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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.

THE STROLLING ASTRONOMER

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ALPO

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IN THIS ISSUE

MERCURY. PART I. THE BLUNTED CUSP EFFECT AND TERMINATOR IRREGULARITIES.

By: Dale P. Cruikshank

Introductory Remarks

This is the first in a short series of papers which is intended to present readers with a summary and limited (but critical) analysis of the observations of Mercury contained in the ALPO files through the November, 1960 western apparition. Various Mercury Section Recorders have issued reports of individual apparitions of the planet, and these have been useful to observers right along. But the entire ALPO collection through 1960 contains only about 350 drawings--fewer than the Jupiter Section receives for one apparition--and certain things, the topics of these papers, cannot be handled properly with so few observations as are submitted in the course of a year or so. I am grateful to Geoffrey Gaherty, Jr., the present Recorder of the Mercury Section, for making available to me the Section files and for his encouragement.

Observations of Blunted or Truncated Cusp Tips

For many years observers have reported that the south cusp of the crescent Mercury occasionally appears blunted as opposed to the usually sharp north tip. Schroeter noted this in 1800 and 1801; and, according to Antoniadi[1], the effect was confirmed by Burton, Noble, Franks, Trouvelot, Denning, and Antoniadi. The Jarry-Desloges observers (V. and G. Fournier) also noted this aspect from time to time, as well as small terminator deformations. Of this phenomenon, Schiaparelli says, "I must confess...that I have always seen the entire southern cusp very well though its light was weaker (than the north) ; and only once (June 5, 1882) I found that cusp so little luminous, that from time to time, during the least distinct moments of vision, one could suppose it truncated. That unequal splendor of the polar regions is the real cause of the apparent truncation of the southern cusp..." ("Sulla Rotazione di Mercurio", *Astronomische Nachrichten*, **123**, 2944, pp.242-50, 1890). Because of the brightness diminution at the cusps approximately according to the Lambert cosine law of diffuse reflection, usually imperfect seeing conditions, and general low surface brightness of the image, one expects to find the cusp tips on the limit of visibility. As Schiaparelli points out, however, the apparent truncation of the southern cusp is due to a *darker* region in that vicinity; and it is a purpose of this paper to determine whether observations in the ALPO files are commensurate with such an interpretation.

Clearly, the planet is a complete sphere and observations of a blunted cusp simply represent inability to see the whole of what is really there. A dark region at the south cusp would produce the observed effect as Schiaparelli suggests; but of the planispheres extant, only those of Antoniadi[1], de l'Isle[2], and Wegner[3,4] show anything of the sort in the proper place. The Dollfus photographic chart[5] reproduced in Figure 1 shows only a dusky continuum in this region, and Schiaparelli's own map[6] shows both polar zones quite light and devoid of detail. We adopt the Dollfus map as generally the most reliable. This chart was made from composite photographs taken in 1942 and 1944 by Lyot and Camichel, and shows no particular dark region sufficient to produce the observed effect. The Fourniers often noted dark markings at both cusps but omitted them from their 1920 planisphere[7]. The drawings of B. Lyot[8] also show dark polar markings. On the basis of these results and the fact that other planispheres show dark polar areas, we are led to conclude that the Dollfus chart is inadequate at the poles. Such is not an unreasonable assumption in view of the limits of the photographic process. This opinion does not imply that the central and limb regions of the Dollfus planisphere are incomplete, though I suspect that they are. We must mention that all of the planispheres discussed above (except Wegner's[3]) are drawn for mean librations. Probably, then, we must look to the libratory regions for the cause of the blunted cusp.

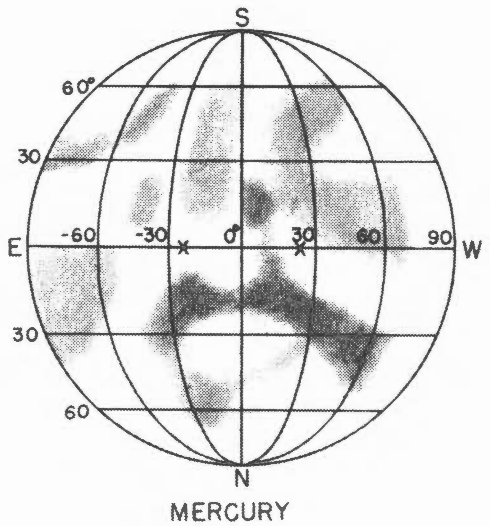

FIGURE 1. Planisphere of Mercury constructed by A. Dollfus from composite photographs. The hemisphere turned toward the sun at perihelion and aphelion is shown. Redrawn for publication here by Dale P. Cruikshank with the addition of a different grid system.

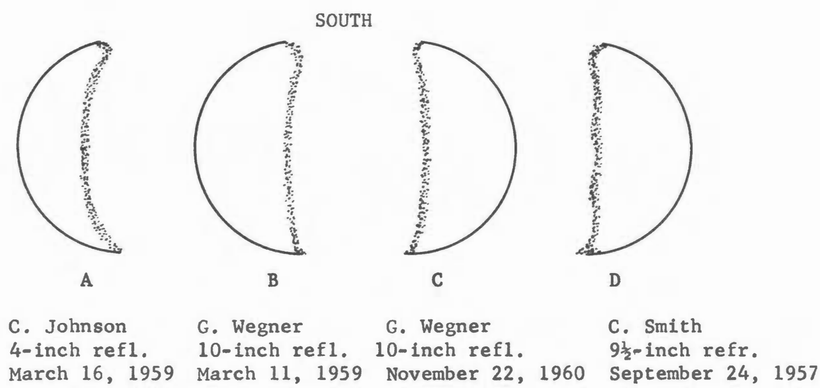

FIGURE 2. Typical A.L.P.O. drawings of Mercury showing blunted cusps and terminator irregularities. Other detail is omitted. See also text of accompanying article by Mr. Cruikshank.

Fifteen drawings in the ALPO files (9% of all drawings made with $k < 0.5$) show a blunted south cusp tip. At least one of these may be omitted because of bad seeing. Of the remainder, eight were made by Gary Wegner, three by C. L. Johnson, two by C. J. Smith, and one by W. H. Haas. Haas' drawing shows the north cusp rounded to the same slight degree as the south and probably indicates imperfect observing conditions. One of Wegner's drawings is similar. Eight of the observations were made at an eastern apparition and six at a western so that no particular correlation is noted with respect to morning and evening apparitions. Figure 2 shows some representative views of the truncated cusps. These copies show only the limb and terminator; shadings and details are omitted.

Since the cusp is not seen blunted in a large fraction of the observations on hand, we may assume that the dark region near the presumed south

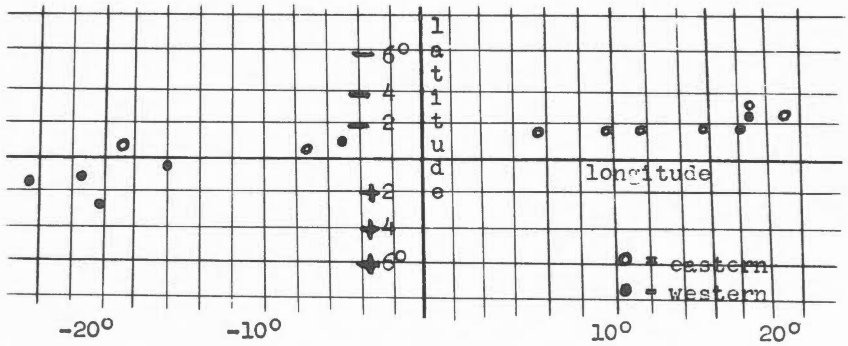

FIGURE 3. Graphical representation of libration in latitude and longitude for 15 A.L.P.O. observations of blunted cusps on Mercury. The points plotted are those of Table I. The libration in longitude is positive when the east limb is exposed for a terrestrial observer; the libration in latitude, when the south pole is exposed. See also text.

Table 1. Data on 15 A.L.P.O. observations of blunted cusps on Mercury

Date	Observer	Apparition	Measured k	Blunted Cusp	Longitude Libration	Latitude Libration
Nov. 22,1960	G. Wegner	W	0.46	S	18°.6	-2°.4
Aug. 6,1960	G. Wegner	W	0.42	S	-18 .6	2 .6
Aug. 5,1960	G. Wegner	W	0.42	S	-19 .5	1 .6
Aug. 2, 1960	C. Johnson	W	0.23	S	-22 .3	1 .8
June 19,1960	G. Wegner	E	0.5 (irregular)	S	-17 .0	-0 .8
Mar. 18, 1959	C. Johnson	E	0.19	S	18 .0	-1 .9
Mar. 16, 1959	C. Johnson	E	0.31	S	16 .0	-1 .9
Mar. 14, 1959	G. Wegner	E	0.38	S	12 .5	-1 .9
Mar. 13, 1959	G. Wegner	E	0.39	S	10 .8	-1 .8
Mar. 11, 1959	G. Wegner	E	0.47	S	7 .0	-1 .5
Mar. 5, 1959	G. Wegner	E	(irregular)	S & N	- 6 .6	-0 .5
Sept. 6, 1958	G. Wegner	W	0.32	S	-14 .5	0 .1
Apr. 15, 1957	C. J. Smith	E	0.35	S	20 .8	-2 .8
Sept.24, 1957	C. J. Smith	W	0.43	S	- 4 .5	-1 .0
Apr. 19, 1950	W. H. Haas	E	0.41	S & N	+18 .5	-2 .5

pole is a particular marking with definite boundaries. Then there should be a unique combination of latitude and longitude librations which puts the dark area in just the right place to give the observed illúsion. Both librations were computed for the dates when blunted cusp observations were made, and the results are found in Table 1* It will be noted that there is a strong preference for positive librations (east limb exposed) when Mercury is at eastern apparitions and for negative librations (west limb exposed) when at western apparitions. This is well shown in Figure 3. This result suggests that a large distinct dark area on the sun-averted hemisphere is responsible for the appearance of the blunted cusp, one extremity at the positively librated eastern hemisphere (eastern apparitions) and one at the negatively librated western hemisphere (western apparitions). The possibility of two distinct dark features is not precluded, of course. Figure 3 also suggests a correspondence with libration in latitude and the

* Latitude librations were computed on the assumption that the axis of rotation of Mercury is perpendicular to the plane of its orbit.

quartersphere visible, positive librations (south pole displaced toward observer) being closely associated with western apparitions.

Though all of this looks rather convincing, we must beware of the pitfalls of the statistics of small numbers. With so few data we may at best regard these conclusions as tentative. It will be of some interest to examine the many Jarry-Desloges observations as well as the current (1961 through present) ALPO Section records in a manner similar to that above.

While the entire collection of drawings in the ALPO files has not been examined to see if observers have reported normal cusps at the extremes in libration, it is certain that these reports occur. It is apparent that certain observers have greater visual acuity than others and that finer seeing conditions may preclude the appearance of a blunted cusp. It is important, I believe, that the blunted cusp observations do conform to a logical pattern despite the number of individual observers, diverse skills, and telescope complements, and a span of ten years.

Terminator Irregularities

Oddly shaped terminators are reported by ALPO observers about as frequently as blunted south cusps, though this is not generally the case with the Fourniers, Antoniadi, or Schiaparelli. Figure 2 (D) by Smith is a representative example of sketches in the ALPO files depicting this effect. Contrast is clearly to blame. The dark markings on Mercury can "deform" the terminator where it cuts across them. As I pointed out in a recent note on Venus phase effects[9] (and as has been known for centuries), low magnification makes for high contrast; and we can easily fall prey to optical effects so induced. Most observers use less than 250X on Mercury, probably because the image is so faint and seeing is rarely optimum. These low magnifications can give unreal contrast impressions and result in deformed terminators.

I am grateful to W. K. Hartmann and C. R. Chapman, who have read and criticized this paper.

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1. Antoniadi, E.M., La Planète Mercure et la Rotation des Satellites, Gauthier-Villars, Paris, 1934.

2. de L'Isle, Bidault, L'Astronomie, 42, 1928, p. 301.

3. Wegner, Gary, Strolling Astronomer, 14, 11-12, 1960, p. 191.

4. ------ Sky and Telescope, 23, 6, 1962, p. 333.

5. Dollfus, A., "Visual and Photographic Studies of Planets at the Pic du Midi", in Planets and Satellites, Kuiper and Middlehurst, ed., Univ. of Chicago Press, Chicago, Plate 4, 1961. (This planisphere is also found in many publications in French and Russian).

6. Schiaparelli, G. V., Astronomische Nachrichten, 123, 2944, pp. 242-50, 1890.

7. McEwen, H., Journal of the B.A.A., 46, 10, 1936, p. 382. (Also in the publications of the Jarry-Desloges observatories, but these are very difficult to obtain.)

8. Dollfus, op. cit.

9. Cruikshank, Dale P., Strolling Astronomer, 17, 1-2, 1963, p. 1.

A REPORT ON THE TOTAL SOLAR ECLIPSE OF JULY 20, 1963

By: Craig L. Johnson

Though I observed with the Montreal Centre of the R.A.S.C. at their Plessisville station, this is by no means a report for the group. We observed from the power station of the Shawinigan Power Co., on the east side of Plessisville, Quebec. This site was approximately 4000 yds. from the central line of totality. Predicted contact times:

1st contact: $20^h\ 35^m$ UT (4:35 P.M. EDT)
Totality: $21^h\ 40^m$ UT (5:40 P.M. EDT)
4th contact: $22^h\ 45^m$ UT (6:45 P.M. EDT)

The actual observed times were slightly earlier (see text of report). At 20^h UT, the temperature was 83°F., and the relative humidity was 60%.

Eclipse day dawned completely overcast; but the moist, fluffy clouds gradually burned away, until by 1 P.M. EDT it was completely clear. However, strong westerly winds aloft brought more clouds in so that between 1st contact and totality the sun was clouded out completely several times, and was rarely totally clear. During totality there was some cloud over the sun, and after totality had ended the sun was completely obscured most of the time.

My telescopic equipment was set up by noon but was not put in complete readiness until the last hour before 1st contact. By 4:30 P.M. EDT everything was in readiness; and since first contact was scheduled for 4:35, I started looking at 4:33 P.M., using 135X (direct vision) with a green Edmund filter, on my 4-inch reflector at 2 inches of aperture. It was immediately evident that 1st contact had already occurred, perhaps 1 minute earlier. The seeing at this time was about 3 (Tombaugh-Smith) and was slowly improving, while the transparency was good.

Between 1st contact and 50% eclipse, there was no visible change in the illumination of the landscape. Also, during this time the lunar limb was carefully scanned with 135X for limb mountains, but none of appreciable size were seen. No telescope on the grounds, and these ranged from binoculars used with direct vision to a 4-inch Zeiss refractor used at an aperture of about 1.5 inches by projection, was able to detect any sunspots on July 20 (this includes my 2-inch aperture direct vision setup) so that the sunspot occultation timing group of the Montreal Centre was thwarted.

