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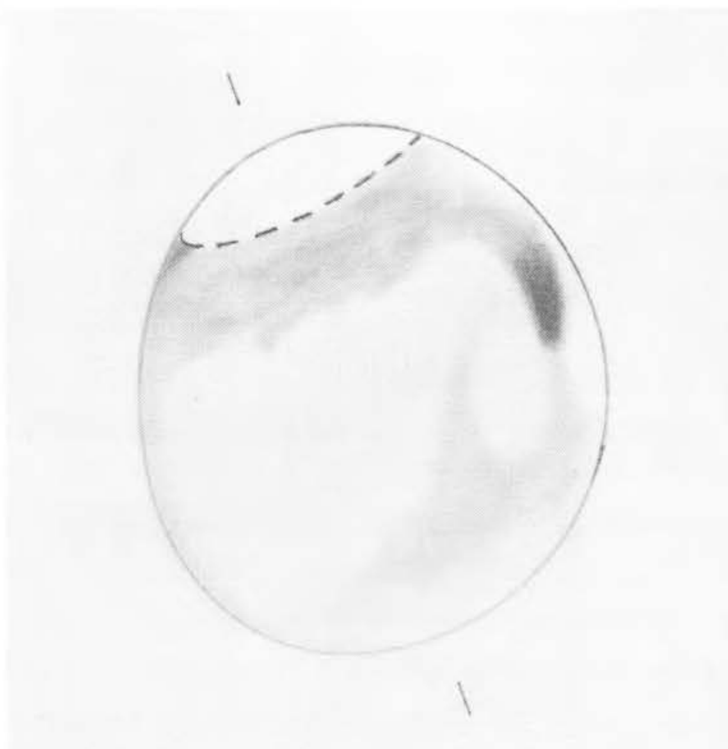

Drawing of Mars by Robert B. Rhoads with a 6-inch reflector at 300X on March 9, 1971 at 13 hrs., 10 mins. Universal Time. C.M. = 247°. Angular diameter 6″.8. Martian Date August 17. Note Syrtis Major inside the limb, the south polar cap, Mare Tyrrhenum, Mare Cimmerium, and the Nubis Lacus region. Current observations of Mars are discussed by Mr. C. F. Capen on pages 9-10 and 34-37.

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IN THIS ISSUE

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THE 1965-66 APPARITION OF JUPITER

By: Paul K. Mackal, A.L.P.O. Jupiter Recorder

1. Preface

This report is appearing late for the same reasons which delayed the 1964-65 apparition report. Very little material was available for this period so that the sample studied is not very rich or detailed. Most of the full disc drawings submitted, however, were valuable; and more than 50% of the observations are referred to below.

2. List of Visual Contributions

(1) Jean Dragesco (Prof.); Paris, France; 10-inch and 7-inch reflectors; 29 full discs.
(2) Walter Haas (Prof.); Las Cruces, N. M.; 12.5-inch reflector; 3 strip sketches, 210 CM transits, and an intensity report.
(3) Charles J. Pollak; Binghamton, N. Y.; 8-inch reflector; 2 full discs.
(4) Tom Pope; Las Cruces, N. M.; 4-inch reflector; 1 full disc.
(5) Douglas Smith; Vinton, Va.; 6-inch reflector; 26 full discs.

3. List of Photographic Contributions

(1) Jean Dragesco; Paris, France; 10-inch reflector; 3 prints.
(2) Viscardi; Monte Carlo, Monaco; ?; 2 prints.

All in all, there was a grand total of 66 observations of Jupiter, exclusive of CM transit observations, during 1965-66 which were available to the A.L.P.O. Jupiter Recorder.

4. Distribution of Contributed Observations

1965, August	September	October	November	1965, December	1966, January	February
8	4	6	2	6	4	10

March	April	May, 1966
18	5	2

March was covered well with 18 contributions. The average number of days between successive disc drawings was five. This continuity provided adequate data for analysis. Observation began on August 11, 1965 and ended on May 16, 1966. Opposition was on December 18, 1965 and conjunction on July 5, 1966.

Figures 1-22 should be studied in connection with the discussion which follows.

5. Major Structural Aspects of Jupiter

North Polar Region, North North North North Temperate Belt, and North North North Temperate Belt

The NPR was rather featureless throughout 1965-66 except for an occasional sign of the faded NNNTB. Somewhat visible in 1963-64 and very prominent in 1964-65, the NNNTB soon faded out and was no longer a border to the enlarged NPR. A section of it was imbedded in the NPR on a Dragesco disc with its following end at about 133° II on August 23. Nothing was seen of it by Dragesco from September through late October. By December a weak NNNNTB was noted in the longitudes of the RS region and appeared to cut the NPR in half (December 11, 69° II). By January 9 the NNNNTB was still visible and was darker, but the NNNTB was also noted with a very faint NNNTeZ to its north across the entire disc. See Fig. 10. This belt was confirmed on two photos by Viscardi in mid-February. See Fig. 12. By late February and mid-March the NPR was faint and was reduced in size, while the NNNNTB was gone. A strong NNNTeZ formed and graded into the fuzzy edge of a much reduced NPR. The NNNTB was strong and was isolated by flanking zones at 252° II on March 14 and at 303° on March 17. In several days the NNNNTB as a series of two fragments only appeared at 127° II, however with a faint NNNTeZBd visible midway between the NNNNTB latitude and the faint NNNTB, according to J. Dragesco. Columns of dark material obscured the NNNTeZ at 221° II on March 28, though. The NNNNTB then faded out, and the NNNTB appeared the more prominent in the preceding RS and RS longitudes. This aspect was also noted at 107° II and 299° II. The NPR was also very weak in tone at this time. By April 16 (143° II) the NNNTB was very dark, and two white ovals were noticed on its south side by Prof. Dragesco. Very weak NNNTB and NNNNTB were seen by C. J. Pollak on April 10 at 37° II and on April 18 at 109° II.

North North Temperate Belt and North North Temperate Zone

In August the NNTB was rather strong in the regions--112°, 43°, and 343° II--according to J. Dragesco. Dark segments were imbedded in the NNTB, according to Dragesco, in following RS and near the RS longitudes in late August and early September. A considerable darkening and widening of the NNTB was noted in mid-September by Dragesco at 145°, 301°, and 84° II. A dark following section of the NNTB was noted by Prof. Haas at 131° II on October 15, 1965. This section was seen again at 142° II on November 6 by Haas with a dark preceding section at 105° II. By October 20 Dragesco noted a darkening of the NNTB with a distinct preceding end located at 110° II, and also at 300° II on November 24. The NNTeZ was faint but visible throughout the period discussed. Its preceding end was located on October 25. The NNTB showed signs of reversal or disintegration by December and mid-January. It had an uneven south border, and a white spot was conspicuous on January 9. See Fig. 10. At 200° II on February 3 the NNTB was faint and wide, according to Dragesco. This was confirmed on a photo by Viscardi in mid-February at 302° II. A very dark "barge" in the NNTB latitude was noted with a preceding end at 302° II. On February 12 a dark short rod was noted in the NNTB at 287° II, and a 12°-long rod from 234° to 246° II was seen on March 8, 1966 by Haas. Another "barge" thickening was noted with a following end at 123° II on March 11 by Dragesco. See Figs. 12 and 14. In the RS longitudes, by March 29 the NNTB was nearly gone and was so faint that it produced a dusky NNTeZ-NTeZ appearance. Only the "barge" at 299° II remained in the region, which was dusky from the latitude of the NNNTB to the position of the NTB all around the planet. By April 16 a faint thin zone appeared in place of this dusky region at 143° II. See Fig. 21. On April 18 Pollak noted two "barges" in the NNTB at 109° II and a barge in the NNNTB directly below the second one on the NNTB. See Fig. 22.

