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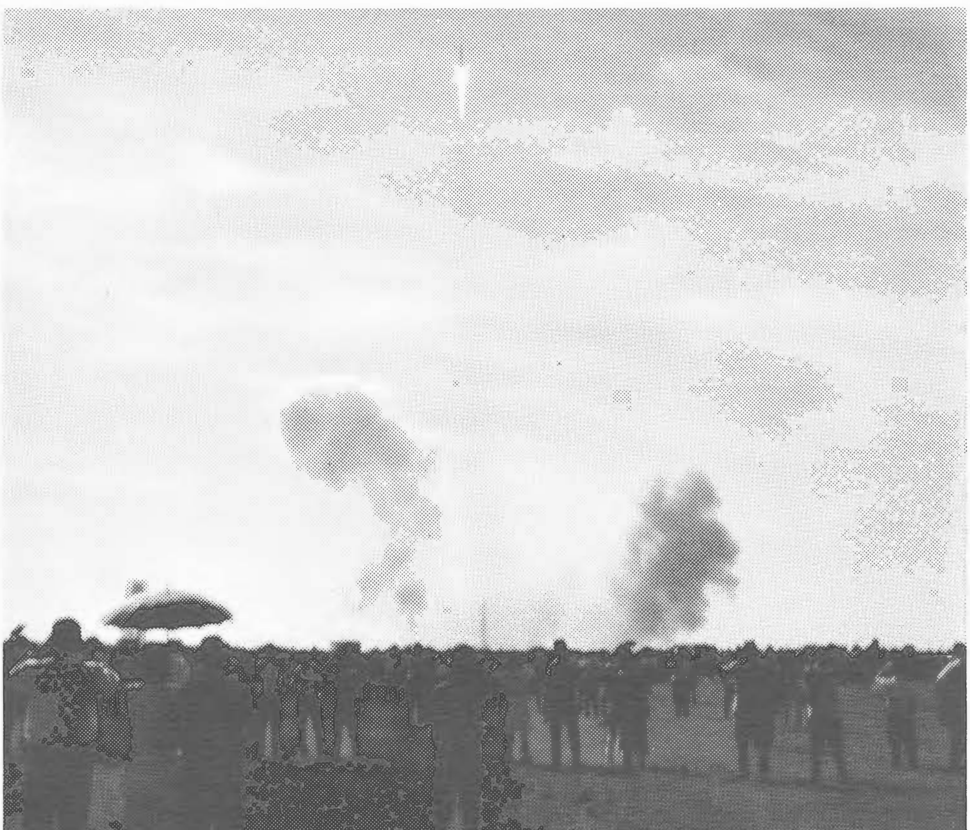

Photograph of Apollo 15 launch by Reverend Kenneth J. Delano. Taken with a 35-mm. Petri Color Camera from the area of the Vertical Assembly Building, about 3½ miles from the launcher. Saturn V and flame near top center. Mr. Delano's description of the launch is on pages 77 and 78.

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ALPO
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IN THIS ISSUE

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THE LAUNCH OF APOLLO 15

By: Kenneth J. Delano

The television cameras used by the three major networks give home viewers a much closer-up look at the launchings of the Apollo/Saturn rockets, but that does not deter hundreds of thousands of people from traveling hundreds or thousands of miles to be on hand for the blast-off of the Moon-bound rockets. After all, there is nothing like being on-the-spot eyewitnesses to history in the making, nor can TV adequately convey the atmosphere that pervades Cape Kennedy at the time of a Moon-shot --- an atmosphere characterized by an awe of the mammoth man-made facilities, an admiration of the complexity of the space vehicles and of the men who dare ride them, an excitement that grows more and more perceptible among all the persons present as the day of launch approaches, and a certain anxiety that is tempered by the quiet confidence of the men of NASA.

Up until Apollo 15, my only previous witnessing of an Apollo blast-off was that of Apollo 8, which I watched from a causeway about 15 miles from the launch pad. Without a pass admitting them to the missile base as a guest of NASA, viewers must take up positions along the highways, causeways, and beaches, which are 10 to 20 miles distant from the rocket. Nevertheless, even at those great distances the sight and sound of the streaking Saturn rocket make it well worth while going to the Cape for the launching, instead of just watching it on TV. Indeed, NASA makes it all the more interesting by letting the general public tour the Space Center on the day before the launch and within a couple of hours after the rocket has left the pad. The two-hour bus tours take you on a 50-mile trip through the missile base, bringing you within a few hundred yards of launch complexes 39A and 39B, from which the Apollo astronauts take off.

Seeing the launch of Apollo 8 in person and watching all the others on TV did not quite prepare me for the immense thrill of seeing the lift-off of Apollo 15 from the area of the Vertical Assembly Building (VAB), only 3½ miles from the rocket. I obtained a pass to what is called the VIP stands through the kindness of Captain Chester Lee, Apollo Mission Director, whom I met at a conference on America's future in space, at which I spoke in favor of the manned space-flight program.

A formal invitation was sent to each guest of NASA, notifying us of the scheduled times for the briefings and tours of the Kennedy Space Center on the two days before the launch and on the day of the launch. I arrived Sunday night, the evening before the launching, and, as requested, checked in at the NASA Guest Center, located in the Cape Royal Office Building at Cocoa Beach, where I received an identification badge.

Later that evening, I attended a preview film showing of the 1 and 3/4-hour color movie titled "Moonwalk One". It is billed as "a dramatic presentation of the first lunar landing and its impact on mankind" and is supposed to be released to commercial theaters soon. I enjoyed this documentary film very much and recommend that you see it when it appears.

On Monday morning, the day of launch, I arose at 5:30 A.M. to be at the Cape Royal Building in time for the first busses that were to take us for the three-quarter-hour drive to the viewing site. The last of the chartered busses was to leave at 8:00 A.M. to assure that traffic would not cause anyone to miss the 9:34 A.M. lift-off. At the early hour of 6:30, traffic was moving along fairly smoothly; for the people who had chosen to view the launch along the busses' route on the Atlantic seaboard had already arrived, most of them having been camping there for 2 or 3 days.

The busses brought us to the north side of the VAB, the south side having the grandstands reserved for the 1500 members of the press who showed up to cover the Apollo 15 launch. There were ample bleachers next to the VAB for those of the approximately 5,000 guests who wished to be seated. One set of those bleachers was set aside for such VIP's as members of Congress, foreign dignitaries, and high-ranking military personnel.

A public address system kept us posted on the countdown; and in the meantime we could busy ourselves during the 2-hour wait for blast-off by watching the magnificent Saturn rocket, brilliantly shining in the sun and venting a misty plume that was readily apparent to the naked eye. Those who brought binoculars, of course, could see the rocket and its launch tower in much greater detail.

People were allowed to set up their cameras on tripods in the field in front of the bleachers provided that they were far enough out not to block the view of others.

Since I did not know beforehand that we would have a place to set up camera tripods, I had brought only my little 35-mm. Petri Color camera; but I was quite pleased with my color slides of the launch, considering that the camera has a focal length of only 40 mms. Indeed, the slides show the Saturn rocket just about as it looked to the naked eye from the VAB location.

We paid for the perfectly clear skies that everyone was hoping for by putting up with temperatures in the 80's and with no shade in the bleachers or on the field. This fact spelled good business for the owners of the refreshment stands set up behind the bleachers.

Up until half an hour before lift-off, spectators were quietly conversing with one another. From then on, a sort of restless anxiety began to build up as people began to leave the bleachers for the open field in front of them, in order to be a few hundred feet closer to the stupendous event about to take place. United in their concern for astronauts Scott, Irwin, and Worden, the spectators remained speechless during the final 20 seconds of the countdown, and remained so during lift-off, as large tongues of flame licked out on either side of the concrete trench beneath the rocket, followed by billowing clouds of steam on both sides of the rocket. Slowly the rocket climbed up past the launch tower, requiring 10 seconds to clear the tower, but this time seemed to be little more than a second or two to the camera fans. Only when the rocket was well clear of the launch tower, burning and climbing steadily, did the spell of silence that fell over the crowd break with a spontaneous applause of handclapping. The Saturn V vehicle appeared to be reaching for the skies with a power suggestive of the strength of Man's determination to break free of the bonds of Earth.

Everyone privileged to be at the 3½-mile-distant viewing site agreed that the launch was not only a spectacle that is out of this world, but a great emotional experience as well. The hearts of everyone went out with concern and admiration for three fellow human beings, who were riding that 100-yard-long tongue of flaming exhaust, and who were determined to reach a world nearly ¼ million miles away.

The most startling thing to me about the launch was the unimaginably loud noise of the Saturn V engines. The first sounds did not reach us until about 20 seconds after ignition, when the rocket was well clear of the launch tower; and those first sounds seemed extremely loud, but that was only the beginning. The best comparison is to think of a crack of thunder accompanying a lightning bolt striking next door; but instead of being over in a fraction of a second, the roar of the Saturn's 5 engines is like a chain reaction of thunder-cracks sustained at an ear-piercing level for about 15 seconds. Watching Apollo 15 piercing the sky and being overwhelmed by the roar of its engines led my imagination to think that the sky was about to crack open, in much the same fashion that the rumble of an earthquake is followed by an opening of the earth's surface. The metallic walls of the VAB and the unoccupied metallic bleachers could be heard resonating in response to the departing Apollo rocket. In fact, the ground we stood on quivered, and I could feel reverberations within my chest --- a feeling comparable to that provided by the massaging assemblies which many hotels and motels attach to their beds. Veteran "bird watchers" claimed that the launch of Apollo 15 was the loudest of them all, and I believe it.

We were close enough to Apollo 15 that binoculars were not at all necessary for a good view of the launch. Only when a height of several miles had been attained did binoculars come in handy. Even so, the explosive separation of the first stage was clearly visible to the naked eye about three minutes into the flight; and the exhaust tail of the second stage could then be seen as a red dot in a beautiful blue Florida sky until it became lost in the glare of the sun approximately four minutes after lift-off.

After staring for a few moments at the sky where the rapidly receding Saturn rocket had faded from view, people began returning to the busses for the return trip to the Cape Royal Building or to other busses which took us on a post-launch tour of the Space Center. It was the standard tour that is given to the general public, except that we were allowed to walk the full length of the transfer aisle of the VAB, where we could see the second and third stages of Apollo 16 being readied (the first stage had not arrived yet) and another stage being designed and tested for the Skylab Program.

After witnessing the launch of Apollo 15 and after seeing the preparations being made for coming years, I left with the very definite impression that here, at Cape Kennedy, the future is already present.

MARS 1969 - THE NORTH POLAR REGION - ALPO REPORT II

By: C. F. Capen and T. R. Cave, A.L.P.O. Mars Recorders

(Concluded from Vol. 23, Nos. 3-4, pp. 67-75)

North Cap Peripheral Aspects

Only the earliest ALPO pre-opposition observations in 1969 showed the peripheral aspects of the North Polar Cap during its thawing phase. Consequently, the Mars Recorders found this period not well documented. The aspects of the NPR were well observed during the northern late Martian summer and autumn by ALPO members.

Observations by T. Osawa, J. Mitchell, K. Delano, R. Rhoads, B. Salmon, C. Capen, and E. Cross indicated that the dark collar or dark peripheral band, which is contiguous to the North Cap, was not especially prominent during the 1969 apparition. The dark band increased in apparent contrast and width during Martian June. It was noted to be a small, dark entity surrounding the cap on 10 August, Martian Date, after which time it faded and became lost in the returning Arctic hazes. In comparison, the ALPO 1967 observations showed a very dark and broad collar during the similar season. The edge of the large North Cap was drawn as a smooth compass. Later in the season, during the maximum thawing phase, the edge of the smaller cap appeared to have slight irregularities and dark notches along its periphery. The small, static cap was drawn with a smooth edge and perfect circle, when noted at all, by ALPO observers. E. Cross' NPC drawing made on 69 06 18 Y 0605UT, published here as Figure 1, is representative of the appearance of the late summer North Cap.

Schiaparelli noted in 1888 that the NPC became divided into two unequal parts by a dark rift which he called Rima Tenuis in the direction of 140° to 320° areographic meridians. Maggini also observed this cap rift in the 1918 apparition. The complete summer thaw rift has not been noted on ALPO drawings and photographs during the past decade. Some evidence of the rift has been recorded on the late spring and summer NPC's periphery as indentations at the proper aerographic longitudes at times. On July 13 and 16, 1969 (early October, MD) E. Cross reported, during good seeing, a well defined rift in the newly reforming NPC that started at about longitude 230° and cut a chord across the cap, as shown in Figure 2. During moments of good seeing the widest part at the head of the rift located at about 52° north latitude appeared to be a dark green hue to E. Cross. Tricolor filter (red, green, and blue) observations of this same side of the planet during July 12-19, Terrestrial Date, by K. Krisciunas, R. McClowry, B. Salmon, H. Smith, J. Mitchell, V. Capen, and T. Osawa indicated a progressive, small NPC with a diameter of about 24° (edge at 78° lat.) and a dense Arctic hood (NPH), with a contiguous bright cloud just south over the Scandia-Phlegra-Diacria-Cebrena region which covered the north part of the Propontis complex. Because of the southward planetary axial tilt of -5 degrees to the Earth at this date and the presence of dense aerosols which appeared bright in green and blue-green light, it is surmised that the cap rift was actually the dark Propontis II-Stymphalius-Gyndes region showing through the tenuous division between the two aerosol masses. A similar phenomenon between the NPH and a cloud was recorded in visual drawings by R. Rhoads, K. Simmons, B. Salmon, and T. Ross and on color photographs by C. Capen during the first week of July, T.D. The autumn polar hood and related high latitude clouds are observed to form in the cold-trap that is created as the north pole tilts away from sunlight and enters the long night of winter. The white substance of the cap possibly comes from the polar hood.

There are three areas in the Martian Arctic which retain a salient white residue as the North Cap reaches its maximum regression rate through the +65° to +80° areographic latitudes. Sometimes these white areas are first noticed as bright projections on the edge of the cap, and then become detached as the cap edge retreats past the +80° latitude. These residual white patches occasionally appear to fluctuate diurnally in size and brightness, which is possibly due to the presence of Arctic hazes or daytime dissipation and night redeposition. As the cap retreats farther toward the north pole, they eventually shrink in size and retreat with the cap to a relatively static position prior to complete disappearance. This retention of NPC residue is indicative of differences in cap composition (H_2O vs. CO_2) or of topographic relief. The white remnants are named after the areas they occupy. Their names and average center-of-area static positions observed by students of Mars from 1879 to 1969 are given in Table 3. Observations of the North Polar Region by the ALPO in 1969 possibly indicated the detection of two of these white patches, namely, Ierne (136°, +80°) and Cecropia (302°, +80°). The Lemuria, also known on older maps as Olympia, was not recorded in ALPO reports. An examination of the 1969 photographic material in search of these delicate objects is under way.

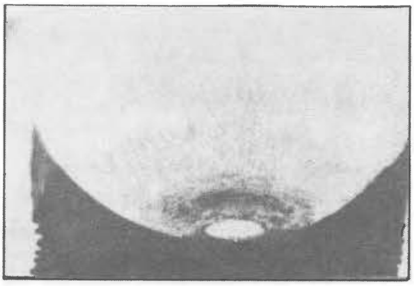


Figure 1. Drawing of North Polar Cap and bordering North Polar Band on Mars by Eugene W. Cross on June 18, 1969 at 6^h5^m, U.T. Yellow filter. 6-inch refr., 260X. C.M. = 134°. Martian Date September 17.

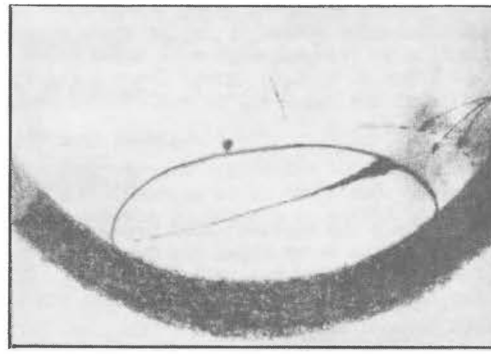


Figure 2. Drawing of North Polar Cap of Mars and vicinity by Eugene W. Cross on July 16, 1969 at 3^h40^m, U.T. Yellow filter. 6-inch refr., 260X. C.M. = 206°. Martian Date October 4. Note dark rift in re-forming North Cap. See also text by Messrs. Capen and Cave.

