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COMPARATIVE ANALYSES OF OBSERVATIONS OF LUNAR TRANSIENT PHENOMENA

WINIFRED SAWTELL CAMERON

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GREENBELT, MARYLAND

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ABSTRACT

A collection of > 800 reports of lunar transient phenomena (LTP) contained 771 positive and 112 negative observations with sufficient ancillary data to be analyzed for five hypotheses of causes. Greater than one third of these reports involve Aristarchus, divided almost equally between two observing groups. One homogeneous group involved one observer, Bartlett, and the other, heterogeneous group comprised all other observers. These two groups plus their combination were each separately analyzed for each hypothesis for Aristarchus. The observations seemed to form four categories, viz. (1) gaseous, (2) reddish, (3) bluish, and (4) colorless brightenings and were analyzed under each category for each hypothesis and group, as well as the total Aristarchus and total of all sites which were analyzed for each hypothesis. Each and all were compared. The five hypotheses involved the effects of (1) tides, (2) sunrise, (3) low-angle illumination, (4) earth's magnetic tail, and (5) solar particles.

The analytical results for Aristarchus suggest the following: (1) gaseous phenomena of Bartlett differed in analytical behavior from those of all others; (2) Bartlett's reddish phenomena differed from all others, being seen at times when gaseous phenomena were not present, suggesting he saw ground color in

the absence of events of an obscuring medium. All others' reddish phenomena were probably lunar events; (3) Bartlett's bluish phenomena correlated similarly to all others brightenings (and their bluish), suggesting that similar phenomena were observed by the two groups, but that Bartlett may be blue-sensitive, seeing color when others do not. Absence of reports of reddish, orange or pink phenomena by Bartlett (his reddish were browns, coppers and yellow-browns) imply lower sensitivity to red for him as well as greater blue sensitivity; (4) behavior of each separate site considered was capricious with few similarities between near neighbors.

For all sites the following are deduced from the analyses: (1) Nearly all categories, individual sites, and the totality of observations correlated most strongly with sunrise. Selection effects probably do not account for all of this correlation, implying that sunrise conditions are favorable to the observation of phenomena; (2) High correlation was also found for magnetic tail effects; (3) Tidal effects correlated almost exclusively with perigee only, being less than expected for apogee, but even perigee correlations declined with increased numbers of observations, resulting in only a slight excess over expected percentages even at perigee. The correlation is somewhat stronger at times of greater orbital eccentricity than at the lesser eccentricities; (4) A tidal correlation though, is weakened by the similar correlation (instead of the expected opposite) of the Absent phenomena, and the progression around the lunar anomalistic orbit of dates of the Onset of phenomena; (5) The correlation for direct solar bombardment from solar flares is weak but appears to be enhanced if the moon is within the earth's magnetic tail at the time of arrival of the energetic flare particles in the earth-moon vicinity. The correlation comes with the magnetopause rather than the bow-shock front turbulence; (6) Some of the brightenings phenomena may have explanations in atmospheric and instrumental effects, but many puzzling aspects remain; (7) Comparisons of the distribution of LTP sites with those of dark, flat-floored craters and the author's proposed lunar ring dike features—all generally found near the mare peripheries—imply internal activity as the source for most of the LTP—even more strongly when the distributions of other volcanic features, such as the lunar domes, sinuous rills and dark-haloed craters are compared with the LTP distribution. All have strong affinities to the edges of the maria; (8) LTP are found at all ages of lunations, having been seen at age 0^d to age 28^d, with > 50% observed within four days of full moon. Therefore, if observers confine their observations to times near perigee only, three fourths of the phenomena will be missed. It is urged that observers continue to observe the moon at all phases.

COMPARATIVE ANALYSES OF OBSERVATIONS OF LUNAR TRANSIENT PHENOMENA

I. INTRODUCTION

Lunar transient phenomena (LTP) have been reported by lunar observers for the past 400 years, antedating the invention of the telescope. Diligent search of the literature, still incomplete, has revealed that these sightings were more frequent than previously realized. Until relatively recently they had been generally dismissed as due to spurious telescopic, atmospheric, or lighting effects. LTP were not taken seriously until Kozyrev (1959) announced his spectral observations of an event in Alphonsus in 1958. Increased interest came with the observations of two cartographers, Greenacre and Barr (1963), of the Aeronautical Chart and Information Center (ACIC), who observed three separate reddish (later followed by violet) glows in and around Aristarchus and Schröter's Valley simultaneously. Similar phenomena were observed by them and confirmed by others at the next lunation at the same phase (near sunrise) on Aristarchus, which is at IAU selenographical coordinates 47°W, 23°N. Photographs taken at this apparition did not reveal the phenomena, probably because of the insensitivity of the film to the red end of the spectrum. Kozyrev (1962, 1963) had obtained spectra from Alphonsus again in 1959 and then from Aristarchus in 1961.

The author became interested in these phenomena after Kozyrev's Alphonsus observations and began collecting various reports resulting in nearly 900 observations garnered from the literature and private communications from groups and individuals. (A catalog of these reports is in preparation.) Various hypotheses for the causes of the phenomena have been proposed and the observations have been analyzed with respect to five potentially basic causes, some of which have variations. The analyses here follow and expand upon similar investigations by the author (Cameron and Gilheany, 1967; Cameron, 1967). Other papers have dealt mainly with a single possible cause (see Burley and Middlehurst, 1966; Blizard, 1967a, 1967b; Chapman, 1967; and Sidran, 1968).

II. DIVISION OF DATA AND HYPOTHESES CONSIDERED

The data in the present paper have been divided into a number of different categories. Of the approximately 900 reports, 770 had sufficient information with ancillary data to be analyzed in regard to most of the hypotheses. For others there were fewer ancillary data. Of the 770 observations of all sites of lunar phenomena, about 270 positive reports concerned the crater Aristarchus and its environs. Such a large number of observations of a single site provided a basis for significant analyses. These observations of Aristarchus alone could then be compared with those for other individual sites and with those for all sites combined. In addition there were some valuable negative data, e.g., instances when phenomena were looked for but found to be absent, with which the positive phenomena could be compared.

The Aristarchus observations were considered first. It was found that the observations were divided almost equally between two groups of observers. One group involved those of one observer, Bartlett, who published his reports of 107 observations of bluish phenomena, which he called the "violet glare" (Bartlett, 1967), but which had certain variations. Included in his report (comprising 1/3 of his observations) were the 51 negative observations (see Table VII here). His observations made up a body of relatively homogeneous data of a single area by a single observer with the same equipment, observing conditions, and techniques that could be compared to those of a heterogeneous group of many observers with diverse equipment, conditions, and techniques. Among the latter there were no negative reports until very recently, and these were incorporated when possible. Additional observations and information were kindly supplied by Bartlett for these analyses. This includes observing period instead of mean of interval as he published. Features he included are Plateau m, area north of crater designated VA, east wall brightspot (EWBS), and southwall brightspot (SWBS). The Aristarchus observations thus were divided into three groups: Bartlett (B), "all others" (A.O.), and both combined (C). There were about a half-dozen cases of coincident observations between the two groups, which were counted as only one in each instance in the combined group.

Scrutiny of the observations revealed that the phenomena differed and seemed to fall mainly into four categories. Many of the descriptions, e.g., mists, obscurations, shadow anomalies, etc., suggested that a gaseous or gas-and-dust medium was involved. These were analyzed under the category designated Gaseous. Other observations were of phenomena whose color ranged from yellows through oranges, browns or coppers, to red and were considered under the category designated Reddish. Still others were reported as colored phenomena ranging from greenish to bluish to violet and these were categorized as Bluish. Finally, many were reported as bright points or brightenings with no color mentioned, and were treated under the category of Brightenings. If a report mentioned more than one category it was analyzed under each category but as only one in the total group of All Aristarchus observations. The absent phenomena were treated separately for comparison (Absent). It was also noted that many observations were sequential or in the same lunation and the initial observation might be considered the onset of activity: these initial dates were analyzed separately and called Onset.

The three groups, B, A.O., and C, and the six categories, Gaseous, Reddish, Bluish, Brightenings, Absent, and Onset, were analyzed with respect to the five following hypotheses: (1) Tidal, (2) Sunrise, (3) Low-angle illumination, (4) Earth's magnetic tail, and (5) Solar, effects. J. Green (1963), from the study of the varying levels of terrestrial water and oil in wells, found a relationship between height levels and the tides. He found that the levels were highest at low tide. By analogy for the moon, lunar events should occur at eccentric apogees and few or none at more circular perigees. He found some support for his hypothesis at that time from the small number of observations (25) that he had available for analysis. His hypothesis involves the eccentricity (shape) as well as the period of the orbit. The Burley-Middlehurst (1966) analysis only considered the period.

Sunrise effects could arise from (a) ultraviolet radiation excitation of gases that escaped during the lunar night, or of ground materials, (b) thermoluminescence of gases or ground materials (Blizard, 1967b; Sidran, 1968), or (c) low-angle illumination which might render any existing medium more visible than at high sun angles. Low-angle illumination effects would obtain at sunset conditions for relevant features as well as at sunrise.

The magnetic tail effect could occur from at least two possible mechanisms. One was suggested by Speiser (1965), who was able to explain terrestrial aurorae by the action of the neutral sheet and magnetic lines of force of the earth's magnetic tail which accelerate the solar particles and send them spiralling down these lines to localized areas near the earth. He suggests that the particles may also be accelerated in the opposite direction, thus onto local areas on the moon when it is within the tail. The energies of the particles would be increased by these accelerations, perhaps sufficiently to account for the energies observed in the lunar phenomena. The lunar phenomena exhibit energies comparable with that of direct sunlight. The strongest correlation would be expected within the magnetopause (MP) whose boundaries are encountered by the moon approximately two days before and after full moon and therefore the observations should correlate with full moon.

A. G. W. Cameron (1964) suggested that the turbulence at the bow-shock front (BSF) of the tail might increase the energies of the particles, and if the moon were in the vicinity of the BSF at that time, the particles might have sufficient energies to excite or activate luminescence of surface materials or gases. The moon enters and exits the BSF about 4.5 days before and after full moon respectively. The turbulence may be considered to be effective up to one day inward from the front. The correlation of the observations would be expected to come at ±3.5 to 4.5 days from full moon.

Luminescent excitation from solar flare particles was suggested by Kopal and Rackham (1964) when they found a reasonable coincidence with their observations of LTP and solar flares and possible solar relationships with some historic LTP. As in the past (Cameron and Gilheany, 1967), in the present paper the K_p index was chosen as a good indicator of the energy and time of arrival in the earth-moon vicinity of solar particles (Matsushima, 1967, analyzed LTP with respect to this quantity also). More importantly, the onset or sudden commencement (sc), progress of a magnetic storm (ms) or aurora (when noted) are indicators of the presence of energetic particles. These K_p and magnetic storm data are to be found in Bartels (1962) from 1932-1961; and in articles by J. V. Lincoln in the Journal of Geophysical Research through 1968, and since 1968, in the Solar Geophysical Data which is issued by ESSA Research Laboratory in its monthly series IER-FB.

Table I contains all the readily available data for analyzing the observations with respect to the hypotheses considered here, with additional information for other possible analyses. Column (1) gives a running serial number; (2), the Gregorian date; (3), the time of or time interval of observation in Greenwich Time (GT) when available. Times followed by a question mark are guesses by the author based on considerations of the location of the observer, time of sunset, moonrise, sunrise, and moonset, and professional or non-professional status of the observer. In the analyses these time guesses were used and are followed by a colon as being uncertain. These times are not likely to be in error by more than a quarter of a day $\cong$ .01 in ϕ) except possibly for those observations near midnight. Column (4) gives a brief description of the phenomena. Parentheses indicate the present author's remarks. Column (5) gives the code for the category(s) under which the observation was analyzed: G = gaseous, R = reddish, V = bluish (violet), Br = brightening. Those in parentheses were not used in the statistics. Column (6) gives the duration of the phenomena in days (d), hours (h), minutes (m) or seconds (s); (7), the moon's age in days; (8), the sun's colongitude (the selenographic longitude of the rising terminator which progresses westward starting at the moon's center of face = 0°). Column (9) gives the distance of the sunrise [R] (before full moon) or sunset [S] (after full moon) terminator from Aristarchus; (10) gives the dates and times (hour) of perigee (Per.) surrounding the LTP date and the intermediate apogee (Apo.) using abbreviations for the months. Column (11) gives the values of the horizontal parallax for the dates in Column 10 and also that of the event date and time (Event), using the approximate mean of the observing interval. Column (12) gives the calculated anomalistic period phase (ϕ) in which the upper figure (π) was calculated from the approximate horizontal parallax formulas for the true anomaly,

$$\cos E = \frac{\frac{1}{\pi_a} + \frac{1}{\pi_p} - \frac{2}{\pi}}{\frac{1}{\pi_a} - \frac{1}{\pi_p}}, \quad V^\circ = E^\circ + 5^\circ.89 \sin E, \quad \phi = \frac{V^\circ}{360^\circ},$$

where E is the eccentric anomaly; π_a, the horizontal parallax at apogee; π_p, the horizontal parallax at perigee; π, the horizontal parallax for LTP mean date and time; V, the true anomaly; and ϕ_π, the phase in regard to the true anomalistic period. The lower figure (d) in Column (12) is the phase calculated by the simple relation,

$$\phi_d = \frac{D - P_1}{P_2 - P_1}$$

where ϕ_d = anomalistic phase in days, D = date of observation, P_1 = date of perigee preceding LTP date and P_2 = date of perigee following LTP date. The latter calculation is less accurate as it assumes that the lunar orbit is circular, when in fact, it has an average eccentricity of about 0.06. The two quantities ϕ_π and ϕ_d should not differ by more than ~0.1 and usually much less and therefore they serve as checks for each other. In the analyses ϕ_π was always used when

Table I. LUNAR TRANSIENT PHENOMENA IN ARISTARCHUS, (47°W, 23°N)

(1) No.	(2) Date Mo. d. yr.	(3) Time (GT) h m	(4) Phenomena Description	(5) Cat.	(6) Dura-tion	(7) Age days	(8) Co-long. deg.	(9) Term. Dist. deg.	(10) Dates Per. Mo. d. h.	(10) Dates Apo. Mo. d. h.	(11) Hor. Parall. Per. ′ ″	(11) Hor. Parall. Apo. ′ ″	(11) Hor. Parall. Event ′ ″	(12) Anom. Ph. (φ) (d)	(13) Nr. F.M. Date	(14) Sol. Act. $K_{p_{max}}, \Sigma K_p$	(15) Observer	(16) Location (City), (Country)	(17) Instru. Ap. Ty. Pr.	(18) See. (S) (T)	(19) Source	(20) App. Ref.	(21) No.
	1600			1600								1600							1600				
1	/50		"Red hill" (Mons Porphyrie = Aristarchus)	(R)													Hevelius		6′f.l. Sext.?			86	1
	1700			1700								1700							1700				
2	3/ /83		Bright pts. near Aris. dur. occult.	(BR)													W. Herschel	Windsor, Eng.	9″ L			2	2
3	5/ 4/83	2000?	Red, mag. 4 bright. < 3″ diam.	R,BR		4:	320:	87:R	Ap 19 My 17	My 05	60 24 61 09	54 12	54 17N 54 14M	.46: .54:	My 14:		W. Herschel, Lind	Windsor, Eng.	9″ L			3	3
4	5/13/83	2200?	2 small conical mts. formed near last erupt. never seen before, not on any map.	BR		13½:	75:	28:R	My 17	My 05	61 09	54 12		.86:	My 14:		W. Herschel	Windsor, Eng.	9″ L			3	4
5	/84		Nebulous spot of light. (gas?)	(G)													Schroter	Lilienthal, Germany	L		MB	4	5
6	/85		Nebulous spot of light. (gas?)	(G)													Schroter	Lilienthal, Germany			MB	4	6
7	12/24/86	1800?	Extraordinarily bright in earthshine.	BR		4.0:	320:	87:R	D 04? J 01	D 17	60 48	54 07	56 30M 56 14N	.78: .71:	J 04 00 (eclipse)		Schroter	Lilienthal, Germany			MB	4	7
8	4/19/87	1036ST 2230 GT	3 volcanoes, brightest 3′57″.3 from N. limb, other 2 nearer center, > Mechain comet, not seen prev. lun.	BR	1^d?	2.5:	300:	107:R	A 19	A 07	60 55N 60 53M	54 16	60 55N 60 53M	.00 .035	My 02?	(A) on 18th, 19th	W. Herschel	Windsor, Eng.	9? L			5	8
9	4/20/87	1002ST 2200 GT	Brightest vol. even brighter, > 3″ diam. others irreg. shape, sharply distinct at edges, like a nebula-like glowing coals, adj. mts. illum. by it. (gas?)	G, R, BR		3.5:	310:	97:R	A 19	A 07	60 53M	54 16	60 53	.035 .04	My 02?	(A) 19th	W. Herschel	Windsor, Eng.	9? L			3	9
10	5/19-20/87	2300?-0100	Extraordinarily bright.	BR	2^h?	2.5:	300:	107:R	My 17	J 01	61 25M	54 07N	61 02N 60 46M	.10: .11:	J 01? J 30 15 (ecl.)		VonBruhl	Germany?			MB	4	10
11	10/ 7/87	0300?				24:	205:	22:S	O 01	O 16, 17	59 36	54 20	58 14N 58 01M	.17: .21:	S 28?		Schroter	Lilienthal, Germany	Herschel refl.		MB	4	11
12	4/ 9/88	2000?-2100?	Extraordinarily bright. (Indep. confirm of No. 13?)	BR	1^h	4:	320:	87:R	A 12	My 29, 30	59 26N	54 23	58 59N 59 08M	.92: .89:	A 19?		Bode	Berlin, Germany	L		MB	6	12
13	4/9-11/88	2000?-2100? 2100?	Bright spot 26″ N. of crater rim. (Confirmation of Bode?)	BR	2-3^d?	4: 5: 6:	320: 335: 350:	87:R 72:R 57:R	A 12	My 29, 30	59 26N	54 23	59 08M (9th)	.89: .92: .96:(d)	A 19?		Schroter	Lilienthal, Germany	L		MB	4	13
14	9/26/88	0000?-0030?	Bright spot 26″ N. of rim.	BR	30^m	16.0:	110:	117:S	S 26	S 10, 11	60 19M	54 13	60 17N 60 19M	.00: .00:	S 24?		Schroter	Lilienthal, Germany	L		MB	7	14
15	12/ 2/88	0535	Extraordinarily bright, star-like	BR		4.5	306:	83:R	D 15?	D 02?				.50:	D 11 09?		Schroter	Lilienthal, Germany	Herschel refl.		MB	4, 84	15
16	/88		Brilliant spots.	(BR)													Bode	Berlin, Germany			MB	6	16
17	3/30?/89	2000?	Brilliant spots, luminous and Aris. a nebulous spot. (gas?) (Schroter obs. similar phen. nr. Grim. & Riccioli on 30th)	G,BR		4:	320:	87:R	A 07	M 22, 23	60 39	54 05	56 43M	.70: .71: (30th)	A 11?		Bode, Schroter	Berlin, Lilienthal, Germ.	L		MB	8	17
18	4/30?/89	1900?	Brilliant, luminous spots in dark part Aristarchus?) [N.M. Apr. 25]	BR		4-5:	320-: 335:	87:R	A 07		60 39			.7?	My 09?		Bode	Berlin, Germany			MB	8	18
19	5/29?/89	2000?	Same as last 2 lunations, brilliant luminous spots in dark part. N.M. My 24.	BR		4?	320?	87?R:						.1?	J 08? (My 24 22 ecl.)		Bode	Berlin, Germany			MB	8	19
20	1/17/90	1800?	Small, hazy spot in crater. (gas?)	G,BR		3:	305:	102:R	J 04 05	J 20	59 44	54 17	55 05N 54 53M	.39: .43:	J 29?		Schroter	Lilienthal, Germany	L		MB	4	20
21	2/15-18/90	1800?-2000?	Small, hazy spot in crater. (gas?)	G,BR	days?	2:	295:	112:R	F 01	F 17	60		54 24 (16th)	.44:(15)	F 27?		Schroter	Lilienthal, Germany	L		MB	4	21
22	3/19/90	2100?	Small, hazy spot in crater. (gas?)	G,BR		5: 3.5:	332: 310:	75:R 97:R	M 30	M 16	60 40M 61 36N	54 10 54 04	54 18 54 23N 54 32M	.61:(18) .57: .61:	M 30? (A 29 00 ecl.)		Schroter	Lilienthal,	L		MB	4	22
23	/ /92		Many occasions, special appearance.														Bode	Berlin, Germ.			MB	4	23
24	3/ 7/94	2000?	Star-like pt. in dark. (Aris.?) (Indep. confirm.?)	BR		4:	320:	87:R	M 01	M 15, 16	61 33M	54 06	58 05N 57 37M	.25: .25:	M 17		Wilkins, Stratton, Maskelyne	Camb., Green., Eng.				9, 10	24
	1800			1800								1800							1800				
25	1/27/21	0300?	8th mag. star-like pt. seen thru overcast!	BR		23.3:	193:	34:S	F 04	F 20	60 27	54 01		.71:	J 17 19	V.	V. Struve (W?)	Russia	9.6?R	Overcast	P	11	25

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	A	(11) Hor. Par.	(12) ϕ	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1800			1800							1800					1800					
26	2/ 4/21	1930?	6th mag. bright pt. in crater, 3'-4' diam., luminous. (Same as in MB cat. for Feb 5-6?)	BR	days?	2.5:	300:	107:R	F 04	F 20	60 27 54 01 60 27	.00: .00:	F 16 13		Kater, Ward, Bailey	Germany?, Eng.?			F	12	26
27	2/ 5/21	2000?	Bright pt., 6th mag. in crater. Looked like a cloudy spot. (gas?) Olbers thought due to magnification	G,BR	days?	3.5:	315:	92:R	F 04	F 20	60 27 54 01 60 23N 60 15M	.05: .04:	F 16 13		Garding, Olbers	Bremen, Germany	5' f.l. R, 132X		F	11, 13	27
28	2/5-6/21	2300?-0100?	6-7 mag., 3'-4' diam. luminous appearance in dark. (Description similar to No. 26 – Same obs.? – Indep. Confirm?)	BR	days?	3.8:	318:	89:R	F 04	F 20	60 27 54 01 60 15M (5th)	.06: .07:	F 16 13		Kater, Olbers, Browne	Germany, Eng.?			MB	14, 15, 16, 17	28
29	2/ 6/21	2000?	Like a cloudy spot in dark part. (Indep. confirm.?) (gas?)	G	days?	5:	330:	77:R	F 04	F 20	60 27 54 01	.08: .07:			Ward, Bailey	London, Eng.	lge. aper., 80X		F	16	29
30	2/ 7/21	2100?	Like a cloudy spot in dark part. (gas?)	G	days?	6.1:	343:	64:R	F 04	F 20	60 27 54 01	.11:									30
31	5/4-6/21	2130-2200, 2145	In dark part < 1' diam. looked like a small comet extend. toward Grimaldi. Never saw it before – not last lunation. Confirm by Bailey. = mag. 136 Tau at occult. at 22^h05^m55. (gas?)	BR,G	days?	3.3- 5.3	295: 320:	112:R 87:R	A 30	My 12, 13	59 19N 61 06 54 01 (4th) 58 51M	.20 } 4th .14 } .21 (6th)	My 16 16		Ward, Bailey	London, Eng.			MB	18	31
32	11/28/21	2200?	Bright pt. 6th mag., star-like	BR	days?	4.6:	325:	82:R	N 10? D 07, 08?	N 23, 24?		.65:?	D 08 16		Fallows	Capetown, S. Africa			F	19	32
33	11/29/21	2300?	Bright pt. 6th mag., star-like	BR	days?	5.6:	337:	70:R	D 07, 08?	N 23, 24?		.68:?	D 08 16		Fallows?	Capetown, S. Africa			F	19	33
34	11/30?/21	2300?	Bright pt. 5th mag., star-like. (Day not given, is it 3rd day in row?)	BR	days?	6.6?	348?	57?R	D 07, 08?	N 23, 24?		.72:?	D 08 16		Fallows?	Capetown, S. Africa			F	19	34
35	1/27/22	2000?	8th mag. bright point.	BR		5.1:	330:	77:R	J 31	J 16	58 41N 59 14 54 11N 58 48M	.90: .86:	F 05 18		F. Struve	Estonia, Russia	20?R		MB	20	35
36	6/22-23/22	2130?-0100?	Lunar "volcano"	BR	hrs.?	4.1:	320:	87:R	J 18-19? Jy 16-17?	J 4-5?		.14:?	Jy 03 23		Rüppell	Germany?			MB	21	36
37	5/ 1/24	2100?	Blinking, 9-10th mag. light on dark side. (gas?)	BR,G		3.1:	307:	100:R	My 06	A 22	58 13N 59 16 54 11 58 25M	.85: .82:	My 12 14.5		Göbel	Germany?			MB	22	37
38	7/ 4/24	2200?	Star-like light in crater.	BR		8.2:	15:	32:R	J 30 - Jy 01? Jy 28?	Jy 14?		.14:?	Jy 10 16		Emmett	Eng.?			M	23	38
39	10/18/24	0500?	In N.W. and W. of crater mingling of all colors in small spots (gas?) (Similar to Bartlett's granulation? See No. 193 and others)	G,R,V		25.7:	215:	12:S	O 19, 20	O 03	59 58N 60 15 54 04 60 06M	.08: .04:	O 07 16		Gruithuisen	Germany?			MB	24, 25	39
40	11/ 8/24	0000?	In crater, mingling of all colors in spots. (gas?) Violet glimmer near Cobra Head and Plateau. Starts just after sunrise.	R,G,V		16.5:	105:	122:S	O 19, 20 N 16?	O 31?	60 15	.71:	N 06 07		Gruithuisen	Germany?				26	40
41	1/22/25	2000?	Star-like point in dark part.	BR		4.0:	318:	89:R	J 10-11? F 09-10?	D 25? J 22?		.43:?	F 03 00		Eng. Officers	Ship in G. of Siam	Spyglass?		F	27	41
42	4/22/25	2030?	Periodic illumination. (gas?)	BR,G		4.8:	330:	77:R	A 02? A 30	A 14, 15	56 10N 60 41 53 58 56 27M	.69: .71:	My 02 03		Argelander, Göbel	Abö, Finland, Germany			MB	28, 22	42
43	12/25/32	1800?	Bright spot.	BR		4.1:	320:	87:R	J 26	D 25	53 57N 61 15 53 57 53 58M	.50: .50:	J 05 20		Smyth	Scotland			MB	29	43
44	12/22/35	1800?	Star-like pt. 9-10 mag. (Indep. confirm?)	BR		3.3:	310:	97:R	D 18-19	D 31	59 42N 61 17 53 58 59 15M	.16: .14:	J 03 13		Smyth, F. Bailey	Scotland, Eng.			M, F	29, 30	44
45	10/18-/42 19	2300?-0100?	In W. and N.W. of crater, a mingling of all colors in spots. (gas?) (Same descrip. as No. 40, are year nos. transposed?)	G,R,V		15.3:	90:	43:R					O 18 23		Gruithuisen	Germany?			Ri	31	45
46	6/10/66	0300?	Star-like point in dark part.	BR		27.0:	242:	15:S	My 13 21 J 11 05	My 27 01	60 59 54 00 60 35:	.92: .96:	My 29 01		Tempel	Venice, Aus.? or Marseilles, France?			F	32	46
47	6/14-16/66	2130?-2230?	Reddish-yellow in dark part of moon.	R		2.4:- 4.5:	300: 325:	107:R 82:R	J 11 05	J 23 12	59 37(14) 60 59 54 06 57 20(16)	.15: (14) .11: .27: (16)	J 27 16		Tempel	Venice, Aus.? or Marseilles, France?			MB	33	47
48	4/ 9/67	1930-2100	7th mag. on dark part.	BR	1.5^h	5.4	335	72 R	A 07 13	A 23 10	59 53 54 09 59 41	.065: .07	A 18 11		Elger	Bedford, Eng.	4R or 8.5L?		MB	34, 84	48

