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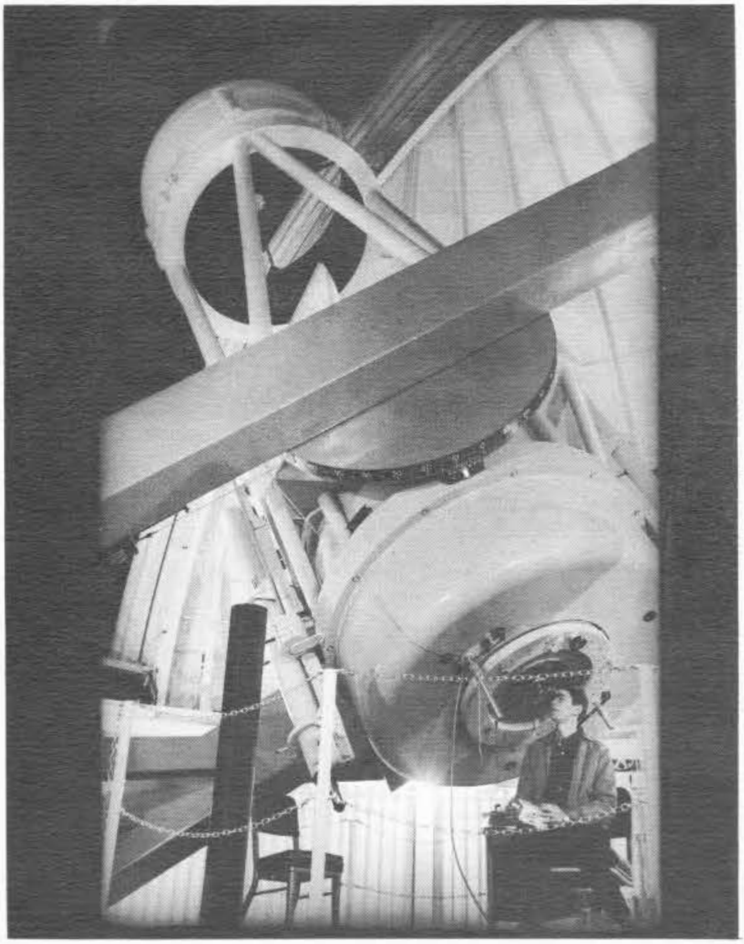

Lunar and Planetary Laboratory 61-inch reflector in Catalina Mountains of Arizona, near Tucson. Observer Steve Larson. Persons attending the A.L.P.O. Convention at Tucson, August 26 - 28, 1966, will have the opportunity to visit this telescope and to observe with it. Photograph by Dennis Milon.

THE STROLLING ASTRONOMER
Box AZ
University Park, New Mexico
88070
Residence telephone 524-2786 (Area Code 505)
in Las Cruces, New Mexico

ASSOCIATION OF LUNAR & PLANETARY OBSERVERS
ALPO
Founded In 1947

IN THIS ISSUE

THE 1963-4 APPARITION OF JUPITER

By: Richard E. Wend, A.L.P.O. Assistant Jupiter Recorder

Introduction

The rotation periods for this apparition, along with a number of drawings, have already been published in The Strolling Astronomer.[1] Elmer Reese, then Assistant Jupiter Recorder, discussed the various currents and drift rates and presented a number of charts listing the numerous markings used in establishing rotation periods. The planet was at opposition on October 8, 1963, on which date its declination was +4°.

Contributing observers are listed below, along with observing station, principal telescope, and the number of observations of all types.

TABLE I

Ault, Robert	Greensburg, Pa.	8" Refl.	6
Bartlett, J. C., Jr.	Baltimore, Md.	4¼" Refl.	36
Brasch, K. R.	Rosemere, Quebec, Canada	8" Refl.	43
Budine, Phillip	Binghamton, N. Y.	4" Refr.	446
Capen, C. F.	Table Mountain, Calif.	16" Refl.	21
Chalmers, James	Dunfermline, Fife, Scotland	8" Refl.	42
Chapman, Clark	Buffalo, N. Y.	12½" Refl.	59
Delano, Rev. K. J.	New Bedford, Mass.	8" Refl.	15
Dey, W. E.	Ottawa, Ontario, Canada	6" Refl.	45
Dragesco, J.	Le Vesinet, France	10" Refl.	99
Farrell, Joanne	Binghamton, N. Y.	4" Refr.	142
Gaherty, G.	Montreal, Canada	8" Refl.	39
Glaser, P. R.	Menomonee Falls, Wisc.	8" Refl.	3
Gordon, R.	Pen Argyl, Pa.	4" Refr.	33
Goodman, Joel	San Francisco, Calif.	12" Refl.	86
Grasdalen, G.	Albert Lea, Minn.	6" Refl.	7
Haas, W. H.	Las Cruces, N. M.	12½" Refl.	445
Herring, Alika	Hawaii	12½" Refl.	11
Hodgson, R. G.	Gloucester, Mass.	12½" Refl.	4
Howie, F. G.	Dunfermline, Fife, Scotland	8½" Refl.	99
Jamieson, H. D.	Muncie, Indiana	10" Refl.	191
Kidwell, Gary	Los Gatos, Calif.	6" Refl.	1
Kolman, R. S.	Chicago, Ill.	6" Refl.	85
Lagen, G.	not stated	6" Refl.	2
Leary, Colleen	Hartford, Conn.	4" Refl.	10
Low, J.	St. Lambert, Quebec, Canada	8" Refl.	12
Mackal, Paul	Mequon, Wisc.	6" Refl.	150
McIntosh, P.	Sunspot, N. M.	4" Refr.	7
Matter, Eleanor	Arlington, Va.	12" Refr.	2
Milon, Dennis	Houston, Tex.	8" Refl.	3
Newman, E.	Roanoke, Va.	6" Refl.	7
Olivarez, J.	Mission, Tex.	8" Refl.	12
Osypowski, T.	Milwaukee, Wisc.	12½" Refl.	14
Pope, T.	Milwaukee, Wisc.	12½" Refl.	1
Reese, E. J.	Research Center, NMSU	16" Refl.	2599
Ricker, C. L.	Marquette, Mich.	8" Refl.	149
Roberts, W. O.	Alameda, Calif.	4" Refr.	62
Rost, Carlos	Santurce, Puerto Rico	6" Refl.	38
Schaefer, Jack	Davenport, Iowa	6" Refl.	1
Smith, J. R.	Eagle Pass, Tex.	16" Refl.	13
Spivak, R. B.	Brightwaters, L. I., N. Y.	10" Refl.	1
Starbird, J.	Topeka, Kans.	6" Refl.	10
Tronfi, A.	La Spezia, Italy	12" Refl.	2
Vitous, J. P.	Riverside, Ill.	8" Refl.	33
Wedge, G.	Montreal, Canada	6" Refl.	63
Whitehead, J.	Elyria, Ohio	6" Refl.	4
Williams, D. B.	Normal, Ill.	9" Refr.	6
Young, J.	Table Mountain, Calif.	16" Refl.	1

Thus 48 observers made a total of 5,160 observations of Jupiter. The distribution of these observations by months in the table below shows again the importance of observations made as soon as possible after conjunction with the sun, and again just before the planet becomes lost as it approaches the next conjunction.

1963,	May	61	1963,	September	896	1964,	January	488
	June	292		October	1039		February	108
	July	360		November	685		March	44
	August	612		December	570			

GENERAL APPEARANCE

The Equatorial Zone remained active during this apparition, but lost much of the orange hue so prominent in '61 and '62. It retained its dusky character, merging gradually with the belts on either side of it.

The EZ complex, F. Howie noted in July, was no longer north of the equator, as it was in '61 and '62, but now lay right along the equator. Clark Chapman was impressed in June, '63 with the large white clouds in the southern portion of the EZ. Paul Mackal described (7-20-63) a large polygonal structure (creamy white) that was at least twice as large as the Red Spot. With its central portion in System I, the object had both northern and southern extremities under the influence of System II, he reported. Four days later, this structure was much less conspicuous and was flattened into a large white oval. Another white oval, adjacent, was probably the result of the larger feature's breaking up. See Figure 8.

Reese commented (8-16-63) that the bright ovals in the EZ were cream colored in 1963-4, and not so orange as in '62. By November, however, some dull, very deep orange ovals were seen by Reese in the EZ_s.

The Equatorial Belts presented a problem in nomenclature. Clark Chapman wrote (6-23-63) that with excellent seeing and large apertures he resolved the equatorial regions into a complex of at least seven parallel belts!

Table II lists two belts, the EB_n and the EB_s; but most observers recorded only one belt in this region, calling it the EB. Haas (11-25-63) described the EB_n (eighth most conspicuous belt in that report) as located about midway between the NEB and the EB (fourth most conspicuous belt). He also noted that the narrow EB was near the SEB_n. Paul Mackal also listed the EB as the fourth most conspicuous belt (7-1-63), but such reports were in the minority. Most lists had the EB last or not at all.

Reese called the EB_s orange brown and the EB neutral grey.

The South Equatorial Belt - North Component was not so intense as it was during the previous apparition; and it also had lost some of its color, being more brownish, and sometimes reddish brown or orange brown. Bartlett found a virtual disappearance of the very dark edge bordering the south edge of the SEB_n. The belt blended with the EZ complex and with the duskiness of the SEB Z. During the first part of the apparition, the SEB_n was ranked the third most conspicuous belt by Haas and Mackal, being preceded by the NEB and STB. By September, Haas ranked the SEB_n as the most conspicuous belt on the planet; and for the remainder of the apparition it was either the most conspicuous, or else second only to the NEB.

Haas noted that the latitude of the SEB_n differed substantially in different longitudes, being sometimes so far south that it might be thought to be the SEB_s. On 5-11-63 he noted that the SEB_n was closer to the STB than the NEB. Mackal wrote that on June 30, 1963 an oval deflected the SEB_n southward; see Figure 4. He also noted (7-18-63) that in the vicinity of the Red Spot the SEB_n was dark and agitated.

The South Equatorial Belt Zone was reported clear and bright (except preceding the Red Spot) by Reese in June. The SEB Disturbance of the previous apparition, a major outbreak, may have collapsed prematurely, he thought. On 8-21-63 Mackal found the SEB Z composed of a string of ovals, very yellow, making this zone much brighter than the STrZ. In October Olivarez reported the SEB Z dusky, and on 11-29 Reese called attention to a lot of delicate detail in the SEB Z-STrZ near the long enduring oval BC. He didn't think this detail constituted a Disturbance, however. Toward the end of the apparition the SEB Z brightened up.

The South Equatorial Belt - South Component was expected to begin the apparition

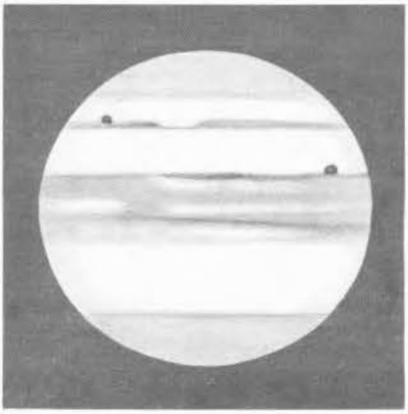

Figure 1. Drawing of Jupiter by Paul Mackal on June 15, 1963 at 9^h42^m, U.T. 6-inch reflector, 212X. Seeing 7, transparency 5. C.M.$_1$ = 113°. C.M.$_2$ = 63°. Shadow II near left limb, STeZ oval BC near C.M., and shadow I near right limb. The views of Jupiter in Figures 1-22 are all simply inverted ones with south at the top.

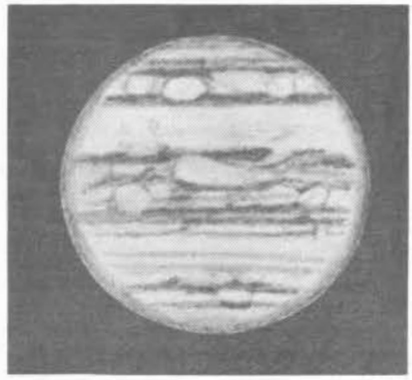

Figure 2. Drawing of Jupiter by Clark Chapman on June 16, 1963 at 11^h20^m, U.T. 12-inch reflector, 250X. Seeing 8-9, transparency about 5½. C.M.$_1$ = 331°. C.M.$_2$ = 273°. Note STeZ oval FA.

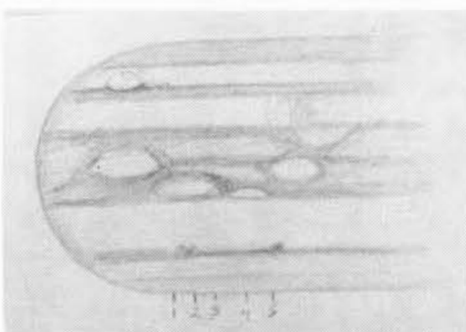

Figure 3. Drawing of Jupiter by Patrick Mc-Intosh on June 29, 1963 at 11^h12^m, U.T. 4-inch refractor. Seeing 4½, transparency 6. C.M.$_1$ = 218°. C.M.$_2$ = 60°.

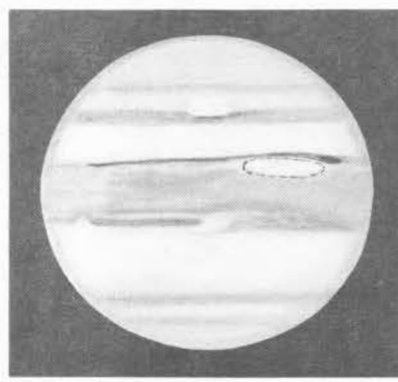

Figure 4. Drawing of Jupiter by Paul Mackal on June 30, 1963 at 9^h42^m, U.T. 6-inch reflector, 212X. Seeing 6, transparency 2½. C.M.$_1$ = 321°. C.M.$_2$= 156°. Note STeZ oval DE and large EZ_s oval.

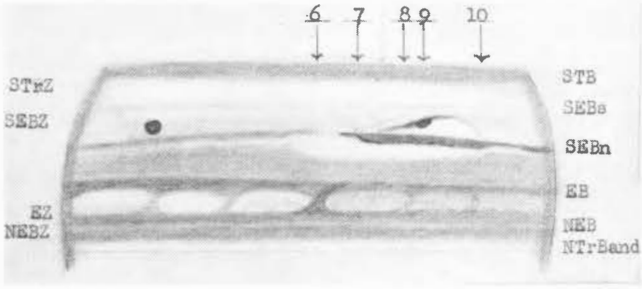

Figure 5 (left). Drawing of portion of Jupiter by Paul Mackal on July 1, 1963. 6-inch reflector, 212X. Seeing 2-4 (?), transparency 2½ - 3½. C.M.$_1$ = 110°. C.M.$_2$ = 298°. Note shadow of J.I.

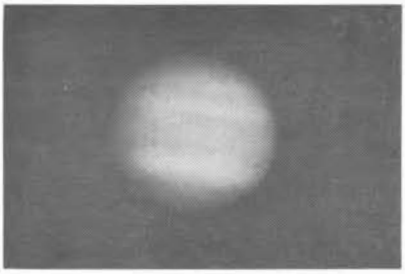

Figure 6. Photograph of Jupiter by Dennis Milon with an 8-inch Astrola reflector used at F:170 on July 7, 1963 at $10^h30^m30^s$, U.T. $C.M._1$ = 15°4. $C.M._2$ = 157°3. Royal Pan, 1 sec. exposure, developed in DK60a. Note bay in STB, dark nodules along N edge of NEB, and dark condensation in NNTB.

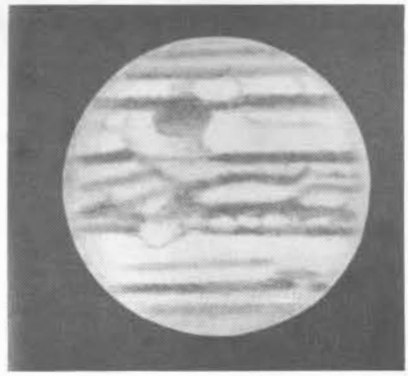

Figure 7. Drawing of Jupiter by Clark Chapman on July 13, 1963 at 11^h52^m, U.T. 4.3-inch refractor, 200X. Seeing 7, transparency 4. $C.M._1$ = 292° $C.M._2$ = 28° Red Spot and STeZ oval BC near conjunction.