Other smaller transient white patches of ice-fog or frost, which are apparently not dependent upon a static position, have been observed in the past and should be investigated for frequency of occurrence. Lowell, Maggini, and Dollfus have occasionally observed a recurrent white patch just east of Hyperboreus Lacus at 10° to 18° longitude, +75° latitude; and Dollfus has recorded another one at about 35° longitude.

A salient, white, oval, frost patch was observed visually and photographically on the Cecropia just below the Copais Pons by C. Capen during the 1963, 1965, 1967, and 1969 apparitions, and was recorded by K. Brasch in 1965, Ref. 12. It appeared along the cap edge during Martian June when the NPC was experiencing maximum thaw at the position 280° to 308° long., +60° to +68° lat. The relative albedo or brightness of this peripheral white patch was not quite equal to that of the NPC; however, it varied from day to day. The white oval did not appear to retreat with the NPC edge, which was at about the 70° to 73° latitudes, but instead held its relative position until it dissipated in approximately 3 to 4 weeks, References 10 and 12.

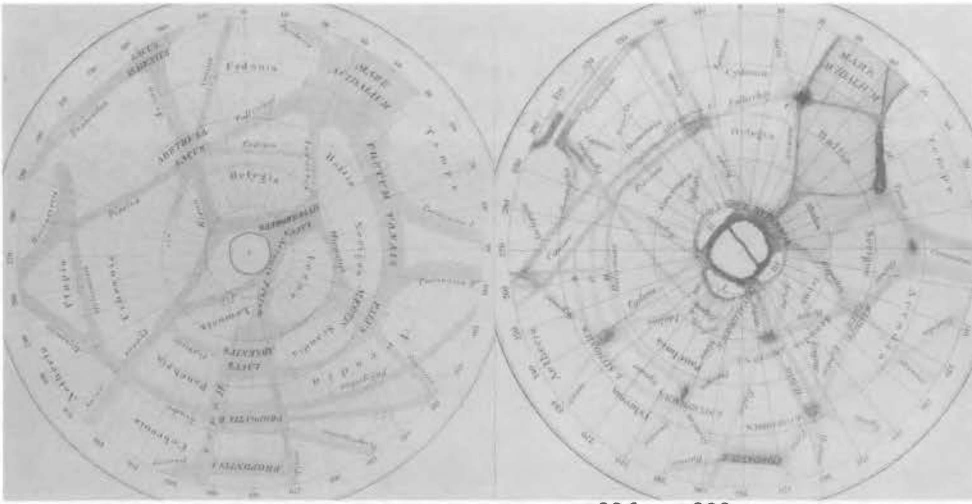
A fuzzy white patch was reported in January, 1969 just off the NPC edge at 0° long., +65° lat., when the NPC edge was located at +77° latitude. Refer to Capen's drawing M 69 01 07 (Str. A., Vol. 23, Nos. 3-4, pg. 72). It is not known whether these transient white patches are ice-fogs contiguous to the surface or are the white material of the polar cap. According to color filter comparisons between blue, blue-green, green, and red light, they have the characteristics of ice-fogs, similar to the "white-outs" of the terrestrial polar regions.

When the Arctic hazes reappear in the Martian autumn, the three vacant residual areas are usually lost from view. It would be interesting to learn whether the residual areas become actively white again when the NPC starts to reform. The reformation phase or growth of the autumn-winter NPC as determined from 1969 observations will be discussed in a future ALPO Mars Report.

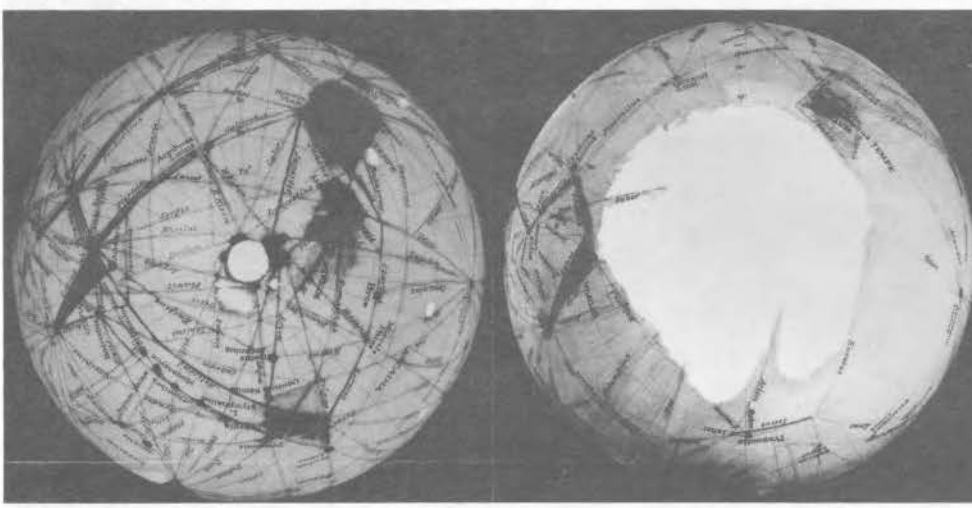
The seasonal spring and summer appearances of the subliming NPC and the aspects of the peripheral, residual white areas are shown for different Martian years in Figures 3 and 4.

Refer to the pre-opposition Martian disk drawings on pages 82 and 83 of this issue and on pages 72 and 73 of Vol. 23, Nos. 3-4 for the appearance of the NPR from August 31, 1968 through April 30, 1969. These drawings will also be useful references for the discussions in future Mars Reports. The Mars drawings shown were selected chronologically from all observers according to merit in order to obtain the best areographic meridianal coverage for a given subject or epoch. Consequently, the Mars Reports will present illustrations derived from many individuals with a wide range of observational experience, artistic style, and persepctive differences of presentation. Obviously, the observer who makes observations over a longer period of time during the apparition will produce more homogeneous data and contribute more useful illustrations.

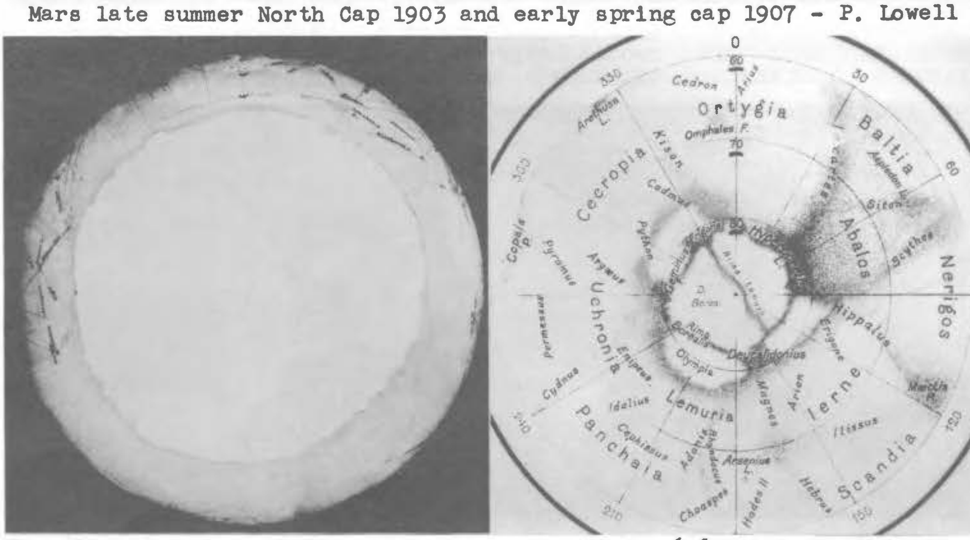
(text continued on page 85)



Regiones Martis boreales late summer caps 1886 & 1888 - G. Schiaparelli



Mars late summer North Cap 1903 and early spring cap 1907 - P. Lowell



Vernal equinox cap 1907-Lowell. Polaires Boreale été 1920's-E. Antoniadi

Figure 3. Northern spring and summer appearances of subliming North Polar Cap of Mars in different years, and related aspects of the peripheral residual white areas.

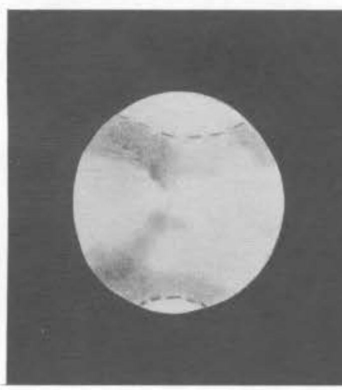
MARS - 1969

Pre-opposition drawings, April 4, 1969 - April 19, 1969

M 69 04 04 I 1200UT
CM175° 6"NEWT 300X
8AUG MD R. RHOADS

M 69 04 06 CI 1000UT
CM128° 10"REFL 475X
9AUG MD B. SALMON

M 69 04 08 V-R 1420UT
CM170° 24"CASS 620X
10AUG MD C.& V. CAPEN



M 69 04 09 V-R 0800UT
CM071° 12.5"NEWT 300X
11AUG MD K. DELANO

M 69 04 12 R 0700UT
CM029° 6"NEWT 300X
12AUG MD E. MAYER

M 69 04 12 I 1925UT
CM210° 8"REFL 286X
12AUG MD T. OSAWA

M 69 04 13 I 1145UT
CM080° 6"NEWT 300X
13AUG MD R. RHOADS

M 69 04 18 I 1945UT
CM160° 8"REFL 286X
16AUG MD T. OSAWA

M 69 04 19 I 1910UT
CM142° 8"REFL 333X
16AUG MD T. OSAWA

MARS - 1969

Pre-opposition drawings, April 21, 1969 - April 30, 1969

M 69 04 21 I 0555UT
CM290° 6"NEWT 220X
17AUG MD E. MAYER

M 69 04 23 B-R 1100UT
CM343° 6"NEWT 300X
18AUG MD R. RHOADS

M 69 04 24 CI 1050UT
CM334° 8"REFL 400X
19AUG MD B. SALMON

M 69 04 25 I 0825UT
CM290°12.5"NEWT 500X
19AUG MD T. CAVE

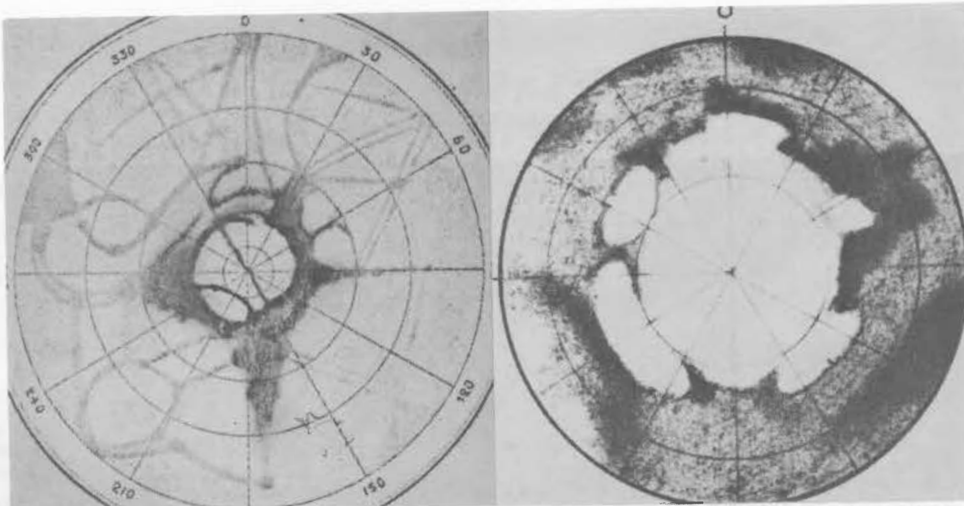
M 69 04 25 I 0920UT
CM304° 6"REFL 360X
19AUG MD R. McCLOWRY

M 69 04 26 V-R 1100UT
CM320° 16"CASS 500X
20AUG MD C. CAPEN

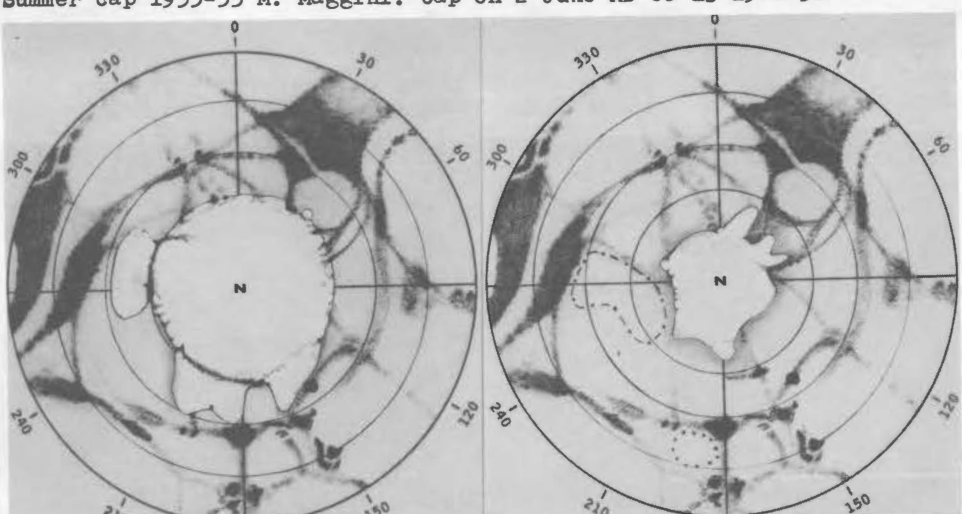
M 69 04 28 V-R 1015UT
CM289° 6"NEWT 300X
21AUG MD R. RHOADS

M 69 04 28 V-Y 1055UT
CM299° 8"NEWT 200X
21AUG MD R.& H. LINES

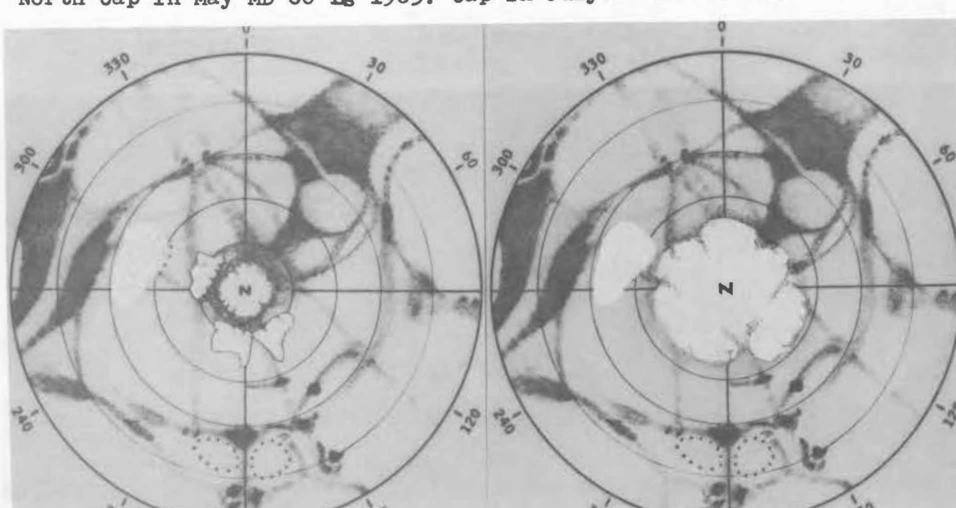
M 69 04 30 B-R 0930UT
CM260° 12.5"CASS 490X
22AUG MD J. MITCHELL



Summer cap 1933-35 M. Maggini. Cap on 2 June MD 68°Ls 1946-52 A. Dollfus



North Cap in May MD 60°Ls 1963. Cap in July MD 110°Ls 1965 - C. Capen



North Cap August MD 140°Ls 1967. Cap in June MD 89°Ls 1969 - C. Capen

Figure 4. Northern spring and summer appearances of subliming North Polar Cap of Mars in different years, and related aspects of the peripheral residual white areas.

