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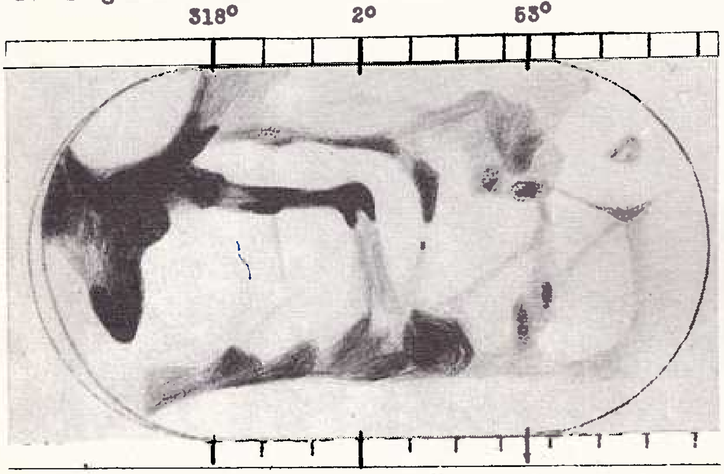
The longitude coördinates as drawn



A continuous drawing of Mars on an extended orthographic projection by Clark R. Chapman with a 10-inch reflector on November 22, 1960, 4 hrs., 15 mins. to 10 hrs., 45 mins., Universal Time. Features shown include, from left to right, Syrtis Major, Sinus Sabaeus, Margaritifer Sinus, Mare Acidalium, Aurorae Sinue, an unusual Ganges-Lunae Lacus dark development, and Solis Lacus. See also page 33, first paragraph, in this issue for a description of Mr. Chapman's procedure. Seeing a variable 7, transparency 3-4, diameter of Mars 13.3 seconds, central meridian of longitude on Mars 315 degrees to 50 degrees.

THE STROLLING ASTRONOMER

Pan American College
Observatory
Edinburg, Texas

IN THIS ISSUE

DIMENSIONS OF THE LUNAR DOME KIES 1

By: Joseph Ashbrook

There is a serious lack of quantitative information about the properties of lunar domes--diameters, slope angles, and heights. Such data are helpful in defining what a dome is, and essential for subclassification and for meaningful interpretation. This missing information can be easily gathered by amateur observers, without special equipment. To illustrate some of the methods, this article discusses in some detail the well-known dome between Kies and Mercator. This dome is shown in Figure 1.

This object is named Kies 1 by Patrick Moore and P. J. Cattermole (1) in their catalogue of domes. The first question is the selenographic position of the dome, as fairly accurate coordinates are needed in evaluating slope observations. Moore and Cattermole's positions are too rough for this purpose; for Kies 1 they give Xi = -.361, Eta = -.460, some distance southwest of the true place. Much more reliable positions will be readily available from the forthcoming supplement to G. P. Kuiper's Photographic Lunar Atlas, this supplement to consist of accurately gridded photographs. Meanwhile, good coordinates can be scaled from the IAU atlas, from which I find -.365, -.452, which are adopted for this article. As a check, I measured -.366, -.453 from sheet E6-a (ungridded) of the Kuiper atlas. This last position was found by Maedler's second-order method.

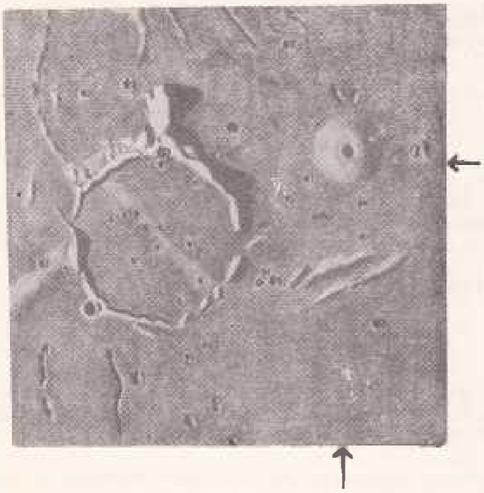


FIGURE 1. Drawing of Lunar Crater Kies and Vicinity by Alika K. Herring. 12.5-inch reflector at 275X. August 2, 1960. 3^h 30^m, U.T. Seeing 5-7 on a scale of 0 to 10, with 10 best. Transparency 5 on a scale of 0 to 5, with 5 best. Colongitude = 26°.5. The arrows point to the lunar dome Kies 1, discussed by Dr. Joseph Ashbrook in his accompanying article.

The diameter of a dome is easily found visually without a micrometer, by comparison with nearby craters whose sizes are known. The observation consists in estimating the ratio between an apparent diameter of the dome and the parallel diameter of a comparison crater. For example, if the crater has a diameter of 10.0 kilometers, and the dome's diameter is estimated as 0.55 of this, the dome diameter is 0.55 x 10.0 = 5.5 kilometers.

The diameters of the comparison craters can be taken from J. Young's list (2), or measured from photographs. The values actually used by me for Kies 1 are given in Table 1.

Table 1. Comparison Craters for Diameter Estimates

Crater	Diam. in kms.
Koenig	22.1
Bullialdus B	21.9

Table 1.-continued.

Crater	Diam. in kms.
Kies A	16.4
Nicollet	15.8
Kies B	8.7

Table 2 summarizes visual diameter estimates of Kies 1 on seven nights, with 6-inch and 10-inch reflectors at 200X.

Table 2. Visual Diameters of Kies 1

U.T.	Diam. in kms.	No. of Comparisons
1958, July 26.021	10.8	5
Sept. 22.959	10.6	1
Dec. 20.955	11.4	1
1959, July 29.373	10.9	2
Aug. 13.994	10.1	3
Dec. 9.959	10.9	3
1960, Jan. 8.935	10.6	2
Weighted mean	10.7 ±0.2 kms.	

For comparison, the diameter of Kies 1 was also measured from Kuiper's Atlas, the scale being again found from nearby craters. Sheets E6-a and E6-d gave 12.6 and 13.0 kms., respectively. The mean, 12.8 kms., is significantly larger than the 10.7 kms. found visually. Perhaps the telescopic estimates have not included the extreme margin, visible on the photographs as a slight change of brightness. In any extensive study of dome dimensions, the possibility of a systematic difference between photographic and visual diameters should be looked into.

Information about the vertical cross section of a dome can be gathered by watching the progress of its shadow near sunrise or sunset. The dome can be imagined as a slight swelling of the lunar surface, with gently sloping sides. Soon after sunrise, the shadow retreats down the eastern flank; at the edge of this shadow, the slope angle of the surface is equal to the angular elevation of the sun. The sunlit upper part of the dome has a slope less than the sun's altitude, while the still-shadowed lower portion is on the average steeper. As the sun's altitude increases in the lunar morning, the shadow will finally completely disappear when the slope angle at every place on the dome's eastern side is less than the solar altitude.

In noting the progress of the shadow, a convenient method is to estimate from time to time the fraction x of the dome's east-west diameter that is covered by black shadow. Care is to be taken to distinguish between true, black shadow and the dark gray shading which represents grazing illumination by sunlight. At the time when $x = 0.25$, the sun's altitude can be taken as equal to the average slope of the dome flank.

At a point on the moon whose selenographical latitude is B and longitude is L, the sun's altitude h_0 is given by the formula:

$$\sin h_0 = \sin b \sin B + \cos b \cos B \sin (C + L).$$

Here b and C are the sun's selenographical latitude and colongitude, respectively, and are taken from the American Ephemeris. The two latitudes must be used with their proper signs, positive when north and negative when south. A negative computed value of h_0 means that the sun is below the lunar horizon. Colongitude is always measured toward the east, up to 360°; lunar longitudes are positive to the west and negative to the east.

The observations of this type for Kies 1 are summarized in Table 3, where the letters M and E refer to morning and evening illumination, respectively.

Table 3. Slope Observations of Kies 1

U.T.	Solar Altitude		x	Remarks
1960, Aug. 2.038	0.°6	M	0.4	
1960, Aug. 2.042	0.7	M	0.38	

Table 3.-continued.

U.T.	Solar Altitude		x	Remarks
1960, Aug. 2.059	0°.85	M	0.33	
1960, Aug. 2.083	1.1	M	0.28	
1959, Dec. 9.959	1.2	M	0.25	
1960, Aug. 2.101	1.3	M	0.25	
1959, Dec. 10.006	1.7	M	0.2	
1959, Sept.26.417	5.0	E	0.0	West foot gray; no umbra
1959, July 29.373	5.4	E	0.0	No umbra
1960, Jan. 8.935	5.7	M	0.0	East foot dark, but no umbra

From Table 3, it follows that the average slope angle of the eastern side of Kies 1 is about 1°.3. The summit is very nearly a flat, horizontal surface (apart from the well-known central pit). Furthermore, even the steepest parts of the eastern and western flanks nowhere have slopes greater than about 5°, except possibly in very limited areas.

The height of Kies 1 can now be estimated by multiplying the radius of the dome, 6.4 kms. from the photographs, by the tangent of the average slope angle, 1°.3. It turns out that the summit of the Kies dome is approximately 145 meters higher than the surrounding plain.

The new data make the Kies dome somewhat smaller and even flatter and lower than in Baldwin's brief description (3): "One [dome], lying between Mercator and Kies, is 2,000 feet high and 9 miles broad. The mean angle of the outer slope is 4°.8." Baldwin does not tell how his numbers were obtained, and there is no way to judge their precision.

On the other hand, the new slope data for Kies 1 are similar to recently published values (4) for the very large dome Maraldi d, near Vitruvius. This is 60 kms. in diameter, and has an average slope of 1°.9, with 4°-5° on its lower parts and with a few localized steeper places around the margins. Maraldi d can be usefully regarded as a scaled-up version of Kies 1.

Readers who would like to try diameter and slope observations of other domes might consider the two east and north of Arago. The eastern, Arago 1, is centered on Xi = +.343, Eta = +.109, corresponding to L = +20°.2, B = +6°.3. The coordinates of the northern, Arago 2, are Xi = +.363, Eta = +.133, or L = +21°.4, B = +7°.6. These positions were measured by the writer from photographs. For both the Arago domes, the following comparison craters are useful; their diameters, taken from Young's catalogue, are in kilometers: Arago, 26.4: Maclear, 21.1; Manners, 16.9; Ross, 26.7; and Sosigenes, 18.4.

References

1. Journal of the International Lunar Society, Vol. 1, No. 1, 16-18, 1957.
2. J. Young, A Catalogue of Lunar Craters, 1953. (Privately published by D. W. G. Arthur.)
3. Ralph Baldwin, The Face of the Moon, p. 153, 1949.
4. Joseph Ashbrook and Ernst Both, Strolling Astronomer, Vol. 13, Nos. 11-12, 137-140, 1960.

Postscript by Editor. We express our thanks to Dr. Ashbrook for his clear and informative discussion of a very worthwhile amateur lunar program. Surely no one who reads this article need ever complain again of a lack of observational problems on the lunar surface. It will be most gratifying if a goodly number of our members undertake and report the investigations of the lunar domes Arago 1 and Arago 2 described in the very last paragraph, for which all necessary data are there supplied. Quantitative studies of this kind have been much neglected in amateur studies of the lunar and planetary surfaces, even in some professional work.

A LOOK AT ASTRONOMY IN RUSSIA

By: Patrick Moore

In the summer of 1960 I received an invitation to go to the U.S.S.R. and deliver some lectures about the Moon. The invitation came via the Academy of Sciences, and was decidedly unexpected; apart from some correspondence with Dr. Kozyrev, and personal acquaintance with Professor Alla Masevich when she came to England earlier in 1960, I had had no previous contact with Russian astronomy or, indeed, with the Soviet Union or anything connected with it. However, I was delighted to accept, and on October 3 I duly flew to Moscow.

I cannot speak Russian, and I am equally unfamiliar with German; I am fairly comfortable in French, but clearly had to have an interpreter. I was fortunate in having Gregory Molyikov, whose English was absolutely fluent and who was moreover a most agreeable companion. When I lectured, the system was that I gave an introduction in English; Gregory Molyikov then read the actual lecture in Russian, while I did any demonstrations and showed the slides; and the question and answer period at the end was coped with by means of simultaneous translation.

At the headquarters of the Astronomical Council, in Moscow, I renewed my acquaintance with Professor Masevich, whom I was very glad to see, and also met many other leading Russian astronomers--among them Professor Mikhailov, whose fame is world-wide, and who (to my relief) speaks almost perfect English. It is clear that the Council organizes Soviet astronomy very well indeed, and does not neglect the amateurs, of whom there are many.

One point which interested me was a plot of all the reported "landing positions" of Lunik II on September 13, 1959--including my own tentative positional observation. The scatter is considerable, and the Russians consider that the general evidence is so slender that the visual observations on this occasion were of little or no value. With this I am bound to agree. My own observation was admittedly uncertain, and I never had much faith in it.

The chief Moscow observatory is the Sternberg, close to the vast University building. I was cordially greeted by the Director, Professor Martinov, and his colleagues. The Observatory is very well equipped; all the instruments are Soviet made, and are obviously very good, though I was unable to make any practical observations owing to bad weather (in fact, I was cursed by cloud during my whole period in Russia). I also met eminent men such as Dr. Bronshten, Dr. Khromov, and Professor Lipski. Professor Lipski has just completed a new chart of the Moon's hidden side, based on some 30 photographs--which I saw--taken from Lunik III. I was particularly glad to see that he had Dr. Wilkins' lunar map beside him, and said that he found it invaluable, as it was much the best for checking and correlating between the familiar and averted sides. I am only sad that Dr. Wilkins did not live to see it. I lectured at the Sternberg, dealing with theories of the Moon, and became involved in many interesting discussions. I also lectured at Moscow's excellent Planetarium, which is as good as any I have seen, and is deservedly popular; it has a daily audience of 3,000 people--including many youngsters. The interest in astronomy, as well as in space research, is very marked.

From Moscow I went to Leningrad. Here, of course, lies the Pulkovo Observatory. It has been completely rebuilt since its destruction by German shelling during the war, and has many optical and radio telescopes, including a fine 26-inch Zeiss refractor. There is also a lunar and planetary laboratory, headed by Professor A. B. Markov, with whom I had several long and interesting conversations, and who (like everyone else) was kindness itself. Professor Markov has just edited an important book about the Moon, and has himself made many contributions of great importance.

Pulkovo has a long and honorable history; and its future career will, I am sure, be equally fruitful. Unfortunately the climate at Leningrad is

FIGURE 2. Dr. N. T. Kozyrev (left) and Patrick Moore on balcony of 102-inch dome, Crimean Astrophysical Observatory, U.S.S.R. Figures 2, 3, 4, 5, and 6 are photographs contributed by Patrick Moore.

FIGURE 3. Dome of 50-inch reflector, Crimean Astrophysical Observatory. Taken from balcony of 102-inch dome.

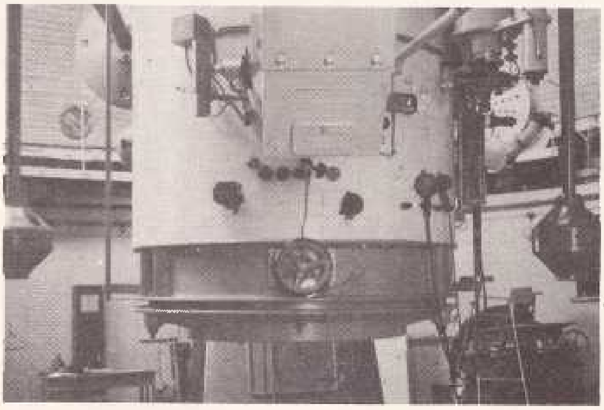


FIGURE 4. 50-inch reflector, Crimea. This telescope made the famous November 3, 1958, Alphonsus spectrograms.

FIGURE 5. Dome of 50-inch reflector, Crimean Astrophysical Observatory.

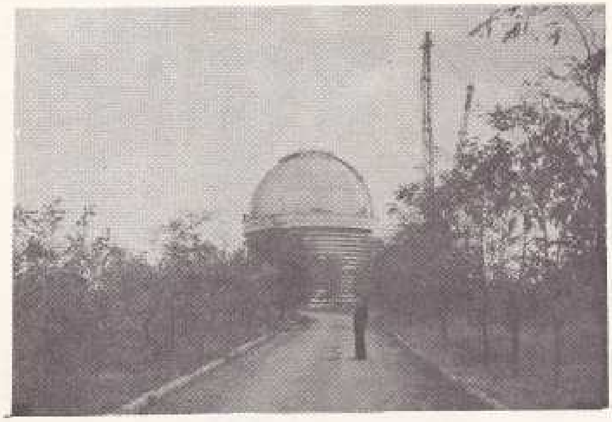


FIGURE 6. Dome of 102-inch reflector, Crimea.

not good; during the summer the sky never becomes dark, while in the winter there is a great deal of cloud and fog. Wisely, the Russians are moving their main attention to the south part of the Soviet Union. Professor Sharonov, of Leningrad University--where there is a small observatory--told me, rather wryly, that in Leningrad the only tolerable months for astronomical observation were March and October! Professor Sharonov is another great authority on planetary studies. He is particularly interested in Mars, and is one of the few Russian astronomers I met who does not think that the dark Martian areas are necessarily due to vegetation. It is a reminder that the problem is still not definitely cleared up.

I flew from Leningrad to the Crimea, and stayed at the Crimean Astrophysical Observatory. The main emphasis here is on solar research; and of course the Director, Professor Severny, is one of the leading solar physicists of the world. I delivered my lecture, as I had done at Sternberg and Pulkovo, and spent several days at the Observatory.

I was extremely glad to meet Dr. Kozyrev, whose name is familiar to everyone. Unfortunately he speaks no English; but Gregory Molyikov interpreted nobly, and in any case we could manage quite well. In the evenings, when we wandered forlornly into the domes of the 102-inch and 50-inch reflectors and looked at the clouds, each of us must have known what the other was thinking about the Clerk of the Weather! Examination of the famous Alphonsus spectrograms leaves me in no doubt that the outbreak of 1958, November 3 did actually occur just as stated (not that I had ever doubted this). I also asked Dr. Kozyrev about the later report of activity there in 1959, when I had myself been observing the area without seeing anything unusual. Dr. Kozyrev said that this observation was uncertain, and depended on one possible line in a spectrogram. Nothing was seen visually, so it is not surprising that my own observations were negative.

The 50-inch reflector, used by Kozyrev for these observations, is a superb instrument (Figure 4); it again is a German Zeiss. It has, however, been dwarfed by the new 102-inch, which has been set up in a dome nearby (Figure 6). During my stay, the new dome was almost finished, though workmen were still running round like ants and scaffolding was much in evidence. The reflector itself is, of course, a skeleton, with a Palomar-type mount; the optics were made in Leningrad. As well as its main rôle in astrophysics, it will be used for some lunar and planetary work. Professor Severny and Dr. Kozyrev are at present designing some special auxiliary equipment for it, to be used in this research. The results should be most interesting. There are, of course, many other instruments at the Crimea, as well as workshops and other observatory "essentials." The climate is good, and I have no doubt that the clouds retreated as soon as I did! Yet the new 236-inch reflector, now under construction and expected to be ready well before 1970, is not going to the Crimea. After expeditions had been sent to all parts of the Soviet Union, it was decided to erect the giant telescope in Asia. I hear that one favored site is Novosibirsk, near Omsk, though I am not sure whether this decision is absolutely final.

There was much else of interest to see; space prevents my describing features such as the amateur-built planetarium in the Palace of Pioneers at Leningrad, the "Chamber of Curiosities" from which Mikhail Lomonosov observed two centuries ago, and the satellite tracking station at Zwinegorod, near Moscow. Suffice it to say that I was greatly impressed both with Russian astronomy and with Russian astronomers.

One point should, I feel, be made. I am not a professional astronomer, and make no claim to eminence; I am merely one of many thousands of modestly-equipped amateurs. As I stressed, I had almost no previous connections with Russian astronomy, and in fact I have more than once written critical articles about various aspects with which I did not agree. Moreover, I was equally devoid of any other connections; nobody could be less of a Communist than I am. Yet it would be impossible to over-emphasize the courtesy and friendliness with which I was greeted everywhere I went. I have mentioned a few names--Mikhailov, Masevich, Martinov, Bronshten, Khromov, Lipski, Sharonov, Kozyrev, and Severny, for instance--but the list could be greatly extended; and all these world-famous men went to an immense amount of trouble to make me welcome and to help me in every way they could. This also applied to the non-scientists, of whom I met many. I did indeed spend an enjoyable fortnight as well as an instructive one.

I was left in no doubt as to the flourishing state of Russian astronomy. Neither was I left in the slightest doubt that the Soviet astronomers are extremely willing and anxious to co-operate with those in Western countries as well as Eastern. They have much to contribute in "pure" astronomy as well as in astronautics, and it is greatly to be hoped that their spirit will spread until it covers all fields of human activity. This is no idle dream. I am convinced that it can, and will, come true.

Postscript by Editor. We are much indebted to Mr. Moore for his informative and highly readable description of his recent visit to Russia. Knowing that some of our members travel to other countries from time to time, we shall welcome similar articles in the future. Ordinary snapshots of good quality will serve splendidly to illustrate such accounts. Of course, descriptions of visits to the United States by colleagues overseas will be equally very welcome. Naturally all articles of this kind for *The Strolling Astronomer* should highlight astronomy, and particularly lunar and planetary astronomy.

This front cover, to which attention is directed, is an "extended drawing" made by Chapman on November 22, 1960. Of the method Chapman writes: "This extended drawing is drawn with the theoretical southern--most visible part of the disk as the upper boundary. For this reason the greatest defect is not symmetrically placed. This is an extended orthographic projection. The drawing is centered on the time scale so that the apparent CM is in phase with time; however, on the CM scale below the time scale, the true CM for that time is plotted. To find the longitude of a feature on the drawing as corresponding with the time scale, add about 4°8 to the figure in the CM scale (this has been done above the drawing where the plotted meridians do correspond with the drawing)." This somewhat novel idea seems to require a great deal of practice to be used successfully. The advantages lie in the continuity of the features, but they are offset by the fact that such drawings could not be used for the determination of positions (particularly latitudes) nor for measurements of the polar cap. Such a method, however, would be particularly suited for observations of Jupiter. [It was very successfully so used by Chapman and several others in 1960.--Editor.]

Finally it is hoped that many more members will send in their observations of Mars. Photographs are especially needed, no matter how poor the quality may be.

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3. Graff, K., "Die Ausdehnung des Polflecks," Astron. Abh. Hamburger Sternw. Bergedorf, Vol. II, No. 7, Hamburg, 1926, pp. 17-19.
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THE EVOLUTION OF THE MOON (ABSTRACT)

By: Dr. Dinsmore Alter

(Paper read at the Sixth A.L.P.O. Convention at San Jose, California, on August 24, 1960.)

This paper abstracts some previous hypotheses on the evolution of the moon, considering the arguments for and against each of them. It revives an old hypothesis that the moon is a captured, independent planet and considers the evidence from four viewpoints:

1. The uniqueness of the earth-moon system.
2. The relationship of the present orbit to the ecliptic.
3. The ratios of the moments of inertia of the moon's figure.
4. The surface appearance and the distribution of the maria.

The conclusion is that it is probable that the moon always has been a quite rigid body throughout the existence of the earth-moon system. The maria have evolved primarily as the result of disruptive tides during the first perigee passages. Impact-, tidal- and endo-forces all have contributed importantly to the present surface of the moon.

ANNOUNCEMENTS

Errors in Past Issues. On p. 129 of the September-October, 1960, Strolling Astronomer, fourth paragraph, lines 1 and 3, read NTrB for NTB. On p. 129, fifth paragraph, line 1, read NTB for NNTB. The nomenclature of Mr. Cruikshank's paper on Saturn will then be consistent with Figure 8 on p. 123 of our July-August, 1960, issue, where Mr. Cragg gives A.L.P.O. standard nomenclature for Saturn. Mr. Beaufort Ragland of Richmond, Virginia, tells us that the umbral immersion time for lunar crater Herschel imputed to him on p. 165 of the November-December, 1960, Str. A. was actually secured by someone else. The Editor has been unable to check further. Mr. Lewis Dewart tells us that the A.L.P.O. Convention speaker shown in Figure 41 on p. 183 of our November-December, 1960, issue is not he. We are sorry for this error, and we should be glad to hear from anyone who can correctly identify this man. The orientation of Figure 27 on p. 176 of our November-December, 1960, issue, a drawing of Venus by Mr. Steve Almen, is obviously not the simple astronomical inversion; but we have no information from Mr. Almen or Dr. Bartlett to tell us what the orientation actually is.

Binocular Telescope. Mr. T. F. Cheaney, Box 1382, Fort Lauderdale, Florida, is much interested in designs of binocular telescopic systems. He has sent us a diagram of such a system with objectives 2.4 inches in diameter and focal lengths of 10 to 40 inches. We shall be glad to lend this diagram to any interested person.

Request for Lunar Students. Mr. Leif J. Robinson, 1411 Amapola St., Torrance, Calif., is anxious to hear from observers with telescopes 8 inches in aperture and upwards who would like to join in a statistical survey of the lunar surface. The amount of time needed is not known but might be small. Participants should have the Wilkins Moon and the Str. A. reproduction of the Wilkins map; the Kuiper Photographic Atlas is useful but not essential. Mr. Robinson would also very much appreciate lunar photographic prints with resolution of detail of 1½ miles or less between moon ages of 6 and 21 days (roughly First Quarter to Last Quarter). Such photographs should be at least 8 by 10 inches on glossy paper and must be printed for maximum contrast. Full details about photograph and instrument must be supplied. Photographs submitted cannot be returned, but all contributors will receive full credit upon publication of results.

Mr. Robinson is Chairman of the A.L.P.O. Methods Committee.

"The Lunar Straight Wall." We invite attention to a paper by Joseph Ashbrook with this title in the Publications of the Astronomical Society of the Pacific, Vol. 72, No. 424, February, 1960. This paper is a good example of the application of simple and needed quantitative techniques to determining lunar heights and slopes. The average slope of the exposed east face of the Straight Wall is found to be $41^{\circ} \pm 3^{\circ}$.

The Coming Eighth Convention of the A.L.P.O. with the League. Our next Convention will be held as part of the Astronomical League National Convention at Detroit, Michigan, on July 1, 2, and 3, 1961. Convention headquarters and meeting place will be the air-conditioned Henrose Hotel near the downtown Civic Center. A well-organized Convention Committee has already held a number of meetings, and detailed planning is well advanced; the General Chairman is Dr. C. D. Marshall, 17396 Westmoreland Road, Detroit 19, Michigan. The same Committee held a very successful Great Lakes Regional Convention last July (see The Strolling Astronomer for November-December, 1960, p. 184 and front cover). The Detroit Astronomical Society, the host society, has about 280 members, including about 90 juniors. It was started informally about 1900 and was formally organized in 1934. Details about registration, hotel rates, banquet, field trip, and professional speakers will be given in a later issue.

The Convention Committee has kindly allotted the A.L.P.O. a half day for our Eighth Convention, and we shall have at least as much room for an Exhibit as at Haverford in 1960. Our present big need is for program papers and drawings, charts, and photographs for the Exhibit--members who send in such items now, or at least as soon as practical, will save us time and trouble. All papers and exhibits should be mailed to Walter H. Haas, Pan American College Observatory, Edinburg, Texas.

We urge that as many members as possible make every effort to attend what will surely be a stimulating and informative three-day League Convention.

OBSERVATIONS AND COMMENTS

Further Note on Ruemker. Mr. Alika K. Herring has submitted this discussion: "In my previous discussion of this feature, (Strolling Astronomer, May-June, 1960, pp. 95-96 and front cover), I suggested that Ruemker was probably a giant compound dome. And while I still believe that this is most likely to be the correct explanation of its nature, there are several mysteries concerning the formation which must be solved before we can have a whole-hearted acceptance of this conclusion. One of these is why a large number of domes should group themselves together into one composite mass, while exhibiting but little tendency to do so elsewhere on the lunar surface. It is true that there are other large dome-like features, such as the large masses in Darwin and near Vitruvius, which are comparable in size to Ruemker; but in each case the surface topography is most dissimilar. In my opinion there is the distinct possibility that Ruemker may be unique, and certainly at this writing I do not know of any comparable feature elsewhere on the lunar surface.

"Another question is the apparent lack of summit craterlets on the domes in Ruemker. Statistical studies of their frequency made on other lunar domes indicate that fully one-third of them possess summit pits, yet in numerous observations I have been unable to detect a single one on the Ruemker domes.

"These questions should be well worth the attention of serious lunar observers. Those with moderate apertures might carefully scan the lunar surface since it is always possible that other large domes truly similar to Ruemker may yet be found. Certainly a concerted effort should be made to detect possible summit pits on the Ruemker domes; apertures larger than 12½ inches would probably be necessary for this purpose. The formation could be best observed when favorable librations in longitude and latitude combine to bring it near its mimimum distance from the center of the lunar disk, as occurred when my drawing was made."

Possible Peculiar Aspects of Piton. We have received some surprising observations of the lunar mountain Piton. These will be described in a later issue. We shall be extremely glad to receive observations, especially any made with red color filters, and above all photographs at these U.T. dates and times: 10^h5^m to 10^h24^m on November 12, 1960, and near 23^h20^m on December 25, 1960.

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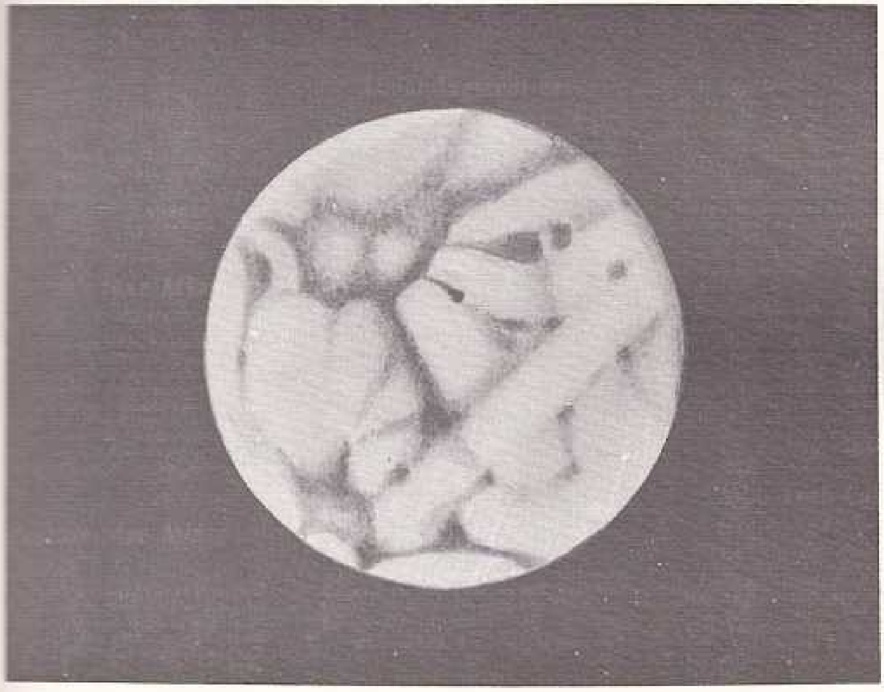
Published April, 1961



Drawing of Mars by Ernst E. Both on January 20, 1961, at 23 hrs., 40 mins., Universal Time. 8-inch refractor at 375X to 500X. Seeing 7 (good), transparency 5 (extremely clear). C.M.=76°. Diameter 13".7, tilt to earth 0°.9 south, heliocentric longitude of Mars 109°. Note Solis Sacus, Mare Erythreum, Mare Acidalium, and strong development of Lunae Lacus-Ganges.

THE STROLLING ASTRONOMER

Pan American College
Observatory
Edinburg, Texas

(Continued from Page 40)

Observer	Telescope(s)	Station
Ronald Storey	2"25 refr.	Mill Valley, Calif.
Joseph Sullivan	3" refr.	Binghamton, N. Y.
Richard F. Tompkins	8" refl.	Jenkintown, Pa.
Joseph P. Vitous	8" refl., 4" refr.	Berwyn, Ill.
George Wedge	6"5 refr.	Montreal, Quebec, Canada
Gary Wegner	10" refl.	Bothell, Wash.
Richard Wend	13" refl.	West Allis, Wis.
William J. Westbrooke	4" refl.	San Francisco, Calif.
Stephen Zuzze	8" refl.	Fresh Meadows, N. Y.

[Did Mr. Glaser modestly omit to list himself?--Editor.]

SOME OBSERVATIONS OF MERCURY IN JUNE, 1960 AND SOME COMMENTS ON A COMPOSITE DRAWING TECHNIQUE

By: Dale P. Cruikshank

Observations of Mercury during the evening apparition (eastern elongation) of June, 1960, were obtained by the writer with the Yerkes Observatory 40-inch refractor. Drawings were made on June 4, June 8, June 9, June 18, and June 25. The first four of these were used to make the composite representation of the planet shown in Figure 38 on p. 48. The intensity values indicated on the adjacent schematic diagram on Figure 38 are averages of estimates made on June 4 and June 18. They are based on the standard A.L.P.O. scale of 0 darkest and 10 brightest. These estimates have little value; because Mercury was always observed in daylight, there was no black sky as a basis of reference. The values are, then, relative only to each other and serve only to give a general impression of relative intensities over the surface.

A large, abnormally bright area appeared at the northernmost limb region marked 7 on June 4 and June 8, and at the southern limb region marked 7 on June 4. The first area has been seen in varying form many times in 1958 and 1959 (Cruikshank, 1959).

The convex dotted line on the drawing shows the position of the terminator on June 4; the concave line shows its position on June 18. In this 14-day period the features on the surface naturally shifted toward the left. Positions on drawings after June 4 were approximately corrected for rotation in making the final composite drawing. In this period Mercury librated in longitude from +22° on June 4, to +23° on June 9, and to +19° on June 18 (all eastern librations). Latitude libration in this period was 4°5. [Assuming axis perpendicular to plane of orbit?--Editor.]

Each of the four drawings which comprise the composite was weighted according to the seeing conditions and the general quality of the observation. An attempt was made to correct for the writer's personal equation; the June 4 drawing was his first view of the planet in six months, and the observation on this date is accordingly given slightly lesser significance. The June 18 observation was the most heavily weighted. Seeing was then 7-8 on a scale of 0 to 10 with 10 best. As with all the observations, a yellow (Schott GG-14) filter was used to reduce extrafocal blue light. Magnification was 550X at apertures between 30 and 40 inches. The major features recorded on this June 18 drawing were seen simultaneously by another observer at the 40-inch.

A few notes on the making of composite drawings, this one in particular, may be of interest. All four original sketches were made on the same scale. Six-inch squares of medium weight acetate plastic were placed over each original, and the outlines and rough shadings of the drawing were transferred to the plastic with a soft pencil (soft pencils used by editors and engravers for photocopying serve well). The plastic squares were then placed on top of each other, care being taken to preserve proper orientation.

FIGURE 34. Jupiter. Tom C. Constanten. 12.5-in. refl. July 13, 1960. 3^h 30^m U.T. C.M. I=360°. C.M. II=173°. Shadow of J I on disc.

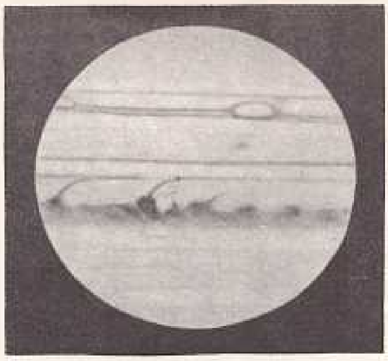


FIGURE 35. Jupiter. Joseph P. Vitous. 8-in. refl. Aug. 26, 1960. 1^h 35^m U.T. C.M. I=37°. C.M. II=235°. Note DE, FA, & SEB_s Spot 2.

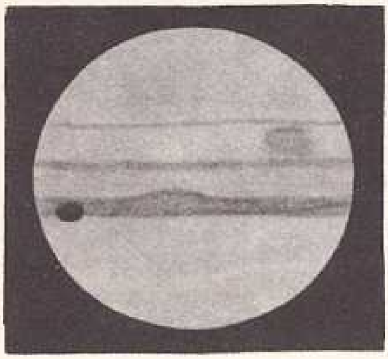


FIGURE 36. Jupiter. José Olivarez. 2.4-in. refr. Sept. 29, 1960. 2^h 15^m U.T. C.M. I=25°. C.M. II=323°. Note J I shadow on disc.

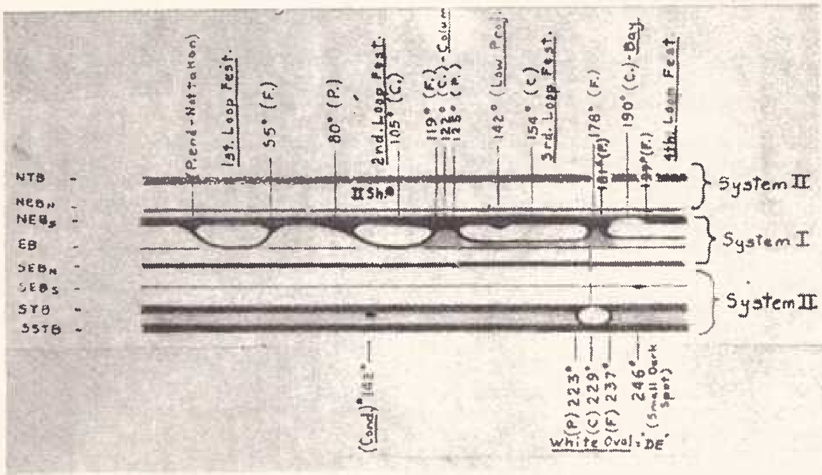


FIGURE 37. Jupiter. Carlos E. Rost. 6-in. refl. June 12, 1960. 1^h 07^m to 5^h 01^m U.T. C.M. I=54° to 197°. C.M. II=105° to 246°. North at top, prec. direction in longitude at left. Strip sketch of a 4-hour observation.

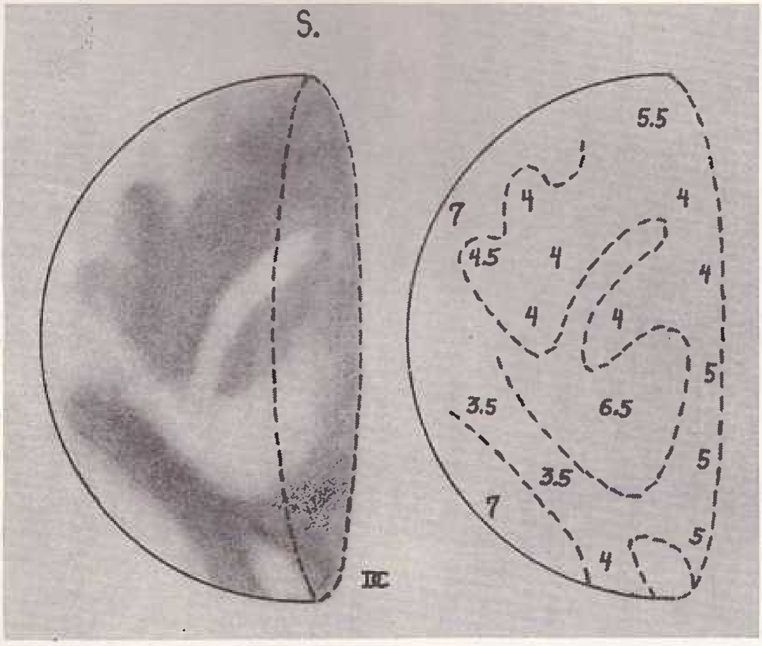


FIGURE 38. Composite drawing of Mercury constructed by Dale P. Cruikshank from four actual drawings with the Yerkes Observatory 40-inch refractor, as follows: June 4, 1960, $0^h\ 10^m$-$0^h\ 30^m$, U.T., seeing 5; June 8, 1960, $0^h\ 0^m$-$0^h\ 25^m$, U.T., seeing 3; June 9, 1960, $0^h\ 0^m$-$0^h\ 36^m$, U.T., seeing 5-6; and June 18, 1960, $0^h\ 20^m$-$0^h\ 55^m$, U.T., seeing 7-8. See also text of Mr. Cruikshank's paper. Simply inverted telescopic image with south at the top.

It was a simple task to see which markings maintained the same general position. The composite final sketch was then prepared as the plastic pieces were viewed on an opal glass viewer, taking into account, of course, the weight of individual observations mentioned before. Because of the difficulty in copying on the plastic overlays, relative intensities of the features were completed with the use of the original drawings.

This method of reproduction is similar to that employed in making composite prints of planetary photographs where several images are obtained at the telescope in a short time interval. In such a case, several of the best images are projected on the same piece of photographic paper in the enlarger, each in turn, and each for a time proportional to its "weight." A fair quality image might receive only one-fourth the exposure of a good quality image. In photography this method serves to enhance faint details not otherwise visible on a print from a single image and to supress grain, emulsion defects, and general lack of sharpness.

Obviously, the composite drawing technique works only for Mercury (unless one still adheres to the sidereal=synodic period for Venus) and then only for drawings made in relatively short time intervals. The fourteen days covered by these observations actually stretch the limit a bit, but the planet passed through dichotomy during this period and the longitudinal libration differential was at a minimum. Nearer conjunction with the sun, the interval would best be shortened, perhaps to about eight days to lessen the libration and rotation effects. Once again, phase changes must also be accounted for; and the final drawing must be reduced to a fixed terminator, as was done here.

This method has at least one obvious disadvantage. If Mercury does possess an atmosphere with opaque or semi-opaque clouds* which sometimes obscure surface features, and if these clouds are sometimes short-lived (a few hours to about two days), the composite image method has the effect of lessening or completely disguising the record from an individual drawing. That is, if a feature is shown on one good drawing but does not appear on two or more others in the same eight- or twelve-day series, one might conclude that the feature is not real. If the finished composite were then intended for map-making, the resulting omission of the obscured feature would be unfortunate.

The above discussion assumes that an observer can secure several drawings of the planet in a relatively short time period. It is the writer's opinion that this procedure is the only way to attack difficult Mercury, with small telescopes or large. Scattered observations--one or two at each apparition--however skilled the observer, can add only a little to our work on the planet.

Reference

Cruikshank, D. P., "Observations of Venus and Mercury with Large Apertures," Str. A., 13, Nos. 9-10, p. 108, September-October, 1959.

ON THE VARIATION OF THE PHASE OF VENUS FROM THEORY

By: Minick Rushton

(Paper read at the Seventh A.L.P.O. Convention at Haverford, Pa., on Sept. 5, 1960.)

The difference between the times of theoretical and observed dichotomy of Venus has long been an established fact. Yet it comes as a surprise to many to learn that this deviation from prediction applies not only to dichotomy, but to all phases of Venus.

In August, 1958, a short article appeared in Sky and Telescope which mentioned the work of two Russian amateurs, Michelson and Petrov, on this subject. Figure 39 shows the results of their work.[1] The vertical axis represents the phase as given by ephemerides. The horizontal axis is the observed phase minus the theoretical phase. The heavy line marks zero deviation. These observations indicate a definite pattern in which the crescent appears larger than expected, while the reverse is true for the gibbous phase. The first question to arise concerning these observations is that of their accuracy. Since the measurements were made from drawings, the question of "personal equation" must be carefully considered.[1] It can be answered in part by the comparison of their work with that of other observers. However, accurate measurements of this phenomenon for extended periods of time are somewhat rare. Henry McEwen, a past Section Director of the British Astronomical Association, made over 900 measurements of the phase variation using a Slade micrometer mounted on a 5-inch altazimuth telescope.[2] The eyepieces employed were a Ramsden of 156 diameters and a Zeiss orthoscopic of 180 diameters. All measurements were made in daylight in order to reduce the effects of irradiation. A discussion of the observations made during the period 1919-1927 appeared in the Journal of the British Astronomical Association. Figure 40 shows the results of McEwen's work. Many observers claim that the retardation of the phase is greater in western elongations (or apparitions) than its acceleration in eastern ones. The graph for the western elongation of 1927 contradicts this belief, for it in no way differs radically from the graphs of the other elongations.[3] However, it must be stressed that the graph represents only twenty-five observations during one elongation.[4] These curves in Figure 40 indicate a

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*This matter is open to considerable question in view of the positive observations by Antoniadi, McEwen, Haas, and others; and the recent negative observations by Dollfus at Pic du Midi.

exceptions. Once in July Chapman observed a bright line in the position normally occupied by Encke's Division (Figure 49). Also, Budine once observed in July the inner part of Ring B to be brighter than the outer part (opposite to the normal). Haas in October found Ring A to be brightest in a narrow annulus adjacent to the Cassini Division, as he also did in 1958.

Ring D (outside Ring A) was unreported in 1959. It appears so far to remain the general impression that Ring D is harder to see at high inclinations of the rings while basically the opposite is true for the Crape Ring.

Ring Divisions

C5: Not reported by any observers in 1959.

B0: Observed occasionally by Chapman, Cragg, and Haas.

B3: Observed by Chapman, Haas, and Wegner.

B5: Observed a number of times by Cragg and Wegner, and further confirmed by Meisel. Cragg continues to find this division the easiest minor division, sometimes stronger than Encke's.

B7: Not reported by any observers in 1959.

Cassini's Division: Observed by all participants, and found by more than half of the observers all the way around the ring.

Encke's Division: Observed by Budine, Chapman, Cragg, Haas, and Wegner. It was generally placed slightly outside the center of Ring A.

"SAUCERS" IN PTOLEMAEUS

By: Alika K. Herring

(Paper read at the Sixth A.L.P.O. Convention at San Jose, Calif., on August 24, 1960.)

So far as is known, no serious attempt has yet been made to survey or study the very shallow depressions that are found here and there on the lunar surface and which have been popularly referred to as "saucers". Reference to them in the literature is ordinarily casual or vague, with the result that this type of detail is usually dismissed as being of little or nc importance. I believe, however, that the contrary should be true. Any comprehensive theory concerning the formation of the lunar craters must also explain the genesis of these saucers. Conversely, any valid theory concerning the origin of these objects may in turn provide us with important clues concerning the formation of the features containing them. The folowing remarks may therefore be of some interest.

Several common characteristics of the saucers may be briefly described. With few exceptions they are rimless, approximately circular in shape, and are of such shallow depth that the sunlight must fall almost at grazing incidence to bring them into relief; in fact the very great majority of them will be totally invisible when more than 12 hours away from the terminator. So shallow is their depth that an observer could be situated in the center of one of them and have absolutely no inkling of the fact; it is even entirely possible that some of our future astronauts may land their moon rockets in the middle of a saucer and be totally unaware of its existence. It is interesting to suggest that if similar shallow depressions exist on the surface of the earth, they will unquestionably remain undiscovered until the earth is observed from some lunar observatory!

It should be noted that the saucers almost invariably occur in either the walled plain type of crater having the dark maria-type floors which are relatively smooth and free of detail, or on other portions of the lunar surface which have apparently been inundated by maria-type material. This dis-

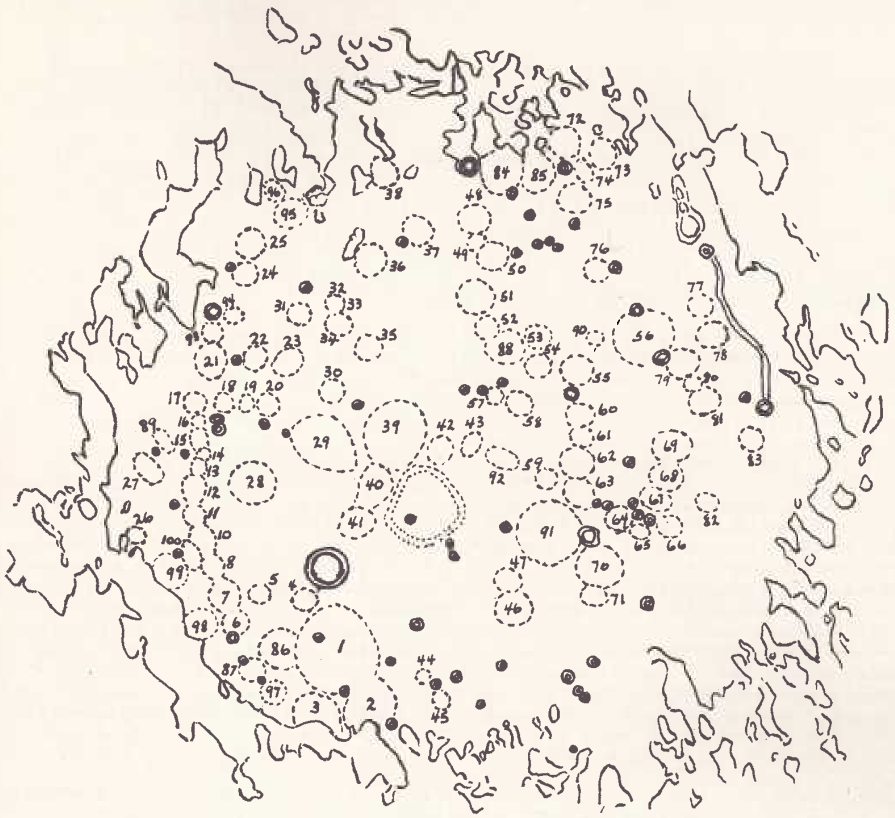

FIGURE 51. Chart by Alika K. Herring of "saucers" in lunar walled plain Ptolemaeus. Chart based upon observations in 1955-59 with 8-inch and 12.5-inch reflectors and upon a photograph by Dr. Dinsmore Alter. See also text of Mr. Herring's paper in this issue.

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tribution is undeniably a fact of some significance. We thus find saucers in Plato, Archimedes, Fracastorius, and other walled plains, as well as in the numerous small inundated areas northwest of Hipparchus in the vicinity of Saunder and Lade. And as with the lunar domes, these features may occur in far larger numbers than has previously been supposed. It is indeed a rare instance when with a fairly large telescope and the proper conditions of seeing and illumination, a number of these objects cannot be found along the terminator at any given time.

Yet perhaps the largest known concentration of saucers will be found on the floor of Ptolemaeus, where they occur in considerable profusion. At this writing, some 100 of these objects have there been charted; and the study is by no means complete. Figure 51 is a preliminary chart by the writer. Of these, number 1, lying closely adjacent to Lyot on the north, is the largest and deepest, and is exceptional in being visible for perhaps several days after sunrise and also several days before sunset.

it is further exceptional in having a low raised rim, which may indicate that this object is better regarded as a buried crater which has been partially covered by a later inundation of the floor of Ptolemaeus. That such inundation has occurred is clearly indicated by the small ghost ring southeast of Lyot.

Attention is also directed to the curious tendency of the saucers on the eastern half of the floor to arrange themselves in semi-circles. Two of these configurations may be easily seen on Figure 51 formed by the saucers numbered 50, 51, 52, 88, 54, 55, and 56 and by 60, 61, 62, 63, 64, 67, 68, and 69. Other less conspicuous arcs are formed by 56, 79, 78, and 77 and by 46, 47, 91, 70, and 71. Another curious arrangement may be found in the chain of partially coalesced saucers, extending from 6 to 95, these forming a long and curved shallow valley which is more or less concentric with the west wall. Such concentricity can hardly be accidental, and implies a connection with hidden crustal weaknesses, perhaps even indicating a distant kinship with the clefts and crater-chains which occur in similar situations elsewhere on the lunar surface.

It is, of course, interesting to speculate on the question of how the saucers may have been formed. While several possible answers may immediately occur to us, I wish to suggest one solution that I believe may have some merit. It can be demonstrated that a pot of melted wax or pitch, after cooling slowly, will not possess a perfectly smooth and level surface, but instead one that is covered with numerous very shallow depressions so slight in depth that they must be viewed from a most oblique angle to be seen at all. And if we but think for a moment, we must realize that these minute irregularities could only have been caused by convection currents in the melted material which persisted up to the actual moment of solidification. Such turbulence, as it might more properly be called, is nature's way of dissipating heat, and may manifest itself in many ways; a good example is the rice grain structure of the solar surface. There is certainly every reason to believe that such turbulence was also present during the cooling of the lunar surface. We admittedly must be extremely wary of attempting to interpret large scale lunar phenomena by small scale laboratory experiments; for if such comparisons were completely valid, it would be a simple matter to prove that the lunar craters were formed in at least a half dozen different ways! So perhaps we should yet consider the question of the saucers to be an open one, and place it alongside the many other lunar mysteries which must await a solution by selenologists in the future.

THE REPORTED OUTBREAK IN ALPHONSUS: AN ANALYSIS

By: Patrick Moore, F.R.A.S., F.R.S.A.

(Paper read at the Sixth A.L.P.O. Convention at San Jose, Calif., on August 24, 1960.)

As on several past occasions, I have been honored with an invitation to submit a paper to an A.L.P.O. Convention; I greatly appreciate this, and am only sorry that I cannot be with you to read it in person. As my subject, I have taken the controversial report by the Russian astronomer N. Kozyrev that on 1958, November 3 a volcanic outbreak was recorded in the lunar crater Alphonsus. The main facts are probably known to most people here today, and the purpose of my paper is to attempt an analysis. However, it may be as well to give a brief statement of what actually happened.

Alphonsus is a particularly prominent crater near the apparent center of the lunar disk. It lies between Ptolemaeus and Arzachel, and has long been regarded as a possible site of variations. During the last century, H. Klein[1] described it as "one of the most active regions on the Moon," and I have collected various other notes leading to the same conclusion[2]. How accurate these reports are is, of course, problematical; and they are certainly not conclusive. Studies of the crater were carried out some years ago by D. Alter, now Director Emeritus of the Griffith Observatory. Following an examination of photographs of Alphonsus taken at Lick in 1937, Alter considered it worthwhile to photograph the region in both infra-red and blue-violet. On the morning of 1956, October 26, under excellent conditions, he obtained results which led him to conclude that in blue-violet, the western part of the floor of Alphonsus was "obscured," while the corresponding area in Arzachel was not. Alter suggested that small amounts of gas were being discharged from the tiny dark spots along some of the clefts.[3]

This research came to the notice of N. Kozyrev, at the Crimean Astrophysical Observatory, who began studies on his own account, using the 50-inch reflector. Kozyrev commented that the lunar surface is exposed to all the hard radiation sent out by the Sun, and he began searching for fluorescent effects due to a very tenuous "atmosphere" inside Alphonsus. It was during this work that he observed his now-famous eruption. Various reports of it have been published, one of which is by Kozyrev himself[4]. While guiding a plate, he noticed that the central peak had become blurred, and was apparently engulfed in a reddish "cloud" which shifted considerably. The slit of the spectrograph was extended in an east-west direction across the central peak, and when the spectrograms were developed they provided confirmation. The observation was made on November 3, between $1^h\ 00^m$ and $3^h\ 45^m$, U.T. When I first heard about it, which was some days later (when the observation was released), I wrote to Kozyrev and asked for additional information. He was kind enough to send me copies of his spectrograms, and also a description of what had been seen. I quote from his letter to me, which I received early in December, 1958:

"On the spectrogram obtained at 1^h U.T., the peak of the crater appears redder than the adjacent floor; possibly at that time the peak was being observed and illuminated by the Sun through the dust thrown up by the eruption. On the spectrogram obtained at $3^h\ 00^m$ - $3^h\ 30^m$, U.T., the spectrum of the peak shows a bright gaseous emission. The most prominent emission bands are at 4756 angstrom units (not yet identified) and the Swan band group, due to C_2 molecules, at 4735, 4713, and 4696 angstroms. Swan bands also occur at 5165 and 5130 angstroms. A group of C_3 lines from 4100 to3950 angstroms is clearly visible, and there are many other lines which have not so far been identified. During the guiding of the spectrogram, I noticed a marked increase in the brilliancy of the area, and an unusual white color. Suddenly the brightness began to lessen. I stopped the exposure and began a new one, from $3^h\ 30^m$ to $3^h\ 45^m$, U.T.; the resulting spectrogram showed the normal appearance."

Here, for the first time, was an observation of activity on the Moon which was confirmed photographically. The news was decidedly unexpected, and was received with some incredulity in Western Europe and the U.S.A.; until I had Kozyrev's letter, I was inclined to believe that there had been some mistake either in the original message or in its translation.

Shortly afterwards, H. P. Wilkins, using his $15\frac{1}{4}$-inch reflector in England, recorded a reddish patch on the site of the "eruption," presumably due to colored material ejected on November 3. Wilkins saw this patch on November 19 and again on December 19; and its existence was confirmed, independently, on both occasions by G. A. Hole using a 24-inch reflector at Brighton.[5] Other observers also have seen it; for instance, on 1960 January 6, B. Warner, at the University of London Observatory, recorded it unmistakably.[6] All this seemed clear enough, but doubts were expressed in various quarters. The reality of Kozyrev's "eruption" was questioned; and some authorities failed to see the subsequent red patch, concluding that it did not exist. Before giving a general summary, it may be as well for me to add what observations I have made on my own account.

I have studied Alphonsus for some years--my first observation of it dates back to 1937--and I think I may claim to be fairly familiar with its topography. The famous dark patches show apparent variations, but these are explained by the changing illumination, and I have yet to record anything in the crater which cannot be accounted for in such a way. Neither, regrettably, have I seen the red patch. I have searched for it on frequent occasions since November, 1958, using mainly my $12\frac{1}{2}$-inch and $8\frac{1}{2}$-inch reflectors, but with no success whatsoever. On 1960, June 3, at $21^h\ 20^m$, U.T., I was observing with G. A. Hole; the instrument was Hole's splended 24-inch reflector, used at the Cassegrain focus. Conditions were fair. Hole could see the red patch; I could not, despite all my efforts. I do not regard this as at all significant. I am not particularly color-sensitive at the best of times.

More interesting is the fact that Kozyrev reported new activity in Alphonsus on the night of 1959, October 23. I was studying the formation between 1^h and 3^h, U.T., using my 8½-inch reflector (trees prevented my using the 12½-inch) and could see nothing unusual. Therefore, anything which took place at that time was, I am sure, beyond the range of my telescope. [See also Str. A. for Jan.-Feb., 1961, p. 7, lines 2 to 8.--Editor.]

If we accept the reality of the outbreak and of the subsequent red patch--or, for that matter, the outbreak only--some interesting conclusions follow. Alter's conjectures will have been borne out; and we will have to agree that minor activity does take place on the Moon, which lends force to the oft-reported "obscurations" in various features which have been noted by almost every serious amateur who has been observing for twenty years or more. It is too much to maintain that the long argument as to the formation of the lunar craters would now be settled in favor of the volcanic theory, but it would appear that the central peak of Alphonsus is associated with vulcanism. We would also have to accept at least isolated pockets of heat below the lunar crust.

It has been suggested that there may have been errors of observation or interpretation. This would indeed be surprising for a man of Kozyrev's experience and reputation; but after studying his account and his confirmatory photographs, I feel that we must reject the "error" idea out of hand. The photographs exist, and they show unmistakable traces of activity. If they are genuine, they prove that activity did occur. There is no room for mistakes made in good faith; if we suppose that no outbreak took place, we must also suppose that Kozyrev deliberately published a false report and followed it up by manufacturing fake spectrograms. This is obviously ludicrous. In the case of the red patch, there is room for honest observational error, since there are no confirmatory photographs. However, further observations should clear the matter up.

My conclusions, therefore, are that there is overwhelming evidence of a minor outbreak in Alphonsus on November 3, 1958, and that some of our ideas as to the inertness of the Moon must be revised. The procedure now must be to keep a close watch on Alphonsus, and I suggest that all those who have suitable equipment should pay constant attention to the whole area.

My very best wishes to you all for an extremely happy and successful Convention.

References

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2. Patrick Moore. "The History of Alphonsus," Strolling Astronomer, 13, 83.
3. D. Alter. "A Suspected Partial Obscuration on the Floor of Alphonsus," Publ. Astr. Soc. Pacific, 69, 158.
4. N. Kozyrev. "Observation of a Volcanic Process on the Moon," Sky and Telescope, 18, 184.
5. G. A. Hole. "The Alphonsus Eruption Area," Jnl. International Lunar Soc., 1, 90.
6. B. Warner. "Red Spot in Alphonsus," Jnl. International Lunar Soc., 1, 144.

Remarks by Dr. Dinsmore Alter. Dr. Alter offered some informative comments from the floor on the subject of Mr. Moore's paper during the Sixth A.L.P.O. Convention. An edited version follows: "Kozyrev wrote me that the density at the orifice of the craterlet was about one-one billionth (10^{-9}) that of our atmosphere at sea level. He got this value by assuming 100% ionization of the gas, which would be sufficient to produce the effect. Kozyrev's observations are honest and are very valuable; however, his conclusions regarding C_2 can be doubted. There is further evidence that he overlooked something in his report. There is almost no spectrum shorter than 4300 angstroms in the spectrogram showing emission; but this part of the spectrum returned in the immediately following spectrogram, which did not show emission."

PROGRESS REPORT OF THE A.L.P.O. LUNAR METEOR PROJECT IN 1959-1960

By: Robert M. Adams

Herein are presented the results of our 5th year of observations covering the period from Oct. 1, 1959, to Nov. 30, 1960. All participating stations were located at a distance apart sufficient to distinguish lunar flashes from earthly meteors.

The following individual observers were engaged in the meteor search observations for the stated total amounts of time:

H. M. Blake, Tracy, California, 4-1/4" reflector, 2.0 hours.
James Bukowski, San Francisco, California, 4" reflector, 6.1 hours.
Tom Cragg, Inglewood, California, 12-1/2" reflector, 1.5 hours.
Jim Colburn, Oxnard, California, 4" reflector and 6" refractor, 1.8 hours.
Tom Constanten, Las Vegas, Nevada, 3-1/4" refractor, 0.2 hours.
Stuart and Stanley Emig, Leavenworth, Washington, 8" reflector, 2.0 hours.
Val Hennessee, Greensboro, North Carolina, 4-1/4" reflector, 3.4 hours.
Mike Kelly, Neosho, Missouri, 4-3/8" refractor, 0.5 hours.
Robert W. Miller, Miami, Florida, 12-1/2" reflector, 1.0 hours.
William J. Westbrooke, San Francisco, California, 4" reflector, 0.7 hours.

Mr. Craig Johnson observed with his 4" reflector from Boulder, Colorado; and recently he has coordinated his efforts with William Nelson, who uses a 6" reflector. Johnson 7.1 hours, Nelson 0.5 hours.

Observers from Manchester, Connecticut, were divided into two stations: Eugene Spiess with his 5" refractor and Daniel and Doris Fraher, who operate a 3" reflector. Spiess 6.2 hours, the Frahers 4.3 hours.

As in previous years the large group of observers from Montreal was divided into no less than eleven active stations. These are: Miss I. K. Williamson, E. M. Towne, C. M. Good, Mrs. R. Prezament, and Miss C. L. Drolet operating station 1 and using an 80 mm. refractor; Mrs. D. Yane, Louis Duchow, and Mrs. K. Zorgo operating station 2 using a 3" reflector; Miss I. K. Williamson, G. Wedge, S. Downing, C. Papacosmos, and G. Gaherty operating station 4 with a 6-1/2" refractor; G. Gaherty and D. Sands operating station 5 with an 8" reflector; W. A. Warren operating station 8 using a 6" reflector; K. R. Brasch of station 10 using an 8" reflector; Vic Williams of station 14 using a 6" reflector; Mrs. K. Zorgo of station 15 using a 5" reflector; C. Papacosmos and K. R. Brasch operating station 17 utilizing an 8" reflector. There is a map giving the locations of all the Montreal stations. Brasch 2.5 hours, Drolet 0.5 hours, Duchow 0.2 hours, Gaherty 7.4 hours, Good 1.8 hours, Papacosmos 0.4 hours, Prezament 0.5 hours, Sands 0.1 hours, Towne 1.7 hours, Wedge 3.5 hours, Warren 2.9 hours, Williams 10.7 hours, Williamson 5.6 hours, Yane 1.0 hours, and Zorgo 7.2 hours.

The Pittsburgh observers included J. Mullaney using a 2.4" refractor and M. Paston using a 2.4" refractor also. Mullaney 1.5 hours and Paston 0.3 hours.

To Vic Williams goes the honor of having observed the greatest amount of time followed in order by Mr. Gaherty, Mrs. K. Zorgo, and Mr. Craig Johnson.

Since this project is concerned solely with the times of overlapping observations and since space is at a premium in this publication, it is proposed to give a rundown of only those observations where actual overlapping took place. This is a departure from previous procedures when a complete inventory of all reported descriptions of flashes, flares, and trails of light was given. There were again many interesting reports of discoveries of flashes, flares, and trails of light; and we wish to thank all those who submitted positive findings. Due to the enormous difficulty of formulating schedules over such a wide range of time and space, most of the overlapping of observations was achieved by the large Montreal group. Incidentally, all times below have been translated to Universal Time.

On Nov. 5, 1959, Montreal stations 5 and 14 overlapped to the extent of ten minutes from 23:00 to 23:10. On Dec. 4 overlapping was achieved from 23:00 to 24:00 by station 5, 14, and 15, and by the Frahers. Stations 5, 10, and 15, and Paston overlapped from 23:00 to 24:00 U.T. on January 1, 1960. On the 2nd there was overlapping from 23:00 to 23:05 most of the time by stations 1, 5, 14, and 15. On the night of Jan. 31-Feb. 1 there was overlapping for most of the period from 23:44 to 0:30 by stations 1, 5, and 8. Stations 1 and 2 overlapped from 0:00 to 1:00 most of the time on March 1, 1960. On the 2nd four stations overlapped for an hour from 0:00 to 1:00. These stations were 1, 2, 5, and 10. On the 3rd stations 1, 5, and 10 searched from 0:00 to 1:00. It should be pointed out that many of the above stations achieved triple and quadruple overlapping from time to time. On April 2 stations 4 and 14 searched from 0:58 to 1:30. On May 2nd stations 1 and 4 investigated from 2:09 to 2:18. No less than five stations searched on the night of May 3rd: stations 4 and 14 began at 2:30 and continued to 3:30, and stations 8 and 15 began at 2:45, with station 8 stopping at 3:22, U.T. In June, 1960, Montreal stations 2, 4, 8, and 14 watched from 3:00 to 4:00 on the 2nd. There were at least two stations at the telescopes at any one time. Stations 4 and 14 overlapped on July 1st from 3:01 to 3:11. There was triple overlapping from 3:00 to 4:00. Four stations overlapped during August 1st: stations 1, 4, 14, and 15. There was at least triple coverage from 3:00 to 4:00. Spiess and the Frahers overlapped on August 26th from 0:00 to 0:21. Stations 1, 14, and 15 searched with at least partial overlapping and even partial triple overlapping. There were no confirmations in any of the above searches. On August 29th while station 17 was observing from 5:00 to 6:30 Mr. Papacosmos saw an instantaneous flash at 6:10, and Mr. K. Brasch saw one at 6:23. Both objects had trails from which the observers surmised that they were earthly meteors. Mr. Craig Johnson continues to see many flashes and trails, but to date there is no confirmation of his findings. He writes that some of his objects may be psychological in origin. Both Craig Johnson and Tom Cragg searched for lunar meteors during the total phase of the lunar eclipse of September 5, 1960. Mr. Johnson saw a bright flash at 10:38 U.T. about 100 miles S. and E. of Mare Crisium. He saw a bright 0.5 second flare 200 miles south of Aristarchus at 10:55 and a slow streak S. to N. near the limb at 11:14. He saw a flare at 11:39 175 miles S.E. of Plato and a suspected flash at 11:46 just off the west tip of Gassendi. William Nelson searched from 10:55 to 11:20. He states that he saw four flashes practically together at 11:10 plus or minus 30 seconds. Three of them were within 50 miles of Delambre. Mr. Cragg diligently searched with his 12-1/2" reflector during totality, but he did not see any flares or flashes. Stations 1, 8, 14, and 17 of the Montreal team observed on Sept. 26th, but there was a minimum of overlapping. On the 28th stations 1, 4, and 14 overlapped from 1:00 to 1:25. On the 28th(?) stations 1, 4, and 14 observed. Stations 4 and 14 overlapped from 1:13 to 1:25. On Nov. 22, 1960, stations 1 and 5 overlapped from 23:19 to 23:23, although each team observed for a much longer period of time without overlapping. On the 23rd at least two of stations 1, 5, 14, and 15 overlapped from 23:00 to 24:00, U.T.

Once more we are confronted with no confirmations by means of overlapping observations. And once more we are obligated to the Montreal team which produced by far the greatest number of observations.

It occurs to this writer that there is a possible whole new approach to our problem of lunar meteor verification. This idea is brought to mind by the apparent observation of Lunik II kicking up a dust cloud some forty kilometers in diameter (see Sky and Telescope, November, 1960, page 265). Any cursory examination of the area south of Autolycus shows many dark spots, but the possible verification by two stations (still awaiting photographic confirmation) gives us a new *modus operandi*. Why not set aside at least a half hour every month for searching an area 100 miles wide along the terminator on the bright side of the lunar surface on the night of First Quarter? This search might also be attempted on the night before First Quarter and on the night after First Quarter. This would all be in addition to our customary observations of the earthlit portion of the lunar surface. A plausible reason for taking the First Quarter is that it is an easy date for all to remember, and most of us can search at the same time (weather conditions permitting). The rays of the sun are at an acute angle along the terminator affording easy visibility of possible dust clouds.* With this in mind the writer is offering a schedule (use Central Standard Time):

1961,	Dec. -	6:00 to 6:30, P.M.
	Nov. -	6:30 to 7:00, P.M.
	Oct. -	7:00 to 7:30, P.M.
	Sept.-April	7:30 to 8:00, P.M.
	Aug. -May	8:00 to 8:30, P.M.
	July -June	8:30 to 9:00, P.M.

The sky need not be completely dark for this kind of observation.

Please continue observations for lunar meteors as indicated by flashes, flares, and streaks of light as in the past. Again this writer wishes to thank all of those who have so generously given of their time to the lunar meteor project.

BOOK REVIEW

Der Sternenhimmel 1961. Edited by Robert A. Naef. Aarau, Switzerland: H. R. Sauerlaender & Co., 142 pages. Available in the U.S. through Mr. Albert J. Phiebig, POB 352, White Plains, N. Y. Numerous illustrations and diagrams.

Reviewed by Ernst E. Both

This very excellent observing handbook has been a faithful and handy companion for the past 21 years. This year the well-known format and arrangement have again been retained: explanation of use; observable phenomena in 1961; celestial calendars for each month with monthly star charts; positions of the sun, planets, and the moon in 1961; planetary data (including the larger asteroids); a list of Swiss observatories (the number listed is about 38, including private observatories); detailed lists of interesting celestial objects; directions on how to find the brighter stars; and various explanations of symbols and terms used.

M. Du Matheray's map of Mars, based on personal observations in 1941-1952, is again reproduced; but the nomenclature has been changed to conform with that proposed by Section 16b of the International Astronomical Union. Here is one of the finest of the modern maps of Mars, and the new nomenclature ought to increase its usefulness considerably. The small general map of the moon, which had appeared in last year's issue, has unfortunately been omitted.

A great variety of charts and diagrams add materially to anyone's enjoyment of the booklet. Outstanding among these are: elongations of Mercury in 1961, total solar eclipse of February 15, 1961, a comparison of the motion of Venus through Aries in 1945 and 1961, and the positions of Ceres and Vesta for this year. Particularly the monthly celestial calendars are a mine of information, giving, among many other things, minima

*According to the observations of Lunik II there was a rapid expansion of the dust cloud from a minute black spot to a greying area of over 40 kilometers in diameter which rapidly disappeared, the whole phenomenon taking only a very few minutes. According to Prof. Haas in a letter to the writer, dust will fall back to the lunar surface according to the approximate formula $s=2.6\ t^2$. Thus it will fall some 9500 feet in one minute so that the whole process of rising and falling might require in the neighborhood of 3 to 5 minutes. It appears probable that dust clouds produced by meteorites much smaller than Lunik II will escape ordinary telescopes.

and the morning of August 26 (Sat.). The annual G. Bruce Blair Award will be given to Mr. Carl Wells of Roseville, California, for his long and outstanding service to amateur astronomy. Mr. Wells is one of the founders of the W.A.A. He is a professional in optics; and his instruments include the mirror for an 8-inch Maksutov for the University of California at Berkeley, a 6-inch refractor for the Nevada Astronomical Society, the first mirror for the Franklin Wright Camera, and a 12-inch mirror for Sacramento City College. He has always been extremely helpful to amateurs with advice, lectures, correspondence, and loans of instruments. The Lafayette Hotel will have plenty of highly suitable room for exhibits, and an extensive display of current A.L.P.O. work is hence desired. An outstanding gathering at Long Beach seems assured; and we urge all who possibly can to attend for information, fun, and good astronomical fellowship.

The W.A.A. Convention Chairman is our old-time colleague, Tom Cave, 4137 E. Anaheim St., Long Beach 4, California.

Further Notes on Eighth A.L.P.O. Convention. It will be recalled that this meeting will be part of the Astronomical League National Convention at the Henrose Hotel in Detroit, Michigan, on July 1, 2, and 3, 1961. The General Chairman is Dr. C. D. Marshall, 17396 Westmoreland Road, Detroit 19, Michigan. There will be plenty of space for astronomical exhibits. A very large display of amateur telescopes is planned. The A.L.P.O. Convention will be held from 9:30 A.M. to 12:30 P.M. on Sunday, July 2. Registration payments should be sent to Mr. George Meyerson, 19777 Cheyenne, Detroit 35, Michigan. The cost of registration is one dollar per person and two dollars and a half per family before June 1, 1961, two dollars per person and five dollars per family after that date. Hotel reservations should be made directly with the Henrose Hotel, Detroit 26. A special Convention rate schedule has been set up and varies according to what accommodations are desired; single rooms, double rooms, and twin rooms are available. Rates begin at $6.50 for single rooms. Two professional astronomers will address the League Convention; these are Professor Haddock of the University of Michigan and Dr. Helen Sawyer Hogg of the David Dunlap Observatory of the University of Toronto. A field trip on the afternoon of July 1 will be made to the Peach Mountain station of the University of Michigan. Here there are two radio telescopes, 28 and 85 feet in diameter respectively, a 36-inch Schmidt camera, and a 24-inch reflector. The 85-feet radio telescope is the fourth largest in the world. The Peach Mountain facility works on a United States Navy Research Project. The customary Honor Dinner will be at 7:30 P.M. on July 2.

We heartily invite all A.L.P.O. members and others who are able to come to Detroit next July.

Program Papers and Exhibits. We still need papers for our programs at Detroit and Long Beach and display material for the A.L.P.O. Exhibit at each place. Members are again invited to contribute. Papers submitted should be typed and double-spaced, and we need two copies. Reading time must not exceed 15 minutes. Practical exhibit material consists of drawings, photographs, and charts. The A.L.P.O. Exhibit Chairman at Long Beach is Mr. Alika K. Herring, 1312 Arlington Ave., Anaheim, California. A Chairman for Detroit will be appointed soon.

Birthday Remembrance. This issue marks the fourteenth anniversary of *The Strolling Astronomer* and the A.L.P.O. Our first six-page, wide-margin issue was mimeographed at Albuquerque, New Mexico, in March, 1947, and went to about 50 persons. It is fitting here to acknowledge the assistance of many, many colleagues in 1947-61 as observers, correspondents, authors, Recorders, helpers at Conventions, and the like. Whatever service we have been able to supply to astronomy rests upon this considerable assistance, so freely and unselfishly given. Our deep thanks!

OBSERVATIONS AND COMMENTS

Lunar and Planetary Research in Japan. Dr. S. Miyamoto, Director of the Kwasan Observatory, University of Kyoto, Japan, has described for us several of their research programs on the moon and planets, as follows:

"(1). Meteorological Study of the Martian Atmosphere. Visual observations with the Cooke 12-inch refractor are concentrated upon the accumulation of meteorological records of the Martian atmosphere. Since the 1956 apparition, the appearance and disappearance of clouds and haze and their drifts by wind have been recorded. Our observations are to be continued until we can reduce from these data the pressure distribution and the general circulation of the Martian atmosphere for every season of the year. Observations and the method of analysis are quite parallel with those obtainable with the Tiros satellite of our earth. In spite of the similarity of rotation period and inclination of the axis between Mars and our earth, the Martian general circulation is expected to show a quite different pattern from ours. At the 1956 apparition we fortunately witnessed the emergence and subsequent development of a great yellow cloud. Photographic recording of Martian clouds with red and blue filters with the new 24-inch reflector at Kwasan Observatory will be started in the near future.

"(2). Geological Study of the Lunar Surface. For the geological study of the lunar surface, a photographic atlas was prepared with the 12-inch Cooke refractor, showing the surface features under different illuminations by the sun. The 24-inch reflector will be used to secure finer details, especially to collect the observational data necessary to criticize theories of lunar maria and crater formation.

"(3). Polarimetric Observation of Venus Clouds. This program will be put in operation with the 24-inch reflector in coöperation with the Pic du Midi Observatory under the direction of Dr. A. Dollfus."

A description of the Kwasan Observatory, with several photographs, appeared upon pages 90 and 91 of Sky and Telescope for February, 1961.

Pan American College Summer Institute in the Astro-Sciences. From June 5 to July 15, 1961, the second annual Institute in the Astro-Sciences will be held at Pan American College at Edinburg, Texas. The program is supported by the National Science Foundation. American high school students in grades 10, 11, and 12 were eligible to apply. (A circular letter was mailed to American members of the A.L.P.O. in March.) Formal instruction will be in two parts: first astronautics and space technology, and second astronomy and astrophysics. The principal telescope at Pan American College is Professor Engle's 17-inch reflector. A trip to the developing Infiernillo High Altitude Observatory south of Monterrey, Mexico, and 10,391 feet above sea level will be made. The latitude of Edinburg (26°18'N.) will be favorable for studies of Jupiter and Saturn at their present large southern declinations, for viewing many southern deep-sky objects, and for some Moonwatch operations.

The Strolling Astronomer

ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

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...graph taken during ...ral eclipse of the ... February 15, 1961, ...essor Jean Bigay ... 47-inch reflector ... Haute Provence Ob... ...ry, France. En... from part of the ...aph shown as Fig... ... on page 106 in ...ssue. Exposure 6 ..., Kodak G2 paper. ... large prominence ... of inner corona. ...raph supplied by ...sor Bigay and ...tted by Mr. A. C. ....

THE STROLLING ASTRONOMER

Pan American College
Observatory
Edinburg, Texas

Notable Negative Observations

On Feb. 21, 1960, Alan McClure attempted to photograph Comet Burnham 1960a. This comet was discovered by Burnham shortly after his discovery of the much brighter 1959k. This negative observation places an upper limit of about the 14th magnitude on 1960a on this date.

On April 19, 1960, under very excellent conditions Meisel attempted to locate Comet Wild 1960b. Since galaxies down to the 12th magnitude were visible, it is assumed that the comet was still fainter on this date.

Searches for a possible comet which was reported by Malsch were made but were all negative. A positive report was later identified with a small galaxy. However, as a result of the Malsch object search H. L. Giclas of the Lowell Observatory found a fast moving asteroid instead! This experience demonstrates that one must be very careful in such searching since another object may always show up. Initially the reports were very confusing, to say the least.

Conclusions

Although the number of reports received on the objects mentioned in this report exceeded the number in a previous equally long time-period, too few reports were received on each particular object to make a truly scientific study feasible. Nevertheless, special recognition should go to Alan McClure, John Bortle, and Robert Shayler for their excellent work which made this report possible. An exception to the general statement concerning the number of reports was the abundant material received on Comet 1959k, even in spite of the very bad weather that prevailed. The Recorder would like to thank all those who contributed reports to the Comets Section. In addition, those who contributed publications are also thanked for their interest.

The names and locations of observers whose work is used in this report are as follows:

Alan McClure, Hollywood, California	7" & 4" astrographs 7 x 50 binoculars
David Meisel, Fairmont, West Virginia	8" reflector, 6" reflector
John Bortle, Mt. Vernon, New York	6" reflector
Robert Shayler, Randolph AFB, Texas	8" reflector
Leonard Abbey, Decatur, Georgia	30" refractor
Robert Provine, Tulsa, Oklahoma	8" reflector
Paul Knauth, Houston, Texas	8" reflector

A SIMULTANEOUS OBSERVATION PROGRAM

By: Clark R. Chapman

The A.L.P.O. during its more than fourteen years of existence has based much of its work on individual lunar and planetary drawings. Recently there has been considerable criticism of some of the pictorial work turned in to the Sections and published in *The Strolling Astronomer*. Much of the criticism has been voiced in private conversations rather than in print, but it has come to the point where something should be done.

One of the major criticisms concerns drawings of minute surface detail with relatively small instruments--detail which would sometimes be theoretically impossible to observe even if the contrast were a maximum. Drawings of detail on Uranus with three- or four-inch telescopes or drawings of detail on Jupiter's four brightest moons with similiar instruments are extremely questionable. In fact, on page 267 of B. M. Peek's *The Planet Jupiter* the author shows that telescopes smaller than 25 inches in aperture probably cannot show true features on the Galilean satellites.

While examples such as those cited above are usually mentioned, this problem does not remain with Uranus, Neptune, and Jupiter's satellites alone.

Drawings have been turned in to the Mars Section recently that appear to show detail that would rival the best work done at Pic du Midi, while made with only modest instruments.

Are these observers dishonest? Of course not. Their problem is that they do not realize whether the detail they are drawing is true detail just at the limit of resolution or whether it is fictional, brought about subconsciously by inventions in the eye or by optical illusions.

Another major criticism of A.L.P.O. drawings is that on occasions when simultaneous drawings happen to be made and are published together in The Strolling Astronomer, there is sometimes little resemblance. Although much more obvious cases can be found, I believe the following example will illustrate the problem. Figures 3 and 4 on page 35 of the March-April, 1960, issue of The Strolling Astronomer are two drawings of Jupiter made within two minutes of each other by two very respected members of the A.L.P.O. The agreement on prominent large-scale features is generally excellent, particularly the latitudes and the relative conspicuousnesses of the belts and zones. There is some agreement on the positions of the major NEB projections. In respect to finer detail, however, Figure 3 clearly shows a prominent detailed gap in the SEB_n which is not shown at all on Figure 4. There is also a gap in the NEB on Figure 4 for which there is no real counterpart on Figure 3. The scale of both drawings and their general characteristics are such that there is no doubt that the observers thought they saw these details.

It is not too difficult to find much more serious disagreements in other issues of The Strolling Astronomer. I should hasten to add that there have also been numerous instances of excellent agreement between drawings, but good agreement should be the binding rule and not the exception.

Difficulties such as those mentioned above cause no end of trouble when the Recorders try to assemble the material turned in to them, and prepare a scientific report on exactly what really did happen during the apparition of the planet. To add to this, though, there are often difficulties in interpreting what was actually seen from drawings made in markedly different styles. For instance, the Mars canal controversy could be considerably alleviated if the proponents of the Antoniadi viewpoint would realize that drawings that show extremely finely drawn canals are not necessarily incorrect, only stylized; and if the proponents of the Lowellian view would face the facts and realize that such fine lines cannot possibly be resolved with amateur telescopes, and that they should work toward a more reasonable interpretation and representation of the desert features on Mars that actually exist.

Some people have asked why the professionals regard the work of amateurs so lightly and negatively. I think the matters dealt with above contribute greatly to this viewpoint of the professionals. Something should definitely be done to correct this situation. Suggestions have already been made (such as in Leif Robinson's discussion on page 81 of the May-June, 1960, Str. A.).

I propose a program of simultaneous observations. These would help solve these problems and would also be interesting and stimulating in other ways as well. Simultaneous observations have already been suggested (A. C. Larrieu in the Sept.-Oct., 1959, Str. A., for example) though not with these particular ends in mind. In fact, William K. Hartmann, our Venus Recorder, has already conducted a simultaneous observational comparison program in that Section. A small group of A.L.P.O. observers carried out a program last year very similiar to the one I am proposing now, though on a much smaller scale. The results were most encouraging, but far more observers are needed for real accomplishment.

At the end of this article I have given a list of dates and times for the members of the A.L.P.O. jointly to make simultaneous observations of several lunar craters and of the planets (principally Jupiter, Saturn, and Venus). The times have been arranged on convenient dates and also so that observers can rather easily observe from throughout the continental

United States. Also, some of the Jupiter times occur near some satellite phenomena which should also be timed by observers. If it is impossible to make a drawing exactly at the given time from where you are, observe as close as possible to that time. Observers should be at the telescope at least fifteen minutes early to become familiarized with the object by the time drawing is begun at the given time. In addition to making drawings, try also to time transits and satellite phenomena, to make intensity estimates, and to carry out all other possible types of observation so that those also can be compared. If possible, please use the standard A.L.P.O. observing forms for the Jupiter, Saturn, Venus, and Mercury observations. Be sure to fill in all the data called for. (Should a standard Saturn form not be available, I will gladly supply a limited number of suitable forms upon request).

Especially beneficial would be drawings or photographs made with very large telescopes at the given times to provide checks on the drawings made with amateur instruments. The times are arranged so that some of them occur when it is still late twilight in the Far West where many of the major observatories are located. If it could be arranged to have some of the large observatories take photographs that would coincide with the times of the simultaneous observation program, before they begin their regular nightly observing schedules, it would greatly add to the success of this program.

Within two weeks of an observation, please send the entire observation (drawing and notes) to me at the following address:

Clark R. Chapman
2343 Kensington Ave.
Buffalo 26, New York.

Please be very careful in making copies of your drawings, since they are primarily what we are comparing. Photographic copies of your drawings would be the best. I will send all observations to the various Section Recorders after I am through analyzing them. In order to speed this process, I ask again that all observations made for this program be submitted <u>within two weeks</u>.

I will analyze all the observations turned in to determine exactly how accurate and consistent the drawings are in order that the Section Recorders can be assured of just how much faith can be put in the drawings. Within some limits, I can make photographic reproductions of drawings made at the same time by different observers so that they appear side by side on a single photograph. I will send these series of pictures to interested observers for their own comparison if they enclose a <u>stamped self-addressed envelope</u> with one of their early observations. I will also be glad to discuss with individual observers how their drawings compare in general with others, if they so request and enclose a stamped self-addressed envelope.

The A.L.P.O. is an excellent group and has accomplished much in lunar and planetary astronomy. But excellent though it is, it can still be improved. I hope this article stimulates considerable creative thought and provokes useful discussions on this topic. I will be particularly glad to have comments or suggestions about this program.

Thirty or more drawings made at the same time on many of the dates should not be too much to hope for. Even if your primary interest is not with Jupiter or the moon, try to join in anyway. Also, do not hesitate to join in if you only have a small instrument. Your drawings will be compared with those made with similar telescopes. The friendly rivalry between observers should not only lead to an interesting program, but should also increase the scientific value of our work.

The list of times for simultaneous observations is below. Mark them on your calendar or in your observing notebook and try to observe on as many dates as possible. Unless otherwise specified, <u>all dates and times are U.T.</u> In addition to making drawings and other related observations, try also to observe the phenomena mentioned in parentheses.

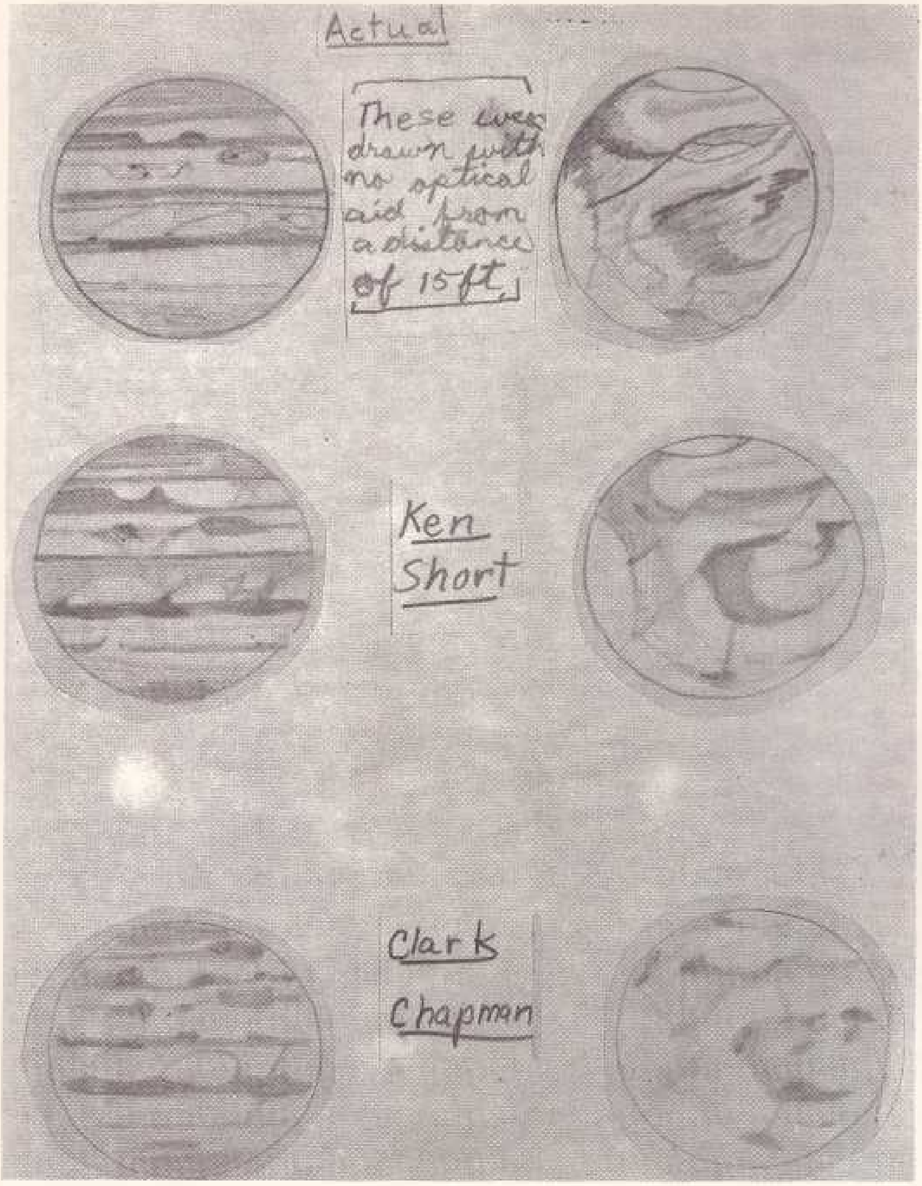

FIGURE 5. Sample of a study involving comparative drawings carried on by some students at the Pan American College Summer Institute in the Astro-Sciences in June and July, 1960. Upper pair of drawings, artificial discs intended to resemble Jupiter and Mars; middle pair, drawings of discs made with the eye alone by Ken Short, Odessa, Texas, from a distance of 15 feet; lower pair, drawings of discs made by Clark Chapman. The observers had no advance knowledge of detail on the artificial discs. Many informative comparisons can be worked out here by the specialist or close student. Attention is drawn to the different styles of drawing of the two observers. Studies of this kind are recommended to A.L.P.O. members; they will be most informative if great care is taken to simulate actual telescopic observation.

Target Times - 1961 Simultaneous Observation Program

June 16.	1:00 - 4:45 U.T. MARS and URANUS (very near together).
June 21.	45 minutes before sunrise (local time). VENUS.
June 23.	8:05. JUPITER (satellite phenomena between 6:06 and 9:08).
June 27.	7:50. JUPITER (J I transit ingress at 8:03).
July 5.	45 minutes before sunrise (local time). VENUS.
July 18.	6:15. JUPITER (also observe J III and its shadow).
July 23.	About sunrise, local time. MERCURY (note the apparent phase).
July 25.	6:30. JUPITER (watch ingress of J III over its shadow 16 mins. later).
August 2.	5:40. SATURN.
August 8.	6:00. JUPITER (also transit of J I and shadow, disappearance of J IV).
August 15.	30 minutes past sunset, local time. Crater GUTENBERG.
August 17.	4:50. SATURN.
August 22.	4:15. JUPITER (mutual satellite phenomena at 4:00 and at 6:15).
August 24.	4:10. Crater HERODOTUS.
September 18.	Between 1:15 and 3:15. Crater CASSINI.

Postscript by Editor. The Editor personally appeals to every A.L.P.O. member to give all possible support to Mr. Chapman's well-planned program. It is easy to find excuses for our failures; but it is more important to try to do something constructive here on an old, old problem of visual lunar and planetary astronomy. Colleagues outside of the United States are heartily invited to participate in this study whenever the scheduled times above allow them to do so.

DISCUSSION OF UMBRAL CONTACT CRATER TIMINGS AT THE LUNAR ECLIPSE OF MARCH 2, 1961

By: Joseph Ashbrook

From the United States, satisfactory observing of the partial lunar eclipse of March 2, 1961, was possible only in the western part of the country, during late morning hours, and weather conditions seem to have been generally unfavorable. Nevertheless, several good series of records were obtained of the times when specific lunar craters entered the earth's umbra.

Suppose an observer has noted that at a particular moment the center of the crater Tycho appears to be exactly on the edge of the umbra. From the *American Ephemeris*, we can calculate the position at that moment of the moon's center relative to the center of the earth's shadow. Also, from the selenographic coördinates of the crater and the libration, we can tell the location of the crater with respect to the midpoint of the moon's disk. Hence, it is possible to deduce the distance of the crater from the shadow center--in other words, the radius of the umbra. This computation has been made for 38 timings of crater entrances and one timing of first contact at the March, 1961, eclipse. The procedure is exactly the same as used in the discussion[1] of timings at the March 13, 1960, total eclipse, where further information is given.

The results are listed in the following table. For each of the 39 observations is listed the observer, the crater name, the observed Universal Time, the deduced umbral radius (expressed as a fraction of the earth's equatorial radius), and the excess of this radius over the predicted value (in which the effects of the earth's atmosphere are ignored). The last column gives Psi, the angle at the shadow center between the point of ingress and the projection of the earth's equator. Psi is thus the geographical latitude at which a line from the crater to the sun grazes the earth.

Entrance Into Umbra

Observer	Crater	U. T.	r_o	$r_o - r_c$	Psi
PH	Contact I	11:50.6	.725	+.029	+50°
P	Grimaldi	11:57.4	.724	+.029	+60
G	Grimaldi	11:58.4	.718	+.023	+61
WH	Schickard	11:58.4	.722	+.026	+45
WH	Grimaldi	11:58.8	.716	+.021	+61
K	Grimaldi	11:58.9	.715	+.020	+61
PH	Grimaldi	11:59.3	.712	+.017	+61
WH	Billy	12:01.3	.722	+.026	+57
P	Schickard	12:01.4	.700	+.004	+46
P	Gassendi	12:04.2	.726	+.030	+55
WH	Gassendi	12:04.9	.722	+.026	+56
WH	Reiner	12:07.9	.727	+.032	+67
K	Reiner	12:08.2	.726	+.031	+67
K	Bullialdus	12:13.2	.721	+.025	+55
WH	Bullialdus	12:13.5	.719	+.023	+55
P	Tycho	12:13.5	.726	+.030	+47
PH	Tycho	12:14.6	.718	+.022	+47
K	Tycho	12:14.6	.718	+.022	+47
WH	Tycho	12:14.7	.718	+.022	+47
P	Kepler	12:16.7	.728	+.033	+69
WH	Kepler	12:17.1	.725	+.030	+69
K	Kepler	12:17.5	.723	+.028	+69
G	Kepler	12:18.6	.717	+.022	+70
P	Herodotus	12:26.7	.704	+.009	+80
G	Aristarchus	12:27.3	.721	+.026	+79
P	Copernicus	12:28.0	.728	+.033	+71
P	Aristarchus	12:29.0	.715	+.020	+80
WH	Aristarchus	12:29.0	.715	+.020	+80
K	Copernicus	12:29.5	.720	+.025	+72
G	Copernicus	12:29.6	.720	+.025	+72
WH	Copernicus	12:29.7	.720	+.025	+72
PH	Copernicus	12:30.1	.718	+.023	+72
P	Pytheas	12:37.0	.727	+.032	+78
K	Eratosthenes	12:37.2	.727	+.032	+75
P	Fracastorius	12:43.4	.719	+.023	+58
P	Timocharis	12:49.5	.723	+.028	+85
P	Goclenius	12:54.2	.723	+.028	+64
P	Gutenberg	12:54.4	.720	+.025	+65
P	Plinius	12:58.9	.733	+.038	+78

Key to Observers

P--Thomas C. Porter, Orange, Calif. 3-inch reflector, 62X. Sky conditions very good until 13:00 U.T. when clouds from the west halted observing.

WH-Walter H. Haas, Edinburg, Tex. 17-inch reflector with 7-inch off-axis stop, 107X. Transparency 3 on scale of 0 to 5 (best); at one time thin cirri over the moon. Observations during morning twilight.

K--Gary L. Kraus, Edinburg, Tex. 5-inch refractor, 20X. Sky conditions same as for WH.

G--Howard Grams, Gary Schmidt, Donald Dunsmore, and Ken Carlisle, Rapid City, S. D. 4-inch reflector, 50X. Much trouble with clouds, which stopped work at 12:50 U.T.

PH-Peter Haustein, La Mesa, Calif. 3-inch reflector, 60X. Clear skies.

The average of all 39 values of $r_o - r_c$ is +.0253 earth radius, with a mean error of ±.0011. By dividing this average by the theoretical equatorial shadow radius, .696, we find 3.64 ± 0.15 percent as the observed enlargement of the umbra. This enlargement is unusually great, as 2% is usually cited as a typical value. At the March 13, 1960, eclipse, the excess was 2.78 ± .06 %, from 256 crater timings.[1] Nevertheless, all five series at this year's eclipse give accordant values:

Observer	No. Observations	Average $r_o - r_c$	Mean Error
P	14	+.026	±.0024
WH	10	+.025	±.0012
K	7	+.026	±.0017
G	4	+.024	---
PH	4	+.023	---

The great excess of the umbral radius over its theoretical value does not seem, therefore, to result from personal errors of observation. But before the eclipse can be classed as abnormal, the effects of twilight and poor sky transparency on such observations have to be better understood.

Reference

1. Ashbrook, J. "Report of the A.L.P.O. Observations of Crater Times at the March 13, 1960, Lunar Eclipse," Strolling Astronomer, Vol. 14, Nov.-Dec., 1960, pp. 163-167. On p. 167, line 5, read "+0.6 minute correction" instead of "-0.6 minute correction."

Postscript by Editor. We are very much indebted to Dr. Ashbrook for carrying out the reduction of the timing data secured. There were a few reports contributed which have been omitted from this analysis for one reason or another. Their inclusion would have had no appreciable effect on the results given above. In the future reports of this kind should be submitted promptly after the eclipse.

This program can be attempted again during the partial lunar eclipse on August 26, 1961. It is suggested that some experienced observer should try using color filters to determine whether the umbra size is different in red and blue light. The filters must be ones with known transmission characteristics, and the observer should make some of his timings without a filter to permit needed comparisons. It would also be advantageous to receive timings of the August 26 lunar eclipse both from observers who see it in the evening twilight and from ones who observe it on a fully dark sky. The comparison might give useful information about the effects of sky brightness and poor transparency on such observations.

ROTATION PERIODS OF SPOTS ON SATURN NEAR LATITUDE 60° NORTH IN 1960

By: Thomas A. Cragg

Bright spots in the +60° latitude region on Saturn were observed by members of the Association of Lunar and Planetary Observers (A.L.P.O.). Central meridian transits were obtained on 20 nights from May 6 through September 20, 1960, by nine different observers. Bright spots in this region (known as the North Polar Zone or NPZ) are extremely rare, none of appreciable longevity ever having been recorded before. Botham of South Africa, A. Dollfus of Pic-du-Midi, France, and others observed one or two spots in the Zone prior to May 6. In fact, perhaps the first evidence of this great surge of activity was obtained by Budine[1] on September 5, 1959, just before the close of the 1959 apparition of Saturn.

The first of the long-lived spots was the one observed by Dollfus in late April and early May, and followed to its eventual end by A.L.P.O. members. After its subsidence, the region was relatively inactive until late July and early August, when several spots burst forth almost simultaneously. These were followed ardently by the A.L.P.O. observers through September 20.

For convenience, a system of longitudes was set up using a sidereal period of $10^h 40^m.0$ as the basic rotation rate and an initial epoch of 06:00 U.T. July 7, 1960, for the prime meridian. Corrections introduced in the longitude tables include only light-time, Saturn's advance in longitude, and the effect of the earth's motion on the observed Saturnian longitudes. No phase correction was included since other errors in the observations exceed this correction very substantially.

OBSERVATIONS AND COMMENTS

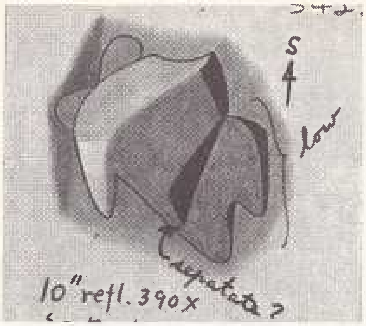

FIGURE 18. Lunar dome east of Arago. (Arago 1). Takeshi Sato. Feb. 21, 1961. $10^h\ 15^m$, U.T. 10-inch refl. 390X. Seeing 5-6 (fairly good). Transparency 4. Colongitude = 342°3.

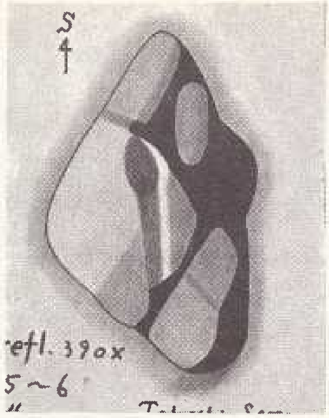

FIGURE 19. Lunar dome north of Arago. (Arago 2). Takeshi Sato. Feb. 21, 1961. $11^h\ 30^m$, U.T. 10-in. refl. 390X. Seeing 5-6. Transparency 4. Colongitude = 343°0.

On pp. 1-3 of our Jan.-Feb., 1961, issue we carried an article by Joseph Ashbrook about needed quantitative studies of lunar domes. Dr. Ashbrook invited attention to two lunar domes near the crater Arago; and in this connection the following parts of a letter dated March 31, 1961, from Mr. Takeshi Sato in Hiroshima, Japan, are of much interest:

"The domes are less simple in shape and structure than one might imagine from the word 'dome'. Of course, one cannot say much from a single observation; but the dome north of Arago is composed of a few mountain blocks [Figure 19]. Over the main body of this dome a cleft runs approximately north-south. It is very interesting to note that this cleft under poor seeing conditions looks as if it were a central craterlet.... The southern part of the cleft is rather more prominent than the rest, but it appears unlikely to be a craterlet.

"The dome east of Arago looks like an asteroid with short arms [Figure 18]. This dome also has no craterlet visible under the prevailing seeing with the 10-in. reflector. To the east of the dome there is a low hill. It is not certain whether the hill is part of the dome, but it seemed to me to be a separate feature."

ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

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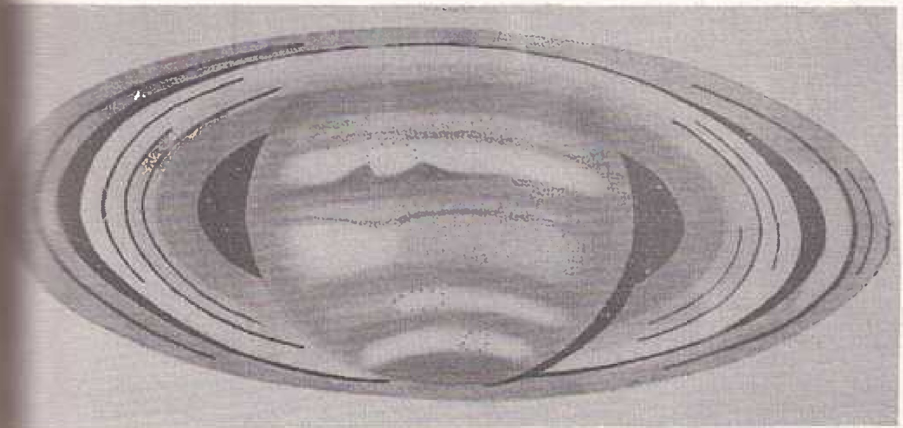
South



Following

Drawing of Saturn by Leif J. Robinson on July 25, 1960, at 6 hrs., 25 mins., Universal Time. 16-inch, F:20 reflector of Biela Observatory at 225X and 550X. Seeing 7 (good), transparency 4 (clear). Note on the ball the two projections from the south edge of the North Equatorial Belt and the associated Equatorial Zone oval and also the activity in high northern latitudes. Note in the rings the delicate division A8 exterior to Encke's Division. This drawing may be compared with the text of Mr. Cragg's article "Saturn in 1960" in this issue.

THE STROLLING ASTRONOMER

Pan American College
Observatory
Edinburg, Texas

IN THIS ISSUE

THE LUNAR TRAINING PROGRAM OF THE MONTREAL CENTRE

By: George E. Wedge

(Paper read at the Seventh A.L.P.O. Convention at Haverford, Pennsylvania, on September 5, 1960.)

In every amateur astronomical organization there is always the newcomer who has had no previous observing experience, particularly in lunar and planetary work, which is usually the field in which he first becomes interested. Without the help of experienced observers, the beginner must acquire this experience through trial and error. As a result, a large number of novice observers have little knowledge of what they are doing. Here the need arises for a program of training.

The training program I am about to describe has been used most successfully by the lunar group of the Montreal Centre for over three years. This group consists of twenty-four members, eight of whom have completed the program of training, while the remaining sixteen are currently participating in this course.

This training course is in two parts. The first part teaches the beginner to become familiar with the general topography of the Moon; the importance of this acquaintance is manifest. To accomplish this, the observer is required to locate, identify, and plot the 300 features shown on the lunar map published by <u>Sky and Telescope</u> a few years ago. First the observer is supplied with a form showing a blank disk eleven inches in diameter, on which is drawn a grid of coördinates identical to the grid shown on the map. Using a low power, he first locates and identifies the more prominent features; then, using these as guideposts, he identifies the less prominent. Once he has spotted a dozen or so features, the observer plots them upon the blank using the grid of coördinates as a guide. At this point no attempt is made actually to draw the crater, but merely to plot its position as accurately as possible. The plotting is not done at the telescope, but is copied later from the map. While this process is very elementary, it does give the beginner a feeling that he is accomplishing something, which makes the course interesting.

Once the novice is familiar with the general lunar topography, the second phase of the course is begun. This stage deals with the making of pencil sketches of individual features. The observer makes three drawings under different angles of solar illumination of six different features. Any craters may be selected, of course; but for our program the following six were chosen: Petavius, Posidonius, Aristoteles, Plato, Bullialdus, and Gassendi.

These features, it will be noted, are easily located; and, because of their different locations, at least one will be visible at any time during the lunation. We have purposely avoided the more rugged areas so as not to confuse the beginner. At first all drawings are completed within a set time, usually fifteen minutes, using a power of between 150 and 200X. The size of the sketch is limited to approximately 2½ inches. By keeping these things as uniform as possible, the beginner finds it easier to compare his work with that of others in the group. In this way it has been possible to judge the ability and honesty of each observer. After making eighteen drawings, the observer should be ready for independent work, if he has followed the course faithfully.

One of the main problems often encountered with beginners is that they are inclined to omit certain pertinent information relating to an observation. To avoid these errors, all drawings made in this course are on a standard form which has space for all the necessary information; and the beginner is instructed in how it should be filled in after each observation. Any observations made on scraps of paper are not accepted.

The success of this training program is indicated by the quality of work now being done by members who have completed this course. We have found that in a relatively short time a person with very little sketching ability soon becomes a fairly good draughtsman, whose work can be relied upon to be a true representation of what he observed.

SOME SUGGESTIONS FOR SOLAR SYSTEM OBSERVATION

By: L. J. Robinson

(Paper read at the Sixth A.L.P.O. Convention at San Jose, California, on August 24, 1960.)

In this time of consistent and rapid change one may find, at least for the present, a refuge within Solar System amateur astronomy. Here is a field where old problems are dealt with in a long-established way; indeed, new problems often find the same venerable treatment. One should not be misled into believing that these methods were not effective--they were, and will probably remain so in the future. The only objection one may have, strangely enough, is that these methods were so effective as to make persons hesitant to change and/or experiment in new fields. It is interesting to note that many of these "new" fields are as old as the established ones. The reasons why they are not, at the present time, as popular as the established ones are varied--running the gamut from "more laborious" to "need for accessory equipment."

In the following paragraphs it is my intention to show that there is nothing wrong with these venerable methods--only that they should be used in conjunction with new and more refined techniques. For the sake of uniformity and clarity, the methods of the present time will be reviewed; these will be followed with suggestions concerning certain aspects of the "new" Solar System amateur astronomy.

Planetary

By far, yet unfortunately, the largest effort of the planetary observer is expelled in the least useful form, the purely subjective and reflective planetary drawing. It is common practice to go to the telescope and construct an image of the impressions which one thinks he sees. Such impressions, of course, depend upon the size and quality of the instrument, one's visual acuity, the observing conditions, and, in the last stage, one's ability as a draftsman. When the drawing is completed, assuming one had all of the above positive requirements and conditions, one has the aspect of the planet at one particular instant. To this drawing one might add such things as intensities or color-estimates, both of which add little to the value of the drawing as these two dimensions are physiologically and psychologically more subjective than position placement or shape. At times, certain observers make transit observations, usually without the aid of a micrometer. Such observations, while far from being of professional quality, form the best single visual effort by amateurs with respect to positional accuracy. This form of observation, if made with great care, is most useful and should be encouraged. A moment's reflection will show that the primary purpose of amateur astronomy is to supplement professional endeavors--little is to be gained if the foundation of this purpose, the observation, is of unacceptable quality.

Having tersely reviewed the present day amateur planetary astronomy, we are now in a position to view what instruments and/or methodology will improve the aspects of attaining the ideal as stated in the last sentence of the above paragraph. We will find that the bringing into play of accessory equipment will be the largest single advance.

Of all the many pieces of accessory equipment useful in the field of astronomy, the camera is unquestionably the simplest to use. In planetary studies the photographic plate will allow one, on subsequent drawings, to place with considerable accuracy the location of the major features. The lesser markings, which would have been sketched at the time of the photograph, may now be placed with respect to the larger or photographed ones. Through this method a most accurate drawing may be produced. In practice, it would be best to procure an exposure immediately preceding and following the drawing; in this way the positions of the objects with respect to the changing central meridian would be known. The photograph may then be measured with a micrometer, giving the positions of the major features. Of course, such measurements may also be made at the eyepiece of the telescope. From the above discussion it is seen that the camera and the micrometer form a very close bond--each one being much less useful if separated from the other.

Another and rather new field in amateur astronomy is the photometric study of the planets. It would be wise for all but the most advanced amateur to stay clear of this field, for the use of a photometer on a planetary surface is most difficult but not beyond the scope of the advanced amateur. Such projects as the brightness of the zones and belts of Jupiter, the subtle variations in the brightness of Venus, or the detection of the "blue-clearing" of Mars could be very interesting and important projects.

Lunar

Like planetary observations, lunar studies are carried out, for the most part, in the mode of drawings. Here, more than in the field of planetary observing, the emphasis is placed upon observing the finest detail permitted by the telescope and the conditions. While the planets, for the most part, have changing surface features to hamper observations, the moon presents varying solar illumination together with libratory shifting to confuse the accuracy of a single observation. For these reasons, a single drawing, or even a limited series of drawings, is slightly better than useless. One may, through such a short series of observations, locate the principal features; but the important data--accurate height determinations, exact positions, and exact sizes will go unknown.

Because of the above conditions and due to the prevailing attitude of amateur astronomers, the surface of the moon is in great need of intensive study. Realistically speaking, little useful work has been accomplished, other than roughly defining the general features. An ambitious program of accurately measuring the lunar features would find great welcome in the field of selenography. Mountain altitudes, crater depths, cleft lengths, positions of craters, sizes of craters--all are in need of study. One may say that even the general surface is poorly known. The libratory regions are a good example of this fact. While all these areas are under investigation at the present, greater numbers of competent workers are needed and are in demand. How can the projects as listed above be accomplished?

The most accurate but probably the most tedious way would be to make micrometric measurements at the telescope. A less accurate and still quantitative way would be to measure a photograph. By using the second approach, the student must measure several photographs in order to achieve an adequate degree of accuracy. The photometer may be applied to determine the brightness-changes of craters, spots, or the general surface. Multi-color photometry of an eclipsed moon might also prove interesting.

Cometary

Until recently, few useful observations, other than discovery, were made by amateurs in this field. Progress is being made, due primarily to the fine efforts of the Comets Section of the A.L.P.O.; and with continued proper guidance this section will produce very worthy material. The observational procedures with respect to comets fall roughly into two classes: (1) detection, (2) subsequent observation. While detection is often accomplished with the eye at a telescope, the most rewarding instrument is the large-wide-angle camera. Once a comet is discovered the process of determining its orbit and other physical particulars are next in order. For this goal the camera is again a most powerful tool; the photographic plate may be measured for position, brightness, size, etc.

In a photographic search for comets one might incorporate such long term programs as a nova patrol, thereby making each plate do double duty. It is also possible that one may find a heretofore undiscovered asteroid on such a patrol plate. It is this field of discovery in which the amateur may do the professional a great service. The professional does not have sufficient telescope time to observe for such sporadic events.

Conclusions

It is hoped that the many competent amateurs who read this paper will be stimulated into proceeding beyond the visual methods of astronomy. In working with these new techniques the advanced amateur will find that he may be of greater service to both the professional and his fellow amateur; for his findings will be, within themselves, accurate, complete, and truly representative of the object under study. He will no longer require the necessary confirmation of routine observations. The end result will be: More topics will be better covered by fewer observers.

The person undertaking such advanced projects need not fear that the visual observations en masse will go neglected. The many less advanced amateurs or persons who simply prefer to do visual work will supply adequate coverage. In fact, the person working along advanced lines might find it best to undertake a single advanced project at a time. He could then give the remainder of his observing hours to visual routine work. It should also be remembered that a night which would permit visual observations may be useless for work with sensitive equipment. Once the amateur raises his methods and his goals--he will then make valuable and significant contributions to astronomy in the field of fundamental research.

Postscript by Editor. We hope very much that Mr. Robinson's article will stimulate A.L.P.O. members to some creative thought and constructive action in regard to our methods of studying the lunar and planetary surfaces. Section Recorders and advanced observers in particular can profitably give these matters some thought. Such thinking, of course, need not be a blind, literal acceptance of all that Mr. Robinson asserts. For example, B. M. Peek and others contend that the simple visual central meridian transits are actually preferable to micrometric measures of longitudes of planetary features; and certainly the visual transits have given us almost all of our present knowledge of atmospheric currents at the visible surfaces of Jupiter and Saturn.

It might also be mentioned here that Dr. Hugh M. Johnson of the University of Arizona in conversations with the Editor and others in April, 1961, suggested that an amateur's chief present contribution to planetary astronomy might well be in the direction of correlating optical surface features and radio noise emissions.

SOME PROBLEMS ABOUT THE NAMES OF THE MARTIAN MARKINGS

By: Tsuneo Saheki

(Paper read at the Sixth A.L.P.O. Convention at San Jose, California, on August 24, 1960).

As is already known very well, the present names of the Martian markings were given by G. Schiaparelli in 1877 when he selected names from the famous gods, goddesses, and others in the Bible, the mythologies of Greece and Rome, and elsewhere. For these reasons we are able to find the beautiful, fantastical stages of drama of old mythologies on the surface of Mars when we observe this red star through the modest telescopes. Unfortunately, I think, there have occurred some errors or troubles in the nomenclature of this planet's markings, during the years from 1877 to now. Some of them which I have found during my study of the markings' names will be described here with my private opinions.

Name of Feature	Longitude	Latitude	Number
Sirenum Mare - Phaethontis boundary	-----	-42°0	8
Syrtis Major (east)	300°6	-----	9
Thoth (east)	261.9	-----	9
Thoth (west)	242.7	-----	7
Thoth (south)	-----	+ 4.5	7
North Cap (south)	-----	+60.0	32

AMATEUR RESEARCH

By: William E. Shawcross

(Paper read at the Seventh A.L.P.O. Convention at Haverford, Penna. on Sept. 5, 1960.)

Each year as we meet for the annual Astronomical League Convention, we see many familiar faces--and many new ones. Every year amateur astronomy gains new devotees, but why the losses?

Any good hobby must hold the interest of the hobbyist. Just looking around the sky with a telescope is not enough; you must be looking for something. Many simply take the opportunity to marvel at the wonders of the heavens--their love is really philosophy. I am not concerned with these staunch lovers of the heavens; we are in no danger of losing their interest. Rather, it is usually the younger, searching mind that needs a goal to keep up its interest. Here astronomy has much to offer--it is one of the very few fields in which an amateur, with practically no equipment, can make lasting contributions. To name just a few branches of astronomy in which this is the case, we can cite variable star observation, meteor counts, aurora observation, and planetary and lunar observation.

Nothing can surpass a planned program of observation as a practical education, as a sustainer of interest, and as a way of gaining results of lasting importance. Let us anaylze in some detail a few of the avenues open to the amateur.