After the eclipse reached 50% the landscape grew gradually darker until by 95% eclipse the level of illumination was that of very late evening at sea level, in which the sun is visible, but casts negligible light. By 90% eclipse, what with the cloud cover, I could look at the sun briefly with only variable density polarizing goggles at maximum density; and the sun could be seen as crescentic to the naked eye (either procedure is hardly to be recommended !).

Though there were two groups of observers for shadow band observation, each using white-painted 4x8 surfaces, neither saw nor suspected the presence of shadow bands at any time; nor did I, using a large, flat concrete pad, that supported an electric transformer, as a viewing screen.

By the time the sun was 50% eclipsed, time signals from station WWV were coming in loud and clear on all radios, even the broadcast band ones since a local station at 1400 kc on the B.B. was rebroadcasting WWV. However, at about the beginning of totality the signals all suddenly faded out and remained absent until shortly after totality, at which time they came in strongly again.

About 15 seconds before the beginning of totality, the moon's shadow on the earth became visible in the air, just a little N of NW. The shadow, which appeared noticeably darker than the sky background but still not abnormally dark for a shadow, seemed rapidly to swell in size without changing position much; just before totality it seemed to be indefinite, and a

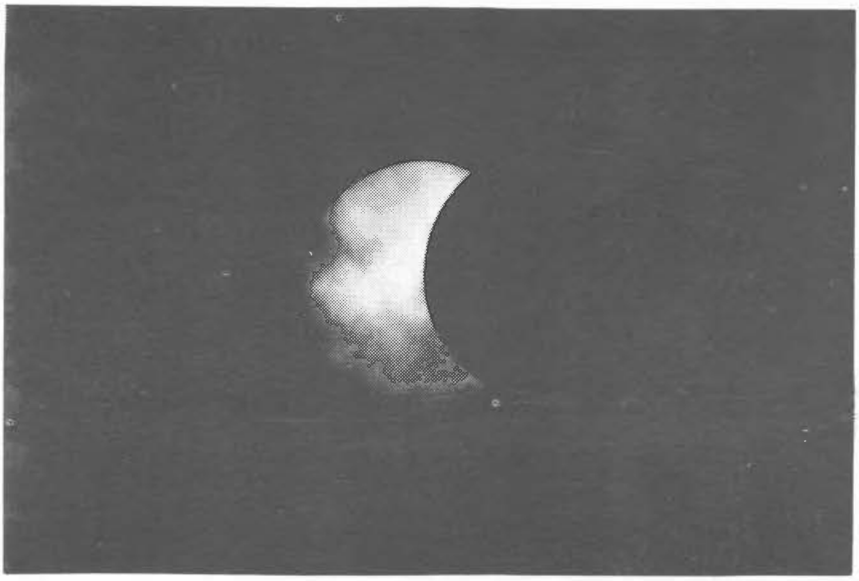

FIGURE 4. Photograph of total solar eclipse on July 20,1963 by Craig L. Johnson at Plessisville, Quebec. 2-inch f: 8 camera on driven mounting. Plus - X Film. Developed for 3.5 minutes at 79°F. in Hyfinol. Enlargement in printing 12X. This photograph at $21^h\ 7^m$, U.T., 1/500 sec. Some clouds present over 50% eclipsed sun before totality.

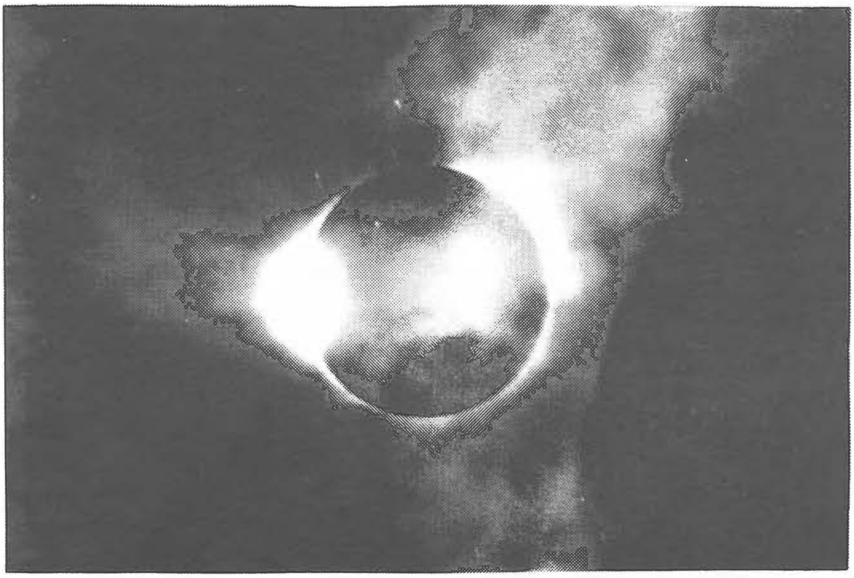

FIGURE 5. Photograph of total solar eclipse on July 20,1963 by Craig L. Johnson. $21^h\ 40^m$, U.T., 1/30 sec. Other data as on Figure 4. Diamond ring at beginning of totality with overexposed chromosphere adjacent to diamond ring. Inner corona visible on other side of sun.

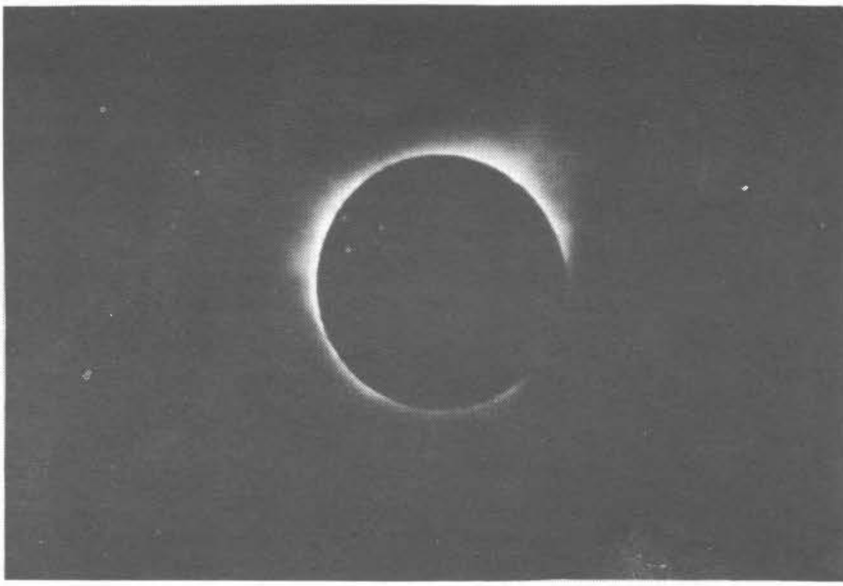

FIGURE 6. Photograph of total solar eclipse on July 20,1963 by Craig L. Johnson. 21^h 40^m, U.T., 1/30 sec. Other data as on Figure 4. Totality, fair transparency. Inner corona shown.

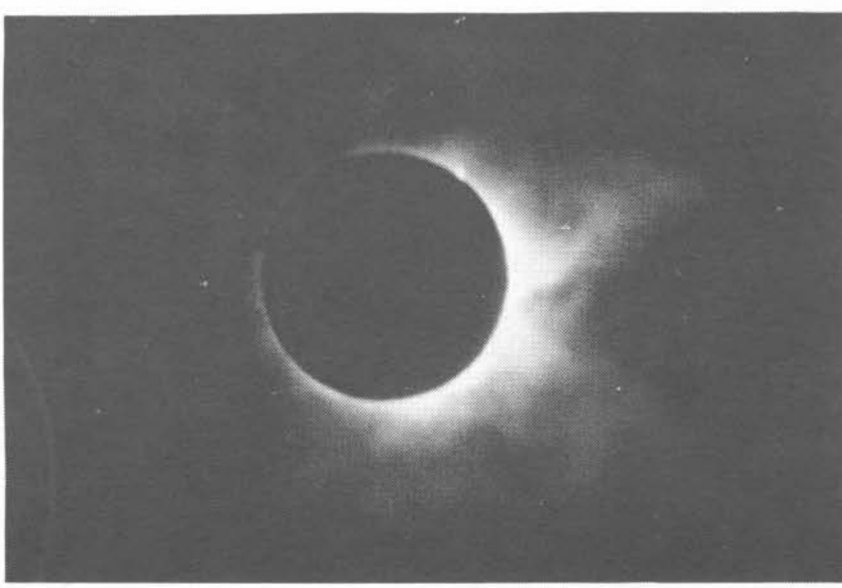

FIGURE 7. Photograph of total solar eclipse on July 20,1963 by Craig L. Johnson. 21^h 40^m, U.T. 1 second. Other data as on Figure 4. View near end of totality; moon displaced to east (left) side of sun. Overexposed chromosphere on right limb and prominence at upper right.

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 <u>lower</u> limit to the slope, if we cam see shadow. If no shadow is visible, the solar altitude gives an <u>upper</u> 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:

$$\sin \underline{A} = \cos \underline{B} \sin (\underline{L} + \underline{C}),$$

where $\underline{A}$ = angular elevation of the sun
$\underline{B}$ = selenographic latitude of mountain ($\sin \underline{B}$ = Eta)
$\underline{L}$ = selenographic longitude of mountain ($\sin \underline{L}$ = Xi $\sec \underline{B}$)
$\underline{C}$ = 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.

dark and conspicuous object.

Some data pertinent to the apparition follow:

Date of Opposition: 1962, August 31.
Dates of Quadrature: 1962, June 3, November 27.
Declination of Jupiter: 10° S. (at opposition).
Equatorial Diameter: 49.4 seconds (at opposition).
Zenocentric Declination of Earth: + 1.4° (at opposition).

This report is based on 5,466 visual central meridian transit observations of 52 observers. About 65 percent of these transits (3,562) form usable drifts for 163 Jovian spots distributed in 15 different currents. The contributing observers are listed below by name and number of transits submitted, along with station of observation and telescope (s) employed.

Bartlett, Dr. J.C.,Jr.	Baltimore, Maryland,	5-in. refl., 2t.
Binder, A.	Tucson, Arizona,	4-in. refl., 83t.
Bornhurst, L.	Monterey Park, Calif.,	10-in. refl., 8t.
Bradbury, D. P.	Texas University,	9½-in. refr., 1t.
Brasch, K. R.	Montreal, Canada,	8-in. refl. 215t.
Budine, P.W.	Binghamton, N.Y.,	4-in. refr., 4t.
Cahill, W. J.	Princeton University,	9½-in. refr., 7t.
Chapman, C. R.	Buffalo, N.Y.,	10-in. refl.,629t.
Cyrus, C.M.	Baltimore, Maryland,	10-in. refl., 34t.
Delano, Rev. K.J.	New Bedford, Mass.,	8-in. refl., 12t.
Eastman, J.	Manhattan Beach, Calif. ,	12½-in. refl.,74t.
Epstein, E. E.	Holywood, Calif.,	10-in. refl., 1t.
Fallon, F.W.	Silver Spring, Maryland,	8-in. refl., 11t.
Farrell, Mrs. A.J.	Binghamton, N.Y.,	3-in. refr., 2t.
Gaherty, G.	Montreal, Canada,	8-in. refl.,111t.
Giffen, C.H.	Princeton University,	9½-in.refr.,681t.
Glaser, P.R.	Waukesha, Wisconsin,	8-in. refl., 10t.
Goodman, Dr.J.W.	San Francisco, Calif.,	6-in. refl., 12-in refl., 24t.
Gordon, R. W.	Pen Argyl, Penna.,	6-in. refl., 67t.
Grasdalen, G.	Albert Lea, Minn.,	6-in. refl., 21t.
Haas, W.H.	Edinburg, Texas and Las Cruces, New Mexico,	6-in. refl.,& 12½-in.refl.,821t.
Hartmann, W.K.	Tucson, Arizona,	8-in. refl., 16t.
Herring, A.K.	Tucson, Arizona,	12½-in. refl. 29t.
Hills, J.G.	Lawrence, Kansas,	6-in. refr.,138t.
Hirabayashi, I.	Tokyo, Japan,	4-in. refl., 67t
Hodgson, R.G.	Gloucester, Mass.,	4-in. refr., 3t.
Jamieson, H.D.	Rock Island, Illinois,	10-in. refl., 85t.
Johnson, C.L.	Boulder, Colorado,	10½-in. refr., 8t.
Louderback, D.	South Bend, Wash.,	8-in. refl., 2t.
Mackal, P.K.	Mequon, Wisconsin,	6-in. refl., 61t.
Matthies, D.	Milwaukee, Wisconsin,	12½-in.refl., 1t.
McIntosh, P.S.	Sunspot, New Mexico,	4-in. refr. 103t.
Meeus, J.	Belgium,	6-in. refr., 9t.
Milne, J.	Schenectady , New York,	2.4-in.refr., 2t
Milon, D.	Houston, Texas,	8-in. refl., 15t.
Olivarez, J.	Pan American College Obs.,	17-in. refl., 1t.
Osypowski, T.	Milwaukee, Wisconsin,	12½-in.refl., 5t.
Pazmino, J.	Brooklyn, New York,	7-in. refr., 1t.
Pope, T.	Milwaukee, Wisconsin,	12½-in.refl., 1t.
Reese, E.J.	Uniontown, Penna. ,	6-in. refl., 8-in.refl.,1765t.
Ricker, C.L.	Albuquerque, New Mexico,	6-in.refl., 76t.
Roberts, Mrs. J.		2.4in.refr., 7t.
Roberts, W.O.	Alameda, California,	2.4in.refr., 9t.
Rost, C.E.	Santurce, Puerto Rico,	6-in.refl., 209t.
Schulze, M.		8-in. refl., 3t.
Smith, J.R.	Eagle Pass, Texas,	8-in. refl., 16-in. refl., 23t.

Tronfi, A.	La Spezia, Italy,	12-in. refl.,	78t.
Wedge, G.	Montreal, Canada,	6-in refr., 8-in.refl.,	87t.
Wend, R.	Milwaukee, Wisconsin,	$12\frac{1}{2}$-in. refl.,	2t.
Williams, D.B.	Normal, Illinois,	6-in. refl.,	7t.
Wyburn, F.	Red Bluff, California,	4-in. refr.,	6t.
Zit, R.E.			1t.

The distribution of transit observations by month is as follows:

March, 1962	29	July	753	November	531
April	151	August	1213	December	443
May	286	September	483	1963	
June	491	October	744	January	259
				February	74
				March	9

Supplementing these visual transits are 49 longitudes measured from good quality photographs taken by Glaser, Milon, Osypowski, and Pope with reflectors from 8 to $12\frac{1}{2}$ inches in aperture.