Table 3. Average Observed Longitudes of Martian Arctic White Residual Areas

Observer	Ierne	Lemuria	Cecropia
G. Schiaparelli, 1879-88	121°	208°	310°
P. Lowell, 1901-05	122°	206°	311°
E. M. Antoniadi, 1903-29	122°	208°	309°
M. Maggini, 1918-35	136°	213°	278°
A. Dollfus, 1946-52	142°	227°	292°
ALPO Observers, 1962-69, Brasch, Capen, et al.	140°	196°	290°

References

The references cited in this part of the Mars Report by Capen and Cave are included in the list in Vol. 23, Nos. 3-4, pp. 70, 71, and 74, of this Journal.

THE CHARACTERISTICS OF LUNAR DOMES

By: Kenneth J. Delano, A.L.P.O. Lunar Recorder

This report of the A L.P.O. Lunar Dome Survey is concerned with the lunar domes' sizes, shapes and surface features. It is a complementary report to the distribution study published in the February, 1969 issue of The Strolling Astronomer[1] and also to the supplementary list of 15 domes which appeared in the January, 1970 issue.[2] To these 149 domes, the following 4 are being added to bring the total to 153:

DOME**	LONGITUDE*	LATITUDE	REMARKS and DIAMETER
+915+025	66°10'E	01°25'N	Flat summit; circular; 27 kms.
+904+025	64°40'E	01°20'N	Flat; irregular border; 35 kms.
+840+290	64°20'E	16°15'N	Moderate slopes; 15 kms. x 22 kms.
-173+738	14°45'W	47°50'N	Round; hemispherical; 11 kms. x 16 kms.

The present report is based on observations by the 32 members of the A.L.P.O. and of the British Astronomical Association whose names appear on page 76 of the February, 1969 issue of The Strolling Astronomer. Since then, three more A.L.P.O. members have contributed observations. They are: Paul Gruntmeyer of Brockton, Mass.
Steven Kates of Hackensack, N. J.
Douglas Smith of Vinton, Va.

DIMENSIONS OF LUNAR DOMES. The two above-mentioned lists of lunar domes give the dimensions of each dome but without listing them according to size. The 153 domes under discussion were all observed visually at the telescope by participants in the Lunar Dome Survey, and they range in size from diameters of 3 kms. to 65 kms. Of these, 69% are less than 16 kms. in diameter, as can be seen by referring to the following table of statistics on the abundance of domes in relationship to their diameters.

The Diameters of Lunar Domes

Diameters in kms.	Number of domes	Diameters in kms.	Number of domes
		31-35	3
1-5	18	36-40	2
6-10	47	41-45	2
11-15	40	46-50	0
16-20	14	51-55	0
21-25	14	56-60	2
26-30	7	61-65	4

All lunar domes were put into three major categories according to the shape of their perimeters. Thus 76 domes, or 50% of the total, appear circular. The 30 elliptical domes represent 19% of the total; and the other 47 domes have polygonal, irregular, or ill-defined perimeters. By listing each dome under its proper perimeter classification and in ac-

*Longitudes are in the IAU sense, where the east lunar hemisphere is that of the Mare Crisium.

**Domes are identified by their xi and eta lunar coördinates in a rectangular system.

cordance with its size, it was found that 14 of the 18 smallest size domes (1-5 kms.) are circular in form. No other coorelation was found between the sizes of domes and their perimeters.

HEIGHTS AND SLOPES OF DOMES. Efforts were made in the Lunar Dome Survey to determine the heights and slope angles of the domes but with little success. Participants in this part of the program used Joseph Ashbrook's method of ascertaining the slope angles and heights of domes.[3] Difficulty was encountered in trying to distinguish between the domes' dark, black shadows and the dim, sun-averted slopes of the domes. As a result, there was no consistency in the estimates made by different observers, and even the same observer would occasionally derive diverse values for heights and slopes in his later observations. Despite the inconsistencies concerning slope angles, almost all 153 confirmed domes were reported as having less than 5-degree slopes. The steepest slope reported was that of the well known dome -510+175, west of Milichius, which may have a gradient of 10 or 11 degrees.

Considerably more agreement was evidenced by the participating observers over the question of whether the individual domes were hemispherical, platykurtic, or leptokurtic. Of the 153 domes, 104, or 68%, are hemispherical, 45 (29%) have rather flat summits (i.e., platykurtic), and 4 (3%) have sharp summits (i.e., leptokurtic). The 104 hemispherical and the 45 platykurtic domes are listed according to size in the two tables below; the domes are identified by their xi and eta coördinates. At the top of each column are numerals designating the diameters of domes in increments of 5 kilometers, except that the last column includes all domes between 31 and 65 kilometers in diameter. At the bottom of each column, immediately beneath the totals, the percentage figures show the relative abundances of the hemispherical and platykurtic domes in each size category. For example, the tables show that 78% of the 1-5 km. domes are hemispherical and that 62% of the 13 largest domes (31-65 kms.) are flat-topped.

Platykurtic Domes (45)

Diameters in kms.	1-5	6-10	11-15	16-20	21-25	26-30	31-65
	-343+574	+615+126	+537+204	-232-467	+523-334	+915+025	+904+025
	-343+580	+568+244	+523+206	-503+245	+152+510	+595+055	+697-075
	-458+137	+556+042	-366-453		-121+670		+615+065
	-459+131	+536+183	-450+207		-297-475		+610+042
		+430+280	-483+157		-496-062		-301-233
		+091-117	-497+218				-500-290
Domes		-429+057	-502+228				-502-068
		-466+124	-510-220				-600-140
		-472+125	-515+228				
		-506+439	-532+200				
		-510+175	-717+345				
		-528+220					
		-630+155					
Totals	4	13	11	2	5	2	8
Percentages	22%	28%	28%	14%	36%	29%	62%

Hemispherical Domes (104)

Diameters in kms.	1-5	6-10	11-15	16-20	21-25	26-30	31-65
	+781-243	+777-238	+768-237	+840+290	+703-113	+777-318	+534+288
	+737-217	+618-167	+593+131	+745+265	+339+107	+055+508	-108+317
	+603-380	+608-376	+357+554	+729-172	-089+561	-114+780	-643+651
	+061+068	+524+187	+274+299	+012+827	-297-472	-486+219	-884-326
	-001+080	+519+186	+259+304	-145-307	-440-100	-931-071	-897+144
	-019+730	+510+200	+183+348	-212+049	-508+200		
	-162-347	+507+184	+098+260	-257+030	-538+474		
	-218+042	+358+149	+095+582	-384-442	-900+005		
	-343+582	+353+155	+004+041	-492+238			
	-449+132	+349+161	+002+088	-523+484			
	-474+243	+325+733	-074+374	-773+155			
	-475+244	+110+777	-075-053				
	-476+238	+090+768	-156-353				

Hemispherical Domes (104)
(Continued)

Diameters in kms.	1-5	6-10	11-15	16-20	21-25	26-30	31-65
Domes	-478+242	+085+764	-173+738				
		-060-060	-193+005				
		-077+784	-217-485				
		-078-059	-247+013				
		-139+447	-375-554				
		-155-347	-514+477				
		-185+854	-514-206				
		-205-069	-523+183				
		-214-507	-528+247				
		-250+030	-566-131				
		-362-556	-612+451				
		-363-561	-620+452				
		-370-563	-624+445				
		-378-560	-804-365				
		-385-555					
		-455+136					
		-462+132					
		-510+228					
		-510+460					
		-523+441					
		-532+166					
Totals	14	34	27	11	8	5	5
Percentages	78%	72%	67%	79%	57%	71%	38%

The four domes with steep summits are: +424-462, -435+042, -431-197, and +363+130. The first two have diameters of 14 kms. and 12 kms. respectively; the third dome measures 16 kms. across; and the last, 24 kms. Their steep summits do not exclude these objects from the list of domes; for their average slopes are 5 degrees or less, in keeping with the criterion adopted by the Lunar Dome Survey.

Comparatively few of the 153 domes have more than one summit. Complex domes, those with two or more summits, appear in all sizes over 5 kilometers in diameter, as shown in the following table:

Complex Domes (15)

Diameters in kms.	1-5	6-10	11-15	16-20	21-25	26-30	31-65
	---	+777-238	-510+220	+745+265	+363+130	-486+219	+697-075
		+349+161		-384-442	+339+107	-931-071	+534+288
Domes		-510+288			-440-100		-500-290
							-643+651
Totals	0	3	1	2	3	2	4

SURFACE FEATURES ON DOMES. The most common surface feature on the lunar domes is craterlets. Elevations in the form of hills, small peaks, or ridges are much less numerous; and clefts or rilles are even less likely to be found on the domes. Thus:

77, or 50%, of the domes have craterlets on them;
30, or 20%, of the domes have hills, peaks, or ridges on them;
14, or 9%, of the domes have clefts or rilles on them.

Although craters were reported on 50% of the domes, many of the craters were too far off center to be considered summit craters. Consequently, only 36% of the domes can be described as having craters on one of their summits. Only if a crater was within one-half radius of the summit was it classified as a summit crater. The results of the A.L.P.O. Lunar Dome Survey definitely refute the commonly made statement that the majority of domes have summit craters. Of course, Lunar Orbiter and Apollo photographs may show some summit craters a kilometer or less in diameter; but they would be of inconsequential size in comparison with dome diameters of 10 kms. and more. The summit craters reported by participants in the Lunar Dome Survey usually have diameters of 2 to 4 kilometers.

A possible explanation of the overestimation of the abundance of summit craters may lie in the fact that domes with diameters between 6 and 15 kilometers are the most easily recognized, and domes of this size more often have summit craters than both smaller and larger domes. According to the listing of domes with summit craters given here, 43% of the 6-10 km. domes and 50% of the 11-15 km. domes have craterlets on their summits.

Domes With Summit Craters (54)

Diameters in kms.	1-5	6-10	11-15	16-20	21-25	26-30	31-65
	-343+574	+618-167	+537+204	+745+265	+523-334	+055+508	+697-075
	-458+137	+615+126	+523+206	-232-467		-486+219	-534+288
	-459+131	+568+244	+424-462	-384-442		-931-071	-301-233
		+556+042	+183+348	-492+238			
		+536+183	+004+041	-773+155			
		+519+186	-074+374				
		+510+200	-217-485				
		+430+280	-366-453				
		+353+155	-450+207				
		+349+161	-483+157				
Domes		+110+777	-502+228				
		-077+748	-510+220				
		-078-059	-514+477				
		-429+057	-523+183				
		-462+132	-528+247				
		-466+124	-532+200				
		-472+125	-612+451				
		-510+175	-620+452				
		-523+441	-717+345				
		-630+155	-804-365				
Totals	2	20	20	5	1	3	3
Percentages	17%	43%	50%	36%	7%	43%	23%

The 13 domes which have been underlined in the table of Domes With Summit Craters are those having one or more craters on their lower slopes in addition to the crater(s) at the summit. The following 4 domes have not just one but two summit craters: +523+206, -532+200, -717+345, and +523-334.

Observers reported seeing summit craters on only 3 of the 18 domes from 3 to 5 kms. in diameter. However, most summit craters on these small domes could be expected to have diameters of less than 2 kms.; and consequently they would not be noticeable in the 6- to 12-inch telescopes employed in the Survey.

By grouping summit craters according to the shapes of their domes, it was found that the flat-topped domes have a higher percentage of summit craters than do any of the other catagories.

27 of the 45 platykurtic domes have summit craters, i.e., 60%.
19 of the 47 irregular domes have summit craters, i.e., 40%.
29 of the 76 circular domes have summit craters, i.e., 38%.
27 of the 104 hemispherical domes have summit craters, i.e., 26%.
1 of the 4 leptokurtic domes has summit craters, i.e., 25%.
7 of the 30 elliptical domes have summit craters, i.e., 23%.

Despite the fact that 60% of all flat domes have summit craters, only 29% of these domes over 10 kms. in diameter have craters on their summits. On the other hand, 22 of the 28 (79%) platykurtic domes with diameters of 10 kms. or less have summit craters. The craterlets on top of the smaller domes usually give the domes a flattened appearance.

Elevations such as hills, small peaks, and ridges were found on only 30 domes listed in the table of Domes With Elevations. The nine underlined domes in this table have some sort of elevation on them at a distance from the summit no greater than one-half the dome's radius.

[As Mr. Delano would be the first to stress, readers must remain keenly aware of the role of observational effects on the data in the tables in his splendid report. Hills and ridges are more likely to be detected on the larger domes; summit craters and non-summit craters will be a confused merge on small enough domes. Future Lunar Dome Survey work under the leadership of Mr. Harry Jamieson can much improve our dome data, and the regular participation of those able to use 12-inch and larger telescopes would be especially valuable. --Editor]

Domes With Elevations (30)							
Diameters in kms.	1-5	6-10	11-15	16-20	21-25	26-30	31-65
		+608-376	+424-462	+729-172	+703-172	-486+219	+595+055
		+325+733	+183+348	+012+827	+363+130		-108+317
			+095+582	-212+049	+152+510		-301-233
Domes			-193+005	-431-197	-440-100		-500-290
			-483+157	-492+238	-508+200		-502-068
			-532+200	-503+245			-600-140
			-620+452				-643+651
			-624+445				-884-326
Totals	0	2	8	6	5	1	8

Clefts and rilles are even less common on domes than are elevations. Nine domes are bisected by short clefts or long rilles, and four other domes are the starting points of rilles leading away from them. The following five domes have clefts traversing their slopes without extending beyond the dome itself: +325+733, +152+510, -483+157, -566-131, and -897+144. The large dome in Darwin, dome -884-326, has two clefts on it; one aligned north-south, the other, east-west. Two domes near the crater Menelaus, +274+299 and +259-+304, are both bisected by Rima Menelaus I. Also, a small dome near the crater Birt, dome -156-353, is bisected by Rima Birt I, a rille which extends northward after passing through the dome, but considerably reduced in width.

Of the four domes which appear to be the point of origin of a rille, only the rille leading from dome -162-347 is a straight one; the other three are sinuous rilles. The very narrow, northernmost part of Rima Birt I commences at the summit of the 4 km.-wide dome -162-347, goes down its south slope, and crosses nearby dome -156-253, where it becomes wider and more pronounced. South of the crater T. Mayer, dome -492+238 has a broad but short sinuous rille leading from its northwest base. However, the three sinuous rilles commencing on the lower slopes of two domes north of the crater Prinz are much more noticeable. Rima Prinz II starts on the lower south slope of dome -612+451, turns west to get around the dome, and then follows a northerly course between dome -612+451 and dome -620-+452. Another conspicuous rille begins at the southeast base of dome -612+451. Still another sinuous rille, Rima Prinz I, begins on the lower east slope of dome -624+445. Rima Prinz I travels west between dome -624+445 and dome -620+452 before following a northerly course like the other two rilles.

<u>PROXIMITY TO RILLES AND RIDGES</u>. In an effort to see whether there is any correlation between lunar domes and the proximity of rilles, the position of each of the 153 cataloged domes was plotted on the USAF's Lunar Atlas Charts (LAC). A list was then made of all domes which are no more than 20 kilometers away from a rille. In addition to the 13 domes already mentioned which have clefts or rilles actually on them, there were found to be only nine other domes in the proximity of rilles. Thus only 22 domes, or 14% of the total number, were within 20 kilometers of a rille. There is obviously no tendency for rilles to occur where domes are located, at least not of a width great enough to be visible in Earth-based telescopes. The nine domes which lie in close proximity to rilles are:

+593+131	-440-100	-503+245
-155-347	-486+219	-510+220
-217-485	-502+228	-620+452

Dome -620+452 is the one of three north of Prinz around which Rima Prinz I and Rima Prinz II pass on opposite sides. An even more striking relationship between domes and a sinuous rille is to be found in the region south of crater T. Mayer. This particular 60 km.-long sinuous rille is barely visible and only in parts through Earth-based telescopes, but shows very well in the Lunar Orbiter IV frame No. 133 (#2 of 3 high resolution photos). The rille begins about 5 kms. south of dome -510+220, curves around its eastern base, passes through the valley formed by the dome's NE slope and the SW slope of dome -502+228, curves again to the north to avoid dome -510+228, and follows a wavy course along the western bases of domes -502+228 and -492+238. This rille follows the contours of the 4 domes so well that we can safely conclude that the rille was formed after the domes.