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	A	(11) Hor. Par.	(12) ϕ	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1800				1800						1800						1800				
49	4/12/67	1930-2100	Seen in earthshine, grew fainter, 7th mag. much fainter in last 15^m barely perceptible at 2100^h. Had seen similar phen. before.	BR	1.5^h	8.3	15	32 R	A 07 13	A 23 10	59 53 54 09 58 34	.16 .17	A 18 11		Elger	Bedford, Eng.	4R or 8.5L?		ALPO (W)	35	49
50	5/ 7/67	2100?	Reddish-yellow beacon-like light. (Indep. confirm.)	BR,R	hrs.	4.0:	320:	87:R	My 05 11	My 21 00	60 43 54 01 60 20:	.08: .08:	My 17 14		Tempel, Flammarion	Marseilles?, Paris, France			MB	33,84	50
51	1/23/80	2000?	Light like a luminous cable or shining wall.	BR		13.7:	75:	28:R	J 09 12 F 06 05	J 21 08	60 31 59 36 54 10 56 05:	.54: .52:	J 26 22		Trouvelot	Meudon, France			F	36	51
52	2/ 3/81	1900 (Loc. Time)	Very bright, 8.0 mag., star-like with pulsations (gas?)	G,BR		5.0:	330:	77:R	J 28 16 F 25 22	F 10 01	61 12 60 27 54 03 57 22	.27: .21:	F 13 19		Gamma, (Pseudonym)				MBMW	84,87	52
53	8/6, 7/81	2000?-0000?	Strong violet light in whole region between Aris. and Herod. and S. V., as if covered by a fog. (gas?) Spread further on the 7th.	G,V	> 1^d	12.3: 13.3:	60: 72:	13:R 25:R	Jy 11 14 A 08 23	Jy 25 20	61 18 61 20 53 57 60 26:	.88: .90:	A 09 07		Klein	Cologne, Germany	6R, or 5L?		MB	4,26	53
54	12/ 5/81	0509	In ecl. it was a white spot and continued so in the coppery disk	BR	> 1^h?	14.1	90	43 R	N 25 03 D 22 17	D 10 22	59 33 60 28 54 10 56 18	.29 .37	D 05 05		S. Johnson				MB	4,37	54
55	11/ 5/83	1800?	Very bright, 7-8 mag. star.	BR		5.8:	340:	67:R	N 13 17 D 12 03.5	N 26 13	61 23 60 50.5 53 59 55 34	.65: .72:	N 14 05		Rr (Pseudonym)				MBMW	84,88	55
56	11/29/84	1900-2100 (Loc. Time?)	Nebulous at center, elsewhere featurds are well defined. (gas?)	G	2^h	12.0:	54	7 R	N 04 04 D 02 15	N 19 14	60 59 61 28 53 56 59 48	.84 .90	D 02 07		Hislop	Eng.?			MBMW	84,89	56
57	6/10/86	2100?	Star-like light.	BR		8.2:	8:	39:R	J 05 11 Jy 03 05	J 21 05	59 49 60 37 54 10 58 24	.17: .19:	J 16 02		Tempel	Marseilles? France			MBMW	84,90	57
58	7/12/89	0900 (Mid Ecl.)	Brilliance in surrounding gloom was striking during ecl.	BR	> 1^h?	14.5	90	43 R	Jy 11 13	J 27 Jy 24 04	53 57 61 12 54 02 61 11	.02 .03	Jy 12 09		Krueger	Gotha, Germany			MB	4,38	58
59	5/23/91	1800-1900	$½^h$ before end of totality, region of Aris. and N. of it became conspicuous and increased in brightness from then on. (At edge of shadow?)	BR	> $½^h$	15.5	90	43 R	My 04 21 My 31 09	My 16 17	59 08.5 56 38N 59 21 54 13 56 55M	.73 .70	My 23 06.5		W. Jackson	Sheffield, Eng.	6R		MB	4,39	59
60	11/ 7/91	1900?	Very distinct luminous point.	BR		6.4:	349:	58:R	O 16 05 N 13 13	O 28 17	61 11 60 30 54 01 57 31	.74: .80:	N 15 12		d'Adjuda	Lisbon, Portugal			F	40	60
61	/ /95-96		Both, several times saw a faint bluish mist on inner W. wall soon after sunrise, not a secondary spectrum. (gas?)	V,G		12?	50?	3?R							Goodacre, Molesworth	Crouch End, Eng. Trincomali, Ceylon	12L 12L			41	61
62	9/21/97	0400?	Glimmering streaks beneath both E. and W. walls and C.P. dimly seen. Whole crater filled with shadow. (gas?)	G,BR		25.0:	212:	15:S	S 01 10 S 28 12	S 16 16	54 45N 60 15M 54 11 56 06M	.65: .73:	S 10 14		Molesworth	Trincomali, Ceylon	12L			42	62
63	12/27/98	2300-0000	Brilliant in eclipse (mid-ecl. at 1139 G.T. = 2339 civ. time)	BR	> 1^h	14.5	90	43 R	D 14 01 J 11 14	D 29 06	61 06 54 11N 61 24 53 58 54 06M	.45 .47	D 27 11.5		Stuyvaert	France?			MB	4,43	63
	1900				1900						1900						1900				
64*	/ /00		Apparent vapor column, variations. (gas?)												W. Pickering	Peru	12?L			44	64
65	3/ 1/03	1830	Star-like pt., flashing intermittently, in earthshine. (gas?)	BR,G		2.9	295	112 R	F 10 01 M 10 01	F 22 01	60 48N 56 23N 59 58N 54 04N 56 38N	.73 .68	M 13 00		Rey	Marseilles, France			F	45	65
66	3/ 3/03	1845-2000	Comet nucleus-like pt. in earthshine. Shadow part bluish. (Possibly crater Sharp instead of Aristarchus)	V,BR	$1¼^h$	4.8	326	81 R	M 10 01	F 22 01	59 58N 54 04N 57 30	.77 .75	M 13 00		Gheury	London, Eng.			F	45	66
67	2/19/05	1800-1930	Glimmering in dark like a little star. (Mid-ecl. at 1852)	BR	1.5	15.2	90	43 R	J 23 06 F 20 12	F 08 08	60 15 60 42N 61 02 54 04 60 53M	.98 .97	F 19 19		Moye	Montpelier, France			MB	4,46	67
68	8/ 4/06	0100	Shone conspicuously during eclipse.	BR	> 1^h?	14.0	90	43 R	Jy 31 19 A 26 22	A 12 18	59 52 58 56N 61 06 54 14 58 38M	.15 .14	A 04 01		Ward	Eng.			MB	4,47	68
69	3/21-22/13	2330-0100	During totality remained visible only a red luminous pt. not much larger and same color as Mars. (Mid-ecl. at 2356)	R,BR	> 1^h	14.5	90	43 R	M 21 00 A 18 05	A 02 08	61 06 60 21 54 02M 61 06	.05 .05	M 22 00		W. Jackson	Sheffield, Eng.	6R		MB	4,48	69
70	2/22/31	(U.T. now) 1930?	Reddish yellow. (region)	R		5.2:	330:	77:R	(U.T. now) F 03 22 M 04 11	F 18 22	61 13 61 29 53 57 54 44:	.60: .66:	(U.T. now) M 04 11		Joulia	France?			MB	4,49	70
71	3/30/33	2000?	White.	BR		4.7:	332:	75:R	M 15 18 A 12 11	M 31 13	59 43 60 36 54 08 54 11:	.47: .54:	A 10 14	3_o, 16_o	Douillet	France?			MB	4,50	71
72	9/17/37	2000?	Bright streak, looked later but did not see it; says it may have been refl. from bright wall.	BR		12.8:	60:	12:R	A 29 03 S 23 21	S 11 22	59 17 59 48 54 15 56 54:	.75: .76	S 20 12	4_o, 19+	H. Johnson	Des Moines, Iowa	7L, 8R		MB	4,51	72

*Region actually was W. of and included Schroter's Valley. Variations described for dates: 10/14/01, 10/8/07, and 4/6/08

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	A	(11) Hor. Par.	(12) ϕ	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1900			1900							1900						1900				
73	2/23/39	2000? (Loc.) 2300? (U.T.)	Bright spot.	BR		4.6:	325:	82:R	F 04? 12 M 04 11	M 16? 20	60 00: 54 02 55 27:	.65: .69:	M 05 18	(S.C. 24th) 3−, 14+	Andrenko	Sao Paulo? Brazil?			MBMW	84,91	73
74	12/27/39	0800?	Faint bluish mist on inner E. wall. (Accord. to Firsoff it was right after sunrise, if so, date is wrong, would be 22?). (gas?)	V,G		16.4:	104:	123:S	D 03 07 D 29 11	D 17 16	59 14 59 57 54 13 59 28:	.95: .92:	D 26 11	4−, 21+	Barcroft	Madera, Calif.	6L			52	74
75	12/2-3/40	0000?	Bright spot in dark part.	BR		2.6:	299:	108:R	N 27 12 D 25 06	D 09 08	60 35 59 39 54 10 58 15:	.21: .16:	D 14 20	5_o, 30_o	Vaughn	Des Moines, Iowa	3L		MB, H	4,51	75
76	3/31/41	0315	Seen in earthshine. (Haas thought it must have been unusually bright)	BR		4.3	320	87 R	M 14 22 A 12 08	M 30 10	60 53 61 22 53 59 54 09	.54 .57	A 11 21	(S.C.) 8_o, 43_o	Barcroft	Madera, Calif.	6L		H,MB	51,4	76
77	1/ /45?		Bluish glowing streaks on floor, and on mt. δ (gas?)	(V,G)											H. P. Wilkins	Kent, Eng.	15L		P	53	77
78	11/30/47	0000?	3 bright pts. on inner W. (IAU?) wall.	BR		17.2:	114	113 S	N 03 14 N 30 18	N 18 23	59 24.5 60 17 54 10 60 13	.98: .97:	N 28 09	(S.C. D01) 3−, 14−	Favarger				MBMW	84	78
79	5/ 1/49	2044	Inner terraces, C.P. and other details became distinctly visible, glowing in earthshine as diffuse patch, lasted for 2^s. (gas?)	BR,G	2^s	3.5	314	93 R	A 12 09 My 10 15	A 24 22	61 14 60 34 54 01 56 03	.67 .68	My 12 13	(S.C.My03) 2+, 9−	H. P. Wilkins	Kent, Eng.	3R, 100X			54	79
80	5/ 2/49	0300-0400	Dull glow, silvery phosphorescence, began to glow at 0330. (gas?) (Extension of activity seen by Wilkins a few hours before?)	G,BR	30^m	3.9	320	87 R	A 12 09 My 10 15	A 24 22	61 14 60 34 54 01 56 15	.68 .70	My 12 13	(S.C. 3rd) 4−, 17+	Barcroft	Madera, Calif.	6L, 96X			54	80
81	10/ 7/49	0240-0300	Suspected glow during totality. (Indep. confirm.)	BR	20^m	14.6	90	43 R	S 23 04 O 21 15	O 07 17	61 16 61 23 53 58 53 59	.52 .49	O 07 03	(S.C. 6th) 7+, 42+	Braun, Reed, Hare, Venor, Brinkmen	Montreal, Canada, U.S.	5.5L, 60X 7L 12L, 70X			55	81
82	11/ 3/49	0053-0120	Blue glare at inner W. wall base.	V	> 25^m	12.1	57	10 R	O 21 15 N 19 02	N 03 18	61 23 61 00 54 00 54 01.5	.48 .44	N 05 21	5+, 25−	Bartlett	Baltimore, Md.	3.5L, 100X	S = F - G		56	82
83	4/21/50	0330	Glowed in earthshine.	BR		3.8	315	92 R	A 03 20 My 02 07	A 18 19	61 09 61 26 53 57 54 14	.56 .61	My 02 05	(S.C.22,23) 2−, 8−	Barcroft	Madera, Calif.	10L, 98X			54	83
84	4/22/50	0315-0440	Glowed in earthshine.	BR	15^h	4.7	327	80 R	A 03 20 My 02 07	A 18 19	61 09 61 26 53 57 54 33	.59 .65	My 02 05	(S.C.) 3_o, 9+	Barcroft	Madera, Calif.	10L, 98X			57	84
85	6/27/50	0155-0935	Blue glare at base of inner W. wall.	V	7.5^h	11.4	53	6 R	My 30 16 J 27 21	J 12 06	61 12 60 34 54 05 60 30	.92 .97	J 29 20	(S.C. 29th) 2_o, 11+	Bartlett	Baltimore, Md.	3.5L, 100X	T = 3 S = 4/10		56	85
86	6/28/50	0314-0339	Blue glare, rim of W. wall.	V	25^m	12.4	66	19 R	J 27 21 Jy 25 13	Jy 09 21	60 34 59 46 54 09 60 34	.01 .01	J 29 20	(S.C. 29th) 2_o, 9_o	Bartlett	Baltimore, Md.	3.5L, 100X	T = 3 S = 4		56	86
87	6/29/50	0520-0541	Strong bluish glare, E., S.E. walls.	V	20^m	13.5	79	32 R	J 27 21 Jy 25 13	Jy 09 21	60 34 59 46 54 09 60 21	.01 .05	J 29 20	(S.C.) 6_o, 28_o	Bartlett	Baltimore, Md.	3.5L, 100X	T = 5 S = 6		56	87
88	7/26/50	0238-0257	Blue glare base of inner W. wall C.P. visible (gray) whereas not usually visible. (gas?)	V,G	20^m	10.9	48	1 R	Jy 25 13 A 20 05	A 06 15	59 46 59 18 54 15 59 44	.00 .02	Jy 29 04	2_o, 10+	Bartlett	Baltimore, Md.	3.5L, 100X			56	88
89	7/31/50	0355-0500	Violet glare, E., N.E. rims.	V	> 1^h	16.0	110	117 S	Jy 25 13 A 20 05	A 06 15	59 46 59 18 54 15 57 17	.24 .22	Jy 29 04	3+, 21_o	Bartlett	Baltimore, Md.	3.5L, 100X	T = 5 S = 4		56	89
90	8/28/50	0320-0426	Intense blue-violet glare, EWBS, E., N.E. rims.	V	> 1^h	14.5	92	135 S	A 20 05 S 15 07	S 03 10	59 18 59 54 54 14 56 42	.27 .31	A 27 15	(S.C.) 4+, 26_o	Bartlett	Baltimore, Md.	3.5L, 100X	T = 5 S = 8		56	90
91	9/26/50	0252-0310	Phosphorescent glow, brightening, fading, brightening during totality. (gas?) (Day and month not given but times are nearest Sep. 26 04 mid-totality.)	BR,G	20^m	14.1	90	43 R	S 15 07 O 13 04	O 01 04	59 54 59 43 54 14 55 31.5	.35 .39	S 26 04	5_o, 24−	Reed, Venor	Montreal, Canada	6L, 48X 12L		P	55	91
92	9/13/51	2300? (JST) = 1400? U.T.	Area S. of crater a brownish-red color, blue color on N.W. rim of A.	V,R		12.0:	60	12 R	S 11 20 O 07 07	S 23 21	59 43 59 17 54 14 59 30.5	.07: .07:	S 15 13	6+, 38_o	T. Osawa	Japan	6L			58	92
93	7/14/54	0418-0500	EWBS, violet glare.	V	40^m	13.7	73	26 R	J 27 10 Jy 23 19	Jy 09 08	59 57 59 20 54 14 55 44	.70 .64	Jy 16 00	4−, 20_o	Bartlett	Baltimore, Md.	5L, 150X	T = 3 S = 4		56	93
94	7/16/54	0440-0545	Whole interior strong violet tint, also in Nimbus and VA. ($3\frac{1}{2}^h$ after mid-totality.)	V	> 1^h	15.7	98	129 S	J 27 10 Jy 23 19	Jy 09 08	59 57 59 20 54 14 56 37	.72 .72	Jy 16 00	4−, 15−	Bartlett	Baltimore, Md.	5L, 150X	T = 5 S = 6		56	94
95	7/17/54	0650-0715	Pale violet tint on surface N.E. of crater, no color elsewhere. Drifting clouds.	V	25^m	16.8	110	117 S	J 27 10 Jy 23 19	Jy 09 08	59 57 59 20 54 14 57 38	.79 .76	Jy 16 00	4−, 14−	Bartlett	Baltimore, Md.	5L, 150X	T = 5-1 S = 5		56	95
96	7/24/54	0650-0748	Crater filled with pale violet light, overflowed onto E. glacis and beyond nimbus to mare surface.	V	1^h	23.7	196	31 S	Jy 23 19 A 18 06	A 06 03	59 20 59 42 54 15 59 19	.02 .02	Jy 16 00	3+, 15+	Bartlett	Baltimore, Md.	5L, 150X	T = 5 S = 5		56	96

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	 A	(11) Hor. Par.	(12) ϕ	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1900				1900						1900						1900				
97	8/11/54	2200	Brilliant in red filter, variable. (gas?)	R,G	min.?	13.0	53	6 R	Jy 23 19 A 18 06	 A 06 03	59 20 59 42 54 15 56 49	.74 .75	A 14 11	3_o, 14+	Firsoff	Somerset, Eng.	6.5L, 200X		Fi	P.C.	97
98	8/18/54	0420-0450	Northern half of crater hazy, ill-defined. (gas?)	G	30^m	19.3	140	87 S	Jy 23 19 A 18 06	 A 06 03	59 20 59 42 54 15 59 42	.00 .00	A 14 11	3_o, 18_o	Bartlett	Baltimore, Md.	5L, 150X	T = 4 S = 5	B	P.C.	98
99	10/11/54	0030-0215, 0440-0515	Absent at 0030-0145, color developed at 0145. Violet tint on floor, E. wall and C.P., intermittent. (gas?)	V,G	3.5^h	14.2	79	32 R	S 14 20 O 13 02	 S 30 14	60 33 61 15 54 01 60 40	.94 .94	O 12 05	3−, 11+	Bartlett	Baltimore, Md.	3.5L, 100X	T = 3- 3.5 S = 7		56	99
100	10/12/54	0055-0210, 0449-0524	Pale violet radiance S., S.E., E., N.E., walls and C.P. (gas?) Strong violet tint E. half of floor, very faint W. half. W. wall dark violet, also Nimbus; pale violet on m.	V,G	> 4^h	15.1	91	44 R	S 14 20 O 13 02	 S 30 14	60 33 61 15 54 01 61 05	.97 .97	O 12 05	0_o, 0_o	Bartlett	Baltimore, Md.	3.5L, 100X	T = 5 S = 5, S = 6		56	100
101	10/13/54	0110-0230, 0500-0530	Bright blue-violet glare, E. rim; pale violet radiance within crater and around SWBS. (gas?) Dark violet in nimbus; pale violet on m. Haze, couldn't focus it at 0515 and color was barely perceptible.	V,G	> 4^h	16.1, 16.3	102, 104	125 S, 123 S	O 13 02 N 10 13	 O 27 23	61 15 61 15 61 30 53 56 61 14	.00 .01	O 12 05	2−, 6−	Bartlett	Baltimore, Md.	3.5L, 100X	T = 5 S = 5-3		56	101
102	10/18/54	0615-0730	Violet radiance, wall bands looked faint. (gas?) Strong blue-violet glare, EWBS, C.P. and E. wall.	V,G	1¼^h	21.3	165	62 S	O 13 02 N 10 13	 O 27 23	61 15 61 30 53 56 58 10	.23 .18	O 12 05	6−, 35−	Bartlett	Baltimore, Md.	3.5L, 100X	T = 5 S = 5-1		56	102
103	11/11/54	0430-0448	Violet glare on E. wall? Bartlett uncertain of color phen. Whole crater was ill-defined, couldn't focus it. Herod. was unaffected. (gas?)	V,G	20^m	15.5	97	120 S	N 10 13 D 09 02	 N 24 00	61 30 61 11 53 56 61 25.5	.02 .02	N 10 14	2_o, 11−	Bartlett	Baltimore, Md.	3.5L, 100X	T = 5 S = 4	B	56, P.C.	103
104	*11/12/54*	*0220-0305,* 0450-0525	*Blue-violet glare, EWBS and all E. wall.* Suspected tint on VA, certain on m. Greatly faded at 0507. Brilliantly clear night but couldn't bring it and area between Aris. and Herod. into focus. (gas?)	V,G	3^h	*16.4,* 16.6	108, 109	*119 S,* 118 S	*N 10 13* D 09 02	 N 24 00	*61 30 61 05* 61 11 53 56 61 02	.07 .06	*N 10 14*	4−, *16+*	*Bartlett*	*Baltimore, Md.*	3.5L, 100X	T = 3-4 S = 5-6		56, P.C.	*104*
105	12/12/54	0220-0308	Strong violet glare, E. rim, EWBS, N. wall, changing to brown at 0235; violet suddenly reappeared at 0255 but faded to invisibility at 0300. Again reappeared at 0308. Only time he ever saw such color changes. (gas?)	V,G,R	48^m	16.6	101	126 S	D 09 02 J 06 09	 D 21 09	61 11 60 24 54 02 59 50	.15 .11	D 10 01	3_o, 15_o	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 3-1		56, P.C.	105
106	1/ 8/55	0027-0105	Strong violet glare, whole E. rim, brightest S.E. and around EWBS.	V	30^m	13.7	80	33 R	J 06 09 F 02 19	 J 18 03	60 24 59 29 54 10 60 05	.07 .06	J 08 13	3−, 10−	Bartlett	Baltimore, Md.	5L, 150X	T = 5 S = 3-1		56, P.C.	106
107	1/12/55	0440-0515	Blue-violet glare, EWBS, E., N.E. rims.	V	35^m	17.9	131	96 S	J 06 09 F 02 19	 J 18 03	60 24 59 29 54 10 56 59	.27 .21	J 08 13	(S.C. 11th) 5_o, 12−	Bartlett	Baltimore, Md.	5L, 150X	T = 5 S = 1-4		56, P.C.	107
108	4/ 5/55	0310-0420	E. wall and glacis violet. Bartlett uncertain of phen.	V	70^m	12.0	60	13 R	M 26 16 A 23 19	 A 11 14	60 12 60 58 54 07 56 01	.32 .34	A 07 07	5−, 25_o	Bartlett	Baltimore, Md.	3.5L, 100X	T = 4 S = 4-1		56, P.C.	108
109	5/ 5/55	0320-0340	Pale violet tint in E. half of floor, violet band at base of E. side of C.P.	V	20^m	12.7	66.5	20 R	A 23 19 My 22 04	 My 09 00	60 58 61 21 54 00 54 39	.41 .40	My 06 22	3+, 18−	Bartlett	Baltimore, Md.	5L, 150X	T = 5 S = 5-1		56, P.C.	109
110	7/13/55	0250	Brilliant in blue-green, not as well-defined as other craters. (gas?)	G, V, BR		22.9	180	47 S	J 19 14 Jy 17 20	 Jy 02 09	61 15 60 43 54 02 58 30	.78 .83	Jy 05 05	3+, 14+	Firsoff	Somerset, Eng.	6.5L, 200?X		Fi	P.C.	110
111	8/ 3/55	0440-0500	Plateau m. only – pale violet tint	V	20^m	14.7	87	40 R	Jy 17 20 A 14 18	 Jy 29 22	60 43 59 56 54 09 55 12	.62 .59	A 03 20	4_o, 19_o	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 4		56	111
112	8/30/55	0335-0345	Floor, base of inner E. wall, N.W. wall faint bluish glare. Smoke-like haze, moon yellow, seeing fair to poor.	V	10^m	12.4	56	9 R	A 14 18 S 10 01	 A 26 15	59 56 59 17 54 15 55 10	.63 .58	S 02 08	2_o, 11_o	Bartlett	Baltimore, Md.	5L, 180X	T = 2-1 S = 5-1		56	112
113	9/ 7/55	0300, *0345-0520*	Dirty brownish misty effect on area N.E. (gas?) of crater; *darkened in blue and yellow alike.* (gas?) Strong blue-violet glare, E., N.E. rims, E. base of C.P., dark violet nimbus; granular aspect of S. floor. (Ind. obs.)	V,G,R	> 2^h	20.3 *20.4*	152 *154*	75 S *73 S*	A 14 18 *S 10 01*	 *A 26 15*	59 56 58 57 *59 17 54 15 58 58*	.86 .89	S 02 08	3+, 15−	Firsoff, *Bartlett*	Somerset, Eng. *Baltimore, Md.*	6.5L, 200X *5L, 180X*	V.G. *T = 3* S = 5	Fi B	P.C., *56, P.C.*	113
114	9/ 8/55	0410-0455	Strong bluish glare on E. wall and N.E.; on S. edge of EWBS and bordering both edges of bright floor band around W. of C.P.; nimbus dark violet tint.	V	45^m	21.4	166	61 S	A 14 18 S 10 01	 A 26 15	59 56 59 17 54 15 59 08	.87 .93	S 02 08	3−, 15_o	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 4-1	B	56, P.C.	114

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	A	(11) Hor. Par.	(12) ϕ	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1900			1900							1900						1900				
115	9/29/55	0240-0315	Floor, blue clay color.	V	35^m	12.9	62	15 R	S 10 01 O 05 11	 S 23 11	59 17 59 42 54 15 56 41	.74 .75	O 01 19	5_o, 26−	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 5		56, P.C.	115
116	9/30/55	2045	Area shows eastward (ast.?) yellow smear, looks darkish in red; indicating presence of green.	V		14.5	78	30 R	S 10 01 O 05 11	 S 23 11	59 17 59 42 54 15 57 41	.78 .82	O 01 19	7−, 40−	Firsoff	Somerset, Eng.	6.5L, 200X	F	Fi	P.C.	116
117	10/ 2/55	0530-0555	Violet glare E., N.E. rim over EWBS. Resembled violet mist, crater was hazy but Herod. was sharp. Could not get sharp focus in red, blue, and green filters. (gas?)	V,G	25^m	16.0	100	127 S	S 10 11 O 05 11	 S 23 11	59 17 59 42 54 15 58 49	.90 .87	O 01 19	4+, 23+	Bartlett	Baltimore, Md.	3.5L, 100X	T = 5 S = 7		56	117
118	10/ 3/55	0445-0505	Whole crater hazy, could not obtain sharp focus. Herod. not affected. (gas?)	G	20^m or 1^d?	16.9	111	116 S	S 10 01 O 05 11	 S 23 11	59 17 59 42 54 15 59 23	.92 .91	O 01 19	4_o, 22_o	Bartlett	Baltimore, Md.	3.5L, 100X	T = 3 S = 5	B	P.C.	118
119	10/ 4/55	0000?, 0445-0505	Low dispersion spec. showing emiss. lines in H and K in central part of crater. (gas) (Confirmed by Bartlett?) Pale violet tint EWBS, all E. rim, nimbus dark violet. Still a trace of haziness but much reduced from previous 2 nights.	G,V	hrs.?	17.7: 17.9	120: 123	107:S 104 S	S 10 01 O 05 11	 S 23 11	59 17 59 33 59 42 54 15 59 34	.95: .94, .96 .96	O 01 19	4−, 16_o	Kozyrev, Bartlett	Crimea, USSR; Baltimore, Md.	50L 3.5L, 100X	T = 3 S = 5	MB	4, 59; 56	119
120	10/ 5/55	0340-0348	Intensely bright blue-violet glare, EWBS, E., N. Walls.	V	8^m	18.8	135	92 S	S 10 01 O 05 11	 S 23 11	59 17 59 42 54 15 59 41.5	.00 .99	O 01 19	6−, 26+	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 6		56	120
121	10/28-/55 29	2200? Local Time 0000? U.T.	"Fraunhofer lines in UV seemed narrower than in solar – indicated luminescent glow. Greatest after f.m. but fluctuated monthly. No correlation with solar activity."	BR, V,G		13.2:	65:	18:R	O 05 11 N 02 03	 O 21 06	59 42 60 35 54 09	 .84	O 31 06	3−, 14_o, 3+, 17−	Kozyrev	Crimea, USSR	50L			60	121
122	10/31/55	0040-0500	Bright blue-violet glare, E., N.E. rim, dark violet nimbus; pale violet radiance on m. Similar at 0450 seen on W. rim which is very rare. Variations. (gas?)	V,G	> 4^h	15.2 15.4	90.5 93	43 R 46 R	O 05 11 N 02 03	 O 21 06	59 42 60 00 60 35 54 09 60 04.5	.93 .92	O 31 06	5+, 29+	Bartlett	Baltimore, Md.	5L, 180X	T = 4 S = 3-4		56	122
123	11/ 1/55	0305-0330	Pale violet tint, EWBS, E., N.E. rims; dark violet in nimbus.	V	25^m	16.3	104	123 S	O 05 11 N 02 03	 O 21 06	59 42 60 35 54 09 60 27	.97 .96	O 31 06	5−, 20+	Bartlett	Baltimore, Md.	3.5L, 100X	T = 5 S = 6		56	123
124	11/27/55	0235-0302	Floor, blue clay color.	V	30^m	12.6	60	12 R	N 02 03 N 30 11	 N 17 23	60 35 61 17 54 01 59 35	.86 .88	N 29 17	3−, 11+	Bartlett	Baltimore, Md.	3.5L, 100X	T = 3 S = 6		56	124
125	/ /55		Luminescent substance (fluorescent) within small depression S. of rays; Reached max. soon after f.m. reaching into violet light, 15% of refl. light. (Same obs. as 121?)	(V)											Kozyrev	Crimea, USSR	50L		P, MBMW	61, 84, 91	125
126	1/27/56	0104-0132	Violet glare all of E. wall around EWBS, violet tint in VA.	V	30^m	13.9	81	34 R	J 26 13 F 23 18	 F 07 19	61 07.5 60 19 54 03 61 05	.02 .02	J 27 15	(S.C.) 6_o, 28−	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 4		56	126
127	1/28/56	0220-0245	Pale violet radiance, E., N.E. rims. (gas?)	V,G	25^m	15.0	94	133 S	J 26 13 F 23 18	 F 07 19	61 07.5 60 19 54 03 60 45	.07 .06	J 27 15	(S.C.27th) 6+, 34+	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 3-1		56	127
128	6/20/56	0325-0353	Blue glare, base of inner W. wall – brilliantly clear but variable seeing.	V	30^m	11.3	50	3 R	J 10 03 Jy 08 11	 J 25 08	60 57.5 61 21 54 00 55 10	.37 .36	J 23 06	3−, 16−	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 3-5		56	128
129	6/22/56	0410-0442	S. region distinctly granulated 6° bright rest of crater 8° bright. SWBS absent. (Brightness on scale 1-10°, 10° brightest.)		> 30^m	13.3	75	28 R	J 10 03 Jy 08 11	 J 25 08	60 57.5 61 21 54 00 54 27	.42 .43	J 23 06	(S.C. 23rd) 3_o, 17−	Bartlett	Baltimore, Md.	5L, 180X	T = 3 S = 6	B	P.C.	129
130	6/26/56	0730-0752	Intense blue-violet glare on EWBS, dark violet nimbus.	V	> 20^m	17.4	126	101 S	J 10 03 Jy 08 11	 J 25 08	60 57.5 61 21 54 00 54 03	.53 .57	J 23 06	4+, 25+	Bartlett	Baltimore, Md.	5L, 180X	T = 4 S = 5-4		56	130
131	6/28/56	0515-0552	Intense blue-violet glare, EWBS; dark violet nimbus. Pale violet VA and m.S. region granulated, 6° bright, rest 8° bright.	V	35^m	19.3	149	78 S	J 10 03 Jy 08 11	 J 25 08	60 57.5 61 21 54 00 54 28	.58 .64	J 23 06	4_o, 21_o	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 5	B	56, P.C.	131
132	6/29/56	0600-0620	Faint blue-violet tint on EWBS.	V	20^m	20.4	161	66 S	J 10 03 Jy 08 11	 J 25 08	60 57.5 61 21 54 00 54 55	.61 .67	J 23 06	5−, 24_o	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 5-1		56	132
133	6/30/56	0630-0720	Vivid blue-violet glare, EWBS, E., N.E. walls.	V	50^m	21.4	174	53 S	J 10 03 Jy 08 11	 J 25 08	60 57.5 61 21 54 00 55 29	.64 .71	J 23 06	5−, 30−	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 5		56	133
134	7/28/56	0520-0555, 0708-0733	Vivid blue-violet glare on C.P. band across E. floor to EWBS, E., N.E. walls. Variations on some of the 7 dark bands but not all. (gas?) Absent at later obs. per.	V,G	35^m	20.1 20.2	156 157	71 S 70 S	Jy 08 11 A 05 21	 Jy 22 11	61 21 61 16 53 58 55 31	.65 .69	Jy 22 21	5−, 29−	Bartlett	Baltimore, Md.	5L, 180X	T = 4 S = 5	B	56, P.C.	134
135	10/16/56	0228-0245	Blue-glare base of inner W. wall.	V	15^m	11.9	51	4 R	O 01 02 O 27 06	 O 12 23	59 55 59 15 54 14 54 59	.61 .54	O 19 17	3−, 7+	Bartlett	Baltimore, Md.	3.5L, 100X	T = 5 S = 6		56	135