(1.) Taking the sun as a natural starting point, two specific programs come to mind: sunspot observing and recording of Sudden Enhancements of Atmospherics (SEA). Many amateurs do this work through the Solar Division of the American Association of Variable Star Observers, which works with the National Bureau of Standards. The American sunspot numbers are derived in this manner, and the AAVSO contributes a significant number of the SEA's published by the NBS. Sunspot observing can be done with practically any telescope. The counts depend primarily on two factors--the instrument and the observer. Obviously, the larger the telescope, the more spots that are visible. Experience, though, plays the largest role; and it is interesting to watch the observer's correction coefficient change with his increasing practice. SEA's are recorded electronically, and the equipment is moderately expensive. It is a field particularly suited to the amateur who is also a "ham" radio operator.

(2.) Going outward through the Solar System, we encounter an interesting problem in the phase anomalies of Venus, the most obvious of which is that the time of dichotomy or quarter phase observed usually does not agree with Ephemeris predictions. Amateurs can easily add to our knowledge of this remarkable phenomenon by visual estimates of phase, using a small telescope.

(3.) Numerous things happen in the earth's atmosphere. We are all familiar with amateur contributions to the International Geophysical Year aurora and meteor count programs. The amateur has one advantage over the professional--he outnumbers the professional (of which there are perhaps 500 in the United States). Amateur coverage of the sky is really much more complete for many types of observations. Statistical analysis of vast quantities of data gathered in the aurora and meteor programs has led to several important findings in this field, and the programs are continuing under the International Geophysical Coöperation. Moonwatch and other amateur contributions in the field of artificial satellite observing are too well known to need specific mention here.

(4.) Moving out to the moon, we have a field of study which has always been peculiarly the amateur's, though recently professional interest has centered more and more on our companion. In addition to the traditional charting of the lunar surface, two programs of research come to mind. The first is one that can be carried out with modest instrumental means, and that is measuring the heights and slopes of lunar features by means of shadow lengths, some details of which have appeared in The Strolling Astronomer. The other, which requires practically no optical aid at all, is observing times of umbral contacts during lunar eclipses and also times of crater immersions and emersions in the earth's shadow. From such timings, the earth's shadow turns out to be about two per cent larger than geometrical predictions would indicate, but differs from eclipse to eclipse. This variation may eventually be correlated with some specific phenomenon of the earth's atmosphere.

(5.) We shall briefly mention comets. Here amateurs have a chance to discover new comets and watch old ones--professionals usually do not have the time for this work.

(6.) Planetary work has also been a favorite of the amateur, as we all know. To take a few examples of good programs, let us mention first the determination of the dates of the blue clearing on Mars--occasions usually near opposition when surface detail may be seen in blue light. Times of this clearing are important in framing theories to explain it.

Jupiter is one of the easiest objects in the heavens to observe. Neglecting satellite phenomena, a very useful kind of observation is the timing of central meridian transits of long-lived features in the Jovian atmosphere. On these are based our knowledge of the differing rotation-periods at different latitudes on this giant planet. A recent striking example of the value of amateur drawings of the planet can be found in the article by Otto Struve on planets with rings. Here evidence, mostly from amateur drawings, was presented which strongly suggested that Jupiter has a faint ring similar to Saturn's. If verified, this will indeed be a momentous discovery.

To take one final problem from the field of planetary observing, the rotation period of Saturn is still not known with the highest precision. Here amateur observations of long-lived spots on Saturn's surface, which serve to measure the rotation, are of value, though not too easy to make.

(7.) Taking one example from stellar astronomy leads us to the many opportunities presented by variable stars. Long-period variables are the special province of the AAVSO, which makes very substantial contributions to the knowledge of these objects. Less well studied by amateurs, but worthy of consideration, are the short-period variables. Many of these have periods that change slightly over the course of years, and new timings of minima and maxima are vital. For instance, the bright Cepheids Delta Cephei, Eta Aquilae, and Zeta Geminorum all have changing periods, and are easy objects to study. Another interesting class of variables is typified by RZ Cassiopeiae, an eclipsing variable with a variable period. Times of minima are easy to obtain; yet here is a major field virtually untapped by American amateurs, though German and Russian amateurs have done much good work. It is suspected that these changes in period may be due to stellar evolution, and this would be the only change in a star that would be visible in the course of a lifetime. Here photoelectric photometry, of increasing interest to serious amateurs, offers exciting avenues of exploration.

This completes our brief and far from complete catalogue of opportunities. It merely points the way to the riches that will hold and lead forward the patient watcher of the skies.

A WARGENTIN-TYPE FEATURE ON THE MARE SERENITATIS

By: Alika K. Herring

Concerning the suspected dome on the Mare Serenitatis which was described by Dr. Joseph Ashbrook (Strolling Astronomer, Nov.-Dec., 1960), while observing on Christmas Eve last I also happened to note this formation, which was well placed near the terminator at the time. This was the first time I had seen it, and I found it so intriguing that I felt a sketch should be attempted in spite of the rather mediocre seeing conditions. The descriptive notes which were subsequently entered in my observing book are reproduced in part as follows: "It appears to be a nearly circular plateau of low elevation, with edges that rise rather abruptly from the surrounding plain. The surface is nearly flat, although perhaps possessing a very slight convexity, and, except for a few small scattered hills, contains no other apparent detail.

"The exact nature of this feature may be somewhat obscure. While it is shown on charts C3-b and C3-d of the Kuiper Photographic Lunar Atlas, the photographs leave much to be desired. The Wilkins map apparently depicts it as a ruined crater, but I cannot agree with this interpretation. I also do not believe that it should be considered a dome since the general contour is quite untypical of this class of feature. Pending a further study, I would say that it is more nearly similar to Wargentin, except in the matter of size, than to any other type of feature on the lunar surface. It is indeed a most extraordinary object."

My copy of The Strolling Astronomer containing Dr. Ashbrook's remarks on this formation did not reach me until December 27, 1960; and I therefore had no prior knowledge of his interest in it. I also subsequently learned that a drawing of this same feature was made by D. W. G. Arthur with the 40-inch Yerkes refractor and published in The Journal of the British Astronomical Association for September, 1960. With the exception of a small cleft which I did not see, I believe the drawings are mutually confirmatory. Arthur also describes the feature as a "plateau."

FIGURE 17. Plateau near Linné. Rectangular coördinates xi=+160, eta=+495. Alika K. Herring. December 25, 1960. 2^h 30^m, U.T. 12.5-inch refl. 278X. S=3-5. T=5. Colongitude 353°.1.

The basic difficulty in questions of this sort stems from the fact that as yet there has been no general agreement among students of the moon as to the exact nature of lunar domes. As a result, each individual observer has more or less devised his own criteria or standards for defining them. Unless such an agreement can be reached the probability of bringing order to the chaotic situation is small. I am therefore fully aware that the opinion expressed above concerning the nature of the Serenitatis feature is a controversial one and may not be completely accepted by other observers.

Postscript by Editor. When is a dome a dome? As Mr. Herring says, we need a standardized lunar nomenclature. What are the criteria for defining a dome, a saucer, a cleft, etc.? Perhaps some of our advanced lunar students would like to think in this direction and to discuss the problems present in a future issue.

6 transits near morning quadrature : -6°0 (long. error)
2 transits near opposition : -4.5
12 transits near evening quadrature : -2.9

"Now Mr. Rost's observations of the transits of the shadows of JI and JIV on May 8, 1961, were made near morning quadrature. His transits yield discrepancies in keeping with past tendencies, though a little more extreme:

Date (1961)	Object	O	C	O-C	Longitudinal Error
May 8	Shadow I	6:58	7:07.4	- 9m4	-8°0
May 8	Shadow IV	7:32	7:47.5	-15.5	-7.5

"A quicker method of finding the predicted time of a shadow transit than that given in Appendix II of Peek's book follows:

Computed Time of Apparent C.M. Transit of a Satellite Shadow

$$C = T_1 + \frac{(T_2 - T_1)\ (1 \pm x)}{2}$$

where,

C is the computed time of shadow transit.
T_1 is the predicted time of shadow ingress.
T_2 is the predicted time of shadow egress.
x is a variable depending on the value of i, the Sun-Jupiter-Earth angle. x is positive before opposition, negative after.

"The value of x for any attained value of i is given in the table below:

i	x	i	x	i	x
0°0	.0000	4°0	.0674	8°0	.1301
0.5	.0087	4.5	.0755	8.5	.1376
1.0	.0174	5.0	.0836	9.0	.1451
1.5	.0259	5.5	.0914	9.5	.1525
2.0	.0343	6.0	.0993	10.0	.1598
2.5	.0427	6.5	.1071	10.5	.1670
3.0	.0510	7.0	.1149	11.0	.1742
3.5	.0592	7.5	.1225	11.5	.1811

The Lunar Eclipse of August 26, 1961. The circumstances of this eclipse are as follows:

Event	Universal Time	Eastern Standard Time
Moon enters penumbra	Aug. 26, 0h 36m1	Aug. 25, 7:36.1 P.M.
Moon enters umbra	1 34.9	8:34.9
Middle of eclipse	3 08.2	10:08.2
Moon leaves umbra	4 41.5	11:41.5
Moon leaves penumbra	5 40.4	Aug. 26,12:40.4 A.M.

The magnitude of the eclipse is 0.992. It will thus be almost, but not quite, total; the north rim of the moon will escape eclipse.

There are a number of suitable lunar eclipse observational programs for amateurs. One of the easiest and most important of them is timing umbral contacts for selected points on the lunar surface. The object is to determine how much the geometrical umbral shadow is enlarged by the earth's atmosphere. The four contacts with the moon itself may also be included in this program, though only first and fourth contacts will occur on August 26. Very modest instrumentation is suitable and even preferable.

Joseph Ashbrook recommends apertures of 2 to 6 inches and powers of 30X to 50X. Objects timed will usually be craters, the centers for small craters like Bessel and the moments of first umbral contact and of final complete coverage for large craters like Tycho. It has been found practical to record times to one-tenth of a minute. Results secured in this program from recent eclipses have been published by Joseph Ashbrook in The Strolling Astronomer, Vol. 14, pp. 163-167, 1960, and Vol. 15, pp. 94-96, 1961, and in Sky and Telescope for June, 1960, pp. 474-475. Variations in how much the geometrical shadow is enlarged from one eclipse to another are strongly suspected, but it is necessary to learn more about the effects of a bright twilight sky and a low lunar altitude on the observed umbral contact times. The August 26, 1961, lunar eclipse is capable of supplying very helpful information in this respect because at many stations in the United States timings can be carried out both with a low moon on a bright sky and with a higher moon on a dark sky. Please note for this purpose the eclipse circumstances times given above, and apply them to your own location.

Another possible program consists of estimates of the color and brightness of the eclipsed moon. The stellar magnitude of the moon may be recorded at different times. Color photography is recommended to equipped amateurs. Others may want to use Danjon's scale of 0 (very dark eclipse) to 4 (very bright eclipse), p. 161 of the Larousse Encyclopedia of Astronomy.

It is interesting that lunar eclipses have been recorded briefly to affect certain lunar areas in a fashion apparently different from the normal cycle of changes due to changing solar lighting. Among such reported eclipse-caused changes have been an enlarging of the white area around Linné and a lightening of the south tip of the dark area in Riccioli. Great care must be exercised in a program of this kind if the results are to have any meaning. The feature under study must be carefully examined just before entering the umbra and just after reëntering sunlight, efforts must be made not to be misled by changes in seeing and transparency or by dim penumbral lighting, and comparisons are needed to the normal full-moon appearance of the area.

Other possible observational programs for the Aug. 26 lunar eclipse are searches for possible lunar meteoritic impact-flares and/or lunar meteors, searches for possible sub-satellites of the moon, and, of course, eclipse photography. Some programs are described more fully on pp. 28-32 of our Jan.-Feb., 1960, issue. We wish all our readers clear skies on Aug. 26 and urge them to submit reports of their work very soon thereafter to the Editor.

The Strolling Astronomer

ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

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16-inch Dall-Kirkham reflecting telescope on summit of Infiernillo Peak near Galeana, Nuevo Leon, Mexico. Professor Paul R. Engle (left), Director of Pan American College Observatory, and Mr. Bernardo Levi, physics student at the Instituto Tecnologico of Monterrey. Telescope built by Astro-Dome, Inc., Canton, Ohio. Erected and adjusted on Infiernillo Peak in June and August, 1961. Photograph by Mr. Gary L. Kraus, astroscience major at Pan American College. The telescope will be jointly operated by Pan American College, Edinburg, Texas, U.S.A., and the Instituto Tecnologico y de Estudios Superiores, Monterrey, Nuevo Leon, Mexico.

THE STROLLING ASTRONOMER

Pan American College
Observatory
Edinburg, Texas

IN THIS ISSUE

FIGURE 1. Clark Chapman presenting paper at Eighth A.L.P.O. Convention at Detroit, Mich., on July 2, 1961. Mr. Chapman there received the A.L.P.O. Award for his outstanding services to the Assoc. This photograph and others on this page taken and contributed by Wm. E. Shawcross.

FIGURE 2. David Meisel, A.L.P.O. Comets Recorder, presenting paper at Eighth A.L.P.O. Convention, held as part of the National Convention of the Astronomical League.

FIGURE 3. Dr. Helen Sawyer Hogg, of David Dunlap Observatory, delivering lecture on "Astronomy in Canada Today" during Astronomical League National Convention at Detroit, Michigan, July 1-3, 1961.

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1. Some Notes Concerning Mercury Observations, by Geoffrey Gaherty, Jr. Slides.

2. The Availability of Cometary Information in the Current Literature, by David Meisel.

3. Combining Your Observations, by Wm. E. Shawcross.

4. A Large-Aperture Confirmatory Service for A.L.P.O. Observers, by James J. Mullaney and George A. Doschek.

5. Observation of Planetary Color, by Joseph P. Vitous. Read by Ernst Both.

6. Considerations on the Color Variations of Lunar Features, by G. A. Wegner. Slides.

7. Molds, Mosses, and Martians, by James J. Bartlett, Jr. Read by Thomas Stoeckley.

8. The 1960-61 Apparition of Mars, by Clark R. Chapman. Slides.

9. The Man From Space, by Carlos E. Rost. Read by Phillip W. Budine.

10. About the A.L.P.O. Library, by E. Downey Funck.

11. Venus Observations of the Montreal Centre of the R.A.S.C., by Klaus R. Brasch. Slides.

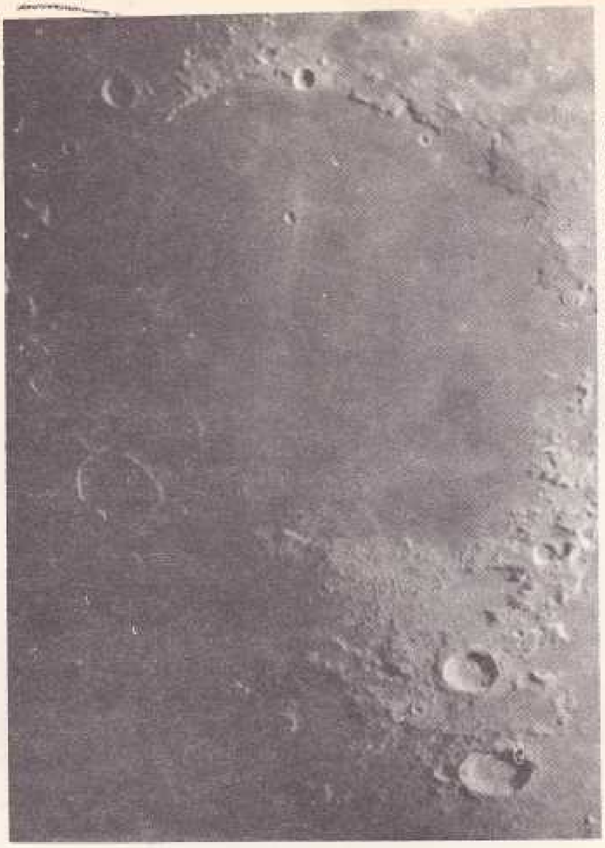

FIGURE 8. Photograph of portion of moon by Jack Eastman with 12.5-inch reflector on July 25, 1959, at 9^h 50^m, U.T. Effective focal length 65 ft. Seeing very good. Ansco superhypan film, developer D-19. Mare Serenitatis and vicinity. Colongitude=149°9. On Figures 8 through 11 some of the detail present on the positive prints used may be lost in publication.

FIGURE 9. Photograph of portion of moon by Jack Eastman with 12.5-inch reflector on January 9, 1960, at 3^h 45^m, U.T. Focal length 65 ft. Ansco superhypan film, developer D-19. Colongitude=34°3. Copernicus, Eratosthenes, and vicinity.

a final map was produced from about 30 observations. From Figure 12 it can be seen that, although a limited degree of agreement is indicated, it cannot be said to be very convincing. However, it should be borne in mind that our map is based on rather few observations made with smaller instruments, inferior seeing, and less experienced observers than the one made at Pic du Midi. Furthermore our map was based almost entirely on direct observations, while the French map is based mainly on filter observations.

A further experiment that may be undertaken is one in which the same superimposing method may be used coinciding with a certain rotation period, in which case appropriate calculations and corrections would have to be made (Figure 13). This, however, would be very difficult to do and extremely time-consuming.

Thus as with all experiments and observations of Venus, nothing is definitely proven or disproven, no conclusions can be reached, and in fact one knows no more about the planet than before except that people will go on observing and speculating about this truly fascinating planet.

A RECONNAISSANCE CHART OF THE CENTRAL OCEANUS PROCELLARUM

By: John E. Westfall

I. Introduction

At the 1958 Convention of the Association of Lunar and Planetary Observers, a paper of the author's was read concerning a lunar mapping project.[1] The map described here forms a rather fragmentary realization of the initial phases of such a project. This map appears as Figure 15 on pages 162 and 163.

II. Procedure

A. Region

The region studied (Central Oceanus Procellarum) was chosen for two reasons; (i) the excellent horizontal control afforded by the efforts of D. W. G. Arthur,[2] and (ii) the fact that the author had studied the region previous to the commencement of this chart. The exact boundaries of the area are the 40° and 60° meridians east, and the equator and the parallel 25° north. This quadrangle is bounded by a 25-kilometer marginal zone, for overlap with other possible charts. Such hypothetical future charts form the reason for the code designation IIC, referring to chart C of the second quadrant, as in Figure 14.

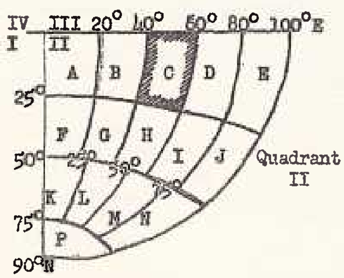

FIGURE 14. Sketch by Mr. John E. Westfall showing scheme of possible future lunar charts and associated proposed code, by quadrant and region.

B. Projection

The projection selected reproduces the region with little distortion, far less than with the conventional central orthographic. The projection is the transverse case of the cylindric equivalent (equal-area), having its equator as the 50° meridian east, the central meridian of the map. For optimum distribution of error, the chart has been rendered conformal on parallels 4°50', from the central meridian, giving a scale distortion on the central meridian of 0.36% and a 1.18% distortion in the corners (for a tabulation of scale distortion, see appendix 1).

The adopted scale is 1:1,000,000 (15.78 mis./in.), and the reproduction included here is at a scale of 1:2,000,000 (31.57 mis./in.). The reference sphere has a radius of 1738.0 kms. (1080.0 mis.). Latitudes and longitudes were computed at 2° intervals and are given in appendix 2. The formulae used were:

(1) $\sin \phi' = \cos \phi_x \sin \Delta \lambda$ (3) $x = \alpha \sin \phi'$
(2) $\sin \lambda' = \cos \phi_x \sin \Delta \lambda \sec \phi'$ (4) $y = \beta \lambda'$,

for scale, 1:1,000,000; radius, 1738.0 kms., standard parallels, $\phi' = 4°50'$, $\alpha = 174.44$ cms., $\beta = 0.050379$ cms./minute of lunar arc. [Mr. Westfall's scale has been altered in the published reproduction of his map on pages 162 and 163.--Editor.]

C. Relief and Tone Representation

Measured altitudes were far too sparse and unreliable to justify the use of contour lines, so the hachure method was employed to indicate relief. Slopes were divided into nine classes, with a corresponding spacing of hachure lines, as follows.

Class	Slope	Spacing	Class	Slope	Spacing
1	1° - 2°	2.00 mms.	6	15° - 20°	0.50 mms.
2	2 - 4	1.67	7	20 - 25	0.35
3	4 - 7	1.33	8	25 - 30	0.25
4	7 - 11	1.00	9	Over 30	Solid
5	11 - 15	0.75			

The classes are stepped due to the uncertainties of the slopes, while the hachure spacing is non-linear due to the wide range of slope values and the relatively low range of visibility. Also in order to improve visibility, light hachures are drawn thicker than the dark.

Slopes were determined by computation from measured altitudes (Schmidt), and from observations of shading as a function of solar altitude (visual and photographic). Dark hachures are used for eastward-sloping gradients; light hachures are used for westward-sloping gradients. Grey represents level, while light and dark tones represent light and dark areas as they appear under high lighting. The intention is not to produce a "photographic" or even a realistic effect but merely to give the map a degree of plasticity as well as of cartographic stylization.

D. Crater Dimensions

Visual measures were found to differ consistently (but not systematically) from photographic measures, due probably to irradiation. For this reason, visual measures were rejected, and the following photographic determinations were used:

Weight	Source
6	Arthur
6	Saunder
6	Young
1	Blagg and Müller
1	Paris Atlas, #57 (Measured by J. Westfall)
1	" " #62 (" " " ")
1	" " #71 (" " " ")
2	Mt. Wilson, #256a(" " " ")
2	Lick Observatory Set (" " " ")

The adopted diameters are given in appendix 4.

E. Insertion of Detail

1. Control:

The control points used are divided into 2nd. order (p.e. ±0.0003 R or less) and 3rd. order (p.e. ±0.001 R or less). The 91 2nd. order points were derived from Arthur, Young, and Saunder, while the main source for the 41 3rd. order points was the Blagg and Müller catalogue. Thus, control was established with 132 measured points, whose coordinates were transferred from the orthographic projection to the chosen projection, using the formulae given above and the equalities, $\sin \varphi_x = \eta_x$ and $\sin \lambda_x = \xi_x \sec \varphi_x$. The probable error of most points on the 1:1,000,000 projection is about ½ mm.

2. Photographic Detail:

Four sources were consulted: (i) The Paris Atlas (Pl.57,62,71), (ii) Mount Wilson Lunar Photographs 253, 256a, (iii) Lick Observatory Lunar Set, and (iv) the author's photographs taken with the 8-inch Leuschner Observatory reflector and the Chabot Observatory 20-inch refractor.

3. Drawings:

During the period 1952-1960, the author made a series of thirty-one sketches of the region under a wide range of lighting conditions and with 3½, 4¼, and 8-inch reflectors and 4, 5, and 20-inch refractors. Drawings were mainly used to supplement photographs. Detail was accepted if shown on at least two drawings, excepting low ridges, which might be accepted if only shown once, due to the necessity for low lighting.

4. Plotting of Detail:

Positions were transferred from photographs or drawings to an orthographic projection (100 ins./lunar radius) on transparent acetate, by radial trisection from three known points (the triangle of error obtained was almost always under 1 mm.). Finally, the orthographic chart was transferred to the desired projection.

F. Nomenclature

The author has attempted to follow strictly the International Astronomical Union's standard nomenclature.[3] Names have generally been placed to the right and above the appropriate formation, save in marginal cases where this would be awkward. The accepted designations are listed in appendix 5.

III. Critique

While compiling the chart, the author was impressed by the inadequacy of his efforts--hence the term, "reconnaissance." It is apparent that an individual can no longer materially advance selenography without aid from others. The map is not intended as an authoritative representation of the lunar surface but rather as a demonstration of the application of cartographic principles in selenography. Thus, this work is presented as a suggestion and basis for future study. Specifically, it is hoped that larger scale (perhaps 1:500,000) charts can eventually be compiled for this region, utilizing relief representation, on a more-or-less true projection, and drawing in part upon the material given in the appendix and bibliography--all to be executed by a group of interested selenographers.

If future work is encouraged by this effort, it will have more than served its purpose.

Appendices

I. Scale Deviation of Projection

Scale in terms of basic scale = 1:1,000,000

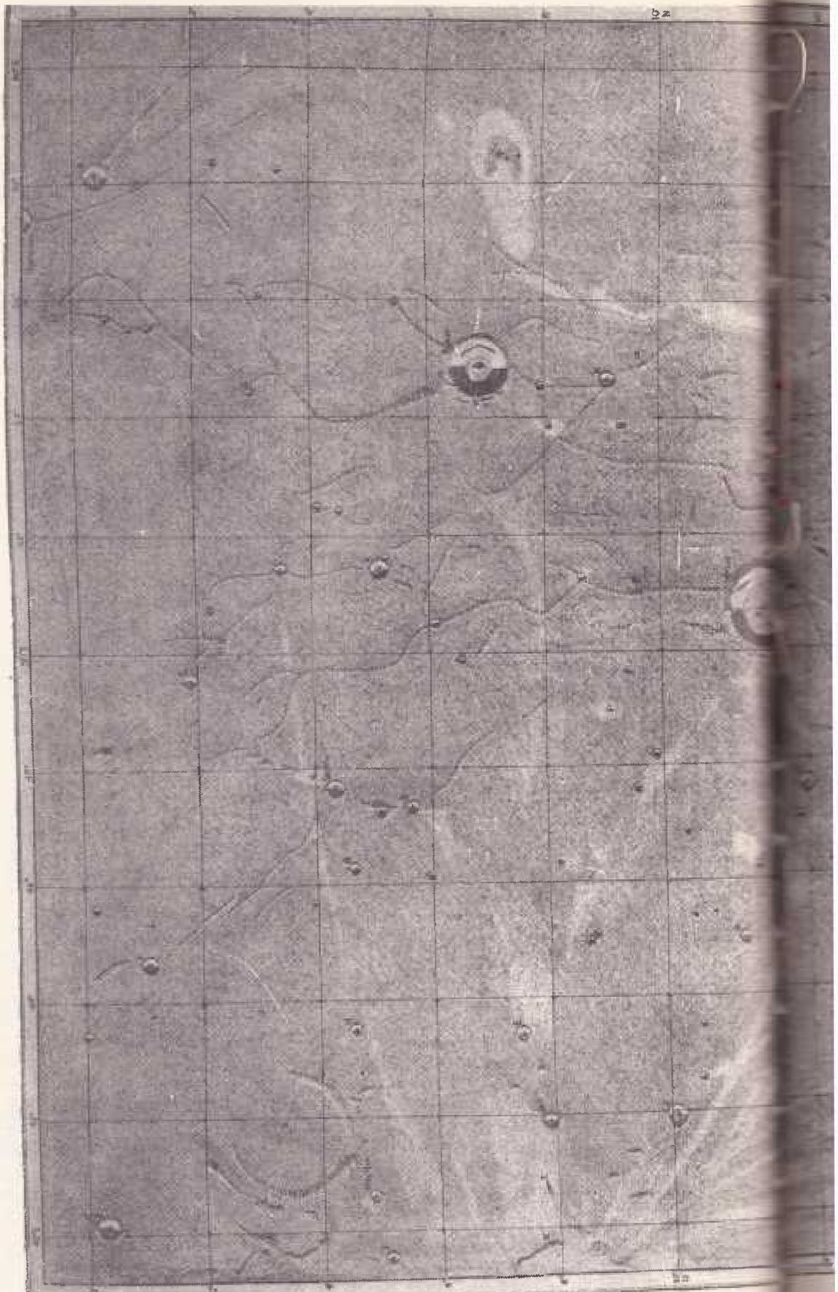

FIGURE 15. Chart of central portion of Oceanus Procellarum constructed by John E. Westfall. See article "A Reconnaissance Chart of the Central Oceanus Procellarum" in this issue. Approximate extent of chart in lunar latitude 0° to 25°N., in lunar longitude 40°E. to 60°E.

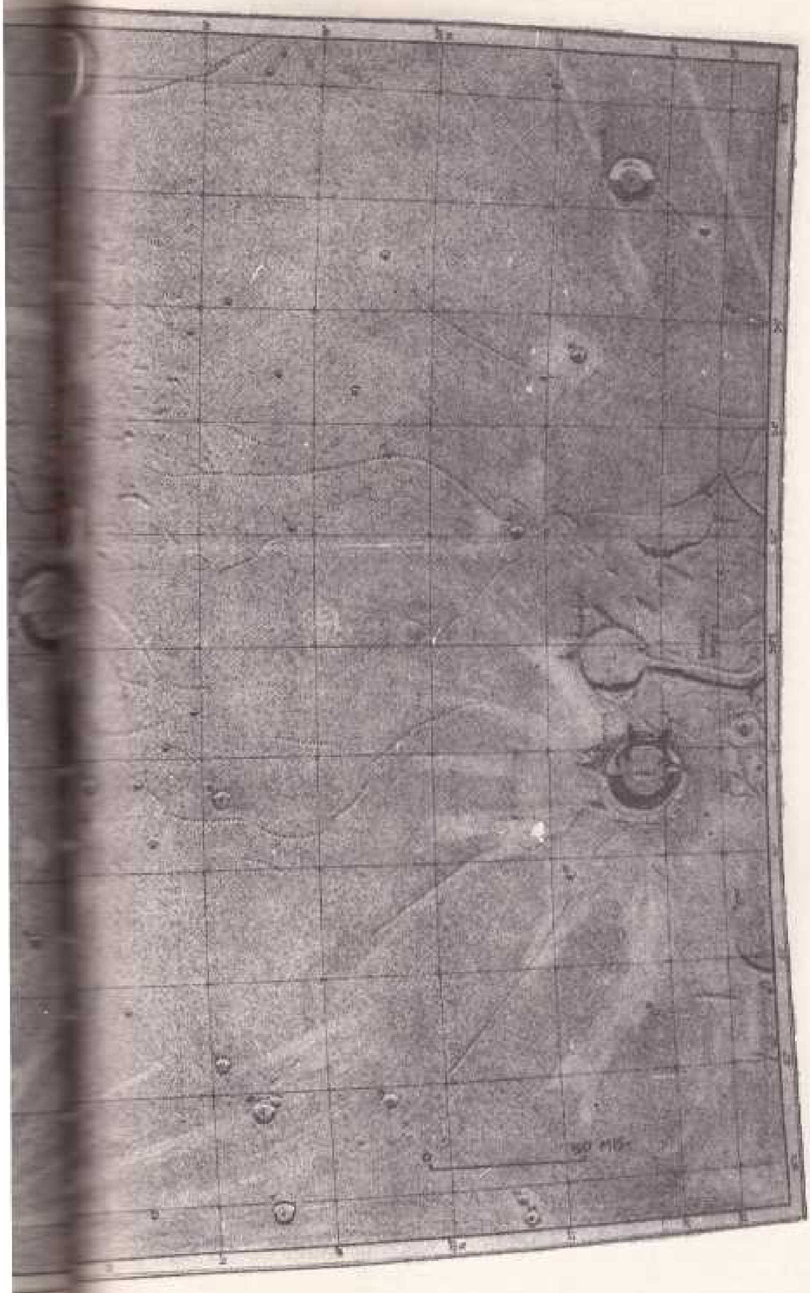

Chart on transverse cylindric equivalent projection, with "equator" at 50°E. meridian of longitude and conformal at $\varphi' = 4°50'$. Lunar radius= 1738.0 kms. Nomenclature by I.A.U. Control: D. Arthur, S. Saunder. Cartography: J. E. Westfall, 1960. Original scale, 1:1,000,000 or 15.78 miles=1 inch. Note scale of published reproduction near lower right corner.

Arc Distance from Central Meridian	N-S Scale	E-W Scale	Areal Scale	Max. Deformation
0°	0.9964	1.0036	1.000000	+ 0° 35'
1	0.9966	1.0034	1.000000	+ 0 33
2	0.9971	1.0030	1.000000	+ 0 29
3	0.9978	1.0022	1.000000	+ 0 21
4	0.9989	1.0011	1.000000	+ 0 11
4°50'	1.0000	1.0000	1.000000	0 00
5	1.0003	0.9998	1.000000	- 0 02
6	1.0019	0.9981	1.000000	- 0 19
7	1.0039	0.9961	1.000000	- 0 38
8	1.0062	0.9938	1.000000	- 1 00
9	1.0089	0.9912	1.000000	- 1 25
10	1.0118	0.9883	1.000000	- 1 53

II. Coordinates of Latitude and Longitude Intercepts

Longitude from Central Meridian (50° East). X,Y in cms. X positive to east.

Latitude	0° X, Y	2° X, Y	4° X, Y	6° X, Y	8° X, Y	10° X, Y
0°	00.00,00.00	06.09,00.00	12.17,00.00	18.23,00.00	24.28,00.00	30.29,00.00
2	00.00,06.05	06.08,06.05	12.16,06.05	18.22,06,10	24.26,06.10	30.27,06.15
4	00.00,12.09	06.07,12.09	12.14,12.14	18.19,12.19	24.22,12.24	30.22,12.29
6	00.00,18.14	06.05,18.14	12.10,18.19	18.13,18.24	24.14,18.29	30.13,18.39
8	00.00,24.18	06.03,24.18	12.05,24.23	18.06,24.33	24.04,24.43	30.00,24.53
10	00.00,30.23	06.00,30.23	11.98,30.28	17.96,30.38	23.91,30.50	29.83,30.68
12	00.00,36.27	05.96,36.27	11.90,36.37	17.83,36.47	23.75,36.63	29.63,36.83
14	00.00,42.32	05.91,42.32	11.81,42.42	17.69,42.57	23.56,42.72	29.39,42.92
16	00.00,48.36	05.85,48.41	11.70,48.46	17.53,48.62	23.34,48.82	29.12,49.07
18	00.00,54.41	05.79,54.46	11.57,54.56	17.34,54.66	23.09,54.91	28.81,55.22
20	00.00,60.46	05.72,60.51	11.43,60.61	17.13,60.76	22.81,61.01	28.46,61.31
22	00.00,66.50	05.66,66.55	11.28,66.65	16.91,66.85	22.51,67.05	28.08,67.41
24	00.00,72.55	05.56,72.60	11.12,72.70	16.66,72.90	22.18,73.15	27.67,73.50
25	00.00,75.57	05.52,75.62	11.03,75.72	16.53,75.92	22.00,76.22	27.45,76.58

III. Coordinates of Control Points

Only points which have been positively identified and shown on the chart are given below. An asterisk (*) denotes a point in the marginal zone.

Second Order Points:

Name or D.W.G. Arthur Designation	ξ	η	λ	ϕ	x(cms.)	y(cms.)
Encke E	-.6444	.0058	40°07'E.	00°20'N.	-29.93	01.01
gA8080	-.6877	.0004	43 27	00 01	-19.90	00.05
Möstlin H	-.6862	.0807	43 31	04 38	-19.62	14.06
Kepler C	-.6564	.1740	41 48	10 01	-24.49	30.78
gB5863	-.6648	.1833	42 33	10 34	-22.24	32.19
gB7864	-.6763	.1839	43 29	10 36	-19.47	32.24
gB9591	-.6988	.1506	44 59	08 40	-15.09	26.30
Marius D	-.6928	.1976	44 58	11 24	-15.00	34.56
Bessarion C	-.6497	.2760	42 31	16 01	-21.82	49.32
gC6572	-.6667	.2520	43 33	14 36	-18.96	44.38
gC9140	-.6938	.2095	45 12	12 06	-14.27	36.68
gC9671	-.6967	.2608	47 52	15 07	-06.26	45.74
Bessarion D	-.6256	.3378	41 40	19 45	-23.79	58.24
Suess F	-.7026	.0199	44 39	01 08	-16.26	03.48
hA1043	-.7143	.0034	45 35	00 12	-13.43	00.60
hA1210	-.7113	.0201	45 21	01 09	-14.15	03.48
hA1649	-.7137	.0688	45 41	03 57	-13.10	11.94
Suess D	-.7231	.0812	46 16	04 39	-11.32	14.11

Name or D.W.G. Arthur Designation	ξ	η	λ	φ	x(cms.)	y(cms.)
Suess	-.7368	.0757	47°38'E.	04°20'N.	-07.19	13.15
hA3319	-.7313	.0887	47 14	05 05	-08.39	15.42
Reiner B	-.7316	.0983	47 19	05 38	-08.13	17.08
hA4077	-.7468	.0068	48 19	00 23	-05.13	01.16
hA4609	-.7398	.0688	47 52	03 57	-06.47	11.94
Reiner E	-.7604	.0328	49 32	01 53	-01.41	05.69
hA6482	-.7681	.0423	50 15	02 25	00.77	07.30
hA7349	-.7735	.0392	50 43	02 15	02.18	06.80
Reiner A	-.7786	.0895	51 25	05 08	04.29	15.52
Reiner C	-.7803	.0606	51 25	03 28	04.31	10.48
hA9711	-.7911	.0713	52 29	04 05	07.54	12.39
hB0802	-.7002	.1825	45 25	10 31	-13.71	31.89
hB0808	-.7000	.1884	45 28	10 52	-13.54	32.95
hB1074	-.7172	.1039	46 09	05 58	-11.63	18.09
hB1473(S. of 2)	-.7166	.1426	46 23	08 12	-10.90	24.84
hB1871	-.7174	.1812	46 51	10 26	-09.44	31.59
hB2686	-.7282	.1658	47 36	09 33	-07.20	28.87
hB3741	-.7345	.1712	48 12	09 51	-05.39	29.82
hB4548	-.7441	.1576	48 58	09 04	-03.10	27.41
hB5623	-.7518	.1632	49 38	09 24	-01.10	28.41
hB6076	-.7670	.1059	50 29	06 05	01.47	18.39
hB6104	-.7596	.1138	49 52	06 32	-00.40	19.75
hB7510	-.7709	.1499	51 14	08 37	03.72	26.05
hC0073	-.7071	.2026	46 14	11 41	-11.22	35.42
Marius A	-.7019	.2181	45 59	12 36	-11.93	38.19
Marius B	-.7048	.2812	47 16	16 20	-07.99	49.42
hC1308	-.7103	.2385	47 00	13 48	-08.86	41.76
hB9672	-.7971	.1621	53 53	09 20	11.65	28.26
Marius C	-.7160	.2413	47 33	13 58	-07.24	42.21
hC1537	-.7131	.2569	47 33	14 53	-07.22	45.04
hC1696	-.7191	.2655	48 14	15 24	-05.18	46.55
hC2744	-.7241	.2736	48 50	15 53	-03.42	48.01
hC5049 (in Marius)	-.7543	.2090	50 28	12 04	01.38	36.47
Marius	-.7574	.2058	50 43	11 53	02.13	35.92
Marius E	-.7790	.2096	52 49	12 06	08.37	36.63
hC8088	-.7883	.2079	53 42	12 00	11.01	36.32
hC8142	-.7835	.2118	53 18	12 14	09.82	37.03
hC8909 (diffuse)	-.7801	.2987	54 50	17 23	14.02	52.70
hC9148	-.7940	.2176	54 26	12 34	13.15	38.09
hC9743	-.7935	.2731	55 34	15 51	16.27	48.11
hC9864	-.7962	.2837	56 08	16 29	17.86	50.08
Herodotus A	-.7334	.3666	52 02	21 30	05.76	65.04
hD5793	-.7590	.3733	54 54	21 55	13.82	66.50
Herodotus B	-.7593	.3835	55 18	22 33	14.88	68.41
hD7221	-.7718	.3207	54 34	18 42	13.15	56.72
Schiaparelli	-.7836	.3962	58 35	23 20	23.92	71.29
hD9228	-.7921	.3282	57 00	19 10	20.08	58.34
hE6197 (diffuse)	-.7687	.4169	57 44	24 38	21.35	75.07
iA2146	-.8238	.0161	55 29	00 55	16.68	02.82
iA2160	-.8257	.0095	55 40	00 33	17.22	01.66
iA2242	-.8238	.0224	55 29	01 17	16.68	03.88
iA2594	-.8286	.0545	56 05	03 07	18.46	09.47
iA2955	-.8250	.0948	55 58	05 26	18.05	16.52
Hermann A	-.8488	.0067	58 05	00 23	24.53	01.16
iA4597	-.8489	.0572	58 15	03 17	25.00	10.03
iA5402	-.8501	.0419	58 19	02 24	25.21	07.30
iB0378	-.8068	.1382	54 33	07 57	13.69	24.08
iB0401	-.7996	.1406	53 52	08 05	11.63	24.48
Reiner H	-.8054	.1577	54 39	09 04	13.97	27.51
Marius α	-.8062	.1686	54 53	09 42	14.64	29.42
Reiner	-.8118	.1205	54 51	06 55	14.65	20.96
iB4298 (center of Reiner r)	-.8448	.1284	58 25	07 23	25.33	22.52
iC0448	-.8035	.2477	56 02	14 21	17.76	43.58
iC3209	-.8296	.2289	58 27	13 14	24.96	40.40

Name or D.W.G. Arthur Designation	ξ	η	λ	φ	x(cms.)	y(cms.)
Aristarchus	-.6755	.4020	47°32'E.	23°42'N.	-06.87	71.69
Bessarion A*	-.6116	.2936	39 47	17 04	-29.58	52.40
iC3842*	-.8339	.2822	60 23	16 24	30.16	50.33
iC3904*	-.8295	.2935	60 12	17 04	29.53	52.39
iC3918*	-.8313	.2978	60 34	17 20	30.54	53.20
Seleucus A*	-.8053	.3746	60 17	22 00	28.87	67.46
iD2086*	-.8281	.3056	60 26	17 48	30.07	54.61
ia2065*	-.8260	-.0046	55 41	00 16 S.	17.27	-00.81
Hermann*	-.8418	-.0152	57 21	00 52 S.	22.31	-02.67

Third Order Points (IAU, Young, Arthur, Moore):

Name or Designation	ξ	η	λ	φ	x(cms.)	y(cms.)
Bessarion B	-.636	.290	41°39'E.	16°51'N.	-24.25	51.49
Dome Kepler 1*	-.630	.150	39 35	08 38	-31.13	26.50
Aristarchus D	-.625	.401	43 01	23 38	-19.43	72.04
Aristarchus F	-.674	.369	46 29	21 39	-09.94	65.64
Aristarchus H	-.662	.380	45 42	22 20	-12.11	67.71
Aristarchus ε	-.684	.409	48 33	24 09	-04.03	73.00
Herodotus	-.701	.394	49 42	23 12	-00.84	70.13
Herodotus ε	-.722	.421	52 45	24 54	07.59	75.27
Herodotus δ	-.715	.409	51 36	24 09	04.45	73.00
Marius P	-.752	.303	52 06	17 38	06.09	53.30
Marius R	-.756	.235	51 04	13 36	03.16	41.11
Marius β	-.766	.168	50 59	09 40	02.97	29.22
Marius γ	-.768	.258	52 39	14 57	07.78	45.19
Marius δ	-.760	.246	51 38	14 14	04.81	43.02
Marius λ	-.758	.330	53 24	19 16	09.77	58.44
Marius ι	-.810	.232	56 23	13 25	18.87	40.71
Marius κ	-.750	.225	50 20	13 00	00.99	39.30
Reiner α	-.807	.121	54 23	06 57	13.22	21.01
Reiner r	-.845	.133	58 30	07 39	25.55	23.12
Möstlin R	-.665	.060	41 46	03 26	-24.87	10.58
Encke ι	-.658	.038	41 11	02 11	-26.72	06.60
Encke χ	-.649	.020	40 28	01 09	-28.89	03.48
Kepler D	-.661	.138	41 52	07 56	-24.44	24.13
Kepler E	-.681	.130	43 23	07 28	-19.92	22.77
Kepler ζ	-.646	.136	40 42	07 49	-27.93	23.98
Möstlin	-.649	.085	40 38	04 53	-28.29	14.90
Reiner G	-.812	.052	54 24	02 59	13.35	09.06
Aristarchus A*	-.667	.436	47 50	25 51	-05.93	78.19
Aristarchus Z*	-.675	.430	48 23	25 28	-04.45	76.98
Brayley C*	-.591	.364	39 23	21 21	-29.93	65.54
Brayley E*	-.596	.362	39 44	21 13	-28.97	65.09
Encke J*	-.634	.089	39 32	05 06	-31.57	15.72
Encke β *	-.640	.053	39 52	03 02	-30.65	09.32
Kepler F*	-.623	.145	39 02	08 20	-32.83	25.64
Kepler δ *	-.618	.200	39 06	11 32	-32.32	32.52
Kepler κ *	-.633	.136	39 43	07 49	-30.84	24.03
Kepler ι *	-.625	.126	39 03	07 14	-32.88	22.27
Harbinger α *	-.618	.434	43 18	25 43	-18.33	78.19
Harbinger γ *	-.606	.435	42 18	25 47	-21.05	78.54
Prinz*	-.630	.435	44 24	25 47	-15.33	78.29
Aristarchus ζ *	-.682	.432	49 08	25 36	-02.37	77.38
Herodotus ε *	-.752	.426	56 13	25 13	17.19	76.58

IV. Adopted Crater Diameters. (For weights, see text above.)

Name or Designation	Dia.(kms.)	Weight	Name or Designation	Dia.(kms.)	Weight
Aristarchus	38.4	14	Möstlin	6.4	6
Aristarchus D	3.5	4	Möstlin H	5.2	4
Aristarchus F	18.1	14	Reiner	30.1	17

Name or Designation	Dia. (kms.)	Weight	Name or Designation	Dia. (kms.)	Weight
Aristarchus H	3.5	4	Reiner A	9.4	12
Bessarion B	12.2	4	Reiner B	6.8	6
Bessarion C	8.7	4	Reiner C	6.3	6
Bessarion D	8.7	4	Reiner E	7.0	4
Encke E	12.2	4	Reiner G	3.5	4
Hermann A	13.9	4	Reiner H	7.5	11
Herodotus	35.6	16	Schiaparelli	24.0	13
Herodotus A	9.6	10	Suess	8.3	17
Herodotus B	7.0	4	Suess D	5.9	7
Herodotus C	3.5	4	Suess F	8.7	4
Kepler C	11.8	10			
Kepler D	8.7	4	Aristarchus A*	9.0	6
Kepler E	7.0	4	Aristarchus Z*	8.3	8
Marius	41.2	17	Bessarion A*	11.6	6
Marius A	14.6	17	Brayley C*	8.0	6
Marius B	10.4	12	Brayley E*	5.0	6
Marius C	10.4	12	Encke J*	5.2	2
Marius D	7.3	13	Hermann*	15.3	6
Marius E	7.0	4	Kepler F*	7.0	2
Marius P	3.5	4	Prinz*	circa 40.8	2
hC1308	5.4	5	Seleucus A*	5.2	2
gC9140	4.2	7			
hC0073	4.9	6			

V. Named Objects on Chart (IAU).

Aristarchus, A, D, F, H, Z, α, δ, ϵ, ν, η, Ir, IIr.
Bessarion A, B, C, D.
Brayley C, E.
Encke E, J, β, ι, κ.
Harbinger α, γ.
Hermann, A.
Herodotus, A, B, C, ϵ, θ, δ.
Kepler C, D, E, F, δ, ι, κ, ξ.
Marius, A, B, C, D, P, R, α, β, γ, δ, λ, ι, κ.
Möstlin, H., R.
Oceanus Procellarum.
Prinz.
Reiner, A, B, C, E, G, H, α, r (or γ).
Schiaparelli.
Schröter's Valley.
Seleucus A.
Suess, D, F.

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General: The works listed below concern, in whole or in part, the region covered by the chart. This is not a comprehensive bibliography, but merely consists of those references noted by the author; this list could, no doubt, be greatly augmented by any others studying this area. Some brief descriptions are included.

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Postscript by Editor. We congratulate Mr. Westfall most heartily on the quantitative and painstaking job of lunar mapping which he has carried out so very well. May his efforts find many imitators! His bibliography, if not intended to be exhaustive, demonstrates extensive reading and is a needed example of organizing and tabulating lunar literature on a limited subject. Mr. Westfall's address is Apartment 3, 3104 Varnum St., Mt. Rainier, Maryland. It would be a very worthwhile project for the A.L.P.O. to carry out from group observations similar chartings of other portions of the moon.

MUTUAL PHENOMENA OF JUPITER'S SATELLITES, NOVEMBER 18-DECEMBER 31, 1961

One satellite of Jupiter can occult another satellite when the earth is close to the plane of the satellite-orbits, which is also the plane of Jupiter's equator. Likewise, one satellite can be eclipsed in the shadow of another when the sun is near the plane of Jupiter's equator. These mutual occultations and eclipses hence occur in "seasons" at intervals of about six years, one-half the period of Jupiter's revolution around the sun. Such a series began on August 7, 1961. The list below continues ones on page 104 of the May-June, 1961, Str.A. and on pages 123-124 of the July-August, 1961, Str.A. The data are taken from pages 38-40 of the 1961 Handbook of the British Astronomical Association. In our table dates and times are by Universal Time. In the second column below E denotes eclipse and O, occultation. The third column tells which satellites are involved. An eclipse may be penumbral only. Magnitude in the rightmost column is the fraction of the diameter of the eclipsed satellite covered by umbral shadow.

We invite all A.L.P.O. members to observe these mutual phenomena closely. We would be especially interested in observed times (first and last contacts, mid-eclipses and mid-occultations), notes on comparative colors and surface brightnesses of two satellites in contact and on possible optical effects then remarked, and especially in careful descriptions of the phenomena which will indicate how well our telescopes resolve detail on these small discs.

On August 22, 1961, Mr. Frank C. Clark and the Editor confirmed the occurrence of the occultation of J.II by J.III from $3^h\ 56^m$ to $4^h\ 1^m$, U.T., with Mr. Clark's 6-inch reflector at Cocoa Beach, Florida. The Editor made more detailed observations of the occultation of II by III on August 29, 1961, with a 6-inch reflector at 298X, seeing poor (3-4) and transparency good (4). This occultation was predicted to last from $7^h\ 4^m$ to $7^h\ 11^m$, U.T.

FIGURE 16. Pan American College Summer Institute in the Astro-Sciences, 1961. Max Kerr Photography, Edinburg, Texas. Front row (sitting), left to right: Thomas E. DeMary; Bruce R. Bowman; Alfred J. Hulbert; Robert L. Webb, Jr.; Robert F. Loewenstein; Ted F. Schmeckpeper; Karl R. Moore; James M. Tippett; Ronald C. Hoy. Middle row, left to right: Carlos E. Rost, guest lecturer; Prof. Walter H. Haas; Mrs. Mary Kies, Counselor; Fredrica W. Wiegand; Nellie M. McGrath; Carol A. Foreman; Patricia K. McCoy; Sandra A. Hanson; Gary L. Kraus, student assistant; David Meisel, guest lecturer; Prof. Paul R. Engle, Director. Top row, left to right: Michael D. Bell; Philip M. Kelly; Peter G. Backes; Henry C. Fallen; Gerald R. Thrasher, Jr.; Stanton E. Wyllie; Michael L. Wiseman; Basil H. Boyd, Jr.; Dale A. Gillette; Billy C. Wilkinson; William R. Eason; John D. Garner; Ronald D. Silver; Jay L. Lemke; Royce D. Brough; Nevel T. Gladd; Donald L. Nelson; Lewis A. Duncan.

FIGURE 17. Pan American College Summer Institute students studying Sun and Venus from summit of Infiernillo Peak, Nuevo Leon, Mexico, in June, 1961. Telescope is Dr. William Brashear's 4-inch refractor. Figures 17 through 20 are photographs taken by Dale Gillette, one of the Institute students.

Clocker's

FIGURE 18. Student Dale Gillette observing with 16-inch Dall-Kirkham reflector erected on Infiernillo Peak by Pan American College Summer Institute personnel. Telescope built by Astro-Dome Corporation, Canton, Ohio.

FIGURE 19. "A sea of clouds", seen from above. A frequent sight from near top of Infiernillo during week spent there by Summer Institute students. Elevation of summit of mountain 10,392 feet above sea level.

FIGURE 20. Living cabin built near top of Infiernillo with funds provided by the Instituto Tecnoló-gico y de Estudios Superiores, Monterrey, Nuevo Leon, Mexico. Cabin occupied during Pan American College Summer Institute in June, 1961. Edge of temporary tent showing in right foreground.

In the Saturn Section Mr. Thomas A. Cragg and Dr. Joel W. Goodman have interchanged places; i.e., Dr. Goodman is now the Saturn Recorder, and Mr. Cragg is now the Assistant Saturn Recorder. As before, all observations of Saturn should be mailed to Dr. Goodman, who requests members to submit quickly their records on Saturn in 1961 now that the apparition is almost ended. Dr. Goodman also has a new address; it is: Dept. of Microbiology, University of California School of Medicine, San Francisco 22, Calif.

Mr. David Meisel, the Comets Recorder, has changed his address from 800 8th St., Fairmont, West Virginia, to Box 3017, University Station, Columbus 10, Ohio. Mr. Meisel is beginning graduate study in astronomy and/or astrophysics at the Ohio State University, where we wish him every success.

Mr. Alika K. Herring, long a Lunar Recorder of the A.L.P.O., has joined the staff of Dr. Kuiper's Lunar and Planetary Laboratory and finds it necessary to give up his A.L.P.O. post. Mr. Herring's help to our lunar observers has been considerable, and he has regularly given very generously of his time in guiding the studies of young or inexperienced colleagues. The high quality of his personal lunar studies is well enough known to require no discussion, and indeed his appointment to do professional lunar research speaks for itself. We wish Mr. Herring all possible good fortune in this new endeavor. We are very sorry to lose him from our staff, and we hope that he will find it possible to continue to contribute lunar papers to this periodical from time to time. Up to now no replacement for Mr. Herring has been found.

In Memoriam. Mr. Beaufort Ragland of Richmond, Virginia, died some months ago. A tribute by one of our members will appear in the next issue.

Mr. George H. Aderhold of Saxonburg, Pa., passed away on June 9, 1961. He was the Founder and President of Saxonburg Ceramics, Inc. He had been a member of the A.L.P.O. since 1953 and had attended at least one A.L.P.O. Convention. We express our sympathies to his survivors and friends.

Suspension of A.L.P.O. Photoduplication Service. Mr. William E. Shawcross finds it necessary to drop this service for at least a year because of active military duty.

Orders of A.L.P.O. Jupiter Handbook. Mr. Philip R. Glaser reports a very gratifying amount of interest in the Jupiter Handbook. In fact, a second printing is being planned, with some changes and improvements from the first printing. Mr. Glaser expects some delay in filling orders for the Handbook received after September 1, 1961, and asks for patience about such delays.

Since the A.L.P.O. Jupiter Handbook clearly filled a real need, it appears evident that further Handbooks by other A.L.P.O. Sections would also be a real service to our members. The work involved can be considerable, but the idea is strongly recommended to the Section Recorders.

Simultaneous Observation Program. This very worthy project was described on pp. 90-94 of our May-June, 1961, issue. It is supervised by Mr. Clark R. Chapman, 2343 Kensington Ave., Buffalo 26, New York. Mr. Chapman _urges_ that all observers turn in _promptly_ to him all drawings and data which they have for the 15 selected target-dates. He will also welcome more discussion about the general project. Mr. Chapman's present plans are for two articles as final reports on the program, probably in early 1962 issues of _The Strolling Astronomer_.

Concerning Divisions in Ring A of Saturn. Mr. Leif J. Robinson has communicated the following note bearing on his discussion on pages 129-130 of our July-August, 1961, issue. The observation cited was made in June, 1961. "I talked with Tom Cave yesterday. He described an observation of Saturn confirming everything I said in my previous note. He saw A8 and Encke's as double at A4 and A6. He was using a 12.5-inch reflector in seeing at least 9 on the common scale of 0 to 10 with 10 best."

ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

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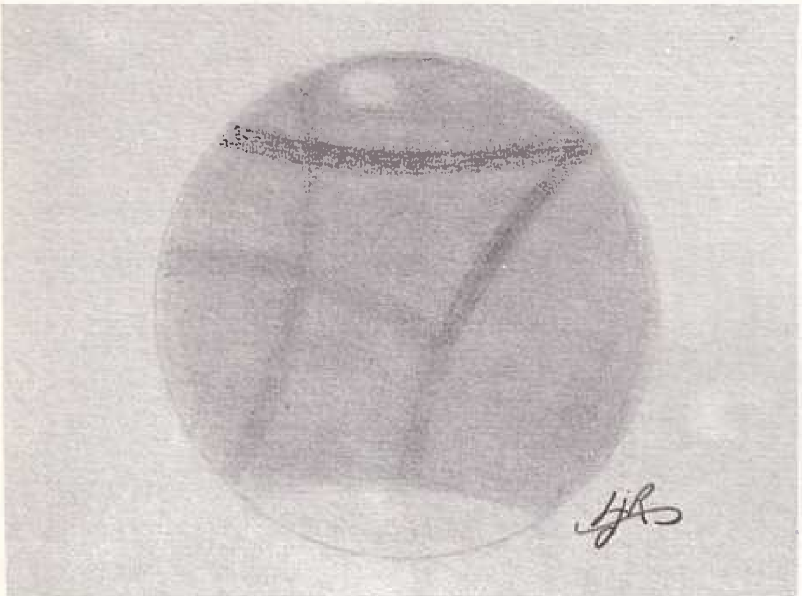

...mposite drawing of Ganymede, or Jupiter III, constructed by Mr. L. J. Robin- ... from eight independent drawings made on August 26, 1961, $6^h 30^m - 7^h$ [illegible]^m, Universal Time. Two 10-inch reflectors, about 650X, seeing good. Only ...rkings seen by more than one observer appear on the composite, and the ...ber of observers seeing a given marking has been used as a measure of ... marking's visibility. This group-effort carried out during W.A.A.-A.L.P.O. ...vention at Long Beach, California. See pages 218 and 219 for the individual ...wings and additional discussion.

...HE STROLLING ASTRONOMER

Pan American College
Observatory
Edinburg, Texas

FIGURE 9. The Ninth Convention of the A.L.P.O. at the Lafayette Hotel, Long Beach, California, on August 24-26, 1961. Photograph by Jack Eastman, Jr.

FIGURE 10. Mr. George Carroll observing solar prominences with his 3-inch coronagraph during W.A.A.-A.L.P.O. Convention at Long Beach. Photograph by Jack Eastman, Jr.

FIGURE 11. Presentation of an A.L.P.O. Award to Mr. Alan McClure (standing, left) during the W.A.A.-A.L.P.O. Convention Banquet. Photograph by Eugene Fair, Redondo Beach, California.

FIGURE 12. Presentation of the Western Amateur Astronomers G. Bruce Blair Award to Mr. Carl Wells (standing, right) by Tom Cave, Convention Chairman, during the 1961 Convention Banquet. Photograph by Eugene Fair.

like to make a suggestion for future conventions. In the future, let us have those persons who are present give their papers first, having as lengthy a discussion period as needed after the paper for the complete audience response--subject to control from the Chair. Then, after these papers are finished, have the <u>in absentia</u> papers read. The question and discussion period is the most helpful part of any paper, and I am sure that the authors would appreciate the opportunity to defend their views against the criticism of their colleagues.

The A.L.P.O. had a magnificent exhibit under the direction of Mr. Alika Herring. Jupiter, Mars, the moon, and Mr. Chapman's simultaneous observing project accounted for much material of interest. Also presented was a 3" coronagraph constructed by Mr. George Carroll, a telescope and instrument maker of renown. This instrument, with its 4.5 Å bandpass monochromator, was set up beside the hotel's swimming pool so that the delegates could view the solar prominences. The first day the sun obliged with no less than 12 prominences; the second day 14 were visible, including a giant "surge" which could be observed to grow by the hour! A view not soon forgotten! Speaking of observing: at the star-party the delegates were blessed with seeing 7. As a matter of fact no less than eight persons saw detail on Ganymede--there was good agreement among all drawings. The observations were made with two ten-inch f/7 telescopes--a homemade job by Fread Alrich and an ANRA commercially made telescope with a mirror by the same craftsman, who is chief optician for that firm. The magnification used was approximately 650X.

The final night of the convention included the banquet, during which Alan McClure was presented the A.L.P.O. Award by Dr. Goodman. Of course, this award was given in recognition of the unparalleled skill Mr. McClure has shown in wide-field astrophotography. It is rather anti-climactic, but McClure had his photographs of Comet Wilson on no less than three magazine covers in September, 1961: <u>Sky and Telescope</u>, <u>The Review of Popular Astronomy</u>, and <u>The Griffith Observer</u>.

Lastly, on behalf of all A.L.P.O. members, this writer wishes to express his most heartfelt thanks to Dr. Goodman for his superb management of the A.L.P.O. session, to Mr. Alika Herring for the fine production of the A.L.P.O. exhibit, and to the W.A.A., under the direction of Mr. Thomas Cave, President, for making its facilities available to the A.L.P.O.

AN ANALYSIS OF THE SEEING AND TRANSPARENCY SCALES AS USED BY AMATEUR OBSERVERS

By: L. J. Robinson

There is little doubt in the minds of the more experienced observers that seeing and transparency scales, as currently used by amateurs, are vitually useless. The scales themselves are subjective and/or ill-defined; also, there is mystery surrounding the exact nature of these scales, and little mention of them as unique entities reaches the journals. Due to these facts that the scales are inadequate and that few persons know what the existing scales really mean, we have an ideal opportunity to review the entire system. Let me begin by relating a couple of stories, which I hope will efficaciously demonstrate the above facts.

One night, about two years ago, I had the occasion to estimate the seeing concurrently with three observers of high repute. The instrument in use was a 12-inch refractor; the overall conditions might be described as "average." The first observer went to the telescope and made his estimate of the seeing; keeping this value to himself, he stepped down, and the next observer went up. So things progressed until all four persons had made their estimates. The results were that two observers rated the seeing as "2-3"; one of the others said "3"; and the last stated, with supreme confidence, "6-7." Recalling that all these observers were seasoned, one can only reach the conclusion that one observer used greatly different criteria in making his estimate (it was stated before the observations were made that all were to use the "A.L.P.O. scale").

Concerning transparency, I recall a quite similar instance. I had just moved to a new home which lies in proximity to the Pacific Ocean. The sky is hazy most of the time, making the sky condition, in general, much poorer than I had been accustomed to in my former location (which, by the way, was at a considerable altitude next to the San Gabriel Mountains, which form the eastern border of Los Angeles). One night I was observing with a very good friend who is deservedly a highly reputed amateur. I asked him about the transparency; he estimated the transparency as "4+" (sic!). Mentioning the fact that conditions nowhere approximated "4+" since the faintest star visible was third magnitude, I asked why and how he had made the estimate. His answer follows: "...well, it never gets much better here, and if I used your scale I would never be able to rate the transparency better than 3." With chagrin, I pointed out the fact that there is nothing magical about rating the transparency high and that a low estimate does not necessarily mean a loss of value to the observation. Also, I pointed out that it may be well for him to use his own scale except for the fact that no one else knows about it.

The point I have been attempting to make is that the observer's location has a direct influence regarding his "education" relating to subjective matters such as seeing and transparency. He may read, for example, that seeing "10" is "perfect" or "is the best seeing possible"; but if this observer never experiences true seeing better than 5, he will be prone to relate this true 5 to his personal 10. How is it possible for one to discern a fractional part of a perfection which he will never be able to see? An analogy might be attempting to measure a length of lumber with a piece of material of some standard length. Our subject knows the second piece to be a standard but is ignorant of which standard it is. He knows what it is for but does not know how much of it there is. The following discussion will consist of an analysis of the meaning of "seeing" and "transparency", an analysis of two seeing scales, and a suggested revision of the seeing and transparency scales in use today.

Seeing

Fundamentally, "seeing" is defined to be that quality of the atmosphere which produces an instability in the image of an object as seen in an astronomical telescope. There are two principal types of seeing: (1) The "slow" seeing pattern which moves the image in a lateral manner about the field. (2) The "fast" seeing pattern which distorts and blurs the image. In visual observation, which is the only aspect of observing being considered in this paper, it is this fast pattern which accounts for the major loss in recorded detail; the slow pattern is not usually detrimental. It has been found that a slow pattern may be resolved into a fast pattern with a sufficient increase in aperture. In other words, slow seeing is merely a summation of fast seeing patterns. The nomenclature "fast" and "slow" was probably derived from researches by Ellison and Seddon (1), who concluded that seeing waves showed a frequency of from 5 to 100 cycles per second. It was Douglass (2), however, who determined the actual length of seeing waves. It was his conclusion that such waves vary from 0.7 to 4.0 inches in length.

It has been mentioned that an increase in the aperture D will resolve a slow pattern into its faster counterparts. Using the empirical relations:

$D < 5\lambda$ produces lateral motion in the field (slow seeing),

$D > 5\lambda$ produces blurring and distortion (fast seeing),

and $0.7 \leq \lambda \leq 4.0$ inches,

we may conclude that under mean conditions, a telescope larger than about 8.5 inches in aperture will show a fast pattern, while a smaller instrument will show slow seeing. Of course, this relation is subject to much variation, i.e., 3.5 inches to 20 inches in aperture.

The above are the basic characteristics of seeing *per se*; seeing, however, is subject to localized variations: altitude and object location. The aspect of altitude, more commonly referred to as Zenith Distance, may be approximated by the well known function, sec Z. In other words, the seeing at $Z \doteq 60^\circ$ will be twice as poor as at $Z = 0^\circ$; also, at $Z \doteq 75.^\circ 5$ the seeing will be twice as poor as at $Z \doteq 60^\circ$. The object location factor stems from the fact that some portion of one's unique sky may always be subject to much different conditions than another. An example of this effect would be the seeing conditions directly to the N.E. of my old home. The reader will recall that a mountain range was found in that direction; the updrafts caused by that range *always* deteriorated the seeing in that direction by 2 or 3 points as compared to, say, the S.W. Many similar effects could be found for other locations.

Seeing Scales

The fundamental purpose of a seeing scale is to describe, as accurately as possible, the stability of the atmosphere during a given observation. Such a determination is necessary in order to relate the degree and quality of one person's observations to those of another. For this reason, it is paramount that a precise method be arrived at which will allow for such a determination; also, by the condition of this relation, it is necessary to have a scale which is applicable to widely separated observers.

The criteria for an adequate seeing scale are described below; they are also reproduced in Table I, which relates several contemporary seeing scales to each other.

Seeing Scale Criteria

(Physical Criteria)

(1) *The location of the object under observation*. For a seeing scale to meet this most important requirement (sec Z), the seeing estimate must be made at the same celestial location as that of the object under observation.

(2) *Consideration for the aperture of the instrument*. It has been shown above that the aperture of a telescope affects the type and amount of seeing; it is apparent that any useful scale must relate the seeing "limits" to which a given telescope may penetrate.

(3) *Emancipation from instrumental quality*. All estimates of the seeing should be independent of the degree of perfection of the instrument through which they are made.

(4) *Recording the best moments*. Any seeing scale should indicate the best moments of seeing, for only at that time is the greatest accuracy or greatest amount of detail realized.

(5) *Frequency of the best moments*. As the finest observations are made during the best moments, the overall quality will be realized by the number of these optimum periods experienced during the observing session.

(6) *Non-subjective standard*. It is necessary to have a standard or basis for subsequent fractional estimates formed on a non-subjective maximum condition. It is also necessary that this maximum condition be attainable or in some other way be capable of precise visualization.

(Personal Criteria)

(7) *Impersonality*. As it is necessary to have a standard reference, it is necessary to have a standard criterion for fractional division, again allowing no possibility for misinterpretation. The use of *constant* and uniform differentials is paramount.

(8) *Simplicity of use*. Any system which will be used by large numbers of persons with widely differing backgrounds and abilities *must* be the ultimate of simplicity.

(9) Efficiency. When dealing with volunteer labor, it is desirable that any supplementary observation or condition consume as little excess time as possible. The ultimate is that such additional material be procured while the principal observation is being made.

(10) Universal application. It is necessary that any comparative system be constructed so that all observers may use the same points of comparison as well as the same criteria.

Table I. Seeing scale criteria described by L. J. Robinson in his article in this issue. Evaluation by Mr. Robinson of several scales in current use.

	#1	#2	#3	#4	#5	#6		#7	#8	#9	#10	Total Physical	Total Personal	Grand Total
Pickering	1	0	0	3	0	1		1	1	1	3	5	6	11
Tombaugh-Smith	0	3	1	3	0	3		3	1	0	1	10	5	15
Robinson	3	3	3	3	3	3		1	3	3	3	18	10	28

0 no consideration
1 partial consideration
3 total consideration

The realization of all, or even a vast majority, of the above criteria is very difficult to procure. The first real effort in this direction was undertaken by W. H. Pickering. Indeed, it is this noble but somewhat inadequate accomplishment which is in widest use today. In principle, this system utilizes the visibility and quality of the diffraction disk and of the surrounding diffraction rings as its criteria. This scale was designed for a 5-inch objective being used with a magnification greater than 300X on a first or second magnitude star. From Table I, one will see that Pickering's scale is quite lacking in physical criteria, less so in personal criteria. Its major faults are: it fails to relate all telescope sizes to a common system; it fails to consider the quality aspect of the telescope; it fails to record the frequency of the best moments of seeing. Remaining partial deficiencies are: it only approximates, due to the necessity of locating a first or second magnitude star, the location of the object under discussion; it is subject to personal estimations of degree; it is only relatively simple to use; it is inefficient to some degree, due to the fact that the observation of seeing must almost always be made on a separate star; lastly, the fundamental standard is somewhat subjective, i.e. "...virtually [sic!] stationary." This phrase Pickering used to define seeing 10. The points which it fully realizes are: it does record the best moments of seeing, and it also has universal application.

A major advance in the methodology of seeing estimation came from Messrs. C. W. Tombaugh and B. A. Smith (3). Here, indeed, we find a much improved method of seeing estimation as compared to Pickering. In general, the Tombaugh-Smith Scale is based on the appearance of the "confusion disk", progressively poorer seeing giving rise to larger diameter disks. It is significant to note that Tombaugh and Smith bring into consideration two major facts. First, the seeing is recognized as a function of the telescope's size; also, it is necessary to have measurable quantities in order to arrive at a factual estimate of the seeing. Much of the subjectiveness has been removed, though at a sacrifice of efficiency. The total deficiencies are: a complete lack of consideration for the location of the object under observation since all estimates of the seeing are made using "standard" double stars near the north celestial pole; it also fails to record the frequency of the best moments of seeing; lastly, as previously mentioned, much time is consumed in making the estimate. Partial realization of the optimum is found in: a consideration of the quality of the observing telescope (lacking but superior to Pickering); its simplicity of use once the stellar estimate has been made; its limited application because its fundamental standard is located about the north celestial pole. Total optimum conditions are found in its consideration for the size of the observing telescope, its recording of the best moments of seeing, its non-subjective standard, and lastly, in its impersonality. In all, it is easy to see a vast improvement in many areas over the old Pickering scale--especially in areas of physical criteria. In conclusion, it should be stated that the principles presented in the Tombaugh-Smith Scale were heavily relied upon by the author in his construction of another scale.

A Practical Seeing Scale For Visual Observers

It was soon apparent to this writer that in order to create a seeing scale which would meet all the basic criteria it would be necessary to relate all seeing estimates to the object under observation. In this manner criteria #1, #8, #9, and #10 would be fulfilled. Upon making this decision, any consideration of a system of constants like those used by Tombaugh-Smith is ruled out. In its stead, time was chosen as the constant, thereby fulfilling criteria #4, #5, #6, and #7. The final major aspect, that of relating all telescopes to a common system, was solved by the application of the well known relation for the resolving power of a telescope, $4''.56/A$. With this choice criteria #2 and #3, the last ones, were carried into the relations below. As all inter-relations for the scale are now established, the seeing may be expressed as:

$$S_f = k\bar{E}, \qquad (1).$$

where S_f is the value of the fast seeing pattern.
k is a constant and is equal to the reciprocal, $A/4.56$, for any one telescope, A being the aperture in inches.
$\bar{E}$ is the mean estimate of the portion of the time, to the nearest 10% and taken at 10 minute intervals throughout the observation, during which the image was so steady as to show no perceptible blurring under observational magnification.

$$S_s = k\bar{\bar{E}}, \qquad (2).$$

where S_s is the value of the slow seeing pattern.
k is the same constant as above.
$\bar{\bar{E}}$ is the mean estimate of the portion of the time, to the nearest 10% and taken at 10 minute intervals throughout the observation, during which the image showed no perceptible lateral motion in the field of view.

It is necessary to estimate both the fast and the slow pattern due to the fact that a given "bundle" of seeing waves will contain some odd length waves, leading to this dual impression.

With these relations we may calculate some of the following extreme limits ($0\% \leq \bar{E} \leq 100\%$) for the seeing, using different apertures in order to demonstrate the maximum variation.

(1).	0"	$0 \leq S \leq 0.000$
(2).	4"	$0 \leq S \leq 0.877$
(3).	8"	$0 \leq S \leq 1.754$
(4).	12"	$0 \leq S \leq 2.632$
(5).	16"	$0 \leq S \leq 3.509$

It is immediately obvious that this sytem is both cumbersome and insufficient. To correct this state, it was decided to refer the above scale to a specific telescope under specific conditions. Hence, let seeing 10 be defined as that which is experienced by the observer using a 10-inch telescope under 100% atmospheric steadiness, and allow all other telescopes and conditions to be expressed as a function of this standard. It is now possible to express (1) and (2) as:

$S_f = A\bar{\bar{E}}$, and

$S_s = A\bar{\bar{E}}$, where A is the aperture in inches.

Let us now recalculate the limits as expressed above.

(1). 0" $0 \leq S \leq 0.0$
(2). 4" $0 \leq S \leq 4.0$
(3). 8" $0 \leq S \leq 8.0$
(4). 12" $0 \leq S \leq 12.0$
(5). 16" $0 \leq S \leq 16.0$

The conclusions are obvious: the maximum seeing that can be experienced with a telescope of given aperture is a function of that aperture only. The following is an example of this method in use with a six and a twelve and one-half inch instrument; the duration of the observation is thirty minutes.

Six-Inch

First 10 minutes	$E_1 = 20\%$	Mean:	$\bar{E} = 27\% \doteq 30\%$.
Second 10 minutes	$E_2 = 30\%$		$S_f = (6)(.30) =$
Third 10 minutes	$E_3 = 30\%$		$1.8 \doteq 2.$

Twelve and One-Half Inch

First 10 minutes	$E_1 = 20\%$	Mean:	$\bar{E} = 27\% \doteq 30\%$.
Second 10 minutes	$E_2 = 30\%$		$S_f = (12.5)(.30) =$
Third 10 minutes	$E_3 = 30\%$		$3.75 \doteq (4)$.

From these two examples it is well shown that the actual seeing is a function of aperture alone--the time factor being equal. In addition, a reference to Table I will show that this revised seeing scale fully meets all the basic criteria, with the possible exception of #7, which alone is left to some interpretation. However, any variation here is apt to be minor and will probably be insignificant--especially in the case of smaller instruments.

Transparency

The question of transparency, as referred to visual observation, is much more easily solved than that of seeing. For the visual observer we may define "transparency" as being "that quality of the atmosphere which, in any physical way, hampers the transmission of light." There are two mechanisms which affect this transmissiveness: (1) Innate atmospheric properties which prevent, in part or in whole, the passage of particular waves of light, and (2) the obscuration of light by foreign matter suspended within the atmosphere.

Property (1) is essentially a constant for visual observers; as such it will only be necessary to give a fundamental explanation of this condition.

Let

$$l = l_o \sec Z \qquad (3),$$

where l_o is the vertical height of the atmosphere, and l is the actual length of any light-path.

Then, if I_o is the original intensity of light and I is the received intensity, we may say:

$$I = I_o e^{-kx*} \qquad (4).$$

*Should light of intensity I pass through a medium of thickness dx, it will be diminished as follows:

$$dI = -kIdx.$$

Hence, $dI/I = -kdx.$

But, $dI/I = d(\log_e I)$; therefore, $\log_e I = -kx + \log_e I_o$, or $I = I_o e^{-kx}$.

But, by letting C become the transmission coefficient for any wave length, equation (4) becomes

$$I = I_o C^l \qquad (5).$$

Substituting (3), we have,

$$I = I_o C^{l_o \sec Z} \qquad (6).$$

Property (2) above is more difficult to define, for it is a function of every situation and every condition. The fact, however, that we have shown (1) to be a constant (excluding, of course, the function of altitude) allows us to extend a scale to this variable.

A Practical Transparency Scale for Visual Observers

The formation of a transparency scale must accord itself with much the same basic criteria as have been enumerated in a previous section of this paper. The only contemporary scale which I am at all familiar with is so nebulous that it is impossible for me to make a comprehensive analysis of it. For this reason, I shall merely propose my suggested revision of that 0-5 scale.

In order for one to describe the total clarity of the atmosphere through which an observation is made, all that is required is that the observer note the faintest star visible, to the nearest one-half magnitude, within a tolerable distance from that object. The phrase "tolerable distance" requires some expansion. It will be recalled that the extinction of starlight is a function of sec Z. Therefore, as the zenith distance* is increased, the extinction becomes greater. Figure 13 shows the tolerable distance limit to which one may extend his observations of the transparency before exceeding Δ magnitude = 0.5.

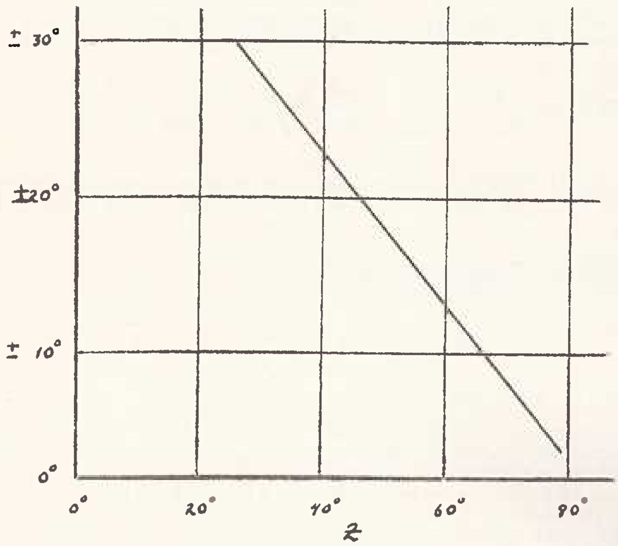

FIGURE 13. Relation between zenith distance Z (horizontal scale) and "tolerable distance" (vertical scale) for selecting a star for a transparency estimate. The criterion is that differential atmospheric extinction between object and star employed should not exceed 0.5 stellar magnitudes. The graph gives the corresponding maximum permissible differences in zenith distance, or also in elevation above horizon, between object and star. This chart by L. J. Robinson. See also text of his article.

* The zenith distance may be computed from latitude, declination, and hour angle by means of spherical trigonometry; or it may often be estimated directly to the degree of accuracy needed here.

The scale itself would read:

Transparency	0	stars	≤0.5 mag.	visible
"	1	"	≤1.5 mag.	visible
"	2	"	≤2.5 mag.	visible
"	3	"	≤3.5 mag.	visible
"	4	"	≤4.5 mag.	visible
"	5	"	≤5.5 mag.	visible
"	6	"	>5.5 mag.	visible

Hence, if one were able to see a 4.4 mag. star within the tolerable distance, the transparency would be "4."

Concluding Remarks

The two sclaes presented within this paper are my attempt to revise the subjective and inadequate scales currently in use by amateur observers. I make no pretense that these revised scales answer all of the problems of massed estimations of conditions, but I do say that they take a step in the right direction. I invite others to take similar steps in order that final scales will be found; also, I invite persons to comment on these scales. Something must be done quickly lest we lose sight of the small foundation which we have at this point.

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(3) C. W. Tombaugh and B. A. Smith, "A Seeing Scale for Visual Observers," Sky and Tel., July, 1958, Vol. XVII, No. 9, p. 449.

Also see: W. H. Haas, "Some Remarks Upon the Tombaugh-Smith Seeing Scale", Str. A., Vol. 12, Nos. 10-12, pp. 144-145.

THE 1961 APPARITION OF JUPITER-- FIRST INTERIM REPORT

By: Clark R. Chapman

I. Introduction

This report will serve as the first article concerning Jupiter's appearance in the 1961 apparition. This paper is based primarily on a summary of my own observations which was first prepared in August, 1961, and was revised in September, 1961. The report was revised again in November, 1961, for publication here and summarizes not only my own work but also the work of some of the other members of the A.L.P.O. from the beginning of the apparition through October.

II. Changes from 1960--The General Appearance

The most obvious change from 1960 was the brightening of the NTrZ-NTeZ so that it was brighter than, and sometimes even more prominent than, the STrZ-SEB Z. As the middle of the 1961 apparition approached, the NTrZ-NTeZ became somewhat less prominent but nevertheless remained considerably more prominent than its dullish appearance of 1960.

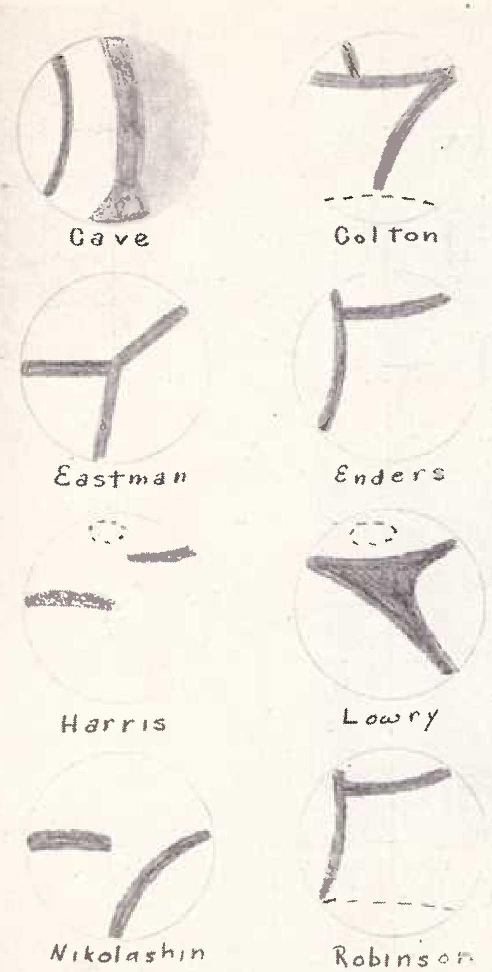

FIGURE 22. Eight drawings of Ganymede (Jupiter III) by different observers on August 26, 1961. Copied and contributed by L. J. Robinson. These drawings are the basis of the composite drawing on the front cover of this issue. Drawings made with two 10-inch reflectors at about 650X in seeing 7 (0 to 10 scale, with 10 best) between 6^h 30^m and 7^h 30^m, U.T.

Readers may wish to compare the composite to the individual drawings. It is, of course, well known that all markings on the satellites of Jupiter are extremely difficult for ordinary apertures. Group studies of this kind are very meritorous in helping to show what features on the small disc are objective. Since Ganymede has been found always to turn the same face toward Jupiter, the markings change with the changing position of the satellite in its orbit. These observations in Figure 22 were made with the satellite 6 days and 23 hours past superior geocentric conjunction. The angular diameter of Ganymede on August 26, 1961, was 1."6 (assuming a linear diameter of 3100 miles). The Dawes Limit of a 10-inch aperture is 0."46. One suspects that many of the markings on the drawings are shown smaller and narrower than diffraction theory permits.

<u>Fault West of Epigenes</u>. Mr. Manasek describes his lunar drawing (Figure 23) as follows: "West of Epigenes lies the crater Epigenes A, part of a pronounced fault which does not appear on the maps of Neison, Goodacre, or Wilkins. The southern part of the fault does not appear to be continuous with the crater, but rather separated from it by a somewhat gentle slope. There are indications of either a ridge or of a ravine with a raised edge situated close to the eastern base of the fault at α . Further observations are necessary to clear this point up. The northern extension of the fault (β) is continuous with the east wall of the crater. The crater itself has smooth walls with no indications of terracing. Two hills appear on the western side of the fault at β . The larger southern hill was damaged by the faulting, since a portion of its slope is found on the eastern side of the fault. The smaller northern hill appears intact."

<u>Capuanus</u>. A sketch by Jose Olivarez on July 4, 1960, with a 2.4-inch Unitron refractor, colongitude=31°.3, shows three domes on the floor, two in the south part and one in the north part. There is fair agreement with a more detailed drawing by Clark Chapman with a 10-inch reflector at 35°.6, Figure 36 on page 61 of the March-April, 1960, <u>Str. A.</u> Other possessors of small telescopes might find these Capuanus floor domes of interest.

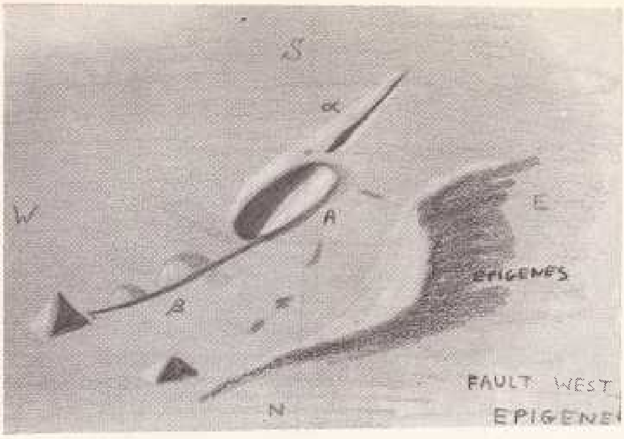

FIGURE 23. Fault west of lunar crater Epigenes. Drawn by F. J. Manasek on May 25, 1961, 2^h 30^m–2^h 45^m, U.T. 6-inch reflector, 300X. Seeing 6, transparency 3. Colongitude 32°.5.

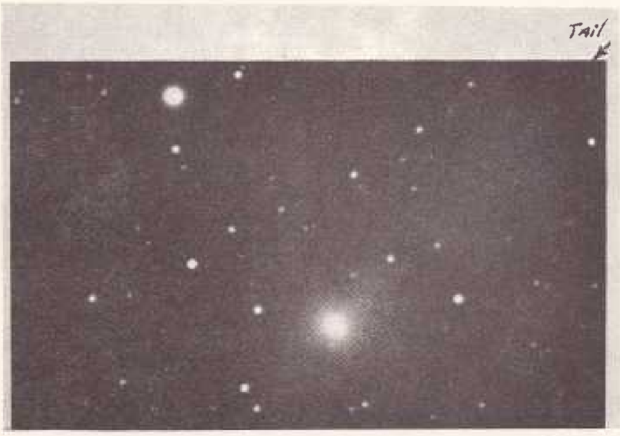

FIGURE 24. Photograph of Comet Seki, 1961 f, by Jack Borde, Concord, California, 2.8-inch F:8 refractor at prime focus, film 103a0, exposure 15 minutes. Photograph taken on November 5, 1961, at 12^h 5^m, U.T. Position right ascension 10^h 52^m 30^s, declination +6°02', epoch 1855.0. The parallel scratches on the film are blemishes.

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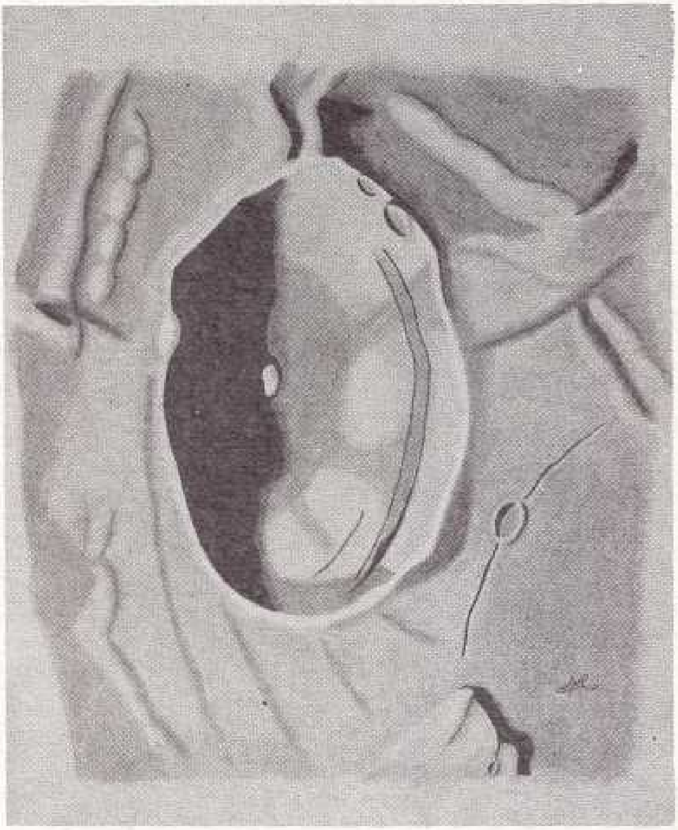

Drawing of the lunar crater Aristarchus and surroundings by Leif J. Robinson with a 10-inch reflector at [illegible]X on January 18, 1962 at [illegible] hrs., 45 mins., Universal Time. Seeing 2-4 (poor to bad), transparency [illegible] (rather poor). Colongitude =54.6°. The dark bands on the walls are discussed by Mr. Robinson in an article on pp. 31-35 of this issue.

THE STROLLING ASTRONOMER

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IN THIS ISSUE

IV. Conclusions

The transit of November 7, 1960, can be said to have been a fairly typical one with no particularly unusual features. Observationally, it was moderately well covered, although a greater striving for accuracy in contact times would have been desirable. Perhaps in future transits photography can play a more important part in determining times of contacts.

The predicted contact times in section II were obtained with the help of McGill University's I.B.M. 650 Computer. Without the use of a computer such computations would have been next to impossible. In this respect, the writer would like to thank Professor T. F. Morris for arranging for the use of computer time, D. Zackon for programming and running, Miss I. K. Williamson for preparing the data cards, and Mrs. Manley and the staff of the Computing Centre for assistance in debugging the program.

Finally, I would also express my thanks to all the members of the A.L.P.O. and others who submitted reports on the transit.

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CONSIDERATIONS ON THE COLOR VARIATIONS OF LUNAR FEATURES

By: G. A. Wegner

(Paper read at the Eighth A.L.P.O. Convention at Detroit, Michigan, on July 2, 1961.)

Abstract

By using spectral and colorimetric measurements the composition and variations in color of various lunar features are examined and are then compared with variations in color of materials which appear to exist on the moon by heating them in the same temperature range as is experienced there. It appears that most of the variations may be attributed to molecular changes caused by the variations of temperature on the lunar surface.

I. Composition of the Lunar Surface

For many years various astronomers, both amateur and professional and including the author, have attempted to determine the composition of the lunar surface by comparing the color reflectivity of the lunar features to that of terrestrial materials by using either photographs taken in the different wave-lengths of light or spectral observations of the total energy reflected from the materials in the different wave-lengths of light. During the years from 1958 to 1961 the author has been attempting to make a determination of the compositions of the different regions of the moon by comparing color filter photographs and spectra with the same type of observations made of terrestrial materials. The equipment used was a spectrograph of his own design and a set of narrow band transmission filters breaking the photographic spectrum into eight regions.

The results of these observations have indicated that the moon's surface consists basically of two types of materials in variations: that constituting the maria and that of the bright areas. Similar results have been obtained for the surfaces of Mercury, Mars, and several asteroids. The reflectivity curves of these areas have been matched quite well with basaltic materials for the maria and with granitic materials for the bright areas. These results agree well with those of several other investigators. This result would then mean that the surface of the moon is not greatly different in basic composition from that of the earth. The earth has its continents composed basically of granite, and the ocean basins are composed of basaltic materials. It must be mentioned, however, that these observations can give no results for the interior of the moon, and so no further comparison can be made.

The composition of the maria appears to vary in different areas as may be simply observed by noting the areas of different intensities in the various maria. This aspect could indicate that they were formed at different times or were the product of a fusion of several simultaneous flows.

Because several observers, by using photometric and polarimetric observations of the light reflected from the lunar areas at different phases, have attributed the lunar surface's composition to a porous material such as pumice, it would appear that the above mentioned materials because of the lesser gravitational effects on the moon would not have become as dense as their terrestrial counterparts and would hence be porous.

II. Color Variations

Variations of color and intensity as a function of solar illumination have been attested to by many observers of the moon through the years. When the author was making spectral observations of the lunar surface he found, when examining sets of spectrograms taken of the same areas made on consecutive nights, that some areas vary in the amount of light in the different wave-lengths that they reflect. A good example of this behavior is Mare Imbrium. Near sunrise the area is weakest in the green part of the spectrum. As the sun rises higher, the reflectivity in the green becomes greater until the green region is almost equal to the other regions of the spectrum in strength. This change can be detected without any optical aid by observing Mare Imbrium with the naked eye on consecutive nights.

Still other areas show variations. On the floor of the crater Eratosthenes are the well-known variable dark spots. Visual and photographic observations of the color changes there have shown that these areas do not vary in the green, but in the red. These color variations are not regular, being affected by rapid fluctuations in temperature which occur during a lunar eclipse. No definite changes were noted for the bright lunar areas, although many were studied.

III. Causes of the Color Variations

After the detection of such interesting variations in the different wave-lengths of light of lunar areas, steps were taken to determine their causes. The color variations in the maria were easily duplicated by merely heating powdered volcanic cinder and basalt to a temperature like that experienced on the moon. As the temperature was raised, the sample was observed visually with a spectroscope and a solar light source. A spectrum which was not affected was selected for comparison parallel to the spectrum of the sample, and the approximate wave-lengths of the variations were measured with a scale above the two spectra. As the material matched with the moon by the colorimetric methods was heated, it brightened in the green region of the spectrum, turning from brownish to dark greyish brown to the eye. When granite was compared, it was found that the reflectivity did not change noticeably in the different colors.

IV. Conclusion

It would appear that the variations in color observed on the lunar surface can be explained, at least for the maria, in terms of changes in molecular structure of the materials there produced by the rising and falling of temperature.

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VENUS IN 1959

By: James C. Bartlett, Jr.

In 1959 the following observers of Venus contributed a total of 362 observations, of which 59 were from the morning apparition:

Observer	Place	Instrument
Jim Berg	————————	4-in. refl.
Gilford C. Bisjak, Jr.	Chino Valley, Arizona	6-in. refl.
Tom Constanten	Las Vegas, Nevada	$3\frac{1}{4}$-in. refr.
Clark Chapman	Buffalo, New York	10-in. refl.
John Cooper	Edmonds, Washington	4-in. refl. (?)
C. M. Cyrus	Baltimore, Maryland	10-in. refl.
R. Doucet	Quebec, Canada	3- & 5-in. refrs.
K. J. Delano	Taunton, Massachusetts	8-in. refl.
Lewis Dewart	Sunbury, Pennsylvania	6-in. refl.
Stuart and Stanley Emig	Leavenworth, Washington	8-in. refl.
Jack Eastman	Manhattan Beach, California	2.4-in. refr.
Paul Hirschorn	Great Neck, New York	3.5-in. refl.
William K. Hartmann	New Kensington, Pennsylvania	8-in. refl., 6- & 13-in. refrs.
C. L. Johnson	Boulder, Colorado	4-in. refl.
Carlos M. Jensen	Salt Lake City, Utah	$3\frac{1}{4}$-in. refr.
Thomas A. Krohley	Huntington Station, New York	6-in. refl.
W. H. Leckie, Jr.	Kingsville, Texas	6-in. refl.
C. C. McClelland	Pittsburgh, Pennsylvania	13-in. refr.
David Meisel	Fairmont, West Virginia	8-in. refl.
Robert Provine	Tulsa, Oklahoma	8-in. refl.
Minick Rushton	Atlanta, Georgia	6-in. refl.
O. C. Ranck	Milton, Pennsylvania	4-in. refr.
Carlos E. Rost	Santurce, Puerto Rico	6-in. refl.
J. R. Smith	Eagle Pass, Texas	8-in. refl.
T. Sato	Hiroshima, Japan	6-in. refl.

No.	Name	Long.	Max.	Lat.	No. Measures	Remarks
45	Thoth p	249°3	6°4		9	"Laocoöntis" complex
	" p	249.39			1	trans.
46	" c	257.0	7.1	+25°0	8	
	" c	254.9	0.2		2	trans.
47	" f	264.3	6.4		8	
48	Tithonius Lacus p	79.0	4.5		2	
49	" " c	86.3	4.3		2	
50	" " f	93.0	4.5		2	
51	Trivium Charontis c	195.8	4.2	+20.0	18	
	" " c	195.22	0.8		5	trans.

The 1960-61 A.L.P.O. Map of Mars published here on pages 22 and 23 was prepared with the positions derived by Both and Chapman as a basis, although the positions shown on the map are not accurate enough to permit scaling-off of positions other than those published. The nomenclature is primarily that of the I.A.U. map, although a few additional names have been inserted from Antoniadi. A detailed description of the more interesting features and their seasonal variations will be published in the next Report.

CONTRIBUTIONS TO SELENOGRAPHY. PART I. ARISTARCHUS, 1957-1960.

By: L. J. Robinson, Biela Observatory

Throughout the years 1957 to 1960, inclusive, it has been my practice to observe long known as well as newly discovered BANDED CRATERS[1,2]. From the results of these observations it is my intention to publish an extended and unified work on the topic, this present paper being the first part of the total effort. In essence, the entire body of this paper circumscribes itself about the included map of the floor of Aristarchus, Figure 42, on which only the band detail is shown; for to include all detail would be to introduce confusion. The drawing by the writer on the front cover of this issue gives a complete view of Aristarchus under low morning lighting. The band detail shown on this map was procured, during the initial stages, through visual observation with a ten-inch, f/6 reflecting telescope. Later, the sixteen-inch, f/20 reflector of the Biela Observatory at Anaheim, California, was employed. Measurements of position were obtained, from photographs taken with the sixteen-inch telescope, for all major radial bands, all other features being referred to these fundamental areas.

Always the most prominent band on the floor of this crater is A (nomenclature on Figure 42). A shares the singular condition with J2 in that they are the only bands which pass over the rim of the crater into the surrounding area between Aristarchus and Herodotus. This writer must comment on the fact that but for a single drawing by Abineri and Lenham[3], this prominent aspect has apparently gone unrecorded. It is indicated by Wilkins[4] that he also observed this effect. Band A is also the only feature to show a light "rift" through its center. Of two other maps of Aristarchus known to me, one by Reese[5] and the other by Bestwick[6], this "rift" is mentioned by the former but not by the latter. One might infer, however, from Bestwick's drawing that he too is aware of the fact. The map of Abineri and Lenham gives no indication of the existence of this feature.

Following A in order of decreasing intensity is the stem of band B. In general the whole of band B may be considered the most enigmatic feature in Aristarchus. Of the three aforementioned maps, all show this marking in a different manner! Abineri and Lenham depict it as a single divergent band with a forked top, the top of the fork reaching the crest of the wall (see Figure 43c). It is interesting to note that they show the band extending beyond the crater wall, the extension also having a fork at its terminus--this extension is not supported by the other observers.

Reese shows the internal fork of B but does not allow it to reach the crest of the wall. He has shown the southern arm of the fork to knot into a ball while the northern arm extends along the upper cleft (see Figure 43a). Bestwick shows the same internal appearance as do Abineri and Lenham (see Figure 43b). My personal observations (see Figure 43d) indicate a qualified confirmation of the other observers.

Band $F^{1,2,3}$ should be mentioned inasmuch as both Reese and Bestwick show it as a single band; such was also my impression until the final observations of this series. Using the sixteen-inch telescope in near-perfect seeing, this band became unquestionably resolved into three component markings. The final major band deserving attention is that marked $J^{1,2}$ on Fig. 42. Reese shows the band as having a noticeable kink approximately 2/5 of the way up the wall. Again, as in the case of F, this was my impression when using the ten-inch telescope. Only after employing the sixteen-inch did the true nature become apparent. In actuality, this band separates into two components, the stronger of the two paralleling A while the lesser projects in a more southward direction.

A few statements are now in order concerning the smaller and fainter bands amid the major (lettered) ones. In general, it may be said that the number of such bands visible is a direct function of aperture. By considering the fact that Reese observed with a six-inch telescope, Abineri and Lenham as well as Bestwick with twelve-inch instruments, and myself with ten- and sixteen-inch telescopes, the following can be deduced:

Observer	Telescope Used	Minor Bands Seen (Approximate Number)
Reese	6"	5
Abineri and Lenham	12"	5
Bestwick	12"	10
Robinson	10"	10
"	16"	15

Summarizing the above, one may conclude that telescopes larger than sixteen inches will be necessary for the recording of appreciably more minor bands.

Special mention should be made of the two parallel minor bands lying along the clefts between A and B1. Since these two secondary bands are the most prominent of the lesser series, they are shown on both the maps of Bestwick and Reese. This writer finds it interesting to note that on several occasions the entire area between these two clefts appeared to be of uniform darkness, i.e., a single band. This aspect is only observed when the sun is quite low; and as soon as the crater becomes free of shadow, this single band resolves itself into the two usual components. As the double nature of this band can be considered "normal", it is so represented on the map.

Comment should also be made on the irregular patch near the north wall of the crater. For some reason this area was recorded by Reese but not by Bestwick; it appeared quite easy in the ten-inch telescope. Such a spot is very incongruous for Aristarchus where everything else is rectilinear. This marking is best seen under a low sun--a typical observation may be seen in Figure 55 of the Nov.-Dec., 1960, issue of this publication.[7]

Attention should be given to the fine and difficult markings lying within the dark ring on the crater floor. These very difficult bands were not recorded by any previous observer. Only once was the north-south band seen in the ten-inch telescope, though it was recorded many times with the sixteen-inch instrument as were the other minor markings. The ring surrounding the interior of Aristarchus is quite remarkable itself. Fundamentally it is of uniform intensity with the exceptions of the small spot at the base of A and the general lightening along the western wall. This ring also exhibits a pronounced degree of edge regularity. The only exceptions found by this observer are on the south edge, where there are one or two bumps.

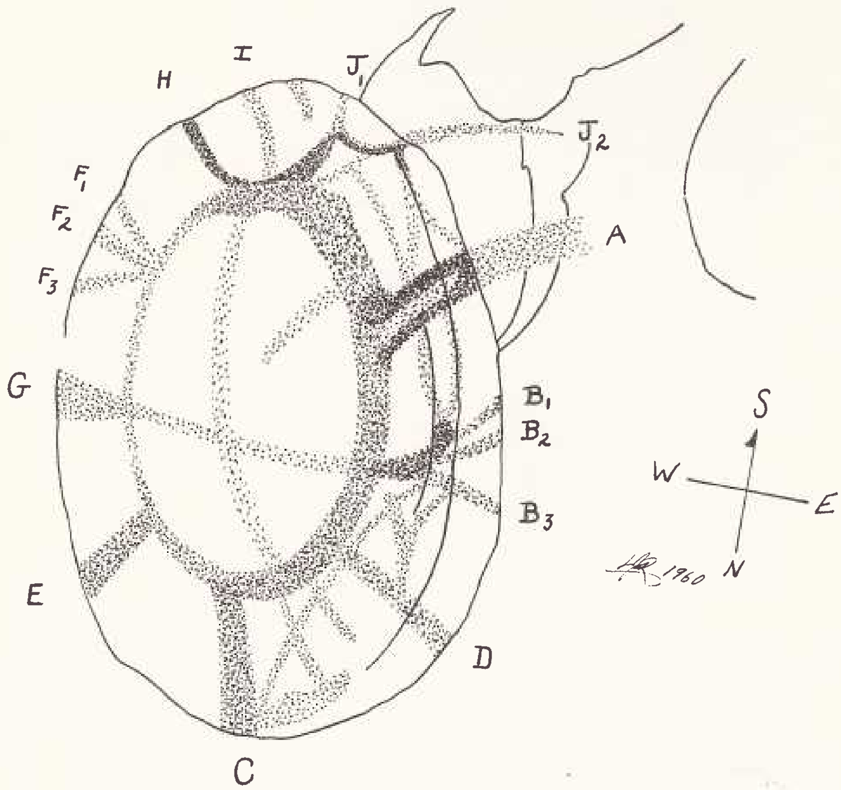

FIGURE 42. A general map of the dark bands of Aristarchus by L. J. Robinson. Interior detail other than the dark bands is omitted, except for the two parallel clefts on the eastern wall. Map based on approximately 25 drawings and photographs secured by Robinson in 1957-60 with 10-inch and 16-inch reflectors. See also text of article by Mr. Robinson in this issue.

The reader will also note that the width of the ring is much less in the west of Aristarchus than in the east. This decrease in width is shown on the Reese map but not on that of Bestwick. [An effect of foreshortening at the position of Aristarchus on the moon?--Editor.]

Heretofore, the observational aspects of the Aristarchus band system have been discussed. But what are the bands? How were they formed? Are they a necessary aspect in bright craters such as Aristarchus? Herewith only the first two questions will be considered, the third query being deferred to Part II of this paper.

From observations under nearly perfect conditions this writer has found that the bands of Aristarchus are not internally homogeneous, but are composed of untold numbers of filaments as well as light and dark nodules, see Figure 44. The only other reference known to the writer of this "breaking-up" of the bands is found in Wilkins'; it is there stated "...Wilkins, at Meudon, detected 'fine structure' in them [the bands], which appearance was confirmed by Moore."[8] This author assumes that the "fine structure" is of the same nature as he observed. It has been stated by other researchers

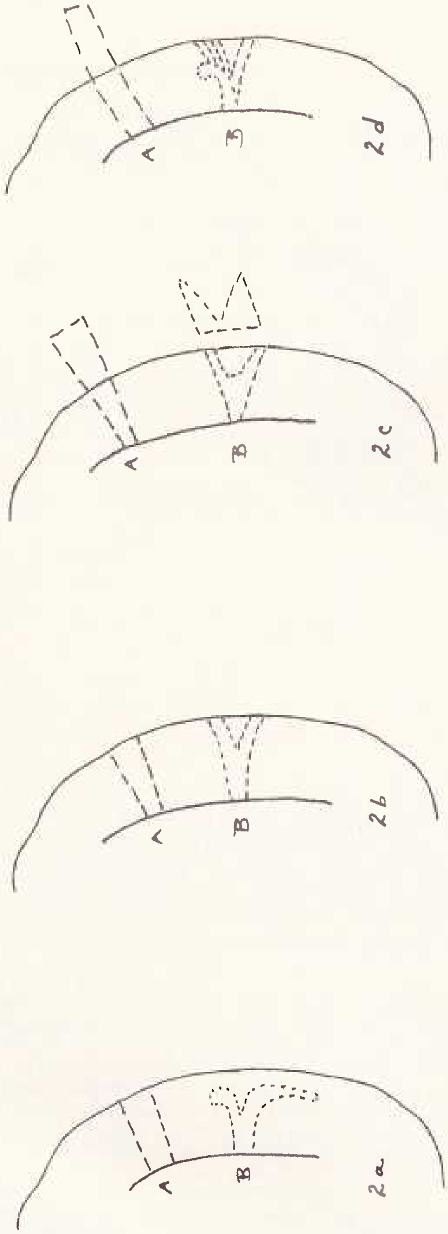

FIGURE 43. Four sketches of Aristarchus dark bands A and B (see Figure 42) by different observers. a, E. J. Reese; b, J. D. Bestwick; c, K. Abineri and A. Lenham; d, L. J. Robinson. See also text.

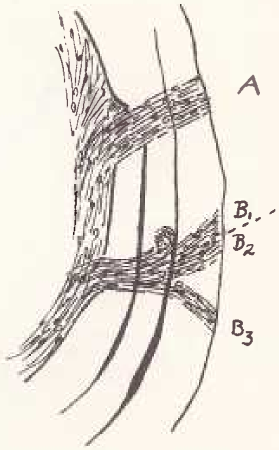

FIGURE 44. Somewhat stylized representation of the fine interior structure of the major bands of Aristarchus. Observation by L. J. Robinson on December 31, 1960, $6^h\ 40^m$, U.T., S=9, T=4, 10-inch f/6 refl. at 800X, colongitude=68°.0. See also text.

that the rays often associated with bright craters have filamentary structure associated with them; the bands have presented a more difficult observational problem. Since the filamentary structure was observed under a low sun, this writer feels that the filaments are shadow-filled clefts of extremely small size. This conclusion is further supported by the fact that under equal observing conditions, but with a higher sun, no such filamentary structure was noted. The reader should not infer from these remarks that the bands are a purely geometrical phenomenon; the work of Reese[9] on the intensity of the bands with changing solar illumination makes it clear that such is not the case. Assuming that the filaments are clefts, and recalling that they are arranged symmetrically with the axis of each band, it would seem most plausible to suppose that they are fracture patterns peculiar to bright craters. As yet, no satisfactory explanation to account for their changing intensity has been found; this problem is currently under investigation.

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OBSERVATION OF PLANETARY COLOR

By: Joseph P. Vitous

(Paper read at the Eighth A.L.P.O. Convention at Detroit, Michigan, on July 2, 1961.)

Prior to the development of color photography for the amateur, the writer devoted considerable time to photo color work, using oils or water colors as required. This work is quite interesting and, for some, more satisfying than actual color photography. It presents a challenge. The individual develops a color memory and the ability to reproduce observed colors quite accurately. Despite the fact that color reproduction is at present not feasible in The Strolling Astronomer, I have decided to sketch Jupiter in color and black and white as often as conditions permit. To a considerable degree the developed "color memory" becomes a valuable aid in this process.

Much valuable colorimetric work has been submitted to the A.L.P.O. in the past by numerous observers. Most individuals possess an inherent appreciation of color. Witness the fact that most of us have good color taste in dress, interior decoration, floral arrangements, etc. I believe that color drawings could be attempted by many to supplement color estimates.

Personally, I find it much easier actually to portray a given color than to try to describe it. It would be interesting to have a number of observers view a color sketch of Jupiter and then proceed to describe the colors independently. The results would be interesting if not amazing. The observer disinclined to making color sketches could instead supplement his estimates with a small "wash" of the color placed right next to his description. Ordinary water colors are convenient for this purpose.

Many booklets on color and its application are available at nominal prices at Art Supply stores. These can be most helpful to the colorist. The knowledge and application of basic colors lends an additional dimension to observing.

While it is difficult to determine one's personal color equation, resort may be had to a good ophthalmologist for testing the eyes and their response to color. This can be done when having the eyes examined for a new pair of glasses.

Some hints for color work:

(1) Planetary color sketching or colorimetric work is best done at or near culmination. Low altitude or poor seeing conditions may result in prismatic dispersion, giving rise to spurious color.

(2) Select a night of reasonably good seeing. A minimum of 4 to 5 on a scale of 0 to 10 (10 best) is advisable. Transparency should be 3 or better on a scale of 0 to 5 (5 best).

(3) The use of orthoscopic or similarly corrected eyepieces is a must for color work. With even the best of eyepieces it is preferred that the image be kept in the center of the field, where definition is of the best quality.

(4) Use moderate powers of 15 to 30 per inch of aperture, and continue to use the same eyepieces and powers throughout the program. A good quality barlow may be used.

(5) The proper collimation of the instrument is of utmost importance since failure in this respect results in color distortion.

(6) Watch for unusual sky conditions. Certain cirrus clouds sometimes produce a light blue image of Jupiter. Certain forms of haze and dust result in a reddish image of the planet. I have noted these conditions from time to time and plan to record a few in color.

(7) Inasmuch as planetary colors are usually vague (hence the value of moderate to larger apertures), they are often affected by atmospheric light scattering, especially if observing during daylight hours, at twilight, or in a moonlit sky. Close proximity of artificial light or the moon may have adverse effects.

(8) The use of colored light while observing may be satisfactory for the black and white sketch; however, the colored light to which the eye adjusts itself may result in inaccurate color estimates. As an example, we may take a prolonged look at a red light source; and on turning away we note a spurious image of that source in its complementary green.

(9) It is difficult, if not impossible, actually to sketch in color at the telescope. The writer has followed this method:

Two blank discs are used--one for the black and white sketch and the other as a "worksheet" on which to make notations as to colors observed. With a little practice the observer will become quite adept at color memory. At no time do you leave the color sketch to memory alone; but when referring to the notes taken, your memory impression aids materially when the color sketch is subsequently drawn. The second drawing in color must be done immediately indoors and under normal lighting conditions. The writer finds colored pencils most suitable for this work.

It has been found useful to refer to previous sketches in making the report to the Recorder, especially when noticeable changes in color have occurred.

The Jupiter forms as provided by the A.L.P.O. are very suitable for this dual drawing work. It will amaze you to note the different aspect a color image presents compared to the same view in black and white.

Postscript by Editor. Some drawings of Jupiter in color by Mr. Vitous were included in the 1961 A.L.P.O. Convention Exhibits. He makes his personal observations with an 8-inch, F:7 Cave reflector, collimated with very great care. In the discussion of Mr. Vitous' paper at Detroit, Dr. Ernst Both stressed the extremely subjective nature of qualitative descriptions of lunar and planetary colors and urged comparisons to standard color charts as a more scientific procedure. Mr. Vitous directs the attention of students of color to these publications:

<u>Color as Seen and Photographed</u>, by Eastman Kodak Company, Rochester, New York. Obtainable at camera shops.

<u>How to Mix Colors</u>, by Walter Foster. At Art Supply Stores.

<u>Science--How? Why? Wherefore?</u>, by Robinson and Polk. Priory Press, Dubuque, Iowa.

Although not entirely devoted to color, this book does discuss the nature of light and color.

MONTREAL CONVENTION NOTES

By: Walter H. Haas

The Tenth Convention of the Association of Lunar and Planetary Observers will be held at Montreal, Quebec, Canada, over the Labor Day weekend, August 31-September 3, 1962. We shall be the guests of the Montreal Centre. It will be our first Convention in Canada and indeed our first outside of the United States. Lest four days of conventioning may seem too heavy a diet, we should add that present plans are for nothing more than a social hour or a visit to the Centre's Observatory on the evening of August 31 and that we expect to close the meeting by noon on September 3 (Labor Day Monday) in order to help those who will have a long return trip.

The Laurentien Hotel has reserved a block of rooms for our use. This hotel is clean and modern and is located in mid-town. It is not far from the intended meeting sites and is also accessible to the Montreal Centre Observatory. It is only a step from the two railway stations. We hence urge attending A.L.P.O. members, along with their families and friends, to plan to stay at the Laurentien Hotel. It will, of course, help the hotel, the Montreal Centre, and the A.L.P.O. to make your reservation at the Laurentien as early as you can.

Our Montreal colleagues have appointed a Convention Committee of four. The Chairman is Mr. W. A. Warren, 30 52nd Ave., Lachine, Quebec, Canada. General inquiries may be addressed to him. The other Committee members are Geoffrey Gaherty, Jr., W. J. Cullinan, and George Wedge. Such matters as sightseeing tours, Convention group photograph, possible Convention banquet, and possible professional astronomer speakers are being discussed. Of course, the Editor will be glad for ideas from A.L.P.O. members to help guide his thinking.

American citizens going into Canada should carry some kind of proof of residence in the United States such as birth certificates or naturalization papers. Money exchange is no problem, and American currency is very common in Montreal during the summer. It may be well to have proof that such items as cameras, binoculars, and telescopes were in the visitor's possession before he entered Canada.

A number of A.L.P.O. members have already indicated that they expect to attend this meeting. Among them are David Meisel, John Westfall, Phil Glaser, Clark Chapman, Bill Shawcross, Joseph Ashbrook, and Joel Goodman. Patrick Moore has already submitted a paper for the formal program, one treating a novel facet of the igneous-vs.-meteoritic controversy about the origin of the lunar craters.

Further news items will be carried in future issues as plans develop. The Editor wishes that he could extend to everyone in the A.L.P.O. a special, individual, invitation to be at Montreal. This meeting has every chance of being the best A.L.P.O. Convention yet. With your help and participation it certainly will be.

ANNOUNCEMENTS

Pan American College Courses in the Astro-Sciences. A.L.P.O. members or their friends entering college soon and others who know such students might like to consider the courses in the astro-sciences offered at Pan American College. These are listed below. The "hours" are semester-hours of college credit. The courses are lectures unless a laboratory is mentioned. It is possible to take either a major (30 semester hours) or a minor (21 semester hours) in the astro-sciences.

Introduction to Astronautics. 3 hours.
Introduction to Astronomy. 3 hours.
General Astronomy. 8 hours. Two sequential courses, 6 hours lecture, 2 hours laboratory.
General Astronautics and Space Technology. 4 hours (3 lecture, 1 lab.).
History of Astronomy and Astronautics. 3 hours.
Lunar and Planetary Astronomy. 3 hours.
Stellar and Galactic Astronomy. 3 hours.
Astrophysics. 3 hours.
Astro-Science Seminar. 3 hours.

Distinctive features of this program are the large content of astronomy on the undergraduate level, direct contact by students with astronomical instruments and their accessories (including a 17-inch Newtonian-Cassegrainian reflector) at this phase, and a presentation of the whole complex of astro-sciences. A Pan American College graduate of this program can go on to graduate work in astronomy and astrophysics or to employment in government or industry in one of the many current space science research programs. The continuing development of the High Altitude Observatory in Northern Mexico, mentioned in past articles in The Strolling Astronomer, has great training value for the college student. The geographical location of Pan American College at latitude 26°18'N. offers unusual advantages in lunar and planetary observations and in other ways.

We shall gladly send the Pan American College Catalog, giving much additional information, to persons indicating serious interest. By the time that this issue reaches our readers, we also expect to have available a descriptive, illustrated brochure upon the Pan American College Observatory and Astro-Science Center.