Whereas only 14% of the 153 confirmed domes are either bisected by, or lie in the proximity of rilles, fully 46% of the domes have ridges within 20 kilometers of their base. The ridges drawn on the USAF's Lunar Atlas Charts were used in arriving at the 46% figure. However, since ridges are so abundant on the <u>maria</u> and 85% of all the domes lie in the maria,[4] there can be no great significance attached to the fact that almost half the domes are within 20 kilometers of a ridge.

The Recorder for the Lunar Dome Survey wishes to thank everyone who has taken part in the program. It is through their efforts that we have acquired an appreciably greater amount of knowledge of the distribution and characteristics of lunar domes than was known before the survey was initiated 7 years ago by Harry D. Jamieson in coöperation with Leslie Rae of the British Astronomical Association. The Lunar Dome Survey is now being continued under the leadership of Mr. Jamieson, and we urge all interested lunar observers to give him their full support.

References

1. The Strolling Astronomer, Vol. 21, Nos. 5-6, pp. 76-79.

2. The Strolling Astronomer, Vol. 22, Nos. 1-2, p. 9.

3. The Strolling Astronomer, Vol. 15, Nos. 1-2, pp. 1-3.

4. The Strolling Astronomer, Vol. 22, Nos. 1-2, p. 10.

STATISTICAL ANALYSIS OF LUNAR DOME CHARACTERISTICS

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

The following table presents the results of Chi-Square analyses of the dome characteristics presented in the several tables in Mr. Kenneth J. Delano's paper "The Characteristics of Lunar Domes". Basically, such tests tell us whether any apparent relationship between two variables (e.g., dome profile and the existence of summit craters) is statistically significant or, instead, may be presumed to be random in nature. The degree of significance is expressed by "level of confidence". For example, the level of confidence of 99% found for the relationship between dome profile and the existence of summit craters means that we would expect the observed relationship to occur less than 1% of the time due to random causes; loosely speaking, we are "99% certain" that there is a real relationship.

It should also be pointed out that "real" relationship, statistically speaking, means "observed" relationship. The tests employed here assume that there is no observer bias in favor of, say, large domes. One might reasonably argue that the relationships found between dome diameter and the presence of summit craters or elevations indicate merely that observers are more likely to spot such features on large domes than on small ones. To answer such a question is beyond the power of this statistical test.

Relationship Between: Variable 1	Variable 2	Chi- Square (χ^2)	Categories Within Variable 1[a]
Diameter	Platykurtic	3.45	(km.) 1-5, 6-10, 11-15, 16-25, 26-65.
Diameter	Hemispherical	2.52	(km.) 1-5, 6-10, 11-15, 16-20, 21-25, 26-30, 31-65.
Diameter	Complex	3.16(*)	(km.) 1-10, 11-65.
Diameter	Summit Crater	8.03((*))	(km.) 1-5, 6-10, 11-15, 16-20, 21-25, 26-65.
Diameter	Elevations	16.14***	(km.) 1-10, 11-20, 21-65.
Profile	Summit Crater	10.15**	platykurtic, hemispherical, leptokurtic.
Plan	Summit Crater	1.71	irregular, circular, elliptical.

((*)) Significant with level of confidence = 80%.
(*) Significant with level of confidence = 90%.
** Significant with level of confidence = 99%.
*** Significant with level of confidence = 99.9%.

[a]In some of the tests, some diameter ranges had to be combined in order to obtain a significant number of domes in each category.

Verbally, we may conclude:

1. There is an extremely significant relationship between dome diameter and the presence of elevations.

2. There is a highly significant relationship between dome profile and the presence of summit craters.

3. There are less significant relationships between dome diameter and (a) complex plan, and (b) the presence of summit craters.

4. The other three relationships given above (diameter: platykurtic, diameter: hemispherical, and plan: summit crater) are not statistically significant.

STATISTICAL ANALYSIS OF LUNAR DOME DISTRIBUTION

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

Introduction

The A.L.P.O. Lunar Section's Lunar Dome Survey has been a success, as is shown by the two comprehensive reports prepared by its former director, Rev. Kenneth J. Delano.[1]

Rev. Delano's first report (Jan., 1970) commented on several examples of the non-random distribution of lunar domes. For example, he noted the preference of domes for maria locations, as opposed to highlands. Furthermore, he pointed out that domes tend to be located near mare margins and also to favor the (IAU) western hemisphere of the Moon. The purpose of this paper is to apply statistical tests to the problem of the distribution of lunar domes. Two questions are asked: First, are domes concentrated more, in terms of domes per unit area (e.g., 100,000 Sq.Kms.), in some maria than others? Second, are domes randomly distributed within each mare?

Statistical tests will be applied to answer these questions, according to the following procedure:[2]

1. State the null hypothesis; in this case, "dome distribution is random."

2. State the alternative hypothesis; "dome distribution is not random." (It is simply the converse of the null hypothesis. The two hypotheses are mutually exclusive, thus one of them must be true.)

3. Select a level of significance, α, which is the likelihood that the null hypothesis will be rejected when it is actually correct (and thus the alternate hypothesis is accepted when it is incorrect).

4. From the actual dome distribution, a test statistic is calculated.

5. a. If the test statistic falls outside a specific range of values (depending on the level of significance), the null hypothesis is rejected and the alternate hypothesis is accepted.

   b. Conversely, if the test statistic falls within a specific range of values, the null hypothesis is accepted and the alternate hypothesis is rejected.

The dome sample used for this study consists of 226 domes, which comprises all domes found on earthside maria and appearing in the dome catalogs, either as compiled by Rev. Delano,[1,3] or in unpublished lists compiled by Harry D. Jamieson and the writer. These domes, listed by mare unit and with their rectangular coördinates, are given in the Appendix.

Figures 5 and 6 show the distribution of the domes used for this study on the lunar earthside maria. The mare units are indicated by letter and number and correspond to those defined by the U. S. Geological Survey[4] (the conventional names of these units are given in the Appendix). Figures 5 and 6 are on an azimuthal equivalent ("equal-area") projection, where a given area on the Moon (e.g., 100,000 Sq.Kms.) is always represented by a constant area on the map, wherever on the Moon this may be. For any type of distribution, an equivalent projection gives a far truer picture than does the conventional, foreshortened, orthographic projection.

The 226 domes mapped in Figures 5 and 6 are correctly called a "sample" of front-side *mare* domes, even though they constitute all *mare* domes given in the published and unpublished A.L.P.O. dome catalogs. Many domes were not used because they were uncertain in nature or were unconfirmed. Undoubtedly, many domes are not even suspected, if only because of their small size (some Orbiter photographs show dome-like objects as small as 100 meters--difficult to confirm from Earth!). Observer bias undoubtedly is partly responsible for the apparent overwhelming preference of domes for *maria* rather than highlands (which fortunately does not affect this study). Also, the tendency for domes to "thin out" towards the limb is probably also due, at least in part, to such bias (see Figures 5 and 6; the decrease in dome density toward the limb is concealed in the usual orthographic map)--unfortunately, this effect may well affect the accuracy of this study, at least in the Oceanus Procellarum area.

Dome Distribution Between Maria

In this case, we ask whether the density of domes is the same from *mare* to *mare*, or, more precisely:

Null Hypothesis: Except for random variation, the number of domes in *mare* units is proportional to the areas of those units, excluding enclaved highlands (i.e., let A = area of all *mare* units, A_i = area of *mare* unit *i*, N_i = number of domes in unit *i*; then, $N_i = 226\ (A_i/A)$.)

Alternate Hypothesis: The number of domes in *mare* units is not proportional to the areas of those units (i.e., differences in dome densities exceed those expected for random effects).

The statistical test used here is the Chi-Square test (χ^2), which is used for comparing the expected number of items in a category with the observed number of items in that category (i.e., E_i *versus* O_i, where *i* is the number of the category, or, in this case, the *mare* unit). Thus,

(1) $E_i = 226\ (A_i/5{,}462{,}400 \text{ Sq.Kms.})$, and,

(2) $$\chi^2 = \sum_{i=1}^{n} \frac{(O_i - E_i)^2}{E_i},$$

where 5,462,400 Sq.Kms. is the lunar area of all *mare* units considered.[5]

Because we have a fairly large sample, we may select a high level of significance, $\alpha = 0.001$ (meaning we will say the distribution is not random if it can originate from random causes less than 1 time out of a thousand). Chi-Square is then calculated as shown in Table 1.

Table 1. Chi-Square Test for Distribution of Domes Between Maria.

Mare Unit(s)	Area (10^3Km.^{2})	O_i Observed No. of Domes	E_i Expected No. of Domes	(O_i-E_i)	$(O_i-E_i)^2$	$\frac{(O_i-E_i)^2}{E_i}$	Dome Density (Domes per 10^5Sq.Kms.)
A1	835.4	19	34.6	- 15.6	243.36	7.03	2.27
A2, A3	378.1	6	15.6	- 9.6	92.16	5.91	1.59
A4, A6	506.4	48	20.9	+ 27.1	734.41	35.14	9.48
A5	334.0	17	13.8	+ 3.2	10.24	0.74	5.09
A7,A8,A9d,A9e,A9g	388.1	64	16.1	+ 47.9	2294.41	142.51	16.49
A9a	298.8	1	12.4	- 11.4	129.96	10.48	0.33
A9b, A9c	1044.9	22	43.2	- 21.2	449.44	10.40	2.11
A9f	648.0	19	26.8	- 7.8	60.84	2.27	2.93
A10	239.6	13	9.9	+ 3.1	9.61	0.97	5.43
A11, A12	144.2	7	6.0	+ 1.0	1.00	0.17	4.85
B1, B3	447.6	7	18.5	- 11.5	132.25	7.15	1.56
C1	197.3	3	8.2	- 5.2	27.04	3.30	1.52
TOTAL	5462.4	226	(226.0)	(0.0)	------	226.07 $= \chi^2$	MEAN = 4.137

Conclusion: $\chi^2 = 226.07$, while $\chi^2_{11,.001} = 31.264$. Thus, the distribution is significantly non-random with a level of significance of 0.1%.

Note: Some *mare* units have been combined because, by convention, E_i should always exceed 5.0.

According to Table 1, χ^2 equals 226.07. Tables of χ^2 show that the limiting value of this statistic, for $\alpha = 0.001$ and 11 "degrees of freedom" (the "degrees of freedom" equals the number of categories minus 1) is 31.264. Because the calculated value of χ^2 exceeds this limiting value, we reject the null hypothesis and thus accept the alternate hypothesis. Loosely speaking, we are 99.9 percent "sure" that the actual numbers of domes found in the different *mare* units are not proportional to the areas of those units; domes are more densely concentrated in some *maria* than in others. The right-hand column in Table 1 indicates, in terms of domes per 100,000 Sq.Kms., which *maria* units have more, or less, domes than one would expect solely from the average dome density for all *mare* units (4.137 domes per 100,000 Sq.Kms.).

Dome Distribution Within Maria

Having determined that domes prefer some *maria* to others, the remaining question is whether domes are randomly distributed within the *mare* units themselves. This test is performed on each *mare* unit by itself. Randomness is now defined by the "nearest-neighbor statistic," *R*, where:[6]

$$(3) \quad R = \bar{D}_o/D_r.$$

Here $\bar{D}_o$ is the mean distance between a dome and the nearest other dome in the same *mare* unit. Quantity D_r is the expected nearest-neighbor distance for a truly random distribution of *n* points in an area *a*, namely:

$$(4) \quad D_r = \tfrac{1}{2}\sqrt{a/n} \quad .$$

By definition, R = 1 for a truly random distribution. Actual values of R may vary from 0 to 2.149. A value of R = 0 indicates a completely clustered distribution, the hypothetical limiting case where all domes lie on the same point. A value of R = 2.149 means a completely regular distribution, where domes would be regularly arrayed (in a hexagonal pattern) to be as far from each other as possible. In most real cases, of course, R is equal to neither 0, 1, nor 2.149; but its probable range of error can be calculated for any desired level of significance. If the maximum acceptable value of R is less than 1, the distribution has a significant tendency to clustering. If the minimum acceptable value of R is greater than 1, the distribution is significantly regular. Thus, the hypotheses to be tested are:

Null Hypothesis: $R = 0$ (i.e., the distribution is random).
Alternate Hypothesis: $R \neq 0$ (i.e.; (i) if $R_{max} < 1$, the distribution is clustered, or (ii) if $R_{min} > 1$, the distribution is regular).

The significance level chosen here is $\alpha = 0.05$, which means that the range of uncertainty of R (i.e., between R_{max} and R_{min}) is such that we would expect 1 to fall outside this range only 5 per cent of the time were a distribution truly random.

For this portion of the study, nearest-neighbor distances were measured for 207 domes in 11 *mare* units (the number of domes is less than the 226 used for the Chi-Square test because some units were not used because they contained too few domes for a reliable nearest-neighbor test). The actual measurements and the determinations of the values of $\bar{D}_o$, D_r, and R for the 11 units were performed by a BASIC-Language program on an IBM 360/67 computer, with distances calculated directly from the rectangular coördinates of the domes. The results of this study are summarized in Table 2.

Table 2 (pg. 96) shows that R is not significantly different from 1 (i.e., 1 lies between R_{max} and R_{min}) in seven cases. These seven *mare* units can thus be accepted as having random distributions of domes upon them. In four other cases, however (i.e., A4, A9b, A9e, and A12), R is significantly less than 1 (i.e., R_{max} is less than 1) so that, in each of these four *mare* units, we are 95 per cent "sure" that there is a significant tendency for their domes to cluster. This supports the intuitive impression given by Figures 5 and 6.

(text continued on page 96)

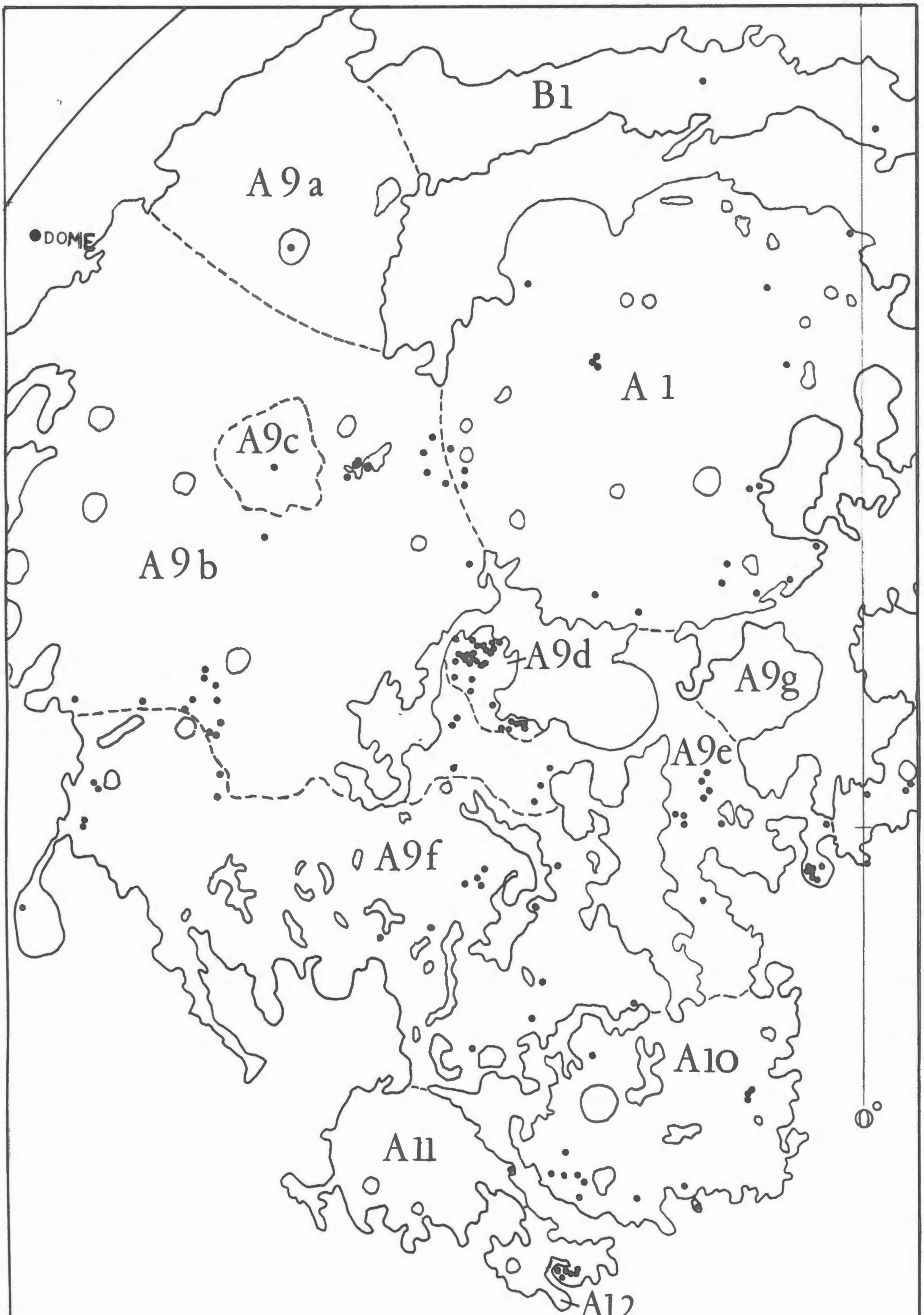


Figure 5. Azimuthal equivalent ("equal-area") projection of Quadrants 2 and 3 of lunar earthside hemisphere, showing locations of lunar mare units and of domes within them. Same scale as Figure 6.

