F-3b	229.19	- 1.2	271

[a]I.e., Photograph No. 10 furnished by Patrick S. McIntosh.

[b]I.e., Plate E-3b in Kuiper, Photographic Lunar Atlas.

[c]I.e., Table Mountain Observatory photograph No. 1689b.

For each photograph, the model was illuminated by a slide projector, placed so that the lighting angle on the model corresponded to that of the sun on the AHR at the time of the photograph. The projector was placed at a distance such that the apparent angular diameter of the lens was the same as the sun's (0°.5). Then, the model was molded by hand until its shadow pattern duplicated that on the photograph. The use of a series of photographs allowed shadow areas to be filled and ambiguities of slope to be resolved. This iterative process produced a model that, when illuminated correctly, duplicated the shadow pattern on any photograph; it was then felt that the model was an accurate scale representation of the AHR, within the resolution limitations of the photographs.

Figure 8 shows two views of the completed 1/250,000 scale plasticene model of the AHR. After completion of the project, a plaster cast was made of the plasticene model for a permanent record.

C. Measurement of Contour Lines.

Provisional 250-meter interval contour lines for the final map were measured directly from the model. To do this, the model was flattened and placed in a tray which was leveled by leveling screws and then gradually filled with a solution of water, india ink, and "Photo-Flo" (an Eastman Kodak Product which reduces surface tension, insuring a level liquid surface). This "flooded" the model, and the "shoreline" of the solution at a particular depth represented a particular contour. Because the vertical scale of the model was 1/250,000, 1 millimeter depth increments represented a contour interval of 250 meters. The model was flooded in twenty-one 1-millimeter stages to cover the entire elevation range in the AHR (about 5,000 meters), each level being photographed.

The contour level photographs were projected, as slides, in sequence onto a base map; and the successive "shorelines" were traced onto this map, resulting in a provisional contour map. These contours were then adjusted to better fit minor relief features and to correspond with the 174 A.L.P.O. relative altitude determinations for the AHR (see Section

Figure 7. Two earthbased photographs of the AHR with unusually high resolution, taken with the Lick Observatory 120-inch reflector. North is at the top in both views. The upper photograph shows the AHR under a low morning sun (Colong. = 057°.3; the solar altitude at the center of the AHR is 9°), taken on September 30, 1963 at 06:48:30 U.T. The lower view was taken under a high sun (Colong. = 148°.8; solar altitude at center of AHR = 65°), bringing out the tonal variations within the region—except in Aristarchus, which is highly overexposed. Taken on June 22, 1962, at 12:11 U.T. Again, some detail on the photographs may be lost in reproduction.

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IV.A.).

Although contour lines theoretically can give a complete topographic description, they are not very graphic and thus are difficult to interpret unless one is familiar with them. For this reason, a method of relief depiction known as hachuring was used to supplement the contour lines. In the hachure system employed by the writer (modified from the Dufour system used in Swiss topographic maps), the hachures are short lines pointing downslope and are slightly broadened at their high end. Steep slopes are represented by closely spaced hachures (the spacing becomes zero for slopes over 45°); gentle slopes, by widely spaced hachures. In order to give a more graphic effect, oblique hachuring was used, the illumination being assumed to come from the West (lower left on the final map), and the hachures were drawn with thinner lines on the lightward slopes than on the shaded slope (i.e., 0.2 mms. vs. 0.3 mms.). On the original map, contour lines were drawn in black and hachures in brown; the hachures appear grey on the reproduction published with this report. A number of vertical photographs of the model, at differing angles of illumination, were helpful in drawing the hachures.

Naturally, all altitudes given or implied on the AHR map are based on an arbitrary datum (i.e., "zero" contour from which all others are measured). This is due to the moon's lack of a natural datum surface. It is of some interest to know the absolute altitude of the arbitrary datum in terms of its radius vector from the moon's center; unfortunately, this value can be found only approximately. The writer estimated this radius vector by a

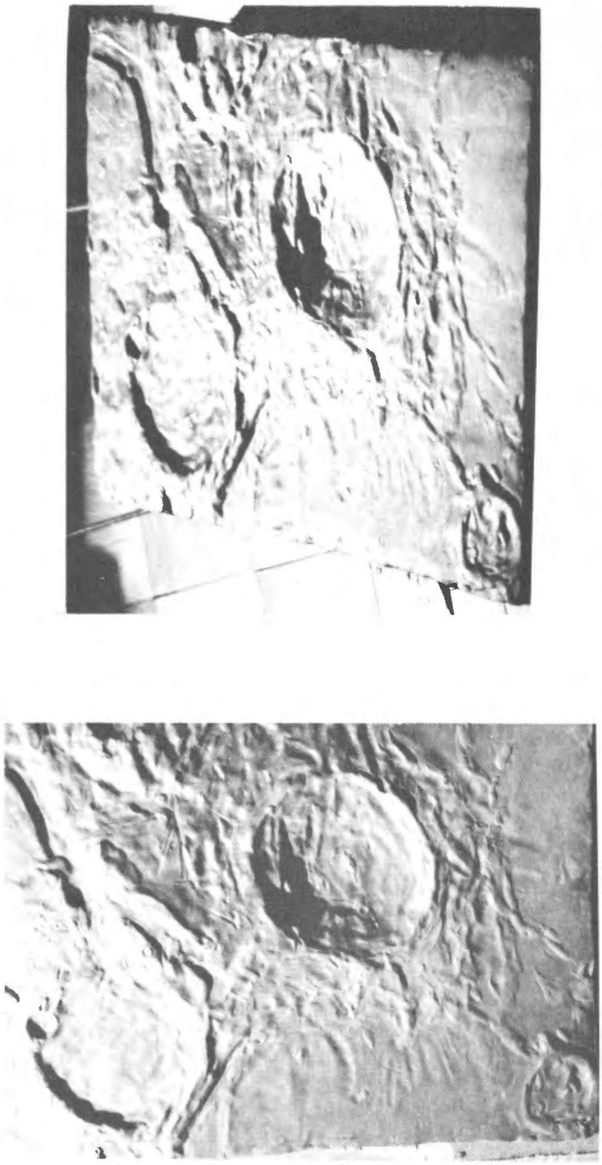

Figure 8. Two photographs of the plasticene model of the AHR under a simulated late afternoon sun (solar altitude = 20°; Colong. = 207°). The upper view approximates the perspective from Earth at mean libration. The bottom view is a vertical view in "true" perspective. The model does not show the changes subsequently made to the AHR map from the Lunar Orbiter photographs. North at top in both views, and IAU East at right.

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two-step process:

First, the AHR is shown on two USAF-ACIC LAC's (i.e., United States Air Force, Aeronautical Chart and Information Center, Lunar Astronautic Charts, at 1/1,000,000 scale), LAC-38 (West of 50° West) and LAC-39 (East of 50° West). Both these charts show elevations by 300-meter contours, with spot elevations given more precisely (to 100, 50, or 10 meters). Several features on these charts have measured radius vectors[18] so that the absolute chart datums can be estimated.

Second, elevations of the same features, as shown on the LAC's and the A.L.P.O. AHR map, were compared, giving the difference between the ACIC and the A.L.P.O. datums. Then, assuming the ACIC datum to be correct, the A.L.P.O. datum could be found approximately.

Tables 9 and 10 summarize this two-step process.

The mean absolute datum of the LAC-38 is 1735.6 kms., and that of LAC-39 is 1734.3 kms., indicating that the contours on LAC-38 should be 1.3 kms. lower than those on LAC-39. It is evident that this figure is quite uncertain since the contours on the East margin of LAC-38 are about 1.8 kms. lower than on the West margin of LAC-39; also, the datums of both charts are stated to be 1735.4 kms.

Table 9. Estimated Absolute Datums, LAC-38 and -39.

Chart	Feature Identification	ACIC Point Designation	Elevation in Kilometers: Rim Elev. on LAC	Radius Vector[a]	Derived Abs. Datum
LAC-38	Herodotus A	130	+ 1.22	1736.91 ± .22	1735.69
LAC-38	Marius M	131	+ 0.73	1736.22 ± .06	1735.49
LAC-39	Wollaston	124	+ 2.72	1736.58 ± .05	1733.86

Table 9. Estimated Absolute Datums, LAC-38 and -39. (Cont.)

Chart	Feature Identification	ACIC Point Designation	Elevation in Kilometers: Rim Elev. on LAC	Radius Vector[a]	Derived Abs. Datum
LAC-39	Diophantus B	125	+ 3.64	1737.88 ± .18	1734.24
LAC-39	Brayley D	129	+ 4.23	1738.89 ± .01	1734.66

[a]Meyer and Ruffin, loc. cit. The probable error (±) is 0.6745 σ_R.

Table 10. Estimated Datum of AHR Map Based on Datums of LAC-38 and -39.

Area	LAC No.	LAC Elev. (kms.)	Elev. (kms.) AHR	Elev. (kms.) (LAC - AHR)	Derived AHR Datum (kms.)
Aristarchus--floor	39	2.4	1.0	+ 1.4	1735.7
Herodotus--floor	39	4.5	3.2	+ 1.3	1735.6
Herodotus--floor	38	2.4	3.2	- 0.8	1734.8
Mare near Aristarchus H	39	3.3	2.8	+ 0.5	1734.8
Mare near 22°N/48°.5 W	39	3.6	2.8	+ 0.8	1735.1
Aristarchus--rim	39	5.8	5.0	+ 0.8	1735.1
Herodotus--rim	39	5.8	4.5	+ 1.3	1735.6
Herodotus--NE rim peak	39	6.4	5.0	+ 1.4	1735.7
Peak SE of Cobra Head	39	6.3	6.0	+ 0.3	1734.6
Cobra Head--floor	39	4.8	4.0	+ 0.8	1735.1
					Mean = 1735.2 ± 0.3

Because the A.L.P.O. AHR map shows the elevation of the mare to the South and East of Herodotus as about 2,000 meters (+ 2.0 kms.), the general level of the surface seems to have a radius vector slightly above 1737 kms. so that the original assumption of a lunar sphere of radius 1738 kms. (see above, Section III.A.) does not appear to be greatly in error.

D. Orbiter Photographs.

During 1967, Lunar Orbiters -IV and -V photographed the AHR under a morning sun, at a ground resolution of about 80 meters for Orbiter-IV and as small as 3 meters for Orbiter-V. These photographs became available during the final compilation of the AHR map.

As described above (Section III.B.), Orbiter-IV High Resolution Frame No. 150 was used for secondary horizontal control of the AHR map, making a complete recompilation necessary. The several Orbiter frames were also used to confirm and revise detail that was only marginally visible in earthbased visual observations and photographs. In addition, many minute features were added from the Orbiter photographs which had been previously completely unknown.