In the tables which follow, the first column gives an identifying number or letter to each object. The second column indicates whether the object was dark (D) or bright (W) and whether the preceding and (p), center (c), or following end (f) was being observed. The third column gives the first and last dates of observation; the fourth column, the longitudes on those dates. The fifth column gives the longitude at opposition, August 31, 1962. The seventh column indicates the number of degrees in longitude that the marking drifts in 30 days, negative when the longitude decreased with time. The eighth column shows the rotation period in hours, minutes, and seconds.

S.S. Temperate Current (SSTB and SSTeZ), System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Dp	Apr.30-Jun.14	260° - 214°	---	4	-30°.7	9:54:59
2	Dc	Aug.23-Dec.14	152 - 55	146°	5	-25.8	9:55:05
3	Wc	Jul. 7-Aug.25	350 - 311	---	5	-24.0	9:55:08

Mean rotation period: 9:55:04

No. 1 was the preceding end of a darker section of the SSTB. No. 2 was a dark condensation on the N. edge of the SSTB. No. 3 was a bright nodule indenting the north edge of the SSTB.

S. Temperate Current (S. edge STB, STeZ), System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
D	Wp	May 1-Feb. 4	89° - 251°	3°	84	-21°.3	9:55:11
2	Wc	May 1-Feb. 4	98 - 261	12	92	-21.2	9:55:12
E	Wf	May 1-Feb. 4	108 - 271	21	87	-21.2	9:55:12
4	Wc	Jul.14-Aug.24	69 - 41	--	4	-20.5	9:55:13
5	Wc	Jul.25-Dec.19	83 - 333	55	5	-22.5	9:55:10
6	Dc	Jun.11-Sep. 6	120 - 63	67	12	-19.7	9:55:14
F	Wp	Apr.18-Jan.28	170 - 330	73	66	-21.1	9:55:12
8	Wc	Apr.18-Jan.28	180 - 338	81	86	-21.4	9:55:11
A	Wf	Apr.18-Jan.28	189 - 347	89	80	-21.4	9:55:11
10	Dc	May 18-Sep.11	172 - 86	94	19	-22.2	9:55:10
11	Wc	May 19-Oct.30	188 - 54	103	27	-24.5	9:55:07
12	Wc	Jul. 1-Jan.10	181 - 20	134	24	-25.0	9:55:06
13	Dc	Jul. 1-Jan.10	195 - 32	145	15	-25.3	9:55:06
14	Wp	Aug.31-Jan.10	170 - 85	170	11	-19.3	9:55:14
15	Dc	Jul.26-Oct.21	246 - 187	224	9	-20.3	9:55:13

South Temperate Current (Contd.)

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
B	Wp	Apr.28-Jan.22	311° - 132°	230°	55	-19°.8	9:55:14
17	Wc	Apr.28-Jan.22	321 - 141	239	64	-19.9	9:55:13
C	Wf	Apr.28-Jan.22	330 - 151	248	62	-19.8	9:55:14
19	Wc	Jul.25-Sep. 8	322 - 289	294	6	-22.0	9:55:11
				Mean rotation period:			9:55:11.2

The three long enduring ovals were distinctly visible throughout the apparition. Oval FA had recovered from the temporary faintness which had made it a difficult object during much of the previous apparition. The length of the ovals remained at about 18 degrees; however, some drawings and photographs show FA nearly circular in outline with a length of only 12° to 15°. Oval FA may have varied in size from time to time as the result of intrusion of dusky material flowing around it.

The center of the Red Spot was in conjunction with the center of DE on August 30, 1962 at longitude (II) 13° and with the center of FA on December 2, 1962 at 17°. The drift of DE in decreasing longitude became retarded on about August 18 and then resumed its former rate on about August 31 after having fallen back about 6° from the extrapolated line of its earlier drift. On the other hand, the drift of FA remained practically linear as it passed the Red Spot.

The rotation periods of the three long-enduring ovals during the apparition of 1962-63 and between the oppositions of 1961 and 1962 are summarized below:

Oval	Period During 1962-3 Apparition	Period Between 1961 and 1962 Oppositions
BC	9:55:13.5	9:55:13.8
DE	9:55:11.6	9:55:10.8
FA	9:55:11.5	9:55:11.8
Mean	9:55:12.2	9:55:12.1

An easy way to identify and keep track of these ovals is to convert their observed longitudes from System II to a special system and to use the latter to construct a long-term graph. A special system of longitude having a period of $9^h\ 55^m\ 7^s.8$ and a drift of exactly -0°.8 per day relative to System II has been found convenient to use. To convert a longitude from System II to the special system, subtract 2437925 from the Julian Date of the observation, multiply the remainder by 0°.8, and add this value to the System II longitude.

The special system longitudes of the preceding and following ends of the white ovals on the dates of some recent oppositions follow:

	B	C	D	E	F	A
1959, May 18	44°	61°	247°	267°	9°	26°
1960, Jun.20	91	110	282	301	0	19
1961, Jul.25	157	177	319	339	19	37
1962, Aug.31	216	234	349	7	59	75

The STeZ was greatly disturbed in longitudes near, and closely following, the oval FA. Small bright ovals separated by dusky columns abounded in this region. Much of the detail is recorded on a beautiful photograph in color by P. R. Glaser on September 21, 1962 at central meridian 114° (II). The detail was drifting more rapidly than FA. When passing the latter, the detail apparently streamed around the south edge of the oval. It would seem that Nos. 11, 12, and 13 were rotating under the influence of the S.S. Temperate Current.

Middle STB, System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Df	Nov.9-Feb.18	294° - 211°	--	5	$-24^{\circ}.7$	9:55:07

Red Spot Region, System II

Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
RSp	Mar.29-Jan.26	355° - 7°	0°	167	$+1^{\circ}.19$	9:55:42.3
RSc	Mar.29-Jan.26	7 - 19	12.5	220	+1.22	9:55:42.3
RSf	Mar.29-Jan.26	20 - 31	24	182	+1.09	9:55:42.1
RSHp	Apr.16-Jan.26	345 - 1	353	12	+1.69	9:55:42.9
RSHf	Apr.16-Jan.26	26 - 41	34	16	+1.58	9:55:42.8

Adopted rotation period of Red Spot: 9:55:42.3

The mean System II longitudes of the center of the Red Spot during twelve-day intervals in 1962-63 follow:

Central Date	Mean Longitude	Ave. Deviation	Transits	Smoothed Longitude
Apr. 9, 1962	$7^{\circ}.0$	---	1	---
Apr.21	7.5	$1^{\circ}.5$	4	$7^{\circ}.4$
May 3	7.8	2.2	4	7.7
May 15	(7.9)	---	--	8.2
May 27	9.0	1.3	3	8.1
Jun. 8	7.4	1.6	6	8.6
Jun.20	9.4	2.0	5	8.6
Jul. 2	9.1	1.1	8	9.8
Jul.14	10.8	2.2	9	10.8
Jul.26	12.4	0.4	5	11.7
Aug. 7	11.9	1.4	23	12.1
Aug.19	12.0	1.5	23	12.1
Aug.31	12.5	0.6	8	12.5
Sep.12	12.9	1.6	24	13.2
Sep.24	14.1	1.6	16	13.5
Oct. 6	13.4	1.2	23	13.9
Oct.18	14.1	1.5	17	14.5
Oct.30	16.0	1.4	11	15.4
Nov.11	16.0	1.5	10	16.1
Nov.23	16.3	0.3	4	16.7
Dec. 5	17.7	1.1	7	17.3
Dec.17	18.0	2.0	2	17.6
Dec.29, 1962	17.0	1.0	2	17.5
Jan.10, 1963	17.5	0.5	2	---

There are no observations for the May 15 time interval, and a value is interpolated in order to preserve continuity. The "smoothed" longitudes are obtained by the common practice of adding to each longitude the preceding and following values, and then dividing the sum by three.

It is interesting to plot the smoothed longitudes against time. Such a graph suggests two possible interpretations of the movement of the Red Spot: (1). A series of connected linear drifts having these different rates of rotation:

March 29, 1962	- June 20,1962,	$7^{\circ}.0$ - $8^{\circ}.8$,	$9^h\ 55^m\ 41^s.5$
June 20, 1962	- July 26,1962,	$8^{\circ}.8$ -$11^{\circ}.6$,	$9^h\ 55^m\ 43^s.8$
July 26, 1962	- Aug. 31,1962	$11^{\circ}.6$ -$12^{\circ}.5$,	$9^h\ 55^m\ 41^s.7$
Aug. 31, 1962	- Jan. 26,1963	$12^{\circ}.5$ -$19^{\circ}.3$,	$9^h\ 55^m\ 42^s.5$

(2).One linear drift having a rotation period of $9^h\ 55^m\ 42^s.5$ on which is superimposed an oscillating component having an amplitude of about one degree before opposition and half a degree after opposition and a period of roughly 120 days.

Although the mean rotation period of the Red Spot was $9^h\ 55^m\ 42\overset{s}{.}3$ during both the 1961-62 and 1962-63 apparitions, the period between the oppositions of 1961 and 1962 was only $9^h\ 55^m\ 41\overset{s}{.}8$. This decrease in the period was due to the Red Spot's remaining nearly stationary in System II longitude from late November, 1961 until early June, 1962. (Phase exaggeration may have been a contributing factor. The cause of phase exaggeration is explained very clearly at the bottom of page 116 in Peek's The Planet Jupiter.)

At the beginning of the apparition the Red Spot appeared much the same as it had prior to conjunction. The Spot continued to be a very dark and conspicuous feature until about the middle of November. A remarkably dark, red-brown border was clearly seen during July and August. Considerable detail in the form of light yellow-orange patches and dark orange wisps gave the interior a mottled appearance. The length of the Red Spot measured from 14 photographs was $24\overset{\circ}{.}4 \pm 1\overset{\circ}{.}0$ (mean deviation of individual measures). When corrected for foreshortening, the linear dimensions of the Spot were about 17,500 x 9,000 miles. The Red Spot became rather diffuse and ragged during late November and December as the retrograding spots of the SEB Disturbance tried in vain to get past that region. Although the interior of the Red Spot remained quite dark, the dark border had faded away. The elliptical shape became camouflaged by an increasing amount of dark material in the STrZ preceding the Spot. A light oval-shaped haze was seen over the north preceding portion of the Spot on December 29. This characteristic feature should have heralded the return of the Hollow to prominence, but not so. Although the Red Spot remained rather indefinite during January, a darkening may have taken place in early February, according to W. H. Haas. When Jupiter returned to view in the morning sky following conjunction, the Red Spot was once again a very dark and conspicuous object! This failure of the Hollow to replace the Red Spot following the outbreak of the SEB Disturbance of 1962-3 must be regarded as anomalous.

Circulating Current in S. Tropical Zone, System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Dc	May 6 - Jun. 13	143° - 34°	---	6	-86°.0	9:53:43
2	Dc	Jun.16 - Jul. 15	35 -101	---	23	+68.3	9:57:14
3	Dc	Jul.19 - Aug. 23	105 -145	---	12	+34.3	9:56:28
4	Dc	Jul.19 - Sep. 21	69 - 69	69°	25	0	9:55:41
5	Dc	Jul. 2 - Sep. 6	30 - 44	43	12	+ 6.4	9:55:49

No. 1. Small, very dark condensation on or very near the north edge of the STB. The southern branch of the circulating current.

No. 2. Dark condensation on the south edge of the SEB_s. The northern branch of the circulating current.

No. 3. The continuation of No. 2 after a sudden acceleration.

No. 4. A dark condensation in the middle of the STrZ, which apparently broke away from No. 2 around July 8 near longitude (II) 77°.

No. 5 A thin dusky column extending across the STrZ from a diffuse dark spot on the SEB_s. This column apparently outlined the following end of the inconspicuous Red Spot Hollow and the turning point of the circulating current.

The drifts in longitude of numbers 1 through 4 are plotted in the upper portion of the chart on page 143.

Drawings and transits provide strong evidence that condensation No.2 was the very same object as No. 1 after the latter had crossed the STrZ from the north edge of the STB to the south edge of the SEB_s. The first observation of this most interesting feature was made by W. H. Haas on May 6, 1962. The spot was then a tiny very dark condensation on the

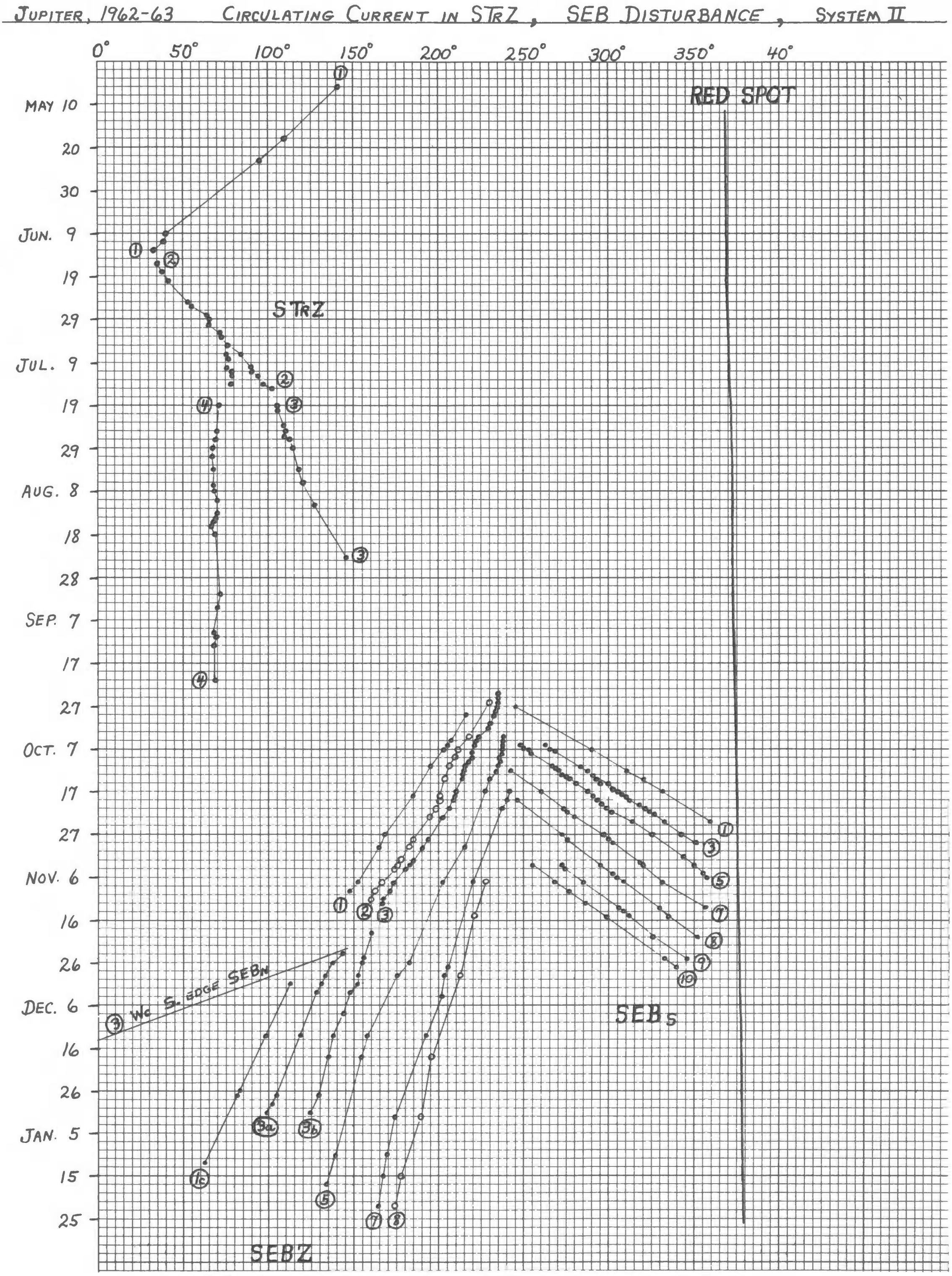

FIGURE 8. Longitude vs. time graph of selected features in STrZ and SEB Z of Jupiter during 1962-3 apparition. Graph constructed by Elmer J. Reese. See also discussion in accompanying text.

north edge of the STB near 143° (II). During the next few weeks the spot moved very rapidly along the north edge of the STB in the direction of decreasing longitude. On June 13 the condensation had reached longitude (II) 34°, and it was positioned a little north of its former latitude. On June 16 the spot had retrograded to 35° and was then located in the northern part of the STrZ. Thereafter No. 2 was observed on the south edge of the SEB_s, drifting rapidly in the direction of increasing longitude.