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	A	(11) Hor. Par.	(12) ∢	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1900				1900						1900						1900				
136	10/20/56	0035-0055	Bright blue-violet glare on EWBS, E., N.E. rims; nimbus dark violet.	V	20^m	15.8	98	129 S	O 01 02 O 27 06	 O 12 23	59 55 59 15 54 14 57 10	.74 .72	O 19 17	5+, 34−	Bartlett	Baltimore, Md.	5L, 180X	T = 4 S = 4		56	130
137	11/15/56	0105-0130	Faint blue radiance at base of inner W. wall. (gas?)	V,G	25^m	12.3	55	8 R	O 27 06 N 21 17	 N 09 19	59 15 59 46 54 13 56 25	.74 .74	N 18 07	(M.S.?) 8−, 45_o	Bartlett	Baltimore, Md.	3.5L, 100X	T = 5 S = 7		56	137
138	11/16/56	0305-0400	Floor bright bluish tint E. of C.P.; blue-gray W. C.P.	V	35^m	13.4	68.5	21.5 R	O 27 06 N 21 17	 N 09 19	59 15 59 46 54 13 57 14	.76 .79	N 18 07	(M.S.?) 7−, 36_o	Bartlett	Baltimore, Md.	3.5L, 100X	T = 5 S = 8		56	138
139	11/17-/56 18	2330?-0030?	Extraordinarily bright.	BR	1^h?	15.3:	91:	44:R	O 27 06 N 21 17	 N 09 19	59 15 59 46 54 13 58 34:	.84: .86:	N 18 07	(M.S. 16th) 5−, 23_o	Argentiere, et al.	Brazil? or France?	12L?		MBMW	84, 91	139
140	3/17/57	0630-0655	Strong violet glare, EWBS, all of E. wall; dark violet nimbus. Pale violet on m. Haze on crater couldn't focus. Brilliant clear night. (gas?)	V,G	25^m	15.6	102	125 S	M 14 22 A 12 01	 M 27 04	61 04 60 16 54 03 60 15	.11 .08	M 16 02	4_o, 24−	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 4		56	140
141	3/18/57	0630-0655	Strong violet glare, EWBS, E. wall; very strong violet hue in nimbus.	V	25^m	16.6	114	113 S	M 14 22 A 12 01	 M 27 04	61 04 60 16 54 03 59 30	.16 .12	M 16 02	4_o, 21+	Bartlett	Baltimore, Md.	5L, 110X	T = 4 S = 5-1		56	141
142	6/11/57	0435-0500	Floor uniform bluish radiance. (gas?)	V,G	25^m	12.7	70.5	23.5 R	J 03 04 J 30 08	 J 18 11	59 29 60 15 54 12 57 00	.23 .30	J 12 10	1+, 7−	Bartlett	Baltimore, Md.	5L, 110X	T = 4 S = 4		56	142
143	7/11/57	0510-0530	Pale violet radiance in crater and on m. (gas?)	V,G	20^m	13.3	78	31 R	J 30 08 Jy 28 10	 Jy 16 03	60 15 60 59 54 05 55 20	.42 .39	Jy 11 23	3−, 9_o	Bartlett	Baltimore, Md.	5L, 180X	T = 3 S = 6		56	143
144	8/18/57	0620-0735	Pale blue tint on walls, floor dazzling white, 9° bright; inner walls dull, 6° bright, uniformly tinted pale blue-gray.	V	1¼^h	22.1	182	45 S	Jy 28 10 A 25 18	 A 12 14	60 59 61 23 53 59 55 59	.67 .74	A 10 13	3−, 14+	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 8		56	144
145	10/11/57	0305-0325	Bright blue-violet, EWBS, E., N.E. rims, dark violet nimbus.	V	20^m	17.3	119.5	107.5 S	S 23 05 O 21 13	 O 05 22	61 17 60 43 54 01 55 15	.63 .63	O 08 22	4+, 27−	Bartlett	Baltimore, Md.	5L, 180X	T = 4 S = 4-1		56	145
146	16/12/57	0213-0308	Bright blue-violet glare, EWBS, E., N.E., N., N.W. walls; dark violet nimbus.	V	55^m	18.3	132	95 S	S 23 05 O 21 13	- O 05 22	61 17 60 43 54 01 55 39	.65 .67	O 08 22	(S.C. 14th) 4−, 22_o	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 3-1		56	146
147	10/13/57	0300:-0400, 0345-0415, 0700?	Flash, then brownish-red color patch. Weak violet glare, all of E. wall. Bright spot of light – "explosion". (Independent confirmation of activity?)	R V BR	hrs.?	19.5	144	83 S	S 23 05 O 21 13	 O 05 22	61 17 60 43 54 01 56 10	.68 .71	O 08 22	(S.C. 14th) 5+, 29_o	Dachille(s), Bartlett, Haas	Univ. Pk., Pa. Baltimore, Md. Univ. Pk., N.M.	10.5L, 75X 5L, 180X 12L	G T = 4 S = 5	D MB	P.C. 56 62, 4	147
148	10/15/57	0500-0547	Strong blue-violet glare, all of E. wall.	V	> 45^m	21.4	157	70 S	S 23 05 O 21 13	 O 05 22	61 17 60 43 54 01 57 22	.73 .78	O 08 22	(Aurora) 3+, 20+	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 6		56	148
149	10/16/57	0547-0613	Faint blue-gray tint, N., N.W., W. floor and walls.	V	25^m	22.5	182	45 S	S 23 05 O 21 13	 O 05 22	61 17 60 43 54 01 58 08	.76 .81	O 08 22	(A, 15th) 2−, 7+	Bartlett	Baltimore, Md.	5L, 180X	T = 3-2 S = 5		56	149
150	5/ 1/58	0250-0310	Entire sunlit area of floor bluish. Light Cirro-nebula clouds of varying density.	V	20^m	12.0	58.5	11.5 R	A 03 21 My 02 06	 A 16 23	61 25 60 59 53 58 60 48	.90 .96	My 03 12	4+, 28_o	Bartlett	Baltimore, Md.	5L, 180X	T = 1-3 S = 1-5		56	150
151	5/ 4/58	0610-0645	Blue-violet glare, S. side of EWBS; dark violet nimbus; pale violet on m.	V	35^m	15.1	97·	130 S	My 02 06 My 30 07	 My 14 11	60 59 60 12 54 05 60 24	.10 .07	My 03 12	3_o, 16_o	Bartlett	Baltimore, Md.	5L, 180X	T = 3 S = 7		56	151
152	5/31/58	0320-0400	Pale blue-gray floor, violet band at E. base of C.P.	V	40^m	12.3	65	18 R	My 30 07 J 26 09	 J 11 05	60 12 59 27 54 13 60 08	.04 .03	J 01 21	(M.S.?) 8_o, 38_o	Bartlett	Baltimore, Md.	5L, 180X	T = 3 S = 7		56	152
153	6/29/58	0345-0419	Floor, very pale bluish tint.	V	35^m	11.8	60	12 R	J 26 09 Jy 21 11	 Jy 08 23	59 27 59 28.5 54 16 58 58	.10 .11	Jy 01 06	(M.S.?) 8_o, 48_o	Bartlett	Baltimore, Md.	5L, 180X	T = 3 S = 3-5		56	153
154	7/ 2/58	0620-0638	Strong violet glare all of E. wall, including EWBS; dark violet nimbus.	V	20^m	14.9	98	129 S	J 26 09 Jy 21 11	 Jy 08 23	59 27 59 28.5 54 16 57 04	.23 .23	Jy 01 06	2+, 14−	Bartlett	Baltimore, Md.	5L, 180X	T = 3 S = 3-5		56	154
155	7/ 3/58	0700-0712	Bright blue-violet glare, E., N.E. rims; dark violet nimbus, pale violet on m.	V	> 10^m	16.0	110	117 S	J 26 09 Jy 21 11	 Jy 08 23	59 27 59 28.5 54 16 56 38	.24 .28	Jy 01 06	5−, 23−	Bartlett	Baltimore, Md.	5L, 180X	T = 3 S = 5		56	155
156	8/ 2/58	0550-0607	Strong violet glare, EWBS, N.E. wall; dark violet nimbus; strong violet on m.	V	> 15^m	16.4	116	111 S	Jy 21 11 A 17 15	 A 05 18	59 28.5 60 15 54 13 55 04	.37 .43	Jy 30 17	4−, 21−	Bartlett	Baltimore, Md.	4L, 240X	T = 3-5 S = 5		56	156
157	8/31/58	0718-0735	Whole crater filled with pale violet radiance (gas?) Especially bright on walls. Pale violet on VA and m.	V,G	> 15^m	16.2	111	116 S	A 17 15 S 14 17	 S 02 11	60 15 60 59.5 54 05 54 22	.44 .49	A 29 06	3_o, 14−	Bartlett	Baltimore, Md.	4L, 240X	T = 5 S = 5		56	157
158	1/23/59	0620	Brilliant blue interior, later turning white. Obtained very good photos.	V		14.3	79	32 R	J 05 20 J 31 06	 J 17 17	59 44 59 13 54 14 56 15.5	.70 .68	J 24 20	3_o, 15+	D. Alter	Mt. Wilson, Calif.	60L, 700X	S = 2 (F)		63	158
159	3/24/59	0224-0235, 0435-0515	Strong blue and blue-violet glare, E. wall, EWBS, SWBS; intermittent display and variations; wall bands abnormal. (gas?) Haze assoc. with color only and indistinctness in E. half and Aris. A. only; S. and W. unaffected. Used filters and considers it extraordinary phenomenon.	V,G	> 2.5^h or 1^d?	14.6	84 86	37 R 39 R	F 26 10 M 26 09	 M 14 09	59 56 60 03 60 48 54 07 60 06	.93 .92	M 24 20	(S.C. 26th) 3−, 16_o	Bartlett	Baltimore, Md.	4L, 120X 5L, 110X	T = 5 S = 3	B	56, P.C.	159

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	A	(11) Hor. Par.	(12) ϕ	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1900			1900							1900						1900				
160	3/25/59	0506-0542	Intense blue-violet glare, all of E. rim and EWBS; dark violet nimbus; filled with haze, could not focus it. Herodotus unaffected. (gas?)	V,G	$> 35^m$	15.8	98	129 S	F 26 10 M 26 09	M 14 09	59 56 60 48 54 07 60 36	.94 .96	M 24 20	(S.C. 26th) 5+, 31+	Bartlett	Baltimore, Md.	4L, 240X	T = 5 S = 7	B	56, P.C.	160
161	9/ 5/59	1913-1945	Star-like point 8-9th mag., intermittent $2\text{-}5^s$ in groups of 4 periods; intervals of $30^s\text{-}3^m$. (Moon set at 1945, prob. atm. phen.?)	BR	$> 30^m$	2.7	306	101 R	A 13 16 S 07 17	A 26 06	59 27 59 29 54 15 59 17	.94 .93	S 17 01	(A, 3rd) (S.C. 4th) 6−, 34+	Rule	London, Eng.	3R, 130X		MB	4,64	161
162	11/ 5/59	1900?	Blinking light in crater; 2 round white moving objects. (gas?)	BR,G		4.9:	330:	77:R	N 02 01 N 30 12	N 17 07	61 05 61 29 53 57.5 59 21:	.17: .13:	N 15 10	5_o, 31−					M	23	162
163	2/15/61	0811	Seen as a bright feature (and 2 others) in a film of a solar ecl. Shown on BBC 5/6/66.	BR	min.?	0.0	270	137 R	F 14 11 M 14 18	F 26 21	61 13 60 29 54 02 61 05	.04 .03	M 02 14	A (17th) 3_o, 13+	Middlehurst, Sartory				M	65	163
164	5/30-/61 31	2300?-0030?	Enhancement in UV spectrum.	V,BR	$> 1^h$?	16.3:	104:	29:R	My 06 12 J 02 03	My 21 05	59 20 60 02 54 14 59 35:	.92: .92:	My 30 04	4_o, 29+	Grainger, Ring	Eng.?			MBMW	84, 92	164
165	6/27-/61 28	2330?-0030?	Enhancement in UV spectrum.	V,BR	1^h?	14.8:	86:	39:R	J 02 03 J 30 01	J 17 22	60 02 60 49 54 07 60 14:	.90: .93:	J 28 13	2−, 9_o	Grainger, Ring	Eng.?			MBMW	84, 92	165
166	11/25/61	2130	Emiss. lines in spect. of C.P., sharp at red end, several km^2 area. (gas?)	R,G	min.?	17.5	126	101 S	N 17 05 D 12 00	N 29 22	59 19 59 32 54 15 55 34	.34 .35	N 22 10	2+, 9_o	Kozyrev	Crimea, USSR	50L	E		60	166
167	11/27/61	2330	Emiss. lines in spect. of C.P. in red and blue; H_2 identified. (gas)	R,V,G	min.	19.6	152	75 S	N 17 05 D 12 00	N 29 22	59 19 59 32 54 15 54 34	.42 .44	N 22 10	2_o, 8−	Kozyrev	Crimea, USSR	50L	E		60	167
168	12/ 3/61	0305-0340	Emiss. lines in spect. of C.P. in red and blue, several km^2 area projected into wall shadow. Source rose above crater. (gas)	R,V,G	35^m	24.8	216	9 S	N 17 05 D 12 00	N 29 22	59 19 59 32 54 15 55 07	.63 .64	N 22 10	(S.C. 5th) (A, 1st) 7−, 40−	Kozyrev	Crimea, USSR	50L	E		60	168
169	10/ 8/62	0100-0200	Activity (not included in analyses).	(BR?)	1^h	9.3	22	25 R	S 14 16 O 13 03	S 29 01	61 22 61 25.5 53 55 58 12	.77 .82	O 13 12.5	6+, 34−	Adams	Missouri	10L, 57X				169
170	10/4?-5/63	2335-0045	Strong luminescence ~30% of total light, recorded photoelectrically. Effect strongest in Aris. region in green (5450 Å); effects in Hα, NaD, Fe.	V,R, BR	70^m	17.1	115	112 S	O 04 15 N 02 00	O 20 02	60 54 61 26 53 58 60 53	.02 .04	O 03 05	3+, 15−	Scarfe	Cambridge, Eng.	36L		P	66	170
171	10/30/63	0115-0220, 0150-0215	Ruby-red spots (3), brilliant sparkle, movement (lightning?). Pink on rim. Later, violet Jamieson didn't see anything till 0115. Event at 0158-0205 for one of these indep. obs. Surface details blotted out under red color on cobra head spots. (gas?)	R,V,G, BR	$> 1^h$	12.6	60	13 R	O 04 15 N 02 00	O 20 02	60 54 61 26 53 58 58 20	.79 .90	N 01 14	(M.S.) 8−, 25_o	Budine, Farrell, Jamieson, Greenacre, Barr	Binghamton, N.Y. Flagstaff, Ariz.	4R, 300X 24R	F S = 3-4	ALPO (W) S	P.C. P.C., 67	171
172	11/1-2/63	2235-2242, 2330-0200	Enhancement in red light; photos, filters (6725 Å, 5450 Å). Lumin. 86% above background. Moore noted something unusual from 2230-0200. (Indep. confirm.)	R,BR	3.5^h	15.5	95	132 S	N 02 00 N 30 13	N 16 06	61 26 61 25 53 56 61 26	.00 .00	N 01 14	5_o, 23+	Kopal, Rackham, P. Moore	Picdumidi, France Sussex, Eng.	24R 12L		 P	 68, P.C. (Moore)	172
173	11/11/63	2330?	Reddish orange, sparkle in some areas. (lightning and gas?)	R,G, BR		25.5:	215:	12:S	N 02 00 N 30 13	N 16 06	61 26 61 25 53 56 54 46	.40: .34:	N 01 14	4−, 24_o	Jacobs	Flagstaff, Ariz.	24R	V.G.	P	69, P.C.	173
174	11/27/63	0300	Red glow in dark part.	R,BR		10.8	42	5 R	N 02 00 N 30 13	N 16 06	61 26 61 25 53 56 59 38	.83 .88	D 01 00	2+, 4+	Fisher, Olivarez	Colfax, Calif. N. Mex.?	8L, 300X 17L	V.G.		P.C.	174
175	11/28/63	0030-0145, 0500-0600	Reddish-orange, sparkle, then blue later. Indep. confirm., but not seen by Cyrus at 0225-0230. Haze assoc. with the blue. (gas?)	R,V, G, BR	5.5^h	11.7	53	6 R	N 02 00 N 30 13	N 16 06	61 26 61 25 53 56 60 25	.88 .90	D 01 00	3+, 9+	Fisher, Barr, Hall, Greenacre Tombaugh, Cyrus	Colfac, Calif. Flagstaff, Ariz. Las Cruces, New Mex.	8L, 300X 24R, 61L 16L	V.G.		P.C., 70,	175
176	12/28/63	0115-0200	Tiny red spots on E. rim, reddish-orange on hill E. of Schr. Valley. Obs. wonders if it was effects of spurious seeing. Absent at $00^h04\text{-}10^h00$ at Table Mt. obs.	R	45^m hrs.?	12.0	58	11 R	N 30 13 D 29 00	D 13 09	61 25 60 53 53 58 60 45	.97 .98	D 30 11	4−, 24_o	Olivarez, Capen, et al.	Edinburg, Tex. Table Mt., Cal.	17L 16L			58, 94	176
177	12/28/63	1555-1636	Red area, spreading to Herod. Peculiar fainter obscuring gray area in N. Edge of glow. (gas?) (Continuation of act. seen earlier?)	R,G	$> 40^m$	12.5	65	18 R	N 30 13 D 29 00	D 13 09	61 25 60 53 53 58 60 51	.97 .99	D 30 11	4−, 24_o	Yamada, et al.	Hiroshima, Japan	10L, 278X	E		71	177
178	12/29-/63 30	2200-0300	Purplish colors in crater.	V	5^h	13.9	82	35 R	N 30 13 D 29 00	D 13 09	61 25 60 53 53 58 60 43	.05 .03	D 30 11	4−, 24_o	Doherty, et al.	Eng.			GR	72	178

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	(10) Anom. Date A	(11) Hor. Par.	(12) ϕ	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1900				1900						1900						1900				
179	2/25/64	0237-0238, 0239-0242, 0100-1000	Red flashes also in Cobra Head (lightning?) Table Mt. obs. saw nothing unusual at 0100-1000.	BR,R	5^m	11.5	56	9 R	F 21 08 M 17 16	 M 05 17	59 14 59 42 54 15 58 40	.11 .15	F 27 13	6–, 23_o	Budine, Capen, et al.	Binghamton, N.Y. Table Mt., Cal.	4R, 250X 16L	T = 4 S = 6 T = 5 S = 0 = G?	ALPO (W),	73, 94	179
180	3/16/64	2358-0030	Sudden red glow on S.W. rim, in earthshine.	BR,R	½^h	2.9	310	97 R	F 21 08 M 17 16	 M 05 17	59 14 59 42 54 15 59 41	.98 .97	M 28 03	3+, 16+	Lecuona	Madison, N.J.	, 225X	S = 6		74	180
181	3/18/64	0059	Flash(es?)	BR		3.9	323	84 R	M 17 16 A 14 10	 A 02 12	59 42 60 34 54 10 59 42	.01 .01	M 28 03	2–, 6+	Earl(2)	St. Petersburg, Fla.	2.4R, 35X	V.G.	MBDC	P.C.	181
182	3/26/64	0027-0047, 0332-0358	Floor, blue clay color. Table Mt. Obs. saw nothing unusual from 03^h32-03^h58.	V	20^m	11.9 12.0	60 61	13 R 14 R	M 17 16 A 14 10	 A 02 12	59 42 60 34 54 10 56 50.6	.28 .30	M 28 03	4_o, 18–	Bartlett, Young	Baltimore, Md. Table Mt., Cal.	4L, 240X 16L	T = 2 S = 5, T = 6+ S = 2 = G?		56, 94	182
183	3/28/64	0140-0218	Blue-violet glare, E., N. walls, EWBS, nimbus violet tinge.	V	40^m	14.0	85	38 R	M 17 16 A 14 10	 A 02 12	59 42 60 34 54 10 55 50	.33 .37	M 28 03	0_o, 1–	Bartlett	Baltimore, Md.	5L, 180X	T = 3 S = 5		56	183
184	5/26/64	0410-0435	Strong blue-violet glare, E. wall and EWBS, Strong violet tinge in nimbus. Crater hazy, couldn't focus it in red, green or blue filter. (gas?)	V,G	25^m	14.3	86.5	39.5 R	My 12 16 J 10 02	 My 27 09	61 11 61 21.5 53 59 54 03	.46 .48	My 26 09	4–, 12+	Bartlett	Baltimore, Md.	5L, 180X	T = 5 S = 5	B	56, P.C.	184
185	5/28/64	0525-0552	Blue-violet glare, E., N.E. walls; dark violet nimbus.	V	25^m	16.3	111.5	115.5 S	My 12 16 J 10 02	 My 27 09	61 11 61 21.5 53 59 54 01.5	.52 .55	My 26 09	3–, 16_o	Bartlett	Baltimore, Md.	4L, 240X	T = 2 S = 4-5		56	185
186	5/30/64	0710-0752	Bright blue-violet glare, EWBS, E., N.E. walls; dark violet nimbus.	V	40^m	18.4	137	90 S	My 12 16 J 10 02	 My 27 09	61 11 61 21.5 53 59 54 24	.57 .62	My 26 09	3+, 12_o	Bartlett	Baltimore, Md.	4L, 240X	T = 3 S = 3		56	186
187	6/ 6/64	0820-0910	2 red spots, glimmer, like ruby gem, sketches. (gas?) (Predicted by Greenacre as circumstances similar (?) to Oct. '63 obs.)	R,G, BR	50^m	25.4	222	5 S	My 12 16 J 10 02	 My 27 09	61 11 61 21.5 53 59 59 23	.82 .86	My 26 09	A (8th) 2_o, 7_o	Schmidling, Platt, Cooper	Riverdale, N.Y.	8L, 256X		MBDC	P.C.	187
188	6/23/64	0445-0505	Blue-violet glare, N.E. rim, nimbus strong violet tinge. Absent 1^h earlier.	V	20^m	13.0	76	29 R	J 10 02 Jy 08 11	 J 23 12	61 21.5 61 04 53 59 54 00	.49 .46	J 25 01	2+, 13_o	Bartlett	Baltimore, Md.	5L, 180X	T = 3 S = 4-1		56	188
189	6/25/64	0405-0435	Blue-violet glare, EWBS, E., N.E. walls; nimbus faint violet tinge. (Correction to his pub. data.)	V	30^m	15.0	93	134 S	J 10 02 Jy 08 11	 J 23 12	61 21.5 61 04 53 59 54 07	.53 .53	J 25 01	4_o, 17+	Bartlett	Baltimore, Md.	5L, 180X	T = 2-3 S = 4	B	56, P.C.	189
190	6/26/64	0510-0538	Nimbus dark violet; pale violet on m; absent from crater.	V	30^m	16.0	106	121 S	J 10 02 Jy 08 11	 J 23 12	61 21.5 61 04 53 59 54 20	.54 .57	J 25 01	2_o, 11+	Bartlett	Baltimore, Md.	5L, 180X	T = 4 S = 5		56	190
191	6/27/64	0520-0557	Bright blue-violet, EWBS, E., N.E. rims; nimbus dark violet.	V	> 35^m	17.0	118	109 S	J 10 02 Jy 08 11	 J 23 12	61 21.5 61 04 53 59 54 37	.58 .60	J 25 01	2_o, 11–	Bartlett	Baltimore, Md.	4L, 240X	T = 4 S = 5		56	191
192	6/28/64	0557-0625	Blue-violet glare, EWBS, E., N.E., N., N.W. walls; brownish tinge on floor, changed to yellow-brown, coppery.	V,R	30^m	18.0	131	96 S	J 10 02 Jy 08 11	 J 23 12	61 21.5 61 04 53 59 54 58	.61 .64	J 25 01	4–, 17–	Bartlett	Baltimore, Md.	5L, 180X	T = 4 S = 5	B	56, P.C.	192
193	6/29/64	0705-0733	Violet glare? Suspected on EWBS but too faint to be certain. S. region of floor granulated and coppery tint.	V,R	30^m	19.1	143	84 S	J 10 02 Jy 08 11	 J 23 12	61 21.5 61 04 53 59 55 27	.64 .68	J 25 01	3–, 12_o	Bartlett	Baltimore, Md.	4L, 240X	T = 4 S = 5	B	56, P.C.	193
194	6/30/64	0550-0610	Nimbus only, dark violet hue. S. floor granulated, brown tinge, changed to yellow. Hazy night but obs. not affected.	V,R	20^m	20.0	155	72 S	J 10 02 Jy 08 11	 J 23 12	61 21.5 61 04 53 59 56 00	.66 .71	J 25 01	2–, 6+	Bartlett	Baltimore, Md.	4L, 240X	T = 3 S = 6	B	56, P.C.	194
195	7/ 5/64	0745-0805	Deep ravine on E. glacis obscured for most of its length (gas?)	G	20^m	25.1	217	10 S	J 10 02 Jy 08 11	 J 23 12	61 21.5 61 04 53 59 59 48	.84 .89	J 25 01	2+, 10_o	Bartlett	Baltimore, Md.	4L, 240X	T = 5 S = 5	B	56, P.C.	195
196	7/21/64	0200-0223, 0411-0501	Ravine interrupted by break at EWBS, normally continuous – probable obscuration (gas?) Absent at Table Mt. 04^h11-05^h01.	G	23^m	11.6	50	3 R	Jy 08 11 A 05 15	 Jy 20 21	61 04 60 23.5 54 05 54 05	.51 .45	Jy 24 16	(M.S. 19th) 3–, 13–	Bartlett, Young	Baltimore, Md. Table Mt., Cal.	5L, 180X 16L	T = 5 S = 7 T = 5+ S = 2 = G?	B	56, P.C. 94	196
197	7/23/64	0445-0505	S. floor granulated rated 6° bright, rest of of crater 8°, distinctly yellow-brown. Had never seen browns or yellows before 6/28/64.	R	20^m	13.7	75	28 R	Jy 08 11 A 05 15	 Jy 20 21	61 04 60 23.5 54 05 54 23	.56 .52	Jy 24 16	2_o, 11_o	Bartlett	Baltimore, Md.	5L, 180X	T = 3 S = 1-4	B	56, P.C.	197
198	7/27/64	0455-0510	S. region again granulated 6° bright. Bright spots on gray background no color. Large SWBS seen on 24th, no longer visible.		15^m	17.7	124.5	102.5 S	Jy 08 11 A 05 15	 Jy 20 21	61 04 60 23.5 54 05 55 52	.65 .66	Jy 24 16	(M.S. 29th) 1–, 4–	Bartlett	Baltimore, Md.	4L, 240X	T = 2 S = 7	B	56, P.C.	198