North Temperate Zone, North Temperate Belt, and North Tropical Zone

In August the NTB was strong at 112° and 13° II, according to J. Dragesco. Connectors from the NTB to the NEB were common in this period, and the first of these was located at about 300° II on August 15, 1965. See Fig. 2. On August 30 a second connector was noted at about 45° II and was still visible on September 13, according to Dragesco. See Fig. 3. Following the RS longitudes more connectors were obvious in late September and on October 20. Both the NTeZ and the NTrZ were clear in these early months of the apparition. Note the activity on the south side of the NTB in Figs. 9 and 11. Haas picked up a dark preceding section of the NTB at 128° II on October 20. By February 3, 1966 the NTeZ was dusky, and a faint NTB_n was noticed by Dragesco at 192° II. The dark preceding section of the NTB was picked up at 66° II by Haas on February 6. By March 17 the NTeZ was back to normal. A connector festoon between NTB_s and NEB_n was also noted at 303° II. On March 28 the NTB_s was thinner and began to break up in mid-March at 127° II + 30°. See Figs. 17 and 18. It was still strong in the RS region, however, on March 29. The NTB_s regained its strength at the 100° II and 221° II regions on March 30 and 31, according to Dragesco.

North Equatorial Belt and Equatorial Zone North

In 1964-65 the NEB had returned to a single aspect (<u>J.A.L.P.O.</u>, Vol. 22, pg. 2). In 1965-66 this process was reversed. The single aspect lasted from August 11, 1965 to January 9, 1966, when an NEB Z and a fragmented NEB_n formed at 69° II, according to J. Dragesco. Throughout the period large white ovals were noticed in the EZ_n and NTrZ. Festoons off the single NEB into the EZ were just as likely to be inclined backwards as forwards and produced numerous large symmetrical ovals in the EZ_n. Unlike those of 1964-65 and 1963-64, these ovals were not "kidney shaped" but were essentially elliptical in appearance and were again seen in 1966-67, 1967-68, and 1968-69. The belt is usually weak in its single aspect, strong and active in its double aspect. In 1967-68 it stabilized and became most active in the short space of five months. This revival might be called a disturbance except that much of the presumed activity is due to sub-atmospheric interaction and not necessarily sub-surface eruption. I thus choose to call it a complex with the proviso that indeed some sub-surface eruptions probably took place. This kind of subatmospheric interaction is all the more prevalent in the NEB because of the collision with the material already visible to the observer. On October 20 the NEB was exceptionally strong, according to Dragesco, at 101° and 110° II. See Fig. 6. This was characteristic for it at this time in all longitudes until it faded in December and split up by January

SAMPLE ALPO DRAWINGS OF JUPITER DURING ITS 1965-66 APPARITION

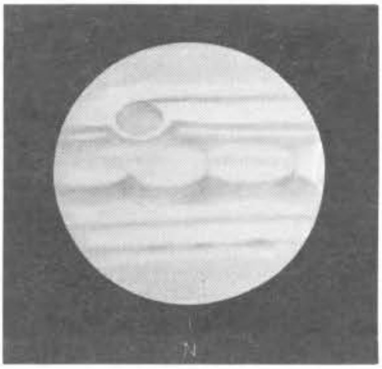

Figure 1. Jean Dragesco; Aug. 13, 1965 - 3:35 UT; CM I - 359°, CM II - 43°; Seeing 4-6, Transparency 5; 7-inch reflector, 200x.

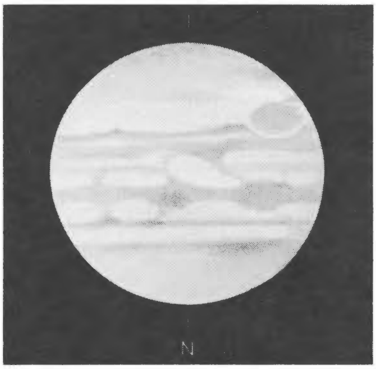

Figure 2. Jean Dragesco; Aug. 15, 1965 - 3:40 UT; CM I - 317°, CM II - 346°; Seeing 4-6, Transparency 2-3; 7-inch reflector, 200x.

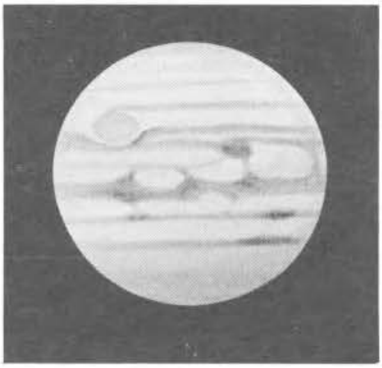

Figure 3. Jean Dragesco; Aug. 30, 1965 - 3:05 UT; CM I - 143°, CM II - 58°; Seeing 4-6, Transparency 0-4; 7-inch reflector, 200x.

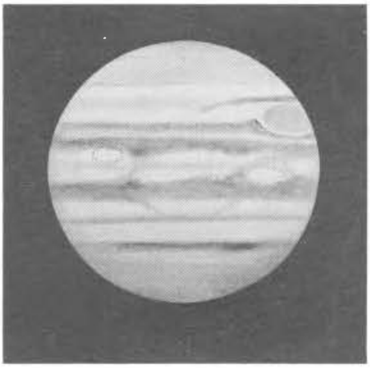

Figure 4. Jean Dragesco; Sept. 15, 1965 - 4:05 UT; CM I - 186°, CM II - 338°; Seeing 4, Transparency 4; 7-inch reflector, 200x.

of 1966. Gaps were noted in the RS region longitudes, and a series of "barges" formed a fragmented NEB_n at 224° II on February 1. See Fig. 11. But this aspect was the lull before the storm. A big "barge" was noted as an NEB_n fragment with a following end near 300° II on February 4 on a photo by Viscardi. See Fig. 12. Preceding the RS the NEB was still single in mid-February and preceding oval BC in mid-March, according to Dragesco; but it was clearly double in the oval DE region by mid-March. See Figs. 14 through 19. A "barge" was noted on March 28 at 221° II. A white oval obscured the preceding end of a barge. The double aspect was obvious preceding the RS by March 29. The BC and FA longitudes were double on March 30 and 31, according to Dragesco; and a barge was located at 107° II. Pollak confirmed the double aspect of the NEB on April 10 and 18. The placid nature of the single aspect is obviously the older material which rises up to the surface during the final phase of the double aspect. There are usually few if any divergencies in intensity in the single aspect, whereas the double aspect shows much activity and in-

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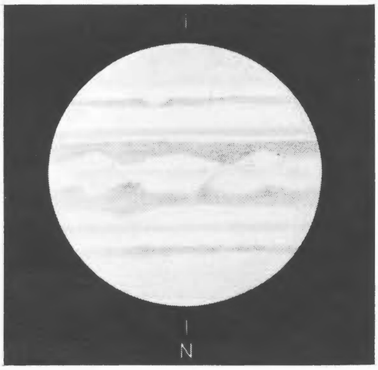

Figure 5. Jean Dragesco; Sept. 16, 1965 - 3:50 UT; CM I - 334°, CM II - 119°; Seeing 4, Transparency 5; 7-inch reflector, 200x. [Notice DE p. CM.]

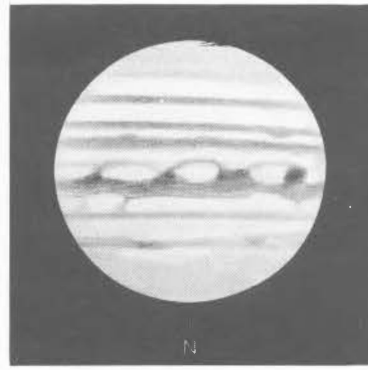

Figure 6. Jean Dragesco; Oct. 20, 1965 - 2:10 UT; CM I - 242°, CM II - 128°; Seeing 8, Transparency 2.5; 10-inch reflector, 200x & 265x.