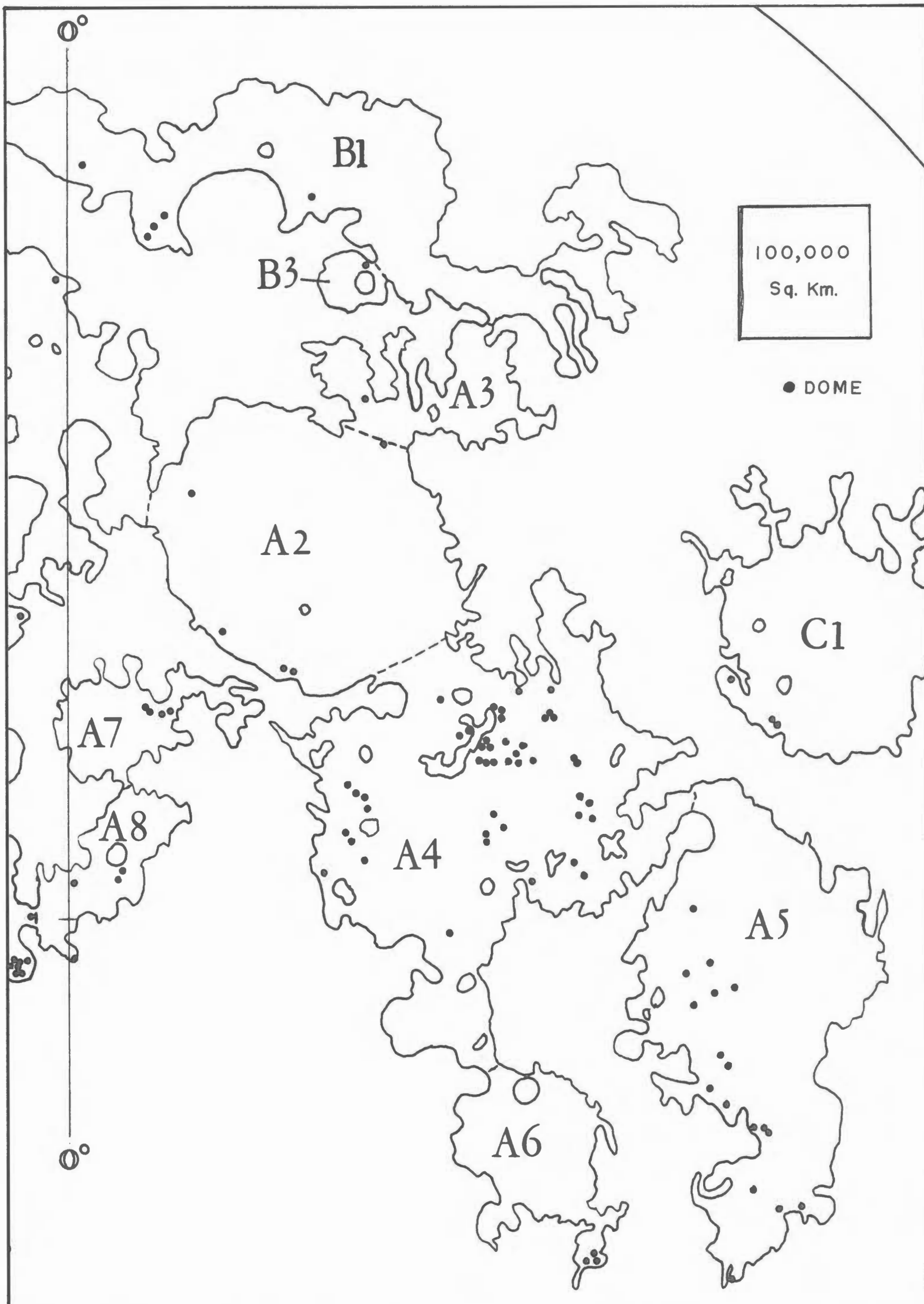


Figure 6. Azimuthal equivalent ("equal-area") projection of Quadrants 1 and 4 of lunar earthside hemisphere, showing locations of lunar mare units and of domes within them. Figures 5 and 6 are charts prepared by John E. Westfall. North at top, I.A.U. east to the right in both charts. See also text of "Statistical Analysis of Lunar Dome Distribution". The mare units are identified and the individual domes are listed on pages 96-98. The Moon's zero meridian of longitude is marked on both figures.

Table 2. Summary of Nearest-Neighbor Analyses.

Mare Unit	No. of Domes	Area (10^3Kms^2)	R	95% Confidence Limits of R R_{min}	R_{max}	Is R Significantly Different from 1?
A1	19	835.4	0.898	0.461	1.335	No
A2	5	311.7	1.476	0.395	2.149	No
A4	45	407.6	0.700	0.453	0.947	Yes
A5	17	334.0	0.854	0.611	1.098	No
A9b	21	993.9	0.514	0.243	0.785	Yes
A9d	31	22.8	1.178	0.840	1.516	No
A9e	25	218.7	0.642	0.404	0.880	Yes
A9f	19	648.0	0.822	0.497	1.147	No
A10	13	239.6	0.730	0.240	1.219	No
A12	6	28.8	0.397	0.360	0.434	Yes
B1	6	433.4	1.170	0.335	2.005	No
TOTAL	207	4473.9	-----	-----	-----	4 - Yes 7 - No

Appendix: Dome Catalog by Mare Unit.

Positions are given in rectangular coördinates in units of 0.001 lunar radii. The first 3-digit number is ξ (+ if I.A.U. east, - if I.A.U. west); and the second 3-digit number is η (+ if north, - if south). Where the writer has measured a dome position that differs from the published A.L.P.O. position, the previously published position is given in parentheses. Domes not given in the previously published A.L.P.O. catalogs are followed by an asterisk.

A1. Mare Imbrium. (19 domes; 835,400 Sq.Kms.)

+095+582
-019+730
-073+375 (-074+374)
-108+317
-121+675 (-121+670)
-138+447
-140+305*
-142+448*
-183+344*
-192+320*
-300+290*
-343+582
-343+580
-343+574
-356+305*
-410+657*
-506+439
-510+460
-514+477

A2. Mare Serenitatis. (5 domes; 311,700 Sq.Kms.)

+357+554
+269+300 (+274+299)
+255+304 (+259+304)
+183+348
+148+511 (+152+510)

A3. Lacus Somniorum. (1 dome; 66,400 Sq.Kms.)

+335+607*

A4. Mare Tranquillitatis. (45 domes; 407,600 Sq.Kms.)

+615+126
+610+042
+606+146*
+602+177*
+599+183*
+596+151*
+595+055
+593+131
+568+244
+567+269*
+565+247*
+565+243*
+556+042
+548+185*
+537+204
+536+183
+534+288
+531+195*
+524+187
+523+206
+522+122*
+520+240*
+519+251*
+519+186
+517+247*
+516+131*
+510+200
+507+207*
+507+184
+503+203*
+500+112*
+500+105*
+494+192*
+478+229*
+465+225*
+449-030*
+430+280
+373+095*
+363+130
+358+149
+357+077*
+353+155
+349+161
+339+107
+312+053*

A5. Mare Fecunditatis. (17 domes; 334,000 Sq.Kms.)

+795-316*
+781-241 (+781-243)
+777-318
+776-232 (+777-238)
+768-237
+761-305*
+755-074*
+744-172*
+740-215 (+737-217)
+736-085*
+732-395*
+729-172
+728-060*
+719-190*
+710+015*
+704-113 (+703-113)
+697-075

A6. Mare Nectaris. (3 domes; 98,800 Sq.Kms.)

+609-381*
+608-376
+603-380

A7. Mare Vaporum. (4 domes; 53,300 Sq.Kms.)

+125+259*
+115+252*
+098+260
+096+262*

A8. Sinus Medii. (4 domes; 48,900 Sq.Kms.)

+061+068
+055+058*
+005+044*
+004+041

A9a. Oceanus Procellarum--Sinus Roris. (1 dome; 298,800 Sq.Kms.)

-643+651

A9b. Oceanus Procellarum--Northern Section. (21 domes; 993,900 Sq.Kms.)

-507+337*
-523+484
-523+441
-537+446*
-538+474
-611+451 (-612+451)
-620+452
-624+446 (-624+445)
-627+436*
-717+345
-773+155
-773+127*
-782+172*
-782+119*
-783+120*
-790+191*
-791+183*
-802+158*
-813+141*
-839+161*
-897+144

A9c. Oceanus Procellarum--Aristarchus Hills. (1 dome; 51,000 Sq.Kms.)

-701+430*

A9d. Oceanus Procellarum--Milichius Dome Field. (31 domes; 22,800 Sq.Kms.)

-449+132
-455+136
-458+137
-458+130 (-459+131)
-462+132
-466+124
-472+125
-475+244
-476+238
-477+242 (-474+243)
-478+242
-483+157
-485+235*
-486+219
-489+217*
-492+235 (-492+238)
-497+218
-499+238*
-502+227 (-502+228)
-503+245
-508+200
-510+229 (-510+228)
-510+220
-510+175
-515+228
-516+225*
-523+227*
-523+183
-528+247
-528+220
-530+200 (-532+200)

A9e. Oceanus Procellarum--Intermaria Section. (25 domes; 218,700 Sq.Kms.)

-050+010*
-057-047*
-060-056 (-060-060)
-061-051*
-066-057*
-067-050*
-077-060 (-078-059)
-078-054*
-193+005
-205-069
-212+049
-213+069*
-214+062*
-218+042
-218-090*
-247+013
-250+021
-257+030
-410+078*
-429+057
-435+042
-527+141*
-532+166
-536+136*
-540+070*

A9f. Oceanus Procellarum--Riphaeus Section. (19 domes; 648,000 Sq.Kms.)

-301-233	-500-290	-885+046*
-409-060*	-502-071 (-502-068)	-888+055*
-431-197	-514-206	-897+005*
-438-102 (-440-100)	-566-131	-900+005
-438-245*	-600-140	-931-071
-496-062	-775+076*	
-498-078*	-777+057*	

A10. Mare Nubium. (13 domes; 239,600 Sq.Kms.)

-155-347	-297-475	-383-445*
-156-353	-350-441*	-384-439 (-384-442)
-162-347	-351-473*	-388-420*
-217-485	-359-298*	
-232-467	-366-453	

A11. Mare Humorum. (1 dome; 115,400 Sq.Kms.)

-444-438*

A12. Palus Epidemiarum. (6 domes; 28,800 Sq.Kms.)

-362-556	-370-563	-378-560
-365-561	-375-554	-385-555

B1. Mare Frigoris. (6 domes; 433,400 Sq.Kms.)

+262+790*	+090+768	+012+827
+110+777	+085+764	-186+851 (-185+854)

B3. Lacus Mortis. (1 dome; 14,200 Sq.Kms.)

+325+733

C1. Mare Crisium. (3 domes; 197,300 Sq.Kms.)

+779+211*	+776+217*	+745+265

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4. Mason, Arnold C. and Hackman, Robert J. "Photogeologic Study of the Moon." In: Kopal, Zdeněk and Mikhailov, Zdenka Kadla (Eds.). The Moon. (London and New York: Academic Press, 1962), pp. 301-315. Hackman, Robert J. and Mason, Arnold C. Engineering Special Study of the Surface of the Moon. U. S. Geological Survey, Miscellaneous Geologic Investigations, Map I-351. (Washington, D.C.: U. S. Government Printing Office, 1961.)

[5]Westfall, John E. "The Areas of the Lunar Lowlands." Str. A. 22, 7-8 (Aug., 1970), pp. 112-121.

[6]Westfall, John E. "The Floor Craterlets of Plato: A Nearest-Neighbor Analysis." Proceedings 69, Joint Convention of Western Amateur Astronomers and Association of Lunar and Planetary Observers (San Diego, Calif., August 21-23, 1969), pp. 19-24.

COMET RUDNICKI 1966e

By: John E. Bortle and Dennis Milon, A.L.P.O. Comets Recorder

ALPO observers followed Comet 1966e from November, 1966 to February, 1967 as it rose to 6th magnitude. The discovery was made on a photograph taken on October 15th, 1966 by Konrad Rudnicki, an astronomer from Warsaw, Poland, who was searching for supernovae with the 48-inch Schmidt at Palomar Observatory. The photographic magnitude was then 13.5. At first in the southeast evening sky in Cetus, the comet moved westward until it was lost in the evening twilight. The ALPO again picked it up in the February morning sky.

Closest approach to Earth of 37 million miles came at Christmas time, 1966, and coincided with greatest brightness. The orbit of Comet Rudnicki can be visualized in the diagram by H. B. Ridley (Figure 7) and from the parabolic elements published on IAU Circular 1993 by Brian Marsden:

T = 1967, Jan. 20.89 $\Omega = 75^\circ.0664$
q = 0.419628 AU $i = 9^\circ.0726$
$\omega = 79^\circ.7082$

Calculations by Jean Meeus in The Journal of the British Astronomical Association (Vol. 77, p. 292) give a minimum distance between the comet's orbit and the Earth's of less than half the Earth-Moon distance. The Earth was closest to the comet orbit on June 6, 1967; but the comet had passed this position 97 days previously on March 1, 1967. Thus the possibility of a meteor shower from Comet Rudnicki was slim. In addition, the predicted radiant was near the Sun and would have been observable only by radar.

Reports on Comet 1966e extending from November 11, 1966, to February 11, 1967 were received from:

Bob Bailey, Houston, Texas
John Bortle, Mount Vernon, New York
Darrell Conger, Elizabeth, West Virginia
Michael McCants, Houston, Texas
Tom Middlebrook, Nacogdoches, Texas
Dennis Milon, Houston, Texas
Kenneth R. Polley, Ajo, Arizona
Karl Simmons, Jacksonville, Florida
Douglas Smith, Vinton, Virginia
George Van Biesbroeck, Tucson, Arizona
Wayne Wooten, De Funiak Springs, Florida

The Comet's Appearance

Comet Rudnicki could hardly be called spectacular, generally being described as a large round patch of mist with little condensation. Estimates of coma diameter varied widely because of varying sky background and different instruments, making an analysis difficult. A nucleus was reported by only two observers, Simmons and Bortle. Mr. Bortle was the first to see the extremely dim nucleus on December 4, calling it magnitude 12 or fainter in a 22-inch telescope. Toward the end of December and early in January and February, Simmons reported the nucleus as between magnitudes 10 and 12.