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	A	(11) Hor. Par.	(12) Φ	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1900			1900							1900					1900					
199	7/28/64	0430-0457	Blue-violet glare EWBS; nimbus dark violet; pale violet on m.	V	$> 25^m$	18.7	135.5	91.5 S	Jy 08 11 A 05 15	 Jy 20 21	61 04 60 23.5 54 05 56 22	.69 .70	Jy 24 16	(M.S. 29th) 1+, 4+	Bartlett	Baltimore, Md.	4L, 240X	T = 3 S = 7	, B	56, P.C.	199
200	7/29/64	0540-0606	Nimbus only, dark violet. S. region granulated and very dull, 6°, yellow-brown, faint tinge. Crater 8° bright.	V,R	25^m	19.8	149	78 S	Jy 08 11 A 05 15	 Jy 20 21	61 04 60 23.5 54 05 56 57	.71 .74	Jy 24 16	(M.S.) 5–, 22+	Bartlett	Baltimore, Md.	4L, 240X	T = 3-2 S = 6		56	200
201	7/31/64	0517-0548	Pale blue tint, N.E., N., N.W. walls and floor.	V	30^m	21.8	173.5	53.5S	Jy 08 11 A 05 15	 Jy 20 21	61 04 60 23.5 54 05 58 08	.77 .81	Jy 24 16	(M.S. 29th) 3–, 16–	Bartlett	Baltimore, Md.	4L, 240X	T = 3 S = 4		56	201
202	8/19/64	0400-0430	Ravine on E. glacis apparently obscured for 2/3 length N. of rim of EWBS craterlet. (gas?)	G	30^m	11.4	45	2 R	A 05 15 S 02 02	 A 17 12	60 23 59 34.5 54 12 54 24	.56 .50	A 23 05	2_o, 10+	Bartlett	Baltimore, Md.	4L, 240X	T = 3 S = 4-3	, B	56, P.C.	202
203	8/24/64	0410-0435	Bright blue-violet EWBS, E., N.E. walls.	V	25^m	16.4	106	121 S	A 05 15 S 02 02	 A 17 12	60 23 59 34.5 54 12 56 34	.71 .67	A 23 05	1+, 6_o	Bartlett	Baltimore, Md.	4L, 240X	T = 5 S = 7		56	203
204	8/25/64	0450-0500	Bright blue-violet, EWBS E., N.E. rims; nimbus dark violet; S. region almost as bright as rest of crater, 8°; yellow-brown and granulated.	V,R	10^m	17.4	119	108 S	A 05 15 S 02 02	 A 17 12	60 23 59 34.5 54 12 57 04	.73 .71	A 23 05	3_o, 15_o	Bartlett	Baltimore, Md.	4L, 240X	T = 4-0 S = 1-3	, B	56, P.C.	204
205	8/26/64	0200-0300, 0403-0430	Red and blue bands. Blue-violet glare, EWBS, E., N.E. rims; nimbus dark violet. (Indep. confirm.?)	R,V V	2^h5	18.4	130.5	96.5 S	A 05 15 S 02 02	 A 17 12	60 23 59 34.5 54 12 57 32	.76 .74	A 23 05	3+, 18–	Grenatt, Reid, Bartlett	Greenbelt, Md. Baltimore, Md.	16L, 360X 4L, 240X	P-G T = 3 S = 3-4	MBDC,	P.C., 56	205
206	8/27/64	0430-0445	Blue-violet glare, EWBS, E., N.E. walls; nimbus dark violet; pale violet on m.	V	15^m	19.4	143	84 S	A 05 15 S 02 02	 A 17 12	60 23 59 34.5 54 12 58 00	.78 .78	A 23 05	3–, 16_o	Bartlett	Baltimore, Md.	4L, 240X	T = 3 S = 4-3		56	206
207	8/28/64	0430-0450	Faint blue-violet radiance (gas?) EWBS, nimbus dark violet. S. region dull, 6°, granulated distinct yellow-brown, rest of crater 8° bright.	V,G, R	20^m	20.4	155	72 S	A 05 15 S 02 02	 A 17 12	60 23 59 34.5 54 12 58 24	.80 .82	A 23 05	2–, 5–	Bartlett	Baltimore, Md.	4L, 240X	T = 3 S = 5-4		56	207
208	9/18/64	0105-0126, 0550-0910	Craterlet at base of N.W. wall bluish; thick cirro-nebula clouds. Nothing unusual seen at Table Mt. 0550^h-0910^h and on 19th.	V	20^m 3^h5	11.9 12.1	50 52	3 R 5 R	S 02 02 S 27 05	 S 14 07	59 34.5 59 20 54 16 55 23	.64 .63	S 21 18	2–, 11–	Bartlett Capen, et al.	Baltimore, Md., Table Mt., Cal.	4L, 240X 16L	T = 2 S = 5-6, T = 6+ S = 1 = G?		56, 94	208
209	9/20/64	0415-0450	Several red spots in area from Aris. to Herod. No change when obs. stopped.	R	$> 35^m$	14.0	80	33 R	S 02 02 S 27 05	 S 14 07	59 34.5 59 20 54 16 56 43	.73 .72	S 21 18	1+, 3_o	Crowe, Cross	Whittier, Cal.	19L, 390X	F-G	AADC	P.C., 75	209
210	9/22/64	0254-0303	Bright blue-violet glare, EWBS, N.E. rim; nimbus dark violet; S. region 8°, rest of crater 7°, red-brown changed to coppery to yellow-brown.	V,R	9^m	16.0	100	127 S	S 02 02 S 27 05	 S 14 07	59 34.5 59 20 54 16 57 52	.80 .80	S 21 18	8–, 29_o	Bartlett	Baltimore, Md.	4L, 240X	T = 5 S = 5	, B	56, P.C.	210
211	9/23/64	0320-0340	Blue-violet glare, EWBS, N.W., E., N.E. and N. walls.	V	20^m	17.0	112	115 S	S 02 02 S 27 05	 S 14 07	59 34.5 59 20 54 16 58 23	.83 .84	S 21 18	4–, 15–	Bartlett	Baltimore, Md.	4L, 240X	T = 5 S = 6		56	211
212	9/24/64	0320-0340	Crater 8° bright. S. region duller, 7° and pale yellow-brown.	R	20^m	18.0	125	102 S	S 02 02 S 27 05	 S 14 07	59 34.5 59 20 54 16 58 49	.87 .88	S 21 18	3+, 17–	Bartlett	Baltimore, Md.	4L, 240X	T = 5 S = 6	, B	56, P.C.	212
213	9/25/64	0355-0415	Blue-violet glare, EWBS; nimbus dark violet.	V	20^m	19.0	137	90 S	S 02 02 S 27 05	 S 14 07	59 34.5 59 20 54 16 59 07	.90 .92	S 21 18	3–, 9_o	Bartlett	Baltimore, Md.	4L, 240X	T = 5 S = 5-1		56	213
214	9/26/64	0500-0515	Moderately intense (violet glare?), EWBS; nimbus dark violet.	V	15^m	20.1	149	78 S	S 02 02 S 27 05	 S 14 07	59 34.5 59 20 54 16 59 17	.97 .96	S 21 18	2_o, 7_o	Bartlett	Baltimore, Md.	4L, 240X	T = 5 S = 5		56	214
215	10/19/64	0155-0210	Blue glare on E. part of floor.	V	15^m	13.4	68	21 R	S 27 05 O 23 22	 O 12 03	59 18 60 04.5 54 13 57 50	.86 .82	O 21 05	5–, 31–	Bartlett	Baltimore, Md.	4L, 240X	T = 3 S = 4	, B	ALPO Meet.	215
216	10/22/64	0210-0215	Blue-violet glare, EWBS, E., N.E. walls; nimbus dark violet.	V	5^m	16.4	105	122 S	S 27 05 O 23 22	 O 12 03	59 18 60 04.5 54 13 59 43.5	.94 .93	O 21 05	2–, 7_o	Bartlett	Baltimore, Md.	4L, 240X	T = 2.5 S = 4		56	216
217	10/23/64	0235-0245	S. region granulated, 6° bright, pale yellow, rest of crater 8° bright.	R	10^m	17.4	117	110 S	S 27 05 O 23 22	 O 12 03	59 18 60 04.5 54 13 60 01.5	.97 .97	O 21 05	0+, 1_o	Bartlett	Baltimore, Md.	3R, 200X	T = 4 S = 3-5	, B	56, P.C.	217
218	10/24/64	0400-0405	Blue-violet glare, EWBS, E., N.E. rims, nimbus dark violet.	V	5^m	18.5	130	97 S	O 23 22 N 21 00	 N 08 22	60 04.5 60 57 54 05 60 05.5	.01 .01	O 21 05	3_o, 8+	Bartlett	Baltimore, Md.	4L, 240X	T = 5 S = 4-3		56	218
219	10/25/64	0430-0445	Blue-violet glare, EWBS, E., N.E. walls; nimbus faint violet tinge. (Corr. to time in his pub. data.)	V	15^m	19.5	142	85 S	O 23 22 N 21 00	 N 08 22	60 04.5 60 57 54 05 59 56	.04 .05	O 21 05	3–, 8_o	Bartlett	Baltimore, Md.	4L, 240X	T = 5 S = 5	, B	56, P.C.	219
220	10/26/64	0415-0430	Nimbus only, dark violet.	V	15^m	20.5	154.5	72.5 S	O 23 22 N 21 00	 N 08 22	60 04.5 60 57 54 05 59 39	.09 .08	O 21 05	5+, 23–	Bartlett	Baltimore, Md.	4L, 240X	T = 5 S = 5-3		56	220
221	11/21/64	0150-0204	Bright blue-violet glare, N.E., N., N.W. rims.	V	15^m	16.8	110	117 S	N 21 00 D 19 11	 D 06 12	60 57 61 27 53 58 60 57	.00 .00	N 19 16	2–, 5_o	Bartlett	Baltimore, Md.	3R, 200X	T = 5 S = 5		56	221

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	(10) Anom. Date A	(11) Hor. Par.	(12) ϕ	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1900			1900							1900						1900				
222	11/23/64	0324-0335	Blue-violet glare N., N.E., N.W. walls, nimbus dark violet.	V	10^m	18.9	135	92 S	N 21 00 D 19 11	D 06 12	60 57 61 27 53 58 60 20	.10 .07	N 19 16	5−, 26_o	Bartlett	Baltimore, Md.	3R, 200X	T = 5 S = 4		56	222
223	11/24/64	0445-0455	Blue-violet glare, N. rim; nimbus dark violet; VA pale violet.	V	10^m	19.9	148	79 S	N 21 00 D 19 11	D 06 12	60 57 61 27 53 58 59 41	.15 .11	N 19 16	1+, 5−	Bartlett	Baltimore, Md.	3R, 200X	T = 5 S = 4		56	223
224	12/19/64	0313-0314	Brightened 5X during totality. (gas?) (Indep. confirm.)	BR,G	1^m	15.0	90	43 R	N 21 00 D 19 11	D 06 12	60 57 61 27 53 58 61 25	.99 .99	D 19 03	3+, 17−	Budine, Farrell, Hill, et al.	Binghamton, N.Y. Baltimore, Md.	4R, 120X 12R?	T = 5 S = 7	ALPO (W)	73, 75	224
225	5/15/65	0140-0215	Moon Blink detection. Pulsation of image. (gas?) Photos don't show event.	R?,G	35^m	13.5	80	33 R	My 05 01 J 01 18	My 20 20	59 45 60 34 54 10 55 58	.32 .36	My 15 12	2_o, 8+	Johnson, McClench, Weresiuk	Pt. Tobacco, Md.	16L, 240X Moon Blink	T = G S = F	MBDC	75	225
226	7/ 2/65	0420-0550	Star-like flashes to patchy blotches, 4th mag. (Indep. confirm.)	BR	80^m	3.0	308	99 R	J 30 00 Jy 28 09	Jy 14 17	61 22 61 22.5 53 58 60 28	.12 .08	Jy 13 17	2_o, 12−	Albert, Welch, Emanuel	Azusa, W. Covina, Cal.	8L, 375X 4.5L		AADC	76, 75	226
227	7/ 3/65	0425-0534	Star-like flashes, pulsating, 4th mag. (gas?)	BR,G	70^m	4.0	320	87 R	J 30 00 Jy 28 09	Jy 14 17	61 22 61 22.5 53 58 59 47	.12 .11	Jy 13 17	2+, 11_o	Albert, Welch, Emanuel	Azusa, W. Covina, Cal.	8L, 375X 8L 4.5L		AADC	76, 75	227
228	7/ 4/65	0353-0559	Star-like flashes. (Indep. confirm.)	BR	> 2^h	5.0	332	75 R	J 30 00 Jy 28 09	Jy 14 17	61 22 61 22.5 53 58 59 00	.19 .15	Jy 13 17	1+, 6+	Gridley, Welch, Albert, Emanuel	Azusa, W. Covina, Cal.	4.5L 8L 8L, 375X		AADC	76, 75	228
229	8/ 1/65	0500	Star-like flashes.	BR		3.7	315	92 R	Jy 28 09 A 25 19	A 10 20	61 22.5 61 05.5 53 59 59 25	.10 .14	A 12 08	3−, 9−	Welch	Table Mt., Cal.	6L	E	AADC	76, 75	229
230	8/ 2/65	0357-0358	Star-like flashes.	BR	1^m	4.6	327	80 R	Jy 28 09 A 25 19	A 10 20	61 22.5 61 05.5 53 59 58 30	.22 .17	A 12 08	3+, 19+	Bomhurst	Monterey Pk., Cal.	10L, 240X	S = 5/10	AADC	76, 75	230
231	8/ 3/65	0418-0424	Star-like flashes. (Indep. confirm.)	BR	6^m	5.6	339	68 R	Jy 28 09 A 25 19	A 10 20	61 22.5 61 05.5 53 59 57 33	.26 .20	A 12 08	2+, 14−	Bomhurst, Leasure, Emanuel	Monterey Pk., Cal. Whittier, Cal.	10L, 240X 19L	F - G	AADC	76, 75	231
232	8/ 4/65	0402-0404	Star-like flashes.	BR	2^m	6.6	352	55 R	Jy 28 09 A 25 19	A 10 20	61 22.5 61 05.5 53 59 56 40	.30 .24	A 12 08	3−, 13+	Bomhurst	Monterey Pk., Cal.	10L, 240X	F - G	AADC	76, 75	232
233	8/21/65	0655-0805	Moon Blink detection – pink color.	R	70^m	23.9	201	26 S	Jy 28 09 A 25 19	A 10 20	61 22.5 61 05.5 53 59 58 44	.79 .84	A 12 08	(A) 4_o, 18_o	Johnson, Gilheany	Pt. Tobacco, Md.	16L	E	MBDC	75	233
234	9/ 9/65	U.T.? 1320	Orange-red strip on floor.	R		13.7	69	21 R	A 25 19 S 22 23	S 07 04	61 05.5 60 24 54 04 54 23	.56 .52	S 10 23.5	1_o, 5−	Presson	Cal.?			MBMW	84	234
235	9/10/65	0408-0438	S. region granulated, 7°, very faint brown tinge, rest of crater 8° bright.	R	30^m	14.4	83	36 R	A 25 19 S 22 23	S 07 04	61 05.5 60 24 54 04 54 34	.58 .55	S 10 23.5	1_o, 5_o	Bartlett	Baltimore, Md.	5L, 180X	T = 3 S = 4	B	P.C.	235
236	9/11/65	0805-0815	Red glows, continued to be luminous. Photos didn't show it. Haze stopped obs.	R,BR	10^m	15.5	94	133 S	A 25 19 S 22 23	S 07 04	61 05.5 60 24 54 04 54 55	.62 .62	S 10 23.5	2−, 7+	Cross, Rasor	Palos Verdes, Cal.	22L, 132X	F - P	MBDC	75	236
237	10/10/65	0600-0607	Pale violet radiance in all of W. interior and interior E. wall. (gas?) Nimbus dark violet, pale violet on m.	V,G	> 5^m	15.2	90	43 R	S 22 23 O 20 11	O 04 20	60 24 59 32.5 54 11 55 56	.67 .63	O 10 14	1+, 5+	Bartlett	Baltimore, Md.	3R, 300X	T = 5 S = 4		56	237
238	10/11/65	0135-0200	Whole crater except S. region, pale violet, violet all around wall except W. Yellow tinge on S. floor; nimbus dark violet; plateau m. pale violet; whole crater very bright, 9°, S. region 8°, pale yellow-brown.	V,R	25^m	16.0	100	127 S	S 22 23 O 20 11	O 04 20	60 24 59 32.5 54 11 56 21	.69 .66	O 10 14	1_o, 6_o	Bartlett	Baltimore, Md.	4L, 280X	T = 5 S = 3		56	238
239	10/12/65	0215-0225	Nimbus only, dark violet.	V	10^m	17.0	113	114 S	S 22 23 O 20 11	O 04 20	60 24 59 32.5 54 11 56 52	.72 .70	O 10 14	2_o, 13−	Bartlett	Baltimore, Md.	5L, 280X	T = 3-2 S = 5-3		56	239
240	10/13/65	0250-0315	Pale blue-violet tint, EWBS, all E. wall; pale violet radiance in crater except S. area (gas?). Nimbus dark violet.	G,V	25^m	18.1	127	100 S	S 22 23 O 20 11	O 04 20	60 24 59 32.5 54 11 57 21	.75 .73	O 10 14	3_o, 15−	Bartlett	Baltimore, Md.	4L, 280X	T = 5 S = 4-3		56	240
241	10/18/65	0730-0736	Moon Blink detection, intermittent. (gas?) Observers dubious.	R,G	6^m	23.2	187	40 S	S 22 23 O 20 11	O 04 20	60 24 59 32.5 54 11 59 16	.85 .92	O 10 14	3_o, 11−	George, Dervage	Huntsville, Ala.	20L, 125X	G	MBDC	75	241
242	10/30/65	0200	Brightening in ashen light. Photos show it.	BR	min.?	5.5	332	75 R	O 20 11 N 14 08	N 01 15	59 32.5 59 20 54 14 54 48	.40 .39	N 09 04	3_o, 16_o	Eastman	Palos Verdes, Cal.	12L		AADC	76, 75	242
243	11/ 6/65	0320-0350, 0550	Strong blue-violet glare, E., N.E. walls; nimbus dark violet. Absent at 0320-0350. (Date corrected from pub. data.)	V	min.?	12.7	58	11 R	O 20 11 N 14 08	N 01 15	59 32.5 59 20 54 14 55 53	.68 .67	N 09 04	4+, 24_o	Bartlett	Baltimore, Md.	3R, 300X	T = 5 S = 6	, B	56, P.C.	243
244	11/10/65	0125-0157, 0500-0530	Violet tinge on nimbus; in red filter, Aris. A became larger. Violet tinge at 0500-0530 also.	V	> 4^h	16.5	104	123 S	O 20 11 N 14 08	N 01 15	59 32.5 59 20 54 14 58 15	.84 .83	N 09 04	0+, 1−	Bartlett	Baltimore, Md.	4L	T = 5 S = 6	ALPO (W)	P.C. 75	244

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	(10) Anom. Date A	(11) Hor. Par.	(12) ϕ	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1900			1900							1900						1900				
245	11/15/65	0555-1000	Moon Blink detection; Confirmation network alerted – 2 partial confirm.; 4 neg. Photos don't show event. Radio λ records don't show anything unusual.	R	$> 4^h$	21.5	169	58 S	N 14 08 D 11 06	 N 29 12	59 20 60 11 54 11 59 17	.03 .04	N 09 04	2–, 5–	Johnson, Hall, Nordling, Genatt, Fries, Weber	Pt. Tobacco, Greenbelt, Md. Philadelphia, Pa.	16L, 400X 4R, 50X 10R, 415X 80 ft. dish	VG G	MBDC	75	245
246	11/26/65	0137-0206	Brightening in ashen light. Photos show it. Harris, et al., saw flashes on S.E. (IAU?) rim.	BR	30^m	2.9	300	107 R	N 14 08 D 11 06	 N 29 12	59 20 60 11 54 11 55 02	.35 .44	D 08 17	2–, 8–	Bomhurst, Harris, et al.	Monterey Pk., Cal.	10L	T = E. S = V.G.	AADC	76, 75	246
247	11/27/65	0100	Brightening in ashen light.	BR		4.1:	317	90R	N 14 08 D 11 06	 N 29 12	59 20 60 11 54 11 54 39	.41 .47	J 07 05	3_o, 19–	Bomhurst, Harris	Monterey Pk., Cal.	10L		AADC	76, 75	247
248	2/ 7/66	0100-0120	Nimbus only, intense dark violet hue.	V	20^m	16.4	95	132 S	F 05 22 M 06 11	 F 19 21	61 30 61 22 53 55 61 17	.05 .04	F 05 16	2–, 9+	Bartlett	Baltimore, Md.	3R, 200X	T = 5 S = 3		56	248
249	4/ 2/66	2330-2350	Central peak very bright and a clear silvery glistening effect.	BR	20^m	11.8	57	10 R	M 06 11 A 03 19	 M 19 03	61 22 60 44 53 58 60 40	.90 .94	A 05 11	5–, 17–	Brown	Eng.	12L, 250X			95	249
250	4/ 3/66	2300-2330	C.P. very bright with a clear silvery glistening effect.	BR	30^m	12.8	69	22 R	A 03 19 My 01 14	 A 15 18	60 44 59 52 54 07 60 44	.90 .98	A 05 11	3–, 14–	Brown	Eng.	12L, 250X			95	250
251	5/ 1/66	2130-2245	Moon Blink detection and visual obs. of a very bright spot and red spots. (Indep. confirm.) Ringsdore did not see it.	R,BR	$> 1^h$	11.0	50	3 R	My 01 14 My 27 14	 My 13 13	59 52 59 18.5 54 13 59 52	.01 .01	My 04 21	3+, 16–	Paterson, Brown, Sartory, Ringsdore	Eng.	12L, 252 8.5L	G		95	251
252	6/ 1/66	0310-0340	All sunlit area of floor, bluish.	V	30^m	11.8	59	12 R	My 27 14 J 22 08	 J 10 08	59 18.5 59 47.5 54 15 58 22	.15 .18	J 03 08	5+, 14_o	Bartlett	Baltimore, Md.	4L, 145X	T = 5 S = 3		56	252
253	6/ 2/66	0400-0430	Brownish-yellow edge on S. rim. 2 other obs. saw nothing unusual. (These obs. in response to plea for obs. of many features for 2 weeks period to test Green's hypothesis. Only 1 pos. event reported; all others were neg. for the 2 weeks.)	R	30^m	12.8	71	24 R	My 27 14 J 22 08	 J 10 08	59 18.5 59 47.5 54 15 57 53	.18 .22	J 03 08	3+, 17+	Jaeger	Hammond, Ind.	6L		ALPO (R)	P.C., 77	253
254	6/ 3/66	0100-0145, 0600-1620	Deep blue color on N. wall; S. part of crater brownish. At 0600-0620 violet hue in nimbus only. (Not on above alert, indep. confirm.)	V,R	hrs.?	13.6	82	35 R	My 27 14 J 22 08	 J 10 08	59 18.5 59 47.5 54 15 57 21	.23 .25	J 03 08	3+, 13–	Gordon (2), Bartlett	Ackermanville, Pa. Baltimore, Md.	3.5L, 3R 160X 5L	T = 4 S = 3-5, T = 5 S = 5	ALPO (R)	P.C., 77 56	254
255	7/ 4/66	0615-0635	S. region of floor granulated, dull 6°, pale yellow-brown tint; rest of crater 8° bright.	R	20^m	15.5	103	124 S	J 22 08 Jy 20 01	 Jy 08 01	59 47.5 60 36 54 09 55 03	.38 .43	Jy 02 20	4+, 19_o	Bartlett	Baltimore, Md.	5L, 283X	T = 4 S = 5	B	P.C.	255
256	7/29/66	0340	Spot on S. wall visible only in red filter, 9° bright. Ricker was uncertain about obs.	R		10.9	47	0 R	Jy 20 01 A 17 09	 A 04 16	60 36 61 13 54 02 55 55	.33 .32	A 01 09	3_o, 10_o	Simmons	Jacksonville, Fla.	6L, 192X	T = 4.5 S = 7	ALPO (R)	P.C., 77	256
257	7/30/66	0535-0729	Red color on S. rim, then later on N. rim and near Herod. and fork of Sch. Valley. Variations. (gas?)	R,G	2^h	12.0	60	13 R	Jy 20 01 A 17 09	 A 04 16	60 36 61 13 54 02 55 22.5	.36 .36	A 01 09	3–, 11–	Arriola, Cross	Whittier, Cal.	19L, 390X	T = 3/5 S = 3-5/10	CR	P.C.	257
258	8/ 1/66	0050-0120	Moon Blink detection (red?) color on S. wall. Confirmed on another moon blink instru., telephone link. (Indep. confirm.?)	R?	30^m	13.8	82	35 R	Jy 20 01 A 17 09	 A 04 16	60 36 61 13 54 02 54 42	.40 .42	A 01 09	3_o, 12–	Moore, Moseley, Corvan	Armagh, Ireland	10R			78	258
259	8/ 5/66	0522-0538	S. region granulated 6° bright, faint yellow-brown tint, rest of crater 8°, white.	R	16^m	18.0	133	94 S	Jy 20 01 A 17 09	 A 04 16	60 36 61 13 54 02 54 03	.52 .57	A 01 09	4–, 18–	Bartlett	Baltimore, Md.	4L, 281X	T = 5 S = 4	B	P.C.	259
260	8/30/66	0510-0525	Distinct brownish tone in S. region.	R	15^m	13.7	79	32 R	A 17 07 S 14 17	 A 31 23	61 13 61 24 53 57.5 54 06	.46 .45	A 31 00	(S.C.) 7+, 45+	Bartlett	Baltimore, Md.	5L, 283X	T = 3 S = 3-5	B	P.C.	260
261	10/26-/66 27	2345-0030	N.E. (IAU?) wall at rim definite violet hue, effect not seen on 2 following nights.	V	45^m	12.8	64	17 R	O 13 03 N 10 09	 O 25 10	61 05.5 60 20 54 04 54 13	.54 .49	O 29 10	4–, 23–	Gordon	Ackermanville, Pa.	3.5L, 160?X		ALPO (R)	P.C., 77	261
262	10/27/66	0230-0300	C.P. noticeably less bright in blue filter but very bright in red filter and none. (gas?) Shadow of c.p. faint gray whereas wall shadow was normal black. (Indep. confirm.?)	G,R	20^m or $> 3^h$?	12.9	65	18 R	O 13 03 N 10 09	 O 25 10	61 05.5 60 20 54 04 54 14	.55 .50	O 29 10	3–, 13–	Delano	New Bedford, Mass.	12.5L, 300X	T = 6 S = 6	ALPO (R)	P.C., 77	262
263	10/30/66	0132-0148	S. region granulated 6° bright, light brown tone, rest of crater 8° bright.	R	16^m	15.9	102	125 S	O 13 03 N 10 09	 O 25 10	61 05.5 60 20 54 04 55 09	.62 .60	O 29 10	5–, 19	Bartlett	Baltimore, Md.	5L, 194X	T = 3 S = 5	B	P.C.	263
264	11/ 1/66	0247-0258	S. region granulated, 6° distinctly yellow-brown, rest of crater 8° bright.	R	10^m	17.9	126	101 S	O 13 03 N 10 09	 O 25 10	61 05.5 60 20 54 04 56 02	.67 .67	O 29 10	3+, 33	Bartlett	Baltimore, Md.	5L, 283X	T = 4 S = 6	B	P.C.	264
265	3/23/67	1840-2130	Suspicion of color on S.E. (IAU?) wall by Marsh, Farrant definitely saw color at 1842-1930. (Sartory and Moore had a moon blink on Cobra Head. Indep. Confirm.)	R	3^h	12.7	64	17 R	F 25 21 M 26 08	 M 13 01	61 05 61 27 53 58 60 29	.91 .92	M 26 03	3–, 8+	Marsh, Farrant	Eng., Cambridge, Eng.	8L, 320X 8L	S = 2/10		79	265

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	A	(11) Hor. Par.	(12) ϕ	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1900			1900							1900						1900				
266	4/15/67	1915-2100	Very bright, seeing very good till 2100. Nothing unusual on 16th and 17th.	BR	1¾^h	5.9	343	64 R	M 26 08 A 23 19	A 09 03	61 27 61 16.5 53 56 55 56	.67 .72	A 24 12	2–, 7+	Classen	E. Germany			MBMW	84	266
267	4/21/67	1915-2120	On exterior wall of Aris., Herod. and 3 pts. in Cobra Head were glowing red. Farrant couldn't bring hill N. of Herod. into focus. Deep red-orange steady for 3^m. Also seen on 22nd and maybe 23rd by Darnell. (gas?) (Indep. confim.)	R,G	> 2^h	11.9	54	7 R	M 26 08 A 23 19	A 09 03	61 27 61 16.5 53 56 60 41	.89 .93	A 24 12	(S.C. 23rd) 2+, 15+	Darnell, Farrant	Copenhagen, Denmark, Cambridge, Eng.	3.5R 8L, 160X	S = 1-2/10 Fine		80	267
268	4/22/67	2100?	Crater so bright could be seen with naked eye! (Indep. confim.?)	BR		13.0:	69:	22:R	M 26 08 A 23 19	A 09 03	61 27 61 16.5 53 56 61 10:	.98: .97:	A 24 12	(S.C. 23rd) 5–, 25+	Classen	E. Germany	3.5R?		MBMW	84	268
269	5/20/67	2015, 2105-2120	Red spots on S. rim. Moon was low.	R	1^h	11.2	50	3 R	A 23 19 My 22 02	My 06 11	61 15.5 60 40 59 00 60 29	.95 .96	My 23 20	2+, 11+	Darnell	Copenhagen, Denmark				86	269
270	5/29/67	0640-0725	Red brown color at ξ .685, η .390, glow strongest and largest at 06^{h}40. Shrank and faded, brightened, faded out. At low altitude. (gas?)	R,G	45^m	19.7	153	74 S	My 22 02 J 18 20	J 03 02	60 40 59 50 54 08.5 56 01	.20 .26	My 23 20	(A) 7–, 34+ (S.C. 30th)	Anderson	Manchester, N. Hamp.	10L, 210?X	T = E S = G	ALPO (R)	P.C.	270
271	9/17/67	0205-0221	Rim to craterlet next to major dark band almost as bright as C.P. in red filter but much duller in blue. Red color in craterlet became less noticeable at 0212 then flared again. (gas?)	R,G	15^m	12.6	66	19 R	S 06 08 O 04 14	S 22 00	60 36 61 14 54 02 55 09	.37 .38	S 18 17	(S.C. 19th) 2, 12–	Delano	Fall River, Mass.	12.5L, 400X	T = 5 S = 5		81	271
272	10/15/67	0338-0342	Ravine on E. glacis invisible for its full length, though normally sharp black line at this time. E. wall craterlet also invisible. He thinks both were obscured. (gas?)	G	< 5^m	11.3	49	2 R	O 04 14 N 02 02	O 19 08	61 14 61 25.5 53 58 54 52	.40 .37	O 18 10	4, 13	Bartlett	Baltimore, Md.	4L, 280X	T = 5 S = 5	B	P.C.	272
273	11/15/67	0540	Red color on N. and E. of crater and on E. rim of Cobra Head. Later confirmed by Tombaugh.	R	min.?	13.0	67	20 R	N 02 02 N 30 14	N 15 08	61 25.5 61 04 53 59 53 59.5	.00 .00	N 17 05	4–, 17–	Cross, Tombaugh	Las Cruces, N. Mex.	16?L, 520X?		M	82	273
274	12/13/67	2140	Moon blink detection, red color E. side of crater, intermittent. Violet on W. side. *(gas? or chrom. or atm. aberr.? not incl. in* statistics.) (Obs. selection biased to per.-apo.)	(R,G, V)	min.?	12.2	56	9 R	N 30 14 D 28 19	D 12 18	61 04 60 16 54 05 54 09	.53 .47	D 16 23	2–, 10–	P. Jean	Montreal, Canada	4R, 140X?		M	82	274
275	12/16/67	2200?	Unusual appearance of N.E. (IAU?) inner wall, very pale blue, opposite wall pale red. No other crater showed this which lasted only 10 min. but survived a change of eyepiece. Moon was high, seeing V.G.	V,R	10^m	15.2:	92:	45:R	N 30 14 D 28 19	D 12 18	61 04 60 16 54 05 54 58:	.61: .58:	D 16 23	(S.C. 18th) 3, 16+	Farrant	Cambridge, Eng.	8L	VG		93	275
276	12/18/67	0331-0407	Violet color on limb (Aris. and Herod. mentioned); intermittent; not seen next night or 21st. (gas? or chrom. and atm. aberr.?) (Not used in statistics.)	(V,G)	> 35^m	16.5	96	131 S	N 30 14 D 28 19	D 12 18	61 04 60 16 54 05 55 29	.65 .62	D 16 23	(S.C.) 4, 26+	Coallick	Eastern U.S.	5R, 130X		M	82	276
277	1/13/68	0100-0800?	Blue-violet color on the limb(?); also on Herod. and Tycho. (chrom. aberr.?) (not used in statistics).	(V)	hrs.?	12.8:	62:	15:R	D 28 19 J 25 00	J 09 13	60 16 59 23 54 11.5 55 03:	.56:	J 15 16	(S.C. 11th) 4–,	P. Jean?	Montreal, Canada	4R?			P.C.	277
278	3/14/68	0132-0206	Moon Blink and visual obs. of bright areas on C.P. and 2 white spots near N. wall and S. crest.	R,BR	34^m	14.8	85	38 R	F 18 16 M 17 02	M 05 07	59 28 60 21 54 11 59 19	.86 .89	M 14 19	5, 29	Olivarez, Mayley, Etheridge	Edinburg, Tex.	17L, 125X	T = 3 S = 5		P.C.	278
279	4/11/68	2200?	Unusual appearance of N.E. (IAU?) inner wall, very pale blue, opposite wall very pale red. No other crater showed this. Similar to obs. of 12/16/67.	V,R	10^m	13.9:	76:	29:R	M 17 02 A 14 07	A 01 23	60 21 61 05 54 03 60 15:	.88: .92:	A 13 05	3, 18+	Farrant	Cambridge, Eng.	8L			93	279
280	4/13/68	0500:-0545:	About ½ doz. star-like pts. during eclipse, 1st seen at about 20^m before totality ended. One was Aris. – not seen earlier. Seen in 6"R and 12"L but not 36"L at 400X. Glittered but no pulsation or dance. Point minute compared to feature.	BR	45^m:	15.2	90	43 R	M 17 02 A 14 07	A 01 23	60 21 61 05 54 03 60 54	.95 .96	A 13 05	5–, 28+	W. Cameron, V. Laczo	Greenbelt, Md.	6R, 50?X 12L, 80X 36L, 400X	E			280

Table I (Continued)

(1) No.	(2) Date	(3) Time	(4) Description	(5) Cat.	(6) Dur.	(7) Age	(8) Col.	(9) T.D.	(10) Anom. Date P	A	(11) Hor. Par.	(12) ϕ	(13) F.M.	(14) S.A.	(15) Obs.	(16) Loc.	(17) Inst.	(18) See.	(19) So.	(20) Ap. Ref.	(21) No.
	1900			1900							1900						1900				
281	5/ 2/68	0120-0214	Bright area in crater surrounded by a faint glow fainter at 0156. ALPO recorders Kelsey and Ricker consider it abnormal.	BR	55^m	4.5	323	84 R	A 14 07 My 12 17	A 29 09	61 05 61 25 53 57.5 54 22	.57 .63	My 12 13	5−, 21−	Doughty	Red Bank, N.J.	8L, 120X		ALPO (R)	P.C.	281
282	7/18/68	0050-0130	Distinct red glow and obscuration seen 1st at 00^{h}52, faded and brightened several times; obscured area reached greatest extent at 0125 when it was ½ size of Cobra Head and S.S.E. of it. Moore saw it with moon blink but no color visible. He was alerted to it. Gassendi, Kepler and Plato were checked with neg. results. (gas?)	R,G, BR	40^m	22.1	183	44 S	Jy 08 09 A 05 03	Jy 20 09	60 40 59 51.5 54 08 54 35	.42 .35	Jy 10 03	3+, 17	Selsey, Moore, Moseley, Corvan	Sussex, Eng. Armagh, Ireland	3R, 120X 10R, 255X	P - F		83	282
283	10/10/68	1000?	Pink and blue colors on Aris. on 10th and reddish clear zone S.E. (IAU?) of it on 11th. (Chrom aberr.? – not used in stat. – obs. selection bias to apogee and perigee.)	(V,R)	1^d?	17.9: 18.9:	133, 145:	94:S 82:S	S 25 20 O 23 15	O 11 17	59 49 54 14: 60 41 54 07.5 54 07:	.53:	O 06 12		P. Jean?	Montreal, Canada	4R?			P.C.	283
284	12/ 4/68	1900-2015	Moon blink in red and blue S. of crater toward Herod. max at 19^{h}10. Weak blink in Plato.	V,R	1¼^h	14.5	100	128 S	N 21 00 D 19 12	D 05 15	61 20 61 28.5 53 56.5 53 58.5	.50 .48	D 04 23		Dall'Ara	Switzerland	16L, 140X		S.I. CSLP		284
285	12/23/68	0230	Brightened 1 mag. faded 1.5 mag., brightened again, etc. (gas?)	G,BR	1¼^h	3.3	311	98 R	D 19 12 J 17 00	J 01 15	61 28.5 61 02 53 58 59 32	.17 .13	J 03 18		Harris	Calif.			S.I. CSLP		285

available. Colons indicate uncertainty (usually in the time of observation) but were used in the statistics. Column (13) gives the date of full moon nearest to that of the LTP date. Column (14) gives the solar activity including the highest K_p index for that date, ($K_{p_{max}}$) the sum of the K_p's (ΣK_p) for that day, and the occurrence of a sudden commencement (sc), a magnetic storm (ms) or an aurora (A), if known to the author. Column (15) gives the name(s) of the observer(s). Column (16) gives the location of the observer(s), where the upper name is the city and the lower is the country (or state). Column (17) gives the telescope aperture in inches, the type (L = reflector, R = refractor), and the highest power used on the telescope in the observation. Column (18) gives the seeing (S), usually on a scale of 10 where 10 is best, or E = excellent, VG = very good, G = good, F = fair and P = poor; and transparency (T) indicates the faintest star magnitude that can be seen with the naked eye on a scale of 1-5. Column (19) gives the information source of the observation in appreciation of all those who have generously reported and contributed them. No letter = the author, garnered from the literature, MB = Middlehurst-Burley catalog (1966), P = W. Pala, F = C. Fort, ALPO (Association of Lunar and Planetary Observers), whose lunar recorders were J. Westfall (W) and C. Ricker (R), Ri = P. Ringsdore, B = J. Bartlett, H = W. Haas, D = F. Dachille, S = E. Shoemaker, MBDC = reports to Moonblink data center, AADC = Argus/Astronet data center through W. Calkins, CR = E. Cross, Fi = V. Firsoff, M = B. Middlehurst bimonthly letter, MBMW = Middlehurst, Burley, Moore, Welther catalog (1968), SI = Smithsonian Institution Center for Short-lived Phenomena, and GR = J. Greenacre. Column (20) gives an appendix number reference. The appendix gives a more original reference. Column (21) repeats Column (1).