In Memoriam. We have learned with sorrow of the death of Mr. Morris Solomon of Los Angeles, California. He had been an A.L.P.O. member for three years. We extend our sympathy to his widow and other survivors.

Dr. Albert W. Recht, for 33 years the Director of the Chamberlin Observatory at Denver, died in January, 1962. Those who attended the Nationwide Amateur Astronomers Convention at Denver in 1959 will remember Dr. Recht's hospitality. He gave much help to the Denver Astronomical Society and held very well-attended open houses with the Chamberlin Observatory's 20-inch refractor. Few other professional astronomers have served the causes of amateur astronomy and of popular education in astronomy so well.

Clark Chapman Honored. It has been very gratifying to learn that Mr. Clark Chapman was named to the Honors Group in January, 1962, in the Twenty-First Annual Science Talent Search for the Westinghouse Science Scholarships and Awards. His subject was "Observations of Mars and Jupiter in 1960-1961." We extend our congratulations and best wishes for future college success to our young member, who is certainly becoming extremely well known to the readers of this periodical. His outstanding observational work was recognized with an A.L.P.O. Award at the Detroit Convention in 1961.

Reorganization of A.L.P.O. Lunar Section. For some time our Lunar Section has not been functioning as it should. Dr. James Gant has found it necessary to give up his Lunar Recordership because of the severe press of personal matters and professional duties. We are most grateful for the help which Dr. Gant has given us and know that he wanted it to be many times more. The Editor further feels that he should not himself continue as a Lunar Recorder because he cannot with his other obligations give to this post the time and attention which it requires.

It may well take some time to find a whole new set of Lunar Recorders. One has been chosen so far to take charge of Special Lunar Projects, involving comparatively advanced work for our more experienced and better equipped members. He is Mr. Leif J. Robinson, 1411 Amapola Avenue, Torrance, Calif. Mr. Robinson addresses the following message, necessarily edited and shortened to conserve space, to interested lunar observers:

"Several weeks ago, Prof. Haas invited me to accept a Lunar Recordership for the express purpose of organizing and directing specialized lunar studies, these studies being either consummate with professional needs or sufficient unto themselves. Firstly, therefore, it will be the objective of this Section to study isolated selenological or selenographical problems. These studies will usually be of short duration, their course being measured in months. While all programs will necessarily be supported on mathematical and theoretical foundations, the observations themselves will, in most cases, be the ultimate of simplicity. No special equipment will be required, nor will the observers be asked to reduce their own observations. Secondly, this Section will endeavor to partake in programs of international cooperation. Recent correspondence indicates that this desire is strongly supported on both sides of the Atlantic.

"With these two objectives in mind, we may list four fields which should, at one time or another, find their way into the basic program.

(1) Cartography of the lunar surface--emphasis being placed on observations of mare areas with large telescopes.
(2) Distribution of specific types of features--domes, faults, clefts, craters, etc.
(3) Determination of the parameters of specific objects--depth, diameter, slope, length, etc.
(4) Cartography of libratory regions--the mapping of those areas of the moon not always visible from the earth.

"Those readers who are familiar with current areas of lunar investigation will recognize that some of the above fields are fundamental in importance, while others tend to be more theoretical; all, nevertheless, are of unquestioned value. If you believe this type of research to be your cup-of-tea, I ask for the following information.

(1) Name.
(2) Address.
(3) Telescopic equipment.
(4) Are you able to take photographs?
(5) Hours per week usually available for observing.
(6) Are you able to make morning observations?
(7) Artistic ability.
(8) Lunar books, etc., available to you.
(9) How long an observing amateur?
(10) Math background.
(11) Would you be willing and able to calculate?

"Please forward this information to this Recorder at the first opportunity. The initial program will be announced as soon as the observer interest and instrumental capabilities are assessed."

Two Reminders. We would once more urge A.L.P.O. members to use the A.L.P.O. Library more intensively. The Librarian, Mr. Funck, can supply a list of available books. The borrowing of books appears to be largely limited to our younger members. While their interest is gratifying, we also think that we have books in the Library that can be of interest and value to our whole membership.

There is a complete file of all back issues of The Strolling Astronomer in two libraries: the Library of Congress in Washington, D.C., and the Library of New Mexico State University at University Park, New Mexico. Most back issues are out of stock here at headquarters, especially prior to 1958.

Addition to Staff: Book Review Editor. The Editor has found it singularly difficult to get books reviewed in this periodical--expressed good intentions by various colleagues repeatedly fail to materialize in actual reviews. We have been fortunate in just securing as a Book Review Editor:

J. Russell Smith
The Skyview Observatory
1465 Del Rio Blvd.
Eagle Pass, Texas

Mr. Smith will already be known to many A.L.P.O. members. He is one of our most experienced observers and was already drawing Mars in 1937. He employs 8-inch and 16-inch reflectors, the latter primarily in astro-photography. He teaches science in the eighth grade at Eagle Pass and has written a small and very helpful book, Teaching a Unit in Astronomy, addressed to teachers of astronomy in grades 1 through 8.

A New A.L.P.O. Transparency Scale. In the future A.L.P.O. members are requested to make all estimates of transparency according to this definition: The transparency is the stellar magnitude of the faintest star visible to a normal eye in the object's position in the sky, corrected when necessary for moonlight, twilight, or daylight. This definition is a generalization of the scale proposed by L. J. Robinson on pp. 211-212 of our Nov.-Dec., 1961, issue. The end-points of the adopted scale are, however, flexible; one might make a useful lunar observation with Venus barely visible to the eye, transparency=-3, and one might want to use transparency=7 when stars of the seventh magnitude could be seen on an extremely exceptional night or in future observations outside the earth's atmosphere. It would normally be sufficient to estimate transparency to the nearest whole number, or at best to the nearest one-half. The definition allows more refined estimates when they are justified.

The definition of transparency may appear wordy. We want a normal eye, or 20/20 vision, because the transparency must be independent of the individual's visual acuity. We are concerned with the transparency only where we are observing; if all the rest of the sky is cloudy, that does not affect our estimate. The corrections for moonlight, twilight, and daylight will admittedly be hard to apply exactly. However, such corrections do appear necessary. The transparency is not poor because there is a full moon in the sky or because the sun will soon rise.

Estimates of transparency on this new scale may be written with a subscript r for revised, e.g., $T_r = 3$.

Revising our seeing scale is a much more difficult problem. A.L.P.O. members who wish to use Mr. Robinson's proposed new seeing scale (pp. 209-210 of the Nov.-Dec., 1961, Str. A.) may do so if they will explicitly say that they are using the Robinson Scale. Their experience with it may well help guide our future thinking.

OBSERVATIONS AND COMMENTS

Concerning the Lunar Maria. On January 23, 1962, Gary Wegner wrote in part as follows:

"Recently there have been some papers published by a British group concerning the lunar maria as being the result of dust, caused by the actions of micrometeorites and short wave solar radiations, which flowed from the higher regions into the lower basins. This was first proposed by T. Gold in 1955. One of the proofs they give for this assumption is that the faces of faults which would expose the interiors of the maria are brighter, thus indicating that the surface is a layer of dust and their interiors are composed of the same rock which makes the highlands. In a paper that I am writing concerning the interiors of the maria as observed by like means, I have observations which would dispute this.

"With color filters, the marial materials can be differentiated in deep red light. A Wratten #70 filter is especially suitable. With the filter, the faces of these faults grow darker when at low illumination and at high illumination are extremely difficult to distinguish from the surrounding maria. The bright regions are made to appear much brighter. Because they act differently than the bright regions, it appears to me that the maria are not of the same composition as the bright regions, even under the layer of surface dust."

Curious Color in Eratosthenes. James Bartlett has reported a faint blue coloring at the base of the inner east wall (but on the wall) of Eratosthenes on October 18, 1961, $1^h 5^m$ to $1^h 25^m$, U.T., colongitude=14°7. The transparency was very good; the seeing, very poor. The appearance was that of a fluorescence, becoming more violet and more widespread by $1^h 25^m$. The strange blue was remarked with a 5-inch reflector at 110X and 180X, with a 4½-inch reflector at 120X and 240X, and with a 3.5-inch reflector at 100X.

Years of experience would lead us to predict with great confidence that no one else was observing Eratosthenes at this same time!

Crater Moore. Harry Jamieson, 1222 19th Street, Rock Island, Ill., is anxious to learn whether others have been able to detect a wall band he has suspected in the southeast part of the floor of Moore. It is the topmost of the three dark bands shown in Figure 45, where other details of the observation are given. Readers are invited to examine Moore and to write Mr. Jamieson their findings.

Linné. The following note from Elmer Reese and the drawings here published as Figures 46 and 47 accompanied his Christmas card. Figure 46 is a model of careful execution of lunar charting, and the scale of miles adds much to its value. Mr. Reese says:

"On December 14, 1961, I saw Linné for the first time in the aspect depicted by Avigliano (Str. A., Vol. 7, P. 167, Fig. I) and by Goodacre in 1900. Goodacre correctly described Linné as a crater cone close to the east rim of a shallow ring. Dr. Wilkins apparently misinterpreted Goodacre's drawing, not realizing that the 'shallow ring' was not a part of Linné but instead was a large ruined ring twenty miles or so in diamter! (Compare Figure 47 with my drawing, Figure 46, using X and Y as references.)

"On December 14, 1961, Linné appeared as a conical peak, perhaps blunted on top, casting a shadow about 5 miles long. The brilliant sunlit face of this peak was extremely sharp and well-defined and was by far the brightest object included in the drawing."

Urgent: Early 1962 Jupiter Observations. Our Jupiter Recorders, Phil Glaser and Elmer Reese, are very anxious that the Giant Planet should be effectively observed in the morning sky as soon as possible. Since Jovian events are still unpredictable, almost any observations of the sort described in the A.L.P.O. Jupiter Handbook are worth-while. However, the four kinds of study listed below are especially needed on the basis of our 1961 records. They will be discussed much more by Mr. Glaser in an article in the March-April, 1962, Str. A.

1. The appearance of the south part of the E.Z. and of a conspicuous belt there in 1961, which may or may not be the $S.E.B._n$. If the belt is the $S.E.B._n$, it is amazingly far north. Future events if properly observed may well clarify what is now a confused picture. Central meridian transits of recognizable marks in the conjectured $S.E.B._n$, and especially on its south edge, may also help identification.

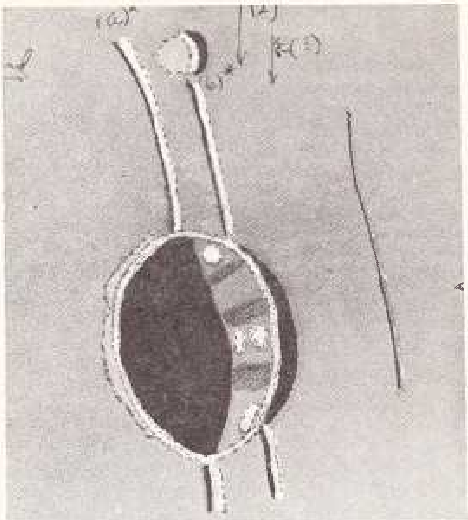

FIGURE 45. Moore. Harry Jamieson. April 26, 1961. $4^h\ 27^m$ - $4^h\ 46^m$, U.T. 10-in. refl. 222X, 333X with Barlow. S=6-7. T=5. **Colongitude=39°.4. See also text.**

FIGURE 47. Linné and Vicinity. Corder and Goodacre in 1900, J.B.A.A. Vol. 64, p. 87. Compare to Figure 46 and text.

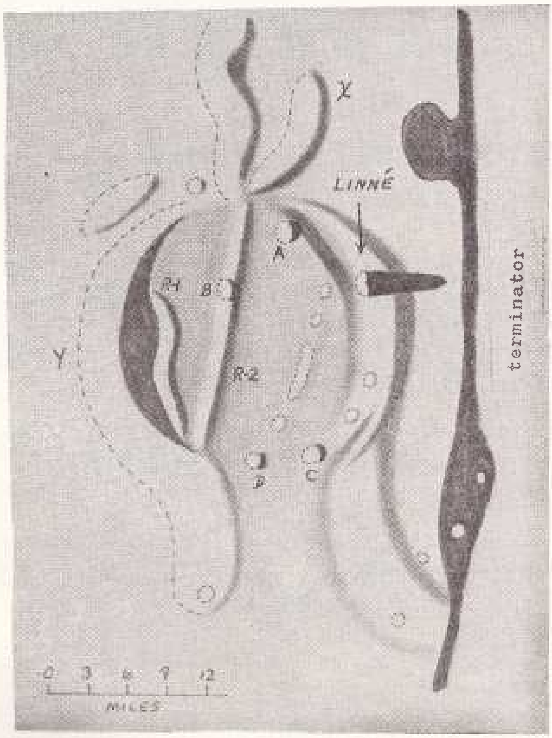

FIGURE 46. Linné and Vicinity. Elmer J. Reese. Dec. 14, 1961. $0^h\ 20^m$, U.T. 8-in. refl. 250X. S=7. T=4. Colongitude=347°.9. Compare to Figure 47 and text.

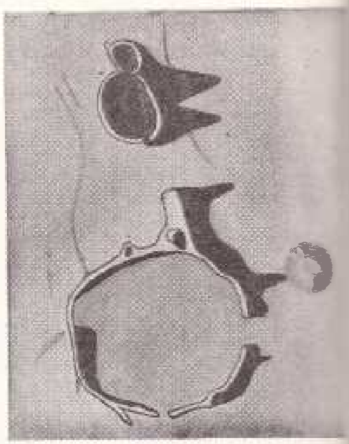

FIGURE 48. Kies and Vicinity. Including Dome. Carlos E. Rost. 6-in. refl. 285X. Oct. 19, 1961. $0^h\ 53^m$, U.T. S=5-6. T=3. Colongitude=26°.7. Compare to Plates D-6 and E-6 in Kuiper's Photographic Lunar Atlas and to Figure 1 on p. 1 of the Jan.-Feb., 1961, Str. A.

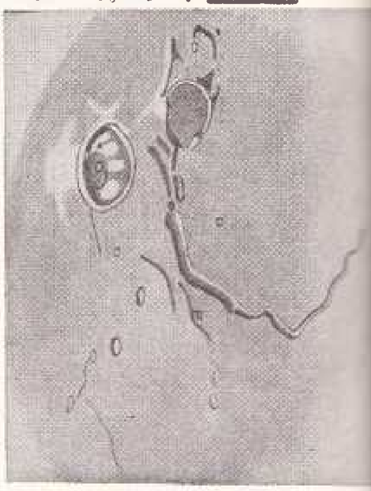

FIGURE 49. Aristarchus, Herodotus, and Schroeter's Valley. Carlos E. Rost. 6-in. refl. 285X. Oct. 22, 1961. $1^h\ 19^m$, U.T. S=7-8. T=3-4. Colongitude=63°.4.

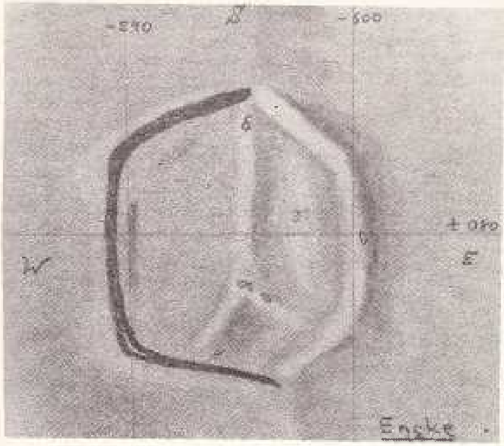

FIGURE 50. Encke. F. J. Manasek. 6-in. refl. 300X. May 26, 1961. $1^h\ 10^m - 1^h\ 15^m$, U.T. S=5. T=2-3. Colongitude=43°.9.

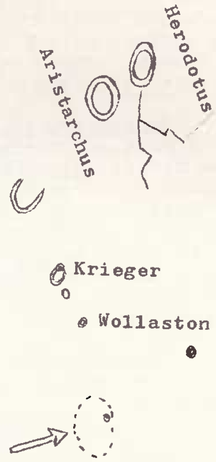

FIGURE 51. Depression near Aristarchus (note arrow) photographed at Kwasan Observatory, Kyoto, Japan. See text.

2. Central meridian transits of features in the E.Z. and along the south edge of the N.E.B. Mr. Reese is studying some intriguing evidence for a survival of features in these latitudes from one apparition to the next in recent years. Effective coverage of Jupiter as soon as possible after the conjunction with the sun on February 8, 1962, is critical to this important problem.

3. The Red Spot--Red Spot Hollow region--color, aspect, intensity, and longitude.

4. Detailed observations of apparent interactions between the Red Spot region and the three long-enduring South Temperate Zone ovals, with which it has conjunctions in longitude.

Kies and Vicinity. Attention is directed to the drawing by Mr. Carlos E. Rost here published as Figure 48 on p. 42.

Aristarchus, Herodotus, and Schroeter's Valley. Another drawing by Mr. Rost, Figure 49 on p. 42, will be of interest to observers of this popular lunar region. Mr. Rost's general style of drawing, as here illustrated, is very good.

Encke. Mr. F. J. Manasek discusses his drawing of this lunar crater, Figure 50, as follows: "The ring plain Encke, for which Neison gives a diameter of 20.33 miles (Goodacre and Wilkins both quote a value of 20 miles), lies about 50 miles to the south and 15 miles west of Kepler, in the Oceanus Procellarum.

"Although Neison and Goodacre mention the ridge in Encke, neither they nor Wilkins describe the bifurcated nature of its northern part. Neison mentions a peak (α on the drawing) '...united to the south wall by a ridge almost as high extending across 4/5 of the floor, leaving only a narrow gap between the peak...and the north wall...' Goodacre's map doesn't indicate the ridge, but shows 3 small peaks situated on a north-south line. His map also contains two curved marks which could possibly have been meant to indicate the bifurcation; however, the precise nature of the structure they are supposed to represent is unclear. Wilkins may have misinterpreted these marks, for he shows a craterlet (in the same region on the drawing) which doesn't exist. The peak α itself is not very pronounced and frequently appears as merely a brighter, somewhat larger, part of the ridge. This appearance is especially enhanced under the light of a waxing moon. Under eastern (morning) illumination the peak stands out better, and the ridge is seen to have two other high points, one at δ and the other at β . The high point at δ lies about 2 miles north of the apex of the southern walls. East of the straight portion of the ridge there appears a trough, with the gradually rising eastern part γ leading up to a flat plateau which is parallel to the eastern wall. There are some indications that this plateau extends around the entire periphery of the floor."

Depression Near Aristarchus. On January 10, 1962, Mr. Takeshi Sato wrote in part as follows: "On the Kwasan photographs I have found a large shallow depression near Aristarchus on the moon. (See Figure 51.) It is best shown on Plate 71 of the Photographic Atlas of the Moon, Contributions of the Institute of Astrophysics and Kwasan Observatory, University of Kyoto, No. 95, by Dr. S. Miyamoto and Mr. M. Matsui, though also shown on some other plates in their Atlas. This depression is a little larger than Aristarchus and has a craterlet near its east edge. Though there appears to be some connection with the nearby ridges, the shape of the depression suggests that it is a large 'saucer.'

"On the great Wilkins map in The Moon, by Wilkins and Moore, this depression apparently is not shown; or if it is shown, it is shown very inaccurately."

NEXT ISSUE--FIFTEENTH ANNIVERSARY ISSUE.

Fifteenth Anniversary Issue

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ALPO

IN THIS ISSUE

THE MOON AS A LABORATORY FOR BASIC SCIENTIFIC RESEARCH

By: Dinsmore Alter

A few months ago the President of the United States proposed an expansion of our experimental program which leads toward the landing of men on the moon and their safe return. Unofficial sources speak generally of this voyage as being undertaken by a party of three men (perhaps of three women to conserve mass of the payload). The reason, most commonly stated in our newspapers, for the acceleration of our program, is the propaganda value to be secured, either through winning over the Russians in the race to space or, at the very least, of not being outdistanced by them. The cost of the project, especially under the augmented time scale, is tremendous and the question of value versus cost has been discussed often. A reasonable conclusion would appear to be that even if the competition in national propaganda were the whole of the story, it truly would be worth spending much to win. However, the extreme sums which are necessary are greater than could be the value to be received from propaganda effects alone.

A second possible value, which has been much discussed, concerns the military value of a lunar base. Artificial satellites which can photograph the surface of the earth in great detail certainly do possess much value as gatherers of data which can be processed for military intelligence. Indeed, we can make a fairly safe guess that no large nation will dare to neglect the use of them. Such satellites, if manned, will be either close enough to the earth that the radiation of the inner van Allen belt will not be too severe; or else they will be far enough away to escape serious difficulty from the outer van Allen belt. Satellites which revolve in the inner orbits may be thought of as developments from our present weather satellites. They may be, say, 600 miles above the surface of the earth with sufficient booster-rocket power to compensate for the tiny friction between them and the upper atmosphere. Such satellites would be vulnerable to enemy attack. At these short distances from the surface, especially through use of the maser, they could be used in guidance of rockets which were fired from one part of the earth to land at any other part. This would be true whether the payloads were atomic warheads or were commercial products to be delivered with "Buck Rogers" speed to customers far away from their source. These satellites would have much military usefulness.

The idea of using them to "drop" bombs on the earth is one to be considered seriously only by persons who have not passed a beginning college course in physics.

If we should place such "spaceships" in orbits outside the main part of the outer van Allen belt, their distances from the surface of the earth would be, say, forty times those of the inner satellites we have been considering. If the same cameras were to be used, the scale of the pictures they would make of the terrestrial surface would be lessened by that same ratio. A single second of arc would span about 500 feet. The desired fine, surface detail would be difficult to secure. A lens with a four and a half inch diameter would have a "circle of confusion" equal to this distance. It would require a very large lens, or mirror, to reduce this confusion area to fifty feet, even if we should neglect the effects of the troublesome terrestrial atmosphere. Inner satellites would possess a far greater advantage from this point of view. The outer satellites would also suffer a serious, though not necessarily fatal, disadvantage in their use for guidance of terrestrial rockets. It would require nearly a quarter of a second for radio signals to travel from the earth to them and back. Balanced against this handicap is the fact that nearly half the surface of the earth would be visible at one time. One hundred and seventy degrees of longitude and of latitude would be turned toward the satellite. Some of the visible area would be too much distorted by foreshortening to assist in rocket guidance, but the useable area probably would extend for a third of the way around the earth. The development of such vessels is a legitimate and important military objective.

The moon is about ten times as far away as the outer band of satellites would be. The scale of pictures secured from its surface, therefore, would be only a tenth that from the same cameras used at one of the outer satellites. Our best pictures of the lunar surface, as observed from the earth, barely reveal the existence of an object a quarter of a mile in diameter unless the albedo difference between it and the surrounding area is unusually large. The builders of military bases minimize that difference, and therefore such targets must be much larger for visual observation. Sensors which depend on heat radiation, etc., do not suffer from this linear limitation. They depend on the intensity of the signal, not on the area from which received. However, the intensity decreases by the same inverse square law as does the area. The signal caused by a rocket launching, as received at the moon, would have only a hundredth the strength it would have if monitored by a satellite which was ten times closer to the earth. A satellite inside the van Allen belts would receive it with roughly 160,000 times its intensity at the lunar distance.

The moon would be quite unsatisfactory for either destruction or guidance of a terrestrial rocket during the early part of its trajectory because of the more than two and a half second round trip time lag. It could be used for the later part of the path but less satisfactorily than a closer satellite. It would appear that the moon itself can have practically no advantage militarily, unless we permit our minds to join the armadas, fighting in space, which have entranced most of us as we have read their sagas late at night. However, the developments of the lunar program probably will push the success of a valid military program more rapidly than it would progress if the latter were our only aim. In accomplishing this, the lunar program would justify large national appropriations even though it had no public advantages of its own.

The third reason for undertaking the lunar program is the old, often quoted one that "the moon is there." This is the reason which has led explorers to the terrestrial poles, to the summits of the highest mountains, to small islands of the oceans, and to underwater explorations. It has given romantic sounding achievements which have thrilled all of the literate population of the world. It has stirred people to desire to accomplish more than the mere humdrum work of earning a living. We have grown because of its emotional urge. It is much more important even than this, because it is the chief factor which drives man to the basic research which improves our picture of the universe and which, less importantly, has resulted indirectly in all the gadgets which can give pleasure and security to modern man.

None of these reasons, although each is a valid one, comes to grips with the problem which causes the exploration and use of the moon to be, perhaps, the most important single task which the race ever has undertaken. The indirect results which have accrued from basic research are the subjects of nearly all the advertisements produced by "Madison Avenue". Unfortunately such gadgetry comprises almost the whole of life for many men. The applied results are, however, one valuable factor for all the rest of us. Indirect results from basic research have provided us with those technologies of medicine, of engineering, and of geodetics which have given the race its opportunity to accomplish many worth-while things. They have provided a salutary circle with basic research, which partnership is increasing the pace of our accomplishments at an explosive rate. There will be unbelievable advantages in opportunities for basic research resulting to all the physical sciences, and probably to the biological branches as well, from proper use of the moon. The main thesis of this paper is a very sketchy abstract of what can result to the race from use of the moon solely as a laboratory for basic, scientific research. This includes, of course, all of the technological activities which are necessary to support both the research itself and the people who perform it. In this is found the most cogent reason for pushing the endeavor in every way that it can be done.

There is not sufficient space here to discuss the conditions which man will find on the lunar surface. Their story has been told in many places. It is sufficient to state that the maximum technological ingenuity of the race will be taxed by the mere endeavor to keep alive on the moon and in such a condition that work can be carried out efficiently. We know most of the environmental handicaps and already can plan to overcome them. The handicap which is least known is that caused by the rather recently discovered high speed particles from the sun. If we were to consider the quality and density of the lunar atmosphere from our knowledge of the laws of gases, without introduction of complicating factors, we would estimate the density to be, perhaps, a ten thousandth of our own at sea level. We have measured it by use of radar and find that it is only a ten trillionth as dense, which is a much higher vacuum than man can produce in his laboratories. It appears to be certain that the discrepancy has been caused by the high speed solar particles which have stripped almost all gases from the lunar surface. Certainly the particles will trouble us. However, we can, legitimately, expect man to surmount the difficulties which they impose. This little discussion of the use of the moon is based on the assumption that he succeeds.

The geologist will have a world to study, on which there has been neither wind nor rain to produce erosion. It is one on which the effects of cosmic rays and solar particles will be more clearly visible than at the bottom of our "ocean of air." The physicist will need no walls for his particle accelerators. He will have a much better vacuum in which to work than he can have here. His synchrocyclotrons and linear accelerators can be built to tremendous size and without some of the complications which bother him on the earth. It may be possible that by using them he will begin to glimpse the detailed structure of even the subatomic particles. Perhaps also he may get a tiny glimpse at the ontological problems.

We can think of a lot of things which the biologist may desire to do. Nevertheless, it is better that we give him a description of the conditions which he will find on the moon's surface and let him tell us what he plans to accomplish.

It is, however, the astronomer whom we, logically, can expect to be the chief gainer. The advantages which the moon offers to him are of two families: technical circumstances and superior quality of data secured. There are numerous items in each category, and they will be listed in semi-tabular order.

A partial list of the technical comparisons:

(a) On the earth a large mirror, or a lens, sags because of its weight. This distorts the images. We have been able to prevent serious sagging of mirrors up to and including the 200" at Palomar Mountain. However, for our largest telescopes success has come only through use of complicated lever systems in the cells. On the moon, with a weight only a sixth the terrestrial one, such mirrors will not require elaborate protection against sagging.

(b) The weight potential here forces the use of a much greater mass in the mounting to secure the necessary rigidity than will be necessary at the lunar observatory. Much more complicated bearings must be used on the earth than on the moon.

(c) Expensive domes are necessary to protect terrestrial telescopes from wind and rain. On the moon a light screen probably will be necessary to protect against direct solar radiation and, perhaps, against micrometeorites when the telescope is not in use, but that is all.

(d) There will be less corrosive action on the aluminized surfaces of our mirrors than there is here. The damage from micrometeoritic etching should not be too difficult to reduce to less seriousness than that of atmospheric corrosion at our earthly observatories. A thin metallic tube can be extended out toward the principal focus to stop all such particles, except those from a small angular area of the sky.

(e) Motors necessary to move the telescope will be smaller.

(f) There will be no vibration from wind.

(g) The astronomer will know in advance exactly the conditions under which he will work at any future time. He can plan his schedule as far ahead as he may desire.

(h) There will be no troublesome illumination of the sky by the lights of some large city a hundred miles away. The natural luminescence of the sky will be many times less than it is here. Our air is slightly luminescent. Also it reflects moonlight sufficiently to bar certain types of observations when the moon is above the horizon.

(i) A large telescope can be used as efficiently as a small one. Our air distorts images from large telescopes so badly that often the mirror must be "stopped down." There is no reason except cost against the construction of a 1,000-inch reflector and its continual use at full aperture.

(j) The slow rotation of the moon and the lack of differential refraction between the zenith and the horizon will make almost perfect guidance a much simpler matter than it is here. When we consider exposures hundreds of hours long, using large telescopes either for direct photography or to obtain spectra of high resolution, we begin to appreciate what we shall gain from use of the moon.

The preceding list concerns merely the practical, observational advantages which are important only because they lead to our securing incredibly better astronomical data. Some of these better data are:

(a) The scale of distance which we use for the observable universe depends fundamentally on measurements which, in principle, are identical with the triangulation of the surveyor. We measure the parallactic displacement of certain asteroid and from the results calculate, through use of Kepler's harmonic law, the distances of the sun and of all of the planets. Probably for planetary distances we shall soon substitute radar measures of distance. However, the distances of even the nearest stars still will be determined by such primary triangulation, which uses the diameter of the earth's orbit as a baseline. The largest measured total displacement for a star has been $1''.52$, a very small angle. To these direct measurements made of the nearest stars we apply statistical and other theoretical means to obtain the distances of more remote objects. The earth's atmosphere causes large uncertainties in the parallaxes of even the nearest stars and consequent uncertainties in the theoretical distances of the farther objects. The almost perfect stellar images which we shall secure at the moon will increase our accuracy by fully one order.

(b) The increase in accuracy of measurements of parallax should give good results for, say, ten times the present distance. This gives us 1,000 times as many stars as a sample. The study of the nature of subdwarf stars is very important in hypotheses of stellar evolution. Because of their low luminosity, our observed sample has been much too small to give us certain important information.

(c) Nearly half of the light from a star is lost in passage through our atmosphere. In addition to this, the lack of blackness of our sky fogs the plates before we can secure measurable images of the faintest objects. On the moon we shall carry our observations to much fainter objects than we can from here.

(d) Lack of contrast is, perhaps, the chief difficulty in observing the most distant of the galaxies. At present the limiting distance is an estimated two billion light years. If man ever is to understand his universe he must know what the conditions are at far greater distances than he does today. Long photographic exposures in the blacker lunar sky should carry our data much farther out than is now possible. From the earth our plates would be fogged much too soon to permit any great gain over results already known. Is space limitless? Does it curve back on itself? Did the universe come into existence only, say, a dozen billion years ago, so that there still is empty space if we go far enough? Is the universe in a "steady state" without beginning or end? These are ontological questions, toward the answers of which we desire to secure every possible clue. It is possible that we never shall get the answers but we must keep on trying. Perhaps the equivalent of our 200-inch telescope, if used on the moon, would give us a thousand times as large a sample and through it provide some hint about the answers.

(e) From the moon, with such a telescope as the 200-inch, the actual disks of the nearest of the supergiant stars should just begin to be visible. Our atmosphere always will prevent any such observation from the earth.

(f) The laws of optics produce an area of confusion around the image of a point. This is true even for the case of perfect optics and light paths which lie entirely in vacua. For a one-inch telescope the confused diameter is 4".5, which covers an area of about 700 miles diameter on Mars even when it is closest. Under the same conditions a 10-inch telescope would reduce this area to 70 miles, and a 100-inch would leave a blurred residual of only 7 miles. If albedo differences were sufficient this would provide observations of what truly could be called fine detail. Because of atmospheric conditions we cannot even approach this resolution from the earth. From the moon we shall approximate it closely. (Probably Mars is not a good example to choose, because it seems probable that long before very large instruments have been installed on the moon, our probes will have sent back more detailed pictures.)

(g) Our observations of the constituent gases of the Martian atmosphere are very difficult to make from the earth because of the fact that the same ones exist in greater densities in the terrestrial atmosphere. Spectrographs in rockets and artificial satellites will give much of the answer but high dispersion spectrographs are, probably, too massive for such installations.

(h) Our high dispersion lunar spectrographs can be used to investigate the ultraviolet spectra of the stars and thus lead to more accurate classification according to physical characteristics.

(i) From the moon we shall be able to obtain detailed spectra of some of the lowest luminosity subdwarfs and learn much additionally about their nature.

(j) With the sharper, and smaller, stellar images we shall be able to separate many double stars which now can be observed only as single. With the better measures of their distances apart, we shall obtain better orbits for them and probably shall gain a bit more information toward solving the problem of their evolution.

(k) We shall, for the first time, get truly accurate measures of the apparent brightnesses of stars and of the variations of these brightnesses. Changes in the transparency of our atmosphere produce irregular errors in determinations made from the earth.

(l) The long lunar nights will make it possible to follow many of the variable stars continuously throughout their cycles. It is possible that, except for interference from the solar corona, we shall be able to continue the observations during the day.

(m) The corona of the sun can be followed outward in exquisite detail, probably beyond the orbit of the earth. The observations will require only the simplest of coronagraphs. The corona will be studied by radio waves, infrared ones, all bands of visible light, and by ultraviolet light, even down through the X-rays.

(n) The changes in coronal streamers can be followed for days at a time. This will be an especially important thing to do at times of solar flares.

(o) Finer structure of the "rice grains" of the solar photosphere will be observed and the detailed patterns of their changes will be followed.

(p) We shall not be bothered by atmospheric cutoffs in the radio wave spectral regions.

(q) We shall obtain detailed spectra from galaxies which are so far away that their light has required hundreds of millions of years, perhaps longer, to reach us. This observation will be limited only by a too large Doppler effect. Have our cosmological constants varied? It is possible that we shall receive part of the answer at our lunar observatories.

(r) It seems to be very probable that the solar radiation to which our atmosphere is opaque affects our weather more than does that which passes through easily. We can expect detailed study of this radiation and its variations to aid our meteorological research.

(s) In our galaxy there are great clouds of gas and dust of low enough density that some starlight does pass through them to us from stars which are beyond. Lunar observations will multiply the volume and quality of such observations.

(t) Our knowledge of space conditions in the Solar System and of their effects on meteorites will jump suddenly.

These twenty advantages are merely a few from the long list which the astronomer will secure to aid in his attempt to do his share in our study of the nature of the universe. Even his first, small observatories will give him data which it would be impossible to secure from terrestrial observatories, no matter how big. Instead of, perhaps, 5% telescopic efficiency as is the case here, his work will be done with fully 95% efficiency.

For those of us who believe that the race has an important function to perform in the evolution of the universe, the present opportunity seems to be the critical one. We can go ahead to the destiny for which we exist, or we can lean back lazily and pretend to ourselves that there is little to do. The amateur, lunar student can help very much by using every means at his command to insure that his community knows the importance of the present endeavor. Scientific progress has reached the point where we are walking a tightrope between possibilities of complete destruction and of a grandeur too great to be found even in our dreams. It is "up to us." THE GREAT MOMENT OF DECISION IS HERE. OUR LABORATORY IS ONLY A QUARTER OF A MILLION MILES AWAY. WE MUST BE CAREFUL THAT NO ONE USES IT FOR ANY OTHER PURPOSE.

<u>Postscript by Editor</u>. The preceding article was contributed by Dr. Alter upon request for this Fifteenth Anniversary Issue. Dr. Alter is the Director Emeritus of the Griffith Observatory and Planetarium in Los Angeles. He has assisted the A.L.P.O. in various ways over the years and has given several Morrison Lectures at A.L.P.O. Conventions in California.

<u>LUNAR AND PLANETARY OBSERVING</u>: <u>THE RÔLE OF THE AMATEUR</u>

By: Patrick Moore, F.R.A.S.

Fifteen years ago the A.L.P.O. was born. As one of its more geographically remote members, I am honored to be invited to contribute to this anniversary issue; and I have chosen a subject which is bound to be important to us all--all of us, that is to say, who are amateurs, which includes most of the A.L.P.O. membership.

It is, I think, fair to say that until the last decade or so, professional astronomers tended to neglect physical observations of the Moon and planets. This was quite understandable, and even logical. Professional work is concerned with the really important matters, and we cannot claim that our Solar System is of the slightest importance in the cosmos as a whole. Moreover, the world's large telescopes are built for stellar studies, and it would be unwise to divert them to research which may be carried out adequately with smaller instruments. Lastly, there are not enough professional astronomers, with first-class equipment, to do everything. This is why the amateur had so pronounced a rôle to play.

Even now, when space research is under way and the first manned voyage to the Moon looms ahead, the amateur still has a rôle. It is rather more limited than it used to be; there is not much point in using, say, a 3-inch refractor to draw lunar features which are recorded in detail photographically. Yet the work of the amateur is as important as it ever was; the vital point is to direct it into the proper channels--and this, I feel, is where some improvement in world organization is called for.

Amateur work with regard to physical studies of the bodies in the Solar System is largely confined to the Moon and the planets Venus, Mars, Jupiter, and Saturn. Mercury needs a large aperture--I consider my own 12½-inch reflector quite inadequate--and while something useful may be done with regard to the variations in brilliancy of Uranus, surface details are beyond most amateur telescopes. (Occultation timings are still valuable; so are studies of comets, meteors, and artificial satellites--but I do not propose to deal with these branches in the present short paper.)

It would be quite wrong to suppose that the photographic charts of the Moon are exhaustive. They are not. In my view the small photographic atlas compiled by the Japanese observers Miyamoto and Matsui is quite outstanding, but direct observation with a moderate telescope can add to the details shown in it. The Kuiper Atlas is, of course, a major contribution; but many of the plates are not sharp enough for measurement of the fine features, and the limb regions are not shown clearly enough for precise charts to be drawn up from them. So the amateur with a moderate telescope retains a rich field--particularly if he concentrates on some specific classes of lunar features. There seems, too, to be a research program available in measuring the shadows inside craters to obtain better depth-estimates. Moreover, the amateur is relied upon to watch the various areas which are suspected of minor variation. This is work which the professional has no time to undertake.

Visual observations of Venus are difficult, and all attempts to clear up the vexed problem of the rotation period by visual work have met with failure; but the periodicity of the cusp-caps is promising, and only long-continued studies can confirm or deny the value of such work. There is, too, the "Schröter effect" or phase-discrepancy, where precise micrometrical measures are urgently needed. Careful studies of the Ashen Light are equally necessary.

Jupiter is, of course, probably the most rewarding of the planets from the amateur's point of view, and much of our knowledge of the surface is due to amateur work. A night can never be dull when Jupiter is above the horizon! Saturn is obviously more difficult--but remember that the last of the really important outbreaks, the white spot of 1933, was discovered by an amateur, W. T. Hay. I do not propose to say anything about Mars, since it is a planet which I have never observed really seriously except during the last three apparitions, but it is evident that the amateur is the best source of cloud observations and associated phenomena.

These comments are not new; every A.L.P.O. observer must have heard them many times, and I feel I should apologize for repeating them. But I am leading up to my main point--which is that the amateur work so far is not correlated so well as it might be.

There are a few societies which have pioneered the way. In Britain, the British Astronomical Association, formed in 1890, has a long and honorable record of observational work--I need only point to the work of the Jupiter Section and to the lunar reports and memoirs. Up to the time of the A.L.P.O. there was nothing really comparable in America, and this is why the A.L.P.O. has proved to be so important; it has gathered the amateurs together, and presented their work in a way which has been of the utmost value to astronomical science. Other countries, too, have their amateur societies, and produce reports which are of great interest.

The real trouble is that, in my view, the national societies do not have sufficient contact with each other. To give one example: both the B.A.A. and the A.L.P.O. have lunar sections, but there is no direct contact between the two. What contact there is depends solely upon a handful of observers who, such as myself, belong to both bodies. Unless a B.A.A. member takes The Strolling Astronomer he will not hear of the A.L.P.O. lunar work. And on an allied subject, how many A.L.P.O. members have come across the recent lunar papers by B. Warner published in the B.A.A. Journal?

In the past, it was a common fault for amateurs to direct their energies in the wrong direction; there were many people who would make pretty drawings of Jupiter, but only a few who were prepared to do the hard grind of staying outside for hours timing surface-transits. This is no longer the case, and the credit here is due to societies such as the A.L.P.O., where the sections are controlled by skilled directors who lay down their programs and analyze the results. (Let me add that as a pure amateur myself I have made probably more mistakes than most people--and I still do, even though I pretend that I am aware of the pitfalls.) So progress has been made on a national basis--but it is a national basis, not an international one.

Professional astronomy has the I.A.U., which produces publications and holds annual meetings in various countries. In the amateur world matters are more difficult, because few amateurs have the money to travel to conferences abroad, and sponsorship is generally out of the question. Yet I do not think that the difficulties are insuperable, and I would like the A.L.P.O. to take the lead in the formation of the I.U.A.A.--the International Union of Amateur Astronomers. It would at least be practicable to produce a periodical which would in no way cut across national journals such as The Strolling Astronomer, but which would be devoted to summarizing and correlating the work published, in more detail, elsewhere.

The advantage of such a scheme would be that it would improve the co-operation between amateurs in different countries without in any way affecting the national societies themselves. It seems a logical next step; and, provided that the various national societies were in agreement, it would work--in spite of the obvious difficulties, financial, linguistic, and otherwise.

This may seem something of a pipe dream, but there are many of us who are more than anxious to see amateur astronomy well-directed, organized, and correlated on an international basis. If a lead is to be given, I feel that it must come from the A.L.P.O., which has a deserved reputation of being energetic, skillful, and always ready to consider new ideas.

As one who, unfortunately, knows only a very few of you personally, it may seem out of place for me to put forward so bold a scheme; but I do not regret having done so--if it comes to nothing, there is no harm done. Meanwhile I would like to add my congratulations to you all upon your work during the past fifteen years, and I may perhaps also add to the many congratulations which must have been received by the man who was mainly responsible for the impetus--Professor W. H. Haas.

The first fifteen years of the A.L.P.O.'s existence have been fruitful indeed. I believe that the next two decades may be even more rewarding. I suppose I am fairly typical of the many amateurs who have no claims to academic distinction and who work with modest equipment; but I know that our work is well worth-while--and without societies such as the A.L.P.O., its value would be drastically reduced.

THE SHIFTING SAND[1]

By: L. J. Robinson

I don't know how many of you have ever experienced a desert wind storm; but if you had, you would have seen how the wind-blown sand covers and uncovers all which is in its path. How unrecognizable the appearance of the terrain becomes; how quickly heretofore unseen things greet the watchful eye; how quickly familiar objects disappear to those who dare to blink! Such is the truism of modern society in general, and of modern science in particular. To carry our allegorical analogy one step further--to amateur astronomy--we may say that the amateur astronomy of today is the underlying stratum, professional astronomy the sand, and scientific thought the storm. Like it or not, our avocation is under constant revision, and like a hapless Brünnhilde must meet its obligations or suffer the wrath of our Wotan, obsolescence.

Such a statement should neither give us concern about our value to astronomy in future years, nor should it cause a negative reflection on past efforts. One only needs to refer to such statements as:

"More and more this branch [physical observations of planetary surfaces] of planetary work, including the study of the Moon, became the topic par excellence of amateurs--who did remarkably well with it."[2]

"This map [Mars 1954] was made by the Association of Lunar and Planetary Observers, an amateur organization, but I find it quite useful."[3]

"I'm convinced that much that still needs to be done in lunar mapping can be done from presently available photographs and from direct visual observations with existing telescopes."[4]

"There are, however, many other fields in which the cooperation of amateurs would be invaluable. We discussed one of those yesterday afternoon, namely, the possibility of monitoring for such luminescence phenomena as Kozyrev observed..."[5]

It is at once seen that amateurs have performed valuable survey work in years past. But is this what is expected (or desired) of them in the future?

To a great extent, I believe that the answer is yes. The amateur has always been, and should continue to be, the "monitor" of the skies--he is best equipped for that task. But as both Kuiper and Kopal infer, there are two kinds of monitorial services: the undirected or survey service, and the directed or specific objective service. Up to the present time, the amateur has mostly been concerned with the former; but again we ask ourselves, "Is this the correct course to steer in the future?" I believe that a quick look at contemporary professional thinking will give us the answer.

As we all know, the space program has created a dire need for exact knowledge of the lunar and planetary topography, sub-surface conditions, and atmospheric constituents. Therefore, the professional astronomers have been called upon to supply this information; hence, great efforts are currently being made in these directions. The USAF-ACIC lunar maps, the Kuiper Lunar Atlas, and the de Vaucouleuers Mars map all bear out this statement. The most interesting aspect of the above research projects is that they are all fundamental in nature, bringing planetary cartography to the same degree of precision as was found in stellar "cartography" with the publication of the Bonner Durchmusterung in 1863. It is indicated, therefore, that the survey service era of amateur astronomy is drawing to a close. The complete supersedure of amateur efforts in this direction by professionals may require another decade, but sooner or later the inexorable transition will occur. The contemporary amateur would do well, therefore, to begin his transition into the second form of service--one which will not become outmoded until man walks upon the planets themselves. Today, it would be best if this form of amateur study were incorporated into the general survey program, either as independent observer endeavors or as cooperative efforts under the direction of the Section Recorder.

What are some specific projects suitable for amateurs? To list a few:

1) The rotation of Saturn at different latitudes.
2) The variation in brightness (?) of Uranus. E.
3) The variation in brightness (?) of Neptune. E.
4) The correlation of planetary radio emission with visual sources.
5) Three color photographic or photoelectric observations of lunar and planetary surfaces. E.
6) Comet hunting.
7) Study of the nature of Jupiter's Equatorial Band.
8) Lunar limb cartography.
9) Determination of fundamental quantities of lunar features, i.e., distribution, number, diameter, height, depth, and position.
10) Photometry of planetary satellites for variations in magnitude. E.

And these are just a few of the possible amateur projects. Most of them can be done by amateurs with no special training or equipment; a few (which I have marked with an "E" to denote "exotic") would require advanced training or equipment. But even these are within the scope of the advanced amateur.

In conclusion, the amateur must not only be aware of the professionals' needs and desires, but must continually re-evaluate his program to meet these wants. In this day of rapid and drastic astronomical developments, a once useful program may soon become shopworn or obsolete. The place of amateur astronomy is a supplemental one. It must exist where needed if it is to be of value. So long as the amateur recognizes his position and, at the same time, appreciates the position of the professional, so shall he always have a welcome and valued place in fundamental astronomical research.

I should like to take this moment to thank Professor Haas for the opportunity to express the foregoing views in this Fifteenth Anniversary Issue, which in itself speaks highly for amateur lunar and planetary astronomy, and is deserving of hearty congratulations from us all.

References

(1) This paper is adapted from a lecture given by the writer to the J.A.C. of New York City. It was tape-recorded by Mr. A. E. Pearlmutter, to whom this author is deeply in debt.

(2) Kuiper and Middlehurst (Editors), Planets and Satellites, University of Chicago Press. Chicago, 1961, p. vi.

(3) R. S. Richardson, "Proceedings," Lunar and Planetary Exploration Colloquium, October 29, 1958, Vol. 1, No. 3, p. 19.

(4) E. M. Shoemaker, "Proceedings," Lunar and Planetary Exploration Colloquium, September 23 and 24, 1959, Vol. 2, No. 1, p. 20.

(5) Z. Kopal, "Proceedings," Lunar and Planetary Exploration Colloquium, ibid., p. 52.

ANNIVERSARY LETTER FROM THE A.L.P.O. SECRETARY

Foreword by Editor. The following letter from our Secretary, Mr. David P. Barcroft, does the Editor too much credit and the Secretary and others far too little. However, the usual editorial scissors have been spared; for rewriting would too much change the spirit of a message which expresses very well the underlying spirit of the A.L.P.O. and what is best in our Association. Dave Barcroft himself has long been one of our most respected and best loved colleagues and has given unsparingly of himself again and again to assist in countless ways amateur astronomy, amateur astronomers, and the basic purposes of the A.L.P.O.

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Sesquidecennium

Madera, California
March 2, 1962

Professor Walter H. Haas
Director, Association of
Lunar and Planetary Observers
Pan American College Observatory
Edinburg, Texas

Dear Walter,

It is with the greatest pleasure that I answer "present" at our fifteenth annual roll-call. And of the numerous congratulations of which you will be the recipient, none can be more heartfelt than mine. For we have been together for a long, long time. Years ago, before some of our younger fellow members were born, with the kindness which has ever characterized you, you took me under your wing, and you have never set me adrift though the temptation to do so must have been great at times. I was attempting some lunar observations and was having a pretty bad time of it. Had it not been for your timely encouragement, one more telescope might have landed atop the junk heap.

When in 1942 you published "Does Anything Ever Happen on the Moon?", I realized that I had hitched my wagon to a star; and I determined that the hitch should stay fast. You will recall that I overcame your objections to the title based on its possible implications of sensationalism by pointing out that we could successfully lay the blame at the door of Simon Newcomb. I now confess to a small grudge I have always held against Simon on account of the disdain he manifested, and in his best pontifical manner, toward our Moon. He didn't think there would ever be a flying machine, either.

Anyhow, the rapidity with which our large stacks of reprints of Does Anything Happen dwindled proved conclusively that there were amateur observers everywhere who were avid for material of that kind. I feel that this little lunar classic should not be relegated to oblivion, but should be printed again. Think about it, Walter. As a matter of fact, this was undertaken a few years ago by another amateur organization, but alas, no one is better aware than you are of the perils which are a threat to infant publishing enterprises; and this one was stricken down in the midst of a laudable endeavor. Does Anything Ever Happen was the first treatise on selenology to appear on this continent of any consequence from the time your brilliant mentor, W. H. Pickering, laid down his pen in order to "join the Majority" as the English were wont to say.

There was no large scale newscast to herald what happened in March 1947. As I recollect, there was no fanfare at all. But a proposal had been made, and it was directed to a few people hither and yonder who might be interested. All things considered, the response was surprisingly good. About four months later there were about 50 enrolees; and The Association of Lunar and Planetary Observers was off its launching pad. But its orbit was not to be established and stabilized without a good deal of strenuous work at the controls. For this was a "lift yourself by your bootstraps" operation, if there ever was one, and so it would continue to be for several passes. There appears no hint of this in those choice collectors' items which in toto constitute the back volumes of the journal which members have affectionately nicknamed "The Stroller". But I was there at the start; and from the favorable vantage point to which you had assigned me I think I have had a better opportunity to observe what was happening than anyone else save yourself. I know of problems you had to solve, many appearing to have no solution. I know of obstacles which confronted you which to a less determined soul would have seemed unsurmountable. But I don't think the issue was ever in doubt. You have never faltered; and today our Association is an institution of such strength and stature that it enjoys the respect of astronomical circles throughout the world, and justly so.

And there have never been finer individuals than those who have made up the ranks of the Association during its lifespan. They have been your inspiration; the way in which they have rallied to your call has rewarded you, and amply so.

I have come to feel that every fellow member, regardless of where he may be, and irrespective of whether I know his name, is a personal friend of mine. For if each of us likes to observe the moon and planets with our telescopes, how can we be other than friends? What other type of common interest could form the basis of a warmer friendship? But lest you start thinking that I'm up to my old tricks again, I pause long enough to say that I know they were always your friends, and I only want to share them with you.

Fifteen lighted candles are shedding their pleasant glow on this happy occasion, Walter, and all of these friends of ours are with us. Every one of them wants you to know that he fondly hopes that the future will yield to our Association that which the present so certainly promises, which is another way of saying, "There'll be lots more candles."

Cordially yours,

David P. Barcroft
Secretary, A.L.P.O.

THE 1961 A.L.P.O. SIMULTANEOUS OBSERVATION PROGRAM--FIRST REPORT

By: Clark R. Chapman

Abstract

This is the first of two articles summarizing the work of thirty-six A.L.P.O. observers in the 1961 Simultaneous Observation Program. All data are presented, and there are numerous illustrations of simultaneous drawings. Matters considered include: phases of Mercury and Venus; latitudes, longitudes, and intensities of features on Jupiter and Saturn; satellite phenomena and central meridian transit timings for Jupiter. The moon and Mars receive little consideration. Average deviations of single observations from the average of the group of observations are given in the final table. For Jovian latitude measurements from drawings, the average deviation from the averages after correction for systematic error is 1.4 parts per one hundred of the polar diameter. Although there are random differences among observers, there are also systematic differences which can be seen quite easily upon examination of the data. Simultaneous observation can be helpful to train observers and to improve the reliability of amateur work. If there is to be another Simultaneous Observation Program, there must be more interest on the part of more observers. Comments are invited by the author; his address is 2343 Kensington Ave., Buffalo 26, New York.

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A Simultaneous Observation Program was carried out during the summer of 1961 to determine the accuracy of A.L.P.O. observational material. Fifteen target times were listed in my first article, "A Simultaneous Observation Program," in the May-June, 1961, issue of The Strolling Astronomer. Thirty-six observers submitted observations. Some of the results are very interesting.

The list below includes the name, U.S. state or Canadian province, aperture of telescope(s) used to the nearest ½-inch, and the type of telescope (L=reflector, R=refractor) for each observer.

Carl Anderson, N.H.	6 L	Richard Fennelly, Colo.	8 L
James Bartlett, Md.	4½ R	Geoffrey Gaherty, Quebec	6 R, 8 L
Alan Binder, Ariz.	4½ R	Roger Greene, Colo.	4½ L
Klaus Brasch, Quebec	8 L	W. H. Haas, Texas, Jamaica	6 L, 10 L
Clark Chapman, N.Y.	10 L	William Hartmann, Ariz.	4½ R, 12½ L
Doug Cooke, Calif.	4 L	Earl Hicks, Montana	5 R
Dale Cruikshank, Ariz.	4½ R	Harry Jamieson, Ill.	10 L
Charles Cyrus, Md.	10 L	Craig Johnson, Colo.	10½ R, 3½ L
Roger DeKing, N.Y.	2½ R	Dennis Jones, Calif.	3 L
Jack Eastman, Calif.	12½ L	James Loudon, N.J.	6 L

Pat Lowry, Calif.	12½ L, 8½ L	Charles Ricker, Mich.	6 L
Russell Maag, Missouri	6 L, 4 L	George Rippen, Wisc.	6 L
James Marshall, Texas	2½ R	Leif Robinson, Calif.	10 L
David Meisel, W.Va.	8 L	Bob Shayler, Calif.	8 L
John Milne, N.Y.	2½ R	James Sitler, Penna.	4½ L
Dennis Milon, Texas	8 L	George Wedge, Quebec	6 R
José Olivárez, Texas	2½ R	Mac Wellman, Ohio	4½ L
Tom Osypowski, Wisc.	12½ L	Fred Wyburn, Calif.	4 R

There will be two final reports on the program. This first report primarily will summarize the observations that were reported and will present the data for the reader to draw his own conclusions. The second article will be devoted to interpretations of the work submitted and will summarize some of the comments concerning the problem of the accuracy of amateur work which I have received in correspondence. I hope that the illustrations and material presented in this paper will provoke further discussion.

The lunar observations received for the program are completely beyond analysis because there is so much disagreement! I will postpone all discussion of these observations until the second article.

A number of people have suggested that another Simultaneous Observation Program be carried out again this year. This will depend on the co-operation of A.L.P.O. members. To be truly worth-while, there must be more observations by more of the people. Also, there will have to be provisions made for good simultaneous photographs; during 1961 only three photographs were submitted, of which only one was worth-while in reducing the data. A new program will have to be a more disciplined effort with every observer using the same observing form and making his drawings and other observations at exactly the same time. Simultaneous lunar observations will have to be devised differently (with everyone using general outlines from the Photographic Lunar Atlas and with everyone concentrating on the accuracy of smaller detail). I would appreciate comments on the possibility of another program. If one is to be carried out, it will be announced in the next article.

Some people have even suggested that the Simultaneous Observation Program be made a permanent section of the A.L.P.O. to serve as a training course for newer A.L.P.O. observers. This suggestion surely merits much thought. The A.L.P.O. cannot continue to publish drawings made by inexperienced or inaccurate observers. There is, nevertheless, a need for encouraging new observers and helping them to see their faults and to improve their work. Arbitrarily not using the observations of a new observer for one year would be a poor practice because it would have a discouraging effect. Also, it has been my experience that the first observation of a new observer can be quite reliable (although this is the exception) while some observers never seem capable of making satisfactory observations. Comments on this subject will gladly be incorporated in the second article if they are sent to me quickly.

The rest of this article will be devoted to a summary of the observations submitted, with the exception of the three series of lunar observations. Few observations were received for the early dates. Five or more drawings were received for the observations on July 5, July 18, July 25, August 2, and August 17.

June 16, 1961. 1:00 - 4:45 U.T. Mars and Uranus.

The intention was to have observers draw detail on the planetary surfaces and to make careful estimates of the positions of the two planets. Only one of the four observers who submitted observations used an instrument large enough to record surface detail on Mars. The other observations were only approximate drawings of the planets with respect to some stars in the same field of view.

June 21, 1961. 45 minutes before local sunrise. Venus.

Only two observations were received. Although the predicted phase was just over 50%, both observers agree that the terminator was still con-

If readers have any questions, they should write to the author at the following address. Observations should also be sent here.

George W. Rippen
1701 Ellen Avenue
Madison 4, Wisconsin

BOOK REVIEWS

Review by Geoffrey Gaherty, Jr.

Der Sternenhimmel 1962. Edited by Robert A. Naef. Aarau, Switzerland: H. R. Sauerlander & Co., 130 pages. Available in the United States from Albert J. Phiebig, P. O. Box 352, White Plains, New York.

Almost every serious observer has a copy of the current American Ephemeris on his bookshelf. This should not prevent him from investigating the smaller handbooks published by various national societies since they contain most of the commonly used information in more concise and convenient form. The Handbooks of the Royal Astronomical Society of Canada and the British Astronomical Association are those most commonly encountered; but the observer with some knowledge of German should give consideration to Der Sternenhimmel, now in its twenty-second year of publication under the auspices of the Swiss Astronomical Society (S.A.G.).

Der Sternenhimmel includes unique features too numerous to describe in detail so that I must simply single out a few which caught my eye. Observers of Mercury will appreciate the ingenious chart for locating the little planet; this not only shows the planet's elongation from the sun but also the angle of elongation relative to the horizon. The layout of the daily and monthly phenomena is a model of clarity with symbols being used very effectively. Everywhere throughout the book thorny points are cleared up by excellent diagrams, half-tones, and Naef's explanations of the terms used. These latter recommend the book to students of German who wish to become familiar with the basic technical vocabulary of astronomy.

On the negative side I would put the binding of the book which seems very flimsy even by the standards of paperback publishing. Sturdier covers would help and probably should be added by the purchaser since this book is deserving of much use at the telescope.

Reviews by J. Russell Smith

An Atlas of the Moon's Far Side, The Lunik III Reconnaissance, N. P. Barabashov, A. A. Mikhailov, and Yu N. Lipsky, editors. Translated by Richard B. Rodman. Interscience Publishers, New York, and Sky Publishing Corporation, Cambridge, Mass., 1961, $7.00.

For many years astronomers have conjectured about the side of the moon they have never seen. A few astronomers have attempted to make a rough sketch of this unknown portion based on what were probably intelligent guesses.

Some definite ideas about the moon's far side have come to us from the Soviet Union's Lunik III, which was launched on Oct. 4, 1959. This space vehicle was the world's first automatic interplanetary station. Carrying a battery of both photographic and television systems, Lunik III passed within 62,500 kms. of the center of the moon and for 40 minutes automatically photographed the lunar surface that is perpetually hidden from the earth. The images were later televised to the earth and received in the Soviet Union. It is interesting to note that the camera used for this work was equipped with a pair of objectives, one with a focal length of 200 mms. and a relative aperture of f 5.6, and the other 500 mms. and f 9.5.

The first part of the book deals with the photographs and their transmission, interpretative techniques, the photometric cross sections, and the reduction of the materials. This is followed by the final lunar map in four quadrants. The maps are keyed for reliable and well defined formations, less well defined formations, formations with uncertain outlines, formations darker than surrounding field, formations lighter than surrounding field, catalogue number, bright rays, and boundary of area accessible to camera. The central meridian of each map is 120 degrees west longitude, and lines of latitude and longitude are given at 10 degree intervals.

The next section of the book, which is by far the major portion, is a catalogue of the formations observed on the moon's far side. This is given in chart form and is divided into first reliability class, second reliability class, and third reliability class objects.

The final part of the book consists of duplicates of 20 plates containing 30 photographs of the hidden side of the moon. These represent the best negatives obtained by the Soviet space probe.

Inside the back cover there is an envelope containing a copy of the lunar map on a large folded sheet. The moon's diameter here is about 14 inches which makes the chart quite suitable for posting.--J.R.S.

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Astronomical Photography, From the Daguerreotype to the Electron Camera, Gerard de Vaucouleurs, The Macmillan Company, New York, 1961, $6.00.

It seems fitting that Dr. de Vaucouleurs should bring us a book of this type since his astronomical career as well as the science of photography began in France. The author is well experienced in all phases of astronomical photography and as a result is very qualified as a writer on this subject. The aim of this small volume of about 100 pages is to trace the development of photography before it finally established itself as the astronomer's indispensable tool and to serve as a reminder of the early achievements of the pioneers in celestial photography.

The subject is treated in five different sections as follows: The Beginnings of Astronomical Photography: 1839-1851, The Development of Astronomical Photography: 1851-1879, The Rise of Astronomical Photography From 1879-1887, Progress in Astronomical Photography Since 1888, and The Present and Future of Astronomical Photography.

Following an index, after page 96, the author has included 21 plates to show the development and progress of astronomical photography. Subjects include the sun, the moon, the planets, nebulae, composite photography of nebulae, and indirect photography with an image-orthicon television camera attached to a telescope. Plates 20 and 21 show equipment of project stratoscope and a photograph of a small section of the sun taken at 80,000 feet.

The book is recommended for those interested in the history and development of astronomical photography.--J.R.S.

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Astronomical Spectroscopy, A.D. Thackeray, The Macmillan Company, New York, 1961, $3.95.

This is the second volume in the series A Review of Astronomy, and is designed to bridge the gap between elementary astronomy and purely technical astronomy. It tells of the beginnings of spectroscopy, the instruments, atomic spectra and energy levels, spectra of normal stars, ionization in stellar atmospheres, the Doppler Effect and stellar motions, the spectra of the sun and planets, double stars, gaseous nebulae, interstellar matter, unstable and pulsating stars, spectroscopic determination of distance, galaxies, widths of spectrum lines, and the composition of the universe, as well as stellar evolution and current problems. This work can be recommended for the serious amateur and the student. Includes an appendix of useful tables, a bibliography, and a glossary. Written by a specialist in the field.--J.R.S.

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Tools of the Astronomer, G. R. Miczaika and William M. Sinton, Harvard University Press, Cambridge, Mass., 1961, $7.75.

tion fee of $1.00 per person should be sent to Mrs. William Lipscomb, 906 Waterford Road, Alexandria, Virginia. A.L.P.O. members attending and wishing to set up exhibits should contact Mr. H. J. Walls, 7103 Georgia Street, Chevy Chase, Maryland. Telescopes, their accessories, books, charts, and photographs are all wanted for the Convention Exhibit.

Mercury Solar Transit Photographs. The three photographs of the Mercury solar transit on November 7, 1960, published on page 4 of our January-February, 1962, issue came out somewhat poorly. On Figure 1 the arrows mentioned in the caption are missing on some copies; the image of Mercury is 1-1/8 inches from the left edge of the published picture and 1-1/4 inches from its lower edge. On Figure 2 Mercury lies at the limb of the sun and 7/8 inches below the top edge. On Figure 3 the planet is precisely an inch below the top edge.

Errors in November-December, 1961, Issue. Mr. Takeshi Sato, Hiroshima, Japan, has reported the following errors in the article by Mr. Saheki and himself in the issue mentioned:

1. Page 191, tenth line from bottom. For "on any given night" read "on any given short succession of nights."

2. Page 200. For $E)^3$ read $E)^1$.

3. Page 200. For F) read $F)^3$.

Termination of A.L.P.O. Confirmatory Service. Mr. James Mullaney writes that he must with regret discontinue the large-aperture confirmatory service described on pp. 155-156 of our September-October, 1961, issue. Personal changes in his position at the Allegheny Observatory have required this change. Perhaps in the future someone else can offer such a service. Commenting by letter some months ago on requests made of the Confirmatory Service, Mr. Mullaney felt that most of them were too complex and far too demanding of telescope-time and staff-time. Simple, specific requests requiring but little of a large telescope's limited time are the easiest to satisfy, and hence the ones most likely to be processed quickly and correctly.

Disclaimer. Opinions expressed in articles in The Strolling Astronomer are those of their authors. They are not necessarily in accord with the views of the editor and other staff members or with the policies of the A.L.P.O. They may even contradict such staff opinions and also each other.

Honors Achieved by Young A.L.P.O. Members. The primary purpose of the A.L.P.O. is to encourage qualified amateur astronomers to undertake observational, and in part related theoretical, studies of the moon, the planets, and comets, to evaluate critically such studies, and to publish the results. A byproduct is the training of members of the Association to make such observations. Yet this secondary function may be important and has sometimes shown its effectiveness. From this point of view it is most gratifying that three A.L.P.O. members were among the forty national winners in the recent Science Talent Search for the Westinghouse Scholarships and Awards. They were Mr. Clark Chapman of Buffalo, New York, Mr. Joseph Eyer of Philadelphia, Pennsylvania, and Mr. Jack Hills of Independence, Kansas.

The three winners were in Washington, D.C., from February 28 to March 6, 1962, on an expense-paid trip to the Science Talent Institute at the Hotel Statler Hilton. They had a tremendous time! They visited scientific laboratories in the Washington area, talked with famous professional scientists and with other winners, placed exhibits of some of their scientific work in the Presidential Ballroom of the hotel, and met President Kennedy at the White House.

During the Institute all forty were judged in competition for the highest scholarships. Joseph Eyer won the third-place scholarship award of $5,000 and was runner-up to the second-place scholarship of $6,000. His research report, "A New Corrector for Astigmatism," described his new method for correcting astigmatism in the construction of two types of telescopes. His new "corrector" system is easily manufactured in contrast to other methods which are commercially impractical for the purpose. Jack Hills won a $250 award for an investigation of the atmospheric currents of Jupiter, applying the theory of least squares to his analysis of central meridian transits. Clark Chapman won a $250 award for his paper on his observations of Mars and Jupiter.

Clark writes: "I am sure that a primary factor in the success of Jack and myself was our membership in the A.L.P.O. And surely the A.L.P.O. has been an important factor in Joe's developing career." We are, of course, extremely glad for whatever assistance we have been able to give these three talented and outstanding young members.

Lunar Training Program and Recorder. In our reorganization of the A.L.P.O. Lunar Section we have appointed a second Lunar Recorder in charge of a Lunar Training Program. He is:

Clark Chapman
2343 Kensington Avenue
Buffalo 26, New York

Mr. Chapman directs the following message to all interested readers:

"I have been asked to take on the Recordership of the Lunar Training Section. As has been obvious to many A.L.P.O. members, the haphazard methods of observing the moon carried out by many A.L.P.O. members in the past are not worth-while. In the Lunar Training Section we will try to improve observers' methods of drawing and observing, and we will guide them into scientifically useful studies. Some of the objectives of this Section are listed below:

(1) New observers will be shown how to make more accurate and more realistic drawings of lunar features. Observers will be asked to use copies of general outlines from the Photographic Lunar Atlas, which will be supplied by this Section, as the basis for drawings of larger features. A standard reporting form will be adopted by the Section. The early drawings of new members will be constructively criticized.

(2) More advanced observers will be shown different types of study which can be undertaken. The general methods of doing special projects not being specifically worked on in the Special Projects Section will be discussed. This part of the Section will be emphasized. Random drawings of random craters will not be encouraged after observers have mastered drawing techniques.

(3) Training in the use of filar micrometers, photography, color filters, and other special methods of observing the moon will be undertaken with those observers having the necessary equipment.

(4) Until and unless another Section is set up for the primary purpose of analysing random observations, the Training Section will serve as the clearinghouse for various lunar drawings. The Section will not attempt to analyse such random drawings but will give them to the proper persons for analysis. Lunar observations should all be used and should not just be filed away and never studied.

"I will be happy to hear from any A.L.P.O. member having ideas on how the Section should be run. In the near future I will print up some helpful material on techniques of observing the moon which will be distributed free to any interested observer."

The Editor has felt for some years that such a training program is much needed. With the coöperation of members it can become an important and rewarding activity of the A.L.P.O.

In Our Next Issue. The May-June, 1962, Strolling Astronomer will contain Clark Chapman's second article on the Simultaneous Observation Program, another article from David Meisel on the recent Comet Burnham, a description and interpretation of A.L.P.O. Venus observations in 1960 and 1961, some pages of Jupiter drawings in 1961 prepared by Phil Glaser, and other items. You will greatly enjoy this issue.

U.S. citizens entering Canada are reminded to carry some kind of proof of citizenship, for example birth certificates.

A program of papers is gradually taking shape. Among the papers so far scheduled are:

1. "New Vistas in Astronomical Optics," lecture by Dr. Alberic Boivin, Laval University, Quebec.

2. "Lunar-Type Terrestrial Vulcanoids," by Patrick Moore.

3. "The Nature of Jupiter's Atmosphere," by Walter Murawski.

4. "The Reduction and Elimination of Instrumental and Atmospheric Effects using Glare Screens and Filters," by Rodger W. Gordon.

5. "The Scientific Conscience," by Robert M. Adams.

6. "Planetary Colorimetry, 1962," by Charles H. Giffen.

Other papers are expected from Joseph Ashbrook, Philip Glaser, Joel Goodman, and Clark Chapman.

The eventual final list will be much longer.

This meeting at Montreal will be the first time that our A.L.P.O. has held a Convention by itself. Your support with ideas, papers, and exhibit materials and, if possible, your attendance are thus particularly requested. This Convention will be, to our knowledge, the first time that an American amateur astronomy group has met outside of the United States, surely a proper development. Skies allowing, Jupiter and Saturn will be available for observation in the evening sky during the Convention.

Though essential, these things cited above are certainly not the best part of astronomical meetings. One remembers afterwards the stimulating informal discussions between paper sessions, very late (or very early!) coffee parties, the new friends one makes, the old ones whose acquaintance is renewed and refreshed with common memories, and some odd idea or two upon telescope design, instrumental procedures, or the like.

See you at Montreal!

THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS, 1947-1962

By: Walter H. Haas

With this issue we come to the fifteenth anniversary of the founding of the A.L.P.O. and the initiation of this periodical. Both were born in March, 1947. It is gratifying that many of the "charter members" are still members, namely these: David P. Barcroft, Dr. Albéric Boivin, Ralph N. Buckstaff, Charles Cyrus, Charles A. Federer, Dr. James Q. Gant, Jr., Fred M. Garland, Walter H. Haas, Theodore R. Hake, Lyle T. Johnson, Russell Maag, Hal Metzger, Oscar Monnig, Dr. Robert Lee Moore, A. W. Mount, Elmer J. Reese. David Rosebrugh, Milton Rosenkotter, J. Russell Smith, Howard D. Thomas, Dr. Clyde W. Tombaugh, Frank R. Vaughn, Jr., and the Yakima Amateur Astronomers--a surprisingly large number from the few dozen members we had 15 years ago. A number of other friends of those early days now live only in our memories.

In a period of history characterized by rapid and violent changes everywhere astronomy is not what it was in 1947, nor even lunar and planetary astronomy as pursued by amateurs. No doubt the most striking change is the beginning of Man's pentration of space. In 1947 it was definitely scientifically risqué to speak of space flight, unless in the vaguest terms and not before future centuries; in 1962 great sums of public money are being spent to achieve manned exploration of the moon. The corresponding government subsidization of professional astronomy and job opportunies of many kinds for persons with some astronomical background are in great contrast to what was true 15 years ago. In 1947 the average amateur used a 6-inch reflector and often searched hard to learn of sources of telescopic accesories he wanted; in 1962 he frequently employs 8- to 12.5-inch telescopes and has a wide choice of goods from competing commercial companies. In 1947 many amateurs lived and worked alone; in 1962 there is a greatly increased number of astronomy clubs and of national and regional annual conventions. In 1947 the methods of observational and analytical lunar and planetary amateur astronomy were largely the classic visual techniques of several preceding decades; in 1962 there is much talk (though much more talk than actual performance) of replacing these with more sophisticated methods such as photography, photometry, micrometric measures, radio telescope studies, electronic computer reductions, and the like.

I have noticed much concern among many of our members as to how the A.L.P.O. can assist professional scientists in space research. I have also noticed much concern about our relations with professional astronomers and about how we can have our work "accepted" by them. These are not easy questions, nor should we expect simple answers. It is hardly the function of amateur astronomers to compete with large agencies spending vast sums of federal money on complex space programs. If and when we reach a day of continuous close-up television surveillance of every planet, then what the amateur may do from the earth's surface is scientifically slight. Our avocation would presumably have value for little but training observers, learning techniques, and personal pleasure. That day is not here yet, however; and we may well be entering a period when the reliable amateur observer is potentially of great value to the professional research space scientist, whose specialty is often not astronomy. How well the potential is to be realized will naturally depend upon cooperation on both sides. It may be significant and symptomatic that the A.L.P.O. was recently requested to participate in a well-known coming space experiment.

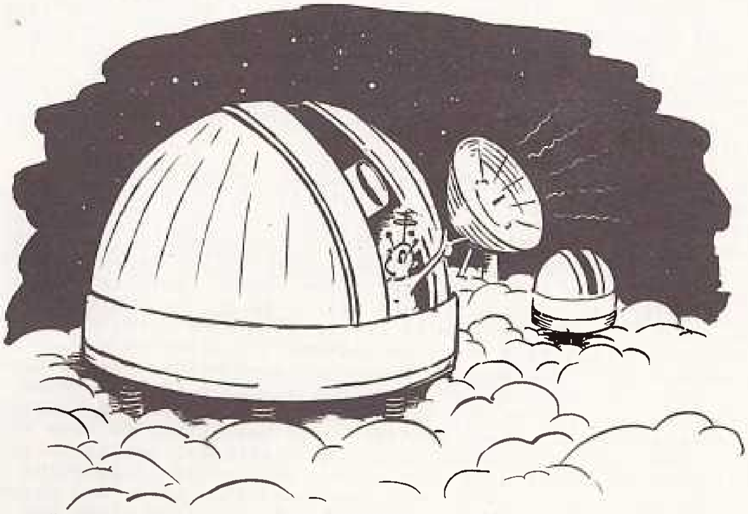
I have noticed in recent years a substantial amount of criticism from some of our members of the methods and results of lunar and planetary studies. To some extent, perhaps, we merely have here that youth is again discovering the failures of previous generations. However, in so far as we are showing an increased capacity for objective self-criticism and for recognizing our limitations, this trend is a very fine thing. Ability to evaluate and to weigh objectively are important assets to any scientist. We know, of course, that the A.L.P.O. can be improved in many ways. After 15 years of operation, we still find our observations too often to be small in quantity (regularly with planets visible only after midnight) and disappointing in quality (as with highly discordant sketches of Venus with small apertures). We have not solved the problem of needed rapid communication between active observers, and amateur radio has failed to show that it is the answer. We have established an A.L.P.O. Library, but it is still used much too little. The growth of some of our observational programs makes effective worldwide cooperation more important than ever, but observational contributions from colleagues overseas have declined since our early years. Nor have we worked out details of really effective liaison with lunar and planetary groups in other countries.

What we have achieved during our first 15 years has been possible only because of many different kinds of help from many different people, far more than can be mentioned. It has been a great pleasure to recognize the work of some of our friends with the nine A.L.P.O. Awards given to date--to Dave Barcroft, Frank Vaughn, Tom Cragg, Elmer Reese, Alika Herring, David Meisel, Tom Cave, Clark Chapman, and Alan McClure. Others have assisted the A.L.P.O. in diverse ways--with observations, papers for *The Strolling Astronomer*, papers for Conventions, material for exhibits, ideas in correspondence, gifts to the A.L.P.O. Library, and even direct financial aid. We have greatly enjoyed our relations with our colleagues in the Astronomical League and the four A.L.P.O. Conventions we have held with them (Kansas City in 1957, Ithaca, N.Y., in 1958, Haverford, Penna., in 1960, and Detroit in 1961). We have also greatly enjoyed our relations with our colleagues in the Western Amateur Astronomers and the four Conventions held with them: Flagstaff in 1956 (First A.L.P.O. Convention), Pasadena in 1958, San Jose, Calif., in 1960, and Long Beach, Calif., in 1961. There was also, of course, the unique Nationwide Amateur Astronomers Convention at Denver in 1959. A special word is owed to the late Carl Richards, whose donation of his set of back issues made possible the first complete library file of The Strolling Astronomer, at New Mexico State University. Later David Rosebrugh supplied his set to create a second such file at the Library of Congress. We owe much to the interest and cooperation of our publishers, who have been (after the first year or so) the Stevens Agency at Albuquerque, New Mexico, the Bronson Printing Company at Las Cruces, New Mexico, and the Mercedes Enterprise at Mercedes, Texas. The assistance of David P. Barcroft as Secretary has been invaluable. From 1959 to the present Pan American College has furnished substantial secretarial help with the preparation and mailing of The Strolling Astronomer. And not least of all, for their contribution is instead most essential, we are grateful for the selfless and considerable contributions of our staff members, past and present, as follows:

Mercury Recorders--C. B. Stephenson, Donald O'Toole, Jackson T. Carle, Owen Ranck, Geoffrey Gaherty, Jr.

Venus Recorders--Thomas R. Cave, Jr., James C. Bartlett, Jr., William K. Hartmann.

Mars Recorders--D. P. Avigliano, Frank R. Vaughn, Ernst E. Both, Leonard B. Abbey, Jr.



"Of course we must send them congratulations - they've been observing US for fifteen of their orbits."

(Translation by Interplanetary Communications Commission)

FIGURE 10. Contemporary view of unidentified Planet X. The elevator observatories above the cloud cover and the use of radio receivers to transmit messages should be noted. Contributed by Edgar Paulton, Chairman Emeritus of Observing Group, Amateur Astronomers Association, New York City.

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Jupiter Recorders--Elmer J. Reese, Edwin E. Hare, Ernst E. Both, Robert G. Brookes, Henry P. Squyres, Chester J. Smith, Phillip W. Budine, Philip R. Glaser.

Saturn Recorders--Thomas Cragg, Phillip W. Budine, Joel W. Goodman.

Uranus-Neptune Recorder--Leonard B. Abbey, Jr.

Comets Recorder--David Meisel.

Lunar Meteor Search Recorder--Robert M. Adams.

Lunar Recorders--Alika K. Herring, James Q. Gant, Jr., Walter H. Haas, Leif J. Robinson, Clark Chapman.

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Book Review Editor--J. Russell Smith.

The first 15 years of the existence of our Association have brought us great personal satisfaction and many deep rewards. Let us go forward then with constant efforts to improve the standards of our work on the moon and the planets. With the continuing support and cooperation of you, the members of the A.L.P.O., an active and fruitful future is assured.

JUPITER IN 1961 - PART II
(A Discussion of Selected Phenomena as Observed by A.L.P.O. Members.)

By: Philip R. Glaser

Perhaps the most interesting and unusual Jupiter apparition of recent years has just ended and while new observational material is being received by the Jupiter Section almost daily, your Recorder hopes that the following short discussion of certain unusual features of the planet's 1961 aspect may be of interest at this time. In particular, it is hoped that it will encourage our fine group of A.L.P.O. observers to resume systematic Jupiter study as early as possible in 1962 in order that the extensive and dramatic activity which has been evident in 1961 may be followed as closely as possible.

The Observers. There follows a list of the participating observers, based on reports received up to February 8, 1962.

Observer	Telescope(s)	Station
Larry Anthenien	6" refl.	San Jose, Calif.
S. W. Bieda, Jr.	6" refl.	San Jose, Calif.
Gil Bisjak, Jr.	6" refl.	Chino Valley, Arizona
Jean Paul Boudreault	5" refr.	Cap de la Madeleine, Quebec, Canada
Klaus R. Brasch	8" refl.	Montreal, Quebec, Canada
Phillip W. Budine	4",2.4" refrs.	Binghamton, New York
Arthur Burns	6" refl.	Barrington, New Jersey
Clark Chapman	10" refl.	Buffalo, New York
Douglas Cooke	4" refl.	San Diego, Calif.
Dale P. Cruikshank	12" refl.	Des Moines, Iowa
	4.3" refr.	Tucson, Arizona (?)
Charles M. Cyrus	10" refl.	Baltimore, Md.
René Doucet	5" refr.	Cap de la Madeleine, Quebec, Canada
Jean Dragesco	10" refl.	Le Vesinet, France
Jack Eastman	12" refl.	Manhattan Beach, Calif.
Stanley Emig	8" refl.	Leavenworth, Wash.
Stuart Emig	8" refl.	Leavenworth, Wash.

The Strolling Astronomer

Founded In 1947

THE JOURNAL OF THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

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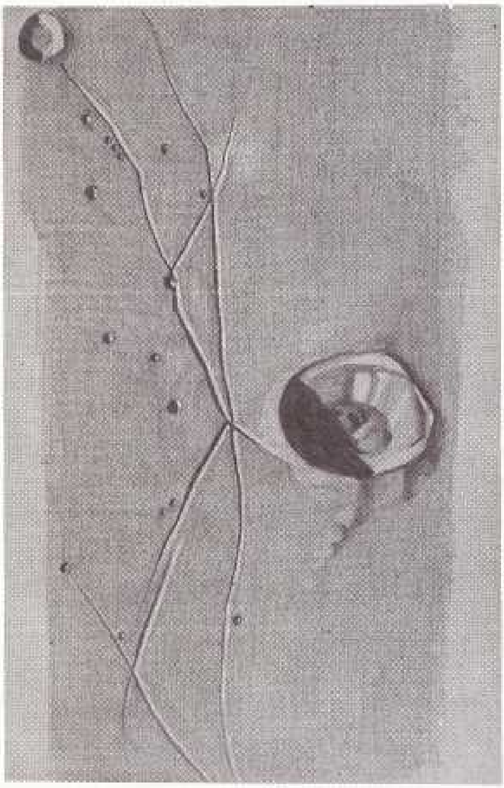

Lunar Crater Triesnecker and System of Clefts to its West. Drawing by Charles M. Cyrus on July 21, 1961, 0 hrs., 55 mins., to 1 hr., 45 mins., Universal Time. 10-inch reflector, 316X, seeing 6, transparency 4. Colongitude 8.4 degrees (low morning lighting).

THE STROLLING ASTRONOMER

Pan American College Observatory Edinburg, Texas

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ASSOCIATION OF LUNAR & PLANETARY OBSERVERS — ALPO

IN THIS ISSUE

NOTE ON COMET HUMASON, 1961e

By: David D. Meisel, Comets Recorder

This object is now becoming available for detailed observation. The Comets Section is very desirous of obtaining a long series of photometric and photographic observations for correlation studies with solar activity. The object should be visible in small instruments and is well placed for southern observers. The following ephemeris is provided from Marsden's elements.

Date 1962		Position R.A.	Position Dec.	Distance Geocentric Δ	Distance Heliocentric r	Stellar Magnitude
June	15	0h 05m.64	+ 5° 22'.5			
	25	0 02.17	+ 4 06.2	2.668	2.866	8.2
July	5	23 55.52	+ 2 16.4			
	15	23 44.60	- 0 18.8	2.128	2.725	7.5
	25	23 27.98	- 3 54.0			
Aug.	4	23 04.07	- 8 40.7	1.682	2.593	6.8
	14	22 31.66	-14 34.6			
	24	21 51.25	-20 57.5	1.471	2.472	6.2
Sept.	3	21 06.40	-26 41.9			
	13	20 23.06	-30 55.3	1.588	2.366	6.2
	23	19 46.32	-33 33.1			
Oct.	3	19 18.13	-35 02.3	1.926	2.276	6.5
	13	18 57.94	-35 51.8			
	23	18 44.22	-36 21.7	2.323	2.205	6.8
Nov.	2	18 35.39	-36 43.4			
	12	18 30.16	-37 03.1	2.678	2.157	7.0
	22	18 27.53	-37 24.3			
Dec.	2	18 26.73	-37 48.8	2.933	2.134	7.1

It is hoped that all A.L.P.O. observers will attempt observations of this unusual object. Reports may be submitted to the Comets Section during or after the observing period.

REPORT ON DR. K. KORDYLEWSKI'S "CLOUD SATELLITES:" A NEGATIVE OBSERVATION OF THE L 4 POSITION

By: Richard G. Hodgson

News of the alleged discovery of faint satellite clouds revolving around the Earth in the Moon's orbit, approximately at the libration points (60° ahead of and also 60° behind the Moon) by Dr. K. Kordylewski of Crakow Observatory, Poland, first came to my attention through a brief announcement in Sky and Telescope magazine, Vol. XXII, No. 1 (July, 1961), p. 10. This was followed by a more detailed report in the same magazine in Vol. XXII, No. 2 (August, 1961), p. 63f, and a note by G. Fielder in The Journal of the British Astronomical Association, Vol. 72, No. 1 (1962), p. 48. Dr. Kordylewsi claims discovery of two faint clouds near the L 5 point, 60° behind the Moon in its orbit. These he reports were visible to the naked eye on very dark, clear nights, and were first photographed early in 1961. He suspects that there may be also a cloud or clouds of satellites at the L 4 position, 60° ahead of the Moon in its orbit.

The first opportunity to observe the L 4 position favorably in the northern hemisphere was on October 18, 19, and 20, 1961. Unfortunately for me, clouds prevented observation on October 18 and 20; but I was afforded a very good opportunity to search the L 4 position on October 19, from 5^h30^m to 5^h50^m U.T. on Pigeon Hill (alt. 180 ft.), Rockport, Massachusetts. Seeing was very good (7 on a scale of 10); transparency was good to very good

(3 to 4 on a scale of 5). The area was quite dark, and in the country, away from city lights. After the Moon had set, I began to search Pisces, particularly the vicinity of ν Piscium, with 7 x 50 binoculars and with the naked eye. The search was carefully extended at least 15° and up to 20° in every direction from the L 4 position. The whole area was swept completely several times. There was no evidence of any clouds or whitish patches.

From this observation I conclude that if there is a cloud or clouds of satellites at or near the L 4 position, it or they must be quite faint, and well below the threshold of naked eye visibility.

I await with interest knowledge of any other observations of the L 4 and L 5 positions.

ADDITIONAL DRAWINGS AND PHOTOGRAPHS OF JUPITER IN 1961

Mr. Philip R. Glaser, the Jupiter Recorder, supplied a large number of drawings of the Giant Planet to illustrate his article "Jupiter in 1961--Part II" on pp. 89-95 of our March-April, 1962 issue. Unfortunately, space was not available to publish most of them in that issue. We accordingly present in this present issue five full pages of Jupiter drawings, pages 101 to 105, inclusive. While we greatly regret this separation of text and illustrations, we still urge all students of Jupiter to study this material with some care; it will illustrate many of the points discussed in the two earlier articles about Jupiter in 1961.

We also publish on this page several photographs of Jupiter by Mr. Glaser. It must be appreciated that there is invariably some loss of photographic detail in reproduction.

Our Jupiter Recorders, Messrs. Glaser and Reese, urge all Jupiter observers who have not yet done so to begin systematic studies of Jupiter as soon as they can.

FIGURE 30.* Photograph of Jupiter with an 8-inch reflector by Philip R. Glaser. August 11, 1961. $4^h 35^m$, U.T. $C.M._1=299°$ $C.M._2=346°$ Note Red Spot and dark spots to its south.

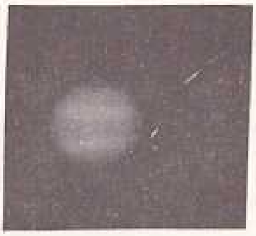

FIGURE 31.* Photograph of Jupiter with an 8-inch reflector by Philip R. Glaser. August 17, 1961. $3^h 36^m$, U.T. $C.M._1=131°$ $C.M._2=132°$ Note STeZ bright oval BC and much darker section of STB.

FIGURE 32.* Photograph of Jupiter with an 8-inch reflector by Philip R. Glaser. September 16, 1961. $1^h 45^m$, U.T. $C.M._1=120°$ $C.M._2=253°$ Note bright bay on north edge of NEB.

While recognizing that photographs of the quality of the originals of Figures 30, 31, and 32 are of limited scientific value, Mr. Glaser also stresses that such photographs are extremely helpful to him in the analysis of Jupiter Section visual data.

*These numbers are in sequence after Figures 1 to 29 on pages 101-105.

stream caused temporary coma expansion for several days after the 30th. Contrary to the behavior of the "blue" coma, the images in red light showed violent fluctuations of an apparently random nature. Since the visual appearance of the coma is dependent on the superposition of both the red and blue images, it would seem that the variations observed visually were due mainly to variations in the red-yellow coma and tail images. The tail length visually reached its greatest extent after a brightness maximum. On the other hand, the maximum coma extent nearly coincided with the time of minimum of the short-period brightness component. For the slowly varying component an opposite behavior seems to be indicated. On May 4 the slow component was at maximum. On the same date, the coma extent was nearly maximum as was the tail length. Since the brightness components have been identified, structural variations can be similarly assigned, which are:

1) A slowly varying, dimensional fluctuation going directly with the slowly varying brightness component is present, apparently induced by increased ultraviolet excitation affecting the blue coma and tail images.

2) A rapid variation of the red and yellow images varying in an opposite sense from that of the short term brightness variation. Apparently, corpuscular streams "tear off" the tail material, at the same time exciting the low luminosity outer coma regions. The exact excitation mechanism is still unknown.

3) Color index variations previously mentioned are apparently due to the red-yellow short-term variation.

It can be seen from the foregoing discussion that the volume of material received and collected on Comet Burnham 1959k was great. It is indeed fortunate that the comet was so close to the earth during the height of great solar activity. During this same period the Pioneer V space probe was functioning some 10 million miles away. This stresses the value of space experiments in solar and terrestrial-comet relations as it would have been nearly impossible to identify some of the flare actions without the preliminary data from the probe. Nevertheless, the data from the space probe pose a problem. Because there is so much information now available, the final results from this research on Comet Burnham and indeed on several other objects will be some time in emerging. Thus all those interested in final results will have to be even more patient now than while waiting for the appearance of this paper.

References

1. Bouska, I.A.U. Circular, No. 1730, June 15, 1960, and Z. Sekanina, I.A.U. Circular, No. 1735, July 19, 1960.

2. Statistik and Physik der Kometen, see Richter, pages 59-60. This formula is obtained from Lewin's theoretical formula by neglecting a factor of $(r^{-\frac{1}{4}})$ which apparently in the case of 1959k is significant.

3. Richter, op. cit., p. 61. Also, Lewin, "Variation der Helligkeit der Kometen in Abhängigkeit von ihrer Sonnendistanz," Abh. Sowj. Astronomie, Folge I, page 105, (1951) and Lewin, Ber. Akad. Wiss. UdSSR 38, 82 (1942).

4. Akasofu and Chapman, "A New Theory of the Aurora Polaris," American Rocket Society Technical Paper 1444-60. Presented at the ARS 15th Annual Meeting, Dec. 5-8, 1960.

ABSTRACTS OF FOUR PAPERS GIVEN AT THE EIGHTH A.L.P.O. CONVENTION

By: Thomas R. Stoeckley

Foreword by Editor. The following four papers were presented at the Eighth A.L.P.O. Convention at Detroit, Michigan, in July, 1961. The abstracting has been done by Mr. Thomas Stoeckley of Fort Wayne, Indiana. Mr. Stoeckley attended the 1960 Pan American College Summer Institute in the Astro-Sciences and is now a student at Michigan State University. We regret that available space does not allow us to publish these papers in full.

Molds, Mosses, and Martians

By: James C. Bartlett, Jr.

Many early writers attempted to describe the anatomy of extra-terrestrial races in terms of adaptation to the supposed environmental conditions on other worlds, leading to grotesque and ridiculous conceptions that are nowadays laughed at. Yet today, our knowledge of extra-terrestrial conditions, still meager, is constantly being modified by new determinations. When we reach Mars, we will undoubtedly find life forms completely different from anything we expected.

The whole concept of Martian life has rested upon the nature of the blue-green "maria"; yet, the Martian deserts may be equally good indications of life. The great uniformity of the color (attributed to iron oxides derived from the oxidation of granite) over so vast an area demands a suspiciously immense amount of weathering. Simple plants and animals manufacture substances which, when dissolved, greatly increase the weathering rate of many rock and mineral forms. Iron bacteria, for instance, have the property of oxidizing ferrous solutions, and apparently even iron metal, to insoluble ferric hydroxide. Higher forms of life are also known to concentrate mineral substances. Vital activities such as these could account for the mineral colors and extent of the Martian deserts, formerly believed to be devoid of life.

The Man from Space

By: Carlos E. Rost

We, as amateur astronomers, are well acquainted with the problem of trying to conduct astronomical research from the bottom of a turbulent atmosphere. Flustered by these adverse conditions, we would give anything to become one of those popularly conceived "men from space" of our popular literature and movies.

But, in a sense, we have already been able to throw off our atmospheric blanket and take to the heavens in the form of man-made instruments that can reach out and discover information that we, as yet tied to the earth, cannot seize. Lunar probes, high-altitude research programs, and many satellites orbiting the earth and sun are all present-day representatives of our "men from space". And tomorrow, true "spacemen" shall undoubtedly be operating astronomical research bases on the moon.

At the dawn of this new age we still find widespread misbeliefs and misconceptions about astronomy and related sciences. Yet, as Science advances, mankind will change his thinking in the light of newfound knowledge; and the fictional "man from space" shall be replaced by a closer realization of the true mysteries of the universe.

Remarks on A New Interpretation of Martian Phenomena

By: Minick Rushton

Recently a new interpretation of Martian pehnomena has been advanced, based on the spectroscopic evidence that the oxides of nitrogen may be present in large quantities in the Martian atmosphere. The polar caps may consist of solid nitrogen tetroxide, and the observed darkening as the polar cap recedes can be attributed to reactions of southward-flowing nitrogen dioxide with surface deposits. Blue clouds may be a mixture of NO_2, NO, and N_2O_3; yellow clouds, a high concentration of NO_2; and white clouds, a condensation of N_2O_4. The blue clearing can be explained, but not without flaws, as a change of yellow NO_2 to colorless N_2O_4 due to a sudden drop in temperature.

Although these explanations fit well the observed characteristics, two assumptions contrary to present belief are required: (1), Water must be totally absent on Mars, since water reacts with all nitrogen oxides to form nitric acid; and (2), the atmospheric pressure must be at least 140 mms. to account for the melt band. Both assumptions, unfortunately, are opposed by evidence to the contrary.

Although it represents a radical departure from current thought, this new theory should at present be considered along with presently accepted beliefs.

The Lunar Programme of the Montreal Centre, R.A.S.C.

By: George Wedge

The lunar program of the Montreal Centre, Royal Astronomical Society of Canada, is divided into four different projects:

The first is a lunar training course for new observers, designed to familiarize the beginner with lunar topography and to help him acquire experience in sketching at the telescope.

Pencil sketching of lunar formations is the second project. In special cases, continuous study of single formations is being undertaken.

The third project consists of searching for lunar domes and plotting their positions on a map.

Lunar cartography, the fourth and most ambitious project, is being limited to mapping only a few small regions at a time. Each observer records his observations on a base map, obtained by tracing regions from high-quality photographs and enlarging to a scale of 200 inches to the moon's diameter. The base maps of all observers will be used to compile the final map.

BOOK REVIEW

The Planet Venus. Third Edition. Written by Patrick Moore. Published by Faber and Faber, London, June 26, 1961. 18 shillings (Macmillan, N.Y., $3.75). 151 pages, 8 plates, 8 figures, fifteen chapters plus four appendices.

Reviewed by William K. Hartmann

Most readers of this review will be familiar with Mr. Patrick Moore's series of astronomical books. Thus, let me first say only that this one is a typical Moore product: very readable, full of interesting historical notes, designed for and of interest to, (1) the beginning amateur or young student of astronomy, say from junior high school level on, (2) the more advanced amateur without any technical training in physics, math, and/or astronomy, who wants to learn more about what is known and what he might see on the planet, and (3) the advanced amateur or professional with technical knowledge who wants to know more about the history of his subject especially before about 1900, and who may want handy bibliographic references to more advanced articles in the "learned journals."

Like the earlier editions, the third edition of The Planet Venus is divided into a series of chapters covering various topics such as movements of Venus, dark areas, rotation, ashen light, etc. However, the new edition has been considerably expanded and revised. Some new developments, such as the evidence for water vapor resulting from the 1959 balloon work, have been added. Also, the results of Mr. Moore's recent visit to the U.S.S.R. are evident: a great many fascinating references to Russian work, both historical and contemporary, are included. It is of further interest to note that a Russian edition is being prepared. A final advance over the older edition is an expansion of the bibliography. References from points in the text to the literature now number 385 (not all different) versus the 155 of my first edition.

Traditionally, reviewers keep an eye peeled for flaws. The best I can do is this: in a discussion of attempts to determine the obliquity of the axis of Venus, pp. 57-58, no reference is made to a 1955 paper by R. S. Richardson, giving what is probably one of the better modern determinations, although this paper is listed twice in another chapter as references 142 and 146.

Next, I will comment on some statements which I thought were a little strong: "...it seems...best to dismiss the [cusp-collars] as optical effects..." (p. 62); "The terminator seldom appears entirely regular..." (p. 74); and "...when two observers show linear streaks, there is never any real agreement..." (p. 94). In answer to these statements, respectively, I would suggest that the cusp-collars often seem to fit in with the ultraviolet photographic bands, that only a minority of observations show the terminator as other than a regular curve, and that the last statement applies no more strongly to linear streaks than to any other kind of marking (see comparisons of simultaneous observations in the 1960-61 Venus Section Report, prepared before this review was written, Parts 1-5 appearing elsewhere in this issue). This paragraph has concerned matters of interpretation. Thus, it does not demonstrate errors in the book, but rather highlights points of controversy which serve as examples of fields where groups like the A.L.P.O. and the B.A.A. may do useful work.

Perhaps the most basic criticism that someone might make of a book like this one is the charge that it puts too much emphasis on historical and amateur work and too little on modern astrophysical investigation. However, there is an answer to this charge. In the first place, Mr. Moore recognizes this problem in the foreword to the second edition, and has expanded coverage of modern results. But the real answer, I think, is that the book does not pretend to be an advanced astrophysical text. It is aimed at those readers described in the first paragraph. It mentions modern results (of which there are precious few) but does not attempt to explain in detail modern methods. Similarly, it does not go into the physics of planetary models, and in this sense is not on the level of de Vaucouleurs' Physics of the Planet Mars. It does not attempt to provide the answers to all the mysteries of Venus, but instead points out clearly that little is really known. In short, it does what it sets out to do and does that well.

The third edition is new and different enough that it would make a good replacement for the first edition as well as a worthy addition to any planetary library. If you fit into one of the categories mentioned in the first paragraph, then it may be said that you should read Moore.

PROGRESS REPORT ON THE A.L.P.O. LUNAR METEOR PROJECT: DEC. 1, 1960 TO JAN. 31, 1962

By: Robert M. Adams

This paper presents a summary of the observations covering the period from Dec. 1, 1960, to Jan. 31, 1962. As in previous years, all participating stations were located at a distance from each other sufficient to distinguish lunar flashes from earthly meteors. The bulk of the observations were again obtained from the several stations comprising the Montreal Groups, those of the Montreal Centre and those of the so-called French Center of Montreal.

The following individual observers were engaged in the meteor search program for the stated total amounts of observing time:

Larry Anthenien, San Jose, California, 6" reflector, hours unknown.
H. M. Blake, Tracy, California, 4¼" reflector, 1.8 hours.
Dick Nelson, Northridge, California, 16" reflector, hours unknown.
Bruce Weaver, Catskill, New York, 6" reflector, 4.5 hours.

Observers from the Manchester, Connecticut, group: Eugene Spiess with his 5" reflector and Dan and Doris Fraher, who operate a 3" reflector. Spiess 1 hour, Frahers 1 hour.

The Montreal Centre comprised 9 active stations. These are: Miss I. K. Williamson, C. M. Good, E. M. Towne, operating station 1 using an 80 mm. refractor; G. Gaherty, G. Wedge, K. Chalk, C. Papacosmas, J. Low, operating station 4 using a 6" reflector; G. Gaherty, K. R. Brasch, G. Wedge, operating station 5 using an 8" reflector; W. A. Warren, operating station 8 using a 6" reflector; Miss E. Sundell, R. Sundell, operating station 13 using a 6" reflector; V. Williams, operating station 14 using a 6" reflector; K. R. Brasch, operating station 17 using an 8" reflector; Mrs. E. E. Bridgen, operating station 18 using a 4½" refractor; K. Chalk, operating station 19 using a 6" reflector; W. A. Warren, operating temporary station X using a 6" reflector. Each observer contributed the following hours of observations: Brasch 2.6 hours, Mrs. E. E. Bridgen 1.7 hours, Chalk 2.4 hours, Gaherty 3.9 hours, Good 1.7 hours, Low 0.25 hours, Papacosmas 1.7 hours, Miss E. Sundell 1 hour, R. Sundell 0.5 hours, Towne 0.4 hours, Warren 5.4 hours, Wedge 5.8 hours, V. Williams 11.25 hours, and Miss I. K. Williamson 7.2 hours.

The French Center comprised one station which usually worked in coordination with the Montreal Centre. Using 3-1/4", 3-7/8", 6", and 8" telescopes, the observers were Mrs. J. P. Jean (the group leader), Father Buist, Mr. A. Rousseau, Mrs. Y. Cahrest, Mr. Mailloux, Mr. Lemieux, Miss E. Guay, Mrs. L. Pideaux, Pierre O'Keefe, Miss F. A. Laforest, Brother DaMasse and Raymond Masse. Each observer contributed as follows: Jean 2.5 hours, Buist 0.15 hours, Rousseau 0.03 hours, Charest 0.1 hours, Mailleux 0.15 hours, Lemieux 0.1 hours, Guay 0.16 hours, Pideaux 0.16 hours, O'Keefe 0.16 hours, Laforest 0.16 hours, DaMasse 0.16 hours, and Masse 0.21 hours.

There were a few reports of individual flashes and light trails; but since this project is concerned with overlapping observations, only those observations where there was actual overlapping will be described. All times are given as Universal Time.

On Dec. 20, 1960, two or more of Montreal stations 1, 5, 8, and 17 overlapped for over 15 minutes from 23:00 to 23:16. On Jan. 19, 1961, two or more of stations 1, 5, and 8 observed from 23:12 to 24:00. As Mr. Brasch states, "I'm freezing." Three cheers for our Canadian friends! On the 21st when it was 3 below zero four stations overlapped most of the time: 1, 4, 5, and 8. The times were from 23:00 to 24:00 with at least two of the stations at their 'scopes. As Mr. Brasch reports, there was "much detail on the dark side." On March 20, with transparency fair, stations 14 and 18 overlapped from 0:00 to 0:14. On March 21, 1961, when the transparency was good to very good stations 4 and X observed with continuous overlapping from 00:10 to 00:32. On the 22nd stations 4 and 14 observed continuously from 00:00 to 01:00. On April 19, 1961, stations 1, 4, and 14 managed to overlap between the three of them from 00:30 to 01:30. As Wedge states, "observations abandoned because of cloud and refractor cramp." On the 20th four stations, 1, 4, 8, and 14, were on duty from 00:30 to 01:30 with continuous overlapping coverage by at least three of the stations. On the 21st stations 4, 8, and 14 reported continuous coverage from 00:30 to 01:30 with excellent transparency. G. Wedge at station 4 reported an object at 01:16 moving northwesterly across the field of his 6" refractor and red in color. Mr. Wedge realized it to be a terrestrial phenomenon. Mrs. J. P. Jean, not then a contributor to the A.L.P.O. meteor search project, reported to Mr. Gaherty that she had seen two more similar objects moving in a northeast direction and seeming to originate on the dark side of the moon from the Herodotus and Boscovich regions. The time of this observation was about an hour later than that of the one seen by Wedge, thus 02:20. A 3" refractor was used, and the object was believed to be of the 5th magnitude. On June 19, 1961, stations 1, 4, and 18 overlapped their observations from 01:30 to 02:15 for most of the time with rather poor seeing conditions consisting of clouds and haze. C. Papacosmas reported flash activity at 02:05:47 at station 4, consisting of a point flash of duration one second, white in color and in the vicinity of Descartes; and this was seen twice in the following two minutes. When Mr. Gaherty took over the 'scope at 02:11 to relieve Papacosmas "there were still hints of some sort of activity in this region. Papacosmas and I feel this effect might have been caused by a sunlit peak, although the flash was quite a distance from the terminator." Stations 1 and 18 did not confirm this phenomenon although they were observing at the same time. On July 19, 1961, stations 4 and 17 overlapped from 01:38 to 01:56 with the exception of from 01:45 to 01:50. On the 20th stations 4 and 8 overlapped from 01:33 to 02:00. The Montreal Centre was a buzz of activity in August, 1961. On the 17th at least two of the stations 4, 13, and 14 overlapped from 00:30 to 01:15. On the 18th stations 1, 4, 13, and 14 observed for most of the time from 00:30 to 01:30 while there was overlapping for the whole one hour period. On Aug. 19, 1961, the same was true for stations 1, 13, and 14 from 00:30 to 01:30. Mrs. J. P. Jean's observers observed, taking turns overlapping with stations 1, 13, and 14 on the 18th from 00:30 to 01:30. Mrs. Jean saw a point of light of about the 5th magnitude at 00:53 lasting some two minutes, but this object was not detailed by any one of the three Montreal Centre stations observing at the same time. Two stations searched during the partial lunar eclipse of Aug. 26 but under very poor seeing conditions; stations 8 and 17 overlapped from 03:27 to 03:36. On Sept. 16 stations 1 and 17 watched from 00:00 to 00:30 except from 00:18 to 00:23 when only station 17 observed. Station 14 watched from 00:00 to 00:12. On the 17th stations 5, 14, 19, and X all observed from 00:00 to 01:00 so that at least two stations were watching all the time. Mr. Chalk saw a 4th magnitude short trail, but it was not picked up by the others. On the 18th stations 1, 5, 14, and 17 were all overlapping from 00:00 to 01:00 except for part of the time when only two were watching. On the 15th of October stations 5, 8, and 14 overlapped from 23:00 to 23:28. Mrs. Jean and one of her assistants also watched from 23:00 to 23:20. On November 13 stations 1 and 8 observed from 23:07 to 23:44(?) except for 5 minutes from 23:30 to 23:35. On December 11 there was overlapping between 23:09 and 23:15 at stations 14 and 19. On December 13 there was overlapping from 23:30 to 24:00 as between stations 14, 18, and 19. On January 9, 1962, stations 1 and 14 observed from 23:30 to 00:25 except for 4 or 5 minutes; and on the 10th stations 1, 14, 18, and 19 assured overlapping between them from 23:30 to 00:30.

Thus once more we are confronted with the fact that there were no lunar meteor verifications, and this negative evidence was achieved as the result of very diligent and coordinated observing by as scientific a minded group of observers as exists anywhere. There were several instances of discoveries of short trails or streaks of light, some of which were mentioned above. These were of the order of the third to the sixth stellar magnitude. Those might easily have been judged lunar meteors had we not had negative results from others observing at the same time. These no doubt were earthly meteors coming head on or nearly so. An interesting by-product is the glow reported in the vicinity of Descartes by the seasoned observers Gaherty and Papacosmas.

The writer must report that the leader of the Montreal group, Geoff Gaherty, has had to resign because of the press of college work. Great praise is due to this young man for his indefatigable efforts to keep the Montreal group going. He has turned over his "torch" to his successor, Kenneth Chalk.

Now then a plea is in order for more American observers and for a continuation of the project as a whole. We have seen some rather rough days. I have heard some rather lame excuses and have had some rather critical letters, the gist of which is that it is impossible to tell the difference between an earthly meteor and a lunar meteor. Mr. Chalk has worked up a time schedule for the Montreal group and the French Center. Using this as a basis I add a suggested "universal" time schedule below. The suggestion is to observe on the three nights preceding the 1st night before the moon's First Quarter in every month as follows:

<u>Based on Standard Time</u>

	EST	CST	MST	PST
Dec. and Jan.	18:30 to 19:30	18:00 to 19:00	18:30 to 19:30	18:00 to 19:00
Nov. and Feb.	18:30 to 19:30	18:00 to 19:00	18:30 to 19:30	18:00 to 19:00
Oct. and Mar.	19:30 to 20:30	19:00 to 20:00	19:30 to 20:30	19:00 to 20:00
Sept. and Apr.	19:30 to 20:30	19:00 to 20:00	19:30 to 20:30	19:00 to 20:00
May and Aug.	20:30 to 21:30	20:00 to 21:00	20:30 to 21:30	20:00 to 21:00
June and July	21:00 to 22:00	20:30 to 21:30	21:00 to 22:00	20:30 to 21:30

It will be noted that this plan affords one-half of overlapping between any two adjacent time zones.

CONCERNING THE SPEED OF THE POLAR MOVEMENT DURING THE EARTH'S HISTORY

By: Péter Hédervári, Budapest, Hungary.

According to modern palaeomagnetical research, it is well known that the poles of the Earth have had significant movements in relation to the continents during the Earth's history. Using the data of several explorers, we can calculate how great was the speed of the polar movement in a number of geological periods. In Table I we show the average coordinates of the North Pole, calculated from the data of Hramov, Creer, Irving, Runcorn, Doell, Graham, Campbell, Gough, Du Bois, Wegener, and Köppen respectively.

In accord with the average coordinate-values from the authors mentioned, we calculated the path of the North Pole relative to Europe-Asia, North America, Africa, and Australia. We determined the movement of the pole in kilometers to intervals of 5 million years. Later, we carried out an adjustment of these values. The results were then weighted according to the length of several geological periods, expressing the time-unit in 5 millions of years. Finally, we derived from these results the speed of the polar movement for different periods of the Earth's history.

We also calculated the polar movement in centimeters per year. Table II shows the results. The average value for Europe-Asia is 4.25 cms./yr., for North America 2.97, for Africa 5.26, and for Australia 4.85. It is evident that the order of the polar movement is some centimeters per year. According to the calculations of Wanach, the real movement of the North Pole is 14±2 centimeters per year in the present Century. The agreement between this value and the result of our calculations is excellent, the more so since Wanach's data originated by geodetic methods, but our results from palaeomagnetic and palaeoclimatic data.

Table I

The average geographical coordinates of the North Pole, calculated from palaeomagnetic and partly palaeoclimatic data.

Period	From European Data		From American Data			From African Data			From Australian Data	
Pleistocene	88°N.	147°E.								
Pliocene	76	202(?)	85°N.	150°E.	(?)	70°N.	300°E.	*	86°N.	282°E.
Miocene	80	126(?)	83	135	(?)	75	210	*	(?)	
Oligocene	72	140	82	88	(?)	(?)			67	303
Eocene	72	145	82	88	(?)	45	200	*	67	303
Cretaceous	66	168	74	131		47	220	*	(?)	
Jurassic	63	153	(?)			55	256	**	50	337
Triassic	51	144	58	104		50	235	*	39	323
Permian	46	165	36	115		35	245	*	32	351
Carboniferous	47	144	44	119		30	215	*	39	337
Devonian	34	156	39	124		0	230		66	192
Silurian	42	167	20	138		0	230		60	203
Cambrian	17	169	-1	177	***	0	230		35	197
Upper proterozoic	6	237	28	217		0	230		40	290
Lower proterozoic	35	244	32	216		0	230		6	14

*According to Wegener and Koppen (1924). Palaeoclimatic data.
**The average value of the data of Irving and Wegener.
***-1°N = +1°S (southern latitude).

2. The Strolling Astronomer, Vol. 10, p. 122, 1956.

3. The Strolling Astronomer, Vol. 14, p. 58, 1960.

4. The Journal of the British Astronomical Association, Vol. 71, p. 8, 1961.

THE 1961 A.L.P.O. SIMULTANEOUS OBSERVATION PROGRAM--SECOND REPORT

By: Clark R. Chapman

I. Introduction

Thirty-six observers cooperated by making simultaneous observations of selected lunar craters and planets on fifteen target times in the summer of 1961. This is the second of two articles summarizing the 1961 Simultaneous Observation Program. The first report appeared in the March-April, 1962, Strolling Astronomer and summarized the observations themselves. Included with the article were sample illustrations of drawings made on six of the target times. This second report is devoted to interpretations, explanations, and suggestions toward improving observational accuracy. A number of A.L.P.O. members have written fairly lengthy letters with comments about the problem of observational accuracy. Some of these ideas are included in this report. I would like to thank the thirty-six observers and all the other people who offered suggestions and helped the Simultaneous Observation Program in other ways.

Some A.L.P.O. members have urged that a second Simultaneous Observation Program be undertaken this summer, but the response has not been great enough to warrant another program at this time. One prerequisite for another program is a well-organized simultaneous photographic patrol. No offers for one have been made.

II. The Lunar Observations

There were three simultaneous lunar observation target times. The first lunar target time was August 15, 1961; and the object under observation was the crater Gutenberg, 45 miles in diameter. Eleven observers submitted drawings. Of these, none show enough detail to better even fairly mediocre photographs, and the detail most of them show is distorted or erroneous. For instance, according to Wilkins the diameter of the intruding ring "E" is 14 miles (31% of the diameter of Gutenberg itself). Of ten completed drawings of Gutenberg, two drawings show no trace of the ring, two drawings have the diameter of "E" greater than 45% of the diameter of Gutenberg, and three drawings have the diameter of "E" about 20% of the diameter of Gutenberg. There is even disagreement on the actual shape of Gutenberg itself! Several observers saw Gutenberg practically round, others saw it elliptical, others saw it pear-shaped, and one saw it triangular. Concerning the detail on the floor there is no better agreement. Two observers show a single cleft, while the other observers show numerous arrangements of craters, mountains, hills, and domes. In fact, of all ten of the completed drawings, only one had a fairly close resemblance to the appearance of Gutenberg in the Kuiper Photographic Lunar Atlas. This particular drawing was made under very unfavorable conditions. According to the observer the moon was behind a tree from the position of the telescope mount so that the telescope was "lifted out of its cradle and carried to another part of the yard where it was propped on the back of a chair. The sketch could be a record for having been made under the worst possible conditions. The hour required for the observation consisted of 15 minutes observing, 15 minutes drawing, and 30 minutes cursing the rickety support."

The second lunar target was the crater Herodotus on August 24, 1961. Seven drawings were received. Again, there is practically no agreement on crater shape or on the finer detail. Three of the drawings have the longest dimension of the crater less than one inch in length! (It is usually considered to be impossible to make an accurate drawing on a scale this small.)

Ten drawings were submitted for the September 18 crater Cassini alert. There is agreement that Cassini contains two interior craters, but the observers disagree on the locations of the craters. Most observers saw some floor detail southwest of Cassini A, but the representations of the detail range from a series of dark spots to a white streak. Because Cassini is of a rather symmetrical shape, the drawings resemble each other considerably more than those of the first two lunar alerts, but none of the Cassini drawings comes close to adding any knowledge to selenography.

It would be unwise to publish a series of simultaneous lunar observations side by side in the same manner as simultaneous planetary drawings were published in the last article. I still plan, however, to send the observers themselves some comparative illustrations.

Why are the lunar observations of such poor quality in comparison with the planetary observations? There are several answers to the problem. Many observers have a great deal of difficulty in representing the proportions of a large object. Also, very few observers spend the time and care necessary for drawing a large and complicated object such as a lunar crater. Most amateur lunar observers tackle too much and finish with an incomplete and inaccurate drawing of a large object, rather than with an accurate drawing of a small object. Another reason why observers often have more difficulty with the moon is because of the much greater artistic ability necessary to represent realistically the heights, depressions, shadows, and shadings visible on the lunar surface.

Several conclusions about lunar observations may be reached from this study. The first and most important conclusion is that the making of single drawings of random craters is of practically no scientific use. If lunar studies are to be undertaken by the means of drawings, the observer should have a lengthy period of practice and training and should concentrate on the accuracy of smaller detail. He should trace the framework of the drawing from a photograph (or a <u>good</u> lunar map) and should just add to what is shown on the photograph. In no case should the observer undertake a large object. If an observer is to observe the moon by making drawings he would probably do best by selecting a single formation and then by studying it systematically. A.L.P.O. members should be especially wary of placing confidence in lunar drawings unless the observer has convincingly demonstrated that he has overcome the pitfalls common to most lunar observers. Newer students of the moon would probably do best by trying other types of lunar studies not involving drawings of the traditional type. Some of these ideas are being incorporated in the programs of the newly formed Lunar Sections of the A.L.P.O.