The comet's degree of condensation (on a scale of 0, very diffuse, to 9, stellar) was very slight; and on many nights observers found no evidence of condensation at all. The average value for November was 1.4; for December 1-15, 1.0; and from December 16 to February 5, 3.1. However, in the last ALPO observation on February 11 Simmons called it 8.

Comet Rudnicki's tail was a very difficult feature and was unusually short for a comet passing so close to the Sun (39 million miles). The tail was first observed on December 1 and thereafter was seen intermittently by four of the observers up to January 3, 1967; but it was not observed after perihelion on January 20. Unfortunately, the observed position angles varied widely so that no study of the tail's direction was possible. Using a photograph appearing in Vol. 79, No. 468 of The Publications of the Astronomical Society of the Pacific to back up visual observations, it can safely be assumed that Comet Rudnicki possessed a short gas tail of Bredichin Type I (straight and narrow), which visually did not exceed a length of 230,000 miles.

Total or Coma Magnitudes

Each magnitude estimate was corrected for the aperture effect according to the formula of N. T. Bobrovnikoff (Popular Astronomy, Vol. 49, No. 467, 1941, and Vol. 50, No. 473,

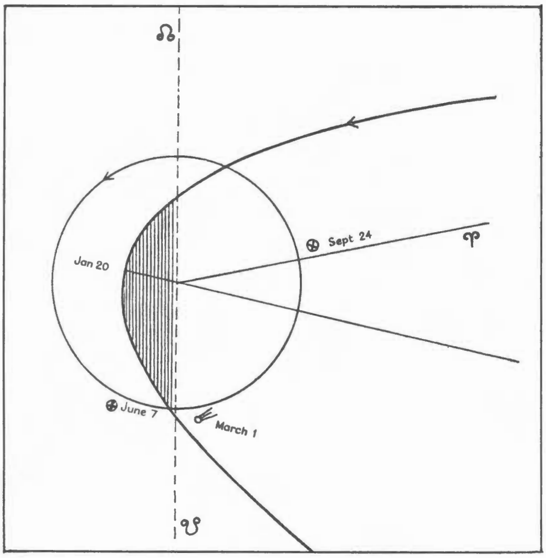

Figure 7. Diagram of orbits of Comet Rudnicki 1966e and Earth. Drawn by H. B. Ridley and reproduced from, and with the permission of, The Journal of the British Astronomical Association, Vol. 77, No. 4, 1967, page 260. The shaded portion of the comet's orbit is to the north of the plane of the ecliptic. See also text of article "Comet Rudnicki 1966e".

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1942). Corrections were also made for the comet's changing distance from the Earth based on an ephemeris supplied by Michael McCants, now at Austin, Texas. The resulting heliocentric magnitudes were placed on punch cards by D. C. Livingston and were run through a SDS computer programmed to find the least squares line best fitting the observations. The magnitudes were also divided into subgroups in attempts to find better fits. The final analysis involved 31 selected observations listed in Table I. They give: $m = 9.37 + 7.10 \log r$, $n = 2.84$.

The first value, 9.37 is the comet's "absolute magnitude" and is useful in comparing the intrinsic brightness of various comets. Parameter n is a value for the rate of brightening. Telescopic and binocular estimates gave these formulas:

telescopic $m = 9.61 + 12.38 \log r$, $n = 4.96$
binoculars $m = 9.44 + 6.33 \log r$, $n = 2.53$

In examining these three formulas, it was noted that the exponent n had a smaller value than that found for most comets. In fact, the value is not too much more than would be expected for a simple reflecting body. The telescopic n was similar to that usually found for cometary nuclei. Checking the word descriptions of the three observers who estimated the comet's magnitude early in its apparition, it was clear that one of them, the person giving numerous very faint estimates, was seeing only the innermost areas of the coma, in essence the nucleus. For example, the "faint" observer called the diameter under one minute of arc in November, while one of the "bright" observers called it 3-4 minutes. Generally, telescopic observers saw the comet much smaller than did binocular observers.

Studying these comet observations has pointed to the necessity to observe as far from artificial lighting as possible. In a few cases observers near large cities saw only a fraction of the coma's total diameter, thus making their magnitude estimates difficult to compare with darker-sky observers.

After checking solar activity and ionospheric disturbances data from the AAVSO's Casper Hossfield, and considering the predictable appearance of Comet Rudnicki, it was concluded that this was a very quiescent comet with no indication of solar interaction.

Table I.

Comet Rudnicki 1966e Visual Magnitude Estimates.

UT Date			Observer	Aperture (inches)	Magnitude
1966,	Dec.	2.00	Simmons	6	9.6 a
		4.02	Bortle	2	8.0 a
		5.00	Bortle	2	7.9 a
		5.05	Conger	2	7.6 a
		9.00	Simmons	6	8.5 a
		10.00	Simmons	6	8.5 a
		12.00	Bortle	2	7.2 a

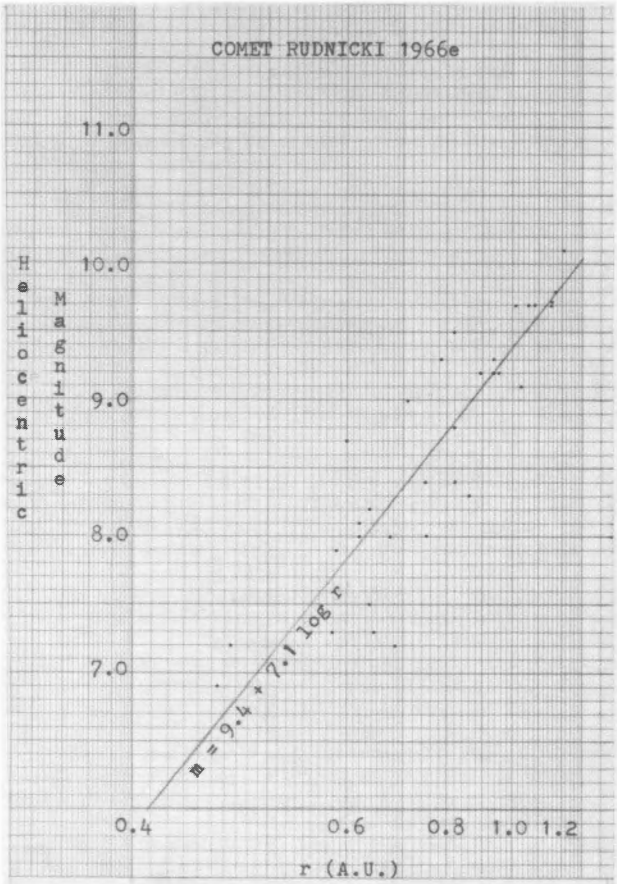

Figure 8 (left). Photometric graph of coma brightness prepared from visual magnitude estimates of Comet Rudnicki 1966e made by ALPO Comets Section members. Heliocentric magnitude is the observed brightness after correcting for the varying distance of the comet from the Earth. The distance from the Sun, or r, is on a log scale. See also text on pages 99-100.

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Figure 9 (below). Sketch of Comet Rudnicki 1966e on December 4.04, 1966, U.T. Made from a negative obtained by John E. Bortle with a 200-mm. f/3.9 camera. The total diameter was 6 minutes of arc, and the observed stellar magnitude was $7\frac{1}{2}$. Note the arrow to show directions in the sky and the scale -- both excellent ideas for drawings of comets.

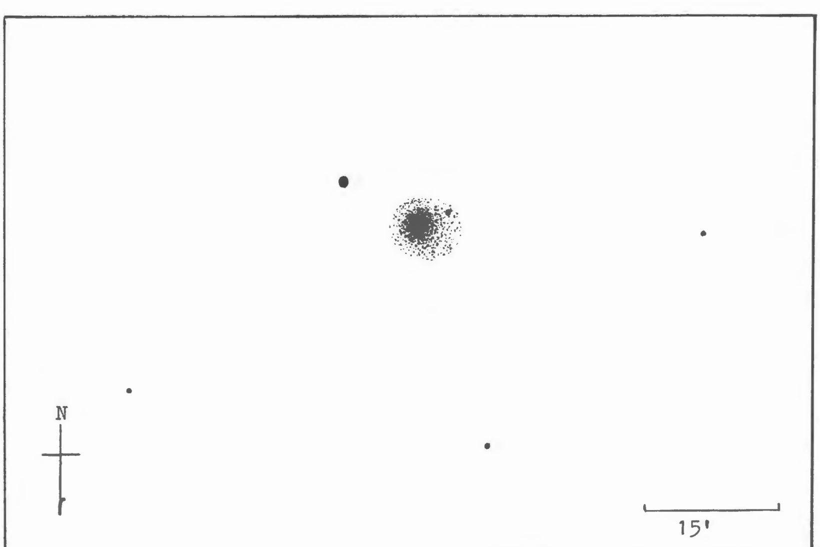

Table I. (Cont.)

UT Date			Observer	Aperture (inches)	Magnitude	
1966,	Dec.	13.02	Conger	2	7.7	b
		16.00	Conger	2	7.2	b
		17.00	Bortle	2	7.3	b
		17.01	Conger	2	7.2	b
		19.06	Wooten	10	8.5	
		20.96	Simmons	6	7.0	a
		22.96	Simmons	2	6.8	a
		22.96	Simmons	6	7.0	a
		23.07	Polley	2.4	7.5	d
		24.96	Simmons	2	7.3	a
		26.96	Conger	2	6.0	c
		27.95	Smith	6	7.0	d
		29.10	Polley	2.4	7.0	
		30.97	Conger	2	6.0	c
1967,	Jan.	1.96	Simmons	6	6.2	e
		2.96	Conger	2	6.0	e
		3.03	McCants	2	6.1	b
		4.08	Milon	2	6.8	b
		4.96	Simmons	2	6.0	e
		27.50	McCants	2	6.5	d
		28.48	Simmons	2	6.8	a
	Feb.	5.47	Simmons	6	8.0	a
		9.25	McCants	9.5	8.7	
		11.46	Simmons	8	8.5	a

a. AAVSO charts
b. Smithsonian Astrophysical Observatory Star Catalog
c. Yale Bright Star Catalog
d. Skalnate Pleso Atlas
e. Skalnate Pleso Catalog

SOME NEW METHODS AND GOALS FOR THE SELECTED AREAS PROGRAM

By: Harry D. Jamieson and Christopher A. Vaucher, A.L.P.O. Lunar Recorders

The Selected Areas Program, as many readers may know, was originally designed to search for transient lunar phenomena as well as longer term "seasonal changes". Recently, however, responsibility for TLP has been given to Mrs. Winifred S. Cameron, who will be in charge of a separate program to study this important aspect of lunar science. In view of this important change in the direction of the SAP, it has been deemed advisable to make several necessary changes in our policies:

1. The SAP will as of now concentrate most of its attention upon long-term variations, or "seasonal changes". These would normally include such things as tonal and shape variations, since these occur during the course of a lunation.

2. While the older "blink" device - so useful to TLP work - will no longer be used extensively, work with individual color filters will still be of prime importance to the program.

3. New areas have been incorporated into the project. These include: Pico, Piton, Atlas, Gassendi, Hell, Aristillus, and Endymion. These features were chosen on the basis of their known changes, as well as - wherever possible - proven observer interest.

Observations for this program are neither hard to make, nor to submit. Forms are provided for the observer to make his drawings and intensity estimates on. Also, the Recorders will be happy to answer any questions observers may have, as well as to offer personal attention to anyone having trouble getting started. A few simple instructions for completing the forms may be helpful.

1. Each individual observation should be placed on a separate form to facilitate filing by area.

2. Intensity estimates will be of prime importance. Observations should be based on the standard ALPO 0-10 scale in both white and colored light. Wratten Filters which have been found very useful for this type of work include 25 (red), 58 (green), and 38A (blue). Estimates may be either placed on the drawing itself or on a separate sheet, whichever the observer prefers.

3. While drawings should always be as pleasing to the eye as possible, accuracy is more important than art. Readers should understand that drawings are prime material for publication, and that inaccurate efforts are far more likely to damage an observer's reputation than inartistic ones. Few of us are artists; but all of us should be able to achieve accuracy of form, shape, and position. Special attention should be paid to the shapes and lengths of shadows when making drawings, for there is a vital need to know more about the vertical profiles of many of the areas under study.

4. Colongitude should always be computed for the evening's work, and instructions for correctly carrying out this simple procedure can be obtained from the Recorders.

5. Written notes are very valuable additions to any type of observation. Under the section on the form headed "Descriptive Notes", one should discuss anything which was not immediately apparent on the drawing. One should note the relationships between individual features and their surroundings, the nature and extent of bright rays, features seen only under low or high lighting conditions, and any unusual or anomalous aspects.

6. Times and dates should be given in Universal Time only; careful attention should be paid to establishing the correct correspondence between UT and colongitude.

7. Observations should be mailed to the Recorder at the end of each lunation, and specific data should always be kept in duplicate. The Recorder will comment upon them and acknowledge receipt of the reports as they arrive.

8. It has been found necessary to charge for new forms in order to help offset the cost of their printing, which comes to about 4¢ apiece. It is hoped that observers will understand and sympathize with our problem here.

Long experience has taught the Recorders that best results are obtained from observers who select one or two areas only and "specialize" on them. While we do not wish to assign areas to observers, some controls are necessary in any scientific project; and we ask that each observer pick one or two areas which he likes very much, and sticks to them. Observers who really <u>know</u> their areas are better qualified to detect the changes and variations which this program is primarily interested in.

Many readers who have followed the progress of this program over the years will be interested in knowing the status of some of our original areas. All areas not on the present forms may be considered "closed down" and no longer under study. In some cases, interest in the features dropped off before we felt satisfied that we had learned all that we could about them; in other cases, a point of diminishing returns was reached in which several hundred observations were on hand, and additional ones appeared lacking in new data. Of the program's original six areas, Plato and Messier-Pickering were reported on some years back, while Kepler and Alphonsus are ready for publication now, and Aristarchus and Eratosthenes are nearly so. We are deeply indebted to Lunar Recorders Delano (Kepler) and Westfall (Aristarchus) for their efforts in writing these reports up. All of the original areas will be published upon as the Editor finds space for the reports.

The program has recently made some discoveries which the two Recorders, at least, feel justify the time and effort put into the program by so many observers. While details of these observations and others will be found in the individual area reports now awaiting publication, some remarks about them may be in order now.

Perhaps the most surprising of these concerns a heretofore unsuspected system of dark bands within the crater Alphonsus. While certainly not so dark or evident as the bands to be found in such craters as Aristarchus, the Alphonsus dark bands nevertheless exist, and have been seen in whole or in part by a number of respected observers working independently of each other. The bands have been seen as a system of dark lines crossing the crater's floor in several places. The first observer to record these was Carl F. Dillon.

Figure 10. Drawing of lunar crater Alphonsus by Carl F. Dillon, Jr. February 13, 1968. 0^h28^m - 0^h44^m, U.T. 6-inch refl. 150X. Seeing 6 (scale of 0 to 10). Transparency 3 (limiting magnitude). Colongitude 79°6. Lunar south at top, lunar west (IAU sense) at right. All dark streaks hard to see.

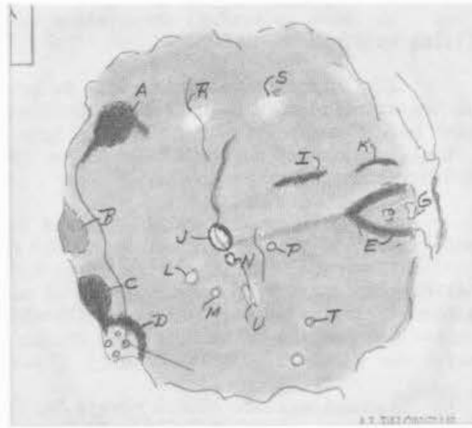

Figure 11. Drawing of lunar crater Alphonsus by Inez N. Beck. August 25, 1969. $4^h 30^m$ - 4^h45^m, U.T. 6-inch refl. 152X. Seeing 9. Transparency 6.5. Colongitude 59°0.

Figure 12. Drawing of lunar crater Alphonsus by Bruce A. Waddington. August 14, 1967. 4^h0^m - 4^h45^m, U.T. 8-inch refl. 195X. Seeing 4. Transparency 3. Colongitude 13°1. Passing clouds at times. Early morning lighting.

