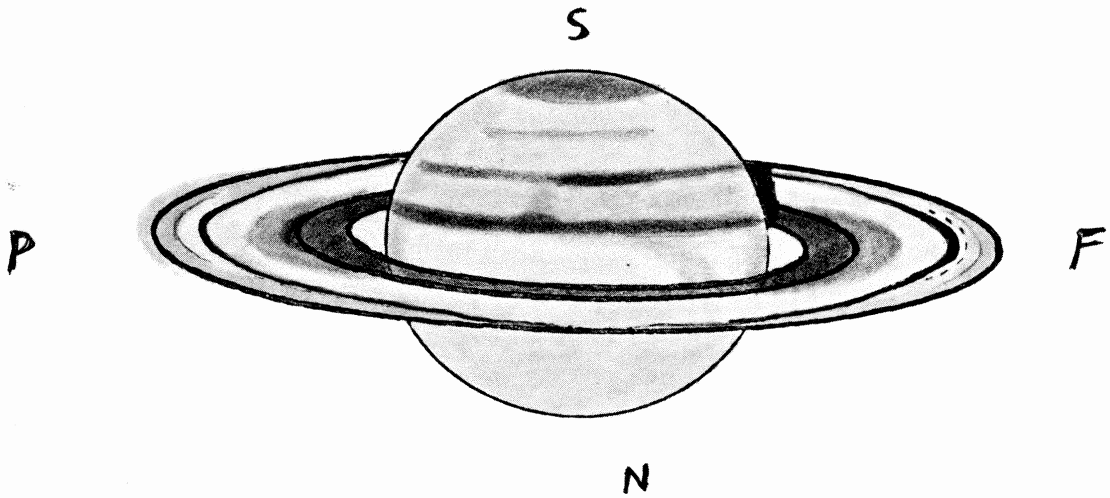
The Journal Of The Association Of Lunar And Planetary Observers

The Strolling Astronomer

Volume 27, Numbers 9-10 Published March, 1979



Drawing of Saturn by Donald C. Parker on April 8, 1978, 4 hrs., 0 mins. to 4 hrs., 45 mins., Universal Time. 12.5-inch (31-cm.) Newtonian reflector at Coral Gables, Florida, 515X to 750X. Several color filters employed. Seeing 7-10 (good to perfect), transparency 5 (limiting magnitude). The Ringed Planet will be well placed in the evening sky during the spring of 1979, and observers should prepare for the approaching edgewise presentation of the rings.

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Founded In 1947

IN THIS ISSUE

THE REAL STORY OF THE DISCOVERY OF THE ROTATION IN FOUR DAYS OF VENUS' ATMOSPHERE

By: Professor Jean Dragesco, National University of Bénin, West Africa

In one of the latest issues of the ALPO journal (Vol. 26, page 192) Paul K. Mackal published his research, done in 1962 by Rodger Gordon and himself, which tended to prove a rotation of Venus' atmosphere taking four and a half days (contrary to the rotation of the planet itself, which takes 247 days). Without taking anything away from the merits of our two colleagues, I feel obliged to point out that the historical facts of the article are inaccurate. Paul K. Mackal wrote: ". . . the discovery of the four-day rotation of the atmosphere of the planet Venus . . . can be credited to Elmer Reese and Tom Pope of the New Mexico State University Observatory and to Dr. C. Boyer of Pic du Midi Observatory in France in 1968". I have often heard French astronomers regretting that their work is, most of the time, unknown in the United States. The above quoted article shows eloquently how justified that complaint sometimes is.

It appears to me to be very important to relate here the real history of that important discovery, especially since it is the work of a rank amateur, working with modest means. Charles Boyer was President of the Brazzaville Tribunal (Congo) and an enthusiastic amateur astronomer, having a 25-cm. altazimuth telescope built with his own hands. From the beginning of 1957 Mr. Boyer contemplated a photographic study of Venus in violet light. The "seeing" at Brazzaville being excellent, Mr. Boyer rapidly discovered undeniable spots on the planet (using Kodak microfilm with a Wratten no. 34 filter). Boyer's greatest merit was in being able to analyse in depth the negatives obtained between August 28 and September 16, 1957. That difficult analysis made him notice the existence of a rotation of Venus within a little more than 4 days. Our friend immediately sent a letter to the Paris Academy of Sciences registered under the number 13716, at their meeting of September 18, 1957. Boyer also sent his first results to Jean Texereau (of the Optic Laboratory of the Paris Observatory), who published the first account of it in the magazine l'Astronomie (1958, page 73). Mr. Boyer's own verbal communication was made to the session of April 26, 1958 of the French Astronomical Society (L'Astronomie, 1958, p. 376). Boyer then asked his friend Camichel to verify his discovery at the Pic-du-Midi Observatory. The latter found the characteristic spots of Boyer's photographs and confirmed the rotation in four days. However, given the impact of the American discovery of the rotation in 247 days, few people gave much credit to the unexpected work of the amateur C. Boyer. Later, when C. Boyer had convinced Mr. Dollfus and other French astronomers, a photographic observation program was undertaken, first at the Pic du Midi (between 1960 and 1967) by Boyer himself, with the assistance of Camichel and Guerin. This research enabled them to determine the exact length of the short rotation. In the meantime several articles widely publicized the French discovery: Astronomie (1960, p. 371), Annales d'Astrophysique (1961, T.24, p. 551), Comptes Rendus de l'Académie des Sciences (1/18/1965, 7/11/1966, and 3/29/1967).

One might therefore expect that after 1967 all astronomers knew about the discovery and its author, especially since the (famous) Brad Smith, of the New Mexico State University Observatory, published an article in Science (6 Oct. 1967, Vol. 158, no. 3797, pp. 114-119) in which the American astronomer, showing perfect objectivity, established the anteriority of the French amateur's discovery beyond any doubt: "as early as 1957 C. Boyer reported to the (French) 'Academie des Sciences' that he had obtained a repetition pattern at 4-day intervals. These results were reaffirmed in a series of publications over the past 6 years . . ." Given the wide readership of a magazine like Science, that article should have definitely settled the question. However, I can cite articles, and even books, published since 1967 which continue to ignore either the 4-day rotation or the history of its discovery.

It must be said here that B. Smith had worked with Boyer at the Pic du Midi and that later the French observatory worked together with the New Mexico State University Observatory, as well as others, to confirm definitely the discovery of the modest French amateur. Actually, it wasn't until 1974 that the rapid rotation of Venus' atmosphere was finally accepted by everyone, thanks to the stunning confirmation given by the American Mariner 10 probe. But if the astronomical fact is now universally known, even now few people know how it was first discovered.

That is the reason why I have seen fit to tell this story here. It is all the more interesting since it is the work of an amateur having at his disposal only a modest altazimuth telescope (the camera was placed inside the focal plane of the telescope, and was moved by means of an ingenious device built with a Mecano toy construction set.)

FORTHCOMING PARTIAL LUNAR ECLIPSE: MARCH 13-14, 1979

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

On the night of March 13-14, 1979, U.T., the Moon will undergo a partial eclipse of magnitude 0.858 (i.e., near total). Only the end of the eclipse will be visible from anywhere in the United States; but observers in Europe, Africa, and Asia (i.e., most of the human race) will see all or most of the event. The predicted Universal Times of eclipse phenomena are:

Phase	U.T.	General Zone of Visibility
Moon enters penumbra	MAR $13^d\ 18^h\ 10^m.9$	Central & E. Europe, Africa (excluding NW), Asia, Australia
Moon enters umbra	$13^d\ 19^h\ 28^m.9$	Europe, Africa, Asia, Australia
Middle of the eclipse	$13^d\ 21^h\ 08^m.0$	E. Brazil, Europe, Africa, Asia (excluding Japan & E. Siberia)
Moon leaves umbra	$13^d\ 22^h\ 47^m.3$	Canadian Maritime Provinces, E. part S. America, Europe, Africa; Central, W.,& S. Asia
Moon leaves penumbra	$14^d\ 00^h\ 05^m.1$	E. half Canada & United States, S. America, Europe, Africa, Central & W. Asia, India

Recommended Observations

Except for magnitude and luminosity estimates for totality, a wide range of useful observations can be made of a partial lunar eclipse such as this one. For example:

1. Notes, sketches, and photographs of (a) visibility, color, and tone of penumbra; (b) sharpness and possible ellipticity of edge of umbra; (c) color and tone of umbra; (d) zonal or time variations of tone or color in umbra; and (e) visibility of features within the umbra.

2. Estimates of the Moon's apparent magnitude at frequent times during the eclipse. For this eclipse, the reversed-binocular and convex-reflector methods are suitable.

3. The two umbral contacts should be timed to ± 0.1 minute. Estimates when penumbral shading is first and last visible are also useful.

4. Searches for temporary, eclipse-induced changes in lunar features, or "lunar transient phenomena", should be made. Features showing such reported activity in past eclipses include Aristarchus, Atlas, Grimaldi, Manilius, Menelaus, Proclus, and Riccioli.

5. The actual dimensions of the Earth's shadow can be accurately determined by timing (again, to ± 0.1 minute) when selected craters enter and leave the umbra. To do this, average the observed times when the umbra edge touches each edge of the crater. This process should be done for both immersion and emersion. For this particular eclipse, the recommended craters, and the approximate Universal Times (± 5 minutes) when they will be within the umbra, are:

Grimaldi	(19:35-21:45)	Copernicus	(20:05-21:50)	Menelaus	(20:30-22:00)
Kepler	(19:55-21:45)	Pytheas	(20:10-21:40)	Plinius	(20:35-22:05)
Tycho	(19:55-22:25)	Timocharis	(20:20-21:40)	Taruntius	(20:40-22:25)
Aristarchus	(20:00-21:30)	Manilius	(20:25-22:00)	Proclus	(20:45-22:10)
Eudoxus	(Possible umbral graze *ca.* 21:15)				

Interested observers may write to the author (address on inside back cover) to obtain an "A.L.P.O. Lunar Eclipse Observation Form". Completed eclipse reports should be sent to Prof. Walter H. Haas (address also on inside back cover), except for crater timings, which should be sent to Sky and Telescope (address on observation form).

SATURN CENTRAL MERIDIAN EPHEMERIS: 1979

By: John E. Westfall, A.L.P.O. Associate Director

The two tables on pages 176 and 177 give the longitude of Saturn's geocentric central meridian (C.M.) for the illuminated (apparent) disk for 0^h, U.T., for each day in 1979. These tables are a continuation of those for 1969-78, previously published in the JALPO, and include corrections for phase, light-time, and the Saturnicentric longitude of the Earth.

"System I" assumes a sidereal rotation rate of $844^\circ.0$ per day (period = $10^h\ 14^m\ 13^s.08$), intended for use with features in the NEB, EZ, and SEB. "System II", intended for the rest of the ball, assumes a sidereal rotation rate of $812^\circ.00$ per day (period = $10^h\ 38^m\ 25^s.42$). These rates are only approximate because latitude-dependent rotation rates for Saturn are more uncertain than, say, for Jupiter; however, longitudes calculated from these tables should give conveniently small drift rates for most features. A.L.P.O. Saturn observers are urged to make central meridian timings, combined with latitude measures (or at least estimates) whenever possible, so that these rotation rates, and any future C.M. tables, can be made more accurate.

To find the central meridian at any time, find the 0^h U.T. central meridian for the appropriate date and system, and then add the hours and minutes corrections from the related table, "Motion of the Central Meridian", as shown in the example below.

Example: A festoon in the EZ transits the central meridian at $12^h\ 17^m$ on March 1, 1979, U.T. (note: the EZ is in System I).

System I C.M. at 0^h U.T., 1 MAR 1979	. . . . . .	$320^\circ.6$
+ Motion of the System I C.M. in: 12^h	. . . . . .	062.0
10^m	. . . . . .	005.9
07^m	. . . . . .	004.1
System I C.M. at $12^h\ 17^m$, 1 MAR, 1979 U.T.	. . . .	$392^\circ.6$
		$-360^\circ.0$
		$032^\circ.6$ (033°)

Note that, if the calculated longitude exceeds 360°, one subtracts 360°. Also, in general, it is more realistic to round calculated longitudes to the nearest whole degree.

JUPITER IN 1975-76: A POSTSCRIPT

By: John H. Rogers, British Astronomical Association, Jupiter Section.

The great disturbances on Jupiter in 1975 have elicited a huge body of reports by the ALPO[1-5], the British Astronomical Association (BAA)[6-10], and the Unione Astrofili Italiani (UAI)[11]. The main outlines of the upheavals are clear: however, there has been considerable disagreement among the various reports as to the details of what happened and as to its significance, which appears to require brief further comment.

What Actually Happened?

The most striking events were the following:

(1) South Temperate Belt Fade. The STB preceding the white oval FA, which had faded in 1975 Jan., returned to normal, while the following section from FA to BC underwent a similar drastic fade[9]. Here FA, BC, and DE are long-enduring white ovals in the South Temperate Zone.

(2) South Equatorial Belt Revival. There were an unprecedented three or even four distinct sources of this exceptionally violent outbreak. However, it is disturbing that the ALPO[1] and the BAA[9] report very different rotation periods for material

SATURN, 1979

LONGITUDE OF CENTRAL MERIDIAN OF ILLUMINATED DISK

SYSTEM I -- 0^h U.T.

Day	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	199.5	86.2	320.6	205.9	325.1	206.4	322.5	202.1	82.0	198.9	81.1	200.9
2	323.5	210.3	84.7	329.9	89.0	330.2	86.3	325.9	205.8	322.8	205.0	324.9
3	87.6	334.4	208.7	93.9	213.0	94.1	210.2	89.8	329.7	86.7	329.0	89.0
4	211.7	98.5	332.8	217.9	336.9	218.0	334.1	213.6	93.6	210.6	93.0	213.0
5	335.8	222.6	96.9	341.9	100.9	341.9	97.9	337.5	217.5	334.5	217.0	337.0
6	99.9	346.7	220.9	105.9	224.8	105.8	221.8	101.4	341.4	98.5	340.9	101.0
7	224.0	110.8	345.0	229.9	348.7	229.7	345.6	225.2	105.2	222.4	104.9	225.1
8	348.0	234.9	109.1	353.9	112.6	353.5	109.5	349.1	229.1	346.3	228.9	349.1
9	112.1	359.0	233.1	117.9	236.6	117.4	233.4	113.0	353.0	110.2	352.9	113.1
10	236.2	123.1	357.2	241.9	0.5	241.3	357.2	236.8	116.9	234.2	116.9	237.2
11	0.3	247.1	121.2	5.9	124.4	5.2	121.1	0.7	240.8	358.1	240.9	1.2
12	124.4	11.2	245.3	129.9	248.3	129.0	244.9	124.5	4.7	122.0	4.9	125.2
13	248.5	135.3	9.3	253.8	12.2	252.9	8.8	248.4	128.6	246.0	128.9	249.3
14	12.6	259.4	133.4	17.8	136.2	16.8	132.6	12.3	252.5	9.9	252.8	13.3
15	136.7	23.5	257.4	141.8	260.1	140.6	256.5	136.1	16.4	133.9	16.8	137.4
16	260.8	147.6	21.5	265.8	24.0	264.5	20.4	260.0	140.3	257.8	140.8	261.4
17	24.8	271.7	145.5	29.7	147.9	28.4	144.2	23.9	264.1	21.7	264.8	25.4
18	148.9	35.7	269.6	153.7	271.8	152.3	268.1	147.7	28.0	145.7	28.8	149.5
19	273.0	159.8	33.6	277.7	35.7	276.1	31.9	271.6	151.9	269.6	152.8	273.5
20	37.1	283.9	157.6	41.6	159.6	40.0	155.8	35.5	275.8	33.6	276.8	37.6
21	161.2	48.0	281.7	165.6	283.5	163.9	279.6	159.3	39.7	157.5	40.8	161.6
22	285.3	172.1	45.7	289.6	47.4	287.7	43.5	283.2	163.7	281.5	164.8	285.7
23	49.4	296.1	169.7	53.5	171.3	51.6	167.3	47.1	287.6	45.4	288.8	49.7
24	173.5	60.2	293.8	177.5	295.2	175.5	291.2	171.0	51.5	169.4	52.8	173.8
25	297.6	184.3	57.8	301.4	59.1	299.3	55.1	294.8	175.4	293.3	176.8	297.9
26	61.7	308.4	181.8	65.4	183.0	63.2	178.9	58.7	299.3	57.3	300.8	61.9
27	185.8	72.5	305.8	189.3	306.9	187.0	302.8	182.6	63.2	181.2	64.8	186.0
28	309.9	196.5	69.9	313.3	70.8	310.9	66.6	306.4	187.1	305.2	188.9	310.0
29	74.0		193.9	77.2	194.7	74.8	190.5	70.3	311.0	69.2	312.9	74.1
30	198.0		317.9	201.2	318.6	198.6	314.4	194.2	74.9	193.1	76.9	198.1
31	322.1		81.9		82.5		78.2	318.1		317.1		322.2

MOTION OF THE CENTRAL MERIDIAN

01^h -- 035°.2	09^h -- 316°.5	17^h -- 237°.8	10^m -- 005°.9	01^m -- 000°.6
02 -- 070.3	10 -- 351.7	18 -- 273.0	20 -- 011.7	02 -- 001.2
03 -- 105.5	11 -- 026.8	19 -- 308.2	30 -- 017.6	03 -- 001.8
04 -- 140.7	12 -- 062.0	20 -- 343.3	40 -- 023.4	04 -- 002.3
05 -- 175.8	13 -- 097.2	21 -- 018.5	50 -- 029.3	05 -- 002.9
06 -- 211.0	14 -- 132.3	22 -- 053.7		06 -- 003.5
07 -- 246.2	15 -- 167.5	23 -- 088.8		07 -- 004.1
08 -- 281.3	16 -- 202.7	24 -- 124.0		08 -- 004.7
				09 -- 005.3

SATURN, 1979

LONGITUDE OF CENTRAL MERIDIAN OF ILLUMINATED DISK

SYSTEM II -- 0^h U.T.

Day	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.
1	301.7	276.4	334.8	308.1	187.4	156.7	32.9	0.6	328.5	205.4	175.5	55.3
2	33.8	8.5	66.8	40.1	279.3	248.6	124.8	92.4	60.4	297.3	267.5	147.3
3	125.9	100.6	158.9	132.1	11.2	340.5	216.6	184.3	152.2	29.2	359.5	239.3
4	217.9	192.7	251.0	224.1	103.2	72.4	308.5	276.2	244.1	121.1	91.4	331.4
5	310.0	284.8	343.0	316.1	195.1	164.2	40.4	8.0	336.0	213.1	183.4	63.4
6	42.1	16.9	75.1	48.1	287.0	256.1	132.2	99.9	67.9	305.0	275.4	155.4
7	134.2	109.0	167.2	140.1	19.0	348.0	224.1	191.7	159.8	36.9	7.4	247.4
8	226.3	201.0	259.2	232.1	110.9	79.9	315.9	283.6	251.7	128.8	99.4	339.5
9	318.4	293.1	351.3	324.1	202.8	171.8	47.8	15.5	343.6	220.8	191.4	71.5
10	50.4	25.2	83.3	56.1	294.8	263.7	139.7	107.3	75.4	312.7	283.4	163.5
11	142.5	117.3	175.4	148.1	26.7	355.5	231.5	199.2	167.3	44.6	15.4	255.6
12	234.6	209.4	267.4	240.1	118.6	87.4	323.4	291.1	259.2	136.6	107.4	347.6
13	326.7	301.5	359.5	332.0	210.5	179.3	55.2	22.9	351.1	228.5	199.3	79.6
14	58.8	33.6	91.5	64.0	302.4	271.2	147.1	114.8	83.0	320.4	291.3	171.7
15	150.9	125.6	183.6	156.0	34.4	3.0	239.0	206.7	174.9	52.4	23.2	263.7
16	243.0	217.7	275.6	248.0	126.3	94.9	330.8	298.5	266.8	144.3	115.2	355.8
17	335.1	309.8	7.7	340.0	218.2	186.8	62.7	30.4	358.7	236.2	207.2	87.8
18	67.1	41.9	99.7	71.9	310.1	278.7	154.5	122.3	90.6	328.2	299.2	179.8
19	159.2	134.0	191.8	163.9	42.0	10.5	246.4	214.1	182.5	60.1	31.2	271.9
20	251.3	226.1	283.8	255.9	133.9	102.4	338.3	306.0	274.4	152.1	123.2	3.9
21	343.4	318.1	15.8	347.8	225.8	194.3	70.1	37.9	6.3	244.0	215.2	96.0
22	75.5	50.2	107.9	79.8	317.7	286.1	162.0	129.7	98.2	336.0	307.2	188.0
23	167.6	142.3	199.9	171.7	49.6	18.0	253.8	221.6	190.1	67.9	39.2	280.1
24	259.7	234.4	291.9	263.7	141.5	109.9	345.7	313.5	282.0	159.9	131.2	12.1
25	351.8	326.5	24.0	355.7	233.4	201.7	77.5	45.4	13.9	251.8	223.2	104.2
26	83.9	58.5	116.0	87.6	325.3	293.6	169.4	137.2	105.8	343.8	315.2	196.2
27	176.0	150.6	208.0	179.6	57.2	25.5	261.3	229.1	197.7	75.7	47.3	288.3
28	268.0	242.7	300.0	271.5	149.1	117.3	353.1	321.0	289.6	167.7	139.3	20.3
29	0.1		32.0	3.5	241.0	209.2	85.0	52.9	21.5	259.6	231.3	112.4
30	92.2		124.1	95.4	332.9	301.1	176.8	144.7	113.5	351.6	323.3	204.5
31	184.3		216.1		64.8		268.7	236.6		83.6		296.5

MOTION OF THE CENTRAL MERIDIAN

01^h -- 033°.8	09^h -- 304°.5	17^h -- 215°.2	10^m -- 005°.6	01^m -- 000°.6
02 -- 067.7	10 -- 338.3	18 -- 249.0	20 -- 011.3	02 -- 001.1
03 -- 101.5	11 -- 012.7	19 -- 282.8	30 -- 016.9	03 -- 001.7
04 -- 135.3	12 -- 046.0	20 -- 316.7	40 -- 022.6	04 -- 002.3
05 -- 169.2	13 -- 079.8	21 -- 350.5	50 -- 028.2	05 -- 002.8
06 -- 203.0	14 -- 113.7	22 -- 024.3		06 -- 003.4
07 -- 236.8	15 -- 147.5	23 -- 058.2		07 -- 003.9
08 -- 270.7	16 -- 181.3	24 -- 092.0		08 -- 004.5
				09 -- 005.1

retrograding on the SEB(S) (SEB(S) = south component of the SEB) and, according to the ALPO and UAI[11], prograding between the roughly stationary major sources in the SEB Zone. At least in the latter case, changes in form were occurring so rapidly that misidentification of spots was easy, and it may never be possible to settle the matter. It would be a great help if the actual observations could be published in chart form so that the reliability of reported rotation periods could be assessed by the reader.