Certainly there is no clear analogy between conditions leading up to this latest presentation of a circulating current and those leading up to earlier presentations so carefully observed by the British Astronomical Association (see Peek's The Planet Jupiter, Chapter 18). In previous years, the circulating current was a phenomenon apparently associated with, or at least influenced by, the great S. Trop. Disturbance of 1901-39. The circulating spots then were confined to that portion of the STrZ that was clear of the Disturbance. The spots moved very rapidly in increasing longitude along the south edge of the SEB_s until they reached the preceding end of the Disturbance. They then would become diffuse for a few days during which time they apparently were swept across the STrZ along the concave leading edge of the Disturbance. A few days later they would return to prominence as small dark spots along the north edge of the STB moving very rapidly in decreasing longitude. The spots approached the Disturbance with a relative velocity of about 145 m.p.h., looped across the STrZ, and then receded at about 120 m.p.h. In a personal letter dated November 29, 1962 Mr. Peek wrote: "The dark spot of 1962 illustrates exactly what would have happened if a STB_n spot belonging to the circulating current had reached the following end of the S. Trop. Disturbance about June 14 and if (as was never observed for certain) it had there been carried back along the SEB_s to begin a new circuit. Wishful thinking, of course! But what fun it would be if the grey stuff, now preceding the Red Spot in the STrZ, turned out to be a new S. Trop. Disturbance and if we were later able to extrapolate the position of its following end back to about 25° (II) on June 14!"

SEB Z Branch of Disturbance, System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Dc	Sep.29 - Nov. 9	217° - 148°	--	10	- 50°.5	9:54:32
1a	Dc	Dec. 1 - Dec.27	100 - 55	--	7	- 51.9	9:54:30
1b	Wc	Nov.30 - Jan.17	108 - 43	--	6	- 40.6	9:54:45
1c	Dc	Nov.24 - Jan.12	121 - 62	--	6	- 36.1	9:54:51
2	Wc	Sep.26 - Nov.11	230 - 160	--	21	- 45.7	9:54:38
2a	Wc	Dec. 3 - Jan.31	117 - 63	--	6	- 27.5	9:55:03
2b	Wc	Nov.28 - Dec.27	140 - 119	--	5	- 21.7	9:55:11
3	Dc	Sep.24 - Nov.12	235 - 166	--	43	- 42.2	9:54:43
3a	Dc	Nov.24 - Dec.31	140 - 99	--	11	- 33.2	9:54:55
3b	Dc	Nov.19 - Dec.31	160 - 122	--	12	- 27.1	9:55:04
4	Wc	Sep.29 - Dec.18	240 - 144	--	10	- 36.0	9:54:51
5	Dc	Oct. 4 - Jan.17	238 - 133	--	23	- 30.0	9:55:00
6	Wc	Oct.11 - Dec. 4	243 - 185	--	6	- 32.2	9:54:57
7	Dc	Oct.17 - Jan.22	242 - 163	--	12	- 24.4	9:55:07
8	Wc	Nov. 7 - Jan.22	226 - 173	--	7	- 20.9	9:55:12
9	Df	Nov. 7 - Dec. 1	244 - 229	--	7	- 18.8	9:55:15
10	Wc	Oct.19 - Dec. 1	252 - 239	--	10	- 9.1	9:55:28

Mean rotation period (without Nos.9, 10): 9:54:53

The highlight of the apparition was the outbreak of a major Disturbance in the SEB. The first indication of the Disturbance was a thin dark festoon extending from the south edge of the SEB_n into the SEB Z observed by Mr. Bornhurst at longitude 234°(II) on September 24, 1962. The development of the Disturbance was quite typical; and very early views were recorded by Herring on September 27, Hills on September 29, and Louderback and Glaser on September 30. Nothing was seen of the Disturbance by Vitous on August 17, Binder on September 10, or Budine on September 22. Isolated dark bumps had been observed on the south edge of the SEB_n by Jamieson at 238°(II) on

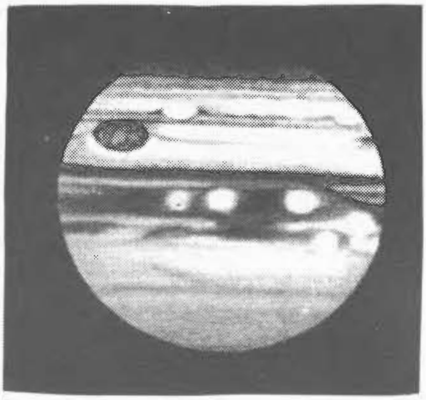

FIGURE 9. Jupiter. Charles H. Giffen. July 27, 1962. $6^h 40^m$, U.T. 9.5-inch Clark refractor. 175X - 345X. Seeing 3-6. Transparency 7. $CM_1 = 159°$. $CM_2 = 54°$. STeZ ovals DE, 4, 5, and FA. Features 11, 12, and 13 in N part EZ.

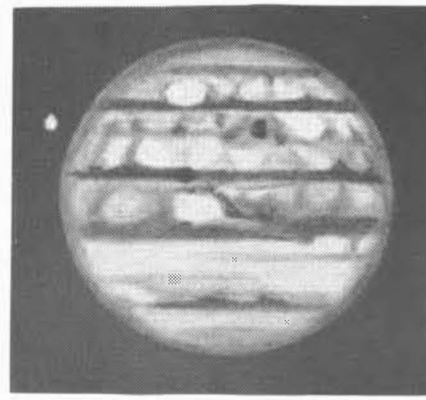

FIGURE 10. Jupiter. Clark R. Chapman. January 9, 1963. $22^h 35^m$, U.T. 7.5-inch refractor. $CM_1 = 306°$. $CM_2 = 10°$. Shadow of II on Red Spot. STeZ oval FA. EZ features 16b and 16c.

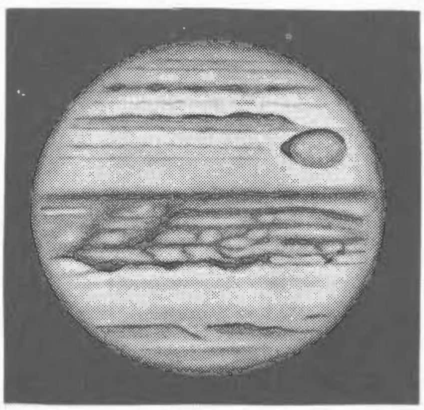

FIGURE 11. Jupiter. Alika K. Herring. August 29, 1962. $6^h 17^m$, U.T. 12.5-inch refl. 208X. Seeing 6 - 8. Transparency 6. $CM_1 = 320°$. $CM_2 = 324°$. Interior of Red Spot flecked with minute white spots. Note STeZ oval DE.

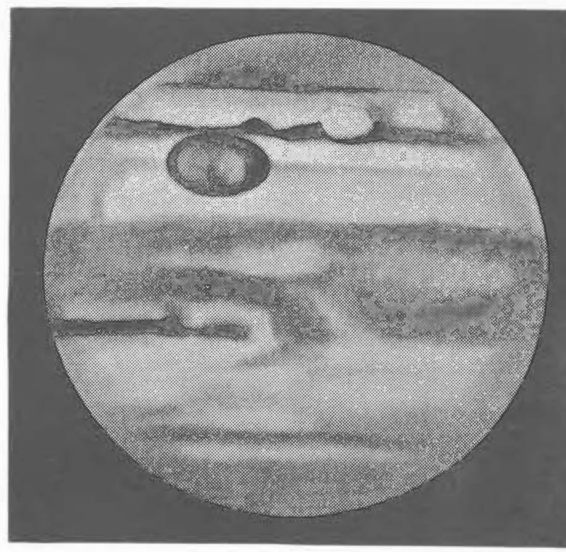

FIGURE 12 (above). Jupiter. J. Dragesco. October 20, 1962. $21^h 5^m$, U.T. 10-inch refl. 200X, 269X. Seeing 4-5. Transparency 4. $CM_1 = 74°$. $CM_2 = 38°$. Note structure in Red Spot, STeZ oval FA, and closely following fainter oval, No.11.

FIGURE 13 (left). Jupiter. I. Hirabayashi. October 16, 1962. $12^h 34^m$, U.T. 4-inch refl. S = 4. T = 5. $CM_1 = 212°$. $CM_2 = 207°$. STeZ oval BC. Large dark festoon in SEB Z is No. 3 of table and chart for this current. For other views of SEB Disturbance see Nov.-Dec., 1962 Str.A., Figures 1, 6, and front cover.

July 26, Gordon at 243°(II) on August 27, and by Mrs. Farrell at 250°(II) on September 22. However, since similar spots had been observed on the SEB_n in other longitudes during this interval, it seems unlikely that any of these spots was directly related to the great Disturbance. A graph of the expanding Disturbance shows its component parts diverging from a well defined "source of eruption" near 240°(II) on September 23 (see lower portion of chart on page 143).

The rotation periods of features in the SEB Z were typical of those observed during previous Disturbances. The leading elements were the faint hump, No.1; the brilliant white oval, No.2, which formed a shallow bay in the SEB_n; and the very dark festoon, No.3. Each of these features apparently geminated during the later part of November perhaps as a result of activity associated with the very sudden appearance of a large, brilliant cloud over the SEB_n first seen by Glaser on November 23 at 146°(II) (No.3 in table for S. edge SEB_n). The components after gemination are listed separately in the table above with a small subscript letter.

SEB_s Branch of Disturbance, System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Dc	Oct. 7 - Oct.24	290° - 359°	--	5	+121°.8	9:58:28
2	Dc	Oct. 7 - Oct.24	280 - 348	--	4	+120.0	9:58:26
3	Dc	Oct. 6 - Oct.29	263 - 352	--	23	+116.1	9:58:20
4	Wc	Oct. 6 - Oct.21	255 - 312	--	12	+114.0	9:58:18
5	Dc	Oct. 6 - Nov. 6	246 - 359	--	32	+109.4	9:58:11
6	Dc	Oct. 8 - Nov. 6	242 - 346	--	13	+107.6	9:58:09
7	Dc	Oct.12 - Nov.13	242 - 357	--	17	+107.8	9:58:09
8	Dc	Oct.19 - Nov.20	246 - 352	--	12	+ 98.4	9:57:56
9	Dc	Nov. 3 - Nov.25	271 - 346	--	8	+102.3	9:58:01
10	Dc	Nov. 3 - Nov.27	255 - 340	--	8	+106.3	9:58:07
11	Dc	Nov. 7 - Nov.25	255 - 323	--	4	+113.3	9:58:16
12	Dc	Nov.15 - Dec. 5	270 - 340	--	7	+105.0	9:58:05

Mean rotation period: 9:58:12

These spots on the south edge of the SEB_s belonged to the retrograding branch of the SEB Disturbance. Spots 1 and 2 were rather faint, while 3 and 4 were very dark and conspicuous prior to October 22. Observers were unable to agree on what happened to the SEB_s spots when their rapid motion in increasing longitude brought them into the immediate vicinity of the preceding end of the Red Spot. The spots seemed to fade and become diffuse as they approached the Red Spot - as though going under an overlying bank of haze. (See remarks under next table). No.1 reached the preceding end of the Red Spot on October 24 and then disappeared. Spots 3 and 5 arrived at the preceding end of the Red Spot on November 1 and 7 respectively.

S. Tropical Zone, System II

(Activity Possibly Associated with SEB Disturbance)

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Dp	Nov. 9 - Dec.18	256° - 198°	--	5	- 44°.6	9:54:40
2	Dc	Nov.15 - Jan.22	251 - 149	--	5	- 45.0	9:54:39
3	Wc	Nov. 3 - Dec.18	281 - 215	--	4	- 44.0	9:54:40
4	Dp	Oct.27 Dec.18	295 - 223	--	9	- 41.6	9:54:44
5	Dc	Nov.15 - Jan. 2	275 - 210	--	4	- 40.6	9:54:45
6	Df	Nov.12 - Dec.18	283 - 235	--	4	- 40.0	9:54:46
7	Wc	Oct.27 - Jan. 2	308 - 222	--	7	- 38.5	9:54:48
8	Dp	Nov. 3 - Jan. 2	315 - 232	--	10	- 41.5	9:54:44
9	Df	Nov. 3 - Jan. 2	330 - 250	--	9	- 40.0	9:54:46
10	Wc	Nov. 3 - Jan. 2	340 - 257	--	10	- 41.5	9:54:44
11	Dp	Nov. 3 - Jan. 2	346 - 265	--	9	- 40.5	9:54:45
12	Dc	Nov. 3 - Dec. 9	351 - 299	--	10	- 43.3	9:54:41
13	Df	Nov. 3 - Jan. 2	356 - 296	--	8	- 30.0	9:55:00
14	Wc	Nov. 6 Jan. 2	357 - 302	--	8	- 29.0	9:55:01
15	Dc	Nov.13 - Dec.29	355 - 318	--	11	- 24.1	9:55:08

Mean rotation period: 9:54:47
Mean rotation period (without Nos.13, 14, 15): 9:54:44

Dusky material began to build up in the STrZ in longitudes closely preceding the Red Spot near the time of the initial eruption of the SEB Disturbance. For the most part, this activity in the STrZ was confined to those longitudes occupied by the retrograding SEB_s spots. During November, Patrick McIntosh and others frequently found the dusky Disturbance in the STrZ following 240°(II) to be considerably darker than the SEB Z preceding that longitude. It is tempting to speculate that the rapidly retrograding SEB_s spots were subjected to much turbulence as they moved towards the very intense Red Spot. Perhaps the spots were torn asunder and sent swirling into the STrZ where they spread out into dusky masses which were carried along by a rapidly rotating current in the opposite direction from whence they came. It is interesting to note that the rotation periods of these markings were typical of periods observed between 1947 and 1954 for similar markings in the STrZ preceding the Red Spot.