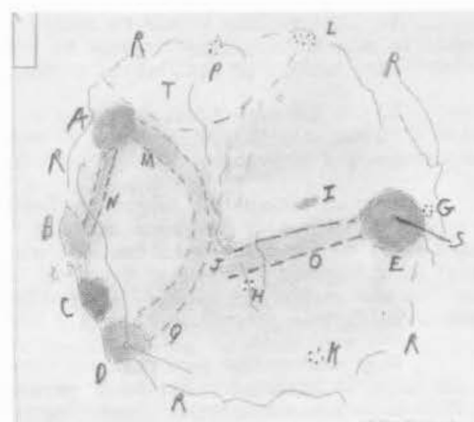

Figure 13. Drawing of lunar crater Alphonsus by Ronald F. Fournier. September 22-23 1969. 23^h33^m - 0^h50^m, U.T. 6-inch refl. 126X. Seeing 6. Transparency 6. Colongitude 50°7.

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Though Atlas has only recently been added to the program's list of areas for study, quite a bit about it has already been determined. The long-famous dark patches within the crater have now been found to be dark-haloed craterlets adjoined by a system of very delicate rilles. This aspect appears to be very similar to what has long been known about the dark areas within Alphonsus.

Many more interesting and important discoveries remain to be made on the Moon, and the role of the amateur in lunar research must still be considered an important one. While Orbiter photographs of Atlas were used to help identify the rilles and craterlets associated with that crater's dark patches, these were first suspected visually with ordinary amateur instruments. Moreover, the band system within Alphonsus is not to be found on spacecraft based photographs at all, and can only be made out visually from Earth. The writers would certainly welcome hearing from anyone honestly interested in doing this type of important lunar research.

Figures 10-13 are sample drawings of the dark bands on the floor of Alphonsus and may also indicate something of the general quality of lunar observations in this project.

LUNAR NOTES

By: Charles L. Ricker, A.L.P.O. Lunar Recorder

Our new Recorder in charge of the Lunar Transient Phenomena Program, Mrs. Winifred Cameron, has communicated the following plans for that program: All observers of the Moon who are interested in LTP should concentrate on a limited number of formations (less than 6), and should spend several lunations becoming thoroughly familiar with their appearance under all conditions of lighting. They should then undertake a systematic program of surveying these formations for any abnormal appearances. In case anything abnormal is noted, every effort should be made to eliminate any possible sources of error. Changing eyepieces, moving the feature around in the field of view, and checking nearby formations are some methods which should always be followed in checking one's suspicions. If one is still sure of the reality of the event, he should try to get confirmation from an observer elsewhere if at all possible. Full descriptions of positive events should be reported, such as UT time and date, location of observer, size of telescope, kind (reflector or refractor), and powers used at times of observations. Lists of negative observations should also be reported, including times, features examined, and telescopic data.

A more comprehensive article will appear in a later issue, but in the meantime Mrs. Cameron has expressed a desire to hear from all members who are seriously interested in taking part in this patrol so that she can organize coverage of all or most LTP features. It is hoped that all our lunar students will respond to this very worthwhile project. Her address is Mrs. Winifred S. Cameron, NASA, Goddard Space Flight Center, Code 641, Greenbelt, Maryland 20771.

Mr. Julius Benton has left the Lunar Section because of his appointment to a Jupiter Recordership. Mr. Harry Jamieson has replaced Mr. Benton as the head of the Selected Areas Program. Mr. Christopher Vaucher continues to be the Assistant Lunar Recorder in the SAP.

Otherwise, the Lunar Recorders and their projects are the same as described in our last issue (Str. A., Vol. 23, Nos. 3-4, pg. 62).

We regret that lack of space has obliged us to postpone the publication of the balance of Dr. John Westfall's report on the ALPO Lunar Photograph Library to a later issue than this one.

THE 1971 ASTRONOMICAL LEAGUE - A.L.P.O. CONVENTION AT MEMPHIS

By: Julius L. Benton, Jr.

The Nineteenth Annual Convention of the Association of Lunar and Planetary Observers was held in conjunction with the 25th National Convention of the Astronomical League on the campus of Southwestern College at Memphis, Tennessee on August 18-22, 1971. The host for the gathering was the Memphis Astronomical Society under the auspices of the Southwestern at Memphis Physics Department.

At noon on Wednesday, August 18th, the Convention opened with registration at Briggs Student Center. During the afternoon, exhibits were set up; and a number of delegates did some sight-seeing in and around Memphis. That evening an informal observing session was held in the athletic field, with telescopes of various sizes trained on Mars and Jupiter. Mr. Harry Jamieson collected and set up the A.L.P.O. Exhibit; we thank all who contributed to it.

After breakfast on Thursday morning, the Convention opened at 9:00 A.M. with the usual welcoming speeches. General Chairman for the Convention was Mr. William J. Busler of the Memphis Astronomical Society, who presented some opening remarks. He was followed by Mr. John C. Flippen, President of the Memphis Astronomical Society, Mr. W. C. "Bud" Shewmon, President of the Astronomical League, and Mr. Walter H. Haas, Director of the Association of Lunar and Planetary Observers.

A preliminary business meeting of the Astronomical League was held at 9:30 A.M. the same morning; and at 10:30 A.M. the first formal paper session got underway, Mr. Busler presiding. All papers on Thursday were those of Astronomical League members and guests. Mr. James Gettys spoke on "Computer Analysis of Star-Streaming in Open Clusters", and Mr. Richard A. Sweetsir discussed "Jacksonville Florida's New Minolta Planetarium and the Amateur Astronomer". Mr. Sweetsir pointed out how the planetarium was utilized to help train members of the Astro-Gator Astronomy Club in the techniques of meteor observing and path-plotting. Mr. Robert T. Little spoke on "Astrophotography for the Amateur", followed by a paper presented by Mr. William M. Duvall for Mr. Joseph Kis, who could not attend the Convention. The title of Mr. Kis' paper was "Axis Orientation of Nearby Stars".

On Thursday afternoon, the second Astronomical League paper session began with Mr. Robert E. Cox acting as Chairman. Following a few remarks on astronomical instrumentation by Mr. Cox, Mr. Henry S. Harris presented a delightful paper on "A Practical Private Astronomical Observatory", in which he described some advantages of a sliding-roof type observatory as opposed to the more complex and expensive domed structures. Mr. Saul Levy, of Kitt Peak National Observatory, showed some slides and offered comments on "Construction of the 150-Inch Telescope at Kitt Peak". A special highlight of the afternoon session was a talk on "Black and White Holes of Space" by Dr. Ernest Reuning of the University of Georgia's Department of Physics. Dr. Reuning presented some of the current theories on the gravitational models of the Universe and offered an explanation for the peculiar behavior of pulsars. Mr. Robert Cox spoke on "Some New Optical Tests for the Amateur", describing the correct technique for performing the Null and Ronchi Tests for a variety of telescope mirrors. Following the paper sessions of the day there was the annual business meeting of the ALPO during the evening hours, as well as the Astronomical League's Council meeting. The ALPO business meeting will be described in a later issue.

On Friday morning, the first ALPO paper sessions opened with Mr. Walter H. Haas, the Director of the ALPO, serving as Chairman. Mr. Charles F. Capen, the ALPO Mars Recorder, discussed the current favorable apparition of Mars in his presentation, "ALPO 1971 Mars Apparition Observations." Mr. Capen showed a number of color slides taken at the Lowell Observatory during 1971, giving special attention to an oblong dusky marking and a few bright spots near the South Polar Cap of the planet. Mars had just passed opposition at the time of the Convention, being closer to the Earth than it had been since 1924. The writer, who is the ALPO Saturn and Jupiter Recorder, presented a paper on "The Recent Reorganization of the ALPO Saturn Section: Prospects for the Future." Observers were urged to take a more active part in all aspects of Saturn observing in the current and future apparitions. In the absence of Mr. Richard G. Hodgson, the writer also read "Iapetus in the Glare of Saturn", a discussion of the method of making visual estimates of satellite magnitudes and how glare from the primary can affect one's results. Mr. Charles S. Morris spoke on "The Decay of Short-Period Comets"; and in the absence of Mr. Rodger W. Gordon, Mr. Richard E. Wend read his paper on "The Effect of Magnification on Central Meridian Transit Timings." Mr. Gordon noted that as magnifications were increased, transit timings tended to be more accurate; he suggested experimentation to determine the proper magnification for one's own instrument in observing the planet Jupiter. The Reverend Kenneth J. Delano introduced his new lunar program in a paper entitled, "Dark Haloed Craters: A New Lunar Program." As the Lunar Recorder for the ALPO, Reverend Delano urged active observational participation in the new program. Another Lunar Recorder, Mr. Harry Jamieson, gave a progress report on the vertical profile study of specific lunar features in "A Progress Report on a Study of Messier-Pickering", the paper being co-authored by Mr. Jamieson and Mr. Roy Parish. In the absence of Lunar Recorder Dr. John Westfall, Comets Recorder Dennis Milon read a paper on "Luna Incognita: The Last Frontier?" Dr. Westfall discussed the value of amateur observational work in the light of current space efforts, reiterating the fact that a vast amount of visual study is still needed on the Moon. Miss Grace Fox, who has perhaps attended more ALPO Conventions than anyone else, gave a meaningful description of her feelings about junior astronomers in a paper entitled, "What Can We Do to Assist our Young Astronomers?". Mr. Charles Capen again came to the rostrum to discuss "Mars: The 1971 Map." He outlined progress that is taking place on the new Mars Map at the Planetary Research Center at Flagstaff, Arizona; and he pointed out its bearing on the up-coming close approach of the Mariner spacecraft to the planet in November, 1971.

The Friday afternoon paper sessions opened with Mr. Richard E. Wend presiding. Mr. William H. Glenn spoke on "The Shadow of the Moon in the Sky at Total Solar Eclipses." Mr. Glenn presented his method for photographing the Moon's shadow throughout the duration of the March 7, 1970 solar eclipse, suggesting that he would like to see more work done in this realm of astrophotography. The writer and Mr. Glenn are planning expeditions to pursue such photography programs for the 1972 and 1973 solar eclipses. Mr. Charles L. Ricker, the ALPO Lunar and Planetary Training Program Recorder, spoke on the highly controversial topic of refractor vs. reflector in "The Lunar and Planetary Telescope." He

Figure 14. Julius L. Benton (left), A.L.-P.O. Jupiter and Saturn Recorder, and C. F. Capen (right), A.L.P.O. Mars Recorder, looking at portion of A.L.P.O. Exhibit during Astronomical Convention at Memphis. Figures 14-19 are photographs taken and contributed by Mr. Charles L. Ricker.

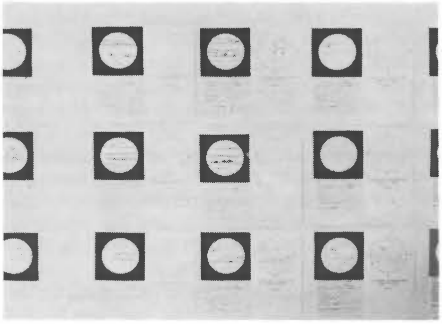


Figure 15. Jupiter drawings forming part of A.L.P.O. Exhibit at Memphis. The Exhibit was collected and arranged by Harry Jamieson. It was set up on tables and walls just outside the main Lecture Room.

Figure 16. William R. Winkler (right foreground) and others at Memphis Convention. Mr. Winkler is an active amateur in the Washington, D.C. area and is especially interested in lunar and planetary photographic techniques. He has given papers on this subject at A.L.P.O. meetings.

Figure 17. Miss Grace A. Fox of Fort Dodge, Iowa at lectern during Astonomical League - A.L.P.O. Convention at Memphis. Miss Fox spoke on the astronomical training of young people. She has taught astronomy classes for both teen-agers and adults.

Figure 18. William H. Glenn of New York during a break in the paper sessions. Mr. Glenn gave a paper on the aspects of the shadow of the Moon in the sky during total solar eclipses.

Figure 19. Cafeteria lunch line during the Memphis Convention, showing some delegates and a portion of the campus of Southwestern at Memphis.

noted, from his own experiences, that he got consistently better results with his 4-inch refractor than with his 10-inch reflector. Mr. Ricker points out that these results were obtained in northern Michigan, where seeing conditions are seldom good; and he urges the observer faced with poor seeing to buy a small refractor to observe the planets with. Mr. Ricker went on to note that he finds his 10-inch reflector to be of advantage only for deep-sky observing. Mr. William R. Winkler discussed "Simultaneous Multicolor Planetary Photography"; and ALPO Director Walter Haas spoke on "Little Rainbows", calling attention to the effects of differential refraction and advising the use of appropriate color filters for low angular altitude observations of celestial objects. Mr. Haas noted that some Lunar Transient Phenomena may be attributed to this effect. A variety of color slides were shown by Mr. Haas to illustrate the effect on Sirius and on Mars.

The ALPO session was followed by a short junior paper session, in which Mr. Richard Sweetsir presented comments on "Amateur Club Publications: What Not To Do". Afterwards, the Dallas Junior Astronomical Society showed everyone a hilarious movie entitled "An Observer's Nightmare", relating experiences of the amateur who must go into the field to escape city lights. The remainder of Friday afternoon was devoted to a third Astronomical League paper session, which involved papers on photographic techniques for identification of Novae (Orville Brettman), the relevance of astronomy to human experience (Ernest Robson), and construction of an 18-foot solar telescope for radio observations of solar radio noise (Paul Wilson).

Dr. James H. Taylor, Head of the Physics Department at Southwestern, conducted a tour of the Physics Building and the Observatories on Friday evening. A number of facilities are available at Southwestern for sophiisticated work in astrophysics. The Observatories house a 31-inch reflector and a 6-inch refractor, the latter instrument being trained on Jupiter for public viewing.

Saturday morning was the last Astronomical League paper session, and it was highlighted by a talk on the Moon by Mrs. Winifred Cameron of NASA. Her topic was "Specific Volcanic Features Revealed by Lunar Exploration", in which she described the possible origin and evolution of isolated lunar features as revealed by Lunar Orbiter and Apollo photographs. Mrs. Cameron is the newly appointed Lunar Recorder for the ALPO in charge of the Lunar Transient Phenomena Patrol (LTP Patrol). Other papers on Saturday morning were devoted to observational topics, such as "Amateur Solar Observing and Seeing Problems", by Walter Scott Houston; "Photometry in the Red and Ultraviolet Conducted at the Lunar Eclipse of February 9-10, 1971", by Jonathan E. Kern; and "A New Astronomy Program for League Participation", by Mr. Robert Cox. Mr. David W. Dunham spoke on "Applications of Occultation Observations", and following his paper all delegates gathered for the group photograph. After lunch, the afternoon was open for sight-seeing, etc.

At 6:30 P.M. on Saturday evening, cars departed for the Mississippi River waterfront and the Showboat cruise and banquet. Dr. John D. Strong of the University of Massachusetts spoke on "Balloon Infrared Astronomy". Delegates enjoyed informal socializing, a dinner with selections like barbecue, catfish, and spaghetti ... all one could eat, and a sandbar observing session. A number of door prizes were presented during the banquet, followed by the presentation of the Astronomical League Award.

After breakfast and church on Sunday morning, the Convention came to a close. It was decided at the ALPO business meeting that the organization would join the W.A.A. at Riverside, California in August, 1972.

ANNOUNCEMENTS

Reorganization of Jupiter Section. Mr. Phillip Budine has resigned as the Assistant Jupiter Recorder. His services to the A.L.P.O. over the years have been many, and they are deeply appreciated. We are glad to take this opportunity to thank Mr. Budine for his help in the Jupiter Section and in many other ways, and we are glad that he intends to remain an active observer.

The Jupiter Section has been reorganized with two Jupiter Recorders as follows:

1. Paul K. Mackal, 7014 W. Mequon Road, 112 North, Mequon, Wisconsin 53092. He will supervise qualitative studies: full-disc drawings of Jupiter, visual color and intensity estimates of the belts and zones, and general photographic programs.
2. Julius L. Benton, Jr., 735 E. 49th Street, Apt. A, Savannah, Georgia 31405. He will supervise quantitative studies: C.M. transits and related strip

sketches, the determination of latitudes on Jupiter, and general satellite observations.