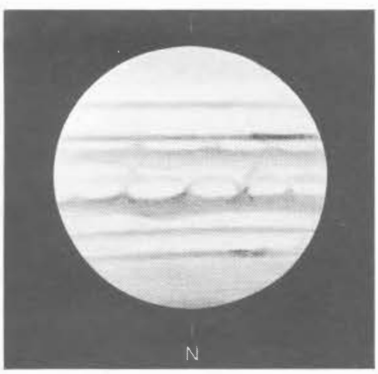

Figure 7. Jean Dragesco; Oct. 23, 1965 - 5:20 UT; CM I - 112°, CM II - 334°; Seeing 4, Transparency 4; 10-inch reflector, 200x & 265x.

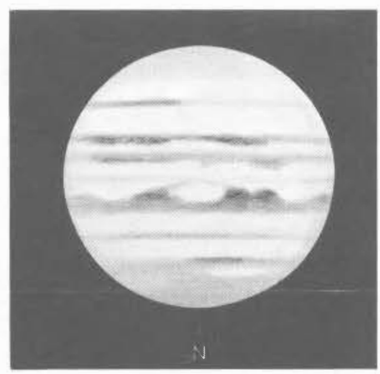

Figure 8. Jean Dragesco; Oct. 24, 1965 - 3:40 UT; CM I-209°, CM II - 64°; Seeing 4, Transparency 4; 10-inch reflector, 200x & 265x.

tensity gradation. Some turbulence in the belt is noticeable sometimes during the single aspect, however. Clearly the revival of the belt or its renewal, which is based on the amount of older material accumulated, can only occur during the double aspect. Wynn Wacker has informed me that prior to the onset of the revival or renewal of the belt the color changes noticeably from a cooler to a warmer tone. Mr. Wacker has also discovered a series of apparitions in which the NEB and the rest of the planet appear rather active indicating a protracted revival which he calls "zenological", which appears to have taken place, e.g., in 1918-19 and in 1926.

Equatorial Band and Equatorial Zone South

The EB was fragmented in 1965-66 but was visible none-the-less in places formed by the tops of the NEB white ovals in the EZ. When a sequence of such ovals covers the whole disc, they are often confused with a true EB. A true EB must be wholly or nearly entirely

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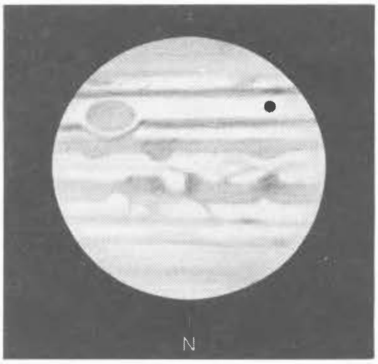

Figure 9. Jean Dragesco; Dec. 11, 1965 - 3:15 U.T.; CM I - 219°, CM II - 68°; Seeing 2-6, Transparency 5; 10-inch reflector, 200x. Shadow of J. I in STrZ.

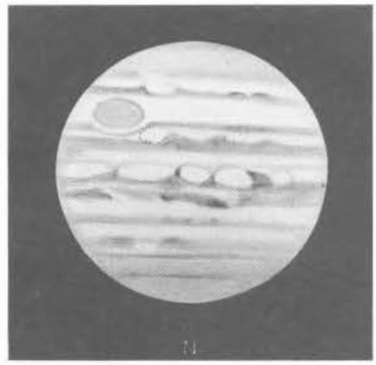

Figure 10. Jean Dragesco; Jan. 9, 1966 - 21:40 UT; CM I - 75°, CM II - 57°; Seeing 4-8, Transparency 3; 10-inch reflector, 200x. [Notice FA nearing conjunction with the RS.]

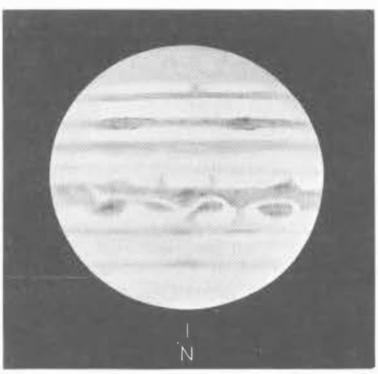

Figure 11. Jean Dragesco; Feb. 1, 1966 - 20:12 UT; CM I - 53°, CM II - 220°; Seeing 4-6, Transparency 2; 10-inch reflector, 200x.

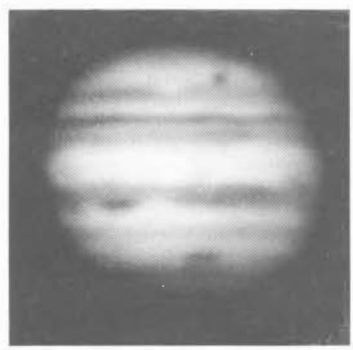

Figure 12. Photograph of Jupiter by Viscardi; Feb. 4, 1966 - 20:00 U.T.; CM - I 160°, CM - II 304°; Seeing and Transparency not reported; 12-inch refractor. Note Jupiter III in transit as prominent dark spot in STeZ.

separated from the NEB in order to be classified as the true EB. Otherwise, it deserves to be referred to as the psuedo EB. In fact, this pseudo EB is more frequent in occurrence than the true EB. In 1967-68 and 1968-69 we were lucky to see the true EB in consecutive apparitions, a rare event indeed. On August 28, 1965 Walter Haas noted a dark enclosed portion of the EZ_s flanked by festoons on either side following a dark section of the EB at 151° to 167° I. The first festoon was an extension of an NEB_s festoon located at 136° I. White ovals occurred in the EZ_s above the festoon roofs over the NEB white ovals on September 16 at 297° I, according to Prof. Dragesco. See Fig. 5. Prof. Haas noted a dark following section of the EB on October 10 at 56° I. Similarly, a dark following section of the EB was noticed on November 6 at 330° I by Haas. The true EB did form in this period, however, for example on October 23 and 24, 1965 at 112° and 85° I, respectively. See Figs. 7 and 8. You can see there that the connectors of a forward and a backward festoon system (the forward one preceding the backward one in System I longitude) form a roof or hood over the white ovals in the EZ_n. True EB connectors between these pseudo EB segments occur between the backward festoon of a system and a forward festoon of another system (the backward one preceding the forward one in System I longitude). The true EB tends to be flatter than the roofs or hoods of the NEB ovals; but if the true EB is superimposed on the pseudo EB, then the roofs flatten out somewhat as well. See the sample disc drawings here published.