S. Edge SEB_n (SEB_n Branch of Disturbance), System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Dc	Nov.26 - Dec.19	110° - 315°	--	5	-202°.2	9:51:06
2	Wp	Nov.25 - Dec.19	122 - 319	--	9	-204.0	9:51:04
3	Wc	Nov.23 - Jan. 2	146 - 233	--	17	-204.8	9:51:03
4	Dc	Dec. 3 - Dec.19	85 - 330	--	4	-215.7	9:50:48
5	Wc	Dec. 3 - Jan. 2	93 - 251	--	6	-202.0	9:51:06
6	Wf	Nov.26 - Jan. 2	133 - 260	--	9	-189.0	9:51:24

Mean rotation period: 9:51:05

Although the SEB Z and SEB_s branches of the great Disturbance developed in a manner very typical of previous upheavals, the SEB_n branch was quite invisible for two months following the initial outbreak. Then, on November 23 at 146°(II), a conspicuous, bright cloud suddenly appeared over the southern part of the SEB_n and the northern part of the SEB Z. During the next few weeks this great bay appeared to break up into several smaller bays with the components diverging somewhat as time went on. Extremely dark condensations appeared on the south edge of the SEB_n between these bays. A number of dark festoons in the EZ seemed to be directed toward these condensations. Also, bright clouds in the EZ showed a tendency to be drawn out toward the SEB_n bays. There is evidence that the cloud which produced the original bay in the SEB_n on November 23 eventually moved across the SEB_n and dissipated into the EZ.

The rotation periods of these features were typical for the SEB_n branch of a Disturbance. It seems very significant that an extrapolation of the drift of the great bay, No.3, would place it very near the position of the intial eruption of the Disturbance at 240°(II) on September 24. This suggests that the bright SEB_n clouds were formed at the time of the initial eruption but did not reach the visible surface for two months!

S. Equatorial Current (N. Edge SEB_n, S. Part EZ), System I

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Wc	May 19 - Sep.11	181° - 165°	167°	7	- 4°.2	9:50:24
2	Dc	May 17 - Sep.11	190 - 185	185	9	- 1.3	9:50:28
3	Wc	Jun. 2 - Sep.16	202 - 202	202	12	0.0	9:50:30
4	Dc	Apr.10 - Sep.21	224 - 215	216	13	- 1.6	9:50:28
5	Wc	Aug. 3 - Oct.23	230 - 235	232	5	+ 1.9	9:50:33
6	Dc	May 22 - Aug.13	295 - 278	---	5	- 6.1	9:50:22
7	Dc	May 18 - Jul.20	337 - 322	---	4	- 7.1	9:50:20
8	Wc	May 25 - Jul.19	345 - 332	---	5	- 7.1	9:50:20
9	Dc	May 13 - Oct. 1	355 - 330	336	9	- 5.3	9:50:23

Mean rotation period: 9:50:25

N. Equatorial Current (S. Edge NEB , EZ_n), System I

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Wc	Apr. 2 - Jan.21	354° - 339°	343°	27	- 1.°5	9:50:28
2a	Dc	May 18 - Mar. 1	0 - 8	355	30	+ 0.8	9:50:31
2b	Wc	May 18 - Nov. 4	8 - 13	11	12	+ 0.9	9:50:31
2c	Dc	Apr.16 - Feb. 4	11 - 41	13	28	+ 3.1	9:50:34
3	Wc	Mar.26 - Mar. 6	26 - 62	41	47	+ 3.1	9:50:34
4	Dc	Apr.16 - Aug. 5	50 - 46	---	13	- 1.1	9:50:29
5	Wc	May 9 - Jul.10	64 - 53	---	3	- 5.3	9:50:23
6	Dc	May 7 - Mar. 6	74 - 74	63	36	0	9:50:30
7	Wc	May 7 - Feb. 9	63 - 88	72	18	+ 2.7	9:50:34
8	Dc	Apr.22 - Feb.25	100 - 101	82	21	+ 0.1	9:50:30
8a	Dc	Jul.10 - Aug.18	109 - 100	---	7	- 6.9	9:50:21
8b	Wc	Apr.28 - Aug.20	119 - 117	---	12	- 0.5	9:50:29
9	Dc	May 3 - Aug.18	144 - 128	---	13	- 4.5	9:50:24
11	Wc	May 3 - Dec.29	151 - 176	161	34	+ 3.1	9:50:34
12	Dc	Mar.18 - Feb. 5	167 - 196	172	40	+ 2.7	9:50:34
13	Wc	Mar.23 - Feb.19	180 - 210	186	64	+ 2.7	9:50:34
14	Dc	Mar.23 - Feb.19	196 - 225	196	53	+ 2.6	9:50:34
15	Wc	Apr.30 - Sep. 9	215 - 206	206	17	- 2.0	9:50:27
16a	Dc	Apr.10 - Aug.15	225 - 225	---	21	0	9:50:30
16b	Wc	Apr.17 - Feb.20	237 - 297	264	76	+ 5.8	9:50:38
16c	Dc	Apr.17 - Mar. 3	251 - 311	278	55	+ 5.6	9:50:38
16d	Dc	Oct. 7 - Feb.20	255 - 280	---	13	+ 5.5	9:50:37
19	Wc	May 22 - Oct.12	279 - 291	290	20	+ 2.5	9:50:33
20	Dc	Mar.28 - Jun.26	285 - 285	---	7	0	9:50:30
22	Dc	Apr.15 - Oct.14	301 - 299	301	24	- 0.1	9:50:30
24	Dc	Apr.27 - Jul.16	314 - 307	---	11	- 2.6	9:50:26
25	Wc	Apr.18 - Dec. 2	324 - 315	317	35	- 1.2	9:50:28
26	Dc	Apr. 2 - Jan.21	343 - 315	334	32	- 2.9	9:50:26
				Mean rotation period:			9:50:31

Identification of many of the objects in this table with long-enduring features observed in 1960 and 1961 appears quite probable. For some objects, such as Nos.12, 14, 22, 24,and 26, identification appears certain. On the other hand, identification of No.16c is very uncertain because of that feature's very rapid drift in increasing longitude compared to that of any feature observed during the previous apparition. If the indicated deceleration took place near the end of the previous apparition, No.16c could be identified with No.16 of 1961-62; however, if the deceleration began near the beginning of the apparition here under review, 16c could be a continuation of No. 18 of the former apparition (Str. A., Vol.16, pp. 197, 198).

The most remarkable features in this current were the bright oval, 16b, and the dark projection, 16c. In mid-October these two complex features appeared to be "pressing" very hard against each other. The oval was extremely brilliant, and the projection was very black at the point of contact. These two objects were drifting very rapidly in the direction of increasing longitude and apparently overtook and obliterated a number of slower-moving features, such as Nos.19, 22, and 25. Near the end of the apparition the rapid drift of 16c had apparently been arrested just as it was about to "collide" with the large projection, No.26, which had been drifting in the direction of decreasing longitude.

Nos.12, 13 and 14 were very prominent features during most of the apparition. No.14 may have been temporarily faint for a few days near the middle of September.

An attempt has been made to make the identifying numbers in this table correspond with those in the tables for 1960 (Str. A., Vol. 15, p. 76) and 1961. At this writing, it appears quite probable that some of the features have endured to the present time (October, 1963). However, a remarkable lengthening of the rotation period of some of the objects in 1963 has made extrapolation of drifts more difficult. P. K. Mackal has reported an average rotation period of $9^h 50^m 48^s$ for 4 objects in this current during July and August, 1963. This period has been confirmed.

Middle NEB, System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Wf	Aug. 8-Nov.25	23° - 320°	10°	16	-17°.3	9:55:17
2	Wc	Jun.23-Dec. 5	122 - 69	105	28	- 9.9	9:55:27
3	Wp	Jul.10-Oct.23	139 - 105	125	13	- 9.7	9:55:27
4	Wc	Jul.15-Oct.18	146 - 115	131	7	- 9.8	9:55:27
5	Wc	Jun.10-Oct.11	249 - 186	208	8	-15.4	9:55:20
6	Wf	Jun.10-Nov. 7	259 - 185	217	12	-14.8	9:55:20
7	Wp	Aug. 2-Dec. 2	328 - 272	315	13	-13.8	9:55:22
8	Wc	Jul.19-Nov.29	341 - 287	327	11	-12.2	9:55:24
9	Wc	Jul.16-Dec.19	23 - 298	358	20	-16.4	9:55:13

Mean rotation period: 9:55:23

Most of these objects were located somewhat north of the middle of the NEB. These small bright clouds usually appeared pure white in marke contrast to the deep yellow-orange ovals in the EZ.

N. Tropical Current (N. Edge NEB, NTrZ), System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Dc	Jun.25-Sep.13	35° - 18°	20°	10	- 6°.4	9:55:32
2	Wc	May 20-Aug.25	52 - 30	--	21	- 6.8	9:55:31
3	Dc	Apr.14-Aug.15	75 - 43	--	15	- 7.8	9:55:30
4	Wc	Aug.15-Nov. 3	53 - 14	41	9	-14.6	9:55:21
5	Dc	Apr.29-Sep.13	106 - 70	74	9	- 7.8	9:55:30
6	Wc	Mar.25-Sep.16	125 - 81	86	37	- 7.5	9:55:30
6a	Wc	Nov.10-Dec.27	57 - 42	--	4	- 9.6	9:55:28
7	Dc	Jun. 2-Sep.11	120 - 90	94	18	- 8.9	9:55:27
8	Wc	Jun. 2-Jan.31	144 - 58	115	56	-10.6	9:55:26
9	Dc	Jun.21-Aug. 3	145 - 127	--	11	-12.6	9:55:23
10	Df	May 19-Oct.16	219 - 155	160	14	-12.8	9:55:23
11	Dp	Apr.30-Jun.12	270 - 253	--	7	-11.8	9:55:24
12	Dc	Apr.30-Jul. 2	283 - 263	--	7	- 9.5	9:55:28
13	Df	Apr.30-Jul. 2	291 - 278	--	5	- 6.2	9:55:32
14	Wc	May 5-Dec.18	301 - 260	276	72	- 5.4	9:55:33

Mean rotation period: 9:55:28

No. 6a may have been a continuation of No. 6. A very dark condensation seen at longitude 139° (II) on March 26 may have been object No.7. The drift of No. 10 was one of continual deceleration. Nos. 6,8, and 14 were prominent white nodules which formed deep notches in the north edge of the NEB. A very delicate belt (a NTrZB), frequently was seen beginning at a small condensation on the north edge of nodule No. 8 and extending in the direction of increasing longitude. This belt became more prominent in 1963-64.

Markings along the north edge of the NEB are characteristically stable or long-enduring. In the past many features undoubtedly have persisted through two or three apparitions. Even so, it is very difficult to establish positive identifications from one apparition to the next because the markings tend to occur in groups and are subject to sudden changes in rotational velocity. No. 14 is almost certainly a continuation of No. 12 of 1961-62. No. 6 may be a continuation of No. 9 of 1961-62; however, identification here is much less certain (<u>Str</u>. <u>A</u>., Vol. 16, p. 200).

N.N. Temperate Current (NNTB), System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Dp	May 9-Dec.18	234° - 180°	209°	29	- 7°.3	9:55:31
2	Dc	May 7-Oct.21	243 - 208	225	28	- 6.3	9:55:32

N.N. Temperate Current (NNTB), System II (Contd.)

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
3	Df	Apr.30-Nov. 7	265° - 227°	240°	36	- 6°.0	9:55:32
4	Dp	Jun. 6-Dec.19	38 - 335	6	12	- 9.6	9:55:27
5	Dc	May 13-Dec.29	52 - 342	15	37	- 9.1	9:55:28
6	Df	Jul.31-Dec.19	36 - 353	25	7	- 9.2	9:55:28

Mean rotation period: 9:55:30

The rotation periods of these two dark rods were several seconds shorter than is normal for the N.N. Temperate Current. No. 2 was a darker section of the $NNTB_n$, while No. 5 was a thin, very dark rod on the $NNTB_s$.

N.N.N. Temperate Current (NNNTB), System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	Period
1	Df	May 23-Nov. 6	118° - 30°	65°	17	- 15°.8	9:55:19
2	Dc	Jul.20-Aug.18	103 - 84	--	6	- 19.7	9:55:14
3	Dp	Jul.17-Nov. 7	173 - 128	155	8	- 11.9	9:55:24
4	Dp	Mar.27-Aug. 6	288 - 233	--	8	- 12.5	9:55:24
5	Dc	May 5-Jun.12	288 - 275	--	6	- 10.3	9:55:27
6	Df	May 5-Jun.12	300 - 285	--	4	- 11.9	9:55:24
7	Dp	Jun.10-Oct.17	304 - 250	270	10	- 12.6	9:55:23
8	Dc	Jul. 7-Oct.17	310 - 270	290	4	- 11.8	9:55:24
9	Df	Jun.18-Nov.15	345 - 265	310	10	- 16.0	9:55:19
10	Dp	May 18-Nov.15	34 - 285	330	21	- 18.1	9:55:16
11	Dc	May 18-Nov.15	45 - 308	349	22	- 16.1	9:55:19
12	Df	Jul. 7-Nov.15	31 - 334	8	22	- 13.1	9:55:23
13	Dp	Jul. 7-Sep.16	44 - 20	27	7	- 10.1	9:55:27

Mean rotation period: 9:55:22

MEAN LATITUDES OF JUPITER'S BELTS IN 1962

By: Elmer J. Reese, A.L.P.O. Assistant Jupiter Recorder

The mean zenographic latitudes of the Jovian belts for the apparition of 1962-63 are tabulated below. These values are based on measures by the writer of the following photographs of Jupiter:

1962,	Jun. 18,	0904 U.T.,	CM_2 38°,	8-in. Refl.,	Milon.
	Jun. 14,	0907 U.T.,	CM_2 159°,	8-in. Refl.,	Milon.
	Jun. 14,	1028 U.T.,	CM_2 207°,	8-in. Refl.,	Milon.
	Jul. 2,	0957 U.T.,	CM_2 14°,	8-in. Refl.,	Milon.
	Jul. 4,	0921 U.T.,	CM_2 293°,	8-in. Refl.,	Milon.
	Jul. 7,	0826 U.T.,	CM_2 351°,	12½-in. Refl.,	Osypowski.
	Jul. 7,	0857 U.T.,	CM_2 10°,	12½-in. Refl.,	Pope.
	Jul. 7,	0614 U.T.,	CM_2 271°,	8-in. Refl.,	Glaser.
	Sep. 3,	0612 U.T.,	CM_2 353°,	12½-in. Refl.,	Osypowski.
	Sep. 3,	0619 U.T.,	CM_2 357°,	12½-in. Refl.,	Osypowski.