III. DISCUSSION AND INTERPRETATIONS

The observations will be discussed from Figures 1 and 2 separately under each category. Figure 1 presents the data in histograms. The key to the various graphs is given and the numbers in parentheses are the numbers of observations for each group and category as indicated. The numbers on the left side pertain to the anomalistic period data and those on the right pertain to the Age data. On the left panels the letters (P) and (A) indicate perigee and apogee respectively in the anomalistic period phase and are emphasized by the vertical lines drawn through them since these are the critical quantities for correlations. The first two tenths of a period are repeated, as is customary in light curves, for example. The right-hand panels present the data with respect to the moon's age and can be scrutinized for correlations with the sunrise, low-angle illumination, and magnetic tail hypotheses. On these right-hand panels, the following references are noted: the average age at which N.M. = new moon, F.Q. = first quarter, S.R. = sunrise on Aristarchus, BSF = bow-shock front boundaries, MP = magnetopause boundaries, F.M. = full moon, L.Q. = last quarter, and S.S. = sunset on Aristarchus occur and are emphasized by vertical lines. The actual ages can shift by as much as ±1.5 days, depending on the varying eccentricity which changes the amount of acceleration and librations of the moon.

Figure 1 is difficult to read so the data have been smoothed in accordance with the relation

$$\frac{A + 2B + C}{4}$$

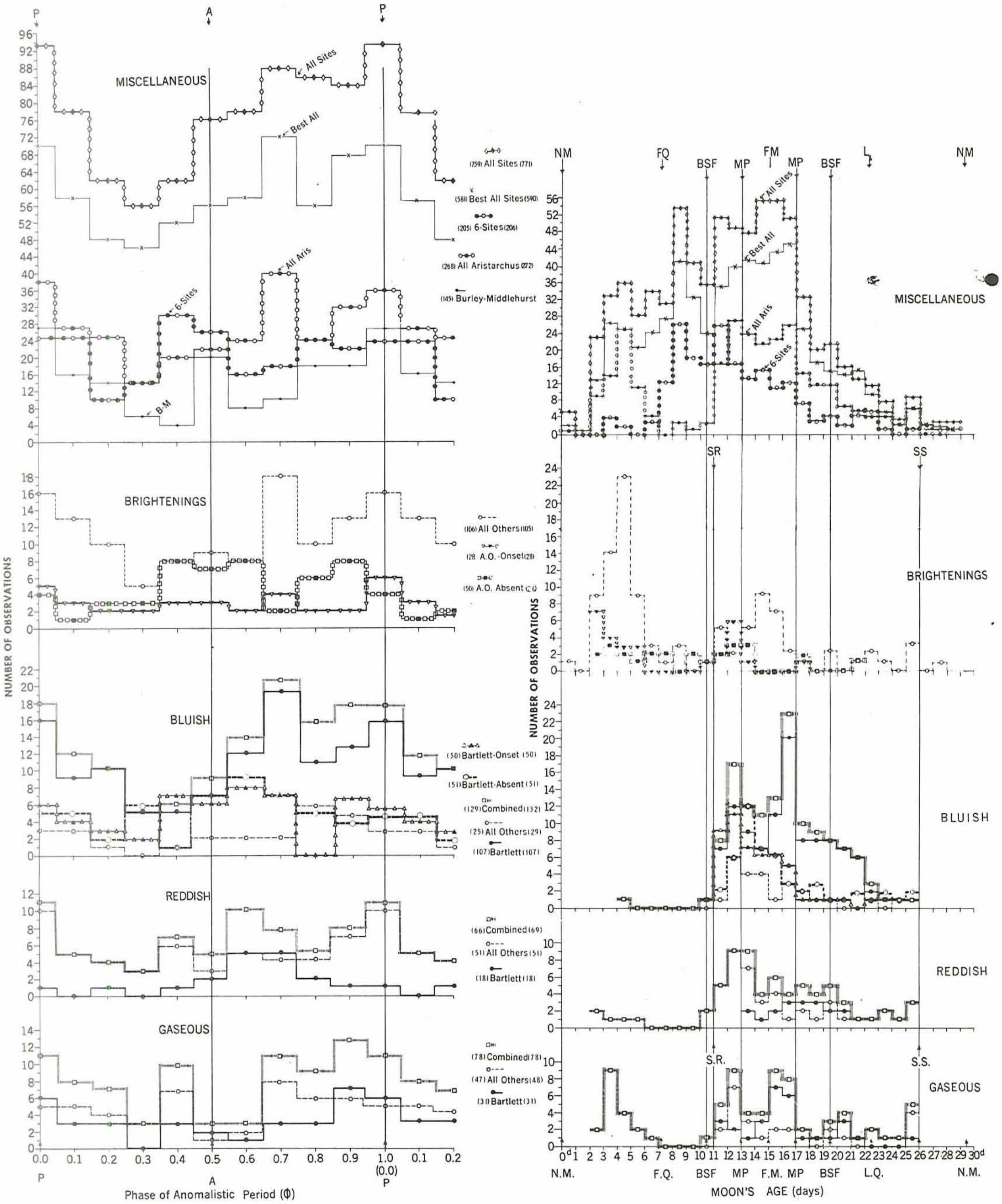

Figure 1. Histograms of Lunar Transient Phenomena (LTP) for each category and group discussed in the text. The left side panels give the data with respect to the phase (ϕ) of the lunar anomalistic orbit (perigee to perigee) where (P) designates perigee and (A) designates apogee. The right side presents the data with respect to lunar age (in days) where the average approximate boundaries for the hypotheses of (1) sunrise (S.R.) and/or low-angle illumination (including sunset, [S.S.]), (2) earth's magnetic tail with its magnetopause (MP) and bow-shock front (BSF) are located at the bottom and top. The average ages of the phases are also indicated. The center key panel indicates the number of observations (in parentheses) involved for each group in each category where the left side number is for the anomalistic period (tidal) panels and the right side numbers are for the age data panels. The numbers differ in some cases because of incomplete ancillary data.

where A = preceding datum, B = datum of moment, and C = datum following. Figure 2 presents the smoothed data as curves in the same notations as Figure 1 and will be used for the discussions of the data.

1. Gaseous Phenomena

At bottom left Figure 2 for the anomalistic period (tidal effects) we see that Bartlett's (B) observations differ from those of All Others (A.O.). His curve has a definite maximum (at 0.95) near perigee (P), whereas, surprisingly, there is no correlation with (P) or (A) for All Others. The combined gaseous observations (C) show a maximum at ϕ = 0.9 and a very minor peak at ϕ = 0.4. If a tidal effect is acting, the offset of 0.1 period suggests a lead hysteresis. Referring to the gaseous panel at the right for the age data, we find that there appear to be four peaks or humps for Bartlett and five for All Others (only one of which is statistically significant for B and two for A.O.). It should be pointed out that Bartlett observed Aristarchus only when it was in sunlight, therefore only half a lunation (from sunrise to sunset) and thus would not have any observations during the first 10 days or the last 4 days of a lunation. When Bartlett did observe, he observed regularly, weather permitting, and thus when he found the bluish phenomena absent (only reported for the bluish) they probably were really absent, which was 1/3 of the time. The peaks for Bartlett and All Others are within a day of each other but the amplitudes alternate in importance. The peaks near 12^d, 16^d, and 25^d correspond nearly to the entrance and exit of the magnetopause, and near sunset respectively and suggest a causal relationship to the magnetic tail for the former and low-angle illumination to the latter. However, the 12^d peak comes close to sunrise ($\sim 11^d$) on Aristarchus and could be due to either sunrise or low-angle illumination effects or both, and also a

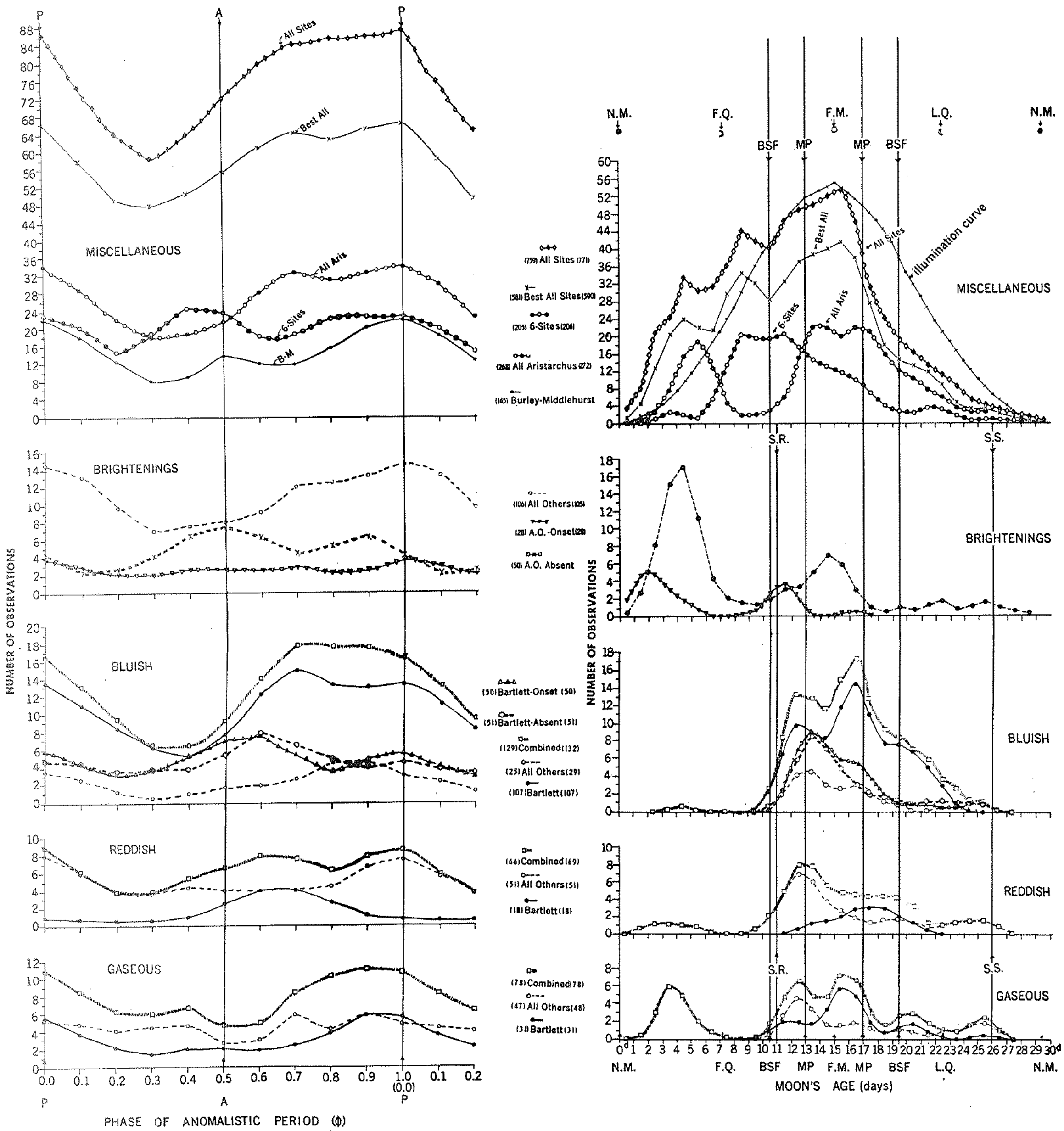

Figure 2. The same data as in Figure 1 in the same arrangement where the data have been smoothed. (see text)

possible bow-shock front effect (which comes at $10^d.5$). The boundary conditions for these overlap and make it very difficult to distinguish causal effect (if any). On the other hand, there is no cause in any of these hypotheses for the 4^d peak. Tidal and solar effects are not represented here. There is a slight rise in the curve at about 20^d which is close to the BSF exit boundary. Probably the only significant peaks are the 4^d and 12^d for All Others and the 16^d for Bartlett.

2. Reddish Phenomena

In the tidal effects panel, for Bartlett's 21 observations a peak comes at $\phi = 0.65$ which has no significance in the tidal hypothesis. In contrast, the 50 observations of All Others have a maximum at (P) differing considerably from Bartlett's. These differences imply that different phenomena are being seen by the two groups. Indeed, the descriptions do differ. Bartlett's reddish and gaseous curves are opposite in phase. This opposition suggests that when he sees one kind of phenomenon, he does not see the other. In this graph we are dealing with all of his observations, over many years, but when they are examined lunation by lunation the same results are found. It is my opinion that his reddish phenomena are instances in which he was observing true ground color in the absence of an obscuring medium. Bartlett's descriptions and private communications support this opinion. His reddish descriptions are really of coppers, browns, and yellows, frequently mentioning a granulated appearance of the southern part of the floor of Aristarchus with these. If the interpretation for Bartlett's reddish observations is correct, then his reddish maximum supports his apparent gaseous correlation with perigee (but there is no corresponding apogee effect).

The 50 reddish observations of All Others have a curve very similar to Bartlett's gaseous (but not similar to their own gaseous!). The similarity may mean that

Bartlett's gaseous events may have been lunar activity that was similar to others' reddish ones, but that his eyes are less sensitive to reds. He never reported any phenomena that were pink, red, or orange as others did. An eye response for him that is less sensitive to red is suggested also by other observations to be discussed later. It is curious that the two groups of gaseous observations differ. It may be due to relatively small numbers of observations. None of the peaks are really significant.

Examining the reddish curves for age, we find four peaks for All Others but only one for Bartlett. The 16^d peak for A.O. is almost completely smoothed out. Again we see that for (B) the behavior of his reddish phenomena curve is inverse to that of his gaseous, corroborating the results seen in the tidal panel, and supporting the suggestion above as to the cause. His reddish curve is also inverse to that of A.O. as in the anomaly curve. If the above interpretation offered for Bartlett's observations is correct then it is evident that the combined results in both the anomaly and age curves are not valid. We are probably dealing with two different kinds of phenomena and there should have been a fifth category.

3. Bluish Phenomena

Looking first at the anomaly panel of bluish phenomena we find a significant double-peaked curve for Bartlett's 107 observations, the stronger one at $\phi = 0.7$ and the other at 1.0 (0.0) = P. There is a significant minimum at $\phi = 0.4$, not far from apogee (A). The tidal hypothesis would not call for a correlation at $\phi = 0.7$.

All Others have even less of a tidal correlation among these few (25) events. The maximum peak comes at the mean of Bartlett's double peak. The combined curve, of course, reflects the preponderant observations of Bartlett.

The other two curves on this panel are very interesting and may be very instructive. The two are Bartlett's Onset and Absent observations. The Onset curve is for the initial date of a series of consecutive or nearly so observed phenomena. The Absent observations pertain only to the bluish phenomena and were published in his paper (Bartlett, 1967) and given here in Table VII. Note that these two curves are very nearly in phase. The Absent show a strong maximum near (A); i.e., the phenomena had a strong tendency to be absent at times near apogee, and to a lesser extent near perigee! If the Absent data are combined with the 107 bluish phenomena, the resulting curve is very similar to that for the bluish present phenomena alone. The near coincidence of behavior of the Absent and present Onset phenomena renders a possible tidal correlation somewhat dubious for the present phenomena. It may be illusory or coincidental.

The data with respect to age bear out much the same conclusions, although here the behavior of the observations of Bartlett and All Others is more similar except that the amplitudes of the two peaks alternate. Again the Absent and Onset curves are very similar in phase and amplitude. In these bluish curves, the strongest peaks suggest sunrise and magnetic tail correlations.

4. Brightenings

Bartlett did not report phenomena of brightening as did others and therefore there is no curve for him, just one for All Others. Inspection of the anomalistic curve reveals that the Brightenings have a double-peaked curve with the two peaks at ϕ = 0.7 and ϕ = 1.0 (0.0). Referring back to the discussion of the bluish curves we note the striking similarity between Bartlett's bluish and All Others' brightenings. Bartlett's bluish observations were mostly called the violet glare. The shapes of the two curves are practically identical but the amplitudes of the double peak alternate for the two kinds of observations (in the smoothed curves but not in the histograms which are very similar). The similarity suggests that Bartlett's violet glares are similar kinds of events to the colorless brightenings of all others. Perhaps Bartlett is more blue-sensitive (and red-insensitive?) as compared with most other observers. Such a physiological response would account for the similarities between his colorless gaseous and All Others reddish, and his "bluish" to others' colorless brightenings.

Included in this panel are All Others Onset and Absent. The concept of Onset here is similar to that for Bartlett. In the case of the Absent, it represents absence of phenomena from other sites as well as Aristarchus, although the latter are in the vast majority. It is only quite recently that absence of phenomena have been reported. For (A.O.) the Onset data show no correlation. The absent phenomena are almost inverse to that of the present ones therefore supporting the conclusions for the brightenings. (The A.O. Absent differ by 0.1 period with those of Bartlett). The A.O. absent data reflect the rather consistent deficiency of events near apogee found in most of the data. This result is contrary to the predictions in Green's hypothesis and differs from the earlier results of Burley and Middlehurst.

In the age diagrams we note two major peaks for the brightenings, at 4^d and 14^d with insignificant humps at 11, 19 (?), 22, and 25 days. Again the 4^d peak has no causal relation to any of the hypotheses represented on this diagram. The 14^d peak occurs within the magnetopause and could arise from the mechanism suggested by Speiser. The 11-day hump comes at sunrise (and near the BSF) while that for 25 days comes near sunset. They could arise from the influence of low-angle illumination, but the former could also be due to other sunrise effects. The 19^d peak comes at the exit boundary of the BSF (and the 11^d peak at its entrance) while the 22^d peak has no hypothetical effect to cause it. Any effects considered are very minor except for the possible sunrise one.

All Others Absent shown here are considerably reduced in number because approximately half of the observations (Young, 1967) were sunrise-sunset selective which would have biased the results and therefore were excluded in the age diagram. Again they behave similarly to the Onset data except the early peak occurs later than the Onset peak.

The Onset data show two major peaks at 2^d and 11^d (leading the general observations) and one insignificant one at 16^d. As remarked in the general curve, the 11^d peak could result from bow-shock front turbulence, sunrise (UV excitation or thermoluminescence) or low-angle illumination effects. The possible 16^d hump comes near the magnetopause exit boundary.

5. Miscellaneous

In this panel various sets of data are presented. The B-M curve shows the plot of the 145 observations of all sites analyzed by Burley and Middlehurst (1966). It reveals the major peak at perigee and the minor peak at apogee that lead them to the conclusion that there is a tidal effect on lunar phenomena. The 6-sites curve represents the combined data of 206 observations from the six next most frequently reported features of temporary anomalies. These will be discussed separately later (see Figure 4). The characteristics of these 6 sites combined differs from those of the B-M curve by offset and interchange of amplitude. They also differ somewhat from all of the Aristarchus observations (268) data combined irrespective of category. For the latter we find the complete elimination of the B-M and 6-sites midperiod maximum (at and near apogee respectively) and find instead a double-peaked curve with the two peaks coming at ϕ = 0.7 and ϕ = 1.0 (0.0) respectively (or a mean of 0.85). It is the same behavior as for the bluish and the brightenings (which make up the large majority of the observations for Aristarchus). It may be that the 0.5 peak migrated to the position of 0.7.

In the author's collection of LTP reports for all sites of which 759 had sufficient data to be analyzed this way, we find yet another result. It consists of a rather broad minimum in the first half of the anomalistic period and a very broad maximum in the last half. It closely resembles the data from Aristarchus alone but the dip between the latter's double peak has filled in. These data are directly comparable to the B-M analyses, differing only in the number of observations. In this panel all analyses have sufficient numbers of observations to provide a reliable sample so that any differences may be regarded as real and significant. It also suggests that the differences found in our previous small samples may be real.

The All Sites data of 759 observations includes all observations regardless of reliability of the observation. To determine the effect of the poor observations, many of the obviously poor observations were discarded. The remaining 581 observations and the smoothed curve for these data are shown, designated

Best All. One can see that it is essentially identical to the whole body of data. It does show slightly the dip at $\phi = 0.8$.

Referring now to the age-data curves (which do not include a B-M curve since those authors did not consider the data in this way, nor did they publish the itemized observations they analyzed) we find differences in the data here too. The All Aristarchus curve of 271 observations shows a strong peak at 5 days and a double peak maximum at 13 and 16.5 days age. These double peaks come at the entrance and exit boundaries of the magnetopause of the earth's magnetic tail (MP). The 13^d peak also falls within possible sunrise or low-angle illumination effects.

The 6-sites curve has one major broad peak between age 9-12 days and minor humps at 4^d, 16^d?, 21^d, and 25^d. None of the hypotheses can account for the 21^d rise. (The 4^d peak comes near sunrise on Proclus which is one of the six sites.) These six sites combined depart in behavior considerably from that for Aristarchus or for All Sites combined.

All Sites and the Best All sites show essentially three humps on a generally rising curve which declines rather suddenly after age 16 days. The humps occur at 4^d, 8^d, and 15^d (= full moon). Obviously, the seven sites considered here previously contributed heavily to the All Sites data, comprising about 60% of all observations.

An illumination curve has been superimposed and it can be seen that the observations generally follow it with some departures. There is a general excess of observations in the early phases and a deficiency in the later phases in a lunation.

It reflects, probably, the fact that the majority of the observations were contributed by non-professional astronomers. In general, most observers will be observing features when they are directly lighted by the sun, but many phenomena occur in the shadowed part of the moon illuminated only by earthlight (ashen) and these attract the observer's attention. There are also some programs for observing the moon in the ashen light, e.g., the Argus/Astronet program (1966). Beyond full moon, when the moon has to be observed very late at night or in the early morning hours the observers will usually be professional astronomers and a few enthusiastic and dedicated amateurs. Since there is such an observational bias, perhaps the small humps in the curves are significant.

Several of the Age data peaks fall near the boundary conditions for more than one hypothesis and others have no apparent cause. Tidal effects cannot be determined from the data in this form, but we can examine the data for each of the four major age peaks. Therefore the Aristarchus observations (through 1967 only) for ages $4^{d}.0 - 4^{d}.9$, $12^{d}.0 - 12^{d}.9$, $16^{d}.0 - 16^{d}.9$, and $25^{d}.0 - 25^{d}.9$ were each separately analyzed with respect to the phase of the anomalistic period. The histograms (and smoothed curves) are presented in Figure 3. In the 4^{d} peak panel (lower left) there is a definite peak at $\phi = 0.5$ (apogee) but a minimum at $\phi = 0.0$ (perigee), as well as at $\phi = 0.3$. The letters indicate the kind of category of each observation, where the code is the same as defined above (p. 5) and A.C. = all colors. Most of the observations at this age of 4^{d} were brightenings but the behavior of these is different from the total number of brightenings seen in Figures 1 and 2. It is almost the inverse! Such a difference may be attributable to small samples again.

AGE PEAKS vs. ANOMALY

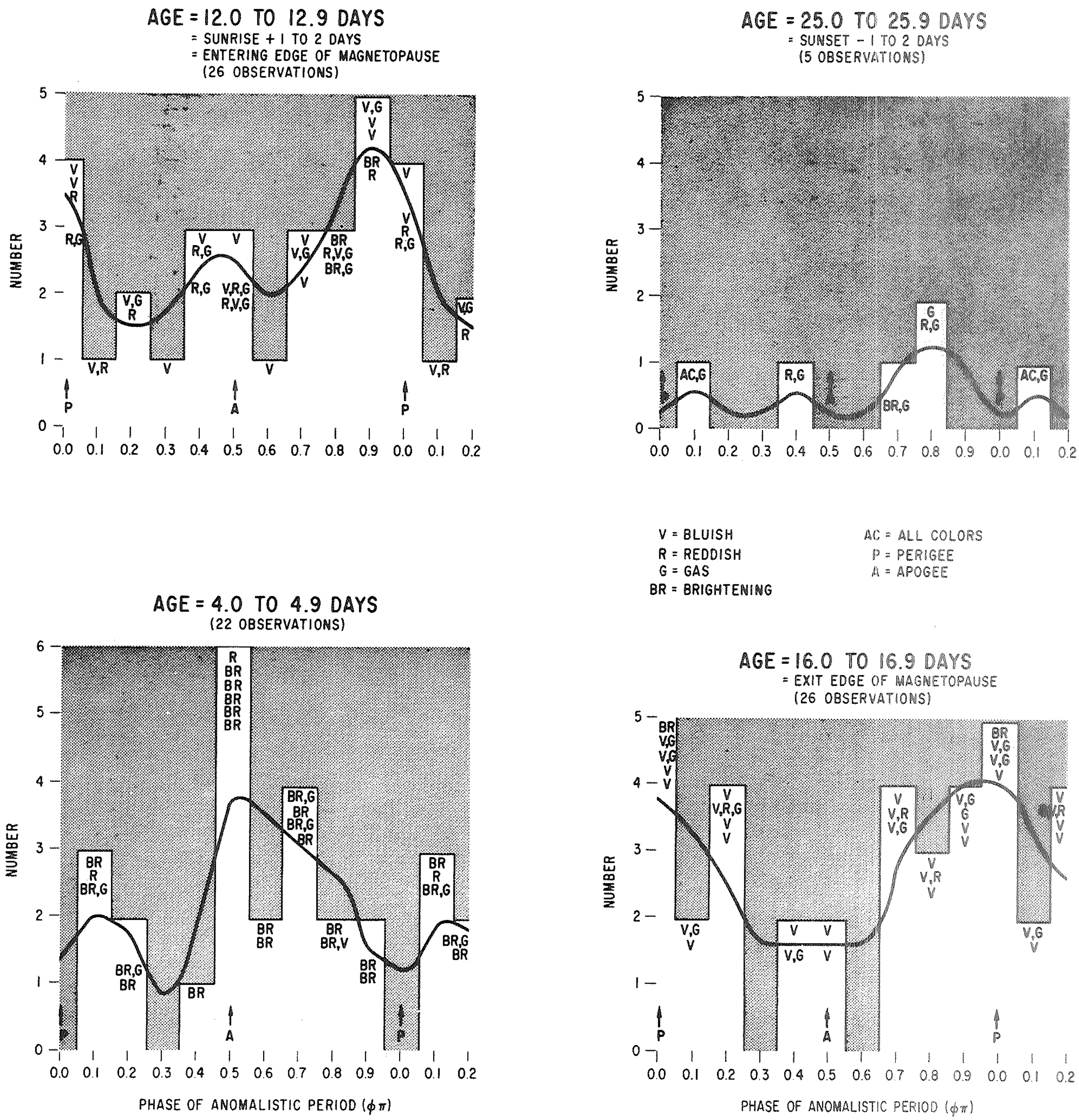

Figure 3. Histograms of four lunar ages at which the data generally peaked in the right-hand panels of Figures 1 and 2. The data are plotted with respect to the phase of the true anomalistic period ($\phi\pi$). Perigee (P) and apogee (A) are designated with arrows. The letters within the histograms bars indicate the kind of phenomenon for each observation in that bar (see text). The pertinent hypotheses relationships (other than tidal, which is given by the abscissa) are indicated at the top of each panel.