South Equatorial Belt North; the South Equatorial Belt Zone;
South Equatorial Belt South; and the South Tropical Zone

The SEB_s and SEB_n were single and weak, but constant all around Jupiter throughout 1965-66 and were connected to each other preceding the RSH and following the RSH in the early part of the apparition. See Fig. 1. Elmer Reese reported a minor SEB Disturbance at 60° II on August 4, 1965, which was missed by the A.L.P.O. Jupiter Section. Perhaps some transits were gotten, but it appears unlikely because of the time very early in the apparition. No hint of this disturbance may be seen on any of the early disc drawings submitted by the observing team. It must have been a very minor and faint eruption indeed. At times in August the SEB_n was wide and was connected to the NEB or to the hoods of NEB ovals. This appearance was first noted in 1962 by the Recorder. It rarely takes place but has been seen also by Pollak in the late 60's. Such connectors are rather unstable and often may shift and be dissipated within a short space of time, anywhere from a week to a month; for they are subject to contrary motions. In September the SEB_n was very dark and active preceding the RS and preceding oval BC. This was confirmed by Haas on November 6 at 332° I. Haas also noted a dark preceding section of the SEB_s following the RS on August 28. This section was reobserved at 294° II on October 24 by Haas. On September 15 the SEB_s was noted to be separated from the SEB_n preceding the RSH and following the RSH by Dragesco. See Fig. 4. The SEB Z was also dusky. This was also true in the oval DE longitudes on September 16. See Fig. 5. On October 10 Haas got a look at a faint dark column across the STrZ at 38° II. The base of a dark column on the SEB_s (south edge) was noted by Haas on November 20 at 129° II. The SEB_n, still wide but fainter on its north edge, toned down from late October to early January. On January 8 Haas noticed a dark following section of the SEB_s at 10° II. It was seen again at 13° II on January 11. It darkened and had moved to 24° II by February 6, 1966, according to Haas. By February the SEB was rather featureless, and the SEB Z was very bright and consistent. See Fig. 11. On February 12 a base of a small dark projection was noted on the south edge of the SEB_s by Haas at 250° II, followed by a 5° long white oval. This feature or another one was noted at 23° II on February 20. A series of "barges" was noted by Prof. Dragesco in the SEB_n (in Fig. 14) on March 11; and a strange thin line midway between the SEB_s and the SEB_n appeared, which might be called the SEB ZBd, in the BC region. The SEB_s was not too dark throughout March but flared up once more at 221° II on March 28, according to Dragesco. See Figs. 18 and 19.

According to Phil Budine, who wrote an interim report of the 1965-66 apparition presented at an A.L.P.O. Convention, during April the STrZ:

> ". . . . was usually a fairly active region with bright spots, ovals, and dusky columns being observed. . . A prominent dusky section was observed by Pollak on April 18, 1966 [Fig. 22] with the p.e. of the section at 109° II. . . . The STrZ was recorded very dusky around the RS (earlier) by Budine on Nov. 28 and Dec. 20, 1965. And by Pollak on April 10, 1966 (later)."

The STrZ was usually recorded as "bright white", according to the Binghamton observing team.

Red Spot

The RS appeared to be orange, according to J. Olivarez, and brilliant. This aspect was reported by Mr. Fox of the British Astronomical Association. It was rather consistent throughout after August, 1965; but in that early period the southern border was distinctly more obvious to Dragesco. Haas noted a ringed aspect in late August.

South Temperate Belt and South Temperate Zone

The STB section obscured in 1964-65 from oval BC to oval DE by a "milky white haze" (<u>J.A.L.P.O.</u>, Vol. 22, pg. 7) also persisted in 1965-66! This long-lived haze either weakened or the STB darkened underneath it; however, since the STB was less conspicuous during this apparition compared to 1964-65, the odds are in favor of the former hypothesis. Haas did note dark sections of the STB, however. (Cf. <u>J.B.A.A.</u>, Vol. 77, pg. 350.) The obscur-

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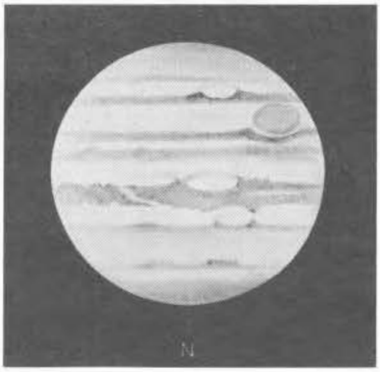


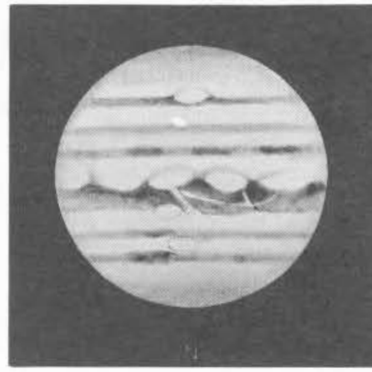
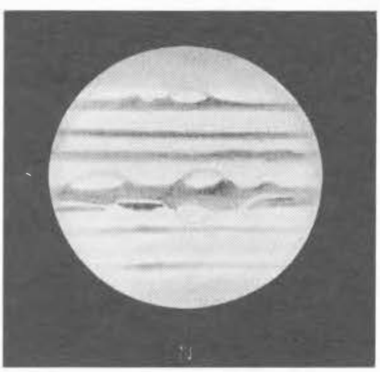


Figure 13. Jean Dragesco; early or mid-Feb., 1966 - 18:45 UT; CM I - 321°, CM II - 352°; Seeing 6, Transparency 3-4; 10-inch reflector, 200x & 265 x. [Notice FA past the RS and p. CM.]

Figure 14. Jean Dragesco; March 11, 1966 - 19h UT; CM I - 246°, CM II - 123°; Seeing 4-6, Transparency 5; 10-inch reflector, 200x. [Notice BC over CM.]



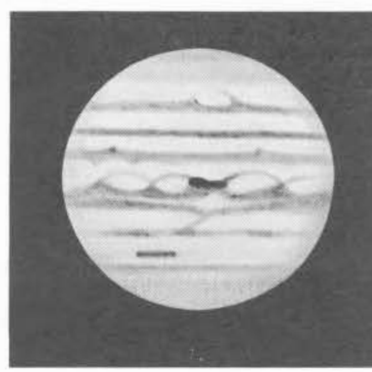


Figure 15. Jean Dragesco; March 14, 1966 - 20:05 UT; CM I - 39°, CM II - 252°; Seeing 6-8, Transparency 2.5; 7-inch reflector, 200x. [Notice DE over CM.]

Figure 16. Jean Dragesco; March 17, 1966 - 19h UT; CM I - 112°, CM II - 303°; Seeing 6, Transparency 5; 7-inch reflector, 200x. [Notice DE over CM, Cf. with fig. 15. Hint of rapid changes in NEB-NTB region.]

ation was obvious in August due to the proximity in time with 1964-65 and the long distance vector between Jupiter and earth. Oval BC was past conjunction with the RS in mid-August; but by September 15, 1965 the STB began to appear normal preceding the RS, according to Dragesco. Cf. Figs. 1 and 4. By September 16 the STB preceding oval DE was wholly normal. See Fig. 5. Yet following oval BC the STB was still weak, according to Dragesco, on October 24 at about 300° II. See Fig. 8. On the Viscardi photo, Fig. 12, the STB was normal following BC on March 11. A white preceding oval bay on the south edge of the STB was observed on February 6, 1966 by Prof. Haas. Hoods were well formed over the three STB long-enduring white ovals in 1965-66, but they were also more obvious because the ovals were so dull. Hoods were suspected as early as 1962 by the Recorder. Also spots

SAMPLE ALPO DRAWINGS OF JUPITER DURING ITS 1965-66 APPARITION

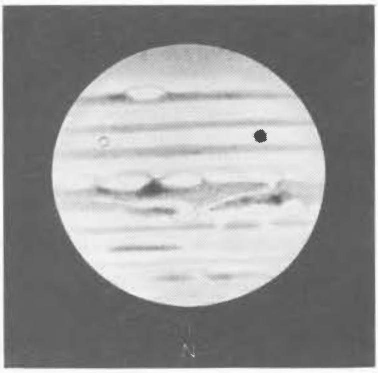


Figure 17. Jean Dragesco; mid-March, 1966 - 19:05 UT; CM I - 341°, CM II - 127°; Seeing 8, Transparency 5; 7-inch reflector, 200x. Note satellite and shadow on disc. [Notice BC past the CM on the p. side.]