There were also important features reported by the BAA but not mentioned by the ALPO, and vice versa. This may be because of gaps in the observations available to each recorder.

Although the fading of the Great Red Spot was probably precipitated as usual by the leading edge of the retrograding SEB(S) Disturbance[9,11], the most prominent SEB(S) spots from Source no. 2 never did reach it[1,9], contrary to one assertion.[1]

(3) South Tropical Zone activity. The ALPO[1] reported a "STrZ Disturbance" at 217°-246°(II) from October to December. This was much shorter-lived than the seven or so classical Disturbances, and it was probably just an enhancement of the general disturbance of the zone alongside the violent SEB(S) activity; other disturbed regions (not the reported disturbance) are shown in fig. 4 of ref. 1. Possibly the feature represented material whipped off the retrograding SEB(S), as in other violent SEB Revivals, and did not have the characteristic structure and evolution of a classical Disturbance. The main counter-objection is the report[1] of two spots reflected off its preceding end in the Circulating Current, something not seen since the great South Tropical Disturbance of 1901-39. Again, it is highly desirable for the details of observations of these spots to be published.

The BAA[9] and UAI[11] reported a different phenomenon in the STrZ (315°-015°(II) in late December), which again somewhat resembled a South Tropical Disturbance, but was in fact related to the concurrent STB Fade and persisted along with it until the end of the apparition.

(4) Equatorial Zone. The southerly Equatorial Band remained dark and strong. Meanwhile the activity in the north reached a climax, with the two long-lived plumes of Reese and Beebe[12] repeatedly colliding with and ejecting other projections[13] and finally disintegrating in a confused mêlée (BAA data, to be published). The UAI observers recorded the same features but connected their data points with no indication of collisions or ejections (fig. 10 of ref. 11). Detection of the latter required not only a longitude chart but also close attention to the prominence and morphology of the objects plotted, which is invaluable in tracking features through crowded regions.

The ALPO reported some incredibly fast drifts over very short intervals[1], and again it would be desirable for the actual data to be made available.

(5) North Temperate Belt (south edge)/North Tropical Zone outbreak. The ALPO[1] and the BAA[8] agree on the unprecedentedly rapid motion (period $9^h\ 47^m$) of most of the spots in this outbreak, the first since 1970. However, the UAI identifies one much slower spot[11]; and the ALPO claims one very much faster[1]. Could these inconsistencies be due to mistaken identifications of spots?

At the height of the NTB_s outbreak, the ALPO reported a "NTrZ Disturbance", suggested to be analogous to classical South Tropical Disturbances[1,4]. The comments made above about the STrZ activity apply again: this was probably simply a region highly disturbed by the adjacent jetstream eruptions. In fact it was reported[1] as arising exactly alongside the most active stretch of the NTB_s[8], and C. Boyer's photograph of the region one day earlier[4,8] shows how material was being violently sheared right across the NTrZ. (In fact such was the turmoil that a few days later a new white spot--no. 7 in ref. 8, NTrC-A no. 4 in ref. 1--was apparently torn out of it near the preceding end of the "Disturbance" into the much slower North Tropical Current!) Given such intense disturbance in a narrow zone, it was no doubt easy for observers to visualise deceptively simple shadings, and indeed the "preceding end of the Disturbance" was not well defined[4].

The ALPO[4] also described the white spots seen in June-July in the North Tropical Current in terms of an organized Disturbance. Surely these were merely the first observations after solar conjunction of some unconnected stable spots.

What Did It All Mean?

The uniformly rotating source hypothesis for SEB Revivals. In 1953 Reese[14,15] proposed that all SEB Revivals erupt from two or three long-lived subsurface sources which rotate with a period of $9^{h}55^{m}42^{s}.55$. Budine has plotted SEB outbreaks and many other features on a chart of these sourcelines[16]; and it is evident that the major SEB outbreaks are often 20° to 30° away from the lines, while the minor features in the SEB and other latitudes bear no relation to them at all. However, Reese subsequently proposed instead[17] three sources with a period of $9^{h}55^{m}30^{s}.1$, close to the System III period which is that of the planet's magnetic field. These sourcelines lie within 11° of all but two of the 15 major SEB outbreaks, including the first and last of 1975[9,11]; however, the UAI point out[11] that the second 1975 eruption shows a poorer correlation than was originally reported[9], coming at 206°(II) on August 3, 1975 when Reese Source B should have been at 228°(II). Thus the System III hypothesis fits the SEB outbreaks well in general: however, it would not be expected to relate to outbreaks in other latitudes, most of which tend to appear over a wide range of longitudes near-simultaneously.

Global upheavals. The simultaneous occurrence of a SEB Revival, a NTB_S outbreak, and a massive Equatorial Band (left over from 1972) fits perfectly into Wacker's timetable[18] of "zenological disturbance" or global upheaval. Mackal[5] argues that these 1975 occurrences are simply coincidences. This may be true, and certainly the timetable is not inflexibly observed; but my impression is that such coincidences are by now too many[8]. The fact that there was no large scale disturbance of the NEB (North Equatorial Belt) in 1975 (despite all the usual minor fluctuations[5]) is no problem for the global upheaval hypothesis since the NEB Disturbance is one of the most inconstant elements in the scheme[8]. Nor is the absence of STB color a problem since such color does not figure in the Wacker timetable. Even if there was a global upheaval in 1967-68 (and it appears to me that the only feature suggestive of a new upheaval then was the EZ coloration, which may have been a forerunner of the 1971 upheaval), then the STB color was irrelevant--as were the STB Fades in 1967 and 1975 and the South Tropical Disturbance-like phenomena also seen in those years.

Finally, a detailed correspondence in longitude among individual features in different latitudes has been suggested[1]. The 1975 reports taken together agree on a surprising rough correlation in longitude between five white spots in the North Tropical Current and the five in the South and South South Temperate Currents--currents with similar rotation periods--even though the table in ref. 1 (page 231) has the wrong correlations listed, and the suggested correlation of certain longitudes with the "NTrZ Disturbance" is groundless since the latter was some 82° long. Similar approximate correspondences appeared in 1974 and 1976-77 (personal observations). However, the unlikelihood of any physical communication between the NTrZ and South Temperate Zone, across many highly zonal currents, means that rigorous statistical proof would be necessary before this intriguing pattern can be accepted as more than a coincidence. My present conclusion is that, although there is probably a global coherence in the general waxing and waning of activity, there is no proof of, and no physical justification for, any point-to-point correlations among individual features.

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OBSERVATIONS OF COMET MACHHOLZ (1978L) BY DON MACHHOLZ

While very few of us can speak from personal knowledge, it would appear reasonable that an observer should take a special interest in a comet of which he is the discoverer, or even one of the co-discoverers. Thus we are glad to report below observations by Mr. Don Machholz of Los Gatos, CA of the comet he recently discovered, as described in this journal, Vol. 27, Nos. 7-8, pp. 161-164. Perhaps other readers would like to submit their own observations of this comet. The gaps present in the observations below represent cloudy nights, interference by moonlight, or dates when the weary observer slept.

All Mr. Machholz's observations were made with a 25.4-cm. reflector, F/3.8, at 36X. The site was Loma Prieta Mountain, Calif., at the 3350-feet level, latitude 37°04'N., longitude 121°50'W. The comet was diffuse unless otherwise noted, and the coma diameter was about 3 minutes of arc. No tail was observed. The magnitude estimates given are visual, and those in parentheses are of lesser accuracy because of the low altitude of the comet.

Date (U. T.)	Right Ascension	Declination	Observed Magnitude	Notes
1978, Sept. 12.511	$6^h39^m.3$	-18°24'	11	Discovery observation
Sept. 13.475	6 38.7	-19 14	10.7	Somewhat condensed
Sept. 14.494	6 37.9	-20 00	10.7	Confirmed on this date
Sept. 19.510	6 33.7	-24 15	10.5	Diffuse, with condensation, Moon up
Sept. 21.513	6 31.6	-26 06	10.8	Diffuse, with condensation, Moon up
Sept. 23.523	6 29.3	-28 01	10.6	Moon up
Sept. 28.492	6 21.7	-32 56	10.8	
Sept. 29.522	6 19.8	-33 58	10.6	
Sept. 30.509	6 18.1	-34 58	10.6	
Oct. 1.529	6 15.8	-36 06	10.7	
Oct. 3.535	6 11.3	-38 14	10.7	
Oct. 4.510	6 9.1	-39 19	(10.8)	Within 15 degrees of horizon
Oct. 5.528	6 6.2	-40 28	(10.6)	
Oct. 6.522	6 3.6	-41 32	(10.5)	
Oct. 7.512	6 0.6	-42 35	(10.7)	
Oct. 8.526	5 57.6	-43 41	(10.7)	
Oct. 9.522	5 54.5	-44 46	(10.7)	
Oct. 11.533	5 47.2	-46 59	(10 ½)	6 degrees above S. horizon

If any of our readers have photographs of this comet, Mr. Machholz would be grateful to receive copies of them. His address is 34B Fillmer Ave., Los Gatos, CA 95030.

RESOLUTION AND CONTRAST

By: Rodger W. Gordon

"Resolving Power measurements are not adequate to predict ability of a lens to define small detail. Contrast is much more important, and contrast and resolving power are not the same thing at all." With these words, published in a review of NBS Circular 526 "Optical Image Evaluation" on page 430 of the October, 1954 issue of Sky and Telescope, Earle Brown summed up a situation which had truly become a thorn in the side of opticians. It was often found that lenses which gave good resolving power on bench tests failed to reveal fine detail when used on common everyday objects.

The realization that resolving power measurements were not the last word in defining lens performance was slow in coming. Even today many astronomical texts and periodicals (which should know better) define resolving power as "the ability of a lens to show fine detail." In fact, resolving power as measured by the two standard formulas R = 5.5/D and R = 4.5/D (the former is the Rayleigh formula based on wavelength of light, and the latter is an empirical formula derived by W. R. Dawes from actual observation) does not adequately predict the smallest detail visible in an image, though it is a rough approximation. According to the above formulas, a telescope of 5.5 inches and 4.5 inches aperture respectively will resolve 1 second of arc.

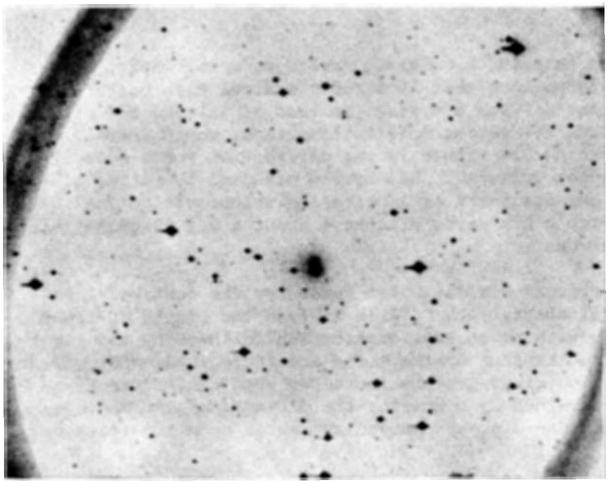

Figure 1. Photograph of Comet Machholz (1978L) by Hans Schuster of the European Southern Observatory in Chile. Taken with the 1.0-meter (39-inch) Schmidt and a 10-minute exposure on September 14, 1978. Red filter employed because of strong moonlight. Negative print. This photograph is thought to be the confirmation one of the newly discovered comet.

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The Dawes formula is found in actual practice to be more applicable to instruments in the amateur class--e.g. 2"-12". The Rayleigh formula is better for large professional instruments, the reason being that the larger instruments are much more sensitive to atmospheric turbulence than smaller ones.

We shall describe some concrete examples of differences in resolving power and contrast. Let us suppose that we use a 3" F/15 achromatic refractor and a 3" F/15 non-achromatic refractor for our purposes. According to the Dawes formula both should resolve to 1.5 seconds of arc. If we examine a 1.5 second double star, we find in the achromatic instrument that we can see two sharp overlapping diffraction patterns with a definite intensity minimum, indicating true resolution has been achieved. In the non-achromatic instrument, however, we shall see two diffraction patterns surrounded by a blur of color. By careful focussing we can resolve the stars in each "color." In both instances we have "resolved" the double star according to the formula, but it is immediately apparent there is a vast difference in the "quality" of the images. The same two telescopes directed to a planet such as Jupiter will play the following scenario: the achromatic instrument shows a sharp disc with numerous details, while the non-achromatic instrument shows a blurred disc with little or no detail present. We can say that the latter image is not "sharp" and lacks contrast.

Unfortunately, the contrast-producing qualities of telescopes have long been neglected by both professional and amateur astronomers. In part this failure is due to the fact that information on contrast, while not lacking in the professional optician's literature, has failed to filter down to the persons who need this information most--the observing astronomers. Another reason is that astronomers have often relied on information from sources that were vastly out of date. As a result, the astronomer's only concern was larger and larger apertures where it appeared that performance could be predicted by referral to one of the formulas given earlier.

Happily, the last ten to fifteen years has seen a partial reversal of this myopic thinking. The photographic industry was the first to realize the importance of contrast in defining picture quality, especially since a particular lens/film combination did not always yield the expected results. Shortly after this, the television industry in their search for longer and longer focal length lenses, short-focus wide angle lenses, and fast Zoom lenses realized that resolution, while important, was by no means the last word in faithful image reproduction. Photographic and television lenses are seldom "diffraction limited", however; and various aberrations are usually left over which do not normally interfere with the job the lens was designed to do. On the other hand, telescopes are "diffraction limited" systems (or they should be) in which the size of the diffraction image "predicts" the ultimate detail visible. All telescopes have some defects which reduce the contrast and sometimes the resolving power, depending on the amount and types of defects present. We shall assume that our optical systems are "perfect" with the realization, of course, that they are not. By using this assumption we can evaluate the performance of various telescopes.

Years ago Lord Rayleigh stated that if the maximum wavefront error (e.g., error at the image plane) could be kept to no more than ¼λ O.P.D. (Optical Path Difference), then the image would be "near perfect". Such a system, instead of imaging 84% of the light in the Airy or central disc and 16% in the diffraction rings, would instead image 68% in the disc and the remaining 32% either in the diffraction rings or scattered about the field. This "Rayleigh Criterion" has become standard operating procedure in the telescope industry when designing or fabricating telescopic optical systems. Thus a system meeting Rayleigh's standards will have about a 20% contrast loss compared to a theoretically perfect one.

In reflecting systems with "perfect" optics we can determine the contrast loss by examining the size of the central obstruction. Table 1 gives the amount of light in the image of a perfect telescope with no central obstruction followed by the light distribution pattern as various sized central obstructions are introduced. Note how the amount of light in the diffraction rings greatly increases when the obstruction exceeds 30%. These effects are determined by comparing the diameter of the obstruction to the diameter of the main mirror--e.g.--3" secondary mirror on a 10" telescope as an example.

Figure 2 shows the image point spread functions of systems with varying amounts of spherical aberration.

Figure 3 shows the image point spread functions of theoretically perfect systems with central obstructions.

A comparison of Figures 2 and 3 shows that the ¼λ spherical error has about the same effect on the light pattern distribution as does a perfect system with a 33% obstruction. Thus as far as contrast is concerned, the two effects are about identical, which led Theodore Dunham in a classic investigation on the effects of these obstructions to state that any system which has a central obstruction larger than about 30% will violate the Rayleigh Criterion as far as the redistribution of the light in the diffraction pattern is concerned, no matter how well figured that system is.

This information has serious consequences for all lunar and planetary observers since high contrast then plays a large part in determining the amount of detail to be seen. Detail is seen, in fact, only by reason of its being of higher contrast than the adjacent background; and in most cases there must be a 5% difference (ratio 19:20) in contrast to allow the eye to detect this tonal variation, though some skilled observers can perhaps do somewhat better. It is of the utmost importance, then, that in reflecting systems any central obstruction and possibly the support system used (a 3 or 4 vane spider in a Newtonian, for example) be kept as reasonably small as possible in order to diffract as little light as possible. Catadioptric Cassegrains usually have somewhat larger central obstructions than Newtonian forms of the same aperture; but as the latter use supports to hold the secondary mirror, the amount of diffracted light is about the same in each, and contrast will thus be reduced about the same amount in both systems. Again we assume top quality optics in each case.

In the last ten to fifteen years new techniques for measuring the contrast efficiency of an optical system have been developed. Most amateurs are unaware of these new techniques; and many telescope manufacturers have not employed them, though the camera and TV lens manufacturers have used them extensively. The new contrast measurement technology depends on a method called MTF or Modulation Transfer Function. Briefly, MTF is the ratio of the contrast of the object in the object plane to that of the contrast of the image of the object in the image plane of the optical system when the test object is a sine wave target. A sine wave is a simple harmonic wave pattern usually employed on a test target of variable frequency and contrast in this instance. Harmonic waves are simple wave patterns which can be rigorously analyzed mathematically for definite quantitative results. If a lens is tested on such a target, its contrast at variable spatial frequencies (lines/MM) can be compared to the theoretical contrast predicted for its diffraction limited aperture, and the two compared. The result is the MTF or contrast function of the lens or system under the test. MTF measuring machines such as the Eros 200 by Ealing-Beck are commonly accurate to 5%, but a unit such as the Ealing-Beck Eros IV may be accurate to 1%. The latter, incidentally, is the standard reference MTF measuring machine as employed in the British equivalent of our National Bureau of Standards.

Table 1. The Effect of Central Stops on Distribution of Intensity in the Diffraction Pattern of a Circular Aperture.

	Relative Diameter of Central Stop									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Percentage of Total Light in										
Central Disc	84	82	76	68	58	48	37	27	17	8
Ring System	16	18	24	32	42	52	63	73	83	92
Percentage of Total Light of Ring System in Individual Rings										
Ring 1	44	48	58	69	73	67	55	40	25	11
Ring 2	17	10	3	1.4	4	14	25	28	21	11
Ring 3	9	13	17	8	0.9	0.3	5	13	17	10
Ring 4	6	2	1.4	6	8	1.3	0.1	5	12	10
Ring 5	4	7	4	0.3	2	5	0.7	0.5	7	9
Outside Ring 5	20	20	17	15	12	12	14	14	18	49
	100	100	100	100	100	100	100	100	100	100
Radius of Circle Containing 50% light of entire Ring System (unit = radius of 1st dark ring when c = 0)	2.1	2.1	1.6	1.5	1.4	1.4	1.5	2.2	2.7	4.6

Figure 4 is an example of a typical resolution test chart as employed by the National Bureau of Standards. It is not a sine wave target but can be employed for MTF analysis techniques by using the appropriate mathematics. This particular target is a high contrast target. A similar low contrast target can also be used.

The MTF machine can measure not only the effects of any central obstruction present, but also can determine the loss of contrast and resolving power caused by residual aberrations, by light scatter from poorly polished or dirty optical surfaces, or by the unfocused residual color present in an "achromatic" system. Thus the final contrast plot of the system under test is a measure of the total performance of the system in question. Even the effect of the intervening atmosphere can be evaluated as can the MTF of any film used to photograph the result.

Figure 5 shows the MTF curve for a perfect, diffraction-limited system. The scale will change depending on the focal ratio of the instrument and on the wavelength of light used in testing. This MTF testing has superseded many ordinary lens testing procedures. NASA and some other Government agencies often require MTF tests for evaluation of systems under production contract to them. This is especially true in aerial camera systems, where a wide variety of performance demands may be required of the same system.

Figures 6 and 7 show the MTF curves for the well-known 3½" and 7" Questar telescopes. The results indicate that the system gives good contrast. A refractor of the same diameter and F/ratio might or might not equal or exceed these results depending on whether there are any residual aberrations present, including secondary spectrum.