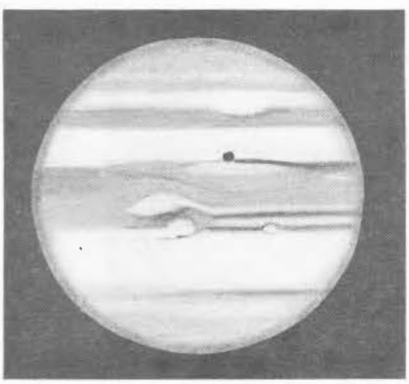

Figure 8. Drawing of Jupiter by Paul Mackal on July 24, 1963 at 8^h45^m, U.T. 6-inch reflector, 212X. Seeing 7, transparency 6. $C.M._1$ = 115° $C.M._2$ = 128° Note STeZ oval DE and shadow of J.I.

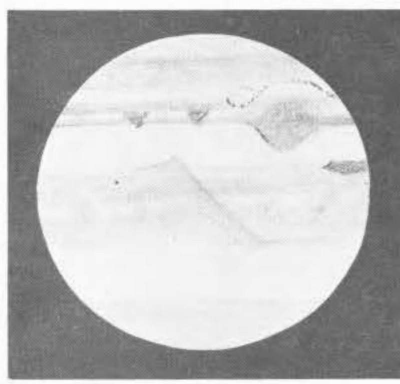

Figure 9. Drawing by Charles Ricker on August 10, 1963 at 4^h25^m, U.T. 8-inch reflector, 155X-233X. Seeing 7, transparency 6-. $C.M._1$ = 122° $C.M._2$ = 6° The RS is imbedded in a widely doubled STB.

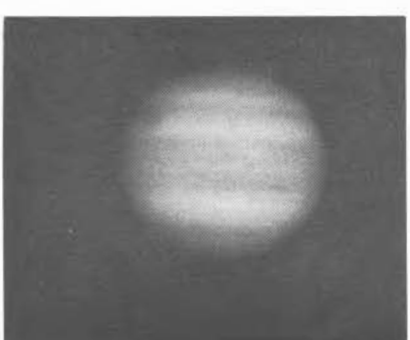

Figure 12 (left). Photograph of Jupiter by Paul Knauth and Dennis Milon with Mr. Knauth's 12.5-inch reflector on September 5, 1963 at $7^h24^m 55^s$, U.T. $C.M._1$ = 19°3. $C.M._2$ = 64°4. F:120, ½ sec. exposure, Royal Pan with Edmund Astro Camera and projection by an 8 mm. Brandon. Developed in DK60a. The dark area on the north edge of the NEB preceding the C.M. was the only area in the equatorial belts possessing color which Milon had seen.

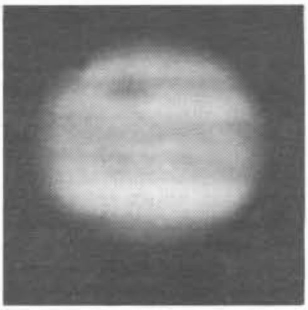

Figure 10. Photograph of Jupiter by Tom Osypowski on Aug. 31, 1963 at 7^h19^m, U.T. $12\frac{1}{2}$-inch reflector. Seeing 8, transparency 4. $C.M._1 = 306^\circ$. $C.M._2 = 29^\circ$. F:84, exposure 1 sec., KB-14 film. Note shadow of Jupiter III near left limb.

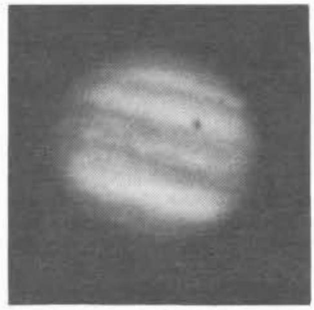

Figure 11. Photograph of Jupiter by Tom Pope on Sept. 1, 1963 at 6^h57^m, U.T. $12\frac{1}{2}$-inch reflector. $C.M._1 = 90^\circ$. $C.M._2 = 166^\circ$. Shadow of J. I. following C.M.

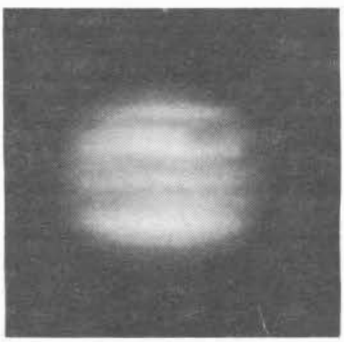

Figure 13. Photograph of Jupiter by J. Dragesco on September 23, 1963 at 1^h40^m, U.T. 10-inch reflector(?). $C.M._1 = 134^\circ$. $C.M._2 = 43^\circ$. Red Spot dark, prominent oval following C.M.

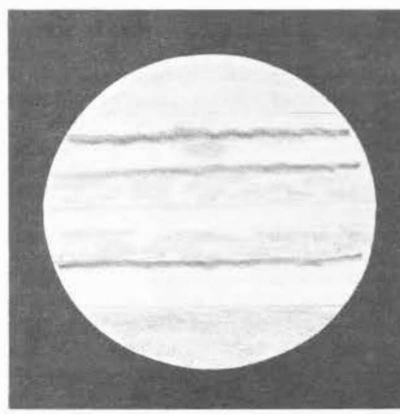

Figure 14. Drawing of Jupiter by James C. Bartlett, Jr. on September 10, 1963 at 3^h37^m, U.T. $4\frac{1}{4}$-inch reflector, 50X - 240X. Seeing 4, transparency $2\frac{1}{2}$. $C.M._1 = 310^\circ$. $C.M._2 = 319^\circ$. Note "psuedo Red Spot", and see discussion in text.

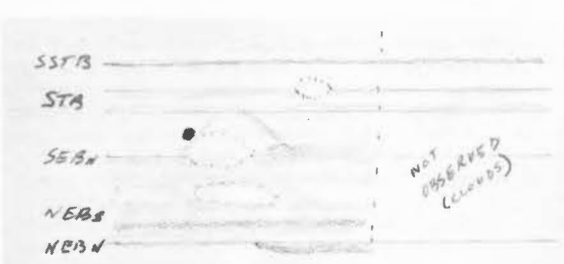

Figure 15 (left). Extended drawing of part of Jupiter by Charles L. Ricker on September 10, 1963, 3^h37^m - 4^h12^m, U.T. Seeing 5, transparency 6. 8-inch reflector, 170X. This view simultaneous with Figure 14, same C.M.'s. at 3^h37^m. Note shadow of J.I., and see discussion on pg. 114 of text.

rather dark, as a result of the Disturbance of '62. Instead, it appeared surprisingly faint, ranking from fifth to eighth in relative prominence. It was most noticeable as a fine line preceding the Red Spot. See Figure 21.

A. Tronfi called attention to dark spots on the SEB_s (11-3-63). See Figure 22. Reese said at this time that there are things happening in the SEB Z and STrZ, perhaps an aftermath of the 1962-3 SEB Disturbance.

The South Tropical Zone varied in brightness, being duskier in the vicinity of the old Disturbance. Generally, it was similar to the SEB Z, but occasionally brighter. In November Haas found the STrZ white with a tinge of violet. At the end of the apparition, early in '64, it became whiter.

J. Barlett, Jr. noted on 9-10-63 an object in the STrZ that looked like a faded Red Spot, greyish in color (see Figure 14) and called a psuedo Red Spot by Bartlett. His drawing was made with a 4¼" reflector. At the same time, C. Ricker was observing this part of Jupiter with his 8" reflector. He made a sketch (see Figure 15) of the "psuedo Red Spot" which he called surprising and disturbing: what appeared to be a wide festoon, extending from the SEB to the STB, turned out to be a central meridian transit of the shadow of J.I. On either side of the CM the satellite shadow mixed with the finer detail to appear as a wide festoon, and even on the CM it was only during moments of tolerable seeing that the true nature of the satellite shadow was evident. Ricker concluded "you cannot always trust your own eyes at the telescope."

The Red Spot confounded many observers who had predicted that, as a consequence of the SEB Disturbance of 1962-3, the Red Spot would fade and disappear. The Spot was plainly visible throughout the apparition, with a few minor exceptions, as of a redder or darker orange color when compared to the previous apparition. At different times, Reese called it very red (June and July), strong orange or salmon (August), and red orange with a very dark neutral border (Nov.). On 7-20-63 Haas pronounced the Red Spot "the reddest I have ever seen it - absolutely fiery!" Then, the next night he observed the Red Spot to be reddish brown; the striking red color seen the preceding night was not confirmed. J. Vitous thought the Red Spot's color in September faded relative to the previous apparition, but still easily seen in contrast to the loss of color over the rest of the disk.

Also notable was the way in which the Red Spot was imbedded in the wide STB, instead of being separated from it by the Red Spot Hollow. (See Figure 9). Reese commented on the strong contrast between the brown STB and the very Red Spot.

The Red Spot did not exhibit the pointed ends that were apparent during the previous apparition. However, Jim Young, observing with a 16" reflector on October 13, noted dark brown cusps in the dusky southern STrZ, adjacent to the preceding and following ends of the Red Spot, which was orange with a red interior and a thin brown border.

Occasionally festoons would connect the Red Spot to small dark spots on the southern border of the SEB_n.

The South Temperate Belt was double, causing some confusion as to what was the SEB_s and what was the STB_n. Figure 17 shows how these two belts appeared in relation to the Red Spot, the SEB_n, and one of the long enduring white ovals.

The STB was darker than during the previous apparition. Most of the time it was the second most conspicuous belt, but occasionally after opposition (October 8) it was the equal of the NEB. J. Olivarez called the split section of the STB in his drawing of October 6 (Figure 18) darker than any other feature on the planet. The south component was extremely dark and active, modulated throughout, commented Mackal. The north component was generally more subdued, and diffuse in places. Mackal also pointed out that on July 4 the southern side of the STB following the Red Spot was approximately coincident in latitude with the northern side of the STB preceding the Spot, giving the impression that the belt exited from the following portion of the Red Spot. In places the STB was almost as wide as the Red Spot itself.

The north edge of the STB was displaced well into the STrZ. In August, Reese suggested that perhaps the dark material from the 1962 Disturbance had piled up against the STB, thus broadening it. After opposition, when the STB darkened and withdrew some of this northern material,it retained slender wisps connecting it with the preceding and following ends of the Red Spot.

The South Temperate Zone was generally the brightest zone on the planet, again featuring the three long enduring white ovals: BC (Figure 7), DE (Figure 4), and FA (Figure 2). Oval FA was more brilliant than usual. Reese noted on several occasions that DE appeared crescent-shaped (concavity south), with the northern edge bright and with a few bright spots at the horns of the crescent.

The South South Temperate Belt was reported by Mackal as definitely darker than the South Polar Region, and as a neutral grey in color. Observers making conspicuousness estimates generally ranked it about sixth in prominence (see Figure 21).

The SSSTB was seldom reported but was occasionally seen as a slightly darker edge to the South Polar Region.

The Polar Regions were generally featureless, though occasional light or dark wisps were seen; Dragesco calls attention to the strange white streak near the south pole on September 30, see Figure 17. The South Polar Region was somewhat smaller than the North Polar Region; and the intensity estimates of Haas rated the NPR slightly darker than the SPR most of the time, the two being equally dusky for the remaining times.

Mackal called the NPR light brown, the SPR grey with a hint of light brown. Haas described both regions as grey. Jamieson described an experiment on 10-13-63 wherein he observed Jupiter with his 10-inch reflector and a blue 48A filter. He found the NPR the darkest feature on the disk with this arrangement.

The North North Temperate Belt was in a very active area. Several observers commented on the complexity of belt formations in the high latitudes of the northern hemisphere. Reese reported a striking golden hue in the NNTB and NNNTB, with a clear yellow between them. Haas and Mackal rated the NNTB fourth in relative conspicuousness, and only occasionally fifth. Howie termed the NNTB quite conspicuous, separated from the NPR by a narrow zone. The fainter NNNTB and NNNNTB encroached upon the NPR, with occasional dark spots. See Figure 18.

The North Temperate Zone was the brightest zone on the planet, along with the adjacent NTrZ; and in instruments in which the NTB, the NTrB, and the NNTB weren't visible, there appeared to be a single zone from the NPR to the NEB which was the brightest area on Jupiter. Reese called the color of this wide zone bluish white.

The North Temperate Belt, when seen at all, was the faintest belt on most lists. This rank was in marked contrast to that at the closing of the 1962-3 apparition, when it was dark and conspicuous, the equal of the NEB and SEB_n.

The North Tropical Zone was bright during the entire apparition. J. Smith called it white with a tinge of violet. Within this zone appeared a belt that was christened with a variety of names. Sometimes it was mistaken for the NTB. Mackal called it the NTrB; in Table II Reese called it the NTrZB?, and later suggested NTB_s. Jamieson observed on 10-11-63 that the NEB_n slanted northward and actually merged with the NTrB. Two nights later, Haas observed a similar confusion of the belts. Reese called this thin belt red-brown in color, and at times it was conspicuous. Haas estimated it as sixth or seventh in relative conspicuousness when he saw it.

The North Equatorial Belt was the most prominent belt on the planet, a dark red-brown in color. It was clearly double, with a variably dusky NEB Z containing festoons. Chapman and Jamieson noted brilliant white spots in the NEB. Bright bays along the northern edge were also a feature; Bartlett observed several that penetrated deep into the interior of the belt. Occasionally the northern component itself was double. Figure 8 shows some of the variations that the NEB exhibited.

ZENOGRAPHIC LATITUDES

The following latitudes of the Jovian belt system were measured by Elmer Reese with a Mann measuring machine at the New Mexico State University Research Center from two photographs by Tom Osypowski, made on August 18, 1963 (8^h7^m) and on August 31 (7^h5^m), using a 12½" reflector. The two series of measurements were averaged whenever two measurements of the same belt were obtained. For comparison, figures for 1962-3 and 1949-62 are reprinted from a previous Jupiter Report.[2]

TABLE II

Belt	Lat. 1963-4	Lat. 1962-3	Lat. 1949-62
SSTB	-44°.4	-46°.2	-44°.9
STB, S. edge	-33.9	---	---
STB, center	-30.3	-30.4	-31.0
STB, N. edge	-26.7	---	---
SEB_n, S. edge	-10.8	- 9.9	---
SEB_n, N. edge	- 7.0	- 3.3	- 6.7
EB_s	- 2.9	---	---
EB_n	+ 0.8	---	---
NEB, S. edge	+ 8.1	+ 7.3	+ 6.8
NEB, N. edge	+18.1	+18.8	+17.9
NTrZB	+23.8	+23.6	---
NTB	---	+28.0	+27.2
NNTB	---	+38.5	+36.0
NNNTB	+44.5	+45.7	+45.3

PHOTOGRAPHIC TECHNIQUES

Photographs, particularly with the color emulsions, have produced more useful images of Jupiter than for any previous apparition. It is striking to note how colors change from one year to another, and most valuable to have a photographic record of these changes. Experienced ALPO observers have commented that the colors obtained by P. R. Glaser (ALPO Jupiter Recorder) using Ektachrome-X, and by T. Osypowski using Kodachrome-X, are true colors just as seen at the eyepiece under favorable conditions. Osypowski recommends the use of CC filters on longer exposures. Specifically, he recommends CC05M in the one second and ten second exposures, and CC10R for 100 seconds and 1000 seconds. These are recommended for Kodachrome-X, which he used in his experiments.

J. Vitous has experimented with the faster High-Speed Ektachrome since his mechanical system doesn't permit the longer exposures of the slower films. This faster film, he concedes, is grainier; and the colors are not as true.