All observations and routine correspondence about Jupiter should be sent to Mr. Benton, who will pass on the qualitative material to Mr. Mackal. Orders for the Jupiter Handbook should go directly to Mr. Mackal, as before.

New Address for Harry Jamieson. Lunar Recorder Jamieson is now at the following address: 4030 S.E. Gladstone, Apt. 15, Portland, Oregon 97202.

Lunar Section Staff Changes. Mr. Julius Benton has resigned as a Lunar Recorder because of his new duties as a Jupiter Recorder. The Selected Areas Program, which Mr. Benton headed, is now supervised by Mr. Harry Jamieson, with Mr. Christopher Vaucher continuing as Assistant Lunar Recorder on the Selected Areas Program.

New Staff Member in Lunar and Planeatry Training Program. Mr. Richard J. Wessling, 946 Deblin Drive, Milford, Ohio 45150 has joined Mr. Charles Ricker as his Assistant in the Training Program. Mr. Wessling is an expert in photography and will provide training and guidance to those ALPO members who are interested in improving their photographic techniques, or who wish to commence photography of the Moon and planets. He will also assist those trainees who need additional help in drawing techniques, which is another of his specialties. With the fantastic advances in Solar System research these days, it is becoming increasingly important that amateurs develop their observing skills to the fullest extent and adopt more precise and sophisticated methods wherever possible. For these reasons Mr. Wessling is a welcome addition to our staff. Mr. Ricker has asked that prospective members of the Training Program continue to send their inquiries to him, and those desiring such advanced training as cited above will be referred to Mr. Wessling as appears appropriate. There has been a very gratifying response to the Training Program in recent months, and it is hoped that such an encouraging amount of interest among our members will grow even more with the addition of these new branches of the Lunar and Planetary Training Program.

Site of 1972 ALPO Convention. Mr. Clifford Holmes, President of the Riverside Astronomical Society, on August 1, 1971 invited the ALPO to join the Convention of Western Amateur Astronomers at Riverside, California in mid-August, 1972. During the ALPO business meeting at Memphis it was voted to accept this invitation. Early plans by Mr. Holmes and his helpers are for the use of University of California at Riverside student housing, which will reduce costs, and for visits to the Big Bear Solar Observatory and the Table Mountain and Ford Observatories.

Some Memphis Convention Thank-Yous. The A.L.P.O. hereby expresses its deep appreciation to the Astronomical League for the opportunity to participate in this astronomical gathering. We wish to thank the Memphis Astronomical Society and Southwestern at Memphis, our hosts, for their numerous acts of helpfulness and hospitality. Only those societies who have recently held such meetings know the huge amount of work and careful planning that is required. Finally, we want to thank those many individuals who contributed in any way to the success of this enjoyable astronomical meeting.

Policy on Possible Future League - ALPO Conventions. During the Memphis Convention Walter Haas, the Director of the ALPO, requested permission to be present at a Council Meeting of the Astronomical League. The League Council kindly gave this permission. At the meeting the ALPO Director invited the League to formulate a policy for possible future joint meetings with the ALPO, describing ways in which such coöperation might be mutually advantageous and also considering financial arrangements. The Council discussed this matter; and on September 19, 1971 the League Executive Secretary, Mrs. Wilma Cherup, wrote in part as follows:

> "Your attendance at the Council Meeting of the Astronomical League on Friday night, August 20, 1971, was appreciated and your proposal very well received.
>
> "After proper discussion, it was the consensus of the Council that whenever the Association of Lunar and Planetary Observers hold a joint convention with the National Convention of the Astronomical League, an agreement will be made between the League Convention Committee and the authorized representatives of ALPO, establishing a percentage figure for sharing in the profits or deficits of the convention. Such agreement is to be dependent upon approval of the League. This agreement and percentage figure is to be determined before each convention, to enable the Convention Committee to plan for registration and other costs.
>
> "In the event that the National Amateur Association, Inc. invites the Astronomical League to participate in one of their meetings, the Astronomical League will not have jurisdiction over such a decision.

"We trust that the above arrangement will be satisfactory to the ALPO as it is a distinct pleasure to have ALPO participate in the activities of the Astronomical League Conventions."

Increase in Subscription Rates. The ALPO business meeting at Memphis in August, 1971 voted to increase the subscription rates to The Strolling Astronomer to these amounts:

1 year, $6.00 — 2 years, $10.00

It was voted that this increase should go into effect on January 1, 1972. Renewals at the old, lower rates can be accepted prior to that date. This increase is our first subscription increase since 1962 and only the third in the entire 24 years that the ALPO has existed.

While we regret the need to raise subscription prices, we have been affected by a number of contributing reasons: (1) Publication costs have been increasing for some time. (2) Postal costs have also been increasing. (3) A large backlog of papers awaiting publication stresses the need to try to include more pages in this journal, which must in turn increase publication costs. (4) The Editor has been very strongly urged to hire assistance to relieve himself of a number of minor routine, secretarial tasks connected with the ALPO and its journal.

THE GREAT MARTIAN YELLOW CLOUD OF 1971 - PRELIMINARY REPORT

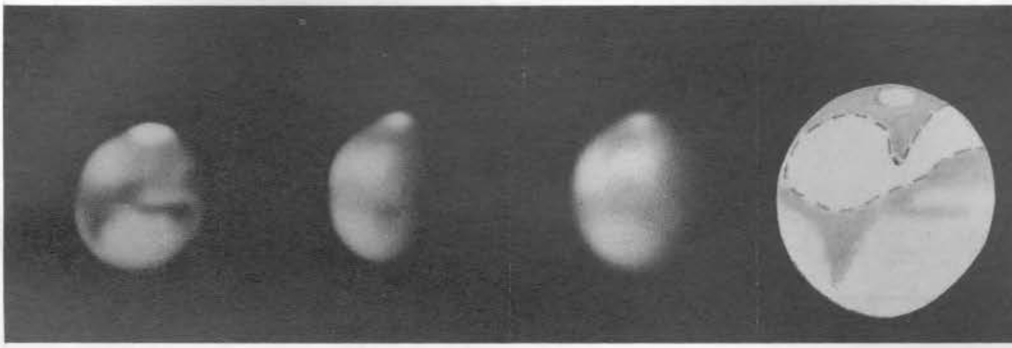
By: C. F. Capen, ALPO Mars Recorder

A yellow storm is raging on Mars! D. Milon, ALPO Comets Recorder, was the first to report that a large, bright, yellow-white cloud with a well defined boundary was observed visually and photographically with a 9-inch Clark refractor on Sept. 25, 26, and 27, UT. The obscuration covered parts of Hadriacum-Euripus, Hellespontus, Iapygia, and Pandorae Fr. and all of the Hellas and Noachis areas. This phenomenon was confirmed by M. Mattei on Sept. 26 and 27, and by C. Capen on Sept. 28. It was identified on previous visual drawings and color photographs made on Sept. 23 and 24. A yellow cloud alert was immediately sent out to ALPO Mars observers in the "Martian Chronicle '71," No. 6 on Sept. 28-29. Three ALPO Mars observers reported the cloud activity to the IAU Central Bureau for Astronomical Telegrams in Circular No. 2358, Sept. 30. The yellow cloud prediction in the last issue of The Strolling Astronomer was also referred to in the same circular.

Observational reports, drawings, and photos have been received from D. Milon, J. Mitchell, C. Haase, M. Fornarucci, R. Yajko, J. R. Smith, J. Wiseman, Jr., J. Prideaux, M. Mattei, R. Rhoads, R. Capen, S. Miyamoto (Japan), and P. Crump (Hawaii). Two photos of the storm have been received from J. Wiseman, Jr. J. Mitchell telephoned a thorough report of his September and October observations. D. Milon kept the Mars Recorder advised of cloud changes and sent in 45 excellent photos and 5 composite photos. His many hours of observing and darkroom work are certainly to be commended. Some observers did not know of the current yellow obscuration, and they were puzzled and disappointed over their recent observations. It is rewarding to see in their drawings that they are recording what they don't observe as well as what they do. Except for the bright, white-yellow concentrations or core of the storm, the extent and boundary is best identified by what is not seen or is lacking on the Martian disk.

According to visual and photographic observations, the storm started on Sept. 21 or Sept. 22, UT during late Martian spring in the southern hemisphere. A bright, white-yellow bar-shaped feature appeared across M. Serpentis, Hellespontus, and Noachis on Sept. 22, TD (12 Dec., MD). The next day the cloud moved mostly in an E-W direction. The cloud front moved east across the Hellespontus and Yaonis Fr. into the Hellas and west into the Noachis. By Sept. 28 it had expanded into the Ausonia to the east, into the Iapygia to the north, and into the Sinai-Thaumasia region to the west. The cloud partially covered the Sabaeus S. and cut off the southern boundary of the Margaritifer S. and flowed around the Aurorae S. through the Eos and Capri Cornu (Protei R.) into the Eye-of-Mars. In the south, parts of the Bosporus, Hellespontus-Amphitrites, and Oceanidum stood out as dark islands in contrast to the encompassing yellow cloud. The South Polar Cap appeared less bright on Sept. 28, and it completely disappeared on Sept. 30. It was once again noted by C. Capen on Oct. 7. Observations of Oct. 2-8 indicated that the storm was also affecting the northern hemisphere features. The early aspects of this storm are shown in the photographs and drawings of Fig. 20.

The 1971 yellow storm appears to be bigger than the dust storm of 1956. Great dust storms of the past have had average lifetimes of 4 to 6 weeks. This current storm is also expected to last as long a time. Since this storm appeared as predicted by C. Capen, it

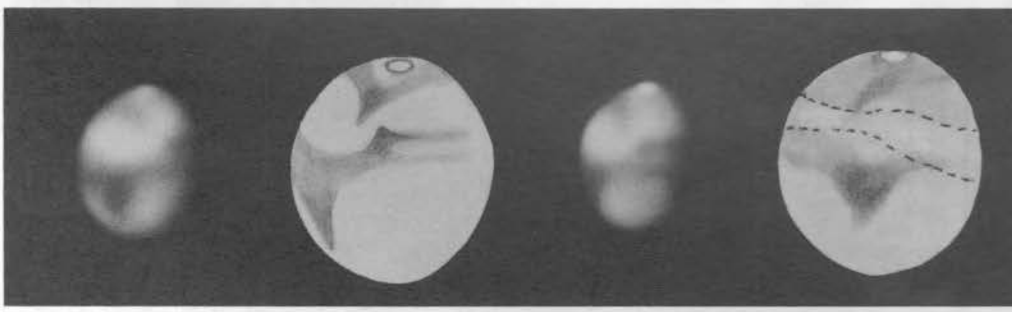


M 71 08 30 I 0722
CM335° 16"Newt 6-
images composite
Normal appearance
D. Milon

M 71 09 25 I 0141
CM015° 9"Refr 4-
images composite
Yellow-cloud on
Hellas-Noachis
D. Milon

M 71 09 26 I 0120
CM001° 9"Refr 3-
images composite
Cloud moving W &
NW. D. Milon

M 71 09 26 Y 2320
CM322° 12"Refl off-
axis 4". Cloud mov-
ing E-W. M. Amphit-
rites very dark
M. Mattei

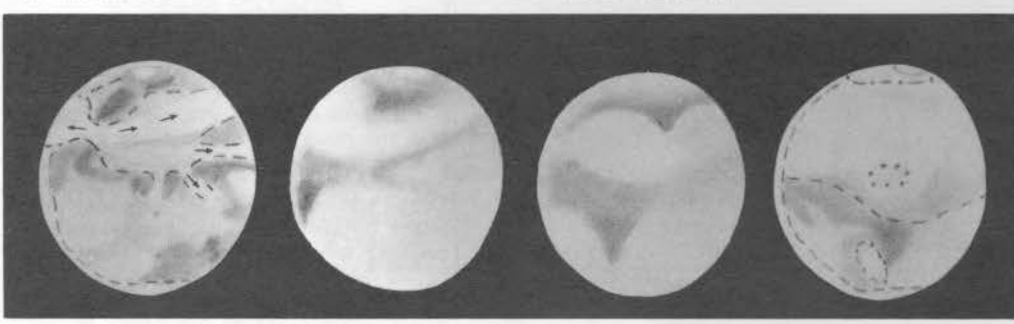


M 71 09 26 I 2332
CM325° 9"Refr 6-
images composite
Storm over Auso-
nia, Hellas, and
Noachis. D. Milon

M 71 09 27 I 0030
CM340° 8"Newt218X
Yellow-cloud. M.
Serpentis very
dark. J.R.Smith

M 71 09 27 I 0108
CM348° 9"Refr 6-
images composite
SPC still bright
Pandorae & Serpen
tis dark. D.Milon

M 71 09 28 R 2340
CM308° 4"Refr248X
Bright yellow-cloud
streak in red-light
R. Yajko



M 71 09 28 Y 0320
CM011° 24"Refr
830X. SPC weak.
Arrows show cloud
frontal motion
C. Capen

M 71 09 29 O 0215
CM346° 6"Newt185X
SPC weak. Sabaeus
& Meridiani obscu-
red. R. Rhoads

M 71 10 02 I 0150
CM312° 6"Refl300X
SPC obscured by
yellow haze.
C. Haase

M 71 10 07 Y&G 0330
CM290° 12"-24"Refrs
SPC vaguely seen
Golden haze spreads
into no. hemisphere
Syrtis Maj. vague.
C. Capen

Figure 20. Drawings and photographs of Mars showing the development and spread of the Great Yellow Cloud of 1971. A.L.P.O. Mars Section observers. Drawings and photographs shown selected and arranged by C. F. Capen, A.L.P.O. Mars Recorder.

is possible that similar storms occur each Martian year during late spring in the southern hemisphere. Refer to "Martian Yellow Clouds - Past and Future," Sky and Telescope, Vol. 41, 2, Feb., 1971; and "Observing Mars III - The ALPO 1971 Observing Program," J.A.L.P.O., Vol. 23, Nos. 3-4, August, 1971. Each apparition of Mars partly overlaps the same season that is observable during the next apparition. Consequently, it is highly probable that a yellow cloud will again appear sometime between July 19 and August 18 in 1973.

OBSERVATIONS AND COMMENTS

South Equatorial Belt Disturbances on Jupiter. A preliminary account of these features in the summer of 1971 has appeared in Sky and Telescope, Vol. 42, No. 3, pp. 176-180, Sept., 1971. The very disturbed condition of the S.E.B. is shown in Dennis Milon's photograph published here as Figure 21. Readers will appreciate that some detail on the original photograph may have been lost in reproduction. Note the prominent dark oval of the Red Spot in the upper central part of the planet.

Figure 21. Photograph of Jupiter by Dennis Milon on August 1, 1971 at 1^h27^m, U.T. 9-inch Clark refractor at Harvard Observatory, Cambridge, Mass. f/195 by eyepiece projection. 2 second exposures on Tri-X developed in DK60a for 6 minutes at 72° F. This photo is a composite of 6 negatives. C.M.$_1$ = 35°. C.M.$_2$ = 14°.

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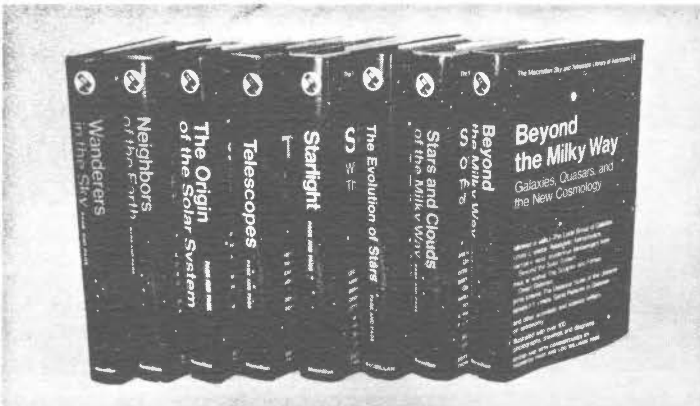

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