Although the Orbiter photographs were valuable in compiling the final AHR map, they have serious limitations due to their being exposed only for a very limited range of solar illumination. First, large areas (e.g., the East inner wall of Aristarchus) were completely in shadow. Conversely, some bright sunward-facing slopes were seriously overexposed (e.g., the West inner wall of Aristarchus) so that little detail could be seen. Also, altitudes were not measured from the Orbiter photographs because the limited range of colongitudes made it impossible to draw profiles, which would be necessary in order to revise contour lines. The contour lines and hachures, however, were modified to fit the small details visible in the Orbiter views. Some of the Orbiter-V views of the AHR overlapped and made stereoscopic views possible. It is hoped that these will be used by ACIC or AMS, using photogrammetric methods, to produce contour maps with which the A.L.P.O. map can be compared.

Figures 9, 10, 11, and 12 are a sample of the Orbiter photographs of the AHR. Figure 9, by Orbiter-IV, shows the approximate boundaries of the AHR map. Figures 10-12 are all larger-scale views taken by Orbiter-V.

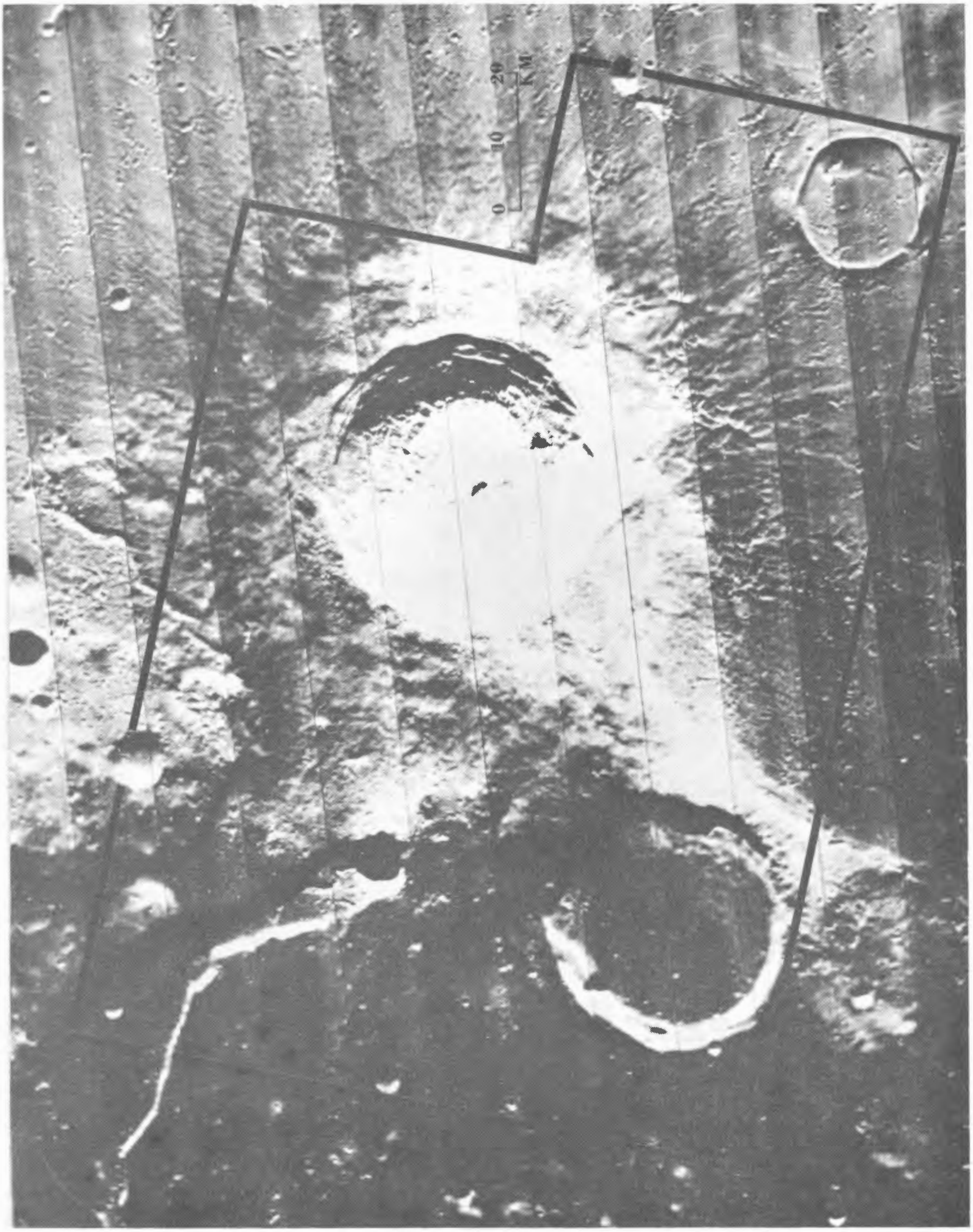

Figure 9. A general view of the AHR by Orbiter-IV (frame H-150). The outlines of the final AHR map are superimposed on the photograph. North is at the left. Data for this photograph are: U.T. date and time of exposure = 1967, May 22, 06:00:12. Colong. = 067°.4 (solar altitude at center of AHR = 17°). Altitude of spacecraft = 2667.04 kms. Angle between surface and camera axis = 86°.78.

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Notes by Editor. Dr. Westfall's final topographic map of the Aristarchus-Herodotus region is reproduced as Figure 13 on pages 198 and 199 at a reduced scale of 1/500,000 (1 cm. = 5 kms., 1 inch = 7.89 miles).

Figure 10. The SW portion of the rim of Aristarchus, as photographed by Orbiter-V (frame H-198) on August 18, 1967. The photograph is 11.6 kms. in width. North at left, sun to the top at an altitude of 16°. Several interesting features that are discussed in the text are shown: the SW rim "craterlet" and "trough" (lower right, scene of one of the "red glows" observed by Greenacre and Barr), the radial furrows possibly associated with the dark bands of Aristarchus (center), several wall terraces, a large number of rock fragments, and a cleft on the crater floor (upper left).

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We regret the need to publish this paper in several serial installments. Its physical length is simply too great for one issue. We congratulate Dr. Westfall, Mr. McIntosh, and all the others who had a share in the work which culminated in this Final Report, definitely including the A.L.P.O. observers themselves of Aristarchus and Herodotus. We hear many questions these days about the value of continuing amateur, and even earth-based, observations of the moon and the planets. Perhaps a Final Report of the quality of this

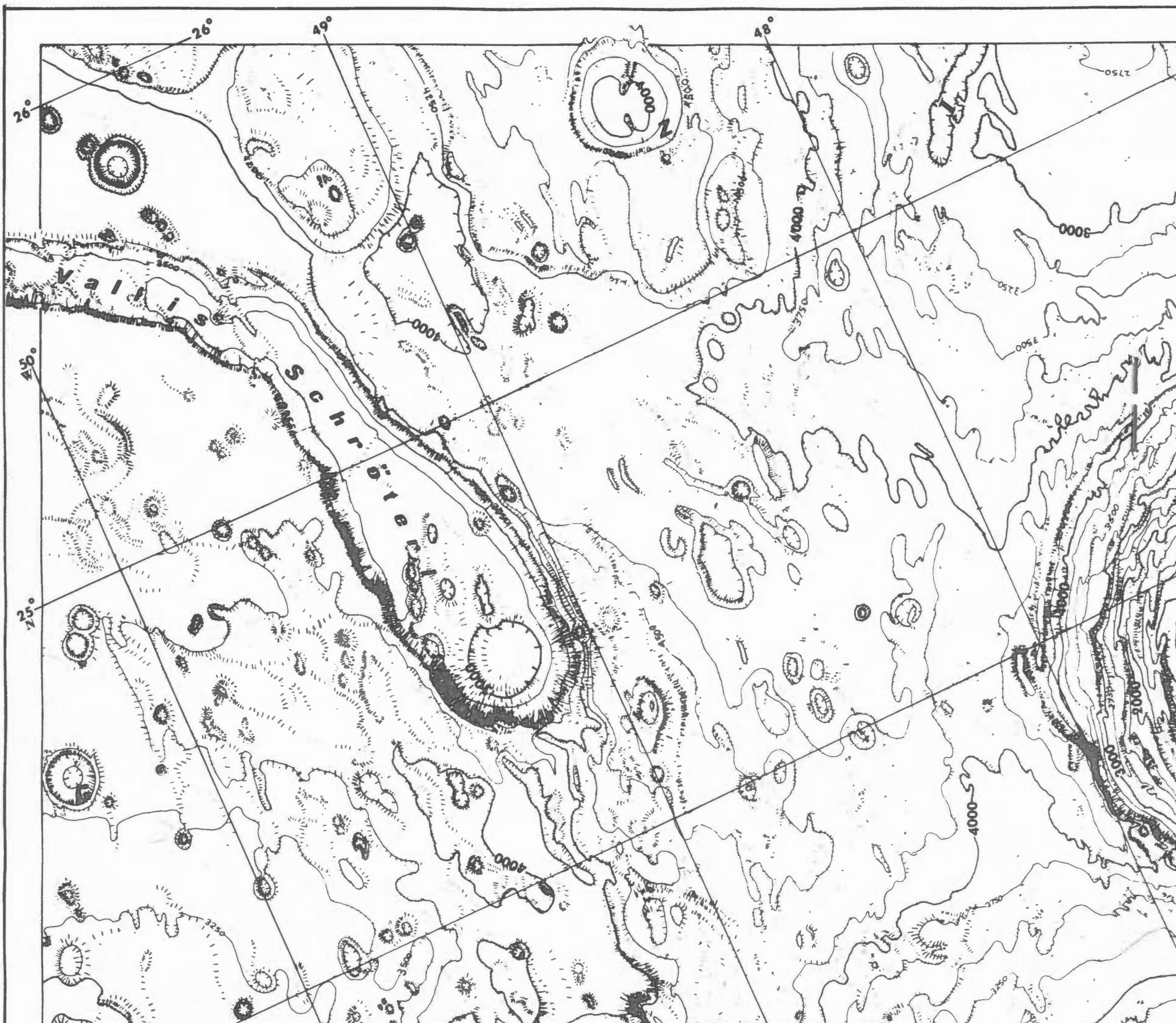
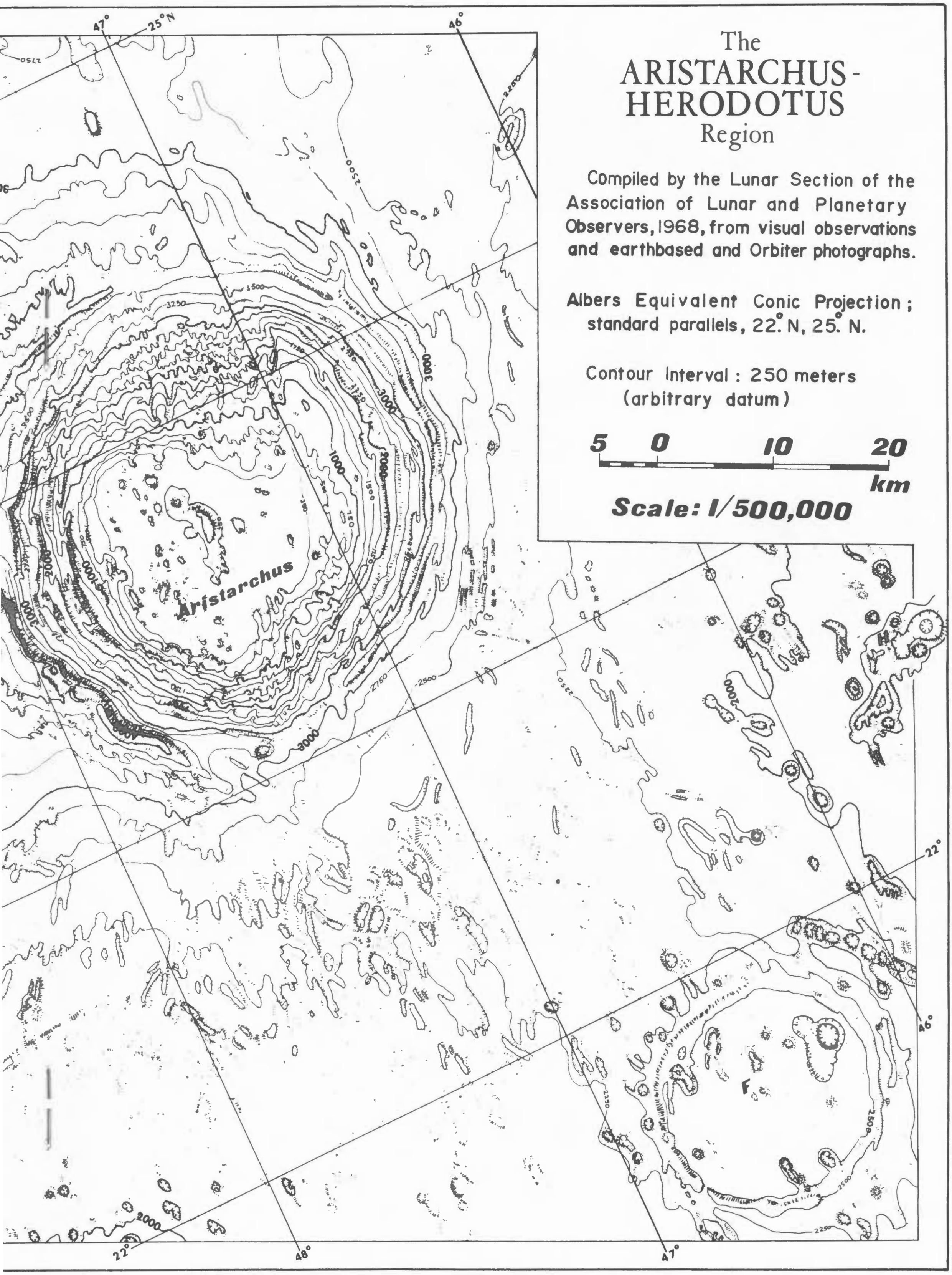