Those observers who would like to experiment with color films are referred to The Strolling Astronomer article "Photographing Jupiter in Color" by Philip R. Glaser.[3]

OBSERVED SATELLITE PHENOMENA

TABLE III

Date	Predicted (U.T.)	Observed (U.T.)	Observer
1963, May 30	I Tr I 12:12	12:08.3	Haas
July 30	III Oc R 6:49	6:48.4	Jamieson
August 2	I Tr I 5:25	5:25.5	Jamieson
August 2	I Sh E 6:18	6:17.9	Jamieson
August 2	II Ec D 6:50	6:51.1	Jamieson
August 2	I Tr E 7:34	7:33.2	Jamieson
October 6	III Tr E 3:37	3:40 1st 3:47 2nd	Roberts
October 7	II Tr E 3:45	3:40 1st 3:47½ 2nd	Roberts
October 13	III Tr Sh CM 6:13	6:18	Haas
October 13	III Tr E 6:53	6:42.2 1st 6:49.8 mid 6:58.4 2nd	Haas
October 13	III Sh E 7:34	7:28.2 int 7:32.2 mid	Haas
October 17	I Tr I 6:21	6:23	Roberts
October 17	I Tr E 8:31	8:27 1st 8:34½ 2nd	Roberts
October 17	I Sh E 8:46	8:41	Roberts
October 18	I Ec R 6:07	6:05	Roberts
October 21	II Tr E 8:14	8:08 1st	Roberts

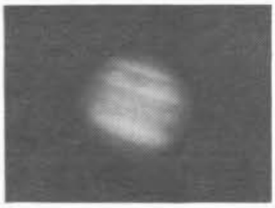

Figure 16. Photograph of Jupiter by J. Russell Smith on Sept. 22, 1963 at 5^h 19^m, U.T. 16-inch reflector. C.M.$_1$= 109°. C.M.$_2$= 25°. Red Spot again present and conspicuous.

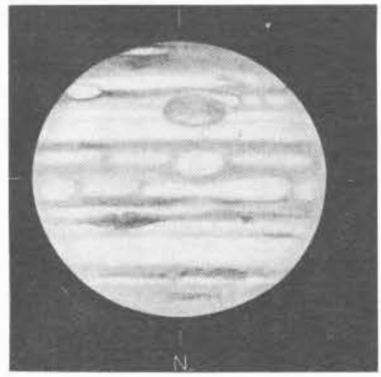

Figure 17. Drawing of Jupiter by J. Dragesco on September 30, 1963 at 21^h35^m, U.T. 10-inch reflector, 269X. Seeing 2-4, transparency 4½. C.M.$_1$= 168°. C.M.$_2$= 18°. Good view at moments. Note Red Spot and STeZ oval BC.

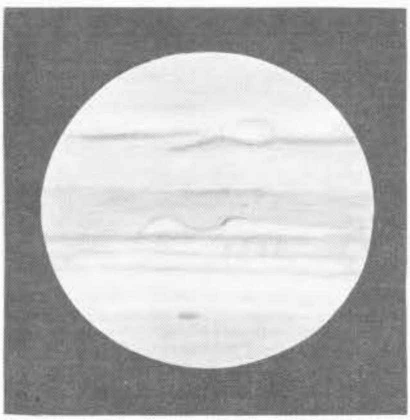

Figure 18. Drawing of Jupiter by José Olivarez on October 6, 1963 at 5^h5^m, U.T. 8-inch reflector, 180X. Seeing 9, transparency 5. C.M.$_1$= 153°. C.M.$_2$= 322°. STeZ oval BC.

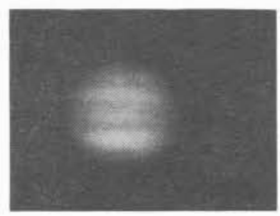

Figure 19. Photograph of Jupiter by E. Newman on October 19, 1963. 6-inch reflector. C.M.$_2$= 192°. Note STeZ oval FA.

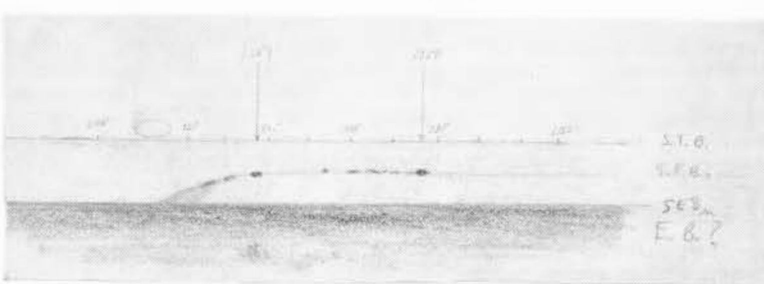

Figure 22. Drawing of portion of Jupiter by A. Tronfi on November 3, 1963. 12-inch reflector. Longitudes (II) are given on the scale in the upper part of the sketch.

TABLE III (Cont)

Date	Predicted (U.T.)			Observed (U.T.)	Observer
1963, October 21	II	Tr E	8:14	8:17 2nd	Roberts
October 21	II	Sh E	8:57	8:53	Roberts
October 24	I	Tr I	8:05	8:00 1st	Roberts
				8:06 2nd	
October 24	I	Sh I	8:29	8:29	Roberts
November 15	II	Tr I	1:52	1:51.2 mid	Haas
				1:54.2 int	
November 15	II	Tr E	4:17	4:17.5 mid	Haas
				4:19.6 ext	
November 15	II	Tr Sh CM	4:43	4:42	Haas
November 18	I	Tr Sh CM	4:10	4:14	Haas
November 18	I	Tr E	4:28	4:22.8 int	Haas
				4:25.7 mid	
				4:28.3 ext	
November 25	III	Tr I	0:49	0:41.0 ext	Haas
				0:47.9 mid	
				0:54.3 int	
November 25	III	Tr E	3:24	3:18.9 int	Haas
				3:23.3 mid	
				3:30.8 ext	
November 25	I	Tr I	4:05	4:00.4 ext	Haas
				4:03.2 mid	
				4:05.3 int	
November 25	III	Sh I	5:10	5:09.6 mid	Haas
				5:13.2 int	
November 29	II	Tr I	6:38	6:30.4 ext	Haas
				6:33.1 mid	
				6:38.2 int	
December 2	III	Tr I	4:26	4:20.0 ext	Haas
				4:24.7 mid	
				4:31.1 int	
December 2	III	Tr CM	5:44	5:44	Haas
December 2	I	Tr I	5:55	5:50.0 ext	Haas
				5:52.8 mid	
				5:55.8 int	
1964, January 18	II	Tr I	0:31	0:25 ext	Budine
				0:27 mid	
				0:31 int	

When nothing else is indicated, the observed times refer to the observed middle of a phenomenon. Some abbreviations are: 1st, first contact for a phenomenon; 2nd, second contact for a phenomenon; int, internal contact; ext, external contact; mid, middle of a phenomenon.

References

1. The Strolling Astronomer, v. 18, #5-6, pp. 85-95.

2. The Strolling Astronomer, v. 17, #7-8, pp. 150-151.

3. The Strolling Astronomer, v. 16, #11-12, pp. 247-251.

LATITUDE DEVIATIONS OF THE NEB_n AND NEB_s OF JUPITER

(Paper read at the Thirteenth A.L.P.O. Convention at Milwaukee, Wisconsin, July 4, 1965.)

By: Paul K. Mackal

The importance of Jupiter latitude measurements has not been adequately stressed in popular journals for many years. This is mainly due to the relatively unsatisfactory results obtained after laborious efforts to secure and reduce micrometric data obtained di-

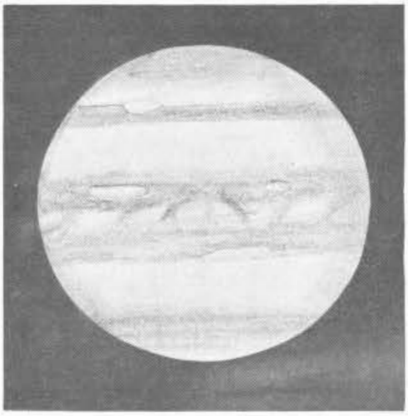

Figure 20. Drawing of Jupiter by Roger Kolman on October 25, 1963 at 2^h25^m, U.T. 6-inch reflector. Seeing 8, transparency 5. C.M.$_1$= 178°. C.M.$_2$= 203°. Note STeZ oval FA.

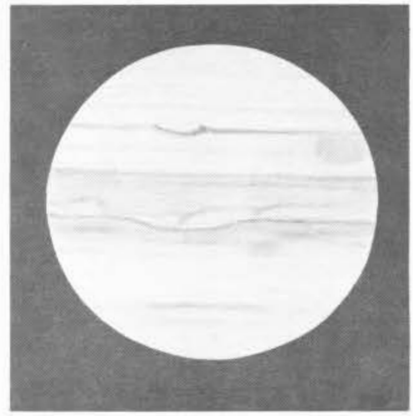

Figure 21. Drawing of Jupiter by Joseph P. Vitous on November 2, 1963 at 2^h30^m, U.T. 8-inch reflector. Seeing 6-8, transparency 5. C.M.$_1$= 5°. C.M.$_2$= 329°. STeZ oval BC near C.M. and Red Spot near right limb. Mr. Vitous' original drawing is in attractively done natural colors.

rectly at the telescope. Furthermore, the belts and zones are very inconsistent in their appearance in medium-sized telescopes, making any sort of rigorous records virtually impossible. With today's excellent photographic methods, it should not be too hard to produce better tables than those which have been provided by the British Astronomical Association for the last fifty years or so.

In the hope of studying these fluctuations I selected observations of the most conspicuous feature on Jupiter, the North Equatorial Belt, a choice which I felt minimized the innumerable statistical pitfalls in the old records as a consequence of error in micrometrical measurement. I also thought that the large range in deviation of this particular belt would tend to minimize the variations produced by the poor position of Jupiter when at large southern declinations. The relative faintness of other features and the resulting poor frequency of consecutive observations and measurements of high quality from apparition to apparition also helped me to make my selection. The range in latitude--Zenographic--of the NEB$_s$, lower to upper quartile, is 2.2 degrees, 1903 to 1947, inclusive. Similarly the range of the NEB$_n$ is 5.5 degrees.

Figure 23 exhibits the basic data for the NEB$_s$ and NEB$_n$, based on the B. A. A. Memoirs. My first statistical trial was to see whether any relation persisted between the values for the respective components of the NEB. The results of computing linear correlation were inconclusive, yielding a value of +0.284, where the NEB$_n$ is taken as the independent variable. Fitting a periodic curve also appears to be difficult. A simple least squares line is tilted only five degrees to the mean of the values. Therefore, it was concluded that general trends do not apply on the basis of the data and its quality. This, however, is not too surprising for a gaseous atmosphere like Jupiter's.

If one refers directly to Figure 23, several rather interesting facts are apparent which relate the extrema of the NEB$_s$ northern displacements to the NEB$_n$ southern displacements, and likewise more conspicuously relate the NEB$_n$ northern and southern displacements. In general, it is obvious that the NEB$_n$ is in a more fluctuating state than the NEB$_s$.

We should state that Figure 23 uses the zenographical latitudes of the NEB components given in the table on page 63 of B. M. Peek's The Planet Jupiter. While head of the Jupiter Section of the B.A.A., Mr. Peek made plausible adjustments of measured latitudes already published in B.A.A. Memoirs. His table is hence statistically the best source of Jovian latitudes. Even so, there are not enough details in the B.A.A. Memoirs to establish observational errors; the greatest handicap is that there are not enough measurements with a micrometer.

TABLE I

NEB_n Northern and Southern Displacements
(Flux range for the NEB_n is equal to 13.7 degrees.)

1) Northern Displacements	2) Southern Displacements
1908 - 09	1906 - 07
1913	1912
1919	1917 - 18
1922	1920 - 21
1928 - 29	1925
1931 - 32	1930 - 31
1936	1934
1942	1940 - 41
1946	1943 - 44

One can easily observe the proximity of the maximum northern displacement with the maximum southern displacement, where a southern displacement tends to precede a northern displacement by one apparition.

TABLE II

Time Intervals for Northern and Southern Displacements of the NEB_n

1) Northern Displacements	Interval in apparitions between displacements, counting both apparitions of displacements
1908 - 09	5
1913	6
1919	3
1922	7
1928 - 29	4
1931 - 32	5
1936	6
1942	4
1946	-

2) Southern Displacements	Interval in apparitions between displacements, counting both apparitions of displacements
1906 - 07	5
1912	6
1917 - 18	4
1920 - 21	5
1925	6
1930 - 31	4
1934	7
1940 - 41	4
1943 - 44	-

A glance at Figure 23 from 1913 to 1920 - 21 and from 1936 to 1943 - 44 emphasizes the various cycles indicated above. These relations, 5-6-3, 5-6-4, and 7-4 might suggest some period.

TABLE III

NEB_s Northern and Southern Displacements
(Flux range for the NEB_s is equal to 7.4 degrees.)

1) Northern Displacements	2) Southern Displacements
1908 - 09	1906 - 07
1911	1909 - 10
1914	1913
1916 - 17	1915
1919 - 20	1917 - 18

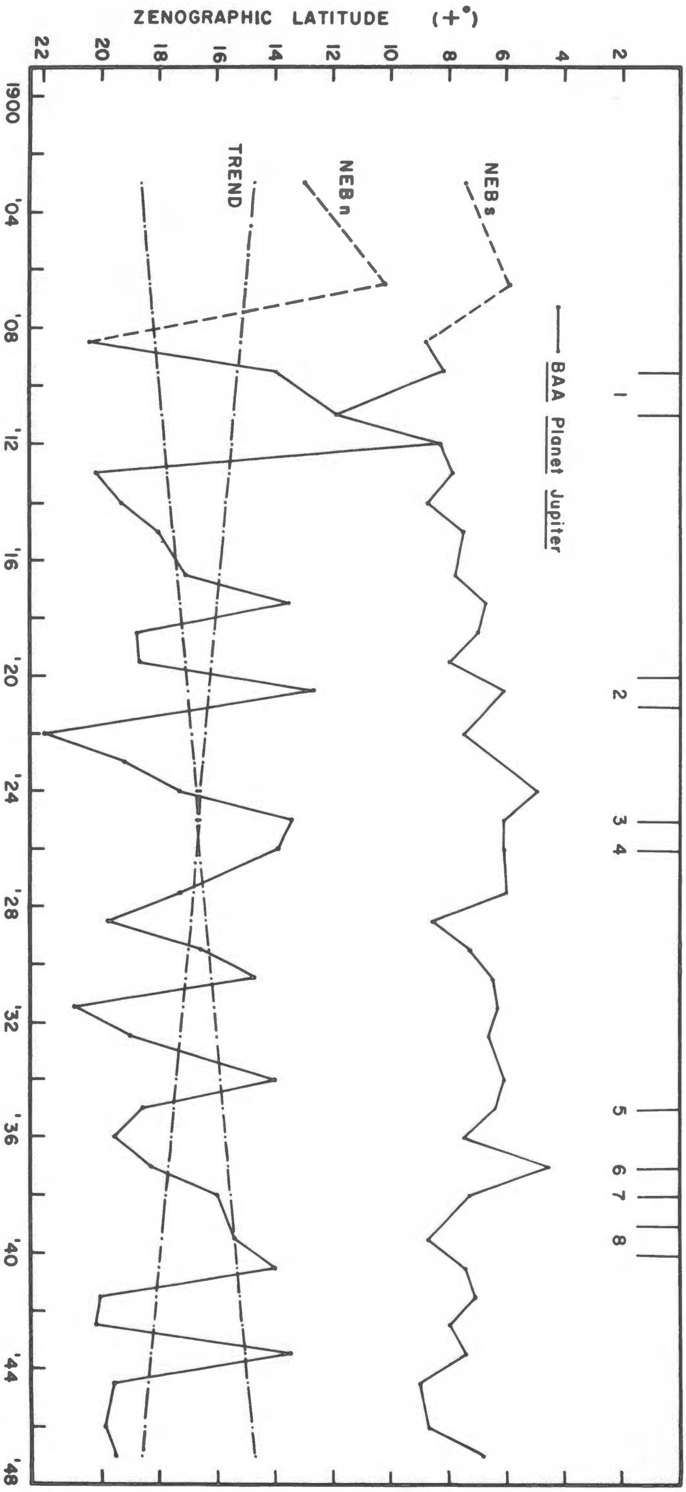

Figure 23. The zenographic latitudes of the north and south components of the North Equatorial Belt of Jupiter (NEB_n and NEB_s respectively). Data taken from table on page 63 of B. M. Peek's The Planet Jupiter, except that broken lines before 1908 are for data from B.A.A. Memoirs. Graph constructed by Paul K. Mackal. Numerical codes at top: 1, 2, and 8, North Tropical Zone brightest zone; 3, 5, and 6, NTrZ very bright; 4 and 7, NTrZ decidedly bright. See also discussion in text of Mr. Mackal's article.