The amateur cannot afford to purchase an MTF measurement device. Even a "bare bones" Eros 200 system can go $9,000-$15,000 or more. Given the necessary schematics, an enterprising amateur could, by "scrounging" up the necessary optics and electronics, make one up for perhaps one-fifth of this sum; but the device would still be of little use unless the same individual were familiar with Fourier analysis techniques to reduce the raw observational data.

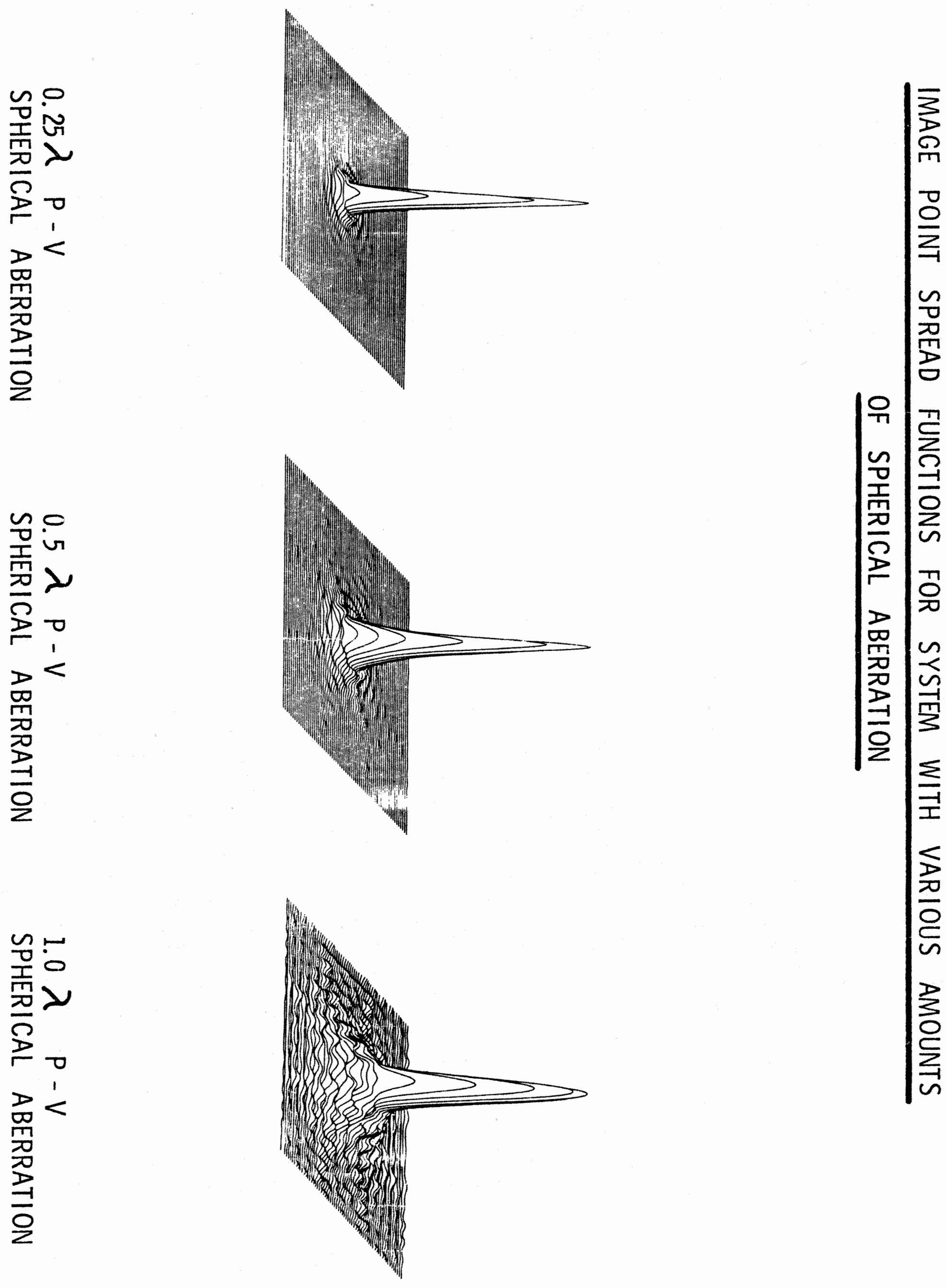

Figure 2. See text on page 182, and compare to Figure 3. Source of diagram is reference 3 on page 189.

What can one do, then, to determine the performance at different levels of contrast for a particular optical system? Though limited, the following method can be used to determine the resolution and contrast limits of the telescope. One can obtain NBS-SP-374, "Method for Determining the Resolving Power of a Photographic Lens",

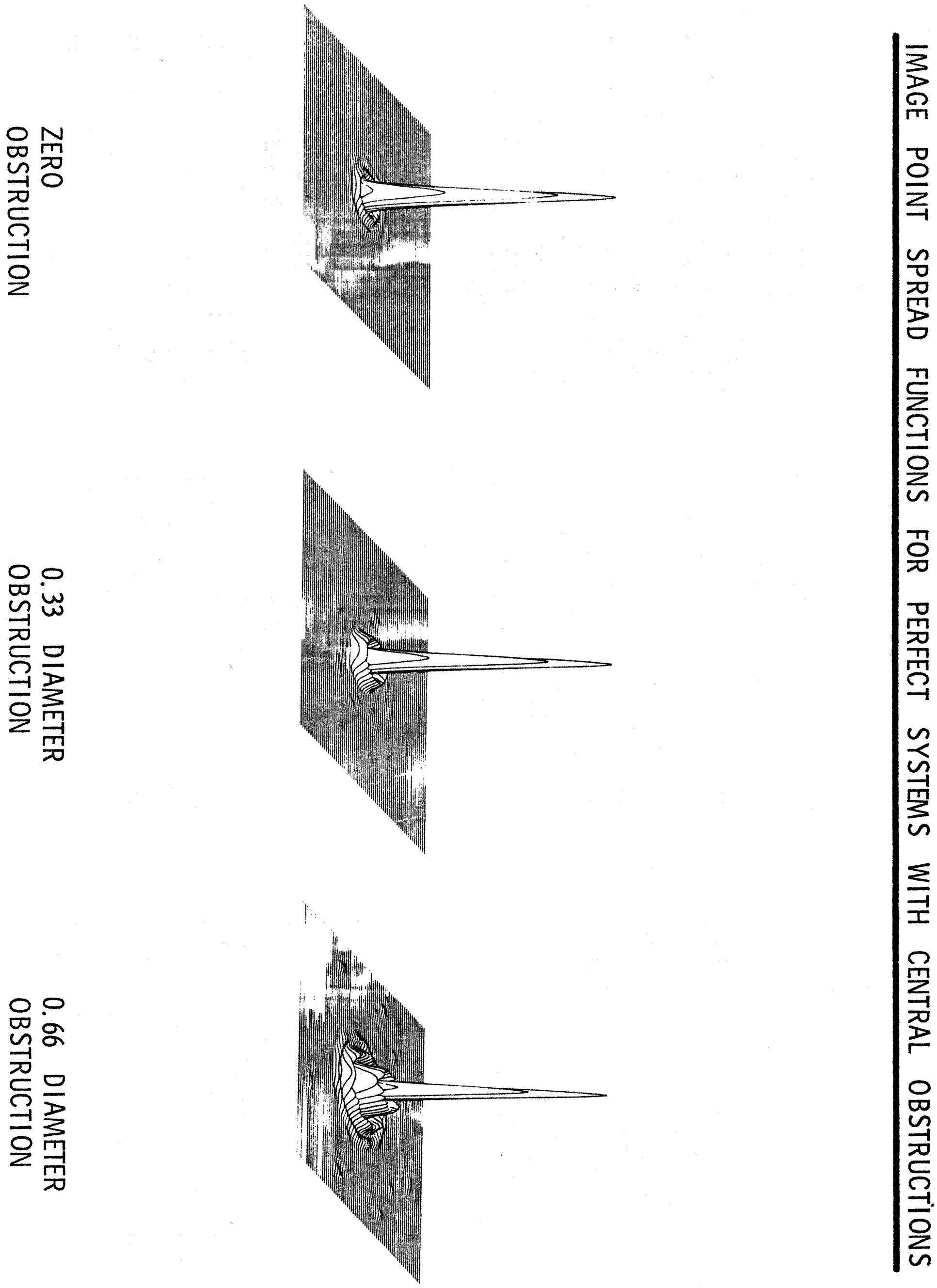

Figure 3. See text on page 182, and compare to Figure 2. Source of diagram is reference 3 on page 189.

for less than $5.00 from the Supt. of Documents, U.S. Govt. Printing Office, Washington D.C. 20042. Included in it is a high contrast chart with a contrast ratio of 0.9. Another low contrast chart is included with a contrast ratio of only 0.2. This latter chart more nearly resembles the relative contrast of real planetary or lunar surface

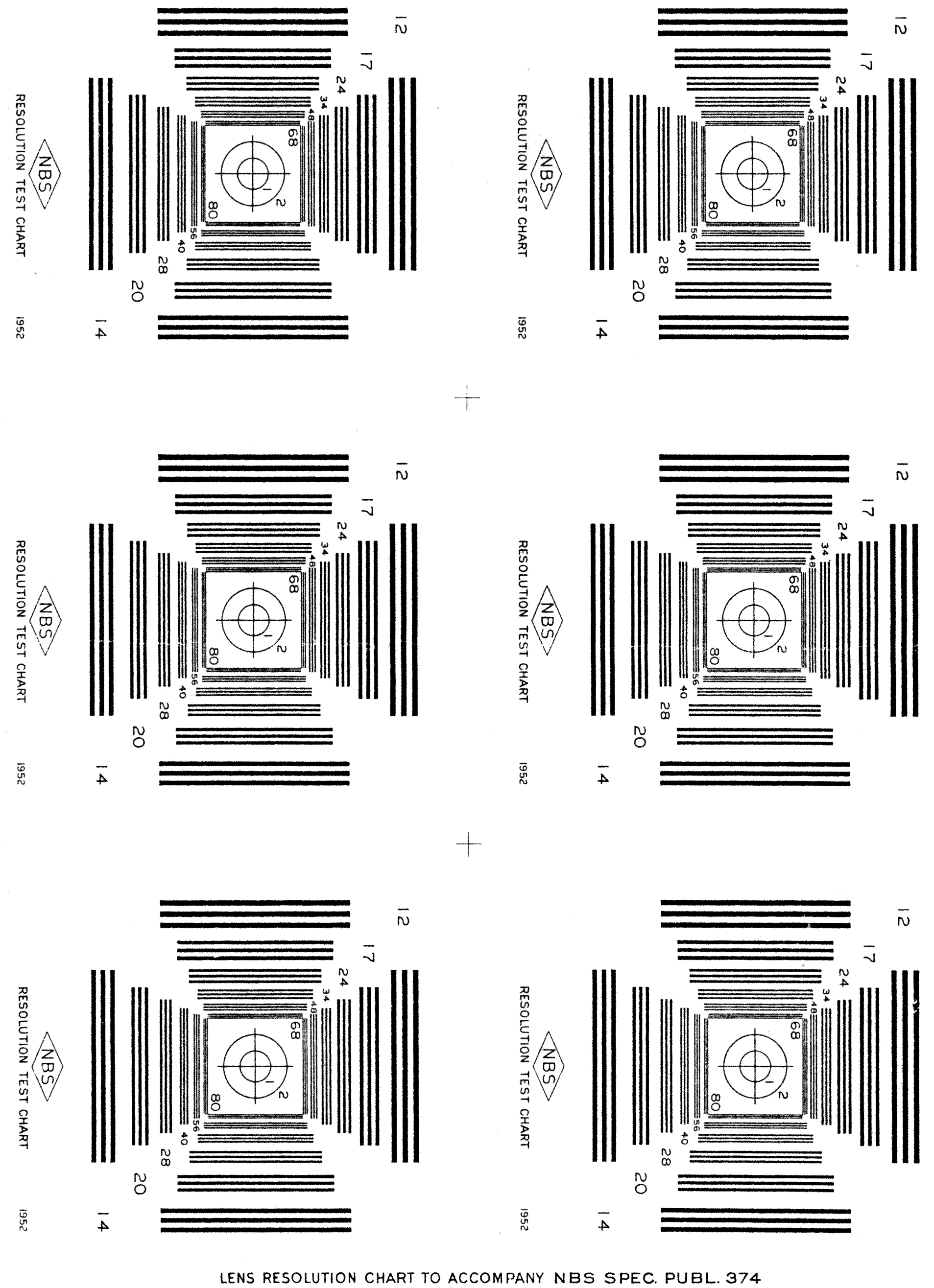

Figure 4. A typical resolution test chart with a high contrast target as employed by the National Bureau of Standards. See also text.

detail; and by determining the finest line pattern visible, according to the published table in the brochure, one can read off the results in arc seconds. Be careful of the phenomenon known as "spurious resolution". This occurs when lines past the true resolution point begin to be visible again, but a count of the lines in the image will

Table 2. Tabulation of Data on Some Popular Catadioptric Telescopes.

Telescope	Clear Aperture	Diameter of Central Obstruction	% Ratio of Obstruction to Clear Aperture
4" Quantum Mak-Cassegrain	100 MM (4")	33 MM (1.3")	33%
6" Quantum Mak-Cassegrain	150 MM (6")	50 MM (2")	33%
3" Copernicus Mak-Cassegrain	70 MM (2.8")	19 MM (0.8")	27%
3½" Questar Mak-Cassegrain	89 MM (3½")	30 MM (1.2")	34%
7" Questar Mak-Cassegrain	178 MM (7")	60 MM (2.4")	34%
3½" Celestron Mak-Cassegrain (C-90)	90 MM (3½")	35 MM (1.4")	39%
5" Celestron Schmidt-Cassegrain	125 MM (5")	50 MM (2")	40%
8" Celestron Schmidt-Cassegrain	200 MM (8")	70 MM (2.8")	35%
8" Dynamax Schmidt-Cassegrain	200 MM (8")	70 MM (2.8")	35%

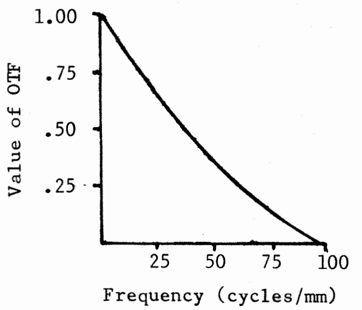

Figure 5. Theoretical MTF curve for a diffraction-limited optical system. The actual scale is determined by the f-number and by the wavelength of light. See text of Mr. Gordon's article on page 183.

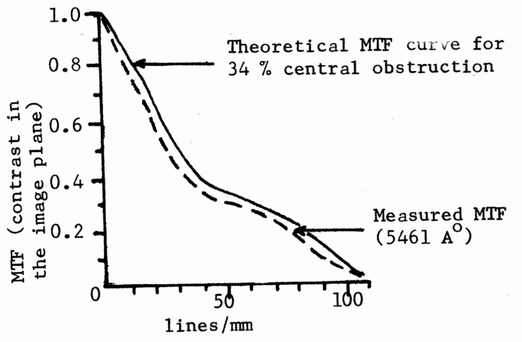

Figure 6. The MTF curve for a 3.5-inch Questar reflector. See also text.

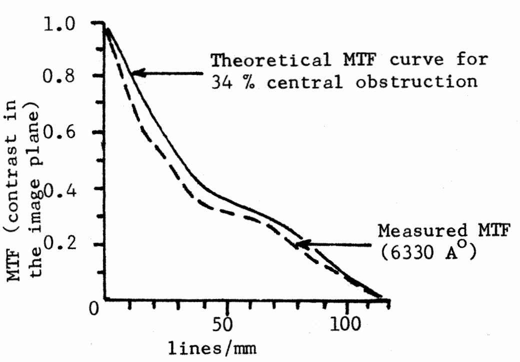

Figure 7. The MTF curve for a 7-inch Questar reflector.

be different from the lines in the target. The true resolution is reached when the last pattern is resolved which shows the same number of lines in the image of the target as on the target itself.

One should also measure the number of lines visible in the high contrast chart. Usually a given optical system will resolve more lines/mm. on a high contrast chart than on a low contrast one, and the difference can be used as a judge of the performance of the telescope at two widely different contrast levels. This isn't the whole picture, but does give a reliable indicator of real performance capabilities. Most telescopes will not resolve to the theoretical limit on the low contrast chart. A 3½" Catadioptric I tested some years ago gave 1.25 arc seconds on a high contrast chart and about 1.45 arc seconds on a low contrast chart.

Figure 8 shows different degrees of resolution of a triple star with various apertures. There may be some differing interpretations as to on which image the

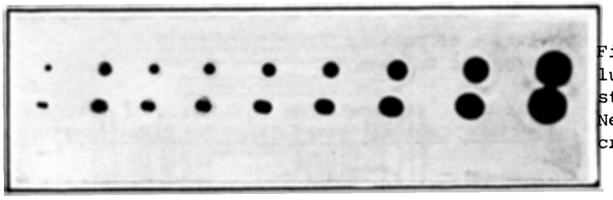

Figure 8. Progressive resolution of an artificial triple star as a function of aperture. Negative print. Aperture decreases to the right.

actual third component is "truly resolved," depending on your own interpretation of resolution.

It is easily noted, however, that the two smaller stars can be seen as double very easily in several instances long before they are "resolved" in the true theoretical sense. It is also well known that certain planetary details can be seen even though they are theoretically below the resolving power of the aperture employed. Thus, the shadows of Jupiter's moons on its cloud deck or the Cassini Division in Saturn's ring are visible with far smaller apertures than theory predicts. This type of detail, however, has high contrast. Lower or fainter contrast details may or may not be seen, depending on the contrast efficiency of the instrument used. Unfortunately, there has never been an adequate study of the smallest possible details visible on an extended image. The Dawes and Rayleigh Limits deal with diffraction phenomena of relatively bright point sources of light (double stars or single ones). On an extended image the diffraction discs, which build up a mosaic of the whole picture, are not at their full effective size; and consequently the classical formulae fail on these subjects. One proof of this is the fact that while the smallest lunar crater one may expect to detect is about the same size as the predicted Dawes Limit for that aperture, linear detail such as rilles, ridges, etc. are seen at far smaller angles. Both the eye and the telescope are more sensitive to linear details than to circular spots; but a full study of these phenomena has never been approached, to my knowledge.

Table 2 on page 187 is a list of some popular Catadioptric telescopes, giving their clear aperture, diameter of central obstruction, and percentage of obstruction compared to clear aperture on a diameter to diameter ratio. It can be seen that most of the popular Catadioptrics have central obstructions exceeding 30%. This is "normal" for most Cassegrain type systems so as fully to baffle the system (even when baffle tubes are employed.) However, those instruments which approach the 40% obstruction figure will have poorer contrast than those with the smaller obstructions, assuming that all other parameters are equal.

One should not use Table 2 to construe that a refractor or a Newtonian will give superior performance to a Catadioptric. It may or may not. The spherical and chromatic errors of refractors 4" and larger frequently cause a loss of contrast greater than even a 30% obstruction would. Newtonian reflectors by current manufacturers generally have obstructions ranging from 17%-33% or so. These in turn are supported by three- or four-vane spiders, which frequently diffract a goodly amount of light. Add to this that the usual Newtonian in amateur hands is likely not to be in top collimation and with its open tube is more susceptible to internal turbulence, and we find that Newtonians often fail to live up to expected results. Much of the performance of the three main systems will be determined not only by the manufacturer but also by the user, and individual cases may vary greatly.

It is not the purpose of this article to enter into a debate about which system is best for lunar and planetary work. Rather all three (refractors, reflectors, and Catadioptrics) will give excellent performance on these subjects <u>if they are made well optically and mechanically</u>. <u>Some differences in performance will occur among the best examples of each type</u>. We shall leave the portability factor out here since "portability" means different things to different people.

It is true that there are three and four element apochromatic refractors available, and there are also off-axis or tilted component reflector designs which leave nothing to be desired in terms of optical performance. The high cost of the apochromats and the stringent requirements of mechanical workmanship in collimating an off-axis system usually eliminate these from consideration to all but the dedicated few.

It also matters little about the theoretical parameters of one design over another if the optics are always dirty (fingerprints, dust, etc.). Experiments by the National Bureau of Standards show that even a single thumbprint on a lens can markedly reduce contrast, and a layer of dust will do the same thing. Resolution may not be adversely affected on high contrast details in such circumstances, but they will easily wash out the low contrast details we are looking for. Thus it is always wise to clean (gently) optics periodically (twice a year in heavy use) before a residue gets a chance to build up; an air syringe is a great help.

Thus while in high quality optical systems the diameters of the central obstructions, if present, can be a general guide to the performance of certain classes of telescopes, there are other external factors which may affect the performance (or its lack) just as seriously. Regardless of what system is ultimately chosen, we demand in our pursuits the highest in optical and mechanical quality of that choice so as to reduce as much as possible external parameters which affect the instrument's design performance. Even one particular type of error or aberration can affect performance differently than the same amount of error or aberration of another type. For example, a $\frac{1}{4}\lambda$ astigmatic or comatic error is far more serious in its effect on the image than a $\frac{1}{4}\lambda$ spherical aberration error. The spherical error will be distributed (in general) symmetrically around the diffraction pattern; its biggest effect is to brighten the first diffraction ring, causing some loss of contrast uniformly. A $\frac{1}{4}\lambda$ astigmatic or comatic error, on the other hand, destroys the symmetry of the diffraction pattern itself by brightening it in preferred orientations at the expense of others. As a result, a $\frac{1}{4}\lambda$ astigmatic or comatic error has a far greater effect on resolving power and contrast of the image. Thus rating a mirror at $\frac{1}{4}\lambda$ or $1/8\ \lambda$, etc. is meaningless unless it is known what type of errors are present so that their effects on the image are predictable.