July and August (Four photographs taken at a large observatory).

Also tabulated for comparison, are mean latitudes for the interval from 1949 to 1962, inclusive, based on measures of photographs taken by members of the A.L.P.O.

Belt	1949-1962	1962
SSTB (center)	- 44°.9	- 46°.2 ± 1°.3
STB (center)	- 31.0	- 30.4 ± 0.3
SEB_s (S. edge)	- 20.9	- 21.1 ± 1.4

Belt	1949-1962	1962
SEB_n (S. edge)	---	$-9.^{\circ}9 \pm 0.^{\circ}5$
SEB_n (N. edge)	$-6.^{\circ}7$	-3.3 ± 1.2
NEB (S. edge)	+6.8	$+7.3 \pm 0.8$
NEB (N. edge)	+17.9	$+18.8 \pm 1.2$
NTrZB (Center)	---	+23.6
NTB (Center) (very faint)	+27.2	$+28.0 \pm 1.9$
NNTB (Center)	+36.0	$+38.5 \pm 1.3$
NNNTB (Center)	+45.3	$+45.7 \pm 0.9$
Red Spot (Center)	---	-22.8 ± 0.6

The average deviation of the individual measures from the mean for each belt is indicated for 1962.

AIMS OF THE A.L.P.O. VENUS SECTION IN 1963-4

By: Dale P. Cruikshank, A.L.P.O. Venus Recorder

Director Haas has given me the opportunity to work with the Venus Section upon the resignation of the former Recorder, W. K. Hartmann. I think that we can do little better than to maintain the course set some years ago by Mr. Hartmann, who has taken a realistic view of what can be done by visual observers. In a future issue of this Journal will appear an article reviewing past ALPO studies of Venus with an evaluation of current methods and with comments on what may be the expected outcome of our work. At this time, however, we will briefly discuss certain observations of Venus that can be made during this current evening (eastern) apparition of the planet.

As I see it, the ALPO can provide data toward the solution of five general problems of the planet Venus. These are: (a) continuation of J. C. Bartlett's statistical studies of the occurrence of the cusp-caps and rough determinations of their angular extent; (b) study of the phase of Venus near dichotomy to extend the statistical study by Hartmann and to record the profile of the terminator; (c) studies of the occurrence and characteristics of the diffuse dusky bands and markings, both by visual and photographic methods; (d) observation and measurement of the angular extent of the cusps near inferior conjunction for determination of the height of the reflecting layer in the Venus atmosphere (according to the theory of H. N. Russell); and (e), continued search for the ashen light in order to obtain statistics which may lend clues to its origin. We now consider each of these topics in greater detail.

(a). The statistics of the appearance of the bright cusp-caps were first treated by Bartlett. His values need confirmation, however, and this can be done most effectively with a long and continuous series of observations. These observations should include a sketch showing the size and extent of the cusp-caps (when seen) and some notes as to their relative intensities, as well as their intensity relative to other parts of the disk.

(b). Estimates of the phase of Venus near dichotomy will allow us to extend the statistics of Hartmann to determine the magnitude of the Schroeter dichotomy effect with greater precision. Observers are urged to remain ignorant of the predicted date of dichotomy and to be quite content to know that it occurs in April, 1964. For several weeks on either side of dichotomy, sketches should be made of the profile of the terminator, as these may yield parameters for the determination of the scattering properties of the Venus atmosphere. Phase estimates are best made by measuring sketches prepared at the telescope (C. Giffen, Str. A., 17, 89, 1963). Micrometers used at the telescope may provide a little greater accuracy.

(c). It has been noted on U-V photographs by Ross, Kuiper, and others that the normal pattern of bands on Venus consists of three dark and three light streaks running roughly perpendicular to the terminator but that often the pattern is greatly different, probably representing a "disturbed" state of the Venus atmosphere. We can provide useful information by making observations to supplement Hartmann's initial determinations of the percent of the time that the markings take on the banded form or are simply amorphous. This can be done visually, or better, photographically with ultraviolet sensitive materials. Techniques of photography will not be discussed here, but the reader may refer to many articles on the subject in this Journal and elsewhere. Visual observations should consist of sketches and/or notes giving the characteristics of the features that may be seen (the disk is often devoid of <u>any</u> detail whatever) and estimates of the relative intensities (darkness) of the shadings.

(d). Near inferior conjunction, reflection of sunlight in the upper atmosphere of Venus causes the cusps to appear extended beyond their geometrical positions. A measure of this angular extension allows determination of the height of the layer of the atmosphere doing the reflecting. This topic will be dealt with in a forthcoming paper, which will include results of the last inferior conjunction as observed by Hartmann, the writer, and a few others.

(e). Some would have it that the ashen light is auroral in origin. If so, it should be sensitive to solar activity. Observers should look carefully for the ashen light at every observing session. If this illumination of the night hemisphere is noted, the observer should make <u>careful</u> notes of the sky transparency, the cleanliness of his optics, the color of the apparent illumination, etc.

Color filters will be of use in making observations in the above suggested programs, but one must beware of using filters that are so <u>dense</u> that their transmission properties are reduced to insignificance. Experimentation with neutral filters is strongly recommended to acquaint observers with the problems that they face when trying to squeeze conclusions from color filter observations of Venus.

C. Giffen has shown (<u>Str</u>. <u>A</u>., <u>17</u>, 59, 1963) that maximum contrast perception is obtained with Venus when one uses about fifty-five times magnification per inch of aperture with a normal telescope in normal conditions. This means about 220X on a 4-inch, 330X on a 6-inch, 440X on an 8-inch, 550X on a 10-inch, and 660X on a 12-inch. Poor skies and poor seeing lower optimum magnification, while superb conditions and optics allow higher powers; but as a rule, the above values are suggested for maximum contrast.

An intensity scale of 0-10 in current use enables observers to make a quantitative estimate of the darkness or lightness of a particular feature. Zero is taken as the darkness of the background sky, while nine or ten is used as the brightness of the very brightest feature ever seen on the planet. Most often the limb is recorded to be 8.5 or 9, bright cusps are about 9 to 9.5, and the darkest of the dusky markings are 8.0 to 8.5. These values are given simply as a rough guide to observers.

In addition, notes should be made as to the conspicuousness of a given feature. That is, one should note how certain he is of seeing a dusky shading, a terminator deformation, a cusp-cap, etc. One seldom sees markings on Venus which are absolutely certain and as well-defined as those on Mars (or even Mercury); and the conspicuousness estimates enable the Recorder to evaluate markings shown on two or more simultaneous observations, should they occur.

All observations should be reported to the Recorder on standard ALPO Venus Section report forms, available on request from the Recorder. The universal use of these forms will greatly aid the process of reduction of observations submitted to the Section.

In the past, Mr. Hartmann has suggested that observers with limited time or otherwise busy schedules make an effort to observe the planet on week-ends (Friday, Saturday, and Sunday afternoons), if at no other time. I would encourage the same schedule. In all of the above-mentioned programs, we must make an effort to obtain simultaneous observations, because of the subjective nature of the features reported to occur on Venus. If the bulk of the observers concentrate on making observations on week-ends, the probability of simultaneous observations increases.

The brightness of the background sky at the time of observation governs to a large extent what may be seen on the planet. I prefer to observe in full daylight when seeing is optimum (usually late afternoon in my location), but faint streaks on the planet may be lost because of lack of contrast. After sunset the planet is usually so much brighter than the sky that faint shadings are likewise lost in the glare. Late afternoon to sunset may be best; but the observer must determine for himself and for his location the best time to observe, and notes on the observing report concerning the position of the sun (above or below the horizon) at the time will be of some use.

I will be happy to correspond with observers as time allows and to answer questions about these and other programs which pertain to Venus. All correspondents are requested to use my address listed on the inside back cover of this Journal.

IMPROVEMENT OF THE IMAGE CONTRAST IN A NEWTONIAN TELESCOPE

By: H. M. Hurlburt

The amateur's urge for a telescope with which to do good lunar and planetary research has been well demonstrated by the alacrity with which he has adopted the more sophisticated designs, such as the Cassegrainian and Gregorian telescopes and, particularly, the Gregory-Maksutof and the Schiefspiegler. It is a fact, however, that the simplicity of the Newtonian recommends this instrument to good use and that prominent observers obtain excellent results with it. Actually the relatively small field of view required for lunar and planetary observing can be well provided by the Newtonian, and one will do well to obtain the ultimate from it. The single drawback here is the Newtonian's diagonal which, as a "central obstruction", introduces "diffraction effects" into the image, one of the most serious of which is a deterioration in the image's contrast. Because of this recognized handicap, the Newtonian is sometimes passed by in favor of types which promise superior results.

In general, the troubles which are caused by the diagonal are insignificant if the diagonal is small enough; if the diagonal is made small enough so that image contrast is sufficiently improved, the image will be a good one. The effect of the Newtonian's central obstruction (its diagonal) on image contrast is discussed by R. E. Cox in Sky and Telescope (Sept.,1960). Here the theoretical relation between diameter of the central obstruction (relative to the main mirror) and image contrast, as obtained by Everhart and Kantorski, is compared with experiments, and there is ample evidence that image contrast can indeed be greatly improved by making the diagonal size smaller.

There are at least two devices for accomplishing this improvement. One is arranging a Barlow Lens to lie between the diagonal and the main mirror, but very close to the diagonal (see ATM, Book III, p. 279). In this case both Barlow and diagonal are practically at the prime focus of the main mirror, and the width of the bundle of rays from the main mirror is very small here so that the Barlow and the diagonal can also be very small. The image produced by the Barlow, moreover, lies near the wall of the telescope's tube where it can be picked up conveniently by the eyepiece.

Another device is the "transfer lens", which permits the prime focus to lie near the tube axis and translates the prime focus image to a

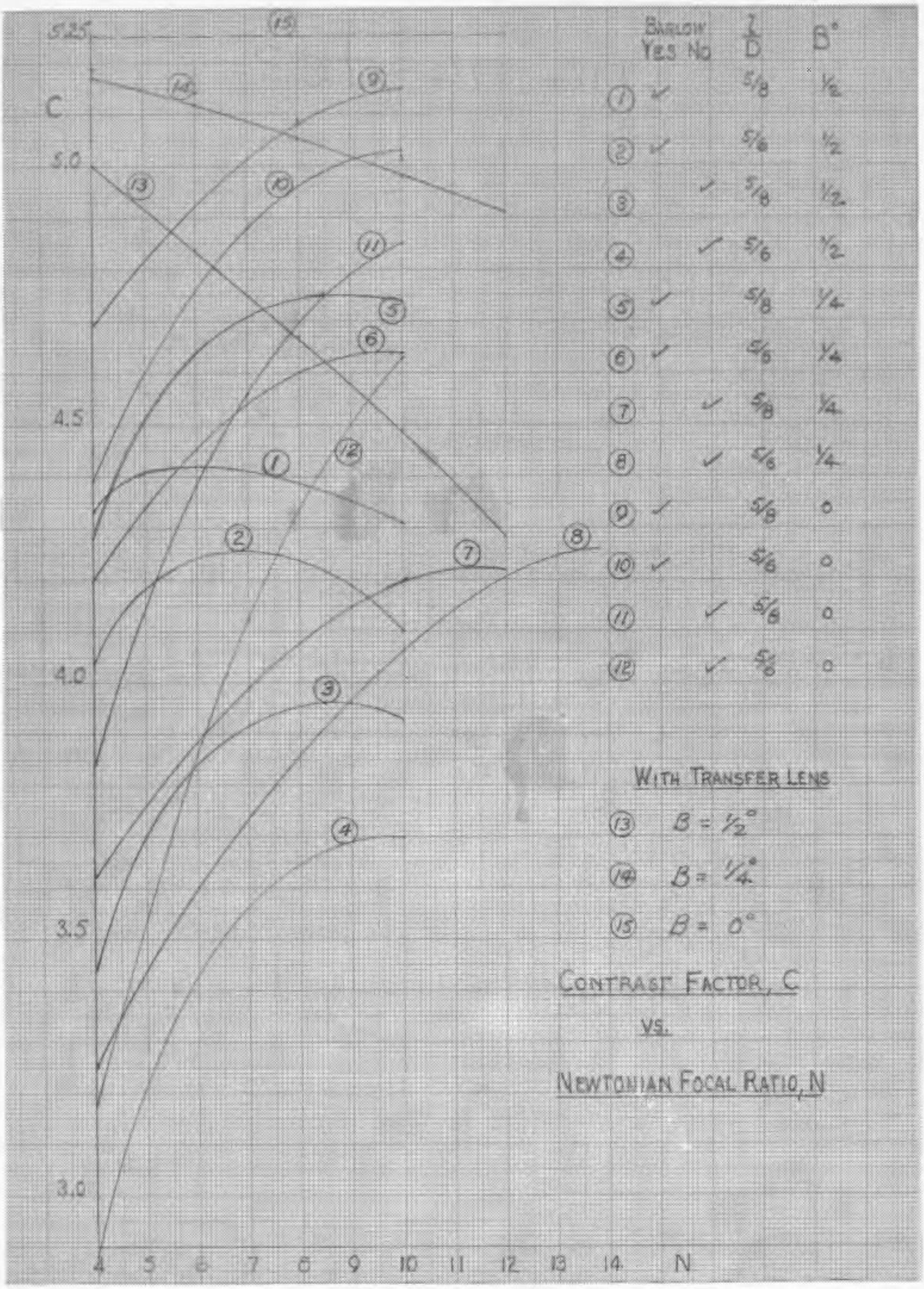

FIGURE 14. Curves to show relation between contrast factor C and Newtonian focal ratio N. See pg. 155 for meaning of l and D; B is the field of view in degrees. Curves drawn by H. M. Hurlburt; see also text of his article in this issue.