Graph prepared for publication in this journal by Steve Larson.

TABLE III (cont.)

1) Northern Displacements	2) Southern Displacements
1922	1920 - 21
1925	1924
1928 - 29	1927 - 28
1932 - 33	1931 - 32
1936	1934
1939 - 40	1937
1942 - 43	1941 - 42
1945	1943 - 44

In general, one can see that this list confirms the observations made about Table I, where again the maximum southern displacement precedes the maximum northern displacement by one apparition. (There appears to be less consistency in this list; however, this result may be attributed to the statistical superiority of the original measurements with respect to the NEB_n because of a greater flux range.) Nevertheless, one can not rule out the possibility of a southern displacement actually preceding a northern one by two apparitions instead of one. Also, it should be kept in mind that "apparition" does not tell us anything about when the actual measurements were made, i.e., beginning, middle, or end.

TABLE IV

Time Intervals for Northern and Southern Displacements of the NEB_s

1) Northern Displacements	Interval, as in Table II
1908 - 09	3
1911	4
1914	3
1916 - 17	4
1919 - 20	3
1922	4
1925	4
1928 - 29	5
1932 - 33	4
1936	4
1939 - 40	4
1942 - 43	3
1945	-
	Average = 4

2) Southern Displacements	Interval, as in Table II
1906 - 07	3
1909 - 10	4
1913	3
1915	3
1917 - 18	4
1920 - 21	4
1924	4
1927 - 28	5
1931 - 32	3
1934	4
1937	5
1941 - 42	3
1943 - 44	-
	Average = 4

These results cannot be treated as well as those for the NEB_n, but it appears possible to suggest some general periodicity of every four apparitions, inclusive of the apparitions of displacements. The very small deviations are also quite difficult to analyze, and therefore any sort of statement similar to that with respect to the NEB_n periodicity would be out of the question unless specific details of each numerical value used in Figure 23 were confirmed well enough so that one could give them their proper significance.

It appears best to dispense with putting too much emphasis on the belts and zones of Jupiter per se. Obviously, the NEB_n and the NEB_s must partake of local influences, the NTrZ and EZ respectively. Of course, there is no clear evidence as to whether or not the NEB and its components are related. Nevertheless, some people will find such simple periodicity to be highly suggestive of some sort of mechanical explanation of latitude deviation, such as some meteorological analog to the earth's jet streams, etc.; but I think that nothing will be understood unless all present observations of Jupiter continue at a faster pace, with more accuracy, and with more experimental design, and if the proper reduction of these observations follows with interpretations and conclusions coming solely from a mass of highly specialized and integrated observations.

PLANETOLOGICAL FRAGMENTS - 4

The Planet Venus

A new book by this title has appeared in the USSR, but it is presently available only in Russian. The author, V. V. Sharonov (who also wrote Physics of the Planets), died in 1964; and this has left a wide gap in Russian planetary astronomy. The Planet Venus treats virtually all physical and observational problems of Venus in considerable detail, but one can argue that a technical treatise on this planet is premature owing to the many open questions concerning its atmosphere and the physical nature of its surface. This book will probably be available in English in a year or so.

Another important Russian book is in preparation, called Physics of the Giant Planets, and will appear in Alma Ata, hopefully this year.

The Earth's Dust Belt

A few years ago Otto Struve wrote an article for Sky and Telescope in which he discussed the possibility that Jupiter has a tenuous equatorial ring of dust which may make its presence known by a periodic variation in the appearance of the general tone of the equatorial belts and zones on the planet. The dynamics of a possible equatorial belt of dust around the earth has been investigated recently by S. J. Peale. The effect of radiation pressure on dust particles in orbit around the earth causes a diffuse concentration of these particles symmetric relative to the ecliptic plane (the plane of the earth's orbit around the sun). Dust particles will not maintain their stable orbits if they come within about 7.7 earth radii because of the intense perturbations then caused by the earth's oblateness.

The Zodiacal Light has long been thought to be caused by the scattering of sunlight by dust particles or electrons in a flattened cloud (symmetric about the ecliptic plane) concentric with the sun. Now, Dr. Peale suggests that at least part of the Zodiacal Light may orginate by scattering of sunlight in the geocentric, flattened cloud which he has shown can exist. Measurements ofthe brightness of the Zodiacal Light at various distances from the sun (ideally carried out from a satellite) can give information about the size of the particles causing the scattering and the distribution of the particles in space. Ordinary Doppler shifting of spectral lines in the Zodiacal Light can also yield information on the motions of the dust particles and can help sort out the fraction of the light originating in the heliocentric cloud from the fraction in the possible geocentric cloud, but data of sufficiently high precision are not yet available. Dr. Peale notes that the present rate of small particle accumulation by the Earth-Moon system appears to be sufficient to account for a cloud having scattering properties which would give the observed brightness of the Zodiacal Light. Determination of the contributions of the heliocentric cloud and the possible geocentric cloud will probably have to wait for detailed observations from artificial satellites.

Reference: Peale, S. J., Dust Belt of the Earth, Jour. Geophysical Research, 71 (3), page 911, February 1, 1966.

Ganymede

The largest satellite in the Solar System is Jupiter's Ganymede. Bodies of this size (slightly larger than the moon) are now attracting considerable attention because the new techniques of instrumental astronomy permit us to make new attacks on the problems of atmospheres and surface conditions on these little planets. We will have much more to say about satellite atmospheres in a later installment of Planetological Fragments, but we can now make some inferences as to physical conditions on the surface of Ganymede because of some new infrared studies by Bruce Murray and his co-workers with the 200-inch Palomar telescope.

When in direct sunlight, solid bodies in the Solar System emit infrared radiation in the form of heat. Sensitive detectors now available can record the amount of radiation in a given wavelength region reaching the telescope from a particular body. Murray's group recorded the infrared radiation in the 8-14 micron part of the spectrum of Ganymede as the satellite went into eclipse by Jupiter. These eclipse events occur slowly, and Ganymede requires nearly 20 minutes to be fully extinguished after the partial phases of the eclipse begin. During this time, the visual light curve is very steep since about 90% of the light from Ganymede is extinguished in the first 10 minutes of the eclipse. The infrared heat emission does not diminish so rapidly, however; and there is a time lag of a little less than 5 minutes between the visible and infrared curves. This is quite a short time lag and indicates that the rock materials covering the surface of Ganymede have a very low thermal inertia, as is the case with the moon. That is to say, the upper few millimeters of surface cools so quickly that we know it cannot be solid rock. The similar rapid cooling of the moon as it goes into eclipse is the root of the early concepts of dust, and to some extent, of our modern ideas of a fairy-castle structure. These initial results of Murray's group point out the great need for detailed studies of Titan, the moon, and the satellites of Jupiter in the infrared wavelengths.

Reference: Murray, B. C., Westphal, J. A., and Wildey, R. L., "The Eclipse Cooling of Ganymede", Astrophysical Journal, to be published.

DPC

ARISTARCHUS: THE SOUTH WALL BRIGHT SPOT AND THE SOUTHERN AREA

By: James C. Bartlett, Jr.

The southern portion of Aristarchus has long been the site of remarkable phenomena which only now (Sept. 1964) are beginning to receive professional acknowledgement. Why only now? Because until the Bolsheviks upset the Universe with their Sputnik I, thereby ushering in the Space Age, the moon was regarded by the astrophysicists who largely adorn the profession mainly as an annoyance. Their great delight was the photography and spectroscopy of extra-galactic nebulae. Meanwhile, a little closer to home, some interesting events were escaping notice but events which are not likely to be noticed in any case by the casual observer, requiring for their demonstration a reasonably long series of systematic observations to be used as a frame of reference. This paper deals with a few such events as they have appeared to this writer over the past ten years and more.

The nature of the events convinces me that the whole southern region of Aristarchus constitutes a distinct Selenological province, differing fundamentally in some presently unknown way from all other parts of the crater and its immediate environs. This is strongly indicated by the uniqueness of some of the phenomena therein observed, of which the more conventional aspect is represented by the South Wall Bright Spot (SWBS). In some respects the behavior of the SWBS is very similar to that of the EWBS, described in Str. A., Vol. 19, pp. 7-12; but it is not so consistently visible and occasionally fails altogether. Thus in August, 1964 it was not visible to this observer through colongitude 156°, after which time clouds ended observation for that lunation.

The nature of the SWBS is not precisely known. The EWBS, as we have seen, arises from the high-sun expansion of a bright white area around a small craterlet close to the crest of the East wall (IAU sense); and while it is probable that the same relation may obtain for the SWBS, the hypothetical associated craterlet must then be even more minute. At any rate, no craterlet has been demonstrated by the same apertures (up to 5 ins.) which easily show the East wall craterlet. Therefore, either a SWBS craterlet is too small for their powers, or the SWBS may be a mere surface deposit. In location, the SWBS also differs from the EWBS. Unlike the latter, the SWBS appears to lie at the foot of the southern glacis; but like the EWBS, it is also subject to great variations in size which variations - again like those of the EWBS - are quite independent of the colongitude. The SWBS is also much more variable with regard to intensity.

Like the EWBS, the SWBS does not develop at a fixed colongitude; but whereas the former may begin development as early as col. 47°.5, the latter has so far not been observed before col. 60°.3. Indeed, this value may be regarded as abnormally early for the SWBS, which does not become consistently visible until around colongitude 72° with a peak of consistent visibility between colongitudes 87° and 195°. There are, however, occasional breaks even in this range when the SWBS is not visible.

As we have seen, on rare occasions the SWBS apparently does not develop at all; and on other occasions it is abnormally late in developing, its latest date of first appearance being 87°.9 as so far observed. Thus between the colongitudes of first appearance as observed to date there is a range of 27°.6. It is certainly suggestive that this value is also the range so far found for the EWBS, notwithstanding that colongitude relationships are themselves out of phase by about a day. The extreme range of visibility for the SWBS, as so far determined, is from 60° to 217°. It is therefore a little less persistent than the EWBS, which has been observed over the range from 47°.5 to 221°, but here again the difference is only a little more than a day.

Like the EWBS also, the SWBS exhibits no reasonably fixed relation, either in visibility or appearance, to the colongitude, and that by such wide margins as to indicate that something more than the angle of incidence of sunlight is involved. Table No. 1, which is a selection from 126 comparison colongitudes, will make this point clear.

Table No. 1

Appearance at comparison colongitudes

Colongitude	Local Time Date	Remarks
60°.39	April 4, 1955	Small, 7° bright spot.*
60.23	November 26, 1955	Absent.
60.30	March 25, 1964	Large, 6° bright spot.
61.77	September 28, 1955	Absent.
67.68	January 6, 1955	Brilliant; 8°.5 bright.
68.48	November 15, 1956	Absent.
72.73	June 30, 1958	Absent.
72.58	March 26, 1964	Large; 8° bright.
79.42	October 11, 1954	Small, 6° bright.
79.79	July 3, 1955	Very large; 9° bright.
79.61	July 30, 1958	Absent.
92.59	October 30, 1955	Large; 9° bright.
92.33	July 31, 1958	Absent.
96.77	May 4, 1958	Absent.
97.59	July 16, 1954	Absent.
97.57	July 2, 1958	Very small, brilliant; 9°.
109.77	July 30, 1950	Very large; 10° bright.
109.12	November 12, 1954	Large; 10° bright.
110.55	July 17, 1954	Absent.
135.16	October 4, 1955	Minute; 10° bright.
136.61	May 30, 1964	Large; 9° bright.
136.53	July 27, 1964	Small; 6° bright.
208.84	August 8, 1950	Absent.
208.95	July 25, 1954	Small; 8° bright.

It is clear, therefore, that both as to relative size and estimated intensity the SWBS exhibits marked variations for closely comparable colongitudes, when indeed it is not wanting altogether; but the table does not reflect the even more significant changes occasionally observed in a given lunation. These may be both spectacular and very rapid, as the three examples below will demonstrate.

In 1954, at 2^h U.T. on Oct. 13 by U.T. date, I observed the SWBS to be large and brilliant (10°) making a distinct hump in the southern outline of the crater. Transparency was 5; and seeing was variable, 3 to 5. At $5^h 15^m$, the SWBS was found to have been reduced to an abnormally small spot but still 10° bright. Transparency was then the same but seeing had risen to 7. The same telescope, a 3.5-inch Newtonian, was used in both observations. This particular observation was also notable for providing another example of the curious parallelism between the behavior of the SWBS and its analogue, the EWBS; for at 2^h the latter was both larger and brighter than at $5^h 15^m$. However, the SWBS suffered a much greater decrease in size (at least by a factor of 2) while retaining its intensity (referred to the

*These intensities are on an arbitrary scale of 0 (shadows) to 10 (most brilliant features).

central peak); the decrease in size of the EWBS, though perceptible, was slight and was accompanied by an estimated decline of 1° in intensity as referred to the central peak. The point of it is that both spots nevertheless were affected more or less simultaneously.

A much more spectacular example of rapid change in the SWBS was observed by me in 1959. On March 24 (U.T. date) at 2^h 33^m, T 5, S3, the SWBS was found to be absent, the southern outline of the crater (which was actually the outline of the white area outside the crater) showing a smooth and unbroken curve. At 4^h 55^m, a large, brilliant hump was observed to break the curve, which hump represented the SWBS. The general brightness of this area at both times was great and estimated as 9°. The SWBS, when it appeared, was also estimated as 9° and was distinguishable from the background only by virtue of the distortion caused in the latter's outline. The appearance of the SWBS, between 2^h 33^m and 4^h 55^m, therefore was not due to an increase in brightness but to an increase in area. A 4.25-inch reflector was employed for both observations, with a 5-inch to check results of the second observation as well. Again, as in 1954, simultaneous changes were found to have affected the EWBS, though of a different nature. At 2^h 33^m, the EWBS was large and estimated as 10° bright as referred to the central peak, but totally lacking its characteristic tail. At 4^h 55^m, the intensity of the EWBS had declined perceptibly but slightly, as referred to the central peak, and was estimated at 9°, but without perceptible reduction in size. Meantime, however, a large 9° bright tail had also put in an appearance. Thus, again, while the observed variations were not analogous, none the less both the SWBS and the EWBS exhibited more or less simultaneous variations with respect to time.

An analogous, but much less rapid, rise from invisibility to prominence had also been observed in 1954. On July 24, 1954, at 7^h 19^m, T5, S5, col. 196°.11, the SWBS was found to be absent. Some 24 hours later, July 25, at 8^h 18^m, col. 208°.95, it was conspicuously present as a small, 8° bright spot, T5, as before, but S variable (4 to 1). A 5-inch reflector was employed in both observations. Again, variations were also observed in the EWBS, though the considerable advance in colongitude renders the coincidence much less significant.

The SWBS therefore appears to exhibit random increases and decreases in both size and intensity which are unrelated to any specific colongitude, or range of colongitudes, and which may continue into late lunar afternoon. In this respect its behavior is strictly analogous to that of the EWBS. A very marked specific difference, however, is exhibited with respect to the violet glare phenomenon. While the EWBS is commonly involved, the SWBS is only rarely so; but detailed discussion will be deferred to a paper dealing with this particular phenomenon.

The SWBS, however, is merely one of the many variable phenomena which characterize the southern region of Aristarchus, and we must now give some attention to this area as a whole.