It is interesting to note in wave-rating optical systems the difference in contrast between a $\frac{1}{4}\lambda$ system and one of,say,$1/20\ \lambda$. The former reduces contrast by 20%; the latter, by less than 3%. Whether this gain in performance is justified by the extra cost of the more finely made system must be answered by the individual and his needs. Texereau points out that $\frac{1}{4}\lambda$ optics are more susceptible to atmospheric turbulence; but unless seeing is really good, differences in performance between $\frac{1}{4}\lambda$ and $1/20\ \lambda$ optics will not be seen except by the more skilled observers. The $1/20\ \lambda$ optics are like high power rifles used by big game hunters--nice to have when you need them!

This article has attempted to show why contrast is so important to the observer and why its neglect can sometimes spell disappointment. As an aid to those who wish to pursue this subject more closely, I have compiled a list of articles and references. Some of these are difficult to obtain such as Fischer's work, which was a limited printing given as a handout to some advanced amateurs at the 1974 Stellafane Convention. Other sources are extremely expensive such as Horne's, which currently sells for over $50.00 and is advertised by some booksellers in Sky and Telescope. In some cases no publicaton date is given (Fischer's), but I have used the date it was distributed to the select few.

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3. "Wavefront Errors in Cassegrain Systems and other Optical Oddities", by Robert E. Fischer, Itek Corp., 1974. (Figures 2 and 3 are taken from this publication.)
4. "The Influence of Central Stops on the Performance of a Telescope", Theodore Dunham, Journal of Optical Society of America, Vol. 41, 290 (1951).
5. NBS-SP 374, "Method for Determining Resolving Power of a Photographic Lens", National Bureau of Standards, 1973.
6. "Improvement of the Image Contrast of a Newtonian Telescope", H. M. Hurlburt, J.A.L.P.O., Volume 17, Nos. 7-8, July-Aug., 1963, pp. 153-158.
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9. "The Limits of Telescope Resolution--a Symposium", J.A.L.P.O., Volume 8, Nos. 5 and 6, May-June, 1954, pp. 68-71.
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11. "Resolves To The Theoretical Limit: Fact or Fancy," Peter W. Mitchell, Review of Popular Astronomy, October-November, 1964, Vol. LVIII, #530, pp. 36-39.

12. "Astronomy: A Handbook", Günter Roth, Springer-Verlag, 1975, Chapters 2, 3, 19.
13. "Telescopes For Skygazing", by Henry Paul, Amphoto, 1965, Chapter 8.
14. "Reflectors versus Refractors", W. H. Pickering, Amateur Telescope Making, Book II, Scientific American, 1965, pp. 606-615.
15. "The Telescope", Louis Bell, McGraw-Hill, 1922, Chapter XI.
16. "How to Make a Telescope," Jean Texereau, Doubleday-Anchor, 1963, Chapter 1.
17. "How Images are Formed," F. Dow Smith, Scientific American, September, 1968 (entire issue devoted to light).
18. "Resolution Testing of Small Telescopes," Rodger W. Gordon, LVAAS Observer, April, 1975, Vol. XV, No. IV, pp. 3-7.
19. "Star Images In the Presence of Aberrations," H.W.J. Blöte, Sky and Telescope, Vol. 55, No. 4, April, 1978, pp. 347-354.

This original paper (now somewhat revised) was presented at the Joint Astronomical League--ALPO Convention at Kutztown, Pa. on Aug. 20, 1976. Because of the numerous requests I've had regarding its publication, I've revised it and have expanded the list of references.

CONCERNING THE BRIGHTNESS VARIATIONS OF COMET KOHOUTEK (1973 XII)

By: Karl S. Simmons, A.L.P.O. Comets Section

[This paper by Mr. Simmons is a summary of an article, "Photometric Parameters of Comet Kohoutek 1973 XII", in Comets, Asteroids, Meteorites, Interrelations, Evolution and Origins, edited by A. H. Delsemme, the University of Toledo, 1977. The authors of the article were Messrs. T. Kleine and L. Kohoutek, Hamburg Observatory. Mr. Simmons' paper was communicated by Mr. Dennis Milon, the A.L.P.O. Comets Recorder. Mr. Milon writes that additional reports, by different authors, of comets observed by A.L.P.O. members in recent years are in the process of preparation. -Editor]

Fully 2796 visual observations of Comet 1973 XII (or 1973f) from September 22 to December 23, 1973 and from December 31, 1973 to March 22, 1974 were used by Kleine and Kohoutek to analyze the light curve of the comet before and after perihelion. Most of these observations came from Japan, USA, and Germany, and include many observations by ALPO members communicated by Dennis Milon, Comets Section Recorder.

The observing conditions for Comet 1973 XII were approximately the same before and after perihelion. The large atmospheric extinction diminished the accuracy of visual estimates of the cometary brightness in both periods. The authors have taken into account the aperture correction based on a new method. The correction values differ slightly in the periods before and after perihelion passage. Their method implies a dependence of aperture correction on the zero point, i.e., on the reference aperture D_0. They use $D_0 = 0$ as well as $D_0 = 6.78$ cms. in order to compare their correction with the results of Bobrovnikoff and Morris (PASP, Vol. 85, pg. 470, 1973). For $D_0 = 0$ the value for a was 0.037 (refractors) and 0.021 (reflectors); and for $D_0 = 6.78$, they found a = 0.026 (refractors) and 0.014 (reflectors). The aperture correction equation is $m_{1,cor} = m_1 - a(D - D_0)$.

The light curve they obtained is published here as Figure 9. Near the beginnings and ends of the two observing periods the time interval of a daily mean was increased in order to contain at least three observations. The curve before and after perihelion appears to be smooth without flares.

The two-parametric model for the light curve was applied in the well-known form: $m = m_0 + 2.5\ n \log r$; here the corrected magnitudes $m_{1,cor}$ were reduced to a unit of geocentric distance assuming the Δ^2-law.

The authors concluded: "Starting in September, 1973 the brightness of the cometary coma was increasing with the mean photometric exponent of about n = 2.5, and reached the value $m_0 = 5.1$ (5.4) for aperture correction $D_0 = 0$ ($D_0 = 6.78$) at the standard distance 1 AU. After the perihelion passage the decrease of brightness occurred according to n = 3.6, and the absolute magnitude dropped by 1.5 magnitudes for the two-parametric model, and even by 1.9 magnitudes when we compared the 'local' values of m_0." The authors also estimated the contribution of dust and gas to the visual brightness of the coma from UBV data, using two different methods. In both approaches they found that the coma was more gaseous before perihelion than afterwards. "The observed changes in the coma luminosity and composition could be ascribed

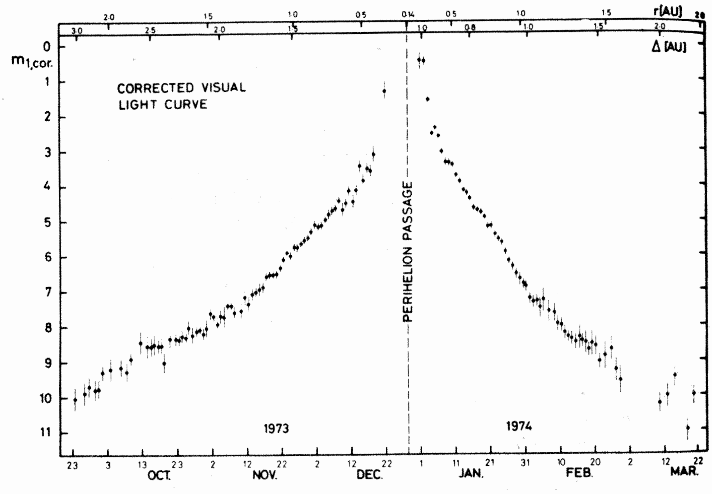

Figure 9. Corrected visual light curve of Comet Kohoutek 1973 XII. Taken from article by T. Kleine and L. Kohoutek in Comets, Asteroids, Meteorites, Interrelations, Evolution and Origins. Curve constructed using 136 daily means corrected to reference aperture $D_0 = 0$. See also Mr. Simmons' article on page 190.

Figure 10. Photograph of Comet Kohoutek 1973 XII (or 1973f) by Richard and Helen Lines and Evered Kreimer at Mayer, Arizona on January 20.1066, 1974, U.T. 16-inch, f/8 Newtonian reflector. Exposure 5 minutes. Tri-X film, no filter, developed in D-19. Tail 0.5 degrees long at position angle 60°.

to the respective decrease of both the molecular production rates as well as the production rates of dust."

The authors derived the following "local" values of absolute magnitude at a distance r = 1 AU: m_0 (A) = 4.97, m_0 (B) = 6.87 (AC for D_0 = 0); m_0 (A) = 5.22, m_0 (B) = 7.08 (AC for D_0 = 6.78). The symbols are: A--before perihelion, B--after perihelion, and AC--aperture correction.

Postscript by Editor. The obtaining of careful and accurate estimates of the stellar magnitude of a comet is among the most valuable observational data which an amateur observer can supply for the research of professional astronomers. The proper techniques have been described, for example, by Dennis Milon in Journal A.L.P.O., Vol. 20, pages 200-209, 1968. (Comet observations in general are discussed there). The interested reader is also encouraged to write for information to either Derek Wallentinsen or Dennis Milon of the A.L.P.O. Comets Section staff; their addresses appear on the back inside cover of this issue.

A COMPREHENSIVE CATALOG OF LUNAR TRANSIENT PHENOMENA

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

[Foreword by Editor. While the next article was written as a book review, it appears to the Editor that its importance justifies its separate presentation with its own title. We are especially glad that this excellent review can be followed by the first installment of Mrs. Cameron's discussion of A.L.P.O. observational studies of Lunar Transient Phenomena in recent years.]

Lunar Transient Phenomena Catalog, by Winifred Sawtell Cameron. NASA, National Space Science Data Center, Greenbelt, Maryland 20771. July, 1978. 109 pages (pp. 22-109 unnumbered). No price. Paperbound. NSSDC/WDC-A-R & S 78-03.

A.L.P.O. members should be interested in this monograph for several reasons--the author is an A.L.P.O. Lunar Recorder, a large proportion of the observations reported are by A.L.P.O. members, and observations of lunar transient phenomena ("LTP's") are among the more useful that can be made by the amateur.

Following a short introduction, and a longer bibliography, the bulk of this book, as the title states, is a catalog of reported LTP's. In fact, 1468 reports are listed, with extensive information for most. Obviously, this is a reference work, not intended for casual reading, and should form the basis for much future observational planning and research.

For every event, when known, we are given 23 columns of data. These include the Universal Time date and time--from A.D. 557 to 1977! Then follows the name of the feature concerned, its selenographic longitude and latitude, and a description of the phenomenon. For statistical analysis, the catalog supplies the nearest dates of perigee and apogee, and the lunar horizontal parallax for those dates and for the date of observation. Next come the event's duration, the Moon's age, the phase of the anomalistic period (both true and approximate), colongitude and distance from the terminator, nearest date of Full Moon (and time before or after that date), and solar K_p indices (a measure of the effect of magnetic storms). Columns 16-21 give background information--the observer, the location, the instrument and aperture, seeing (and sometimes transparency), the information source, and the appendix reference. Column 22 gives the author's assigned weight, ranging from 0 (useless or not a lunar phenomenon) to 5--confirmed or permanently recorded (246 reports are given weight 5). The final column gives the event type: B = brightening, D = darkening, G = gaseous, R = reddish, V = bluish. Clearly, there is enough information here to keep a statistician busy for years.

There are a few minor criticisms--some debatable. First, some "events" reported are probably not transient phenomena and thus are not well-described by their event type classifications. For example, the Linné "disappearance", if real, would appear to be more a physical change than a temporary event. Second, this catalog is just that--there are no interpretations of the events listed. Third, the user may be confused by the form of organization because reports are listed, not events, so that separate events hundreds of miles apart on the Moon (albeit approximately simultaneous) are often grouped together with the same serial number. More definitely undesirable is the rather low quality of printing, with parts of the tables poorly legible (a sad contrast with NASA's palmy days!). Also, the author herself admits the incompleteness of this catalog, although it is the most complete extant; and a totally complete catalog of this nature is, of course, not possible. Finally, it is certainly not the fault of the author that data are frequently missing; they are missing because the observer, or the information source, did not record them.

One impression that this catalog gives is that LTP reports are both physical and cultural in origin. After all, an LTP report means that, not only did an event occur (or seem to occur), but also that someone was looking, recorded his or her observation, and then managed to report it. Figures 11-a and 11-b demonstrate this point. Note the apparent explosion of activity in the 1960's, peaking in 1969. It appears very unlikely that the Moon was uniquely unsettled at just that time, and more likely that instead the widely-publicized Alphonsus spectrograms of Kozyrev (1958), the Aristarchus-area observations of Greenacre and Barr (1963), the "Moon-blink" program (starting in 1964 and continuing into the early 1970's), and the Apollo-11 mission resulted in this surge of reports. Figures 11-a and 11-b also show that, despite

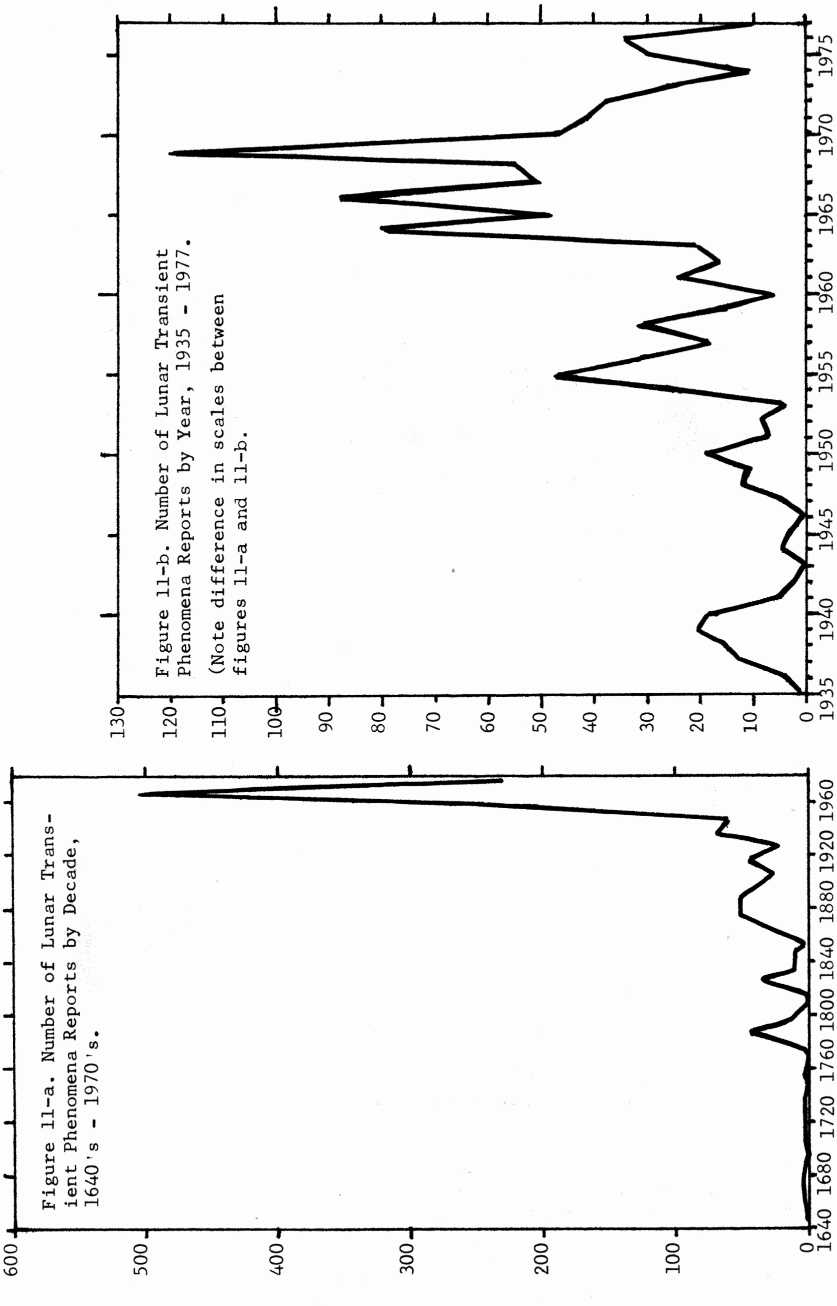

Figure 11. Diagrams to show frequency of reported Lunar Transient Phenomena over selected time intervals. Prepared by John E. Westfall from Winifred S. Cameron's Lunar Transient Phenomena Catalog.

recent "popularity", substantial numbers of events have been reported for the last 40 years; and "spurts" of apparent activity go back to Herschel's reports in the 1780's.

Figure 12 gives the approximate selenographical distribution of LTP reports. Probably both physical and human causes have affected this map. Undoubtedly, some areas and features (e.g., Aristarchus and Plato) receive more reports partly because

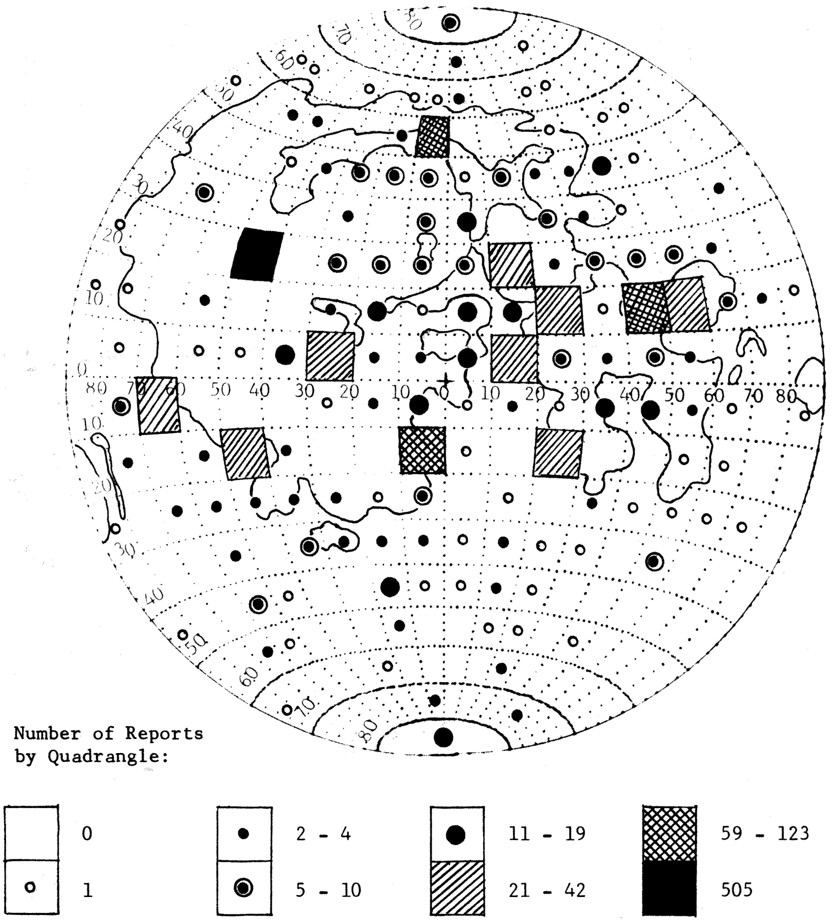

Figure 12. Distribution of locatable Lunar Transient Phenomena reports by 10-degree Latitude/Longitude Quadrangles. (Azimuthal Equal-Area Map Projection.) Lunar north at top, lunar west (hemisphere of Aristarchus and Oceanus Procellarum) at left. Chart prepared by John E. Westfall from Winifred S. Cameron's Lunar Transient Phenomena Catalog. See also text.

they are closely observed, both because these features are of interest in themselves and because observers have been alerted by the numerous LTP's already reported there--the last is a fine example of positive feedback. Nonetheless, it is difficult to believe that, for example, 23 times as many observer-hours are devoted to the Aristarchus area (505 reports) than to Copernicus (22 reports) so that some real differences probably exist. For example, the preference of LTP's for the rims of the circular maria has been pointed out before, and appears indicated in Figure 12 as well.

No more than a brief perusal of the listings in this catalog should convince even the most conservative that the Moon is not a "dead world". Certainly many of the reports are dubious; however, other events have been: simultaneously observed by distant and independent observers; detected by filters or "Moon-blinks"; photographed in color and black-and-white; have had their spectra observed and photographed; have been detected by polarimetry; have been seen by Apollo astronauts or detected by instruments placed on the Moon by them; and have even been measured by photoelectric photometers. In spite of all this evidence, it is surprising how LTP's continue to be ignored, or glossed over, in even recent professional literature. In this writer's opinion, the time for debating the existence of LTP's has long passed; and, aided by this impressive catalog, we now need to go on and winnow the bad from the good, investigate patterns of activity, set and test hypotheses, and, ultimately, seek causes.