The 12^d and 16^d peaks were composed mostly of bluish observations and their gross characteristics with respect to the anomaly are generally similar to each other, with maxima near perigee and minima at apogee (opposite to that of the brightenings in the 4^d peak). These resemble only broadly those characteristics of the combined bluish of Figures 1 and 2. In the latter, the brightenings and the bluish were almost identical, while here they are inverted with respect to each other.

The 25^d peak consists of only five observations, all of which are gaseous. The distribution shows no correlations but is probably meaningless because of so few observations. However, it corroborates the results of the gaseous of all others in Figures 1 and 2.

We have thus far been considering the data distributions with respect to the anomalistic period and lunar age. Now we might inquire into their observed behavior compared with what we would expect under each hypothesis if they were to occur at random and under no external influences. These considerations have been ignored in previous analyses. If the data are analyzed with respect to the anomalistic period in intervals of 0.1 of a period, one might adopt 0.1 period as a boundary condition for a tidal influence or correlation. On a random basis then one would expect 20% of all observations to come within ±0.1 period of perigee and a like percentage within the same limits for apogee, totalling 40% of all observations within these limits for perigee plus apogee. One could adopt more restrictive boundary conditions, and were adopted in these analyses. The arbitrary limits of $\leq \pm 0.05$ and $\leq \pm 0.1$ period were investigated for the period portion of the tidal effect. These limits correspond in days to $\tilde{\pm}1.4$ and ~2.8 days respectively of P and A.

Similarly for low-angle illumination (which includes sunrise effects alone), the limits chosen were $\leq +12°$ and $\leq +24°$ of sunrise and $\leq -12°$ and $\leq -24°$ sunset respectively. These limits correspond in days to one and two respectively. Sunrise on Aristarchus, on the average, occurs at about age 11^d and sunset occurs at about age 26^d.

For the magnetic tail effects we adopt three conditions, viz. $\leq \pm 2$ days from full moon for the magnetopause, $\leq \pm 4.5$ days from full moon for the whole tail including the bow-shock front (BSF), and $\leq \pm 3.5$ - 4.5 days from full moon for the bow-shock front turbulence effect.

Arbitrary limits adopted for the solar effects were $\leq \pm 0.5$ days, $\leq \pm 1$ day and $\leq \pm 2$ days of coincidence of magnetic storm effects on the earth and LTP dates. The terrestrial effects considered were sudden commencements (SC) of magnetic storms, storms in progress (MS) and, when known, aurorae (A).

Calculation of the numbers of observations and percentages of observations expected (Exp) were made by the ratios of the number of days involved in the limits to the total number of days in an observing period (indicated in parentheses at the top). The observing period for Bartlett was 15^d and for All Others was taken as 25.5 days since the moon is rarely observed within $\pm 2^d$ of new moon in a lunation period of 29.5 days. The combined data in each category had a pro-rated observing period weighted by the ratio of the numbers of observations contributed by the two groups, (B) and (A.O.). Some adjustment was made under the bow-shock front limits for Bartlett since he did not observe until sunrise had occurred on Aristarchus and by that time the moon is already within the bow-shock front. Thus we have for the expected percentages at this limit for Bartlett and All Others respectively, $\frac{8.5}{15} = 57\%$ and $\frac{9.0}{25.5} = 37\%$. All numbers of observations and percentages were rounded off to the nearest number.

Table II presents the results for these analyses for the various categories for the Aristarchus observations. The columns under each group for each category within that boundary condition (ordinate) give the following data: (1) number of observations expected (numerator) out of the total number of observations (denominator) for that group in that category; (2) the same as (1) in terms of percent; (3) number of observations observed (numerator) out of total number of observations (denominator) in that group and category; (4) the same as (3) in terms of percent; and (5) the ratio of columns four to two, where 1.0 of course means the percent observed = percent expected. The circled figures in column 5 indicate the highest ratio (correlation) for that group in that category.

Examining the table in detail shows that only two groups, out of 14, departed from a highest correlation with sunrise. The two departures were Bartlett's reddish which correlated most strongly with the magnetopause, and the brightenings which, surprisingly, correlated most strongly with solar effects. In other words, the brightenings occurred very often within a day of the arrival of solar particles at the earth (and moon) which caused disturbances on the earth (and moon?). Note that more than 1/4 of all observations of brightenings on the moon occurred when a terrestrial event (magnetic storm or aurora) occurred within one day of it.

The ratios for sunrise effects are substantially high for most groups and categories and for the most part are found at the more restrictive boundary conditions. In fact, it can be seen that this is generally true under all the hypotheses, that the higher correlations come within the narrower limits (which probably should be expected).

The tidal effects ratios are quite interesting. Most of the groups and categories have a ratio greater than 1.0 at the narrow limits for perigee, indicating a fairly persistent excess of observations near perigee over those expected. The reverse is found for apogee limits (except for Bartlett's absent phenomena which had a high ratio at apogee). It corroborates the trends seen in Figures 1 and 2. Note, however, that the same is true for the Absent phenomena. For a true or strong tidal effect to be operating on the lunar phenomena, one would expect the maximum peaks for the Absent phenomena to come at midperiods, i.e., at about ϕ = 0.3 and 0.7 or 0.8, which we do not find. We find them coming near perigee and apogee! (See Figures 1 and 2.)

Table IV summarizes the O/E results for all the groups and categories of Tables II and III. Table III is very similar to Table II and gives the same quantities for the six next most frequently reported sites of LTP: (1) the combined results of these six (6 sites) all Aristarchus, (2) All Sites from the author's collection, (3) the best of the latter, and (4) the Burley-Middlehurst results, for comparison. Here again, out of these 10 categories only one (other than B-M) does not have the highest correlation (circled) with sunrise, and all but one of these is with the narrower limits. The one exception is for the crater Proclus whose highest ratio was for solar effects. Some of the sunrise ratios are very high, e.g., Schröter's Valley with 15.5, meaning more than 15 times as many events were observed than would be expected on a basis of random occurrence.

Table II

GASEOUS

Effect	Boundary Conditions	Bartlett (15^d) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	All Others ($25^d.5$) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	Combined (21^d) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E
Tidal	≤ ± 0.05 P	3/31	10	6/31	19	1.9	5/48	10	5/48	10	1.0	8/78	10	10/78	13	1.3
	≤ ± 0.05 A	3/31	10	2/31	6	0.6	5/48	10	2/48	4	0.4	8/78	10	4/78	5	0.5
	≤ ± 0.1 P	6/31	20	11/31	36	1.8	10/48	20	9/48	19	1.0	16/78	20	19/78	24	1.2
	≤ ± 0.1 A	6/31	20	6/31	19	1.0	10/48	20	6/48	12	0.6	16/78	20	12/78	15	0.8
	≤ ± 0.05 P and A	6/31	20	8/31	26	1.3	10/48	20	7/48	15	0.8	16/78	20	14/78	18	0.9
	≤ ± 0.1 P and A	12/31	40	17/31	55	1.4	19/48	40	15/48	31	0.8	32/78	40	31/78	40	1.0
Low-Angle Illumination	≤ + 12° R	2/31	7	5/31	16	(2.3)	2/50	4	7/50	14	(3.5)	4/80	5	12/80	15	(3.0)
	≤ − 12° S	2/31	7	1/31	3	0.4	2/50	4	4/50	8	2.0	4/80	5	5/80	6	1.2
	≤ + 24° R	4/31	13	6/31	19	1.5	4/50	8	13/50	26	3.2	8/80	10	19/80	24	2.4
	≤ − 24° S	4/31	13	1/31	3	0.2	4/50	8	5/50	10	1.1	8/80	10	6/80	8	0.8
	≤ ± 12° R and S	4/31	13	6/31	19	1.5	4/50	8	11/50	22	2.8	8/80	10	17/80	21	2.1
	≤ ± 24° R and S	8/31	27	7/31	23	0.8	8/50	16	18/50	36	2.2	15/80	19	25/80	31	1.6
Magnetic Tail	≤ ± 2^d FM	8/31	27	15/31	48	1.8	8/50	16	12/50	24	1.5	15/80	19	27/80	34	1.8
	≤ ± $4^d.5$ FM	16/31	57	24/31	77	1.4	18/50	35	22/50	44	1.2	32/80	40	45/80	56	1.4
	≤ ± $3^d.5$-$4^d.5$ FM	4/31	13	3/31	10	0.8	4/50	8	2/50	4	0.5	8/80	10	5/80	6	0.6
Solar (1)	sc, ms, A on date	2/31	7	1/31	3	0.4	1/31	4	2/31	6	1.5	3/61	5	3/61	5	1.0
(2)	≤ ± 1^d event	4/31	13	3/31	10	0.8	2/31	8	4/31	13	1.6	6/61	10	7/61	11	1.1
(3)	≤ ± 2^d event	8/31	27	5/31	16	0.6	5/31	16	9/31	29	1.8	11/61	19	14/61	23	1.2
(4)	≤ ± 2^d event in M.T.			4/31 (4/5)	13 (80)				2/31 (2/9)	6 (22)				6/61 (6/14)	10 (43)	
(5)	On date in M.T.			1/31 (1/1)	3 (100)				1/31 (1/2)	3 (50)				2/61 (2/3)	3 (67)	
(6)	≥ K_{pmax} 6−			2/31	6				2/31	6				4/62	6	

REDDISH

Effect	Boundary Conditions	Bartlett (15^d) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	All Others ($25^d.5$) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	Combined (23^d) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E
Tidal	≤ ± 0.05 P	2/18	10	1/18	6	0.6	5/51	10	10/51	20	2.0	7/66	10	11/66	17	1.7
	≤ ± 0.05 A	2/18	10	2/18	11	1.1	5/51	10	3/51	6	0.6	7/66	10	5/66	8	0.8
	≤ ± 0.1 P	4/18	20	1/18	6	0.3	10/51	20	11/51	22	1.1	13/66	20	12/66	18	0.9
	≤ ± 0.1 A	4/18	20	3/18	17	0.8	10/51	20	7/51	14	0.7	13/66	20	10/66	15	0.8
	≤ ± 0.05 P and A	4/18	20	3/18	17	0.8	10/51	20	13/51	26	1.3	13/66	20	16/66	24	1.2
	≤ ± 0.1 P and A	7/18	40	4/18	22	0.6	20/51	40	18/51	35	0.9	26/66	40	22/66	33	0.8
Low-Angle Illumination	≤ + 12° R	1/18	7	0/18	0	0.0	2/52	4	10/52	20	5.0	3/66	4	10/66	15	3.8
	≤ − 12° S	1/18	7	0/18	0	0.0	2/52	4	4/52	8	2.0	3/66	4	4/66	6	1.5
	≤ + 24° R	2/18	13	0/18	0	0.0	4/52	8	24/52	46	(5.8)	6/66	9	24/66	36	(4.0)
	≤ − 24° S	2/18	13	0/18	0	0.0	4/52	8	4/52	8	1.0	6/66	9	4/66	6	0.7
	≤ ± 12° R and S	2/18	13	0/18	0	0.0	4/52	8	14/52	27	3.4	6/66	9	14/66	21	2.3
	≤ ± 24° R and S	5/18	27	0/18	0	0.0	8/52	16	28/52	54	3.4	11/66	17	28/66	42	2.5
Magnetic Tail	≤ ± 2^d FM	5/18	27	9/18	50	(1.9)	8/52	16	20/52	38	2.4	11/66	17	28/66	42	2.5
	≤ ± $4^d.5$ FM	9/18	57	17/18	94	1.6	18/52	35	32/52	63	1.8	24/66	37	46/66	70	1.9
	≤ ± $3^d.5$-$4^d.5$ FM	2/18	13	2/18	11	0.8	4/52	8	3/52	6	0.8	6/66	9	4/66	6	0.7
Solar (1)	sc, ms, A on date	1/18	7	2/18	11	1.6	2/40	4	3/40	8	2.0	2/55	4	5/55	9	2.2
(2)	≤ ± 1^d event	2/18	13	2/18	11	0.8	3/40	8	5/40	12	1.5	5/55	9	6/55	11	1.2
(3)	≤ ± 2^d event	5/18	27	2/18	11	0.4	6/40	16	10/40	25	1.6	9/55	17	11/55	20	0.8
(4)	≤ ± 2^d event in M.T.			1/18 (1/2)	6 (50)				4/40 (4/10)	10 (40)				5/55 (5/12)	9 (42)	
(5)	On date in M.T.			2/18 (2/2)	11 (100)				1/40 (1/3)	2 (33)				3/55 (3/5)	5 (60)	
(6)	≥ K_{pmax} 6−			2/18	11				4/43	9				6/58	10	

*Includes other sites; total number of observations differ because some observations were biased toward sunrise and were not included in age data.

Table II (Continued)

Effect	Bound. Cond.	BLUISH															BRIGHTENINGS					ABSENT										ONSET									
		Bartlett (15d)					All Others (25d5)					Combined (17d)					All Others (25d5)					Bartlett (15d)					All Others* (25d5)					Bartlett (15d)					All Others (25d5)				
		No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	No. Exp.	% Exp.	No. Obs.	% Obs.	O/E
Tidal	≤ ± 0.05 P	11/107	10	17/107	16	1.6	3/26	10	3/26	10	1.0	13/130	10	19/130	15	1.5	11/106	10	18/106	17	1.7	5/51	10	6/51	12	1.2	6/61	10	8/61	13	1.3	5/50	10	7/50	14	1.4	3/28	10	5/28	18	1.8
	≤ ± 0.05 A	11/107	10	7/107	7	0.7	3/26	10	3/26	10	1.0	13/130	10	10/130	8	0.8	11/106	10	9/106	8	0.8	5/51	10	8/51	16	1.6	6/61	10	3/61	5	0.5	5/50	10	6/50	12	1.2	3/28	10	3/28	11	1.1
	≤ ± 0.1 P	21/107	20	30/107	27	1.4	5/26	20	8/26	31	1.5	26/130	20	37/130	28	1.4	21/106	20	32/106	30	1.5	10/51	20	11/51	22	1.1	12/61	20	12/61	20	1.0	10/50	20	14/50	28	1.4	6/28	20	9/28	32	1.6
	≤ ± 0.1 A	21/107	20	11/107	10	0.5	5/26	20	4/26	15	0.8	26/130	20	15/130	12	0.6	21/106	20	18/106	17	0.8	10/51	20	12/51	24	1.2	12/61	20	13/61	21	1.0	10/50	20	12/50	24	1.2	6/28	20	7/28	25	1.2
	≤ ± 0.05 P and A	21/107	20	24/107	21	1.0	5/26	20	6/26	23	1.2	26/130	20	29/130	22	1.1	21/106	20	27/106	25	1.2	10/51	20	14/51	25	1.2	12/61	20	11/61	18	0.9	10/50	20	13/50	26	1.3	6/28	20	8/28	29	1.4
	≤ ± 0.1 P and A	43/107	40	41/107	39	1.0	10/26	40	12/26	46	1.2	52/130	40	52/130	40	1.0	42/106	40	50/106	47	1.2	20/51	40	23/51	45	1.1	24/61	40	25/61	41	1.0	20/50	40	26/50	52	1.3	11/28	40	16/28	57	1.4
Low-Angle Illumination	≤ + 12° R	7/107	7	13/107	12	(1.7)	1/29	4	4/29	14	(3.5)	8/133	6	17/133	13	(2.2)	4/106	4	6/106	6	1.5	4/51	7	14/51	27	(3.9)	2/38	4	7/38	18	(4.5)	4/50	7	14/50	28	(4.0)	1/28	4	7/28	25	(6.2)
	≤ − 12° S	7/107	7	0/107	0	0.0	1/29	4	2/29	7	1.8	8/133	6	2/133	2	0.3	4/106	4	2/106	2	0.5	4/51	7	0/51	0	0.0	2/38	4	1/38	3	0.8	4/50	7	0/50	0	0.0	1/28	4	0/28	0	0.0
	≤ + 24° R	14/107	13	22/107	21	1.6	2/29	8	8/29	28	3.5	16/133	12	30/133	23	1.9	8/106	8	10/106	9	1.1	7/51	13	21/51	41	3.2	3/38	8	13/38	34	4.2	6/50	13	22/50	44	3.4	2/28	8	10/28	36	4.5
	≤ − 24° S	14/107	13	0/107	0	0.0	2/29	8	2/29	7	0.9	16/133	12	2/133	2	0.2	8/106	8	4/106	4	0.5	7/51	13	2/51	4	0.3	3/38	8	1/38	3	0.4	6/50	13	0/50	0	0.0	2/28	8	1/28	4	0.5
	≤ ± 12° R and S	14/107	13	13/107	12	0.9	2/29	8	6/29	21	2.6	16/133	12	19/133	14	1.2	8/106	8	8/106	8	1.0	7/51	13	14/51	27	2.1	3/38	8	8/38	21	2.6	6/50	13	14/50	28	2.2	2/28	8	7/28	25	3.1
	≤ ± 24° R and S	29/107	27	22/107	21	0.8	5/29	16	10/29	34	2.1	32/133	24	32/133	24	1.0	17/106	16	14/106	13	0.8	14/51	27	23/51	45	1.7	6/38	16	14/38	37	2.3	14/50	27	22/50	44	1.6	4/28	16	11/28	39	2.4
Magnetic Tail	≤ ± 2d FM	29/107	27	49/107	46	1.7	5/29	16	15/29	52	3.2	32/133	24	63/133	47	2.0	17/106	16	21/106	20	1.2	14/51	27	20/51	39	1.4	6/38	16	5/38	13	0.8	14/50	27	25/50	50	1.8	4/28	16	2/28	7	0.4
	≤ ± 4d5 FM	54/107	57	92/107	85	1.5	10/29	35	24/29	83	2.4	61/133	46	113/133	85	1.8	37/106	35	33/106	31	0.9	26/51	57	43/51	84	1.5	13/38	35	10/38	26	0.7	25/50	57	48/50	96	1.7	10/28	35	11/28	39	1.1
	≤ ± 3d5-4d5 FM	14/107	13	13/107	9	0.7	2/29	8	1/29	3	0.4	16/133	12	13/133	10	0.9	8/106	8	1/106	1	0.1	7/51	13	3/51	6	0.5	3/38	8	2/38	5	0.6	6/50	13	6/50	12	0.9	2/28	8	2/28	7	0.9
Solar	(1) sc, ms, A on date	7/107	7	9/107	8	1.1	1/21	4	1/21	5	1.2	8/125	6	10/125	8	1.3	2/50	4	4/50	8	2.0	4/51	7	9/51	18	2.6	2/38	4	1/38	3	0.8	4/50	7	4/50	8	1.1	1/19	4	1/19	5	1.2
	(2) ≤ ± 1d event	14/107	13	16/107	15	1.1	2/21	8	1/21	5	0.6	15/125	12	16/125	13	1.1	4/50	8	14/50	28	(3.5)	7/51	13	11/51	22	1.7	3/38	8	3/38	8	1.0	6/50	13	7/50	14	1.1	2/19	8	3/19	16	2.0
	(3) ≤ ± 2d event	29/107	27	20/107	19	0.7	3/21	16	1/21	5	0.3	30/125	24	21/125	17	0.7	8/50	16	17/50	34	2.1	14/51	27	11/51	22	0.8	6/38	16	7/38	18	1.1	14/50	27	12/50	24	0.9	3/19	16	5/19	26	1.6
	(4) ≤ ± 2d event in M.T.			9/107 (9/20)	8(45)				1/21 (1/1)	5(100)				9/125 (9/21)	7(43)				5/50 (5/17)	10(30)				8/51 (8/11)	16(73)				7/38 (7/7)	18(100)				12/50 (12/12)	24(100)				3/19 (3/5)	16(60)	
	(5) On date in M.T.			7/107 (7/9)	8(78)				1/21 (1/1)	5(100)				7/125 (7/10)	6(70)				1/50 (1/4)	2(25)				5/51 (5/9)	10(56)				1/28 (1/1)	3(100)				4/50 (4/4)	8 (100)				1/19 (1/1)	5(100)	
	(6) ≥ K_{pmax} 6−			10/107	7				4/21	19				13/125	10				6/54	11				7/51	14				0/38	0				4/50	8				1/19	5	

Table III

Effect	Bound. Cond.	PROCLUS (15^d) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	AGRIPPA (15^d) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	ALPHONSUS ($25^d.5$) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	PLATO ($25^d.5$) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	GASSENDI ($25^d.5$) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E
Tidal	$\leq \pm 0.05$ P	3/27	10	3/27	11	1.1	3/34	10	4/34	12	1.2	3/33	10	3/33	9	0.9	5/50	10	4/50	8	0.8	2/21	10	4/21	19	1.9
	$\leq \pm 0.05$ A	3/27	10	3/27	11	1.1	3/34	10	3/34	9	0.9	3/33	10	2/33	6	0.6	5/50	10	8/50	16	1.6	2/21	10	2/21	10	1.0
	$\leq \pm 0.1$ P	5/27	20	6/27	22	1.1	7/34	20	9/34	26	1.3	7/33	20	6/33	18	0.9	10/50	20	9/50	16	0.8	4/21	20	4/21	19	1.0
	$\leq \pm 0.1$ A	5/27	20	6/27	22	1.1	7/34	20	10/34	29	1.4	7/33	20	5/33	15	0.8	10/50	20	15/50	31	1.6	4/21	20	4/21	19	1.0
	$\leq \pm 0.05$ P and A	5/27	20	6/27	22	1.1	7/34	20	7/34	21	1.0	7/33	20	5/33	15	0.8	10/50	20	12/50	24	1.2	4/21	20	6/21	29	1.4
	$\leq \pm 0.1$ P and A	11/27	40	12/27	44	1.1	14/34	40	19/34	56	1.4	13/33	40	11/33	33	0.8	20/50	40	24/50	49	1.2	8/21	40	8/21	38	1.0
Low-Angle Illumination	$\leq +12°$ R	2/27	7	2/27	7	1.0	2/34	7	2/34	6	0.5	1/33	4	13/33	39	(9.8)	2/51	4	16/51	31	(7.8)	1/21	4	11/21	52	(13.0)
	$\leq -12°$ S	2/27	7	0/27	0	0.0	2/34	7	0/34	0	0.0	1/33	4	3/33	9	2.2	2/51	4	2/51	4	1.0	1/21	4	0/21	0	0.0
	$\leq +24°$ R	4/27	13	2/27	7	0.5	4/34	13	7/34	21	(1.6)	3/33	8	18/33	55	6.9	4/51	8	23/51	45	5.6	2/21	8	15/21	71	8.9
	$\leq -24°$ S	4/27	13	4/27	15	1.2	4/34	13	1/34	3	0.2	3/33	8	6/33	18	2.2	4/51	8	3/51	6	0.8	2/21	8	0/21	0	0.9
	$\leq \pm 12°$ R and S	4/27	13	2/27	7	0.5	4/34	13	2/34	6	0.5	3/33	8	16/33	48	6.0	4/51	8	18/51	35	4.4	2/21	8	11/21	52	6.5
	$\leq \pm 24°$ R and S	7/27	27	6/27	22	0.8	9/34	27	8/34	24	0.9	5/33	16	22/33	67	4.2	8/51	16	26/51	51	3.2	3/21	16	15/21	71	4.4
Magnetic Tail	$\leq \pm 2^d$ FM	7/27	27	13/27	48	1.8	9/33	27	11/33	33	1.2	5/33	16	1/33	3	0.2	8/51	16	12/51	24	1.5	3/21	16	2/21	10	0.6
	$\leq \pm 4^d.5$ FM	14/27	57	17/27	63	1.1	16/33	57	16/33	49	0.9	12/33	36	7/33	21	0.6	18/51	36	23/51	45	1.2	8/21	36	18/21	86	2.4
	$\leq \pm 3^d.5$-$4^d.5$ FM	4/27	13	3/27	11	0.8	4/33	13	1/33	3	0.2	3/33	8	5/33	15	1.9	4/51	8	7/51	14	1.8	2/21	8	5/21	24	3.0
Solar (1)	sc, ms, A on date	2/25	7	4/25	16	2.3	2/33	7	0/33	0	0.0	1/30	4	3/30	10	2.5	1/27	4	4/27	15	3.8	1/19	4	2/19	11	2.8
(2)	$\pm 1^d$ event	4/25	13	9/25	36	(2.8)	5/33	13	4/33	12	0.9	2/30	8	5/30	17	2.1	2/27	8	5/27	19	2.4	2/19	8	3/19	16	2.0
(3)	$\pm 2^d$ event	7/25	27	10/25	40	1.5	9/33	27	5/33	15	0.6	4/30	16	12/30	40	2.5	4/27	16	6/27	22	1.4	2/19	16	5/19	26	1.6
(4)	$\pm 2^d$ event in M.T.			2/25 (2/10)	8 (20)				2/33 (2/5)	6 (40)				4/30 (4/12)	13 (33)				4/27 (4/6)	15 (67)				3/19 (3/5)	16 (60)	
(5)	$\pm$ on date in M.T.			0/25 (0/4)	0 (0)				0/33 (0/0)	0 (0)				1/30 (1/3)	3 (33)				2/27 (2/4)	7 (50)				2/19 (2/2)	11 (100)	
(6)	$\geq K_{pmax}$ 6−			2/25	8				0/33	0				4/30	13				6/27	22				2/19	11	

*About 1 dozen Herodotus observations are included here.

Table III (Continued)

Effect	Bound. Cond.	SCHROTER'S VALLEY* ($25^{d}.5$) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	6 SITES COMBINED (23^{d}) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	ALL ARISTARCHUS (23^{d}) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E
Tidal	≤ ± 0.05 P	4/39	10	5/39	13	1.3	20/204	10	23/204	11	1.1	27/268	10	38/268	14	1.4
	≤ ± 0.05 A	4/39	10	5/39	13	1.3	20/204	10	23/204	11	1.1	27/268	10	22/268	8	0.8
	≤ ± 0.1 P	8/39	20	8/39	21	1.0	41/204	20	42/204	21	1.0	54/268	20	64/268	24	1.2
	≤ ± 0.1 A	8/39	20	9/39	23	1.2	41/204	20	49/204	24	1.2	54/268	20	40/268	15	0.8
	≤ ± 0.05 P and A	8/39	20	10/39	26	1.3	41/204	20	46/204	23	1.2	54/268	20	60/268	22	1.1
	≤ ± 0.1 P and A	16/39	40	17/39	44	1.1	82/204	40	91/204	45	1.1	107/268	40	104/268	39	1.0
Low-Angle Illumination	≤ + 12° R	2/39	4	24/39	62	15.5	8/205	4	68/205	33	8.2	11/271	4	29/271	11	2.3
	≤ − 12° S	2/39	4	1/39	3	0.8	8/205	4	6/205	3	0.8	11/271	4	5/271	2	0.5
	≤ + 24° R	3/39	8	29/39	74	9.2	18/205	9	94/205	46	5.1	24/271	9	50/271	18	2.0
	≤ − 24° S	3/39	8	1/39	3	0.4	18/205	9	15/205	7	0.8	24/271	9	8/271	3	0.3
	≤ ± 12° R and S	3/39	8	25/39	64	8.0	18/205	9	74/205	36	4.0	24/271	9	34/271	13	1.4
	≤ ± 24° R and S	6/39	16	30/39	77	4.8	35/205	17	107/205	52	3.1	46/271	17	59/271	22	1.3
Magnetic Tail	≤ ± 2^{d} FM	6/39	16	9/39	23	1.4	35/204	17	48/204	24	1.4	46/269	17	95/269	35	2.1
	≤ ± $4^{d}.5$ FM	14/39	36	35/39	90	2.5	73/204	39	116/204	57	1.5	105/269	39	166/269	62	1.6
	≤ ± $3^{d}.5$-$4^{d}.5$ FM	3/39	8	3/39	8	1.0	18/204	9	24/204	12	1.3	24/269	9	16/269	6	1.5
Solar (1)	sc, ms, A on date	1/31	4	4/31	13	3.2	7/165	4	17/165	10	2.5	8/206	4	17/206	8	2.0
(2)	± 1^{d} event	2/31	8	7/31	23	2.9	15/165	9	29/165	18	2.0	19/206	9	32/206	16	1.8
(3)	± 2^{d} event	5/31	16	11/31	35	2.2	28/165	17	49/165	30	1.8	35/206	17	46/206	22	1.3
(4)	± 2^{d} event in M.T.			10/31 (10/11)	32 (91)				25/165 (25/49)	15 (51)				19/206 (19/46)	9 (41)	
(5)	± on date in M.T.			4/31 (4/4)	13 (100)				9/165 (9/17)	5 (53)				10/206 (10/17)	5 (59)	
(6)	≥ K_{pmax} 6−			4/31	13				18/165	11				18/209	9	

Effect	Bound. Cond.	ALL SITES (26^{d}) No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	BEST ALL SITES No. Exp.	% Exp.	No. Obs.	% Obs.	O/E	BURLEY-MIDDLEHURST No. Exp.	% Exp.	No. Obs.	% Obs.	O/E
Tidal	≤ ± 0.05 P	76/759	10	97/759	13	1.3	58/581	10	75/581	13	1.3	14/145	10	27/145	19	1.9
	≤ ± 0.05 A	76/759	10	77/759	10	1.0	58/581	10	52/581	9	0.9	14/145	10	21/145	14	1.4
	≤ ± 0.1 P	152/759	20	172/759	23	1.1	116/581	20	134/581	23	1.2	29/145	20	35/145	24	1.2
	≤ ± 0.1 A	152/759	20	151/759	20	1.0	116/581	20	110/581	19	1.0	29/145	20	28/145	19	1.0
	≤ ± 0.05 P and A	152/759	20	174/759	23	1.1	116/581	20	127/581	22	1.1	29/145	20	48/145	33	1.6
	≤ ± 0.1 P and A	303/759	40	323/759	43	1.1	232/581	40	244/581	42	1.0	58/145	40	63/145	43	1.1
Low-Angle Illumination	≤ + 12° R	31/771	4	166/771	22	5.5	24/590	4	130/590	22	5.5					
	≤ − 12° S	31/771	4	26/771	3	0.8	24/590	4	22/590	4	1.0					
	≤ + 24° R	62/771	8	243/771	32	4.0	47/590	8	191/590	32	4.0					
	≤ − 24° S	62/771	8	43/771	6	0.8	47/590	8	35/590	6	0.8					
	≤ ± 12° R and S	62/771	8	192/771	25	3.1	47/590	8	152/590	26	3.3					
	≤ ± 24° R and S	116/771	15	286/771	37	2.5	100/590	17	226/590	38	2.2					
Magnetic Tail	≤ ± 2^{d} FM	116/771	15	215/771	28	1.9	100/590	17	170/590	29	1.7					
	≤ ± $4^{d}.5$ FM	239/771	31	397/771	51	1.6	218/590	37	323/590	55	1.5					
	≤ ± $3^{d}.5$-$4^{d}.5$ FM	62/771	8	58/771	8	1.0	47/590	8	45/590	8	1.0					
Solar (1)	sc, ms, A on date	19/486	4	41/486	8	2.0	18/441	4	39/441	8	2.0					
(2)	± 1^{d} event	39/486	8	98/486	20	2.5	35/441	8	77/441	16	2.0					
(3)	± 2^{d} event	73/486	15	147/486	30	2.0	75/441	17	122/441	25	1.5					
(4)	± 2^{d} event in M.T.			84/486 (84/147)	17 (57)				64/441	13						
(5)	± on date in M.T.			19/486 (19/41)	4 (46)				19/441	4						
(6)	≥ K_{pmax} 6−			42/496	8				41/441	9						

This is in contrast with the same quantity for Aristarchus in which the number observed is 2.8 times that expected. A large portion of the sunrise ratio may be due to observational effects, but probably not all of it can be attributed to such selective effects. The differences between the two physically close sites of Schröter's Valley and Aristarchus plus the fact that observations are reported for all lunar ages suggest that selection is not the whole answer. The numbers of observations before and after full moon are approximately equal for All Others. Even the brightenings, although predominantly seen in the early phases, were reported at all ages, and had 50% more observed near sunrise than expected. There is probably a real effect here, something about sunrise conditions that favors the detection of lunar transient phenomena. Figures 1, 2, 4, and Table VI emphasize that LTP are to be observed at any time with little or no preference for any specific time, e.g., at perigee. In fact, if observations are confined to perigee, 2/3 to 3/4 would be missed.