Variation in the Southern Outline

Aristarchus is the center of a minor ray system, and on the south and west sides (IAU sense) the crater is enveloped by a high-sun bright area which begins development shortly after sunrise. The development of this bright area results in an apparent increase in the size of the crater, and also in an apparent deformation such that the central peak and floor area appear to shift position both north and east (IAU). This effect reaches a maximum after local noon for Aristarchus. The apparent northward and eastward shift of the central peak and floor area is due to a corresponding southern and western extension of the white area outside the crater. The eye being unable to distinguish between the true crater and its expanded outline, the latter is taken for the former and the central peak therefore appears to be off center.

In The Moon, the late H. P. Wilkins speaks of certain curving ridges to the south of Aristarchus which appear to be the remains of eroded rings. One such ring, marked by an X, is shown in Section XVIII of the Wilkins map. On the S.S.E. (IAU) wall of object X is a small craterlet, and a similar one is to be found just outside the S.S.W. (IAU) wall. The low walls increase in height to the north, with the result that crater X appears as a pair of curving arcs having the aforementioned craterlets at their southern extremities. This gives a horned appearance to the southern outline of Aristarchus. See Figure 24. However, this horned appearance may alternate with that of a large, rounded hump (Figure 25), while at other times neither aspect is seen and the southern outline appears to be more or less smoothly rounded (Figure 26). Like the SWBS phenomena, these appearances cannot be related exclusively to any fixed colongitude or order of colongitudes. Table No. 2 gives some examples.

Table No. 2

Colongitude of first appearance

Hump Aspect		Horned Aspect	
Col.	Local Time Date	Col.	Local Time Date
68°46	June 22, 1964	82°17	Aug. 22, 1964
75.67	July 23, 1964	103.26	Apr. 5, 1958
86.11	Mar. 24, 1964	110.07	July 3, 1958
89.83	Oct. 11, 1954	118.22	June 27, 1964
114.06	Mar. 18, 1957	124.51	July 26, 1964
116.28	Aug. 2, 1958	131.37	Oct. 11, 1957

Thus in the samples given there is a range of over 47° of colongitude for the first appearance of the hump aspect, and of over 39° for the first appearance of the horned aspect. As observed so far, col. 68°46 has been the earliest at which the hump aspect had developed and col. 82°17 the earliest at which the horned aspect has been seen. The latest colongitudes at which either has been seen are 195°73 for the hump and 178°75 for the horned aspect.

Not only are there pronounced differences between the colongitudes of first appearance, but in addition the aspects are not always the same for comparable colongitude but may alternate. Table 3 gives a few examples taken from 104 comparison colongitudes.

Table No. 3

Aspect of South Outline at comparison colongitudes

Col.	Local Time Date	Aspect
72°73	July 13, 1954	Smooth curve
72.73	June 30, 1958	Hump
79.42	Oct. 11, 1954	Smooth curve
79.79	July 3, 1955	Hump
96.83	Nov. 10, 1954	Hump
96.77	May 4, 1958	Horned
103.88	Oct. 13, 1954	Smooth curve
103.96	Oct. 31, 1955	Hump
103.26	Apr. 4, 1958	Horned
110.55	July 17, 1954	Smooth curve
110.07	July 3, 1958	Horned
130.84	Jan. 11, 1955	Hump
130.88	June 28, 1964	Horned
131.25	July 26, 1956	Hump
131.37	Oct. 11, 1957	Horned

Nothing but the smooth curve aspect has so far been observed from col. 196°11 through 221°03. Of the 104 comparison colongitudes from which the above samples were taken, 48 represented the hump aspect; 35 the smooth aspect; and only 21 the horned aspect. The horned aspect therefore would appear to be the least common.

What is the cause of this variation in aspect ? Clearly because there has been variation in the shape and extent of the white area south of the crater. Whether this represents a variation in the white area as such, or whether it represents a variation in dark areas is at present uncertain; but one or the other (and possibly both) unquestionably varies. The principal variation would appear to take place in the floor of the ring, X. When this object is seen under the aspect of two curving bright ridges, the space they enclose is always dark; but when this appearance is replaced by the always bright hump aspect, it is clear that the floor of X has become as bright as its walls. The hump, of course, represents the filled-in outline, as it were, of the ring X. Changes in both color and intensity of the floor of crater X are responsible for the alternation between hump and horned aspect. The difficulty is to explain the observed lack of relationship to colongitude. When either aspect is replaced by the smooth curve effect, it must be because the white area has extended to embrace both X and its environs.

Distortion of the S.W. Outline

Closely related to the phenomena described above is another which may actually be a relatively new development. At least it does not appear in my records prior to October 11, 1957, though the colongitudes at which it now appears had been covered many times before then.

On the S.W. (IAU) side of Aristarchus occur the two well-known white rays which connect the crater to Herodotus. Of these, the southern ray appears remarkably straight and bright at sunrise, apparently a ridge which forms part of the completed high-sun ray. Between these two rays is a dark gray surface, which (until 1957) always appeared to me to be bounded on the East (IAU sense) by the convex curve of the white area around the crater. This is no longer true. At the present time, with approach to noon there is a sensible expansion eastward of the dark area inclosed between the bright rays, which has the effect of deforming the hitherto smooth curve of the S.W. boundary (Figure 27). In this case there can be no question of what has varied; definitely it is the extent of dark area.

While Figure 27 gives one aspect of this intrusion, it is by no means always of the same extent or shape; and occasionally very abnormal appearances are seen. Like the other phenomena considered above, it shows no fixed relation to colongitude but generally begins to become evident around col. 130°. However, I have seen it as early as col. 124°.51, on July 27, 1964. Its duration is brief, lasting about four days, after which the S.W. bright area is restored to its original convex outline.

The Granular Aspect

The southern inner wall, part of the southern floor, and the southern glacis are all subject to an appearance as of bright granulation. This too bears no fixed relation to colongitude; and while in general it may begin around col. 118°, I have twice seen its first appearance as early as 75°, and once found its first appearance delayed until 148°.93, a range of 73° in colongitude. The appearance of the granular aspect is always linked to a marked decrease in the relative intensity of the southern areas; but when these areas remain as bright as contiguous areas of the crater, e.g. the inner west wall (IAU sense), they always appear bright white and amorphous (at least to a small aperture).

The fading, which usually begins around col. 118°, may be uniform; or it may be greater on the west (IAU sense) than on the east. The general intensity falls to an estimated 6°, occasionally to 5° in the western part, while the other parts of the crater remain very bright. As a result, the southern area then assumes a grayish aspect, and against this grayish background there now appears a sprinkling of small bright spots which give a granular aspect to the whole. Their number is impossible to estimate, though it appears to vary; and the general impression is that of a multitude of bright points scattered randomly over a somewhat darker background. Occasionally, however, much larger and brighter isolated spots are seen which may be as much as 9° bright.

We have seen that the date of first appearance of this phenomenon shows no fixed relation to colongitude, and may occasionally exhibit a very marked lag; but even more abnormal variations are occasionally recorded. Thus at the very early col. of 75°.67, July 23, 1964, at $4^h\ 54^m$ U.T., the granulated aspect was already well developed, the general intensity of the southern area being estimated at no more than 6° as compared to 8° for west wall and floor on the east. But 24 hours later, July 24, at $5^h\ 01^m$ U.T., col. 87°.91, the southern area appeared as bright as the rest of the crater; and the granular aspect had vanished. On July 27, however, at col. 124°.51, it had reappeared; and the southern area intensity was again down to an estimated 6°. The same phenomenon was observed in 1956, when on June 22, $4^h\ 26^m$, col. 75°.15, the extreme southern area of the inner wall was estimated as only 6° bright (with 8° for the crater average) and was found to be sprinkled with minute bright spots. Another observation was not obtained until June 26, at $7^h\ 42^m$, col. 125°.6, when the southern area was a brilliant 9°, amorphous, and equal in intensity to the rest of the crater. Two days later, at col. 148°, the granulated aspect was found to have returned; and the intensity had again dropped to 6°. Finally I find two instances, some ten years apart, in which the granulation apparently failed to develop at all. In October, 1954, I found no trace of it from col. 77°.59 through col. 165°.46; and in May, 1964, it was not seen from col. 86°.5 through col. 136°.61.

Because of the variations in date of first appearance, and the occasional abnormalities noted above, it is difficult to determine its true range of visibility. But it can become visible as early as 75° and remain visible through 192°. Perhaps from col. 118° to col. 192° is the best guess. Elucidation of the cause depends upon finding an explanation for the non-systematic fading of the background.

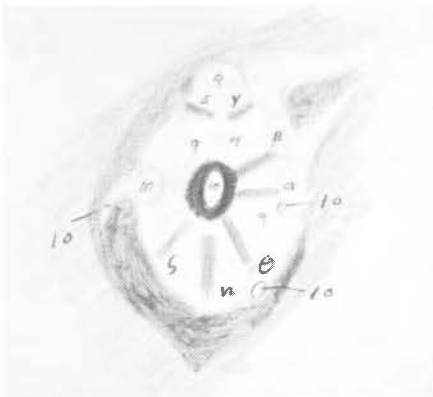

Figure 24. Drawing of lunar crater Aristarchus by James C. Bartlett, Jr. November 11, 1954, $4^h 48^m$, U.T. 3.5-inch reflector, 60X-100X. Seeing 5, transparency 4. Colongitude = 96°.8. Lunar south at top, lunar west (IAU sense) at right. See also text of Dr. Bartlett's article.

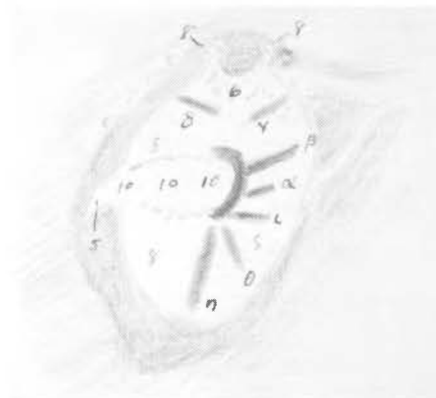

Figure 25. Drawing of lunar crater Aristarchus by James C. Bartlett, Jr. May 4, 1958, $6^h 28^m$, U.T. 5-inch reflector, 110X-180X. Seeing 7, transparency 3. Colongitude = 96°.8, the same as on Figure 24. See also text.

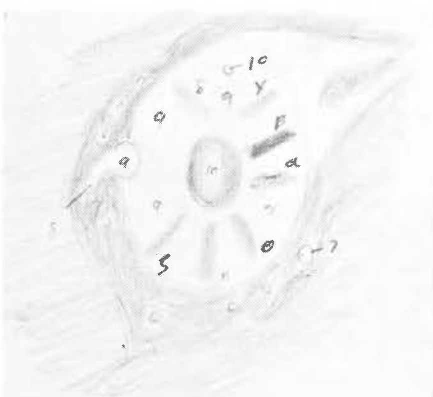

Figure 26. Drawing of lunar crater Aristarchus by James C. Bartlett, Jr. October 13, 1954, $5^h 15^m$, U.T. 3.5-inch reflector, 60X-100X. Seeing 7, transparency 5. Colongitude = 103°.9.

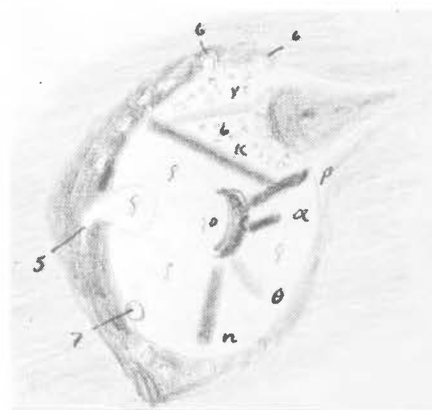

Figure 27. Drawing of lunar crater Aristarchus by James C. Bartlett, Jr. August 27, 1964, $4^h 37^m$, U.T. $4\frac{1}{4}$-inch reflector. 50X, 120X, 240X. Seeing 4-3, transparency 3. Colongitude = 143°.0. See also text of Dr. Bartlett's article.

Recent Appearances of Color in the Southern Area

On the 28th of June, 1964, at $6^h 44^m$ U.T., col. 130°.88, T4, S5, with a 5-inch reflector at 110X-180X, I was very much surprised to find the dull background of the granulated southern area to have a faint but unmistakable brownish tint, a sort of copper color and therefore a little more red than brown. By col. 143°.39 this coppery hue had become stronger; but by col. 154°.94 a strong yellow component had been introduced, and the resultant color was now yellow-brown. Twenty-six hours later, col. 168°.09, the whole region had been restored to grayish-white and so continued until sunset.

In the July lunation, as previously noted, the southern region was found dull and granulated as early as col. 75°67; and the background had a definite, though faint, yellow-brown tint. Both granulation and color had vanished by col. 87°91, and the region was then bright white. By col. 124°51 the granulation, but not the color, had returned; and color was not again seen until July 29, 1964, at 5^h 50^m U.T., col. 149°3. The hue was yellow-brown and so continued through August 1, col. 185°9. It will be noted that in June it had vanished by colongitude 168°.

In the August, 1964 lunation, color first appeared on August 26, 1964, at 4^h 16^m, U. T., col. 130°58, the same colongitude at which it had first appeared in June. The shade was again a yellow-brown. On August 27, 1964, at 4^h 37^m, col. 142°95, color was found to have vanished; but on August 28, at 4^h 40^m, col. 155°16, color was again strongly present and was again yellowish-brown. Unfortunately weather clouded out the remainder of the lunation.

On September 15, 1964, the Baltimore Evening Sun and the Washington Evening Star both carried accounts of a spectacular observation of color in Aristarchus. The two observers were given as S. H. Genatt and Edwin Reid, both Space Agency scientists; and the observation was said to have been made with the 16-inch reflector of the National Aeronautics and Space Agency station in Prince Georges County, Maryland. I take it that there will be no question here as to ample aperture. The observation was made on August 25 between 10:00 and 11:00 P.M. Two bands of color were noted, a pair of red ones across the southern region and a blue band across the northern region of the crater. The blue band is said to have lasted only 30 minutes, while the red bands across the southern area lasted for slightly more than an hour. The red color is said to have been "very strong" at about 10:00 P.M., changing to pink by 10:30 P.M. and fading to a lighter pink at about 11:00 P.M., shortly after which it vanished completely. Unfortunately, the time system, whether EST or EDST, is not given; and so I am uncertain as to the relation this observation bears to my own of August 26 (above), which was August 25 by local time date. If the time systems are the same, then I would appear to have begun observation only minutes after the disappearance of the phenomenon, at which time I found the southern region to be tinted yellow-brown.

Is the appearance of color in the southern region of Aristarchus a genuinely new development? Insofar as these red and brown tones are concerned, I believe that it is. Though displays of the violet glare have been seen here in the past, it is at least certain that not until the night of June 28, 1964, did I ever record copper or yellowish-brown tones here.

At any rate it is no accident that most of the strange events recently chronicled for Aristarchus should have taken place in the southern area. It is, as the French would say, mystérieux.

BOOK REVIEWS

Der Sternenhimmel 1966. Edited by Robert A. Naef, Aarau, Switerzerland. H. R. Sauerländer & Co., 166 pages. In German. Available in the United States from Albert J. Phiebig, P. O. Box 352, White Plains, New York.

Reviewed by William E. Shawcross

The ideal skywatcher's handbook would tell you what to observe, when to see it, and how to watch it. Of all the guidebooks for amateurs, Der Sternenhimmel undoubtedly comes closer to this ideal than any of the others we have seen. Its only shortcoming for many American readers is that it is written in German.

This 26th annual issue follows in general the plan of previous years. Descriptions of planets and the like are given, together with a day-by-day calendar of celestial happenings. Many clever diagrams and attractive photographs help make clear what is happening and what one may expect to see. May 20th's annular eclipse of the sun is generously treated, and many maps are presented. Naturally, occultation predictions and similar events are predicted for Swiss observers, but most of the information in the book is of use to any lover of the skies.

As in previous years, the binding is still too weak for rugged use outdoors; and many owners will want to reinforce it with cloth tape. A special feature for telescope users is the listing of 540 variable stars, nebulae, and other deep-sky objects.