Some lunarians will wish to turn from this catalog to more readable accounts, and analyses, of these varied events; and so the "outside readings" listed below may be in order:

Cameron, W.S. Comparative Analyses of Observations of Lunar Transient Phenomena. NASA X-641-71-12. Greenbelt, Md.: NASA, Goddard Space Flight Center, January, 1971.

Firsoff, V.A. The Old Moon and the New. Cranbury, N.J.: A.S. Barnes and Co., Inc., 1970. Chapters 13-15.

Middlehurst, B.M.; Burley, J.M.; Moore, P.; and Welther, B.L. Chronological Catalog of Reported Lunar Events. NASA TR R-277. Washington, D.C.: NASA, July, 1968.

Moore, P. New Guide to the Moon. New York: W.W. Norton & Co., Inc., 1976. Chapter 15.

RESULTS FROM THE LTP OBSERVING PROGRAM FOR THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS (ALPO)

By: Winifred Sawtell Cameron, A.L.P.O. Lunar Recorder,
National Space Science Data Center, Goddard Space Flight Center, Greenbelt, Maryland

This program has been in effect for three years (as of 1977) and has yielded some interesting results. Objectives of the program are: 1) to monitor the Moon for Lunar Transient Phenomena (LTP), 2) to establish the albedo characteristics of features throughout all lighting aspects (lunation), 3) to establish a more objective seeing scale based on the behavior of a star's out-of-focus disk, and 4) to establish the frequency of occurrence of LTP.

Observations have been submitted from which all four objectives can be analyzed for a few lunar features, and for a few more some of the objectives can be realized. Of the 100 or so LTP sites about one quarter have sufficient data in this program to establish their normal aspects for a lunation period. There were less than a dozen LTP reported, but the albedo charts suggest unnoticed anomalies. Reasons for this will be discussed later.

Methods of Observation

There were suggested methods of observation, which are reviewed below. It was desired that an albedo scale be set up with which the observer could compare each feature for the apparent albedo at that moment. This scale could be set up in various ways, but all should be set up by observing at the time of Full Moon when the true albedo is found. At other times it would give an apparent albedo that would be influenced by the Sun angle, roughness of ground, and composition. Elger's albedo scale was the model. Each of his steps (from 0 to 10 in half steps) was to be matched by a gray that was closest to the appearance in the telescope (at Full Moon) of the representative features in Elger's scale for that step. These grays could be obtained by pencil shadings (on a white sheet), pieces of exposed film of different densities, a commercial or homemade photographic wedge, etc. The most objective way would be to insert neutral density filters of steps of 0.05 or 0.1 density increments into the light train until the features disappear. The number of density filter steps would be recorded. This system would be more accurate and quantitative and could be more easily related to other published brightness scales such as photometric values (McCord (1972, 1973)*& Mikhail (1970)), or stellar magnitudes (Wildey & Pohn, 1964). This optimum method has not yet been used by any ALPO observers.

The method for estimating seeing conditions is the following:
1) Turn off the drive mechanism of the telescope and rack the eyepiece out of focus (doing it by the same amount and direction each time).
2) Direct the telescope to a star as near the Moon as possible.
3) Place the star's disk at the trailing edge of the field of view (FOV) and estimate the time it takes for the disk to disappear off the edge.
4) Place the star's image at the leading edge of the FOV, and time the drift of the

*Mrs. Cameron's paper is being published in more than one issue of this journal, and the list of references will accompany the last installment.

disk across the middle of the FOV (this should be tested and the telescope adjusted in declination (or altitude) until the disk drifts across the central line of the FOV).
5) Observe the pulsations of the disk and time the interval between blow-ups.
6) Place the star's disk at an edge of the FOV and estimate, in terms of a fraction of the FOV (e.g., 1/20) how far inward the image darted from the edge (excursions).
7) Time the interval between excursions.
8) Estimate seeing on the observer's old scheme of judgment, e.g., excellent (E), very good (V.G.) etc., or 0-10 where 10 is best, or Antoniadi's scale (I, II, III, etc., where I is best). Points 5 and 7 above are the most important for comparison with LTP variations when there are any. In general, the two timings will be different because the seeing effects are caused at different atmospheric altitudes. The seeing estimates should be made prior to the lunar observations, and should be repeated immediately afterwards if any LTP are observed.

In order to distribute all the LTP sites among the participating observers, features were assigned. Four LTP sites, one non-LTP comparison site, and a seismic epicenter (determined from the Apollo seismometers--Latham, et al, 1973) were assigned to each observer. Approximately 40 people expressed interest in the program, which meant that all LTP features could be covered and some could even be covered by more than one observer. This arrangement was ideal since then it might be possible to get confirmations of LTP. Unfortunatley, only half a dozen of the observers reported observations so that the ideal situation was not realized.

There are half a dozen features which have extensive reported measures so that a reliable albedo behavior can be established for a lunation for these features. One of these--Dawes--was discussed in previous reports (Cameron, 1974, 1975, 1977). Updated results for Dawes are similar and are included here in tabular form (Tables VI and VIII)*but will not be discussed further in this paper. The Dawes observer (Porter) provided similar extensive observations for five other features. Another observer (Bartlett), although not officially in the ALPO-LTP program, observes albedos with a method similar to the suggested procedures of my program, and therefore can be analyzed too. He has provided extensive measures on Aristarchus and Proclus, which are included in this paper.

Several kinds of analyses were performed with the data. One analysis deals with the albedo measures versus age of the Moon. These data are found in the Albedo Charts (Tables I through IX) for each feature discussed. From these the brightness and normal aspects of the feature can be found for all lighting aspects. Ancillary data such as age of the Moon, colongitude, date of Full Moon, anomalistic period (perigee, apogee dates), and solar flare-terrestrial effects afforded analyses of the observations with respect to several hypotheses for causes of LTP. These were analyzed in histographic and tabular forms in order to elicit periodic behavior for the former and comparisons with expectation if observations were scattered uniformly throughout the periods under consideration within certain boundary conditions for the effect. These analyses will be discussed separately and will compare the features together in each analysis.

Interpretations of Results of ALPO-LTP Observations
Albedo Tables

The behavior I would expect throughout a lunation for individual points would be as follows: north and south points would have albedos of about the same value throughout a lunation, possibly brighter at local noon and at Full Moon, and would be similar to each other in behavior. I would expect mirror behavior between the east and west walls where the (IAU) east one would be dull near sunrise, then rise in brightness (albedo) to probably brightest at sunset. The west wall would be bright at sunrise and decline in brightness toward sunset. Brightness might be greater at local noon and at Full Moon. Dark areas might also brighten at those times, though some may darken when the Sun is high. The following describes the actual behavior.

Aristarchus (longitude 47°W, latitude 23°N)--James Bartlett, Baltimore, MD, several telescopes ranging from a 3.5-in. refractor (R) to a 5-in. reflector (L).

*Some of the tables and figures cited here and elsewhere will be published in a later installment of the paper.

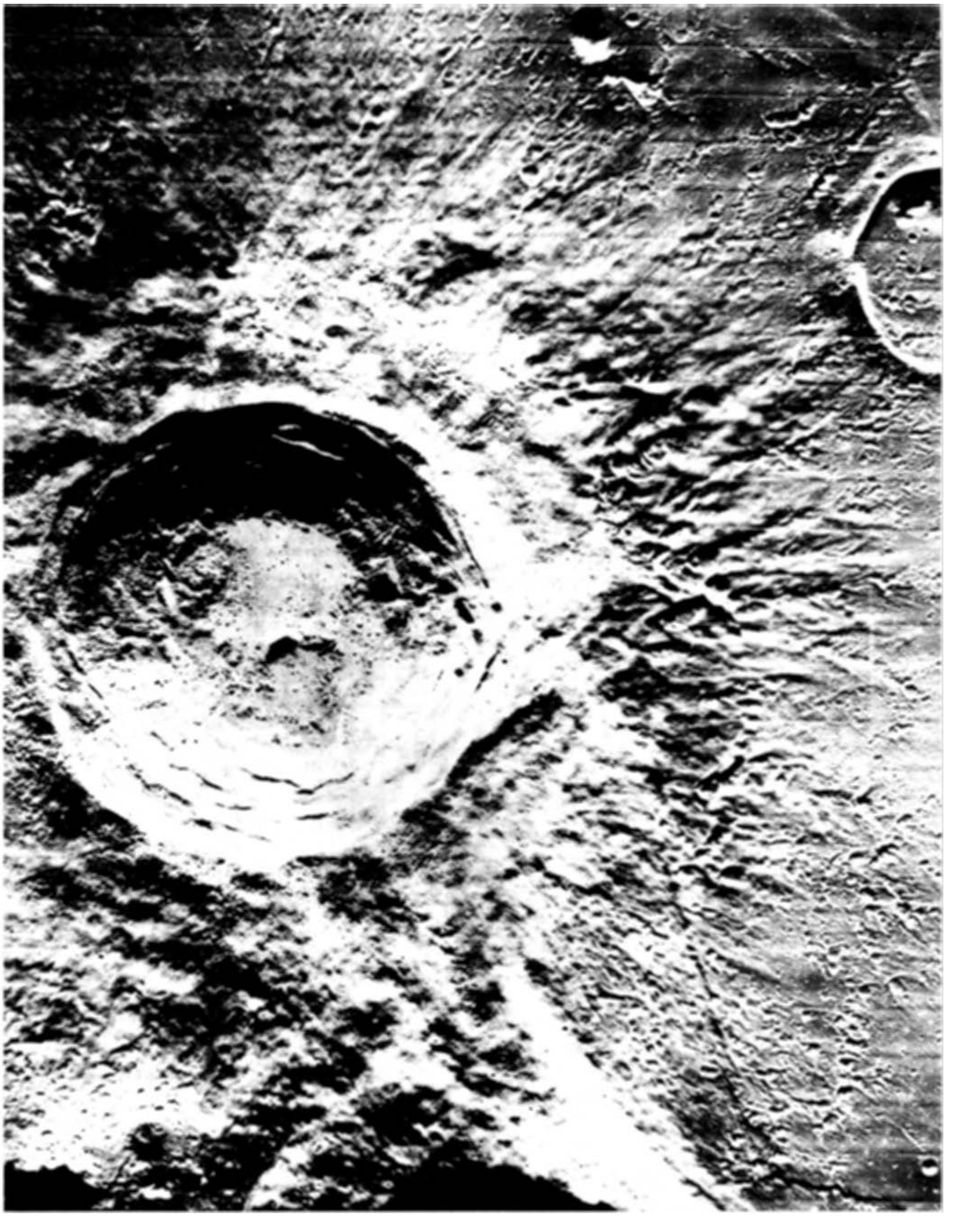

Figure 13. Lunar Orbiter V, frame 197 M photograph (medium resolution) of the crater Aristarchus. This shows the interior of the crater well, particularly the floor where many LTP apparently occur. The orientation of the photo (and for all in this paper) is that as seen in an inverting telescope, where south is at the right and IAU west is at the bottom. Parallel lines in Orbiter pictures are framelet edges. The picture is a mosaic of the framelets.

Figure 13 shows the rayed crater Aristarchus, brightest feature on the Moon, at relatively low illumination (solar height 20°). Observations will be discussed below. There were LTP (asterisked) reported by Bartlett on 11 nights (30%) with 131 individual measures involved (14.5%). Seven additional unreported but possible anomalies

J. Bartlett
Baltimore, MD
3R-5L

ARISTARCHUS (47°W, 23°N)

ALBEDO CHART

Sunrise Colongitude = 47° = 11^d age
Sunset Colongitude = 227° = 26^d age
Local Noon Colongitude = 137° = 18^d age

AGE	S. Wall	Av.	W. Wall	Av.	N. Wall	Av.	E. Wall	Av.	S. Floor	Av.	N. Floor	Av.	Central Peak	Av.
$0^d.0$-$0^d.9$ . . 10.0-10.9							DARKSIDE SUNRISE							
11.0-11.9	8;	8.0	8; 8;	8.0	8;	8.0			8; 8;*	8.0	8; 8;	8.0		
12.0-12.9	8;	8.0												
13.0-13.9	9;	9.0												
14.0-14.9	9;	9.0					V_{rad};*							
15.0-15.9	8;	8.0	8;*	8.0	8;	8.0			8;*	8.0	8;	8.0	10;	10.0
16.0-16.9	6, 9; 9;	8.0	8; 9;	8.5	8; 9;	8.5	8; 9;	8.5	6; 6; 6; 8;* 8;*	6.8	8; 8; 7; 9;*	8.0	8; 8;*	8.0
17.0-17.9	9;	9.0	8;	8.0	8;	8.0	8;	8.0	6; 6; 5;	5.7	8; 8;	8.0	10;	10.0
18.0-18.9	8;	8.0	8;	8.0	8;	8.0	8;*	8.0	6; 6;	6.0	8;	8.0		
19.0-19.9	9; 8; 8, 9;	8.5	-; -; 8, 8;	8.0	-; -; 8, 8;	8.0	8;*	8.0	6; 5; 8;	6.3	8; 8;	8.0		
20.0-20.9	9; 8; 8;	8.3	8; 8;	8.0	8; 8;	8.0	8; 8;	8.0	6; 6; 6;	6.0	8; 8;	8.0		
21.0-21.9	8; 8, 9;	8.3	-; 8, 8;	8.0	8; 8;	8.0	8;* 8;	8.0	6; 5; 6;	5.7	8; 8; 8;	8.0		
22.0-22.9	6; 8, 9; 6;*	7.2	4; 6; 8; 6;*	6.0	6; 8; 6;*	6.7	-; 8, 8; 6;*	7.2	-; 6, 5; 6; 6; 6; 9;*	6.4	8; 6; 9;*	7.7		
23.0-23.9							6; 8, 9;	7.7						
24.0-24.9			5;	5.0					4; 5;	4.5	4; 5;	4.5	10;	10.0
25.0-25.9														
26.0-26.9							6, 9;	7.5						
27.0-27.9 . . 29.0-29.5							SUNSET DARKSIDE							
Lunation Average		8.3		7.6		7.9		7.9		6.3		7.6		9.5

* = Reported LTP
◯ = Unreported, Possible Anomalies
V_{rad} = Reported LTP of Violet Color with Radiance (Suggesting Gas)

Whole Crater Average = 7.8

37 Nights of Observation
131 Individual Measures
11 Reported Anomalies
7 Unreported, Possible Anomalies

Table I. See discussion in text.

(19%) are suspected (by the writer) from Table I (circled). Combining reported and possible anomalies, on 49% (18/37) of the nights and 20% (26/131) of the individual measures anomalies were recorded in Aristarchus by Bartlett. Table I gives individual measures of albedos for each point for each day of age. Measures within a night are separated by commas while semicolons separate different nights of observation. The column marked Av gives the average of all measures for that age and that point. Sunrise and sunset are indicated, and the times when the feature is on the darkside are indicated by slanted lines. Looking at each point and its behavior throughout a lunation (see Table I and Fig. 14) we see that the south wall remains at an almost constant brightness of about albedo step 8. The west wall remains constant till near sunset, at which time the albedo decreases considerably. The east wall remains at

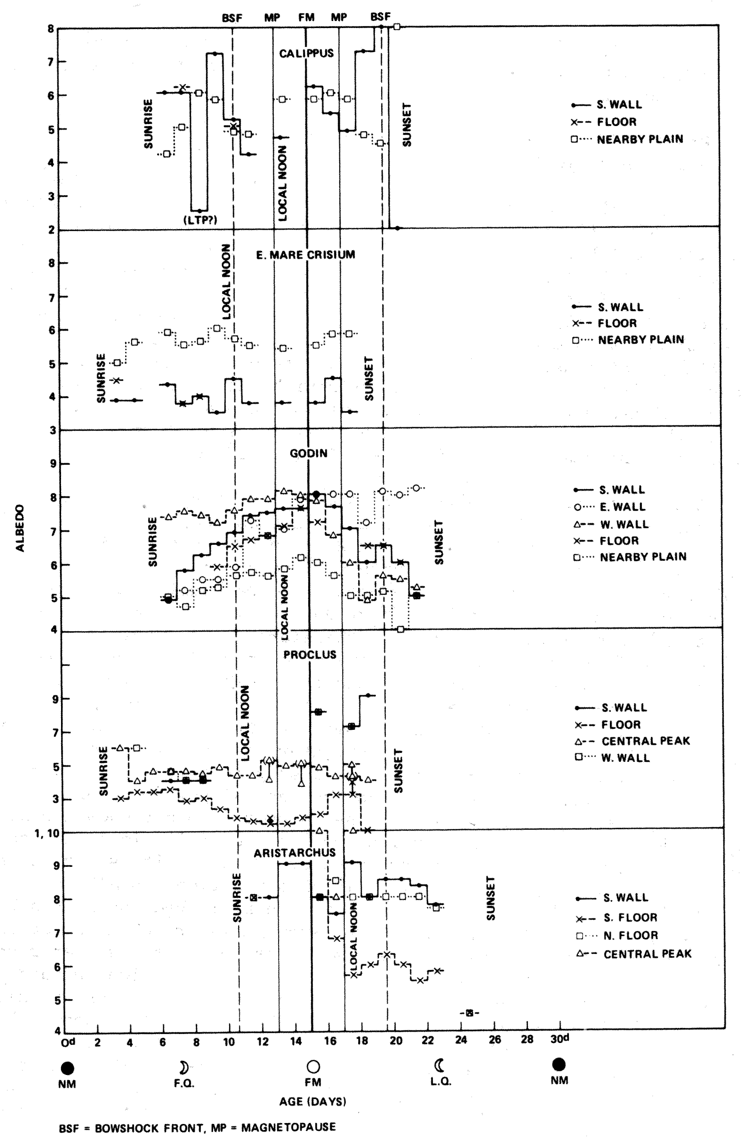

Figure 14. Plots of albedo vs. age of Moon for the five features discussed in the paper. At least one wall point, and a floor point is shown for each feature. Near-by plain points are shown for three features, and the central peak for two. Vertical lines represent respectively: Bow-shock front (BSF) boundary of the Earth's magnetic tail, magnetopause (MP) boundary of the magnetic tail, and Full Moon (FM). Sunrise, sunset, and local noon are indicated for each feature, as well as the phases of the Moon. Behavior over a lunation period is depicted for each of the points shown.

the same brightness of about 8. The average brightness of the south part of the floor of Aristarchus is 6, while that of the north part of the floor is 8. This dichotomy is puzzling since both parts of the floor are rough. The southern part is frequently reported as granulated (many small asperities?--perhaps due to the small hills and domes?--see Figure 13) and also contains color--from yellow to brown and coppery. The northern section was never reported with warm colors. All parts frequently are reported (by Bartlett) as being of blue or violet hues, sometimes described with a radiance, which suggests that a medium (gas?) is involved. The warm and cold colors were never reported together in the same locality, but twice he observed a section (the south floor) to change from violet to yellow-brown. The average albedo for the whole crater is 7.8. The central peak (with few observations) averaged 9.5.

Proclus (46°E, 16°N)--James Bartlett, Baltimore, MD--telescopes 3.5-inch refractor to 5-inch reflector.

Figures 15 (a and b) show the very bright, rayed crater Proclus, under low and high Sun respectively, for reference for the discussion below. In Table II (arranged similarly to Table I) we find that there were 252 nights of observations of albedos in Proclus with 556 individual measurements of albedos (not all are recorded in the chart as some features don't fit categories). In the 252 nights, on 28 of them LTP were reported (11%). These were almost entirely of a feature (called the central peak) which was frequently invisible when it usually had been visible under the same lighting conditions. It is thought that its brightness decreased to that of the floor, and it therefore became indistinguishable. In addition, from the albedo chart it is evident that eight unreported but possible anomalies occurred (circled). Combining the reported and possible anomalies gives a frequency of possible LTP of 14% (36/252) of nights of observation and 6% (36/556) of individual measures.

Looking at the individual points measured (see Table II and Fig. 14), we see that the south wall of Proclus was dull (albedo = 4) for the first few days of the lunation and grew considerably brighter over the last few days (A = 8). This contrasts with Aristarchus, whose south wall remained the same brightness and was bright (albedo = 8). The west wall of Proclus also was dull at first and grew bright as the sun became westerly and shadows lengthened. (I would expect this wall to start out bright and to diminish near sunset; therefore, its behavior is unexpectedly opposite). The north wall remained about the same brightness (A = 6.5) if the two anomalous measures are discarded. Normally, the only feature of albedo 10 is the central peak of Aristarchus; yet once the north wall of Proclus was reported at 10. The east wall starts out with a low albedo and becomes bright near sunset. This is as would be expected. The floor of Proclus is brighter near sunrise and sunset than near Full Moon, when it decreases more than a full step in albedo. Perhaps the photos bear this out. The feature designated as the central peak was more or less constant in brightness (near A = 4.5). Space mission photos do not show a central peak although there are some eminences in Proclus, but not centrally located (see Fig. 15). It is not clear what Bartlett is observing here. Whatever it is, it is variable. It apparently fades in brightness until it matches the floor in albedo and becomes invisible. This invisibility has no relationship to Sun angle because it has been reported at ages 5, 8, 10, 11, 12, 13, 14, and 16 days and later, when the apparent central peak is lost in shadow as sunset approaches the crater. It has been reported invisible most frequently at age 14^d, when the contrast between highland and <u>mare</u>-like material is usually greatest. Here Fig. 15b shows little contrast on the floor under high Sun. Four out of 13 times the apparent peak was invisible. The normal brightness at this age is about 5, while the floor is about 2. Therefore, normally there are 6 half steps (3 full steps) difference, which is a 10% change in brightness in the Moon's range of albedos (.04-.3). This is equivalent to distinguishing the difference in brightness between the floor of Julius Caesar (darkest part) or Cruger, and the rays around Aristarchus or Kepler (at Full Moon). Apparently, there are real changes taking place in Proclus, but the cause is still obscure. The large majority of the changes were observed within a few days of Full Moon (at which time the Moon is within the Earth's magnetic tail, which may affect solar particles in it). Approximately 1/4 of them occurred near perigee; 1/4 occurred on the same days that the Earth experienced magnetic storms; and 1/4 occurred near sunrise and sunset. These percentages are close to expectation if evenly distributed except for solar effects, which are 3 times more than expectation. The results indicate that the environs of Proclus are influenced by the bombardment of solar flare particles whose energies have been enhanced by the Earth's magnetic tail. The whole crater has an average albedo of 5.3 when the floor is included, or 5.9 if it is excluded. The floor averages 2.6 in albedo. Such an albedo is equivalent to the darker <u>maria</u>. The contrast in behavior between the floor and central peak (and walls) is particularly evident in Fig. 14.