III. The Errors and the Reasons for Them

<u>Unconfirmed work</u>. Drawings of the planets comprise a large part of A.L.P.O. observational work. It is for this reason that I believe it is of primary concern to us that the drawings be accurate and reliable. It is not infrequent that the Recorders place considerable faith in a single observation in the final reports. (For instance, it is possible that the conflicting descriptions of the darkness of the NPR on Saturn in 1960, <u>Str. A.</u>, Vol. 15, Nos. 7-8, page 128, interpreted as actual day-to-day changes, were actually errors on the part of the observers. In the 1961 Saturn Report there is more similar confusion over the NPR: the Recorder reports that intensity estimates indicated that the NPR was the "darkest area on Saturn" while on the majority of 1961 Saturn drawings published on pages 66, 67, and 73 of the March-April, 1962, <u>Strolling Astronomer</u> the NPR is either inconspicuous or totally absent. These inconsistencies are probably the result of observers' errors.) Some people have suggested that the best way to counteract such errors is to disregard any unconfirmed observations. I believe that this principle would be very bad indeed. For instance, one of the most remarkable observations made in recent years was the observation reported on page 102 of the September-October, 1959, issue of <u>The Strolling Astronomer</u>. Mr. Tom Quinn reported seeing a Jovian festoon change position in a period of only twenty minutes on March 29, 1959. Although a friend of Mr. Quinn's was reported to have confirmed the observation, there was no really independent confirmation. Had this observation been disregarded for

lack of confirmation, it would be forever lost from published records. Actually this amazing observation is not erroneous: I happened to be observing at the same time and noted in my observing notebook that "the marking protruding south from the North Equatorial Belt grew very rapidly." This is the only time I have ever observed a rapid change of this type on Jupiter, but I did not report it to the A.L.P.O. because I was not a member at that time. There have been other single unconfirmed observations of importance in the past, and similar ones in the future should not go disregarded. In order to insure more accuracy, however, more discretion should be taken in the interpretation and reduction of observational data so that mistaken observations are excluded from the analyses as much as possible.

Careless drawings. In the past some fallacious drawings have been printed in The Strolling Astronomer. These errors were most obvious when two drawings happened to be made at precisely the same time and disagreed; in addition, several single drawings obviously were in error. The quantitative results of the Simultaneous Observation Program published at the end of the first report indicate, nevertheless, that drawings can be quite accurate in many respects. It seems likely, therefore, that a large factor in the cause of the errors is simple carelessness on the part of the observers. There are other causes of errors which should be investigated in the future.

Artistic styles. One important difference between drawings of different observers is the difference in artistic styles. Every observer has a separate drawing style--no observer successfully draws a photographic view. Some observers have cultivated rather extreme and unrealistic styles. Examples of these can be seen in collections of Jupiter drawings published in past Jupiter Reports. Differences in style can sometimes produce erroneous results in certain analyses while the same drawings can be very reliable in other studies. Differences in style result from many of the other factors discussed below. The different styles become exaggerated at times if the observer falls into a "rut". If an observer loses his open-minded interpretation at the telescope, he may well draw features less as they actually look and more like similar features he has seen in past years. One way an observer can rid himself of an unrealistic style is to experiment with his observing methods and drawing procedures. Try experimenting with different magnifications, different-sized disks, and different pencils. Experiment with your methods of beginning drawings and darkening in the detail. One well-known astronomer made half his drawings of Mars while looking through an inverting eyepiece. (Most Mars observers would probably hesitate to make drawings of the well-known Mars surface features "upside down"; but if the observer is completely objective and open-minded, such an observation should be just as accurate as one made through a regular eyepiece.)

Too sharp boundaries. One common fault of drawings is the tendency of observers to show sharp boundaries to planetary features or sharply linear lines when actually fairly broad bands are seen. The boundaries to Jupiter's belts can never be resolved to perfectly sharp lines--the boundaries must always be somewhat indefinite. Similarly, the Lowellian type of Martian canal is just a misrepresentation of the true features. Mr. James Sitler ran an extensive experiment by having persons draw artificial disks of Mars from various distances. Almost invariably the splotched features on the original disk were interpreted to be straight lines. Many errors of this type could be checked if observers would use blunt pencils for making drawings. A similar misrepresentation occurs when observers draw the cusps of Mercury perfectly sharp even when the seeing is poor. The drawing by Geoff Gaherty during the July 23, 1961, Mercury alert (Figure 3 in the first report) is much more realistic.

Differences in resolution and seeing. Differences in drawings often result from differences in aperture, seeing, and individual visual acuity. Observers with smaller apertures, poorer seeing, or poorer acuity often make drawings which are simplified in comparison with observations made with larger telescopes under better seeing conditions. A double festoon on Jupiter may appear to be one large dark area to a person with less resolving power. During the July 25 Jupiter alert a rectangular hump on the NEB was seen rounded by two observers with smaller telescopes. Linear Martian canals are also over-simplified representations of detail below the resolving power of most instruments.

Contrast sensitivity. Another factor which contributes to differences in drawings and intensity estimates is differing sensitivity to faint shades of contrast. Some observers have very poor contrast sensitivity. Their drawings are characterized by only two or three variations in tone (generally "light", "dark", and "intermediate", with "shadow" a fourth category if a shadow is present). These observers have great difficulty in observing detail within the dark regions on Mars. They also cannot see well the faint shadings visible on the flat lunar regions, in the Martian deserts, and on the planet Venus. Intensity estimates by these observers are likely to be inaccurate, particularly if they have not had experience in estimating intensities. Some other observers have excellent contrast perception. Sometimes such a person will unknowingly exaggerate certain faint differences in tone. In experiments with artificial disks such an observer may draw a large dark spot where none seems to exist on the original. Careful inspection of the original will probably indicate a faint tonal difference. Such an exaggerated representation is as misleading as a three-toned drawing. With practice, such a person can probably estimate intensities accurately nearly down to a tenth of an intensity unit on the A.L.P.O. scale. If you are bothered by being unable to represent successfully with a pencil the great variety of tones you observe when drawing a lunar crater, you probably have excellent contrast sensitivity.

Relative proportions. Another cause for differences in drawings is the factor of estimating proportions. We have already seen great errors in estimations of the shapes of lunar craters. The problem of proportion manifests itself in other ways, too. For instance, some observers systematically draw the dark features on planets too small in relation to the size of the disk. Others tend to draw the dark areas relatively too large. Many examples of these errors were evident in the drawings made by the participants in Mr. Bitler's Mars experiment. Although often these errors are the result of personal differences between the observers, these effects can be caused by other factors. If a low magnification is used on a relatively bright planet such as Mars, irradiation can often cause the dark areas to appear smaller. This tendency has often been given as an explanation for linear representations of the canals. Similarly if a high magnification is used on a fainter planet, or if a planet is observed through very hazy skies, I have found that the dark regions often can appear exaggerated in size.

Systematic positional errors. Another significant cause of variations in observations was revealed by the analysis of the simultaneous drawings: systematic positional errors. Most observers seem to have small systematic errors in position, which, if corrected for, would greatly increase the accuracy of the observations. These errors are brought out well in latitude and longitude placements and in central meridian transits. Positional placements on a drawing tend to be more consistent with other positions on the same drawing than with positions on other drawings by the same observer; however, there is considerable evidence to indicate that there are general "personal equations" which remain true for an observer for a fairly lengthy period of time. Observers should test their own systematic errors and correct for them, if possible, when they reduce their data.

Color sensitivity. Still another cause for error is different sensitivity to color. This circumstance greatly affects intensity estimates and drawings. Leif Robinson considers it to be one of the most important factors. It is well known that different people react to differences in wavelength in very different manners. Some eyes are especially sensitive to certain wavelengths and insensitive to others (this is probably true for most eyes and is not limited to the greatly extreme cases of color blindness). Color can cause important effects even when the color itself is not readily visible. A person with blue sensitivity would probably call the STrZ on Jupiter the brightest zone on the planet right now (June, 1962), while a person with yellow sensitivity would probably consider the NTrZ to be the brighter. This difference in color sensitivity has been considered by some to be an explanation of why some observers see the "spokewheel" pattern on Venus while others see an entirely different pattern. The hypothesis is that both patterns actually exist but that the patterns are of different color. This factor of color is so important that special studies of the effects of color sensitivity would be invaluable to planetary observers.

Pure imagination. Another important problem is the problem of "seeing what isn't there". Many observers attempt (probably unwisely) to draw everything down to the limit of visibility. Some observers invariably fall into the trap of drawing small spots and other features that obviously could not be resolved. The suggestion has been made that the markings seen on Jupiter's satellites with small telescopes are actually features on the diffraction disk rather than on the true disk. Other people will record features which are actually transitory motes in the observer's own eye. There are many other cases where the markings are probably just imagined. This problem is particularly troublesome in Venus drawings. The markings on Venus are especially faint, and it is very difficult to be entirely objective when observing the planet. James Sitler and Joseph Eyer made a series of simultaneous Venus observations between August 28 and 31, 1961, to analyse this problem. These careful observers seem to show real agreement on many of the drawings, but there are still numerous cases of presumably imaginary markings which show up as differences in the two sets of drawings. An observer can usually discover whether he suffers from the error of drawing features which do not exist by comparing his drawings with other drawings made by himself as well as by other observers.

Other factors. Some of the largest and most glaring errors in drawings cannot be explained by any of the factors mentioned above or by other less important factors such as twilight, altitude in the sky, transparency, etc. (which usually cause negligible differences except in extreme cases). The remaining possibilities are that the observer was inexperienced, careless, or sleepy. An observer should always be careful to make accurate and thorough observations. We cannot compete with professionals in the amount of work we do, nor in the extensiveness of our equipment; but there is no reason why our smaller tasks cannot be done carefully and thoroughly.

IV. Recommendations and Suggestions

The best way for the typical lunar and planetary observer to correct for the factors which lead to errors and differences is for the observer to acquaint himself with these factors, analyse his own errors, and correct for his errors. Doing so will require a considerable amount of conscious effort on the part of some members of the Association. More programs similar to the Simultaneous Observation Program should be run in the future with more controls and more participation. One type of Simultaneous Observation Program which should be carried out would be one conducted by members of a local astronomy club so that precise physiological and psychological tests could be made on each observer to serve as controls. Another Simultaneous Observation Program throughout the whole A.L.P.O. would serve to educate the observers to the problems of observing and would be very useful. Individual observers who insist on drawing exceedingly fine canals on Mars or numerous ring divisions on Saturn's rings should conduct their own tests with artificial disks to prove to themselves the impossibility of such observations. Few observers maintain that Dawes Limit can be bested by a factor of two on double stars, but there are many observers who incorrectly seem to feel that there is practically no limit to the resolution of linear features.

Some experts in the field of lunar and planetary astronomy have noted the errors in disk drawings with great alarm and have advocated that drawings not be used for scientific analysis (except to provide a pretty picture of the general appearance of the object under observation.) There is a particularly large amount of feeling against using drawings for positional work. I believe that this is a very unfortunate attitude, for with correct reduction drawings can provide a wealth of information. For instance, using just eleven 1961 simultaneous drawings of Jupiter (July 18 alert), I found latitudes of the Jovian belts that are nearly as precise as some of the photographic and micrometric measurements reported in past Final Jupiter Reports. If quantitative measurements were made from the large number of drawings which are turned in to many of the Recorders, much more information could be obtained. I have found accurate positions on Mars (Str. A., Vol. 15, Nos. 7-8, page 118), accurate rotation rates for dozens of Jovian features, and other information from quantitative analyses of a relatively small number of my personal drawings. While individual drawings often have serious errors, the errors are considerably reduced when large numbers of observations are averaged together.

I strongly suggest that the Recorders apply this type of analysis to the drawings they receive. Despite the doubts expressed by some experts, I feel confident that very accurate positional measurements, rotation rates, small atmospheric motions, phases, etc. can be determined from an effective analysis of the data. Despite the poor quality of individual intensity estimates, averages of the carefully reduced estimates of the large number of observers who make intensity estimates could be very precise. Greatly increased accuracy could be achieved if corrections were made for the systematic errors of the observers. For some of the Sections, this type of effective analysis would be impossible to do with only two Recorders.

A problem of great importance concerns the training of new observers to make reliable observations. A number of correspondents have suggested to me that a method of "apprenticeship" such as is used by the Solar Division of the A.A.V.S.O. be adopted. One objection to this is discussed by Dr. James Bartlett, Jr.: "Because of the inherent discriminatory nature of the method its application has to be carefully weighed. The goats naturally do not relish public separation from the sheep, and a membership drop may be the result. On the other hand, if skillfully handled, it may also promote membership in that it confers the distinction of belonging to an organization of first class reputation." There are other objections, however, which should be considered. There can hardly be a fixed time interval set for a training period. I have witnessed one observer make a very satisfactory drawing of Jupiter the first time she had ever seen the planet through a telescope. There are a number of observers, however, who have been observing for decades and still make unacceptable drawings. Perhaps a more fundamental objection is this: the A.L.P.O. really needs as many observations as possible. We would be doing far more harm to ourselves than good if we decided to use the observations of only the top 25 observers in the Association.

I have a suggestion of a similar type of training method that I think would greatly alleviate the problem. In the past the Recorders have to some extent weeded out and not used the work reported by inferior observers. Too many times, however, mistakes and poor drawings have slipped through. I suggest that a definite plan be set up whereby each Recorder assigns, on the basis of his own judgment, a rating to each observer who communicates with his Section on the following scale:

A: means that the observer is judged to be very reliable (a rating to be given with considerable discretion).

B: means that the observer submits observations of some value to the Section but still needs to make more improvement (to be given to most observers).

C: means that the observer's observations are not reliable and therefore should not ever be seriously considered (to be given to beginning observers and to the poorest of the long-time observers).

A beginning observer would start with a "C" rating and would work up the ladder as he improves. Work by "C" observers would never be used in the final reductions or Final Reports. As the quality of the work improves (rapidly for most observers), the observer is given a "B" rating. The reports of a "B" observer would be used, but his observations should always be marked on the working papers of the Recorder and in published reports as by a "B" observer. After a period of some time (a matter of years in most cases) the best observers would be given an "A" rating. Considerable faith would be placed in the work of "A" observers.

It should be pointed out that the rating would be done individually by each Recorder for his own Section. Some observers can make excellent observations of Jupiter but do very poorly on the moon, for example. An "A" rating would be a goal for the observers to strive toward; yet most of them could still have their observations used and published if marked as coming from a "B" observer. Only the poorest observers would remain for any length of time in the "C" category. The Editor could effectively serve as a final check on material to be published. I suggest that readers consider this plan and write to the Editor and myself about your ideas; probably you can think of useful improvements.

The Simultaneous Observation Program has been a very interesting and educational enterprise. I urge all serious observers in the A.L.P.O. to consider the results in the first report and the ideas in this report to help make themselves aware of some of the problems of lunar and planetary observing. Those who are interested could do a great service by conducting tests of greater precision on some of the factors mentioned in this article. Again I thank all those who contributed to the Simultaneous Observation Program, and I hope that the results have been as interesting and informative to the readers as they have been to me.

ANNOUNCEMENTS

Tenth Convention of the Association of Lunar and Planetary Observers. This meeting will be held at Montreal, Quebec, Canada, on August 31-September 3, 1962. Our hosts are the Montreal Centre; and the General Convention Chairman is Mr. W. A. Warren, 30 52nd Ave., Lachine, Quebec, Canada. Readers may write for information either to Mr. Warren or to the Editor. Mr. Geoffrey Gaherty has pointed out that this meeting will not be the first one outside of the United States by an American amateur group since our friends in the A.A.V.S.O. have already met several times in Canada--the Editor's oversight.

We shall not repeat information upon our Convention already given on pp. 85-86 of the March-April, 1962, *Strolling Astronomer*. There are a few new developments. It has now been arranged that the papers sessions will be in a large lecture room of Sir George Williams University, located in downtown Montreal and only a few blocks from the Hotel Laurentien. This room has blackboards, movie screen, fluorescent lighting, microphone jack with speakers, etc. The Exhibit will be either in this room or in an adjacent room in the same building. A registration fee of only one to two dollars per person will be levied upon arrival to cover costs, but there is no advance registration charge. The Sunday evening banquet will be in the Windsor Station Restaurant of the Canadian Pacific Railway Company. The 1962 A.L.P.O. Award, a sterling silver necktie clasp, will be given after the banquet; and we are working on finding an after-dinner speaker. About 20 papers have been selected so far for the program, and it is very gratifying that a large majority of these will be by authors present at the meeting. Topics to be discussed include the moon, Jupiter, Saturn, observational techniques, astronomical optics, and even scientific philosophy.

IT IS IMPORTANT THAT ALL THOSE ATTENDING THIS CONVENTION SHOULD RETURN TO THE EDITOR THE REGISTRATION BLANK MAILED OUT WITH OUR MARCH-APRIL, 1962, ISSUE. WE NEED THIS BLANK BACK BY JULY 14, 1962. AS OF JUNE 7, ONLY A SMALL NUMBER OF BLANKS HAVE BEEN RETURNED, EVEN BY PERSONS WHO WRITE THAT THEY WILL BE AT MONTREAL. IT IS IMPORTANT TO CONVENTION PLANNING TO ESTIMATE ACCURATELY THE ATTENDANCE IN ADVANCE. WE HAVE A FEW EXTRA BLANKS FOR THOSE WHO MAY HAVE LOST THE FIRST ONE. PLEASE--THE REGISTRATION BLANK NOW! AND SEE YOU IN MONTREAL SOON!

Address for Submitting Montreal Convention Exhibit Material. Mr. Clark Chapman is collecting and arranging our A.L.P.O. Exhibit. From June 25 to August 25, 1962, his temporary address for receiving Exhibit material will be c/o Mr. Alika K. Herring, 5010 East Montecito Street, Tucson, Arizona. It will help Mr. Chapman to send photographs, charts, drawings, etc. for this display as soon as possible and certainly in no case later than August 18. Your help with this aspect of the Convention will be appreciated.

New Address for Mercury Recorder. Soon after his return from England, Mr. Geoffrey Gaherty will move to:

2800 Hill Park Road
Montreal 25, Quebec, Canada.

All future correspondence should go to this new address. (P.S.--A better sky should here allow him to do much more Mercury observing as well as recording.)

Back Issues Requested. The Library of New Mexico State University at University Park, New Mexico, wishes to complete its second set of The Strolling Astronomer. This library and the Library of Congress are the only ones, to the Editor's knowledge, having complete files of our journal. The issues which The N.M.S.U. Library lacks from its second set are:

Volumes 3-5; Volume 6, Nos. 2, 3, 9, 10, and 12; Volume 7, Nos. 1, 4-6, and 8-11; Volume 8, Nos. 1-6; Volumes 11-13; and Volume 14, Nos. 11-12.

Persons wishing to assist the Library by supplying part or all of these issues should write to the Editor, stating just what issues they have, in what condition these are, and what price they are asking.

New Subscription Prices. Readers are reminded that the price of The Strolling Astronomer is now four dollars per year or seven dollars for two years. Single issues are one dollar. The new rates went into effect on June 15, 1962, and represent our first price increase since 1949.

New Lunar Meteor Search Recorder and Request. Mr. Robert M. Adams is being replaced in this position by Mr. Kenneth Chalk, 3489 Grey Avenue, Montreal 28, Quebec, Canada. Mr. Adams has filled this post for many years with devotion, scientific thoroughness, and careful and detailed planning. He has been a model correspondent in his Section. We are all grateful to him. Indeed, many of our members may not know that lunar meteor searches began more than 15 years before Mr. Adams took charge of A.L.P.O. activities in this direction.

Mr. Chalk already supervises the Montreal Centre's considerable and excellent work on the Lunar Meteor Search program. He directs to A.L.P.O. members this announcement: "Mr. Robert Adams has asked me to take over the Lunar Meteor Search Section, and I should like to see this project receive a little more of the attention it merits. A large percentage of the participants in recent years has come from Montreal; and while they have done their part well, they are limited by the comparatively small area they cover, and by weather. This difficulty would be overcome by a loose net of observers spread over the United States and Canada. Observers added in the other time zones would add other hours to the total observing time. That total might easily be increased by 300-400%. Spreading out of stations within time zones would help overcome the weather difficulties which a single group of participants encounters. Observers are asked to contribute only three hours monthly to the project, weather permitting. Addition of larger instruments to the search will increase the probability of sighting one of these trails, which would be in any case very faint.

"The program should also be extended to include a patrol for other lunar events, such as dust clouds and vulcanism. These will involve a new observation schedule, but such a new program can be carried out at Full Moon.

"I would greatly appreciate your co-operation in reviving this project. Increased participation will make results already obtained more valuable."

Error in March-April, 1962, Issue. On page 90 of this issue the telescopes used on Jupiter in 1961 by Mr. Charles Giffen were incorrectly given as 19½" and 15.6" reflectors. They were actually 9½" and 15.6" Clark refractors.

Astronomical League 1962 National Convention and Award. This year's National Convention of the Astronomical League will be held in the Western Skies Motor Hotel at Albuquerque, New Mexico, on September 1-3. For information, write to Mr. Dan Fenstermacher, 9700 Claremont Avenue, N.E., Albuquerque, N. Mex. The theme of this League Convention is "The Moon and Its Exploration." A featured speaker will be Dr. Lincoln La Paz, the Director of the Institute of Meteoritics of the University of New Mexico and the Counselor of the A.L.P.O. The Astronomical League Award will be given to Mr. Robert E. Cox, O'Fallon, Missouri, Optical Division, McDonnel Aircraft Corporation, St. Louis. Mr. Cox and his work have long been very well known to American amateurs. Mr. Cox will be at Albuquerque to receive the Award.

W. A. A. Hawaii Convention. The Western Amateur Astronomers are meeting under the tropical skies of Hawaii, August 20-25, 1962. Most of August 20 to 23 will be given to sightseeing. Tours include shopping centers on the island of Oahu, the island of Hawaii and the volcanic area, and the Satellite Tracking Station on Maui. The hosts are the Hawaiian Astronomical Society and the Bernice P. Bishop Museum at Honolulu. The Convention Chairman is Dr. Earle G. Linsley, Bishop Museum, Honolulu 17, Hawaii. The final event will be a reception and luau at the Bishop Museum on Saturday, August 25. The Convention will include the usual papers, exhibits, and star party. Chartered tours from California are being arranged.

Dr. Linsley very graciously invited the A.L.P.O. to hold a Convention at Hawaii with the W.A.A.; and it was with great regret that we declined, primarily because of our meeting at Montreal.

A.L.P.O. Library. A number of books have been added to our Library since the last listing appeared; we plan to carry these titles in our next issue. A.L.P.O. members in the United States and Canada are again invited to borrow books. The price of borrowing a book is only 25 cents and the return mailing costs.

Co-op Program at Pan American College. Pan American College at Edinburg, Texas, has begun to participate with the National Aeoronautics and Space Administration in a co-op program allowing science students to do technical work while still undergraduates, with evident economic advantages to the student plus the valuable opportunity to learn early about his intended profession. The work phases in the program will be at the Manned Spacecraft Center in Houston, while the study phases will be at Pan American College. Students may join the program at the end of either the freshman or the sophomore college year. Selection will be based on such criteria as grades, native abilities, character, professional potential for a career in science, etc. A security clearance is also necessary. Candidates chosen must major in either physics or mathematics; at Pan American College they can also take courses in the astro-sciences, perhaps even a minor or a major. The director of the program at Pan American College is Professor L. A. Youngman, Dept. of Physics, Pan American College, Edinburg, Texas. At this date (June 12) one candidate for September, 1962, is still not chosen; and vacancies at later times will need to be filled.

OBSERVATIONS AND COMMENTS

Dome-Like Ridges near Marius. On March 10, 1962, Mr. Takeshi Sato of Hiroshima, Japan, wrote in part as follows: "On Plate 71, and less distinctly on Plate 70, of the Photographic Atlas of the Moon by Dr. S. Miyamoto and Mr. M. Matsui of the Kwasan Observatory of the University of Kyoto, I have found that the ridges around the lunar crater Marius are resolved into a great number of dome-like hills. I first noticed this fact probably more than a year ago but supposed that such prominent features would be shown in the great map of the moon by Dr. H. P. Wilkins. However, when I recently examined the Wilkins map, I found that they are mostly shown as simple ridges and that only a small number of these dome-like hills are shown in the Wilkins map. As far as I could tell from the photographs mentioned, it is uncertain whether these dome-like hills are really true domes, terminology also here posing difficulties; but it appears to me that these features are of great importance in theories of the origin of the lunar surface formations, including craters. I would hence like to ask A.L.P.O. lunar observers to examine the details of these features. It is hoped that details of other ridges will also be carefully observed and that possibly such observations will reveal the evolution of ridges. If pure speculation is permissible from my poor knowledge, it appears that such ridges as those of Marius may have evolved into crater-chains like those near Stadius."

Depression North of Aristarchus. Mr. Takeshi Sato called attention to this feature in our January-February, 1962, issue, text on p. 44 and location sketch (Figure 51) on p. 43. Mr. Sato writes that this object was observed by Mr. Isamu Hirabayashi on February 17, 1962, probably with a 4-inch reflector.

FIGURE 50. Lunar Valley Near Crater Geminus. Isamu Hirabayashi. 4-inch refl. 220X. Sept. 19, 1959. 13^h 20^m, U.T. S=8-6. T=3. Colongitude=115°6.

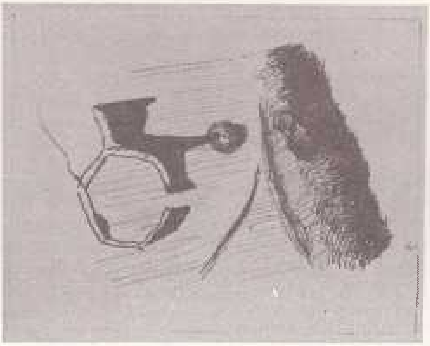

FIGURE 51. Lunar Crater Kies and Vicinity. A. C. Larrieu. 10-inch refl. Oct. 6, 1954. 19^h, U.T. Colongitude=25°7.

Lunar Valley Near Geminus. Mr. I. Hirabayashi of Tokyo, Japan, calls attention to a curious lunar valley near the crater Geminus and thus close to the moon's northwest limb north of Mare Crisium. One of his drawings here appears as Figure 50, showing a low evening lighting aspect. On February 6 and May 17, 1962, Mr. Hirabayashi wrote in part as follows: "I am the leader of the Club of Lunar and Planetary Research, composed of about 30 Japanese amateur astronomers, most of them senior high school and university students. We have observed a large valley near Geminus on the moon. It is not present at all on the Goodacre map of the moon; and while on the Wilkins map something is drawn with a dotted line, I think that his object is smaller and less prominent than my observed valley. It is a very curious thing that, so far as I know, this prominent object is not recorded in any lunar maps at all. The object can be called either a 'valley' or a 'groove' but for convenience I shall here call it a valley. I first observed this valley on January 7, 1958, at 12^h 12^m, U.T., colongitude=114°8. The overall appearance as observed by members of the club is as follows:

"The Valley runs southwest from near the west edge of Geminus to a large plain, as shown on Figure 50. The east end of the valley contacts a craterlet near Geminus, and the west end reaches to the small hill (or mountain) west of Burckhardt. Under poor seeing the valley looks like a chain of craterlets, but we can observe complex objects with good conditions and proper solar illuminations. The valley is about 50-100 kms. long and about 15 kms. wide in its widest part. It is deeper and wider in its east part than in its west part, which is hard to detect under high lighting since it is very shallow and narrow. No mountain nor cleft has been found on the interior. One observer says that this large valley is formed from two parallel grooves. If so, there is a convexity in this valley as in the Ariadaeus Rille.

"I have searched for this object in the Kwasan Observatory Photographic Atlas of the Moon and have found it on Plates 2 and 29; but these do not show much detail, and I think that we need many observations under different solar illuminations for a close study. During a recent visit to the Kwasan Observatory to meet Dr. Miyamoto, I looked for the Geminus valley in Dr. Kuiper's Photographic Lunar Atlas, but I found no plate taken under favorable solar lighting.

"I think it unlikely that the valley can be observed usefully on the narrow crescent moon."

Kies and Nearby Dome. Mr. A. C. Larrieu of Marseille, France, expresses interest in Mr. Carlos E. Rost's drawing of Kies and the dome to its east, Figure 48 on p. 42 of the Jan.-Feb., 1962, Strolling Astronomer. Mr. Larrieu invites attention to one of his own drawings of this lunar area, Figure 51 in this issue. He saw on this occasion the curious aspect that the shadow of a high peak on the east rim of Kies was falling upon the dome, an appearance never reobserved since the 1954 date of this drawing. This aspect is obviously of brief duration and may also vary appreciably with the small changes in the sun's selenographic latitude.

Triesnecker Drawing and Lunar Drawing Techniques. Mr. Charles M. Cyrus, 1216 Leeds Terrace, Baltimore,27, Maryland, has contributed the drawing of Triesnecker and its clefts which appears on the front cover of this issue. He also discusses certain general questions about lunar drawing procedures. This drawing of Triesnecker was compared to a tracing of a photograph (he does not say what one); the Editor found agreement of drawing and tracing of photograph to be excellent indeed. Readers may want to make their own comparisons, certainly including photographs of Triesnecker from Dr. Kuiper's Photographic Lunar Atlas. The drawing, to be sure, thus here added very little to what we already knew from the photograph; but Mr. Cyrus points out that he has never seen really outstanding photographs of such popular craters as Aristarchus, Gassendi, or Petavius. One difficulty with using photographs as base outlines for drawing in the finer lunar detail in our visual studies (such a base assuring much more accurate positions and proportions) is scale. Most lunar photographs would need to be enlarged considerably before they can be so used. Mr. Cyrus wonders whether to submit to A.L.P.O. Lunar Recorders the composites of a number of drawings rather than the individual drawings. Certainly the composite is preferable for topographical studies and is more reliable for detail. The Editor would suggest that individual drawings would be useful in certain studies of errors on drawings, in determining at what solar lighting various features or aspects are visible, and perhaps in studies of possible curious variations in aspect at the same solar lighting in different lunations.

Peculiar Dome near Herigonius. Leif J. Robinson invites attention to a horseshoe-shaped dome northwest of Herigonius, xi=-.51 and eta=-.21. It looks like three large domes fused together. Just to its west is a "classical" dome with a small mountain mass on its summit instead of the usual crater pit. Meaning in lunar surface formation theories? Careful observation, especially with larger apertures, may prove rewarding.

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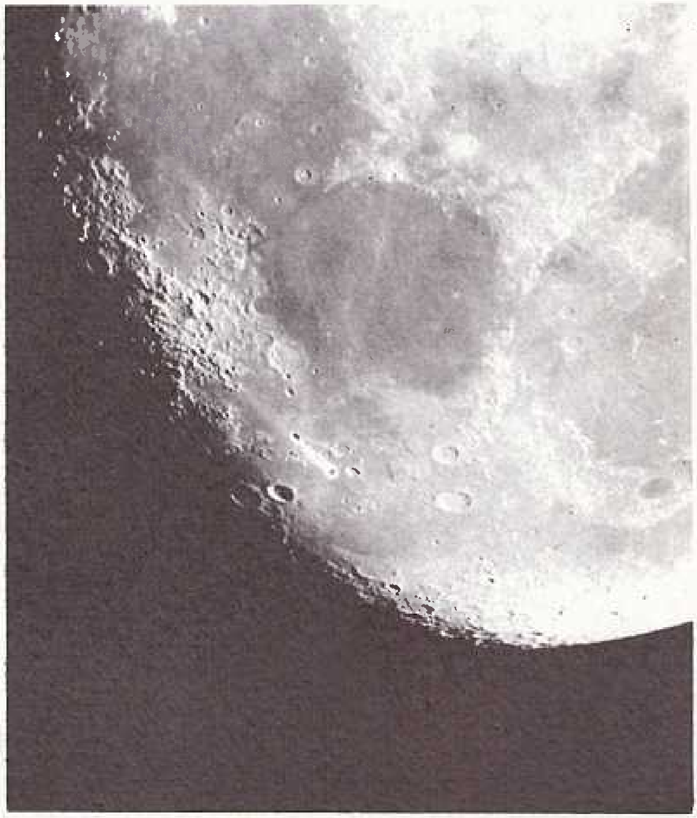

Photograph of Mare Serenitatis, Mare Tranquillitatis, and vicinity under evening lighting on the moon. Taken by F. Jack Eastman, Jr., with a 12.5-inch reflector on July 12, 1960, at 10 hrs., 46 mins., Universal Time. 65 ft. e.f.l. Seeing 6, transparency 4. Ansco Super Hypan. One-half second exposure. Colongitude = [illegible].3 degrees. Read Mr. Eastman's discussion of lunar photography in this issue.

THE STROLLING ASTRONOMER

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ASSOCIATION OF LUNAR & PLANETARY OBSERVERS — ALPO

IN THIS ISSUE

LUNAR PHOTOGRAPHY

By: F. Jack Eastman, Jr.

More and more amateurs are hooking their cameras to their visual telescopes, and taking some rather good photographs. The extremely good photograph is, however, usually the exception rather than the rule. More often than not, one's first photograph is as disappointing as one's first look at Mars in seeing 0 - - !

There have been many attempts to control techniques, etc. with the idea that a person can go to the telescope and get a perfect picture every time. While it is true that one can analyze a situation and eliminate many problems, there still exist a host of random variables to plague us. The most notorious of these is transparency, which includes reflectivity of mirrors, transmission of eyepieces, and, of course, atmospheric conditions. These variables make a purely mathematical approach unsuitable. One will have to make test exposures anyway. The other problems, such as focal length, speeds, etc. follow the same laws in lunar work as they do in ordinary photography.

The following is a discussion of the author's methods and equipment, and is intended only as a guide, since differences will exist in the individual equipment and conditions.

Before embarking on the problems of photography, let us see about a suitable telescope. Perhaps the most important thing is the mounting. We all know the frustration of trying to look through a shaky telescope; well, the problem is much more so for a photographic instrument. If we can keep our exposures short, say 1/150th of a second, we won't need a drive; but for anything much longer, a fairly good drive will be necessary. For example, in 1/15th second of time, the moon will move about 1", which corresponds to the resolution of a 4½-inch 'scope. (The actual motion will be approximately 1 sec. arcXcosD, where D is the declination). For projected focal lengths, a drive is a must; and slow motions will be helpful.

Optically, there is no substitute for aperture. The larger the aperture, the brighter the image (for a given focal length), and the sharper it is. As to the type of telescope, the reflector is by far the best. While visual observers have their controversies, photographic observers almost all will agree that the absence of chromatic aberration in the reflector is a great boon. One can shoot in the ultra-violet or infrared with the reflector without fear of being out of focus, etc.

While on the subject of optics, let us see how the focal length, speed, etc. affect the photograph. If we are photographing a star, which is a point, the brightness of the image depends <u>only</u> on the area of the collector, i.e., lens or mirror. Since the moon is an extended object, the final brightness of its image will also depend on how spread out the light is, thus on the size of the image. The size of the moon's image is determined by the focal length of the objective. In fact, the diameter of the moon's image is 1/115th of the focal length at the moon's average distance, so a mirror of 115 inches focal length will form a 1-inch image of the moon.

Perhaps this idea can be clarified by way of example. Let our standard telescope have an aperture of 8 inches, and a focal length of 57.3 inches. Let us say that the half-inch image of the moon has a surface brightness of 4 units. If we increase the focal length to 114.6 inches, the brightness will go down to one unit, since the image is now twice as large in diameter, and spread over four times as much area. If we now increase the aperture to 16", increasing the light by a factor of four, our image is once again 4 units bright. Further, a 16" aperture at a focal length of 57.3" would form an image with a surface brightness of 16 units, four times that formed by the original 8" (fourfold increase in light grasp, no change in image size). We will come back to this idea when we discuss exposures.

"What image size is the best?" is an often heard question. The answer will, of course, depend on the reader's own requirements; but remembering that the image diameter is about 1/115th of the focal length will help. For a 35mm. negative, a 22mm. image is good for the whole moon, being secured from an 8-feet focus. A 35-feet focus will do about the same for a 4x5 inch negative,forming about a 3½-inch image. For almost all his work, the writer uses a 7½-inch image, corresponding to a focal length of 65 feet.

About the most important accessory which one can have is a guide telescope. The function of the guide telescope is to keep the "camera" aimed, and, still more important, to monitor the seeing. The guide should be as large as possible, so the seeing with it will be as near as possible to that in the main 'scope. As a minimum size, let us say that the guide telescope should be no less than 1/3 the aperture of the main 'scope, and of about the same focal length. It would be much better if the guide were 2/3 of the main aperture.

The author's equipment is the permanently mounted 12½-inch shown in Figure 1. The main mirror has a focal length of 96 inches, f/7.7. The rack and pinion eyepiece holder is removable, allowing the camera (and other accessories) to be bolted directly to the tube. The camera on the 12½" is a 4x5 inch projection camera, more about which will be said later. The finders are 2½-inches aperture; the lower one is f/5, and the upper, near the eyepiece, is an f/9, usually used at 20X, though it will take up to 170X to serve as an emergency guide. The guide telescope is the long-focus 4.2-inch reflector on the right side (Figure 1). This has a focal length of 92 inches (f/22) and is used with 140X to 340X for monitoring the seeing. Mechanically, the mounting is equipped with a hand-operated slow motion in declination, and a dual speed electric drive, providing electric slow motions in right ascension, operating at the sidereal rate. This telescope was built from odds and ends of scrap metal, etc., and cost the writer about $200.00.

For portable use on the moon, the writer also has a 6-inch f/8.3 reflector with a 4.2-inch f/10 guide 'scope. The 2/3 ratio in aperture of guide to main telescope here is better; but this ratio would require an 8-inch guide for the 12½", which would have introduced mechanical difficulties.

Now that we have looked at the telescope, let us examine the camera attachments a little more closely. As we said before, the image size depends only on the focal length of the system, for the moon being about 1/115th of the focal length. If we want to fill a 35mm. negative, a focal length of about 90 inches is very good. This is about the focal length of the average 6-inch refractor or 12-inch reflector. To fill a 4x5 inch negative, a focal length of about 35 feet is necessary. This is about what we would expect from a 24-inch refractor or about a 60-inch (f/7) reflector!! In order to get these long foci on smaller instruments, it is necessary to use some kind of compound system, such as a Barlow Lens or a projection eyepiece. In this discussion, we shall consider the latter. Figure 2 is a diagram of a typical projection camera system. In Figure 2, F is the focal length of the objective, P is the distance from the focus F to the eyepiece, and P' is the distance from the eyepiece to the film (F'). The distances P and P' must be measured with the system in focus since the eyepiece is moved out from its usual position so as to converge the light from F to F'. The problem now is to compute the effective focal length (hereafter to be known as F'), knowing P, P', and F. This is done as follows:

$$F' = \frac{F\,p'}{p} \qquad \text{..................(1)}$$

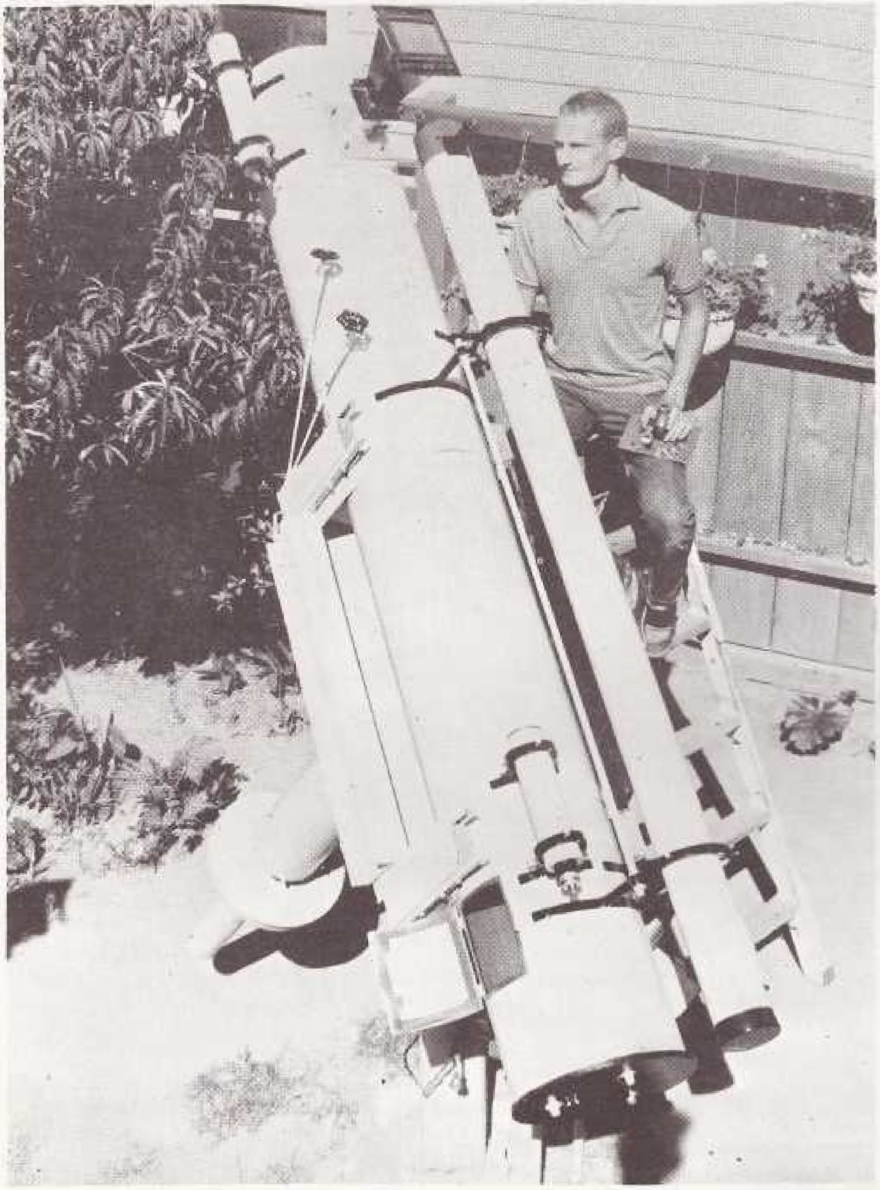

FIGURE 1. F. Jack Eastman, Jr. and his 12.5-inch reflecting telescope used for lunar photography. See also text of Mr. Eastman's article in this issue. All lunar photographs by Mr. Eastman in this issue were taken with this telescope. 4x5-inch camera in place over eyepiece holder. Rack and pinion eyepiece holder in observer's hand.

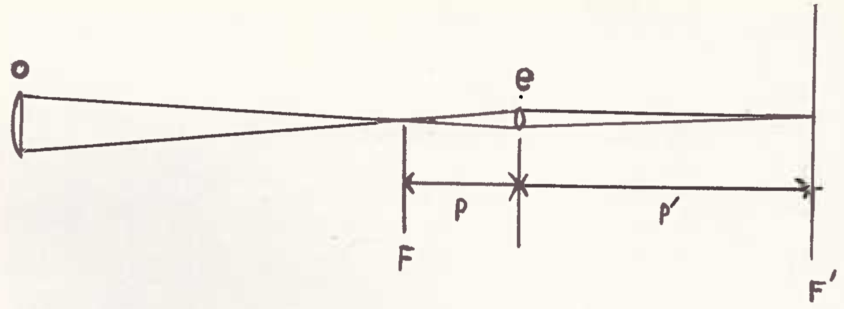

FIGURE 2. Diagram by Jack Eastman of typical projection camera system for lunar photography, with notation. See also text.

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The writer's camera is fully described, with illustrations, in the Sept.-Oct., 1961 Strolling Astronomer, Vol. 15, Nos. 9-10.

With this brief description of instrumentation, let us now look into the specific problems of lunar photography. The proper exposure for an object will depend on the surface brightness of the image, speed, or sensitivity of the detector (in this case the film emulsion), and the time of exposure. First, let us look at the laws which govern the surface brightness of the image. This will depend on the surface brightness of the object, and the speed or f/number of the camera. The surface brightness of the object will be a function of its distance from the source of light (by the inverse square law, i.e., twice as far means one-fourth as bright), and its reflectivity.

In the case of the moon, if we hold the speed of the telescope constant, the film speed constant, and assume the mean reflectivity of the moon to be constant, the only variable will be the changing distance of the moon from the sun. The brightness change then amounts to about 4% from the mean value, which change is negligible.

From the above, we see that we need not worry about the distance of the moon, since the differential in brightness is well within the latitude of the film. There is, however, a radical change in illumination with phase. As the sun gets lower and lower, the total light per unit area becomes less. The illumination may be called 1 at the sub-solar point ($h = 90^\circ$), going to 0 when $h = 0^\circ$. The illumination varies as sin h. (h = altitude of sun as seen from lunar point in question.) It follows, then, that the exposure will vary as csc h, the exposure being unit time for vertical solar illumination (as seen from the earth), going to double that time at the point where h is 30°, to four times the unit where h is $14\frac{1}{2}^\circ$, and finally to infinity at the terminator, where h is 0°. It is beyond the scope of this paper to derive the results for all phases of the moon, but it turns out that if the proper exposure for the Full Moon is 1 unit, then the First and Last Quarters will be about 3, and the crescents within $3\frac{1}{2}$ days of New Moon about 12. Before we leave this subject, we should remember that at Full Moon, the earth and sun are almost in a line, so that we can consider all parts of the moon's surface as then being at the sub-solar point as seen from earth. The above relative exposures are empirical, taking this concept into account.

Enough theory! Now let's go to the telescope and take some pictures. The first thing to be determined is the exposure time for a given film. For this purpose there are more formulae, but these formulae contain certain "constants" that depend on transparency of the air, reflectivity of the telescope mirror, and cleanliness of the eyepiece. These "constants" hence have to be guessed at, so let's see if there is a way we

FIGURE 3. Photograph of part of moon near full phase by F. Jack Eastman, Jr. with 12.5-inch reflector. Lunar north at left, lunar east at bottom. Copernicus in upper left center, Aristarchus in lower left, Grimaldi near bottom center, Gassendi in lower right. June 28, 1961, 7 hrs., 45 mins., Universal Time. Focal length 65 feet. Contrast Process Pan, a good film near Full Moon. Exposure 1 second. Development in DK - 60 a. Colongitude = 90.4 degrees. See also text.

can guess at the exposure directly. The moon is a big hunk of rock in bright sunlight, and so is a mountain scene on a clear day. For a film with a speed of 100 we would set our snapshot camera at 1/100 second and f/16. Well, if the moon is the same type of scene, let's shoot it at 1/100 with f/16. Upon developing the film, we find that the negative, in most cases, is fairly good. Don't expect to get a light meter reading from the moon, even though it is as bright per unit area as the mountain scene, since it doesn't subtend a big enough angle in the sky. In other words, there isn't enough apparent angular area to reflect back enough light to affect the meter.

Before giving any specific exposures, let us talk a little about films. For photography directly at the focus of the telescope, we shall want a slow fine-grain film such as Panatomic X, or Kodachrome. For the Full Moon, we shall want a maximum of contrast. Microfile is good in this respect. For the projection camera, a faster film is necessary, due to the slower speeds of the optical system. Kodak Royal Pan and Ansco Super Hipan are good. For Full Moon, Kodak Contrast Process Pan is very good. Below is a table of exposures taken at random from the writer's notebook. As emphasized before, these are only to be used as a guide.

Newtonian Focus . . . . Focal length 8', f/7.6.

Subject	Film type	Time
Moon 6½ days from new	Kodachrome	1/5- 1/25 sec.
" near full	"	1/25- 1/50 "
" " "	H.S. Ektachrome*	1/250 "
" in total eclipse	" " "	9- 20 secs.
Moon, Quarters	" " "	1/50- 1/100 sec.

Projection Camera . . . Focal length 65', f/64.

Subject	Film type	Time
Moon, near term.	Ansco Superhipan	½ - 1 sec.
" " "	Kodak Royal Pan	½ - 1 sec.
Moon, Full (h near 90°)	Contrast process	½ - 1 sec.

* Plus - X may be substituted for H.S. Ektachrome.

In order to get the most out of one's photography, one should do his own processing. The commercial photofinisher works on a production line basis, based on the average snapshot. He cannot afford to take the time carefully to control one or two pictures. If one does his own processing, it is rather easy to control things like contrast, grain, and so forth. Processing of films is rather simple, and all the needed chemicals and instructions can be purchased in a kit for a few dollars. Another advantage to home-processing is that the results are immediately available for inspection; and if a mistake is made, corrective measures may be taken without waiting. A darkened closet is all that is needed to begin. The best results will be realized if the instructions packed with the film and chemicals are followed to the letter.

Almost all of the author's photographs were developed in DK-60a, although some other developers might be used for special needs. Perhaps the following table will be of use.

Developer	Grain	Contrast	
Kodak Micridol	F	L	F-fine
" D-76	F-M	L-M	M-moderate
" DK-60a	M	M	B-bad
" D-11, D-19	M*	H	L-low
" D-8**	M	Very H	M-moderate
Accufine ***	F	M	H-high

*D-11 is a little less grainy than D-19.

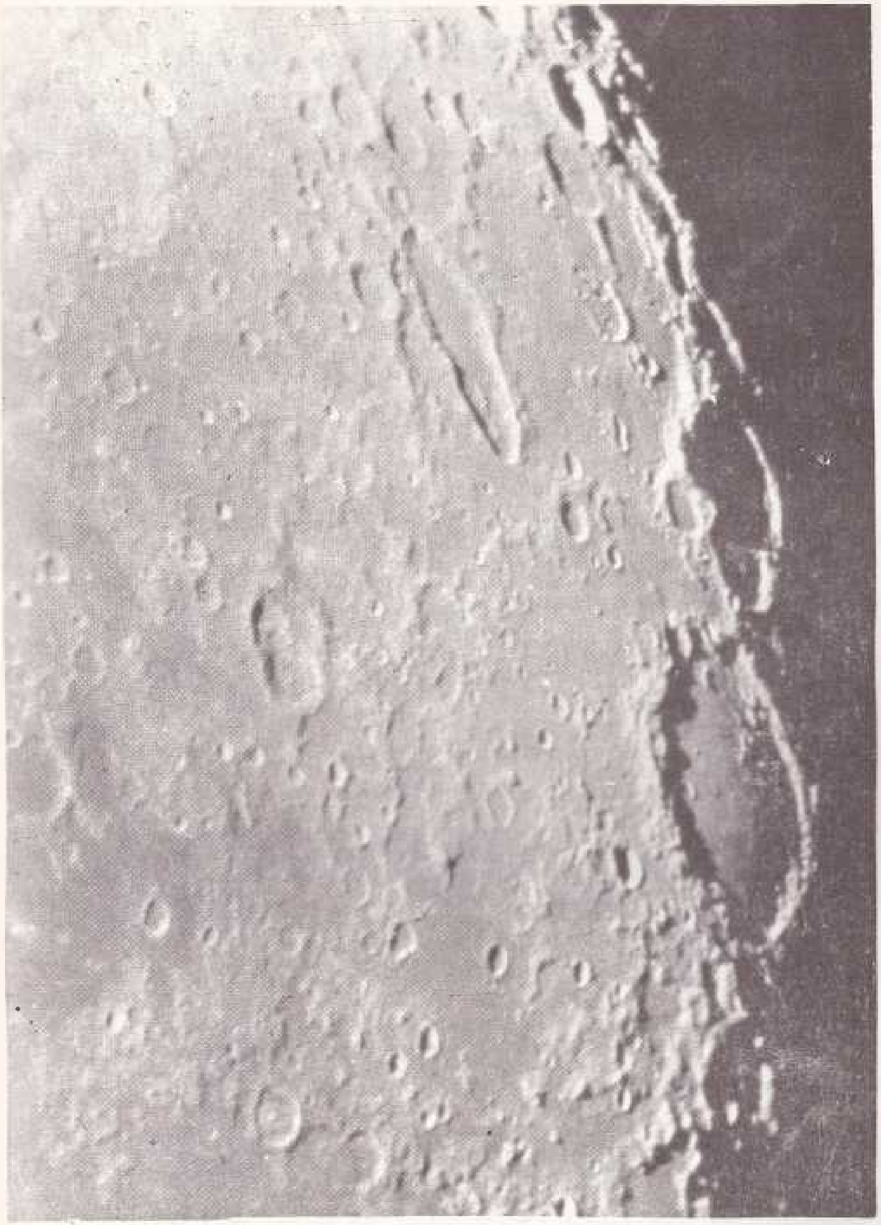

FIGURE 4. Photograph of part of southeast quadrant of moon by F. Jack Eastman, Jr. with 12.5-inch reflector. South at top, east at right. Schickard and Phocylides on sunrise terminator. June 18,1959, 5 hrs., 15 mins., U.T. Focal length 65 feet. Seeing fairly good (6). Colongitude = 55.5 degrees. Readers will realize that these published reproductions necessarily lose some of the finer contrasts of tone present on the prints supplied by Mr. Eastman, which in turn must have been inferior to the originals which he secured at the telescope.

**D-8 has a very short life.
***Accufine and Ethol UFG are very good developers, but are easily contaminated!

So far the discussion has been concerned with one instrument. If the reader's focal ratio is the same as the author's, there is no problem in using the recommended exposures for the initial tests. If the reader's f value is different, the following relation will be of use:

$$\frac{(f')^2}{(f)^2} \text{..................} (2)$$

where f is the focal ratio of the first instrument and f' is the focal ratio of the second. If the exposure is 1 second on a telescope of f/64, then it will be:

$$\frac{(32)^2}{(64)^2} = \frac{(1)^2}{(2)^2} = \frac{1}{4},$$

or one-fourth second on an f/32 'scope. The exposure varies inversely as the film speed; i.e., a film that is twice as fast will require half the shutter speed.

About the most important thing associated with any type of astronomical work, and especially so with photography, is the keeping of a complete set of records pertaining to date, time, instrument, etc. The following outline contains 10 items which should accompany any and all photographs. It has been the author's experience that the information should be put down as soon as possible, lest one forget some point.

1. Date, Day, Month, and Year, preferably in Universal Time.
2. Time, to nearest minute, also in U.T.
3. Instrument, including:
   - A. Aperture.
   - B. Effective focal length.
   - C. Type of camera attachment (projection, etc.)
   - D. Type of telescope.
   - E. Maker of instrument.
4. Film type.
5. Exposure time.
6. Filter Data, number and maker, or transmission.
7. Developing data, type of developer, time and temperature.
8. Sky conditions, especially:
   - Seeing, Quality (1-10), and type of motion, slow, fast, etc.
   - Transparency (this will affect exposure time).
9. Physical data, like colomgitude, central meridian, etc.
10. Personal comments.

Any photograph with the above information can be and often is a contribution to science. Unfortunately, there are a lot of excellent photos which are really useless because the photographer doesn't remember when he took them, or the exposure, etc.

In conclusion, let us go to the author's 12.5-inch telescope and actually shoot a photograph of the moon. The first thing that is done is to set up the telescope visually, and to see whether the seeing is any good. If the seeing is good, i.e., we can use 800X, but the image is "wandering", we can say it is a good night for visual work but not for taking pictures. Any wandering will kill a photograph, which integrates the movement over the time of exposure. Well, let us assume that the seeing tonight is good enough for taking pictures. The eyepiece holder is then removed from the telescope, and the camera is attached. At the same time the guide telescope is uncapped and fitted with a 270X crosshair eyepiece. The shutter on the camera is opened on "time"; and the image is focussed carefully on the ground glass back of the camera, care being taken that the corners of the plate are in focus as well as the center. Tonight we have set up the camera at an E.F.L. of 65', the effective aperture ratio being f/64. The film is Kodak Royal Pan (ASA 400). The exposure for an average scene in bright light is about 1/250 sec. at f/16. Since we are working at f/64, our exposure will be about 1/10 sec. We have chosen a region about 30 degrees from the terminator, so the average illumination will be about half of the above, requiring about twice as long an exposure. Another look is taken at the ground glass to be sure that everything is properly centered, and the crosshair in the guiding eyepiece is placed over a familiar feature. From the above ideas we finally decide that 1/5 sec. is the proper exposure, and the shutter is so set. The filmholder is then inserted into the camera, and the dark slide is withdrawn. (It is most disconcerting to make an exposure with the dark slide in place!) The moon is then watched in the guide telescope, to make sure that the centering is proper, and that the seeing is still good. We find that the seeing has become a little worse, and hence the moon is watched carefully so that the exposure can be made at the time when the seeing is best. The slide is replaced, and the film is taken into the darkroom and developed. In about 10 minutes, we can look at the negative. If the negative has been too thin (underexposed), we can go to the telescope again and take another picture, doubling the exposure. Fortunately, this negative was good; so all the information is put down in the notebook, and the finished negative is put in the file.

Now, while the moon is still up, let's try a prime-focus shot in color. The projection camera is removed, and replaced with an Exakta body loaded with Kodachrome (ASA 10). Since this is a single-lens reflex, we can focus and monitor the image directly through the camera, using the 12½-inch 'scope as its own guide-telescope. The exposure at the f/7.7 focus is "guesstimated" to be about 1/25 second, reasoning as we did with the projection camera. The exposure is set, and made in a method similar to that with the projection camera. Since we are unable to develop this negative right away (if at all), it is good to take two more pictures, one at half the above exposure, the other at double the original exposure.

The question now is: "What do I do with the pictures?" We all know that the eye is much better in seeing fine detail than the photographic plate, but the eye is also affected by certain psychological and physiological effects which detract from the accuracy of the observation. The photograph is a permanent, accurate record, which may be compared with other photographs. Also, for visual observations, if the coarse details are obtained from a photograph, one can place the finer details with greater accuracy.

If it is clear tonight, go on out to your telescope and take some pictures - - it's easy, and the results may surprise you.

Suggestions for further reading

Books:

Paul, H., Outer Space Photography for Amateurs, Amphoto, 1960. A good general treatment of astrophotography and equipment.

Rackham, Thomas, Astronomical Photography at the Telescope, MacMillan Co., N.Y.,1959. A general treatment.

Selwin, E.W.H., Photography in Astronomy, Eastman Kodak Co., 1950. An excellent technical treatment of the subject.

Magazine articles and pamphlets:

Cassell, Robert R., "An Amateur's Lunar and Planetary Photography", Strolling Astronomer, Vol. 15,, Nos. 9-10.

Eastman, Jack, Jr., "A Planetary Camera for a 12½-Inch Telescope", Strolling Astronomer, Vol. 15, Nos. 9-10.
Description of camera for telescope.

Eastman, Jack, Jr., "Astronomical Photography in your Back Yard", Griffith Observer, Feb., 1961.

Eastman Kodak Co. Data Guides:
Kodak Films
Materials for Spectrum Analysis*
Processing and Chemicals and Formulas*
Kodak Wratten Filters*

* Especially valuable.

COMET BURNHAM 1959k: FINAL REPORT, PART IV. SUPPLEMENTARY NOTES

By: David D. Meisel, Comets Recorder

In Part III in the May-June, 1962 Strolling Astronomer, the most general aspects of the postperihelion period of this comet were outlined. However, certain details were deleted which will be included in future papers. Other miscellaneous data do not fit into the continuity of any of the planned papers, but have definite interest and should be published. It is this material with which Part IV is concerned.

A. Colorimetric Observations

During the period of observation some colorimetric work was done. Alan McClure attempted to obtain nearly simultaneous photographs, one on a red sensitive emulsion, the other on blue. The venture was very successful. From two plates of the series it was possible to confirm the existence of short term variations in the size and shape of the comative appearance in red light. Also, differences in internal structure and tail structure were noted. The blue tail images always had a definite ray structure, while the red images showed little of such structure. On photographs taken on Apr. 22, 1960 this difference is especially evident. (Figures 5 and 6). On the blue plate the ray structure is very strong. On the red plate only the two main tail streamers are at all plain. The measured diameter of the image from the red plates was more variable than could be expected from differences in exposure and sky condition.

Gary Wegner attempted to make colorimetric intensity measurements over the entire visual range. He found that on Apr. 27 and Apr. 29 the comet's surface was brightest in the middle of the green region of the spectrum. The average intensity values on the A.L.P.O. Scale (0 darkest and 10 brightest as compared to the total intensity of the coma) according to Wegner were:

Red	0	
Orange	0 to 2.5	
Yellow	2.5 to 6.0	
Green	6.0 to 8.0 to 7.0	Apr. 27 and
Blue	7.0 to 5.0	Apr. 29, 1960.

This result bears out the strength of the photographic image on these dates. Wegner's observations were made using filters visually with a 10-inch reflector.

B. Spectral Observations

In addition to colorimetric estimates, Wegner obtained a visual

A RE-EXAMINATION OF THE PLATO PROBLEM

By: Alika K. Herring

While the floor of Plato has been one of the most observed areas on the lunar surface, the amount of detail seen thereon has varied enormously. Some observers have reported numerous craterlets and spots (2, 8), others have seen far smaller amounts of detail, with one observer even stating categorically that no more than 5 true craterlets exist on the floor (9). A comparison of the charts of the floor detail that have been compiled by these various observers does little to settle the question. Not only do these charts suffer from errors that are subjective in nature; but for the most part they are rather poorly drawn, with the result that serious discrepancies in the positions of even obvious details may be present. These charts, which have been based principally on visual observations, are therefore inconclusive, and probably have little intrinsic value.

The chart based on the observations of the writer unfortunately suffers from the same defects. Shortly after its publication (8), a comparative study was made between the various published charts; and the review of the situation that subsequently followed indicated that visual observations extending over more than a century had in truth answered few of the questions concerning the detail in Plato, and that there was little possibility that they would do better in the future. When it became obvious that further efforts of this nature would do little more than add to the already existing confusion, the personal observations by the writer of the floor detail were discontinued indefinitely, pending a better approach to the problem.

New information on the matter became available in the form of a photograph that was recently brought to the attention of the writer. This photograph, No. 822 of the Yerkes series, was made with the 40-inch refractor; and an examination of the original negative revealed a remarkable amount of detail upon the floor. The accompanying chart (Figure 8) was drawn from this photograph. Only those details that could be identified with reasonable certainty were inserted, those of a doubtful nature being omitted altogether.

The writer believes that this chart, which is based solely on objective evidence, will have a significant value in throwing new light on the Plato problem.

Bibliography

1. A. S. Williams, "Light Spots and Streaks On Plato, 1879-82", Telescopic Work For Starlight Evenings, W. F. Denning, page 126.

2. W. H. Pickering, "Plato, 1895", Annals of The Observatory of Harvard College, Vol. 32, Part 2.

3. P. B. Molesworth, "Plato, 1897", The Moon, W. Goodacre, page 153.

4. H. P. Wilkins, "Chart of Plato Detail, 1936-39", Journal of The British Astronomical Association, Vol.50, No. 4, Feb. 1940, page 153.

5. E. J. Reese, "Chart of Plato Detail, 1946-47", The Strolling Astronomer, Vol. 6, No. 1, January 1952, page 5.

6. H. P. Wilkins, "Chart of Plato Detail, 1945-49", Journal of The British Astronomical Association, Vol. 60, No. 2, January 1950, page 57.

7. E. J. Reese, "Chart of Plato Detail, 1946-49", The Strolling Astronomer, Vol.10, Nos. 7-8, July-August, 1956, page 95.

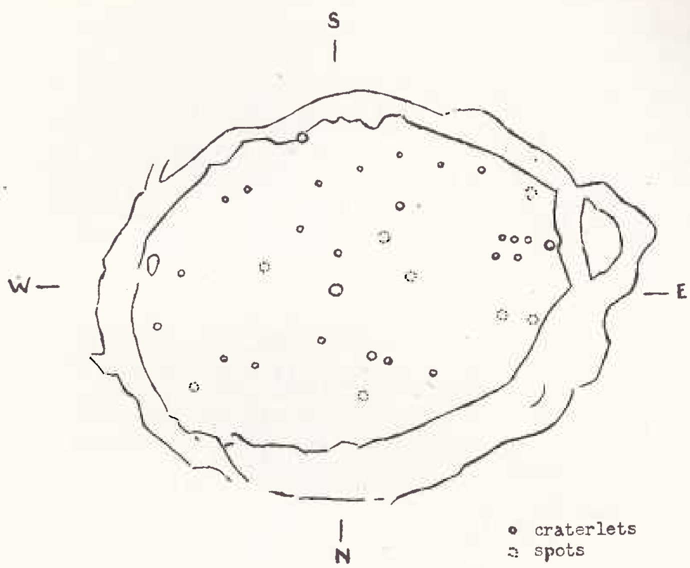

FIGURE 8. Photographic chart of the floor of the lunar crater Plato constructed by Alika K. Herring from Yerkes Photograph No. 822. Made with the 40-inch refractor on March 8, 1960 at 0 hrs., 49 mins., Universal Time. Co-longitude 30.5 degrees (about 1.5 days after sunrise on Plato).

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8. A. K . Herring, "Some Recent Observations of Plato", The Strolling Astronomer, Vol. 11, Nos. 7-10, July-October, 1957, page 96.

9. H. P. Wilkins, "Plato", The Strolling Astronomer, Vol. 12, Nos. 1-3, January-March, 1958, page 10.

10. H. P. Wilkins, "The Spots Within Plato", Journal of The International Lunar Society, Vol. 1, No. 3, July, 1958, page 76.

11. A. K. Herring, "Some Observations of Alphonsus and Plato With A Large Telescope", The Strolling Astronomer, Vol. 13, Nos. 9-10, September-October, 1959, page 100.

12. P. McIntosh, "Chart of Plato Detail", The Strolling Astronomer, Vol. 13, Nos. 11-12, November-December, 1959, page 155.

Postscript by Editor. The quality of Yerkes Photograph No. 822 is indeed very good. Mr. Herring considers it probably the best photograph ever taken of Plato. The detail charted by Mr. Herring on Figure 8 was confirmed almost entirely by Mr. Ewen Whitaker. In Harvard Annals, Vol. 32, Part 2, pg. 180, W. H. Pickering reported from micrometric measurements that the diameter of the conspicuous craterlet in the southeast quadrant of the floor of Plato is 4200 feet. On this basis one might estimate that the diameters of the smallest objects plotted on Figure 8 are 2,000 feet or even less, corresponding to photographic resolution near 0".3.

We certainly share Mr. Herring's desire that this photographic map should provide a sound future basis for further studies of delicate floor detail.

Some may feel our colleague's evaluation of the worth of visual studies of Plato to be rather severe. We must surely recognize, however, that here and elsewhere in lunar and planetary astronomy we serve no useful purpose by studying markings at the extreme limit of visibility. All data then become very uncertain. All scientists, including amateurs, must learn to recognize the limitations of their equipment and themselves. A dozen reliable Jovian C.M. transits timed with a 4-inch telescope may be worth tremendously more than a hundred drawings with such an aperture of very subjective features on Ganymede.

BLOODY BUT UNBOWED

By: James C. Bartlett, Jr.

In the Sept.-Oct., 1961 issue of Str. A., Mr. Joseph Eyer had at me for certain allegedly erroneous ideas concerning the meaning of the dusky limb band of Venus; and I gathered he suspects that a brief course in elementary meteorology would do me no harm. Finally, I am accused of inverting the order of quantitative-qualitative analysis, a sin of no mean proportion. To the last charge I cheerfully plead guilty without more ado, for I do not quite see that the correct approach to a problem should be first to determine if theory will "allow" the observed phenomena. Nature not infrequently produces phenomena "forbidden" by even the most mathematically proper theory. Does not every aerodynamics engineer know that a bee cannot fly?

Mr. Eyer states that even a slow rotation of Venus makes it altogether impossible for "a frontal (cloud) system from pole to pole" to move "in unison with the rotation of the planet". And why? Because by the very fact of rotation certain forces arise (coriolis effect) whereby the circulation in one hemisphere is the opposite of that in the other, with a discontinuity at the equator. The objection is very sound. But to what is it applied? Certainly not to such a claim in my original paper, in the July-August, 1961 Str. A., for no such claim was made. Nowhere was it stated that an unbroken front extended from pole to pole, only that a cloud system extending into both hemispheres existed.

Indeed as to a cloud system coextensive with both hemispheres, including the equatorial discontinuity, I here find myself in company with authorities of the highest tone, who - at least a few years ago - were assuring us that the entire planet is surrounded by a perpetual shell of cloud. Ironically, I do not subscribe to this theory and indeed specifically disavowed it in the very paper which drew Mr. Eyer's attention. The point which Mr. Eyer seems to have missed is that such a system can exist without the necessity of postulating a single, unbroken front. For such a system can consist of several systems united only by propinquity. Hence hemispheric discontinuity in atmospheric circulation is by no means fatal to a cloud cover common to both hemispheres and which, in this sense, might truly extend from pole to pole. It must also be understood that propinquity, when applied to cloud systems viewed at a minimum distance of 25,000,000 miles, can be a very relative term. The actual physical intervals between such systems can be considerable, as measured from the surface of the planet, and yet remain virtually undetectable to an observer on the earth; particularly when the planet is such a one as Venus which shows so little contrast between specific cloud masses and the general background.

As touching upon the general atmospheric circulation of the earth, Mr. Eyer's picture of the thermal exchange between equator and poles is quite correct. As Mr. Eyer implies, the atmospheric circulation of the earth is quite complex. Whether it is necessarily the same on Venus is another matter. But supposing it so, what has this to do with the general proposition that weather fronts move from west to east? Nothing at all. For we must remember that regardless of the local directions of wind systems the whole atmosphere shares in the rotation of a planet.

Hence while a local cloud system may be moving in any direction, relative to the surface of a planet, it is also simultaneously moving steadily eastward with the rotation of the planet (assuming that the rotation is direct); and this is true for both hemispheres since the direction of rotation is the same for both.

Relating these obvious facts to Venus, it is true that a general system of cloud extending into both hemispheres would necessarily move eastward in unison with the planet's rotation (though not necessarily at the same rate). Hence an observed eastward drift of a general cloud cover common to both hemispheres would imply a west-to-east rotation. Whether the twin limb bands of Venus can be correctly ascribed to cloud systems and their shadows I shall leave to the jury.

This last has a conclusive bearing on Mr. Eyer's Point II; for if the eastward drift of either limb band is an objective fact, then it is also at least an index to the rate of rotation which therefore must be short. Unfortunately the delicacy of the phenomenon precludes any hope of establishing even an approximately correct rate thereby.

Mr. Eyer relates the formation of cloud to turbulence, and remarks that "turbulences are by nature local phenomena, certainly not extending from pole to pole". Not in a simple linear distribution, one may agree; but since turbulences by their very nature as local phenomena must exist in one hemisphere as in the other, including the equatorial zone, then however random their distribution, in this sense they do extend "from pole to pole".

Mr. Eyer further objects that his measurements on my drawings of the limb band imply an unlikely height for Venusian clouds, or else a fantastic density for the planet; but I would not suppose that meaningful measurements could be made of any drawing of Venus in relation to such a delicate phenomenon as the limb band. The reason is the notorious lack of contrast, which makes pinpoint precision in delimitation all but impossible and which quite precludes micrometric measurements at the telescope. Hence I do not believe that we need worry about 50-mile high clouds nor impossible planetary density.

In my original paper I had speculated that the faint brownish tinge occasionally - but very rarely - present in the disc shading of Venus was an indication that the atmosphere is translucent rather than opaque; and the suggestion was made that this color might be due to a reddening effect of Venusian haze. Mr. Eyer objects that such an effect would be visible only to an observer on Venus, and even so that it would be the image of the sun alone which would be reddened, the area of red scattering not to exceed much more than twenty degrees and hence virtually undetectable on the earth.

But we are not dealing with red scattering, and Mr. Eyer's objection is valid only if we assume complete opacity of the Venusian atmosphere. Elsewhere I have shown from historical evidence that translucency rather than opacity is the more probable state of the planet's atmosphere. Grant only that on occasion we can visually penetrate through several strata of Venusian air. Eventually we may come to an opaque stratum, but by this very fact it becomes a mirror by which sunlight is reflected back to us through the superincumbent layers of atmosphere. Thus the position is reversed, and now it is we on the earth for whom the haze lies between the observer and the source of light, in this instance a reflecting layer beneath translucent layers of the planet's atmosphere. Here we do not depend upon red scattering, but upon a reddened image, the cross section of which depends upon the cross section of the reflecting area.

Incidentally the modus operandi can be demonstrated experimentally; but,alas, space does not permit its inclusion here. The ingredients, however, are very simple - a Wratten A filter (red), a plane mirror, and a candle. Perhaps it will be amusingto my customers to figure out the relations!

Before I shut down at last, a word of appreciation to Prof. Haas for his generous acknowledgment of an error of interpretation in regard to the drawings which adorned my original paper of this series. Would that I had never made a more serious one!

EFFECTS OF OBSERVATIONAL CONDITIONS

By: Takeshi Sato,
Rakurakuen Planetarium and Observatory, Hiroshima, Japan

As is very well known, the quality of visual observations of the moon and the planets is greatly affected by observational conditions such as the keenness of the observer's eye, differences in telescope aperture, magnification and type of eyepiece, and seeing and transparency in our earth's atmosphere. Indeed, one of the chief tasks of lunar and planetary students is the evaluation of the effects of these observational conditions.

It is quite obvious that very small or very faint markings cannot be seen under poor observational conditions. For this reason it cannot be concluded that a feature has disappeared even though it is invisible under poorer observational conditions than those prevailing when it was previously observed. This fact is obvious, but there are many other effects of observational conditions.

In this article I shall show some examples of these effects and would then like to make a proposal.

The keenness of the observer's eye in lunar and planetary observation is much more seriously dependent upon his experience in observation than upon the natural keenness of his vision. An experienced observer with poorer eyes can see much more detail with much greater accuracy than a novice observer having far better eyes;and indeed if the novice records much detail, many of the observed features are usually illusory.

Even in the case of experienced observers there are many different types of eyes. For example, my own eye is superior in resolving power but is inferior in detecting very faint markings, though some other observers appear to have the reverse experience.[1]

Color is also differently perceived by different observers. Apart from color blindness, color sensitivity is considerably different among different observers; and even with a single observer, one eye is much different from the other eye in color sensitivity. All observers whom I have tested agree that the eye used more often for observation shows warmer color than the other eye. Such disagreement can hence be expected between experienced and novice observers. The disagreement about color between different observers or between a single observer's one eye and his other eye appears to become much greater when very bright markings are observed. Excessively bright markings often show contrary colors to different observers.

As to the telescope, if the seeing is perfect, of course, larger apertures give greater resolving power; but in reality too large an aperture appears to give less resolving power because of the seeing, which more seriously handicaps the larger aperture than the smaller one. On the other hand, small differences in color and brightness, or intensity, between comparatively large regions seem to be almost always more easily distinguished with the larger aperture.

Magnification is less important than aperture; but it also affects resolving power, color, and brightness, or intensity. Observers equipped with giant telescopes, such as Dr. Gerard P. Kuiper, usually employ too low magnifications to take full advantage of the resolving power of the large telescope if the seeing is as excellent as they sometimes claim. Based upon the famous Dawes Limit, it is usually stated that the minimum necessary magnification to allow full resolving power is thirteen times the telescopic aperture in inches; but according to the experience of many observers, including myself, this value is definitely insufficient, and a magnification of at least twenty-five times the aperture in inches is needed. (For example, the minimum necessary magnification on the 200-inch telescope is then 5,000X !)

As to color observations, it is very well known that the color of markings becomes less distinct with smaller apertures and is quite distorted with refractors because of their chromatic aberration.

The seeing and the transparency are also very important. It is quite obvious that under poor seeing conditions very small or very faint markings must become quite invisible; but in addition false color is often observed with poor seeing. For example, the dark maria on Mars often appear much bluer under poorer seeing than under better seeing, probably because of the orange color of the neighboring desert regions.[2] Transparency is less important for resolving power and instead more seriously affects the observations of color and brightness, or intensity, but very poor transparency also reduces the resolving power.

As has been seen, the effects of observational conditions can be classified into two different categories, of which one is the effect on color and brightness, or intensity; and the other is the effect on resolving power. In the following paragraphs I would like to give two concrete examples of the effect of insufficient resolving power.

The first example is the "canals" of Mars. According to such keen-eyed observers as Shirō Ebisawa, Tsuneo Saheki, and Ichiro Tasaka in Japan and Dr. Audouin Dollfus in France, the appearance of the Martian canals varies greatly in different grades of seeing; and if the telescope is sufficiently large[3], the change in aspect of typical canals is as follows:

Under bad or poor seeing, canals are quite invisible; under moderate to fair seeing they appear as diffuse wide bands; under good seeing they appear as narrow lines; and under very excellent seeing, they are resolved into chains of numerous dark spots.[4]

Another good example is the "festoons" of Jupiter. Festoons are most often observed in the Equatorial Zone of Jupiter, though occasionally found also in other zones. With low resolving power most of the festoons in the E.Z. appear to be connecting both to the North Equatorial Belt and to the South Equatorial Belt North; but with higher resolving power most of them are quite detached from the $S.E.B._n$, though connecting with the N.E.B. From this point of view the 1961 apparition of Jupiter was very interesting. In this apparition the north component of the S.E.B. was unusually far north; and even under fair seeing, with a 10-inch reflector most festoons looked as if they were connecting with the $S.E.B._n$ (Figure 9, right); but under very excellent seeing, many of these festoons, though not all, were clearly separated from the $S.E.B._n$, each by a very narrow space (Figure 9, left).

For this reason, when we make a statistical study of the festoons, for example, the results become quite meaningless if we neglect the effect of observational conditions.

Figure 10 illustrates some examples of false appearances of festoons and some other markings in the E.Z. of Jupiter.

As we have just seen, visual lunar and planetary observations

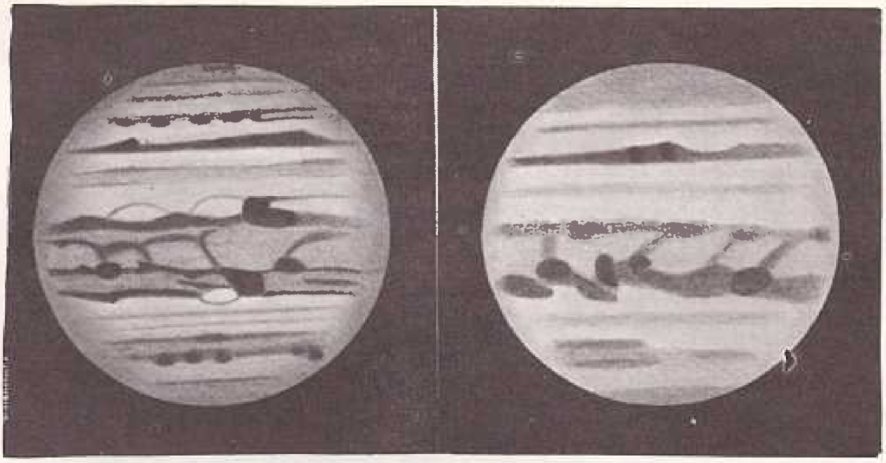

FIGURE 9. Comparative drawings of Jupiter by Takeshi Sato to show effect of different seeing on appearance of surface markings. See also text of Mr. Sato's article. Left drawing: July 15, 1961; 14 hrs., 50 mins., U.T.; $C.M._1 = 7°$, $C.M._2 = 257°$; 10-inch refl. at 278X; seeing 6-8 (excellent); transparency 3-4. Right drawing: August 11, 1961; 12 hrs., 45 mins., U.T.; $C.M._1 = 238°$, $C.M._2 = 282°$; 10-inch refl. at 216X; seeing 2-3 (poor); transparency 4. Compare aspect of Equatorial Zone festoons with excellent seeing (left) and poor seeing (right).

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are strongly affected by observational conditions in various ways. For this reason, the data for observational conditions should always be reported with each observation in order to make correct judgment possible about the true nature of the observed markings. In _The Strolling Astronomer_, the name of the observer, the size and type of telescope, and the magnification are almost always given for each published drawing; but the data for seeing and transparency are often omitted.[5] It is extremely regrettable because the reader cannot then form his own judgment. Of course, the individual observer is another essential factor; but his observations, by themselves, tell about his ability if seeing, transparency and other observational conditions are given. Published drawings are also very useful for many other purposes; but if the observational conditions are omitted, such drawings greatly lose in value.

In concluding this article, I would like to urge all contributors to _The Strolling Astronomer_ to give the data for seeing and transparency as well as the other observational conditions upon all drawings that may be published.

Footnotes and References

1. A number of very excellent examples of similar effects are shown by Brian Warner in the _Journal of the British Astronomical Association_, Vol. 71, No. 5, 1961.

2. A similar effect has been observed by Gerard P. Kuiper. Refer to the _Publications of the Astronomical Society of the Pacific_ for October, 1955.

3. This does not mean "Giant Telescope". During the favorable approaches of the Red Planet an 8-inch telescope is capable of revealing fine details in the Martian canals.

4. See Ichiro Tasaka's drawings of Mars in 1958 in _The Strolling Astronomer_ for September-October, 1960.

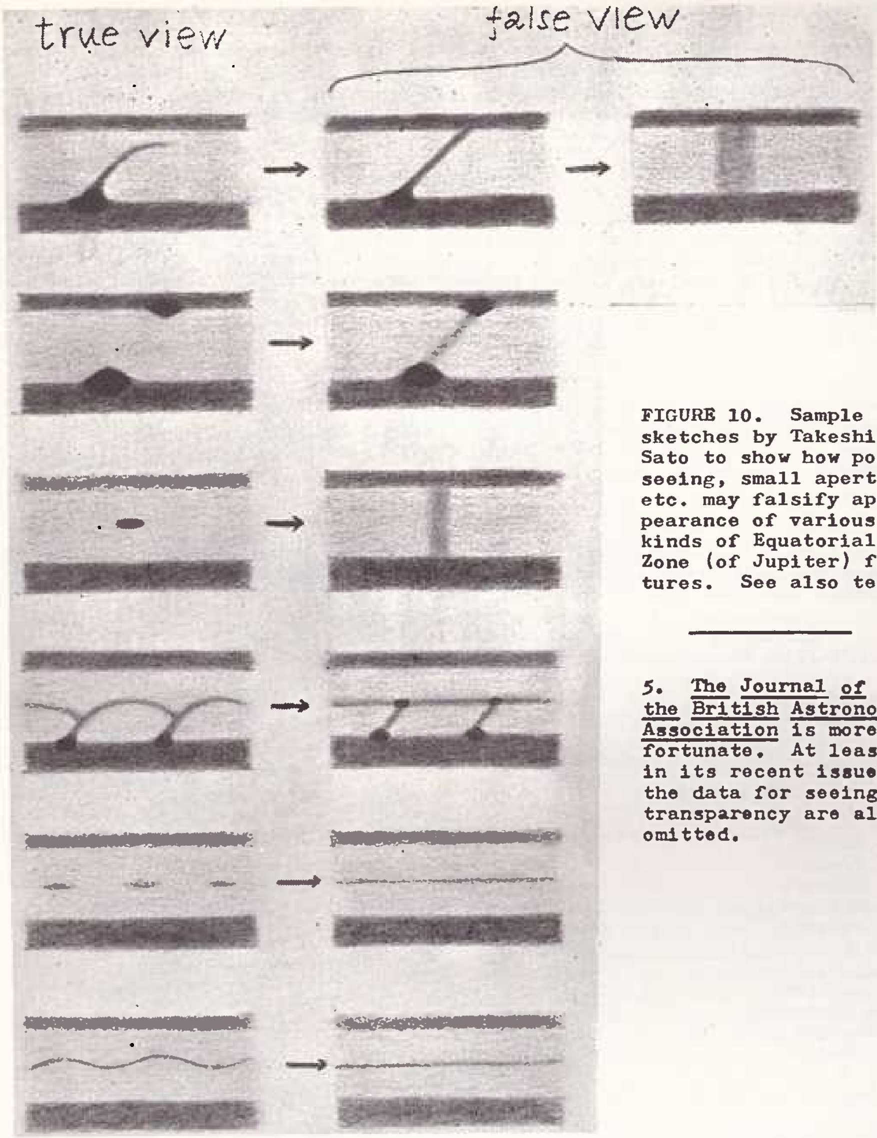

FIGURE 10. Sample sketches by Takeshi Sato to show how poor seeing, small aperture, etc. may falsify appearance of various kinds of Equatorial Zone (of Jupiter) features. See also text.

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5. The Journal of the British Astronomical Association is more unfortunate. At least in its recent issues, the data for seeing and transparency are always omitted.

A.L.P.O. COMETS SECTION: FINAL REPORT FOR 1961.
PART I. - GENERAL DESCRIPTION

By: David D. Meisel

Abstract: During 1961, observations of five comets -- 1960 n, 1960 i, 1961 d, 1961 e, and 1961 f -- were received. This report covers all work submitted before December 31, 1961. Part I of this report deals with general descriptions of the objects. Part II is a more detailed analysis of the physical characteristics of the objects with possible phenomenological

To sum up, the book is well worth $12.50 although the great majority of chapters will interest only professional and very advanced amateur astronomers.

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STARS, MEN, AND ATOMS, Heinz Haber, Golden Press, New York, 1962. 188 pp. $3.99.

Reviewed by Fred C. Trusell

Haber's book might better be entitled, The Universe, Men, and Atoms; for with the exception of a rather brief chapter on the sun the book contains somewhat less about stars than the average amateur astronomer might like. It is, however, a fascinating account of our planet (with a brief nod to its neighbors), the universe in which it exists, and the men who have contributed to our understanding of it.

The author ranges over a wide field of subjects including a model of the sun, atomic structure, radioactive decay, dating by the carbon-14 method, the possibility of life on other planets in our Solar System, the possibility of life on planets of other stars, the practicality of space travel, the fourth dimension, and the finiteness or infiniteness of space. In each of these, Haber displays an unusual ability to explain lucidly the most complex concepts in terms that the average high school student can understand without watering down the book to the point where it becomes dull for the more experienced reader. Another strength of the book, which more writers would do well to emulate, is the manner in which the author makes the ancient ideas concerning the universe seem quite logical in the light of what men knew at that time, rather than making them look ridiculous in the light of what we know today. May writers in coming centuries be as kind to us.

For evenings when the sky is overcast, this book can provide thought-provoking moments, raising as many questions as it answers, but at the same time providing the reader with some of the tools with which to arrive at his own answers.

(another review on p. 189)

ANNOUNCEMENTS

Concerning the Reviewing of Books. In recent weeks we have twice been a little embarrassed to receive reviews of the same book by two different A.L.P.O. members. We appreciate the keen interest and enthusiasm motivating our members to contribute volunteer book reviews. However, a little more coordination of such efforts does appear necessary. In the future everyone is requested to check with Mr. J. Russell Smith, the Book Review Editor, before submitting a review.

New Address for Thomas Cragg. The mailing address of our Assistant Saturn Recorder is now:

Thomas Cragg
Mount Wilson Observatory
Mount Wilson, California

Mr. Cragg was recently promoted to Resident Solar Observer on Mount Wilson, succeeding Mr. Joe Hickox, who had held that post for 40 years. The many A.L.P.O. members knowing Tom Cragg will join us in congratulating him upon this new distinction. He is now on Mount Wilson all but 9 days each month.

Resignation of Special Lunar Projects Recorder. Mr. Leif J. Robinson has given up this post because of the demands of many other astronomical interests. Efforts to organize an effective Lunar Section continue, but no other person to head Special Lunar Projects has yet been found.

Acknowledgments. It is a pleasure to acknowledge the financial help of Pan American College with the preparation and mailing of The Strolling

Unlike Peek's format, the presentation is chronological, which perhaps enhances its readability but detracts somewhat from its convenience as a reference volume; information regarding specific features is scattered throughout its pages. Since the primary function of a book of this type is one of reference, this shortcoming is of considerable moment.

Very little space is specifically allocated to methods of observing Saturn, although, as Dr. Alexander points out, such information is scattered throughout the text. Furthermore, many of the methods described by Peek in his book are equally applicable to Saturn. It can probably be assumed that readers of this book will be familiar with Peek's as well.

Professional as well as amateur work is covered in adequate detail, and the observations are thoroughly documented. Understandably, emphasis is given to the activities of the Saturn Section of the B.A.A.; this emphasis is well deserved since the Section dates back to 1891 and has compiled a very impressive log of observations.

Approximately 20 percent of the book is devoted to pre-telescopic observations of Saturn. These involve determinations of position and little else. While interesting, this part of the book, in the Reviewer's opinion, could well have been condensed. The Planet Saturn is more than 50 percent again as long as The Planet Jupiter. Its price is proportionately greater and may perhaps be considered prohibitive by some amateurs. Both size and price could have been advantageously reduced.

Dr. Alexander describes seventeenth century observations and ideas regarding Saturn in admirable detail. This section of the book, chronicling the pioneering work of Galileo, Huyghens, and Cassini, among others, is perhaps its most fascinating part. Of particular interest is the controversy concerning the nature of the rings between Huyghens, who was the first to correctly interpret their telescopic appearance, and his adversaries.

Contemporary observers interested in such unsolved riddles as minor divisions in the rings and the existence of a faint ring exterior to Ring A will find the pros and cons on these matters set forth objectively. A concept of great importance pointed out by Alexander, which is perhaps not given sufficient consideration by many observers, is that the rings may not be constant with regard to intensity minima. Minor divisions reportedly seen at times with relatively small apertures but absent at others in large telescopes may be transient "ripples" in the rings, due perhaps to the orientation of the satellites.

The text seems remarkably free of flaws despite the forebodings expressed by the author in his preface. A couple of minor typographical errors were found: The caption to Plate IV, Figure 2 should read "...6½-inch reflector..." rather than "...6½-inch refractor..."; on page 421, line 8, several words appear to have been omitted, presumably "...the 1955...". Other specific criticisms are as follows: In describing the occultation of BD-20° 4568 by Saturn in 1957 (p. 425), no mention of the star's magnitude is made. A description of observations of Saturn using filters (p. 426) gives the manufacturer's code numbers but not the transmission properties of the filters, leaving the reader very much at sea unless he happens to be familiar with Dufay code numbers.

The Reviewer has perhaps overemphasized what he has found to be the weak links in a very strong chain. To his knowledge, no significant observations of Saturn up to the year 1960 have been ignored by Alexander, making his book very nearly indispensable for serious students of the planet.

OBSERVATIONS AND COMMENTS

Stereoscopic Lunar Photographs? Mr. Robert H. Henderson, 2210 Ogden St., San Bernardino, Calif., invites comments on these ideas: "A combination of the advanced photographic techniques of the present with the simplicity of the old time stereopticon could, it seems to me, be combined in the de-

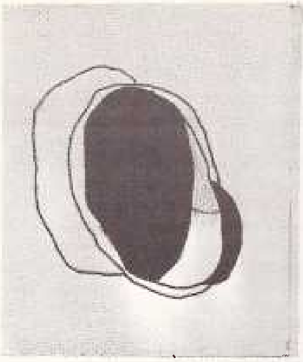

FIGURE 28. Lunar Crater Daniell. Keith Peterson. October 14, 1961. $1^h 1^m - 1^h 14^m$, U.T. 7.5-inch reflector. 60X (for drawing), 120X (for checking). S=2-7. T=2-3.5.Colongitude=325°9.

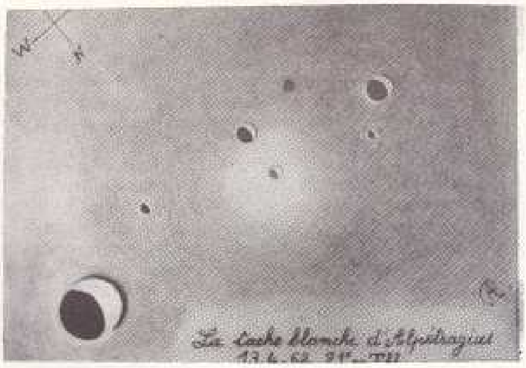

FIGURE 29. White and Dark Spots near Lunar Crater Alpetragius. Robert Abraham. April 13, 1962. $21^h 0^m$, U.T. 8.8-inch reflector. 260X. S=7. T=4. Colongitude=18°8.

FIGURE 30. Lunar Crater Cleomedes. Carlos E. Rost. February 22, 1962. $3^h 17^m$, U.T. 6-inch Fecker catadioptric reflector. 285X. S=3-4. T=2-3. Colongitude=120°4.

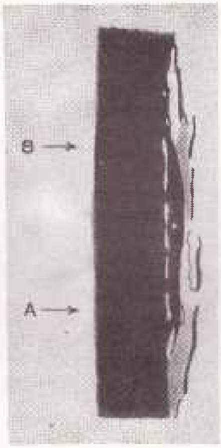

FIGURE 31. Lunar Crater Neper. Carlos E. Rost. February 20, 1962. $1^h 15^m$, U.T. 6-inch Fecker catadioptric reflector. 285X. S=5. T=2. Colongitude=95°1.

velopment of an interesting project. The realism of three dimensions in the old device and its modern counterparts is so striking, compared to an ordinary photograph, that I wonder if it has ever been applied to astronomical photographs. Precise timing would, of course, be necessary, as well as telescopes of the same aperture using identical magnifications. Similar makes of telescopes and cameras would be preferable.

"The moon could be photographed from approximately the First Quarter into the Last Quarter. An observer on the West Coast, and another on the East Coast (identical equipment, etc.) would, at the same instant, photograph some pre-selected feature, carefully centered in the field of view. The comparatively slight difference in the distances from the two observers to the moon might have to be compensated for at the First and Last Quarters.

"The resulting photos in the viewer would represent, at 240 power, the view produced by a pair of 'eyes' some 12 miles apart and 940 miles from the moon. The three-dimensional effect would be about the same as for an object about eight feet from the unaided eyes. These figures are rather approximate, and I am optimistically assuming ideal conditions all around. Different magnifications and observers at varying distances would have to be tried to produce the best results.

"As to the planets, probably the much greater distances would nullify any visible stereoscopic effect. Such lunar, and possibly planetary, views might be spectacular and useful."

Daniell. Figure 28 is a drawing of this rather small crater by Mr. Keith Peterson, 4615 Grand Prairie Rd., Kalamazoo, Michigan, with the usual accompanying information. It will be noticed that the seeing varied greatly. Daniell lies just north of Posidonius on Section III of the Wilkins map of the moon. The observer says: "About one-fourth of the floor was visible. The rim on the northeast cast a shadow varying little in height. The highest part of this portion of the wall lies almost in the middle of the portion involved. The wall height does not vary much in this region. The northern part of the illuminated floor was bright. The southern area appeared dusky. About two-fifths was dusky. No radial bands could be detected. No detail on the floor or rim was observed. Adjacent to the south and west walls was a whitish area not quite so bright as the bright part of the floor. The central hill wasn't in sight at the time." Mr. Peterson is anxious to improve his lunar techniques and will welcome correspondence.

White and Dark Spots near Alpetragius. Mr. Robert Abraham, Verneuil-en-Halatte, Oise, France, has contributed the drawing of these objects appearing here as Figure 29. The white spot reminds one forcibly of the Linné white spot.

Cleomedes. Mr. Carlos E. Rost of Santurce, Puerto Rico, submits the drawing published here as Figure 30, with the usual data in the caption. The drawing was interrupted many times by clouds and was finally terminated while still incomplete. The libration in longitude was east on February 22, 1962, hence unfavorable for studying formations near the west limb (like Cleomedes). The observer notes: "Notice the curvature of the crater floor and craterlets south of the central peak. The west wall is seen to have several depressions. The long, black oval to the northeast of Cleomedes is Tralles, which partly intrudes on the east wall."

Neper. Figure 31 is a drawing contributed by Carlos E. Rost. He remarks: "The darkening of the west wall was at a rather noticeable speed; bright edges at 'A' and 'B' were the last to vanish into darkness. The central peak appeared dusky. The extreme south end of 'B' disappeared at $2^h 29^m$, U.T. The extreme north end of 'A' disappeared at $2^h 38^m$, U.T., or approximately 9 mins. later."

The Strolling Astronomer

Founded In 1947

THE JOURNAL OF THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

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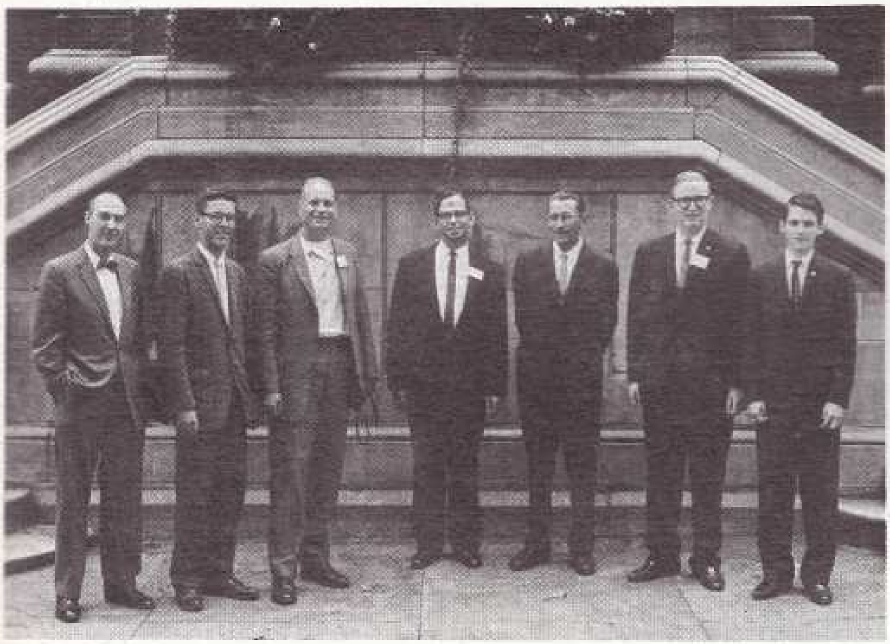

A. L. P. O. staff members at Tenth A. L. P. O. Convention at Montreal, Quebec, September 1-3, 1962. Photograph by William E. Shawcross. Left to right: Phil Glaser, Jupiter Recorder; Clark Chapman, Lunar Training Program; Joel Goodman, Saturn Recorder; Walter Haas, Director-Editor; Ernst Both, Mars Recorder; Geoffrey Gaherty, Jr., Mercury Recorder; Kenneth Chalk, Lunar Meteor Search Recorder.

THE STROLLING ASTRONOMER

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ASSOCIATION OF LUNAR & PLANETARY OBSERVERS

ALPO

IN THIS ISSUE

Time Interval	Central Date	Mean Long.	Ave. Deviation	Transits
Aug. 13-Aug. 24	Aug. 18	242°	±2°.0	11
Aug. 25-Sep. 5	Aug. 30	236	±1.3	7
Sep. 6-Sep. 17	Sep. 11	233	±2.7	14
Sep. 18-Sep. 29	Sep. 23	229	±1.7	7
Sep. 30-Oct. 11	Oct. 5	222	±1.3	7
Oct. 12-Oct. 23	Oct. 17	218	0.0	2
Oct. 24-Nov. 4	Oct. 29	---	---	-
Nov. 5-Nov. 16	Nov. 10	206	±1.5	2
Nov. 17-Nov. 28	Nov. 22	202	---	1
Nov. 29-Dec. 10	Dec. 4	195	±1.0	4
Dec. 11-Dec. 31	Dec. 21	189	±0.5	2

Note: The observed longitude on any given date during an interval was corrected to the central date of that interval by applying the mean drift of -0°.43 per day. This was done to eliminate any errors which might have been caused by unequal distribution of observations during an interval.

IN DEFENSE OF VISUAL OBSERVATIONS OF PLATO

By: Patrick S. McIntosh, Sacramento Peak Observatory

For the past five years the author has worked intermittently upon compiling a chart of Plato which can represent the maximum accuracy obtainable by visual means. The chart presented here (Figure 3) was essentially in the present form two years ago but has not been published until now because of delays caused by finishing college. While I was preparing an extensive report of these years of observations plus an examination of past observations, Alika K. Herring published his excellent chart based on a Yerkes photograph.[1] This chart substantially reduces the value of the report I had planned; and so I here merely present the chart in Figure 3, which I have compiled for a comparison with the definitive photographic chart.

I also present another chart (Figure 4) for comparison which was painstakingly compiled from the several prints of Plato in the Photographic Lunar Atlas.[2] Many of the details on this map are also on the Herring chart. The positions of all specks and craterlets appearing on the prints were carefully measured, and this chart was compiled only from details appearing on more than one print. In this way it was hoped that spurious details would be eliminated. I believe that a few non-existent details remain on the chart, but at the same time many real features are not represented because of being beyond the limit of the photographs or because they appeared on only one print for reasons of suitable angle of illumination. Notice that three small domes, two large hills, and a shallow "saucer" were recorded on Figure 4 from the prints. These have never been seen visually, probably because they require a very low angle of illumination to be detected but perhaps because they do not exist. The extreme difficulty of gleaning small detail from the published prints makes these details highly uncertain.

The visual chart (Figure 3) contains all but one of the spots and craterlets on the Yerkes chart; and the positions are in very good agreement, considering the libration differences of the two charts. It is obvious that there are many more details present to the eye than appear on even the excellent Yerkes photograph. Since the positions of the 31 spots confirmed by the Yerkes chart are reasonably accurate and since the positions of all details were obtained in the same careful manner, is it not reasonable to expect the remaining 33 features to be positioned with good accuracy and actually to exist? A few comments on the observing procedure might aid in answering this question. In previous reports,[3,4] I have described briefly this procedure and will do so again in support of

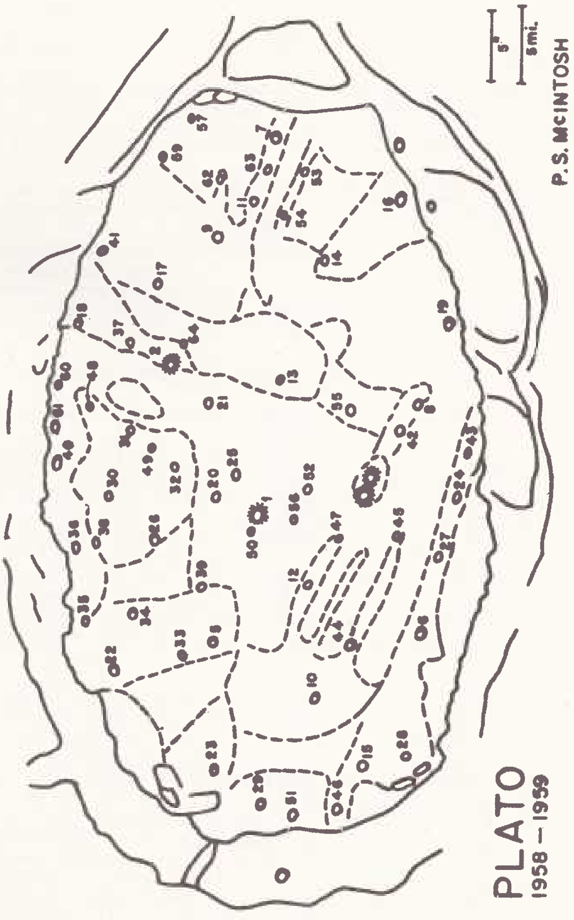

FIGURE 3. Chart of Plato drawn by Patrick S. McIntosh. Based upon visual observations with an 8-inch reflector, a 7.5-inch Clark refractor, and a 4-inch Unitron refractor in 1958 - 62. See also text of article by Mr. McIntosh in this issue.

my belief that careful visual positioning of lunar details can reach reasonable accuracy. The rim detail and the five largest craterlets were originally charted from an enlargement of a Mt. Wilson photograph[3] which represented approximately mean libration. The detail was not merely sketched. Many positions were carefully measured on the photograph so that a large

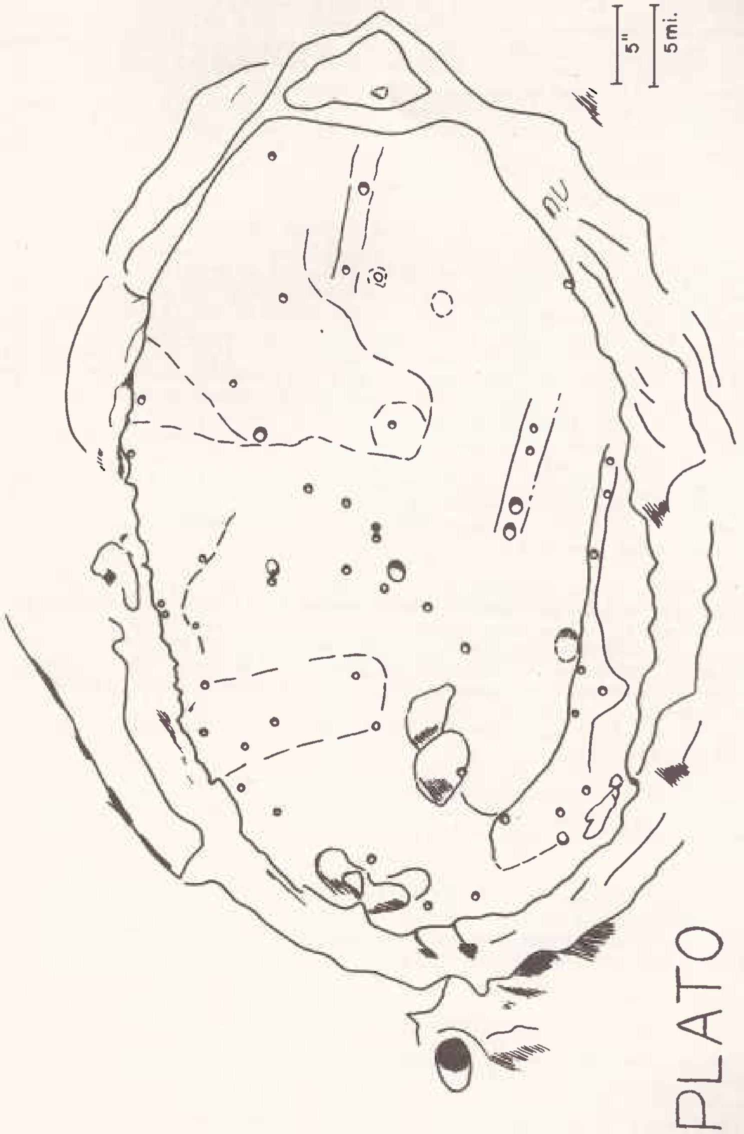

FIGURE 4. Composite chart of Plato constructed by Patrick S. McIntosh and based upon photographs in the Kuiper Photographic Lunar Atlas. See also text.

number of primary reference points would be available for use in positioning the visual details. This outline chart was used at the telescopes (8" reflector, 7½" Clark refractor at Harvard College Observatory, 4" Unitron refractor at Sacramento Peak Observatory), the delicate and elusive bright spots being positioned by carefully noting the alignment of such features with prominent rim features on opposite rims of Plato. The use of two or more sets of reference points insured the accuracy presented here. Each feature was observed and positioned at least three times on each night that it was visible and was further confirmed on several additional nights. Only in the very complex area south of the central craterlet are the positions in doubt. Even here, the Yerkes chart confirms the positions of several spots.

I must agree with Mr. Herring that in the past most of the Plato maps were made with insufficient care, resulting in considerable confusion in the conclusions reached about whether changes actually do occur in Plato. Several careful comparisions have been made of the past maps, and there still exists some evidence for actual changes in the visibilities of features. For example, in A. S. Williams' map of 1883, spots 1 and 13 were charted as crater cones of equal magnitude. Williams' comment on 13 is: "Variable; usually fainter than 1, yet frequently equal to it, and more than once even surpassing it."[6] In recent years it has never been equal to 1, and I have been tempted to call it variable also. It is quite inconspicuous on both of the photographic charts and visually appears as either a minute crater pit or spot immersed in the complex tip of the bright "sector". There are other reports of variations which are difficult to explain by lack of care in the observations or by differences among the observers. My conclusion is that the question of Plato variability is yet to be answered.

Photographs of the quality used by Mr. Herring might be sufficient eventually to establish an answer, when there exist such photographs taken several years apart. The agreement between the photograph and the visual chart indicates, however, that a visual observer may still be the one to produce the next evidence of changes in Plato. Whether his evidence will be accepted as proof will depend on the established reliability of that observer's reports. Repeated confirmation of his observations by photographs or by many other experienced observers should be sufficient to establish his reliability.

Changes can be detected only when there is a reliable chart to use for comparison with future observations. It is hoped that Mr. Herring's chart together with these presented here constitute such reference material.

Patrolling for possible changes in Plato's features is one of the few lunar programs remaining in which amateurs with modest equipment may make a significant contribution to selenography. A look at the excellent U.S.A.F. Lunar Charts[7] discourages one from attempting to discover much else.

Footnotes and References

1. A. K. Herring, The Strolling Astronomer, 16, July-August, 1962, page 158.

2. U.S.A.F. Photographic Lunar Atlas, compiled under direction of Gerard P. Kuiper, plates D1a-D1d, D2a-D2e, 1959.

3. P. McIntosh, "Chart of Plato Detail", The Strolling Astronomer, 13, November-December, 1959, page 155.

4. P. McIntosh, "A Precision Map of Plato", paper read at the Sixth Convention of the ALPO, San Jose, California, August 24, 1960.

5. J. T. Carle, "The Three Riddles of Plato", Sky and Telescope, 14, page 221, April 1955.

6. A. S. Williams, The Observatory, 6, page 87 and page 112.

7. U.S.A.F. Lunar Charts are available on subscription by writing Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. Price $7.50.

Table 1
Plato Detail Confirmed by Two or more Prints

Ic	11c	*23c	*39
2c	12c	24c	40c
3c	13c	25d	42c
4c	14	*26	43c
5	15c	*27c	50d
6c	18c	28c	51c
7c	19c	29c	*57c
8c	20c	*30	60c
*9c	21c	*35c	
10c	22	38	

Unstarred objects are within 1" of arc of photographic position.
* position within 2" of arc of photographic position.
c shadow-holding pit or cone.
d dome.

Number of details on McIntosh map --- 62
Number of McIntosh details confirmed - 38

Table 2
Features on McIntosh Map Confirmed on Yerkes Photograph No. 822

1	10	21	47
2	11	23	51
3	13	26	53
4	14	27	54
5	15	30	57
7	16	36	59
8	18	41	63
9	20	44	

Number of details confirmed ----------- 31

A RELIEF MAP OF ERATOSTHENES

By: John E. Westfall

I. Introduction

This paper describes an experimental project in selenography, the large-scale, three-dimensional mapping of a single formation.

II. Area

The formation selected was the crater Eratosthenes, which was chosen for several reasons:

(i) The crater lies near the apparent center of the disc, reducing foreshortening errors.

(ii) Due to the work of D. W. G. Arthur, good horizontal control exists in the area.

(iii) There is considerable local relief, which furnishes a good test for the method of height determination.

(iv) The formation itself is an imposing, interesting feature, much observed and photographed, and is of a size convenient for mapping.

III. The Base Map

After Eratosthenes was decided upon as an object for study, a base map of the crater and the adjoining region was prepared, showing the selenographic grid for every degree of latitude and longitude, along with six control points from the catalogue of Arthur.[1] The control points (all pits or craterlets) were as follows:

Catalogue No.	ξ	η	λ (Long.)	β (Lat.)
bC 6269	-0.1658	+0.2291	09° 48'.3 E.	13°14'.7 N.
bC 8107	-0.1797	+0.2167	10 36 .5	12 30 .9
bC 9127	-0.1917	+0.2174	11 19 .6	12 33 .4
bC 9402*	-0.1897	+0.2417	11 16 .4	13 59 .2
cC 0360*	-0.2063	+0.2303	12 14 .4	13 18 .9
cC 2482	-0.2276	+0 2420	13 34 .1	14 00 .3

As an aid for later horizontal control, the rim of Eratosthenes was also drawn on the base map.

The projection and scale of the base map were identical with those of the relief model and map, a polyconic projection, with central meridian 11°20'E., on a scale of 1:250,000, based on a reference sphere of radius 1738.0 kms.

IV. The Model

The next step consisted of constructing a relief model of the crater. This model was constructed of plasticine, upon an aluminum base board to which the base map had been transferred. The determination of relief was based on the following assumption: an accurate relief model of a given area, with equal horizontal and vertical scales, when illuminated and viewed from the same altitudes and azimuths as were true when a given photograph of the region was taken, should duplicate the appearance of the photograph.

In practice, slides were made from selected lunar photographs. These slides were viewed through a magnifier with the left eye, while the model was viewed directly with the right. Correct orientation was insured by superimposing the images of the photographic control points with the control points as shown on the model. For convenience, the magnifier and slide were mounted on a frame above the model; they could be moved towards, and away from, the model, or tilted to correct for foreshortening.

With the images thus superimposed, the next step was to compute the solar altitude and azimuth at the center of the crater at the time of the photograph. This was done by the expressions:

$$\sin A = 0.2504 \sin D + 0.9682 \cos D \sin (C - 11^\circ 20'), \text{ and}$$
$$\sin \theta = \cos (C - 11^\circ 20') \cos D \sec A,$$

where: A = Solar Altitude.
θ = Solar Azimuth.
D = Solar Selenocentric Declination.
C = Solar Colongitude.
14°30' = North Latitude of Crater Center (sin = 0.2504; cos = 0.9682).
11°20' = East Longitude of Crater Center.

*Points appearing within the final chart margin.

A floodlight was placed at the corresponding angles in relation to the model. Placing the light at a computed distance from the model closely approximated variations in solar altitude with respect to position on the lunar surface. The distance from center of model to light is found from the formula:

D = r sin A,
where: A = Solar Altitude, as before.
D = Distance from light to model center.
r = Scale Lunar Radius (i.e., 1738.0 kms. X 1:250,000 = 695.2 cms.).

A total of eight photographs of the region were used, all of which, with the exception of SP-15, are available in Kuiper's Photographic Lunar Atlas.[2] For each photograph, the model-light altitude, azimuth, and distance were as follows:

Plate	A (Alt.)	θ (Azimuth)	D(Distance)	Light from:
M284	08°.9	- 94°.1	107.5 cms.	West
P37b	10.9	- 94.1	131.5	West
SP-15	13.3	- 94.5	160.0	West
Y160	22.7	- 97.4	268.2	West
W121	18.2	+ 96.4	217.2	East
W124	18.0	+ 96.4	214.9	East
L11	15.9	+ 96.7	190.5	East
W195	05.8	+ 92.7	070.3	East

(M = McDonald, P = Pic du Midi, SP = Mt. Palomar, Y = Yerkes, W = Mt. Wilson, and L = Lick, Observatories.)

After model, photograph, and light were placed in their correct relationship, the model was added to and molded until its shadow pattern duplicated that of the photograph. When this was true, the same was done with a photograph with lighting from the opposite direction. This was continued until all eight photographs had been "worked", at which time the process was repeated as a check. The use of several photographs also served as a check, along with removing ambiguities of slope.

The final result of this step was a 1:250,000 scale model of Eratosthenes, which, when illuminated and observed from the same angles as in a given photograph, duplicated the appearance of the photograph. Hence, according to the original assumption, the model was an accurate replica of the crater itself.

V. The Map

With the model completed, relief could then be transferred from the model to a map compilation. This was done by placing the model in a leveled tray and gradually filling the tray with a solution of water, india ink, and "Photo-Flo" (a Kodak product which reduces surface tension, thus insuring a level surface). The "shoreline" assumed by the solution at a given depth defined the contour line of that level. The contour interval decided upon was 250 meters (820 feet) on the moon, or one millimeter on the 1:250,000 model. Thus, the model was inundated in one millimeter stages, and photographed at each stage. Then, slides made from the contour level photographs were projected, in sequence, on the map compilation; and the contour lines were traced off directly. The altitude datum was, of course, entirely arbitrary.