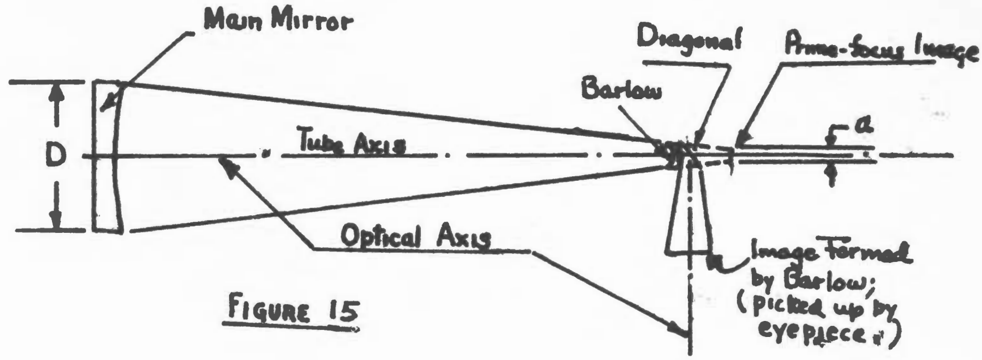

FIGURE 15

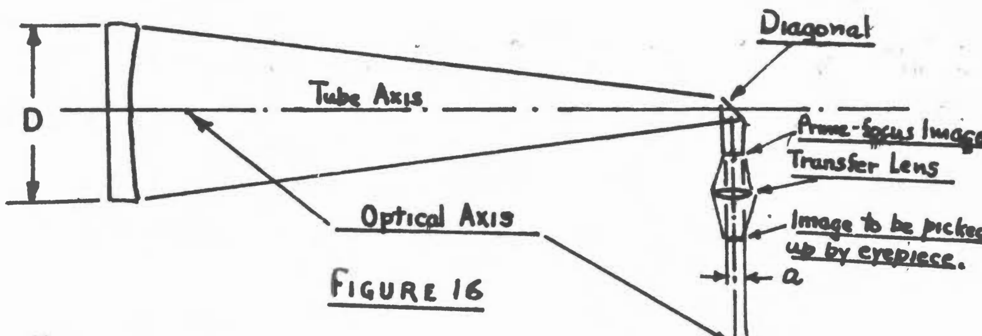

FIGURE 16

NOMENCLATURE:

a = diameter of the prime-focus image.

D = main mirror diameter.

f = main mirror focal length.

l = distance from a point on the telescope's optical axis, just slightly toward the main mirror from the diagonal, to the focal plane of the eyepiece.

d = smallest dimension, normal to the optical axis, the central obstruction, (diagonal or Barlow), can have.

further:

f = ND where N is the focal ratio of the main mirror.

B = Field of view in degrees.

Diagrams to show function of Barlow Lens (Figure 15) and transfer lens (Figure 16) in a Newtonian reflector. See also text of H. M. Hurlburt's article in this issue.

position where it can be picked up by an eyepiece well outside the tube. Both these devices are illustrated schematically in Figures 15 and 16, and it can be seen easily that the central obstructions need not be large at all.

The contrast of the image of a "point of light" depends upon the intensity of the light in the central diffraction spot compared to the intensity of the light distributed in the surrounding rings. In the absence of obstructions to the incident light 84% of the light from a point source falls in the central spot with the remaining 16% scattered among the rings, and the contrast is a maximum. In general, the ratio of the light in the central spot to the light distributed among the rings is called the "contrast factor" C. Clearly, the image of a point of light will be more intense and will contrast better with images of dark areas the greater the portion of the incident light which lies in the central spot.

If there are obstructions to the incident light, less than 84% of the light from a point source will fall in the central spot of the point's image; and the contrast factor C will be less than the maximum. In a Newtonian telescope, for example, the contrast factor depends upon α, the ratio of the diameter of the diagonal (normal to the mirror's axis) to the mirror's diameter; and in general C will be less the greater is the value of α. The curve of C versus α as deduced by Everhart and Kantorski shows C to be a maximum of $84/16 = 5.25$ for $\alpha = 0$ and to decrease rapidly as α increases. The curves in this article (Figure 14) were obtained by computing the α's for various telescope configurations involving a Barlow Lens "built-in" ahead of the Newtonian diagonal or, on the other hand, transfer lenses, and noting the contrast factors C. The equations obtained in the process made it convenient to plot contrast factor versus main mirror focal ratio N, and it is believed that this kind of plot can be of good assistance in the preliminary design of a Newtonian telescope.

These curves are not to be construed as performance indices for particular telescopes but instead as guides which demonstrate comparative performance with respect to image contrast as telescope dimensions vary. For example, the dimension "l" in Figures 15 and 16 is defined as "the distance from a point on the telescope's optical axis (just slightly toward the mirror from the diagonal) to the focal plane of the eyepiece". This "dimension" will vary somewhat in practice and clearly is not to be considered a working dimension. Nevertheless, the image contrast depends greatly upon this dimension since central obstruction sizes, hence image contrast, will vary with it. For definiteness an amplification factor of 2 is assumed here for the built-in Barlow Lens, and this factor serves as a reference.

In general, the use of built-in Barlow Lenses or transfer lenses can improve image contrast in all Newtonian configurations. Only in the case of extremely small main mirror focal ratios ($N = 4, 5$, say) are the improvements, in some cases, so small as to be of negligible value.

The extremely high contrast factors shown by the curves to be obtainable for some configurations are, of course, not ordinarily obtainable because of, say, mechanical difficulties which would attend the construction of diagonals, Barlows, or their supporting structures sufficiently small to obtain these high contrasts. In any case, the effect of the vanes (neglected in this article, but discussed in Cox's article) would be greater than the effect of the diagonal or Barlow Lens. The contrast factor will, however, change in the direction indicated by the curves as changes are made in the diagonal system.

The curve for a field of view of zero degrees is not exactly a fiction. Certainly the angular field of a planet approaches zero, and it has been suggested by R. E. Cox that a planet's image can be centered in the telescope's field (and kept there by a clock drive or a hand-driven slow motion control). With the transfer lens, then, one can approach maximum image contrast, according to the curves.

The two devices suggested here for improving image contrast are not intended to be all-inclusive or confining. For example, there are cases where the distance from the tube axis to the focal plane of the eyepiece is necessarily large. In this case one can use a combination of a built-in Barlow Lens as discussed here in series with one (or two) transfer lenses.

Appendix. Some readers may like to see the equations by which the curves in Figure 14 were computed. We take the Barlow first.

For Figure 15:

$$d_1 = a\left(1 - \frac{L}{2f}\right) + \frac{LD}{2f} \quad , \tag{1}$$

using the well-known formula for the minor axis of a typical Newtonian diagonal to obtain d_1 and noting that, for the selected Barlow amplification factor of 2.0, the distance from the Barlow to the prime focus is L/2. Choose L arbitrarily to vary between the limits:

$$\frac{5D}{8} \leq L \leq \frac{5D}{6} \quad . \tag{2}$$

If f = ND, where N is the focal ratio of the main mirror, (2) becomes:

$$\frac{5}{8N} \leq \frac{L}{f} \leq \frac{5}{6N} \quad . \tag{2'}$$

Now set:

$$a = b \quad ND = \frac{Bf}{57.3} \quad , \tag{3}$$

where B is field of view in degrees and b is field of view in radians. Also set:

$$\alpha_1 = \frac{d_1}{D} \quad , \tag{4}$$

the ratio of the central obstruction to the main mirror diameter. Then (2') can be incorporated into (1) to obtain the limits:

$$bN - \frac{5b}{16} + \frac{5}{16N} \leq \alpha_1 \leq bN - \frac{5b}{12} + \frac{5}{12N} \quad . \tag{5}$$

Values of α_1 can now be computed for, say, the interval $4 \leq N \leq 10$ and for different B's within the limits defined by (5). It is of mainly academic interest that the curves, though rather flat, do have minima within the limits in (5). Let us write:

$$\alpha_1 = bN - 2b + \frac{2}{N} \quad . \tag{6}$$

Then α_1 is a minimum for:

$$N = \sqrt{2/b} \quad ,$$

and its minimum value is:

$$\alpha_1 \text{ (min)} = 2\sqrt{2b} - 2b = \sqrt{2b}\,(2 - \sqrt{2b}) \quad .$$

Now the contrast factor C (α) can be closely approximated by the negative exponential function, with base e :

$$C(\alpha) = c_1 \exp(-c_2 \alpha) \quad ;$$

and a curve C (α_1) will hence have maxima where the α_1 are minima, as one can verify on Figure 14.

We now discuss the transfer lens. Here let the diagonal be situated on the objective's axis and only sufficiently inside the prime focus so that it does not interfere with the prime focus image. Then the minor axis of the diagonal can be as short as:

$$d_2 = a_2 + \frac{b}{f}(D - a_2) = a_2\left(1 - \frac{b}{f}\right) + \frac{bD}{f}, \quad \text{where}$$

$$b \cong a_{2}/2. \tag{7}$$

The ratio of central obstruction to main mirror diameter now becomes:

$$\alpha_2 = \frac{d_2}{D} = \frac{a_2}{D}\left(1 - \frac{b}{f}\right) + \frac{b}{f} =$$

$$\frac{a_2}{D}\left(1 - \frac{a_2}{2f}\right) + \frac{a_2}{2f}. \tag{8}$$

Now as before:

$$a_2 = bND = \frac{BND}{57.3} \quad \text{so that}$$

$$\alpha_2 = bN\left(1 - \frac{b}{2}\right) + \frac{b}{2} = bN + \frac{b}{2}(1 - bN). \tag{8'}$$

The term $-bN$ inside parentheses in the latter expression for α_2 in (8') is so small compared to one as to make the term $\frac{b}{2}(1 - bN)$ a mere small intercept. One can hence closely approximate (8') by:

$$\alpha_2 \cong b\left(N + \frac{1}{2}\right) = \frac{B}{57.3}\left(N + \frac{1}{2}\right). \tag{8''}$$

Equation (8'') is used in the same way as its corresponding equation (6) for the Barlow Lens.

When there is no Barlow Lens ahead of the Newtonial diagonal and no transfer lens is used, the corresponding equations for minimum diagonal minor axis and diagonal size to mirror diameter ratio are:

$$d = a\left(1 - \frac{L}{f}\right) + \frac{LD}{f} \quad \text{and} \tag{1'}$$

$$bN - \frac{5b}{6} + \frac{5}{6N} \leq \alpha \leq bN - \frac{5b}{6} + \frac{5}{6N}; \tag{5'}$$

and the curves C (α) versus N obtained for α's which satisfy the limits of (5') serve as a reference to which the modified designs may be compared.

ON THE ANCIENT ASTRONOMY, CHRONOLOGY, AND COSMOLOGY OF INDIA

By: Péter Hédervári, Fellow of the International Lunar Soc.

India has one of the most ancient cultures in the world. Contemporaneous with the Bronze Age civilization in Europe there already existed in India great philosophers, who occupied themselves with the deepest problems of Existence and Genesis, the origin of our gigantic Universe.

The oldest sacred books of India are the four Vedas: the Rg-Veda, the Sama-Veda, the Yadsur-Veda, and the Atharva-Veda. The word Veda means knowledge, par excellence. R c s, in nominative R k, means poems; Saman is melody; Yadsus is prayer; and Atharvan is charm. The Vedas are about 5000 years old. In the first period of the Sanskrit literature astronomy was impregnated with mystical, magic, and mythological elements;

but actual observations were also being made, chiefly for astrological purposes just as in Europe during the Middle Ages.

We may find the first entries of certain astronomical relations in the Rg-Veda. Chapter 129 of Book X is the so-called "Hymn of Genesis":

> ". . . In that time there was neither Existence nor Non-Existence. What was there? Where? Under whose protection? Were there waters in space? There was neither air nor sky above it! . . . Who knows for certain the origin of this World? Who can explain it? The gods had been born after the Genesis! Who knows the birth of the Universe? In what way did this World come into Existence? Did He do it or not? Perhaps only the Sublime, the Merciful, the Watcher in the Highest Sky above the World knows! . . . Or . . . He doesn't know either! . ."

These abstract speculations show that the ancient philosophers of India not only took pleasure in the wonderful picture of the Universe but also tried to explain the manner of the World's development and to comprehend the dimensions of the Universe. They wanted to understand Man's place in this World-system.

It is well known that the ancient wise men of India had astonishing intuition with the help of several methods of the Yoga-systems. For example, they knew of the existence of bacteria about 2000 years ago, even though they had no microscopes! With their wonderful intuition they could recognize certain laws of Nature and various correlations among phenomena. Their extraordinary intuition also led them to ideas about the origin and development of the Universe and its dimensions in space and time. Thus they speculated upon the age of the earth, even the age of the Universe, as we shall see later.

By archeological researches we know several seals of steatite and tiles from Mohenjodaro, near the Indus River in the northwestern part of India. These seals are about 5000 years old. We find on some of them certain astronomical figures, chiefly of the constellation of the Bull. Instead of the Lion there is often found the Tiger because the tiger was the chief beast of prey in India. However, at that time there were also in India smaller kinds of lions. The frequent occurrence of the Bull may be due to the phenomenon of precession, well known in India in the most ancient times. The ecliptic and the equator intersect in two common points, the vernal and the autumnal equinoxes. The sun is at the vernal equinox on March 21. Because of precession the vernal equinox makes a complete circuit of the ecliptic in 25,920 years and enters a new constellation of the Zodiac every 2,160 years. More than 4300 years ago the vernal equinox lay in the constellation of the Bull. In astrology the Bull's influence is well-disposed. Therefore, the ancient Indians made enormous seals and magic amulets with this Bull symbol.

The five planets known in ancient times, the sun, and the moon were thought to be connected with each other in mystical ways. The Milky Way, the "Heavenly Ganges", was another mystical symbol. In the old sagas the personification of the Ganges was the goddess Gangá, who roams among the reddish locks of Shiva. Shiva is one of the Indian Holy Trinity, the Trimurti or Three Faces. The other two persons are Brahmá and Vishnu. Since the planets, the sun, the moon, and the Milky Way had great significance in astrology and magic, their symbols are often found on old seals and amulets. In ancient cultures great honor was often given to the sun and the moon, for example in Babylon, Egypt, and India. In the two great epic poems, the Rámáyana and the Máhábhárata, there are numerous persons who trace their descent from the family of the sun and the moon respectively. In India the people regarded the thin lunar crescent as the diadem of Shiva.

In the Vedas there was a special chapter on astronomy, but it was later lost. The oldest extant astronomical work is a short one called the Dsyotisa-Vedanga, a supplementary volume of the Vedas. A longer astronomical work, the Surya Siddhanta, was written about 1600 years ago. About 1400 years ago a great astronomer, Árya-Bhata, recognized the cause of eclipses of the sun and the moon and was also familiar with the rotation of the earth. In the Sixth Century (A.D.) another great astronomer, Varaha-Mihira, wrote his works in poems, as was frequently done in old India. The last famous astronomer from whom we have some memoranda was Bhaskara, in the Twelfth Century.