Godin (10°E, 20°N)--Alain Porter, Narragansett, R.I. 6-in. reflector.

Figure 16 presents the highland crater, Godin, to be discussed next. Table III reveals that this crater was observed over 65 nights with 878 individual measures reported. One LTP was reported; and the chart indicates that nine other possible, but

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PROCLUS (47°E, 16°N)

ALBEDO CHART

Sunrise Colongitude = 314° = 3^{d} age
Sunset Colongitude = 134° = 18^{d} age
Local Noon Colongitude = 44° = 10^{d} age

AGE	S. Wall	Av.	W. Wall	Av.	N. Wall	Av.	E. Wall	Av.	Floor	Av.	Central Peak	Av.
0^{d}.0–0^{d}.9 . . 2.0–2.9					DARKSIDE SUNRISE							
3.0–3.9					6;	6.0			3; 0;	3.0	6; 0; –;^{I*}	6.0
4.0–4.9			6; 6; 5; 6;	5.9	7, 6; 6; 6; 6; 5; 6; 6;	6.0			3; 0, 4; 0, 4; 0, 3; 0, 3; 0, 5; 0, 3; 0, 3; 0, 3; 3;	3.4	4?; 4;^{s} 4;^{s} 4; 4.5; 4.5; 4; 2; 4; 5; 0;^{s} –; –;^{I*}	4.0
5.0–5.9									4; 4; 4.5; 3; 3; 3; 3; 3; 3; 3; 3; 3;	3.3	5; 5; 5; 5; 4?; 5; 4; 4; 4; 3;^{*I} 6; 5;	4.6
6.0–6.9	4;	4.0	5; 4;	4.5	7, 8;	7.5	6; 4;	5.0	3; 3; 5; 4; 3; 3; 4; 3; 4; 3; 3; 3; 3.5;	3.5	3;^{I*} 5?; 5; 5; 5; 5; 5; 5; 5; 4; 4; 4; 5;	4.6
7.0–7.9	4;	4.0	4;	4.0	(4);	4.0	4;	4.0	3; 4; 3; 3; 2; 3; 3; 3; 3; 2; 1.5; 2; 3; 3; 3; 3; 3;	2.9	3?;^{I*} 5; 5; 5; 5; 5; 5; 4.5; 5; 5; 5; 4; 5; 5;	4.7
8.0–8.9	4;	4.0	4;	4.0			4;	4.0	3; 2; 3; 4; 2; 3; 3; 3; 2; 3; 2; 3; 2; 2; 3; 3; (5); 2;	2.7	5?; 5; 5; 5; 5; 5; 5; 5; 4; 5; 4.5; 5; 5; 4; 5; 5; 2;^{*I} (2.5); 5;	4.6
9.0–9.9									2; 1; 2; 1; 2; 3; 2; 2.5; 2; 3; 1; 1.5; 2; 2; 3; 2; 2; 2.5; 3; 2; 3; 2;	2.3	5; 5; 5; 4.5; 5; 5; 5; 5; 5; 5; 5; 6; 5; 6; 5; 5; 4; 4;^{d} 4; vis.; 4; 5;	4.9
10.0–10.9									2; 1; 1; 2; 1; 1; 1; 2.5; 2; 1; 3; 1.5; 2; 2; 3; 1; 2; 1, 2; 2.5; 2; 2; 1.5; 2; 2; 2;	1.8	2?;^{*I} 1?;^{*I} 6; 5; 5; 5; 4.5; 5; 5; 5; 6; 5; 5; 4; 5; 5; 5; 4; 2?;^{*I} 4; 5; 5; 3; 4; 2^{I}*?;	4.4
11.0–11.9									2; 1.5; 2; 1; 1; 2; 2; 1; 2; 1.5; 1; 2; 1; 1.5; 2; 1.5; 2; 2;	1.6	(2?); 5; 5; 5; 5; 5; 5; 5; 5; 5; 4.5; 5; 1.5; 4; 4; 5; 2;^{*I} 1^{I}?*;	4.3
12.0–12.9									1.5; 1; 1.5; 2; 1; 1.5; 2; 2; 2; 1; 1; 1; 1; 1.5; 2; 1;	1.4	6; 6; 6; 5; 5; 5; 5; 5; 5; 5; 5; 5; 5; 1?;^{*I} 5; 2;^{*I} 2;^{*I} 5; –;^{*I}	4.1 (5.2)
13.0–13.9									1; 1; 1; 1; 2; 2; 1; 2; 1.5; 2; 1; 1; 2; 1; 2; 1; 2; (6);	1.4	2?;^{*I} 6; 6; 6; 6; 5; 5; 5; 5; 5; 5; 5; 5; 5; 5; 5; 5; 5; 5; 2?;^{*I} 5;	4.9
14.0–14.9									3; 2; 2; 3; 3; 2; 2; 1; 1; 1; 1; 1;	1.8	3?;^{*I} 2?;^{*I} 5; 5; 4; 2?;^{*I} 5; 6; 5; 1?;^{*I} 3; 5;	3.8 (5.4)
15.0–15.9	8;	8.0	8;	8.0	(10);	10.0	9;	9.0	1; 1; 1; 1; 1; 2; 3; 3; 3; 3; 1; 3; 2; 3; 2; 1; 1.5; 2; 1; 3; 2;	2.0	6; 5?; 6; 6; 5; 6; 5; 5; 5; 4; 5; 4; 5; 5; 5; 5; 4; 5; 5; 5; 5; 5; 3?;^{*I}	4.8
16.0–16.9							8, 9;	8.5	3; 3; 3; 3; 3; 3; 3; 3; 3; 3; 3; 3; 3; 4;	3.1	3?;^{*I} 3?;^{*I} 5; 4; 6; 4; 3?;^{*I} 4; 5; 4; 5; 4; 3; 5;^{d} 4; (2.5);	4.2
17.0–17.9	6, 8; 6, 8; 8;	7.2	8; 6; 8;	7.3	6; 6; 6, 8; 8;	6.8	6; 6; 6; 8; 8; 8;	7.0	0; 3; 4; 3; 0; 0; 0; 3; 0; 3; 0, (8); 0;	4.0 (3.2)	3?,^{*I} 0; 5; 5; 5; 0;^{I} 0;^{I} 4; 0;^{I} 5; 5; 5;^{s} 5;	4.9
18.0–18.9	9;	9.0					8, 9; 8;	8.3	0; 0; 0;	0.0	0;^{I} 0;^{I} 4;^{d}	4.0
19.0–19.9 . . 29.0–29.5					SUNSET DARKSIDE							
Lunation Average		6.0		5.6		6.7		6.5		2.6		4.6

* = Reported LTP
( ) = Unreported, Possible Anomalies
I = Invisible

vis. = Visible
d = Dull
s = in Shadow

Whole Crater Average = 5.9 (5.3 Including Floor)

252 Nights of Observation
556 Individual Measures
28 Reported Anomalies
8 Unreported Possible Anomalies

Table II. See text on page 200.

unreported, anomalies were observed. One LTP in 65 nights = 1.5%. The LTP involved 5 individual measures (out of 20 measurements that night). Five of 878 measurements = 1/2 of 1% (0.5%). For the 10 possible plus reported anomalies, involving 26 individual measures, the corresponding percentages are 15% for nights and 3% for individual measurements.

Looking at the behavior (see Table III and Fig. 14) throughout a lunation of the individual points, we find that the south wall of Godin gradually brightens till Full Moon, then declines, which is also true of the north wall, with some fluctuation in the early phases. One would expect the north and south points to behave similarly, and the east and west points oppositely, to each other. The west wall starts out

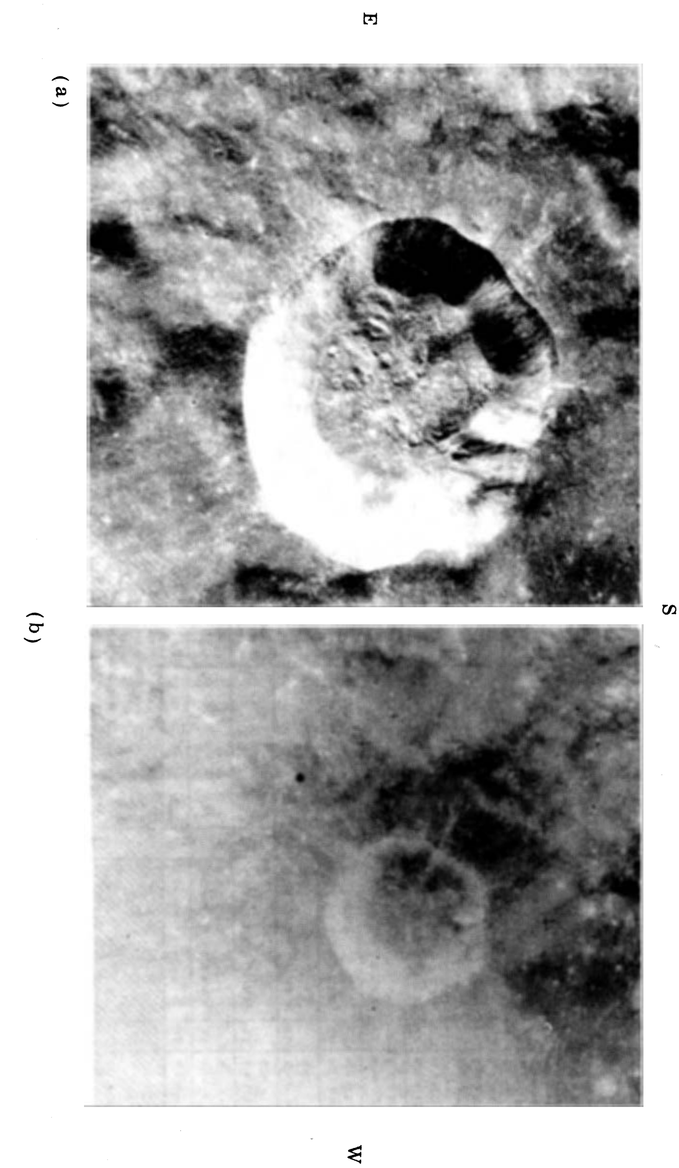

Figure 15. (a) Apollo 17 Hasselblad camera frame 23046 photograph of the crater Proclus under low Sun elevation, showing the interior structure of the crater well, particularly the floor. Note that there are several hills in it, but none of them central. (b) Apollo 15 Metric camera frame 958 photograph showing Proclus under high Sun elevation and the contrast of the floor with the walls. Some of the hills can be discerned as bright spots. Same orientation as Aristarchus had in Figure 13.

bright, then declines after Full Moon to sunset, while the east wall starts out dull and is bright from Full Moon till sunset; thus they mirror each other. This behavior is as would be expected. The nearby plain point is slightly darker near sunrise and sunset and is brighter near Full Moon, and Godin's floor behaves about the same way as the plain. Here the plain is highland terrain and is thus of a generally higher albedo than <u>mare</u> plains. The whole crater average albedo is 6.7 (ranging from 3 to 9.5 in some parts), while the nearby plain is about 1.5 steps lower at 5.3. Godin's albedo behavior is pretty much as would be expected for a lunation period. Figure 14 shows the albedo behavior graphically for some of the points.

Calippus (10°E, 38°N)--Bruce Frank, Fairport, N.Y. 6-in. reflector.

Figure 17 shows the crater Calippus, which is also in the highlands. Calippus is discussed next. Table IV shows that the crater Calippus was observed on a total of 22 nights with 127 individual measurements. Two LTP (9%) were reported, but one did not occur in Calippus, only near it, on the dark side. Our 12 individual measures = 9%. There were six (36%) possible, but unreported, anomalies (14 measures = 11%). The percentages or frequency of occurence of the combination of reported and possible anomalies for Calippus and vicinity are: 8/22 = 36% of nights, and 26/127 = 20% of individual measures. The possible anomaly at 8.0-8.9 days (albedo = 2.5) age for point A was judged by comparison of albedos of surrounding ages since there was only one night's measures for age 8^d. At age 7^d the albedo was 6, and at 9^d it was over 7. Since points B and C did not differ much from their values on surrounding dates at that time, A appears to be quite anomalous. The south wall (point A) fluctuated quite a bit, and more observations are eagerly awaited to see what its normal albedos are. It appears that only the south wall shows this fluctuation (see Fig. 14). The nearby plain low albedo anomalous measures at age 6^d may not really be anomalous since the feature was very close to the terminator (2°), but the high albedo anomaly may be real (terminator distance = 7° whereas at 10° (age 7^d) it was reported as 5).

Looking at the behavior during a lunation for each point (see Table IV and Fig. 14), point A (south wall) starts out bright, drops in brightness, then brightens again before sunset. Point B (north wall) remains about the same brightness except for some anomalous measures in the middle. Its behavior is what would be expected for both south and north. Floor measures were just started recently, and few have been reported. Many more measures for each age are urgently needed to determine what the normal aspects really are. The whole crater average albedo = 5.8 (6.1 if the suspected anomalies in point A are excluded) is not much brighter than the nearby plain point of 5.5. In general, the wall and plain points show mirror behavior even though both are highland materials.

[Note by Editor. We much regret that space problems have required us to publish Mrs. Cameron's report in two parts. We especially regret that a few of the tables and references cited in this installment of the paper are actually in the next (yet unpublished) installment. The reader should note that the illustrations on pages 204-207 relate to this LTP report. All photographs in the paper have been kindly provided by the National Space Science Data Center (NSSDC).

Interested readers are cordially invited to participate in the LTP program; for as with other A.L.P.O. projects, more observational data would allow improved and more certain conclusions. The value of such efforts should be apparent from Mrs. Cameron's report and from Dr. Westfall's book review on pages 192-195.]

(to be concluded in next issue)

BOOK REVIEWS

Flight to Mercury, by Bruce C. Murray and Eric Burgess. Columbia University Press, 562 West 113th Street, New York, N.Y. 10025. 1977. 162 pages. Illustrated. Price $12.95.

Reviewed by Charles F. Capen

Flight to Mercury is the story and preliminary results of the first dual-planet mission, the flight of Mariner 10 that went to Venus and to Mercury in 1974 and 1975. It is immediately obvious that the title is a misnomer, which leads the prospective buyer astray; and this is not the last misleading part of the book. The dustcover blurb states: "The first definitive book about Mercury . . ." What about the definitive volumes: La Planète Mercure, 1934, by E.M. Antoniadi and The Planet Mercury, 1963, by Dr. Werner Sandner? "Mercury's features can not be seen from the earth with even the most powerful telescopes . . ." Then, how were several albedo feature maps of Mercury, with accompanying nomenclature, constructed? These bold and tricky advertising statements alert the scientist and amateur astronomer that this book was meant for the lay reader.

The text, which was written by two professional people, is descriptive and easy to read. Bruce Murray, Director of Cal. Tech's Jet Propulsion Laboratory,is a planetary space mission scientist. Eric Burgess is a renowned popular science writer. The book has a large 10 x 12 inch format with large and wasteful margins, and it is well illustrated with over 100 excellent photos obtained during the four planetary encounters of the best kind. The authors give the insider a chronological report on the mission planning, philosophy, and implementation of the Mariner 10 Project that should become a valuable history of the remarkable success of this unique space mission in the record of Man's conquest of space.

The book begins with a hodgepodge of telescopic observations, speculations, and theories ascribed to the planets by classical astronomers. The findings of radio telescope observations and a short survey of spacecraft missions' results are related. A most interesting description of the "sling-shot method" of using the gravitation

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6L

Index of Points

		A	
E	D	F	B
		C	

GODIN (10°E, 2°N)

ALBEDO CHART

Sunrise Colongitude = 350° = 6^d age
Sunset Colongitude = 170° = 21.5^d age
Local Noon Colongitude = 80° = 14^d age