FIGURE 13. THE FINAL RELIEF MAP OF THE ARISTARCHUS-HERODOTUS REGION. THE INDICATED SCALE
CORDANCE WITH I.A.U. NOMENCLATURE. THE REPRO AND PHOTO SECTION OF THE PHYSICAL SCIENCE



(1/500,000) IS VERY NEARLY CORRECT FOR THIS PUBLISHED REPRODUCTION. PLACE NAMES ARE IN AC-
LABORATORY AT NEW MEXICO STATE UNIVERSITY ASSISTED IN PREPARING THIS MAP FOR PUBLICATION.

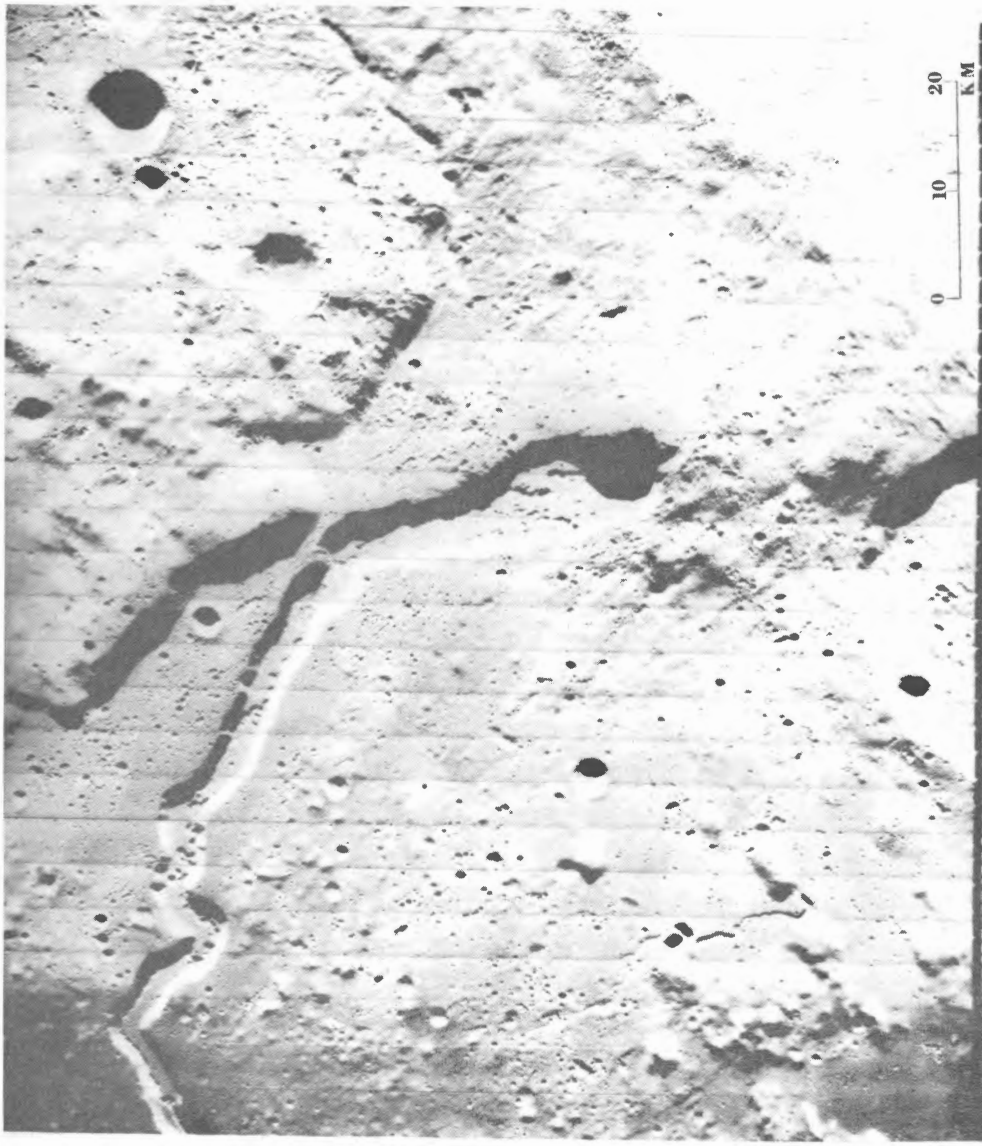


Figure 11. An Orbiter-V view (frame M-202) of Schroeter's Valley and vicinity. North is at the left, the "Cobra Head" slightly right of center, part of Herodotus is at the right, and part of Aristarchus shows in the upper right corner. The area shown is about 105 kms. in width, and was photographed on August 18, 1967, with a solar altitude of about 15°.

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paper will help to show the kind of analysis which it is possible to accomplish from visual observations and amateur-made photographs of sufficiently good quality. We would hope that such a report will encourage increased participation in the projects of the A.L.P.O. Lunar Section.

(To be continued in next issue.)