Photographic Atlas of the Moon, by Zdeněk Kopal. New York and London: Academic Press,

1965. 277 pages. $16.00.

Reviewed by John E. Westfall, A.L.P.O. Lunar Recorder

Photographic Atlas of the Moon is the sort of work one would expect to carry the name of Kopal; it is ambitious, but well conceived and impressively executed.

Although the bulk of the atlas is a collection of lunar photographs (taken at the famous Pic-du-Midi Observatory), the first third of the book is a general textual treatment of several aspects of lunar study--the moon's orbit and physical properties, surface features, radiation, and surface composition. This material is well illustrated but could be skipped by the experienced selenographer because most of it is available elsewhere. The tyro, however, will find this summary of lunar data helpful when he studies the photographs that follow.

Immediately preceding the collection of photographs is a discussion of lunar photography which contains little-known information about the development of lunar photography as well as a description of modern lunar photography as practiced at Pic-du-Midi. This section has some defects, though--the Moore-Chappell Lick Observatory series is not mentioned, nor are the excellent Mount Wilson lunar photographs. Kuiper's Photographic Lunar Atlas is given cursory treatment; for example, the need for precise times and dates for lunar photographs in a general-purpose atlas, with halftone illustrations, appears dubious.

The real heart of the atlas is naturally its collection of lunar photographs, which is divided into five parts: a "phase series" (20 plates), a "terminator series" (133 plates), a full moon photograph with six sectional enlargements, a group of views of special areas (36 plates), and finally, nine examples of Ranger VII close-up lunar photography. As a whole, the photographs are well reproduced. The fine halftone screen that is used appears to have brought out an impressive amount of detail from the original film negatives. Unfortunately, tones are often poorly reproduced, giving some photographs either a "washed out" or "muddy" appearance, depending upon whether a high sun or low sun area is shown. Plates XXIV, LXVI, and LXVIII are glaring examples of the latter problem.

Although the whole-disc ("phase") series will be interesting to the beginning selenographer, it is the terminator series and, to a lesser extent, the selected areas photographs that are the core of this work. The terminator series is at a uniform scale of 1/2,000,000. This scale is large enough to show considerable detail but small enough to keep the book to a convenient size. It is this writer's opinion that the convenience (and lower price!) of this work is its chief advantage over the Photographic Lunar Atlas. Quite often, the resolution of the Pic-du-Midi photographs is better than that of the majority of the plates in the PLA.

The terminator series of photographs shows each region under morning and evening illumination. Because the terminator falls within each photograph, some areas (of limited size) appear in only one photograph. Another disadvantage is that the morning and afternoon views of each area are not placed on facing pages but instead at opposite ends of the section. The arrangement is by groups of increasing colongitude, running south to north in each group. All photographs are oriented with south at the top.

The terminator series is followed by a set of enlarged views of the full moon, useful mainly for their portrayal of the ray systems.

Plates CLXI through CXCVII deserve hours of careful study. This section consists mainly of detailed views of special areas, with a few plates illustrating the effects of libration and illumination. Among the areas shown in detail are Sinus Iridum, Mare Crisium, Petavius, Copernicus (an excellent series showing the effect of changing colongitude), Aristarchus, and several others. Plate CLXXVIII, of the Prinz-Krieger area, is the most detailed earth-based lunar photograph which this writer has ever seen (details one-half kilometer across were visible on the original negative).

The Ranger VII photographs at the end of the book should be familiar. The selection of nine photographs given here is well chosen and annotated.

Finally, the owner of the Photgraphic Atlas of the Moon should remember to look inside the back cover, where he will find a copy of Antonín Rükl's "Skeleton Map of the Moon," an accurate and convenient 1/6,000,000 orthographic view of the visible hemisphere, with parallels and meridians printed in brown, and orthographic coordinates overprinted in red.

The text is marred by only a few dubious statements and misprints. On page 11 (paragraph 3, line 6), read "62.267" vice "62 267." On page 14 (paragraph 3, line 2) "(28 per cent)" refers to the portion of the entire moon, not just the "back side," photographed by Lunik in October, 1959. On the same page (paragraph 4, lines 3-6), the statement that the moon's maximum deviation from a sphere is only "1-2 km" would seem an underestimate. Another underestimate is on page 35 (paragraph 4, lines 3-4), where it is stated that the Leibnitz Mountains do not exceed 6,000 meters in height. Finally, on page 71 (paragraph 5, line 5), read "scale of 1:3,567,000" instead of "scale of 1:3,547,000."

The above criticisms are minor and do not detract from the value and usefulness of a book which, incidentally, is so attractively packaged that the price of sixteen dollars appears quite reasonable. Both text and illustrations are enthusiastically recommended to the beginning lunar student, while the more experienced observer will find the photographs alone worthy of many hours of study.

JAMES V. MARSHALL

By: Dale P. Cruikshank

James V. Marshall, a member of the A.L.P.O. since about 1961, died in an auto accident near Las Cruces, New Mexico on February 11, 1966. Marshall's interest in astronomy began in his high school days, and he contributed occasional reports to the various observing sections of the ALPO. He graduated in 1965 from Texas Technological College with a major in mathematics. During the summers as an undergraduate he held assistantships at the Lunar and Planetary Laboratory of the University of Arizona, where he assisted with the programs of planetary spectroscopy. During the summer of 1964 he wrote a paper, "Improved Test for NO_2 on Mars"[1], which summarized his laboratory comparison studies on this aspect of the problem of the Martian atmosphere. In his last year at Texas Tech he participated in schlieren optics experiments and co-authored a paper, with his physics instructor, which was presented at a meeting of the Optical Society of America. Marshall began graduate studies in astronomy at the University of Arizona in September, 1965, and held an assistantship in the Lunar and Planetary Laboratory. At the time of his death he was working on a program of low-resolution spectroscopy of selected lunar regions for laboratory comparison studies of possible sublimate chemical compounds. Marshall and the writer were also working together on proton-bombardment experiments to simulate the solar wind on possible lunar surface constituents.

His associates and friends at the Lunar and Planetary Laboratory and in the ALPO are deeply sorrowful at the loss of this enthusiastic and promising young scientist.

1. Communications of the Lunar and Planetary Laboratory, 2 (35), 1964.

VENUS SECTION REPORT--EVENING APPARITION, 1963-1964.

PART I

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

Introductory Notes

The appearance of this report of Venus observations during the evening apparition of 1963-1964 has been greatly delayed, and the Recorder wishes to express his apologies to those observers who have waited patiently for this discussion of their efforts. The Recorder has found his ALPO allotment of spare time fully occupied with editorial work on the forthcoming ALPO Observing Manual, which is now nearing completion. Many new and continuing observers who have requested information on observing Venus have received a pre-publication copy of the Venus chapter of the manual, which was prepared by W. K. Hartmann and the present Recorder. A few additional copies exist, and seriously interested persons can have those remaining on request.

With only minor exceptions, Venus Section Reports prepared by the present Recorder will follow the format used by our former Recorder, W. K. Hartmann. Mr. Hartmann's histograms[1] of dichotomy date residuals (Schroeter's Effect) will be periodically augmented as new data become available.

Observations Received

Figure 28. James V. Marshall observing with spectrograph on Lunar and Planetary Laboratory 60-inch telescope. Early 1966. Photograph taken by Dennis Milon.

A relatively small number of observers reported their work for the apparition covered by this report. The Recorder feels that this is a direct and unfortunate result of an article he published upon his acceptance of the duties of Venus Section Recorder[2]. In that article ALPO studies of Venus were reviewed critically in an effort to help clarify certain visual observations in the light of physical studies of Venus. The effect on the observers of that discussion appears to have been that they no longer think that the Section Recorder has any interest or faith in visual observations. This is a misconception in general, but in specific cases it is true. Among the types of observations in which the Recorder feels one can put little faith are the random and unconfirmed observations of the Ashen Light at large phases, the bright limb band, and the appearance of the dark side of Venus as darker than the background sky. Intricate radial spoke systems also fall into this category. The Recorder does not intend to dictate what observers should see and draw, but simply wishes for observers to look critically at what they are reporting in the light of what is known about Venus as a planet. The guidelines along which the Recorder believes the ALPO visual observation programs can move most effectively have been described in a published article,[3] and he will be pleased to supply copies of this article on request.

A total of 315 drawings and 66 written reports of observations of Venus were received from 20 observers. Of the 315 drawings, Alan Binder made 141, which is 45%. Without Mr. Binder's unusual quantity of observations, the number would have been only 43% of the number reported at the 1962 evening apparition. Mr. Binder's observations taken alone constitute a valuable collection for the study of certain problems, such as phase.[4] Included with the remainder reported by other observers, his drawings are valuable for comparison with others made simultaneously, as will be discussed below. We are very grateful to Mr. Binder for his extreme effort and for providing the Recorder with copies of all of his drawings.

The following list gives the names of the observers who contributed drawings, reports, or photographs, and the size of the instruments that they used. The * indicates that the observer contributed photographs.

Anderson, Carl A.	6-inch reflector
Bartlett, Dr. J. C., Jr.	2.4-inch refr., 4.25-inch refl.
Binder, Alan B.	4.2-inch reflector
Brasch, K. R.	8-inch reflector
Chapman, Clark R.	7.5-inch refractor
Cruikshank, D. P.	12-inch reflector
Delano, Rev. K. J.	8-inch reflector
Dragesco, Jean	7-inch reflector*
Gaherty, Geoffrey, Jr.	8-inch reflector
Grant, Robt. E.	4.5-inch reflector
Haas, W. H.	12.5-inch reflector, 6-inch reflector
Heath, Alan	12-inch reflector*
Jamieson, Harry	10-inch reflector
Moore, Patrick A.	various telescopes up to 24 inches
Okada, Masao	10-inch reflector
Reese, E. J.	8-inch reflector
Ricker, Charles	8-inch refl., 6-inch refl., 3-inch refr.
Rippen, George	6-inch reflector
Tanner, John	3-inch reflector
Tronfi, Alberto	2.6-inch refractor

In accordance with the Recorder's request, many observers concentrated on making their observations on week-ends so that the number of simultaneous observations would be greatly increased. The Recorder wishes to express his gratitude to all those observers who participated in the Venus Section programs during this apparition.

Markings on the Disk, Exclusive of Cusp Areas

In the past several years it has been found useful to classify the various types of markings drawn by observers in their representations of Venus in order to aid in the difficult task of distinguishing between those types of markings that are probably illusory and those which most probably physically exist on the visible surface of the planet. Hartmann[5] classified the markings as a) terminator shadings, b) radial patterns, c) band patterns, and d) amorphus markings, and also had categories for those drawings showing no markings at all and for those showing streaky markings of any sort. He gave examples of the different types of markings using drawings from the observers themselves. The criteria by which drawings are categorized are somewhat subjective, and now that a new Recorder is on the job it appears prudent to reiterate the categories with illustrations. These are found in Figures 30 through 34, which are identified as to type by the captions. The present Recorder has dropped the category of terminator shadings because many observers neglect to indicate this ever-present aspect of the Venus disk; and the degree to which it is shown on those drawings indicating it is governed in large part by the individual observer's drawing style and by the brightness of the image in his telescope, which in turn is governed by the magnification, seeing conditions, and transparency. Another category has been added, at least for this apparition, that of drawings showing bright spots or zones, exclusive of cusp "caps". In Hartmann's classification of the drawings it was possible for a given drawing to fall into more than one category if it showed several types of markings. The drawings for the apparition under consideration here were classified in terms of the predominant type of features shown, and therefore an individual observation can occur in one category only.

Table I shows the distribution of drawings in the 1963-1964 apparition in the various categories as well as the tabulations given by Hartmann for three apparitions in the period 1960-1962. It will at once be noted that the number of drawings showing no features at all has increased substantially over that of the other apparitions. This may reflect a wave of conservatism in observers who find that it is no longer in vogue to show great quantities of intricate detail on Venus. It is the Recorder's deep concern that observers have not been intimidated by critical words,[2] but that they are instead looking more carefully at the entire spectrum of problems concerned with visual observations of Venus and are thereby less willing to commit to paper that which has a 95% probability of origin in their imaginations. That the latter is true, and gratifyingly so, appears evident from the discussion of simultaneous observations reported in Part II of this paper.

The number of drawings showing a radial or "spoke" system of markings on Venus has been decreasing in recent apparitions. It was noted in the Recorder's review article[2] that theoretical models by Mintz[6] based on a very slow rotation of the planet yield a radial atmospheric circulation system with the center at the subsolar point. Visual observations by Dollfus[7], Brasch[8], and others have suggested that the basic pattern of dusky markings on

Venus is that of a radial system with the center at the subsolar point. There is now physical proof of the very slow rotation of Venus[9], and the radial circulation pattern may prove to be real at least in certain levels of the Venus atmosphere. We must be reminded, however, that the pattern of dark bands showing in ultraviolet photographs of Venus does not conform to the radial system, for the most part. In general, it appears that visual observations of Venus, by their subjective nature, will not lead directly to a detailed understanding of the circulation system of the Venus atmosphere.

Table I. Percentage of drawings of Venus showing different kinds of features. See also discussion in text.

Type of Marking	213 Drawings 1960-1961 (East)	92 Drawings 1961 (West)	344 Drawings 1962 (East)	315 Drawings 1963-1964 (East)
No Markings	8%	16%	6%	33%
Band Pattern	19	15	17	19
Radial Pattern	7	2	4	1
Streaky Markings of any sort	51	38	42	23
Amorphous Markings	59%	54%	57%	23
Bright Spots or regions	N O T	T A B U L A	T E D	1%

The fraction of the drawings showing band patterns, while not directly comparable to the previous apparitions owing to the slightly different classification criteria, is seen to be quite similar to the usual value. In certain cases, drawings showing only intense cusp collars, or bands near the cusps, were included in this category. Binder had a large number of this type of drawing, as in Figure 34b. The justification for this classification depends in some measure on what we think the cusp-bands are. In the review paper[2] it was suggested that they are dusky bands of the ordinary type that are seen foreshortened because of their proximity to the apparent poles and are therefore relatively dark and pronounced. Often they are the darkest features on the planet.

Binder has noted an interesting effect in his own series of observations. He found that from about $k = 0.9$ to 0.5 the direction or inclination of the bands relative to the line of cusps underwent a nearly cyclic variation having a period of roughly 13 days. Mr. Binder intends to continue this analysis using ALPO observations as well and will prepare it for future publication. This sort of study is one of the fruits of a long and continuous series of observations by a single observer.

Amorphous markings are often seen on Venus, and it is probable that this pattern represents a fairly typical condition of the upper atmosphere of Venus. Ultraviolet photographs often show darkish markings in irregular shapes and sizes. Streaky markings not in the band class are probably of a similar nature, but are usually rather thin and wispy, and for this reason do not often show up on the usual low-resolution ultraviolet photographs.

It is the opinion of certain observers that there is a basic pattern of markings on the visible cloud layer of Venus and that individual observations (visual and photographic) most often show a portion of this pattern. When a large number of such observations made over a long period are combined, the pattern is complete. In other words, daily variations in the cloud cover on Venus alter the appearance slightly from one observation to the next; but when averaged over a long time, the entire pattern becomes apparent. Brasch and other observers at the Montreal Centre have tended toward this approach, which seems to have been developed by Dollfus[7] from photographic observations. Among the observers reporting in this apparition, Jean Dragesco notes that his observations always show a pattern that corresponds to the Dollfus planisphere of "permanent" features.* In this regard it is interesting to note that another observer in France, Charles Boyer[10], has used a large number of visual ob-

*"J'ai trouvé les taches de Venus assez bien visibler cette anneé et le "patern" observé correspond toujours aux planisphéres de Danjon-Dollfus."

servations and ultraviolet photographs to show that a pattern recurs about every four days and that the motion indicates a retrograde rotation of the planet. The rotation period found by Dollfus, at least for the upper levels of the atmosphere, was very long, on the order of the sidereal period of Venus.