Relief shading was added by tracing a photograph of the model, side-illuminated, projected on the compilation sheet. The completed map, as reproduced in this paper in Figure 5, is at approximately one-half the original scale, or 1:500,000 (i.e., 1 cm.: 5 kms., or 1 in.: 7.89 mis.). The code "IIA-i", at the top of the map, states that the map is "Formation Chart One in Quadrangle A of Quadrant II", per the lunar index system out-

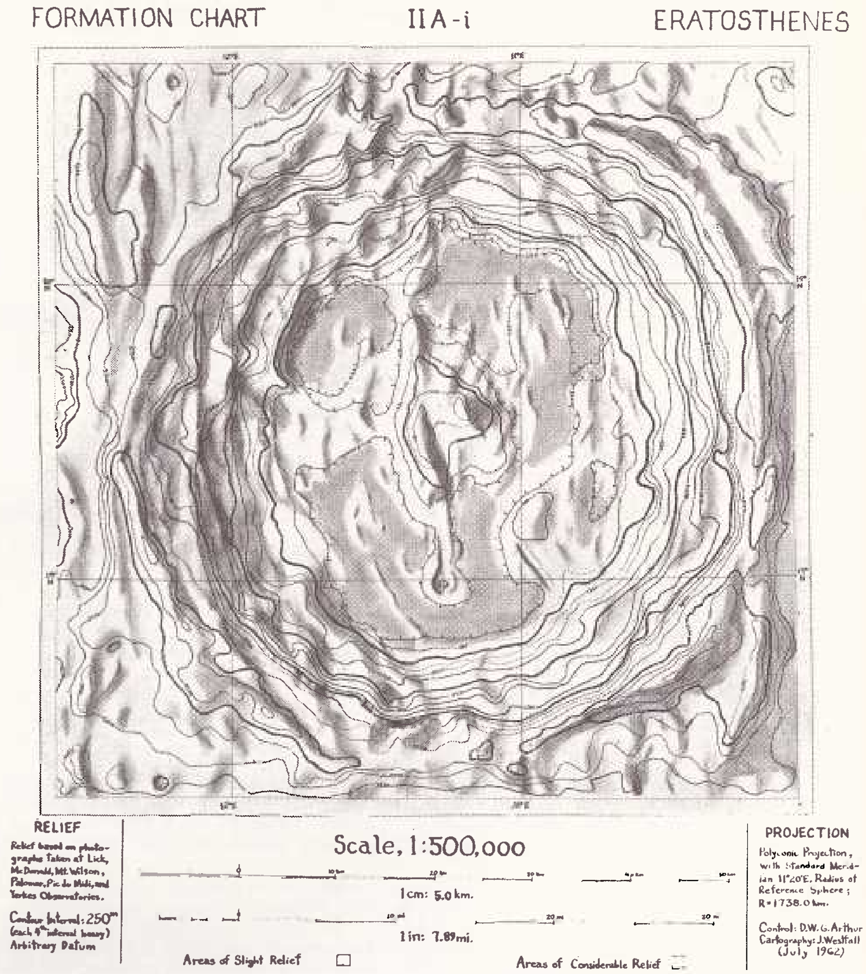

FIGURE 5. Relief map of lunar crater Eratosthenes drawn by John E. Westfall. Lunar north at top, lunar east at left (reinverted from classical lunar orientation). Relief based upon eight photographs at large observatories and detailed study of a plasticine model. Polyconic projection, standard meridian 11°20' E. and radius of reference sphere 1738.0 kms. Control points by D. W. G. Arthur. Though the linear scales sketched above can be used and remain accurate, on the published reproduction here 1 inch will not precisely equal 7.89 miles, nor 1 cm., 5.0 kms. See also text of Mr. Westfall's article in this issue. Contour interval 250 meters, altitude-origin arbitrary.

lined by the author in a previous paper.[3]

VI. Interpretation

A selenologic study of the crater Eratosthenes was not the object

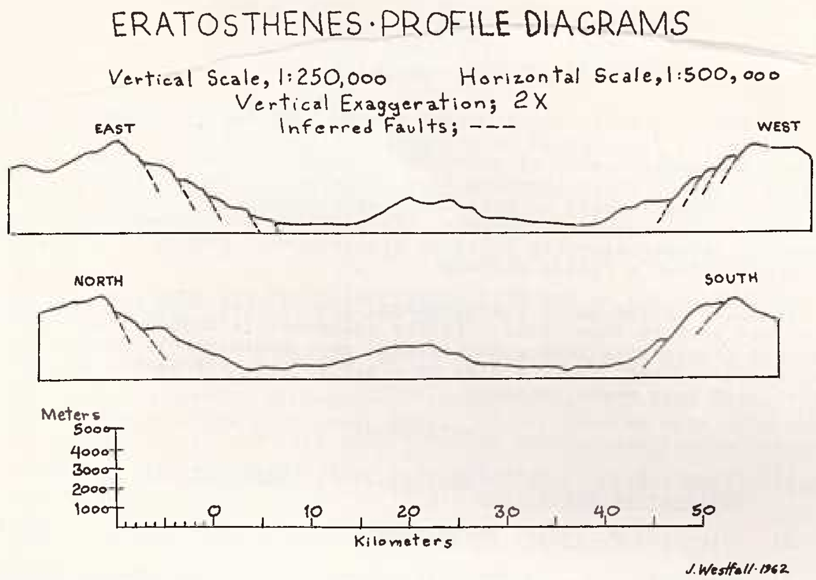

FIGURE 6. Profile diagrams of east-west and north-south diameters of lunar crater Eratosthenes. Contributed by John E. Westfall. See also text of his article in this issue.

of this project, but a few interpretative notes may demonstrate some of the possible uses of a map of this type.

The profile diagrams accompanying this paper as Figure 6 have been prepared from the map. Their horizontal scale is 1:500,000, their vertical scale, 1:250,000; vertical exaggeration is 2X. Some sharp breaks in the slope of the inner wall are evident. The fact that the slopes immediately above the slope breaks are roughly parallel suggests that these slopes are fault scarps. The hypothesized faults causing these scarps are indicated by dashed lines on the profiles. Correlation of the profiles with the plan map shows that the fault blocks between the supposed faults form the terraces of the inner wall of Eratosthenes. Although roughly concentric, these terraces are by no means regular, but start, stop, or branch in their courses. There are many features that a geologist might call splinter faults. In general, the dominant structure of the inner wall seems to be that of step faulting, suggesting large-scale subsidence of the floor. If the floor of the crater did subside, its north portion evidently subsided more than did the south. This is evidenced by three observations: (i) The terraces (fault blocks) tend to slope northwards; (ii) There is a large landslip in the north-n.e.portion of the wall, indicated by inwardly-bulging contours, and; (iii) The actual elevation (ca. 200 meters) of the north floor is lower than that of the south (ca. 400 meters).

The plan map also suggests large scale east-west compression; external ridges tend roughly north-south, the terrace structure of the inner wall is most disturbed in the north and the south, while the central mountain mass runs roughly north-south (this is also indicated by the profile diagrams).

These hasty notes are written solely to suggest the value of large-scale topographic mapping in selenology.

VII. Critique

Due largely to its experimental nature, the map has shortcomings, most of which, I feel, could be corrected in future work. Firstly, a considerably larger number of photographs should be used, and covering a greater range of solar lighting than those used here. Secondly, denser horizontal control should be previously established for the region by photographic measurement. Thirdly, the contours on the map should be systematically corrected for a radial displacement, caused by photographing the model from a finite distance.

In spite of the above shortcomings, I hope that this map will encourage further work in this line. Little equipment is needed, but there is a need for cooperative work - in securing good photographs, making the model, measuring positions, and so on - all in all, furnishing an opportunity for joint work among amateurs.

References

1) Arthur, D.W.G., Contributions to Selenography, No. 5: The Environs of Copernicus (1956).

2) Kuiper, G.P. et al., Photographic Lunar Atlas (Chicago, 1960).

3) Westfall, J.E., "A Reconnaissance Chart of the Central Oceanus Procellarum." Strolling Astronomer, 15, 9-10, pp. 159-171.

FINDING THE HEIGHT OF A LUNAR MOUNTAIN

By: Joseph Ashbrook

1. The observation needed is a visual estimate of the apparent length of the mountain's shadow. We estimate the length as a fraction f of the longest (unforeshortened) diameter of a nearby crater. The time of observation should be known to within a minute or two. Instead of working visually, we could also obtain f from measurements of a photograph taken at a known time. Measurements from drawings are not recommended.

2. The crater diameter D can be taken from Arthur's catalogue, when this becomes available. The best current procedure is usually to measure the rim-to-rim longest diameter from Kuiper's Atlas, whose scale can be assumed 100 inches to the lunar diameter. In any case, D must be expressed in units of the lunar radius, dividing it by 1080 miles or 1738 kilometers as the case may be.

3. From the American Ephemeris and Nautical Almanac, take out the following numbers, interpolated to the time of observation:

L' = Earth's selenographic longitude.
B' = Earth's selenographic latitude.
C = Sun's selenographic colongitude.
B'' = Sun's selenographic latitude.

The interpolation is much easier if the Universal Time is converted to a decimal fraction of a day; e.g., August 31, $3^h 00^m$ = August 31.125. There is a handy conversion table on page 456 of the 1962 American Ephemeris.

4. The selenographic coordinates Xi, Eta of the mountain are best taken from Arthur's Orthographic Lunar Atlas, to 0.001 or 0.0005. The next best general source is the IAU Atlas (1935), which is however less reliable positionally in the limb regions. US Air Force Charts are fine for positions, if they cover your region. Do not use Wilkins' or

Firsoff's maps for this purpose. Convert the Xi, Eta coordinates to:

L = Mountain's selenographic longitude
B = Mountain's selenographic latitude

by means of the formulae:

$$\sin B = \text{Eta} \quad , \quad \sin L = \text{Xi} \sec B.$$

5. Calculate the angular altitude A of the sun, as seen from the mountain at the moment of observation:

$$\sin A = \sin B \sin B'' + \cos B \cos B'' \sin (L + C).$$

6. Calculate the auxilliary angle F, which is the angle between the earth and sun, as seen from the center of the moon:

$$\cos F = \sin B' \sin B'' + \cos B' \cos B'' \sin (L' + C).$$

If you have a number of shadow observations during the same night, it is unnecessary to compute F for each one. It suffices to make this calculation for the first and last times, and to interpolate for the others.

7. The mountain height H, expressed in terms of the moon's radius as a unit, is calculated from:

$$H = f\,D \sin A \operatorname{cosec} F - \tfrac{1}{2} f^2 D^2 \operatorname{cosec}^2 F \cos^2 A.$$

To convert H to feet, multiply by 5,720,400; to convert to meters, multiply by 1,738,000.

8. The value of H obtained in Section 7 is a relative height -- the difference in elevation between mountain and summit and shadow tip. Often it is useful to know approximately the horizontal distance x between the two. Let us use the symbol $(H) = f\,D \sin A \operatorname{cosec} F$ (which we already have evaluated in Section 7.)

$$x = 1738\,(H) \operatorname{cotang} A.$$

This gives x in kilometers; for miles, replace the numerical factor by 1080.

9. During these calculations, keep four significant figures throughout, writing the angles to $0^\circ.01$. Labor can be saved by using trig tables with decimal division of the degree (e.g., E. V. Huntington's Four Place Tables).

The deduced heights are more accurate when the solar altitude A is small, say 1° or 2°, making the shadow long. In such cases, the error in height may be only ± 20 meters. For short shadows, far from the terminator, the error can be very much greater.

In publishing a list of height measurements by this method, it will be wise to put on record all the data needed for someone to recompute the observation, if needed: date and time, coordinates of the measured point, name of the comparison crater and the estimated fraction, solar altitude, and the height (rounded off to two significant figures, perhaps).

10. Three particularly helpful references are:

T. L. MacDonald, JBAA, 41, 367, 1931. By far the best background reference. Covers geometry, gives proofs and detailed explanations for most of the formulae in this abstract.

Gilbert Fielder, JBAA, 72, 216, 1962. Describes a simple visual estimate for getting depths of small craters. Author fails to explain that on p. 218 a more accurate source of east-west diameters (to 0.0001 lunar radius)is needed.

Z. Kopal, Physics and Astronomy of the Moon (1962). Has an interesting treatment of height measurements from the viewpoint of the photographic worker.

11. Some suggested programs involving visual determinations of heights are:

A. Heights of mare ridges. There is surprisingly little published information, but in most cases mare ridges are under 500 feet high. Hence the shadows must be estimated when the ridge is very close to the terminator. A good deal of care will be needed to get really accurate coordinates for the observed points.

B. Area studies. Any amateur who makes a detailed study of a specific locality, such as Plato, should make shadow estimates part of his project. Once the height of some prominent feature in the vicinity is known, it is very easy to determine wholesale the heights of hills, craterlet rims, etc., in the neighborhood, with the aid of Mädler's approximate formula:

$$H/H_o = S \sin A / (S_o \sin A_o)$$

where H is the height of the unknown feature, S its shadow length in any convenient unit, and A the solar altitude in its position at the time of observation; H_o, S_o , and A_o are the corresponding values for the standard.

C. Crater profiles. Because the interiors of many craters are rounded, the height of the rim above the floor will vary as the shadow edge moves across the crater. Hence, from repeated observations of the same crater on many nights, it is possible to determine the crater profile. Especially desirable are such profiles of the outer slopes of craters.

D. Heights of faults. Only in the case of the Straight Wall do we have any detailed information about the heights of lunar faults. A survey of it was published in Publications of the Astronomical Society of the Pacific, 72, 55, 1960. Similar surveys of other major faults, like the ones in Bürg and in Boscovich and the one near Cauchy, are desirable.

E. Diameter-Depth relation for small craters. This is imperfectly known, and some widely quoted formulae (such as Baldwin's) are badly off. Any amateur who determines a considerable number of depths for craters less than, say, 15 kilometers in diameter will do a valuable service. One often-overlooked fact: Because small craters are fairly steep bowls, the interior depth will be underestimated unless the observation is made with the solar altitude A some 15° or more. Hence the observations require estimation of quite short shadows, some distance from the terminator, in bright surroundings.

Any amateur who spends some time with height work will certainly think of still other projects, and of new procedures.

Comments by Editor. The two foregoing papers by Dr. Ashbrook and Mr. Westfall were among those read at the A.L.P.O. Convention in Montreal on September 1 - 3, 1962. That meeting is described elsewhere in this issue.

Surely these two papers, and the one in this issue by Mr. Patrick McIntosh also, indicate that there are still lunar problems which the earnest, capable, persevering, and well-equipped amateur can investigate. Admittedly the requirements for useful lunar work have increased in recent years. The random sketching of scattered individual craters with small apertures and mediocre seeing conditions will ordinarily have little scientific value. It is pointless for amateurs to do poorly what professional astronomers with large government subsidies are doing well. Of course, such sketching may still have value as a training program.

There is need now, in the Editor's opinion, for more concentrated work on selected lunar features, for more realistic evaluation on our part of instrumental and atmospheric limitations, and for certain special lunar projects with limited and well-defined objectives. Surely, Messrs. Ashbrook, Westfall, and McIntosh have given us some leads. The Editor realizes that the meaningful implementation of such ideas will demand some well-qualified A.L.P.O. Lunar Recorders. The search for such persons is now going on, and possibly there will be an announcement elsewhere in this issue.

CONTRIBUTIONS TO SELENOGRAPHY, PART III

By: L. J. Robinson

The two preceding sections of this paper [1,2] have defined and classified the bright-banded lunar craters. It has been shown that they are common objects and that they form a unified morphological group. Having defined our subject, we may now make statements concerning the possible origin of these formations.

Table I [3] relates certain relevant parameters for twenty-eight randomly selected bright craters. Column one contains the author's general catalogue number [4] for each crater. The second and third columns give these craters' diameters and depths respectively. The smallest of these craters is 2.64×10^4 ft. in diameter while the largest, of which there are two, is 2.955×10^5 ft. - approximately a factor of eleven. Depth extremes are: minimum depth 1.9×10^3 ft.; maximum depth 1.5×10^4 ft. - a factor of eight. More important, however, than the actual diameters or depths is the ratio of the depth to the diameter, see column four in Table I. The writer has found through a study of these ratios that, given the ratio, the diameter of the crater having that ratio can be calculated from the expression:

$$D = K e^{-41.4 R},$$

where D is the diameter of the crater in feet
$K = (2.57 \times 10^6)$
e = base of natural logarithms
R is the ratio, d/D, depth over diameter.

The exponential curve obtained from the above expression has been plotted in Figure 7. It will be noted that, on the above figure, a dashed line has been constructed at 0.26×10^5 ft., this line representing the smallest lunar crater used in the calculation of the elements of the function. To the left of that line a small mark "A" has been plotted; this point represents the position of the Arizona Meteorite Crater and corresponds very well to its position on the extrapolated empirical curve. As the craters become smaller, the ratio R rises rapidly, providing a sensitive test for the accuracy of the curve. Figure 8 has been included to show some representative terrestrial impact-craters. Those given here are, in order of decreasing diameter:

Boxhole crater
Odessa #1
Estonia
Odessa #2
Kansas

In Figure 8 these small craters have not been plotted as discrete points, but rather have been shown as vertical lines. These lines indicate the possible error of measurement of the parameters for each crater. Such errors arise in the many problematic quantities inherent to each object; infilling, weathering, etc. must be estimated before the original depth and diameter may be ascribed. Again, as in the case of the Arizona Crater, one will note the fine correlation between the observed and calculated values. Some scatter exists between the values, but such scatter should be expected. Factors such as impact area density, shock resiliency, compressibility, etc. will all affect the resultant crater. Also, errors in the measurement of the lunar craters initially used in determining the curve influence its placement.

A crude approximation of the volumes of bright craters, see column five of Table I, may be found by assuming them to be prolate hemispheroids represented by the expression:

$$V = (5.93 \times 10^4)\, a\, b^2,$$

where V is the volume in cubic centimeters,
A = D/2, in feet,
b = d, in feet.

Throughout this calculation a and b are related by the function used in Figure 7. To refine this expression for V, a more precise determination of the shapes of the bright craters' floors is required; this matter is currently under investigation.

The final column of Table I shows the approximate masses of ejectamenta for the listed craters; in this calculation a density of 2.6 gms/cu. cm. was appended. With this determination of ejected masses, it is possible to arrive at a determination of the energy required to move this mass into the form of a crater. On the assumption that the average particle of mass will be lifted to a height equal to one-fourth the diameter of the crater and that the energy-producing media works at 1% efficiency in forming the actual crater, it is found that a crater one mile in diameter will require approximately 3×10^{23} ergs for its formation. The largest bright craters herewith being considered, say like Copernicus, would require approximately 4×10^{28} ergs. The energy requirements for intermediate craters is given in Table II and is plotted in Figure 9.

Referring once again to Figures 7 and 8, there is considerable evidence that bright craters are the result of meteoroid impacts. Is it possible for meteoroids to produce such energies as are required above? Table III shows that meteoroids are indeed a sufficient source of energy. It should be noted that Table III has been compiled only for meteoroids of small size, i.e.,less than 0.4 miles in diameter; larger bodies at lower velocities than 60 kms./sec. would produce sufficient energies also.

A final argument supporting the depth - diameter relationship in particular, and the above theory in general, is found in the laboratory. Researchers have found that circular craters with definite depth - diameter relationships may be produced with very high velocity projectiles. The angle of incidence at impact or the size of the particle does not appear materially to affect the resulting crater (other than increasing the size of the crater in the case of the latter condition).[5] An effective summarizing statement of this laboratory research was made by C. N. Scully when he said " . . . these photographs [referring to various photographs showing the results of high velocity impacts of silica particles on differing target materials] . . . indicate that you can get almost any type feature with selection of target materials and velocity."[6] While such experiments are in no way conclusive, they do lend additional support to the impact theory of bright crater formation.

In conclusion, many efficacious arguments have been presented advocating the impact theory, but one further test remains. If the bright craters are meteoroidal in nature, then they should show a fundamental

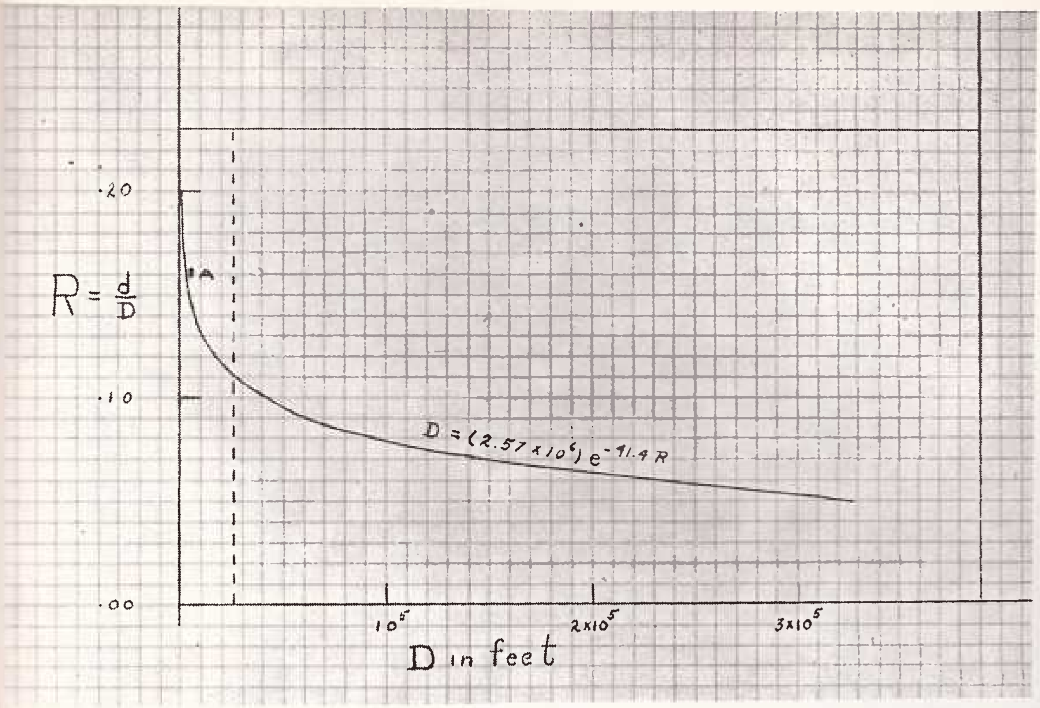

FIGURE 7. Graph contributed by L. J. Robinson to show the curve represented by the indicated function. The dashed line represents the smallest lunar crater used in determining the function. Mark "A" indicates the placement of the Arizona Meteorite Crater on the empirical curve. See also text of Mr. Robinson's article.

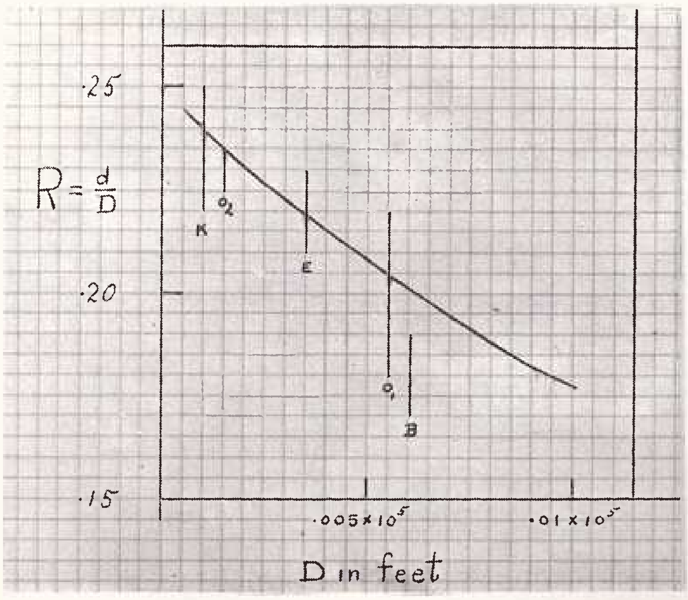

FIGURE 8. This graph is merely an extension of Figure 7 for terrestrial craters of small diameter. The range of R is indicated for each crater plotted, due to the difficulty of arriving at a precise determination of this quantity. Graph made by L.J. Robinson.

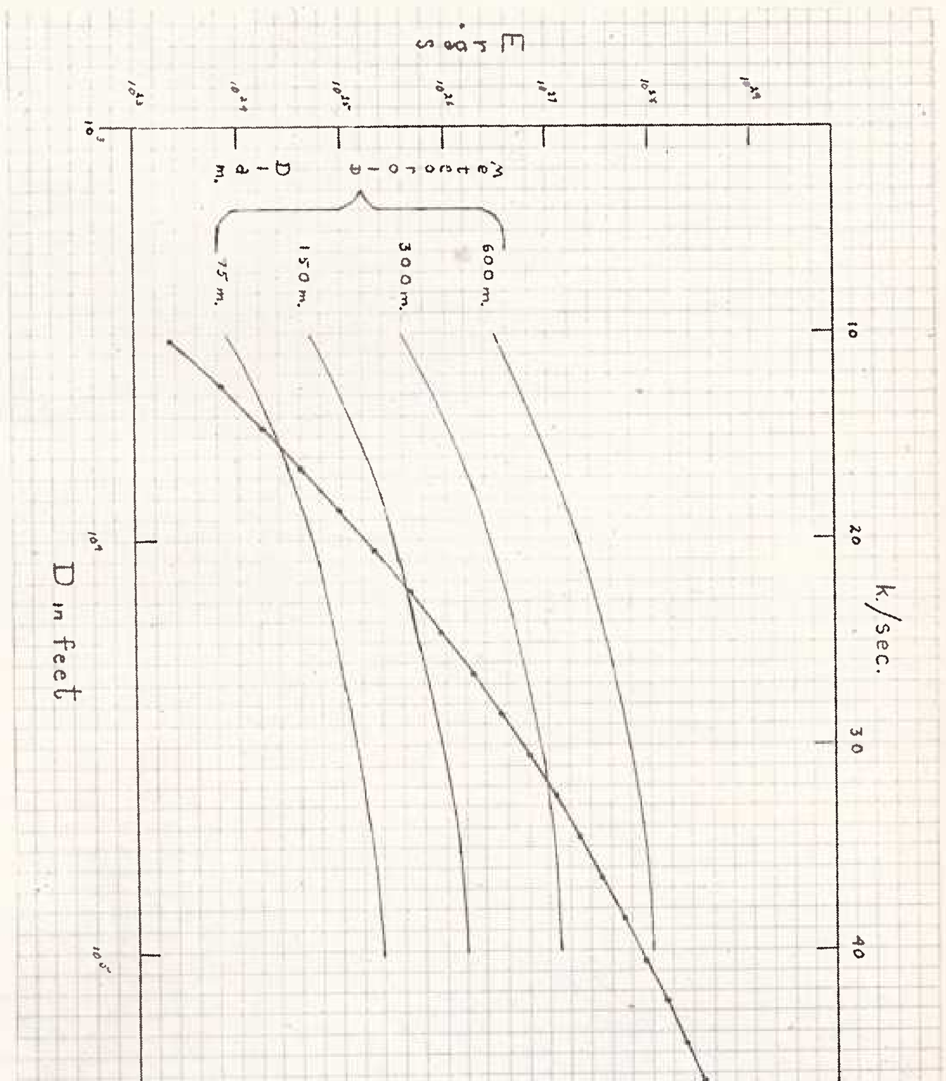

FIGURE 9. Graph by L. J. Robinson to show: (1) the energy requirements to form a lunar crater, and (2) the energy given meteoroids may produce - the four solid curves. The lower abscissa scale should be used with curve (1); the upper, with curve (2). The ordinate applies in both cases. The diameter of the meteoroid for each of the four curves is indicated to the left.

isotropic distribution. A discussion of this distribution and factors which affect it will be considered in Part IV.

Table I

Parameters of craters used in arguments here developed. The final two columns are only approximate but are believed by the author to be sufficient for their purpose in this paper.

Cat.No.	Dia. (D) x 10^4 ft.	Depth (d) x 10^3 ft.	D/d = R	Vol. x 10^{17} cc.	Mass X 10^{17} gm.
005	18.47	11.0	.06	6.62	17.2
019	11.09	5.0	.05	0.821	2.14
039	8.60	7.0	.08	1.25	3.25
115	8.60	10.0	.12	2.52	6.55
156	4.23	8.0	.19	0.815	2.12
225	23.75	15.0	.06	15.9	15.9
246	10.56	8.0	.08	2.00	5.20
263	6.34	3.6	.06	0.244	0.634
323	27.42	9.9	.04	7.97	20.7
338	11.71	7.4	.06	1.90	4.94
347	13.20	12.0	.09	5.63	14.6
414	7.92	7.0	.09	1.15	2.99
418	26.40	11.4	.04	10.2	26.3
526	14.78	9.0	.06	3.54	9.20
702	9.50	7.7	.08	1.67	4.34
734	11.08	8.0	.07	2.09	5.43
1010	3.27	3.6	.11	0.125	0.325
1011	5.81	5.1	.09	0.448	1.16
1116	4.48	6.0	.13	0.478	1.24
1119	29.55	14.6	.05	18.7	48.6
1121	7.76	4.5	.06	0.465	1.21
1203	13.20	6.8	.06	1.81	4.60
1316	29.55	12.0	.04	12.6	32.8
1319	2.64	2.1	.08	0.0346	0.0900
1428	3.96	1.9	.05	0.0403	0.105
1614	15.31	6.9	.05	2.16	5.62
1709	16.89	3.8	.02	0.722	1.88
1801	10.56	10.0	.10	3.31	8.60

Table II

This table was prepared for idealized lunar craters in accord with methods described in the text. The formula used in determining each quantity here and in Table III is given below.

R = d/D	D ft.[1]	d ft.	M_c gm.[2]	E ergs [3]	99 E
.05	3.20×10^5	1.60×10^4	1.58×10^{18}	4.54×10^{26}	4.49×10^{28}
.10	4.14×10^4	4.14×10^3	5.48×10^{16}	5.43×10^{24}	5.36×10^{26}
.15	5.14×10^3	7.71×10^2	4.69×10^{14}	2.78×10^{21}	2.75×10^{23}

(1). $D = (2.57 \times 10^6)\, e^{-41.4R}$

(2). $M_c = (1.54 \times 10^5)(D/2)\, d^2$

(3). $E = M_c (1.57 \times 10^2)(D/4)(3.05 \times 10^1)$

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Comments by Editor. We congratulate Mr. Hartmann on a long-needed statistical study of the observed dichotomy of Venus in his article in this issue. It is important, as he says, to look for a possible "Schröter effect" on Mercury and even on the moon near First Quarter or Last Quarter, using for the moon only the naked eye or low-power field glasses. Controlled studies of the effect of sky brightness, changing seeing, and variable transparency on the observed phase of Venus are needed.

Table III

Energies obtained from meteoroids under specific conditions are given. Most of these values are also plotted in Figure 9.

			E @ ...[6]			
r cm.	V c.c.[4]	M_m gm.[5]	10k./sec.	20k./sec.	40k./sec.	60k./sec.
3.75×10^3	2.21×10^{11}	1.8×10^{12}	9.0×10^{23}	7.2×10^{24}	2.9×10^{25}	6.5 x [illegible]
7.50×10^3	1.76×10^{12}	1.4×10^{13}	7.0×10^{24}	5.6×10^{25}	2.2×10^{26}	5.0 x [illegible]
1.50×10^4	1.42×10^{13}	1.2×10^{14}	6.0×10^{25}	4.8×10^{26}	1.9×10^{27}	4.3 x [illegible]
3.00×10^4	1.13×10^{14}	9.3×10^{14}	4.7×10^{26}	2.9×10^{27}	1.4×10^{28}	3.4 x [illegible]

(4) $V = (4.19 \times 10^0)\, r^3$
(5) $M_m = (8.20 \times 10^0)\, V$
(6) $E = M_m V^2/2$

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2. L. J. Robinson, "Contributions to Selenography - Part II, Banded Craters", J.B.A.A., in print.
3. R. B. Baldwin, The Face of the Moon, Chicago: University of Chicago Press, 1949, Ch. 6.
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5. W. S. Partridge and H. B. Vanfleet, Ap. J., Vol. 128, 1958, pp. 416-419.
6. C. N. Scully, "High Velocity Impact Studies," Proceedings of Lunar and Planetary Exploration Colloquium, Vol.1, No. 4, p. 25.

VENUS SECTION REPORT: THE SCHRÖTER DICHOTOMY EFFECT IN A.L.P.O. OBSERVATIONAL RECORDS, 1951-1961

By: William K. Hartmann

1. Astronomical Background

In Figure 10 we see the orbits of the earth and Venus. When Venus is at either of the two positions shown with respect to the earth, i.e., when the angle between the sun and the earth as seen from Venus is 90°, we should see exactly half of Venus lit by the sun. This half-phase condition is called dichotomy. It occurs near the time of greatest elongation, but not quite at greatest elongation because of the eccentricity of the orbit of Venus. Certainly this orbit is well enough known that we can compute when this situation will occur. In fact, results of such computations are presented in The American Ephemeris and Nautical Almanac, giving the phase angle at five-day intervals. The date of dichotomy may be predicted from these tables.

It turns out, however, that observations give us an unexpected result. From the days of Johann Schröter, observations have indicated that the visually estimated date of half-phase does not occur at the time when it is predicted by the geometrical argument above. Patrick Moore gives a good account of the situation:

"In August 1793 [Schroter] found that theoretical dichotomy differs from the observed date by eight days, and the phenomenon was repeated at subsequent elongations. Forty years later, the German observers, Wilhelm Beer and Dr. Johann Mädler . . . found that the average difference was six days - observed dichotomy being early for eastern elongations and late for western.

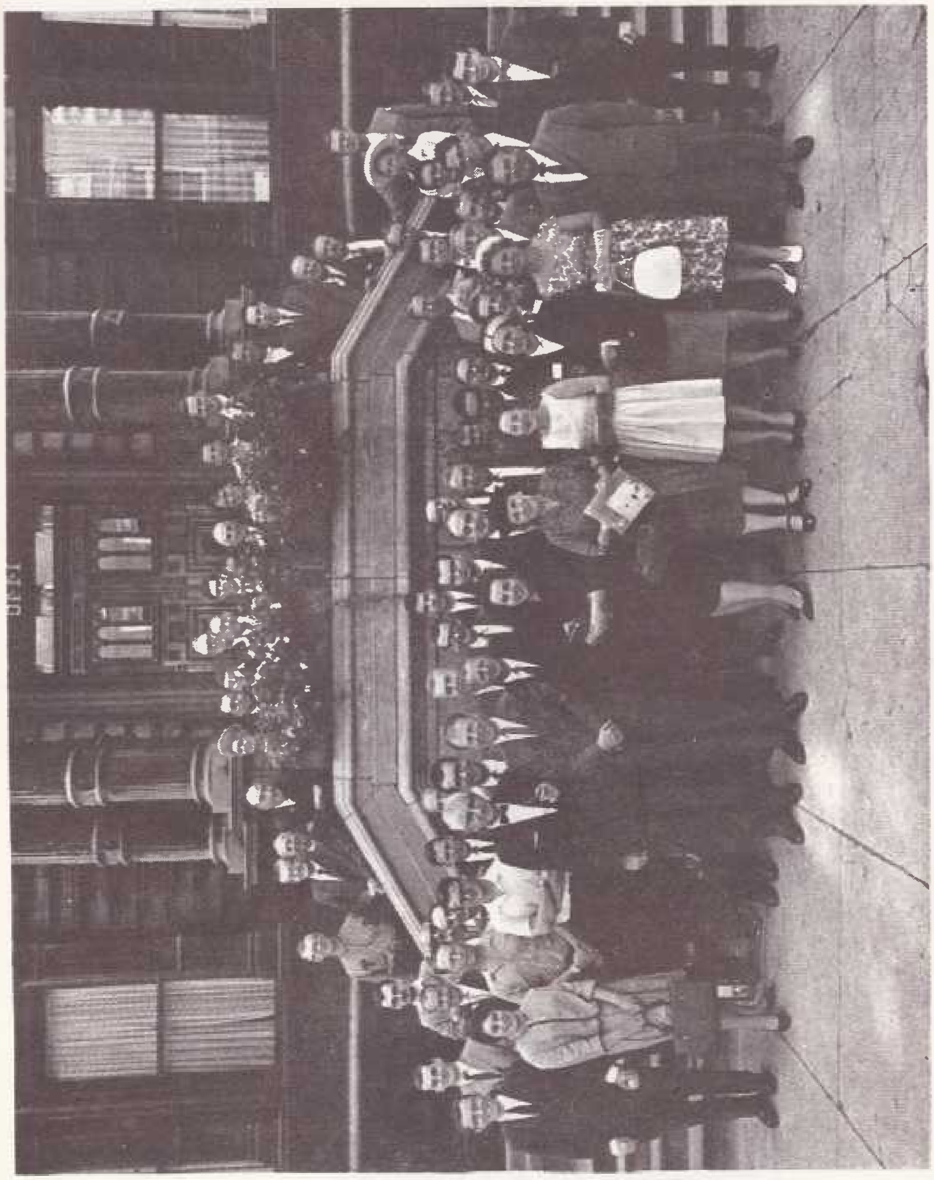

FIGURE 14. The Tenth A.L.P.O. Convention at Sir George Williams University, Montreal, Quebec, Canada, September 1 - 3, 1962. Photograph by William E. Shawcross. See also text of article by Francis J. Manasek in this issue.

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Saturday evening was spent at the Observatory of the Montreal Centre, where excellent refreshments were very kindly provided by the ladies of

FIGURE 15. The 1962 A.L.P.O. Convention Exhibit, collected and arranged by Clark Chapman. See also text. Figures 15 - 18 are photographs taken by William E. Shawcross.

FIGURE 16. Joel W. Goodman presenting paper at Montreal Convention.

FIGURE 17. Open House at the Montreal Centre Observatory during the Convention.

FIGURE 18. Informal discussion between Clark Chapman (center) and Keith Peterson during the Convention.

the Centre. Besides the six-inch refractor already mentioned, the Observatory, which is located on the campus of McGill University, has an amateur radio station, a work shop, and an extensive library. There is also a large meeting room and an observing platform. The Observatory is open to the public on specified nights.

The Sunday afternoon paper session included a report by Dr. Albéric Boivin of Laval University at Quebec about increased resolution obtained from an optical system in which the diffraction characteristics had been modified. Also heard were papers on the 1960 transit of Mercury by David Zackon and a report of an interesting study of Icelandic volcanic structures and their possible similarity to lunar objects by Patrick Moore. George Rippen presented a talk on a subject which has frequently caused ALPO members anguish - the weather. This exposure to the weather, however, was both enjoyable and instructive.

The convention dinner was held on Sunday evening. The ALPO was presented with a cake to honor its 15th year. The ALPO Award was given to Phil Glaser; and the evening was terminated with a talk by Joel Goodman, who spoke about amateur astronomy in England.

The last paper session was held on Monday forenoon and included papers on the construction of a relief model of Eratosthenes by John Westfall, use of glare reduction screens by Rodger Gordon, and a mathematical treatment of the problem of proper telescope powers for optimal resolution and visibility of weakly contrasting areas by Charles Giffen.

A complete list of the papers presented follows. As space allows, it is intended to publish abstracts of many of these in The Strolling Astronomer during the coming months and the full texts of ~~some~~ which appear to be unusually significant. Joel Goodman, Geoffrey Gaherty, and Walter Haas acted as chairmen of the three paper sessions.

1. "Some Recent Changes in Jupiter's Aspect", by Philip R. Glaser.
2. "The Rings of Saturn", by Joel W. Goodman.
3. "Some Observations of the Lunar Features Heraclitus and Licetus", by George E. Wedge.
4. "Some Aspects of the 1961 A.L.P.O. Simultaneous Observation Program", by Clark R. Chapman.
5. "Astronomy and the General Public", by Carlos E. Rost. Read by Louis Duchow in absence of author.
6. "Measuring Heights on the Moon", by Dr. Joseph Ashbrook.
7. "Dynamics of Planetary Atmospheres", by James Sitler.
8. "The Nature of Jupiter's Atmosphere", by Walter Murawski.
9. "The Red Spot Project Program", by José Olivarez. Read by W. J. Cullinan.
10. "The Distribution of Bright Lunar Craters", by Leif J. Robinson. Read by William E. Shawcross.
11. "New Vistas in Astronomical Optics", by Dr. Albéric Boivin.
12. "Theoretical Aspects of the Lunar Meteor", by Kenneth Chalk.
13. "Lunar Meteor Search", by Madame Jean-Pierre Jean.
14. "Calculations of Mercury Transit 1960", by David Zackon.

15. "Lunar-Type Terrestrial Vulcanoids", by Patrick Moore. Read by Frank de Kinder.

16. "The Scientific Conscience", by Robert M. Adams. Read by Bryan Rawlings.

17. "Current Research in Atmospheric Science", by George W. Rippen.

18. "A Relief Model of Eratosthenes", by John E. Westfall.

19. "Resolution, Contrast, and Seeing in Planetary Astronomy", by Charles E. Giffen.

20. "The Reduction and Elimination of Instrumental and Atmospheric Effects Using Glare Screens and Filters", by Rodger W. Gordon.

21. "Klein's 'New' Crater - Another Lunar Puzzle", by Francis J. Manasek.

22. "Studies of the Maria in the Libratory Regions of the Moon", by Dr. S. Miyamoto. Read by E. E. Bridgen.

23. "A Semi-Empirical Brightness Law for Cometary Objects", by David D. Meisel. Read by Geoffrey Gaherty, Jr.

24. "Cloud Satellites", by Richard Hodgson.

25. "The Instability of Small-Size Planetary Cores and the Development of the Moon", by Péter Hédervári. Read by Klaus Brasch.

26. "Plato and Its Mysteries", by Keith Peterson.

The official registration was 29 persons from the United States, 48 from the Montreal Centre, 7 from Le Centre Francais in Montreal, and 3 from elsewhere in Canada - a total of 87. Miss Ruth J. Northcott, the President of the R.A.S.C., was among the registrants.

We are greatly indebted to the Montreal Centre of the RASC for their very generous hospitality and for making the convention such a resounding success. Special thanks must go to Mr. W. A. Warren, the Convention Committee Chairman; to his committeemen, Messrs. Wedge, Gaherty, and Cullinan; and to Sir George Williams University for providing facilities for the meeting over a holiday week-end.

Postscript by Editor. A splendid article about the Tenth A.L.P.O. Convention appeared on pp. 194-196 of the October, 1962 Sky and Telescope. Accounts have also appeared in Skyward, the monthly bulletin of the Montreal Centre, and in The Eyepiece, the periodical of the Observing Group of the A.A.A. in New York. We express our thanks to all these magazines for their coverage of our meeting.

A RED SPOT PROJECT PROGRAM

By: José Olivarez

Much has been said and conjectured about the Red Spot, but very little has been definitely established. Perhaps the main reason that there has been no satisfactory explanation for the Red Spot's behavior is that very little is actually known about the RS in spite of more than 60 years of systematic observation and study. The nature of the RS can be grasped, one hopes, from the realms of mere conjecture by simply studying the RS in every possible detail, carefully, no matter how insignificant it may seem. This is the purpose of the Red Spot Project Program.

The Red Spot Project Program was started in early 1962 for the purpose issues as plans develop.

We have also agreed to participate in a second nationwide Amateur Astronomers' Convention at Denver, probably in late August, 1964. The Chairman-to-be is Mr. Ken Steinmetz, who graciously invited the A.L.P.O. to take part. Many American amateurs will remember with pleasure the first national meeting of this kind, at Denver in 1959. The 1964 meeting will be similar in concept and scope, with some enlargement and some modifications based on experience.

Personal Thanks by Editor. "It is a singular pleasure to express my thanks to all those who contributed to the success of the recent A.L.P.O. Convention at Montreal - by means of papers, display materials, help with physical arrangements, personal attendance, or what have you. Certainly I would consider this meeting, our first solo Convention, also our most successful Convention to date. I find the new and renewed personal contacts at such annual meetings most enjoyable; they truly highlight each summer. I could only wish that more of our members would make the necessary effort to attend - they would not regret doing so. We gain from our interest in astronomy in proportion to what we invest in time, effort, and devotion. I do appreciate all that so many of you have so selflessly done and look forward, with your help, to making the A.L.P.O. a more effective organ for astronomical work in future years." - Walter H. Haas.

Jupiter Photographs Requested. We are planning to publish several pages of current (1962) Jupiter photographs in our next issue, the November-December, 1962 issue. Members having photographs of good quality are accordingly invited quickly to submit these to the Jupiter Recorder, Mr. Philip Glaser, 200 Albert St., Waukesha, Wisconsin. Glossy prints should be supplied, with an enlargement that will make the planet's equatorial diameter between 3/4 and 2 inches. The greatly improved quality of recent Jupiter photographs by a fair number of A.L.P.O. members is one of the most gratifying aspects of our current observational studies.

Total Solar Eclipse Expedition Planned. We have received two bulletins from Mr. Harry C. Stubbs, Milton Academy, Milton 86, Mass. describing early planning for an expedition to observe the total solar eclipse of July 20, 1963 from Copeland Hill, Holden, Maine. Persons interested in helping as workers or observers and certain of going on the expedition (barring unforeseen emergencies) should contact Mr. Stubbs at once. The general concept is that of amateur studies (not basic research) and of experiments pertinent to teaching science in secondary schools. Equipment is being designed and built. Projects include color photography with a 4.5-inch refractor of the complete sun and corona, large scale color photographs with an 8-inch reflector of individual prominences, photographs of the Zodiacal Light near the eclipsed sun with a wide angle camera, sky brightness measurements with light meters, slitless spectrograms of the eclipsed sun, and possibly flash spectra.

New Address for A.L.P.O. Library. Our A.L.P.O. Librarian writes that he will be able to give better and faster service if correspondents will use this address:

E. Downey Funck
Box 156
Boca Raton, Florida.

However, continuing use of the old address (7698 Country Club Blvd., Delray Beach, Florida) is also permissible.

New Lunar Recorder. We are very glad to be able to announce the appointment of another A.L.P.O. Lunar Recorder. He is:

John E. Westfall
3104 Varnum St.
Mount Rainier, Maryland.

Mr. Westfall has been an active contributor to this periodical for many years, and one of his lunar articles appears in this issue. He has in mind some definite lunar projects for A.L.P.O. members. These will involve the study of selected lunar regions by both photographic and visual methods, with appropriate horizontal and vertical controls. Mr. Westfall will partially describe his program soon in a later issue.

Congratulations, Elmer Reese! It is typical of his modesty that Assistant Jupiter Recorder Reese should have listed without comment his 1,731 Jovian central meridian transits during the 1961-2 apparition. We congratulate Mr. Reese very heartily on this outstanding observational achievement! Very few American observers of Jupiter have ever surpassed 1,000 transits in a single apparition.

Errors in Recent Issues. The data on Mr. Fennelly's drawing of Jupiter on pg. 103 of our May-June, 1962 issue were wrongly given. The true values are: July 9, 1961; 8 hrs., 15 mins., U.T.; C.M.I = 258°; C.M.II = 196°. Mr. George Wedge points out some misstatements about time signals on pg. 132 of the same issue. Station WWV is in reality operated by the U.S. Naval Observatory and transmits time signals every five minutes. The station which transmits every minute is CHU, operated by the Dominion Observatory in Ottawa.

The Strolling Astronomer

Founded In 1947

THE JOURNAL OF THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

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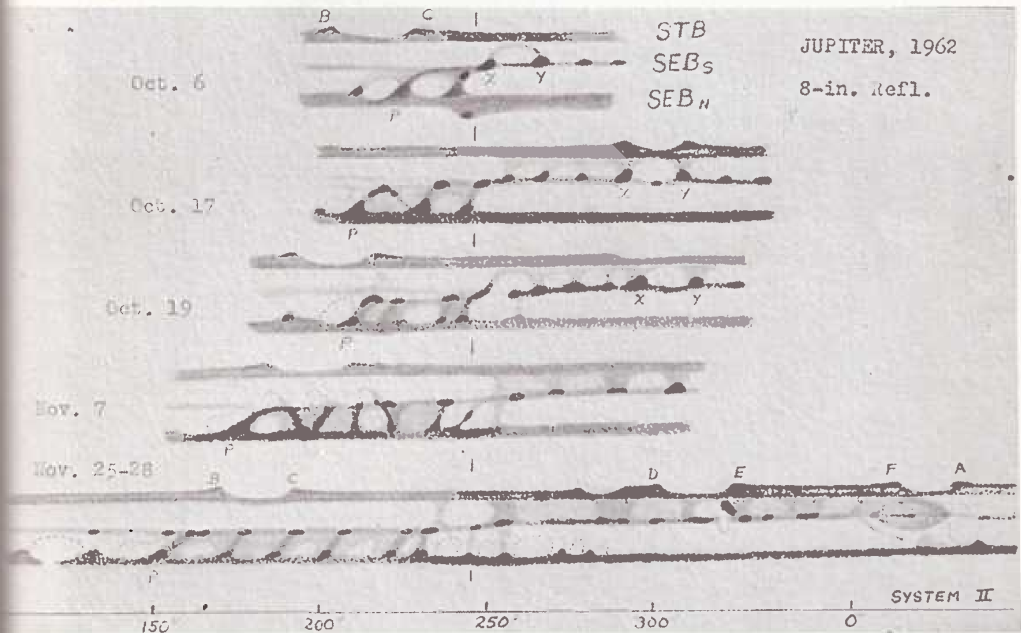

The early development of the 1962 major S.E.B. Disturbance on Jupiter. Drawings by Elmer J. Reese with an 8-inch reflector at Uniontown, Pennsylvania. The initial outbreak occurred at longitude 245°(II) on or very near September 24, 1962. See also Mr. Reese's article on pp. 260 - 263 of this issue A scale of longitudes (II) is given at the bottom.

THE STROLLING ASTRONOMER

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ASSOCIATION OF LUNAR & PLANETARY OBSERVERS

ALPO

IN THIS ISSUE

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3. Dollfus, A., in Planets and Satellites, Kuiper and Middlehurst, Univ. of Chicago Press, 1961.
4. J.B.A.A., Vol. 27, pgs. 7 and 212 (1917).

LUNAR CRATER TERRACING - A PRELIMINARY REPORT

By: Francis J. Manasek

(Paper read at the Ninth A.L.P.O. Convention at Long Beach, California, August 24-26, 1961.)

A characteristic of many lunar craters which has been much neglected in most of the recent lunar literature is the interesting series of terraces which appear on their inner and outer walls. The terraces are frequently concentric and appear to follow the contour of the crater walls rather closely. Complete systems of terracing which extend around the entire wall are most frequently found in newer craters, and here a high degree of concentricity is exhibited. Crater Herschel is but one example of this type. Older craters, especially those which have suffered extensive morphological changes subsequent to their initial formation, exhibit a generally lower degree of terrace concentricity and continuity. This condition is present in craters of the general Stoefler and Maurolycus type.

Terraced craters may be divided into two general types:

1. Those with terracing on the inside slope only.
2. Those with terracing on both the inside and outside slopes.

Conspicuous by their absence are craters with terracing only on their outside slopes. This is not to say that they may not exist; however, a preliminary survey of the lunar surface has failed to reveal any. On the other hand, terracing on the inner slopes is often found in craters which have no outer wall terraces. This condition is especially common among the cauldera, which have either no raised walls or only very low ones, and also among many of the newer craters of the 15 or 20 mile diameter class found scattered about on the surface of the maria. The latter all have walls which are rather low on an absolute scale. The wall height is significant since there appears to be a direct relationship between absolute wall height and presence of terraces on the outer slopes.

Craters of about 10 miles diameter and smaller, which are present in great numbers on the maria, usually do not have the polygonal outlines which the larger terraced craters frequently exhibit. If an assumption is made, namely that the polygonal (usually hexagonal in the case of smaller structures) crater represents the transformation of an essentially round or oval crater by the post-formative, semi-quiescent volcanic activity which also produced terracing, the absence or reduction in number of individual terraces in many of the smaller, round craters is to be expected, since they are now regarded as small and round because of an early cessation of activity. The entire series of crater shapes ranging from smooth-walled, small round pits to larger hexagonal terraced forms can best be seen among the great selection of craters present on the surface of Mare Imbrium, and it will be noticed that only the smaller craters there are circular in outline. Somewhat larger craters are oval; and when the diameter approaches the vicinity of 8 or 10 miles, the polygonal crater makes its appearance, as do the terraces. The absence of terraces from the slopes of the smaller craters may be only apparent; the terraces may be of such size as to make detection with the instruments used in this study difficult or impossible.

The terracing mechanism is obviously closely tied in with that of crater formation and cannot be neglected in any proposed complete mechanism of lunar crater formation and evolution. In some of the craters the internal terraces are probably composed of frozen lava and breccia which was left clinging to the internal slopes when the level of the still molten floor fell because of a lessening of hydrostatic pressure. Either a subsequent series of shifts in the hydrostatic equilibrium, both upward and downward; or just a continuous, gradual, lowering of the floor level could create the concentric terraces. This mechanism can be applied to both the collapse cauldera with no raised walls or with only gently sloping walls and also to the craters with raised walls. In the case of the latter, this mechanism applies only to formation of the inner terraces. Spurr[1] outlines a mechanism whereby the settling of his proposed gas-supported, dome-shaped floor created a series of step-faults visible as terraces. There are several flaws in this theory, and its applicability appears rather limited.

Outer slope terrace formation appears to be an integral part of the very formation of the wall itself. If a plutonic origin for the basic crater, which manifested itself initially by an epimagmatic upheaval with subsequent collapse is assumed, a low rampart surrounding the center of activity and composed of breccia, rubble from the landscape, and congealed lava appears to be a plausible structure. Subsequent overflowings of the raised lava lake would gradually build up the wall in veneer-like layers, and the cumulative effect would be to produce the outer terraces.

The mechanisms just described are admittedly rather brief and sketchy, and an attempt will be made to develop them further in a later paper. However, most interesting of all is the fact that these various stages of epimagmatic upheaval, overflowing, wall development, and inner slope terracing have all been observed[2] in volcanic structures on the earth and represent no mere speculation in the description of the sequence of events. The similarity between the morphology of lunar and terrestrial structures of this type is even more pronounced when other characteristics are also considered, such as the previously mentioned polygonal outlines of terraced lunar craters. Terrestrial structures of this type usually have this outline also. Other similarities, for example concentric craters, which were not discussed in this paper only serve to reinforce the idea that perhaps the moon's most numerous features - her craters - may be more like terrestrial features than we now suppose.

References

1. Spurr, J.E., Lunar Catastrophic History, Concord, Rumford Press, 1948.
2. Jaggar, T.A., Origin and Development of Craters, Baltimore, Waverly Press, 1947.

THE FORMS OF LUNAR CRATERS

By: Patrick Moore

(Paper read at the Ninth A.L.P.O. Convention at Long Beach, California, August 24-26, 1961.)

In discussing the origin of the lunar craters, I am entering a controversial domain. Arguments between the meteoritic theory supporters on the one hand, and the adherents of a volcanic (or, better, "igneous") theory on the other have continued for many years. In point of fact, both processes must have been operative. Undoubtedly there are impact craters on the Moon, just as there are on the Earth; and there are also volcanic formations which look remarkably like terrestrial vulcanoids. Here, however, I want to confine myself to the larger craters, for which I personally believe the basic cause to be found in the Moon itself rather than in meteoritic impact.

Let us consider the cases in which one crater breaks into another. Thebit is an excellent example; its wall is broken by A, while A itself adjoins a still smaller formation. Suppose, for a moment, that both Thebit and A are meteoritic in nature. Thebit is clearly the older (there can be no gainsaying this), and so A must have been formed by a second meteorite's landing on the wall. In this case, surely, there would have been a major "moonquake" which would have shaken down the existing wall for some distance upon either side of the impact point. Yet this is not observed - and it never is observed in lunar formations. The wall of Thebit remains standing right up to the point of junction with the intruding wall of A.

There are almost innumerable similar cases. With twin craters, such as the Sirsalis-Bertaud or Steinheil-Watt pairs, there is a dividing wall; if the twins had been formed by simultaneous meteorite impacts, it is hard to see how such a wall could have survived - it would be more logical to assume that the result would be one larger, perhaps less regular formation. Look at the very deep Tralles, as it intrudes into Cleomedes. And consider the ray-crater Tycho, which, on the impact theory, must be one of the youngest formations in its own particular area of the Moon. Tycho is over 50 miles in diameter, and is relatively deep. Had it been formed by impact at a late stage, the shaking in the lunar crust would have been considerable, to put it mildly. I very much dount whether patently older formations such as Street and Sasserides could have survived in recognizable form; yet Street, for instance, is still more or less regular in shape.

If we are going to assume that such impact craters can be produced without causing widespread devastation in existing formations, we must also assume a very unlikely nature of the Moon's crust - and this seems unreasonable. Of course, the same objections can be raised against any volcanic theory of the "explosive" type, and to me it seems to indicate that the Moon's main craters were not formed by a cataclysmic process at all.

When I put forward an "uplift and subsidence" theory, in 1953, I also mentioned this point about the lack of observed devastation produced by relatively young craters. Unfortunately, no full mathematical investigation of the conditions has yet been carried out. I hope this will be done shortly. Meanwhile, it seems - to me at least - that here we have another objection to the idea that the chief craters of the Moon are due to meteoritic impacts.

Many of you may well disagree with me; I am more than ready to be proved wrong - but in any case there can be no harm in arguing about a problem which is of special interest both to astronomers of 1961 and to the astronauts of tomorrow.

PHOTOGRAPHING JUPITER IN COLOR

By: Philip R. Glaser, Jupiter Recorder

During 1962 Jupiter presented such striking and vivid colors to the telescopic observer that it was quite inevitable that serious attempts would be made by amateurs to record the colors photographically. At the date this is being written (1962, November) it appears that perhaps a dozen workers in at least three countries, the U.S.A., Great Britain, and Italy,have been experimenting simultaneously (and for the most part independently) to establish successful techniques for producing photographs of Jupiter in natural colors with telescopes of 8 inches of aperture and larger. It is hoped that the several results obtained can be compared with each other and evaluated by our most experienced visual observers. In the meantime, perhaps the following account of the writer's own methods and results will be of interest and will encourage others to strive for better results.

Note by Editor. Perhaps the most conservative explanation of the Brinton-Moore Venus phase effect would be that the cusps of the crescentic planet are merely not seen at their true geometric locations. Poor seeing, bright sky-background, poor transparency, low magnification, small apertures, etc. would all increase the difficulty of recording the thin, dim tips of the crescent. Photographs would suffer from these handicaps too. If this interpretation is valid, then the Brinton-Moore effect should become less pronounced as observing conditions improve.

In any event this effect should receive some study, perhaps as part of a systematic general effort to compare the observed and geometric phases of Venus over all phases and not just near dichotomy.

STANDARD LUNAR CRATER OUTLINES

By: Patrick S. McIntosh

In keeping with the trend of this technological age amateur astronomy is in the throes of evolving into a more specialized pasttime. The serious amateur must now come to a full and realistic evaluation of his limitations and his special abilities. Recent issues of The Strolling Astronomer have correctly underlined the direction that amateur lunar research must now take. In general, random sketching of scattered features is of little value. Professional lunar cartography and the space program are making it increasingly difficult for the amateur to contribute to the detailed picture of the moon. Three areas of lunar research which now appear open for work by competent and well-equipped amateurs are: refining of photographic charts by taking fullest advantage of visual acuity and superior seeing conditions, determination of vertical dimensions of features through careful measurements of shadow lengths, and patrol of features suspected of variations. It goes without saying that these observations must be of extraordinary accuracy, as compared to the usual amateur lunar observations. Large telescopes, photographic equipment, and filar micrometers are great boons in this research; but far too few amateurs are fortunate enough to have the use of such instruments. Therefore a simple aid in obtaining the desired accuracy is here proposed -- standard lunar crater outlines.

Other sections of the ALPO are already finding that standard observing forms are helpful in increasing the efficient use of telescope time, in increasing the accuracy of relative positions of planetary features, and in making it easier to compare observations. It has occurred to others[1] that the use of lunar photographs as a base for visual observations would be of great value, but the scale of even the greatly enlarged photographs in the Photographic Lunar Atlas is too small for visual work. The shortcoming is easily remedied by making enlarged outline charts of craters, such as Standard Crater Outline No. 1, here published as Figure 4. This was constructed by placing a transparent overlay ruled into 1/10th inch squares over the print in the Photographic Lunar Atlas and sketching the details square by square onto 1/4 inch-square graph paper. This process allows almost no loss of detail or accuracy and enlarges the photograph in the ratio of 2:5. The resulting scale of the original outline chart was 1:470,000 with 1 mm. to 0".3 or 0.47 kms. This generous scale and the care in reproducing every photographic detail gives a multitude of easily identified and accurately placed reference points for use in positioning the more delicate detail seen with the telescope. This outline is somewhat more complete and accurate than the one appearing in a previous article,[2] except that here only the well defined craterlets on Plato's floor are included.

The use of such standard crater outlines is not without some difficulties; but, if these are recognized and allowed for, very good accuracy in the placing of fine detail can be achieved. The most serious problem is the complex changes in apparent shape of a crater that occur during libration. The appearance of Plato in this outline chart is that of

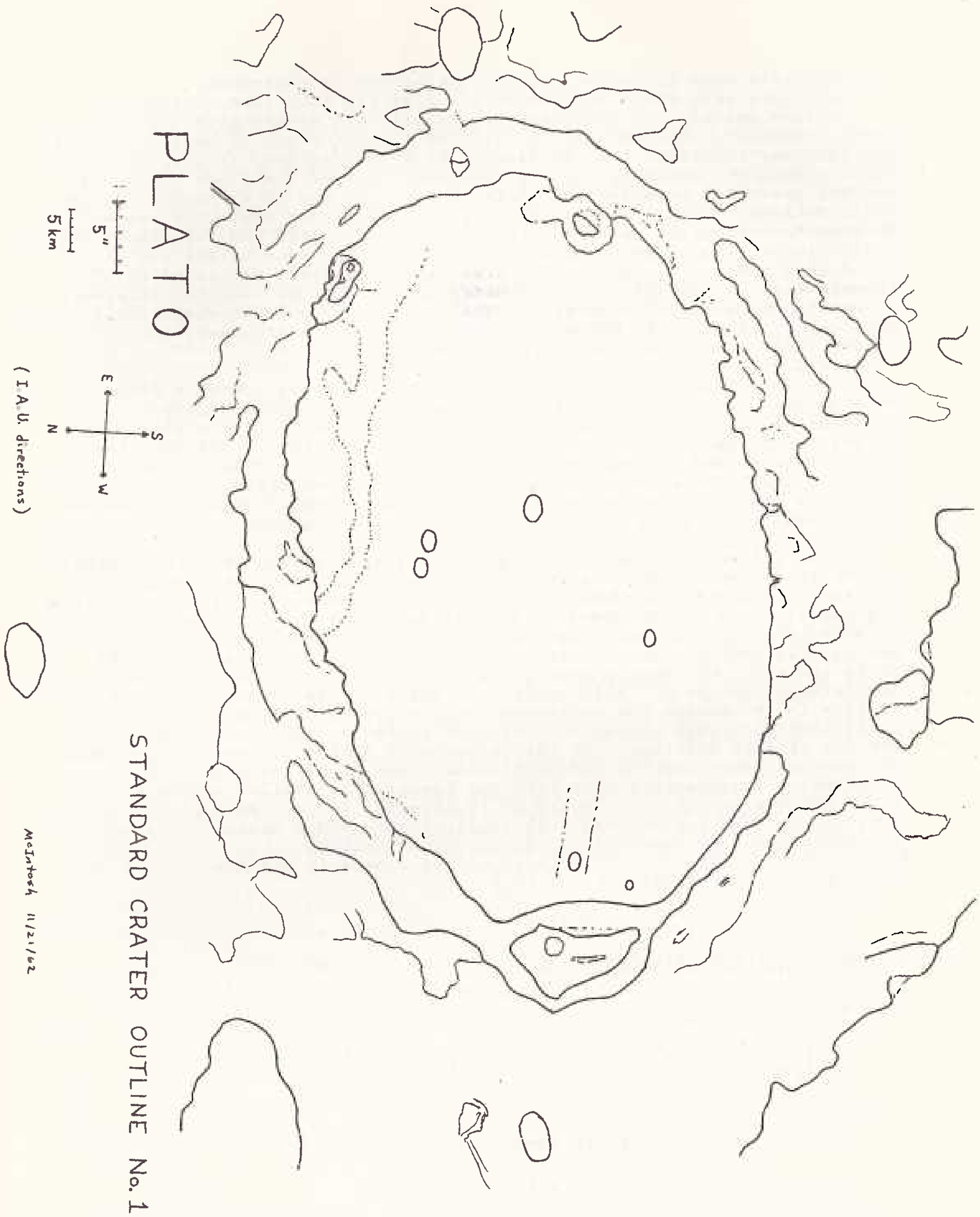

FIGURE 4. Standard Crater Outline No. 1, Plato and its environs. Constructed by Patrick S. McIntosh from Plates D-1a and D-1e in the Kuiper Photographic Lunar Atlas. See also discussion in article "Standard Lunar Crater Outlines". Lunar directions on Figure 4 and in this article are the new I. A. U. directions.

approximately mean libration, so its usefulness is maximized. It has been my experience with Plato that no matter what the libration, triangulation of the fine detail with prominent rim detail will always give the same position. However, regions near the limb will require two or more outlines for adequate coverage. As an example of triangulation, an imaginary line passing from the craterlet in the southwest part of the floor through the central craterlet intersects the rim at the west end of a prominent mound nestled close to the rim. Another line through this craterlet passes through the craterlet in the streak near the west wall and intersects the south rim at a prominent indentation. All other floor detail can be located in a similar manner. Of course, the craterlets mentioned in the example were positioned from the photograph and may be used for reference in placing more delicate detail. The outlines of depressions, ridges, and craters adjacent to Plato are also included as additional, easily identified features for use as reference points.

An almost equally important difficulty is how to create a crater outline that can be used at all solar lightings. Most of Outline No. 1 was made from Plate D1-a (lunar sunset), but the west rim (in shadow on D 1-a) had to be filled in with the aid of Plate D 1-e. The appearance of the base of the rim adjacent to the crater floor is well presented, but only the top ridge of the rim could be outlined in addition. As ALPO observers use this and subsequent outlines, it is hoped that improved ways of representing craters in outline form will be developed.

All interested ALPO observers should take tracings of this outline to the telescope to add fine details to the crater floor, altering the outline into a more accurate form when seeing permits, and always positioning detail with the greatest care by triangulation with the many outcrops, indentations, mounds, and craterlets appearing on the outline. A great amount of detail in the form of complex light patches, delicate bright spots and pits have been mapped in Plato in the past. The most recent and reliable charts [3,2] will serve as a check on the effectiveness of this outline in increasing the positional accuracy of visual mapping of Plato. It is important that visual estimates of shadow lengths be attempted with the use of this outline. If the response of ALPO observers is favorable, outlines of other popular and problematic lunar features will be constructed. Observations made with the use of this outline should be sent to me for evaluation. It would be of interest to know what points on the outline are used for reference in locating each added detail. My address is Sacramento Peak Observatory, Sunspot, New Mexico.

[Mr. McIntosh will carry on this study and others in his new post as an A.L.P.O. Lunar Recorder. - Editor]

Footnotes

[1] The Strolling Astronomer, 16, May-June, 1962, page 144.

[2] Patrick S. McIntosh, "In Defense of Visual Observations of Plato", The Strolling Astronomer, 16, September-October, 1962, page 205.

[3] Alika K. Herring, "A Re-Examination of the Plato Problem", The Strolling Astronomer, 16, July-August, 1962, page 158.

BODE'S LAW APPLIED TO THE SATELLITES OF JUPITER, SATURN AND URANUS

By: H. M. Hurlburt

The distances of the planets of our Solar System from the Sun were observed to fit a regular pattern by the German astronomer, Bode, in the eighteenth century. This pattern, Bode's Law, can be stated as:

Table (cont.)

i	R_i	R_i obs/10^3 miles	R_i comp/10^3 miles	Dev'n		% Dev'n	Diameter Miles
2	a + 2d	417	393		-24	6.1	1800
3	a + 4d	666	658		- 8	1.2	3100
4	a + 8d	1170	1190	20		1.7	2800
				34	-34		
	The Satellites of Saturn. a = 112. d = 31.1.						
0	a	115	112		- 3	2.7	300 ?
1	a + d	148	143		- 5	3.5	350
2	a + 2d	183	174		- 9	5.2	500
3	a + 4d	234	237	+ 3		1.3	500
4	a + 8d	327	361	34		9.4	1000
5	a + 16d	759	610		-149	24.2	2850
6	a + 32d	920	1108	188		17.0	300 ?
7	a + 64d	2210	2105		-105	5.0	800
8	(a + 128d)	-	4098	-	-	-	-
9	a + 256d	8034	8084	50		~~6.2~~ 0.6	200 ?
				275	-271		
	The Satellites of Uranus. a = 81.4. d = 39.6.						
0	a	81	81.4	+ 0.4		0.5	-
1	a + d	119	121	2		1.7	600 ?
2	a + 2d	166	161		- 5	3.1	400 ?
3	a + 4d	272	240		- 32	13.3	1000 ?
4	a + 8d	364	398	34		8.6	900 ?
				36.4	- 37		

Satellite observed distances are taken from Baker's Astronomy.

AN EXPLANATION OF THE PECULIAR TWIN CRATERS MESSIER AND W. H. PICKERING

By: Patrick S. McIntosh, Lunar Recorder

The peculiar twin craters, Messier and W. H. Pickering, have long drawn much attention to Mare Fecunditatis. The elliptical shape of these craters is not in accordance with what is expected from foreshortening. The major axes of the ellipses are almost perpendicular to that of nearby foreshortened craters. This circumstance, plus the existence of a long, low hill passing between the craters, has led to the interpretation that Messier and W. H. Pickering are the two ends of a gigantic tunnel bored beneath the low hill by a meteorite hitting the moon at a very low angle. Some observers have even reported mysterious changes in the shapes of these craters throughout a lunation. Photographs, however, disprove that any such changes occur.*

Dinsmore Alter gives this description of Messier and W. H. Pickering from his lunar studies with the 60-inch Mt. Wilson reflector:[1]

"1. A saucer-like depression exists, partly between them.

"2. The southern ray is a series of bright spots; the northern one, under some illuminations, is observed to branch near the middle of its course, with a very faint component turning slightly northward.

* The Editor would disagree in this sense: changes in apparent shape with chenging solar lighting do occur and have received support from photographs.

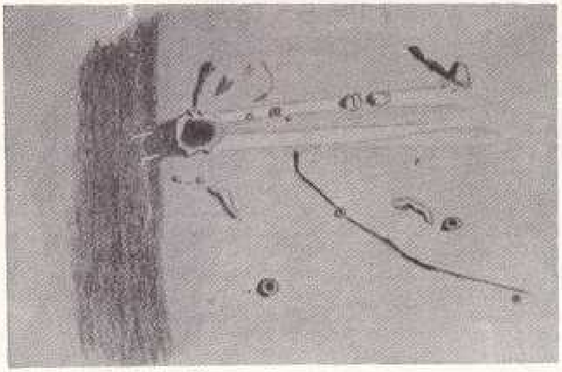

FIGURE 5. Lunar Crater W. H. PICKERING. Drawn by Patrick S. McIntosh with a 4-inch Unitron refractor at the Sacramento Peak Observatory, July 12, 1960. 7^h45^m - 8^h01^m, U.T. 250X. Seeing 8-9. Transparency 5. Colongitude = 131°.9. The rays shown running east (right) from Pickering appeared rounded and elevated above the mare. See also text.

"3. The two main rays are tangent not only to W. H. Pickering but also to another crater of approximately the same size farther east.[2] This eastern crater, especially under a morning sun, is less conspicuous than the other, but merely because of a light background. In the afternoon it is more nearly comparable.

"4. The second of the four pictures [Moore-Chappell Lick photograph of June 2, 1938] shows three more craters of about their size farther east on the same line. These last ones may be merely coincidental.

"5. Bright spots similar to the line of the southern ray usually indicate craterlets.

"6. The conclusion is that probably an east and west fault line exists in the surface rock and that a minimum of three volcanic craters have formed along it, with 'blowhole' craterlets along the southern ray. If this is true, there is nothing mysterious about the pair."

Figure 5 is a view of the interesting pair as seen when the sun has set on Messier except for the north and south rims. The seeing was excellent, affording a chance to resolve the row of bright spots mentioned above into their true forms as shadow-holding crater cones and rough hills. It is noteworthy that the rays exist despite this row of features! It was noted that the rays appeared slightly rounded and were raised above the mare. It seems that this is in keeping with Dr. Alter's interpretation, since the volcanic pressure could have raised the mare floor along the length of the fault. The raised area would be bright because the lunar dust would settle into the lower mare, leaving the top of the arched ray uncovered. Notice the delicate rill that stops abruptly at the edge of the northern ray. It is likely that the rays of Messier and W. H. Pickering are younger than this fault; otherwise the fault might have crossed the ray.

References

[1] Alter, Dinsmore, P. A. S. P., Vol. 70, pp. 491-2, 1958.

[2] East as in the sky. The new ACIC Lunar Charts have east and west reversed from the sky directions, in accordance with an IAU resolution of 1961. [The A. L. P. O. needs to make a decision about how to use east and west on the moon. The I. A. U. resolution reverses the usage in lunar literature for a great many years. The Editor and the Lunar Recorders will welcome constructive discussion from members. - Editor]

Considering these facts, I would like to explain these phenomena as the sudden development of white clouds of moisture brought about by rapid upward currents in the atmosphere due to very complex local meteorological phenomena over these limited areas, or else to the rapid development of clouds of moisture produced by the great force of active volcanoes which erupt intermittently. Unfortunately, however, we cannot examine these curious phenomena with any physical methods, and so I can't give any explanation. For this reason I present only reports of observations of them here.

OCCULTATION OF SATURN BY THE MOON ON SEPTEMBER 11,1962

By: C. F. Capen

The occultation of Saturn by the twelve-day-old gibbous Moon on September 11, 1962 was observed at the Table Mountain Observatory in Los Angeles County, California (lat. 34°22' N, Long. 117°41' W, Alt. 7,500 ft.). A battery of telescopes was employed for the observation: A 4-inch f/15 refractor using 120X for visual timed events, a 16-inch Cassegrain f/20 using a variable focal-length ocular 381X - 666X for visual timed events, and a 6-inch refractor with amplifier lens (-3X) at f/45 for photography with a Praktica reflex 35 mm. camera and a Miranda reflex 35 mm. camera. Both cameras contained Plus-X pan film.

The Plus-X pan was processed in fine grain developer Microdol X for 11 minutes at 68°F (20°C). Because of the considerable relative brightness difference between Saturn and the illuminated lunar limb a wide range of photographic exposures was chosen from 1 second to 1/50 second in order to record the various phases of events of emersion.

The seeing varied from 1 - 4 on a scale of 0 - 10 best. Transparency was 4 on a scale of 0 - 5 best.

The poor contrast condition encountered during the initial observation, due to the bright sky prior to sunset, was the decisive factor against using the 16-inch Cassegrain reflector for photography because of its intrinsic bright field. In fact, the faint planet, Saturn, was not located in a telescopic field until it was already half occulted by the dark limb of the Moon and was only noted with the aid of the 4-inch refractor during the immersion period.

WWV radio time signals, vocal comments, and camera shutter pulses were recorded on a tape recorder for timed events. The data were later reduced by the aid of a stop watch to 0.1 seconds accuracy, and the negatives and prints were critiqued for observational and photographic technique.

Although every photographic negative exposed after V. Capen first "marked" the Saturnian rings emersion from the bright lunar limb at $02^h 24^m 12^s.6$ U.T. recorded the rings, only a few negatives exposed later were chosen for printing because of the difficulty of reproducing (by dodging) the faint image of Saturn next to the bright limb of the Moon. Figures 11 and 12 show two stages of the emersion.

Virginia W. Capen recorded the visual timed events with the aid of the 4-inch refractor, Mars Capen maintained and recorded the WWV signals from the National receiver, and Charles Capen recorded the photographs through the 6-inch refractor operating at f/45.

The time required for the reappearance of the rings (from first contact to second contact) was $58^s.2$ with a relative error of 0.053, which was calculated from the given apparent diameters of Ring A and the planetary disk according to H. Struve, Pub. del'obs. Central Nicolas. XI, p. 226, 1898. The time required for the reappearance of the disk (first contact

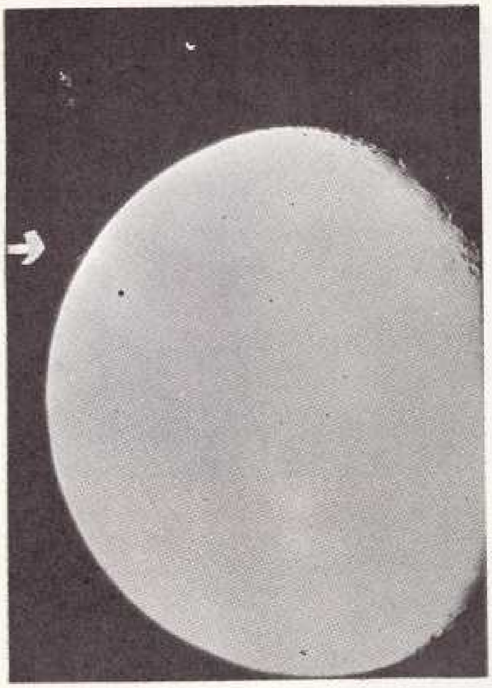

FIGURE 11. Occultation of Saturn by the Moon on September 11,1962. 6-inch f/15 refractor at Table Mountain Observatory. Photograph by C. F. Capen. Plus X pan, 1/50 sec. exposure. 2^h 25^m $45^s.9$,U.T. Arrow points to Saturn just off the bright limb of the Moon.

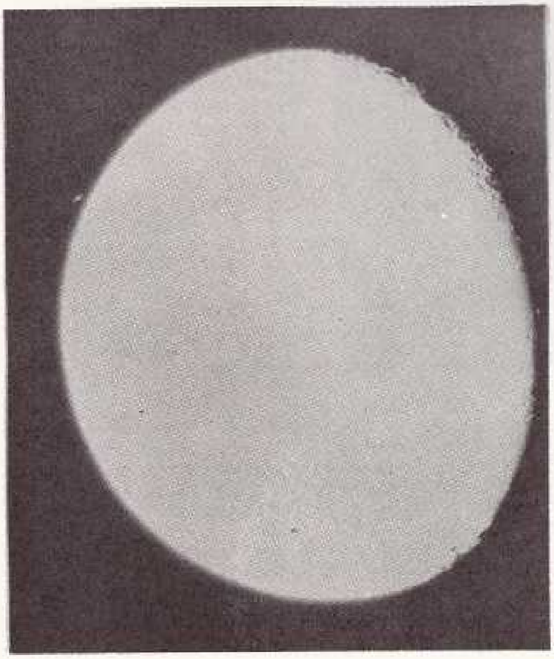

FIGURE 12. Occultation of Saturn by the Moon on September 11, 1962. 6-inch f/15 refractor at Table Mountain Observatory. Photograph by C. F. Capen. Plus - X pan, 1/25 sec. exposure. 2^h 27^m $1^s.2$, U.T.

FIGURE 13. Aerial view of the Jet Propulsion Laboratory's new Table Mountain Observatory in Los Angeles County, California. Figures 13, 14, and 15 contributed by C.F. Capen. Address Table Mountain Observatory, Box 259, Wrightwood, California.

FIGURE 14. Attaching the clock-drive to the 16-inch Cassegrain reflector at the Table Mountain Observatory. Mr. C.F. Capen, Resident Observer, to right.

to second contact) was $27^s.2$ with a relative error of 0.054. The rings' emersion angle with a line tangent to the lunar limb at the point of reappearance was approximately 22° as observed from the Table Mountain Observatory location and was measured from enlarged prints.

Figures 13, 14, and 15 show something of the new Table Mountain Observatory.

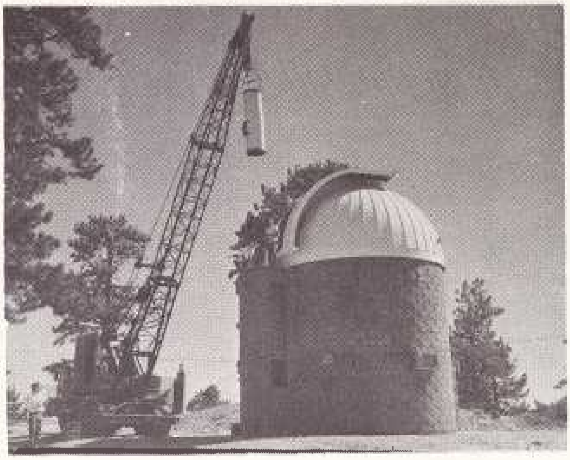

FIGURE 15. Installation of tube of 16-inch Cassegrain in J. P.L. Table Mountain Observatory. Summer of 1962.

Emersion Data

The rings were first noted visually upon emersion from the lunar bright limb at 7: 24: 12.6 P.M., P.D.T. or $02^h\ 24^m\ 12^s.6$, U.T.

$2^h\ 24^m\ 14^s.1$, U.T.	First photo $1/2^s$ exposure. Rings recorded on negative.
23.7	Saturn's disk edge noted visually (first contact).
26.1	Photo $1/2^s$ exp. Rings and disk edge recorded on negative.
48.6	Photo $1/50^s$ exp. Rings and partial disk recorded.
50.9	Saturn's full disk noted visually (second contact).
25^m 05.8	Photo $1/2^s$ full disk recorded. Rings tangent.
10.8	Rings noted complete visually (second contact).
16.8	Photo $1/2^s$ exp. Rings recorded full on negative.
25.4	Photo $1/2^s$ exp.
38.1	Photo $1/50^s$ exp.
45.9	Photo $1/50^s$ exp.
26^m 17.2	Photo $1/50^s$ exp.
29.2	Photo $1/50^s$ exp.
41.3	Photo 1^s exp.
27^m 01.2	Photo $1/25^s$ exp.
11.2	Photo $1/2^s$ exp.
24.0	Photo 1^s exp.
34.2	Photo $1/50^s$ exp.
32^m 34.9	Photo 1^s exp.
42.0	Photo $1/2^s$ exp.
55.0 $\pm\ 5^s.0$	Photo 1^s exp.
34^m 42.6	Photo $1/2^s$ exp.
50.0	Photo $1/50^s$ exp.
35^m 03.6	Photo $1/2^s$ exp.
09.9	Photo 1^s exp.
45.5	Photo $1/2^s$ exp.
58.0	Photo 1^s exp.

ABSTRACTS OF THREE PAPERS GIVEN AT THE A.L.P.O. CONVENTION AT MONTREAL

The Reported "Cloud Satellites" of K.Kordylewski, by Richard G. Hodgson

The "Cloud Satellites" reported by Kordylewski to be revolving around the Earth in the orbit of the Moon at Lagrangian point L 5 urgently await confirmation by other observers. G. Colombo of the Smithsonian Astrophysical Observatory has raised theoretical indications that particles at the Lagrangian points in the Earth-Moon system cannot be stable due to the perturbations of the Sun. Except for a few negative photographic observations by the Smithsonian, little has been done which might evidence their existence, stability, nature, and extent. Much of this work is probably within the range of amateur equipment. Observation requires special conditions of dark, transparent skies, free from moonlight, Gegenschein, aurorae, and Milky Way interference. The Lagrangian point also must have considerable altitude and be in opposition to the Sun.

The Reduction of Instrumental and Atmospheric Effects, by Rodger W. Gordon

Amateur and professional astronomers are plagued in their observations by the following disturbing factors: diffraction, secondary spectrum, glare or brightness, and atmospheric effects. Naturally any devices which reduce or eliminate these factors are of help in observations. To eliminate or reduce such effects a Metzger Glare Reduction Screen or apodizing mask and color filters were used on a 4-inch refractor at various powers from 120X to 375X during 1961 - 62. The screen was used mainly to reduce glare and atmospheric effects, while the filters were used to cancel secondary spectrum and thereby to increase contrast. The screen also modifies the diffraction pattern of extended images. For those interested, the Metzger Screen is fine wire mesh mounted in Kraftboard which slips over the objective. The wire is 1/16 inch thick; and the spacing between the wires is 1/4 inch, which is the correct size for a 4-inch aperture - for larger telescopes the sizes must be altered proportionately. The color filters used were mainly Wratten XI, K2, and 25A.

On most nights the use of the screen or filters will permit a 20% increase in usable magnification on a 4-inch telescope. For example, on a night when 167X was the maximum permissible magnification without the screen, the screen permitted the use of 214X with complete satisfaction. This range of magnification is most helpful for Jupiter and Saturn, although on extremely good nights 250X may be used on a 4-inch. For Mars and Venus 300X and 375X can be used with the screen due to these planets' greater brilliance per unit area. Color filters are also recommended for these planets to reduce glare and to increase contrast. It is true that these devices can exhibit spurious effects in telescopic images, but the careful amateur can usually avoid any such pitfalls.

I recommend that all planetary observers use such devices. They permit observations of comparatively high quality under mediocre conditions. I have discussed these matters also in the May, 1962 and July, 1962 issues of "The Observer", published by the Lehigh Valley Amateur Astronomical Society.

Current Atmospheric Research, by G. W. Rippen

Events that we observe as weather give rise to two major atmospheric electrical effects. The first of these is the $3.6x10^5$ volt potential maintained between the surface of the earth and the ionosphere by cumulonimbus activity. The second also has its origin in cumulonimbus cloud activity. Some of the energy given off as lightning takes the form of electromagnetic waves. These waves are called "sferics". Each lightning discharge radiates at least one sferic. Some twenty million lightning discharges occur in the atmosphere every day. Part of the energy released by these discharges escapes into space. Most, however, bounces back and forth between the surface and the ionosphere until it is used up in the form of heat.

Precipitation and large wind-storms stem from cumulonimbus type cloud activity. This type of cloud activity is usually characterized by the separation of electric charge. In the absence of thunderstorm activity, a clear weather field-strength of a characteristic value is established. As the atmospheric disturbance approaches, the field strength decreases and may, on occasion, even go negative. The magnitude of the negative value increases to a maximum at the closest approach of the disturbance. As the disturbance moves away, the field slowly regains its original strength. Variations in the field strength can be explained, somewhat, by considering the disturbance as a giant electric dipole, with the center of positive charge oriented vertically above the usually negative earth.

Discharges from cloud to cloud, top of cloud to bottom of cloud, and cloud to ground are almost always preceded by an array of complex minor discharges called leaders. These leaders advance in stepwise fashion, following most highly stressed areas between centers of opposite charge. Leaders begin about 10^{-3} seconds before the main lightning arc and often advance as many as thirty to forty steps. Each step produces an electromagnetic disturbance and a sudden change in the field-strength. These disturbances, called 'Delta', have been and are being used to determine the distance and direction of storms from a station. There may be other sophisticated interpretations that can be extracted from them.

Sferics and earth field-strength data are extremely effective tools for forecasting. The reason lies in the fact that cumulonimbus clouds and some other types of clouds provide excellent indications of potentially turbulent air. The recording of sferics at a station constitutes a summation of the weather activity in that area. The profile recorded shows the birth, growth, and death of various cells. A set of simple formulas was recently developed that makes it possible to determine the direction and distance to a system from field observations only.

We expect to balloon launch sferics equipment to test its reception ability. The instrument package will consist of transistors and microminiature components. It is hoped to reach an altitude of between 80,000 and 100,000 feet. Two launches scheduled for the summer of 1963 are planned for altitudes of 200,000 feet. [Mr. Rippen wrote on November 12, 1962 that one very successful test to date has now cleared the way for the 200,000 feet launches in mid-1963.]

There are many areas in sferics research that are promising for the future. One of these is the development of the equipment to such a degree that it will be possible to determine within one-half mile at a range of at least one hundred miles the point where a tornado is going to strike.

Early in 1964 NASA and the Weather Bureau plan to launch a Nimbus satellite containing some sferics equipment. The first Nimbus will be launched from Vandenburg AFB early in 1963 aboard an Atlas-Agena B rocket.

PROSPECTS FOR THE A. L. P. O. LUNAR SECTION

By: John E. Westfall, Lunar Recorder

Goals

The Lunar Section of the A.L.P.O. is currently undergoing a revision of goals and methods with the object of increasing the value of amateur contributions to modern selenography.

It is my opinion that the greatest opportunity for amateur contributions is the intensive study of selected lunar regions. These regional studies would result in the publication, in The Strolling Astronomer, of a series of topographic maps at a scale of 1:500,000 (about 8 mi./in). During the beginning phases of the project, it will probably be best to concentrate on a single region: this "trial area" is that of Aristarchus, Herodotus, and the "Cobra Head". Ultimately, depending on results and response, other regions should be added so that at least one will always be illuminated.

Program

The general plan of action is as follows:

(1) Construction, using Kuiper's Photographic Lunar Atlas, of an outline map of the region, on an orthographic projection and 1:5000,000 scale.

(2) Distribution of the outline map to interested observers who will revise it and add details and notes to it at the telescope.

(3) Determination of relative altitudes within the region, using both the shadow length method[2] and the shadow-terminator contact method.[3] These altitudes would be applied to the outline map.

(4) Construction of a relief model from (i) photographs, and (ii) the altitudes found in step (3). Contours would be taken from the 1:250,000 scale model.[4]

(5) Compilation of the final map (scale 1:250,000, to be reduced to 1:500,000) from the results of the previous steps.

Instrumental Requirements

Amateur observers could contribute to steps 2, 3, and 4 as follows:

Step 2 - Probably only instruments of aperture 8 inches or more would be useful, and results with larger instruments would be correspondingly more valuable. Given exceptional seeing or optics, or an experienced and careful observer, smaller apertures could be used, however.

Step 3 - With the shadow length method, a 4-inch refractor, or 6-inch reflector could be used although, as in step 2, larger instruments would be better. The shadow-terminator contact method, however, requires at least 8 inches of aperture and good transparency to be reliable.

Step 4 - High quality amateur photographs are essential. Usable results can be had with 8-inch reflectors, but there is special need for photographs taken with instruments of 12 inches or larger.[5]

Requests

The program outlined above won't, of course, get anywhere without cooperative effort. Thus, I have three requests to make:

(1) Information. (This can be ignored by those who have responded to Mr. Robinson's query in the Jan.-Feb., 1962 Strolling Astronomer, p. 39.) The Section requires the following information from those interested in participating:

1. Name.
2. Address.
3. Telescopic equipment. Do you have a micrometer?
4. Are you able to take lunar photographs? If so, briefly describe your equipment, methods, and results.
5. Hours per week usually available for observing.
6. Are you able to make morning observations?
7. Artistic ability.
8. Lunar books, charts, etc. available to you.
9. How long have you been an observing amateur?
10. Math background.
11. Would you be willing and able to calculate?

(2) Photographs. Photographs of the Aristarchus-Herodotus-"Cobra Head" egion are requested. We would include observatory photographs which might e available to an individual observer, but which have not been published. otographs contributed should be enlarged to the largest scale compatible

with clarity and lack of grain. Whole-disc photographs are on too small a scale to be usable.

(3) Since the Lunar Section is <u>your</u> section, it should reflect your wishes. For instance:

1. What do you think of the program as a whole? Do you think something else would be more valuable? If so, what?
2. What regions do you feel need concentrated study? Why?
3. Do you have any suggestions as to the methods outlined above?

Conclusion

It is hoped that more specific information can be supplied as the program is gradually implemented. For the time being, communications can be sent to me:

John E. Westfall
3104 Varnum Street,
Mount Rainier, Maryland.

References

1. J. E. Westfall, "A Suggested Program of Lunar Research." Str.A.,13,Nos. 1-4 (Jan.-Apr. 1959), pp. 6-8.
2. Joseph Ashbrook, "Finding the Height of A Lunar Mountain." Str. A.,16, Nos. 9-10 (Sep.-Oct, 1962), pp. 214-216.
3. J. E. Westfall, "A New Method for Measuring Lunar Mountain Heights." Str. A., 10, Nos. 11-12 (Nov.-Dec. 1956), p. 127.
4. J. E. Westfall, "A Relief Map of Eratosthenes." Str. A., 16, Nos. 9-10 (Sep.-Oct. 1962), pp. 209-214.
5. F. Jack Eastman,Jr., "Lunar Photography." Str.A.,16,Nos. 7-8 (Jul.-Aug. 1962), pp. 145-154.

ON THE PROBLEM OF THE ENERGY NECESSARY TO PRODUCE THE LUNAR RING-MOUNTAINS

By: Péter Hédervári, Geophysical Institute, Budapest, Hungary

(Paper read at the Ninth A. L. P. O. Convention at Long Beach, Calif., August 24 - 26, 1961.)

Recently we have been occupied with a very interesting selenological and also vulcanological problem: how great was the energy involved in the formation of the lunar craters,or better, ring-mountains? Here we shall summarize our calculations.

As is well known, there are many theories about the origin of the craters on the moon. The author of this paper will here follow the volcanic hypothesis. Naturally it does not appear impossible that smaller craters may have originated by means of meteoritic impacts as well. However, the writer represents the geophysical point of view on this problem; i.e., he thinks that the most important forces which produced the moon's surface features must have originated from the interior of the moon.

In our present study we used the same method as in I. Yokoyama's research.[1] Dr. Yokoyama, a vulcanologist, studied very intensively the activity of several volcanoes in Indonesia and Japan. According to his interesting investigations, the most important of the several kinds of energy shown by active volcanoes is thermal energy, represented by the heat of lava. The energy of active volcanoes appears in the following different forms:

a. The energy of air-waves during and after an explosion.

b. The energy of volcanic tremors and earthquakes.

c. Potential energy, represented by the change in the lava level between the magma-chamber and the surface during an explosion of the volcano.

d. Kinetic energy, represented by the mass and velocity of ejected volcanic rubble and ash.

e. Thermal energy, as mentioned above. The amount of thermal energy is usually 10, 100, and even 1000 times greater than the other kinds of energy. This same large ratio also holds during the process of formation of volcanic islands. Therefore, the thermal energy is the total energy, for all practical purposes. When we want to calculate the energy required in the formation of volcanic islands, we need to compute the thermal energy and can neglect the other kinds of energy.

The thermal energy is Dr. Yokoyama's formula is a function of the total volume and the mean density of the volcanic islands. In our present calculations we applied this expression to lunar craters. We needed to determine the mass of the crater-walls; but we could ignore the existence of central peaks, which have very small masses compared to the total mass of the walls. We used Baldwin's data in calculating the mass of the walls.[2] According to our results, the thermal energy - that is, the total energy - for lunar craters is a function of diameter, rim-height, and mean density. We used for the density of the lunar surface rocks 2.7 gms. per cu. cm. We obtained for lunar craters:

Diameter (kms.)	Mass (gms.)	Energy (ergs)
1	2.7×10^{15}	3.39×10^{25}
10	3.0×10^{17}	3.77×10^{27}
50	9.2×10^{18}	1.16×10^{29}
100	3.6×10^{19}	4.52×10^{29}
150	7.0×10^{19}	8.79×10^{29}
200	1.1×10^{20}	1.38×10^{30}

We also used our formula to compute the thermal energy necessary to produce Mauna Loa in Hawaii and Aetna in Sicily.

Mauna Loa, mass 2.0×10^{20} gms., energy 2.6×10^{30} ergs.

Aetna, mass 2.3×10^{18} gms., energy 2.9×10^{28} ergs.

It is extremely interesting to note that the energy for Mauna Loa, one of the largest volcanic islands on the earth, is of the same order of magnitude as for Clavius, one of the largest lunar craters.

Let us compare the lunar data mentioned with the thermal energy in ergs computed by certain persons for some earthquakes and volcanic explosions!

Adatarasan volcano, Japan, 1900, 6.40×10^{21} (Yokoyama).

Una-Una volcano, Celebes, 1898, 1.80×10^{22} (Yokoyama).

Guntur volcano, Java, 1843, 6.50×10^{22} (Yokoyama).

Earthquake in Messina, 1909, 5.70×10^{23} (Sieberg).

Earthquake in San Francisco, 1906, 1.60×10^{24} (Sieberg).

Kilauea volcano, Hawaii, 1952, 1.80×10^{24} (MacDonald).

Earthquake in Mino Ovari, Japan, 1891, 2.20×10^{24} (Sieberg).

Mauna Loa volcano, Hawaii, 1907, 3.00×10^{24} (Hédervári).

Submarine explosion near the Azores, 1957, 3.70×10^{24} (Tazieff).

Earthquake in South Chile, 1960, 4.60×10^{24} (Hédervári).

Earthquake in Lissabon, 1775, 1.70×10^{25} (Gutenberg).

Aetna volcano, Sicily, 1669, 1.90×10^{25} (Hédervári).

Kluchewskaya volcano, Kamchatka, 1829, 6.70×10^{25} (Hédervári).

Skaptar Jökull volcano, Iceland, 1783, 5.20×10^{25} (Hédervári).

Tambora volcano, Indonesia, 1815, 8.40×10^{26} (Yokoyama).

Ooshima volcanic island, Japan, 2.00×10^{27} (Yokoyama).

Soofu-Gan volcanic island, Japan, 4.60×10^{27} (Yokoyama).

South Sulphur volcanic island, Pacific Ocean, 2.50×10^{28} (Yokoyama).

We can calculate that the energy necessary for the creation of all the craters on both hemispheres of the moon was at most about 1.364×10^{32} ergs. The energy necessary to produce all the lunar mountain ranges may have been about only 8.5×10^{29} ergs. According to the theory of the moon's expansion [3, 4], we can calculate the energy necessary to lift the lunar crust and mantle during the process of expansion. It turned out that the energy thus required was about $5.6 - 6.7 \times 10^{28}$ ergs per year at a time when the moon still had a metallic core. The moon's expansion lasted more than 10^7 years. If the craters formed during a period of, say, 2.0×10^7 years, then the energy demanded for crater formation in one year was only about 1/10,000 as large as the energy necessary to lift the surface layers as mentioned above. Therefore, during the expansion of the moon the energy available - the source was the transformation of the metallic core of the moon - was many, many times greater than that quantity necessary to produce tectonic processes on the surface of our moon.

References

1. Bulletin of the Earthquake Research Institute of Tokyo, 34, 185, 1956; 35, 75, 1957; and 35, 99, 1957.
2. The Face of The Moon, Chicago, 1949.
3. Hédervári, The Strolling Astronomer, Vol. 14, Nos. 9-10, 1960.
4. Hédervári, Magyar Fizikai Folyóirat (Hungarian Physical Review of the Hungarian Academy of Sciences), 1960, 4.

PETROLOGY OF THE LUNAR CRUST

By: Gary Wegner

In past papers the author has given reports on colorimetric and spectroscopic observations of the Moon which were an attempt to determine the basic composition of its surface by matching the color reflectivity curves of terrestrial and lunar materials. The results of these studies, which are in good agreement with earlier investigators, are basically as follows: The color reflectivities of the marial materials (those in the lunar maria) resemble terrestrial basalts, and those of the bright continental regions resemble terrestrial granites. This result could indicate that the basic mineral compositions of the Earth and the Moon are not much different when the effects of erosion and living organisms are neglected in the case of the Earth.

It must be remembered, however, that these results are only relative since no direct chemical analysis has yet been done for the Moon. Nevertheless, identifications of minerals on the Moon in terms of the different color reflectance species can be made. Studies of this type on the fine details of the Moon were made visually by the author using a 10-inch Dall-Kirkham reflector (f = 184 inches) and a deep red Wratten 70 filter. With the Wratten 70, the contrast between the bright continental materials and the darker marial materials is increased from what it is in white light, and an identification of the different minerals is easily made. In general, the bright areas appear brighter with the filter, and the maria appear darker.

The features studied by these means were domes and the faces of faults. The faults were observed to determine if their faces were of marial or continental materials and to see if any stratification was present. The domes were studied to determine their colors and to learn their relation to the colors of other lunar features. Most regions were studied over a period of a few lunations from September, 1961 to September, 1962. All areas were studied at different solar illuminations.

Usually the mineral identifications were made in two ways. At low illuminations, regardless of composition, the faces of some faults appear bright because they are inclined at angles so that they reflect more light to the Earth than do the other features which at that time have long shadows and appear darker. At high illuminations, the marial materials appear darker, while the continental materials are bright. This change in contrast aids in determining the relative compositions. With the Wratten 70 filter, this difference is more apparent. At low illuminations, if the face of a fault is of a marial composition, it will darken with the filter; but if it is of the continental materials, it will remain bright. The same general thing happens at the higher illuminations, but it is not so marked as at the lower illuminations.

The following regions have been studied to determine the composition of their faces and to check for stratification:

Region	Apparent Composition (M = marial, C = continental)	Number of Observations
Apennine Mts.	M and C	11
Altai Mts.	C	5
Leibnitz Mts.	C	6
Straight Wall	M (and C)	12
Alpine Valley	C	5
Hyginus Cleft	C	7
Ariadaeus Cleft	C	5
Rill Near Gassendi	C	4
Schroeter's Valley	M	5
Rill N. of Plinius	M	3
Rills near Sabine	M	3
Fault near Cauchy	M	3

One interesting result of these observations is that beneath the surface of the upper portions of the lunar crust, the composition still appears to be of the two materials already mentioned. Perhaps this indicates that the lunar surface may not be homogeneous in composition under a layer of dust. If this were so, all regions would probably show the same apparent composition.

The search for stratification gave negative results. All the above-listed fault features were checked for hints of stratification effects at magnifications of 241, 368, and 654 diameters, both with and without color filters. Even under the best conditions and with the highest powers, no signs of lunar stratification were detected, excepting possibly with the

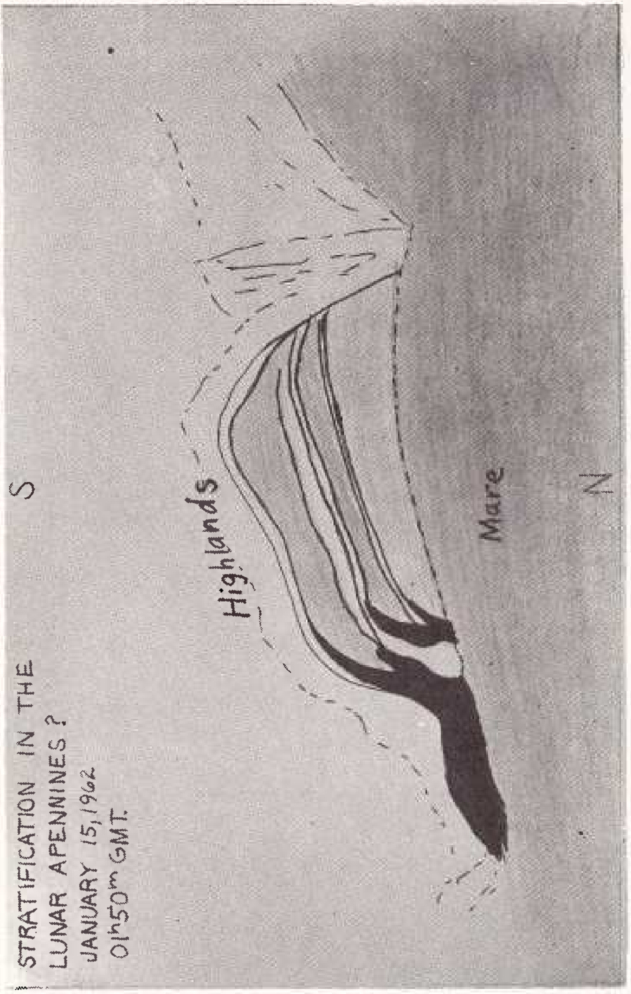

FIGURE 16. View of possible stratification in the lunar Apennines. Observation by Gary Wegner on January 15,1962 at $1^h\ 50^m$, U.T. with a 10-inch reflector. Colongitude = 17°.7. See also text of Mr. Wegner's article.

Apennines. These mountains showed the presence of both the continental and *marial* materials. (Figure 16). These Apennines areas,however, may be too wide to be considered strata and could represent differences in lighting along fractures in the face of the cliffs. Perhaps the best explanation for the invisibility of strata is not that they do not exist, but instead that they are below the resolution of the instrument. If the lunar surface was formed in different stages, the different flows of whatever materials were there would have left a record in the form of strata. Perhaps if the lunar strata are thin and are composed of materials of very similar intensity and color,they cannot be detected even with the largest instruments.

The lunar domes gave no trouble in their detection,and were easily visible for study when they were at low illuminations. In all cases, these features were found to resemble the surrounding *maria* in their color reflectivities. The following domes were observed; the numbers given are the designations of Mr. Kenneth Schneller in his important catalog:[1]

1, 2, 66, 67, 83, 88, 116, 117, 118, 121 to 130,

138, 151, and some from 56 to 65.

Reference

1. Kenneth Schneller, "A Catalogue of Lunar Domes", *Journal of the Planetary and Lunar Spectroscopical Society*, 2, 1, 1961.

New Books in A.L.P.O. Library. The following books have been added to the library since the list in the July-August, 1962 issue appeared.

Title	Author	Publisher	Date
Life on Other Worlds*	H. Spencer Jones	Mentor Books	1959
The Individual and The Universe*	A. C. B. Lovell	Mentor Books	1961
Instructions to Young Astronomers	H. P. Wilkins	Museum Press Ltd.	1957
The Picture History of Astronomy	Patrick Moore	Grosset & Dunlap	1961
Surface of the Moon	V. A. Firsoff	Hutchinson & Co.	1961
Introducing Astronomy	J. B. Sidgwick	Macmillan	1957
Amateur Astronomer's Handbook	J. B. Sidgwick	Macmillan	1955
Statistik und Physik der Kometen**	Nikolaus B. Richter	Johann Ambrosius Barth	1954
Looking at the Stars	Michael W. Ovenden	Philosophical Library	1958
Everyday Meteorology	A. Austin Miller and M. Parry	Philosophical Library	1959
L'Astrophotographie d' Amateur (in French)	Jean Texereau & Gérard de Vaucouleurs		1954
Practical Astronomy	W. Schroeder	Philosophical Library	1957
Astronomie (in German)	Joachim Hermann	C. Bertelsmann Verlag	1960
Changing Views of the Universe	Colin Ronan	Macmillan	1961
Guide to the Heavens	H. P. Wilkins	Frederick Muller Ltd.	1956
The Upper Atmosphere	H. S. W. Massey & R.L.F. Boyd	Philosophical Library	1959
Constructing an Astronomical Telescope	G. Matthewson	Philosophical Library	1957
Insight Into Astronomy (2nd edition)	Leo Mattersdorf	Lantern Press,Inc.	1959
The History of Mathematics	Joseph E. Hofmann	Philosophical Library	1957
Tabulae Caelestes (Eighth Edition)	Schurig Götz		1960
The Astronomical Universe (Second Edition)	Wasley S. Krogdahl	Macmillan	1962

Surely at least one of these books will appeal to every American and Canadian A.L.P.O. member. Librarian Funck is eager to be kept much busier!

Acknowledgment. Thanks are hereby expressed to Mrs. Beryl Haas for the typing of the present and the immediately preceding issue of The Strolling Astronomer and for the preparation of the mailing envelopes for both issues. Without this assistance, getting out these two issues would have been a matter of extreme difficulty.

A.L.P.O. Lunar Section. We have now added to our staff as an A.L.P.O. Lunar Recorder:

Patrick S. McIntosh
Sacramento Peak Observatory
Sunspot, New Mexico

* Donated by R. W. Russell.
** Donated by David Meisel.

Mr. McIntosh has been an active member of the A.L.P.O. for a number of years, and there are two lunar articles by him elsewhere in this issue. He obtained his Bachelor's Degree in Astronomy from Harvard in 1962 and is now engaged in solar research on the staff of the Sacramento Peak Observatory. Mr. McIntosh joins the two other Lunar Recorders, Messrs. John E. Westfall and Clark R. Chapman. On the basis of age, experience, and technical quality of lunar research so far carried out Mr. Westfall has been requested to act as head of the trio. Some of his ideas for our Lunar Section are presented in his article in this issue.

OBSERVATIONS AND COMMENTS

Herodotus. José Olivarez of Mission, Texas carried out a short study of this lunar crater after reading Dr. James Bartlett's "Herodotus - A Light that Failed", Str. A., Vol. 8, pp. 91-97, 1954. A curious intermittent visibility of an apparent central peak in Herodotus was the subject of this article. Mr. Olivarez submitted three drawings to illustrate his recent study, but for lack of space we here can use only one. He says in part: "My first serious examination of Herodotus was on July 25, 1961, using a 2.4-inch Unitron refractor. The colongitude was 58°.5. The small craterlet on the northeastern wall was seen without difficulty. No features were seen or suspected on the floor.

"A drawing on August 23, 1961 at 51°.7 shows some of the 'complex' structure of the western wall. It compares well with the area showing Herodotus in Section XVIII of the Wilkins map of the moon. No sort of central light was seen or suspected.

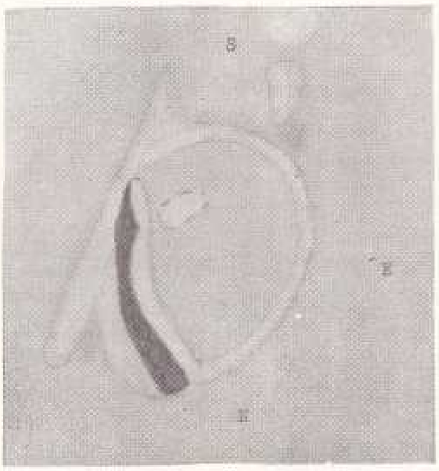

FIGURE 17. Lunar Crater Herodotus. José Olivarez. August 24, 1961. $3^h 25^m$, U.T. 2.4-inch Unitron refractor. 100X. S_o = 5. T = 4 - 3. Colongitude = 64°.8.

"The third drawing was made on August 24, 1961 at colongitude 64°.8, Figure 17. Two white areas were seen on the floor, one in the southern part and the second in the western part adjacent to the shadow of the west wall. [A contrast-effect? - Editor.] Note the sharp points near the south end of the shadow of the western wall. I was especially gratified to see that this drawing agrees well with one by Elmer J. Reese, 6-inch reflector at 220X, on pg. 95 (Figure 9) of Dr. Bartlett's article."

Half-Filled Lunar Crater. On February 23, 1962 Leif J. Robinson wrote in part as follows: "I am making a project of Wargentin-like and Rümker-like lunar objects. One object deserving special mention is a half-filled crater near Reichenbach. It is shown well on Plate B6 - a,b of the Kuiper Photographic Lunar Atlas, at the very top of the plate and just under the word 'Fracastorius'."

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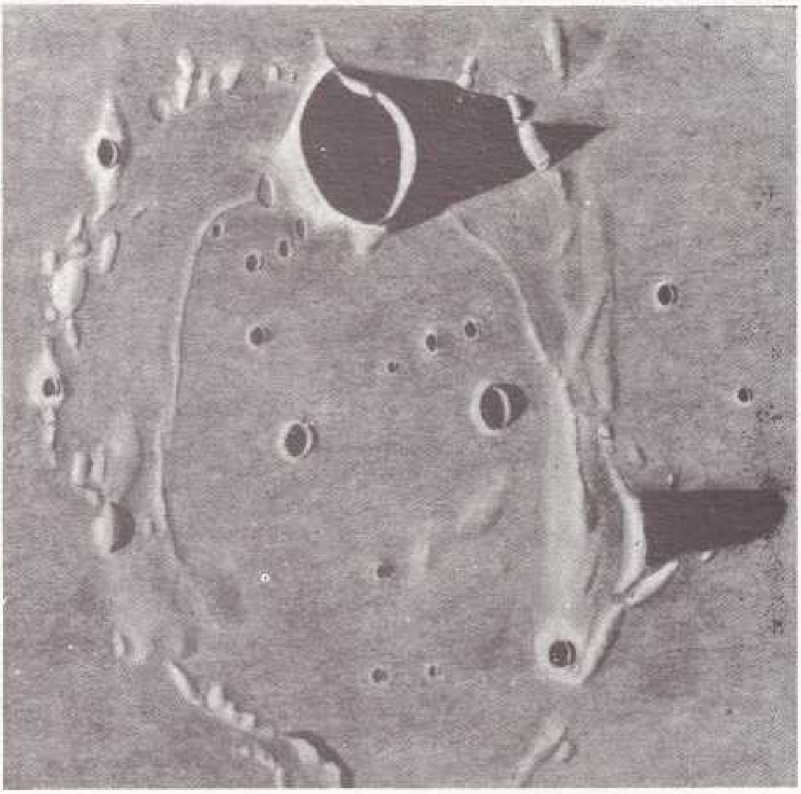

Lunar Crater Flamsteed and vicinity. Drawing by Alika K. Herring on April 16, 1962 at 3 hrs., 15 mins., Universal Time. 12.5-inch reflector, 278X, seeing 4-5, transparency 5. Colongitude 46.3 degrees.

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IN THIS ISSUE

Brinton and Moore(Str. A., Vol. 16, pg. 253, 1962) is the result of the decrease in surface brightness toward the cusps of the crescent. The very photographs which Brinton and Moore describe as "useless" prove the existence of this decrease. Unskilled observers frequently submit to the Venus Section observations which depict a crescent of the shape described by Brinton and Moore. This accords with their report of confirmation by "totally untrained observers". While I do not question the observations recorded by Brinton and Moore, I think it should be pointed out that the untrained observers commonly lack sensitivity to contrast and are notoriously unreliable when recording phases. Therefore, lest someone should suggest that peculiar phases found in certain drawings confirm the effect, I suggest that most such drawings are not examples of the effect.

We note also that under good conditions the cusps are known to be extended when the crescent is very thin, not reduced as shown by Brinton and Moore. This proves that frequently, if indeed not always, the illuminated atmosphere extends beyond the geometric terminator. Their effect thus probably arises when not all of the illuminated portion of the disk is seen.

Further, it has been reported (cf. Str. A., 16, p. 229) that thin clouds passing in front of the disk can change the apparent phase from gibbous to crescentic. Having observed this effect myself, I believe that it can account for the loss of the faint cusp-tips. The greater prominence of the effect at low powers may result from the greater role of irradiation at such powers.

It should be noted that these comments are similar to those I made recently in discussing the Schroeter effect (cf. the above reference). Both the Schroeter effect and that of Brinton and Moore are probably the result of not seeing the faintest portions of the planet. I conclude again that no real evidence has been presented to show that any of the phase anomalies associated with Venus are due to anything more unusual than contrast effects and the rapid decrease in brightness near the terminator.

PITON - A LUNAR PROTEUS

By: James C. Bartlett, Jr.

Having digested a recent and excellent issue of Str. A., namely that for January-February, 1961, my eye chanced to fall upon the very last paragraph of text called prophetically Possible Peculiar Aspects of Piton, from which I gathered that some rather off-beat appearances had been reported. Up to this time I had enjoyed no more than a nodding acquaintance with Piton and indeed knew nothing whatever of the mountain, save the barebone statistics one finds here and there in works on the lunar surface spiced now and then by references to peculiar phenomena, generally thought to be lunar atmospheric in origin. Wilkins and Moore,[1] for example, allude to ancient observations by Gruithuisen, and somewhat more recent ones by Pickering, which seemed to indicate unusual appearances; but on the whole material on Piton is rather scanty and also rather inconclusive.

For instance, the delineators of this formation apparently had some difficulty in making up their minds as to whether Piton is one mountain or two; and if two, which way the units are oriented with respect to each other. Elger shows a smaller southern component running N.W. - S.E., and a larger northern component running N.E. and S.W. and diverging one from the other. Goodacre, however, shows two masses of nearly equal size both oriented N.W. - S.E. and parallel to each other; while Wilkins shows a smaller component running N. and S. and a larger to the N. and E. running N.W. to S.E. [Dr. Bartlett here uses lunar east and west in the older sense, according to which the sun rises in the lunar west and sets in the lunar east. - Editor.]

Oddly enough, photographic evidence is hardly more enlightening. One of the Lick pictures, taken near sunset, shows an integrated mass with a deep cleft on the east and another on the west, the general appearance conforming more to Wilkins than to either Elger or Goodacre (an excellent reproduction of this plate appeared in _The National Geographic Magazine_ for February, 1958, p. 293, where, however, it is erected). A Yerkes photo, taken with the 40-in. refractor, in early lunar afternoon, shows a trifurcated mass with components running (roughly) N. - S., N.E. - S.W., and N.W. - S.E., while a full moon-view by Lick shows a single, L-shaped object. Finally, the W.H. Pickering Atlas shows a half-moon shaped object (Plate 9A), a solid crescent (Plate 9B), an L-shaped mass (Plate 9C), and two distinct, parallel masses (Plate 9E). In short, the photographic appearance of this mountain is profoundly modified by colongitude, and the appearance at any given time will depend largely upon this factor - but not solely as will shortly become clear. In other words, though the singular changes of appearance affecting Piton are connected with colongitude, they are not all the effects of solar lighting alone. Very definitely something more is involved.

Having thus satisfied myself that Piton was worth more than a casual investigation, I began a series of systematic observations in April, 1961, and concluded them in October of the same year. In all 32 observations were made covering the following colongitudes: 2°.94; 8°.38; 26°.7; 38°.56; 58°.25; 63°.74; 71°.13; 82°.85; 84°.18; 88°.41; 94°.69; 107°.14; 113°.48; 115°.06; 119°.27; 121°.4; 124°.71; 125°.03; 132°.23; 132°.58; 137°.02; 138°.25; 144°.52; 145°.02; 150°.86; 157°.04; 157°.43; 163°.16; 163°.21; 169°.51; 176°.08; and 182°.1. The same telescope - a 4.25-in. reflector - with the same eyepieces and powers, 50X, 120X, and 240X, was used exclusively. It will thus be seen that a fairly comprehensive view of the phenomena was obtained from sunrise to sunset; and _if_ one were to base himself on these observations alone, without considering what they may imply, one would come to the following conclusions all of them demonstrable:

a) That Piton is a solid, crescentic mass; b) that Piton is a solid, irregular mass; c) that Piton is neither, but rather two nodular masses, the southern one much smaller than its northern neighbor; d) that Piton is composed of at least seven distinct masses; e) that the mountain is not a mountain at all but rather the fragments of an ancient ring; f) that Piton is the lunar equivalent of an atoll.

I have recorded some astonishing lunar transformations in my day as functions of colongitude, but nothing to equal this unless it be that perplexing affair in J. J. Cassini which so confounded me a few years back; and I think not even that.[2] Proteus, that whimsical godling of Greek fancy who could take all shapes "from Máh to Máhi", had nothing on Piton.

Manifestly Piton is a solid, integrated mass; the sunrise and sunset aspects make this very clear. Just possibly it might be three masses; but whether the clefts on the east and the west actually divide the mountain into separate units is a question which only the largest apertures can resolve. One of the Mt. Wilson pictures, taken at col. 137°, shows the mountain as a single, irregular mass with a very deep cleft on the east and a much shallower one on the west, neither of which cuts completely through the mountain. E. J. Reese very kindly supplied the writer with a topographical outline sketch, based on Mt. Wilson Photograph H10, a copy of which is given here as Fig. 1. The aspect bears a very close resemblance to the Yerkes photograph mentioned above, and may confidently be accepted as a pretty accurate representation of the true state of affairs.