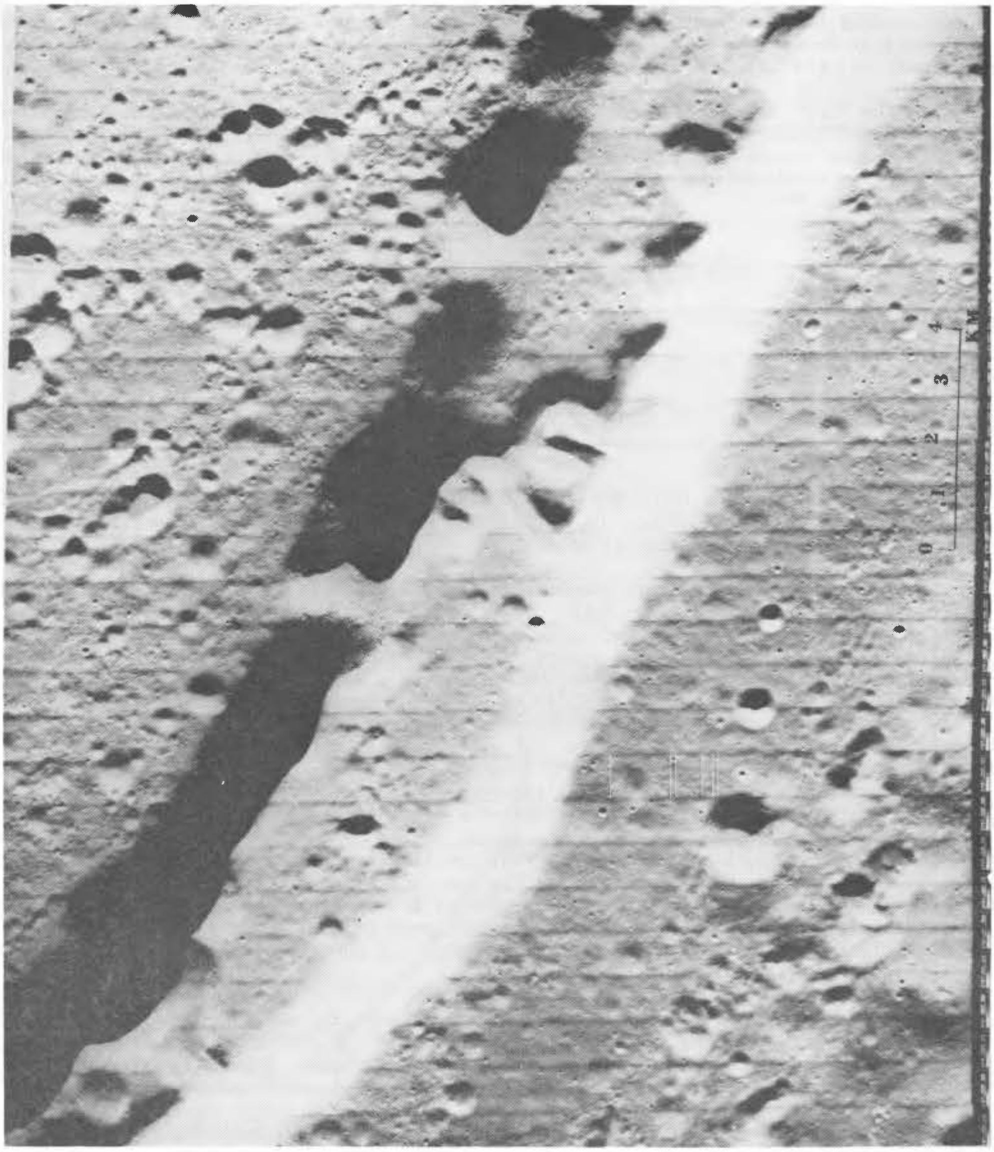

Figure 12. A large-scale view of a portion of Schroeter's Valley (49°9 W/25°7 N), taken on August 18, 1967 by Orbiter-V (frame H-204) with a solar altitude of 15°. North is at the left, and the horizontal (N-S) dimension of the area shown is 17.5 kms. Note the unusual meandering depression on the south portion of the valley floor as well as several prominent landslips on the northern wall. The valley is about 6 kms. wide in this portion.

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COMA DIAMETER OF COMET IKEYA-SEKI 1965f

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

The preceding ALPO paper on the Great Comet of 1965 dealt with the development of its tail (Strolling Astronomer, Vol. 21, Nos. 9-10, July, 1969). Now the ALPO Comets Section has prepared a graph of the diameter of the coma, using only visual estimates with one exception: R. B. Minton measured the Tokyo Observatory photograph taken on the date of perihelion which was published in the December, 1965, Sky and Telescope, page 332. Methods used by the observers varied; Gordon Solberg compared the coma to Jupiter and other objects by moving his telescope, while Minton used the eyepiece reticle illustrated here (Figure 15) and allowed the comet to drift across it (see Figure 16).

The first step in this analysis was to convert the observed diameters in minutes of arc to real diameters in kilometers, and this was done by Solberg at New Mexico State University Observatory. Using an electronic computer he corrected the observed estimates for the varying earth distance with the formula:

$$d = \frac{\Delta \theta}{206,265}, \text{ where}$$

d is the coma diameter in kilometers,

θ is the angular diameter of the coma in seconds of arc,

Δ is the distance between the earth and the comet in kilometers, and

206,265 is the number of seconds of arc in a radian.

The observations show a large amount of scatter, but this is not unexpected. The maximum divergence on the graph (Figure 14 on pg. 203) represents a factor of two in estimating a coma size of about three minutes of arc.

Our graph shows the coma diameter of Ikeya-Seki as it approached toward, and receded from the sun in 1965 and early 1966. The plotted points are daily averages, with the average number of observations two and the maximum seven. The total number of observed diameters is 107. The diameter is seen to increase from the start of the graph on September 23, 1965, to a maximum of about 200,000 kilometers a week or so later. Then the coma diameter began to shrink, getting smaller as the comet approached perihelion, which occurred on October 21st. After perihelion the coma grew; but the diameter diminished again in January, 1966, when Ikeya-Seki was over two astronomical units from the sun.

The symmetrical development of the coma (before and after perihelion) follows the stages outlined for comets by Zdenek Sekanina in the Bulletin of the Astronomical Institutes of Czechoslovakia, Vol. 12, 1961, No.1. While he described three stages in coma development for a comet approaching the sun, the ALPO reports begin at Sekanina's second stage, when the coma was growing. At this time gas was evaporating from the nucleus. Then, in the third stage, the coma decreases as a comet gets closer to the sun. The solar distances at which the three stages occur have been related by Sekanina to the rate of coma brightening, the period of revolution about the sun, and the semi-major axis of the orbit.

The art work on the graph presented here (Figure 14) was done by R. B. Minton, Las Cruces, New Mexico, using the coma diameters computed by Gordon Solberg. The curve was drawn freehand by Mr. Minton to a reasonable approximation. Observations by the following persons were used (with their 1965 locations):

John Bortle, Mount Vernon, N. Y.
Darrell Conger, Elizabeth, W. Va.
Rev. Kenneth Delano, New Bedford, Mass.
William Glenn, Bronx, N. Y.
Bill Grady, Morgantown, W. Va.
Walter Haas, Las Cruces, N. M.
Alika Herring, Tucson, Ariz.
Craig Johnson, Boulder, Colo.
Michael McCants, Houston, Tex.
Lee McDonald, Tucson, Ariz.
David Meisel, Charlottesville, Va.
Dennis Milon, Tucson, Ariz.
R. B. Minton, El Paso, Tex.
Karl Simmons, Jacksonville, Fla.
Gordon Solberg, Las Cruces, N. M.

Table I. A.L.P.O. Observations of Coma Diameter of Comet Ikeya-Seki 1965f

U.T. Date (1965)	Observer	Coma Diameter	U.T. Date (1965)	Observer	Coma Diameter
Sept. 23.50	Minton	1!6	Sept. 25.50	Milon	4'
24.48	Solberg	2.5	26.48	Minton	1.5
24.48	Minton	1.5	26.49	Solberg	3-4
24.49	Herring	3.5	26.50	Milon	4.5
25.40	Bortle	3	27.40	Bortle	3

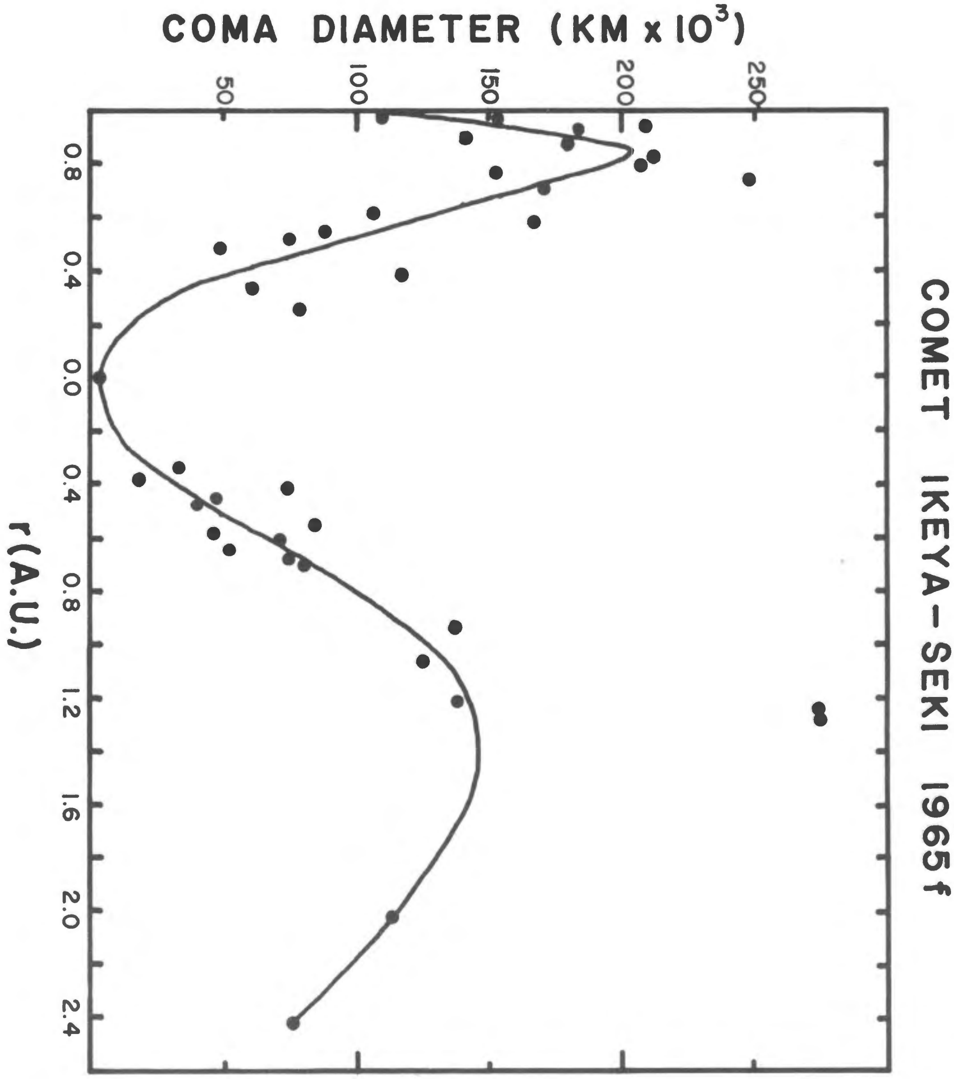

Figure 14. A graph of the coma diameter of Comet Ikeya-Seki 1965f. A.L.P.O. observed angular diameters from Table I have been converted to actual diameters in thousands of kilometers and are plotted against the comet's distance from the sun (r) in astronomical units. Perihelion occurred on October 21, 1965 with r = 0.0. R. B. Minton of New Mexico State University Observatory constructed this graph from points supplied by Gordon Solberg.

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Table I. A.L.P.O. Observations of Coma Diameter of Comet Ikeya-Seki 1965f (Cont.)

U.T. Date (1965)	Observer	Coma Diameter	U.T. Date (1965)	Observer	Coma Diameter
Sept. 27.49	Minton	2'	Sept. 28.50	Milon	3!5
27.50	Solberg	2.5	30.50	Solberg	4
28.40	Bortle	3	30.51	McDonald	4
28.47	McCants	2-3	Oct. 1.48	Minton	3-4
28.49	Solberg	5	1.50	Herring	4.5

Table I. A.L.P.O. Observations of Coma Diameter of Comet Ikeya-Seki 1965f (Cont.)