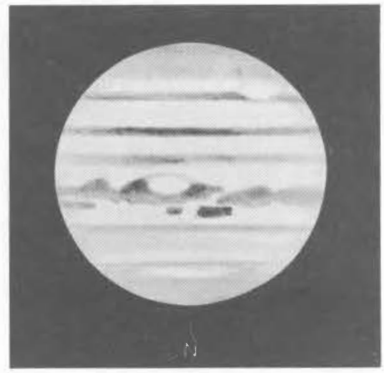


Figure 18. Jean Dragesco; March 28, 1966 - 20:50 UT; CM I - 114°, CM II - 221°; Seeing 8, Transparency 0-5; 7-inch reflector, 200x. [Notice DE f. CM.]

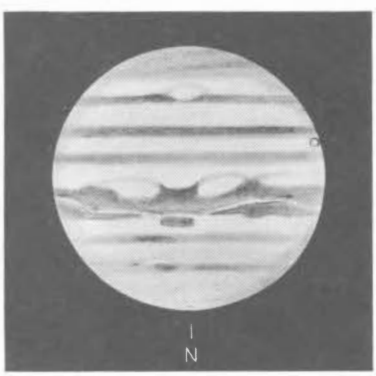


Figure 19. Jean Dragesco; March 30, 1966 - 19:25 UT; CM I - 18°, CM II - 110°; Seeing 6, Transparency 5; 7-inch reflector, 200x. Satellite Jupiter I just inside limb. (Notice BC over CM.)

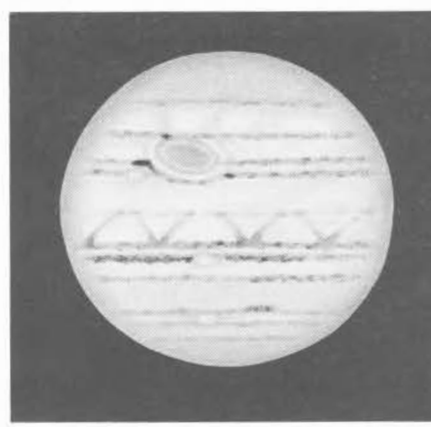


Figure 20. Charles Pollak; April 10, 1966 - 1:40 UT; CM I - 24°, CM II - 37°; Seeing 7, Transparency 3; 8-inch reflector, 150x.

were noticeable over an oval as studied by the Recorder at the New Mexico State University Observatory on prints in various wavelengths of the visible spectrum (J.A.L.P.O.. Vol. 22, pg. 8). No such spots were noticed by Prof. Dragesco, however.

South South Temperate Belt and South Polar Region

The SSTB was gone from August to November in the RS longitudes. However, it was apparent at 145° II on September 14, according to Dragesco, though very faint. A dark condensation on the $SSTB_n$ was observed on November 6 by Haas at 80° II. In December and January the SSTB was evident in the RS longitudes and probably drifted in System II position.

SAMPLE ALPO DRAWINGS OF JUPITER DURING ITS 1965-66 APPARITION

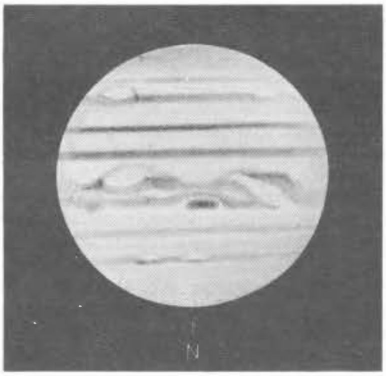


Figure 21. Jean Dragesco; April 16, 1966 - 19:23 UT; CM I - 177°, CM II - 140°. Seeing 1-8, Transparency 3; 7-inch reflector, 200x. [Notice BC near p. limb and notice DE near f. limb.]

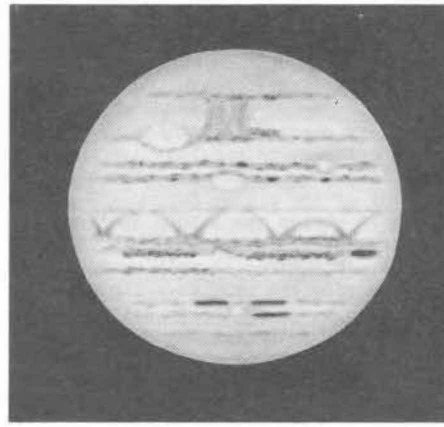


Figure 22. Charles Pollak; April 18, 1966 - 0:20 UT; CM I - 156°, CM II - 109°; Seeing 8, Transparency 3; 8-inch reflector, 200x. [Notice BC p. CM.]

See Figs. 9 and 10. Activity in the STeZ was noticed at 69° II in mid-December by Dragesco, and there was a faint hint of the SSSTB. A small white oval or gap in the SSTB was noted on February 3 by Dragesco at about 200° II. A dark preceding section of the SSTB was noticed at 29° II by Haas on February 6. The STeZ was wider in regions preceding RS through following RS. On March 17 an SSSTB was again noted at 303° II by Dragesco. The SSTB showed signs of weakening considerably throughout the rest of the apparition with a doubling on March 30. Columns between the STB and the SSTB were noted by Pollak on April 10 and 18 at 37° and 109° II respectively.

Note by Jupiter Recorder. I would like to extend my special "thank you" to Messrs. Bradford Smith and Elmer Reese of N.M.S.U. for showing me prints of Jupiter in blue, red, and green light for the period under discussion. I also want to thank Prof. Dragesco and Prof. Haas for their extensive and detailed observations of Jupiter in 1965-66.

NOTES TO MEMBERS OF ALPO MARS SECTION

By: C. F. Capen, A.L.P.O. Mars Recorder

There are 57 individual observers of Mars and 6 astronomical societies with Mars observing sections or groups regestered on this date of Feb. 15, 1971 as members of the ALPO Mars Section. The Mars Section consists of professional contributors, experienced amateurs, and neophytes. Presently, the ranks are increasing by one or two members per week. The Mars Recorders are expecting to receive approximately 1000 individual observations, 500 disk drawings, and 100 to 200 photographs in different colors during this last most favorable of Martian apparitions of this century.

As a result of this most welcomed interest in the planet Mars, it is important that the observing records, data, and drawings for each night (date) be recorded on one observing form, with additional plain sheets used as needed. The front and back of each observing form or additional sheets should be used when needed. Please do not report different observational dates on the same sheet. This format for reporting observational data is requested by the Mars Recorders in order to assist in the chronological assembly, assimilation of, and eventual analyses of large quantities of observational data. It is for this purpose that a simple and efficient Mars Visual Observing Form has been prepared in the past by various Section Recorders. The observing forms can be obtained from the Mars Recorder at cost or may be copied by the individual observer as needed. The present cost is $0.40 per 20 forms. The same form can be used for reporting photographic observations, micrometry, transit timings, intensity estimates, etc. Mars observing kits are still available at a cost of $2.00; overseas mailings are correspondingly higher ($2.30).

AIMS OF THE A.L.P.O. SATURN SECTION

By: Julius L. Benton, Jr., A.L.P.O. Saturn Recorder

Since my recent appointment as Recorder for the Saturn Section, I have been presented sufficient evidence to substantiate the need for a thorough reorganization of the Section. It will be the purpose of the Section to encourage and coördinate detailed and systematic observations of the planet Saturn and its satellites, and it is hoped that these efforts will serve to evolve the Saturn Section into a position as one of the most active and vital divisions of the A.L.P.O. Much of the success of the Section depends necessarily upon observer participation, as well as upon the amount of enthusiasm and intellectual guidance that the Recorder can provide. The Section will have to remain constantly aware of changes that must take place in the techniques and methods of the observers and the way in which observations are interpreted and reported by the Recorder. Also, it will be good for us to establish a favorable and active relationship with the similar Section of the B.A.A. in an effort to maintain international coöperation among individuals interested in the planet Saturn.