In India there were some very interesting astronomical observatories. The most famous one, the Djantar Mantar, is near Delhi. It was founded by Maharaja Dsay Singh, who was a famous astronomer and astrologer himself. He also founded similar institutions near the town of Djaipur. These observatories were naturally very different from European and American ones. In astrological calculations it was very important to know the constellations and the meridian transits of the stars and the planets; therefore, these observatories near Delhi and Djaipur were built about 3000 years ago chiefly for the sake of such observations. The edges of certain edifices coincided with some important astronomical directions; e.g., the edge of the high observation tower in Delhi pointed to the pole star. The degree scale on the white plains can still be read very clearly. Here is the largest sundial in the world with its gigantic columns.

Astrological observations required very exact knowledge of time. In ancient India water clocks and hour glasses were used besides sundials. The unit of time was the truti, which is about 0.0012 seconds. The practical unit of time was the solar year, the time the sun needs for a complete circuit of the ecliptic. Other units of time were multiples of the solar year. These were the Yugas, which had different lengths. Four Yugas made a Mahayuga , <u>maha</u> meaning great and <u>yuga</u> meaning long period. About 72 Mahayugas (71.428571) made a Mantvantara period, and 14 Mantvantaras equalled a Kalpa, which contains 4.32×10^9 solar years (4,320,000,000).

The Kalpa is a dumbfoundingly large unit of time. There is no other religion in which we may find similar data! The beginning of the chronology of the ancient Assyrian-Babylonians and Hebrews was only about 6000 years ago; of the Mayas, 12000 years ago. The brahmans, the priests of the denomination Brahmanism or Hinduism, calculated and are even now calculating time from the beginning of the present Kalpa, that is, according to their comprehension, <u>from the birth of the earth</u>! The present Kalpa began 1,955,188,063 years ago, calculating backward from 1963 in our calendar. According to current scientific opinion the age of the earth is between 2,000,000,000 and 5,000,000,000 years. Astonishingly, <u>the old Indian wise men recognized the age of our planet to the correct order of magnitude</u>!

Nevertheless, the Kalpas were by no means the longest units of time. A Kalpa means "one day-time of Brahma", the Creator, the first Person of the Holy Trinity. According to the brahmanist's philosophy, Brahmá "exhales" the Universe out of himself at the dawn of one of his days (Kalpas); and then in the twilight he revokes the World into himself. The name of his night in Sanskrit is Pralaya. In the old philosophical concepts Brahmá's life does not last indefinitely but consists of 100 Brahmá-years. A Brahmá-year is 360 Brahmá-days, i.e., 360 Kalpas plus 360 Pralayas. A Brahmá-world, the lifetime of <u>one</u> Brahma, is 3.1104×10^{14} years. After this time the existence of the Brahmá ceases, and it is another Brahmá who next creates a new Universe. The longest unit of time in the brahmanist philosophy is the Brahmandá. During one Brahmandá there are altogether 7.2×10^{10} Brahmá - worlds, each with its own Brahmá-Vishnu-Shiva Trinity. The duration of one Brahmandá is 2.2394880×10^{25} years!

According to the ancient Indian comprehension we are at present in the seventh Mantvantara of the 180,001st Kalpa. From the beginning of our Brahmandá there have so far passed about 7.776×10^{14} years. Since the lifetime of a Brahmá is 3.1104×10^{14} years, we now have the third Trimurti, making our Universe also the third one. Its age is about 1.555×10^{14} years, adequate in order of magnitude for the so-called "long time scale" of modern astronomy!

A table may help to clarify these concepts:

Time Unit	Value in Other Units		Value in Years
Brahamandá	7.2×10^{10} Brahmá-Worlds		2.2394880×10^{25}
Brahmá-World	100 Brahmá-Years		3.1104×10^{14}
Brahmá-Year	360 Brahmá-Days		3.1104×10^{12}
Brahmá-Day	1 Kalpa + 1 Pralaya		8.64×10^{9}
Pralaya	about 14 Mantvantaras	about	4.32×10^{9}
Kalpa	same as Pralaya, also 1,000 Mahayugas		same as Pralaya
Mantvantara	71.428571 Mahayugas	about	3.0857×10^{8}
Mahayuga	4 Yugas (see below)		4.32×10^{6}
Satya-Yuga			1.728×10^{6}
Treta-Yuga			1.296×10^{6}
Dvapara-Yuga			0.864×10^{6}
Kali-Yuga			0.432×10^{6}

It is curious that if we divide a Brahmá-Day (8.64×10^9 years) by the precessional cycle (2.592×10^4 years), we get a quotient of $3.333....\times 10^5$, and each remainder in the division is 8640, one-tenth of the number of seconds in a day.

According to Gilbert (*Monthly Notices*, Vol. 116, No. 6, 1956), the "age of the Universe" is 4.1×10^9 years, a value curiously close to the length of the Kalpa, 4.32×10^9 years.

We should like to give an idea of ours, namely that it appears possible that *the ancient Indian wise men had some knowledge of the expansion of the Universe!* We have spoken of their truly astonishing intuition. Perhaps, then, when they spoke about the days and nights of Brahmá and about his "exhaling" and "revoking" the Universe respectively, they wanted in the first case to express the expansion of the Universe and in the second case its contraction. Of course, they clothed the idea in mystical garb. Also, according to Tolman's modern cosmology, the Universe has a *pulsation.* In a first period the Universe is expanding, as is true at the *present* time. After a very long time the Universe will begin to shrink. These alternating phases will be repeated. The concepts of the ancient Indian scholars remind us very much indeed of this current cosmology.

We finally encounter the idea of the Brahman, a name which we must not confuse with the words *Brahmá*, *brahmans*, and *Brahmandá*. Brahmá is the Creator, the first Person *of the Trimurti.* The *brahmans* are the priests of Brahmanism. The Brahmandá is a very long unit of time. The idea of the Brahman is the Completeness of Existence, the Superabsolutum over the World, Who is without space and time. In this religion it is a most glorious idea of God. We first meet the idea of Brahman in the Vedas. We don't actually know what Brahman *is*; we know only what It (Brahman is neuter gender in Sanskrit) *is not!* As the people of India say, Brahman is "without Duality," neither *one* nor more. It is not a personal God. Brahman is over the creation and the existence of the great *series* of Universes and also over the *series* of ceasings of the Universes.

We ought to acknowledge that the ancient Indian philosophers showed an extremely interesting imagination about the development of the world and that they had a wonderful recognition of the fantastically long age of our great Universe.

BOOK REVIEW

Cosmic Rays, by A. W. Wolfendale. Philosophical Library, Inc., New York, 1963, 222 pp. Cloth bound. $10.00.

Reviewed by Terry E. Schmidt

The author presents in his preface his opinion of whom the book was intended to reach when he states that the text would be "suitable for 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 <u>any</u> 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 <u>The Measure of the Moon</u>, 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

Title	Author	Publisher	Date
The Technique of Optical Instrument Design	R. J. Bracey	The English Universities Press Ltd.	1960
Solar Research	Giorgio Abetti	MacMillan Co.	1963
Soviet Science of Interstellar Space	S. Pikelner	Philosophical Library	1963
Cosmic Rays	A. W. Wolfendale	Philosophical Lib.	1963
Astronomy of the 20th Century	Otto Struve and Velta Zebergs	MacMillan Co.	1962
Vistas in Astronomy (Vol.5)	Arthur Beer	Pergamon Press	1962
The Strolling Astronomer (55 copies)			1949-
The American Scientist (15 copies)			
Journal of the British Astronomical Association (50 copies)			
Skyward (40 copies)		Montreal Centre R.A.S.C.	
Meteor Crater, Arizona	Clyde Fisher	Hayden Planetarium	1941
Meteorites, Meteors and Shooting Stars	Frederic Lucas	Hayden Planetarium	1931
Comets, Meteors and Meteorites	Chester A. Reeds	Hayden Planetarium	1933
National Geographic (13 copies of astronomical interest)			
The American Ephemeris and Nautical Almanac		U. S. Naval Observatory	1946-7 1948-54
Introduction to Celestial Navigation	William H. Barton,Jr.		1943
Constellations		Franklin Institute	1940
Relativity	Phillip Frank	Sky Publishing Corp.	1943
Astronomy for Everybody (revised)	Simon Newcomb	Garden City Publishing Co.	1932
Astronomical Physics	F. J. M. Stratton	Methuen and Co.	1925
Mars, A Photographic Story*	Earl C. Slipher	Sky Publishing Corp.	1962

Many of the books in the A.L.P.O. Library are gifts from members and friends. Such donations are always appreciated. Chiefly we prefer books dealing with lunar and planetary observations and their interpretation on a level understandable by advanced amateurs. It is indicative to state that B. M. Peek's The Planet Jupiter has been one of our most borrowed books.

* Gift from Reverend K. J. Delano.

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 <u>The Strolling Astronomer</u> 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

<u>Fault Scarp in Sinus Roris</u>. 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 1 and 25.4 kms. for Arago 2. 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

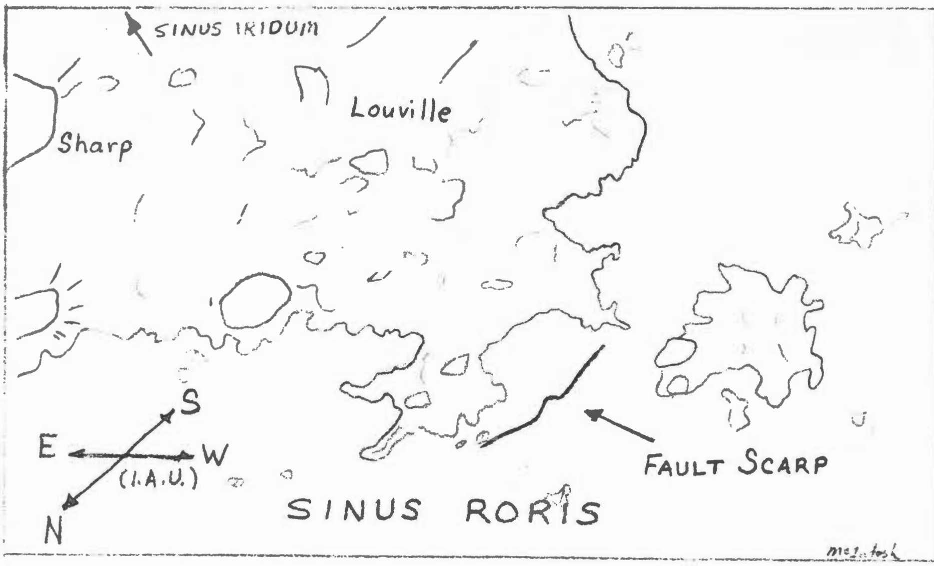

FIGURE 18. Outline based on Plate E1-a of the Lunar Photographic Atlas. Solar illumination from the west (I.A.U. directions). Note fault scarp observed by Harry D. Jamieson.

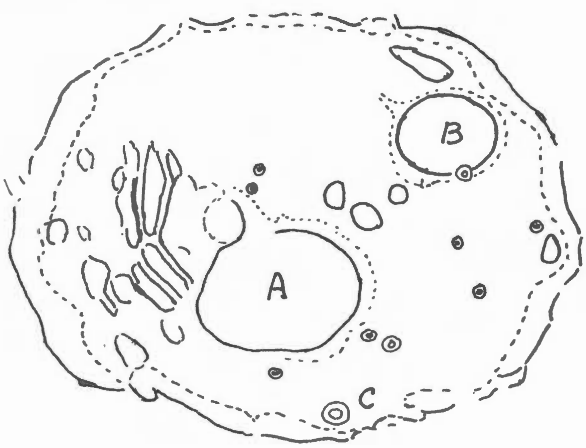

FIGURE 19. Drawing of Lunar Crater Cassini by Alika K. Herring at Haleakala, Hawaii. 12.5-inch reflector. 278 X - 618 X. November 5, 1962. 4^h, U.T. Seeing 8-9. Transparency 6. Colongitude 4°.9. Lunar south at top, lunar west (I.A.U. sense) at right.

sky from Las Cruces, New Mexico, seeing 4 - 5, transparency $5\frac{1}{2}$, 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.

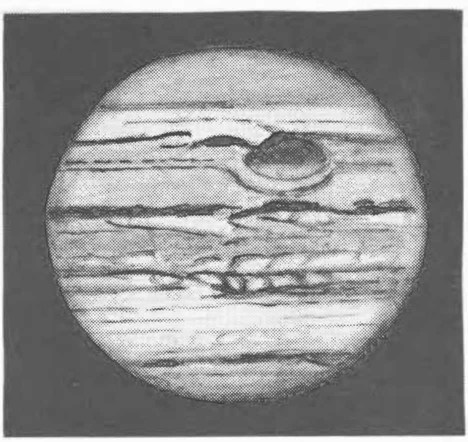

FIGURE 20. Jupiter. Alika K. Herring. August 15, 1963. 13^h 15^m, U.T. 12.5-inch refl. 275X. S = 8-9. T = 6. CM_1 = 155°. CM_2 = 358°.

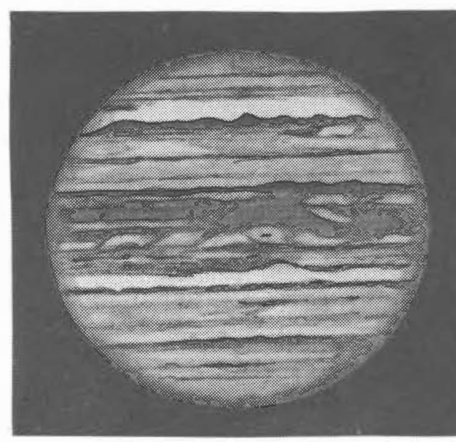

FIGURE 21. Jupiter. Alika K. Herring. August 17, 1963. 12^h 51^m, U.T. 12.5-inch refl. 275X. S = 9. T = 6. CM_1 = 96°. CM_2 = 284°.

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.

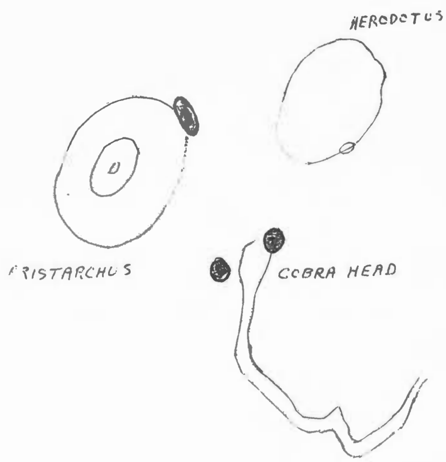

FIGURE 22. Tracing of part of sheet E 3 - A in gridded Kuiper Atlas to show location of three colored lunar areas reported by Lowell Observatory Air Force lunar mappers. Tracing made by Elmer J. Reese.

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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STAFF

Sky and TELESCOPE
Planets with Rings