U.T. Date (1965)	Observer	Coma Diameter
Oct. 2.41	Bortle	2'.5
2.49	Solberg	3
2.50	Minton	3.5
3.41	Bortle	5
4.41	Bortle	4
4.50	Minton	3
5.41	Bortle	3.5
5.49	Minton	2.8
6.49	Johnson	4-5
6.49	Minton	2.3
6.50	Solberg	2
7.49	Minton	1.8
7.49	Johnson	3
7.50	Solberg	2
8.44	Simmons	5
8.47	McCants	5
8.50	Solberg	1.5
8.50	Johnson	5
8.50	Minton	2
9.50	Minton	1.8
10.50	Johnson	2-3
10.50	Solberg	1
11.50	Solberg	1
11.53	Haas	1.3
12.50	Solberg	1
12.50	Johnson	2-3
12.51	Minton	1
12.53	Haas	2.5
13.43	Bortle	2
13.51	Solberg	0.7
13.51	Minton	1.8
13.52	Haas	1.5
14.51	Johnson	4
14.52	Minton	1.8
15.52	Haas	1.5
17.50	McCants	1-2
Oct. 25.52	Solberg	0.3
26.50	Milon	0.3
26.50	Solberg	0.5
26.53	Minton	0.5
27.52	Solberg	0.5
Oct. 27.52	Johnson	1'
28.52	Solberg	0.5
29.44	Bortle	2
29.44	Simmons	3
29.50	Johnson	1
29.50	Solberg	0.5
30.42	Bortle	1.5
30.44	Meisel	0.5
30.47	Glenn	2
30.47	Glenn	1
30.48	McCants	2
30.50	Solberg	0.5
31.42	Bortle	1.5
31.44	Meisel	0.5
31.47	Glenn	1
31.51	Solberg	0.5
Nov. 1.43	Bortle	1.5
1.44	Meisel	0.8
1.50	Solberg	0.7
1.51	Johnson	1.3
2.43	Bortle	1.5
2.44	Conger	2-3
2.51	Solberg	0.8
2.52	Haas	2-3
3.51	Johnson	0.8
4.50	Solberg	1.2
4.53	Haas	2
5.42	Delano	0.5
5.44	Bortle	1.5
5.50	Solberg	1.5
6.43	Bortle	1.5
6.44	Glenn	0.5
6.50	Solberg	1.5
6.51	Haas	3
7.50	Solberg	1.8
15.42	Bortle	1.8
15.42	Delano	1.2
20.51	Solberg	3
20.51	Haas	2.5
26.51	Solberg	3
28.43	Bortle	5-7
28.44	Grady	6
29.43	Bortle	6

SOLAR ECLIPSE PLANS FOR MARCH 7, 1970 BY THE ASTRONOMICAL LEAGUE FOR U.S.A. STATIONS AND FOR MEXICO

By: Russell C. Maag, Chairman, Coördinating Committee

Astronomers, both professional and amateur, will be afforded one of the finest opportunities to do useful scientific work on the upcoming total solar eclipse on March 7, 1970.

The Astronomical League is making a concerted effort in laying plans to provide a service in the way of guidelines for several phases of observational activity. All plans by the League are being channeled through a coördinating committee of the National Science Foundation, Washington, D.C., under the chairmanship of Dr. Albert E. Belon. This organ-

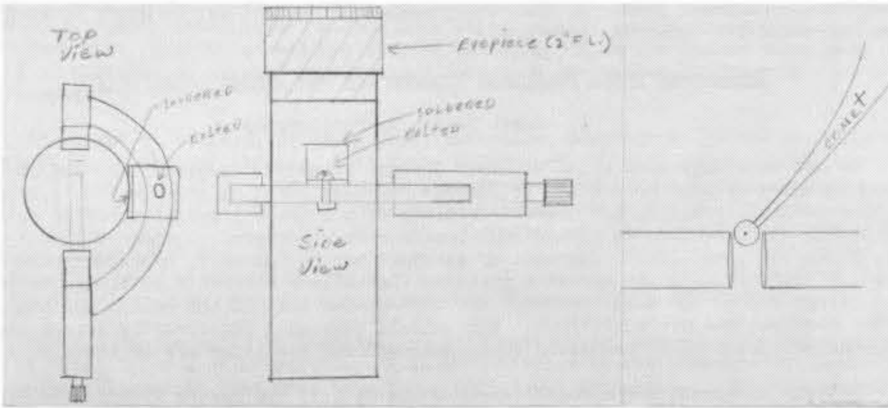

Figure 15. An eyepiece micrometer devised by R. B. Minton for his coma diameter measurements of Comet Ikeya-Seki 1965f. The instrument was calibrated by allowing stars to trail between the jaws of the micrometer and by then applying the table in The Strolling Astronomer, Vol. 20, Nos. 11-12 (Nov.-Dec., 1966), page 206. Mr. Minton mounted this eyepiece on a $4\frac{1}{4}$-inch reflector.

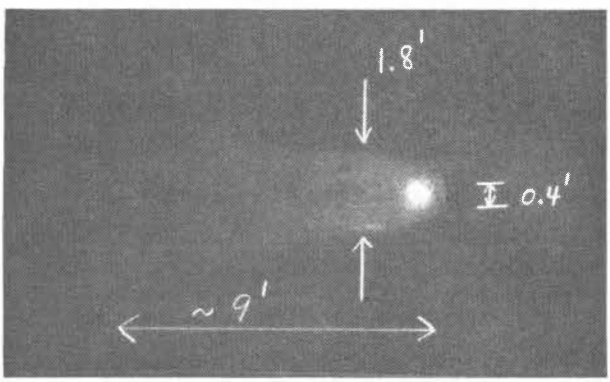

Figure 16. A measurement of the coma diameter of Comet Ikeya-Seki 1965f by R. B. Minton on October 13, 1965, using the device pictured in Figure 15 on his $4\frac{1}{4}$-inch reflector. Approaching perihelion, the comet was only a few degrees above the eastern horizon when observed on this date. Minton estimated the total stellar magnitude at 3.8 in 7 X 50 binoculars.

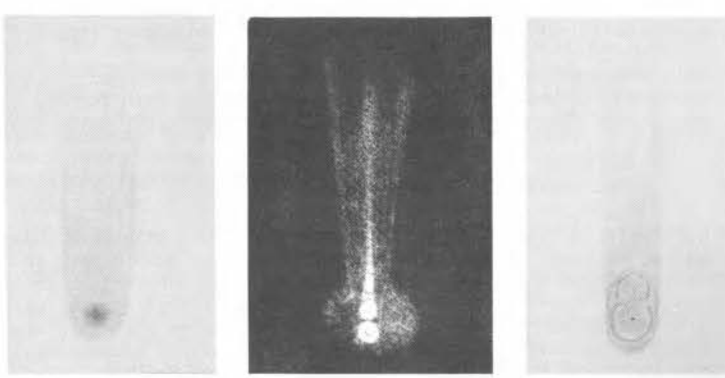

Figure 17. The progressive splitting of the nucleus of Comet Ikeya-Seki 1965f after its perihelion passage. Left drawing, John Bortle on November 6, 1965, 5-inch refractor, 50X, coma diameter $1\frac{1}{2}$ minutes of arc; center, Charles Capen on November 7, bluish color, 16-inch reflector, 105X; right drawing, Bortle on November 15.

ization in turn is coöperating with counterpart groups in both Mexico and Canada. All groups of amateurs and professionals are urged to register their observational intentions through these national groups so that assignments and control may be given to specific areas set aside for observing team use.

Outline of Total Observing Program for The Astronomical League

1. Comet Search by Photography

As has been suggested by ALPO Comets Section Recorder, Dennis Milon, and as has been stated in notes by John Bortle and Dr. George Van Biesbroeck, a photographic search for comets near perihelion during the time of totality of a solar eclipse is a highly recommended project for all observers to engage in. Comets were discovered at solar eclipses in 1882, 1893, 1948, 1963, and 1966. Searches by amateurs can be valuable, especially if their observations contribute to an accurate position that allows a comet's motion to be detected as it swings around the sun. An orbit can be computed only if the motion and time interval between observations are sufficient. Thus widely separated photographic search stations along the eclipse path at precisely known geographical positions are worthwhile.

Minimum equipment for a comet search would be a 35 mm. camera with a wide field and fast lens system having the best quality lenses available. Use of 105 mm. and 135 mm. telephoto lens systems is highly recommended also. Fast lens systems with fast film for the shortest possible exposure time would be a good general rule to follow. Tri-X film in a 35 mm. camera with a 50 mm. lens can be used, and the system would not need be clock driven.

The best photographic system would be the use of astro-cameras with f/ratios of 2.5 to 6. The war surplus Aero-Ektar lens systems, such as the 4-inch aperture f/6, <u>or better</u> the 4.8-inch f/2.5, are highly recommended. The former lens should be masked down to, say, 3 inches in order to cut down inherent field curvature. All lens systems, as a general rule, should be tested out well ahead of eclipse time for field curvature and other aberrations; and if any faults are quite apparent, the lens should be rejected, especially for comet photography as well as for the photography for coronal streamers--a description of which follows. The astro-cameras, with means for accurate alignment, should be attached to a regular astronomical telescope in a "piggy-back" fashion, with the telescope acting as the guide instrument for the array; and it is recommended that the whole system be clock driven.

Tri-X, Royal X Pan, or most other panchromatic film is recommended, because sun-grazing comets most often have a yellow head as they pass perihelion, and hence a yellow sensitive emulsion is needed. All color film having an A.S.A. rating of 64 or above is highly recommended. If one can afford them, spectroscopic emulsions and appropriate filters are highly recommended. Again many trial exposures should be made under varying conditions in order to know what a particular system will do with a particular film under ideal as well as adverse lighting conditions.

For all photographic efforts, self-processing of film is highly recommended because one can increase both film speed and contrast over that needed for ordinary everyday photographs. Experiments should also be conducted to find out how much grain is tolerable as well as to learn to recognize spurious images due to such things as film crinkles due to pressure exposure during storage, lens reflections and dust in the enlarger, etc.

It will be mandatory, considering any scientific value for all solar eclipse photography, that exposures be timed, as nearly as possible, to the second, both for the beginning and ending of exposure. Good timing methods will need to be practiced, using stop watches and WWV time signals.

2. Polarization Photography

A series of photographs taken with small cameras equipped with a rotatable polaroid filter in the optical system, as close to the film plane as possible, should make an interesting experiment. Provision should be made for rotating the filter for various orientations <u>of a known amount</u>, such as 0°, 10°, 20°, or some other known increments for each exposure. A photographic step-wedge should also be used in the set-up so that densities of exposure are known. Electronic photometric measuring devices are highly recommended for this project also in order to record subtle as well as marked changes in light intensity as totality approaches, occurs, and ends.