Table II also shows another general trend in the data in tidal effects. There are little or no excesses of observed over expected observations near perigee plus apogee (last row in tidal effects). This also is apparent in the results of Burley and Middlehurst shown in Table III for comparison despite the correlations with perigee and apogee that they found. The results given here for their data are approximate because the data were not available for units smaller than 0.1 period. For their data almost twice as many (O/E = 1.9) were observed over what would be expected at perigee and 40% (O/E = 1.4) more at apogee. Few other categories or sites approached such high ratios at perigee and only one in apogee in either Table II or Table III. In particular, note the decline of these ratios as larger numbers of observations are used (see the last five groups in Table III).

Under solar effects, both in Tables II and III there are three other limits given that have not been defined or discussed yet. They are the last three rows of boundary conditions listed. I was curious as to what percentage of the observations that occurred within two days of a terrestrial event (defined earlier) occurred when the moon was within any part of the earth's magnetic tail at the time of the LTP (a possible tail enhancement effect). This quantity is given opposite to the heading $\pm 2^d$ event in M.T. I had not expected many events to be correlated with the solar effects so I chose the most liberal limits for the investigation. A more realistic quantity would be for the coincident lunar and terrestrial events and this is given opposite the heading On date in M.T. Column 3 for these two quantities gives two ratios; the left one is the number observed over the total number of observations for that category, and the number in parentheses is the number of observations within the magnetic tail out of the number in the chosen limit. It is the ratio of the numerators of row 4 to row 3 (for row 4) and of the numerators of row 5 to row 1 (for row 5). Column 4 gives these quantities in percentages in the same relationship as column 3. The last row, row 6, gives all the observations in each category that had a K_p maximum of $\geq 6-$ which usually (though frequently does not) leads to a magnetic storm (K_p ranges from 0 to 9).

The results in the parentheses in rows 4 and 5 under solar effects indicate that there is apparently some enhancement from the magnetic tail, if we can believe the results from such small samples. In almost all cases a very high percentage of the events that occurred contemporaneously with or near a terrestrial event occurred when the moon was within the earth's tail. It was also surprising to find the rather high percentage that did occur near a solar event. Nearly 10% of the 486 observations of all sites for which I had solar data occurred at the time of the arrival of solar particles in the earth-moon system and as high as 16% (for Proclus) did. If a 1-day leeway is granted for arrival at the moon compared with the earth, the percentage jumps to 20% and 36% respectively for the two examples. These percentages are comparable with the highest percentages under any of the considered hypotheses. In this respect, note that far from a majority of lunar events occur at perigee as has been mis-reported in regard to the lunar seismic events (Latham, 1970). As high or higher percentages occur at other favorable times, e.g., sunrise, or near full moon, more than 1/3 of All Aristarchus occur near full moon and > 1/4 of All Sites do, as contrasted with 1/7 for perigee. For the narrowest limits, the highest percentage for any group or category for perigee was 20%, for sunrise was 62%, for the magnetopause, 52% and for solar 16% for the present phenomena. The percentages for apogee, sunset, and bow-shock front were generally low, usually less than 10%. These results suggest that any possible tidal effect operates around perigee only, that there isn't much of a low-angle illumination effect, that instead, any low-angle effect is due to other sunrise conditions, and that the turbulence effect of the bow-shock front is small or negligible. The other parts of the respective hypotheses have some support in the data.

In Table IV where the ratios O/E are summarized we find an interesting result in the tidal effects data. Compare the ratios for $\leq \pm 0.05$ P for the five largest bodies of observations. They are, in ascending numbers of observations, Burley-Middlehurst, 6-sites, All Aristarchus, Best All and All Sites. The ratios are respectively, 1.9, 1.1, 1.4, 1.3, and 1.3. This ratio then, has generally declined with increasing number of observations, suggesting a fortuitous or else

Table IV RATIO $\frac{O}{E}$

EFFECT	BOUND. COND.	GASEOUS B	GASEOUS A.O.	GASEOUS C	REDDISH B	REDDISH A.O.	REDDISH C	BLUISH B	BLUISH A.O.	BLUISH C	BRIGHT. A.O.	ABSENT B	ABSENT A.O.	ONSET B	ONSET A.O.	ALL ARIS.	PROC.	AGRIP.	ALPH.	PLA.	GASS.	SCHRO. VALL.	B-M	6-SITES	BEST ALL	ALL SITES
Tidal	≤ ± 0.05 P	1.9	1.0	1.3	0.6	2.0	1.7	1.6	1.0	1.5	1.7	1.2	1.3	1.4	1.8	1.4	1.1	1.2	0.9	0.8	1.9	1.3	1.9	1.1	1.3	1.3
	≤ ± 0.05 A	0.6	0.4	0.5	1.1	0.6	0.8	0.7	1.0	0.8	0.8	1.6	0.5	1.2	1.1	0.8	1.1	0.9	0.6	1.6	1.0	1.3	1.4	1.1	0.9	1.0
	≤ ± 0.1 P	1.8	1.0	1.2	0.3	1.1	0.9	1.4	1.5	1.4	1.5	1.1	1.0	1.4	1.6	1.2	1.1	1.3	0.9	0.8	1.0	1.0	1.2	1.0	1.2	1.1
	≤ ± 0.1 A	1.0	0.6	0.8	0.8	0.7	0.8	0.5	0.8	0.6	0.8	1.2	1.0	1.2	1.2	0.8	1.1	1.4	0.8	1.6	1.0	1.2	1.0	1.2	1.0	1.0
	≤ ± 0.05 P and A	1.3	0.8	0.9	0.8	1.3	1.2	1.0	1.2	1.1	1.2	1.2	0.9	1.3	1.4	1.1	1.1	1.0	0.8	1.2	1.4	1.3	1.6	1.2	1.1	1.1
	≤ ± 0.1 P and A	1.4	0.8	1.0	0.6	0.9	0.8	1.0	1.2	1.0	1.0	1.1	1.0	1.3	1.4	1.0	1.1	1.4	0.8	1.2	1.0	1.1	1.1	1.1	1.0	1.1
Low-Angle Illumination	≤ + 12° R	2.3	3.5	3.0	0.0	5.0	3.8	1.7	3.5	2.2	1.5	3.9	4.5	4.0	6.2	2.8	1.0	0.5	9.8	7.8	13.0	15.5		8.2	5.5	5.5
	≤ − 12° S	0.4	2.0	1.2	0.0	2.0	1.5	0.0	1.8	0.3	0.5	0.0	0.8	0.0	0.0	0.5	0.0	0.0	2.2	1.0	0.0	0.8		0.8	1.0	0.8
	≤ + 24° R	1.5	3.2	2.4	0.0	5.8	4.0	1.6	3.5	1.9	1.1	3.2	4.2	3.4	4.5	2.0	0.5	1.6	6.9	5.6	8.9	9.2		5.1	4.0	4.0
	≤ − 24° S	0.2	1.1	0.8	0.0	1.0	0.7	0.0	0.9	0.2	0.5	0.3	0.4	0.0	0.5	0.3	1.2	0.2	2.2	0.8	0.0	0.4		0.8	0.8	0.8
	≤ ± 12° R and S	1.5	2.8	2.1	0.0	3.4	2.3	0.9	2.6	1.2	1.0	2.1	2.6	2.2	3.1	1.4	0.5	0.5	6.0	4.4	6.5	8.0		4.0	3.3	3.1
	≤ ± 24° R and S	0.8	2.2	1.6	0.0	3.4	2.5	0.8	2.1	1.0	0.8	1.7	2.3	1.6	2.4	1.3	0.8	0.9	4.2	3.2	4.4	4.8		3.1	2.2	2.5
Magnetic Tail	≤ ± 2^d FM	1.8	1.5	1.8	1.9	2.4	2.5	1.7	3.2	2.0	1.2	1.4	0.8	1.8	0.4	2.1	1.8	1.2	0.2	1.5	0.6	1.4		1.4	1.7	1.9
	≤ ± $4^d.5$ FM	1.4	1.2	1.4	1.6	1.8	1.9	1.5	2.4	1.8	0.9	1.5	0.7	1.7	1.1	1.6	1.1	0.9	0.6	1.2	2.4	2.5		1.6	1.5	1.6
	≤ ± $3^d.5$-$4^d.5$ FM	0.8	0.5	0.6	0.8	0.8	0.7	0.7	0.4	0.9	0.1	0.5	0.6	0.9	0.9	1.5	0.8	0.2	1.9	1.8	3.0	1.0		1.3	1.0	1.0
Solar (1)	sc, ms, A on date	0.4	1.5	1.0	1.6	2.0	2.2	1.1	1.2	1.3	2.0	2.6	0.8	1.1	1.2	2.0	2.3	0.0	2.5	3.8	2.8	3.2		2.5	2.0	2.0
(2)	± 1^d event	0.8	1.6	1.1	0.8	1.5	1.2	1.1	0.6	1.1	3.5	1.7	1.0	1.1	2.0	1.8	2.8	0.9	2.1	2.4	2.0	2.9		2.0	2.0	2.5
(3)	± 2^d event	0.6	1.8	1.2	0.4	1.6	0.8	0.7	0.3	0.7	2.1	0.8	1.1	0.9	1.6	1.3	1.5	0.6	2.5	1.5	1.6	2.3		1.8	1.5	2.0
		%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%		%	%	%
(4)	± 2^d event in M.T.	13(80)	6(22)	10(43)	6(50)	10(40)	7(42)	8(45)	5(100)	7(43)	10(30)	16(73)	18(100)	24(100)	16(60)	9(41)	8(20)	6(40)	13(33)	15(67)	16(60)	32(91)		15(51)	13	17(57)
(5)	on date in M.T.	3(100)	3(50)	3(67)	11(100)	2(33)	5(60)	8(78)	5(100)	6(70)	2(25)	10(56)	3(100)	8(100)	5(100)	5(59)	0(0)	0(0)	3(33)	7(50)	11(100)	13(100)		5(53)	4	4(46)
(6)	≥ K_{pmax} 6−	6	6	6	11	9	10	7	19	10	11	14	0	8	5	9	8	0	13	22	11	13		11	9	8

only weak tidal effect. The corresponding decline in apogee ratios is even more evident. The numbers (or percents) observed are about the numbers expected when perigee and apogee are considered together.

Figure 4 presents the histograms and smoothed curves in the same format as Figures 1 and 2, for the separate six sites, repeating the All Aristarchus results. The variations and similarities of the various sites can be compared. The Proclus and Agrippa observations were almost wholly those of Bartlett (private communication) and are all of the gaseous category. The results are almost mirror images of each other in the anomaly data and partly in the age data. Agrippa's tidal behavior is similar to that indicated in Bartlett's Aristarchus (gaseous) observations, but differ somewhat in age behavior (compare Figures 4 and 2). Proclus (46° E, 16° N) shows no correlation with tidal effects. Agrippa (11° E, 5° N), Alphonsus (4° W, 14° S), and Plato (9° W, 51° N) are all near the center of the moon in longitude but in different hemispheres. We find that Alphonsus and Plato are not too dissimilar but they differ from Agrippa, which is not far from Alphonsus in selenographic position. Gassendi (40° W, 17° S) and Schröter's Valley (48° W, 22° N) (which includes observations of Herodotus) behave somewhat similarly yet their behavior differs considerably from that of Aristarchus, despite the proximity of the latter to S.V. All three are nearly of the same selenographic longitude but Gassendi is in the southern hemisphere while the other two sites are in the northern. All six sites differ from all Aristarchus. Note particularly that Plato has no peak, in fact a minimum at perigee, but has one of its maxima near apogee and the other at 0.7. Agrippa has a non-significant peak at perigee and one of the dual peaks of Aristarchus is at perigee. All the other sites have insignificant peaks 0.1 period before or after perigee.

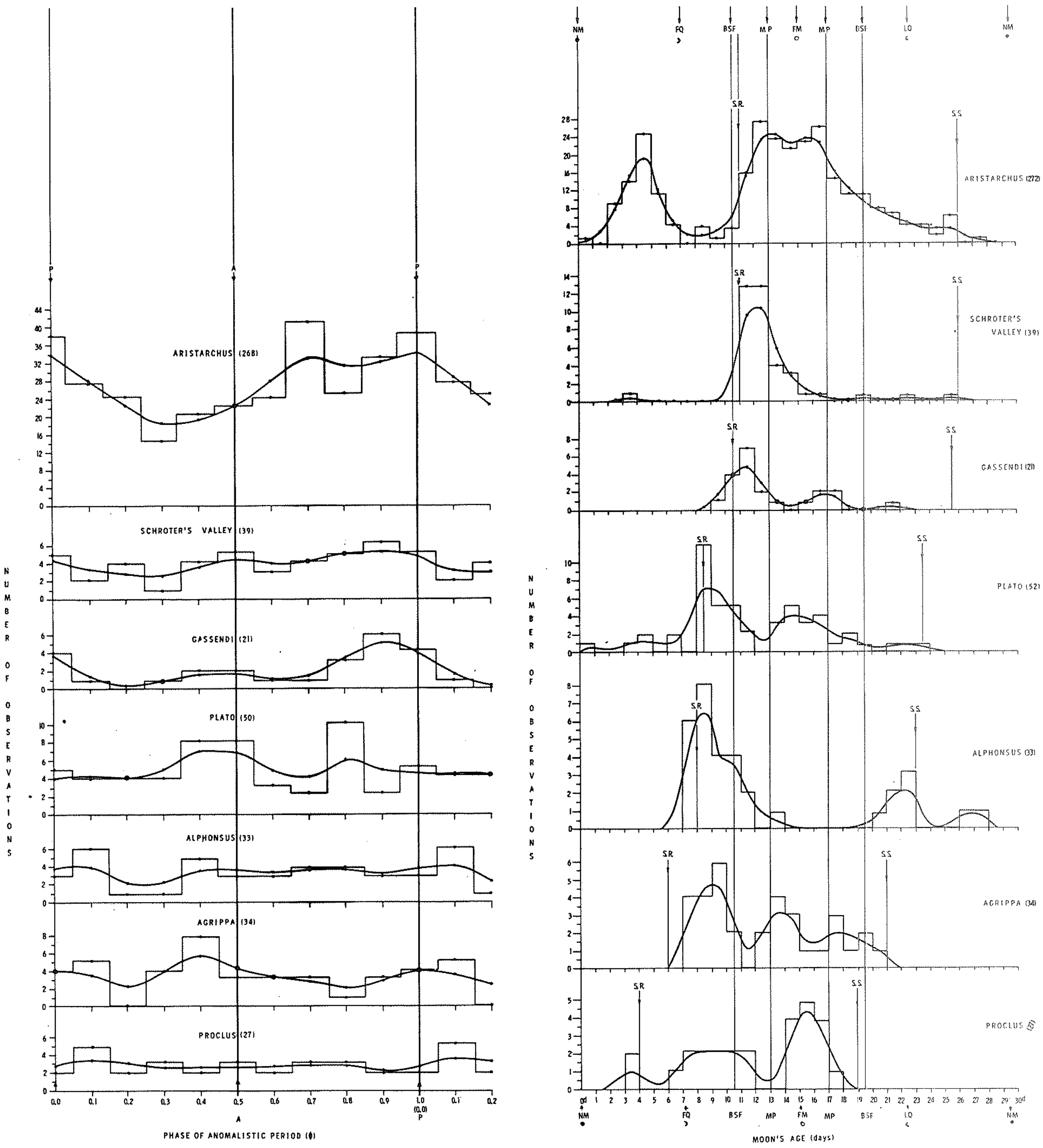

Figure 4. LTP Histograms and smoothed curves of the seven most frequently reported features of the moon. Numbers of observations are indicated in parentheses after the name of the feature. The arrangement is similar to Figures 1 and 2. Note the variability of each site with respect to each other, with very little pattern.

Differences are found in the age graphs also. Sunrise and sunset ages for each site are indicated on its graph. Proclus and Agrippa are the only ones to show no sunrise or low-angle illumination effect. The strongest peak for Proclus comes within the limits of the magnetopause. Agrippa has one there too but its other peaks have no explanation. Alphonsus shows a strong sunrise effect only. Plato has a correlation both with sunrise and magnetopause. Gassendi has a sunrise correlation and a lesser, doubtful magnetopause one. The Schröter's Valley-Herodotus graph shows only a sunrise correlation, while Aristarchus has a sunrise one plus a magnetopause one and a third peak with no explanation.

It is apparent that only Aristarchus, Plato, and Schröter's Valley have been seen in the ashen light, although Alphonsus was observed once well after the sun had set on it. Aristarchus, Proclus, Plato, and Agrippa (?) in descending order have a strong correlation with the magnetopause. The others have little or none. It is most surprising that Schröter's Valley does not correlate with M.P. because many of the observations of it were simultaneous with events on Aristarchus.

We have been considering the tidal effects in period only, yet the hypothesis we wish to test is that of Green which includes the shape or eccentricity of the orbit also. The shape may affect the strength of the tidal effect. To investigate this part of the tidal effect, the observations for Aristarchus were plotted on the anomalistic orbit plot for each year in which observations occurred when the anomalistic data were available. The data are only complete through 1967. Since the sequence of orbits is repeatable, the observations could be transferred to one representative orbit by shifting each yearly orbit until it corresponds to the correct branch of the representative one. It is essentially a phase diagram as in stellar light curves which are referred to one epoch. The representative orbit chosen was for the year 1968 and is a plot of the horizontal parallax as ordinate for the perigee and apogee dates and the Julian date as abscissa (scales not shown).

The results are shown in Figure 5 which separates Bartlett's positive, negative and All Others positive observations. The dotted portion at the right end is a repeat of the left end. The large dashed lines across the top and bottom represent the 0.1 period limits for perigee (P) and apogee (A), respectively. If only a tidal effect operated, one would expect all the observations to cluster outside these dashed lines, but ideally, on Green's hypothesis, at the apogee with the arrow in the maximum degassing region and few or none at the minimum with the arrow in the minimum degassing region. If the events occurred at random with no tidal effect we would expect 40% to occur outside the dashed lines and 60% between them. We would also expect that, if there is a tidal effect, the absent phenomena would come between the dashed lines. Analyses of the observations show that 46% occur outside and 54% between for the positive events and the reverse for the absent (i.e., $\sim$55% of the absent occur within 0.1 period of perigee and apogee).

A glance at the figure shows that the observations are scattered throughout all of the orbits with little tendency to cluster. What tendency there is to cluster comes in the cases of the most eccentric orbits in which few observations are found in those branches from perigee to apogee. The branches from apogee to perigee are almost filled for the eccentric orbits and for the more circular orbits the observations are distributed uniformly around the orbits. The circled

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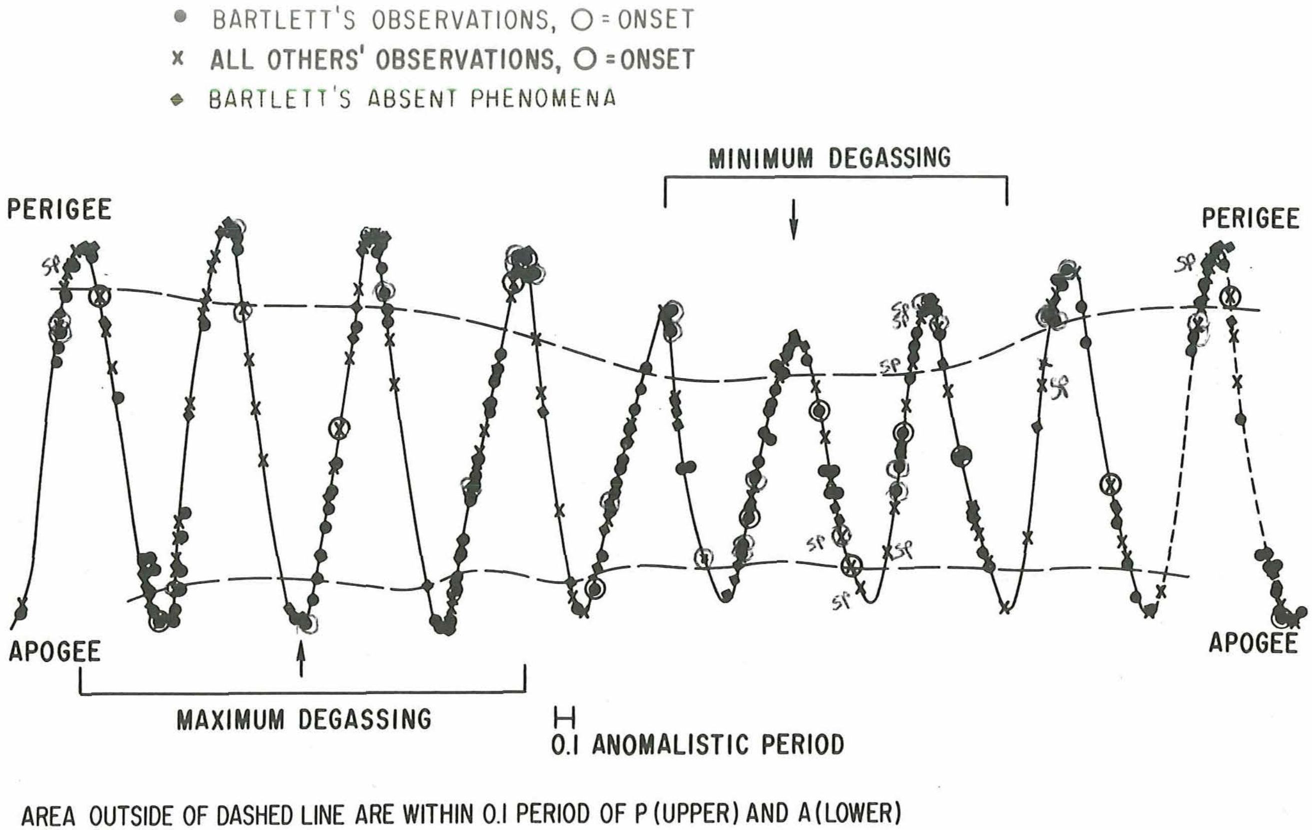

Figure 5. Plot of the anomalistic period data for Aristarchus, all referred to one epochal orbital curve. The areas of greatest number of LTP (maximum degassing) and fewest number of LTP (minimum degassing) expected under the Green tidal hypothesis (see text) are indicated. The upper and lower large-dash lines are the approximate limits indicating 0.1 period from perigee (upper) and apogee (lower) in the anomalistic period. Note the variability in the lunar eccentricity which affects the shape of the orbit. The circled points are the observations that marked the beginning of two or more consecutive days reports, suggesting the Onset of phenomena. (Sp) denotes observations in which spectra were obtained. Note the almost uniform spread of observations throughout the orbits during minimum degassing period and that they are almost uniformly distributed in the maximum degassing period, although with some deficiency of reports in the half period when the moon progresses from perigee toward apogee.

points are the Onset dates and note their tendency to advance along the orbits rather than to cluster. Note also the similarity in behavior of the absent with respect to the present phenomena instead of the reverse as would be expected.

The slight tendency for the observations to cluster near apogee and perigee in the eccentric orbits lends some support to Green's hypothesis, but it is weakened by the uniform distribution around the less eccentric ones. The number of observations in the maximum degassing region is about equal to that in the minimum degassing region, being 122 (51%) and 117 (49%), respectively. Altogether, the analyses indicate either a rather weak tidal effect or none. Table V summarizes the possible correlations for each hypothesis and category.

In the Aristarchus observations the possible effects considered have overlapping or coincidental boundary conditions, making the separation of dominating effects very difficult or impossible. As mentioned before, the moon is already within the bow-shock front when sunrise occurs on Aristarchus. At the same time, perigee or apogee could coincide and would be within the limits chosen for several months because of the near commensurability of the anomalistic period which averages 27.6 days (but varies between 25^d and 29^d) and the synodic period of 29.5 days. If solar activity occurred at this time also, the determination of the real cause (if any) would be impossible. Figure 6 shows the overlapping of all the competing hypotheses except solar activity. The narrower boundary conditions are represented by heavier shading. The figure is a plot of age as the abscissa and the anomalistic phase ϕ as the ordinate. It shows, separately, Bartlett's present and absent phenomena, and All Others present for Aristarchus through 1967, using the same symbols as in Figure 5. Note that about 6% of the

Table V. SUMMARY OF POSSIBLE CORRELATIONS

		TIDAL		SUNRISE AND/OR LOW ANGLE ILLUMINATION		MAGNETIC TAIL		SOLAR ACTIVITY	
		P	A	S.R.	S.S.	M.P.	BSF	S.A.	S.A. IN MAG. TAIL
GASEOUS	B	+	+	+	+	+	+	−?	−
	A.O.	−	−	+	+	+	+	−?	+
REDDISH	B	−	−	−	−	+?	+?	−?	+
	A.O.	+	+?	+	+	+?	+	−?	+?
BLUISH	B	+?	−	+	−	+	+?	+?	+
	A.O.	−?	−?	+	−	+	−	+?	+
BRIGHTENINGS	B								
	A.O.	+?	−	−	+	+?	−	+	−?
ONSET	B	+?	+	+	−	+	−	+?	+
	A.O.	−?	−?	+	−	+	−	+?	+?
BARTLETT'S ABSENT		+?	+?	+	+	+	−	+	+
ALL OBSERVATIONS		+?	−	+	+	+	−	+?	+
AGE 4.0^d–4.9 MOSTLY BRIGHTENINGS		−	+	−	−	−	−	+	−
AGE 12.0^d–12.9 MOSTLY BLUISH		+	+	+	−	+?	−	+	+
AGE 16.0^d–16.9 MOSTLY BLUISH		+	−	−	−	+	−	−	+
AGE 25.0–25.9 ALL GASEOUS		−	−	−	+	−	−	−?	−

(+) = PEAK AT OR NEAR (POSSIBLE CORRELATION)
(−) = NO PEAK AT OR NEAR (PROBABLY NOT CORRELATED)

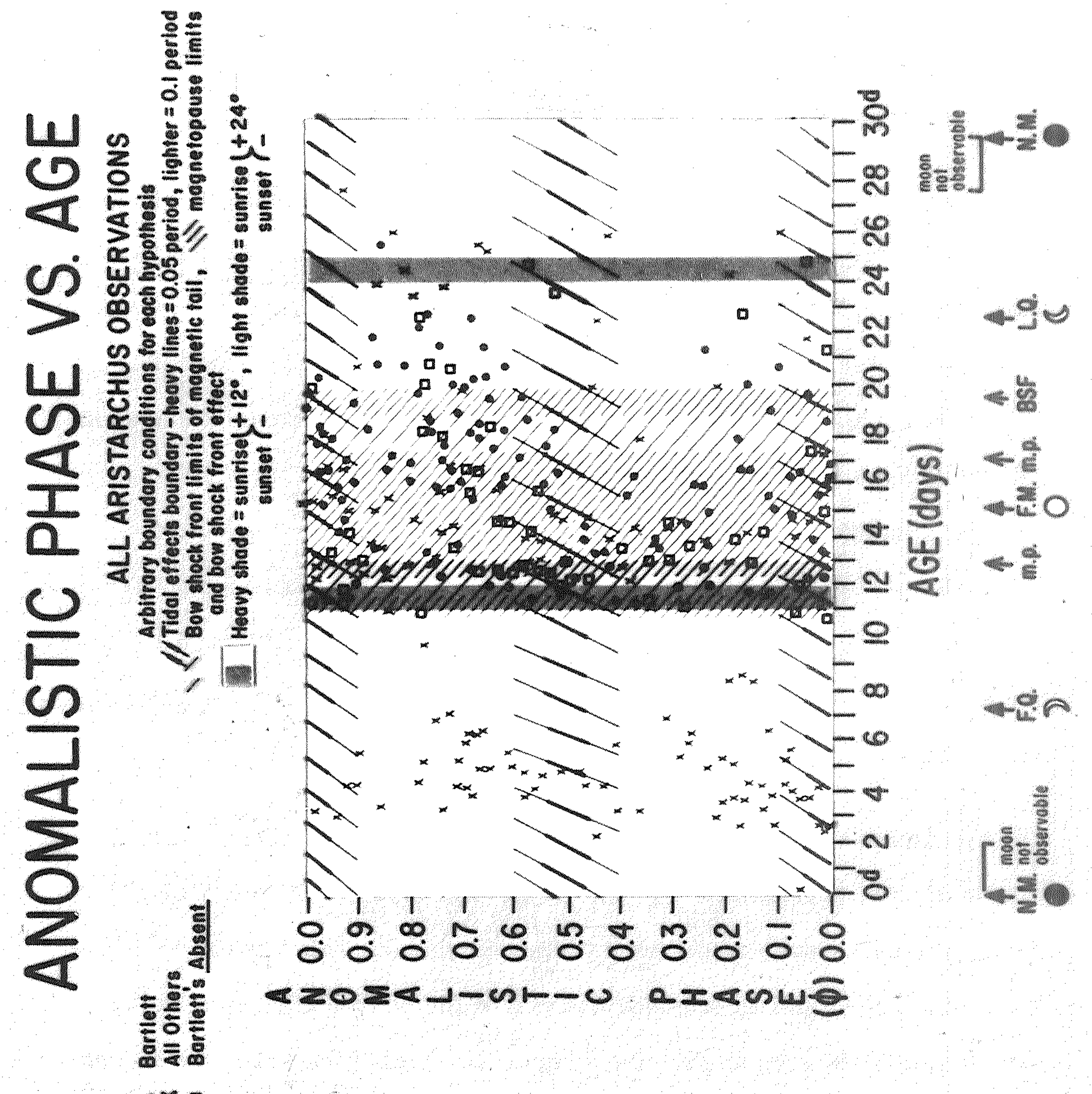

Figure 6. Plot of the anomalistic period phase (ϕ) versus the lunar age for the Aristarchus data. Both narrow (heavier shading) and more liberal boundary limits for the (1) tidal, (2) low-angle illumination, (3) sunrise and (4) magnetic tail hypotheses are indicated. Note the abundance of overlap of theories exhibited in these data making the selection of the causal effect very difficult.

observations fall under three hypothetical causes and about 35% fall under at least two. The absent phenomena exhibit similar behavior.