AGE	Point A (S. Wall)	Av.	Point B (W. Wall)	Av.	Point C (N. Wall)	Av.	Point D (E. Wall)	Av.	Point E (Nearby Plain)	Av.	Point F (Floor)	Av.
$0^d.0$–$0^d.9$ … 5.0–5.9					DARKSIDE SUNRISE							
6.0–6.9	5.5, 4.5, 4.5; 5;	4.9	7, 8, 8; 6.5;	7.4	6.5, 7.5, 7.5; 6.5;	7.0	5, 5.5, 4; 5;	4.8	5, 5, 5; 5;	5.0	–, –, –; 0;	
7.0–7.9	(3, 3, 4); 6, 6.5; 5, 5, 5; 7.5, 7.5; 7, 7, 7; 6.5, 7, 7; 5, 5;	5.8	8.5, 7.5, 6.5; 7.5, 7.5; 7, 7, 7; 8; 8; 8, 8, 8; 7.5, 8, 8; 6.5, 6.5;	7.6	(8, 8), 7; 6.5, 6.5; 5.5, 5.5, 5.5; 7, 7; 7.5, 7.5, 7.5; 5.5, 6.5, 6.5; (5, 5);	6.5	4.5, 4.5, 4.5; 5, 5; 5, 5, 5; 6, 6; 6.5, 6.5, 6.5; 5.5, 5.5, 5.5; 4, 4;	5.2	4.5, 4, 4; 5, 5; 4.5, 4.5, 4.5; 5, 5; 5, 5, 5; 5, 5, 5; 4.5, 4.5;	4.7		
8.0–8.9	6.5, 6.5, 6.5; 6.5, 6.5, 6.5; 5.5, 5.5;	6.2	7.5, 7.5, 7.5; 7.5, 7.5, 7.5; 7, 7;	7.4	6.5, 6.5, 6.5; 7, 7, 7; 6, 6;	6.6	6, 6, 6; 5, 5, 5; 5.5, 5.5;	5.5	5.5, 5.5, 5.5; 5, 5, 5; 5, 5;	5.2		
9.0–9.9	6, 7.5; 6, 7; 7.5, 7.5; 7, 7, 7; 5.5, 5.5; 5, 5, 5; 5.5, 5.5; 6.5, 6.5;	6.2	8, 8; 7, 8; 8, 8; 7.5, 7.5, 7.5; 7, 7; 6.5, 6.5, 6.5; 6, 6; 7.5, 7.5;	7.2	7, 7.5; 6.5, 7.5; 7, 7; 6.5, 6.5, 6.5; 5.5, 5.5; 5.5, 5.5, 5.5; 5.5, 5.5; 7, 7;	6.4	5.5, 6; 5, 6; 6, 6; 6, 6, 6; 5.5, 5.5; 5, 5, 5; 5.5, 5.5; 5, 5;	5.5	5, 5.5; 5, 5.5; 5.5, 5.5; 5.5, 5.5, 5.5; 6, 6; 5, 5, 5; 5, 5; 5, 5;	5.3	–, –; –, –; 7, 7, 7; 5, 5; 5.5, 5.5, 5.5; 6, 6; 6, 6; 5.5, 5.5;	5.9
10.0–10.9	7, 7, 7; 6.5, 6.5; 7.5, 7.5, 7.5; 7.5, 7.5; 5.5, 5.5, 5.5; 7, 7; 6.5, 6.5;	6.9	7.5, 7.5, 7.5; 8.5, 8.5; 8, 8, 8; 7.5, 7.5; 7.5, 7.5, 7.5; 7, 7; 7.5, 7.5;	7.6	6.5, 6.5, 6.5; 5.8, 5.8; 7.5, 7.5, 7.5; 7.5, 7.5; 5.5, 5.5, 5.5; 6.5, 6.5; 6, 6;	6.5	5.5, 5.5, 5.5; 5.5, 5.5; 6.5, 6.5, 6.5; 7, 7; 6, 6, 6; 5.5, 5.5; 5, 5;	5.9	5, 5, 5; 5.5, 5.5; 6, 6, 6; 6, 6; 6, 6, 6; 5.5, 5.5; 5, 5;	5.6	–, –, –; –, –; 7.5, 7.5, 7.5; 7, 7; 6, 6, 6; 6, 6; 6, 6;	6.5
11.0–11.9	(5.5); 8, 8; 7, 7; 8, 8, 8; 7, 7; 7, 7; 8, 8, 8; 7.5, 7.5;	7.4	(6.5), 8.5, 8.5; 8, 8; 8.5, 8.5, 8.5; 7.5, 7.5; 8, 8; 8, 8, 8; 7.5, 7.5;	7.9	(5.5); 8, 8; 6.5, 6.5; 8, 8, 8; 7, 7; 6.5, 6.5; 7.5, 7.5, 7.5; 7, 7;	7.2	(5); 7.5, 7.5; 6, 6; 7.5, 7.5, 7.5; 5.5, 5.5; 6, 6; 7.5, 7.5, 7.5; (5, 5);	6.5	5; 6.5, 6.5; 5.5, 5.5; 6.5, 6.5, 6.5; 5.5, 5.5; 5.5, 5.5; 5.5, 5.5, 5.5; 5, 5;	5.7	–; –, –; –, –; 7.5, 7.5, 7.5; 6.5, 6.5; –, –; 6, 6, 6; –, –, –; –, –;	6.7
12.0–12.9	8, 8; 7, 7, 7, $*\overline{7}$; 7.5, 7.5, 7.5; 7, 7; 8, 8, 8; 7.5, 7.5, 7.5;	7.5	8, 8.5; 8, 8, 7, $*\overline{7}$; 8.5, 8.5, 8.5; 8, 8; 8, 8, 8; 7.5, 7.5, 7.5;	7.9	(5); 7; 6.5, 7, 7*, $\overline{6.5}$; 7.5, 7.5, 7.5; 8, 7; 8, 8, 8; 7.5, 7.5, 7.5;	7.2	6, 5; 6, 6.5, 6.5*, $\overline{6.5}$; 6.5, 6.5, 6.5; 8, 8, 8; 7, 7, 7;	6.8	5, 4.5; 5.5, 5.5, 6*, $\overline{6}$; 6, 6, 6; 5.5, 5.5; 6, 6, 6; 5.5, 5.5, 5.5;	5.6	–, –; –, –, –, –; –, –, –; 6, 6; 7.5, 7.5, 7.5; 6.5, 6.5, 6.5;	6.8
13.0–13.9	7, 7; 7, 7; 8, 8; 8, 8; 8, 8, 8, 8;	7.6	8, 7.5; 7.5, 7; 8.5, 8.5; 8, 8; 8.5, 8.5, 8.5, 8.5;	8.1	(5), 6.5; 6.8, 7; 8, 8; 8, 8; 7.5, 7.5, 7.5, 7.5;	7.3	(5), 6.5; 6.5, 6.5; 8, 8; 8, 8; 7, 7, 7, 7;	7.0	5.5, 5.5; 6, 6; 6, 6; 6, 6; 5.5, 5.5, 5.5, 5.5;	5.8	–, –; –, –; 7.5, 7.5; 7, 7; 7, 7, 7, 7;	7.1
14.0–14.9	7.5, 8; (6), 6.5; 8, 8, 8; 8, 8, 8; 7.5, 7.5;	7.6	7.5, 8; 6.5, 7; 8.5, 8.5, 8.5; 8.5, 8.5, 8.5; 8, 8;	8.0	7.5, 8.5; 7, 6.8; 8, 8, 8; 8.5, 8.5, 8.5; 7.5, 7.5;	7.9	8, 8.5; 6.5, 6.8; 8, 8, 8; 8.5, 8.5, 8.5; 7.5, 7.5;	7.9	6, 6; 6, 6; 6, 6, 6; 6, 6, 6; 6.5, 6.5;	6.1	–, –; –, –; –, –, –; 8, 8, 8; 7, 7;	7.6
15.0–15.9	8, 8, 8; 8, 8, 8;	8.0	7.5, 7.5, 7.5; 8, 8, 8;	7.8	8, 8, 8; 8, 8, 8;	8.0	8, 8, 8; 8, 8, 8;	8.0	6.5, 6.5, 6.5; 5.5, 5.5, 5.5;	6.0	7, 7, 7; 7.5, 7.5, 7.5;	7.2
16.0–16.9	8, 8.5; 8, 7, 7; 7.5, 7.5;	7.6	6.5, 8; 6, 6, 6; 7.5, 7.5;	6.8	8.5, 8.5; 8, 7, 7.5; 7.8, 7.8;	7.6	8.5, 8.5; 8.5, 7.5, 7.5; 7.8, 7.8;	8.0	6, 6; 5.5, 5.5, 5.5; 5.5, 5.5;	5.6		
17.0–17.9	7;	7.0	6;	6.0	7.5;	7.5	8;	8.0	5;	5.0		
18.0–18.9	7, 5, 6, 6, 6; 6, 6.5; 5.5, 5.5, 5.5; 6.5, 6.5;	6.0	(3, 3), 4.5, 4.5, 4.5; 5.5, 5.5; 5.5, 5.5, 5.5; 6, 6;	4.9	8, 7.5, 6, 7, 7; 7, 6.5; 6, 6, 6; 6.5, 6.5;	6.7	8, 7.5, 8, 6.5, 7; 7.5, 7.5; 7, 7, 7; 7, 7;	7.2	4.5, 4.5, 4.5, 5, 5; 5, 5; 5, 5, 5; 6, 6;	5.0	–, –, –, –, –; –, –; –, –; 6.5, 6.5;	6.5
19.0–19.9	6.5; 6.5, 6.5, 6.5;	6.5	6; 5.5, 5.5, 5.5;	5.6	6.5; 6.5, 6.5, 6.5;	6.5	8.5; 8, 8, 8;	8.1	5.5; 5, 5, 5;	5.1	–; 6.5, 6.5, 6.5;	6.5
20.0–20.9	6, 6;	6.0	5.5, 5.5;	5.5	5.5, 5.5;	5.5	8, 8;	8.0	4, 4;	4.0	6, 6;	6.0
21.0–21.9	5, 5; 5, 5; 5, 5;	5.0	5, 5; 5.5, 5.5; 5.5, 5.5;	5.3	5, 5; 5, 5; 5.5, 5.5;	5.2	(9.5, 9.5); 7.5, 7.5, 7.5;	8.2	0, 0; 0, 0; 5, 5;	5.0	–, –; 0, 0; 0, 0;	
22.0–22.9 … 29.0–29.5					SUNSET DARKSIDE							
Lunation Average		6.3		6.9		6.8		6.9		5.3		6.7

* = Reported LTP
( ) = Unreported, Possible Anomalies
$\overline{\ }$ = Normal, as Before LTP

Whole Crater Average = 6.7
Range = 3–9.5
Nearby Plain Average = 5.3

1 LTP Reported
9 Unreported Possible Anomalies
65 Nights of Observation
878 Individual Measures

Table III. See also text.

* * * * * * * * * * * * * * *

from one planet to go to another planet is given. The diagrams and TV pictures of the crater-scarred Mercurian surface and the cloud currents of Venus are outstanding. The deep blue colored TV photos of Venus published elsewhere by JPL would have been good illustrations for this book, and it would have helped to justify the high cost. In their narrative, the authors use a time-wasting and costly chronological comparison of Mariner 10's time and events with those of international headlines. Readers who are interested in learning about new worlds could care less about the political current during Nixon's Watergate.

Figure 16. Lunar Orbiter IV, frame $97H_1$ high resolution photograph of the crater Godin at a Sun elevation of approximately 20°. Interior features are seen well. The small white crosses are from the réseau grid on the camera, and are used for selenodetic purposes. Same lunar orientation as Figure 13.

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This book is largely an authentic personal view of the senior author, B. Murray, a proponent of the Mariner 10 Project and leader of the TV imaging team. He gives an exciting account of Mariner 10's arduous voyage from Venus sunward to Mercury, the problems encountered and overcome, and the final acquisition of scientific data.

B. Frank
Fairport, NY
6L

Index of Points

A
C D
B

CALIPPUS (10°E, 38°N)

ALBEDO CHART

Sunrise Colongitude = 350° = 6^d age
Sunset Colongitude = 170° = 21.5^d age
Local Noon Colongitude = 80° = 14^d age

AGE	Point A (S. Wall)	Av.	Point B (N. Wall)	Av.	Point C (Nearby Plain)	Av.	Point D (Floor)	Av.
$0^d.0$–$0^d.9$ . . 5.0-5.9	$0;^s$		$0;^s$ DARKSIDE SUNRISE		$0;^s$			
6.0-6.9	1.5, 1.5; 0; 0, 0.5; 6, 6;	6.0	7, 7; 6; 0.5, 0.5; 7.5, 7.5;	7.0	4, 4; 4.5; (2.5, 2.5); (6, 6);	4.2		
7.0-7.9	6, 6;	6.0	6.5, 6.5;	6.5	5, 5;	5.0	6.5, 6;	6.2
8.0-8.9	(2.5, 2.5);	(2.5)	7.5, 7.5;	7.5	6, 6;	6.0		
9.0-9.9	7.5, 7;	7.2	7, 7;	7.0	5.5, 6;	5.8		
10.0-10.9	3.5, 3;* 7.5, 7;	5.2	7.5, 3;* 5.5, 6;	5.5	4.5, 4.5?;* 5.5, 5.5;	4.9	-, -; 5, 5;	5.0
11.0-11.9	(4), 4.5;	4.2	(4, 4.5);	4.2	4.5, 5;	4.8		
12.0-12.9								
13.0-13.9	4.5, (4); (3.5, 4); 7.5;	4.7	(4.5, 4); 8, 7.5; 7;	6.2	5, 5; 6.5, 6.5; 6;	5.8		
14.0-14.9								
15.0-15.9	6, 6.5;	6.2	7.5, 7.5;	7.5	5.5, 6;	5.8		
16.0-16.9	5.5, 5.5; 5, 5.5;	5.4	8, 7.5; 7, 7.5;	7.5	5.5, 6; 6, 6.5;	6.0		
17.0-17.9	5, 5; 4.5, 5;	4.9	5, 5; 8, 8;	6.5	5.5, 5.5; 6, 6;	5.8		
18.0-18.9	6.5, 8;	7.2	4.5, 4.5;	4.5	4.5, 5;	4.8		
19.0-19.9	8, 8;	8.0	3.5, 4;	3.8	4.5, 4.5;	4.5		
20.0-20.9	0, 0.5;*	0.0	0, 0.5;*	0.0	8,8;*	8.0		
21.0-21.9								
22.0-22.9 . . 29.0-29.5			SUNSET DARKSIDE					
		(6.5)						
	Lunation Average	5.6		6.1		5.5		5.6

* = Reported LTP
( ) = Unreported, Possible Anomalies
s = in Shadow, Before Sunrise

Whole Crater Average = 5.8 (6.1)

22 Nights of Observation
127 Individual Measures
2 Reported LTP
6 Unreported Possible Anomalies

Table IV. See also text.

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The TV photography revealed a geologist's paradise. The text is not without its prejudices and misleading statements. To quote one example: "Suppose one tabulated all the useful earth-based photographs of Mars laboriously acquired by astronomers over the half century before 1965 . . .; they would barely equal the information contained in the 20 television frames sent back by radio from Mariner 4." The authors do not tell the reader that of these 20 pictures, only 4 or 5 gave any useful information; and these misled scientists to interpret Mars as being very Moon-like. Mariner 4's encounter was of such a short duration and involved so small a sample of the Martian

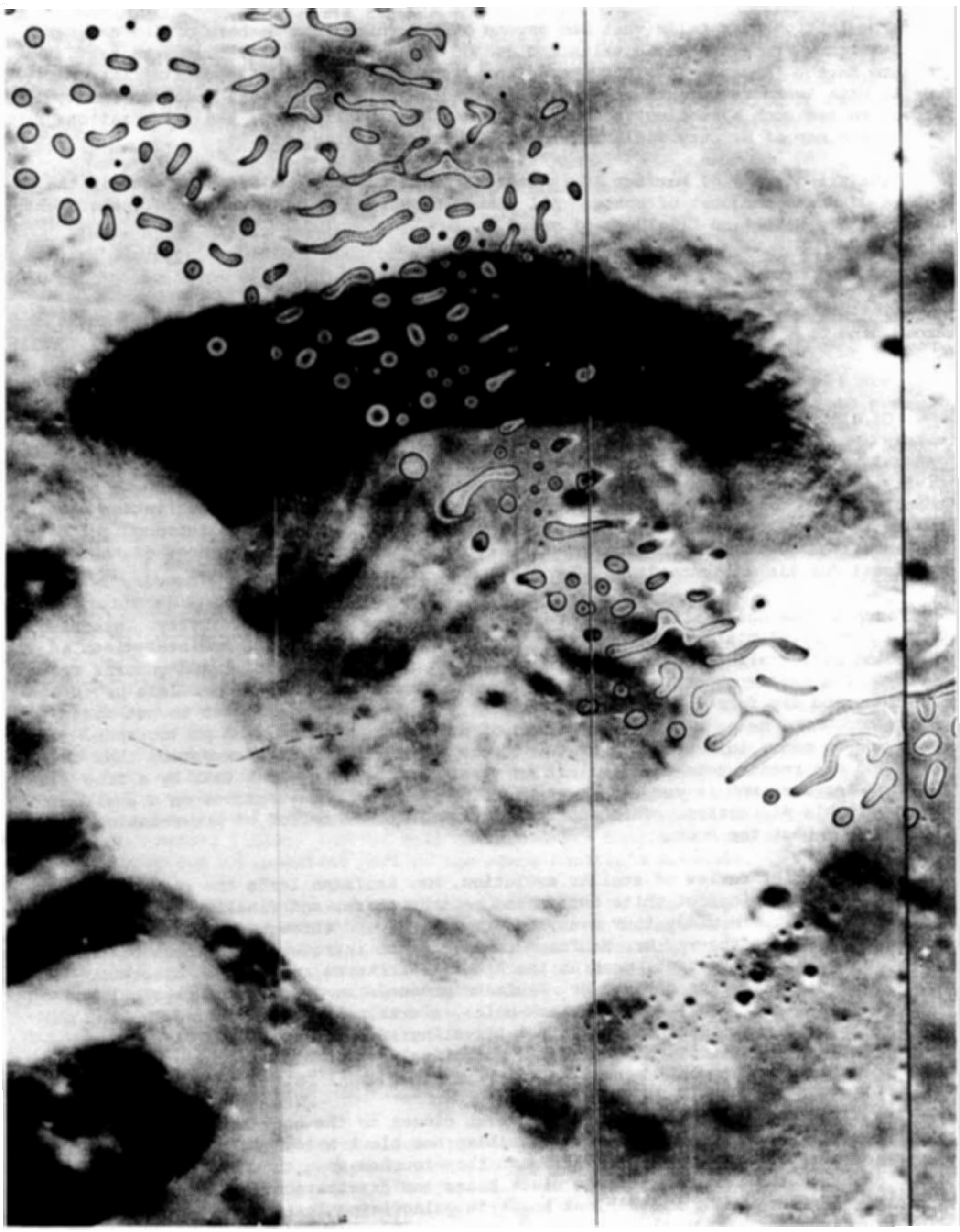

Figure 17. Lunar Orbiter IV, frame $103H_2$, high resolution photograph of the crater Calippus taken with a Sun elevation of about 20°. The contrast between the floor and walls is noticeable. The splotches on a diagonal across the picture are moisture defects produced during on-board processing of the film. Same lunar orientation as Figure 13.

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surface that it lacked data about seasonal clouds, surface changes, polar region phenomena, etc. which have been so rigorously collected with telescopes during the past century.

The last chapter tells what has become of the chief team members of the Mariner Venus-Mercury Project and the value and use of the scientific data that were sent back to Earth. Appendix A lists the science investigators, and Appendix B lists Mariner 10 NASA Award recipients and the various scientific achievement medals. One would expect to see such a listing in a NASA or government publication. An illustration of a complete map of Mercury would have made a more definitive work.

The tri-odyssey of Mariner 10 is indeed the unique space mission to date in the record of Man's conquest of space. All those interested in the history of spaceflight or astronomy will find this book of value.

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The Cosmic Frontiers of General Relativity, by William J. Kaufmann III. Little, Brown, and Co. Boston, MA. 1977. 306 pages. Price $6.95, softcover.

Reviewed by Brian Cuthbertson

Of all the facets of modern astronomy which are within reach of today's amateur, surely one of the hardest to appreciate from firsthand experience is the field of general relativity. Despite its unique fascination and philosophical interest, relativity is one of those areas where much of the most exciting progress has come through thought, through theory, and not through observation (at least, not observation within the amateur's reach!). Hence, in relativity more than in most other astronomical disciplines, the amateur is essentially totally dependent on the good graces of the professional for his understanding.

Such is the need filled by The Cosmic Frontiers of General Relativity. Starting from a very brief historical introduction, Mr. Kaufmann launches immediately into an absorbing presentation of the concepts of space-time, and of special and general relativity. The reader should not, however, expect to run headlong into endless pages of equations and dry formulae. Instead of these, Mr. Kaufmann has chosen to put his points across by using a generous helping of drawings, diagrams, and photographs. There are so many, in fact, that pages of pure print are more the exception than the rule; and the reader gets the distinct impression of being given a talk by a free-wheeling lecturer who is very adept at whipping up quick illustrations on a chalkboard to support his discussion. This interesting and informal method of presentation continues throughout the book.

After a brief review of stellar evolution, Mr. Kaufmann leads the reader through interesting discussions of white dwarfs and neutron stars, and finally on to the main theme of the text: a giddy tour over, under, around, and through the weird worlds of black holes. Along the way Mr. Kaufmann takes time to introduce the "tools of the trade" of the astrophysicist, such as the Kruskal-Szerkeres and Penrose diagrams. Using these diagrams plus others, Mr. Kaufmann proceeds to discuss the physical and visual properties of Schwarzschild black holes, electrically charged black holes, and rotating black holes. One particularly interesting sidelight to these discussions is several series of drawings showing what hypothetical astronauts on various types of trips into black holes would see.

The final chapters of the book reach even closer to the hazy boundaries of current research. After a good chapter describing how black holes might be detected as members of x-ray binary stars, Mr. Kaufmann then touches upon the possibility of white holes, and upon the relation between black holes and gravitational radiation. Finally, the intriguing ideas of massive black holes in galactic nuclei and primordial black holes are discussed. With these thoughts and a quick note added in press, the book ends, leaving the reader feeling very much a part of the current research in relativity, indeed, out on its very "cosmic frontiers".

If it is apparent that this is intended as a favorable review, indeed it is. However, a word of caution must be also included. Though definitely absorbing reading for anyone interested in the subject, the text is also definitely not all "light" reading. Certain sections are indeed somewhat difficult (though not tedious!) to read through, and may require several passes before their meaning sinks in. However, considering the nature of the subject, this should be expected: an understanding of the astrophysicist's and relativitist's view of the universe can never come "for free". All in all, Mr. Kaufmann has done an admirable job of turning the esoterica of modern relativity theory into concepts understandable by the intelligent layman, and is to be congratulated on the results of his efforts.

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Apollo-Soyuz Experiments in Space Pamphlet Series 1-9, prepared by Lou Williams Page and Thornton Page. National Aeronautics and Space Administration, Washington, D.C. 1977. 480 pages. Price $10.00,paperbound. (The group is available as stock number 033-800-00688-8 from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.)

Reviewed by Derek Wallentinsen

These nine well-illustrated pamphlets, each about 50 pages long, give clear and concise descriptions of the experiments performed by the American and Russian crews of the Apollo-Soyuz Test Project in Earth orbit in July, 1975. Each covers a specific topic or category of experiments: (1) The Flight; (2) X-Rays, Gamma Rays; (3) Sun, Stars, In Between; (4) Gravitational Field; (5) The Earth from Orbit; (6) Cosmic Ray Dosage; (7) Biology in Zero-G; (8) Zero-G Technology; and (9) General Science.

Intended as curriculum supplements for high schools and colleges (there are pertinent references to standard texts), these can be used as teaching aids to present some of the mathematical, physical, and biological concepts being explored or utilized in current scientific research. Each pamphlet is divided into three or more sections, explaining the purpose, design, and execution of the experiments--the scientific method. Necessary basic relations (e.g., Newton's Laws) are briefly stated, backed by the fundamental equations, given without proof or detailed mathematical derivation. Questions for discussion by a class (or self-test, since answers are given at the back of each pamphlet), such as: will a pendulum on Pike's Peak run faster or slower than one at sea level?, round out each section. Appendices of SI (International System) units and a glossary end each pamphlet.

The series does make for interesting perusal by the general reader. One learns (Pamphlet 6) about the simple explanation for the seemingly enigmatic "light flashes," first seen by Edwin "Buzz" Aldrin on the Apollo 11 mission, caused by cosmic rays (ionization and the decelerative shedding of Cerenkov radiation) and predicted for spaceflight as early as 1954 by physicist C.A. Tobias. Zero-g crystals, alloys, and materials formation, such as eutectics, foams, and sphericalization, described in No. 8, are seen to have potentially great advantages over those produced in one-g. Much work remains to be done, but it is clear that zero-g technology will pay many of the bills for space travel in profits and in benefits in electronics, metallurgy, and chemistry. Zero-g biology (No. 7) will do likewise. Continued work in both fields is sure to become an important part of the Space Shuttle's schedule.

There are a few errors and gaps in explanation. In "The Flight," the numerical constant in Kepler's Third Law is incorrectly given as 8 instead of 4. An important lapse occurs in Problem 14 in "X-Rays, Gamma Rays," involving the Doppler Effect: it has several significant errors. The description of free-fall (zero-g, weightlessness), which is given in several pamphlets, is not so clear as it could be. Several units of measure without definitions are introduced in the series. The Earth's equatorial radius rather than its mean radius is used, but this is not stated. Airglow, mentioned at least twice, is never explained. In "Biology in Zero-G," Table 2.1 states that all of the fish in compartment 4 died, but the reader is left with no explanation for the reason.