In order that basic observing methods of the Saturn Section can be brought to the attention of every potential observer, the Recorder has prepared a very elementary Handbook describing observing techniques to the newer members of A.L.P.O. At a future date, the Section shall prepare a more advanced book for the amateur who is seeking to do more sophisticated research on the planet. Frequent announcements for this Journal are planned to keep observers informed of latest developments and of new programs that can be undertaken. All of these efforts should serve to keep the participants actively involved in the workings of the Saturn Section, and it is hoped that through such communication amateur astronomers will be able to further their knowledge about Saturn and its related phenomena. The Recorder will always be glad to maintain an active correspondence with observers who show the necessary interest and desire to do serious work.

Several programs that have more or less been carried out in the past, which have been somewhat revised by the Recorder, are listed below. These will form the main body of the work of the Section, but there are always possibilities for new programs by interested individuals. The Section shall strive to maintain an active attempt to meet the challenges offered by the following observational endeavors:

(a) Regular drawings of surface features of the disc of Saturn and the rings throughout the apparition.
(b) Routine visual numerical intensity estimates of all belts and zones on the disc, as well as the major rings, with and without color filters of known transmission.
(c) Visual estimates of colors on the planet, with adherence to a suitable standard (to add the highest possible degree of objectivity to the observations).
(d) Continual patrol of the globe of Saturn for disturbances and spots, which might yield rotation periods for a particular latitude if transits are possible.
(e) Photometric or visual measurements of brightness fluctuations of the satellites.
(f) Attempts to determine, by visual estimates and other methods, the latitudes of belts and zones on the disc.

The above programs are the principal research work of the Section, as mentioned before; but they need not represent all of the possible opportunities for observational work on the planet. The seriously interested observer should contact the Recorder regarding his individual interests, and the Recorder shall be glad to supply additional information specifically related to a particular observing problem.

At this point, it would perhaps be a good idea if I made certain suggestions to potential observers. First of all, the new observer should obtain a copy of the Handbook of the Section, available to new observers only at a price of $1.50; and he should also contact Mr. Charles L. Ricker and enroll in the A.L.P.O. Lunar and Planetary Training Program. These endeavors will introduce the new observer to the basic techniques of making scientifically useful contributions to any observing division of the A.L.P.O. Further suggestions that I would like to make are that observers only attempt those programs that are suited to their instrumentation. A 3" refractor is a bit small for regular Saturn observing, but there are areas in which observations made with such an instrument are helpful. For the observer desiring to specialize in Saturn work, nothing smaller than a 4" refractor or a 6" reflector should be used. A good set of orthoscopic oculars and Wratten Filters will greatly improve one's observing capabilities, as well as a good general knowledge of the planet and its related phenomena. Observations should be recorded on suitable observing forms; and these observations should be kept in duplicate, with the exception of drawings. All observational work should be sent to the Recorder about once every two months, including all necessary details and data. Observers are urged to obtain a copy of The American Ephemeris and Nautical Almanac for the present year, which should greatly improve planning and execution of a suitable program.

I shall be glad to send the necessary observing forms and other details to anyone seriously interested in undertaking a regular program of observing the planet Saturn. It will be most helpful if interested individuals would send details regarding their instrumentation so that I can advise them most appropriately. An active correspondence with participating observers will be sought in an effort to keep the Section as unified as possible.

All correspondence should be directed to:

Julius L. Benton, Jr.
A.L.P.O. Saturn Recorder
735 E. 49th Street, Apt. A
Savannah, Georgia 31405

AN OBSERVATIONAL MODEL OF THE LONG-ENDURING JOVIAN SOUTH TEMPERATE ZONE WHITE OVALS: BC, DE, AND FA

By: Paul K. Mackal, A.L.P.O. Jupiter Recorder

(Paper read at the A.L.P.O. Convention at Sacramento, Calif., August 20-22, 1970.)

The belts of Jupiter and the Red Spot are very unstable and are subject to many fluctuations of activity and intensity, color, and structure. In addition to positional changes, there are variations in the motions of much smaller features, commonly called "spots". The zones of Jupiter and the three long-enduring South Temperate Zone white ovals, on the other hand--BC, DE, and FA--are subject to less instability, although zones often become dull or even dusky.

The existence of a belt or a zone visible on the surface of the Jovian atmosphere is due to sub-atmospheric and sub-surface mechanisms which are not yet elucidated but are thought to be of a volcanic character. Different volcanic theories have been proposed recently by Bronshten, Mackal, and Reese.[1,2,3]

The adiabatic motion in the Jovian atmosphere causes a secondary form of activity of a sub-atmospheric nature, i.e., a process of spot breakage and disruption as material rising upwards collides and interacts. Finally, on the surface of the atmosphere visible to astronomers, further interaction takes place. Because there is a minimum of haze episodes on the Jovian atmospheric surface, tenuous material must rarely move very far upwards.

We see, then, that active matter goes through three phases of fractionation. The up-and-down motion subject to adiabatic flow vectors is the most interesting because it brings the material in the active regions to the visible surface. Once they are visible, the rotation of the planet and motions within the belts take over to further fractionate the spots. Some of these laws of visible motion and interaction have been tentatively established by the A.L.P.O. Jupiter Section during the 1960's: (1) dark spots are more stable over a period of time than white spots but not by very much,[4] (2) dark concentrated spots are more regular in appearance and less subject to change over time than diffuse ones, (3) dark and white spots which persist in an abnormal rotation period for their current are possibly located at varying altitudes as compared to those which are moving at a normal rate, (4) hazes are produced by diffuse matter which is entrapped between rotational velocities which tend to diverge, (5) zonal brightenings or darkenings are produced by diffuse matter entrapped between rotationally convergent boundaries,[5] (6) a, when rotational velocities of a series of spots in a given belt, zone, or component are locally divergent, and the accelerations and decelerations tend to be small, there will be much interaction and breakage of spots and their connectors, in which case their appearance will be very prolix, (6) b, and conversely for locally convergent currents, (7) a,b, a great deal of activity tends to produce locally divergent motions and little activity tends to produce locally convergent motions, (8) a belt will rarely fade although it may become double in the case of the NEB or SEB, producing an NEB Z and a SEB Z over all longitudes, (9) degrees of activity of an active belt may be correlated with certain sequences of periodic outbreaks of activity, producing set reoccurrent qualitative belt types and unique degrees of rather fixed appearance or "stages" of development,[6] and (10) sub-atmospheric activity may be more or less intense, thus affecting the number of observed spots in the belt.

Added to these laws are several more concerning the effects of sub-surface degrees of activity. In this case there may be multiple eruptions from different locations, single eruptions from different locations, multiple eruptions from a single location, or a single eruption from a single location in a given latitude-longitude region of the planet. These non-equilibrium phenomena are the ultimate source of the matter which produces the secondary and tertiary phenomena.[7] The more placid a zone before such an eruption, the more noticeable and persistent will the resulting disturbance appear. A major disturbance is less subject to secondary fractionation than a minor disturbance, but a minor one is more subject to tertiary fractionation. The life-time of a disturbance is due to the strength of the eruptions, their frequency in a given location, the number of locations all around the disc, and the resulting kinds of interactions. The interactions will increase when a disturbance is flanked by active regions or when older material is in the path of the eruption.[8]

Consequently the stability of the STB is not so simple as was once assumed; and it becomes rather difficult to try to explain how the white ovals, BC, DE, and FA, have endured in spite of all these phase changes going on about them. We now know that the ovals repel one another in such a way that the faster they approach one another, the faster they will recede from one another in the opposing direction, suggesting a kind of "repulsion".[9] We also now know that the spots slow up when they are in close proximity with the Red Spot.[10] Might some vortex motion inherent in the white ovals account for such accelerations and decelerations? In this regard it was recently reported in A.L.P.O. Jupiter Reports that dark spots were often present just south of the white ovals in the late 1960's, just as the white ovals tend to lag when due south of the Red Spot. Such a vortical motion might also account for the fast pace of the ovals on the STB track itself.