The question before the house than is simply this: By what process does a single, irregular mass of rock appear to become as many as seven masses each distinctly separate from all the others; or how can a unified mass change its aspect to that of an atoll composed of scattered islets arranged in a definite ring? I think it self-evident that mere change of lighting is quite insufficient to account for transformations of such character, the more so in that the apparent break-up of the mountain into well-defined fragments comes precisely at those colongitudes when shadow is either altogether wanting or its effects at a minimum. It is true that the object in J. J. Cassini may appear alternately as a rectangular block and as a shallow ring plain, and it is equally true that such changes are indubitably related to colongitude in a direct and simple way; but the block is never observed to become seven blocks, and the ring plain is obviously a ring plain and nothing more. Moreover, a factor which contributes heavily to the J. J. Cassini transformations is the obliquity with which objects in such far northern latitudes must always be viewed, a factor which is wanting in the case of Piton which lies a trifle north of the 40th lunar parallel of north latitude. For the same reason the effects of the two principal lunar librations, i.e. in latitude and in longitude, are minimized for Piton.

But before we attempt an explanation for the Piton phenomena, it will be well to become a little more familiar with the mountain itself, and incidentally to remove some common misconceptions in the process.

The commonly accepted height is about 7,000 feet above the surface of the Mare Imbrium; and the mountain is generally described as "bright", but without qualification this is very misleading. It is in fact really bright only at sunrise and again at sunset, a truth which can be readily established by using Pico as a gauge. The brightness of Pico also varies - naturally - with the angle of incidence of sunlight; but the Pico variations are so much less than those of Piton that the former remains conspicuously bright from sunrise to sunset while the latter may - in part - become very dull and grayish and not more than 4° bright. I say "in part" because certain spots on Piton, apparently peaks, may remain from 6° to 7° bright, while the flanks become quite dark. The western face of the mountain appears to be more reflective than the eastern, for at sunrise I have estimated the western flank to be as high as 8° bright while at sunset the eastern flank is estimated at only 5°. [The lunar intensity scale here employed is 0° for black shadows to 10° for the most brilliant marks.-Editor.]

In general the observed variations in brightness run as follows: At colongitude 2°.94, brightness 8°; by col. 26°.7, brightness has fallen to 6°; between col. 63°.7 and 88°.4 average is 7°; but at col. 121° it is down to from 5° to 6°. Between col. 150°.8 and 169° the mountain is very dull, averaging only 4° and looking distinctly grayish but with bright spots, notably one in the north and the other in the south, which vary from 5° to 6° bright. Between col. 176° and 182° (sunset) the brightness is about 5°.

These variations are quite constant and do not, to my mind, suggest the influences of either volcanic or meteorological agencies. As to the cause of them, we shall consider this in due course; but let it be sufficient now to note that the mountain is very bright at sunrise, that this brightness begins to fall off with a secondary brightening with approach to noon, and that in late afternoon the mountain becomes very dull with another brightening just before sunset. It is also necessary to note that the dull phase comes at a time when the mountain appears to be divided into several segments, including its atoll-like ring aspect, and that these segments may vary in relative brightness, some being as high as 6° bright while others may be no more than 4°. Occasional exceptions are also noticed, as at col. 145° when the northern segment appeared 4°.5 bright and the southern 5°, August 1, 1961; while at col. 144°, September 29, 1961, the southern segment was a dull 4° and the northern segment 4° at the crest with a 5° base. Such variations from the norm are very slight and are not significant.

There is considerable evidence to show that the mountain is quite rough in surface texture and that it varies in composition, as for instance a terrestrial mountain would if composed of, say, schists injected by granites. It must be clearly understood, however, that the comparison does not imply a similarity of materials in the case of Piton, only that Piton reflects light in such a way as to suggest reflection from different types of surfaces.

This result is also suggested by examination in light of differing wavelengths, for which purpose Wratten Filters were used by the writer during almost every observation. The overall picture thus obtained is that of an object which is brighter in red and yellow light than in green and blue, and is consistently dullest in blue light. The following table will give the relations found, in which a scale of 1, 2, 3, and 4 was adopted with 1 being brightest and 4 dullest. The initial N stands for "neutral" meaning that no appreciable brightening or dulling was observed in the color used.

Table of Filter Reactions

Colongitude	Blue	Green	Red	Yellow	Colongitude	Blue	Green	Red	Yellow
2°.94	2	1	4	3	124°.71	4	3	N	N
8.38	3	2	N	1	125.13	4	N	N	2
26.70	4	N	N	N	132.58	N	N	1	2
58.25	N	N	N	N	137.02	4	3	N	N
63.74	4	N	N	N	138.25	4	3	2	1
71.13	N	N	N	N	144.52	N	N	N	N
82.85	4	3	1	N	145.02	4	N	N	2
84.18	3	N	2	1	150.86	4	4	N	2
88.41	4	3	N	N	157.04	4	N	2	1
94.69	2	N	N	1	157.43	4	N	N	1
107.14	4	3	2	1	163.16	N	N	N	1
115.06	4	3	2	1	163.21	4	3	1	2
119.27	N	N	1	N	169.51	4	N	2	1
121.40	4	N	N	N	176.08	N	N	N	1

It will be observed that in 28 observations Piton was found dullest in blue light on no less than 17 occasions, while yellow light gave a value of 1 for 11 observations and red for only 4, though the mountain was consistently brighter in red light than in blue or green. Only once - at col. 2°.94 - was the usual order of things reversed, when Piton was definitely brightest in green and blue and dullest in yellow and red. It will also be observed that the results are not consistent with those at the same or at closely comparable colongitudes; and unless the differences are to be referred to simple errors of estimation, there would appear to be no apparent connection between them and varying states of the transparency, which, in most cases, varied no more than a point and in only two cases by as much as 2 points (on a scale of 0 to 5, with 5 best).

However, at no time did the writer observe anything which suggested local lunar mists or other obscurations, though on one occasion, April 25, 1961, at $3^h\ 37^m\ 30^s$ U.T., I could not define the morning shadow sharply. It so happens, however, that the morning shadow falls athwart a naturally dark area to the east of the mountain so that optical confusion is quite possible. Again, on April 28, 1961, at $4^h\ 35^m$ U.T., I found a local haziness at the western and sunlit base of the mountain; but this was very indefinite, and, as Prof. Haas suggested, may well have been due to the inability of a small aperture to define the points of contact of the mountain with the *mare*.

And now, before we consider the amazing transformations of Piton with the advance and decline of the lunar day, we must take speial notice of the very dark, semi-circular area of surface immediately east of the mountain; for it is virtually certain, in my opinion, that this area is to the transformations as cause is to effect.

To begin, there are actually two very dark areas east of Piton, that which is immediately adjacent to the mountain and another still farther east which is separated from the former by a very thin division. The eastermost area is not quite so dark as the other and is of very different extent and shape, being a well-defined triangle with the vertex pointing eastward. It ends on the south in a curious prolongation at the end of which is a much smaller triangle, also pointing eastward. This last

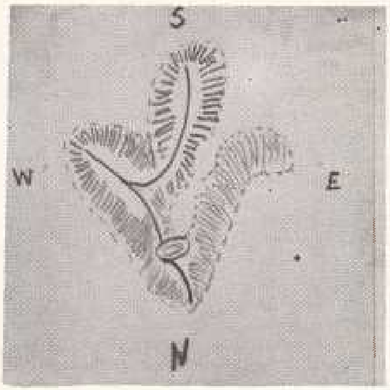

FIGURE 1. Lunar Mountain Piton. Copy from tracing by E.J.Reese of Mt. Wilson Photograph H 10. Col. 137°.

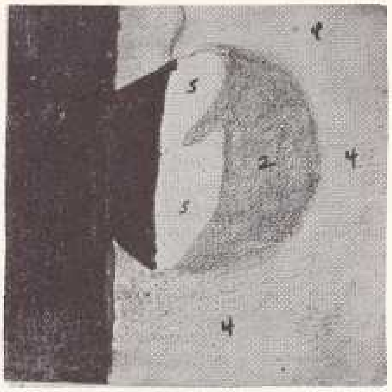

FIGURE 2. Piton. Oct. 2,1961. $6^h\ 34^m$ U.T. 4½-inch. refl. at 240X. S = 1 - 3. T = 1. Col. 182°.1. James C.Bartlett,Jr.

FIGURE 3. Piton. Aug. 19,1961. $1^h\ 49^m$ U.T. 4½-inch refl. at 240X. S = 6. T = 4.Col. 2°.94. James C. Bartlett, Jr.

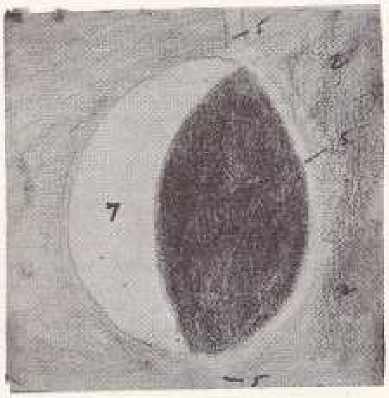

FIGURE 4. Piton. April 28, 1961. 4 35 U.T. 4½-inch refl. at 240X. S = 5. T = 4 to T = 2. Col. 63°.74. James C. Bartlett, Jr.

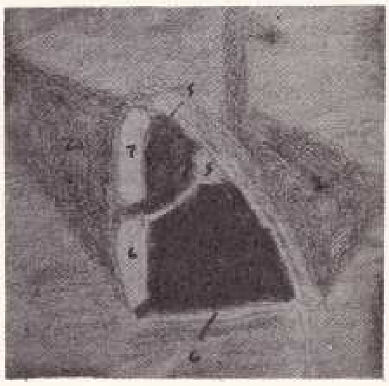

FIGURE 5. Piton. Sept. 23,1961. $3^h\ 48^m$ U.T. 4½-inch refl. at 240X. S = 6. T = 5. Col. 71°.13. James C. Bartlett, Jr.

feature somewhat resembles a flag flying from a flagpole and gives a very distinctive appearance to the region. Though this triangular dark area, together with its "flag", darkens under a high sun and breaks up into faint patches and streaks with approach to sunset, we need not consider it here. It plays no part in the phenomena of Piton. But the semi-circular dark area is the key to an understanding of the whole affair.

Its earliest history is unknown because, unfortunately, at sunrise the shadow of Piton covers the area; but with approach to noon this semi-circle becomes increasingly darker, and I have estimated it as only 1° bright as early as col. 63°, i.e., very nearly as black as shadow. It is very evident on photographs. Its behavior in the afternoon is somewhat variable. I have sometimes estimated intensity as 1° as late as col. 124°.71, but 2° at col. 121°.4 at other times. A definite fading begins in the late afternoon, and at col. 169°.51 I have found the area nearly 4° bright. Just before sunset, however, it again darkens rapidly and again assumes a well-defined semi-circular shape (Fig. 2). I have so seen it when the intensity was estimated as only 2°. This last phenomenon is most important, for it shows pretty conclusively that this semi-circular area of surface is in reality a very shallow depression. It is possible that with sufficient aperture a slight shadow might be found under the eastern rim at sunset, but this is naturally invisible to a small instrument.

Though the structure of this area, assumed to be a shallow depression, would well explain its rapid darkening with approach to sunset, one should notice that its high-sun darkening cannot be so explained; and I hardly think that anyone would seriously argue for mere contrast as the explanation. It is certainly a little hard to believe that the adjacent mare surface becomes so very much brighter as to convert a local area of light gray surface to one nearly as black as shadow.

So much for this particular area immediately adjacent to Piton on the east. We shall return to it a little later. In the meantime we are ready to consider the remarkable phenomena of the mountain itself.

At sunrise the more or less monolithic structure of Piton is clearly revealed (Fig. 3) together with the western cleft or valley. At sunset we see the same thing (Fig. 2) but with a deeper cleft on the east. Both as to observed structure and shadow, therefore, the mountain appears as a solid mass.

For some days after sunrise Piton retains the appearance of a solid mass, resembling a crescent (Fig. 4) forming one lune of a circle of which the other is the high-sun dark surface on the east; but it may also appear as an L-shaped structure of unusual thinness (Fig. 5). As might be expected these differences are related to the libration in longitude, the crescentic phase being prominent when the center of the disc is displaced toward the eastern limb and the thin, L-shaped phase when it is displaced toward the western limb. This does not mean that the eastern side of the mountain is necessarily much steeper than the western side. The reason would appear to be something quite different.

With approach to noon we get the first hint of those apparent alterations which convert Piton from one mountain into several and ultimately into a ring-shaped formation resembling a coral atoll. Thus in Fig. 5 we see the beginning of definite divisions in the solid mass and also the appearance of an apparently isolated bright mass on the very edge of the high-sun dark area. Note also the thin white line forming the boundary of this area which here, incidentally, appears more triangular than circular as if squeezed out of shape; but this aspect is merely an effect of the libration in latitude plus the development of high-sun bright spots on the northern edge of the area.

By col. 107° the whole appearance has radically altered, and we now see what appears to be a complete ring of isolated masses, islets as it were enclosing a 1°.5 dark lagoon (Fig. 6). This phase is observed through

FIGURE 6. Piton. Sept. 26, 1961. $2^h\ 52^m$ U.T. $4\frac{1}{4}$-inch refl. at 240X. S = 5. T = 4. Col. $107^\circ.14$. James C.Bartlett, Jr.

FIGURE 7. Piton. Sept. 27,1961. $2^h\ 47^m$ U.T. $4\frac{1}{4}$-inch. refl. at 240X. S = 3. T = 5. Col. $119^\circ.27$. James C. Bartlett,Jr.

FIGURE 8. Piton. July 31, 1961. $5^h\ 41^m$ U.T. $4\frac{1}{4}$-inch refl. at 240X. S = 6. T = 3. Col. $132^\circ.58$. James C. Bartlett,Jr.

FIGURE 9. Piton. Aug. 1,1961. $6^h\ 05^m$ U.T. $4\frac{1}{4}$-inch refl. at 240X. S = 5 to 6. T= 3. Col. $145^\circ.02$. James C. Bartlett, Jr.

FIGURE 10. Piton. Aug. 2, 1961. $6^h\ 38^m$ U.T. $4\frac{1}{4}$-inch refl. at 240X. S = 5. T = 3. Col.$157^\circ.43$. James C. Bartlett, Jr.

col. 115°; but by col. 119° further extensive changes have taken place, and the atoll has given way to three elongated masses oriented N.W. - S.E. The "lagoon", meanwhile, has begun to brighten and is perhaps 2° intensity (Fig. 7). This trifid appearance is maintained through col. 132°, at which time a well-marked shadow has developed westward from the base of the easternmost mass which now appears to have curved around west through north (Fig. 8).

Twenty-four hours later the mountain has been reduced to two masses (Fig. 9), the southern component being much smaller than the northern. It is important to notice that each throws its own shadow, as if physically separated. A day later still the two shadows have merged into one with two peaks, and here an important fact must be noticed. In Fig. 10 we have the appearance at col. 157°.43, August 2, 1961, and Piton still appears to be composed of two masses; but observe that part of the shadow of the major component, i.e. that portion between the components, appears to arise from nothing!

At col. 157°.04, September 30, 1961 (Fig. 11), we find the explanation. Here the mountain is seen as a single mass from which the shadow arises normally, and on the east we see the well-known cleft. Comparing this view to Fig. 10, it is clear that part of the apparent separation of the two masses was really composed of this cleft. The other part, therefore, must have been composed of the mountain itself; but because the crest at this point (and at this particular time) was of the same color and intensity as the floor of the cleft the eye could not distinguish between them, and so there appeared to be merely open space - open space which threw a shadow! A much larger aperture doubtless would have dispelled the illusion; but in any event the fact is of prime importance to an understanding of the whole series of phenomena. It may be objected that the existence of the two individual shadows is not thereby explained, as indeed it is not; yet there is no great mystery in the matter. We have only to suppose that the main mass of the mountain dips down to the level of the mare, in which case a very slight shadow would doubtless escape detection with a small glass, to spring up again in a peak at the southern end, which would throw a considerable shadow. Hence one would have the reality of two distinct shadows and the illusion of a discontinuity.

The astonishing metamorphoses of Piton are repeated, colongitude for colongitude, with a high degree of regularity and to this extent might be thought to result wholly from changes in the solar lighting; but occasionally such major differences are observed that it seems clear that we must look further for the explanation. For instance, on August 29, 1961, at col. 125°.13, Piton appeared to be composed of four isolated fragments which may be taken as the normal appearance at this time; yet on May 3, 1961, at col. 124°.71, the mountain appeared in its solid phase as a broad, crescentic mass!

Such are the protean transformations of Piton. How are we to explain them?

Let us first return to that semi-circular dark area immediately to the east of the mountain. The facts that it appears to be a very shallow depression, that it is more or less circular, and that Piton forms the western arc of this circle rather strongly suggest that Piton may not be a mountain at all in the proper sense of the term but rather the remains of a rampart which at one time encircled an ordinary crater, the walls of which have everywhere disappeared save on the west. It seems possible, therefore, that Piton may represent an extreme example of the partially submerged crater. That this high-sun dark depression is in fact the remains of an ancient ring, of which Piton forms a still surviving fragment, is also strongly suggested by the delicate, 5° white boundary previously mentioned, which probably represents the surface outline of the original walls.

We are now ready to see how all of this fits into the picture of

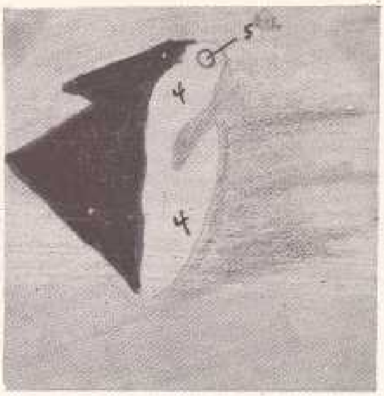

FIGURE 11. Piton. Sept. 30, 1961. $5^h 14^m$ U.T. 4¼-inch refl. at 240X. S = 1 to 3. T = 3. Col. 157°.04. James C. Bartlett,Jr.

Piton's astonishing changes of aspect, culminating in the illusion of an atoll. We start with Fig.4, in which the mountain itself has the appearance of a solid, crescentic mass. Notice the thin, white boundary of the semi-circular dark area. If we measure the width of the true mountain in relation to the width of the dark area it becomes very clear that the "islets" forming the eastern arc of the atoll (Fig.6) cannot be a part of Piton itself, which is represented rather by the western arc of spots. The eastern objects, therefore, including those on the north which form the base of the L-shaped structure (Fig. 5), are really high-sun bright areas which under a low sun are quite invisible. It is very probable that they mark the course of the vanished rampart enclosing the whole high-sun dark circle.

Before writing this paper I discussed the Piton phenomena with E. J. Reese, who expressed the opinion that the atoll aspect and the break-up of the mountain into fragments was simply the result of the development of high-sun bright areas. Mr. Reese also kindly supplied a tracing from Lick Photograph M4a illustrating these bright areas, the whole fairly representing the appearance at col. 129°. With this view I would agree completely in regard to the eastern chain of spots; but in regard to the western - which represents Piton itself - I do not see that the explanation is tenable.

Returning to Fig. 6, we observe that the western components are separated by clear spaces which have the same intensity as the interior of the lagoon, or high-sun dark area. Now these apparent clear spaces are actually part of the mountain itself; therefore, if we are to suppose that they arise merely as contrast effects, then we must also suppose that local areas on the mountain have become so brilliant as to make adjacent areas look at least 2° dark. Yet it is precisely at this time that the bright parts of the mountain are really at their dullest, falling in some instances to 4° intensity and looking quite gray rather than white. Moreover, comparison to Pico (which was made by the writer at every observation) will show that no such super-brightening has taken place, and that in fact the brightest parts of Piton are obviously inferior to any part of Pico. Nor can it be merely coincidental that the development of the apparent dark spaces (which convert the solid mass of Piton into discrete fragments) are part and parcel of the high-sun darkening of the lagoon itself. Rather the one is certainly an extension of the other. What then is the nature of this high-sun darkening? I will not use the naughty word "vegetation"; rather I will say that <u>something</u> develops in the semi-circular area immediately east of Piton, which something becomes extremely dark with approach to noon.

Whatever merit there is in the argument contra that high-sun darkening is an illusion, caused merely by an increase in brightness of the surrounding surface, I should be happy to see anyone prove the point with respect to Piton. For it happens that Piton lies nowhere near a really bright surface, but rather on the relatively dark <u>mare</u> surface, laced it is true by vague whitish streaks, rays, and splotches but none of them more than 5° bright and many of them much less. Moreover, the camera, as well as the eye, testifies that the high-sun dark area east of the mountain is really <u>dark</u> - period. In fact, it is sensibly black in high-sun photos.

This area, therefore, is composed of a something the color of which is much darker than any part of the adjacent surface, a color which may be any very dark color, e.g., a very dark green or blue, but which at the lunar distance and with small apertures ranges from a very dark gray to almost black. Let us suppose too that this dark something overflows, as it were, the eastern flank of Piton itself, thus causing the very narrow aspect when the libration is toward the west, and let us suppose also that this something sends forth tentacles which flow up the flanks of the mountain, across the crest and down the western side. What would be the effect? Why, so far as the eye is concerned, it would be to convert one mountain into apparently several mountains. But should you ask me why this material creeps up the mountain in bands, rather than advancing in a solid wave, I should have to reply that I do not know - any more than anyone knows why the dark material on the walls of Aristarchus also manifests itself as bands.

The point is that the phenomenon appears to be identical with the phenomenon of a banded crater. I propose therefore that in Piton we may have a unique specimen - a banded <u>mountain</u>. It is well known that the bands in Aristarchus are variable, which is to say that in some lunations certain ones do not develop and others may differ in intensity relative to one another; and once I saw Aristarchus when no bands at all were visible. The same is true of Herschel and of Proclus, and will probably be found true of all banded craters. Thus if the Piton phenomenon is the same as the Aristarchus-Herschel-Proclus phenomenon, we have an explanation for its solid aspect on May 3, 1961, at a colongitude when normally it appears as several masses. The Piton bands had simply failed to develop.

So I read the riddle of Piton. Perhaps in a few years the first astronauts will stand in the shadow of the mountain, and this theory will have become as dead as the Diplodocus; but in the meantime there may be gold in those isolated lunar hills one finds here and there, and so I may have a go at another - say Spitzbergen.

References

1. Wilkins, H.P. and Moore, Patrick; <u>The Moon</u>; Faber and Faber, Ltd; London, 1955; p. 233.
2. Bartlett, J.C.; "Object Beta - A Case of Identity"; <u>Str. A.</u>; May-June, 1955; p. 54.

<u>Note by Editor</u>. We are indebted to Dr. Bartlett for a very well-written and detailed discussion of <u>apparent</u> lunar changes in one well-known feature, using the methods pioneered many years ago by W. H. Pickering.

The interpretation of such changes has been controversial. A most critical point is that of whether <u>real</u> high-sun darkenings occur. The Editor would doubt that visual work can ever objectively establish such darkenings as distinct from contrast-effects. Mr. Reese has commented in these pages on the amazing transformation of Jupiter IV from a bright moon on the sky near its primary to an object looking fully as black as shadow when in transit across Jupiter.

The identification of high-sun lunar features with topographical detail visible under lower lighting is also often most troublesome. The best approach is presumably by means of measures of photographs.

OPTICAL STUDY OF CLEAR AIR TURBULENCE

By: John K. Newell

<u>Abstract</u>. Observations using both stars and planets as light sources for optical analysis (along the lines of the Foucault test for telescope objectives) indicate that the principal atmospheric distortion of optical

wave fronts usually is attributable to one or more layers of clear air turbulence. These observations suggest that a camera-equipped astronomical telescope can be used to determine accurately the altitude of the clear air turbulence, and that a simple mechanical device at the telescope may determine wind velocity in the vertical vicinity of the turbulent layers. Wind azimuth in the turbulent layers is directly observable at the telescope.

Of common concern to meteorology and astronomy is the atmosphere's characteristic modification of optical wave fronts passing through it. If the wave front approaching the earth from a celestial object may be thought of as modeled by a very thin disc of metal foil, then its broadside arrival to fill the image plane in an astronomical telescope will find this model of a wave front no longer flat, but badly battered, dented, and wrinkled. The atmosphere as a whole is not guilty of this assault and battery upon the optical wave front. This crime against astronomical seeing usually seems attributable to a single, thin layer of turbulent air - although sometimes two or three such layers contribute to the wave front distortion.

These atmospheric optical effects have long been of concern to astronomers. Such effects have been studied in detail[1] and many of the studies have been published, particularly in <u>The Journal of the Optical Society of America</u>. Lunar and planetary observers are keenly aware of such atmospheric effects on light because of the frustration of trying to confirm, photographically, glimpses of fine detail observed visually in fleeting moments of unusually tranquil seeing. However, most of the studies of seeing have had to do with the scintillation (brightness changes) of stars. Attempts to correlate scintillation and poor seeing with atmospheric layers or conditions have been considerably fewer.

Dr. Elmar R. Reiter of Colorado State University says[2]:
"Indications of atmospheric turbulence are detectable through the scintillation of stars, which is caused by slight inhomogeneities of density.[3] The amplitude of scintillations may be obtained photographically. There seems to be a correlation between wind velocity and wind shear at the jet stream level on the one hand, and the scintillation on the other hand. The high-frequency oscillations (150 cps) of the star image seem to have their origin at the average tropopause level, while the low-frequency oscillations (25 cps) have no marked correlation to wind velocities below 20 kms.[4]

Evidence points to two contributors to atmospheric distortion of optical wave fronts: 1. wind shear, and 2. temperature inversion in which temperature rises directly with altitude.

Dr. W. M. Protheroe of the University of Pennsylvania reports that "it does appear safe to conclude that stellar scintillation is an excellent indicator of the winds at the maximum-vector shear layer."[5]

Dr. Enrique Gaviola, of the National Astronomical Observatory at Cordoba, Argentina, says that the wave front distortion is "produced by the relative displacements of a warmer air mass above a colder one. The comparative 'warmer' and 'colder' refer to the temperature of the adiabatic lapse-rate curve extrapolated from the neighbouring layer. The temperature of the 'warmer' layer may actually be less than the one of the 'colder' ones, provided it is above the one necessary for convective adiabatic equilibrium."[6] "Often", he continues, "at one or more levels in the atmosphere, a warmer layer of air lies above a colder layer. Motion of either layer relative to the other can cause a system of waves or ripples ... a few centimeters or inches long."

Both Gaviola and Protheroe have analyzed the optical Fourier spectra of these waves of atmospheric inhomogeneity - Gaviola, photographically with the Bosque Alegre reflector, and Protheroe, with a specially designed optical Fourier analyzer using a transmission grating.[7]

However, some study of these atmospheric wave patterns can be made visually, using a telescope without camera or grating. Jean Texereau of the optical laboratory of Paris Observatory advises[8] that if the telescope is pointed at a bright star and the eyepiece removed, "we see streaming rapidly across the mirror the 'flying shadows' of the perturbed wave: more or less periodic striae, fairly wide, spaced 2 to 4 inches apart, and of weak contrast except when the turbulence is particularly severe. Often two systems of striae are visible, superimposed one upon the other, and moving in different directions."

This "flying shadow" pattern is produced in one or more layers of air which may be at the same time associated with conditions of shear and temperature inversion. Differences in refractive indices of small portions of air in these layers cause disruption of the wave front arriving at the telescope from a star or planet. The effect is observed when the telescope objective is used as in the Foucault test, with a star as the light source. This test usually is employed as a laboratory check on the surface and figure quality of a telescope mirror. Sensitivity is high - linear magnification of mirror surface variations is on the order of 100,000 times. If this Foucault test is conducted with the light passing through a disturbed refractive medium (as in Schlieren photography of the effect of compression waves in a medium flowing past a model), then the test provides an accurate visual image of the pattern of disturbed refractivity. Hence, the "ripples" in a clear atmosphere may be imaged directly upon the objective of a telescope, where they may be studied visually or photographed.

My own observations with a reflecting telescope of 12½ inches aperture indicate that a bright planet is a much better light source for this kind of observation than is a star. The planetary light source renders observation of the "flying shadows" much easier and offers more image contrast than does stellar light. Undoubtedly, stars have been used in most past studies of scintillation for the simple reason that (to the naked eye) stars scintillate and planets shine with a steady light. This is true because the column of light through the atmosphere to the pupil of the eye is essentially a cylinder of light about 7 mms. in diameter, the approximate measure of the dark-adapted normal pupil. This slender column of light is easily disrupted by atmospheric ripples, which usually are on the order of 8 centimeters, more or less, in wave length. These waves, of length considerably longer than the pupil diameter, cause modulations in the star's apparent brightness and position. The light path from a bright planet to the eye is, however, far from cylindrical. Passing through the atmosphere is a cone, truncated by the 7 mm. eye pupil at one end and spreading to subtend the entire planet at the other, with there an angular diameter of possibly more than 45 seconds of arc. A horizontal cross-section from this cone in the stratosphere would be some meters in diameter, and thus would contain several atmospheric ripples a few centimeters in wave length.

Using planets (usually Jupiter, sometimes Saturn or other planets) as light sources in twilight and in early darkness, I made 27 observations of atmospherically caused "flying shadows". These observations were carried out from September, 1961, to January, 1962.[11] Attempts were made in these 27 observations to correlate work at the telescope in San Antonio, Tex., with meteorological information obtained from the U.S. Weather Bureau in San Antonio. Inquiries were made by telephone. The azimuth of the shadow pattern flow was noted, and inquiry was made as to at what altitude (or altitudes) wind azimuth corresponded to the direction of shadow pattern flow as observed in the telescope. With one (and only one, in observations allowed as valid) coincidence in wind and shadow pattern azimuth established, then information was sought from the Weather Bureau on wind shear and temperature conditions at that particular altitude.

It should be noted that my backyard observatory is some 10 miles from the Weather Bureau's balloon release point, and that my observations were made, in extreme cases, as long as two hours after balloon release

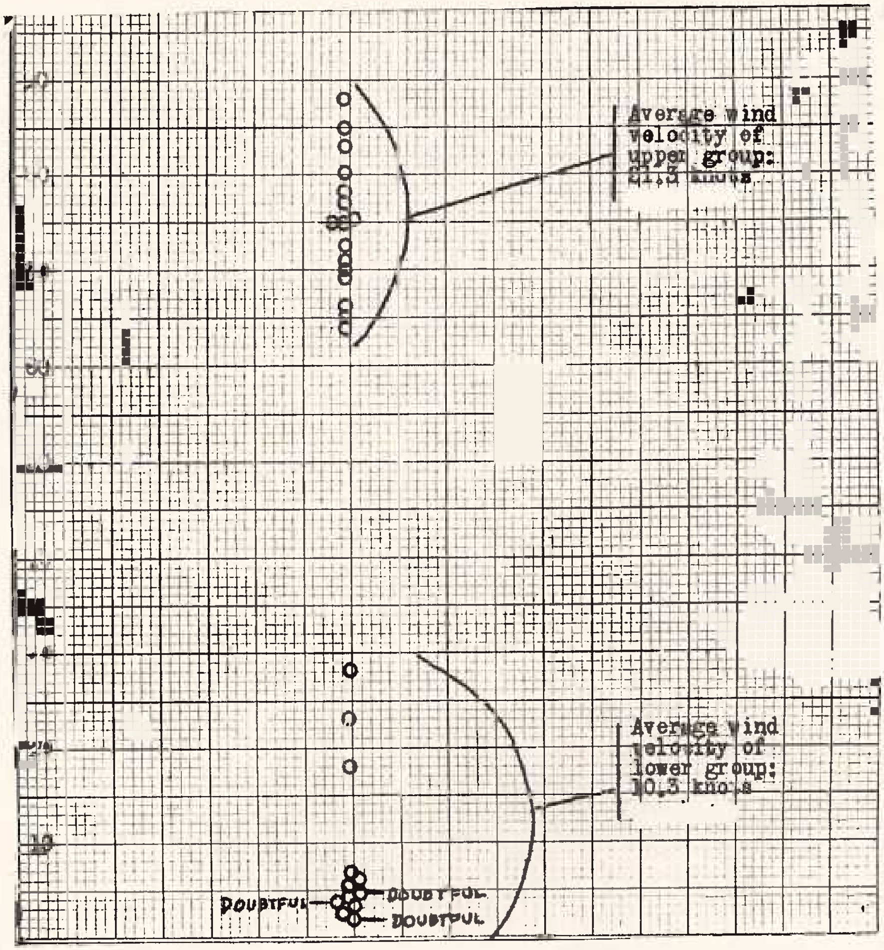

FIGURE 12. Graphical presentation of observed altitudes of layers of optical turbulence as determined by John K. Newell. Each circle represents a single such observation. The scale on the left gives altitude above mean sea level in thousands of feet. See also text of Mr. Newell's article in this issue.

time. But if these adverse conditions and the relatively small number of observations may be admitted as evidence, then there is a good indication that the atmospheric layer causing anomalies in optical wave front behavior is usually, if not always, characterized by both wind shear and temperature inversion.

Average height of the optically disturbing layer was held to be 45,000 feet. But graphic distribution of the reports on altitude leaves a distinct gap at the 45,000 feet level, with groupings of readings at higher and lower levels (Figure 12).

The relatively large number of observations indicating that the disturbing layers were at from 60,000 feet to 90,000 feet possibly has something to do with the temperature inversion common at these altitudes. All observations in this group indicate some wind shear, with the velocities ranging from 8 to 29 knots and averaging 21.3 knots.

In each of the 12 lower-altitude observations (below 30,000 feet) there is some special condition which might have bearing. When three of these readings were taken, the Weather Bureau could supply no information for altitudes above 75,000 feet (in two cases) and 80,000 feet (in one case.) There were no temperature inversions reported for these three instances, and the three readings may not be valid. But for the other nine observations in the low altitude group, definite wind shear and temperature inversion were noted.

These observations would seem to indicate that the principal optical disturbance in the atmosphere may be produced at that altitude at which the combination of wind shear and temperature inversion is strongest.

Protheroe reports two sets of data[12], 46 observations from Bedford, Mass., and 67 from the University of Pennsylvania, in which the mean height of the disturbing layer of air was 9,087 meters and 8,690 meters respectively. This compares with an altitude average above 13,000 meters at San Antonio. Protheroe (in a private communication, June 1962) suggests that this difference may be due to the higher average tropopause level at the latitude of San Antonio.

He reported that good wind direction correlation was obtained by using a slit in his scintillation measuring instrument. Nevertheless, this correlation was on slit angle increased or decreased by 180 degrees, since the sense of motion was not determined by the pattern. The San Antonio observations, using planets, leave no doubt as to direction - the azimuth of motion of the "flying shadow" patterns can be observed directly.

It is suggested here that by using both stellar and planetary light, there need be no dependence upon balloons or any means other than optical for determining altitude, velocity, and azimuth of the principal optically-disturbing layers of clear air turbulence.

The ripple patterns produced by stellar light passing through the atmosphere are easily photographed, and Gaviola has done so.[13] Since patterns produced by planetary light sources are stronger in contrast, there is little doubt that these, too, can be recorded on film.

The light path from a star to a telescope objective is, for all practical purposes, a cylinder of the diameter of the objective. The light path from a planet to a telescope objective is a truncated cone, the sides of which have a known angle of convergence. If a planet and a star appear as neighbors in the celestial sphere, then a layer of disturbing atmosphere cuts a horizontal slice across cone and cylinder at the same time. This slice can be photographed as stellar cylinder and planetary cone, recording ripple marks of measurable wave lengths in each. Simple trigonometry can then be used to calculate the slant range to the layer of disturbance, and the altitude of the layer (when the angle of elevation of the telescope is considered) can be derived.

It is further suggested here that the rate of angular motion of the planet-illuminated shadow pattern across the field of view of the telescope can be measured. If a moving reticle could cause an artificial ripple pattern to move across part of the telescope's field of view, and the rate of the reticle motion could be varied at will, then reticle motion could be made to correspond accurately with shadow pattern motion and then measured. (That rates of motion of striped patterns can be matched accurately has been demonstrated in precision military instruments - the fuse-setting mechanism on the 90mm. anti-aircraft gun, for example.)

Protheroe says that the rate of motion of the scintillation patterns correlates well (although not necessarily in a 1 to 1 relationship) with wind velocity in the disturbing layer. Thus, if the rate of motion of the "flying shadows" is known, then wind velocity can be derived. Use of a relatively short-focus astronomical mirror should be of help in making these measurements. The aperture should be at least 10 inches.

Although optical study of clear air turbulence might, at first glance, seem absurd, more study along these lines would appear to be warranted.

Summary. Visual observations made with a reflecting telescope 12½ inches in aperture pointed at bright planets produced data on atmospheric distortion of optical wave fronts. These data were correlated with U. S. Weather Bureau information on wind direction, wind velocity, wind shear, and temperature over the San Antonio, Tex., area. Principal atmospheric disturbance of optical wave fronts usually is confined to three or less layers of the atmosphere, and these layers of clear air turbulence often occur in the vicinity of both wind shear and temperature inversion. It is suggested that a suitably-equipped telescope may be used in night observations to obtain direct and accurate information upon 1. altitude of principal layers of clear air turbulence, 2. azimuth of winds in such layers, 3. velocity of winds, and 4. wave length of the ripples of optical disturbance.

References and Notes

1. Lord Rayleigh (Scientific Papers, Vol. III, p. 102, Cambridge University Press, 1920) expresses the amount of wave front deformation δ produced by a body of air with a path length of 1 differing in temperature from the surrounding air by t degrees Centigrade:

$$\delta = 1.1\ lt \times 10^{-6}$$

2. Meteorologie der Strahlstroeme, Springer-Verlag, Vienna, 1961, p. 188.
3. Boutet, 1950, Annales de Geophysique 6 (4): 322-330; Gifford and Mikesell, Weather 8 (7): 195-197; Keller, 1952: Ohio State University Research Foundation Contract AF 19 (604)-41, Technical Report No. 1; Protheroe: Journal of the Optical Society of New York 45 (10): 851-855; Royal Meteorological Society 1954: Quarterly Journal, 80 (344): 241-260.
4. Gifford, 1955, Bulletin American Meteorological Society, 36 (1): 35-36; Gardiner et al., 1956: Lowell Observatory, Contract AF 19 (604)- 953, final report, 1956.
5. Science, 17 Nov., 1961, Vol. 134, p. 1596.
6. Astronomical Journal, June, 1949, Vol. 54, p. 155.
7. Op. Cit., Notes 5 and 6.
8. How to Make a Telescope, Interscience, New York, 1957.
9. These studies would never have been attempted but for encouragement given by three scientists whom I met as a newsman attending a symposium at Colorado State University, Sept. 1961: Dr. Wallace Brode, president of the Optical Society of America; Dr. Norman Hillberry, Director of Argonne National Laboratories; and Dr. Herbert Riehl, Director of the Dept. of Atmospheric Science, Colorado State University. Told of my amateur astronomer's interest in the "flying shadows", each of the three said, in effect: "amateur or not, it's your project -- investigate it."
10. Hoffeit, Sky and Telescope, Jan., 1950, p. 58.
11. At least one bright planet is available at some time during most nights of most years. Observations reported here, however, were interrupted by the progress of all major planets toward conjunction with the sun in Feb., 1962.
12. Science, 17 Nov., 1961, Vol. 134, p. 1595.
13. Astronomical Journal, June, 1949, Vol. 54, p. 155.
14. Loc. Cit., note 5.

Remarks by Editor. Mr. Newell will welcome constructive criticism of his paper by qualified readers. His address is 234 Metz Ave., San Antonio 23, Texas. The apparent correlations found with wind shear and temperature inversions will stand on far firmer ground if they are confirmed by other studies with a larger number of observations, at different stations, and at many different times of the night and of the year. Should enough interest develop, the study could even be undertaken as a special A.L.P.O. project. Much attention might need to be given to the determination of suitable observational techniques.

It is symptomatic of the wide interest in the general problem discussed above that one of the future projects at the White Sands Missile Range, where the Editor works, is a study of "natural atmospheric turbulence". The experiment is called Aerospace Photographic Reconnaissance Experiment (APRE), and the principal contractor is Minneapolis Honeywell. The method of securing data will be to photograph a resolution pattern on the upper wing surfaces of an aircraft from a camera borne in the gondola of a balloon. The aircraft will fly at selected altitude differences below the balloon, thus changing the atmospheric layers in the optical path.

KLEIN'S "NEW" CRATER - ANOTHER LUNAR PUZZLE

By: Francis J. Manasek

(Abstract of paper presented at the 1962 A.L.P.O. Convention at Montreal.)

The development of selenography during the 19th century was discussed as a contributing element to the widespread search for lunar surface changes. The role of such influential lunar observers as Birt and Klein was also examined, and the "discovery" in 1877 by Klein of a "new" crater in the Mare Vaporum near Hyginus was examined in the light of the above circumstances. The crater was described by Klein as being about 4000 meters in diameter, darkly colored and without a wall. Edmund Neison stated that his observations indicated that the crater was not present (i.e., not observed by him) between 1870 and 1875.

Following Klein's announcement, the crater was extensively observed, and many descriptions of it seem to indicate that it was a structure whose visibility was very sharply limited by lighting conditions. It was frequently recorded as a hill, and the surrounding region often appeared dark with no traces of the crater visible.

Modern observations substantiate the existence of the object, although its diameter is much less than Klein's estimate of 4000 meters. It is, of course, impossible to say whether Klein's crater really was a "new" object or not.

At the conclusion of the presentation of this paper, Mr. Ernst Both made several comments. He noted that Klein had made several such "discoveries" and was almost obsessed with the notion of finding lunar changes. He also mentioned that the data given by Klein in his announcement of the "discovery" were not clear enough to allow for positive identification, and much confusion resulted when other observers tried to locate the object.

LUNAR METEOR SEARCH

By: Madame Jean Pierre Jean, Le Centre Francais,Montreal

(Paper read at the 1962 A.L.P.O. Convention at Montreal.)

Prior to July, 1961, no observation had been undertaken although I had become interested on learning that some studies were being made to ascertain whether meteorites reach the surface of the Moon, and if so, whether impacts can be observed. The amount of meteoritic matter reaching the Earth suggests that proportional amounts must also fall on the Moon; and since the Moon has little or no atmosphere, there would be some definite probability that meteorites of great enough size may produce detectable flashes on impact with the lunar surface.

In July, 1961, with one other observer, I set up a station at my home in Montreal using my 3¼-inch refractor, and this station has been active ever since.. I interested a few others who joined the observing group at my house from time to time; and observations continued with changes in the numbers, and in those attending, and so the existence of the station became known to the Centre Francais. An announcement was made in their Bulletin, which created some further interest in these observations. The group became larger by means of the addition of interested persons unconnected with the astronomical society so that my home became the central point for these observations. Several of the members brought their own telescopes, and so with several instruments in operation the Moon was kept under constant observation during the whole of the periods required by the A.L.P.O. Lunar Meteor Search on the three assigned nights per month when weather conditions permitted the schedule to be followed.

Interest continued and observing experience was gained to the point where it became desirable to set up another station. With more than one station in operation, confirmation of impacts may be achieved; and continuity of observation is assured should local conditions interfere, as with the Moon in certain positions, city lights, buildings, or other obstructing objects. The first station to be set up, other than at my home, was at Ste. Genevieve de Pierrefonds, using a 2½-inch refractor; and later another group was established in Montreal at a North End location, where an 8-inch reflector was available. A fourth station is being organized at Ste. Dorothee, on Isle Jesu, which will also use an 8-inch reflector.

During observations a varying intensity has been noted in the faint illumination of the dark part of the Moon's disc, at times some features being discernible; and a cone-shaped form has been seen extending from the terminator to the limb of the Moon in the region of the equator. In winter observations distinct violet color was seen along the terminator, which although not reported by other observers in Canada or in the U.S.A. was noted by many observers in England.

THEORETICAL ASPECTS OF THE LUNAR METEOR

By: Kenneth Chalk, A.L.P.O. Lunar Meteor Search Recorder

(Paper read at the Tenth A.L.P.O. Convention at Montreal.)

For a number of years now the A.L.P.O. has sponsored a systematic program, the aim of which is to discover whether it is possible to observe a meteor on the moon. The method is simple: participants observe the unlit part of the moon simultaneously for three scheduled days each month, when the moon is still a crescent. Any flashes or trails seen against the moon's disc are reported to the Recorder. When these are compared later, it becomes obvious whether these flashes are terrestrial or lunar in origin. A terrestrial meteor at the center of the disc for one observer would be completely missed by another station more than 0.22 miles distant. A lunar meteor would be visible to all observers with large enough telescopes.

Telescopes ranging in size from 3 to 16 inches in aperture have been employed in this program; but although emphasis is placed on the importance of larger instruments, most of those currently in use in the search are only 6 - 8 inches in aperture. Observers scan the entire unlit part of the moon for faint, slow-moving points; and the fast, bright streaks that are obviously terrestrial are usually ignored.

The indirect aim of the Lunar Meteor Search is to discover the approximate extent of the very tenuous lunar atmosphere. This question is still in a very unsettled state, with the results of different observers varying by several orders of magnitude. A positive result of the Lunar Meteor Search might at least set a lower limit to the possible surface density of the lunar atmosphere.

The Lunar Atmosphere

Jeans has computed that if the r.m.s. speed of the gas molecules in an atmosphere is 1/5 the velocity of escape, then it will take several hundred million years for half the gas to escape. If the ratio is as much as 1/4, then half will escape in several thousand years; and if it is less than 1/6, then the gas will remain indefinitely.

Selected Gases Showing r.m.s. Speeds and Value of $\sqrt{\bar{v}^2}/v_E$ for the Moon

Gas	$\bar{v}$ (0°C.)	$\bar{v}$ (100°C.)	$\sqrt{\bar{v}^2}/v_E$
Nitrogen	0.49 kms./sec.	0.57kms./sec	1/4
Oxygen	0.46 " "	0.54 " "	1/5
Argon	0.41 " "	0.49 " "	1/5
Carbon Dioxide	0.39 " "	0.46 " "	1/5
Krypton	0.29 " "	0.34 " "	1/6
Xenon	0.21 " "	0.25 " "	1/9

We see that nitrogen, oxygen, and indeed all lighter gases will be absent from the lunar atmosphere, while its most probable constituents are krypton, xenon, and traces of argon and carbon dioxide.

Having established that some gases might be retained in an atmosphere around the moon, it is necessary to consider its possible density at ground level and in the regions where a meteor might be expected to become luminous. The results of different investigators lead to widely divergent results, and it is not the purpose of this paper to evaluate the reliability of these different values. A few experimental results show the range of possible conditions:

Pickering, by measuring the separations of double stars during lunar occultations, observed relative displacements of 0".2 to 0".4. These indicated a ground density of 1/8000, or 1.25×10^{-4}, that of our own atmosphere.

Fessenkoff, in 1943, claimed to have found no lunar atmosphere greater than 10^{-6} our own in ground density. He relied on polarization to identify light scattered by the lunar atmosphere.

Lipski, in 1949, claimed to have discovered an atmosphere with a ground density of 10^{-4} our own.

Dollfus, investigated possible lunar twilight with the 20-cm. coronagraph at Pic du Midi, and claims he would have detected the presence of any lunar atmosphere with a ground density greater than 10^{-9} our own.

It is necessary now to consider the densities or pressures likely to be encountered where lunar meteors would be expected to become luminous. In our own atmosphere, this layer occurs mainly between altitudes of 45 and 100 kms.

There is given below a relation which expresses the approximate variation of atmospheric pressure with altitude. By substituting the values shown for Earth and Moon, we obtain the graphs of log P vs. h shown in Figure 13.

Calculation of Graph: Log P vs. h

The following approximation was used to relate height in the atmosphere (h) with atmospheric pressure (P):

$$h = -\frac{R\,T}{M_0\,g} \log \frac{P}{P_0} \log e.$$

where h = height in kms.
R = 8.31 joule $mole^{-1}$ $deg.^{-1}$.
T = average Absolute temp.
M_0 = average molecular wt., gms.
g = acceleration of gravity.
P_0 = ground density of atmosphere.

Into this expression the following values were inserted. The graphs of Figure 13 were worked out from the relation below:

Earth E	Moon M
T = 288° K	T = 288° K
M_0 = 29 gms.	M_0 = 45 gms.
g = 981 cms./sec.^{2}	g = 163 cms./sec.^{2}
P_0 = 1 atm.	P_0 = various.

$$\text{Log } P - \text{Log } P_0 = \begin{matrix} E\ -5.129\ h. \\ M\ -1.323\ h. \end{matrix}$$

Here all ground densities considered, with the exception of the lowest, indicate that a meteor on the moon might flare into brilliance within altitudes similar to those observed on Earth. It is only for values in the neighborhood of those obtained by Dollfus that there is no part of the lunar atmosphere dense enough to cause a sufficiently bright fireball.

Brightness of a Lunar Meteor

Because of the great distance to the moon, a meteor occurring there would have to be much brighter than one in our own atmosphere in order to appear the same apparent magnitude. There follow the calculations to correct for the effect of distance. It is assumed here that an observer is unlikely to see a meteor trail fainter than apparent magnitude 4 in his telescope. Using a 6-inch, this means that a meteor fainter than about magnitude 11 is likely to be missed. This assumption allows a safety margin in the calculations.

Brightness Required for a Lunar Meteor to be Visible from the Earth

A six-inch telescope is taken as an example.
It is assumed that the average distance (d) of a terrestrial meteor is 50 miles. The distance (D) of a lunar meteor would be about 250,000 miles.

Then $\frac{D}{d} = 5 \times 10^3$, and $\left(\frac{D}{d}\right)^2 = 2.5 \times 10^7$.

The brightness of the lunar meteor must thus be 2.5×10^7 times that of a terrestrial one of the same apparent brightness.
The 6-inch telescope increases the apparent brightness by about 10^2 (5 magnitudes), and the required brightness factor is reduced to 2.5×10^5.

To express this factor as a number of magnitudes, n, we solve:

$$2.5 \times 10^5 = 2.5^n.$$

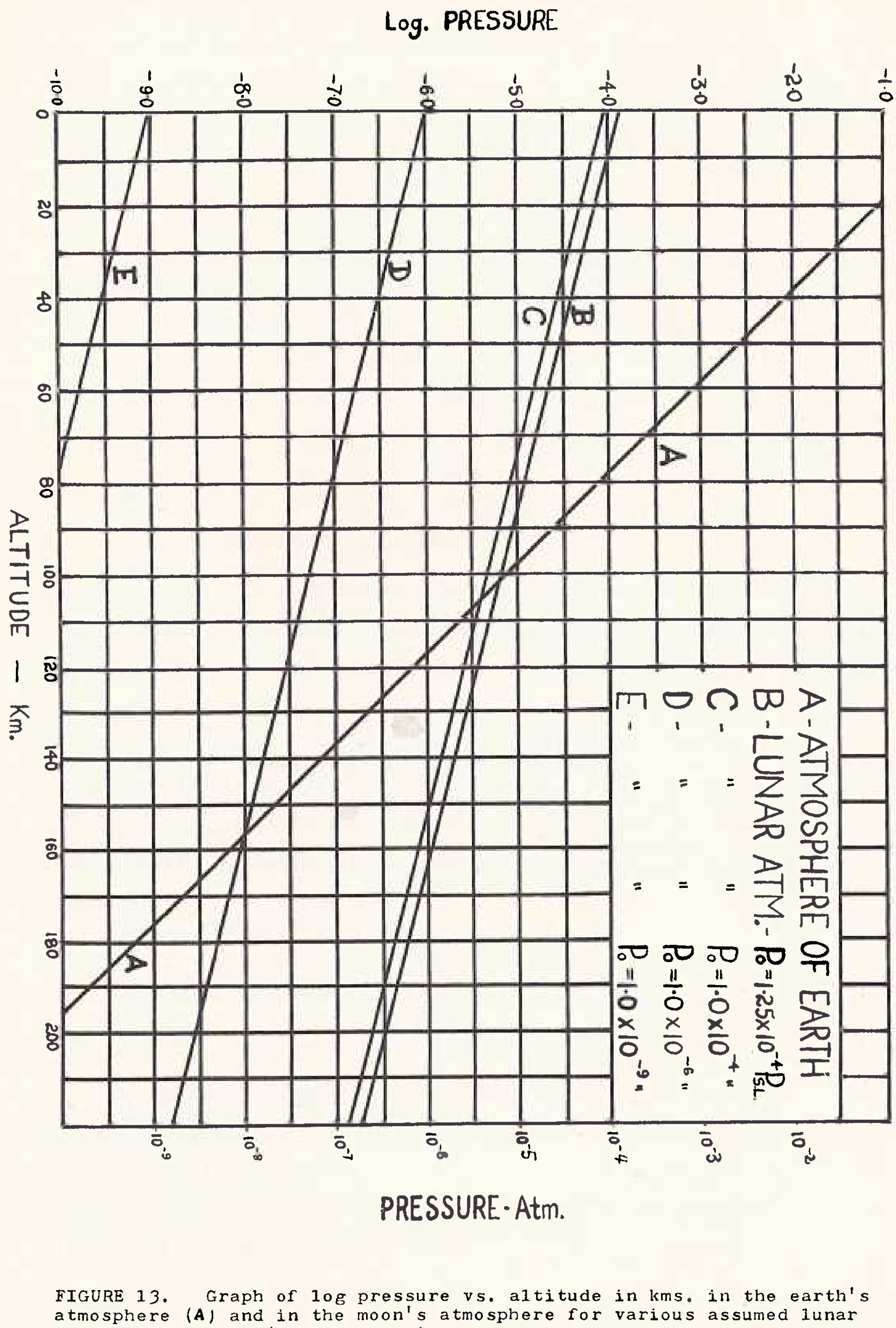

FIGURE 13. Graph of log pressure vs. altitude in kms. in the earth's atmosphere (A) and in the moon's atmosphere for various assumed lunar surface pressures (B,C,D, and E). The unit of pressure is the sea level pressure in the earth's atmosphere. Contributed by Kenneth Chalk. See page 21 for Mr. Chalk's development of mathematical relation between log pressure and altitude.

This becomes:

$$\log 2.5 + 5 = n \log 2.5. \text{ (Common logs.)}$$

Solving for n,

$$n = 13.6 \text{ magnitudes.}$$

Hence a meteor near the moon must be nearly 14 magnitudes brighter than a 4th mag. terrestrial one if it is to be reported, or it would have a magnitude of about - 9.6 at a distance of 50 miles.

It is not known exactly how often meteors of this brightness occur on the earth, but it has been estimated by Millman that nearly 27,000 meteorites reach the earth each year. Since in his tracking program observers are asked to report anything brighter than magnitude -2, it may be inferred that a meteor need not be mag. -10 before the meteorite can reach the ground, and so these probably form a small fraction even of those striking the earth's surface.

Now on the same basis, but considering the smaller diameter of the moon, and the fact that observations cannot at any one time be made of more than about 3/8 of the lunar surface, the number of annual lunar meteoritic impacts is only about 525. Observers in Montreal watch no more than 2 hours per month, on the average, or 24 hours each year. Hence the number of impacts during this time is only 1.4 per year on the average, and the number of sufficiently bright fireballs is much smaller.

In the four years from October, 1957, to September, 1961, members of the Montreal Centre of the Royal Astronomical Society of Canada observed on a total of 82 scheduled nights, during which time they reported 12 flashes. All these are unconfirmed. Owing to weather conditions, this does not represent 82 hours of observation, but perhaps 3/4 as much. Obviously, many of these flashes were of terrestrial origin. The lack of the lunar meteors which would be expected may be explained in a number of ways. First, the small number of -10 fireballs. Second, some of these flashes might have been confirmed had other large telescopes been in use at the time. A 6" might detect a flash which would be entirely missed by a 3". Often there was only one telescope on duty, so no confirmation was possible.

Figure 14 shows a selection of the trails that have been reported by observers during the past four years. The first is an example of the expected appearance of a lunar meteor trail as described by Öpik in Moore's Guide to the Moon. Other reports have shown phenomena including points of light, trails across the moon, and everything between. It is not impossible that some of the shorter trails may have been lunar meteors which were missed by other observers.

At any rate, the results to date of the A.L.P.O. Lunar Meteor Search in no way contradict the assumptions which make the sighting of one of these objects possible. The question of the lunar atmosphere and of the lunar meteor is still open.

Observers are cordially invited to write the Lunar Meteor Search Recorder and to participate in this program. Useful coordination of results requires adherence to a preset schedule. During the next few months this schedule is as follows: 1963, April 27, 28, and 29, 8:30 - 9:30 P.M.; May 26, 27, and 28, 9:00 - 10:00 P.M.; and June 25, 26, and 27, 9:00 - 10:00 P. M. All times here are Local Standard Times.

LUNAR-TYPE TERRESTRIAL VULCANOIDS

By: Patrick Moore, F.R.A.S.

(Paper read at the 1962 A.L.P.O. Convention at Montreal.)

The question of the origin of the lunar formations is still a matter

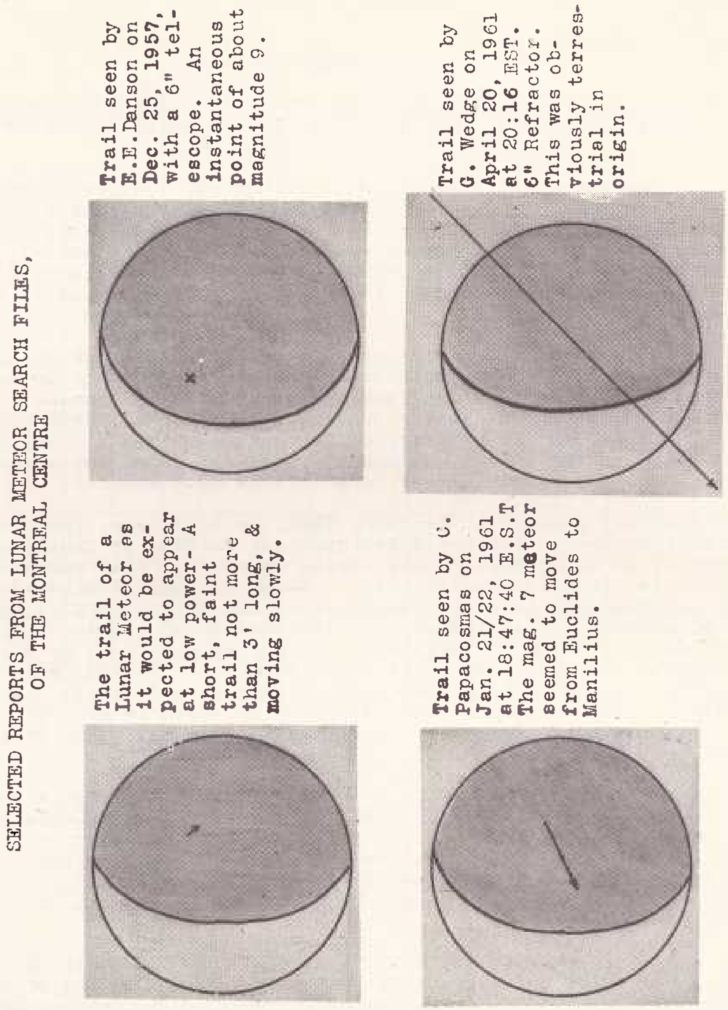

FIGURE 14. Theoretical lunar meteor trail and several sample objects recorded during Lunar Meteor Search observations by members of the Montreal Centre. Contributed by Kenneth Chalk. See also text of his article.

for debate, and the arguments between the supporters of the impact theory and of the igneous theory have aptly been termed the "Hundred Years' War". Of course, it is clear that there must be both impact and volcanic craters, and the main point at issue is whether the really large formations - such as Ptolemaeus - were produced by bombardment or not. I believe not; but I think I am in something of a minority these days.

More than a decade ago an important and most interesting book was written by R. B. Baldwin. Its title was The Face of the Moon; no doubt it is familiar to nearly all members of the A.L.P.O. In this book, Baldwin dealt with terrestrial meteorite craters, and maintained that the depth-diameter ratios of meteorite craters, bomb craters, and lunar craters are closely linked, so that when they are plotted a smooth graph is the result. The conclusion drawn was that this result is an important piece of evidence in favor of an impact origin. Behrmann has since questioned some of the figures, and my own measures of crater depths indicate that the correlations are not so perfect as might be thought - but it is certainly true that the discrepancies are not very great, and that it is possible to produce artificial craters which bear an outward similarity to lunar forms. I maintain, however, that this proves nothing at all, if only because there are certain volcanic formations on Earth which fit even better into the graphs.

Several significant features have been described in the Adrar Mauritanien region of French West Africa, in the neighborhood of Richat. They take two well-defined forms: (1) single-walled, craterlike despressions, with diameters ranging from 500 to 1500 meters; (2) large, circular-shaped areas, up to 50 kms. in diameter, in which a concentric disposition of alternating ridges and valleys is evident. Of the five main features, Temimichat-Ghallaman, Ténoumer, and Richat itself are aligned, with the Dôme des Semisyât near Richat, and Guelb-Aouelloul not far off. They are described by T. L. Monod in the Bulletin de la Direction des Mines, 1952. They are undoubtedly volcanic, and the almost circular shapes suggest that the arching of the originally horizontal strata was caused by a laccolithic intrusion of molten igneous material - in the way that I have suggested for lunar forms. Judging from the photographs, the Richat craters look much more "lunar" than, say, the Arizona Meteorite Crater; and the depth-diameter ratios fit in excellently.

I have not seen these features myself, but I have been to an equally interesting group - near Reykjahlið in the Lake Mývatn area of Iceland. I went there in the summer of 1960, and spent some time in examining the fascinating and spectacular formations Hverfjall and Lúdent. My measures may not be precise, but I do not think that they are far out, and they agree with the values given by the eminent Icelandic geologist Sigurður Thorarinsson.

Hverfjall is a striking feature. It is virtually circular; the distance across the wall-crest is 0.78 miles according to my rather rough measures, while one wall attains 200 feet, and the other 300 feet. The spectacular central peak is about 80 feet high. Both the interior and exterior slopes are gentle, so that the climb is an easy one - in fact it amounts to nothing more than hard walking. Our "expedition" consisted of two, myself and my cousin Brian Gulley (who is not an astronomer in any sense of the word, but who helped me greatly with the measures); and it took us only a few hours to reach the crest, starting from Reykjahlið. The photograph given here (Figure 15) was taken from the crest of the northern wall.

Lúdent, which is visible from the wall of Hverfjall, is smaller, and has no central peak; but is interesting because of the various associated craters. It has walls about 150 feet high and a diameter of about half a mile; the shape is regular except for the intrusion of a large crater, Lúdent A, which has a similar depth-diameter ratio. Also similar is a third feature, Hraunbunga.

Of course it would be wrong to suggest that these Icelandic volcanoes are entirely similar to lunar forms; in particular the floors are not depressed below the outer level (at least, not to any appreciable extent). Yet the obvious resemblance is there, and nobody who has been to the region can fail to be struck by it. When we go back to Iceland, sometime during 1962, I hope to make some more exact studies.

It seems, then, that the graphs linking impact craters, bomb craters,

FIGURE 15. Photograph of the volcanic crater Hverfjall in Iceland. Mr. Brian Gulley in foreground. Photograph taken by Patrick Moore in summer of 1960. See also text of Mr. Moore's paper in this issue.

and lunar craters are in no way conclusive with regard to the origin of the Moon's surface features; and I have no doubt that it would be possible to make artificial "igneous" craters which are just as lunar-looking as the impact ones. Meanwhile, it appears that some of the lunar craters are definitely not of meteoritic origin; these are the small chains of the Hyginus type. On the other hand it is only logical to suppose that impact pits are quite common, so that both processes of formation have applied. There are features on the Moon which look remarkably like true terrestrial-type volcanoes, but these also are small, and the large craters are clearly different. My own view is that the forms and the distribution indicate an origin which was neither cataclysmic nor violently explosive, and that a milder uplift-and-subsidence process is much more likely; but a final solution will probably not be obtained until samples of the lunar crust become available for analysis in the laboratory.

DIMENSIONS OF THE LINNÉ CRATERLET

By: Joseph Ashbrook

1. The observations reported in this note refer to the craterlet (about 1.2 kms. in diameter) that is located within the Linné white patch, in selenographic longitude +11°.80, latitude +27°.73. In this discussion, we use the terms east and west in the ordinary selenographic sense (i.e., Linné is east of Bessel and west of Archimedes).

2. Just after sunrise on Linné, there is an interval of an hour or two when the east rim casts a prominent exterior shadow. There is a corresponding brief interval just before sunset when the west rim throws a prominent shadow. The long black spire of sunrise shadow can be seen in a telescope as small as a 4½-inch refractor, according to R. M. Baum[1]. In the older literature, the eminence causing the shadow is sometimes called a hill, mound, or cone; but it is actually the raised rim of the craterlet.

With a 10-inch reflector at 200X, I have observed the east wall exterior shadow on February 4, 1960, and on May 11, 1962, and that of the west wall on July 23, 1962. On each occasion, I made repeated estimates of the shadow length, in order to find wall heights by the method I explained at the 1962 ALPO Convention in Montreal.[2]

3. The details of these observations may be seen in Table 1. There *f* is the estimated shadow length, expressed as a fraction of the

unforeshortened diameter of Bessel (assumed to be 16.1 kilometers); A is the solar altitude above the horizon of Linné; and H is the exterior height of the craterlet rim, in meters.

Table 1. Outer Wall Heights of Linné

U.T.		f	A	H
1960, Feb.	3.996	0.6	0°75	100 meters
	4.002	.5	0.83	101
	4.010	.3	0.91	70
	4.044	.3:	1.19	94
1962, May	11.009	.7	0.79	119
	11.010	.6	0.80	108
	11.012	.6	0.82	112
	11.015	.5	0.85	110
	11.017	.4	0.87	86
	11.022	.4	0.93	93
	11.024	.5	0.95	115
	11.025	.4	0.96	96
	11.026	.3	0.97	75
	11.031	.3	1.02	80
	11.033	.35	1.06	95
	11.037	.3	1.09	85
	11.049	.28	1.23	85
1962,July	23.357	.5*	1.94	65
	23.359	.7*	1.92	89
	23.362	.7*	1.89	88
	23.363	.8*	1.87	99
	23.365	.9*	1.86	107

In several cases, marked by * in Table 1, the unit of estimated shadow length was the diameter of Aratus C, which according to Arthur[3] is 0.0022 times the lunar radius.

Taking averages and mean errors for each night of observation, we have:

1960, Feb. 4, East wall: H = 91 ± 7 meters (4 observations).
1962, May 11, East wall: H = 96 ± 4 meters (13 observations).
1962,July 23, West wall: H = 90 ± 7 meters (5 observations).

4. From my observations, it appears that the rim of the Linné craterlet rises about 94 meters above the surrounding plain, and that there is little difference between the east and west rims. There are three other determinations, none of a very satisfactory character, that may be compared with my result:

a. J.F.J. Schmidt's crude[4] estimates of 1866-68 average about 90 meters for the east rim height.

b. W. R. Birt[5] measured a few early sketches by Huggins, Noble, and Tacchini, deducing 81 meters for the east rim, 150 for the west. This result deserves little weight, because of the large uncertainty of shadow lengths in drawings not made especially for the purpose of height evaluation.

c. W. H. Pickering estimated the extent of the exterior shadow with the Harvard 15-inch refractor on two nights in 1897, when the sun had risen on Linné about seven hours and four hours before respectively. Pickering's result[6] of "rather over 40 meters" is probably too small, because he observed too late after sunrise, and so saw a very short shadow that presumably ended on the lower slopes rather than on the surrounding plain.

5. We next consider the more difficult problem of the interior depth

of the Linné craterlet. On May 13, 1962, with the 10-inch reflector at 210X, I managed to make six estimates of the east-west length of the interior shadow cast by the west wall. The comparison craters were Linné A and Linné E, whose diameters Arthur[3] gives as 0.0024 and 0.0033 lunar radii, respectively. The average of these comparisons gave the shadow length as 0.00088 lunar radii at 1962, May 13.016, when the sun's altitude as seen from Linné was 22°.2. The depth of the crater comes out at 602 meters. This value is quite uncertain, because of the difficulty in judging the size of the tiny shadow inside the bright patch. There appears to be no previous published determination.

6. Several types of further observations are suggested by this beginning:

a. More estimates of exterior shadow lengths are desirable, particularly at evening illumination. I was surprised to find my few west wall observations to give practically the same results as for the east wall, as some Linné observers have reported a qualitative impression that the west wall is loftier than the other.

b. Observers with large telescopes are invited to make quantitative estimates of the interior shadow. Statements that on such a time on such a date, the east-west diameter of the craterlet was 0.7 in shadow are of great value.

c. Watch Linné carefully as the terminator crosses it. At sunrise, time when the first speck of light becomes visible as sunlight touches the rim. At sunset, it is easier to determine the moment when the last trace of illuminated craterlet rim blacks out. With larger amateur telescopes, these times should be determinate to perhaps two or three minutes. From such observations, the rim height can be very simply calculated by John Westfall's formulae.[7]

d. There are many formations very similar to Linné that have received far less observational attention. For example, Posidonius Gamma and Lassell D are likewise large bright spots with small, deep, nearly central craterlets. All of the techniques mentioned in this note can be applied to them also.

7. Conclusions. The craterlet inside the Linné bright spot has been found to have walls 94 meters higher than the surrounding plain, and to be (with much uncertainty) 602 meters deep. Its diameter is approximately 1.2 kilometers. Observations of this craterlet and of those in other lunar bright spots are important for extending the empirical diameter-depth and diameter-height relationships to smaller objects.

References

1) R. M. Baum, Strolling Astronomer, 10, 93-94, 1956.
2) J. Ashbrook, Strolling Astronomer, 16, 214-216, 1962.
3) D. W. G. Arthur, Communications of the Lunar and Planetary Laboratory, 1, No. 11, 1962.
4) J. Ashbrook, in a discussion of Schmidt's Linné observations, now being prepared for publication.
5) W. R. Birt, Monthly Notices of the Royal Astronomical Society, 29, 63-68, 1869.
6) W. H. Pickering, Harvard Annals, 32, Pt. 2, 201, 1900.
7) J. E. Westfall, Strolling Astronomer, 10, 127, 1956.

Note by Editor. A.L.P.O. lunar observers are very strongly urged to follow up the important suggestions for useful lunar investigations made in Dr. Ashbrook's paper. As is often true, the possessors of the larger telescopes, say 10 inches in aperture and more, will have the greater opportunities. The observations made should be mailed to Lunar Recorder John E. Westfall, 3104 Varnum St., Mount Rainier, Maryland. The Editor will undertake to forward any observations which are sent to him.

Table I. Simultaneous Observation Program,

Schedule: April 1963 - June 1963.

Date	Planet	Observing Period	Project and Notes	
5 Apr.	Mars	02:30 - 03:30 U.T.	Standard.	D at 03:00.
5 Apr.	Mars	05:30 - 06:30 U.T.	Standard.	D at 06:00.
6 Apr.	Mars	03:30 - 04:30 U.T.	Standard.	D at 04:00.
6 Apr.	Uranus	04:45 - 05:30 U.T.	D; I; C.	D at 05:15.
6 Apr.	Mars	07:30 - 08:30 U.T.	Standard.	D at 08:00.
13 Apr.	Mars	03:30 - 05:00 U.T.	Standard.	D at 04:30.
17 Apr.	Mercury	P.M. - Sunset L.T.	Special.	Local Times.
19 Apr.	Mercury	P.M. - Sunset L.T.	Special.	
20 Apr.	Mercury	P.M. - Sunset L.T.	Special.	
21 Apr.	Mercury	P.M. - Sunset L.T.	Special.	
23 Apr.	Mercury	P.M. - Sunset L.T.	Special.	
25 Apr.	Mercury	P.M. - Sunset L.T.	Special.	
26 Apr.	Mercury	P.M. - Sunset L.T.	Special.	
27 Apr.	Mercury	P.M. - Sunset L.T.	Special.	
29 Apr.	Mercury	P.M. - Sunset L.T.	Special.	
1 May	Mercury	P.M. - Sunset L.T.	Special.	
19 May	Saturn	08:00 - 09:00 U.T.	Standard.	D at 08:30.
1 Jun.	Saturn	07:30 - 08:30 U.T.	Standard.	D at 08:00.
8 Jun.	Saturn	07:30 - 08:45 U.T.	Standard.	D at 08:15.
8 Jun.	Jupiter	09:00 - 10:00 U.T.	Standard.	D at 09:30; S at 09:38, 09:45.
15 Jun.	Jupiter	09:15 - 10:45 U.T.	Standard.	D at 09:30, 10:30; S at 09:20, 09:53, 10:00, 10:37.
15 Jun.	Mercury	Sunrise - A.M. L.T.	Special.	Local Times.
16 Jun.	Mercury	Sunrise - A.M. L.T.	Special.	
18 Jun.	Mercury	Sunrise - A.M. L.T.	Special.	
19 Jun.	Mercury	Sunrise - A.M. L.T.	Special.	
20 Jun.	Mercury	Sunrise - A.M. L.T.	Special.	
22 Jun.	Mercury	Sunrise - A.M. L.T.	Special.	
22 Jun.	Saturn	08:00 - 09:00 U.T.	Standard.	D at 08:30.
23 Jun.	Saturn	06:00 - 07:45 U.T.	Standard.	D at 07:00.
23 Jun.	Jupiter	08:00 - 09:00 U.T.	Standard.	D at 08:30; S at 08:25.
30 Jun.	Saturn	06:00 - 10:00 U.T.	Standard.	D at 06:30, 08:00, 09:30.

[Some of the selected target dates, we fear, will already be past when this issue reaches our readers. It is obviously important to begin intensive participation in Mr. Giffen's program as described above as soon as possible. The results may well prove to be extremely informative and rewarding. - Editor.]

A NOTE ON THE DARWIN DOME AS SEEN IN SMALL AND LARGE APERTURES

By: José Olivarez

The Darwin dome, besides being one of the largest domes on the lunar surface, is one of the most rugged and spectacular domes. The dome's position near the eastern limb of the moon does not deprive it of notice by the casual observer. Yet, it certainly doesn't seem that anybody has bothered to take a close look at the dome lately. Therefore, it is the purpose of the author to give an account of his recent observation of the dome with a 12½" reflector (see Figure 16).

The Darwin dome is transversed by a rill. A second and probably more elusive rill was discovered by H. P. Wilkins in 1924. The second, more elusive rill was not seen by the author on this occasion, possibly due to the blending of the rill with the other profuse detail.

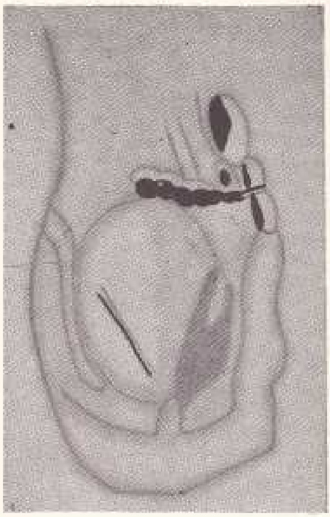

FIGURE 16. Dome in North Part of Lunar Crater Darwin and Environs. Drawing by José Olivarez. 12.5-inch reflector, 235X. June 16, 1962, $3^h 10^m$, U.T. Seeing 4. Transparency 5. Colongitude = 71°1. Lunar south at top, lunar west (in classical selenographic sense) at left.

The dome was certainly not dome-like in the 12½-inch reflector, but instead was a mound of crinkled-like detail. Some of the minute peaks (of which there were many) were seen to project through the lightly shadowed eastern side of the dome. One might say that the dome is a "heap of peaks". Perhaps the best description of the dome was given by R.Barker when observing it with a 12½-inch reflector. He called it a "cindery heap with bristled roughness". This is very true. The dome does not look so rough as it appears through a 12½-inch in a 2.4-or 3-inch refractor. The dome appears rather nicely smooth and of a smaller dimension with small apertures. The dome's dimension appears to increase with larger apertures. This was suspected by the author when he noticed that the dome was of a considerable size in the 12½", while smaller when seen through the same reflector's 3¼" finder-guide refractor. The result is possibly due to the more delicate gently falling and spreading slope of the dome that becomes clearly visible in larger apertures only.

The craterlet chain on the southern side of the dome is certainly most striking. The craterlets get smaller as one goes eastward until the chain becomes a cleft. On the western side of the dome is the rugged wall of Darwin. The rugged peaks from this wall cast beautiful steeple-like shadows over the western edge of the dome.

The observations which the author has just described were made under fair seeing conditions with a good reflector at a very favorable time. The dome was just on the terminator at the time of observations. Interested observers should seek such a favorable condition and observe the dome. They will be well compensated for their trouble (joyous venture?).

Very little has been said in literature generally available to the amateur about the Darwin dome's roughness. It certainly merits observation in both small and large apertures.

CONCERNING THE USAGE OF EAST AND WEST ON THE MOON

For many years in the past it was universal usage to apply the terms east and west to the moon as the same directions in the earth's sky. Thus with the moon near the meridian in middle northern latitudes, a simply inverting telescope showed west at the left and east at the right. (The diurnal drift in this position of the moon is to the left.) One could also identify the lunar western hemisphere as that of Mare Crisium and the eastern hemisphere as that of Mare Humorum. It did follow, however, that for an observer on the lunar surface, the sun rose in the west and set in the east.

In 1961 the International Astronomical Union passed a resolution to reverse this usage of east and west on the moon. The new system is thus inconsistent with almost all of the large body of lunar literature. It is followed on the new A.C.I.C. Lunar Charts, as many A.L.P.O. members already know. The sun will now, of course, cross the lunar sky in the familiar way from east to west for future astronauts.

On pg. 259 of the November-December, 1962 Str. A. the Editor invited comments on the question of how we should use east and west on the moon in the A.L.P.O. Three colleagues have replied at some length.

On February 11, 1963, Joseph Ashbrook wrote:

"Our main concern is to avoid confusion. Hence I propose that we avoid the astronautical usage as far as possible; any merits it may have are entirely outweighed by the ambiguity it has for the practical telescopic observer.

"For clarity, authors of ALPO papers about the moon should specify in each article whether they are using the familiar selenographic convention (Oceanus Procellarum east of the central meridian, Mare Crisium west of it).

"A convenient way of making this clear might be to specify as 'selenographic' the first place in an article where the term east or west is used. For example: 'I observed the rilles west (selenographic) of Triesnecker . . . .' Or the author might prefer to say explicitly, 'The terms east and west are used in their selenographic rather than astronautical sense in this paper.' The main thing is for no ambiguity to come in.

"My personal feeling is that the IAU adoption of the astronautic convention was very ill-advised, and that practical observers should not follow it."

Dr. Ashbrook remarks that Mr. Charles Federer, the Editor of Sky and Telescope, and Mr. Leif Robinson are in agreement with the point of view described above. He stresses the certainty of confusion and needless misinterpretation of the immense body of descriptive selenographic literature which a change must cause.

David P. Barcroft, the A.L.P.O. Secretary, is also opposed to the new usage. He emphasizes: "We are an association of observers; and we are not astronauts." He wonders how stable the new usage yet is, pointing out that in some modern lunar research north and south are also being reversed. He feels that the confusion which a change would produce far outweighs any advantages for earthbound observers primarily concerned with aspects in our telescopes.

However, the Reverend Kenneth J. Delano of Taunton, Massachusetts is strongly in favor of following the I.A.U. resolution. He feels that we would do very well to adopt an A.L.P.O. resolution in 1963, endorsing the new usage. He points out that ambiguity can be avoided by employing the terms preceding and following, where following is the direction of increasing longitude as determined by the rotation of the moon. (Thus following would be east in the old sense.) The Editor has long favored this use of preceding and following on the rapidly rotating planets Mars, Jupiter, and Saturn. However, is the ordinary lunar observer sufficiently conscious of the moon's slow rotation to permit successful application to our satellite?

We would welcome further constructive comments from A.L.P.O. readers, for we intend to make a decision soon. Once the choice is made, all our members will be expected to adhere to the system chosen. It will also certainly be necessary for some time to make clear in all published uses of lunar east and west in Str. A. just how the writer is employing these directions. Changes always create some confusion, and one must evaluate the advantages and the drawbacks of a new usage before adopting it.

New Address for Elmer Reese. Our Assistant Jupiter Recorder has left Uniontown and is at present employed at Temple, Texas. He requests correspondents to use as his temporary address:

Elmer J. Reese
c/o Philip R. Glaser
200 Albert St.
Waukesha, Wisconsin.

Error in November-December, 1962 Issue. Mr. H. M. Hurlburt directs attention to an error in his article in our last issue. On pg. 258, under "Satellites of Saturn", i = 9 (Phoebe), the percentage deviation in the last but one column to the right should be 0.6%, not 6.2%. The error occurred in the manuscript submitted for publication.

Addendum to "Lunar Crater Terracing - A Preliminary Report." Mr. Francis J. Manasek in a letter dated February 17, 1963 requests that the following addition be made to his paper on pp. 245-246 of the November-December, 1962 Strolling Astronomer: "Recent observations (F. J. Manasek, 'Polygonal Crater Distribution', J.B.A.A., in print) of a large number of craters with diameters less than 20 kms. indicate that both polygonal and round (including oval and elliptical) craters are found in all diameter groups but that the percentage of polygonal craters in a given diameter group is proportional to the diameter. In other words, craters of small sizes are less likely to be polygonal than are those of larger diameter. All craters with diameters greater than 20 kms. which were observed had polygonal outlines."

A.L.P.O. Lunar Section Mapping Program. We have received the following invitation to a lunar mapping study from Mr. John E. Westfall, an A.L.P.O. Lunar Recorder:

"The A.L.P.O. Lunar Section currently has available mimeographed outline charts of the Aristarchus-Herodotus region. Interested observers may obtain them through Patrick S. McIntosh, Sacramento Peak Observatory, Sunspot, New Mexico.

"These charts are intended for use at the telescope. Details should be drawn in their correct positions relative to the outlines printed on the map, but observers should not hesitate to correct these outlines if they feel them to be incorrect. The completed sketches, with pertinent information added, should be returned to Mr. McIntosh for evaluation and analysis, in connection with the lunar mapping program outlined in 'Prospects for the A.L.P.O. Lunar Section' in the November-December, 1962 issue of The Strolling Astronomer."

Figure 17 shows the outline chart to be employed in the project just described. The original, but not this published reproduction, is on a scale of 1:500,000. Mr. Westfall transferred detail from the Kuiper Photographic Lunar Atlas to acetate overlays on the scale chosen. He used for this purpose an "Areotopograph", an instrument which normally employs a beam splitter to transfer oblique aerial photographs onto map sheets. Figure 17 is on an orthographic projection.

The Editor strongly urges all interested members to work on this project under the supervision of Mr. McIntosh.

OBSERVATIONS AND COMMENTS

An Open Letter from the Editor. We receive frequent complaints from members about the failure of Recorders to acknowledge quickly observations and correspondence. It would assuredly be ideal if all staff members, and the Editor most of all, were such model correspondents. It may be, however, that the *modus operandi* of the A.L.P.O. is not suffi-

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

ARISTARCHUS-HERODOTUS, 1:500,000

OBSERVER........................ DATE .... TIME........(U.T.)
INSTRUMENT............ MAG.......... S...(0 to 10) T...(0 to 5) COLONG.........

NOTES (Continue on Back if Necessary):

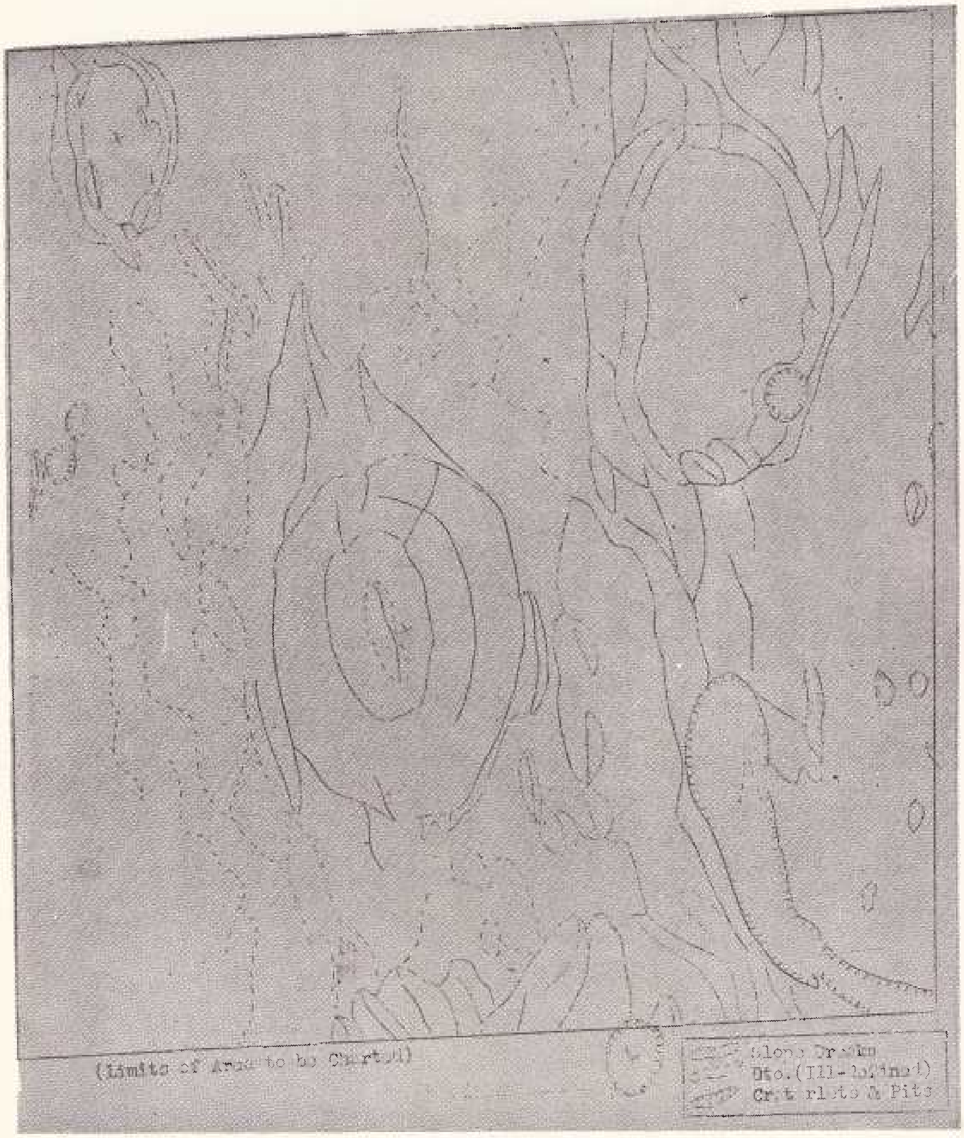

FIGURE 17. Chart of Aristarchus-Herodotus Region on Moon for A.L.P.O. Mapping Project. See also text on pg. 40.

ciently known to some of our members.

Ours is a volunteer Association. The Recorders are not paid. They give of their own time and, with very few exceptions, of their own money in performing the services which they perform. The Recorders pay for their own memberships like everyone else, and few or none of them would be willing to have it otherwise. Surely, however, a Recorder under these conditions can be forgiven for not rushing to spend postage on letters asking questions answered in elementary books, in acknowledging routine observations sometimes of mediocre quality and sometimes not free from careless mistakes, and in responding to requests for "everything free about astronomy". The political and philosophical climate of the times perhaps encourages us to ask for everything and to offer nothing in return. There is none-the-less much merit in the old-fashioned courtesy of a stamped, self-addressed envelope when one is asking a Recorder for assistance or information. The financial resources of the A.L.P.O. have always been very modest. The recent increases in postal rates, the expense of annual Conventions, and generally rising costs now multiply the budget problems.

It is the efforts of the Recorders that have enabled the A.L.P.O. to accomplish whatever it has to date achieved. Without their help *The Strolling Astronomer* would be very much smaller in number of pages and very much poorer in content. These men are very worthy of your full support. They do and will appreciate your patience and your help in enabling them to do a good job with your observations and other contributions.

Flamsteed, Milichius, Jansen, Arago Domes, and Longomontanus. The lunar drawings on the front cover and on pages 43 and 44 are here chiefly presented without editorial comment. The lunar observers among our readers will see much of interest in them, and some will wish to look for details shown at the telescope and also on high-quality photographs.

Mr. Harry Jamieson's observation of the two domes near Arago (Figure 20) is here reported briefly. The estimated diameter of Arago 1 (east of Arago in selenographic sense) was similar to that of Manners, thus 16.5 - 17.0 kms.; Arago 2 (north of Arago) was larger, about 21.5 - 22.0 kms. in diameter. The shadows of the two domes were about the same size. No central pit could be seen in either dome. Mr. Jamieson remarked a valley or depression running from the center to the southeast edge of Arago 2 and an unidentified object on the southwest corner of Arago 1.

A Professional Request for Amateur Lunar Observations. The rise of the Space Age has necessarily obliged us to reëxamine the traditional methods of amateur lunar and planetary astronomy. Since the moon is the presumed first target of Man's direct exploration of space, a tremendous amount of current professional scientific research is being done on a body long neglected by professional astronomers. It is thus not strange that some writers in this magazine should feel some doubts about the usefulness of further amateur lunar studies. In this setting the following letter from Mr. William D. Cannell, Chief of the Lunar Observation Section, Lowell Observatory, Flagstaff, Arizona is worth our very careful attention and thought. The letter was written to the Editor on January 11, 1963:

> "1. We have been very pleased to read the many complimentary remarks by ALPO writers in the *Strolling Astronomer* concerning the USAF lunar charts published by the Aeronautical Chart and Information Center in St. Louis, Missouri. However, we are concerned about a tone of discouragement expressed by some of the writers because they feel they are competing with professionals using very large instruments.
>
> "2. The amateur may find it difficult to compete, but surely not difficult to contribute, as he has so well done in the past. The high quality of the USAF lunar charts is due in part to work of the amateur astronomers. The ACIC observers at Lowell Observatory continuously consult the writings of the amateurs to insure that features previously

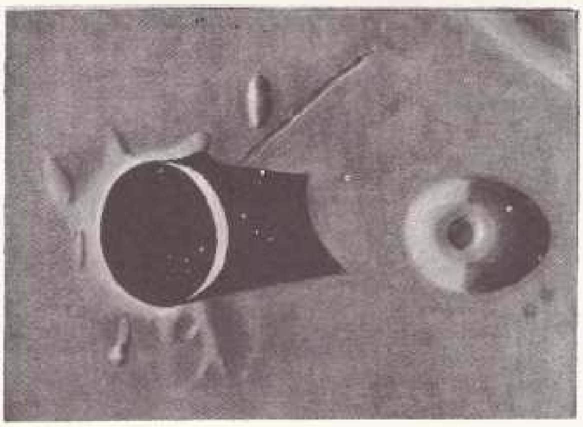

FIGURE 18. Lunar Crater Milichius and Dome to east (selenographic sense). Drawing by Alika K. Herring. April 15,1962, 3^h 15^m, U.T. 12.5-inch refl., 278X. S=4-5. T=4. Colong. = 34°.1.

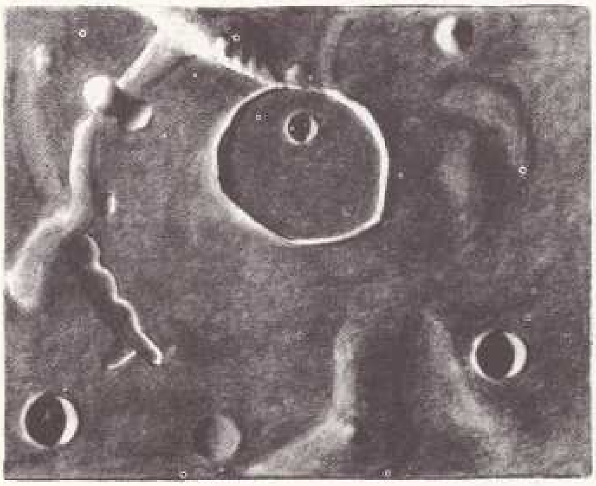

FIGURE 19. Lunar Crater Jansen and vicinity. Drawing by Alika K. Herring. April 11, 1962. 4^h 30^m, U.T. 12.5-inch refl., 278X. S=3-4. T=5. Colong. = 346°.0.

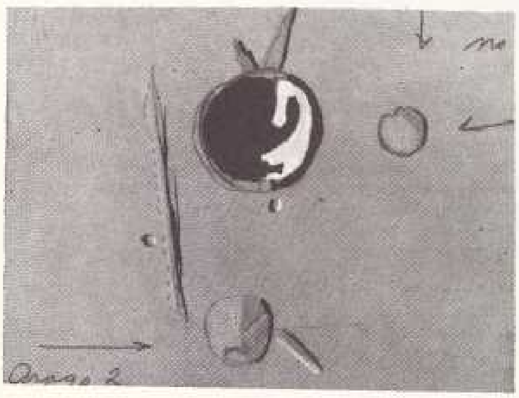

FIGURE 20. Lunar Crater Arago and Domes to its east (selenographic sense) and north. Drawing by Harry Jamieson. May 21, 1961. 3^h, U.T. 10-inch refl. 222X. S= 6-4 (Tombaugh-Smith Scale). T=5. Colong. = 343°.8. The observer gave chief attention to the two domes.

observed by them are not overlooked. This is an important contribution by the amateurs, since it causes the ACIC observer to observe more thoroughly than he might if he were 'starting from scratch'.

"3. We would like to see more lunar observations by the amateurs published; and, in fact, it would be interesting if they would keep up with us in our program or work ahead so that a genuine contribution could be realized. Perhaps it would be possible for some amateurs to check the published charts and find additional features or corrections, which we would appreciate hearing about. The charts do carry a note to the user which encourages him to make corrections and additions and send them to the attention of ACIC in St. Louis, Missouri. A replacement copy will be returned to those who send in such corrections or additions marked on a sheet.

"4. Eventually, mapping of the moon will surely be done from close-up photography obtained by lunar orbiters. That time will mark the end of our present method of mapping through use of the telescope. Still, there are several years remaining for us to continue our present method to map the visible disk; and it is our hope that amateur astronomers will continue their very helpful observations as they have in the past."

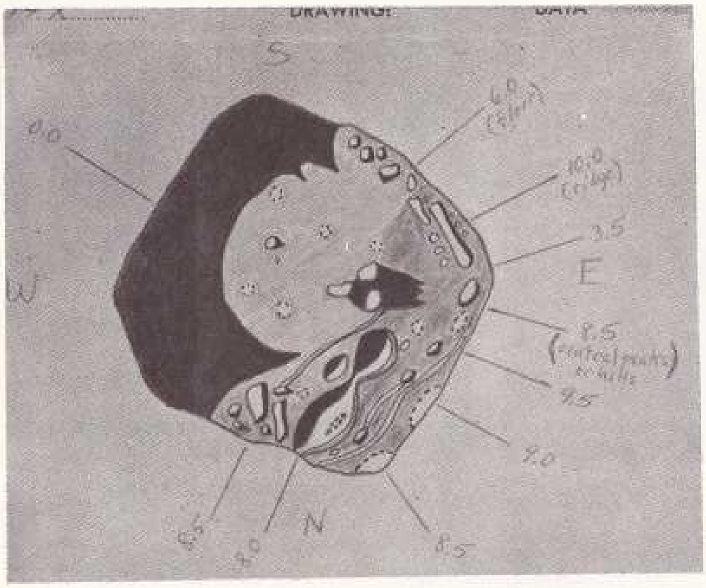

FIGURE 21. Lunar Crater Longomontanus. Drawing by Phillip W. Budine. December 10, 1959. 1^h 50^m, U.T. 4-inch refr. 214X. S = 6. T = 3. Colong. = 28°.6

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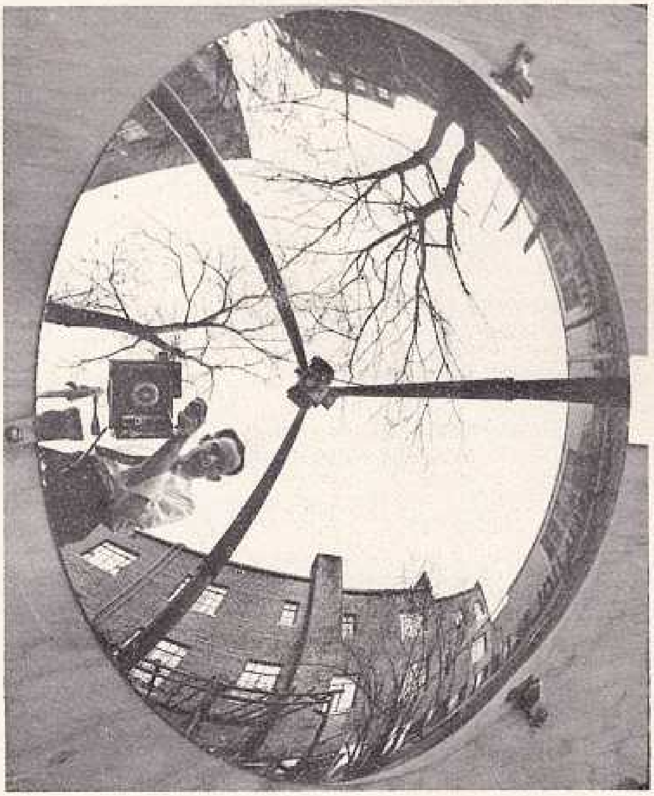

All-sky camera constructed by Mr. Charles Cuevas, New York City, for observations during total solar eclipse on July 20, 1963. Apparatus consists of a 12-inch condensing lens aluminized on convex surface, over which is mounted a Kine Exacta Camera. Camera will be used to photograph moon's shadow projected against earth's atmosphere. Photograph taken by Charles Cuevas, seen in camera view of sky; contributed by William H. Glenn. See article on pages 55-59 of this issue.

THE STROLLING ASTRONOMER

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ASSOCIATION OF LUNAR & PLANETARY OBSERVERS

IN THIS ISSUE

THE ART OF LUNAR DRAWING

By: Clark R. Chapman, A.L.P.O. Lunar Recorder

Introduction. Amateur astronomers have made many thousands of drawings of lunar features, done in all sizes, by all methods, and with varying degrees of success. Sometimes the drawings bear some likeness to the actual lunar features, but more often they do not. In any case, the drawings are mailed in to the lunar recorders and coordinators of various astronomical organizations, including the A.L.P.O. They also are submitted for publication in various popular journals, and they are mailed to professional selenographers. Nearly all of them eventually end up within a dusty folder of worthless material, never to be seen, published, or analysed. A few drawings are occasionally used as filler material in a magazine or as illustrations in descriptive books about the moon. Whenever some optimistic enthusiast attempts to do a scientific evaluation of the drawings, he soon discovers that it is a hopeless task, unless he uses only the works of a very few select observers. Most drawings are so exceedingly inaccurate that absolutely nothing useful can be learned from them.

For these reasons, most selenographers regard lunar drawings as scientifically worthless. With the publication of the Kuiper *Photographic Lunar Atlas* and the even more outstanding photographs taken recently with the Lick 120-inch reflector, drawings seem even more worthless. The latest photographs show with *complete objectivity* detail well below the resolving power of any amateur telescope so that even if a drawing were to be completely accurate, it would still be inferior to the photographs.

Until recently there were a few areas of study where careful and systematic studies by drawings would have been useful, principally because of the lack of professional interest in the moon and because of the relative dearth of top-quality photographs throughout all solar lightings and lunar librations. The need for these studies (including cartography of limb regions, depiction of low *maria* features near the terminator, and studies of very low contrast tonal shadings) is now rapidly disappearing.

There are a number of amateurs who are attempting to work in these few remaining areas of study who could greatly improve their results if their drawings were more accurate. For a few years, at least, there will also be a demand for accurate and realistic drawings of lunar features to serve as illustrations in popular journals. Also, the amateur who just wishes to make a drawing for the fun of it would probably be happier if his drawing were a good representation. Finally, making drawings of lunar features serves as very good training for the beginning lunar observer. Nothing is better than making systematic drawings for a beginning observer to become famaliar with the lunar surface and with the important interpretational problems.

Methods of drawing. Drawings fall into various broad categories depending upon their purposes. Some of the more common types of drawings are the line drawing, the notational sketch, and the artistic drawing. The line drawing is done with either pencil or ink and records topographical features only (hills, craterlets, or streaks but not shadows or tonal differences) by means of various solid and broken lines. The notational sketch is best characterized as an inartistic or incomplete sketch supplemented profusely with written notes and numbers on the face of the sketch. These two methods, along with other types (such as drawing on photographs as done by Krieger), are all subject in more limited ways to the pitfalls encountered by observers using the most familiar method, the artistic drawing, which I will discuss in detail.

Artistic drawings attempt to show accurately and realistically lunar features exactly as they appear. The principal purpose is to make a "photographic" drawing: a drawing that shows everything the way a photograph would but makes use of the eye's greater resolving power, contrast perception, and (to a limited extent) interpretational ability. These drawings are generally done in pencil, but sometimes in ink, paints, or a combination of the three. Paints are very difficult to work with except for such uses as whitening very bright features or blackening shadows. The only satisfactory use of ink alone is in stippling; this method of drawing, when learned well, has a number of advantages as far as objectivity and realism are concerned because it best duplicates the actual method the eye or the camera uses in seeing. It is a rather tedious method and is not at all easily performed at the telescope so that more will be lost than gained by an inexperienced observer using it.

Supplies necessary. The beginning observer should use pencil for his drawings. There are two methods of pencil drawings, both of which are used successfully by accomplished lunar artists. Using either method, the observer should first have a variety of pencils of various hardnesses with some sharpened and some blunted. He should also have a few erasers, some of which are sharpened to a point. One very useful tool is an artist's stump which is a "pencil" made entirely of paper tightly rolled. This can be purchased for a dime at an artist's supply store, or it can be made easily from a sheet of porous paper. Although drawings can be made on practically any type of paper, comparatively smooth paper which is as white as possible and takes pressure well is the best. I have found that regular duplicating paper meets these conditions sufficiently. A better quality paper would be some improvement, and several American lunar artists recommend Pinehurst Tablet paper. Finally, the observer should have a well-placed light and a smooth hard surface on which to draw.

Procedure. If the drawing is to have any scientific value, the outline of the feature to be observed plus the location of other prominent objects within or near it should be prepared before the observation. Outlines may be traced carefully from photographs. If the feature is near the limb, try to use a photograph with a similar libration. The Kuiper Photographic Lunar Atlas is an excellent source of photographs from which to trace outlines. If necessary, photographs may be enlarged by the use of photographic enlarging equipment, opaque projectors, and graphical enlarging means. Outlines of some interesting craters are being issued for interested persons by the A.L.P.O. Lunar Training Section, which the writer directs.

The two methods of making pencil lunar drawings might be called the "sketching" method and the "shading-erasure" technique. The "shading-erasure" technique was well outlined in Sky and Telescope for June, 1959. The paper is first shaded by lightly rubbing it with pencil shavings or by some other method before the observation. Lighter areas are depicted by erasing the shading, darker areas are made by rubbing with the stump, and very dark areas are depicted with pencil.

The "sketching" method is probably the most common. The observer starts by making essentially a line drawing on white paper showing the outlines and positions of all features seen, beginning with the largest and working down to the smallest. After most of this work is completed, the observer shades in the areas in the proper relative tones leaving the brightest areas white.

Both methods have their advantages and disadvantages. Often the drawings done with the "shading-erasure" technique are more artistic, but certain types of features (such as faint maria shadings) are much more difficult to depict clearly. Using either method of drawing, the observer should try to use the entire tonal range available to him. The brightest features should be left white, and the darkest features (not shadow) should be very dark grey. It is difficult to represent with pencil the innumerable variations in tone visible to the perceptive eye. Drawings should show only features definitely and accurately seen. The observer should adopt a style of drawing that makes it very clear what marks he has intended to show and which ones are extraneous. (Impressionistic lunar drawings can be very artistic but are impossible to analyse objectively.) Wavy lines drawn to indicate a general impression of waviness should be avoided.

FIGURE I. First of four stages in the construction of a drawing of the lunar ring-plain Posidonius by Clark R. Chapman. A standard outline has been traced from a large scale photograph.

FIGURE 2. Second stage. The standard outline has been altered to conform to the solar lighting and libration at the time. Boundaries of shadows and major topographical features have been sketched.

FIGURE 3. Third stage in the drawing of Posidonius. The shadows have been filled in, and general shading has been added to the floor.

FIGURE 4. Fourth stage, the completed drawing. The original was about $5\frac{1}{2}$ by $4\frac{1}{2}$ inches. See also text of Mr. Chapman's article.

Every wiggle should be meaningful. Avoid pencil-thin lines or boundaries if possible. A boundary can only be resolved down to the resolving power of the telescope. If a drawing is made to the usual scale of about ten miles to the inch, it is obvious that only under exceptional circumstances can the diameter of a craterlet or the breadth of a line or boundary be less than a sixteenth of an inch.

It takes considerable practice and some talent to make a realistic drawing. One of the key elements in realism is the three-dimensional effect. The moon, unlike any of the planets, has detail which is primarily in relief. The eye tends to take many things for granted that are important in producing the relief effect. There is a big difference between the appearance of a bright spot and a bright mountain on the moon; yet on many drawings they appear drawn the same. The addition of a few shadings, which are there but which the eye tends to take for granted, will transform a featureless spot into a three-dimensional mountain. Similar three-dimensional shadings set off slopes, hills,and crater-rims.

Most important in making a good lunar drawing is accuracy. Be sure that relative <u>positions</u> are correct. Be especially careful with <u>shapes</u> of large objects. One of the most serious failings of many lunar drawings occurs in <u>relative sizes</u>. Continually compare smaller objects within the crater to the size of the crater itself. Be careful not to fall into the trap of systematically drawing interior detail too large or too small. There are two other ways in which systematic size errors may be avoided. Avoid using too little magnification. Also avoid using scales much smaller or much larger than ten miles to the inch on your drawings. For accurate drawings be sure to check and recheck features already drawn as you work on new parts of the crater.

When you think that you are finished, check all regions again, making sure that you have left nothing out. Compare the general appearance of your drawing with the object itself and see if your drawing really looks the same. If not, decide why not and correct the drawing. Be sure to leave plenty of time for an observation. A drawing must be thorough. It also cannot take too long or the lighting will change too much, so do not draw too large a region or you will be unable to finish the drawing. A crater the size of Plato should be about the largest feature that an amateur with a good telescope should attempt to draw.

If it is at all possible, the entire drawing should be finished at the telescope (with the possible exception of erasing stray marks and smoothing things up a bit with the stump). At times, however, observing conditions are so poor (winter weather, mosquitoes, cramped observing position, too little light, etc.) that it is really quite impossible to do accurate shading at the telescope. Under these conditions it may be permissible to come inside and <u>immediately</u> finish the drawing, but a note should be made of the fact. After all, there is nothing magical about standing next to the telescope, and your drawing might be less inaccurate drawn inside your house than if you tried to shade with frozen fingers; but if you are away from the telescope for any length of time, memories fade and the drawing cannot be compared again with the moon itself. It is worthless just to make notes or a hasty sketch at the telescope and then come inside to make the drawing.

Be sure to estimate seeing and transparency conditions while at the telescope. Record the magnification and filters used (a neutral density filter can be helpful for reducing glare) and any other factors which might have an effect on the accuracy of the drawing. Record the Universal Time of the drawing to within at least ten minutes. (This time should refer to the time at which the major shadows were drawn.) If possible, look up the sun's selenographic colongitude from the <u>American Ephemeris</u>, or some other source, as well as the librations if the object is not near the center of the moon.

<u>The Lunar Training Program</u>. In starting his program of learning how

to draw the moon, the beginning lunar observer should pick out several rather prominent moderate-sized craters such as Atlas, Cassini, and Herodotus and perhaps another feature like the Hyginus Cleft. He should make at least half a dozen drawings of each feature under varying illuminations while keeping these instructions in mind. Not until he is confident that he has developed considerable skill with these few objects should the beginner branch out on a drawing program of his own. As Recorder of the Lunar Training Program of the A.L.P.O., I will be glad to offer criticism and suggestions to learning lunar observers if sample drawings are submitted to me.

Once the observer has reached a state of considerable skill and has really learned the appearance of the moon, he is ready to work on more advanced projects. It would be hoped that he would devote his time to a scientifically worthwhile activity which practically precludes the making of individual drawings. A systematic series of drawings of a single feature under all illuminations, if carefully done, can still be of some value; but random single drawings of many craters are quite worthless scientifically, although they may be pretty pictures to show to friends.

When submitting drawings to the Lunar Section, it is best to submit the original drawing. If you do not wish to part with the original, a carefully traced copy will suffice. Half an hour should be spent in copying a good lunar drawing. A photographic copy of the original is fine, but some of the other copying processes which reproduce greys poorly should be avoided. Be sure to include all relevant data about the drawing when it is submitted.

Drawing the moon is practically a lost art. With just a little patience and ingenuity and keeping this article in mind, the beginning observer can become an accurate lunar observer in a relatively short time. The A.L.P.O. Lunar Training Program will be glad to assist any interested beginning lunar observer.

A SUGGESTED CLASSIFICATION FOR LUNAR TOPOGRAPHY

By: L. J. Robinson

The conventional categories for the lunar topography have grown slowly and haphazardly through several centuries of use in the lunar literature. Rigorous definitions of properties and classes of lunar formations are lacking and, as a result, many descriptive terms now used have lost (or for that matter, never had) any precise meaning. A. V. Khabakov makes this point clear when he states in The Moon: A Russian View, "The problem of further ordering and improving of the names, nomenclature, and classification of different land forms of the Moon remains an important one, . ."

A classic example of this confused terminology is found in the words "cleft" and "rille". For many years the two words have been used more or less as synonyms to denote cracks in the lunar crust. Of late, however, the Kuiper Lunar and Planetary Laboratory, in particular, in the explanatory handbook to the Photographic Lunar Atlas proposes that the term "rille" be exclusively used since "cleft" connotates cleavage, an assumption not warranted in the light of current knowledge. Irregardless of the semantic merits or demerits of such a change, it is a welcome simplification of a rather nasty enigma. However, this single instance serves only to point out one aspect of the whole problem.

Fundamentally, one might ask, "What are the bases for a useful classification of the lunar surface?" Primary considerations require that an accepted system should:

(1). be complete enough to provide definitions for all genetic formations. Such definitions should consider only the physical type of feature and should not imply an assumed mode of origin.

(2). be established on a small number of easily recognizable properties.

(3). be in concert with contemporary thinking, using common notation and terminology wherever possible.

(4). subdivide certain genetic classes to show morphological differences.

(5). provide an abbreviated notation for wholesale application.

Of course, meeting fully all of these criteria is problematical at best. The lunar surface does not lend itself well to categorical description - there will always be variants to any class one may establish. On the other hand, photographic or visual inspection should serve to classify any particular feature: there is a sufficient diversity of physical characteristics among the genetic lunar formations to allow each to be unique in at least one respect.

Taking into consideration the aforementioned objectives, the descriptive summaries given in: Alter, An Introduction to the Moon, Baldwin, The Face of the Moon, Grabau, Principles of Stratigraphy, Kuiper (Editor), Photographic Lunar Atlas, Markov, (Editor), The Moon: A Russian View, and Moore, "The Classification of Lunar Walled Formations", J.B.A.A., Vol. 72, No. 5, as well as the oft used glossology of the B.A.A. and the A.L.P.O., this writer arrives at the following scheme. It is doubtful that these classifications and definitions will receive the total subscription of all workers, but it is hoped that this paper will stimulate further endeavors on this problem.

The Classification

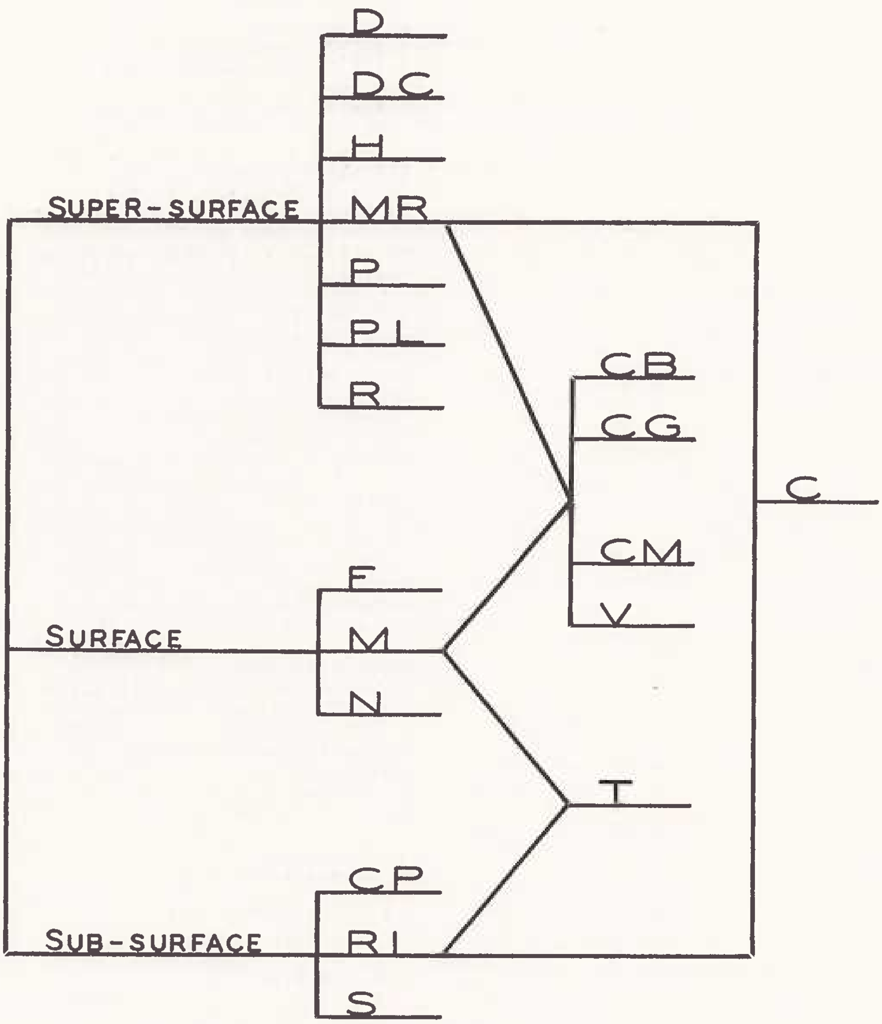
Object Class*	Abbreviation	Examples **
Classic Crater	C	Copernicus (C1). Arzachel (C2). Conon (C1). Maurolycus (C Pec). Alpetragius (C Pec).
Crater Bay	CB	Fracastorius (CB1). Julius Caesar (CB2). Sinus Iridum (CB1). Gassendi (CB2).
Crater Ghost	CG	Ring N. of Flamsteed. Fra Mauro. Guericke. Yerkes.
Crater Mare	CM	Clavius (CM2). Plato (CM1). Deslandres (Hell Plain) (CM3). Cassini (CM2). Ptolemaeus (CM1). Grimaldi (CM1).
Crater Pit	CP	On Kies' dome. On the central peak in Alpetragius.

* See Figure 5.
** See supplementary notation and definitions.

Object Class	Abbreviation	Examples
Dome	D	Inside Darwin. S.E. of Kies. N. of Hortensius.
Dome Complex	DC	Domes E. and N. of Arago. Rümker.
Fault Scarp	F	Straight Wall. In Lacus Mortis In Boscovitch.
Hill	H	On extreme W. portion of Plato's floor. Between Cassini A and Cassini B.
Mare	M	Mare Crisium. Mare Serenitatis.
Mountain Range	MR	Leibnitz Mountains. Caucasus.
Nimbus	N	Posidonius Gamma. Linné.
Peak	P	Piton. Pico. Leibnitz Alpha.
Plateau	PL	Wargentin. Between Kant and Zöllner. N.- N.E. of Linné.
Ridge	R	Serpentine Ridge. Between Plato and Piazzi Smyth. Along W. shore of Mare Humorum.
Rille	RI	Byrgius-Sirsalis system. Hyginus Rille. In Posidonius. Triesnecker system.
Saucer	S	In Ptolemaeus. N. of Wollaston.
Trough	T	S.E. from Bullialdus. S.E. of Triesnecker.
Valley	V	Alpine Valley.

Supplementary Notation

Abbreviation	Definition
	Prefixes
U	object located in uplands: the bright mountanous regions of the Moon.
W	object located in mare: the dark regions.
X	object is member of a chain, range, rim, or complex.
Y	object is a parasite crater or other secondary feature.



SCHEMATIC DIAGRAM OF THE CLASSIFICATION

FIGURE 5. A proposed classification of lunar topography by L. J. Robinson. See his article in this issue for abbreviations and detailed explanations.

Calling All Observers! Every A.L.P.O. member is urged to take part in our new Simultaneous Observation Program. The schedule for June, July, and August is given on pages 81 and 82 of this issue. The assistance of both beginning and experienced observers is needed if results of the greatest attainable value are to be secured.

Class Suffixes

1. crater which has no parasite craters of significance on rim, wall, or floor.