It was because of this frequent ambiguity of possible causative effects that the analyses for the other six sites previously discussed were undertaken at this time. It was hoped that some interpretable trends might emerge to separate or eliminate causes. The variations among them and their differences with Aristarchus are as confusing as Aristarchus or All Sites together. The separation for the Aristarchus observations into various categories of seemingly different properties elicited no strong trends. Somewhat consistent trends or correlations were with sunrise, magnetic tail, and a slight excess near perigee. Table VI summarizes the number of observations with respect to age and shows that phenomena have been reported at every age from 0 days (several during solar eclipse!) to 28^d (also seen in Figures 1, 2 and 4).

The hypotheses considered here were the main suggestions offered as to the causes of these phenomena. The librational tidal component as considered by Chapman (1967) was not undertaken in these analyses. This varies for different areas of the moon and an extended analysis of the three components, period, eccentricity and libration might show a higher correlation for tidal effects than found here and may then account for the strong perigee correlation found in the lunar seismic A events. One can, however, try other possibilities, e.g., importance of size and power of the telescope, kind of telescope, and whether refractor or reflector, or the role of seeing or atmospheric effects. These data were not analyzed here but are included when known in Table I.

Table VI. MOON'S AGE FOR CATEGORIES

Moon's Age (days)	Aristarchus: Gaseous No. B	Gaseous No. A.O.	Gaseous No. C	Reddish No. B	Reddish No. A.O.	Reddish No. C.	Bluish No. B	Bluish No. A.O.	Bluish No. C	Bright. No. A.O.	Absent No. B	Absent No. A.O.	Onset No. B	Onset No. A.O.	Pro. No.	Agr. No.	Alph. No.	Pl. No.	Gass. No.	Sch. V. No.	All Aris. No.	6– Sites No.	All Sites No.	Best All No.
0^d.0-0^d.9										1								1			1	1	5	2
1.0-1.9																							2	1
2.0-2.9		2	2		2	2				9		2		7							9		23	13
3.0-3.9		9	9		1	1				14		3		4	2			1		1	14	4	33	26
4.0-4.9		4	4		1	1		1	1	23		2		3				2			25	2	36	25
5.0-5.9		2	2		1	1						1		3							11		28	20
6.0-6.9		1	1									2			1			2			4	3	34	24
7.0-7.9												2			2	4	6					12	31	27
8.0-8.9										3					2	4	8	12			3	26	54	41
9.0-9.9												2			2	6	4	5	1		1	18	41	32
10.0-10.9	1		1		2	2	1		1	1		1	1	1	2	2	4	5	4		3	17	35	23
11.0-11.9	3	2	5		5	5	7	1	8	5	2	2	9	2	2		2	2	7	13	16	26	51	35
12.0-12.9	2	7	9		9	9	12	6	17	2	6	3	11	6		2			2	13	27	17	49	39
13.0-13.9	1	3	4	2	7	9	9	4	12	5	12	3	7	1		4	1	3	1	4	23	13	48	41
14.0-14.9	3	1	4	1	3	4	7	4	11	9	7		6		4	3		5		3	21	15	55	40
15.0-15.9	7	2	9	2	4	6	11	1	13	7	6		6		5	1		3	1	1	22	11	55	43
16.0-16.9	6	2	8	3	1	4	20	5	23	2	3		5		4	1		4	2	1	26	12	51	45
17.0-17.9	1	2	2	3	2	5	8	2	10	1	2	2	1	1	1	3		1	2		14	7	32	25
18.0-18.9	1		1	3	1	4	8	1	9		3		1			1		2			11	3	20	17
19.0-19.9	1	2	3	2	3	5	8	1	8	2	1		1			2		1		1	11	4	21	15
20.0-20.9	3	1	4	2	1	3	7		7		1		1			1	1				7	2	16	14
21.0-21.9	1		1		1	1	6		6	1	2	1					2	1	1		6	4	13	15
22.0-22.9		2	2		1	1	2	1	3	2	1		1				3	1		1	4	5	11	9
23.0-23.9		1	1		2	2	1		1	1	2							1			4	1	8	5
24.0-24.9		1	1		1	1		1	1		1										2		3	2
25.0-25.9	1	4	5		3	3		1	1	3	2									1	6	1	8	6
26.0-26.9																	1					1	2	2
27.0-27.9										1							1				1		3	2
28.0-28.9																						1	3	1
29.0-29.5																								
Total Obs.	31	48	78	18	51	69	107	29	132	105	51	26	50	28	27	34	33	52	21	39	272	206	771	590

IV. POSSIBLE EFFECTS FOR SPECIFIC TYPES OF PHENOMENA

In regard to seeing or atmospheric effects, private communications and considerable thought have indicated that some of the observations are related to, if not due to, atmospheric effects. Such observations are the class of brightenings in two manifestations, one characterized by pulse-like rises ($\sim 1/4^s$) in brightness of an area, and the other in which the length of time to come up in brightness is from $1\text{-}5^s$. They are usually reported by observers with small-aperture telescopes (<12 in.), but have been reported in telescopes up to 48 inches. They are seen at low elevations but rarely or not at all at high elevations of the observer. One observer, L. Bornhurst, now at Mt. Wilson Observatory, in private conversation said that he sees these phenomena in his 10-inch reflector down in the valley in California but not on the mountain either in his own telescope nor in those of the observatory. J. Dunlap, at Corralitos Observatory, New Mexico, has repeatedly searched for them when they have been reported on the Astronet, but without success. It is unlikely that they would be detected by his moon-blink equipment because of the short duration, but he also has small visual telescopes in which the brightenings are not seen either. The observatory is located in the mountains. These facts suggest that atmospheric effects are acting. These phenomena frequently, however, have been seen simultaneously by several observers separated by distances from 25 to thousands of miles! They have also been photographed (Calkins, private communication). In addition, they occur in only certain lunar areas which strangely have totally different characteristics. Two such areas are Aristarchus and Grimaldi, the brightest and darkest spots on the moon respectively. The brightenings are confined to small spots in some cases and large areas, ~100 miles long in others. (J. Dunlap reported at a

Table VII. BARTLETT'S ABSENT BLUISH PHENOMENA AT ARISTARCHUS

No.	Date	Time (UT)	Age	Colong.	Term Dist.	Nearest P or A	Mean Anom.	Near. FM	Solar $K_{pmax} \Sigma K_p$	Instru.		Seeing		Remarks
										A	Pow.	T	S	
1	7/27/50	03^{h}18^m-57	12.0	61°	14° R	7/25/50P	.06	7/29/50	4_0, 15_0	3.5L	100	5	7	
2	7/29/50	04 45 -0555	14.1	86	39 R	7/25/50P	.13	7/29/50	3_0, 18+	3.5L	100	1	5	
3	8/ 7/50	05 45 -0625	23.2	196	31 S	8/ 6/50A	.52	7/29/50	8-sc 32+	3.5L	100	5	7	
4	8/ 8/50	07 00 -0810	24.4	209	19 S	8/ 6/50A	.56	7/29/50	8-ms 39+	3.5L	100	5	5	
5	7/13/54	01 35 -51	12.5	59	12 R	7/ 9/54A	.63	7/16/54	2- , 11–	3.5L	100	2	4-2	
6	7/25/54	07 30 -0827	24.7	209	19 S	7/23/54P	.05	7/16/54	4- , 20_0	5 L	150	5	4-1	
7	10/10/54	00 25 -0145	13.0	65	18 R	10/13/54P	.89	10/12/54	3- , 11_0	3.5L	100	4	5	
8	10/11/54	00 30 -0215	14.0	78	31 R	10/13/54P	.92	10/12/54	3- , 11+	3.5L	100	3	5-3	
9	10/14/54	02 10 -0328	17.1	115	112 S	10/13/54P	.04	10/12/54	3_0, 12_0	3.5L	100	3-4	5; 5, 7	also 0518-0600
10	11/ 9/54	00 30 -0100	13.3	70	23 R	11/10/54P	.95	11/10/54	2_0, 9–	3.5L	100	3	5	
11	4/ 6/55	04 35 -0445	13.0	73	26 R	4/11/55A	.30	4/ 7/55	4_0, 20_0	3.5L	100	5-1	4-5	
12	7/ 2/55	02 20 -0300	12.1	55	8 R	7/ 2/55A	.49	7/ 5/55	5+, 23_0	5 L	180	3	4	
13	7/ 4/55	03 50 -0418	14.1	80	33 R	7/ 2/55A	.57	7/ 5/55	2–, 6_0	5 L	180	3	5	
14	8/ 1/55	03 55 -0433	12.6	62	15 R	7/29/55A	.58	8/ 3/55	2_0, 9–	5 L	180	4	6	
15	8/ 6/55	06 40 -50	17.8	165	62 S	7/29/55A	.77	8/ 3/55	5+ms 34–	5 L	180	3	3	
16	6/22/56	04 10 -42	13.3	75	28 R	6/25/56A	.39	6/23/56	3_0sc-1 17–	5 L	180	3	6	S. fl. gran.
17	7/26/56	05 35 -50	18.1	131	96 S	7/22/56A	.63	7/22/56	6-ms 37+	3.5L	100	4-2	5	
18	7/28/56	07 08 -33	20.2	156	71 S	7/22/56A	.71	7/22/56	5–, 29–	3.5L	100	5	5	blue 1½^h earlier
19	3/13/57	01 22 -50	11.3	51	4 R	3/14/57P	.93	3/16/57	4–, 17_0	3.5L	100	5	6	
20	9/ 6/57	02 55 -0324	11.6	53	6 R	9/ 8/57A:	.93:	9/ 9/57	6-sc34_0	5 L	180	5	1-5	
21	10/10/57	01 50 -0215	16.2	107	120 S	10/ 5/57A	.65	10/ 8/57	4_0, 26–	5 L	180	5	6	
22	4/ 4/58	05 05 -35	14.8	90	43 R	4/ 3/58P	.54	4/ 4/58	6-ms 34+	5 L	110	4	4-1	
23	4/ 5/58	06 40 -0725	15.8	103	116 S	4/ 3/58P.	.55	4/ 4/58	7-ms+1, 35_0	3.5L	100	4	3-1	
24	5/30/58	02 50 -0343	11.3	53	6 R	5/30/58P	.99	6/ 1/58	3+sc-1, 20+	5 L	180	5	6	
25	6/28/58	03 50 -0402	10.8	48	1 R	6/26/58P	.06	7/ 1/58	8-ms36–	5 L	180	4	4	
26	6/30/58	05 18 -47	12.9	73	26 R	6/26/58P	.14	7/ 1/58	3_0, 17+	5 L	180	4	4-5	
27	7/ 1/58	05 45 -0605	13.9	85	38 R	6/26/58P	.17	7/ 1/58	5_0, 23+	5 L	180	3	3	
28	7/30/58	05 55 -0615	13.4	80	33 R	8/ 5/58A	.27	7/30/58	4-sc-1, +20+	5 L	180	4	5	
29	7/31/58	06 55 -0715	14.5	92	45 R	8/ 5/58A	.30	7/30/58	5+sc21+	5 L	180	4	6	
30	3/25/64	03 02 -25	11.0	50	3 R	3/17/64P	.27	3/28/64	4_0, 24+	4 L	240	3	6	
31	3/27/64	00 38 -0105	12.9	72	25 R	4/ 2/64A	.34	3/28/64	2_0, 6_0	5 L	180	5	1-3	
32	5/23/64	02 28 -48	11.2	49	2 R	5/27/64A	.34	5/26/64	4–, 11+	4 L	240	3	6	
33	6/22/64	03 12 -30	12.0	56	9 R	6/23/64A	.45	6/25/64	3–, 11–	5 L	180	2	6	
34	6/23/64	03 45 -0402	12.9	68	21 R	6/23/64A	.49	6/25/64	2+, 13o	5 L	110	2	5	blue 1^h later
35	7/ 2/64	07 15 -58	22.1	180	47 S	7/ 8/64P	.78	6/25/64	1+, 6_0	4 L	240	5-2	6	
36	7/21/64	02 00 -23	11.6	50	3 R	7/20/64A	.51	7/24/64	3–, 13–	5 L	180	5	7	obsc. on rim
37	7/22/64	03 20 -33	12.6	63	16 R	7/20/64A	.54	7/24/64	3_0, 19–	3 R	200	1-3	3-4	
38	7/27/64	04 55 -0512	17.7	124	103 S	7/20/64A	.73	7/24/64	1–, 4–	4 L	240	2	7	s. fl. gran.
39	8/20/64	05 10 -20	12.4	58	11 R	8/17/64A	.60	8/23/64	2_0, 8+	3 R	200	3-0	4-0	
40	8/22/64	04 45 -0503	14.4	82	35 R	8/17/64A	.63	8/23/64	3–, 14_0	5 L	180	2	3	
41	8/23/64	04 40 -50	15.4	94	47 R	8/17/64A	.67	8/23/64	2–, 8–	5 L	180	5	6	
42	9/27/64	04 44 -53	21.1	161	66 S	9/27/64P	.00	9/21/64	4_0, 9_0	4 L	240	3-1	5-3	
43	10/28/64	06 35 -55	22.6	180	47 S	10/23/64P	.16	10/21/64	2_0, 10_0	4 L	240	5	7-6	
44	11/15/64	23 20 -30	10.8	48	1 R	11/21/64P	.79	11/19/64	4+, 17+	4 L	240	2-3	7-5	
45	9/ 8/65	03 25 -55	12.4	59	12 R	9/ 7/65A	.53	9/11/65	2–, 7_0^*	5 L	180	3	5	
46	9/10/65	04 08 -38	14.4	84	37 R	9/ 7/65A	.61	9/11/65	1_0, 5_0^*	5 L	180	3	4	s. fl. gran.
47	9/12/65	03 15 -25	16.4	107	120 S	9/ 7/65A	.68	9/11/65	4_0, 17+*	4 L	240	3-2	5-6	
48	9/16/65	03 38 -45	20.4	156	71 S	9/22/65P	.75	9/11/65	5+sc+1,35*	5 L	180	3	7	
49	10/14/65	03 00 -30	19.1	138	89 S	10/20/65P	.77	10/10/65	3–, 11+	5 L	283	5	4-3	
50	11/ 6/65	03 20 -50	12.5	58	11 R	11/ 1/65A	.66	11/ 9/65	4_0sc+2,24_0	3 R	300	5	6	blue 2^h later
51	11/ 7/65	03 10 -30	13.5	70	23 R	11/ 1/65A	.70	11/ 9/65	4–, 16+	3 R	300	5-0	6-0	

*Not included in analyses, quantities added here later.

meeting in Houston on September 15, 1970 on unpublished observations with the Corralitos moon-blink equipment in which variations in color, mostly an excess in the blue occur on the moon, especially near Aristarchus.) Some brightenings have been seen with the naked eye, even near full moon, but the duration of these have been longer. These other facts argue against atmospheric causes unless they are of an unknown nature. Atmospheric effects, e.g., scintillation and image-motion, were immediately considered, tested by observers and the lunar phenomena were found not to be due to the common kinds of terrestrial seeing or atmospheric scintillation effects. Also, they are often seen when the moon is highest in the sky (although still low altitudes during crescent phases) and stop or disappear at lower altitudes in the sky during the observation periods (Bornhurst, private communication).

Another kind of phenomenon included under brightenings in this paper is the star-like points frequently reported, even by such eminent observers as William Herschel. Until recently, the author had never observed any temporary phenomena on the moon even though having often looked for them. Twice now I have seen a few star-like points, all occurring at the same time. One was during totality in a lunar eclipse, the other during the crescent phase. In both instances they were somewhat temporary, but also a function of magnification and possibly aperture. In the case of the eclipse, the star-like points were not seen during the first hour of observation in a 12-inch reflector at 250X but later were seen in a 6-inch refractor at 50X but not in a 36-inch reflector at 400X. Some minutes later they were seen in the 12-inch at 250X. In the second instance, at crescent phase, they were not seen in the 12-inch at 250X but were immediately apparent at 80X. They were not visible the next night in the 12-inch at either power.

Another puzzling aspect of the latter observation was that although all the star-like point features were very bright craters, only a few of the myriads of very bright craters partook of this behavior. The points were extremely minute in angular dimension and with respect to the size of the crater in which they appeared. During totality they were located in the center of the crater and in the crescent phase were located on the illuminated wall in the same geometry in the 20 or so craters that showed this phenomenon. I suspect that it was the point normal to the incident rays of the sun (in both observations). They may be due to glints off facets of the rocks or some special kind of reflecting material. The fact that they are star-like points rules out the earth's atmosphere and indicates that they are 0.5 - 2" in dimension which equal 0.5 - 2 miles at the moon's surface (Mikesell, P. C.). If this is the case, it is puzzling that they are not seen at every lunation and that they were seen one night but not the next night under similar, very good observing conditions. The point would be expected to be there but perhaps in a different location on the wall. Also, star-like points were frequently seen in ashen light by others as well as during eclipse and in direct sunlight. Clearly, this phenomenon needs explaining. It may be an instrumental effect, but there are several puzzling aspects concerning the matter. More observations and specific tests need to be made.

V. RELATIONSHIP TO PROBABLE LUNAR INTERNAL ACTIVITY

Even if the matter of the short-lived brightenings and star-like points could be considered as explained by instrumental, atmospheric, and geometric effects, there are other phenomena that seem to represent genuine, abnormal situations on the moon. There are too many instances of obscuration or mists reported in which a portion of a crater or feature (e.g., a peak) was fuzzy or blotted out, while everything else around was very sharply visible. The fact that these are seen in only certain features (e.g., Piton, a mountain with a summit crater, situated on a mare ridge, or Plato, with its dark, flat floor, generally agreed to be of volcanic composition) suggests that these are lunar phenomena and not terrestrial. In fact, the whole body of reports are confined to fewer than 100 features, and of these 100 only a dozen are involved in about 80% of the observations, with Aristarchus making up about a third of the total.

Middlehurst and Moore (1967) and W. Cameron (1967) independently have shown that the LTP sites are not randomly distributed over the moon's face, but instead are closely associated with the edges of the maria. There is a noticeable avoidance of the highlands of the moon. The mare surfaces are volcanic as deduced in several ways and strongly supported by the Surveyor analyses and samples returned by Apollo. The association of the LTP with the maria itself suggests an internal origin for most of the LTP, but there is still further evidence at hand. Figure 7 shows the results of a study by the author (Cameron, 1967) of the distributions of two kinds of features that are thought to be volcanic by most selenologists. This figure shows the distributions of dark, flat-floored craters, others of a ringdike character, and of the LTP sites. It can be seen that all three distributions are very similar; in fact there are many coincidences of two and even all three types, e.g., Posidonius. If other volcanic features are added, such as the sinuous rills (Schubert et al. 1969), domes (Arthur, 1962), rills (Baldwin, 1963; Arthur, 1962), and dark-haloed craters (Salisbury, 1967), the evidence for internal origin becomes overwhelming. The maria present evidence of subsidence (O'Keefe and Cameron, 1962) and their boundaries would be regions of instability

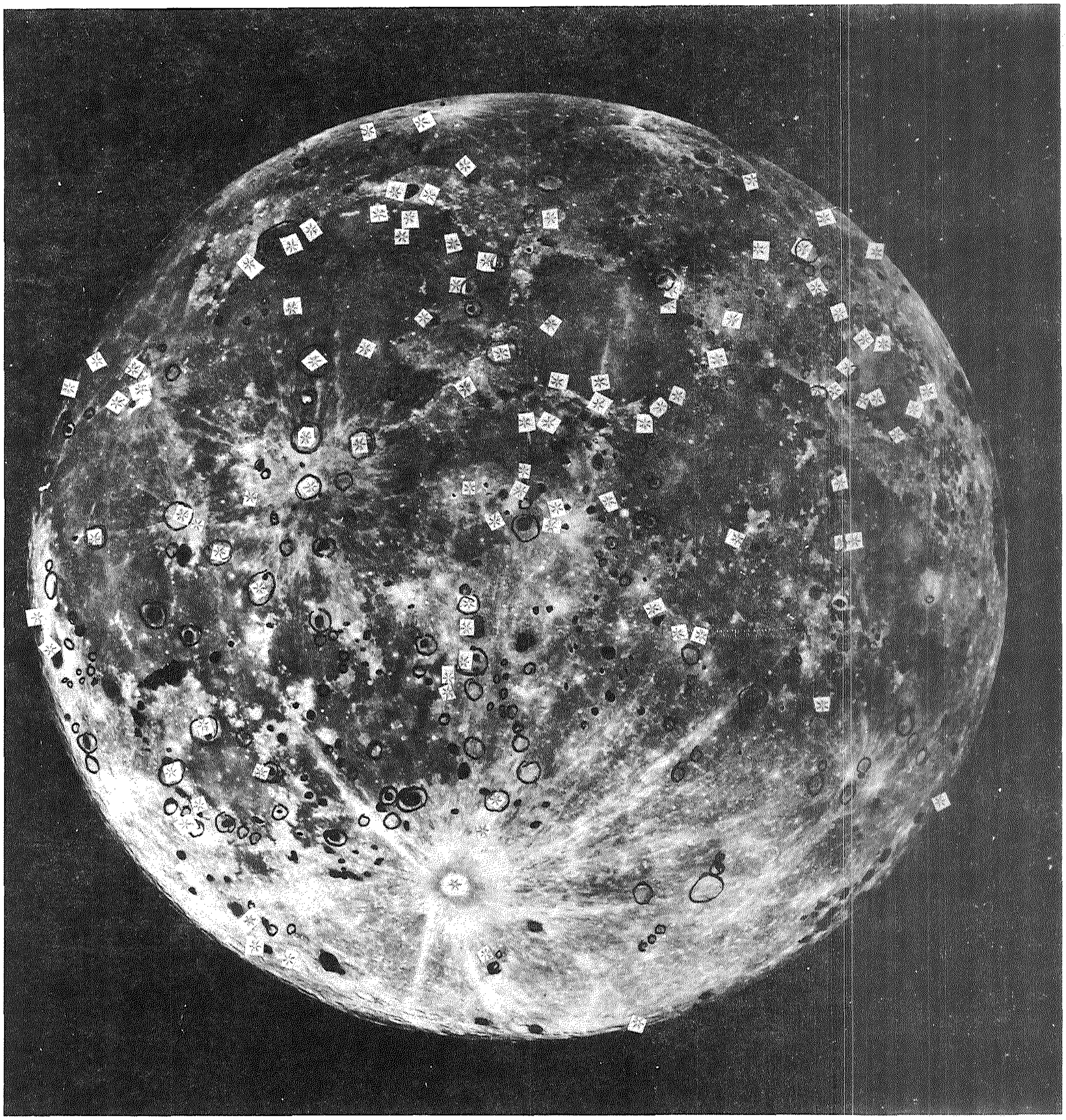

Figure 7. Plot of the distributions of three types of features on the moon. (1) The dark patches mark craters with dark, flat floors, material conceded to be volcanic; (2) ovals are lunar features resembling terrestrial ring dikes according to a study by the author, which also suggest evidence for lunar volcanism; and (3) stars indicate sites of lunar transient phenomena. Note the similarity (some coincidences) of all three distributions and their associations with the edges of the maria (also sites of volcanic activity) suggesting that most of the LTP are manifestations of internal activity. If we added here the similar distributions of the sinuous rills, domes and dark-haloed craters, the implication that LTP are manifestations of internal activity is even more strongly supported.

and therefore likely sites for the escape of material through fissures and vents. The internal activity must be mostly in the form of gentle degassing—leaking of gas—and not volcanic on the terrestrial scale. If there were much of the latter, permanent changes would be expected to be observed, which is not the case. A few of the events seem to be of a magnitude that suggests volcanism, but most are not. Hartmann and Harris (1968) have made calculations that suggest that the first Greenacre and Barr observation involved a volcanic phenomenon. The descriptions, which include sparkle and motion, suggest electrostatic effects (lightning) which frequently accompany volcanic activity. (This was also suggested by Mills, 1970.) Greenacre (private conversation) has remarked that Schröter's Valley seems to have undergone morphological changes since he began observing it. Most of the naked-eye phenomena were seen either before the invention of the telescope, or in its infancy, and any surface changes that may have come from these events would not have been detected then. It is possible that a very thin ash deposit may not differ sufficiently in color from the underlying terrain to be detected in telescopes even now.

A few events have been recorded spectrographically; the constituents or gases identified were C_2, H_2, and N_2 (Kosyrev, 1959, 1963, 1969), which are common constituents in terrestrial volcanic gases. The Apollo 11 and 12 results reported in The Moon Issue (Science, 1970) indicate that there is little water in the moon in these two places at least, even as hydrated minerals. In fact, Cl and F have filled the crystal lattices rather than OH or H_2O (L. Walter, private communication). Mare Tranquillitatis is not one of the sites of the features from which obscurations are usually reported and the Apollo 11 results probably explain why. By inference then, perhaps Serenitatis, Imbrium, and other sites have different compositions from Tranquillitatis. They do differ in color also (Whitaker, 1966); it has been suggested that the difference is due to possible compositional differences. A study by the author (Cameron and Coyle, 1969) also indicates differences in condition (and probably composition) between M. Tranquillitatis, S. Medii, and O. Procellarum. The recent announcement of lunar seismic activity (Latham, 1970) is exciting because of its likely pertinence to the lunar transient events. So far for the few events designated A-type there is a strong correlation with perigee (only). The probable site of the seismic activity is in Fra Mauro, a site thus far not reported as an LTP Site. However, it is a site of fissures and other volcanic features. Perhaps the release of gas here is so slight and so quick that it has escaped detection from earth thus far.

VI. CONCLUSIONS

From the analyses in the present paper, results from other lines of study and long and thoughtful consideration of the reports, it is concluded that the LTP are generally of internal origin and not much subject to external influences—at best only weakly so. The phenomena seem to be of several kinds and may involve gas or a gas-and-dust mixture, luminescence of these gases, and possibly luminescence of surface materials. Studies of the latter effect (Greer and Weber 1969, Nash 1966, Ney et al. 1966 and others) have indicated that the efficiencies of the luminescing constituents and the source energies for excitation are grossly insufficient to account for the lunar events. Recently, Blair and Eddington, 1968, have made further studies and find combinations through coating that might work. There seems to be something about sunrise that renders the phenomena most visible. It does not seem to be low-angle illumination alone because the effect is only very weak at sunset conditions. Perhaps the thermoluminescence mechanism proposed by Blizard (1967b) and Sidran (1968) contribute all or part of the effect that these reports represent. Ultraviolet excitation may also stimulate luminescence when the gases have escaped during the lunar night. Perhaps all three effects are operating together to make the strong sunrise correlation found in most of the analyses here. Added to this must be a component—possibly very strong—of observational selection in that the best time to observe a feature is near the terminator and that the sunrise terminator is observable at convenient and more comfortable times of the night than the sunset terminator. This remark does not pertain to the eastern features, however, and still there are not very many reports of phenomena near sunset for any features. The fact that most features show a correlation with full moon suggests that the earth's magnetic tail may be influential, exerting some kind of effect, perhaps through the mechanism suggested by Speiser. One would not expect large numbers of observations around full moon because of the lack of detail visible at this time therefore relatively uninteresting to most observers, hence the surprise that 1/4 to 1/3 of all observations occur then, suggesting a causative influence. For an event to be seen from earth means that the energy involved is of the order of the energy of direct sunlight. Such energy requirements have been shown to be unattainable by solar particles alone, even from solar flares (Nash, 1966; Ney et al., 1966) although Kopal, (1966) shows otherwise. The mechanisms proposed by Speiser and by A. G. W. Cameron would have to increase the original energies of these particles by a factor of 10^2 at least. The data and analyses show some correlation here and suggest that Speiser's mechanism may be supplying enough increase in energy to have an effect. More theoretical work will be required to verify this hypothesis.

Each of the hypotheses tested shows some correlation with the observational data to varying degrees. The correlations, in general, in descending order of likelihood are with sunrise, magnetopause, tidal (perigee), solar, bow-shock front, and low-angle (sunset). For all Aristarchus (in terms of O/E) the order is sunrise, magnetic tail, solar, bow-shock front, tidal, and low-angle illumination. (S.S.) For All Sites the order is sunrise, solar, magnetic tail, tidal, bow-shock front, and low-angle illumination (S.S.). In terms of highest percentage of total observations for hypotheses, the descending order of correlations was, for all Aristarchus (narrowest limits), magnetic tail, tidal, sunrise, solar and low-angle illumination. For All Sites (%) was respectively, magnetic tail, sunrise, tidal, solar, and low-angle illumination. A surprising 28% of 770 observations of all sites occurred within two days of full moon and 22% came within 1 day of sunrise on any feature reported. The corresponding percentage for perigee was 13%, little excess over the 10% to be expected on a random basis.

Considering everything shown by the data and also other possibilities, such as selective observational effects, difficulty of providing energy requirements by external causes, similarity of behavior of absent phenomena to that of present phenomena, capriciousness of the behavior of the data for different categories and different sites, the progression of observations around the lunar orbit, or in phase, the author is skeptical of the reality of decisive external influences; the activity seems to be of internal origin and occurs almost at random. The distribution and association of the LTP sites with the volcanic maria supports this conclusion. The recently announced lunar seismic events may point to other sites at which events may occur.

Comparison of one observer's finding with others' may have revealed physiological differences in that he may, for example, be particularly sensitive in the blue and comparatively deficient in the red. What he reports as violet or blue glare, others may see as colorless bright areas. He does not report anything in the true reds, pinks, or orange colors. He does however, see colorless and bluish obscurations. His gaseous phenomena exhibit similar tidal behavior to the reddish phenomena reported by others (but the latter differ from their own gaseous and his) but depart from them in the lunar age plots. It is very likely that his reddish phenomena are observations revealing ground color seen in the absence of any obscuring medium.

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APPENDIX

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