However, this series is excellent for those desiring more information on manned missions science than that which is given in popular books, but not the highly technical details presented in scientific papers. Pedagogically, it would serve its designed purpose of a course supplement for "case in point" examples of scientific ideas.

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Many Worlds, One God, by Kenneth J. Delano. Exposition Press, Inc., Hicksville, N.Y., 1977. 126 pages. Price $7.00.

Reviewed by Richard G. Hodgson

Reverend Kenneth J. Delano, a well-known observer in the A.L.P.O., has written a thought-provoking book on the subject of extraterrestrial intelligent life (ETI) and the possible impact discovery of such life would have upon our civilization. It is obviously a well researched book to which Rev. Delano has given considerable thought.

A wide variety of sources are cited, but unfortunately page references are usually omitted.

Many Worlds, One God is a serious effort to look at the question of ETI from a Christian perspective. Two basic assumptions underlie the book: 1. There are probably many other civilizations on other planets in our galaxy, and we may well encounter one or more of them in the next few years. 2. Man is the result of an evolutionary process first described by Charles Darwin, or possibly Adam was the result of an earlier involvement of extraterrestrial beings with planet Earth. For the few who are persuaded by these assumptions, the book is agreeable reading. The reviewer has reservations about ETI as commonly defined. We still have no real observational evidence in favor of it. (cf. Frank Cousins "The Solar System", Chapter 15, for a discussion of ETI and evolution from a learned but negative point of view). We have no scientific basis for estimating the number of intelligent civilizations in our Galaxy. The reviewer is also persuaded that the Hebrew text of Genesis 1 and 2 clearly teaches divine creation rather than gradual evolution as the explanation of Man's origin. Like it or not, that is the biological view; and no amount of reinterpretation can change it. The book tends to gloss over the problem.

The astronomical data presented in the book are generally accurate. Discussing sinuous rills on Mars (p. 22), the author gives the impression they must have been formed by water when a lava flow origin is probably more likely. Again, the diameter of Ceres would be better given as about 1,000 km. or 600 miles rather than the old 480 miles value (p. 25). Satellite Jupiter I is better called "Io" rather than "Jo" (p. 27). The fact that some recent data cast doubt on the reported astrometric binary character of Barnard's Star is not mentioned (p. 30).

In the reviewer's opinion the best chapters of the book are the last two: "Possible Consequences of Contacting Extraterrestrial Societies" and "Astrotheology". The first of these shows the possible disaster which might result from contact with another civilization. It is well illustrated with cases involving Western civilizations and American Indian societies or the societies of Melanesia. The final chapter on astrotheology concludes with a call to prepare ourselves for a possible ETI encounter in the near future, intellectually and spiritually. It is a call which deserves our serious attention. The book, Many Worlds, One God, deserves a wide reading.

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Astrology Disproved, by Lawrence E. Jerome. Prometheus Books, 1203 Kensington Avenue, Buffalo, New York 14215. 233 pages. Price $14.95, hardbound.

Reviewed by Derald D. Nye

This book is Mr. Jerome's latest writing debunking astrology. It is divided into five books. Book I, "Historical Perspectives", describes the origins of astrology from its beginning in Babylonia and China to the discovery that the Mayas and Aztecs also had a form of astrology. The significance of these various civilizations, in different times, each developing its own astrology, is examined. It is interesting to learn why astrology developed and the necessity of it for these early people; but as Man's knowledge grew and he learned more about the true nature of the heavens, the need for this type of magic had vanished by the 20th century. The facts and sound reasoning are all part of Mr. Jerome's presentation in this well-written book.

Book II, "Inside the Inner Temple", shows how the "principle of correspondences" is used in making astrological interpretations. Also, for the neophyte and non-users of modern day horoscopes, a chapter is devoted to the construction of horoscopes. This chapter is the most humorous in the book, and it alone should be enough to make any rational thinking person a non-believer in astrology. The astrological debate is the subject of the final chapter of Book II; and among other things, it shows how planetary tides on a new-born infant are more than offset by the mere proximity of the attending physician.

Book III, "Biological Versus 'Cosmic' Clocks", presents the two current theories of biological clocks. Of the two, the endogenous clock seems to be favored more than the exogenous clock for explaining the behavior of plants and animals and all forms of life. How this behavior is controlled by these biological clocks instead of any planetary "influences" again reinforces the essence of this book to disprove astrology. Book III also deals with the known terrestial effects by celestial bodies. Again, scientists have given us reliable information on "forces" that the celestial bodies have and evidence that they do indeed affect some things here on Earth; but one of the things these "forces" don't do is to control the destiny of our lives.

Book IV, "The Psychology of Magic and Astrology", contains fascinating accounts of the part astrology and occult thinking had in events leading to World War II. It is this section of the book which drives home the very dangerous aspects (no pun intended) of believing in astrology and the occult.

The final book, Book O (why "O" when the rest were Roman numerals I-IV has me puzzled), "The Statistical 'Secret' of Astrology",shows the reason why any random horoscope will have at least a 50 percent success rate with any random client. This section will give the reader good ammunition if he has friends who suffer from "astrologyitis" and want to improve their way of thinking!

The Appendix is the famous "Statement by 192 Scientists' Objections to Astrology".

The book is not difficult reading with only one minor fault; namely, the table of contents does not state where the "figures" referred to in the various chapters are located. They can be found on unnumbered pages between pages 130 and 131. Only one typographical error was noted, and that is in Figure 9.1.

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Astronomy: A Self-Teaching Guide, by Dinah L. Moché, John Wiley and Sons, Inc., New York, N.Y., 1978. 286 pages. Price $5.95, paperback.

Reviewed by Bruce M. Frank

Astronomy: A Self-Teaching Guide is exactly what the title implies; it is a self-paced, programmed instruction text for planetary and stellar astronomy. Dinah Moché, an Associate Professor of Physics at City College of New York, has condensed the sometimes bewildering scope of astronomy into an easily understandable format for the layperson. As a programmed text, the material in each chapter is presented in short sections or frames. Each frame contains a concise monograph on a given topic followed by a question to test the reader's understanding of that topic. A review set of questions is included at the end of each chapter to facilitate retention of that chapter's subject matter.

The text begins with an overview of general principles of Celestial Mechanics. Subsequent chapters provide an up-to-date summary of theories and observations concerning galactic structure, cosmology, and the Solar System. Speculation about life on other worlds, including a good summary of the results of the Viking lander experiments, is reviewed in the final chapter.

Not satisfied with merely describing a topic, Dr. Moché has added numerous drawings and photographs in order to help make technical ideas clear. Simple non-mathematical experiments and sky maps are also included to encourage direct observation of the celestial bodies and to develop concepts discussed in the book.

Due to its versatile format, Astronomy: A Self-Teaching Guide should prove equally useful to both the layperson and the experienced amateur astronomer desiring to test his/her conceptual grasp of the field of astronomy.

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The Structure of Planets, by G. H. A. Cole. Crane, Russak and Co., Inc., 347 Madison Avenue, New York, N.Y., 10017. 1978. 232 pages. Price $19.50.

Reviewed by Michael P. Orley

The voyages of the Mariner, Pioneer, Viking, and now the Voyager Spacecraft have, and are continuing to provide, vast amounts of information which have greatly expanded our knowledge of our Solar System and the planets therein. The Structure of Planets brings together, in a concise, well conceived format, a complete, easy-to-read source book. This little book is packed with the latest up-to-date information gleaned from the latest space probes, as well as Earth-bound observatories. The text is divided into two parts. Part I engages the reader in an in-depth discussion of the underlying principles of geophysics and planetary structure and gently prepares and guides him into Part II, where the author relates these principles to the structure and evolution of the planets within our Solar System.

A good deal of advanced mathematics has been liberally sprinkled throughout the text. Chapter 2, which discusses gravitation and planetary orbits, goes into the basic mathematics necessary for an understanding of orbital mechanics. This chapter goes into great detail on the various applications of Kepler's Laws and the basic mathematical doctrine which governs force and motion. As the book goes on, the mathematics involved becomes increasingly advanced, as evidenced in Chapter 4, on "Internal Conditions and Hydrostatic Equilibrium", and Chapter 6, which deals with the thermodynamics of planetary materials. In each case, the author has dealt with the mathematical expressions in such a straightforward manner as to make them understandable to the average scientific reader.

One of the things that impressed me about this book is the fact that as one progresses into Part II, The Planets of the Solar System, he finds himself less bombarded with information but rather guided from one chapter to another, comparing the various characteristics of the different planets and speculating on the impact of these unique worlds in terms of planetary evolution. I came away from this book with the profound impression that I had personally been in dialogue with the author, who had taken me by the hand and guided me through a course in planetology.

The Structure of Planets is an interesting book that has been badly needed for a long time. In 232 pages, this book has bridged the gap between technical papers and popular articles which provide either too much or too little information for the average reader. This little book, in its attractive green and white cover, provides a fresh new look at the other worlds in our Solar System. It is truly a book whose time has come!

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Astronomical Calendar 1979, by Guy Ottewell. Department of Physics, Furman University, Greenville, South Carolina,29613. 1978. 63 pages. Price $6.00, softcover. Size 11" by 15".

Reviewed by David M. Fliss

The Astronomical Calendar 1979 devotes two pages per month in the first section to a large clear star chart, with white stars on black, and a Solar System diagram, which indicates positions of the terrestrial planets in their orbits for that month. On the opposite page are listed upcoming celestial events by date, interspersed with hand-drawn diagrams of planetary risings and settings. Next come monthly ecliptic charts with planetary positions shown, a section on recent events, a section on double and variable stars, an extensive meteor shower listing for the year with what to look for, and discussions on history, comets, tides, and eclipses. There is also a guest article on astronomical time and the Fine Structure Constant. These are only a few of the larger items among many other nuggets of information, which make this calendar most valuable for planning observing sessions as well as for "armchair star-gazing" on those frequent cloudy nights.

ANNOUNCEMENTS

Sustaining Members and Sponsors. The persons listed below support the work of the A.L.P.O. by voluntarily paying higher dues, $30 per volume for Sponsors and $15 per volume for Sustaining Members. The generous assistance of these colleagues is gratefully acknowledged; it has been, and is, most valuable. If there are errors in these lists, the fault is wholly the Editor's; he expresses his regrets and would appreciate being informed of any needed corrections.

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Riverside Telescope Makers Conference. The eleventh annual meeting of this kind will be held over the Memorial Day Weekend, May 26, 27, and 28, 1979, at Camp Oakes near Big Bear City, California. This meeting has become one of the most popular and best attended astronomical gatherings in the U.S. West, and the program is continuing to expand. Camping and dormitory facilities are excellent at Camp Oakes, and those who prefer a motel can make arrangements at Big Bear City, five miles away. Camping with five meals is $21.00 per person for the weekend. The elevation of the camp is 7300 feet, ideal for astronomical observation and photography.

Speakers for the program are heartily invited. Proceedings of the meeting will be published this year for the first time. There will be Merit Awards, an Astronomical Swap Meet, a raffle with prizes, and many recreational facilities. Those wishing more information should write to Mr. Clifford W. Holmes, Conference Chairman, 8642 Wells Ave., Riverside, CA 92503.

New Address for Julius Benton. The address for our Saturn and Venus Recorder, effective now, is: Dr. Julius L. Benton, Jr., 305 Surrey Road, Wilmington Park, Savannah, Georgia 31410.

International Directory of Amateur Astronomical Societies. This comprehensive directory gives general information on more than 500 amateur groups in 27 countries. A master file is constantly being updated, and a copy including the latest corrections can be supplied at any time as a computer printout. The price, which includes postage and handling, is:

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Orders should be placed with Dr. A. Heck, Villafranca Satellite Tracking Station, Apartado 54065, Madrid, Spain. A convenient form of payment will be an international money order made payable to Dr. André Heck, Liège, Belgium. This directory fills a long-lasting need.

Astrophoto Biennial 77-78. The Orange County Astronomers in southern California have published a 100-page, 8 by 11-inch book of astrophotos, with 80 pages of reproductions with full captions by well-known leaders in the field. The remaining 20 pages are devoted to articles about professional techniques. The price per copy is $8.00 in North America ($8.48 in California) and $10.00 on other continents, airmail. Order from Orange County Astronomers, 2215 Martha Ave., Orange, CA 92667. You can have a beautiful book.

This Year's ALPO Convention. Our 1979 meeting will be a large joint gathering of the Astronomical League (their National Convention), the Western Amateur Astronomers, and the A.L.P.O. The dates are August 15-19, 1979; and the place is the University of Portland at Portland, Oregon. The host is the Portland Astronomical Society. A feature of special interest to ALPO members will be a talk by Mr. Ralph Turner, who designed and built for NASA the remarkable models of Martian satellites Phobos and Deimos. John Westfall has already agreed to take charge of the A.L.P.O. Exhibit. We shall give many more details about this meeting in our next issue, which will probably be mailed near the middle of May. Readers desiring information sooner may want to write to the Convention Chairman, Cliff Caplan, 2535 S.W. Edgemoor Ave., Portland, OR 97005, or to the Convention Treasurer, Bob Amos, 7831 Monument Dr., Grants Pass, OR 97526.

Corrections to Volume 27, Nos. 5-6 of This Journal. Perhaps some very sharp-eyed readers noticed that in Figure 61 on page 125 the sixth data point, for the observation on March 25, 1978, is misplotted. The value of the time in the table on page 126 would place it almost one-fourth of an inch to the right of the position shown.

Dr. Giancarlo Favero has kindly communicated a few corrections to the article by himself and Mr. Ortolani in the same issue. In the paragraph below Figure 8 on page

93 the white oval spot in the NTB "drifted toward high longitudes with a period of $9^h56^m9^s.8$", not $9^h55^m9^s.8$ as there given. In the caption for Figure 13 on page 97 the symbol in parentheses after the words "Red Spot" should be "RS", not "MR".

GIFTS AND SERVICES FROM JOHN MARELLI METEOROLOGICAL ASSOCIATES

Mr. John Marelli, 42 Chestnut St., Charlestown, MA 02129, has donated a very large number of astronomical books to the A.L.P.O. Library. The following list is not complete but should indicate the scope of books he has so generously given.

1. The Nature of the Universe, by Kilminster.
2. Revolution in Earth Sciences, by Hallam.
3. Planets, Life, and LCM, by Bova.
4. Advances in Astronomy and Astrophysics--1968.
5. Introduction to Space Sciences, by Haymes.
6. Introduction to Planetary Physics: Terrestrial Planets, by Kaula.
7. Astrophysics.
8. Discovery of Our Galaxy, by Whitney.
9. Structure of the Universe, by Schatzman.
10. Portrait of the Universe.
11. Structure of Space, by Solomon.
12. Introduction to Astronomy--Student Self Study Guide (2 copies).
13. Dynamics of the Earth, by Spencer.
14. New Horizons in Astronomy, by Brandt.
15. Basic Concepts in Relativity and Early Quantum Theory, by Resnick.
16. Astronomy, by Baker and Frederick.
17. Principles of Astronomy: Short Version, by Wyatt.
18. Picture History of Astronomy, by Moore.
19. Astronomy, by Menzel.
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33. Other Worlds, Other Beings, by Angrist.
34. Mysteries of the Universe, by Corliss.
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36. Stars--Golden Books.
37. Music of the Spheres, Vol. 2, by Murchie.
38. Man in the Universe, by Hoyle.
39. Cosmology, by Charon.
40. Advances in Astronomy and Astrophysics--1972.
41. Annual Review of Astronomy and Astrophysics--1969.
42. Advances in Astronomy and Astrophysics--1967.
43. Music of the Spheres, Vol. 1.
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45. Introduction to Special Relativity, by Resnick.
46. Exploring the Universe, by Young.
47. Annual Review of Astronomy and Astrophysics--1965.
48. Advances in Astronomy and Astrophysics--1971.
49. Interstellar Matter in Galaxies, by Woltjer.
50. Plasma to Planet--Nobel Symposium.
51. Advances in Astronomy and Astrophysics--1970.
52. Concepts in Contemporary Astronomy, by Hodge.
53. Exploration of the Universe, 1973 edition, by Abell.
54. Instructor's Answer Booklet to Principles of Astronomy, short version, by Wyatt.
55. Answer Book to Principles of Astronomy, second edition, by Wyatt.
56. Instructor's Manual for New Horizons in Astronomy, by Brandt.
57. Instructor's Manual for Introduction to Astronomy, by Frederick.

58. Annual Review of Astronomy and Astrophysics--1966.
59. New Cosmos, by Unsold.
60. Realm of the Universe, by Abell.
61. Introduction to Astronomy, by Frederick and Baker.
62. Basic Physics of the Solar System, by Blanco and McCuskey.
63. Principles of Astronomy, second edition, by Wyatt.
64. First on the Moon (about Apollo XI).
65. 1970 Yearbook of Astronomy, by Patrick Moore.
66. 1971 Yearbook, as above.
67. 1974 Yearbook.
68. 1972 Yearbook.
69. Space: From Gemini to the Moon and Beyond.
70. 1975 Yearbook.
71. The Universe, by Otto Struve.
72. 1973 Yearbook.
73. Starflight and Other Improbabilities, by Ben Bova.
74. Problems of Modern Physics, by H. A. Lorentz.
75. Extra-Terrestrial Visitations from Prehistoric Times to the Present, by Jacques Bergier.
76. The Cosmic Clocks: From Astrology to a Modern Science.

Readers are heartily invited to borrow these books. Since mailing costs vary with weight and since the different books vary greatly in weight, the mailing cost will be determined for each request. Of course, the borrower must also pay the return postage and is expected to take proper care of the book.

Readers are also reminded of Mr. Marelli's offer of attractive book discounts to A.L.P.O. members and of NASA educational materials on space missions which he can supply. See *Journal A.L.P.O.*, Vol. 27, Nos. 7-8, pg. 171, November, 1978.

John Marelli Meteorological Associates will further supply to A.L.P.O. members *The Astrophysical Journal* and *The Astrophysical Journal Supplement* at 40% off the list price. The normal rates are $130 per year for the journal and $60 per year for the supplement. The special rates he offers are $78 and $36 respectively, or both for only $110.

Finally, he draws attention to a new monthly magazine called *Cosmic Search*, which is devoted to the origin of life and to the search for extraterrestrial life. The regular rates are $12 for one year or $22 for two years. The rates here offered to A.L.P.O. members are $11 for one year or $20 for two years. The first issue of *Cosmic Search* features articles by Arthur C. Clarke, Norman Cousins, Frank Drake, Carl Sagan, Walter Sullivan, and many other famous persons. The new magazine's address is *Search*, Box 293, Delaware, Ohio 43015.

OBSERVATIONS AND COMMENTS

Lunar Eclipse of September 16, 1978. The only report on this event comes from Mr. Alan W. Heath at Long Eaton, Nottingham, England. Some relevant circumstances, in Universal Time, were:

Middle of eclipse	$19^h\ 4^m$
Total eclipse ends	19 44
Moon leaves umbra	20 48
Magnitude of eclipse = 1.333	

Clouds prevented observing the early part of the eclipse, but there were some good clear periods later on, with transparency of 5.5 or so on the limiting magnitude scale (61 Cygni was easily seen). Since the low elevation of the Moon precluded the use of his 30-cm. reflector, Mr. Heath observed with a 9 x 50 elbow telescope and 8 x 30 binoculars, as well as with the naked eye. Other observers at the site were Colin Rose and Andrew Groocock. Photographs were taken with a 200-mm. Takumar Lens at f 5.6 used together with a 2x converter. The film was HP5(400 ASA) developed in Microphen for 8 minutes at 72° F. Exposures varied from ½ second to 1/25 second, according to the phase of the eclipse. Exposures were also made on Agfa CT18 (50 ASA) color film for 1 second with the same equipment.

The Moon was first seen at $19^h45^m\!.5$, U.T., just after the end of totality. Mr. Heath then estimated the darkness of the eclipse to be L = 2 on the Danjon Scale. He notes: "Detail on the dark part was visible, and there was a deep copper color with the central part of the shadow dark. It is realized that this is not the time to make such an estimate, but it was the first opportunity".

At 19^h51^m the "cusps" of the illuminated crescent were predominantly a copper color with the remainder of the eclipsed part a brownish gray color. The color was stronger to the naked eye than in the two visual instruments cited above. The copper color became less obvious as time passed and was last seen at 20^h20^m. Clouds then hid the Moon until 20^h44^m, and the final shadow detection was at 20^h49^m.

That "Terby White Spot" in the Rings of Saturn. Mr. Michael B. Smith of Alamogordo, N. Mex., was surprised to see very clearly a bright, white, oval marking beside the shadow of the globe on the rings on April 7, 1977 from 3^h40^m to 4^h20^m, U.T. He was using a 10.6-cm. reflector at 92X to 184X, seeing good (6-8), transparency fairly good (5-5.5), and an apodizing mask. He had never seen this feature before in many years of observing Saturn (almost nightly for months prior to April 7), though he knew of it from his reading. His experience has been shared by others. There is little reason to interpret this feature as anything but an effect of contrast with the black shadow, and photographs fail to show the Terby White Spot. If the feature does really exist, one might expect some anomalous brightenings when the satellites of Saturn are eclipsed in their primary's shadow during the imminent edgewise presentation.

The Strolling Astronomer

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