2. crater which exhibits a number of parasite craters but which still retains, to a high degree, the earmarks of a crater, i.e. walls in good condition, minimal internal destruction, etc.

3. crater which is barely recognizable as such due to great internal and/or external destruction: rim almost absent, floor filled or broken, many prominent parasite craters on floor, rim, or walls.

Pec object which markedly departs from the object class with which it is most closely associated.

Suffixes

p polygonal crater.
c convex floor.
b bright crater.
n dark or light material on floor and/or walls.
r ray center.
m major mountain mass (es), relative to crater's diameter, within crater.

Format to be Used with the Classification

Format (complete):

Name, (Orthographic coordinates of center of object), Prefix - Class, Class Suffix - Suffix.

Format (abridged):

Name or Designation, Class, Class Suffix.

Examples

Complete:	Aristarchus, (-.677,+.403), W-Cl-bnr.
Abridged:	Aristarchus, Cl, or (-.677,+.403), Cl.
Complete:	Kunowsky, (-.537,+.055), W-CMl-pm.
Abridged:	Kunowsky, CMl, or (-.537,+.055), CMl.
Complete:	(-.472,+.125), WX-D.
Abridged:	(-.472,+.125), D.
Complete:	Stadius Rille, (-.276,+.270), WX-RI.
Abridged:	(-.276,+.270), RI.

Definitions

Classic Crater — is any closed mountain cirque having a diameter of less than 190 miles. This cirque shall exhibit internal walls leading to a floor which lies below the level of the surrounding environs; evidence of external walls should also be present. The floor of the crater shall compose less than one-half of the crater's rim-to-rim diameter; objects having floors of a larger proportion than one-half shall be considered Crater Maria.

Crater Bay — is any cirque fundamentally of crater form which has had a substantial portion of its "seaward" wall broken or otherwise destroyed. The remainder of the cirque's wall shall, in the greater part, be contiguous with an upland mass.

Crater Ghost — is any cirque found within a mare or the floor of another crater. These craters shall appear obliterated to one degree or another. Such objects shall differ from Crater Bays in that they shall not connect to any major upland mass.

Crater Mare — is any closed cirque less than 190 miles in diameter which exhibits a smooth, mare-like floor that is greater than 50% of the crater's rim-to-rim diameter.

Crater Pit — is a small crater having no visible rim, to the limits of observational resolution. Such objects differ from Saucers in that they can occur anywhere on the lunar surface: the Saucers are confined to the mare-like areas.

Dome — is a single, regular swelling on the lunar surface whose major axis: minor axis ratio shall not surpass 1.5:1. The surface of a Dome shall appear dark under a low sun and shall become invisible under high illumination. Domes may exhibit secondary features such as pits, clefts, or other minor markings.

Dome Complex — is any object similar to a Dome but which has two or more contiguous uplifts or an irregular vertical profile.

Fault Scarp — is a fracture in the lunar crust along which one side has been vertically displaced with respect to the other side.

Hill — is a low mountain mass, usually isolated but sometimes occurring in small associations. A Hill will appear bright and visible under both high and low illumination.

Mare — is a large, generally circular depression which is dark in tone; all known maria have heretofore been officially designated.

Mountain Range — is an association of at least five major mountain masses which are not part of any other formation (such as a crater rim). All peaks of a Mountain Range should have their bases joined by connecting lowland areas. Associations having less than five members or whose members are not connected by lowlands shall be considered as a group of isolated peaks.

Nimbus — is a generally small light spot showing no relief; these spots usually exhibit a small crater at or near their centers.

Peak	is a mountain mass, either an individual member of a range or isolated; it exhibits a large exterior slope, appears bright under all angles of illumination, and has an apex whose minimum cross-section is small compared to its base.
Plateau	is a generally flat, usually dark area whose upper surface lies above the level of its environs. Such objects have diameters greater than their height above said environs.
Ridge	is a low, gently sloped swelling on a mare surface or the surface of a crater floor. It is invisible as a relief feature under a high sun and has the tone and physical appearance of the Mare. Its major axis: minor axis ratio shall surpass 1.5:1.
Rille	is a long, narrow fissure in the lunar crust having steeply sloping sides. The tops of the sides of Rilles show no exterior walls but may exhibit either regular or serrated edges.
Saucer	is a more or less circular, very shallow depression within a Mare or a crater. These objects are rimless and have smooth, regular bottoms of a tone scarcely distinguishable from their environs.
Trough	is a long, rather narrow depression (relative to its surroundings) which exhibits a smooth bottom and low, exterior walls. The surface of these objects is normally quite mare-like in tone.
Valley	is a pronounced cut through a Mountain Range or other mountainous complex. Its floor may be smooth or may exhibit secondary detail.

Postscript by Editor. We express our thanks to Mr. Robinson for an ambitious and needed attempt to clarify lunar terminology. A subject of this kind can be discussed at length, and readers are invited to comment. Perhaps some of these comments can be published in a future issue or can even be developed into a paper for the approaching A.L.P.O. Convention at San Diego. Mr. Robinson will be glad to receive thoughtful and constructive criticism of the proposed terminology; his address is P.O. Box 147, Cambridge 38, Massachusetts.

OBSERVING THE MOON'S SHADOW AND THE DEGREE OF DARKNESS AT THE TOTAL SOLAR ECLIPSE OF JULY 20, 1963

By: William H. Glenn

Any observer in or near the path of totality at the solar eclipse of July 20, 1963, can contribute observations of scientific interest by observing the appearance of the moon's shadow projected against the earth's atmosphere as it appears in the sky just before, during, and just after totality, and by observing the degree of darkness occurring during the total phase. Very little attention has been paid to these phenomena in the past, largely because observers have been so intent on making observations of the corona that they have overlooked other phenomena visible at eclipse time. Any capable observer, however, by allotting a small amount of his observing time to these phenomena, can help fill these gaps in the records of eclipse observations.

At the time of a total eclipse, the shape of the moon's shadow on the ground is that of an ellipse, with its major axis directed towards and away from the sun's azimuth. For an observer witnessing the total phase, the moon's shadow overhead appears dusky blue, if there are no clouds; and the light from outside the shadow appears as a bright border around the horizon. Since air transmits the long wavelengths of light more readily than the short ones, the light from outside the shadow tends to be yellowed or reddened, the exact color depending on the distance of the shadow edge from the observer. According to Dr. John Q. Stewart,[1] when the shadow edge is 50 miles or more from the observer, the reddening is pronounced and the horizon glow has a tawny hue. The bright horizon glow does not extend upward very far before it meets the shadow edge. As the distance from the observer to the shadow edge decreases, the color becomes less yellowish; and the horizon glow extends higher into the sky. If the shadow edge is only five miles away, the horizon glow extends high into the sky and may be expected to be bluish white. Since the shadow edge is constantly moving with respect to the observer, the distance of the observer from the shadow edge is constantly changing, and with consequent rapid variation in the appearance of the shadow in the sky during the eclipse. Careful descriptions of these moment-to-moment changes in the appearance of the sky during totality are of interest. Observations are of particular interest just before and after totality, when the moon's shadow projected against the atmosphere can be seen approaching toward, and receding from, the observer.

Observers in northern Japan, near the beginning of the path, where the moon's shadow strikes the earth almost tangentially, will first see the shadow in the sky above them, as it falls through the atmosphere. During totality the shadow will stand like a truncated V in the eastern sky, with the eclipsed sun placed within it, similar to the cover photograph of the November, 1959, issue of Sky and Telescope. After totality, the shadow will seem to "drop to earth", quickly disappearing as it races eastward. Any observers who happen to be aboard ship in the Atlantic Ocean near the end of the eclipse path on July 20, 1963 will see a reversal of the effects noted at sunrise. The truncated V will be visible in the western sky during totality at sunset, and the shadow will appear to rise as it leaves the earth tengentially. The shadow will not be conspicuous before totality.

In eastern Quebec and Maine the shadow first strikes the earth obliquely from the west and may not be readily observable before second contact. After third contact, however, the shadow will become conspicuous as it appears to "rise from earth", moving upward and away. Observers at other locations along the path of totality will see phenomena similar to those described above, the exact appearance depending on their location in the path.

Observers outside the path of totality along its entire length should attempt to observe the shadow projected against the atmosphere, even though they may be some distance from the nearest location where the eclipse is total. At the total eclipse of July 9, 1945, the moon's shadow was seen near the horizon from Portland, Oregon, 320 miles west of where the eclipse was first total at sunrise[2]; and at the eclipse of October 2, 1959, which was total in Massachusetts, the shadow was seen on the northeastern horizon by an observer only 15 miles northeast of New York City.[3] Observers closer to the path of totality, of course, have a much greater chance of seeing the shadow.

Observers within the path of totality should record the entire sequence of events, from the first appearance of the shadow before totality, through the changes in sky brightness and appearance during totality, to the disappearance of the shadow after totality. Observers outside the path should observe the sky and horizon in the direction of the path of totality,

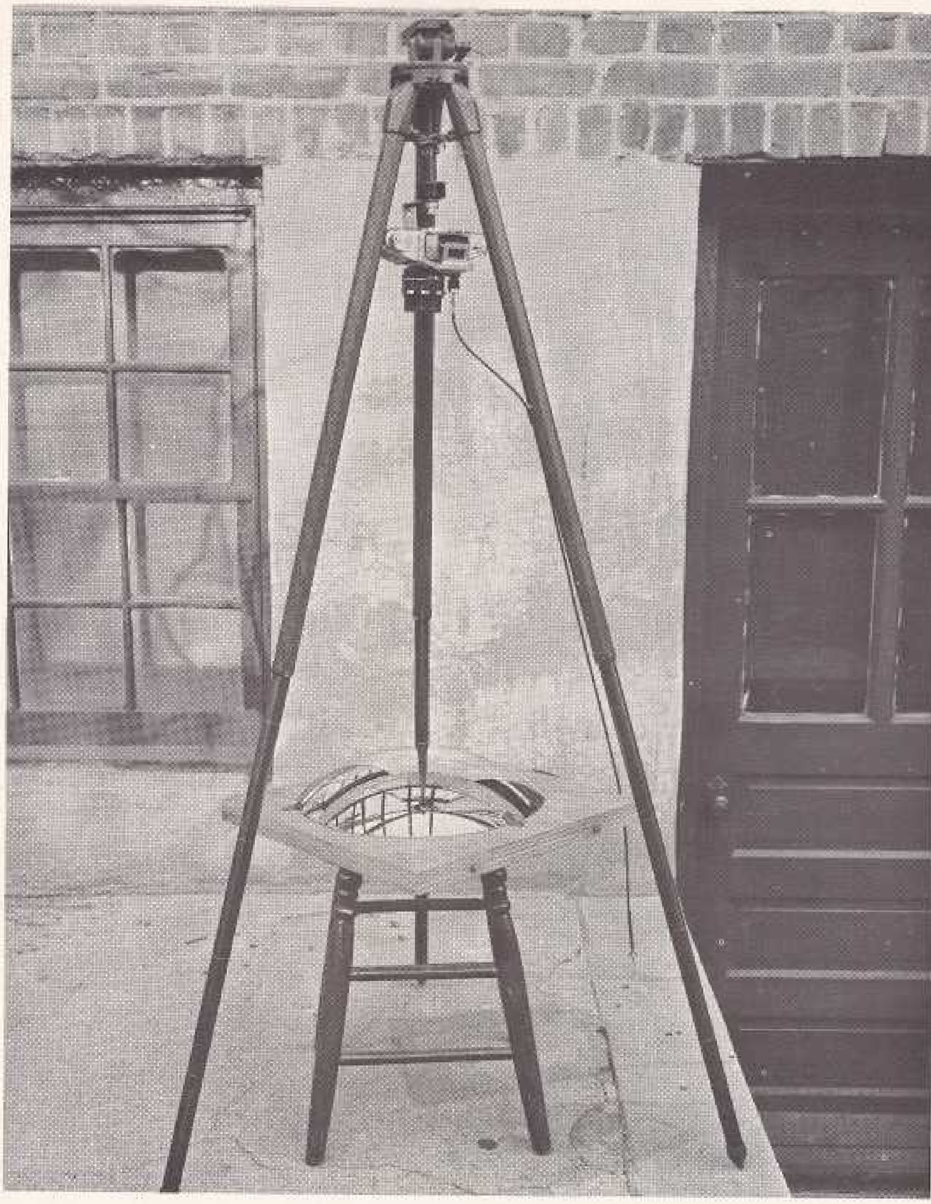


FIGURE 6. All-sky camera constructed by Mr. Charles Cuevas. Photograph by Charles Cuevas, contributed by William H. Glenn. A Kine Exacta camera is mounted above a 12-inch condensing lens aluminized on the convex side. See text of Mr. Glenn's article.

looking for the shadow in the sky near their horizon, for a few minutes just before, during, and after the time when totality is due to occur at the point in the path nearest them. Careful descriptions of the time, color, and general appearance of whatever is observed should be made.

Observations of the degree of darkness during the total phase should also be made by persons within and near the path of totality. One way of doing this is to record the smallest size newsprint readable during totality. Another way is to record the faintest stars visible during the total phase. The first procedure can be carried out even when the sky is overcast, but care should be taken to record the extent and type of cloud cover if observations are made under these conditions. Some clues to the degree of darkness experienced can also be obtained by recording the visibility of landmarks and the figures on the dial of a watch, but these procedures do not lend themselves to control as readily as the newsprint procedure.

Visual observations of the appearance of the shadow and of the degree of darkness should not be considered substitutes for good photographs and photoelectric observations. All-sky cameras should be useful for recording the appearance of the shadow projected against the atmosphere. At the suggestion of the writer, Charles Cuevas, of the Amateur Astronomers Association, constructed three all-sky cameras for use during the total eclipse of October 2, 1959. The cameras consisted of 8" and 14" diameter condensing lenses aluminized on their convex surfaces, over which were mounted still cameras and motion picture cameras. Rain during totality prevented their use in 1959, but it is hoped to employ them again this year to obtain photographs of the shadow.

The attention of readers is directed to Figure 6 and the front cover photograph. Others are encouraged to construct and operate such all-sky cameras. Exposure meter readings can be taken close-up from the mirror. Negatives or transparencies should be flipped over since the mirror gives a mirror image of the sky. Focusing is best done with a single lens reflex camera. Of course, motion picture or still cameras can be used in all-sky cameras; and the diameter of the mirror can vary, Charles Cuevas suggesting that even 6-inch condensing lenses can be used.

At the eclipse of July 9, 1945, Dr. John Q. Stewart employed a series of photocells directed at the zenith and at four points of the horizon to record the moment-to-moment changes of sky brightness during the total phase.[2] The zenith readings obtained during totality were about 0.2 foot candles; and the horizon readings were, of course, higher. A similar arrangement, constructed for the 1959 eclipse by Victor Gogolak, failed to operate properly because of rain during the total phase, but it is hoped to use a revised setup this year. Observers who attempt photoelectric observations should carry out their program even if the sky is totally overcast.

Another type of visual observation that can be made is an estimate of the color of the moon during totality. Since the moon always reflects earthshine to the observer, it should not be totally black during the total phase; and estimates of its color and of the degree of darkness as compared to the sky near the corona are of interest.

The writer will attempt to collate and summarize all observations made of the appearance of the shadow and degree of darkness during this eclipse. The writer has revised the questionnaire used at the eclipse of July 9, 1945, by Dr. John Q. Stewart, and will send copies to persons requesting them. Observations are particularly wanted from observers in northern Japan, Alaska, and western Canada, as well as from those in Quebec and Maine. The writer's address is 3235 Parkside Place, New York 67, New York.

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FOUNDATIONS OF VISUAL PLANETARY ASTRONOMY. I.[1]

By: Charles H. Giffen

Introduction

The methods of visual planetary astronomy have been born in ignorance, bred in misunderstanding, and matured in obstinacy. Early planetary observers were quite ignorant of most principles of optics and vision: they learned to observe by trial and error. Later observers misunderstood newly learned (and often conflicting) facts and fiction about observing technique. Recent history has seen the stubborn adherence to old methods in spite of sound evidence and reasoning which show them to be amiss.

The visual observing technique of both professionals and amateurs has followed this course. Very few of either rank have extricated themselves from this froth of malpractice. Because of the preoccupation of professionals with instrumental techniques, visual planetary astronomy has fallen largely to amateur astronomers. Observing technique has been developed at the hands of amateurs, and the present problems are a result of this fact. More pointedly: amateurs are basically non-scientists, in comprehension, in thinking, and in attitude. Consequently, observing technique has suffered in its development. A reasonable basis upon which to work out observing technique includes some acquaintance with physical optics, with sight phsiology and psychology, and with the optical characteristics of the planets. But rarely have these considerations been made. Moreover, amateurs seldom think analytically or logically about their observing technique. Their evaluation of the methods used and the results secured has been much more subjective than objective. And this clearly leads to a general attitude towards visual planetary studies that is patently wrong and that misrepresents woefully the intentions of the serious amateur astronomer.

To visual observing technique, professionals have added little. They have, particularly in the United States, used the same ill-founded techniques as amateurs and have made no attempts to ascertain whether these methods are valid. It seems their rationale is that, no matter how visual observations are made, they are of the same, essentially nil value. With this as an unwritten bylaw, professionals have employed some of the worst observing methods known, not occasionally, but flagrantly. It is a mis-fortune that visual methods have developed so haphazardly with amateurs -- it is a miscarriage of the scientific method that these have been perpetrated in terrible forms by professional astronomers.

Yet the necessary rudiments for working out suitable observing technique have not gone undiscovered. Many of them have become buried in the literature, but ferreting them out and using them should offer no real problems at all. There has never been a systematic assemblage of these rudiments into a rigorous study of visual planetary technique. In the current and succeeding chapters of this paper, we present the results of such an investigation in an effort to bridge partly this unfortunate gap. Because of space limitations and this serial presentation of only the results of this work, full details will be published elsewhere under the same title as a unified, complete edition.

We take the trouble to describe here some of the principles used in making this investigation. These principles may not be evident in the bare, final results. Nevertheless, they should be acknowledged so as to better understand these results and their significance. Therefore, we have occasionally succumbed in this report to working through a few of the more interesting approaches in a very sketchy manner. The final edition reveals the use of these principles in a great many places -- some in minute detail.

We begin at the very bottom by investigating the limits to which visual planetary astronomy can be taken and the methods by which these limits may be attained. The procedure is quite straightforward in that the calculation of the limits indicates the methods of attaining them. We shall also see that certain factors affecting these limits are variable and that we ought to measure them. Entirely analogous methods will usually show how this may be done effectively.

The general strategy involves a consideration of various factors contributing to the problem. These factors will usually be regarded as (perhaps variable) <u>proto-quantities</u>. In this general context, the "value" of a proto-quantity is merely the characterization of it through relations and operations defined among these objects. Hence, in a given problem, the proto-quantities need not be numerical. It is the variable aspect of the factors which we must analyze in a problem. Some of the factors will be subject to our direct control; these are called <u>free variables</u>. Others will be controlled by the conditions under which we must work and are called <u>parameters</u>; always-fixed parameters may be called <u>constants</u>. And those factors which vary only as a result of all the others are called <u>dependent variables</u>.

The general problem becomes, then, essentially the expression of the relations and operations for factors entering into consideration together with an instruction that tells one what to do with this expression. Some examples of instructions are: find all possible values of the dependent variables; find all values of the free variables which, for given parameters, produce (specified) optimum values of the dependent variables; calculate values of the dependent variables for given free variables and parameters. The solution to the problem is quite simple in essence: follow instructions.

In this form, however, the general problem is usually much too intractable. The usual course of subdivision and simplification is taken in such cases. In each of the component "exercises" of this process,one works for a reduction in the complexity of factors and relations for the expression of the problem. The general characteristic of tractable exercises is a type of homogeneity or compatibility which appears among the factors and relations. Often they become essentially numerical; but others, such as combinatorial or enumeration types, may occur.

One non-arithmetic type of relation which appears repeatedly in analyses of this sort is a <u>tolerance</u> relation. A tolerance relation imposes a kind of indistinguishability among certain objects which are perhaps otherwise distinct without the tolerance. Thus, resolving power of a telescope defines a tolerance on the field of view. Family names place a tolerance on people: after all, a McCoy is a McCoy! Numerical quantities are often given with a superimposed tolerance in the form of mean deviations or probable errors. By analyzing tolerances placed on the visual field of the eye and on the brain, an interesting study of visual perception, which we shall have occasion to use and enlarge, has been initiated by E. C. Zeeman (1)[2].

In the first chapter, we investigate the two most important limiting factors in visual planetary observing: resolution and contrast. We are able to find specific values of our free variables which optimize these factors for given observing circumstances. In addition, we are able to determine what the optimum circumstances should be and what values for resolution and contrast result in these cases. We turn our attention to planetary seeing and transparency in the second chapter, as these most strongly influence resolution and contrast. We seek evaluations of seeing and transparency which allow us to determine the values of optimum resolution and contrast over a wide range of the parameters involved. With this done, the combined results of the first two chapters enable one to determine the limits he is reaching with his methods and to adjust these methods so as to take these limits to their logical extremes.

Thereafter, in immediately succeeding chapters, we attack the real problems of the planets themselves -- what types of data are desired, how these may be secured, how the results are interpreted. Thus, in the third chapter, we consider the problem of determining intensity differences on the planets. The problem is not unlike that of the first chapter, and we actually proceed along lines which are a continuation of that study. Instead of finding the limits of contrast perceptibility between adjacent areas, we wish to determine the actual contrasts among several areas on the planets. Similar approaches will be used for subsequent problems, and from time to time we shall have to investigate new limiting factors, such as color perception.

The 1961 A.L.P.O. Simultaneous Observation Program introduced by Chapman (2, 3, 4) has shown that, while a great many observations are quite discordant, some types can produce remarkably good results and that certain observers have apparently consistent technique which produces uniformly good results. The causes of these phenomena will become quite apparent in this study. It is not our aim to refute or vindicate the many different techniques employed by observers. Nevertheless, the fact is that we must evaluate our methods in these pursuits if we are to get anywhere at all. And in the end, we must choose and adjust our methods carefully in order to yield the most feasible and efficient study of the planets. In doing this, we shall have to realize that both large and small scale changes may be required, that we may have to settle with less than ideal methods in some cases, that no improvement of methods will make different types of observations have equal merit, and that we can never hope to reach the end of improvement in ourselves. Fortunately, an organism or organization with a sense of honor, sincere purpose, and unbigoted attitude is unashamed to meet these realizations.

The author wishes to thank the several members and officials of the A.L.P.O. who have urged, helped, and encouraged him in this project. Hopefully, this assistance will continue, for we should be as thorough and accurate as possible in this endeavor. Any criticisms or opinions would be very much appreciated. These and other comments should be sent to the author, care of the Mathematics Department, Princeton University, Princeton, New Jersey.

I. Resolution and Contrast.

Abstract. Resolution and contrast have long been recognized as the main limitations of planetary astronomy. It is the variability of resolution and contrast with observing conditions that make them so important.

Sato (5) has pointed out this variability qualitatively and has illustrated its great dependence upon seeing and transparency, even while other conditions remain fixed. Following lines similar to those of Danjon and Couder (6), we develop the subject quantitatively, and in greater detail than Dollfus (7).

From planet to eye, the factors which we must consider include: the planet, the earth's atmosphere and its state, the telescope and its properties, and the observer's visual capabilities. The only factors that may be construed as freely variable are: magnification, aperture (restricted by the maximum available), and transmission (which may be reduced by the interposition of filters in the optical path). The rest we may treat as parameters, although we make further restrictions for specific calculations by assuming a reasonable quality for the telescope and by taking average visual capabilities for the observer. There is here no real loss of generality, as these rarely affect the values of the free variables which optimize resolution and contrast. Moreover, the formulae involved may be used to make specific calculations by merely changing the appropriate values of these parameters, since they may be determined for individual observers and telescopes.

We take the course of least resistance and greatest efficiency by treating contrast first and resolution second. In this way,we may eliminate seeing conditions from our initial contrast considerations and use seeing conditions and our results on contrast to handle resolution. Not only is the problem more tractable in this form, but the final results are expressible in a very nice way. We tabulate specific calculations and conclude with a discussion of our results and their applications.

1. Contrast. Intuitively, contrast may be defined as the fractional difference in brightness between two objects. Thus, suppose two areas of surface brightnesses B and 'B, respectively, are given with $B \geqslant {}'B$ as measured, say, in stilbarnes (candles/cm^2). Then the contrast c between the two areas is defined as the quotient B - 'B by B:

$$c = \frac{B - {}'B}{B} .$$

When c = 0, then B = 'B, and the two areas are of equal brightness; when c = 1, then 'B = 0, and that area is perfectly "black".

A detector has contrast sensitivity $\tau(B)$, or simply τ , at the brightness level B, if τ is the minimum detectable value of c in the above expression. If the detector is the eye, we use the special notation $\tau^*(B^*)$, or simply τ^*, for the visual contrast sensitivity at the apparent brightness B*. A plot of visual contrast sensitivity is given in Figure 7 (see 6, p. 50). These values are only typical; the actual contrast sensitivity at its minimum has been known to vary by a factor of three. Nevertheless, the shape of the curve is very much the same for all people. The minimum value of τ^* is about 0.017 and is reached when B* is about 0.01 stilb. For B* between 0.0005 and 0.4 stilb., τ^* is nearly constant and less than 0.020. Outside this interval, τ^* increases rapidly and the eye quickly becomes rather insensitive to contrast. Clearly then, we should like the apparent brightness of a planet being observed visually through a telescope to be inside this interval and as near to 0.01 stilb. as possible.

We consider a planet with brightness B. When the light from the planet passes through the optical train up to the eye, B will be altered to an apparent brightness B* according to the steps to be outlined below. Surface brightnesses of the planets and the Moon are listed in Table 1. For the planets beyond Mars, B is practically constant, and the values listed will serve for most purposes. For the others,the changes in B are quite significant, and the values listed are only typical. The average surface brightness of a planet may calculated from the

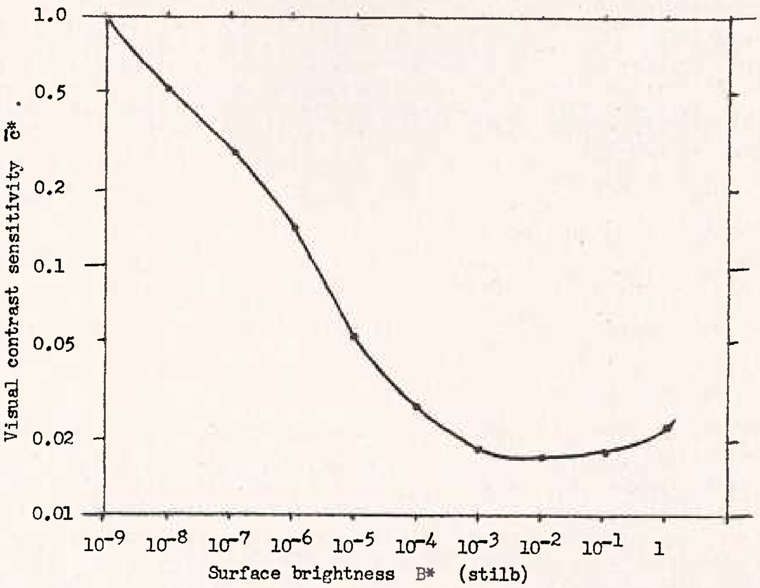

FIGURE 7. Visual contrast sensitivity as a function of apparent surface brightness. See discussion in text of article by Charles H. Giffen in this issue.

following formula:

$$B = \frac{4(10^{-0.4(M)})}{ks^2},$$

where B is in stilbarnes, M is the magnitude, s is the semidiameter in seconds of arc, and k is the fraction of the disk illuminated.

Table 1. Surface Brightnesses of the Planets and Moon.

Planet	B (stilb.)
Mercury	0.6 :
Venus	2. :
Mars	0.2 :
Jupiter	0.070
Saturn	0.028
Uranus	0.0054
Neptune	0.00037
Moon:	
1-2 days from new	0.03 :
quarters	0.1 :
full	0.6 :

When light passes through a medium, a certain fraction of it is lost by absorption, obscuration, etc. To that fraction which travels on through the medium are added amounts of light which are due to local scattering of light from the object in question and to extraneous scattering of other light in the medium. This happens twice in our case, once as the light travels through the atmosphere and once as the light travels through the telescope. If the light is passed through a filter before entering the eye, this happens once more; but we can agree to include any scattering of either type (which will normally be alomst zero) in ths scattering terms for light passing through the telescope. Lastly, because we are dealing with extended objects, there must be a final correction which takes care of the difference in light grasp between the telescope and eye and which allows for the change in scale due to the magnification employed. The apparent surface brightness B* may then be calculated with the following sequence of formulae:

$$B_1 = u_1B + S_1 + H_1 \quad (1)$$

$$B_2 = u_2B_1 + S_2 + H_2 \quad (2)$$

$$B' = uB_2 \quad (3)$$

$$B^* = \frac{p^{*2}B'}{p^2}, \quad p \geqslant p^* \quad (4a)$$

$$B^* = B', \quad p \leqslant p^*. \quad (4b)$$

In equation (1), u_1 is the atmospheric transmission, S_1 is the local atmospheric scattering due to B, and H_1 is the sky brightness. In equation (2), u_2 is the instrumental transmission, S_2 is the local instrumental scattering due to B_1, and H_2 is the extraneous instrumental brightness. In equation (3), u is the transmission of the filter being employed. In equation (4), p* is the equipupillar power per unit aperture, and p is the power per unit aperture being employed. The equipupillar power per unit aperture is that value of p for which the exit pupil of the eyepiece is the same as the pupil of the eye. The two parts of equation (4) result from the manipulation of the following two relations:

$$d = \frac{D}{P} = \frac{1}{p} \quad (5)$$

$$d^* = \frac{D}{P^*} = \frac{1}{p^*},$$

where d is the diameter of the exit pupil of the eyepiece, D is the aperture of the telescope, P is the power being employed, d* is the diameter of the pupil of the eye, P* is the equipupillar power, and p, p* are as before.

The apparent contrast c* may now be calculated using the above formulae together with the following:

$$c_1 = cu_1BB^{-1} \quad (1')$$

$$c_2 = c_1u_2B_1B_2^{-1} \quad (2')$$

$$c' = c_2 \quad (3')$$

$$c^* = c'. \quad (4')$$

Note that by working backwards through these equations by substituting for c* the value $\bar{c}^*$ of the visual contrast sensitivity, one obtains as a solution for c the value $\bar{c}$ of the actual contrast sensitivity being realized on the planet. Note further that the filter and magnification being employed do not change contrast, although they do change the brightness; hence, they also change the contrast sensitivity. The same happens for other parameters, although they are involved in a much more complicated way. It is fortunate that the free variables are involved in so simple a way.

We find that, for the most part, u may also be treated as a parameter—

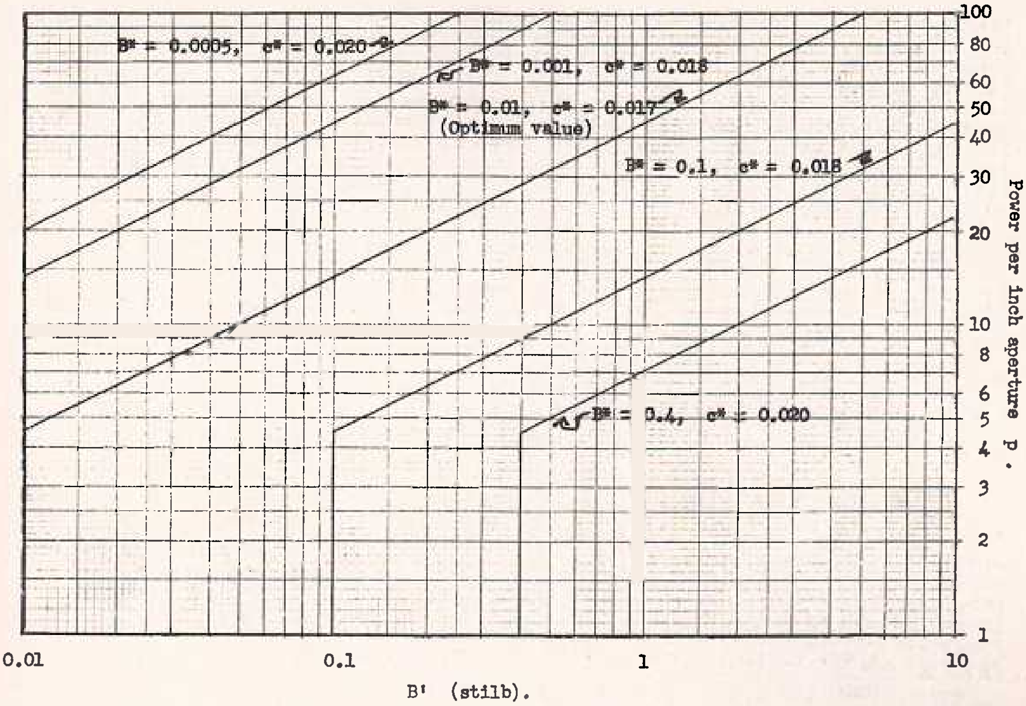

FIGURE 8. Apparent brightness B* and apparent contrast sensitivity c* as functions of B' and power per inch aperture p. Both scales are logarithmic. See also discussion in text.

as indeed it will be if the filter is being used for purposes other than just brightness reduction. For this reason, we shall be mostly interested in the variation of B* with B' and the power per unit of aperture being employed. This variation is shown in Figure 8, where we have plotted p against B' (both logarithmically) for the various contours of equal apparent brightness B*. These contours are drawn for B* equal to 0.0005, 0.001, 0.01, 0.1, and 0.4 stilb.; and they correspond to values of $\bar{c}^*$ of 0.020, 0.018, 0.017, 0.018, and 0.020, respectively, thus covering the region which gives the optimum visual contrast sensitivity (i.e., that region between the contours). The units of p are power per inch of aperture, and the value of p^{*2} which we take is 20, corresponding to a diameter of the pupil of the eye of about 5.7 mms.

We must now investigate the various things contributing to the equations (1) and (2). The atmospheric transmission u_1 is a function of the transparency, given by:

$$u_1 = 10^{0.4(T_r - 6)},$$

where T_r is the value of the transparency defined in the second chapter of this paper (essentially the same T_r as that introduced by Robinson in reference 8). The local atmospheric scattering S_1 is usually insignificant, especially in conditions of high transparency. The sky brightness H_1 is normally about 10^{-8} on clear, moonless, city-lightless nights and about 10^{-4} to 10^{-3} on equivalent days; these values may increase enormously when conditions are worse. Instrumental transmission u_2 is about 0.6 for large refractors and about 0.7 for small refractors; it is about 0.8 for standard aluminized reflectors and about 0.9 for freshly silvered reflectors. As with S_1, the local instrumental scattering S_2 should be quite insignificant, especially when optical surfaces are in excellent condition. The extraneous instrumental scattering H_2 will also be very small normally; however, daylight or other light falling on the optics can increase this to a rather large amount.

The effect of u_1 and u_2 is to decrease brightness, while the effect of the scattering terms is to increase brightness, usually by very small amounts compared to the transmission. Meanwhile, the effect of u_1 and u_2 on contrast is normally rather small compared with that of the scattering terms, which may be considerable. From the overall effects, we conclude that we would like the scattering terms to be as small as possible and the transmission factors to be generally as large as possible. Under the "best" conditions, we may assume that the scattering terms are actually set equal to zero. This will generally give a good approximation to the values of B' and c' , the formulae of which become very much simplified:

$$B' = uu_2u_1B ,$$

$$c' = c .$$

With B' easily computable in this form, we may readily find the range of powers per inch of aperture which produce optimum contrast sensitivity from this and equation (4) above. Moreover, under the conditions which allow the approximation $c' = c$, we have $c^* = c$ from equation (4'). Therefore, the visual contrast sensitivity at apparent brightness B^* is just the actual contrast sensitivity at actual brightness B:

$$\bar{c}^* (B^*) = \bar{c}(B) .$$

To illustrate the use of these results in practical situations, we give in Table 2 the optimum power range on the various planets for different values of uu_2u_1 . A comparison of these values with those values that have been used in the past will show, in part, why visual planetary work is so often useless. In particular, note the maximum permissible powers per inch with Jupiter, Saturn, and the outer planets; also, note the minimum permissible values for Venus and Mercury at typical brightnesses. It is clear that far too many observers are employing the wrong powers for observing detail of low contrast. In at least two cases, Venus and Saturn, this had led to the rather hasty conclusion that little detail exists at all. With Venus, the tendency has been to use powers too low or no dimming filter, especially when seeing (as in twilight) is not very remarkable; with Saturn, the opposite has happened, namely the tendency to use powers far too high to have adequate contrast sensitivity. Much the same problems often occur with Mercury and Jupiter, respectively.

We conclude from our study of contrast that we are limited in our choice of magnifications for observing a given planet by several factors, if we are to obtain optimum contrast sensitivity at that time. These limitations should be adhered to if at all possible. It is important to note here that resolution criteria, treated in the next section, place further restrictions on the lower limit of powers per inch aperture which observers should use.

2. Resolution. Unfortunately, the problem of resolution is not so uncomplicated as that of contrast, principally because of the problem of defining resolution correctly. Actually, several definitions can be given. Of the many definitions that have been devised, several are quite restrictive as to the type of objects considered; however, these usually can be treated in a convenient form with relatively uncomplicated tools (e.g., diffraction theory applied to point sources of light). The con-

Table 2. Optimum Power Per Inch Ranges, for Optimum Contrast Sensitivity.

Planet	$uu_2u_1 = 0.6$ Lo	Opt	Hi	$uu_2u_1 = 0.8$ Lo	Opt	Hi	$uu_2u_1 = 1.0$ Lo	Opt	Hi
Mercury	8.5	27.	85	9.8	31.	98	11.	35.	110
Venus	16.	49.	156	18.	56.	180	20.	63.	200
Mars	4.9	16.	49	5.6	18.	56	6.3	20.	63
Jupiter	--	9.2	28	--	10.6	33	--	12.	37
Saturn	--	5.8	18	--	6.7	21	--	7.5	24

The values under the columns labelled Lo, Opt, and Hi represent apparent brightnesses of 0.001, 0.01, and 0.1 stilb, respectively. The maximum permissible values (corresponding to a value for the apparent brightness of 0.0005 stilb) are 40% greater than the Hi values given; the three maximum values for Saturn are therefore 26, 30, and 34 for uu_2u_1 = 0.6, 0.8, and 1.0, respectively.

sideration of more complicated objects and shapes leads to more complex definitions, many rather incompatible with numerical manipulations. And in visual planetary studies, the particular behavior of the eye must be taken into account.

From these complications in the definition and the investigation of resolution, we should like to choose a road which is both accurate and efficient for our purposes of exhibiting how to calculate and how to attain the limits of resolution. To a very great extent, this can be done in a way that represents other approaches to resolution. I.e., many types of resolution can be derived from each other, and the optimum values of the free variables coincide under given initial conditions for each type. Therefore, we make no attempt at a comprehensive treatment of all types of resolution. Instead, we need only develop those types which are necessary for our analysis -- a few others being mentioned in passing to indicate where they fit in.

Certain applications of tolerance relations, mentioned in the introduction, provide a very unified, although rather novel, approach to resolution. This is the approach we take, because it is also extremely natural and certainly well-motivated. A lack of the necessary geometric and topological foundations undoubtedly explains its not being discovered and used before. For our studies, a further advantage to this approach is its applicability to other considerations, such as the representation and interpretation of the visually perceived planetary image -- to be taken up in later chapters of this work.

Consider the visual field X of the right eyeball and two images A' and B' on X. If the eye cannot tell A' from B', we say that A' and B' are <u>indistinguishable</u> and write $A' \sim B'$; if A' and B' are not indistinguishable, we say A' and B' are <u>distinguishable</u> and write $A' \not\sim B'$. By the very definition of the relation symbol $\sim$, it is <u>reflexive</u> (i.e., $A' \sim A'$, for any image A' on X) and <u>symmetric</u> (i.e., $A' \sim B'$ and $B' \sim A'$ mean the same thing). Any relation among pairs of elements of a set which is reflexive and symmetric is called a <u>tolerance relation</u>. If we let //X// be the set of all images on the <u>right visual field</u> X , then we see that the relation just defined for //X// is a tolerance relation completely characterizing the resolution of the right eyeball. This tolerance relation is called the resolution tolerance of the right eyeball; of course, it varies for different specimens of right eyeballs. Moreover, given an arbitrary tolerance of the images on a visual field, we can imagine an idealized right eyeball which has this tolerance for its resolution tolerance, although practical realization seems next to the impossible. Observe also that we do not have to restrict this type of consideration to the eye; any other light detector will serve just as well for these definitions. We shall call any tolerance relation for images on an optical field a resolution tolerance, or simply either "tolerance" or "resolution", used more or less interchangeably. Similarly, "indistinguishable" and "distinguishable" are interchangeable with "unresolvable" and "resolvable", respectively.

We have managed, at this point, to embed the problem of studying visual resolution in the problem of studying tolerance relations for images on an optical field -- the latter being somewhat larger and more mathematical. By utilizing the abstract mathematical nature of an image on an optical field (i.e., a non-negative, real-valued function) in terms of the brightness of an image at each point of the field, we are in a position to formulate a mathematical problem, which, restricted to the study of vision, is precisely our problem of discussing resolution and its role in visual planetary astronomy. We can go no further in this note than to outline a few of the results of such a mathematical study.

In later chapters we shall be concerned with what types of objects we can resolve. Just now we are more concerned with finding some sort of "measure" of resolution which tells us (in some sense) just how much we can resolve. In particular, we wish to define the concept of a resolution character (a numerical quantity, depending upon resolution) in order to indicate its useful properties, and then to find such a function which we can use. The main property of a resolution character is given by its definition: it is a number, some power of which gives a direct relative measure of the quantity of objects which can be resolved in a homogenous image. There is a further restriction that, for objects distributed in just one dimension, the resolution character itself should measure the quantity of these objects discernible. Hence, if the image were a series of randomly spaced parallel lines, and two observers were realizing resolution characters of 3 and 2, respectively, then the second would resolve 3/2 times as many lines as the first. If, on the other hand, the image were made up of randomly spaced points, a dimensionality argument shows that the second observer would see $(3/2)^2 = 9/4$ times as many points as the first. For homogenous distributions of other objects, the second observer would detect $(3/2)^r$ times as many objects as the first, for some real number r. In the cases we meet, r will generally be no greater than 2 and no less than 1 (as might be reasonably expected). That it is possible to have a function that is a resolution character which is st[illegible]ble (i.e., which works for all configurations coming into consideration) for visual planetary work is a rather lengthy mathematical exercise.

Strictly speaking, resolution is a function of things other than just the image: apparent brightness, contrast sensitivity, contrast of markings, aperture, seeing conditions, transparency conditions, etc. We have managed to eliminate transparency conditions (for our purposes) by including them in apparent brightness and contrast sensitivity limitations; at least for our purposes, this causes no difficulty and more than a little simplification. Also, in the first section of this chapter, we have tried to force the brightness and contrast sensitivity to a uniform value for the various planets -- the uniform value being, generally, the optimum value or at least in an optimum range. This procedure also results in our not having to worry about these considerations in studying resolution, provided that we stay within the limits given by the last section. Under the assumption that the contrast of markings on the various planets is constant, we could drop that restriction; however, this does not seem to be the case -- even at first glance. Nevertheless, since an image is made up of continuous tones and not just light and dark tones, it is best not to try to include directly the contrast of markings on the image in the formulation of a resolution character; further justification for this is the variability of the contrast among markings. Also, what is more useful for later considerations, the elimination of the dependence of a resolution character upon the contrast of markings enables us to use the resolution character in the study of the markings themselves (to be shown in a succeeding chapter).

From this rather brief discussion (it can be rigorized), we see that the effects on resolution with which we are most concerned are those due to the aperture of the telescope and to the seeing conditions at the time of observation. In particular, we should want any resolution character that we define to vary only as a function of aperture and seeing conditions -- provided that the other conditions in the above paragraph are met with. To do this, we shall have to impose some further restrictions on the magnification being used in order to obtain optimum resolution -- just as we had to do for optimum contrast.

We now proceed to the definition of a resolution character which best fits our purpose. Note that if we let s' be the smallest angular separation discernible between two points of light at apparent magnitude 6, then s' is just one of the classical definitions of (numerical) resolution. In fact, if we let $S' = 1/s'$, then S' is essentially a resolution character. Also, from diffraction theory and assuming perfect seeing conditions, s' is inversely proportional to D, the diameter of the telescope objective; and hence D is directly proportional to S', Dawes' criterion giving $4''.56(S') = D$. For these conditions of perfect seeing D is also a resolution character. This observation concerning the relation of S' and D under perfect conditions motivates our own definition of a resolution character which we will use exclusively. The standard resolution character D^* is defined as the diameter a telescope would have (i.e., the apparent diameter) under perfect conditions of seeing in order to produce an image equivalent to the one being observed in the given situation. Thus, an observer may be observing with a 10" telescope but only resolving all that a 6" telescope under perfect conditions can resolve and no more; according to our definition, the apparent diameter $D^* = 6$ even though the actual diameter $D = 10$. It is clear that the quantity D^* defines a resolution character for all conditions. Note also that the apparent brightness B^*, the apparent contrast c^*, and the visual contrast sensitivity $\bar{c}^*$ are not functions of D^*, but of D.

Having defined the resolution character D^*, we should like to be able to compute it. For this, we must note that the principal sequence of obstacles light rays meet in their journey from planet to eye are, in order, the earth's atmosphere, the telescope objective, the eyepiece, and the observer's eye. It is a mathematical exercise to check that D^* is proportional to $a/(a+t)$, where a is the radius of the diffraction disk of a point of light and is simply the familiar $a = 5''.5/D$, and where t is the turbulence and is equal to the radius (in seconds of arc) of the seeing disk caused by deformation of light from a point source. Since this constant $a/(a+t)$ of proportionality is just equal to 1 in conditions of perfect seeing (i.e., when the turbulence $t = 0$), then, except for limitations that might be given by the magnification being used and the observer's eye, we have:

$$D^* = \frac{a}{a+t} \cdot D = \frac{5.5(D)}{5.5 + tD} . \qquad (7)$$

The effect of magnification and of the resolving power of the eye may be treated together as follows:

First, let us suppose our "telescope" is the eye itself, and that we can vary its diameter (with diaphragms). Since the optics of the eye are not so good as those of a telescope, we should expect, even under perfect conditions, that D_e^* (the apparent or effective diameter of the eye) would vary in a different manner with D_e (the actual diameter of the entrance pupil into the eye). This is in fact the case, as is shown

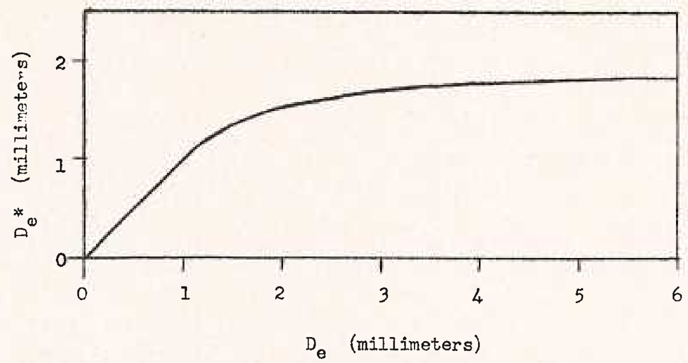

FIGURE 9. Resolving power of the eye of Charles Giffen shown as the variation of the effective diameter D_e* of the eye with the actual diameter D_e. These values were determined experimentally with the writer wearing glasses -- as he does when he observes. Always in making such a graph, the observer should correct for myopia or hyperopia; and if he wears glasses that correct for astigmatism when observing, he should correct for astigmatism as well. See also text of Mr. Giffen's article.

in Figure 9, where the variation of the writer's eye is shown. For $D_e \leq 1$ mm., almost all eyes have equivalent sensitivity, given by $D_e^* = D_e$ in this range. For a few people, this relation holds for slightly greater values of D_e (up to about 1½ mms.); but imperfections in the optics of the eye and the discontinuous structure of the retina impose an upper limit on the value which D_e^* can assume -- usually about 2 mms. Always, $D_e^* \leq D_e$. Just as before, the employment of magnification results in the eye's being diaphragmed, so that $D_e = 1/p$ (p being the power per unit of aperture). Manipulation of formulae (5), (6), and (7) gives the following <u>general formula for the resolution character</u> D* :

$$D^* = \frac{aD}{(a+t)} = \frac{5.5(D)}{5.5 + tD}, \text{ when}$$

$$\frac{a}{a+t} = \frac{5.5}{5.5 + tD} \leq \frac{D_e^*}{D_e} ; \qquad (8a)$$

$$D^* = \frac{D_e^* D}{D_e}, \text{ when}$$

$$\frac{a}{a+t} = \frac{5.5}{5.5 + tD} \geq \frac{D_e^*}{D_e}. \qquad (8b)$$

Now, in perfect seeing, t = 0, and the ratio a/(a+t) = 1; since neither a/(a+t) nor D_e^*/D_e ever exceeds 1, and since the first ratio in conditions of perfect seeing is 1, then formula (8b) gives us the value of the resolution character. And, under these perfect conditions, (8b) reaches its maximum only when $D_e^*/D_e = 1$; therefore, <u>under perfect conditions we must choose a magnification high enough for</u> $D_e^* = D_e$. Choosing the conservative value of 1 mm. (which holds for almost all observers), and converting to inches, we see that a D_e no greater than 1/25 inch will give the complete resolution possible in perfect conditions. I.e., a typical person observing in perfect seeing conditions must use at least 25 power per inch of aperture (since $p = 1/D_e$) to resolve all detail possible.

At any rate, for given observing conditions, a/(a+t) is determined, and we must employ a low enough D_e so that D_e^*/D_e is greater than or equal to a/(a+t) , if we are to maximize D* and hence obtain maximal resolution for the conditions. This means that for given values of a/(a+t) , there are minimum values for the power per inch which one can employ. For a typical specimen of the eye, these minimum permissible values of p are given in Table 3; for a given specimen of the eye, one may plot D_e^*/D_e against D_e and solve the equation $D_e^*/D_e = a/(a+t)$ for D_e using this graph - then the reciprocal of D_e (taken in inches) gives the minimum power per inch $\bar{p}$ which should be used.

Table 3. Resolution Powers per Inch for Given Impersonal Efficiencies a/(a + t)

a/(a + t)	$\bar{p}$
0.30	4.2
.35	4.9
.40	5.8
.45	6.7
.50	7.7
.55	8.6
.60	9.5
.65	10.6
.70	12.0
.75	13.8
.80	15.6
.85	18.1
.90	20.4
.95	22.7
1.00	25.0

Based on a typical eye, somewhat worse than that in Figure 9.

From the identity a/(a + t) = 5.5/(5.5 + tD) , we see that we need only to calculate the turbulence in order to obtain this critical ratio. Actually, in the next chapter, our considerations of seeing allow us to calculate this ratio directly and at the same time to determine the minimum permissible value $\bar{p}$ for p . This value $\bar{p}$ is called the resolution power per inch for the given conditions; in a similar manner, $\bar{P} = \bar{p}D$ is the resolution power for a telescope of aperture D . The most comfortable ranges which observers usually find range from $\bar{p}$ to $3\bar{p}$ for the power per inch being employed. Note that with Saturn, especially in good conditions, one is limited to staying near $\bar{p}$ (which in good conditions is nearly 25) by contrast considerations (see Table 2 and Figure 8); to a lesser extent, the same holds for Jupiter.

Footnotes

[1]The first two chapters are an amplification of a paper, "Resolution, Contrast, and Seeing in Visual Planetary Astronomy", presented in popular form at the Tenth A.L.P.O. Convention in Montreal on September 3, 1962. The introduction has been prefixed as useful background material, as an editorial on the present status of visual planetary observing technique, and as an exposition of the approaches to, and goals of, this series of articles, more of which are forthcoming. A more complete edition of the entire manuscript will be made available in the future, as it is beyond the limits of reason to use excessive space in this journal.

[2]Numbers in parentheses refer to the bibliography at the end of the paper.

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(to be continued).

MERCURY'S LIBRATION IN LONGITUDE

By: Dale P. Cruikshank

Owing to the eccentricity of the orbit of Mercury (amounting to 0.20563 at January 0, 1956, but the value is slowly changing), the planet undergoes a libration in longitude as seen from the earth. This libration now amounts to $\pm 23^\circ 40' 46''.6$ and alternately exposes the east and west limb regions. These libratory regions are of great importance in evaluating drawings of Mercury and in the construction of planispheres.

Lowell gave an adequate derivation of the formulae for this libration in his "New Observations of the Planet Mercury", Memoirs of the American Academy of Arts and Sciences, Vol. XII, No. IV, p. 433, 1898. M. B. B. Heath published the same derivation in The Journal of the British Astronomical Association, Vol. 69, No. 1, p. 46, 1959, and gave a table of libration versus days past perihelion. This relation is to be prefered over libration versus heliocentric longitude because of the precession of the perihelion of Mercury's orbit. Perihelion passages are listed each year in The American Ephemeris and Nautical Almanac.

Figure 10 was constructed from Heath's table. I have found it very useful for my own work. Its accuracy is probably limited to about $0^\circ.5$ in longitude and one day in time.

The nomenclature has caused some confusion in the past. A positive libration means that the mean center of the disk is displaced toward the positive direction, and the opposite limb is exposed. On planispheres, concepts of lunar crater development, intensity measurements on planets, and color photography of the moon and planets. More papers are needed - qualified members are invited to contribute suitable papers, and again there is a need for haste before the Convention.

To find out more about the San Diego Convention, COME AND ENJOY IT. There will be several delightful features we're not mentioning here!

ANNOUNCEMENTS

New Address for Uranus-Neptune Recorder. Mr. Leonard B. Abbey's address is now Box 22236, Emory University, Atlanta 22, Georgia.

Request for July-August, 1962 Issue. The Pan American College Library would like a copy of this issue to complete their file of Volume 16. This issue is out of stock. Persons interested in furnishing this issue should correspond with Professor Paul R. Engle, Director, Pan American College Observatory, Edinburg, Texas.

A.L.P.O. Activities at League Convention. Although the A.L.P.O. has no official role in the Astronomical League National Convention at Orono, Maine on July 18 - 20, 1963, the League has graciously invited attending A.L.P.O. members to participate on an individual basis. Persons having papers to read should send them directly to Mr. Ralph K. Dakin, 720 Pittsford-Victor Road, Pittsford, New York. Persons having drawings, charts, and photographs to exhibit should make arrangements with Mr. John E. Welch, 107 Lower Beverly Hills, West Springfield, Massachusetts. They should naturally inform Mr. Welch how much space their material requires. There is, of course, a need for great haste with both papers and exhibit materials.

We wish our friends in the Astronomical League a very successful Convention and a splendid view of the total solar eclipse.

Acknowledgment. We want to thank all those who have commented in correspondence on the "open letter" on pp. 40 and 42 of the Jan.-Feb., 1963 issue. It is always helpful to receive the opinions of our readers. We want to thank even more those who have reacted by sending stamped, self-addressed envelopes for the use of our Recorders. It is true, however, that our two Canadian Recorders cannot use United States postage stamps.

East and West on the Moon. We also very much appreciate the correspondence received from members about the usage of lunar east and west (see pp. 35-36 of Jan.-Feb., 1963 issue). Clark Chapman, Dr. Seville Chapman, Alika Herring, James Bartlett, David Barcroft, J. Russell Smith, and a few others have expressed their opinions. After some thought, we have come to these conclusions:

1. It is recommended that A.L.P.O. members follow the usage of the I.A.U. resolution of 1961, which names these directions so that the moon rotates from west to east. Thus, Mare Crisium is in the moon's east hemisphere; Oceanus Procellarum, in the west hemisphere. Whatever the merits or demerits of this terminology, it is now in wide usage and will continue to be widely employed. The A.L.P.O. wants to follow that usage which will create least confusion and will help most in lunar studies.

2. It is very strongly urged that all writers in The Strolling Astronomer clearly and adequately describe how they are applying east and west on the moon. This plan is obligatory while two contradictory systems are both in use.

Lunar Training Program. All new members of the A.L.P.O. and also older members who have never done much systematic observing are especially invited to join Clark Chapman's Lunar Training Program. His article "The Art of Lunar Drawing" elsewhere in this issue will be helpful to them.

The Strolling Astronomer

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And Planetary Observers

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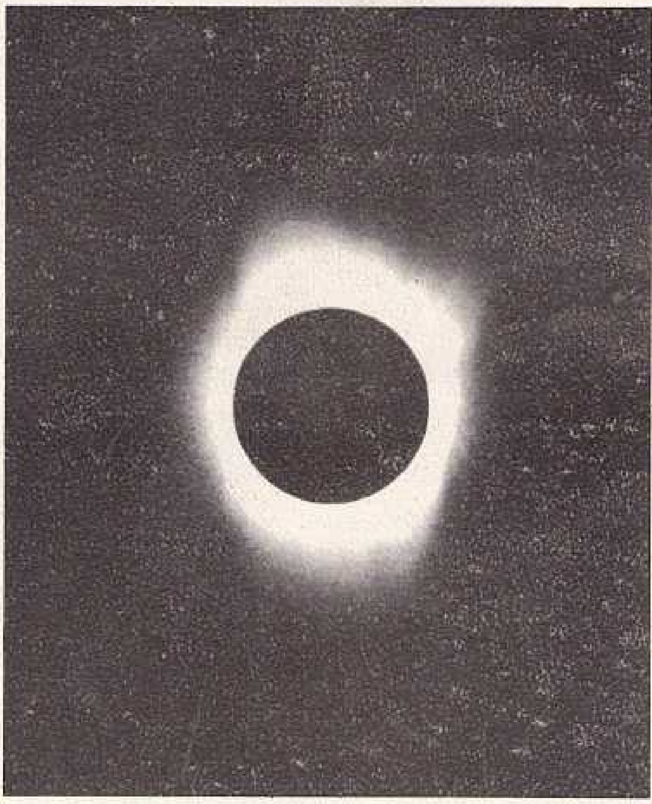

Photograph of total solar eclipse on July 20, 1963. Taken by David Meisel at Moose River, Ontario, Canada at 21 hrs., 27 mins., 35 secs., Universal Time (4:27: 35 P. M., E.S.T.). Exposure 1/4 sec., no drive. Telephoto lens of focal length 13.5 cms., f 4.5. Adox KB - 14 film. Developed for 14.5 minutes in X 22. See also article on pp. 120 - 123 of this issue.

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ASSOCIATION OF LUNAR & PLANETARY OBSERVERS
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Founded In 1947

IN THIS ISSUE

AN ANALYSIS OF SCHMIDT'S OBSERVATIONS OF LINNÉ

By: Joseph Ashbrook

1. Linné is one of the largest and most conspicuous of the diffuse bright spots that are scattered in great numbers over the lunar maria. Since it has been observed much more fully than other bright spots, Linné is especially important to our knowledge of this class of object, of which it is a typical example.

One very valuable series of observations was made by J.F.J. Schmidt[1] with the 6-inch refractor of Athens Observatory between October 16, 1866, and July 21, 1874. Altogether it includes 206 inspections. This series by a skillful and experienced selenographer gives us the means of tracing in detail the varying aspect of Linné during the course of a lunation. From Schmidt's 1866-74 observations we can obtain an overall picture that will be a reliable standard of comparison for earlier and later findings.

2. Reductions. I have calculated the colongitude for each of Schmidt's observations, using Graff's tables[2]. Usually he noted the time to the nearest whole hour, for which cases only I cite colongitudes to 0°.1. In a good many instances, he gives only the date, and I have been obliged to estimate the hour on the basis of the moon's phase, or the hour of the preceding or following observation. In those cases, the colongitudes are uncertain by 1° or 2°.

Since the selenographic coordinates of Linné are Xi = +0.1809, Eta = +0.4649, sunrise at the formation occurs when the colongitude is about 348°, sunset at about 168°.

Schmidt reports many estimates of dimensions in terms of the diameters of neighboring craters. For these crater diameters I adopt Arthur's values[3], expressed in thousandths of the moon's radius: Bessel, 9.1; Sulpicius Gallus, 7.0; Linné A, 2.4; Linné B, 2.9; Linné F, 2.9. The last three craters are referred to as "A","B", and "C" by Schmidt.

In the present article, the terms east and west are used in the ordinary selenographic (not astronautical) sense: Oceanus Procellarum east of the lunar central meridian, Mare Crisium west of that meridian.

3. General Character of Linné. According to Schmidt's observations, Linné consists of a minute crater within a much larger diffuse bright area. At sunrise this white area is invisible, and the craterlet's raised rim appears bright. For a brief interval -- only an hour or two -- the grazingly sunlit crater casts a long exterior shadow. What Schmidt refers to repeatedly as the "bright hillock" or "shadow-casting hill" is simply the rim of the craterlet itself. Later during each lunation, when the sun is higher above Linné, the white area appears larger and more brilliant; and the interior shadow of the craterlet is visible as Schmidt's "black dot". Under a still higher sun, the dot is gone but inside the white patch a bright nucleus may be seen, evidently the interior craterlet. The same appearances occur in reverse order as sunset on Linné approaches but are less completely documented, for the Athens astronomer made many more observations before full moon than after.

A demonstration of this pattern from the 1866-74 observations is given in the following sections, with some further details.

4. Evidence for an Interior Craterlet. The three most specific observations of the craterlet that Schmidt cites are these:

Colong.	Date	
21°	1869, Feb. 20	"With 600x, I recognize Linné as a small craterlet, in diameter 1/6 Linné A, and half-filled with shadow."

Colong.	Date	
24°	1869, July 27	"Linné has the appearance of a minute crater inside a very bright nimbus. Diameter = 1/2 Linné A, 1/2 Linné B."
163	1868, July 10	"Very small point of light, surrounded by a dull nimbus. Diameter of inner point = 0.1 Linné B. With 600x I came to the conclusion that this point is an extremely small crater, 1/10 or 1/12 the diameter of the former Linné."

The three determinations of the craterlet diameter are 0.0004, 0.0013, and 0.0003 of a lunar radius, respectively; the average is 0.0007 of a moon radius (1.2 kms.)

A modern value of the diameter is Arthur's[3]: 0.0012 of a moon radius (2.0 kms.), but he does not state explicitly where it came from. The micrometric measurements with large refractors agree well with Schmidt's estimation. Thus W. H. Pickering[4] (5 nights with 13- and 15-inch refractors, 1892-98) found 1.3 kms. E. E. Barnard[5], with the Yerkes 40-inch telescope, obtained 1.1 kms. from two nights' measures in 1903-04; C. W. Wirtz[6], with the 19-inch refractor at Strassburg, on two nights in 1903 measured 0.7 kms. R. Jarry-Desloges[7] in 1917 found 1.2 kms. from measures on two nights.

Schmidt (page 163) has some interesting additional comments. In March, 1875, he observed Linné carefully with the 9.6-inch Berlin Observatory refractor, and confirmed that the "black dot" was actually a very small walled crater. He states further that A. Secchi (9.6-inch refractor, Rome) and H. C. Vogel (11-inch refractor, Bothkamp) had recognized the craterlet before 1875.

5. Exterior Shadow of Craterlet. Because Schmidt had very extensive experience in finding heights of lunar features by measuring shadow lengths, he was able to judge heights roughly from simple inspection. In the following observations of Linné near sunrise, the shadow is that cast eastward by the east wall of the crater, and the height is that of the east rim above the surrounding plain.

Colong.	Date	Description
348°.9	1868, Aug. 24	"L. appears a well-defined bright hill and -- something I had not seen before -- cast a sharp shadow almost 10" long, so that it can be 60-70 toises high, or probably more." This value corresponds to about 140 meters.
349.1	1866, Dec. 13	Small hill, diameter 0.0007 of a moon radius, height 1/4 that of outer wall of Linné B.
349.3	1868, June 26	Hill almost shadowless, "hence scarcely 20 toises high." This is about 40 meters.
351.9	1867, May 10	Very bright shadow-casting hill. "From the shadow I judge 70 toises high." This is about 140 meters.

To evaluate the second observation, we note that D. W. G. Arthur's diameter-rim height relationship[8] for small craters predicts an outer wall height of 188 meters for Linné B, and 1/4 of this is 47 meters. Averaging all four of Schmidt's estimates, we get approximately 90 meters for the outer east wall height of Linné itself.

This result agrees well with the 94-meter rim height I have found[9] from my own observations of 1960-62.

6. Interior Shadow. Schmidt on 21 different dates mentions specifically a "very small black dot" inside the white area. The colongitudes (rounded to whole degrees) at which he saw this are: 0, 4, 4, 5, 6, 7, 8, 8, 9, 10, 11, 11, 11, 14, 18, 21, 24 (very plain), and 25 (trace). Before sunset on Linné: 152, 152, and 156. Schmidt states that on 1869, May 20 (colong. 36°) he looked for but missed the dark dot. These observations clearly refer to the interior shadow of the craterlet, and correspond well to what is reported by good present-day observers[10]. Schmidt's record of a trace of interior shadow at colongitude 25° indicates that the inner wall of Linné is at least as steep as 32°. This must be a minimum value for the gradient because a 6-inch telescope is small for such a delicate observation.

Compare this with an observation at colong. 33° on June 5, 1941, by H. M. Johnson and Frank Vaughn[11]. With an 8-inch refractor at 480X, they saw a "minute circular dark spot, brightened perhaps at the edge as if rimmed." At that time the sun's elevation above Linné was 38°. Again, with a 10-inch reflector on January 24, 1956, Vaughn[12] detected a crescentic interior shadow at colong. 45°.9 (solar elevation 48°). Walter H. Haas with an 18-inch refractor in 1942 observed morning shadow as late as colongitude 59°.0. This last report implies a steepness of the inner west wall of 57°!

Again, the accord between Schmidt's 1866-74 descriptions and modern ones is excellent.

7. Early-morning Development of White Spot. I have sorted in order of colongitude the 38 descriptions by Schmidt of the appearance of Linné soon after local sunrise. With trivial exceptions, they fit into the following pattern.

Colong.	No. of Obsns.	Typical Description
347° - 349°	10	Small hill; no mention of bright spot.
350° - 354°	7	Small hill; little or no indication of surrounding bright spot.
355°	3	Small hill inside a gray nimbus.
356° - 1°	7	Bright spot; no mention of hill.
2° - 24°	11	Conspicuous bright spot.

Schmidt's pattern is the same one familiar to us today -- the white spot is invisible at sunrise; it is small and inconspicuous a few hours later; it grows and brightens rapidly during the next day or two.

8. Bright Core. On 14 occasions, Schmidt recorded a tiny bright nucleus inside the Linné white spot. The colongitudes in whole degrees at these sightings were 357, 359, 7, 8, 23, 69, 73, 80, 95, 105, 107, 160, 161, 163. Three of these records mention interesting details. On 1868, September 24 (colong. 8°) a black dot was seen inside the nucleus; on 1867, February 18 (73°) the nucleus seemed nearly as large as Linné B; on August 20th of the same year (161°) it was 0.1 times the diameter of Sulpicius Gallus.

The bright core is obviously the interior craterlet.

9. Position of Craterlet Inside Bright Spot. Is the craterlet eccentrically located in the white area? The following observations are affirmative:

Colong.	Date	Schmidt's Description
359°	1867, Feb. 11	Hillock is somewhat west of center.

Colong.	Date	Schmidt's Description
359°	1867, June 9	Small hill displaced west from center.
0	1867, Aug. 7	Small hill is in west part of bright spot.
0	1868, Apr.29	Small hill a little west of center.

However, on several other occasions the craterlet is mentioned as central. Schmidt states that on 1867, January 24 and 25 (colong. 132° and 156° respectively), the white spot showed a faint, diffuse extension toward the west.

It is worth mention that the Athens astronomer noted each of these phenomena only within a rather limited range of colongitude. Does the white spot change in shape (as well as in size) during the course of a lunation?

10. Schmidt's Observations of 1841-43. In addition to Schmidt's systematic observations of Linné at Athens Observatory in 1866-74, there are also a number of drawings of Mare Serenitatis he made as a boy in 1841-43, using small telescopes. These early observations are described in his 1878 book, pages 156-157. Because they have been misinterpreted by several authors of popular books on the moon, it is necessary to correct an impression that these drawings are serious evidence that Linné was once a large crater. On the contrary, a critical analysis of Schmidt's own statements will show that his primitive observations of 1841-43 are reconcilable with his much better work of 1866-74.

Of the early drawings, 10 show nothing in the position of Linné. Their colongitudes in whole degrees are 333, 352, 354, 357, 358, 9, 164, 168*, 175, and 175*. The two starred drawings were made with 88X, the others with magnifications of only 8X to 20X. The colongitudes explain the nonappearance of the Linné we know; in each instance it was either unilluminated, a hill too small to be seen, or an inconspicuous nimbus. At colong. 9° it probably was noticeable, but may have been omitted by chance.

Two drawings indicate some object of unspecified nature in or near the place of Linné, at colongitudes 351° (identity uncertain) and 151°.

Two other drawings show a bright spot, at colongitudes 34° (identity uncertain) and 99°. Under such illuminations, Linné today is also a bright spot in small telescopes.

There remain only five drawings for consideration:

Colong.	Date	Magnif.	Schmidt's Description
18°	1842, Sept.13	88X	Drawn as a crater, diameter = 1/2 Sulpicius Gallus.
37	1843, May 9	88X	One of 22 craters drawn in M. Serenitatis. In the drawing "unquestionably a crater, but scarcely as large as S. Gallus."
133	1841, Dec.2 a.m.	20X?	Crater near the place of Linné.
143	1841, Dec.2 p.m.	20X?	Crater exactly in position of Linné, 1/4 smaller than Bessel.
145	1841, Dec.3 a.m.	20X	Same.

We must bear in mind that Schmidt's descriptions were not made at the time of observation, but when he examined these drawings a quarter century later. There is no indication that Linné received any special attention during these observations. At all five colongitudes, Linné today is a conspicuous bright spot, some distance from the terminator. The obvious explanation is that Schmidt with his small instrument mistook the white area for a bright crater floor. The recorded dimensions of the "crater" agree with this hypothesis.

Thus we see that Schmidt's 1841-43 records of Linné, when carefully weighed, are consistent with its appearance in 1866-74 and today.

11. Conclusions. J.F.J. Schmidt's very extensive observations of the Linné craterlet and bright spot, made in 1866-74 with the 6-inch refractor of Athens Observatory, agree in detail with recent work. The dimensions of the craterlet, the sunrise phenomena, and the behaviour of the bright spot under changing illuminations are the same as we see at present. No evidence can be safely drawn from Schmidt's observations of 1841-43 to support the old idea[13] that Linné underwent a physical change in the middle of the last century.

References

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2) K. Graff, Formeln und Hulfstafeln zur Reduktion von Mondbeobachtungen (Dissertation). Berlin, 1901, pages 43-45.

3) D.W.G. Arthur, "Consolidated Catalog of Selenographic Positions," Communications of the Lunar and Planetary Laboratory, University of Arizona, 1, No. 11, 1962.

4) W. H. Pickering, "Visual Observations of the Moon and Planets," Harvard Annals, 32, Part 2, 203, 1900.

5) E. E. Barnard, "Changements periodique constatées sur l'entourage du cratère Linné", Bull. Soc. Astron. de France, 20, 220-221, 1906.

6) C. W. Wirtz, "Resultate aus Beobachtungen wahrend der Mondfinsternisse 1903 April 11", Annalen der kaiserl. Universität-Sternwarte Strassburg, 3, C16, 1909.

7) R. Jarry-Desloges, Observations des surfaces planétaires, 6, 259-261, 1923.

8) D.W.G. Arthur, "Some Systematic Visual Lunar Observations", Communications of the Lunar and Planetary Laboratory, University of Arizona, 1, No. 3, 24, 1962.

9) J. Ashbrook, "Dimensions of the Linné Craterlet", Strolling Astronomer, 17, 26-28, 1963.

10) For example, D. P. Avigliano, "Aspects of Linné", Strolling Astronomer, 7, 166-168, 1953. The "mound" he mentions is merely the raised wall of the craterlet.

11) W. H. Haas, "Does Anything Ever Happen on the Moon?" Jour. Royal Astron. Soc. Canada, 36, 258-260, 1942.

12) W. H. Haas, "Linné", Strolling Astronomer, 9, 120, 1955.

13) J. Ashbrook,"Linné in Fact and Legend", Sky and Telescope, 20, 87-88, 1960.

SIMULATED VISUAL DICHOTOMY OBSERVATIONS -- PRELIMINARY REPORT

By: Charles H. Giffen

At two successive recent meetings of the Observing Group (O.G.) of the Amateur Astronomers Association in New York, members made estimates of the phase of a simulated inferior planet at various stages of an evening (eastern) apparition. The methods used to determine the phase on the two occasions were different, although the results were substantially the same.

Only Delano, Goodman, Haas, and Schneller participated in this program; and Schneller's contribution was limited to a single date using two filters.

Table III

Intensity Estimates of Ring A with Color Filters.

Filter	Transmission Range (mμ)	Transmission Maximum (mμ)	No. Observers	No. Observations	Mean Intensity of Ring A*
Wratten # 25	590 - 700	617	4	18	3.8
" # 47	400 - 530	470	1	6	4.8
" # 48	400 - 520	471	2	7	4.9
" # 57	460 - 620	531	1	5	4.0
" # 58	470 - 610	538	2	12	4.0
integrated light			2	9	4.0

* The intensity of the outer part of Ring B is set at 5.0 and is used as a reference standard.

The filters used for these observations, together with their transmission characteristics, are shown in Table III. It can be seen from the data in Table III that the discrepancy between the two rings was greatest in red light (Wratten # 25 filter), while in integrated and green light (#57 and #58 filters) the differential was slightly reduced. With blue filters (# 47 and # 48), the intensity of Ring A was only slightly below that of Ring B. Goodman found Rings A and B indistinguishable with a # 48 filter on six occasions, but none of the observers reported A brighter than B at any time. These results tend to confirm Schneller's impression in 1961[1]. It is hoped very much that more observers will submit data for this program in 1963.

Saturn was occulted by the moon on September 11, 1962. Johnson, using prime focus photography with a 10.5" refractor at Boulder, Colorado, obtained a sequence of pictures of approach and immersion, of which one is displayed as Figure 5. He observed the event visually with a 4-inch guide refractor and timed two immersion phenomena: the inner edge of Ring B on the preceding side at $1^h 51^m 51^s$ U.T. and the outer edge of Ring A on the following side at $1^h 53^m 20^s$. Immediately after the disappearance of Ring A, Johnson felt that he could detect a faint patch of light for a second or two but expressed hesitancy about calling it an observation of Ring D. His impression could have been due to a lingering image of Ring A on the retina, akin perhaps to the image one sees when the eyes are closed after looking at a bright object.

References

1. Goodman, J.W., Str. A., 16, 69 (1962).

2. Cragg, T.A., Str. A., 15, 124 (1961).

ABSTRACTS OF THREE PAPERS READ AT THE A.L.P.O. CONVENTION IN MONTREAL

The following three papers were given at the Tenth A.L.P.O. Convention in Montreal in 1962. The abstracts here published were prepared for this journal by Mr. Thomas Stoeckley of Fort Wayne, Indiana. Mr. Stoeckley is a major in astronomy at Michigan State University. We regret that available space does not permit the full texts of the three papers to be published.

tact times; (15) to punch out station-identifying data and the corresponding computed contact times; (16) to return to the read statement (2) in order to repeat the sequence for the next station; and (17) "END" statement.

With the program and data cards loaded into the machine and the button pushed, answers were cranked out. Certain errors were found and corrected, and the entire operation -- programming, punching cards, compiling, and debugging -- took less than four hours, including just two minutes for the machine computations. Hand calculations for all 24 stations would have taken 24 hours.

Plato and Its Mysteries

By: Keith Peterson

The interior of Plato, one of the darkest areas on the moon, is believed to have once been lava. A few prominent craterlets are found on the floor, the largest being two miles in diameter. In addition, a large number of smaller pits, cones, and spots are present, plus a complex system of light streaks and patches. That the darkness of the floor increases with increasing solar altitude has been questioned, and the effect is considered rather to be due to increasing contrast.

During local sunrise, when the floor's eastern half is in sunshine, one line-like shadow extends beyond the "shadow cast" of the western rim all the way across the floor. As this shadow recedes, its outline changes, it grows broader and narrower, and sometimes it has a hooked tip. Twice after sunrise, black oval patches have been observed. At other times no patch is recorded.

Theories of the conformation of the crater floor are quite contradictory. Some say it is extremely convex. It may contain low ridges, and is probably rough, with irregularities and slopes. Others think that Plato is the most level spot on the moon.

The elusive craterlets and spots on Plato's floor sometimes appear and disappear, and change in visibility and intensity and observed size, often independently of each other and of libration and solar altitude. W. H. Pickering and others consider the interior to be an active volcanic region. Some features seem to be aligned in rows, increasing the evidence for volcanic action. Sometimes the interior detail will be temporarily but completely blanked out when features should be visible. Many observations by different observers lead some persons to the feeling that this obscuration is caused by lunar mist which may at first include one area, such as a certain craterlet, and spread out to cover the entire interior.

Other mysteries reported are flashes of light playing across the floor(exposed highly reflecting minerals?), parallel beams of light at sunrise, and two "tongues of light" visible for two hours one day past First Quarter.

VENUS SECTION REPORT: WESTERN APPARITION, 1961

By: William K. Hartmann, A.L.P.O. Venus Recorder

Part 1: Introduction; Observers and Observations

This Report will follow the format established in the Report of the preceding apparition[1,2]. In that Report, more extensive details are given on certain methods of reduction (e.g., illustrations of various "categories" of markings, Str. A., 16, 109-112). Reference should be made to that Report.

Observations were received from the observers listed below. The addresses of most of them were listed in an earlier Section Report[1].

Figures 9 - 14 show the appearance presented by Venus to various observers under good conditions and are typical. It should be emphasized again that the markings shown were seen or suspected only with difficulty by these observers, as indicated by their conspicuousness estimates.

Also included are two illustrations, Figures 15 and 16, showing the thin crescent photographed by Craig L. Johnson.

References

1. Hartmann, William K., 1962, "Venus Section Report: Eastern Apparition, 1960-1961. Parts 1-5", Str.A., 16, 106.

2. Hartmann, William K., 1962, "Venus Section Report: Eastern Apparition, 1960-1961. Parts 6-8", Str. A., 16, 171.

3. Bartlett, James C., Jr. 1958, "A Quantitative Approach to the Problem of the Cusp Caps of Venus", Str. A., 12, 43.

4. Bartlett, James C., Jr. 1958, "Some Statistical Notes on the Auxiliary Phenomena of the Cusp Caps of Venus", Str. A., 12, 123.

5. Hartmann, William K., 1962, "Venus Section Report: The Schröter Dichotomy Effect in A.L.P.O. Observational Records, 1951-1961", Str. A., 16, 222.

INDEX OF VOLUME 16 (1962) OF THE STROLLING ASTRONOMER

By: Dale P. Cruikshank and William K. Hartmann

Foreword by Editor. The need for an annual index of this periodical has been apparent to the Editor and others for years, but preparing and publishing such indices has proven curiously difficult. Considerable time and effort has been spent in indexing past volumes by Leif J. Robinson, Frederick W. Jaeger, and a few others. We are very glad to be able to present here an index of Volume 16 (1962) kindly contributed by Messrs. Dale P. Cruikshank and William K. Hartmann. Constructive criticisms of this index by readers will help guide our future thinking.

We realize that there are drawbacks to publishing an index as ordinary text. Doing so has appeared to be a practical procedure. Should there be sufficient demand, say by 50 to 100 persons, we would probably be able to furnish the index at small cost as a reprint from this issue.

Author Index

Subject Index

Comets

Earth

Jupiter

Lunar Meteor Section

Mars

Mercury

A.L.P.O. SIMULTANEOUS OBSERVATION PROGRAM SCHEDULE, SEPTEMBER - NOVEMBER, 1963

The standard programs for Jupiter and Saturn give preference to central meridian transits, intensity estimates, and drawings -- in that order. Note that on 9 Nov. strip sketches are to replace full disk drawings; these should be made of Jupiter from the NEB_n to the STeZ. An especially large number of satellite phenomena for Jupiter have been included; observers are urged to time these and supply detailed notes of their observations of these phenomena. Again the special Mercury project during the morning apparition is one in which observers are asked to make phase estimates of the planet by carefully sketching the shape of the planet onto a standard Mercury report form (available from the Mercury Recorder); observers are requested not to look up the predicted phase of Mercury from an ephemeris before making observations since this might easily affect the statistics on dichotomy.

Observers should also note that Mr. Giffen's address has changed back to the Mathematics Department, Princeton University, Princeton, New Jersey from his temporary summer address. Observations should be submitted to Mr. Giffen within two weeks after the scheduled target date.

Date	Planet	Observing Period	Project and Notes	
8 Sep.	Jupiter	07:30 - 09:30 U.T.	Standard.	D at 08:30; S at 08:04, 08:50.
14 Sep.	Saturn	05:00 - 07:00 U.T.	Standard.	D at 06:00.
22 Sep.	Saturn	05:00 - 07:00 U.T.	Standard	D at 06:00.
28 Sep.	Jupiter	06:00 - 09:00 U.T.	Standard.	D at 07:00, 08:30; S at 06:28.
4 Oct.	Mercury	Sunrise - A.M., L.T.	Special.	
5 Oct.	Mercury	Sunrise - A.M., L.T.	Special.	
6 Oct.	Saturn	04:30 - 08:30 U.T.	Standard.	D at 05:30, 07:30.
6 Oct.	Mercury	Sunrise - A.M., L.T.	Special.	
7 Oct.	Mercury	Sunrise - A.M., L.T.	Special.	
13 Oct.	Jupiter	04:00 - 08:00 U.T.	Standard.	D at 04:30, 06:00, 07:30; S at 04:34, 04:55, 06:53, 07:34.
20 Oct.	Jupiter	07:00 - 09:00 U.T.	Standard.	D at 08:00; S at 07:49, 08:57.
26 Oct.	Saturn	04:00 - 07:00 U.T.	Standard.	D at 05:00, 06:30.
2 Nov.	Jupiter	04:00 - 08:00 U.T.	Standard	D at 04:30, 06:00, 07:30; S at 04:16, 04:53, 06:27, 07:05.
9 Nov.	Jupiter	05:00 - 07:00 U.T.	Standard.	Strip sketches instead of D; S at 06:02, 06:49.
10 Nov.	Saturn	04:00 - 06:30 U.T.	Standard.	D at 05:00, 06:00.
25 Nov.	Jupiter	03:00 - 08:00 U.T.	Standard.	D at 04:00, 07:30; S at 03:24, 04:05, 05:09, 05:10, 06:16, 07:20, 07:42.

Abbreviations under "project and Notes" above are D for "drawing" and S for "satellite phenomena". All times and dates except those for Mercury are by Universal Time; those for Mercury are by local time.

Contributors to this program are requested to submit their work, whenever possible, on the standard A.L.P.O. Section Report Forms. Doing so will greatly help in the handling and reducing of the observational data.

FOUNDATIONS OF VISUAL PLANETARY ASTRONOMY. II.

PLANETARY SEEING AND TRANSPARENCY

By: Charles H. Giffen

[Foreword by Editor. Part I of this series by Mr. Giffen appeared on pp. 59-72 of our March-April, 1963 issue. The references for this present Part II have already been published on pg. 72 of that issue. Mr. Giffen and the Editor will welcome constructive discussion from readers about the subjects here treated.]

Abstract. Planetary seeing and transparency have been problematic entities for planetary observers -- as much or more so than with other astronomers. Why? Chiefly because planetary observers have discarded the purpose of such quantities, particularly for visual studies. Specifically,

it is the writer's contention that seeing and transparency evaluations should be oriented towards the determination of resolution character (which measures resolving power) and contrast sensitivity. The first chapter of this paper made it quite evident that such a course of action is within the realm of possibility. In this chapter, we aim to demonstrate that this can actually be done effectively and effortlessly.

We first consider transparency and give a scale whose values T_r are essentially those of L. J. Robinson's scale as adopted in slightly modified form by the A.L.P.O. (references 8 and 9). Our scale clears up, we feel, the ambiguities of the scale prescribed for the A.L.P.O. We further show the relevance of such a scale to the problem of determining contrast sensitivity, etc.

As for seeing, we shall see that all of the scales discussed in reference 8 are egregious, especially for the purpose which seeing is to serve. We present a discussion of seeing which leads to a prescription as to the basic type of seeing scale we should look for; the selection of such a scale (from several possibilities which produce equivalent results) is made on the basis of other practical factors -- the actual methods for determining (not merely guessing at) the seeing being indicated by the factors considered. After that, we point out the further advantages of this seeing scale which make it extremely feasible.

Finally, we summarize the results of this chapter and their effects on the results of the first chapter. To this we add a short discussion of the practical application of these combined results and make several recommendations concerning observing procedure and seeing and transparency scales.

1. Planetary Transparency. Transparency is the logarithmic form of transmission. That it, transmission is defined as the fraction of light transmitted by a medium (the atmosphere). We then define directly the transparency T_r by the following formula:

$$u_1 = 10^{0.4(T_r - 6)},$$

or also:

$$T_r = 6 + 2.5 (\log_{10} u_1) ,$$

where u_1 is the atmospheric transmission (corrected for the standard amount of absorption -- as are, e.g., stellar magnitudes). Because we may expect an observer to observe in more or less fixed locations, it is not difficult to determine the transparency on extraneous light-less nights. From experience, the observer decides what the faintest possible magnitude visible on a perfectly clear night is (at the zenith); then, he subtracts 6 from this to give his correction constant: to determine the value of T_r on an extraneous light-less night, the observer notes the faintest magnitude visible in the region of the planet being observed and subtracts his correction constant from it, thus giving the value of T_r. Here, extraneous light-less night is taken to mean absence of daylight, twilight, or moonlight, but allows the presence of lights normally illuminating the sky nightly, for the permanent presence of such lights is taken care of by the observer's correction constant for that location. Moreover, in other situations a reasonable value of T_r may be obtained. By making a table of correction constants for different phases of the moon and for different distances from the moon, T_r may be determined in precisely the manner described above. For daylight and twilight observations, the problem still seems to be difficult; but at twilight a fair approximation can be had by determining T_r while the sky is dark in the direction and altitude of the planet when making the observation.

It is clear that the transparency T_r, defined and determined in this way, is the most useful form that considerations of the subject can take; for T_r leads to a direct evaluation of the atmospheric transmission, which then allows a direct determination of the contrast sensitivity. Therefore, transparency as we have defined it serves its immediate purpose. Note also that this definition of transparency is useful for other than just visual observers.

We note here that T_r can never be greater than 6 by our definition. If an observer comes up with a value greater than 6 after subtracting his correction constant, then either a mistake in arithmetic has been made, or the observer has never seen such faint stars before as he did when making the transparency estimate. In the latter case, the observer should redetermine his correction constant at that time under the (presumably excellent) conditions of transparency.

Lastly, since transparency or transmission is meant to give a measure of obscuration or absorption of light beyond the normal value, and since it specifically does not measure the amount of extraneous light in the atmosphere, then the presence of known or constant amounts of extraneous light justifies ourdetermining the transparency T_r by the above methods, using the correction constant for the observer. Similarly, the correction constant includes allowance for exceptional specimens of eyes (since under identical conditions in the same location, two observers may have limiting visual magnitudes differing by as many as five or six). These considerations take care of the "wordiness" of the A.L.P.O. definition of T_r , by putting the real problems about "normal eyes", corrections for extraneous light, etc., into an easily determined correction constant. Thus we are able to determine accurately T_r in a large number of situations, and T_r is not made the object of a controversy over how to determine it but is itself a much desired physical quantity which can be determined easily on many occasions.[9]

2. Planetary Seeing. Planetary seeing is defined in terms of the fluctuations in the direction of light as it passes through the earth's atmosphere. Fluctuations in the intensity of a light bundle are properly referred to as scintillation, although the term seeing is frequently used for both types of fluctuations. We are concerned almost exclusively with planetary seeing; and hence we are most concerned with some sort of measure of seeing which can be applied directly to determining contrast and resolution. Because of our development of this subject, this really amounts to using such a measure of seeing for determining the resolution character. We have already defined the turbulence t as the angular radius of the cross section of a bundle of light from a point source after being deformed by seeing effects. It is turbulence which causes the reduction of the resolution character by means of the factor a/(a+t), which is just the ratio of the radius of the theoretically perfect central diffraction disk from a point bundle to that of the "false" disk (whose radius is the sum of the turbulence and the radius of the central diffraction disk). This ratio a/(a+t), which is numerically equal to 5.5/(5.5+tD), is called the impersonal efficiency of the system. If we call the ratio $D_e{}^*/D_e$ of the last chapter the personal efficiency, then as long as we make the personal efficiency greater than the impersonal efficiency, the resolution character D* is simply the product of the impersonal efficiency and the diameter of the objective. At any rate, the resolution character D* is the product of the lesser of the personal and impersonal efficiencies with the telescope aperture.

In instrumental, i.e., non-visual, observational astronomy one is usually concerned with all deformations of the image due to seeing; and turbulence measures all deflections of a bundle of light integrated over a period of time. In visual planetary astronomy, we are a little better off. If the "cells" of different refractive index in the air are large enough compared to the diameter of the telescope objective, then what happens with the focal point of a bundle is that it wanders both laterally and in depth with respect to the focal plane. If these cells pass the objective at a relatively low frequency (at least as slowly as 7 times per second), then the eye may be able to follow the motion of the image laterally and can also refocus as the focus shifts. In fact, the eye does this involuntarily even for a perfectly still image; the process is called scanning, and if it did not take place, the sensitivity of the eye would be greatly lessened as one watched an image (due to retinal fatigue and accommodation). Hence, everyone can "follow" up to a certain amount the motion of a telescopic image as described. Beyond these limits, a point bundle (and hence an image) becomes blurred and somewhat more stationary as the eye studies the image. And, of course, if the cells are relatively small compared with the telescope objective, then the effect holds even instantaneously. It has become general usage with visual observers to refer to a seeing "pattern" which the eye can follow as a slow seeing pattern and to one which it cannot follow (i.e., blurring) as a fast one. The dividing line between such patterns depends upon the observer (younger people can frequently follow patterns due to large cells more easily than the average person). But, since seeing should help us determine how much we are able to see (i.e., the resolution character), it is quite reasonable to include this element in the determination of seeing if we desire; in fact, we shall find it expedient to do so -- thus eliminating the necessity of making such allowances elsewhere and at the same time making it much easier to construct a practical seeing scale. Note that there may be a rather small scale fast seeing pattern superimposed upon a larger slow seeing pattern; however, since the eye will disregard the slow pattern it will only have to note the fast pattern. From this discussion, we see that, for visual planetary studies, we are essentially only interested in the turbulence resulting from a fast seeing pattern (i.e., only that part of turbulence which deteriorates the perceived visual image), and that the eye will sift out slow patterns and accommodate itself to them; moreover, in doing so, the eye makes its own allowance for the capabilities of the observer.

At this point we are able to list criteria which a seeing scale should satisfy: (1) most important of all, a seeing scale should be applicable to the direct, easy calculation of the degree to which features may be resolved (i.e., it should lead to a direct calculation of D*, in our case); (2) a seeing scale must measure effects on the image being observed, not of effects taking place in another direction or with another instrument; (3) a seeing scale should measure the better moments and, at the same time, be applicable throughout an observing session so as to give a time distribution of the precise quality of the better moments (we must make the qualification that we measure better moments rather than "best" moments, since the latter kind -- as described by Robinson -- do not exist); (4) any standard objects or values employed must be non-subjective; (5) the determination of the value of the seeing must be an impersonal process (at least as nearly so as possible) and should not involve estimations of any sort on the observer's part (wherever these can be avoided); (6) the actual determination of the value of the seeing, while being impersonal, must at the same time be extremely simple so as to avoid as much as possible the risk of making mistakes; (7) the amount of time required to make the determination of seeing should be as small as possible, preferably not requiring the observer to divert his thoughts from observing by having to make calculations, etc.

The inclusion or non-inclusion of a scale factor corresponding to the aperture of the telescope being employed is equivalent to the differentiation between the resolution character D* and the lesser of the impersonal and personal efficiencies (which when multiplied by D gives D*). To a certain extent, such a thing is a matter of taste; however, because we are interested in D* more than in the efficiency, and because of the ease of application, we shall find it expedient to include the scale factor (as does Robinson, although he does not justify his inclusion of the factor in his proposed seeing scale). Note also, that in calculating D* we have assumed excellent quality telescope optics, and that for less than ideal instruments, we should have to include a factor to take care of this; we again have the choice as to where such allowance should be made. Again, because of several reasons, it is better to absorb this into a seeing scale, since it must be included in D* as well (in order to accurately measure the quality of resolution). Thus, two telescopes in the same location being used by the same person could yield different evaluations of seeing because of their difference in quality. Here we are taking the more practical road (from the standpoint of resolution) by letting seeing apply to the total deviation of an image from perfection. In all of these cases, the factors which we have included in seeing can be measured anytime and subtracted out so as to obtain a precise statement about the quality of the atmosphere, but highly accurate statements of this sort are of secondary interest to the real problem of determining the extent of resolution; and making these allowances to obtain a precise statement of secondary value causes great inefficiency in the determining of seeing on such a scale. Indeed, if such a scale were adopted, it is very likely that to obtain the value of seeing one would have to perform the subtraction of various factors mentioned from a determination which is resolution-oriented; then, to determine resolution from the scale, one would have to add the factors back again. According to Robinson's definition of a seeing scale (which attempts to throw out effects due to poor instrument quality) a poor telescope would always give a slightly blurred image(even if it were possible to eliminate all other effects), and this would lead to a value near 0 for the seeing.[8]

Having pointed out necessary criteria for a seeing scale and having discussed other criteria which are either of relatively minor significance or which definitely hinder our ultimate purpose, we examine the various scales considered by Robinson in this new light. The reasons why the Pickering and Tombaugh-Smith scales are inadequate are given by Robinson.[8] All of the scales, including Robinson's, are very weak in point (1) above. Robinson's scale, as defined, does not meet well with (3), (5), and (7); and in the last paragraph we have pointed out other drawbacks to his scale. The other two scales are weak or completely deficient in most of the criteria given in this paper.

We proceed to the definition of a new seeing scale, which meets well all the requirements given above. To establish the maximal fulfillment of these criteria we shall have to examine both what the scale means and how the values of seeing are to be determined.

Remembering that the relations given in equation (8a) in Part I of this paper for D^* will normally include a factor which allows for less than perfect instrument quality, and that the turbulence t is taken to exclude slow pattern motions (which can be followed visually), we see that D^* itself might be used as a definition of seeing, although we have said nothing about evaluating it directly. Upon dividing D^* by D, we obtain the efficiency being attained by the observer-instrument-atmosphere-planet system, which could also be taken as a definition of seeing. Let us see how we might go about determining D^*. First of all, if we know that the personal efficiency for the observation is less than the impersonal efficiency (from now on assumed to be corrected for instrument quality), then D^* is given by equation (8b) in Part I of this paper; and we need only know the personal efficiency D_e^*/D_e (which is merely a function of the power per inch being employed, since $D_e = 1/p$). If we can plan to observe with personal efficiency at least equal to the impersonal efficiency, as we usually shall, then we must determine the impersonal efficiency, since D^* is given by equation (8a) (with the correction term mentioned).

Now, when the personal efficiency is less than the impersonal efficiency we know D^* when we know the personal efficiency D_e^*/D_e . In this situation, the image will appear perfect (except for perhaps slow patterns which we can disregard). On the other hand, if the impersonal efficiency is less than the personal efficiency, then the eye will detect blurring in the image (as the eye is "more efficient" than the rest of the system),which may be called less than perfect. Let us suppose that we know the value of the personal efficiency D_e^*/D_e for all values of D_e (or, what is equivalent, for all values of p). Now as we raise the power being employed we decrease D_e, while the personal efficiency D_e^*/D_e does not decrease; similarly, decreasing the power increases D_e and eventually decreases D_e^*/D_e. Hence if we start using a power so low that the image appears perfect, we may start raising the power until we reach the point where the personal and impersonal efficiencies coincide and where the image will still appear perfect. Beyond this point, blurring will take place to a greater and greater extent. Therefore, had we noted the last point where the image was still perfect and recorded the power or the power per inch being employed, we could then determine D_e; and, by assumption, we would know D_e^*/D_e at that point, whence we would know D^* at that point from (8b). But at that power and for greater powers, D^* is constant, so that we would then know D^* at all powers. Of course, we can also take a power high enough so that the image appears blurred and then decrease the power until blurring ceases and get the same result.

These may be summarized as follows: (1) if the image does not appear blurred under the magnification being employed, D^* is given by $D^* = (D_e^*/D_e) D = D_e^* pD = D_e^* P$ (p equals the power per inch, P equals the power being employed); (2) if the image appears blurred under the magnification being employed, D^* is given by the value of D^* for the highest magnification possible which does not produce blurring of the image. Hence, we really need only know D_e^*/D_e, or merely D_e^*, for the observer and the fundamental formula:

$$D^* = \frac{D_e^* D}{D_e} = D_e^* pD = D_e^* P, \qquad (9)$$

which holds for an unblurred image. Now, D_e^* or $D_e^*/D_e = D_e^* p$ are readily determined as functions of D_e or p, and a plot of this function for an observer can be kept in his observing log so that it may then be used to determine D^*.

Recall that for most observers $D_e^*/D_e = 1$ only for values of D_e up to about 1 mm., and that D_e^* can only become as high as about 2 mms. (if that much). Note now that, for D_e at least 1 mm., D_e^* is at least 1 mm. and only slowly approaches its maximum, which is usually less than 2 mms. Hence, if we take an approximate value of 1 mm. for D_e^* when D_e is at least 1/25 ins. (or p is at most 25 power per inch), then this approximate value $\bar{D}_e^* = 1/25 \leq D_e^*$ in this range for D_e (or p). By substituting this value for D_e^* in equation (9) as just given, we see that:

$$D^* \geq D/25D_e = pD/25 = P/25, \quad p \leq 25, \qquad (9')$$

where D_e is measured in inches, and where the image is unblurred. This is a good approximation, and it moreover is (as indicated by the $\geq$ sign) not one which will cause seeing to sound better than it is. Moreover, in lieu of a table of D_e^*/D_e , this is a very easy determination to make. An observer knows that if an image is unblurred at the power P, then the resolution character D^* is at least as great as P/25. This suggests the definition of a quantity $\bar{D}^* = P/25 = pD/25$ for unblurred images. This quantity $\bar{D}^*$ is a lower limit on D^*, and if it (or the power one uses to determine $\bar{D}^*$) is recorded, then, once D_e^* is known, we can still determine D^*. In the meantime, $\bar{D}^*$ can be used as a lower bound for, and an approximation to, D^*. However, good eyes will usually give lower values of $\bar{D}^*$ than poorer eyes. At any rate, we have the following inequalities:

$$\bar{D}^* \leq D^* \leq D , \qquad (10)$$

which always hold. As the quality of the seeing goes up, both $\bar{D}^*$ and D^* increase. Note that it is impossible for the P corresponding to the value of $\bar{D}^*$ (or to the value of D^*) to exceed 25D; likewise, p for this determination cannot exceed 25. Hence, the crossover power per inch between impersonal and personal efficiency must take place at less than 25 power per inch. Any observed result to the contrary is grossly in error.

At this point, we see that D^* as a candidate for a seeing scale may be quite feasible. Also we see that $\bar{D}^*$ may also be used, especially in conjunction with D^* , although uniformity among different observers is lost to a certain extent (with $\bar{D}^*$ one can only say that seeing is at least as good as $\bar{D}^*$). Both candidates fulfill condition (1) above, D^* somewhat better than $\bar{D}^*$, but both much better than do previous scales. The other criteria can easily be verified. We note that, while observing, an observer need only jot down in his observing log the highest usable power (or power per inch) which produces unblurred images from time to time; by "usable" power we mean the crossover power mentioned above where the personal and impersonal efficiencies coincide or the actual power being employed (in case the observer is observing only unblurred images at a power lower than the optimum for resolution) -- whichever is lower. Later it is a simple matter to jot down beside these powers (or powers per inch) the values of D^* (when D_e^* is known) or of the lower bound $\bar{D}^*$ (obtained by dividing the powers by 25 or multiplying the powers per inch by D/25). A good observer will note these values several times throughout an observing session together with the times of the determinations, as well as any further notes about sudden changes in the image quality. At the end of the session, the observer then has an accurate record of the image quality in these terms, and can then proceed to decide just what his resolution character throughout the session was. Because of the use of different powers for making the seeing determination, one should observe the limb of the planet when checking the seeing; the contrast between the limb and the sky is so great as to cause no effect in image quality by means of the (relatively minor) changes in the contrast when using different powers. Moreover, the limb is a very well-defined feature, and one cannot help noticing it. With a number of eyepieces or a "zoom" eyepiece, it is not too difficult to determine the seeing very accurately. If there is a gap in the available powers where the crossover between personal and impersonal efficiencies appears to occur, it will be necessary to estimate the power (or power per inch) which corresponds to the crossover. Such estimates should be indicated as estimates by an uncertainty symbol such as a colon (:).

Using these precepts, D^* (or $\bar{D}^*$) may be easily, efficiently, and accurately determined for an observing session. Because it is not difficult to determine D_e^*, D^* appears to offer the better scale of the two. Besides, $\bar{D}^*$ really only need be considered as a lower bound and approximation to D^*, D^* being the ultimate object of our study as presented here.

We point out that the observer will want to enter P , p , or some such value, from which he will deduce D^* later, in his log. Exactly what quantity is entered is a matter of taste; the observer need only leave room therein for D^* when it is determined. For example, the writer in using one telescope has all eyepieces calibrated to indicate the power P being used; he always enters that value in his log when using this particular telescope, although, out of habit, he also frequently enters the value of $\bar{D}^*$. With other telescopes that the writer uses regularly, he is accustomed to entering only the focal length of the eyepiece; dividing this into one of two constants for the telescope being used (which the writer sometimes does at the telescope -- again out of habit) gives either P for that observation or $\bar{D}^*$. The writer has tables of D_e^* as a function of p , or D_e, and (for the first telescope mentioned) P , as well as tables of D^* as a function of p , D_e , P , or $\bar{D}^*$. Determining any of the desired quantities is merely a matter of choosing the right table. One must be careful to distinguish powers (or other quantities) being used to determine D^* from those powers being used for actual observing: this may be done by using the subscripted term P_r for the resolution power, etc.

We offer, then, a seeing scale S_r whose values are just $S_r = D^*$ as a seeing scale which meets all requirements imposed. In addition, the auxiliary scale $\bar{S}_r = \bar{D}^*$ gives a lower bound or temporary approximation to the seeing scale S_r. It should be borne in mind, however, that the real seeing scale we have in mind is $S_r = D^*$. We have used S_r in keeping with the notation introduced before for the new transparency scale[9]; actually D^* itself, or S^* , or any other symbol might work just as well - D^* apparently being best if S_r is not used.

3. Summary. We have shown how the apparent brightness and visual contrast sensitivity can be determined in an explicit manner -- the only loose end being taken care of by the transparency T_r. The use of this standard A.L.P.O. scale cannot be encouraged enough; it has been tragic to note that A.L.P.O. members did not adopt it as soon as it became the official scale for transparency.

In our discussion of resolution, we developed the resolution character D* which measures directly the extent to which resolution is being achieved by an observer; now, in this chapter, we have shown that D* itself can be used as a very practical, accurate, and useful seeing scale by means of a simple technique for determining D* . We have put forth this resolution character as a candidate for a new seeing scale. The writer urges that members and officials of the A.L.P.O. consider it for a new revised seeing scale to supplant their present scale, which is entirely subjective and unscientific.

We noted in the second section of the last chapter that under perfect seeing conditions, we must observe with D_e*/D_e , the personal efficiency, equal to 1 in order to realize all the resolution that those perfect seeing conditions can possibly give. This means that the typical observer must use on the order of at least 25 power per inch in such conditions. Similarly, for any given value of the impersonal efficiency, in order to realize all the resolution that these conditions can give, one must observe with the personal efficiency D_e*/D_e at least as high as the impersonal efficiency. This is equivalent to saying that <u>under given seeing conditions, in order to realize the maximum resolution possible, one must use a power P , the resolution power</u> (mentioned in the last chapter), <u>which is at least as high as the highest power that gives unblurred images</u>. It is common experience that the most comfortable power used under given conditions ranges between the above-mentioned crossover power and three times this value. Referring to Table 2 of Part I of this series, we see that for Saturn and usually Jupiter, staying close to the crossover power is usually best in order to obtain the highest contrast sensitivity and the best resolution simultaneously; certainly powers rather higher than the crossover power should not be used exclusively on these planets since much subtle detail will then certainly be missed. Also, caution should be taken when employing filters to determine the transmission u of the filter and to use this value in the expression uu_2u_1 (the product of the filter, telescope, and atmospheric transmissions respectively), which when multiplied by the brightness of the planet being observed gives the intermediate brightness B' .

Observers should note that in bad seeing, when D* is appreciably lower than D , diaphragming the objective (and hence decreasing D) may increase the impersonal efficiency enough to amount to an overall increase in the resolution character D* . This will be especially true for telescopes 10" in aperture and larger. Care should be taken to use for D the diameter of the diaphragmed objective in all calculations.

THE JULY 20, 1963 SOLAR ECLIPSE: PRELIMINARY REPORT

By: David D. Meisel, A.L.P.O. Comets Recorder

This is a preliminary report of the results obtained at Moose River, Ontario by an eclipse expedition led by the author. The team consisted of twelve observers of various ages and degrees of experience. All but the author were amateurs with little or no previous eclipse experience. A total of eight experiments was attempted:

1) Telephoto outer corona photographs.
2) All-sky camera movie sequence (black and white photographs).
3) Shadow-band color movie sequence.
4) Inner corona color photographs.
5) Outer corona color photographs.
6) Radio wave propagation.
7) Total sky illumination photometry.
8) Photographic photometry of the lunar disk.

On eclipse day, the morning sky was completely overcast. By noon the wind had shifted to the north, and the cloud cover began to break. By

Concerning the Lunar Training Program. Mr. Clark Chapman, the A.L.P.O. Lunar Recorder in charge of the Lunar Training Program, wishes two announcements to be made.

First, at least one person was confused by the large area covered by the form showing Guericke and its vicinity on the moon. It is intended, of course, that the observer draw only one crater during a particular evening, not the whole area shown which is much too large to be adequately covered.

Second, an outline of the lunar crater Cassini is now available to interested observers. Although principally intended for use in the Lunar Training Program, this outline might also be very helpful to advanced observers who are planning to map Cassini. The outline is taken from one of the recent Lick 120-inch photographs, and a rectangular coordinate grid (xi and eta) has been carefully plotted. Persons wanting Cassini outline forms to use should write to Clark R. Chapman, 2343 Kensington Ave., Buffalo 26, New York.

The Editor would like to urge readers new to the A.L.P.O. or new to lunar studies to join Mr. Chapman's Lunar Training Program. It does exist as a training service, and it is of value only as it is actually used. The Editor feels confident that even many of those who have looked at the moon for years and who may accordingly think that they know the lunar surface fairly well can benefit considerably from this training program. We are, after all, learners, ever seeking to improve our methods through study and practice.

Attention, Esperantists. Mr. Walter Murawski, 95 Fort Hill Circle, Staten Island 1, New York, U.S.A. writes: "I am planning to publish an astronomical journal in Esperanto, the international language. I am also trying to form an international astronomical society for amateurs, of which the official language will be Esperanto. If you are interested, please let me hear from you."

Many Thanks, Mr. Glaser. Dr. Joel Goodman, the A.L.P.O. Saturn Recorder, informs us that Mr. Philip Glaser has been supplying the Saturn Observing Forms used by the Saturn Section during the last several years. We are very much obliged to Mr. Glaser for this valuable service. To draw the rings and ball of Saturn freehand usually produces only ludicrous results, and to construct the geometry properly from Ephemeris data is a tedious business. Phil Glaser has kindly spared us both alternatives.

New A.L.P.O. Venus Recorder. In the Venus Section Mr. William K. Hartmann has been replaced as Recorder by Mr. Dale P. Cruikshank. The address of the new Recorder is:

Dale P. Cruikshank
Lunar and Planetary Laboratory
University of Arizona
Tucson, Arizona.

Since both the past Recorder and the present Venus Recorder are on the staff of the Lunar and Planetary Laboratory, have worked together closely on Venus problems in the past, and expect to do so in the future, the change should be an easy one. The reason for the change is that Mr. Hartmann expects to be extremely busy during the next year. We are very grateful to him for the fine job which he has done during his term as Venus Recorder, and we are fortunate to secure Mr. Cruikshank as his successor.

Reorganization of Jupiter Section. After much discussion among those most involved in recent months, the Jupiter Section staff is now as follows:

1. Mr. Philip R. Glaser is the Jupiter Recorder. He will set Section policies and will make necessary decisions.

2. Mr. Elmer J. Reese is Assistant Jupiter Recorder and will continue

the important work of reducing central meridian transits of surface features. Mr. Reese has, however, a new address:

Elmer J. Reese
Box 844
University Park, New Mexico.

We have added to the staff as a new Assistant Jupiter Recorder:

Charles H. Giffen
Department of Mathematics
Princeton University
Princeton, New Jersey.

Mr. Giffen's duties will be the analysis of Jupiter observations other than transits, including intensity-estimates, natural color photographs, and drawings. It is planned that Mr. Giffen should devote himself to an intensive study of A.L.P.O. records on Jupiter other than C.M. transits during the last few years. The results will be published in this periodical.

Concerning Minor Planet 1580 Betulia. Joseph Ashbrook writes to inform us that the ephemeris of this asteroid given on pg. 1 of our January-February, 1963 issue was almost a degree in error during the period of closest approach to the earth in May, 1963. An improved ephemeris was given on Harvard Announcement Card 1602 on June 7, 1963. The positional error was found independently from observation by one or two A.L.P.O. members. However, the observations received by us are too few to justify further discussion at this time.

Sustaining Memberships and Sponsor Memberships in the A.L.P.O. At a business meeting of A.L.P.O. members attending the Eleventh A.L.P.O. Convention at San Diego, Calif. in August, 1963, Mr. Charles H. Giffen offered the following resolution: "Resolved, that the Association of Lunar and Planetary Observers should offer Sustaining Memberships for ten dollars per year and Sponsor Memberships for twenty-five dollars per year." The motion was seconded and was carried. Persons familiar with specialized technical publications of limited circulation and with observing astronomical societies in general will recognize clearly the reasons for the two new classes of membership. They will enable certain persons friendly to the A.L.P.O. and its objectives to give needed financial assistance. Such aid is required now in order to maintain this periodical at its present level. Increased costs and a decline in membership during the last year have produced severe budget problems. Efforts are being made to reduce costs by such means as cheaper mailing envelopes, dropping some complimentary subscriptions, and exploring the possibility of lower postal rates. However, the chief need is for greater income from some source, hence the new types of membership.

We have so far in the new classes of members:

Sustaining Member - Grace E. Fox
Sponsors - W. O. Roberts, Jr.;
David P. Barcroft.

In our next issue we shall report on some other A.L.P.O. business subjects discussed at San Diego and shall carry the usual Convention article.

OBSERVATIONS AND COMMENTS

Possible Unusual Lunar Features: A Curious Coincidence. While unconfirmed reports of anomalous appearances on the moon are common, it is rare that one gets two such reports from the same city on the same night and by independent observers. Have we two ordinary phenomena not recognized by the observers, or was there possibly some unusual activity at the lunar surface on August 27, 1963?

FIGURE 19. A.L.P.O. Members at Sacramento Peak Observatory, Sunspot, New Mexico in June, 1963. Left to right: Walter H. Haas, José Olivarez, Elmer J. Reese, Patrick S. McIntosh. Photograph contributed by José Olivarez.

The first observer was Mr. E.O. Tolson of Fort Worth, Texas; he described his observation to the Editor in personal conversation. On a photograph taken with a 6-inch refractor on August 27 between $1^h 30^m$ and $2^h 0^m$, U.T., a large triangular bright area is present on the terminator near the craters Aliacensis and Werner, colongitude about 0° and the moon near First Quarter. The feature is hundreds of miles long and is visible on both sides of the terminator. The object was not observed visually, being noticed only after the film was developed. It is present only on the first negative on the roll, being quite absent on the second negative exposed 15 seconds later. The bright area shows up best on considerably overdeveloped positive prints. Perhaps the most conservative explanation would be that a light leak fogged the first negative on the film.

The second observer was Danny Arthur of Fort Worth, Texas, his report coming by letter. On August 27, 1963, at $3^h 35^m$, U.T. he observed a "bright light" between Mare Crisium and the pointed south end of Palus Somnii. Three other witnesses saw the object. The instrument was a 3-inch telescope at 30X. Mr. Arthur is not personally known to Mr. Tolson. More details are needed to interpret this second observation.

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Some leading A. L. P. O. members examining A. L. P. O. Exhibit at W. A. A. - A. L. P. O. Convention at San Diego, California, August 22-24, 1963. Left to right: David P. Barcroft, Secretary; Thomas Cragg, Assistant Saturn Recorder; Joel W. Goodman, Saturn Recorder; Thomas R. Cave, Cave Optical Company; Charles F. Capen, Table Mountain Observatory. Photograph by Alan McClure.

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ASSOCIATION OF LUNAR & PLANETARY OBSERVERS
ALPO
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IN THIS ISSUE

few seconds after totality began, the boundary on the WNW was quite well defined, in contrast to the eastern boundary, which gradually faded into nothingness. In the NW, just after the start of totality, the sky outside the shadow took on a very pronounced orangeish cast; this color soon faded, however, and was gone long before totality's end. There was no particular coloring noted in the S or E at any time. I specifically looked for, and failed to see, the shadow racing away at the end of totality.

As totality began, the diamond ring was very distinctly seen, but Bailly's Beads were not; all but two of the observers at the site agree on this. I attribute this lack of visibility of the beads to two things: one was the lack of lunar limb irregularity, and the other was the good seeing that prevailed at the time (4 on Tombaugh-Smith scale). It may be significant that the two persons who saw the beads were placed rather far back at the station, so that they had to look over the most (poor-seeing producing) hot gravel surface. At the end of totality, I again saw the diamond ring, and again did not see the beads.

Just after the beginning of totality I looked at the sun with the naked eye, and noticed that the corona was visible up to about one-third of a solar diameter on each side of the sun, and then started taking photos. I took 7 photos during totality (not all worth looking at !), looking at the sun with 4 inches of aperture and 65X between exposures. The chromosphere was vividly red, and so was a large prominence about at position angle 340°. The corona appeared nearly white, just about like M42 in a small telescope. The moon's disc during totality appeared totally black to me (not counting scattered light from clouds), with both naked eye and the 4-inch reflector at 65X, with no trace of earthshine. I had just finished my 7th exposure, and thought that I had about 30 seconds left in which to look some more and take some longer exposures when the diamond ring again appeared, and totality was over. It was the shortest 63 seconds that I have ever experienced.

The general illumination during totality seemed a little brighter than the full moon at midnight; fine print, the markings on my watch, and the dials on the camera (Pentax H-1) were all readable, but were pretty dim.

STEEP PLACES ON THE MOON

By: Joseph Ashbrook

(Paper read at the Eleventh A.L.P.O. Convention at San Diego, California, August 22-24, 1963.)

1. Most of the moon's surface is surprisingly flat. Its jaggedness is mostly an illusion, caused by the long shadows that gentle relief can cast near sunrise or sunset. Few telescopically visible features show slope angles as high as 40° (except for the interiors of small craterlets). The purpose of this paper is to suggest to you a systematic search for steep places as an observing project.

2. Observationally, the way to find steep places is to search for black shadows far from the terminator. The observer may need some technique for lessening glare. He must use great care to identify correctly shadow-casting features.

3. Presence of a black shadow indicates a surface area whose slope angle is greater than the sun's altitude there. The solar altitude thus gives a lower limit to the slope, if we cam see shadow. If no shadow is visible, the solar altitude gives an upper limit.

For this purpose we need to know the solar altitude only to a degree or so. Hence we can calculate it from a simplified formula:

$$\sin A = \cos B \sin (L + C),$$

where A = angular elevation of the sun
B = selenographic latitude of mountain ($\sin B$ = Eta)
L = selenographic longitude of mountain ($\sin L$ = Xi $\sec B$)
C = colongitude of sun (taken from *American Ephemeris*).

4. Some of the steepest parts of the moon are the topmost crests of large craters. Copernicus is an example. When the sun is 42° up, the Copernicus west* wall still shows sections of crest-line shadow. These shadows become invisible to me when the sun is 49° up. Julius Schmidt says the extreme rim of Copernicus is 50° to 60° steep. This needs checking, because Schmidt sometimes thought that a gray surface grazingly sunlit was actually shadow.

An interesting project would be to watch the shrinkage and disappearance of crest-line shadow in Copernicus on successive nights in several lunations. Herschel, Manilius, Menelaus, Pliny, and Agrippa are similar cases worth checking.

5. Sometimes there are abnormally steep, localized places on the inner slopes of big craters. There are fine examples of this in Eudoxus and Langrenus. It is worthwhile looking at other big craters under a high sun for lingering flecks of shadow.