3. Shadow Band Photography

Just before and following totality, a rapidly moving series of linear shadows can be seen passing over the observer's ground during a solar eclipse. Fast single frame and/or motion picture cameras with fast film may capture these elusive shadow bands. Large screens of light colored paper, cloth, or a white painted surface could be set up to increase contrast; and the screen can thus be photographed as the shadow bands pass over it. Sheets of masonite or plywood panels 4 x 8 feet with the reflective materials covering them are recommended.

Mr. Edgar M. Paulton, 27 Joyce Road, Hartsdale, New York 10530 and Dr. Malcolm Hults, Chairman, Department of Physics, Ball State University, Muncie, Indiana 47306 have been working on shadow band problems for many years. These gentlemen have diagrams and instructions for use of screens and other devices to be employed in the photographic attempt to record shadow bands. ALPO readers who are interested in such a project are urged to write to these persons for more details.

4. Prominence Photography

Solar prominences can be photographed with most color sensitive emulsions during the time of totality of a solar eclipse. A camera attached to the eyepiece end of an ordinary telescope will produce good results without additional accessories. Experiments with this type of photography can be conducted at any time, other than during a total solar eclipse, by the use of a camera attached to a solar monochromator having a half-band width hydrogen-alpha filter and an occulting disc. Details of the construction of such a device, costing around $100.00, can be found in the August/September issue, Volume LXII, No. 552, 1968, Review of Popular Astronomy, pages 26-29, an article by Jim Dominy, Cardington, Ohio.

5. Coronal Streamers Photography

A series of photographs taken along the central eclipse path, at various time intervals, can provide a time lapse effect that may, for the first time, reveal motion in, and changes within, the solar coronal streamers. In the eyes of professional astronomers, success in this type of observation would be the most desirable project for the amateur astronomer to engage in. The amateurs' greater numbers and larger geographical spread would give them the advantage for success in this type of observation.

Since the brightness of the inner and outer corona differs by a factor of near 10,000 to 1, this project will try the patience of the amateur astro-photographer! Several methods can be used photographically to record the bright inner corona and the faint outer corona without "burning out" the photographic film over the area of the inner corona. Radially gradient filters with a denser center than periphery and calibrated to the ratio of 10,000 to 1 can be obtained; however, they are very costly. One source, Herron Optical Co., 2035 East 223rd St., Long Beach, California 90810, can supply such filters at a cost of $95.00 each if they are ordered in lots of 24!

Another method is to have a rotating sector with calibrated holes or vanes which radiate out from the center and are mounted as near to the film plane as possible, with the whole arrangement slowly rotating during exposure. No truly satisfactory method of rotating the sector without imparting vibration to the system, which in turn causes unwanted distortion in the photographs, has been found.

The concensus of opinion of several members of the Astronomical League's committee on instrumentation, whose chairman is Ralph K. Dakin, 720 Pittsford-Victor Road, Pittsford, New York 14534, and who is an optical engineer with Bausch and Lomb Optical Co., Rochester, New York, is to recommend the use of a relatively new type of film known as XR - a triple layer emulsion made by the firm of Edgerton, Germeshausen, and Grier, 160 Brookline Ave., Boston, Mass. 02215. This film should serve to capture the inner corona as well as all transition layers out to the very faint outer corona, perhaps to four or five solar radii. The fast layer of the film has an ASA speed of 400; the medium, 10; and the slow layer, 0.004 ASA. The film is panchromatic; and resolution of each layer is 70 lines/mm. for the fast, 50 lines/mm. for the medium, and 30 lines/mm. for the slow with an exposure time of 1.3 seconds. Processing of XR film can be done by commercial firms, laboratories of EG&G Co., Boston; or users can process their own film by using Kodak Color Processing Kit C-22 with development and processing times the same as for Kodacolor films. The XR film is available in sheets of several sizes, 70 mm. and 35 mm. rolls. Motion picture camera films are also available. For a good description of the XR film for astrophotography refer to Sky and Telescope magazine, Volume XXVII, No. 1, January, 1964; or write to the EG&G Co. at Boston, address above.

Several of the League observing teams will use the XR film in 35 mm. cameras (less their normal lens systems) attached to 5-inch, f/5 Apogee refracting telescopes at selected locations along the central path of totality during the eclipse period. Mr. Ed. Halbach, Milwaukee Astronomical Society, has agreed to furnish some 20 Apogee telescopes mounted in cleverly constructed carrying cases-mountings which will be provided for use at these stations. Anyone else having access to these 5-inch Apogee telescopes, which were widely used by amateurs in the "Moonwatch Program," is welcome to construct similar arrays; and these systems may be added to, and are desirable for, use along the path. Construction details will be published in a later bulletin, to be mailed to anyone interested in this project as well as in all other aspects of the League plans. Publication of this coming bulletin is scheduled for about November 1, 1969; and it may be obtained from the writer (address: Russell C. Maag, 1601 Blackwell Road, St. Joseph, Missouri 64505).

6. Observations of Precise Limits of Total Eclipse Path

Using procedures somewhat like those in grazing lunar occultations, or more exactly - partial occultations of planets, discrepancies between the predicted and the actual path of totality band can be found. It can justly be said that by merely the use of the unaided eye, or a small portable telescope, an observer can measure the relative position of the sun and the moon to a degree of accuracy on the order of ten times that of the most sophisticated astrometry tools. A team of observers spaced at close intervals and perpendicular to the direction of travel of the moon's shadow would find that all observers within the shadow band will say that they noted the appearance of the corona for a few seconds, while observers on the other side will say that a minute portion of the sun's limb remained unobscured throughout the mid-phase of totality. In practice, since the moon's limb is irregular due to jagged mountains that are sometimes as much as 4 seconds of arc (apparent size, base to peak), some observers may see totality on and off, once or twice. Baily's Beads may appear; and the corona may appear, faintly, to observers outside of - but very close to - the predicted limits. Work of this nature needs to be done; however, those observers outside the total path will necessarily miss complete totality; and who is willing, therefore, to gamble and to volunteer for this phase of observational activity?

Topographic Map Services

For all phases of the total observational program, precise location of all observing sites is mandatory if one wishes to contribute his observations to the pooled reports following the eclipse. Precise positions along the eclipse path can be measured with sufficient accuracy from geodetic survey maps of the areas. These survey maps may be obtained from Map Information Office, Geological Survey, Washington, D.C. 20242, for all areas of the United States east of the Mississippi River; and for all areas west of the Mississippi, write Distribution Section, Geological Survey, Federal Center, Denver, Colorado 80225. For survey maps of Mexico, write Dr. Guillermo Haro, Observatorio Astronomico Nacional, Apartado Postal 70-264, Ciudad Universitaria, Mexico 20, Mexico. For Canada, write Map Distribution Office, Surveys and Mapping Branch, Department of Energy, Mines and Resources, Ottawa, Canada.

Observation Sites Confirmed For Astronomical League Use

Headquarters Site for all Astronomical League operations during the eclipse will be the facilities of the Chesapeake Planetarium, 300 Cedar St., Chesapeake, Virginia, with Mr. W. Russell Blake, Planetarium Director, and his staff as hosts. Areas in Chesapeake, Norfolk, Newport News, Virginia Beach, Portsmouth, Hampton, and the NASA Langley Research Center will afford good sites for observing teams.

Sub-sites along or close to the central path of totality are located at the following places:

1. Clyattville, Georgia, 13 miles south of Valdosta.
2. Valdosta State College, Valdosta, Georgia.
3. Waycross, Georgia.
4. Jesup, Georgia.
5. Fort Stewart, Georgia, a large military reservation.
6. Marion, South Carolina.
7. Morehead Planetarium - Greensboro Astronomy Club Expedition to areas in path.
8. Lenoir County Community College, Kinston, North Carolina.
9. Edenton, North Carolina.
10. Elizabeth City, North Carolina.

In addition to these prime sites the League is planning a substantial expedition to Mexico, near the town of Oaxaca, which will be used as a base headquarters. Mr. Glen Chambers, 3023 Aloma St., Wichita, Kansas 67211 will lead the expedition. He should be written to for particulars by those desiring to go to Mexico. All persons going to Mexico should immediately write to Sanborn's Company, McAllen, Texas 78501 for information sheets giving advice to travelers going into Mexico. It is advisable that all persons going should take out travel insurance before leaving the United States. Sanborn's will furnish advice on camping equipment, food, water supply, and many other precautions and DO'S and DON'TS one should consider when in Mexico.

Coöperation With Other Observing Groups

Welcome is extended to all members of the Association of Lunar and Planetary Observers to share any of the sites secured by the League. This invitation is also extended to the AAVSO, Western Amateur Astronomers, all Centres of the Royal Astronomical Society of Canada, and others. The AAVSO will hold their 1970 Spring Meeting at Perry, Florida, which is within the central eclipse path, making observations from near that city. Those ALPO members who are also AAVSO members might consider killing two birds with one stone and meet with the AAVSO group at Perry for observations, since weatherwise this city will be a good site.

In addition to the above invitation, the League is encouraging coöperation of all observing units for a welcome to several foreign observing teams who have indicated their desire to come to the United States or Mexico in order to make studies. Inquiries from both individuals or national groups are at hand from England, France, Sweden, Italy, Holland, Germany, Czechoslovakia, Russia, Japan, Ceylon, Venezuela, Chile, and Brazil.

Circular #125- United States Naval Observatory

The U. S. Naval Observatory, Nautical Almanac Office, Washington, D.C. 20390, has published circular #125, concerning many aspects of the March 7, 1970, total solar eclipse. Anyone wishing to make observations would do well to write for this bulletin which contains path maps, weather prediction tables, and various other physical circumstances for this eclipse.

Partial List of Names and Addresses of the Coördinating Committee, Astronomical League, for Solar Eclipse Plans

Instrumentation:

Ralph K. Dakin
720 Pittsford-Victor Road
Pittsford, New York 14534

Site Location:

Leonard B. Abbey, Jr.
3204 La Vista Road
Decatur, Georgia 30033

Ephemeris:

Robert Sandy
7901 E. 88th Terrace
Kansas City, Mo. 64138

Professional Advisory:

Dr. Gordon A. Newkirk, Jr.
High Altitude Observatory
Boulder, Colorado 80302

Climatological:

Dr. Edward M. Brooks
Dept. of Geophysics
Weston Observatory,
Boston College
Weston, Mass. 02193

Communications Network:

Merlin (Bud) Checkett WØTPB
6821 Woodhurst Drive
Berkeley, Missouri 63121

Ways and Means:

William M. DuVall - 518 Emmerteen Road - Racine, Wisconsin 53406.

We urge all members of the ALPO to participate in the total observational plans and program of the League, and copies of the detailed description of all aspects of these plans may be had by writing to the undersigned after November 15, 1969.