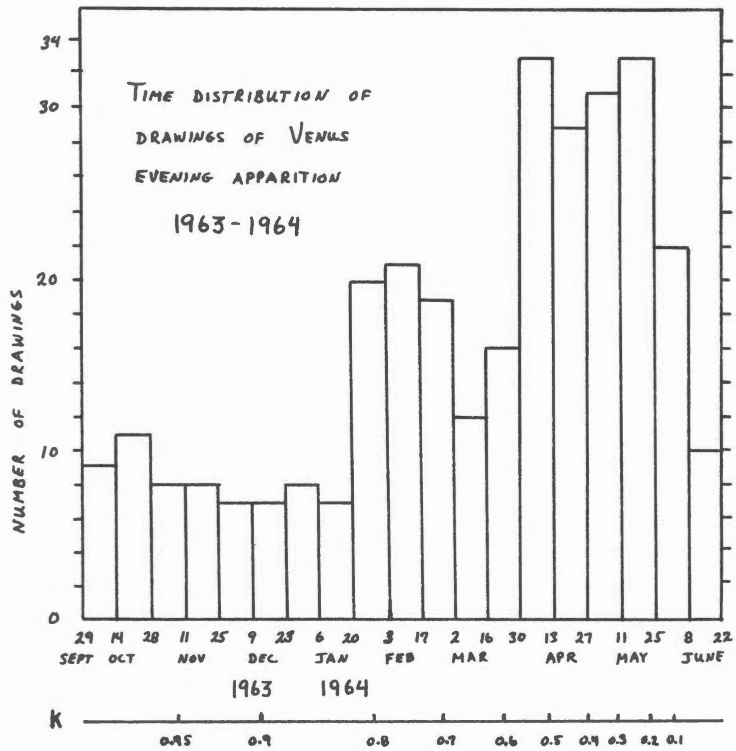

Figure 29. Histogram to show frequency of A.L.P.O. drawings of Venus during 1963-64 evening apparition. The scale at the bottom gives the value of K, the illuminated portion of the disc.

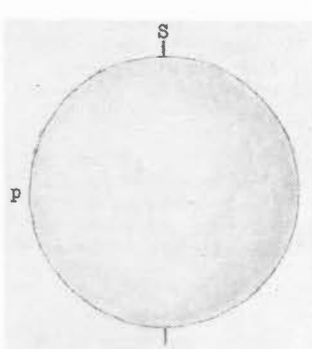

Figure 30. Drawing of Venus with no markings visible. A. B. Binder. October 6, 1963. 4-inch refl., 150X. Seeing 6. Transparency 4.

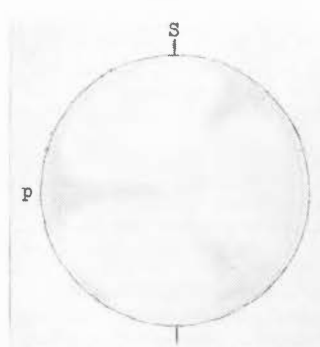

Figure 31a. Drawing of Venus with radial markings. A. B. Binder. October 26, 1963. 4-inch refl., 150X. Seeing 5. Transparency 2.

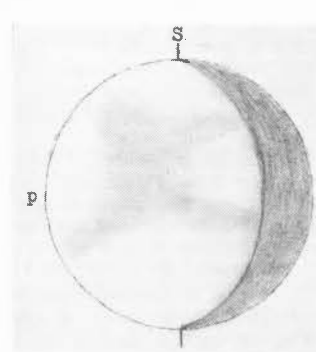

Figure 31b. Another drawing with radial markings. C. A. Anderson. January 19, 1964. 6-inch refl., 150X. Seeing 6+. Transparency 2-3.

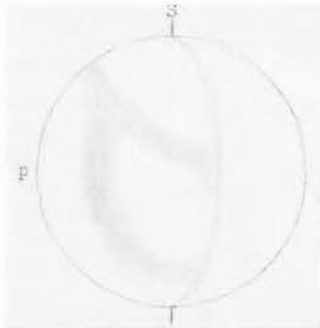

Figure 32a. Drawing of Venus with streaky markings not in the band category. A. B. Binder. Feb. 18, 1964. 4-inch refl., 150X. Seeing 2-5. Transparency 4.

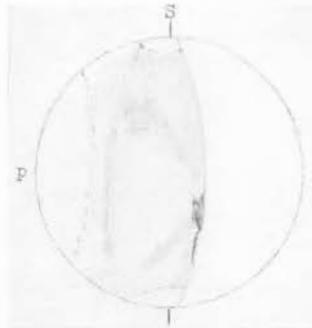

Figure 32b. Another drawing with streaky markings not in the band category. C. L. Ricker. Mar. 8, 1964. 6-inch refl., 200X. Seeing 8. Transparency 4½.

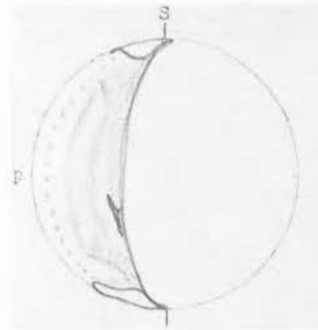

Figure 32c. Still another drawing with streaky markings not in the band category. C. L. Ricker. Apr. 20, 1964. 8-inch refl., 233X with neutral filter. Seeing 4-6. Trans. 4.

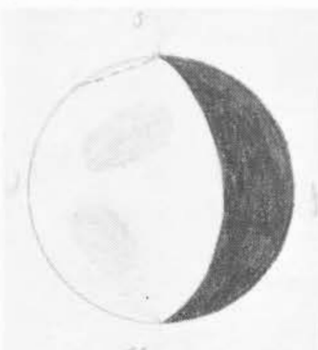

Figure 33a. Drawing of Venus with amorphous markings. R. E. Grant. Feb. 7, 1964. 4½-inch refl., 215X and 130X. Seeing 3-4. Transparency 4. Markings enhanced with red and red-orange filters.

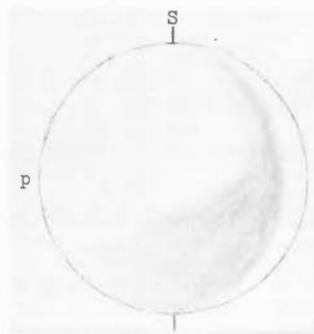

Figure 33b. Venus with amorphous markings. A. B. Binder. Dec. 3, 1963. 4-inch refl., 150X. Seeing 5. Transparency 4.

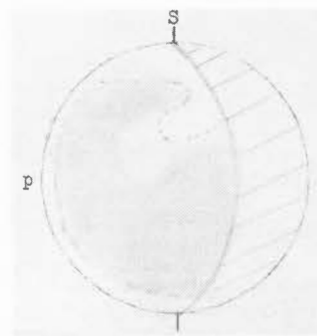

Figure 33c. Another drawing with amorphous markings. C. A. Anderson. Feb. 27, 1964. 6-inch refl., magnifications up to 300X. Seeing 2-3. Transparency 4.

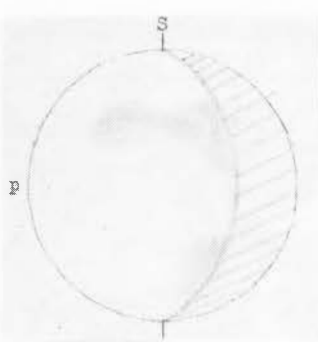

Figure 34a. Venus with banded markings. C. A. Anderson. Feb. 22, 1964. 6-inch refl., magnifications up to 160X. Seeing 2-3. Transparency 2. Markings seen equally well with or without yellow, green, red, and blue filters.

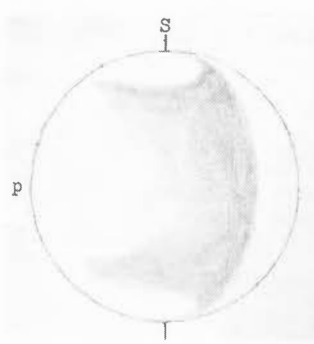

Figure 34b. Drawing of Venus showing banded markings. A. B. Binder. Jan. 1, 1964. 4-inch refl., 150X. Seeing 4. Transparency 4. Detail in N. hemisphere not positive.

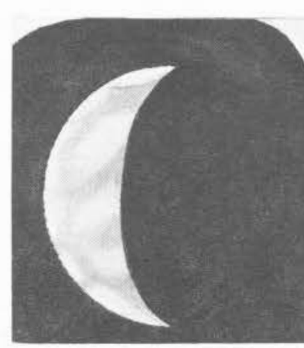

Figure 34c. Venus with banded markings. J. Dragesco. May 14, 1964. 10-inch refl., 260X. Seeing 4.

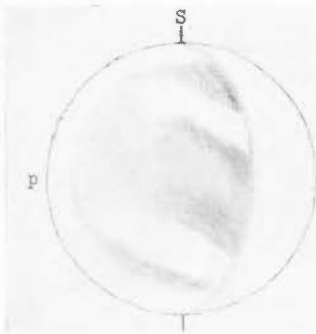

Figure 34d. Drawing of Venus with banded markings. A. B. Binder. Feb. 1, 1964. 4-inch refl., 150X. Seeing 5. Thin clouds over planet.

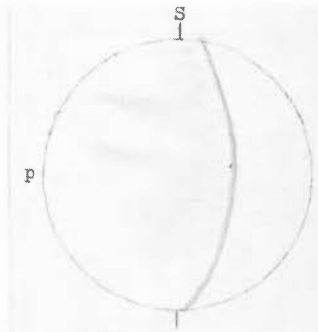

Figure 34e. Venus with banded markings. James C. Bartlett, Jr. Feb. 20, 1964. 4¼-inch refl.; 50X, 120X, and 240X. Seeing 3. Transparency 3. The two streaks appeared brownish in tone.

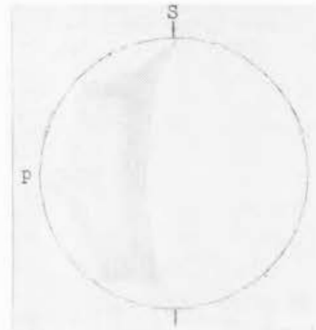

Figure 34f. Another drawing of Venus showing banded markings. Klaus R. Brasch. April 26, 1964. 8-inch refl., 165X and 370X. Seeing 3-5. Transparency 4-5. Markings very similar when viewed through deep blue (Wratten 47b) filter.

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3. Cruikshank, D. P., "Aims of the ALPO Venus Section in 1963-64", Str. A., 17, (7-8), p. 151, 1963.

4. Binder, Alan B., "The Venus Phase Anomaly", Str. A., 18, (9-10), p. 189, 1964.

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7. Dollfus, A., "Visual Observations of the Planets at Pic du Midi", Planets and Satellites (ed. by Kuiper & Middlehurst), Chicago: University of Chicago Press, p. 534, 1962.

8. Brasch, Klaus, "Observations of Venus by the Montreal Centre of the R.A.S.C.", Str. A., 15, (9,10), 156, 1961.

9. Sky and Telescope, December, 1964, p. 341.

10. Boyer, Charles, "Recherches sur la Rotation de Vénus", l'Astronomie, June, 1965, p. 223.

(to be continued)

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Sponsors pay $25 per year in dues; Sustaining Members, $10 per year. The surplus above the regular rate is used to support the work and activities of the A.L.P.O. We greatly appreciate the loyalty and meaningful support of the colleagues listed above.

New Addresses for A.L.P.O. Staff Members. The name and address of our Uranus-Neptune Recorder are now:

Leonard B. Abbey
3204 La Vista Rd.
Decatur, Georgia 30033

After June 1, 1966 our Book Review Editor should be addressed as follows:

J. Russell Smith
8930 Raven Drive
Waco, Texas 76710

W.A.A. Convention at Millbrae, Calif. The Western Amateur Astronomers will hold their meeting this year at the Sheraton Thunderbolt Hotel in Millbrae, Calif. (not far from San Francisco). The dates are Wednesday, August 17 through Saturday, August 20. The daily schedule is for breakfast at 7:30 A.M., then papers until 1:00 P.M., then lunch, and then a field trip. The field trips will be to Tinsley Laboratories and Morrison Planetarium on Thursday, to San Mateo College and Planetarium and the Lick Observatory on Friday, and to the Stanford Linear Accelerator and the Stanford Radio Astronomy Institute on Saturday. The customary Star Party will be at the Lick Observatory on Friday evening,and the Convention Banquet will be on Saturday evening. There will be booths for commercial exhibits, and amateurs are invited to display their own telescopes and equipment. Amateur attendees are also invited to present papers. The above information was furnished by the W.A.A. Chairman, Mr. Hollis De Vines, 333 Elliott St., San Francisco, Calif. 94134, to whom readers may write for more information. The host for the meeting is the San Mateo Astronomical Society.

Astronomical League Convention at Miami. The 20th National Convention of the Astronomical League will be held at Miami, Florida, July 1-5, 1966. The hosts are the Southern Cross Astronomical Society of Miami and the Indian River Astronomical Society of Eau Gallie. The Convention Headquarters will be the famous McAllister Hotel, Biscayne Boulevard at Flagler St., Miami, Florida 33132. The General Convention Chairman, from whom information may be requested, is Mr. Jerry Pardue, 641 Falcon Ave., Miami Springs, Florida 33166. A highlight of the meeting will be a tour of Cape Kennedy on July 5. There will be lectures at Miami and Cape Kennedy by several professional scientists, among them Dr. S. Fred Singer, the Dean of the School of Environmental and Planetary Sciences of the University of Miami. Those wishing to register in advance or to be certain of space on the Cape Kennedy tour should soon write to Southern Cross, Registration Committee, 3280 So. Miami Ave., Miami, Florida 33129. Papers are solicited on any topic of interest to amateur astronomers.

For A.L.P.O. Vistors to England. Mr. P. K. Sartory, Mellow End, Seale, Farnham, Surrey, England, heartily invites members of our Association visiting England to meet him. He is on the technical committee of the Lunar Section of the British Astronomical Association and in February, 1966 was engaged in an evaluation of the "Moon Blink" apparatus. We hope that some of our members travelling abroad this coming summer can make Mr. Sartory's acquaintance.

New Director of McDonnell Planetarium in St. Louis. Mr. Ronald R. Sutherland has been appointed Director of this Planetarium. He is a graduate of the University of Pittsburgh and was on the staff of the Buhl Planetarium before going to Mc Donnell as Assistant Director.

Request for Observations of the Aristarchus-Herodotus Region. Readers may remember that the principal project directed by former A.L.P.O. Lunar Recorder Patrick McIntosh was a special mapping study of Aristarchus, Herodotus, and vicinity. There is a fair amount of material on hand, and Mr. McIntosh and Mr. Westfall would like soon to conclude this study.

Lunar Recorder John E. Westfall, 3104 Varnum St., Mt. Rainier, Md. 20822 has asked us to publish this note: "Observers of the Aristarchus-Herodotus region should now send their observations to me. I also have a supply of observing forms to mail out. What is most needed are detailed observations of limited portions of the region-particularly the inner and outer walls of Aristarchus and Herodotus and the 'Cobra Head'-made with moderate or large apertures under good conditions, and also high-quality amateur photographs of the area. Morning lighting observations are particularly needed." We strongly underscore this request-why not observe this lunar area during the coming warm summer evenings?

A.L.P.O. Convention at Tucson. A brief description and tentative schedule for our Fourteenth Convention at Tucson, Arizona on August 26-28, 1966 appeared on pp. 89-91 of our preceding issue (Vol. 19, Nos. 5-6). For general information on the physical arrangements for the meeting readers should write to Charles A. Wood at 1304 East 7th, Tucson, Arizona 85719. Those desiring to contribute to the A.L.P.O. Exhibit should write to Dennis Milon, Lunar and Planetary Laboratory, University of Arizona, Tucson, Arizona. Experience has shown that drawings, photographs, and charts are the most successful display material. We desire a wide variety of such items as a good cross-section of the current work of the A.L. P.O. Papers for the meeting should be sent to Walter H. Haas, Box AZ, University Park, New Mexico 88070. While one complete paper is on hand and several others have been promised, we need and desire many more papers by qualified authors. We also need them soon--time is passing.