6. Conspicuous mountains sometimes have steep places on their sides, which hold shadow long after their surroundings are sunlit. Instances of this are Cape Agarum, Cape Laplace, and Boscovich Beta. The central peaks of certain craters are also relatively steep.

7. Finally, a particular search should be made for small craters whose interiors are abnormally steep. The classic case is Langrenus M, a crater about 10 miles across, located at Xi = +.469, Eta = -.170. Schmidt observed it carefully in 1854, and thought its inner walls were at least 60° steep. This same object was reported as new by H. P. Wilkins in *The Strolling Astronomer* for October, 1947, but he did not add anything of importance. Langrenus M deserves a systematic reinvestigation. Incidentally, this crater on the west side of the moon is so deep that it shows a shadow on its inner *east* wall even a day or so before full moon.

8. Hunting for steep places is another answer to the frequent question of the amateur lunar observer, "What is there new that I can do with the moon?"

JUPITER IN 1962 - 63: ROTATION PERIODS

By: Elmer J. Reese, A.L.P.O. Assistant Jupiter Recorder

The apparition of 1962 - 63 was unusually active and interesting. In late September, 1962 a long awaited major Disturbance broke out in the South Equatorial Belt. This Disturbance developed in a manner typical of previous eruptions in the SEB; however, there were a few notable anomalies such as an apparent overflow of much dark matter from the SEB_s into the STrZ preceding the Red Spot, a premature collapse of the Disturbance very late in the apparition, and the failure of the Red Spot Hollow to completely replace the Red Spot. A few months prior to theoutbreak of the SEB Disturbance, a tiny dark condensation in the South Tropical Zone was displaying, by its remarkable movements in latitude and longitude, the existence of a "circulating current" in that zone. The Equatorial Zone was even darker and more active than it was during the previous apparition; however, individual features were somewhat more difficult to follow because of the complexity of detail and the overall darkness of the zone. The dark belt referred to as the EZsB in 1961 had shifted southward by about 3° and now was obviously the true SEB_n. Through most of the apparition - indeed except for a few weeks in December - the Red Spot was an extremely

*Note by Editor. In this paper Dr. Ashbrook uses lunar west in the classic selenographic sense, where Mare Crisium lies west of the lunar central meridian.

students at undergraduate level and scientists working in other fields." I fully agree with this statement. The average layman would find himself bogged down after a single technical paragraph (which the book mainly consists of), but this statment is not meant to mean that the author has created an inferior volume as will be shown presently. A basic course in modern physics would be recommended by the reviewer before a thorough comprehension of the text can be grasped.

Mr. Wolfendale starts with a very brief historical background chapter and then elaborates on the fundamentals basic to the subject (time dilation, range-energy relations, etc.) The later phase just mentioned prepares the reader more than adequately for subsequent material. The chapter on cosmic ray detectors is quite complete and is very readable for the layman.

When the fundamentals have been dispensed with, the meat of the subject matter is considered concerning primary cosmic rays, interactions of cosmic rays, cosmic rays in the atmosphere and at sea level, cosmic rays underground, time variation of cosmic rays, the radiation belts, extensive showers, and the origin of cosmic rays. The material is generally concise, to the point, and technical. The serious reader will find the text refreshing and rewarding. Ample diagrams, graphs, and tables are given to aid reader interpretation of the text as well as to supply supplementary information.

The author states in the preface that reference to journals is not given on original results presented in the text. I feel that this practice is bad. Footnotes of this nature are the best way for a diligent student to check current and past results and to evaluate any possible differences. This makes a book valuable at any point in time regardless of when it was written. The "Further Reading" section at the end of each chapter is good but is not a substitute for journal footnotes.

In my estimation the highlight of the book is the mathematical equations. Each equation is broken down into separate expressions, and each expression is explained in the light of physical terms. Here Mr. Wolfendale shines! He has taken the role of professor in written form and has eliminated the need for a professor in his physical form. In other words, from the equation point of view the author has abolished the need for classroom attendance in order for the reader to obtain a firm grasp of the subject. This aspect has been totally overlooked by most writers; and consequently the reader acquires only a superficial knowledge rather than a thorough understanding. The author should be commended.

Here is an excellent book for the serious student of cosmic rays.

A REQUEST FOR OBSERVATIONS OF CENTRAL PEAKS

By: Clark R. Chapman and Charles A. Wood

There is considerable discrepancy among selenographers about the number and distribution of craters with central peaks. In *The Measure of the Moon*, Baldwin claims that 68% of craters over five miles in diameter contain central peaks. In an analysis of D.W.G. Arthur's catalog of craters in the first quadrant, it was found that only about 5% of first quadrant craters over five miles in diameter have central peaks. The percentage and distribution of central-peaked craters can give vital clues to the problem of the formation of craters, and the problem should not be left unresolved.

The problem principally appears to concern the smaller craters where photographs fail to show central peaks clearly when they exist and where visual observations are questionable and scanty. We feel that it would be valuable for amateurs (especially those with larger apertures and good observing conditions) to undertake a program of examining craters under fifteen miles in diameter for the existence of absence of central peaks. The following craters are examples of craters near the fifteen mile upper limit: Mosting, Helicon, Gambart, Proclus, and Wöhler. We suggest that amateurs interested in this program attempt to observe as many craters under fifteen miles as possible when they are near the optimum distance from the terminator (about fifteen degrees, but it varies with the depth of the crater). We also ask that observers with the largest telescopes concentrate on craters five miles in diameter and less if seeing conditions permit. A number of skilled observers using large professional telescopes deny that such craters ever contain central peaks, whereas Nasmyth and Carpenter mention peaks in such tiny craters as a 1 3/4 mile companion of Hell and a 2 3/4 mile companion of Thebit.

If this program is to have any value, reports must be concise and complete. A report should be made for each crater observed, whether central peaks were seen or not. Negative and questionable observations are as important as positive identifications. Reports should contain the following information: (1) if peaks are seen, care should be given to a qualitative description of the peaks: low hills, small but prominent peaks such as a miniaturization of Tycho's peak, convex floor, how much of the area of the floor do they cover, are they multiple, etc. (2) The aperture of the telescope should be given. (3) A careful estimate of seeing conditions is very important. (4) Give an estimate of how positive you were about the existence of peaks if seen (e.g. "absolutely sure", "fairly sure", etc.) (5) Describe how much of the crater contained shadow. This is very important. (6) Try carefully to identify the crater observed. Find its position from some good map if it has not been given a designation, or construct a diagram of its position in relation to some well known features. Also try to give some idea of the diameter of the crater, perhaps by comparing it to some well known craters of the same approximate size. (7) Other information usually asked for in lunar observations (transparency, magnification, colongitude, observing location, etc.) should also be given if possible.

Another problem about central peaks that remains unresolved is the number of central peaks with crater-pits on the tops. This problem also has important theoretical applications. Although a few astronomers, such as Gold, feel that central pits in crater peaks are not inconsistent with meteoritic formation of craters, most experts feel that pits would be strong evidence for the volcanic theory. Therefore the disagreement between some observers who claim that central peak pits are common and others who have seen only a few (which might be explained by random meteorite impacts) should be resolved. Observers with large instruments and good seeing might be interested in undertaking a systematic listing of all positively seen central peak pits (in craters of all sizes). Observers should carefully guard against illusions. It is easy to mistake the space between two close peaks as a craterpit.

Observers are asked to send their observations on either or both of these two projects to:

Charles A. Wood
Lunar and Planetary Laboratory
University of Arizona
Tucson, Arizona

ANNOUNCEMENTS

In Memoriam. We have learned with sorrow of the death in an auto accident on August 6, 1963 of Mr. Stanley E. Putnam of Hawthorne, Nevada. He had been a member and supporter of the A.L.P.O. during most of its existence. Undaunted by physical handicaps which would have discouraged many, Mr. Putnam maintained a great enthusiasm for astronomy and observed with a specially built telescope. His lively sense of humor made his letters always delightful, and only too few. We extend our sympathy to his survivors and friends.

Sustaining Members and Sponsors. As of October 27, 1963 there are in these new classes of membership:

Sponsors - W. O. Roberts, Jr.; David P. Barcroft; Philip and Virginia Glaser.

Sustaining Members - Grace E. Fox; Ken Thomson; Sky Publishing Corporation. These classes of membership have been created in order to give persons desiring to assist the A.L.P.O. financially a mechanism and opportunity for doing so. We express our thanks to the persons and corporation listed above for their generous help. Sustaining Members contribute ten dollars per year; Sponsors, twenty-five dollars per year.

The A.L.P.O. Transparency Scale. Readers are reminded that the observed transparency is the estimated limiting stellar magnitude in the position of the object observed, corrected when necessary for moonlight and twilight. It would perhaps be more scientific to record also the uncorrected limiting stellar magnitude. If standard sixth magnitude stars are at the limit of visibility on a clear, moonless night, the transparency is 6; if Polaris is barely seen with the eye without moonlight or twilight, the transparency is 2. Negative transparencies are possible. The transparencies are possible. The transparency may naturally be different in different parts of the sky.

A.L.P.O. staff members can encourage the use of the new and improved scale by correcting the old transparency scale on observing-forms when a new supply is printed.

Attention is also drawn to the more sophisticated transparency estimation recently described by Charles H. Giffen (Str.A., Vol. 17, pp. 114-115, 1963). A.L.P.O. members are invited to try using Mr. Giffen's precepts and to report their experience with them.

Search for Steep Places on Moon. Observers interested in Dr. Ashbrook's proposed project (pp.136-137) are invited to coordinate their program with other A.L.P.O. members interested in the project. As a coordinated A.L.P.O. Lunar Section project, the search for steep places on the moon will be truly successful only if there are several observers who would be interested enough to work systematically and diligently on the project. Occasional and haphazard reports might be interesting, but a few systematic observers will be much more valuable. Each night during which conditions are good, observers should hunt for as many evidences of lingering shadow as far from the terminator as possible. Especially important in observational reports are: aperture, seeing conditions, estimate of the degree of certainty that the observed shadow was in fact black, Universal Time of the observation, and notes which will help interpretation of the observations. Observers interested in hunting for steep places on the moon are asked to send their reports to: Clark R. Chapman, 2343 Kensington Avenue, Buffalo 26, N. Y., 14226.

New Books and Magazines in the A.L.P.O. Library. The following list itemizes additions to our library since the preparation of the list in our November-December, 1962 issue. Readers are again invited to make full use of this library. A.L.P.O. members in the United States and Canada are eligible to borrow books. The cost is 25 cents per book plus return mailing charges. Our librarian is Mr. E. Downey Funck, Box 156, Boca Raton, Florida.

Title	Author	Publisher	Date
Tabulae Caelestes (Eighth Edition)		Schurig-Götz	1960
Star Gazing with Telescope and Camera	George T. Keene	Chilton Books	1962

THE ELEVENTH A.L.P.O. CONVENTION

By: Francis J. Manasek

The U. S. Grant Hotel in San Diego, California was the site of the three day joint ALPO-WAA convention. The meeting began on Thursday, August 22 and ended with a dinner on August 24, 1963.

Thursday morning was occupied by the formalities of registration, and the meeting was opened that afternoon with an invocation by Rev. R. Royer of the WAA. Mr. P. Branin, executive assistant to the mayor of San Diego, followed with a welcome address. Capt. N. R. Richardson, U.S.N., of the Aero Space Museum in San Diego then discussed the present day implications of science and the development of public scientific educational facilities in the San Diego Region. The importance of such facilities was stressed. Dr. Jocelyn Gill of the NASA staff delivered the keynote address. Dr. Gill lamented the shortage of professional astronomers and very generously praised the efforts of amateurs. She also discussed the satellite program and the problems involved. Such projects as the Mariner shot to Venus, the observatory satellite, and the polar orbit satellite (POGO) were mentioned. Repeated emphasis was placed on the financial problems involved in such work.

The convention was highlighted by an excellent series of papers contributed by ALPO and WAA members. Once again, excellent papers were contributed by Patrick Moore of England, T. Sato of Japan, and Klaus Brasch of Canada, reaffirming the fact that the ALPO is truly an international organization. The complete list of papers presented is as follows:

1. Temperature Problems in Reflecting Telescopes and Some Possible Solutions, by A. Leonard.

2. Grazing Occultations, by D. Dunham.

3. Photomultiplier Amplifiers - Their General Construction and Use by the Amateur, by J. E. Klein.

4. A Study of the Phase of Venus, by K. R. Brasch. Read by Clark Chapman.

5. Some Remarks on the ALPO Simultaneous Observation Program, by C. H. Giffen.

6. Further Note on Linné, by P. Moore. Read by Jeff Lynn.

7. Color Photography of the Moon and Planets, by C. F. Capen.

8. Making a Twelve Inch Newtonian Reflector, by Father R. E. Royer.

9. Current Concepts of Lunar Crater Development, by F. J. Manasek.

10. On the Latitude Abnormality of the South Equatorial Belt North of Jupiter in 1961, by T. Sato. Reader Thomas Cragg.

11. Astronomy in Europe, by C. Adair.

12. Latitudes of Saturnian Features during the 1961 and 1962 Apparitions, by J. W. Goodman.

13. Communications with Distant Races, by G. J. Malek.

14. Intensity Measurements on Planets, by C. H. Giffen.

15. How Solar Radiation Pressure causes Meteoroids to fall into the Sun, by L. Epstein.

16. Some Concepts about the Atmosphere of Mars, by G. W. Rippen. Reader T. R. Cave.

17. Venus Clouds in U-V, Visual, and I-R, by C. F. Capen.

18. Some Excellent Planetary Natural Color Photographs, by Clark Chapman.

19. An Adequate Planetary Aperture for the Amateur, by T. R. Cave.

20. Some Current Phenomena on the Planet Jupiter, by P. R. Glaser.

21. Oceanus Galileo?, by M. A. Sloan.

22. Color Filter Observations of Saturn's Ring A in 1962, by R. W. Gordon. Reader J. W. Goodman.

23. Improving the Reflecting Telescope, by T. R. Cave.

24. Observing Pluto with a Six Inch Refractor, by J. Young. Reader C. F. Capen.

25. Some Thoughts on the Filar Micrometer, by J. Eastman.

26. Steep Places on the Moon, by Joseph Ashbrook. Reader Walter H. Haas.

Two Morrison lectures were delivered, one by Dr. Robert Kraft of Mt. Wilson and Palomar on "The Structure and Rotation of Galaxies" and the second by Dr. Geo. Abell, UCLA on "The Organization of Matter in Space." The Morrison Lectures are open to the public and were well attended.

The displays present at the convention included several commercial ones and a number from the WAA. The very impressive ALPO display was, once again, the work of Clark Chapman. It contained lunar photographic contributions from Dinsmore Alter and J. Dragesco. A series of fine lunar color photographs was the work of J. Vitous. Alika Herring once again made available some of his unsurpassed lunar drawings. Mr. Clark Chapman contributed material on Jupiter, as did Mr. Herring. Mr. Klaus Brasch of Montreal contributed a series of planetary drawings. The photographic items, which predominated this year, included beautiful eclipse totality photographs by Mr. D. Meisel and an astounding display of color planetary photographs by Mr. Charles Capen.

A separate ALPO meeting was held Friday evening. The current status of the ALPO and The Strolling Astronomer was discussed. A more complete discussion on this topic will be given later by the Director. It was also decided to accept an invitation to participate in the Nationwide Amateur Astrononomers Convention at Denver in late August, 1964.

The convention closed with a dinner at which the Blair Award was given to Mr. Thomas Cragg. In accepting this award, Mr. Cragg briefly discussed some interesting aspects of variable star observing. Dr. Clifford Smith of San Diego State College presented an illustrated talk, "The Story of Palomar."

Our thanks, of course, are expressed to the WAA for the excellent arrangements and the opportunity of conducting such a stimulating joint convention with them. We especially want to thank Mr. Martin Sloan, the Convention Chairman, and the host societies, the Palomar Amateur Astronomers and the San Diego Astronomy Associates.

OBSERVATIONS AND COMMENTS

Fault Scarp in Sinus Roris. Mr. Patrick S. McIntosh, A.L.P.O. Lunar Recorder, submits the following note for lunar observers:

> "Mr. Harry D. Jamieson of Muncie, Indiana brings to our attention the existence of a prominent fault scarp on Sinus Roris (see Figure 18). It resembles the well-known Straight Wall, but escapes the notice of most

FIGURE 17. Mr. Jack Eastman showing 7-inch Aero-Ektar camera at WAA-ALPO Convention in San Diego, California, August 22-24, 1963. Left to right: Jim Klein, Bob Weaver, Jack Eastman, Elliot Wyman, Arthur Leonard. Photograph by Alan McClure.

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observers because it is readily visible only under a setting sun, which occurs for this position on the lunar surface when the moon is a crescent in the pre-dawn sky. Since the face of the fault is directed toward the lunar west (I.A.U.), this feature is extremely difficult to see at sunrise or at lunar noon. Mr. Jamieson has tried in vain to view the fault at these times even with good seeing and a 10" reflector. The fault's position is from Xi -.512, Eta +.742 to Xi -.534, Eta +.722, with a length of about 50 kms. Mr. Jamieson first noticed this feature on prints E1-a, E2-a, and E1-b of his Orthographic Lunar Atlas while searching for lunar domes.

"It would be extremely valuable to obtain height determinations from shadow measurements at sunset for comparison with the well-determined heights for the Straight Wall."

Detail in Cassini. Mr. Alika K. Herring has contributed the truly excellent drawing of Cassini here published as Figure 19 and the following remarks:

"While visiting Haleakala, Hawaii, in the autumn of 1962, I was fortunate in being able to observe the moon under conditions that were often excellent and were sometimes superb. One of these observations was of the crater Cassini, which revealed a surprising number of fine details on the floor. Among these were 9 small craterlets, in addition to the easily seen A, B, and C. I had glimpsed several of these tiny pits on previous occasions, namely the two craterlets just west (cartographic direction) of A, and the one on the north rim of B, but the remaining 6 were new to me. Some, but not all, of these 9 craterlets can be confirmed on the excellent photograph of Cassini recently made with the Lick 120" reflector and published in Sky and Telescope.

"The accompanying sketch (Figure 19) of these features may be compared with my earlier drawing of Cassini (cover, The Strolling Astronomer, Oct.-Dec., 1958), which is probably a fair representation of the amount of detail which can be seen under more ordinary conditions."

Diameters of Domes near Arago. On pages 42 and 43 of our Jan.-Feb., 1963 issue we mentioned some measurements by Harry D. Jamieson of two domes near Arago, Arago 1 to its east (in the old selenographic sense) and Arago 2 to its north. On April 15, 1963 Mr. Jamieson wrote in part as follows:

"I have since found that both of the published values are somewhat too small in the light of more recent determinations made by myself from Sheet C 4 - d of the Orthographic Lunar Atlas. The present values are 23.3 kms. for Arago 2 and 25.4 kms. for Arago 1. Both of these values are accurate to within about 1 km. and represent an increase over the previous values by 6.8 kms. for Arago 1 and 3.9 kms. for Arago 2. My explanation for the difference is my known tenacity to exaggerate the smallness of objects when I compare them to somewhat larger features (e.g., the lunar craters used in the estimates). The height of Arago 1 has been found to be about 500 meters by Arthur - a figure in good agreement with what we think is normal for that size of dome."

This report should underscore the need for care in determining dome diameters. It is easy to fail to observe the outer portions of a dome, especially with small telescopes or inferior seeing. Mr. Jamieson's experience also shows how helpful, if indeed not almost necessary, it is to supplement quantitative visual lunar studies with measurements of high-quality photographs.

Eclipse of Japetus in Shadow of Saturn. Joseph Ashbrook called to our attention IAU Circular 1843, in which Dr. J. G. Porter predicted an eclipse of satellite Japetus on October 17-18, 1963. Immersion was predicted for $19^h\ 7^m$, U.T. on October 17; emersion, $1^h\ 8^m$ on October 18. These times were estimated to be 10 minutes or more in error. There was unfortunately too little time to inform active A.L.P.O. observers of this event.

Walter H. Haas observed with a 12.5-inch reflector at 303X in a twilight

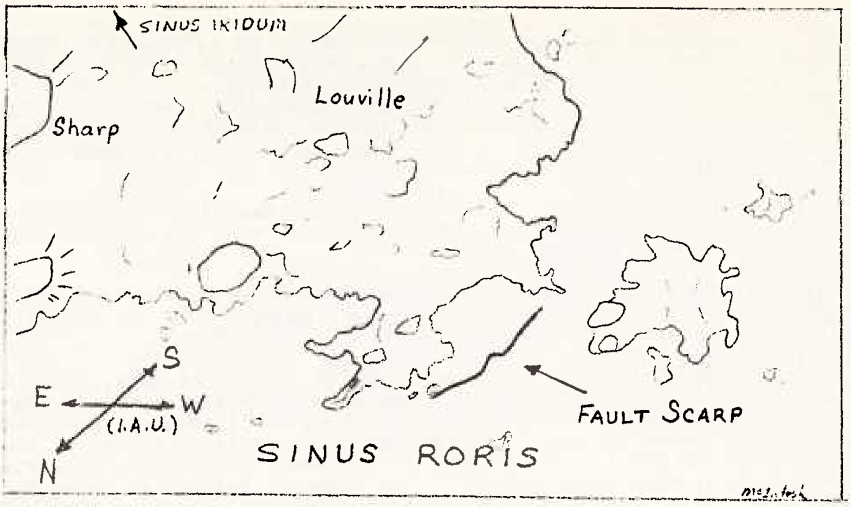

FIGURE 18. Outline based on Plate E1-a of the Lunar Photographic Atlas. Solar illumination from the west (I.A.U. directions). Note fault scarp observed by Harry D. Jamieson.

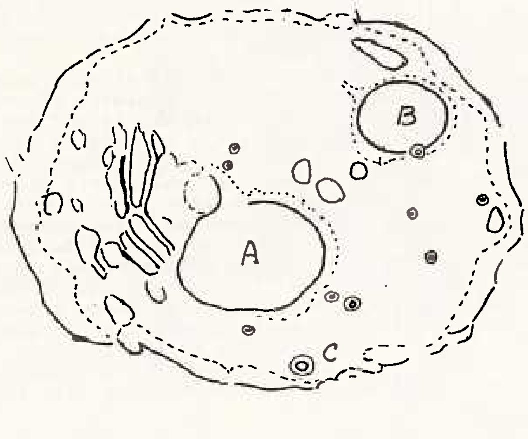

FIGURE 19. Drawing of Lunar Crater Cassini by Alika K. Herring at Haleakala, Hawaii. 12.5-inch reflector. 278 X - 618 X. November 5, 1962. 4^h, U.T. Seeing 8-9. Transparency 6. Colongitude 4°.9. Lunar south at top, lunar west (I.A.U. sense) at right.

sky from Las Cruces, New Mexico, seeing 4 - 5, transparency 5½ , beginning at 0^h 57^m, U.T. The satellite was first seen at 1^h 23^m 30^s, U.T. on October 18; but it may well then have been several minutes out of the planet's shadow. No brightening was detected during the next one or two minutes. The observer had concentrated attention upon the predicted position of emersion, position angle 67° and 54" from the center of the disc of Saturn. Near 1^h 25^m Japetus was apparently about a magnitude dimmer than Rhea and only a few tenths of a magnitude brighter than Dione, then near the east ansa of the rings. Mr. Elmer J. Reese assisted with timekeeping and confirmed parts of the description above.

We would much enjoy hearing from others who may have observed this emersion.

Some Drawings under Favorable Conditions. We invite the attention of readers to several drawings by Mr. Alika K. Herring on pg. 171. These were made with an excellent 12.5-inch reflector at Haleakala, Hawaii, and in part under very favorable conditions. It was, of course, quite impossible to draw all the detail which was then revealed. Mr. Herring estimates that he may have captured about 1/4 of it. On the best nights Jupiter would stand absolutely still for perhaps 30 seconds at a time, and then the limb would ripple very slightly.

We would like to share the following extract from a letter from Mr. Herring on September 10, 1963 with our readers:

> "In my opinion the recent Lick 120-inch lunar photographs are by far the most detailed lunar photos ever taken when it comes to resolution, but the sad facts in the matter are that they still are not equal to my 12.5-inch telescope. This was pretty definitely proved last spring when I was at Haleakala. I had a set of the Lick photos along and spent some time in comparing some of the best photos with what could be seen visually. Such was done under rather mediocre seeing conditions, at which time the telescope was certainly the equal of the photos; and it is safe to assume that under the best seeing conditions it would have surpassed them by a fairly wide margin."

This conclusion, of course, may apply to telescopes of comparable aperture only when they are of similarly extremely good optical quality.

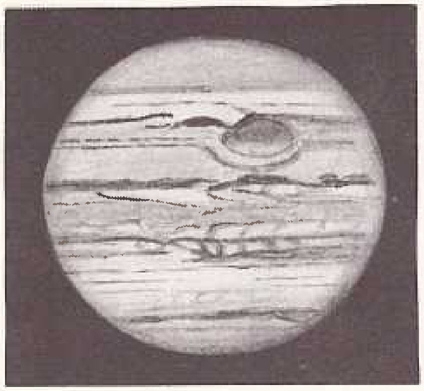

FIGURE 20. Jupiter. Alika K. Herring. August 15, 1963. $13^h 15^m$, U.T. 12.5-inch refl. 275X. S = 8-9. T = 6. CM_1 = 155°. CM_2 = 358°.

FIGURE 21. Jupiter. Alika K. Herring. August 17, 1963. $12^h 51^m$, U.T. 12.5-inch refl. 275X. S = 9. T = 6. CM_1 = 96°. CM_2 = 284°.

Color Reported on the Moon. The contents of H.A.C. 1625 on November 1, 1963 are rather surprising, as follows:

"A telegram from John S. Hall, Lowell Observatory, reports:

'Lowell Observatory reports that Air Force Mappers James Greenacre and Edward Barr have observed unusual colors ranging from reddish-orange to a light ruby red at following selenographic positions in the Vallis Schroteri and Aristarchus areas. U.T. is given for start and stop time of observed phenomena:

1. Cobra head. U.T. 30 Oct., 1963. 0150 - 0210. + .412 eta , -.692 xi.

2. Hill west of Cobra head. U.T. 30 Oct., 1963. 0150 - 0210. + .416 eta , - .685 xi.

actually xi = -.681, eta = +.426

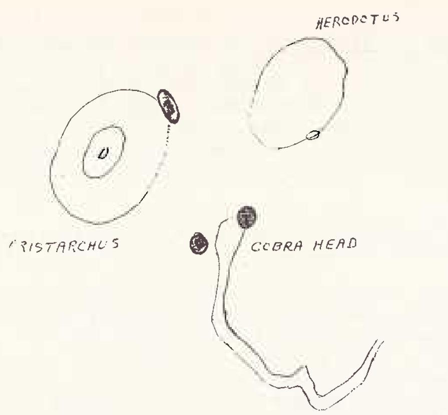

FIGURE 22. Tracing of part of sheet E 3 - A in gridded Kuiper Atlas to show location of three colored lunar areas reported by Lowell Observatory Air Force lunar mappers. Tracing made by Elmer J. Reese.

3. SE rim Aristarchus. U.T. 30 Oct., 1963. 0155 - 0215.
+ .392 eta to + .396 eta
- .682 xi to - .684 xi

'Color along rim of Aristarchus was of a medium pink hue. (All positions were scaled from gridded Kuiper Atlas sheet E 3 - A)'"

One would be glad for more details of such an interesting report, and perhaps there will soon be a fuller account in Sky and Telescope. A basic question is that of the validity of the observation, which apparently was visual only. Reports from others who may have been observing Aristarchus and vicinity between 1^h 50^m and 2^h 15^m, U.T. on October 30, 1963 are hence requested. The reddish hue is reminiscent of the color remarked in the central peak of Alphonsus by N. A. Kozyrev on November 3, 1958. Does a similar explanation, an apparent lunar degassing, here apply to three objects? Presumably no spectrograms were secured this time. Mr. Clark Chapman, A.L.P.O. Lunar Recorder, requests that pertinent observations of Aristarchus and vicinity be sent to him promptly.

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And Planetary Observers

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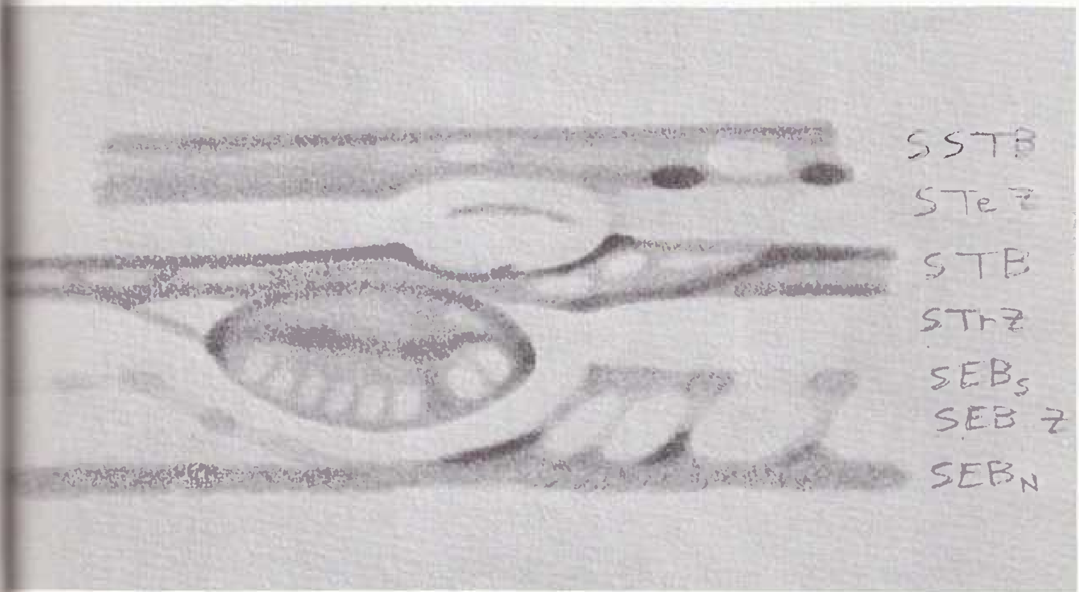

Drawing of Red Spot and vicinity on Jupiter by Elmer J. Reese with Clyde W. Tombaugh's 16-inch Newtonian reflector at 524X. January 21, 1964. 0 hrs., 29 mins., Universal Time. Seeing 7 (Tombaugh-Smith scale), transparency about 6 (twilight). Orientation that of a simply inverted view with south at top. Telescope employed in programs of Research Center, New Mexico State University.

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

Founded In 1947

IN THIS ISSUE

3. Latitudes of various belts on Jupiter from 1908-09 to 1947, inclusive, are tabulated in B. M. Peek's The Planet Jupiter, London (1958), p. 63. Latitudes for other apparitions can be found in such publications as The Strolling Astronomer, the B.A.A. Memoirs, and The Heavens.

4. More recently (personal communication, May 5, 1963), Hirabayashi reported that his measurements of drawings show that the SEB_n reached its maximum northerly latitude in the last half of July, 1961 and that thereafter it rather rapidly moved southward until the end of August. In this connection, it is interesting to note (Figure 15) in the writer's drawing on July 7 at $14^h 45^m$, U.T. that the belt was then not parallel to the equator of Jupiter; it probably supports the idea that northerly motion was still in progress at that time. After the beginning of September the belt was almost stationary, with probable maximum northern latitudes in the last weeks of both October and November, after which time the belt again began to move southward, according to Hirabayashi's measurements. Of course, great credence cannot be placed in all of these results, as Hirabayashi said himself; but they are little different from the results given in this paper.

   Hirabayashi also suggested that the NEB, and probably the STB also, appeared to move with the SEB_n synchronously but in a much less degree. It is a very interesting and, if confirmed, a very important result. But skepticism must arise. Did the abnormal position of the SEB_n lead observers to place the other belts erroneously on drawings? Confirmation using measurements made on photographs or with a filar micrometer is most desirable.

5. P. R. Glaser, The Strolling Astronomer, Vol. 16, Nos. 3 - 4 (1962 Mar.-Apr.), pp. 91-92.

6. E. J. Reese, The Strolling Astronomer, Vol. 16, Nos. 9-10 (1962 Sept.-Oct.), pp. 193-196.

7. C. R. Chapman, The Strolling Astronomer, Vol. 15, Nos. 11-12 (1961 Nov.-Dec.), pp. 214-216. (Chapman's own opinion is that the belt was the SEB_n, but Reese's opinion is also quoted.)

8. S. Murayama, Astronomical Magazine (The Heavens), Vol. 26, No. 289 (1947), pp. 41-43.

9. J. B.A.A., Vol. 71, No. 8 (1961), pp. 337-338.

10. J. B.A.A., Vol. 73, No. 3 (1963), p. 107.

11. See, for example, the drawings by S. Ebisawa in The Heavens, Vol. 32, No. 328 (1951 Apr.), Front Cover; in The Strolling Astronomer, Vol. 5 (1951), No. 5, p. 1; in Sky and Telescope, Vol. 24, No. 2 (1962 Aug.), p. 72; and the Palomar Frontispiece photograph in B. M. Peek's The Planet Jupiter.

A STUDY OF POLYGONALITY AMONG SMALL LUNAR CRATERS AND A POSSIBLE INTERPRETATION IN TERMS OF LOCAL LUNAR TERRAIN

By: Francis John Manasek

Abstract: When small lunar craters were divided into two groups based upon their location on either the maria or in the mountainous regions, a clear relationship between diameter and polygonal outline was observed. The possibility that the nature of the local terrain influenced the shape of the crater is examined.

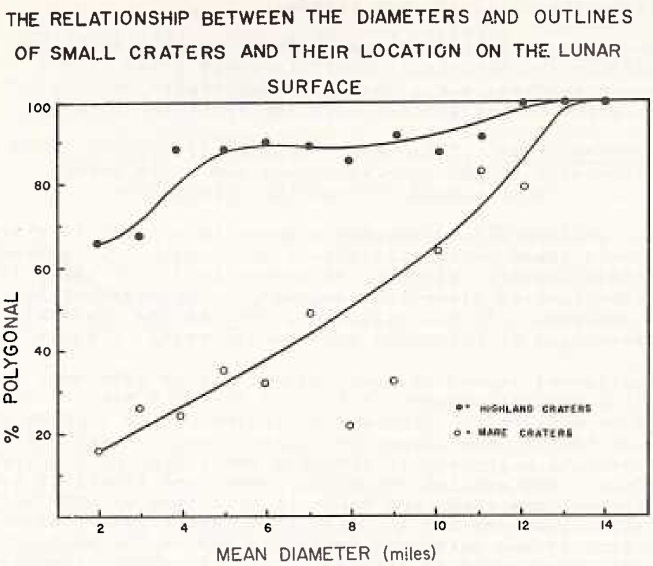

FIGURE 16. Histogram to show frequency of polygonal lunar craters of different diameters in both maria and highlands. Prepared and contributed by Francis J. Manasek. Refer also to text of his article. The study shown embraces 1250 craters selected at random from the central regions of the moon. Each crater is shown clearly on at least one Photographic Lunar Atlas plate.

Almost all lunar craters with mean diameters greater than about 13 miles present boundaries which are polygonal [1,3,5], quite frequently hexagonal. Comparatively little attention has been given to polygonal craters smaller than 13 miles in diameter. Two principal mechanisms responsible for the formation of the polygonal outlines have been postulated:

1. The deformation of circular or nearly circular craters by the combined action of lateral forces.

2. The action of a polygonal meshwork of faults and fracture lines as natural boundaries for the growing crater.

The first mechanism has been discussed at great length by some investigators, notably Spurr[2], while some more recent views on the subject may be found in the works of Fielder[3], Firsoff[4], and Warner[5].

The current study was undertaken with the intention of obtaining data on the relation of polygonal craters to the surrounding terrain. For the purposes of this paper, all craters whose boundaries contained any angular portions were termed "polygonal" craters; all others, round, elliptical, or oval, were termed "round" craters. The data presented here were obtained by measuring structures represented in the Photographic Lunar Atlas[6] and were confirmed, in the case of the smaller craters, by visual observation. The visual work was helpful in differentiating between the two classes established. All diameter measurements were made on PLA plates. A histogram was constructed with an interval of 1 mile, the points on the graph representing each interval. All of the craters which were examined were also divided into the following two classes:

1. Mare Class. This class consists of craters which are found on the relatively level lunabase areas of the moon's surface, e.g., maria, flooded crater bottoms, etc. and which do not impinge upon any other landform.

2. Highland Class. This class consists of craters found in the more rugged lunarite areas and whose boundaries do impinge upon surrounding formations.

All lunar craters with diameters greater than about 14 miles which were examined were found to be effectively polygonal. An analysis of a population of 1250 craters with mean diameters less than about 14 miles revealed that the smaller diameter groupings are composed of both polygonal and round craters. It was also found that as the diameter group decreases the percentage of polygonal craters decreases. (Figure 16.)

If the polygonal aspect of lunar craters is in part due, as is suggested here, to a natural boundary effect of the grid system, such a relationship would be expected. With a grid system having a given spacing between adjacent faults, the larger the crater the greater is its probability of intercepting a segrement of the grid and achieving a polygonal outline. Conversely, the smaller the crater, the less likely it is to encounter a portion of the grid; and hence it will tend to grow more nearly uniformly in all directions and to maintain a more regular boundary. The same would be true if the polygonal aspect is due to the physical limitations to crater growth which would be offered by an encroaching landform.

As is indicated in Figure 16, the incidence of polygonal craters is higher for highland craters than for mare craters. At about the 4 mile diameter range, the percentage of polygonal highland craters rises sharply. This effect can possibly be attributed to the physical interference of surrounding raised areas to symmetrical expansion of the crater. Such a sudden increase is absent in the mare crater class, where none of the craters had surrounding landforms interfering with its growth.

If polygonal characteristics of some craters are due to the confining action of the grid system, these data might suggest that the system has a smaller spacing between adjacent faults in lunarite regions than in lunabase regions. Thus the greater density of faults in the lunar highland regions coupled with the effects of neighboring land masses would then explain the greater incidence of polygonal craters in the highland regions.

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A REVIEW OF SOME ALPO VENUS STUDIES

By: Dale P. Cruikshank, A.L.P.O. Venus Recorder

In the seventeen years of the ALPO journal there has been published a rather large amount of speculation as to the conditions on the surface of Venus and in its atmosphere, based on visual and photographic observations.

BOOK REVIEWS

The Photographic Story of Mars, by Dr. Earl C. Slipher. Sky Publishing Corp., Cambridge, Mass., and Northland Press, Flagstaff, Arizona, 1962. 168 pages. Price $8.50.

Reviewed by Rodger W. Gordon

Only one word is needed to describe this masterpiece and that is "magnificent". Dr. Slipher's book begins where most other Martian texts leave off. Dr. Slipher begins by giving 70 pages of general information about Mars -- its polar caps, atmosphere, and surface features, including his 28 conclusions supported by over 60 years of observational evidence. The remainder of the text is devoted to over 500 photographs. Each plate is preceded by a page of explanation, which altogether give a concise description of all the phenomena on Mars of which we are aware. Especially important in this respect are Dr. Slipher's conclusions concerning the "violet layer", which was discovered by him in 1939. This book is a remarkable record of over 50 years of dedicated observations by the world's greatest Mars specialist. Dr. Slipher gives a description of each phase of Martian phenomena and then groups his photographs in such a way that the reader can easily follow the logical development of thought. Using the photographs, graphs, and charts, he clears up many false notions about the polar caps and violet layer which, needless to say, still appear in many standard texts. In the years to come, this volume perhaps will be compared to Antoniadi's classic "La Planète Mars", because both works are quite definitive in their scope. Those who still doubt the reality of the Martian canals need only look at page 103, photographs 37-42, or pages 143 and 162 to see the reality of these markings. Dr. Slipher remarks that much is unavoidably lost in reproduction, but enough remains to verify the existence of many of the canals. To sum up, anyone who is interested in Mars or who considers himself a Mars specialist would do well to become thoroughly familiar with this tremendous observational work.

The Planet Mercury, by Dr. Werner Sandner. Translated by Alex Helm, F.R.A.S. The Macmillan Co., New York, 1963. 94 pages. Price $3.95.

Reviewed by Rodger W. Gordon

Only 94 pages might not seem a lot to devote to a major planet; but since we know so little about the planet Mercury, it is amazing that Dr. Sandner was able to produce a book of 94 pages about the elusive planet. Those who have attempted to observe Mercury will greatly appreciate this volume. Dr. Sandner shows that much can be accomplished with amateur equipment. In fact, the author cites many of the observations by A.L.P.O. Director Walter Haas and A.L.P.O. observer Gary Wegner to prove his point. Included among the plates is Gary Wegner's map of Mercury plus additional drawings of the planet by noted amateurs. Evidently Dr. Sandner regards amateur observations of Mercury as very valuable. Professional results are not neglected either -- Antoniadi's and Schiaparelli's maps are given full treatment, and attempts by professionals to detect a Mercurian atmosphere are given fairly good treatment. The book makes exciting reading because the manner in which the material is presented will make one want to try to observe Mercury more often. To sum up, A.L.P.O. members will undoubtedly want to add this little book to their collection of planetary literature.

[Mr. Gordon's two reviews above were edited and submitted by Mr. J. Russell Smith. - Editor]

RECENT LUNAR AND PLANETARY WORK IN SWITZERLAND

By: Joseph Ashbrook

The Swiss Astronomical Society (SAS)contains an active group of amateur planetary observers in Switzerland and neighboring countries. Their results are reported mainly in the journal Orion. Though limited in quantity, this work is of excellent quality, and a look at some of it should interest ALPO'ers.

Mars during the 1960-61 apparition is the subject of a summary in Orion for April-June, 1961, pages 110-115. Here are analyzed 42 drawings (10 of them reproduced) obtained with 6-to 10-inch telescopes. There is a good map.

An important Jupiter study by S. Cortesi (Orion, April-June, 1962, pages 106-122) deals with the three persisting white ovals FA, BC, and DE in the STeZ. During 1941-61, the average rotation period of these markings was $9^h 55^m 08^s.5$. Extensive tables of visibilities, longitudes, and rotation periods are provided, partly from data supplied by Elmer Reese of ALPO.

Jupiter's appearance in 1962 is described in Orion, April-June, 1963, pages 92-114, from the work of nine observers (192 drawings, 95 CM transits, 349 intensity estimates). Because of the abnormal state of Jupiter that year, the 32 sketches reproduced are a useful reference. The rotation period of the Great Red Spot was $9^h 55^m 42^s.0$, from 27 transits between June 2 and December 27.

In the same paper, zenographic latitudes of Jovian belts have been deduced by Cortesi from 11 photos by himself and J. Dragesco, and from direct estimates on six nights by himself and D. Courvoisier. He finds: center SSTB = $-43^\circ.5$; center STB = $-30^\circ.3$; north edge Red Spot = $-15^\circ.8$; south edge SEB_n = $-9^\circ.6$; north edge NEB = $+17^\circ.7$; center NNTB = $+40^\circ.9$.

L. Dall'Ara reports his findings on several historic lunar observing problems in the Mare Nectaris region (Orion, January-March, 1963, pages 38-41). These problems are some of those listed in Sky and Telescope, May,1958, page 237. With his 7-inch reflector, 230X, Dall'Ara ascertained that the central eminence in Beaumont A is a dome. The mysterious Bohnenberger B was seen as a wall craterlet on Bohnenberger A, rather than a gap in the latter's wall. His drawing of Fracastorius Y shows it to be a chain of three strongly distorted craters, worthy of further study.

A valuable investigation of Linné has been carried out by Cortesi (Bolletino della Societa Astronomica Ticinese, 2, 30-42, 1962.) He has analyzed micrometer measurements of the Linné craterlet by G. Fournier (R. Jarry-Desloges, Observations des Surfaces Planetaires, 10, 199-201, 1946), and deduces the following dimensions:

Exterior diameter, east-west	2500 meters
Rim-to-rim diameter	1700 meters
West rim height above plain	100 meters
East rim height above plain	40 meters
Average slope of outer west wall	10 degrees
Average slope of outer east wall	15 degrees
Horizontal extent of west rim, at plain level	700 meters
Horizontal extent of east rim, at plain level	160 meters

These numbers can be compared with the independent study by J. Ashbrook in The Strolling Astronomer, 17, 26-28, 85-89, 1963. Cortesi assumed a depth of 160 meters for the craterlet, and then computed the volume of the cavity as 0.15 km^3, the volume of the ramparts as 0.12 km^3.

Next he constructed a 1:50,000 scale model in plaster of Paris, and by photographing it under various illuminations he was able to duplicate beautifully the changing telescopic appearance of the Linné craterlet from sunrise to sunset. From a careful review of earlier observations (18 references), Cortesi finds no trustworthy indication of physical change.

[Persons wishing more information about the work of the SAS planetary group may write Sergio Cortesi, Locarno-Monti, Switzerland.]

ANNOUNCEMENTS

Sustaining Members and Sponsors. As of January 16, 1964 there are in these new classes of membership:

Sponsors - W. O. Roberts, Jr.; David P. Barcroft; Philip and Virginia Glaser; Charles H. Giffen; John E. Westfall; Joel W. Goodman; the National Amateur Astronomers, Inc.

Sustaining Members - Grace E. Fox; Ken Thomson; Sky Publishing Corporation; Joseph Ashbrook; Charles F. Capen; Kenneth J. Delano; Craig L. Johnson.

Sustaining members pay $10 per year; Sponsors, $25. Of these amounts, $4 pays for a subscription to this magazine; and the remainder is a gift to help support the work and activities of the A.L.P.O. We express our thanks to the donors listed above for their generous and timely aid.

Corrections to July-August, 1963 Issue. The listing of the A.L.P.O. staff on the back inside cover of this issue was wrongly made the same as in the March-April, 1963 issue. In reality there had been no changes from the May-June, 1963 issue.

In Dr. Joseph Ashbrook's article, "Steep Places on the Moon", on pg. 137 the coordinates of the abnormally deep crater Langrenus M should read Xi = +.903, Eta = - .170.

A Suggestion about Lunar Directions. The following proposal from the Reverend Kenneth J. Delano of Taunton, Mass. in a letter dated November 13, 1963 appears worthy of adoption:

> "I wrote to you before concerning the use of east and west on the moon, and am glad that the ALPO has adopted the IAU designation. I have noticed that all astronomical publications have to take care to make clear what designations are being used in articles about lunar features. To avoid unnecessary verbosity I would like to suggest that the letters (I A U) in parentheses should follow immediately after the very first use of 'east' and 'west' in reports or articles when the I A U designations are being used. The mere appearance of (IAU) after the words east and west should make it clear what interpretation of east and west is being used."

A.L.P.O. Staff Changes. We have two new Lunar Recorders, namely:

Harry D. Jamieson	José Oliverez
2706 Ethel St.,	804 St. Marie
Muncie, Indiana	Mission, Texas

Mr. Jamieson is in charge of our A.L.P.O. Lunar Dome Survey, and Mr. Olivarez is his assistant. This project will be described in the next issue; interested lunar observers are meanwhile invited to write to the two new Recorders, whom we cordially welcome to our staff.

Mr. Elmer J. Reese desires that correspondents address him at:

Research Center, New Mexico State University
University Park, New Mexico

Mr. Reese is on the staff of the Planetary Astrophysics Group, directed by Dr. Clyde Tombaugh and Mr. Bradford Smith.

Twelfth A.L.P.O. Convention. This meeting will be held at Denver, Colorado during the last week of August, 1964 as part of the second National Amateur Astronomers Convention. The first one was held at Denver in 1959, and those who attended found it very enjoyable and highly successful. Besides the A.L.P.O., the Astronomical League, the Western Amateur Astronomers, and the A.A.V.S.O. will take part in the coming meeting. Further details will be carried in future issues, but it is already not too early to start making plans to be in Denver for an outstanding astronomical get-together. Mark your calendar now!

Papers at Twelfth A.L.P.O. Convention. Mr. Andrew R. Gassman, acting for Convention Chairman Ken Steinmetz, has written us of some general policies about papers at Denver. The A.L.P.O. has been allotted four hours for presenting papers. Those planning the Convention will need to have from each author the title and an outline of his paper by July 1, 1964 at the latest. They will need a complete and reproducible copy of the paper before the Convention for inclusion in the *Proceedings* to be published.

Qualified A.L.P.O. members are heartily invited to begin working on suitable papers very soon; indeed, their contributions are definitely needed. With time on the program rather limited, papers should not be unduly long; and some screening may be necessary. All A.L.P.O. papers should be sent directly to the Editor, who has accepted responsibility for our portion of the program.

In Praise of Abstracts. Mr. Francis J. Manasek recommends that writers of the longer articles in this periodical include a short abstract at the beginning. His own article elsewhere in this issue is a good example of this plan. Mr. Manasek feels that abstracts will helpfully guide readers and will in addition aid the author in developing his own thoughts.

Location of Red Glow East (IAU) of Schroeter's Valley. Harry Jamieson and one or two others have pointed out that the "hill west of Cobra Head", which looked red to Lowell Observatory Air Force mappers on October 30, 1963, was really at: Xi = -.681, Eta = +.426, not where stated on pg. 171 of our last issue. Nevertheless, we did *correctly* quote the Harvard Announcement Card reporting the observation.

Request for Observations of December 30, 1963 Total Lunar Eclipse. The Editor is planning an article on this eclipse for the next issue. He accordingly requests all persons who observed the eclipse to communicate their results to him at Box 26, University Park, New Mexico. He is especially interested in studies to detect possible physical effects of the shadow's passage, and one would think that Aristarchus and vicinity should have been closely watched for such possible changes. Types of eclypse observations adequately processed by *Sky and Telescope* , notably umbral contact times, need not be reported.

We shall state right now that it was an *amazingly* dark eclipse.

An Offer of JPL Observational Data: Recorders Please Notice. Mr. Charles F. Capen, the Chief Resident Observer at the Jet Propulsion Laboratory's new Table Mountain Observatory in southern California, is well known to many of our readers as a frequent contributor to this periodical. We quote a portion of a letter from Mr. Capen dated September 15, 1963:

> "The papers given at San Diego were of good quality and interest; and because of the attention given by several of the JPL staff and the interest shown by the JPL Photographic Section regarding my color photo paper, more recognition has been given to the ALPO by our senior staff scientist, which means in short that I have been given authority to cooperate more closely with the ALPO in the exchange of observational data. All that is essentially necessary is a request from yourself or any Recorder for observational data on a given date or dates, and I will notify our section chief scientist Dr. Drake and the JPL Public Information Office and will send the requested data - providing, of course, that we have the observation and have time to prepare it".

We thank JPL very much for this generous offer of cooperation. It will be most practical if the Recorders themselves initiate requests for observations since they will know best what information is needed. Such requests should be addressed to C. F. Capen, Table Mountain Observatory, Box 367, Wrightwood, Calif. We invite our staff members to make some considered and useful requests of this kind soon, for offers tend to be forgot when no action is taken on them for a long time.

A.L.P.O. Headquarters Zip Code. In this new system our address has become Box 26, University Park, New Mexico, 88070. We are glad gradually to learn the zip codes of our subscribers, but a complete, immediate changeover to their use in our mailing and in correspondence is not feasible.

COLORS IN THE ARISTARCHUS REGION: NEW OBSERVATIONS, OLD OBSERVATIONS, AND COMMENTS

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

We mentioned on pp. 171-172 of our July-August, 1963 issue the Lowell Observatory report of three transient red areas on the moon on October 30, 1963, one in the Cobra Head of Schroeter's Valley, the second on a hill east of this Valley, and the third on the southwest rim of Aristarchus (east and west in IAU sense). A detailed account will be found in Sky and Telescope, Vol. 26, pp. 316-317, 1963 (December). Then Harvard Announcement Card 1631 of December 6, 1963 carried the rather surprising news of a second Lowell Observatory observation of red in this lunar region:

"Unusual Lunar Colors. - Dr. John S. Hall writes, 'Lowell Observatory reports that pink colors have again been observed on the southwest rim of the lunar crater Aristarchus. Observations were made by four people with the 24-inch Lowell refractor. Event lasted from U.T. 0030 to 0145, 28 November, 1963. Coordinates of event were Xi = -.682 to -.685, Eta = + .391 to + .398 scaled from gridded sheet E 3-A of the orthographic lunar atlas'".

There are additional details in Sky and Telescope, Vol. 27, pg. 3, 1964. It is especially important that an observer at a 69-inch reflector on November 28 suspected a red spot in almost exactly the same location as the Lowell observers with only the information that a color phenomenon was occurring near Aristarchus. These observations have all been visual; there is so far no photographic confirmation.

There can be little doubt that a fair number of A.L.P.O. members have made a substantial number of color observations of Aristarchus and vicinity since early November, 1963. The list below is unquestionably extremely incomplete but may still be of interest. So far I know of no satisfactory recent positive color observations other than those mentioned above. The colongitude in the table is the lunar western longitude of the sunrise terminator at the moon's equator. On Aristarchus sunrise occurs at about 47°; local noon, at 137°. The colongitude at the Lowell color observation on October 30 was 60°.3 - 60°.5, at the one on November 28, 52°.6 - 53°.2.

Date 1963	Time (U.T.)	Observer	Telescope	Colongitude	Remarks
Nov. 6	6:25-6:35	Haas	6-in. refl.	147°.7	
Nov.28	3:00-3:15	Haas	12.5-in. refl.	53.9	Red filter used.
Nov.28	7:45-7:55	Haas	12.5-in. refl.	56.3	
Nov.29	5:00-5:08	Haas	6-in. refl.	67.0	Red filter used.
Dec.27	5:55-6:10	Haas	12.5-in. refl.	48.1	Note 1
Dec.28	0:15-0:18	Reese	8-in. refl.	57.3	
Dec.28	0:36-0:41	Haas	12.5-in. refl.	57.5	
Dec.28	0:40-0:45	Reese	8-in. refl.	57.5	
Dec.28	0:53-0:56	Reese	8-in. refl.	57.6	
Dec.28	1:15-2:00	Olivarez	17-in. refl.	57.7-58.1	Note 2.
Dec.28	1:30-1:32	Reese	8-in. refl.	57.9	
Dec.28	1:50-1:56	Reese	8-in. refl.	58.1	
Dec.28	2:02-2:13	Haas	12.5-in. refl.	58.2	Color filters used.
Dec.28	2:25-2:28	Reese	8-in. refl.	58.4	

Date	Time (U.T.)	Observer	Telescope	Colongitude	Remarks
1963					
Dec.28	2:38-2:48	Haas	12.5-in. refl.	58°.5	
Dec.28	2:55-2:57	Reese	8-in. refl.	58.6	
Dec.28	3:11-3:42	Haas	12.5-in. refl.	58.9	
Dec.28	3:30-3:33	Reese	12.5-in. refl.	58.9	
Dec.28	3:52-3:55	Reese	16-in. refl.	59.1	
Dec.28	4:04	Reese	8-in. refl.	59.2	
Dec.28	4:13-4:25	Haas	12.5-in. refl.	59.3	Color filters used.
Dec.28	4:46-4:54	Haas	12.5-in. refl.	59.6	
Dec.28	5:14-5:33	Haas	12.5-in. refl.	59.9	
Dec.28	5:35-5:45	Reese	8-in. refl.	60.0	
Dec.28	5:58-6:06	Haas	12.5-in. refl.	60.2	
Dec.28	6:30	Reese	8-in. refl.	60.5	
Dec.28	6:30-6:43	Haas	12.5-in. refl.	60.5	
Dec.29	0:30-0:37	Reese	8-in. refl.	69.5	
Dec.29	2:40-2:45	Reese	8-in. refl.	70.6	
Dec.29	6:08-6.13	Reese	8-in. refl.	72.4	
Dec.30	2:00-4:00	Olivarez	17-in. refl.	82.4-83.4	

Note 1. The brilliant east (IAU sense) outer wall of Herodotus sometimes looked reddish or brownish in the poorer moments, rather clearly a spurious spectral effect.

Note 2. Reddish-orange hues on the eastern bright rims of Aristarchus, Herodotus, and Schroeter's Valley were probably spurious eyepiece colorations. When the moon was in a clearing in thick high cirrus clouds for about 3 minutes, there was recorded a tiny red spot on the Aristarchus rim and a reddish orange color on the hill east of Schroeter's Valley (the one called red on October 30).

The intensive study on December 28 was motivated by the similarity of the solar lighting to that on October 30. Except as noted, absolutely no peculiar colors were even suspected in the observations listed in the table.

Color filters can be a valuable aid in visual lunar color observations. Of course, one should use only commercial filters whose transmissions at different wavelengths are known, such as Eastman Kodak Wratten Filters or Schott Filters. In general, a red area will look brighter relative to other features with a red filter and darker compared to such features with filters of other colors, such as blue or green.

One interesting question is that of the aperture necessary to see these red lunar spots. It may be significant that Mr. Greenacre and others at the Lowell Observatory could not confirm the colors with a 6-inch finder on October 30 nor with a 12-inch guide telescope on November 28. If it be true that apertures above 12 inches are necessary for such observations, then their infrequency in lunar literature is sufficiently explained. Mr. Alika Herring is strongly of this opinion; in a letter on January 6, 1964 he commented on how vivid he once found colors on Jupiter in a giant reflecting telescope compared to the aspect in his own 12.5-inch reflector, in spite of mediocre seeing in the view with the giant telescope. Mr. Herring concludes: "I think this indicates that color contrast is indeed purely a function of aperture; and assuming the Aristarchus phenomena to be typical, they therefore are not likely to be observable in a six-inch, despite the fact that the angular size might be well within the resolution of such an aperture. What appears to be a 'ruby red' color in a 24-inch telescope might well be completely undetectable in a 6-inch". Mr. Elmer Reese in personal conversations in recent months has similarly frequently described how much richer and clearer planetary colors are with 16 inches of apertures, especially in good seeing, than with a 6 to 12 inches. Certainly A.L.P.O. members owning large apertures or having access to them will possess a significant advantage in lunar color searches in the Aristarchus region and elsewhere.

It may be worth remembering that peculiar colors have been recorded in the Aristarchus region by a number of past lunar observers. R. M. Baum of Chester, England directs attention to some observations by Professor H. Klein described in Popular Astronomy, X, 2, No. 92, pp. 63-64, 1902. Professor Klein wrote in part: "First of all is the intensely green color of the whole surface, which is surrounded by the great Rill [Schroeter's Valley], a coloring which is recognized, immediately, even by an unpracticed eye, and has not its equal in intensity on the whole Moon . . . . Another phenomenon still appears at the mouth of the Herodotus Rill and towards Aristarchus on the plateau there, namely a violet glimmer, which begins to become visible immediately after sunrise and spreads itself out farther and farther with the rising Sun. On the 6th of August, 1881, as the wall of Herodotus had just emerged from the lunar night, the whole region between Aristarchus and Herodotus and the southern part of the great Rill appeared to me in a strong violet light, as if covered with fog. It did not lie around the brightest mountain portions, for the eastern slope of Aristarchus which shines so brightly in the interior, showed no vestige of it, nor was there the slightest trace of it shown there where the shadow of the western wall in the interior of Aristarchus contrasts with the bright eastern slope. In order to be perfectly sure I examined all the other bright spots especially the brilliantly lighted, but did not find even a single trace of violet light. . . . If Aristarchus was placed out of the field the intensity of the violet color was not altered in the least".

As Mr. Baum says, it is difficult to evaluate historical observations of this kind. It is perhaps a little curious that the scientific community of 1902 pretty much rejected Klein's color observations out of hand, while the current scientific world is inclined to accept the recent Lowell Observatory reports. It is obvious from the passage quoted that Professor Klein was aware of some of the pitfalls of lunar color observation. If the current Lowell report is valid, perhaps various past reports of bright if transient colors on the moon deserved more attention than they received. An objective evaluation would require more knowledge of the elements involved in a telescopic visual observation of lunar color and perhaps even of the psychology of the observers. These remarks must also apply to some A.L.P.O. reports of colors in the Aristarchus region in recent years. J. C. Bartlett and one or two others have occasionally reported a violet glow in Aristarchus. On September 13, 1951 T. Osawa with a 6-inch reflector observed a brownish orange or deep yellowish carmine tone over a large area south of Aristarchus and a faint blue on the northwest rim of this crater.

The interpretation of the Aristarchus reds must at present be highly conjectural. Since both positive Lowell observations were soon after sunrise, one guess might be that gases congealed during the long lunar night are responsible. If so, similar effects could well follow eclipses of the moon. (Observations of the December 30, 1963 lunar eclipse for unusual colors in and around Aristarchus were, however, negative - more details in the next issue). One may also wonder whether there is a resemblance to the activity in Alphonsus on November 3, 1958; refer to Sky and Telescope, Vol. 18, pp. 184-186, 1959 (February). In brief, spectrograms of the central peak of Alphonsus taken by N. A. Kozyrev at the Crimean Astrophysical Observatory revealed an emission spectrum probably best interpreted as a volcanic degassing. The central peak looked red at one stage of the phenomenon. Certainly spectra of possible future red spots in Aristarchus and elsewhere should be secured. Amateurs will very seldom have the necessary equipment, but they can watch for such outbreaks and can quickly notify interested professional observatories.

Finally, we invite A.L.P.O. members to join in a systematic patrol of Aristarchus and vicinity. Lunar Recorder Clark Chapman has already initiated such a project; interested persons should write to him at 2343 Kensington Ave., Buffalo 26, New York. As indicated above, the assistance of observers with apertures above 12 inches is particularly wanted. However, those with more modest instruments should also participate with a realistic view of their capabilities, as in all scientific work. Presumably results with any aperture will be almost wholly negative, but they are not less valuable on that account; time spent in searching must be carefully logged even when nothing is seen. Perseverance and carefulness will enable the A.L.P.O. in time to establish sound statistical data upon the frequency of red colors on the moon to replace present pure guesswork. Of course, reflectors are greatly to be preferred to refractors in all studies of colors. Since looking for what one does not see can get extremely monotonous, it might prove advantageous to combine this survey with other lunar projects described in this periodical in recent months. If and when unusual lunar colors are seen, the observer should watch them with the closest possible attention and should also alert other observers to attempt confirmation (more convincing when the information supplied to them is not too detailed).

Suggestions from readers about this proposed patrol in selected regions will be appreciated.

NOTE ON FRONT COVER DRAWING

The drawing of the Red Spot of Jupiter and its environs on the front cover is an encouraging example of how very much planetary detail a skilled and experienced observer can record with a moderately large aperture (16 inches) and extremely good seeing. Most of the internal structure in the Red Spot was not visible to the observer in a view with the same telescope some days earlier but with seeing several grades worse (3-5 Tombaugh-Smith scale). The South Temperate Zone oval in partial conjunction with the Red Spot is DE. Note the impression, shown on the drawing, that the Red Spot partly overlay the South Temperate Belt, as if at a higher level in the atmosphere of Jupiter.

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The Strolling Astronomer

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Photograph of Saturn by C. F. Capen with the Table Mountain Observatory 16-inch Cassegrain reflector. April 29, 1963. Plus X film. No filter. 1260 ins. e.f.l. 5 secs. exposure. Integrated light. Shadow of rings on ball above rings, shadow of ball on rings at lower left. Ring B much brighter than Ring A. Note bright Equatorial Zone, prominent North Equatorial Belt, and rather indefinite North Polar Band. In 1964 rings are much less open than here shown. South at top.

THE STROLLING ASTRONOMER

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Association of Lunar & Planetary Observers ALPO

Founded In 1947

IN THIS ISSUE

vivid, but the cloud was less distinct than on the night before. This was the last observation of the cloud itself, but the desert did not return to its normal pink hue until sometime after March 1. Thus the "dust storm" affected the appearance of the area for at least 5 days, first by the "storm" itself and later by the fine dust which was settling out of the atmosphere.

Table 1 tabulates the data described above.

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Lowell, Percival, 1911, Mars and Its Canals, Macmillan, New York.

Table 1

Date		Time (U.T.)	λ	PH	MC	MH	EC	DS
1962, Dec.	21	7:40	114°.6	X				
	23	8:30	115.4	X				
1963 Jan.	01	6:10	119.1			TC		
	09	5:50	123.1	X				
	13	6:25	125.0	X				
	14	5:45	125.4			TP		
	16	5:15	126.3			TP		
	17	6:10	126.7			TP		
	18	4:50	127.6				SM	
	*20	5:25	128.1			AD	SM	
	23	5:35	129.4	X				
	26	7:10	130.8	X				
	27	5:20	131.2	X				
	** 28	4:50	131.6		SM			
	30	5:50	132.5			SM		
Feb.	05	5:35	135.2			TN		
	05	7:55	135.2		TN			
	06	5:40	135.6			TN		
	15	3:55	139.6		AC			
	***18	3:05	140.9		TP			
	20	3:45	141.8		TP			
	21	4:00	142.2		TP			
	24	3:50	143.5					Ar
	25	3:40	144.0		MS		SM	Ar
	26	3:50	144.4					Ar
Mar.	12	3:40	150.5		TN			
	13	5:40	151.0		TN			

* Fig. 4, left drawing. ** Fig. 4, center drawing. *** Fig. 4, right drawing.

PH - Polar Haze
MC - Morning Cloud
MH - Morning Haze
EC - Evening Cloud
DS - Dust Storm

X - a positive result for the PH
TP - Tempe, usually very close to Acidalium
TN - Thoth Nepenthes
Ar - Aeria
MS - Margaritifer Sinus
TC - Trivium Charonitis
SM - Syrtis Major
AD - Acidalium
AC - Amazonis - Castorius Lacus area

KEPLER

By: Alika K. Herring

Kepler is a typical example of one type of crater that is fairly common on the lunar surface. Other familiar craters that are similar, not only in size, but also in the nature of their interior details, are Sabine, Ritter, Encke, and Marius. Of these,only Kepler is unusual in being the center of a bright nimbus and ray system.

Despite its location well away from the lunar limb, Kepler apparently has not been well observed; and to the best of my knowledge no satisfactory chart of the interior details has yet been made. The exact nature of these features may therefore be somewhat obscure. For example, under a somewhat higher lighting a dusky streak or band appears to cross the center of the floor in a north and south direction; yet at the time my drawing (Figure 6) was made, I clearly observed a complex row of small hills and ridges in exactly the same position.

I also observed a system of terrace-like ridges inside, and concentric with, the west (cartographic or I.A.U. direction) wall, as well as two very minute craterlets located on the largest of these (Figure 6). These small pits apparently have not been previously reported, and other observers should therefore make an effort to confirm them.

Kepler is generally polygonal in outline; and it is interesting to note that at least two sides of the polygon, on the north and northwest, appear to continue beyond the crater walls as lines of faults.

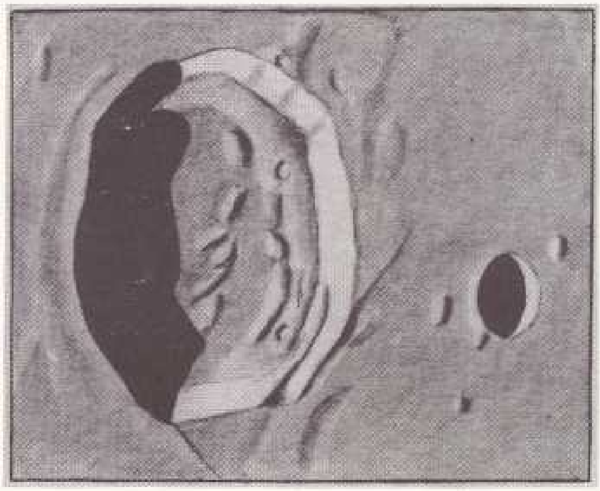

FIGURE 6. Lunar Crater Kepler. Alika K. Herring. January 26,1964. $2^h 10^m$, U.T. 12.5-inch refl. 268X. Seeing 5-6. Transparency about 6. Colongitude 50°.8. See also text of Mr. Herring's article.

A.L.P.O. LUNAR SECTION REPORT: OCTOBER, 1962 - DECEMBER, 1963

By: John E. Westfall, Clark R. Chapman, and Harry D.Jamieson, A.L.P.O. Lunar Recorders

I. INTRODUCTION

By: John E. Westfall

General

In October, 1962, the writer had the honor of being appointed a Lunar Recorder in the A.L.P.O. Since the entire Lunar Section underwent a reorganization then, this report covers the Lunar Section's activities since that time. An article by the writer, "Prospects for the A.L.P.O. Lunar

Section" (Strolling Astronomer, Nov.-Dec., 1962, pp. 273-275), has outlined as a Lunar Section project a Selected Areas Mapping Program. At the present time, response to this program has fallen below expectations, possibly due in part to the specialized approach which this program requires. For this reason, the Lunar Section has initiated several parallel studies which, it is hoped, will result in a more diversified overall program. These parallel studies are discussed in the other sections of this report. A.L.P.O. members are urged to contribute suggestions and comments to the Lunar Recorders as this is the only way in which the Lunar Section can conduct a program satisfactory to the membership at large.

A.L.P.O. Lunar Section Conventional Usages

In order to compile useful reports for publication, some degree of conformity in observations submitted is required:

a. There has been considerable recent discussion as to the east-west convention in selenography (Ref: "Concerning the Usage of East and West on the Moon", Strolling Astronomer, Jan-Feb., 1963, pp. 35-36). At the present time, the Lunar Section (with the exception of the Lunar Dome Section, see below) will accept observations using either the classical system (i.e. Mare Crisium near west limb) or the I.A.U. system (i.e., Mare Crisium near east limb). To avoid confusion, however, all observers must indicate which system they use. Where reference to cardinal direction is made only once or twice, the system used may be indicated in the text, with the note, "(Old)", for the classical system, and the note, "(IAU)", for the I.A.U. system. Such a procedure would be cumbersome if there are many references, and in such cases a general note at the beginning of the report (or article) will suffice. Final Lunar Section reports and maps will use the I.A.U. convention in order to conform with the USAF-ACIC LAC series and with professional observations.

b. In any reference to lunar dimensions, the Lunar Section uses the metric system; horizontal distances or dimensions are in kilometers (km), while altitudes are in meters (m). Observers are asked to follow this system in submitting observations in order to avoid the necessity for unit conversion, which always is a possible source of error.

c. All numerical quantities dependent on the dimensions of the moon (for example, altitudes) consider the moon as a sphere of radius 1738.0 kms.

Appreciation

The writer would like to take this opportunity to thank the other members of the Lunar Section's staff - Patrick McIntosh, Clark Chapman, Harry Jamieson, and José Olivarez - for their generous and indispensable efforts. It is indeed a privilege to be able to work with such enthusiastic and competent students of the moon!

II. SELECTED AREAS MAPPING PROGRAM

By: John E. Westfall

The Selected Areas Mapping Program was conceived with the belief that amateur astronomers can make substantial contributions to selenography by means of the intensive, systematic study of selected lunar areas. The general goals and methods of such a program have been outlined in a previous article ("Prospects for the A.L.P.O. Lunar Section", Strolling Astronomer, Nov.-Dec., 1962, pp. 273-275) and need not be repeated here.

After consultation with interested observers and with members of the A.L.P.O. staff, the Aristarchus-Herodotus region was designated the first "Selected Area." This decision was communicated to the membership in the

"Announcements" section of The Strolling Astronomer (Jan.-Feb., 1963, pp. 40-41), at which time mimeographed outline charts of the region, for use at the telescope, were made available to interested observers. Mr. Patrick S. McIntosh (address: Sacramento Peak Observatory, Sunspot, New Mexico, 88349), as a Lunar Recorder, is in charge of distributing these outline forms. Completed forms are to be returned promptly to him in order to be utilized in the compilation of a "master" orthographic chart, a necessary step in the production of the final map. At the present time, Mr. McIntosh reports a discouragingly poor response; only a handful of completed observing forms have been returned. Thus, the compilation of a reliable "master" chart is impossible as yet.

Those who have contributed, however, deserve credit: these include Patrick McIntosh, Harry Jamieson, Larry Anthenien, Kenneth Delano, George Rippen, William Snyder, and Kenneth Schneller. Clearly, more observations are needed. Particularly necessary are, (i) observations of the Aristarchus-Herodotus region under afternoon lighting, and (ii) photographs. Observations with large apertures (12 inches and above) are especially desirable. although useful contributions can be made with smaller instruments. Interested observers who have not yet contributed to the program should request observing forms from Mr. McIntosh.

Other phases of the Selected Areas Mapping Program are somewhat more encouraging. The 1:250,000 relief model of the region is now being constructed by the writer, but more high quality amateur photographs of the region are needed to complete the model since the professional photographs available do not give an adequate colongitude coverage.

The writer would like to express his gratitude to Mr. Lincoln E. Bragg for his generous and untiring efforts in computing relative altitudes for the region from photographic measures of shadow lengths. To date Mr. Bragg has computed no less than 65 elevations! Mr. Harry D. Jamieson has also contributed several measured elevations, as well as several invaluable profile studies. Thus, the Vertical Control Phase of the Program is progressing well.

Most readers of this report will be familiar with the recent observations of possible "reddish patches" in the Aristarchus area. Because Mr. Chapman discusses these phenomena in his section of this report, they are not discussed here, aside from the comment that, by an exceptionally lucky coincidence, all three suspected areas of change lie within the region being studied. This fact should encourage more intensive observations of the Aristarchus-Herodotus region.

Several writers have commented that one reason for the discouragingly few observations received of the Aristarchus-Herodotus region is that the region can be observed in the evening only for part of a lunation. This suggests the need for the designation of one or more other Selected Areas, in other parts of the visible lunar hemisphere. For example: (i) Arago, Manners, and the great dome west (IAU) of Arago, (ii) the Hyginus or Triesnecker clefts, and (iii) Messier and W. Pickering, are all being considered as possible future Selected Areas. Naturally, this short list is not an exclusive one; the Lunar Recorders are anxious to hear other members' suggestions as to the choice of future Selected Areas. It will probably be necessary, however, to restrict any future Selected Area to, at most, an area 60 by 60 kms.

III. LUNAR TRAINING PROGRAM AND RELATED ACTIVITIES

By: Clark R. Chapman, Lunar Training Program Recorder

This report describes the activities during the past year of the Lunar Training Program and other Lunar Section projects which I have undertaken to handle.

The Lunar Training Program is designed to aid and guide observers new to the study of the moon. Several standard crater outline forms have been prepared in connection with the program described in the initial article (Str. A., pp. 45-49, Mar.-Apr., 1963). Very few observations on these forms have been returned, and it seems that nobody is actively following the suggested training program. On the other hand, a number of observers have had questions which I have been trying to answer. As the next step in the Training Program, I plan to rewrite the original article (bearing in mind the questions most frequently asked) for inclusion in the A.L.P.O. Observing Manual, on which work is well under way.

For more advanced observers, the study of central peaks and central peak craterpits suggested by Charles Wood and myself (Str. A., pp. 162-163, Jul.-Aug., 1963)would be a valuable organized research project for someone interested enough in the moon to do more than casual observing. In the same category is Dr. Ashbrook's proposed systematic search for unusually steep places on the moon's surface, which I am handling (Str. A., pp. 136-137 & 164, Jul.-Aug., 1963). It would seem most unfortunate if there were no one in the whole A.L.P.O. to work on these interesting and comparatively easy projects.

The recent observations of color in the Aristarchus region may be among the most significant lunar observations ever made. ALPO'ers interested in the moon should use the next several lunations to full advantage to watch for a possible recurrence of the phenomena. If the colored spots are in fact caused by some sort of degassing mechanism, the observations are of the utmost significance. It has been suggested, however, by Ernst Both that the color changes may be nothing more than usual color changes which he says are well-known to experienced lunar observers. He reports that many bright mountain peaks have at times shown short-term color effects at very special solar illuminations and librations. Observations of not only the Aristarchus region, but also of other bright features on the moon, would be very valuable for a further understanding of these unusual observations by Lowell observers. I have received a large number of observations (mainly negative) of color in the Aristarchus region, and I hope that the enthusiasm lasts long enough to lead to conclusions about these interesting phenomena. Further observations are strongly urged.

For those who have been corresponding with me at my Arizona address, my mailing address is once again: 2343 Kensington Ave, Buffalo 26, New York, 14226.

IV. THE LUNAR DOME SECTION

By: Harry D. Jamieson

There has long been a need for a serious and coordinated effort to discover, confirm, and study large numbers of lunar domes. This Section has recently been set up with this need in mind. Our purpose is to create programs of dome research and to collect, analyze, and publish in regular Section Reports observations made by interested observers. These programs will include work on many aspects of dome research, such as discovery and confirmation, diameters and heights, surface features, distribution, and dome contours, programs suitable for all from the novice lunar observer to the most advanced amateur.

In many of these areas, much work has already been done. Over 320 domes have been located during the past year, and about half of these have been well confirmed. However, recent studies show that this number, large as it may seem, is but a fraction of the true number of these objects which have yet to be found. Recently, therefore, it was decided that the first program to be undertaken by the new Section should be one of discovery and confirmation.

A. Program Number One: Discovery and Confirmation.

The purpose of this program is simple: we must first locate domes before we can seriously study them. Here, observers who have not had much experience in advanced work can contribute much and at the same time gain experience for the later and more difficult work. Our general plan of action for this first program will be to pass out small-scale maps of the Moon to each interested observer, who will then take them to the telescope and (as the case may be) indicate whether or not he has seen a particular unconfirmed dome or has found a new one. These charts will be kept by the observer for a time and will then be turned in when called for (the observer will receive a new chart in return.) New domes should be marked in blue, confirmed domes in red. Observers will list on the reverse of the chart the exact positions of any new domes found, as well as the source from which the positions came.

One idea on which we would welcome comments is that of an exhaustive survey of one or more selected lunar regions for domes. It would be valuable if the statistical data thus found could then be extrapolated to the whole moon. The regions selected must be small enough that one can hope to obtain data complete for the apertures used in a reasonable time.

B. Instrumental and Other Requirements

These requirements will apply for all programs which this Section undertakes unless otherwise stated.

1. Telescopic. This requirement will, of course, vary somewhat with the program currently underway; but in general it is safe to set a lower limit of four inches in the case of a refractor and six inches for reflectors. Larger instruments are, of course, to be preferred, and it is asked that the observer use the largest one possible.

2. Observational Procedures. All observers must use the new I.A.U. lunar directions when making observations for this Section. They are also asked to use the revised transparency scale adopted recently by the A.L.P.O. Also, where forms are provided, these forms must be used.

3. Reference Material. Observers should have some sort of reliable large-scale lunar chart. Preferred would be any of the following: (i) the *Orthographic Lunar Atlas*, which is best, (ii) the Air Force *ACIC Charts* or, (iii) *The Moon*, by Wilkins and Moore. In any case, the observer must reveal which chart he is using; and the chart must have a usable coordinate grid.

4. Photographic and Other Accessories. These are not requirements, but observers having either photographic equipment or a micrometer (or those fortunate enough to have both) can be of special service to the new Section - particularly in this first program, where photographs can be used to help discover and confirm domes.

Participating observers will receive full credit for their efforts in our regular Section Reports, which will give detailed information on the progress of current programs as well as accounts of individual observations.

Interested observers who can meet the above requirements and who would like to participate in this much-needed work are asked to contact one of the two Recorders for this Section. Their addresses are given on the inside back cover of this issue. Since this is a new Section and since it is also *your* Section, members interested in offering constructive criticisms and suggestions will find a ready ear.

V. LUNAR ECLIPSES

By: John E. Westfall

As mentioned in the beginning of this report, the Lunar Section hopes

A.L.P.O. LUNAR SECTION - LUNAR ECLIPSE OBSERVATION FORM

OBSERVER............................
DATE.................. 19... (U.T.)
TIME........U.T. TO........ U.T.
INSTRUMENT(S): MAGNIFICATION(S):
....
....
....
S(0-10).........T(0-5).........

(FOR OCCULTATIONS ONLY)
LATITUDE.....°....'.....″ N S
LONGITUDE.....°....'.....″ W E
ALTITUDE(Above Mean Sea Level)....FT.

NOTES(Continue on back if necessary):
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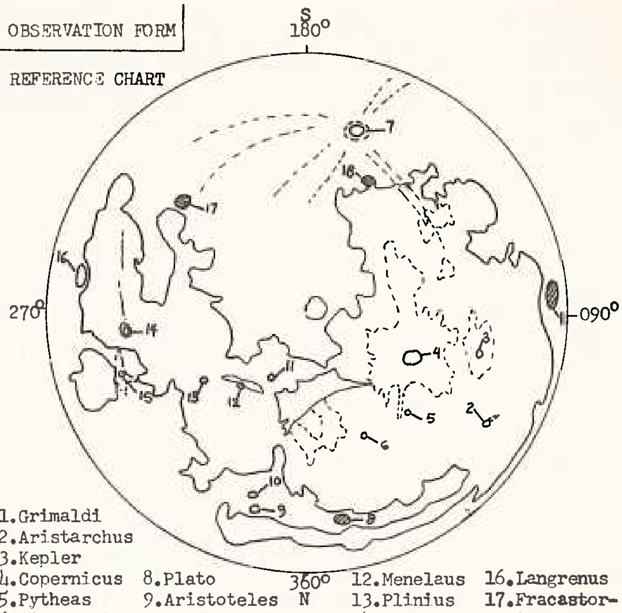
REFERENCE CHART



1. Grimaldi
2. Aristarchus
3. Kepler
4. Copernicus
5. Pytheas
6. Timocharis
7. Tycho
8. Plato
9. Aristoteles
10. Eudoxus
11. Manilius
12. Menelaus
13. Plinius
14. Taruntius
15. Proclus
16. Langrenus
17. Fracastorius
18. Pitatus

CRATER TIMINGS

ENTERING UMBRA: Name	Time(U.T.)	LEAVING UMBRA: Name	Time(U.T.)
....	....	....	....
....	....	....	....
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OCCULTATIONS

Star	Est. Mag.	Disap. or Reap.	Time(U.T.)	Est. Az.	Notes
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......	....	....	....	....	....
......	....	....	....	....	....
......	....	....	....	....	....
......	....	....	....	....	....

ECLIPSE LUMINOSITY (L) - CHECK ONE VALUE:

- ☐ 0: Very dark eclipse, moon almost invisible, especially in mid-totality.
- ☐ 1: Dark eclipse, gray or brownish coloration, details distinguishable only with difficulty.
- ☐ 2: Deep red or rust-colored eclipse, with a very dark central part in the shadow, and the outer edge of the umbra relatively bright.
- ☐ 3: Brick-red eclipse, usually with a bright or yellow rim to the shadow.
- ☐ 4: Very bright copper-red or orange eclipse, with a bluish very bright shadow rim.

FIGURE 7. Preliminary draft of proposed form for reporting lunar eclipse observations. Constructed by John E. Westfall, A.L.P.O. Lunar Recorder. See also text on page 227. Readers are asked to send criticisms and comments to Mr. Westfall or to the Editor.

to increase member participation in Lunar Section studies by means of a more diversified program. The Lunar Dome Section, directed by Mr. Jamieson, is an example of this, as the the central peak study,"steep places" study, and A.L.P.O. Observing Manual already mentioned by Mr. Chapman. This section of the report opens for discussion another possible project.

Many of the readers of this article will have observed the unusually dark lunar eclipse of December 30, 1963. Since three more eclipses are to occur in the near future (June 25th. and December 19th., 1964, and June 14th., 1965), and these also may be unusually dark, the question naturally arises: What can A.L.P.O. observers contribute in observing these eclipses?

It is not here proposed to duplicate publication of certain types of eclipse observations which are usually published in the Sky and Telescope magazine; for certain types of observations, the Sky and Telescope reports are necessarily more complete than any A.L.P.O. report, inasmuch as Sky and Telescope receives observations from a much wider circle of observers than do we. Examples of lunar eclipse observations published there include: eclipse coloration, eclipse darkness, penumbral shading, umbral enlargement (i.e., crater immersion and emersion timing), sky brightness, and whole-disc photography (Ref: "Moon Eclipse December 30th.", Sky and Telescope, Dec., 1963, pp. 324-327).

It is the writer's opinion that the types of observations listed above, although not to be published in The Strolling Astronomer, are valuable and should be encouraged by the A.L.P.O. In line with this view, the use of a "Lunar Eclipse Observation Form" is being considered. A prototype of this form (Figure 7) has been compiled and tested by several observers; granted favorable response, a revised form should be available by the next lunar eclipse. Probably the best procedure will be for the Lunar Section to forward such forms to interested observers, who would then send them directly to Sky and Telescope immediately after the eclipse. In this way, the A.L.P.O. will be assured of a favorable showing in the nation-wide report published in Sky and Telescope. A "Dummy Copy" of this form is included with this report, so that readers may study it and comment on it.

Lunar eclipse observations of a type more within the "territory" of the A.L.P.O. should rightly be published in these pages. Such observations would consist of detailed visual and photographic studies of selected lunar formations during totality and immediately before and after the eclipse. (Lunar Meteor studies, positive or negative, should, of course, be reported to Kenneth Chalk, the Lunar Meteor Search Recorder). Only in this way can physical lunar changes caused by the eclipse be detected and confirmed. This project takes on added importance in light of the alleged color changes in the Aristarchus area; if these are caused by rapid heating of the lunar surface material, one would expect them to recur immediately after an eclipse.

Two Strolling Astronomer references illustrating the physical surface observations desirable during a lunar eclipse are: (i) "The Coming Total Lunar Eclipse on November 18, 1956" by Walter H. Haas (May-Jun., 1956, pp.50-53), and, (ii) by the same author, "The Total Lunar Eclipse on November 18, 1956" (Jan.-Jun., 1957, pp. 64-72).

A.L.P.O. COMETS SECTION REPORT FOR 1961, PARTS II AND III

By: D. Meisel, A.L.P.O. Comets Recorder

In this second part of the 1961 report, the results of the quantitative data reduction will be presented and briefly discussed. Two comets, Comet Wilson 1961d and Comet Seki 1961f, were observed by the A.L.P.O. members and others mentioned in Part I of this report. Part I was published on pp. 165-167 and 170-171 of Str. A., Vol. 16, 1962, July-August issue.

Long. in II at 0 hrs., August 11, 1964	237°.7
Motion in 9 hrs.	326.4
Motion in 35 mins.	21.2
Motion in 3 mins. (3/5 of 3.0)	1.8
Longitude (II)	587°.1
Subtracting 360°, we get	227°.

3. If the Great Red Spot is at longitude 17° (II), when may it be observed on June 16, 1964?

System II again implies Figure 13. We add 360° to the Red Spot longitude in order to subtract easily.

Long. of Red Spot	377°.0
Long. in II at 0 hrs., June 16, 1964	107.8
Required motion in System II	269°.2

We now use the "Motion of the Central Meridian" in Figure 13 in reverse to determine how long Jupiter will require to rotate through the known amount of longitude (II).

Motion in 7 hrs.	253°.8
Motion in 25 mins.	15.1
Motion in 1 min. (1/5 of 3.0)	0.6
Motion in 7 hrs., 26 mins.	269°.5

Thus the Red Spot will transit the C.M. at 7 hrs., 26 mins., U.T. on June 16. The observer will still need to assure himself, of course, that Jupiter is indeed observable at this time, being above his horizon on a dark enough sky. He may want to convert to a zone time; e.g., the P.S.T. would be 11:26 P.M. on June 15. Further transit times on and near June 16 can be obtained by adding or subtracting multiples of the System II period of rotation, namely, 9 hrs., 55.7 mins.

AN OBSERVATION OF THE SOUTHWEST INNER WALL (IAU SENSE) OF ARISTARCHUS

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

The drawing to which the following description applies is reproduced as Figure 14. All Greek letters in the text refer to objects on Figure 14. The region studied might even be called Aristarchus-Herodotus Eruption Point Number Three, for it is a lunar site where Lowell Observatory observers recorded red colors on October 30 and November 28, 1963. The author invites other observers to make a critical study of this portion of the Aristarchus wall, particularly those equipped with larger apertures.

Alpha. Xi: -.6820, Eta: + .3950.

This refers to the small craterlet just inside the (IAU directions here and later) SW wall of Aristarchus, which I will call alpha. Its diameter appears to be about 4½kms. at the major axis;and under a solar elevation angle of +09° 46', I estimated that its depth could not exceed 250 meters at its center (the shadow did not extend to center, but to the point that it did reach I measured the depth as being 200 meters.) A narrow, faint, and more or less diffuse dark band was seen to run from alpha's ESE wall down toward the floor of Aristarchus (see also epsilon), while at the crater's SE wall could be seen a very strange gorge or valley (see gamma). No details within alpha could be made out.

Beta. Xi: - .6805, Eta: + .3930

This pertains to the elongated bright spot just SSE of alpha. At

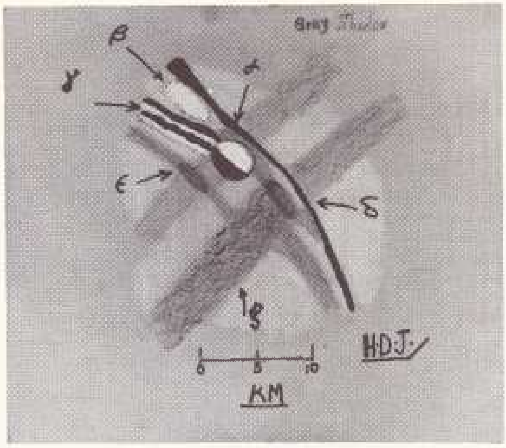

FIGURE 14. Drawing of portion of southwest (IAU sense) inner wall of Aristarchus by Harry D. Jamieson. 10-inch reflector. 313X, 660X (both with Barlow). December 28, 1963. 2^h 39^m - 2^h 55^m, U.T. Seeing 4 - 6 (variable). Transparency 5.5. Colongitude 58°.5. Lunar south at top, lunar east (IAU) at left. The six features with Greek letters are described in the text.

x660, small dark objects of uncertain number, size, or exact location were seen within the spot - but other than that, no other features of interest are to be found near or on beta. It is mentioned here because of its brightness and the fact that it lies just SSW of our next feature of interest, gamma.

Gamma. Xi: - .6805, Eta: + .3940

A most peculiar object, appearing from its shadow pattern to be a depressed area with raised walls - perhaps a gorge or valley. It runs SE from the wall of alpha and cannot have a depth exceeding 100 - 150 meters where it is included in the drawing. Under x660, much detail could be seen inside - but could not be captured because of the quite variable seeing conditions. There was a distinct impression given from the appearance of the object that it may indeed be more of a crater-chain than a gorge or valley - but this will have to await further observation for confirmation. It could not be told whether or not gamma in any way intruded into the SE wall of alpha because of the lighting conditions. I feel that this would be quite likely, however, and suggest that further observations would be of value in determining whether it does.

Delta. Xi: - .6830, Eta: + .3970

A dusky-dark spot at the junction of dark-band "A" (by Robinson) and another dark object, which appeared to be either another dusky band or a terrace casting a gray grazing shadow. Not much of interest here, except that the spot appeared mottled under good seeing and high power. A small, triangular dusky area of lighter shade was found between delta and the rim of Aristarchus.

Epsilon. Xi: - .6800, Eta: + .3950

A slightly lighter edition of delta, also appearing mottled under high power.

Zeta. Extended object.

This object is called "A" by Robinson in his paper "Contributions to Selenography - Part I" (Str. A., 16, 1-2, pp. 31-35) and is, since I have actually paid it little attention in the past, better described there than I could here. I did not notice its double appearance, as shown in Fig. 42 of Mr. Robinson's paper. See also his drawing on the front cover of the aforementioned issue of The Strolling Astronomer.

BOOK REVIEWS

Pictorial Guide to the Moon, by Dinsmore Alter. 135 photographs and drawings, 183 pages. The Crowell Company, 1963. $6.95

Reviewed by Alika Herring

The author of this excellent book on the moon was for many years the Director of the Griffith Observatory and Planetarium in Los Angeles, and has had long experience in presenting scientific topics to the public in lucid form. He was one of the few professional astronomers to study the moon intensively previous to the last decade, and Pictorial Guide to the Moon is primarily the result of his studies. It is based for the most part on a series of papers that were published previously in The Griffith Observer, Publications of the Astronomical Society of the Pacific, and Introduction to the Moon, the modest predecessor to the present work. These papers have been revised, and much new material has been added. In keeping with its title, Pictorial Guide to the Moon is profusely illustrated, and contains numerous drawings as well as a large number of photographs. While many of these photographs are from the famous Lick series by Chappell and Moore, others are from the Mount Wilson and Palomar Observatories; and many of these latter photographs were taken by the author himself. These photographs have been handled well by the photo-engraver, and the general quality of the reproductions is excellent.

The book covers a wide variety of topics related to the moon, beginning with the early history of lunar observation and extending to the time in the not too distant future when man will actually occupy the moon and begin to utilize its scientific possibilities. In addition to these generalized subjects, the author devotes several chapters to a discussion of the physical characteristics of the surface features. The discussion on the nature of such little studied features as the lunar rays and domes is particularly interesting. Also of current interest is a chapter on the probable emission of gases from the lunar interior; and while this material for the most part is a reiteration of the work previously done on Alphonsus by the author and Kozyrev, it assumes added significance in view of the recent observation of apparent activity near Aristarchus. The final chapter in the book, in which the author outlines the great advantages a moon-based observatory will have, is particularly timely.

The preface to the book states that its primary purpose is to "provide to the public that information which they must secure if the space plans to which our government is committed are to obtain successful results". A second purpose is to bring to the attention of lunar students many of the basic problems in selenology that still await solution. A third purpose, certainly implied if not written, is simply to make a timely and thought-provoking discussion of our satellite available to layman and scientist alike. Pictorial Guide to the Moon scores well on all counts.

A Survey of the Moon, by Patrick Moore. W. W. Norton & Company, Inc., New York, 1963. pp. xiv + 333. Clothbound. $6.95.

Reviewed by John E. Westfall, ALPO Lunar Recorder

A Survey of the Moon is a revised and much-expanded version of the author's earlier A Guide to the Moon. Much has taken place in selenography in the ten years between the two books, and the newer book has been updated to 1962. This book is clearly intended for the amateur astronomer who is not a lunar expert, but it should also be enjoyable and profitable reading for the intelligent layman and for the advanced amateur. Mr. Moore has the happy ability to convey large amounts of information in a clear, straightforward style. Mathematics is avoided.

Lunarians familiar with A Guide to the Moon will be interested in comparing the newer book with the older. The general outline of both is the same. The "Lunar Landscapes" chapter has been deleted, but most of its material appears in the new chapter 17, "Into the Future".

Among the new material is a brief discussion of tektites (pp. 47-50), which is informative, although some will argue that a volcanic, rather than a meteoritic, origin for tektites is carrying the volcanic theory too far! Throughout the book, Mr. Moore argues that vulcanism is the basic process behind the lunar surface formations, in particular the craters (to which a separate chapter is now devoted). Many will disagree with this view. The point is certainly debatable, but Mr. Moore has shown a commendably scientific spirit throughout; he presents both sides of the question and always warns the reader when he leaves facts for speculation.

A new chapter, "The Other Side of the Moon", contains an informative discussion of the famous Lunik III photographs, two of which are reproduced, along with a photograph of a "back side" globe prepared from the Lunik photographs. Appendix V shows an orthographic map of the reverse hemisphere, together with a brief description of the major features photographed on the reverse hemisphere. The stated scale of the chart, 1:10,000,000, however, is incorrect; 1:32,000,000 is nearer the truth.

On the whole, the newer book is the better illustrated. Seven photographs from the Kwasan Observatory in Japan are reproduced. These are particularly valuable as they are quite sharp and detailed and yet not so overenlarged (as in most other lunar works) that the beginner finds himself "lost" when he studies them. Also reproduced are twelve of L. F. Ball's excellent lunar sketches, which should serve as an incentive towards better amateur lunar sketching.

The most valuable addition to this book is a medium-scale lunar map, in sixteen sections. Although not intended as an authority for the advanced observer, the map is quite useful as a guide. Surface features are shown in sufficient detail that the beginning observer should have no difficulty in locating even relatively unimportant features. Likewise, the written descriptions of individual formations are detailed enough to give the reader a clear idea of lunar topography without the lengthy, dry, and confusing descriptions found in more advanced works.

Criticisms of this book are few and are restricted to minor points. This writer was disappointed to see that "Observing the Moon" (Appendix I) was cut down to only four pages, although these are concise and informative pages. Perhaps the need for a more complete observing guide will be filled by Mr. Moore's forthcoming <u>Advanced Amateur Astronomy</u>; one wishes, however, that an otherwise thorough and informative lunar text would have included more adequate instructions for amateur observers. Colongitude, for instance, is not mentioned; at the very least, an indication of the approximate phase at which the features on each section of the map can be best observed would have been very useful.

The sectional maps and the textual maps are unfortunately in the "outline" style favored by Goodacre and Wilkins, which gives one a rather schematic picture of the moon which is often hard to interpret, especially when compared with actual views under varying illuminations.

The reader must be careful in following the nomenclature used in <u>A Survey of the Moon</u>; many of the names given for features are unofficial and do not appear on most other maps. Likewise, the author uses the classical system of lunar orientation throughout (south at the top, east at the right), but makes no mention of the newer IAU system, which may cause some confusion for future users of this book.

Those familiar with the history of American lunar studies will be disappointed by the scant coverage given to work in the United States. No mention is made of the excellent Moore-Chappell Lick series of lunar photographs. Also ignored are the several valuable lunar maps now produced by the U.S. Air Force, Army Map Service, and the Geological Survey.

The above deficiencies, although unfortunate, do not seriously detract from the value of the work. A Survey of the Moon is enthusiastically recommended to beginning and advanced lunar students.

Der Sternenhimmel 1964: Edited by Robert A. Naef, Aarau, Switzerland. H. R. Sauerländer & Co., 134 pgs. In German. Available in the United States from Albert J. Phiebig, P.O. Box 352, White Plains, New York.

Reviewed by Klaus R. Brasch

It is once again this reviewer's pleasant task to deal with this fine little Swiss astronomical handbook. As in previous years, this book meets with the highest standards in incorporating, in a clear and concise manner, as much astronomical information as possible.

Somewhat expanded this year, it includes, along with a brief daily presentation of astronomical events, detailed treatments of major celestial objects and special events. Almost every phase of amateur astronomy is touched, from the most elementary, such as a chart for finding the brightest stars, to more advanced aspects, including charts for several variable stars. Throughout the text are scattered attractive photographs of various objects of special interest, as well as informative diagrams as, for example, the orbital paths of the Perseid and Leonid meteor swarms.

Once more the major criticism of this book comes in connection with its binding, which is altogether too flimsy, easily falling apart under the frequent handling demanded of a book of this nature. With the above exception, however, Der Sternenhimmel deserves only the highest praise.

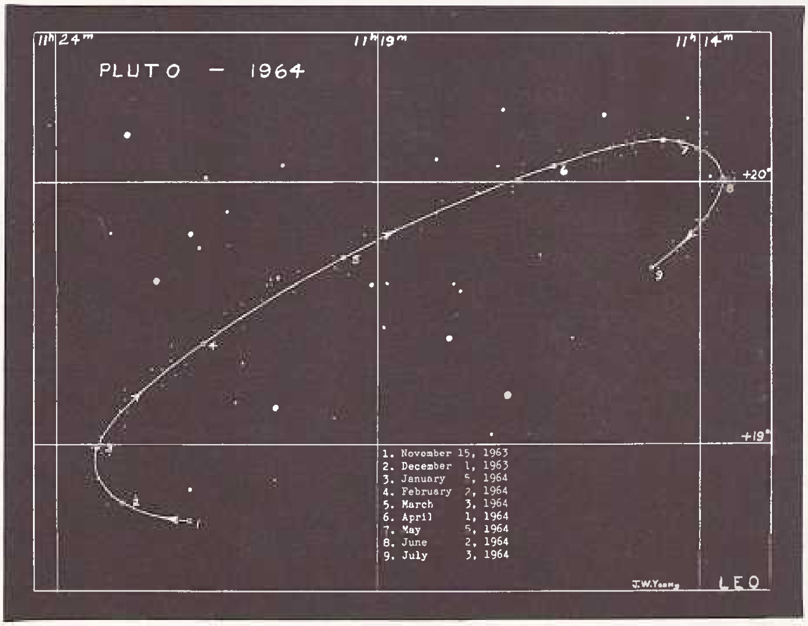

FIGURE 15. Chart of the apparent movement of Pluto among the stars, November, 1963 to July, 1964. North at top, west at right. The orientation is thus that of an erect view in middle northern latitudes with the planet on the meridian. Contributed by James W. Young.

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(to be concluded in next issue)

THE TOTAL LUNAR ECLIPSE OF DECEMBER 30, 1963

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

Introduction: Circumstances and Observers

This lunar eclipse is already famous to most of our readers for the extreme dimness of the moon in the umbra. The circumstances were as follows:

Moon enters penumbra	8^h	25^m.3, U.T.
Moon enters umbra	9	24.3
Total eclipse begins	10	27.3
Middle of eclipse	11	06.8
Total eclipse ends	11	46.2
Moon leaves umbra	12	49.2
Moon leaves penumbra	13	48.3

It will be seen that the early stages of the eclipse were presented to good advantage all over the United States but that in the Eastern States the moon was at a low altitude on a dawn sky during totality and emersion from the umbra.

Several articles about this eclipse have been published, among them the following:

1. "A Remarkable Eclipse of the Moon", Sky and Telescope, Vol. XXVII, pg. 142, March, 1964. Excellent general description.
2. Joseph Ashbrook, "Measuring the Earth's Shadow", Sky and Telescope, Vol. XXVII, pg. 156, March, 1964. A discussion of umbral contact crater timings and their interpretation in terms of enlargement of the earth's geometric shadow.
3. "December 30 Lunar Eclipse", Review of Popular Astronomy, Vol. LVIII, No. 526, pg. 12, February-March, 1964.
4. The Eyepiece (A.A.A. Observing Group monthly), Vol. XI, No. 2, February, 1964, several observational reports, chiefly on umbral contact crater timings.
5. " The Lunar Eclipse of December 30th", Skyward (Montreal Centre monthly newsletter), February, 1964 issue.

The following persons have communicated eclipse observations:

Observer(s)	Station	Telescope(s)
John E. Bortle	Mount Vernon, N.Y.	6-inch refl.,binoculars
K. Chalk and W. Cahill	Teaneck, N.J.	12.5-inch refl.
Clark R. Chapman	Buffalo, N.Y.	10-inch refl., finder, and binoculars
Deniel J. Fernandes and Stephen Forczyk	Fall River, Mass.	4-inch refl.,3-inch refr.
Walter H. Haas	Las Cruces, N. Mex.	12.5-inch refl.

Observer(s)	Station	Telescope(s)
Alika K. Herring	Tucson, Ariz.	12.5-inch refl.,21-in.refl.
Harry Jamieson	Muncie, Ind.	10-inch refl.(?)
Herbert A. Luft	New York, N.Y.	?
David Meisel and others	Fairmont, W. Va.	8-inch refl.
Rodney A. Norden	Norfolk, Va.	8-inch refl.
T. Osawa and M. Shimada	Kobe City, Japan	6-inch refl.
Elmer J. Reese	Las Cruces, N. Mex.	8-inch refl.
Takeshi Sato and others	Hiroshima, Japan	?
Gordon Solberg and R. B. Minton	Las Cruces, N. Mex.	6-in. refl., 4-in. refl., 5 x 50 Moonwatch refr.
Ken Thomson and others	Pasadena, Texas	16-in. refl., 8-in. refl., 3 6-in. refls.

Sample eclipse photographs have been submitted by Meisel and Norden. Several other observers write of taking photographs.

The Penumbral Shadow

The penumbra was first visible to Norden in his 8-inch at 8^h 34^m, U.T. (he found it easy then and thinks that he could have seen it earlier), to Meisel with the eye at 8^h 35^m, to Bortle at 8^h 45^m with eye, binoculars, and 6-inch telescope, to Solberg and Minton at 8^h 51^m (first suspected by Solberg at 8^h 43^m and by Minton at 8^h 47^m), and to Haas in a 12.5-inch reflector at 8^h 52^m (suspected at 8^h 47^m). The color of the penumbra was recorded as coppery by Norden, brownish gray by Meisel, and sandy brown by Bortle. At 9^h 20^m Solberg and Minton estimated the visible width of the penumbra at about one-third of a lunar radius, and Bortle near 9^h 24^m estimated four-tenths of a lunar diameter.

Border of the Umbra

As the umbral shadow crossed the moon before totality and again after totality, Haas recorded a slate-blue border perhaps 10" to 20" in width. Meisel called its width less than 20". Bortle recorded a "bluish contrast border". Thomson and his co-workers report a diffuse brownish band about 90" wide leading the umbra before totality, with a bluish cast near its edge as totality grew near. Chapman recorded at 10^h 21^m: "As totality neared, the leading edge of the shadow was seen to be a greenish blue followed perhaps by an exceedingly dark deep red hue, while the remaining sliver [of the moon] became a yellowish or ochre color".

Brightness of Eclipsed Moon

The "brightness" of the sub-title might well logically be replaced by "extreme faintness", for all observers agree that the moon in the umbra was amazingly and very abnormally dim. Several observers explicitly state that the moon in eclipse was much dimmer than in other lunar eclipses which they had personally observed in recent years. Those who made estimates on the Danjon Scale (e.g., Sky and Telescope, Vol. XXVI, pg. 325, December,1963) rated L at 0 or 1, where 0 is the dimmest possible.

Did the moon actually disappear during the December 30, 1963 eclipse? Some observers so report; e.g., Luft remarks: "During totality the moon became completely invisible, and also with the telescope no trace whatsoever of the moon could be detected". It appears conclusive, however, that all such reports that the moon disappeared in eclipse come from the Eastern States, where totality was largely seen at a low altitude on a dawn sky, and some observers so reporting were further handicapped by poor transparency. It may well be, however, that portions of the lunar globe did at times disappear for the unaided eye or binoculars even with a very clear sky. Reese and Haas comment on the nebulous outlines of the eclipsed moon in transparency 6.2 or better (Reese saw stars of magnitude 6.2 in Gemini); and the latter at 11:00, U.T. noted that large parts of the disc were invisible to the eye.

Figure 17 summarizes 30 estimates by 14 different observers of the integrated stellar magnitude of the eclipsed moon. The rapid fading at the beginning of totality and the rapid brightening at its end are well shown. Special interest may attach to 4 independent estimates by Meisel and his co-workers between 11:10 and 11:15; they found a stellar magnitude near mid-totality of + 3.75±0.08. Figure 17 may be compared to the similar chart in Sky and Telescope, Vol. XXVII, pg. 143, March, 1964; there are many common observations in the two sets.

Color and Other Aspects of Eclipsed Moon

All observers who mention color at all comment on the extreme lack of color at this eclipse, presumably a consequence of the dimness of the moon. The moon was chiefly described as gray, though individual impressions naturally varied. Luft, Solberg, and Minton speak of the umbra as copperish near $10^h\ 0^m$ (before totality) but gray during the rest of the eclipse. Slight bluish tones of the mostly gray moon in the umbra were noted by Chapman, Sato, Jamieson, and Westfall; contrariwise, Reese at $11^h\ 5^m$ recorded "gray with scarcely a tinge of copper", and Haas at $10^h\ 45^m$ noted "a widespread faint reddish or yellowish cast". Solberg and Minton report that guided 35-mm. Anscochrome ASA 32 slides, with exposures of 5-10 minutes, show the moon to be brown. As we shall see a little later, the north limb region of the moon differed from the general coloration described above.

Meisel's team estimated the spectral class of the eclipsed moon between $11^h\ 10^m$ and $11^h\ 15^m$ to be F, one class bluer than the sun. As a comparison, their estimate for the March 13, 1960 total lunar eclipse was class K. Amateur observers should enjoy making such estimates at future eclipses, comparing the moon to stars of known spectral types.

Again as a consequence of the remarkable dimness of this eclipse, lunar features inside the umbra were very hard to distinguish. A note by Bortle is typical: "No surface features could be seen at mid-eclipse such as maria, craters, etc." Meisel (8-inch refl.) could barely see Mare Crisium at $11^h\ 0^m$. Farther west, Reese (8-inch refl.) noted Aristarchus and Kepler near mid-totality. Solberg and Minton found the maria difficult early in totality with 4-inch and 6-inch telescopes but remarked Aristarchus in the 6-inch at $11^h\ 22^m$. Haas (12.5-inch refl.) at $10^h\ 45^m$ compared the general aspect to that of the earthshine about 5 days after New Moon and could see little detail besides the coarse pattern of the large maria.

Many observers were surprised by a greater brightness of the north limb region of the eclipsed moon, surprising because this area was most deeply immersed in the umbra and would hence be expected to be dimmest. Individual descriptions again vary. Solberg and Minton report that 35-mm. Anscochrome ASA 32 slides with 5-10 minute exposures "show the brightening to be a brilliant orange". Jamieson recorded with the naked eye an "orange black patch" in the northern hemisphere. Bortle described the north and northwest limbs as "dull reddish" near 10:20, U.T. (west in I.A.U. sense, the hemisphere of Aristarchus). Urata in Japan sketched the same lunar area brightened at 10:24. Chapman noted a "ruddy limb coloring" on the northeast limb (I.A.U. sense) near 10:33, for a number of minutes.

What was the cause of this brightening? Was it merely an unusual distribution of light within the umbral shadow? Did we have an abnormal luminescence of the north limb during totality? It can hardly be a normal greater brightness of the north limb, which would then be so shown on photographs outside of eclipses. The brightening is certainly not present during most lunar eclipses. The position of the brightening probably did not change much during totality, with center apparently not far from the moon's north pole. This statement rests primarily on a study by Solberg and Minton of their photographs. The data available hardly justify further analysis. Its value is weakened by a failure of some observers to specify times when

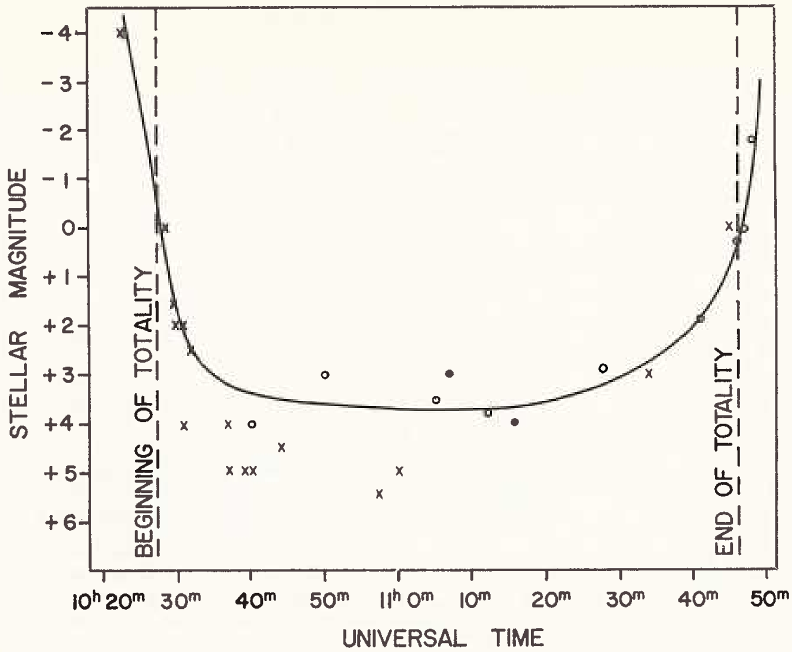

FIGURE 17. The observed integrated stellar magnitude of the eclipsed moon during the eclipse of December 30, 1963 as a function of Universal Time. 14 A.L.P.O. observers, 30 estimates. Open circles - moon compared to stars of known magnitudes. Closed circles - moon dimmer than plotted value. X's - other observations. Prepared for publication by Ray Montes.

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reported aspects were observed and by a failure of some reports to clarify how lunar east and west were being used, I.A.U. system or otherwise.

Umbral Contact Crater Timings

This project constituted the principal program of our observers. Most or all of the observations we have were also sent to Dr. Ashbrook and were employed by him as part of a much larger set in his paper cited above.

Lunar Meteor Searches

Something of the background of this project is given by Kenneth Chalk in his article "Theoretical Aspects of the Lunar Meteor", Str. A., Vol. 17, pg. 19, Jan.-Feb., 1963. The dimness of the eclipsed moon furnishes an unusual opportunity to watch for possible lunar meteoritic impact-flares and/or possible lunar meteors. In view of the extreme dimness of the December 30, 1963 lunar eclipse, it is unfortunate that very few such searches were then made. Haas observed with a 12.5-inch reflector from 10:43 to 11:28, U.T., with a field of view about 90% of the diameter of the moon, but was handicapped by a failure of the telescope drive to operate. Solberg observed the western half of the disc from 11:25 to 11:29. Results were negative.

Possible Eclipse-Caused Changes

Here is a program in which experienced A.L.P.O. lunar observers are peculiarly qualified to contribute. It is critical, however, to appreciate the necessity for adequate controls: peculiar appearances of lunar features soon after emersion from the umbra must be carefully compared to appearances before the eclipse and to aspects under essentially the same solar lighting on other dates, with careful allowance for the role of penumbral lighting, seeing, transparency, etc. At this eclipse interest was naturally great in the red colors in the Aristarchus-Herodotus region recorded at the Lowell Observatory on October 30 and November 28, 1963. A phenomenon apparently occurring soon after sunrise may well also occur when sunlight returns after an eclipse. Reese found the appearance of the Aristarchus-Herodotus region quite normal from 4:00 to 6:00, U.T., as did Haas in intermittent views from 8:05 to 9:18 and Jamieson from 9:32 to 9:50. Aristarchus was in the umbra from (about) 9:30 to 12:01. (Jamieson must have watched the position of Aristarchus inside the shadow.) Reese then observed this region until 12:30 and found no unusual colors but thought that Aristarchus wall bands A and B may have been unusually faint on the upper half of the inner west (I.A.U.) wall. Haas observed at intervals from 12:02 to 13:10 and found no colors; perhaps compatibly with Reese, he observed the dark bands outside the west rim of Aristarchus averaging slightly darker than those on the west inner wall. Haas was uncertain of a change from the pre-eclipse aspect. Reese's bands A and B are shown in his 1946-56 map of Aristarchus, Str. A., Vol. 10, pg. 35, March-April, 1956. Herring observed Aristarchus and vicinity with negative results during this eclipse, using both direct vision and Wratten Filters 45 and 47B in searching for colors; however, the seeing was very bad in his post-eclipse views.

Haas observed the Linné white area for possible changes in size and brightness, comparing it to spots of similar appearance on the Mare Serenitatis. The eclipse had no detectable effect on Linné. Sato suspected soon after totality a brightening of the Copernicus rays near Eratosthenes, an abnormally short south end of the dark area in Riccioli, and others; these effects disappeared after the moon left the penumbra and were probably caused by dim illumination only.

Miscellaneous

Minton and Solberg searched for the L 5 "cloud satellite" near mid-totality; with transparency above 6, Solberg suspected something in the necessary position. Others might like to try at future eclipses. Meisel and Chapman timed some occultations.

The Total Lunar Eclipse of June 24-25, 1964

The circumstances will be as follows:

Moon enters penumbra	June 24,	21^h	$58^m.4$, U.T.
Moon enters umbra		23	09.3
Total eclipse begins	June 25,	0	15.5
Total eclipse ends		1	56.9
Moon leaves umbra		3	03.1
Moon leaves penumbra		4	14.0

Totality will find the moon rising on the Atlantic Coast of the United States. Farther west less and less of the eclipse will be seen. In Europe conditions are very favorable with the middle of the eclipse near midnight. We hence appeal to European members of the A.L.P.O. to observe this eclipse and to communicate their results to us immediately afterwards. The discussion above should certainly indicate several worthwhile projects. The brightness of the eclipse will have special interest. We shall greatly appreciate the help of our European colleagues in observing this phenomenon.

AN INVITATION FROM NASA TO THE ALPO

The following letter was written to Walter Haas by Dr. Urner Liddel, Assistant Director and Chief of Sciences, Lunar and Planetary Programs, Office of Space Science and Applications, NASA Headquarters, under date of February 17, 1964:

"As you well know, the question of transient phenomena on the Moon has received renewed attention recently. The Alphonsus events reported by Alter and Kozyrev, and the Aristarchus events reported by Greenacre and Barr are perhaps the most widely known sightings of recent times. The evidence in favor of transient phenomena on the Moon has become strong enough to warrant an organized effort to study such events for their scientific merit alone. In addition, this country's manned and unmanned lunar exploration effort clearly has a vital interest in phenomena which occur on the Moon.

"For these reasons, the National Aeronautics and Space Administration hopes to initiate a ground-based telescopic surveillance of the Moon. The initial aim of this survey is to assemble meaningful statistical information on the occurrence of changes in the appearance of the Moon. In this connection, it might be well to emphasize that negative sightings are equally as valuable as noticed changes. After a clear statistical picture has emerged, detailed physical investigation can begin.

"I would like to invite the Association of Lunar and Planetary Observers to join in this surveillance program. The large number of appropriately equipped and trained lunar observers in the Association would enable it to make a significant contribution to this important program. I am enclosing further information on the proposed surveillance and hope that ALPO will join in this effort."

Space unhappily permits no discussion here; but the Editor has expressed to NASA scientists our keen interest in this program, and he will welcome guidance by constructive comments and discussion from ALPO members. We hope to include in our next issue more detailed information and an early progress report.