Russell C. Maag, Chairman,
Solar Eclipse Coördination Committee, Astronomical League
1601 Blackwell Road
St. Joseph, Missouri 64505

BOOK REVIEWS

Stars and Clouds of the Milky Way. The Structure and Motion of our Galaxy. Edited by Thornton Page and Lou Williams Page, published by the Macmillan Company, New York, 1968. 361 pages. $7.95.

Reviewed by Richard G. Hodgson

The seventh volume in "The Macmillan Sky and Telescope Library of Astronomy" deserves our notice. Although many A.L.P.O. members tend to specialize in Solar System research, one cannot afford to neglect recent developments in stellar and galactic astronomy. In meeting this need this volume (like the others in this series) will be most helpful.

Skillfully edited by Dr. Thornton Page and his wife, Dr. Lou Williams Page, from articles by many famous astronomers appearing over the years in Sky and Telescope magazine and its predecessors, Stars and Clouds of the Milky Way gives the reader a clear picture of our present state of knowledge of the Milky Way, and the steps by which this knowledge was secured. While a few of the articles were written over 30 years ago, the majority were written in the present decade. Valuable commentary by the editors connects the individual articles in such a way that the presentation is remarkably complete and orderly. Individual chapters cover such subjects as stellar distances, star clusters and the Galaxy's nucleus, the rotation of the Galaxy, and the size and structure of the Milky Way Galaxy.

This volume, like the others in this series, deserves to be in the working library of every astronomer.

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Winds and Turbulence, in Stratosphere, Mesosphere, and Ionosphere, Editor, K. Rawer; Publishers, North-Holland Publishing Co., Amsterdam, and John Wiley and Sons, Inc., New York, 1968. 421 pages. Price $18.50.

Reviewed by George W. Rippen

Winds and Turbulence is the result of the Nato Science Committee's Panel on Radio Meteorology Advanced Study Institute held in Lindau, Germany in the fall of 1966. Those participating in the conference were research meteorologists studying the high atmosphere and scientists working on radio propagation and other related ionospheric studies. The book is a report on the proceedings of the Institute. The text is composed of technical papers concerning various aspects of the physics of the Earth's upper atmosphere. The first series of papers covers the structure of the high atmosphere and experimental methods used in exploring it. These are followed by ones discussing phenomena of the upper atmosphere such as stratospheric warming (sudden), layer inter-relationships, and motions in the upper atmosphere. The final series of papers, in general, is concerned with acoustic and gravity waves in the upper atmosphere and the applications of gravity wave theory to the studies of the upper atmosphere.

Two of the eighteen papers presented are in French with the remainder in English. Another two of the papers are what more properly should be referred to as general discussions. While most interesting, these are, in my opinion, not an essential part of the text.

Prof. Rawer has done an extremely creditable job of editing. The papers are relatively easy to read which, in itself, is a remarkable feat considering the technical nature of the material. Nothing radically new is presented; however, the main point for this text is its technical discussion of the problems researchers face in this area of atmospheric physics. The technical presentations of the groups from Berlin and the Max-Planck Institut für Aeronomie are most excellent. The book is worthwhile reading for those interested in current atmospheric research.

MERCURY IN 1965

By: Richard G. Hodgson, A.L.P.O. Mercury Recorder

1. Introduction

The year 1965 brought a revolution in Mercury studies when, in April, Pettengill and Dyce discovered that the planet does not keep the same face toward the Sun, but instead rotates in approximately 59 days. Details of this discovery, and of the subsequent discussion on this subject, have already been given in The Strolling Astronomer,[1] and need not be repeated here. This discovery invalidated all the older maps and composite drawings, and for a time all visual drawings were suspect. The value of visual drawings of Mercury has since been firmly reëstablished,[2] but for a time in 1965 and throughout 1966 the study of Mercury was generally neglected by A.L.P.O. members.

2. Mercury's Elongations in 1965

The dates of Mercury's conjunctions, elongations, and elongation angles from the Sun in 1965 were as follows:

Greatest Elongation W.	Superior Conjunction	Greatest Elongation E.	Inferior Conjunction
Jan. 8 (23°)	Feb. 24	Mar. 21 (19°)	Apr. 8
May 6 (27°)	June 11	July 18 (27°)	Aug. 15
Sept. 2 (18°)	Sept. 27	Nov. 13 (23°)	Dec. 3
Dec. 21 (22°)			

Mercury was best seen in the northern hemisphere in late March and at the beginning of September; in the southern hemisphere the corresponding favorable periods were late in January and late October.

3. Observers and Observations in 1965

The planet Mercury was very poorly observed in 1965 by A.L.P.O. members. Two apparitions out of the seven available during the year were observed, but only one of these fairly well. The following persons submitted observational reports for the year:

Observer	Station	Instrument(s)
Walter H. Haas	Las Cruces, New Mexico	6-inch (15-cm.) Newtonian reflector & 12½-inch (32-cm.) Newtonian refl.
Karl Simmons	Jacksonville, Florida	6-inch (15-cm.) Newtonian reflector
Michael Suárez*	Puerto Rico	72-mm. (3-inch) Newtonian reflector

The two observed apparitions were those of March 21 (evening) and of July 18 (evening). Observations were distributed as follows in terms of disc drawings (first named) and intensity estimates respectively:

Elongation: / Period Observed:	March 21 (E) / Mar. 7-Apr. 1	July 18 (E) / July 8-19	Totals
Haas	11,11	2,2	13,13
Simmons	3, 3	1,1	4, 4
Totals	14,14	3,3	17,17

Thus there was a total of 17 drawings and 17 intensity estimates. In addition to these observations, Haas reported a verbal description of Mercury without a drawing on one occasion (March 24), and Suárez provided two phase estimates (July 8 and 14). There was hence in all a total of 20 observations reported for the year, up from a total of 11 in the previous year. All of this does not alter the fact that without the work of Walter Haas there would be little indeed to report concerning Mercury in 1965. Mercury was (and still is) grossly underobserved by A.L.P.O. members.

The 20 reported observations were secured with the following apertures:

Aperture	No. of Observations
3-inch (72-mm.) reflectors	2
6-inch (15-cm.) reflectors	7
12½-inch (32-cm.) reflectors	11

The average observation was made with an aperture of 9.3 inches, up from an average of 6.6 inches in 1963 and 8.1 inches in 1964. This trend toward the use of larger apertures is welcome since resolution of a high order is necessary for Mercury studies. Valuable contributions have been made with six-inch reflectors and even somewhat smaller refractors in the past (and the Mercury Recorder keenly appreciates receiving them!), but whenever possible observers should try to gain access to the largest instruments they can find.

4. Disc Drawings

Six drawings are published (Figures 19-21) as part of this report. They are all the work of Walter Haas. Comparison should be made with drawings in other years by the reader. Particular mention may be made of two of these. Haas' drawing of March 15, when the longitude of the Central Meridian (commonly abbreviated "C.M.") was 107° according to Clark Chapman's ephemeris, should be compared with earlier drawings of the same region by Larry Anthenien (1963) and by Klaus Brasch (1964), previously published.[3] Although Anthenien and

*This man is now named M. S. Podanoffsky.

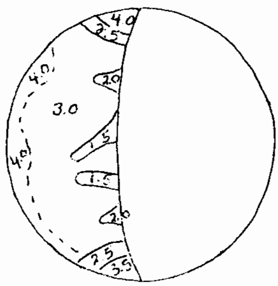

Figure 18. Sample intensity estimate of features on Mercury by Walter H. Haas on July 19, 1965. Made to accompany a drawing. The intensity estimates are on a scale of 0 (darkest) to 5 (brightest), with 3 considered the average brightness of the disc. See also text.

Brasch show some agreement on gross detail, the Haas drawing has only limited agreement with them. Again Haas' drawing of 1965, March 29 (C.M. = 184°) bears only a limited resemblance to his own previous drawing of 1964, April 14 (C.M. = 179°), which has also been published.[4] This lack of agreement is not exactly encouraging, but it constitutes no reason to give up; if anything, it should challenge us to renewed effort and to improving our techniques. We can make a mature judgment of these drawings only when we have secured a far greater number of them for each region of Mercury's surface.

5. The Observed Phase

Estimates of the observed phase of the planet Mercury received particular attention in the work of Walter Haas and Michael Suárez. Haas reported the following estimated values of k (i.e., the ratio of the area of the illuminated portion of the apparent disc to the area of the entire apparent planetary disc, expressed as a decimal fraction):

Date (U.T.)	Estimated k	Theoretical k	Estimated - Theoretical
March 7, $1\frac{1}{2}^h$	.95	.92	+ .03
March 12, $1\frac{1}{2}^h$	.76	.81	- .05
March 15, 1^h	.62	.71	- .09
March 16, 1^h	.58	.67	- .09
March 19, $1\frac{1}{2}^h$	.52	.55	- .03
March 20, $1\frac{1}{2}^h$	.53	.51	+ .02
March 21, 2^h	.48	.46	+ .02
March 22, 2^h	.46	.42	+ .04
March 27, 2^h	.26	.24	+ .02
March 29, $1\frac{1}{2}^h$	.21	.17	+ .04
April 1, 2^h	.20	.09	+ .11

It should be noted that seeing conditions were quite poor for the March 20 and April 1 observations; irradiation may have increased the estimated value of k on these occasions to a greater degree than at other times.

This series of phase estimates covers the March-April apparition fairly well, and may give evidence of the factors, psychological and otherwise, which influence an observer's judgment. It must be noted that all observations given here were made in twilight, when glare and low altitude cause serious observing problems. The pattern of overestimating k for Mercury when the planet is crescentic is similar to that reported in April of 1964.[5]

This writer is inclined to think that the only phases of Mercury which the human eye can judge with fair accuracy are (1) fully illuminated, (2) dichotomy, and (3) totally unilluminated. It would appear that k is overestimated if the disc is nearly fully illuminated. Both the gibbous and crescentic phases are difficult for the eye to estimate; perhaps there is a psychological tendency to estimate the phase closer to the easier situations for human judgment (i.e., full or dichotomy) than is actually the case. Under the conditions of poor seeing which often obtain when observing Mercury, irradiation is also a considerable factor which cannot be ignored, particularly during the crescentic phase.

6. Observing with Filters

Most of the observations of Mercury in 1965 were made with the aid of filters. During the March apparition Haas generally used a Wratten #25 (Red) filter, and found surface detail much enhanced. He found that a Wratten #58 (Green) filter was also helpful, but to a lesser extent. The Wratten #47 (Blue) filter made the image too dim for a useful view, he reported. This experience is consistent with that of other years: the surface of Mercury is best observed with a red or an orange filter. Observers should report their use

Figures 19-21. Selected drawings of Mercury in 1965. See also text of Mr. Hodgson's Report on Mercury.