The white ovals are also not subject to the fortunes of the STB. Hazes do not obscure them, they rarely become dull, and they have never been dusky. This suggests that they are higher in the Jovian atmosphere than the STB. They are also never subject to the influence of the STeZ, suggesting that they are higher than that zone as well. Finally, rotation velocity change data (subtracting the velocities between apparitions) indicates that B and C, D and E, and F and A are closely related but that no such relation exists between C and D, E and F, and A and B. From all this it seems legitimate to hypothesize that the ovals are independent of the normal sub-atmospheric and sub-surface mechanisms discussed above in reference to the STB.

The ovals themselves have altered somewhat in the course of their recent history. They were initially observed by Elmer Reese and others in the period from 1939-40 to 1942-43. Stretches AB, CD, and EF have gotten larger; and at the same time, though initially moving much faster than the STB current by some 10 seconds or more, they lost some of their speed. The STB current itself appears to have speeded up a bit during the same period of about twenty-five years.

The ovals have always been symmetrical in shape, and their ellipticity has become less and less as they have shrunk in size. They are usually very bright and only rarely dullish in tone. It may be that they repel the STB in some manner yet to be discovered. They are also more centrally located over the STB presently but were initially infringing only on the southern edge. At this moment they have very strong dark hoods.

Clearly, the ovals are more stable than the STB current. The problem for theoretical astronomers is to discover why the ovals repel each other and the STB. They appear to be simpler in nature than the Red Spot, however, which tends to be a combination of various mechanisms--Taylor column, vorticity, and belt complex producing the Red Spot Hollow.

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Acknowledgements: A special "thank you" to Elmer Reese, who sent me a list of rotation periods for A, B, C, D, E, and F, which complemented work done by the B.A.A. and the A.L.P.O., and also a "thank you" to Dick Wend for reading this paper in absentia at the 1970 Sacramento Convention.

METEORITIC IMPACTS AS GEOLOGIC FEATURES

By: Craig L. Johnson

(Concluded from Vol. 22, Nos. 11-12, pp. 208-213)

In order that one may better appreciate the energy involved in the impact of meteoritic bodies and sticking to the crater size under discussion in this paper (generally one to one hundred kilometers), let us take the hypothetical case of a small asteroid (or other astronomically small mass of rock from any source) impacting the Earth. While this event will be hypothetical, we will not deviate from the laws of physics and mathematics, or from reasonable size ranges of bodies actually known to the astronomical community. Since the year 1801 some sixteen hundred asteroids have been discovered and have been observed well enough for orbit calculations to be made; and the existence of some forty thousand asteroids has been postulated.[50] They range in size from flying mountains (perhaps one kilometer in diameter) up through Vesta (370 kms.) and Pallas (500 kms.); and the largest, Ceres, slightly exceeds 750 kilometers in diameter.[51] Most of these objects have orbits that keep them between the orbits of Mars and Jupiter; but a few are known with more eccentric orbits, such as Hermes, Eros, and Icarus, whose orbits carry them regularly from inside the orbit of Mercury to as far out as that of Jupiter. These bodies obviously can approach the Earth closely if it is at a certain point in its orbit at the time and have done so in this century as astronomical distances go.[52,53] In 1937 Hermes, with a mass of 10^9 tons, passed approximately 640,000 kilometers from the Earth, or less than twice the distance to Luna.[54]

We shall construct our hypothetical ball of rock so as to have a mass of 3.5×10^{10} tons, and shall endow it with a speed at atmospheric entry of fifty kilometers per second (high, but not unprecedented). This mass could be met by only four cubic kilometers of specific gravity eight; while such a density is unreasonable, of course, one must remember that many meteorites do contain a high percentage of iron so that our meteorite can quite reasonably be less than twenty kilometers in diameter. If this body contains 3.2×10^{16} grams, and $e = 0.5mv^2$, the total energy release could approximate 4×10^{29} ergs. For comparison, the detonation of a million tons of TNT yields 4×10^{22} ergs; the largest earthquakes measured have each released some 10^{27} ergs.[55,56] This energy is to be released within a twenty kilometer circle in less than sixty seconds. (The effect of dissipation of energy from preheating of the atmospheric path column will be small, percentage-wise, for such a dense or iron-rich meteorite; its speed is such that the time interval will be much less than sixty seconds, much closer to the fireball duration of a large fusion weapon).

The above figures should suggest that the impact of our hypothetical meteorite releases great amounts of energy, and indeed it can be seen that 4×10^{29} ergs is equivalent to a ten-tetraton fusion weapon, which is some $10^{5.5}$ times the largest ever detonated. Nor should the comparison with nuclear energy stop there; if our ball of rock is equivalent in energy release to an extremely large fusion bomb, the possibility that nuclear fusion will actually be induced by mechnical means in the surrounding area of atmosphere and crust cannot be dismissed offhand. This release would produce a flood of X-radiation, which could be expected to produce physical changes in those nearby rocks which were not vaporized or melted; it could also produce a burst of neutrons, which would induce secondary radiation in those rocks also. Either of these processes might leave changes at the impact site detectable with sensitive instrumentation for millions of years.[57]

Very well; our hypothetical meteorite has equalled a ten-tetraton fusion weapon in energy release. This is probably of the same order of magnitude as the impact that produced each of the Clearwater Lakes craters in Canada (the largest confirmed impact craters on Earth), but the reader should be reminded that the probably-impact-caused Imbrium basin on Luna is twelve hundred kilometers in diameter. This was the basis of the earlier statement in this paper that no asthenosphere or liquid core was necessary in order to produce the observed lava flows on the lunar surface, or volcanic effects in connection with terrestrial strikes. The impact of asteroidal-size bodies, moving at normally-encountered meteoritic speeds, produces not merely localized melting of surface rocks, but is capable of vaporizing them; melting would definitely not be limited to the immediate vicinity in the largest cases. It has been calculated[58] that the impacting body responsible for the lunar Orientale basin, some one thousand kilometers in diameter and with a central two hundred and ninety kilometer lava bed, was only eighty to one hundred kilometers in diameter. If the basement rocks have been compressed by blast effects and if there has been a lava inflow from melting of the surrounding rocks, one might logically expect positive Bouguer anomalies in such areas; such anomalies have actually been detected by the tracking of space probes in lunar orbit, and were dubbed "mascons". The maria Humorum, Imbrium, Serenitatis, Nectaris, Crisium, and Orientale show surplus concentration of mass.[59]

Thus, the finding of igneous intrusions at the site of large suspected terrestrial impact craters (Witwatersrand basin, Hudson Bay) and proposed drifting of rock masses on magma to account for the island arc chains; the finding of clearly volcanic domes and flow ripples, not to mention lava-drowned craters, on and near the lunar maria;[60] the finding of collapsed volcanic vents within pre-existing lunar craters,[61] and flow marks within Tycho and Aristarchus,[62] and the photographs showing the lunar Hyginus Rille to be a graben with nearby volcanic blowholes[63] do not invalidate the impact hypothesis.

Thus far we have surveyed the surfaces of Luna and Earth, have found many geologic structures that could have been produced by large meteorites, and have shown that large meteorites would indeed have been capable of producing these observed structures. What source or sources could have spawned the meteorites? The currently-well-thought-of theory for the origin of the planets, that of the gradual accretion of cold planetesimals, provides for the idea that much material (numerically speaking) could have been left over after the formation of the planets was essentially complete. Several persons have proposed that this was the source for the asteroid belt since the combined masses of the remaining asteroids do not add up to a respectable planet (thus demonstrating by inference that the asteroid belt did not originate from the collision of formerly existing planetary bodies). And, if most of the left-over planetesimals were ordered into a relatively dense belt by the interacting gravitational fields of the planets, by no means would every last object necessarily have been so gathered (witness the Earth-grazing asteroids Hermes, Icarus, and Eros). Therefore, a fair number (numerically) of very small asteroids, nevertheless the size of mountains or larger, could still be orbiting the sun in orbits that cross that of the Earth at least closely enough that one must be deflected toward a potential location of Earth at rare intervals. One may argue, and correctly so, that the chances of an actual collision are very slight; however, the vastness of known geologic time is sufficient to allow the realization of not one but many seemingly improbable events.