A letter from Mr. Wood on April 2, 1966 conveyed the delightful news that Dr. Kuiper has agreed to let the 61-inch reflector in the Catalina Mts. be used by the conventioneers! Mr. Wood suggests that the professional papers by Lunar and Planetary Laboratory staff members now be moved to Sunday afternoon and that the A.L.P.O. business meeting and paper session be expanded to fill all of Saturday afternoon (August 27). The schedule for Sunday would then be: 8:30--12:00 A.M., A.L.P.O. paper session; 2:00--4:00 P.M., L.P.L. paper session; 6:00--11:00 P.M., trip up Mount Lemmon and observing with 61-inch. Activities are being planned for attending wives temporarily "widowed" by an astronomical meeting. E. A. Whitaker of the L.P.L. staff is going to display his collection of old lunar maps.

The hosts are the Steward Observatory of the University of Arizona and the Tucson Astronomical and Astronautical Association. Plans are still flexible enough that all positive ideas for improving the meeting will be warmly welcomed.

Many Thanks to Phillip W. Budine. Formerly our Jupiter Recorder and Assistant Saturn Recorder, Mr. Budine has given the A.L.P.O. considerable help in recent months by answering dozens of letters about lunar and planetary observing, careers in astronomy, high school science fair projects, and "everything about space." We thank our colleague for his enthusiastic and needed assistance.

A.L.P.O. Library Again Available. The Editor's wife has very kindly agreed to assist the A.L.P.O. by acting as Librarian. Requests for books and information should be addressed to: (Mrs.) Beryl E. Haas, 2225 Thomas Drive, Las Cruces, New Mexico 88001.
The Library is physically housed in the Editor's house. For the present books will be supplied on request to A.L.P.O. members in the United States and Canada for the actual mailing costs plus ten cents per book. Persons borrowing books will be expected to pay return postage and to take reasonable care of books borrowed. The period of loan on a book will be thirty (30) days.

We have received several letters about the A.L.P.O. Library, with opinions varying from wishes that this service be continued to advice that the books on hand be sold. It is the desire of Mrs. Haas and the Editor that an honest effort be made to see whether a Library is a service which a sufficient number of A.L.P.O. members want. If such a desire exists, we are anxious to meet this need.

Mr. Elmer J. Reese has turned in to the A.L.P.O. Library his voluminous and valuable original personal observing notes, a record of almost unique value to persons doing research on the objects observed by the methods employed.

LUNAR AND PLANETARY PROSPECTS, MAY-JULY, 1966

By: **Walter H. Haas**

Moon. Reverend Kenneth J. Delano has furnished the following list of favorable dates in May-July, 1966 for observing various lunar domes. These are identified by accurate positional designations, either latitude and longitude or the rectangular coördinates xi and eta. The list is primarily for observers in the United States and Canada. The double dates refer to local civil times; the night of May 22-23, for example, extends from the evening of May 22 to the morning of May 23, local civil time dates.

Night	Dome eta xi	Long.	Lat.	Remarks
1966, May 22/23	+777-318	+55°03'	-18°35'	
25/26	+269+300	+16°33'	+17°29'	
27/28	-138+447	-08°53'	+26°37'	
29/30	-492+235	-30°25'	+13°36'	(numerous other domes in this region)
29/30	-508+200	-31°13'	+11°32'	
29/30	-510+175	-31°00'	+10°05'	
30/31	-611+451	-43°13'	+26°50'	
May 31/June 1	-643+651	-57°55'	+40°38'	
June 5/6	+777-318	+55°03'	-18°35'	
8/9	+339+107	+19°56'	+06°09'	
13/14	-620+452	-44°03'	+26°54'	
24/25	+183+348	+11°11'	+20°24'	
26/27	-257+030	-14°54'	+01°45'	
27/28	-458+130	-27°32'	+07°29'	(several other very prominent members of the Hortensius cluster of domes in this area)
29/30	-717+345	-49°49'	+20°13'	
July 6/7	+615+126	+38°19	+07°14'	
6/7	+593+131	+36°44'	+07°32'	
8/9	+183+348	+11°11'	+20°24'	
10/11	-218+047	-12°34'	+02°43'	
11/12	-366-453	-24°14'	-26°57'	
13/14	-717+345	-49°49'	+20°13'	

Those concerned with "lunar transient phenomena" may wish to observe Alphonsus, especially the central peak and its neighborhood, and the Aristarchus-Herodotus region. Alphonsus will be in sunlight from May 27 to June 11, 1966, Universal Time dates, and again from June 26 to July 10. Aristarchus will be illuminated from May 31 to June 15 and from June 29 to July 14. It is possible, of course, that these phenomena might also be observed on the earthshine, where the brilliant Aristarchus is an easy formation to detect. Since there is evidence that "lunar transient phenomena" may be more frequent when the moon is near perigee and near apogee than at other times, it may be well to mention that perigee occurs on May 27, June 22, and July 20 and that apogee takes place on June 10 and July 8 (Universal Time dates again).

Mercury. This planet is at superior conjunction on May 27, at greatest elongation east (26° from the sun) on June 30, and at inferior conjunction on July 28. It will accordingly be observable in the telescope in the evening sky during much of June and July. Mercury will be at aphelion on July 12, when its orbital revolution is naturally slowest. The tilt of the ecliptic to the horizon after sunset is only moderately favorable to northern hemisphere observers during June and July. A.L.P.O. members with suitable telescopes are again invited to undertake an optical determination of the period of rotation of this planet. The fact that the planet is not far from aphelion when at greatest elongation will lengthen the interval of time over which this study can be pursued with some prospect of success. Of course, success will demand observing Mercury carefully on as many dates as possible.

Venus. This planet will be a brilliant Morning Star during the months considered. The phase will be gibbous, the value of K increasing from 0.67 on May 15 to 0.85 on July 15. The angular diameter will decrease from 17".1 on May 15 to 12".1 on July 15. Suggestions and ideas for observing Venus may be found in Mr. Dale Cruikshank's Venus Report on pp. 132-138 of this issue and in similar reports in earlier issues of this journal. Among other things, estimates of the observed phase, estimates of the relative size, brightness, and conspicuousness of the north and south cusp-caps, and estimates of the relative darkness and conspicuousness of the bordering north and south cusp-bands are desired.

Mars. Since the Red Planet was in conjunction with the sun on April 29, 1966, it is poorly placed in the morning sky and at a great distance from the earth. Only large telescopes and good seeing are likely to allow any markings to be detected. On July 15 the angular diameter is only 3".8. The vernal equinox of the northern hemisphere of Mars falls on July 31, 1966.

Saturn. The Ringed Planet will be well placed in the morning sky, with quadrature occurring near the middle of June. Chief interest must now attach to the current edgewise presentation of the rings to both the earth and the sun. Intending observers will do well to read again "Saturn's Edgewise Ring Presentation during 1966" by Thomas Cragg and Larry Bornhurst, our Saturn Recorders, Str. A., Vol. 19, Nos. 5-6, pp. 73-75. The graph on page 74 of that issue shows that the earth and the sun will be on opposite sides of the plane of the rings prior to June 15. During this dark side presentation the brightness of the different parts of the rings may be expected to be reversed from the customary appearance; bright spots have been found on such occasions in the past at the positions of Cassini's Division and the Crape Ring, while the outer part of Ring B may be the darkest part of the system. Very close attention should be paid to the visibility and aspect of the rings for a number of days both before and after June 15, when the sun will pass from the north to the south side of the plane of the rings. We shall then see the illuminated side until October 29, 1966, when the earth will again be in the ring-plane. Mr. Alan W. Heath, the Saturn Director of the British Astronomical Association, suggests in a letter dated May 1, 1966, that it would be well to watch for a possible nebulosity of the rings and for the occasionally reported Ring D, a dusky ring exterior to the two bright rings. There is some evidence that Ring D is found more frequently when the rings are almost edgewise.

Other observations of Saturn can follow guidelines in the last Saturn Report, Str. A., Vol. 19, Nos. 5-6, pp. 98-104. The 1965-6 apparition affords us unusual opportunities to observe the satellites of Saturn. Perhaps some enterprising amateur observers will want to undertake programs of photometry of these satellites. The planet is always rather poorly observed when in the morning sky--the time to secure these helpful observations is now. Observers should also remember the current Saturnian satellite phenomena: eclipses, occultations, satellite transits, and shadow transits.

Uranus. Having been in opposition on March 8, this distant planet will not reach conjunction until September 13. It will hence be well placed in the evening sky during May, June, and July. The table below may help the telescopic observer to locate Uranus.

Object	Right Ascension	Declination
Uranus (May 15, 1966)	$11^h\ 7^m\ 54^s$	+6° 26' 10"
Uranus (June 1)	11 7 52	6 25 35
Uranus (June 15)	11 8 33	6 20 37
Uranus (July 1)	11 10 6	6 10 16
Uranus (July 15)	11 12 2	5 37 31
Regulus (Mean Position 1966)	10 6 34	+12 8 3
Spica (Mean Position 1966)	13 23 24	-10 59 4

In Volume 19, Nos. 5-6 of this journal we directed the attention of A.L.P.O. members to several possible kinds of observations of Uranus: a schedule of satellite shadow transits (pp. 88 and 89), possible variations in the brightness of satellites Titania and Oberon (pg. 98), and measures with a filar micrometer of the oblateness of Uranus (pp. 107-108). As of this time (May 8, 1966), the Editor knows of no searches for Uranian shadows in transit with large apertures and favorable conditions. Craig L. Johnson and Walter H. Haas have looked unsuccessfully for such shadows in poor seeing at times when a shadow was presumed to be on the disc. In general, of course, the observer of Uranus must exercise considerable judgement in separating the genuine from spurious optical effects and other illusions, and large apertures are very much to be preferred.

Neptune. This planet is at opposition on May 12, 1966. The following table may help the telescopic observer to find Neptune.

Object	Right Ascension	Declination
Neptune (May 15, 1966)	$15^h\ 15^m\ 11^s$	-16° 11' 43
Neptune (June 1)	15 13 22	-16 4 50
Neptune (June 15)	15 12 3	-15 59 59
Neptune (July 1)	15 10 50	-15 55 52
Neptune (July 15)	15 10 8	-15 53 47
Antares (Mean Position 1966)	16 27 19	-26 21 30

Jupiter. Dr. Charles H. Giffen has kindly sent along a number of current notes about the Giant Planet. We regret very much that delays in the preparation and mailing of this issue will reduce the value of such information for our observers. Jupiter will be in conjunction on July 5. Evening observations are hence not likely to extend much past early June, and the planet by that time will be increasingly poorly placed at a low altitude on a bright twilight sky.

A.L.P.O. longitudes of the Red Spot have chiefly varied between 21° and 26° (II) during the 1965-6 apparition. On March 24, 1966 the Spot was an easy object near longitude 28° (II). It was not so intensly red as earlier in the apparition. The length of the Red Spot has been about 23° of longitude.

A very dark elongated "rod" on the north edge of the North Equatorial Belt lay near 248° (II) on February 15 and near 230° on March 28. The drift has been about -14° per 30 days in System II.

On March 9 the longitudes (II) and drifts (change in longitude by System II per 30 days) of the three long-enduring South Temperate Zone ovals were as follows: FA longitude 353° and drift -20°.6, BC longitude 125° and drift -16°.9, and DE longitude 260° and drift -16°.1. The rotation periods of BC and DE were the longest that they have ever been, a fact perhaps related to the break-up and subsequent revival of the South Temperate Belt during the 1964-5 and 1965-6 apparitions. Dr. Giffen requests close observation of South Tropical Zone features from about longitude (II) 80° to 250° and of projections or condensations on the south edge of the South Equatorial Belt South, which features may be drifting in increasing longitude (II).

OBSERVATIONS AND COMMENTS

Partial Eclipse of Jupiter IV. C. H. Giffen was able to observe this rare event on March 28, 1966. He remarks: "The maximum dimming of about 3.2 magnitudes fainter than Jupiter II occurred at about 1^h26^m, U.T., March 28--at least this value gives the best reflected fit of the decreasing and increasing sides of the light curve. It was impossible to determine first and last penumbral contacts, as might be expected."

Another Doubled Jovian Satellite Shadow. An observation by Reverend Kenneth J. Delano becomes extremely interesting in connection with Mr. Richard E. Wend's article "The Doubling of Jovian Satellite Shadows", Str. A., Vol. 19, Nos. 5-6, pp. 79-80. On the night before this issue reached him Mr. Delano witnessed the same phenomenon for the first time! It was again the shadow of J. I which was involved. The telescope was a 12.5-inch reflector at 300X, seeing 2 and transparency 5. The observer notes: "On three occasions between $0^h 40^m$ and 0^h50^m, U.T., March 22, 1966, in a second or two of steadier seeing when Io's shadow was most distinctly seen, Io's shadow appeared doubled. As I recall, Io's shadow was on the SEB, either in the zone separating the SEB_s from the SEB_n or on the SEB_s itself. Its companion shadow, which was so momentarily glimpsed, was at least one-half as dark or large. It lay to the southeast and was contingent or nearly so. Really everything about the observation was brief and uncertain other than the simple fact that at three moments last night Io's shadow gave the appearance of being double." See also Figure 35.

Mr. Delano further remarks. "...I'm convinced that satellite shadow transits, and in particular those of Io, merit more attentive observation. It has been suggested that what is seen is the satellite's shadow on two different layers of the Jovian atmosphere, but would it be any more difficult to assume that Io has its own huge cloud-like satellite going around it or has a magnetospheric tail (as suggested in Science magazine, Vol. 148, June 18, 1965, pg. 1588)? Perhaps such a cloud satellite or magnetospheric tail is so constituted as to absorb (thus able to cast a shadow) but not reflect (thus not visually detectable) the sun's light. The sun's absorbed light might be released at radio wavelengths instead, bearing in mind that a relationship has already been found between Io and radio noise from Jupiter."

Doubling of Lunar Detail. Mr. P. K. Sartory at Mellow End, Seale, Farnham, Surrey, England on April 13, 1966 wrote in part as follows: "Whilst observing the moon one night during January 1966 with a very fine 5-inch Cooke refractor, doubling of the image was seen. The night was clear and seeing very good. It was at first suspected that tube currents were the cause of the effect, but on checking with a 4-inch Maksutov telescope the same effect was noted. The images were quite sharp and steady. Seven photographs were obtained, and all showed the effect quite clearly. It seems, therefore, that the effect is produced outside the instrument since two different telescopes were tested. The doubling of the image persisted for about $1\frac{1}{2}$ hours. A colleague of mine observing about 50 miles away from my station also observed the effect."

If we are to suppose that Wend, Sartory, and Delano have all observed the same effect, the differences in their descriptions then being regarded as ones of degree only, the explanation cannot be sought in the physics of Jupiter or satellite Io but must presumably be in the optical system, or perhaps in the atmosphere near the station of observation. The great scarcity of known observations of image doubling would suggest some highly unusual condition. The existence of the effect at two stations 50 miles apart may be troublesome from this point of view. Perhaps other readers will have something worthwhile to add to this discussion.

Predicted Possible Occultation of a Star by Pluto on April 29, 1965: a Postscript. Since attempted observations of this event were described in Vol. 18, Nos. 9-10, pp. 207-208 of Str. A., it is proper to say that later evidence shows that the observers involved could not have seen the star occulted. Their work may underscore the great difficulties of such observations.

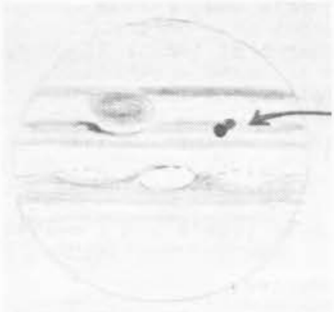

Figure 35. Rough sketch of Jupiter from memory by Kenneth J. Delano. Sketch made to show doubling of shadow of Jupiter I on South Equatorial Belt. March 22, 1966, 0^h46^m, U.T. 12.5-inch refl., 300X. $C.M._1 = 234°$ $C.M._2 = 33°$ See also text on page 143.

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