Fig. 19a. Mercury drawing by W.H. Haas, 1965 March 15, 0^h $39-57^m$ U.T., 12¼"refl., 303X. Seeing 1-3, Transparency 5. Longitude of Central Meridian 107° (Chapman system).

Fig. 19b. Mercury drawing by W.H. Haas, 1965 March 16, 0^h $58^m-1^h18^m$ U.T., 12¼-inch refl., 303X. Seeing 1-2, Transparency 5. Longitude of C.M. 112° (Chapman).

Fig. 20a. Mercury drawing by W.H. Haas, 1965 March 19, 1^h $21-36^m$ U.T., 12¼-inch refl., 303X. Seeing 1-2, Transparency 3-4½. Long. of C.M. 125° (Chapman).

Fig. 20b. Mercury drawing by W.H. Haas, 1965 March 29, 1^h $31-46^m$ U.T., 12¼-inch refl., 202X. Seeing 1-2, Transparency 5. Long. of C.M. 184°(Chapman).

Fig. 21a. Mercury drawing by W.H. Haas, 1965 July 15, 2^h $30-40^m$ U.T., 12¼-inch refl., 202X. Seeing 2-3, Transparency 5½. Long. of C.M. 8°(Chapman).

Fig. 21b. Mercury drawing by W.H. Haas, 1965 July 19, 2^h $35-53^m$ U.T., 12¼-inch refl., 303X. Seeing 1-3, Transparency 5½. Long. of C.M. 28°(Chapman).

of filters along with their observations, noting particularly those which have given the best service.

7. Intensity Observations

In 1965 all disc drawings submitted were accompanied by intensity estimates. These are of great value in interpreting the drawings, and should be made in conjunction with drawings whenever possible. One of these estimates is reproduced, as Figure 18, along with the drawing in order that A.L.P.O. members may see how they are done and better appreciate their value.

8. Conclusion

It must be admitted that 1965 was a lean year in A.L.P.O. Mercury studies. The value of good disc drawings is very great, and members who have moderate apertures available to them should endeavor to observe Mercury at every favorable opportunity. The use of appropriate filters (particularly red and orange) is almost a necessity. The value of daylight observations with large apertures (12 inches and more) also needs to be emphasized: most professional work done on Mercury has been done by means of daylight observations. If daylight is indeed the best time (and the professionals ought to know!), how can we continue to ignore the "prime time" and expect results with such a difficult subject as Mercury?

All Mercury observers would do well to give careful attention to the recent article by Clark R. Chapman, "Optimum Methods for Observing Mercury's Markings," published in The Strolling Astronomer, Vol. 21, Nos. 3-4 (November, 1968), pp. 44-53. It is a major contribution to observational techniques pertaining to Mercury.

For those experienced in the fine art of astrophotography, an observing program which would combine disc drawings, intensity estimates, and nearly simultaneous photographs of Mercury would be of very great value indeed.

Reports on Mercury for the years 1966, 1967, and 1968 will soon be forthcoming. Any unreported observations should be submitted to the Recorder at once. Interest in observing the planet has been increasing of late. It is hoped that the data will be sufficient for a map -- perhaps in 1972 or 1973. That will depend, of course, on securing a number of observations of sufficient quality in the next few years. The Recorder will be glad to supply observing forms to those who would like to participate in this program.

References

1. See "Recent Studies of the Rotation of Mercury" in Str. A., Vol. 20, Nos. 5-6, (published June, 1967), pp. 73-75.
2. Cf. Dale Cruikshank and Clark Chapman in Sky and Telescope, Vol. 34, No. 1, (July, 1967), pp. 24-26.
3. Cf. The Strolling Astronomer, Vol. 21, Nos. 1-2 (published June, 1968), p. 8, and Vol. 21, Nos. 5-6 (published February, 1969), p. 74.
4. Ibid., p. 74.
5. Ibid., p. 75.

ANNOUNCEMENTS

Note from A.L.P.O. Librarian. Mrs. Walter Haas wishes to acknowledge the receipt of the following two books and to thank the donors for their welcome gifts:

1. Ranger VII Photographs of the Moon, by NASA, given by Mr. Ken Thomson.
2. Catalogue of Periodic Comets, by Ichiro Hasegawa, given by Mr. Takeshi Sato.

Members should note that when a book is reviewed in The Strolling Astronomer, the book is normally added to the A.L.P.O. Library; and it may accordingly be borrowed in the usual way.

Changes in Addresses of A.L.P.O. Staff Members. The new address of Assistant Jupiter Recorder Phillip W. Budine is now: Millside Manor, Apt. 58-C
Delran, New Jersey 08075

The present address of Lunar Recorder Clark R. Chapman has become:
Apt. 7, One Chauncy St.
Cambridge, Mass. 02138

Sustaining Members and Sponsors. As of September 30, 1969, we have the following persons in these special classes of membership. Sponsors pay dues of $25 per year; Sustaining Members, $10. The surplus above the regular rate supports the work of the Association.

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Changes in A.L.P.O. Jupiter Section. Mr. Richard E. Wend has felt for some time that personal and business reasons do not allow him to continue as effectively as he wishes as the Jupiter Recorder. We accept the loss of his services with much regret, for he has done an outstanding job in this capacity. Observations of Jupiter usually surpass in volume those of any other planet, and the load on the Recorder in correspondence and in reducing data is correspondingly heavier. We are replacing Mr. Wend with a colleague already on the Jupiter staff; the new Recorder is Mr. Paul K. Mackal, 7014 W. Mequon Road, 112 North, Mequon, Wisconsin 53092. Readers of this journal in recent years will have seen Paul Mackal's name frequently as an author and as a contributing observer. We warmly welcome him to his new post and urge our Jupiter observers, past and intending, to give him their fullest support.

We have asked Mr. Wend to remain on the staff as an Assistant Jupiter Recorder and are tentatively so listing him in this issue. Mr. Phillip Budine is continuing as an Assistant Jupiter Recorder and will remain in charge of the reduction of Jovian C.M. tranists.

Two Training Programs in A.L.P.O. It may be well to point out clearly that we have both a Lunar Training Program and a Lunar and Planetary Training Program. Mr. Clark R. Chapman, Apt. 7, One Chauncy St., Cambridge, Massachusetts 02138 is in charge of both programs. In order to make the distinction clearer, we are giving the Lunar and Planetary Program a separate listing on the back inside cover of this Journal. This program consists of a set of four directed lunar and planetary observations, which, if successfully completed, result in the observer's being recognized as a trained observer. The Lunar Training Program is a more informal program aimed at introducing new observers to lunar observation by answering questions, suggesting observations and improvements in techniques, etc. While participation in both programs is certainly wholly voluntary, the Editor and Recorder Chapman feel that new members and some others can gain greatly from such participation, and in proportion to the time and effort which they invest.

Site of 1970 A.L.P.O. Convention. An important item at each annual "business meeting" of the A.L.P.O. is the choice of the next Convention location. At our 1969 San Diego Convention we were invited to meet with the Western Amateur Astronomers at Sacramento, California in 1970. The invitation was graciously extended verbally by Mr. and Mrs. Ernest Schneider; a later confirming letter came from Mrs. Pearl Rohrke, Secretary of the Sacramento Valley Astronomical Society. After much discussion during the San Diego business meeting, the members present voted to accept the invitation if no other one arrived by October 1, 1969, and otherwise to poll the whole membership on their preference.

No other invitation did arrive before October 1. Therefore, the 1970 A.L.P.O. Convention will be held with the W.A.A. at Sacramento. The dates are August 20, 21, and 22; and the place is the Mansion Inn, in downtown Sacramento and near the Capitol. We thank the Sacramento Valley Astronomical Society very much for this opportunity to enjoy their hospitality and astronomical fellowship. More details about this meeting will be given in future issues.

Readers may wonder at the decision on this invitation reached at the A.L.P.O. San Diego meeting. It is certainly not that we do not enjoy meeting with the Western Amateur Astronomers. However, some of our members have complained that most of our Annual Conventions are in the West and Southwest. Our two most recent meetings east of the Mississippi were, in fact, in Milwaukee in 1965 and in Montreal in 1962. It is certainly our desire to give our widely scattered membership as much opportunity as possible to attend our Conventions. Doing so must in practice depend upon receiving specific invitations from host societies in other parts of the nation, and these invitations have been very scarce during the last few years.

LUNAR OBSERVER'S MANUAL

By: Walter H. Haas, Director, A.L.P.O.

In recent years there has been a fair amount of discussion of the need for the different A.L.P.O. Sections to furnish instructional materials, descriptions of observing programs, and forms for new members and beginning observers. The Lunar Section has now done something much better than just to talk: it has actually produced a Lunar Observer's Manual. All five A.L.P.O. Lunar Recorders have shared in writing the manual--Charles Ricker, Clark Chapman, John Westfall, Kenneth Delano, and H. W. Kelsey. The manual was published privately by Mr. Ricker without the use of Association funds. The booklet measures 11 by 8½ inches, convenient for use at the telescope, and contains 30 pages. A small number of illustrations either clarify the text or constitute samples of observational report forms.

The text is aimed primarily at the lunar observer new to either his subject or to the projects of the A.L.P.O. Lunar Section (or both). The style of writing is clear enough to be readily followed, and the explanations are lucid and detailed. Parts of the manual have been published in this Journal in the past, but it will still be a convenience to have related topics all inside one cover. The chapter headings may sufficiently indicate the contents: Introduction, The Observer Training Programs of the ALPO, Drawing Lunar Surface Features, Lunar Mensuration, Observing Lunar Domes, Selected Areas LTP Patrol, Lunar Eclipse Observations, Lunar Photography, Other Programs, and Selected References. Each chapter can be read by itself as a unit, and indeed more editing would have removed a slight amount of duplication.

The Lunar Observer's Manual appears to me to be very good in furnishing guidance and background information for new lunar observers. More advanced students of the moon will want to pursue hints in "Other Programs" and to read listed books and monographs in "Selected References." For some readers the manual may help answer the question of what the amateur lunar observer can still do in the Space Age. The L.T.P. enthusiast will do well to note the stress on the need for considerable experience before one can reliably recognize an abnormal lunar event.

The Lunar Observer's Manual may be obtained from Charles L. Ricker, 403 W. Park St., Marquette, Michigan 49855. It is recommended.

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Elem.	4.	Color Map of the Northern Sky (wall display size)
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Inter.	5.	Visual Observing of Double Stars (booklet)
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Section S — Sets of Astronomical Photographs

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