If the asteroids were initially distributed more or less at random throughout the Solar System and then gradually were collected either by accretion into planets or by gravitational influences into a discrete belt, one might expect that as one surveyed the existing planets, the closer the planet's proximity to the asteroid belt, the greater the number of impacts it would have endured in the sum total of geologic time. Of course, the planets nearest the asteroid belt on the far side could show no impact scars since they are gas giants. Mercury and Venus are not accessible for survey at this time. That leaves the Earth, Luna, and Mars. Luna is not directly comparable to the other two due to its small mass and consequent lack of atmosphere, but in the matter of survey suitability for impact frequency of asteroidal objects Earth and Mars are very closely comparable. Both have atmospheres of sufficient density effectively to screen the surface from high speed impacts of very small meteorites but insufficient to prevent the arrival of large masses. Both have low enough gravitational attractions that such will not be a major factor in determining the number of impacts. While the efficiency of erosional processes on the Martian surface is unknown for either past or present, the television images relayed from the three successful Mariner series space probes leave little reasonable room for doubt that the Martian surface has suffered many times the number of meteoritic impacts that the Earth has.[65,66] This would certainly seem to confirm the validity of the idea that large craters can be the result of impacts of small, straying asteroids.

Are there any other possible sources of planetesimals? Yes, indeed; the comets. While spectroscopy has shown that the appearances of comets as seen from Earth are due to gas, dust, and ices, and planetary orbit observations have shown that the total mass of a comet is insignificant in comparison to that of the planets themselves, no observations have ever been made which show that masses of rock significant by human standards are not a part of cometary nuclei. Indeed, direct observation has shown (stated by sources too numerous to mention here) that the present day meteor showers are derived from ejected solid cometary debris, and that even small comets are large enough to conceal many small bodies, having in many cases nuclei exceeding 50,000 kilometers in diameter.[67] It is the normal case for the orbits of comets to cross that of the Earth, as opposed to the case for asteroids where such an orbit is the exception. And while several comets with very short periods and relatively circular orbits are known, several times per century a comet with an orbital period so long that human eyes can have seen it only once comes into view. Two very recent examples are Comet Humason 1961e and Comet Tago-Sato-Kosaka 1969g.[68,69] With regard to both asteroids and comets with Earth-crossing orbits, and the idea that considerable masses exist within cometary nuclei, a recent suggestion was made by reputable astronomers[70] that asteroids are the result of the decay of comets, later to be reduced to near-circular orbits by subsequent planetary perturbations.

So much for telescopic observations and theory. Is there good, direct observational evidence for any substantial physical bodies existing within comets? Unfortunately, no. A direct collision between Earth and a cometary nucleus has taken place only once in recorded history, aside from ancient legends of great interest but little verifiability at present[71] and bio-gelogical data in great need of further investigation.[72] This event took place on 30 June, 1908, a few hundred kilometers to the northwest of Lake Baikal in Siberia. In this event, according to available evidence and eyewitness accounts, a very small and slow-moving comet entered the atmosphere. It was previously unknown due to its orbit's carrying it near to the apparent position of the sun, and the final approach was in daylight. However, the loosely-aggregated object had a considerable dust tail pointing away from the sun (which caused unusual sunsets all over Europe). It exploded at an altitude of five kilometers, with force sufficient to uproot and shatter trees twenty-five kilometers from the blast and forcibly to remove tops of trees at twice that distance. Considerable meteoric dust was later found, in a fall-associated pattern.[73]

We can see from the above discussions that both asteroidal fragments and comets are, given a sufficient time interval, capable of delivering geologically significant meteoritic impacts to Earth, Luna, and Mars; asteroidal fragments carry more average energy per unit volume, but comets are vastly more frequent.

It has been mentioned that <u>maria</u> occur only on one face of the moon and cover some thirty per cent of its surface area, and that comets are frequently of sufficient size easily to engulf the Earth. The suggestion has been made a few times that the lunar <u>maria</u> and the Pacific Ocean were formed simultaneously, geologically speaking, by the head-on collision of a cometary nucelus (approaching from the side opposite that of the moon, as seen from the Earth, and directly above the Pacific Ocean basin).[74] The author hopes to have demonstrated in this paper that, no matter how fantastic the idea may seem at first reading, it is not a totally impossible one.

The author hopes that Geology may one day follow the path trod by Astronomy in realizing that, as the Universe does not revolve around the Earth, neither must all geological events necessarily arise from within the Earth, and that no magic, nor fairy tales, nor other unknown agents are necessary in the consideration thereof.

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69. "Photos of Comet 1969g from Cerro Tololo", Sky and Telescope, Vol. 39 (April, 1970), pp. 228-231.

70. "Minor Planets from Comets?", Sky and Telescope, Vol. 38 (November, 1969), pp. 302-303.

71. Immanuel Velikovsky, Worlds in Collison (New York: Doubleday and Company, Inc., 1950).

72. Immanuel Velikovsky, Earth in Upheaval (New York: Dell Publishing Company, Inc., 1968).

73. "Did a Comet Collide with the Earth in 1908?", Sky and Telescope, Vol. 36, (November, 1963), pp. 268-269, and many other sources.

74. Allan O. Kelly, Continental Drift (Carlsbad: Allan Kelly, 1966).

Note by Editor. While it is a matter of great regret that no Proceedings were ever published for the Southwestern Astronomical Conference '68, we have been glad to present in this journal a few of the papers given there. The one beginning on page 17 was an invited lecture.

TIDAL MECHANISMS AND CYCLES IN LUNAR EVENTS

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and

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(Based on a paper read at the Southwestern Astronomical Conference at Las Cruces, New Mexico, August 21-24, 1968.)

Abstract

The relative frequency of recent lunar events at the craters Aristarchus and Gassendi is positively correlated with tidal stresses at these sites. Tidal stresses and other lunar-event periodicities provide further evidence favoring a hypothesis that most lunar transient events originate from internal lunar processes such as volcanic and seismic activity. Evidence of the triggering of earthquakes by earth tides and other lunar-terrestrial analogies suggest an association between lunar events and moonquakes. Because simultaneous monitoring of lunar events from the earth and the moon would produce more useful information than telescopic monitoring alone, seismographs offer possibilities for fruitful coöperation with an existing network of lunar observers.

Introduction

This report is an extension of recent lunar-event investigations by added incorporation of observations through 1967. In particular, a tidal analysis of the 15 events (days of activity) at the crater Gassendi is correlated with an analysis of 38 events at the crater Aristarchus.

In a previous investigation of 25 events, Green (ref. 1) found a decided correlation for times when the lunar orbit was near maximum eccentricity and also found that lunar events occurred preferentially when the moon was near apogee. For 167 dated reports, neglecting orbital eccentricity variations, Burley and Middlehurst (ref. 2) found a strong correlation with perigee and apogee times. Green and Burley and Middlehurst interpret the perigee-apogee effect as evidence of tidal cracking and as probable evidence of the release of gases from below the lunar surface. The topographical distribution of sites is discussed by Middlehurst and Moore (ref. 3), who found that most of the sites are associated with special topography such as the margins of maria. The hypothesis of internal origin is supported by this topographic distribution and by other similarities (discussed by Middlehurst in ref. 4) for many of the sites. Chapman (ref. 5), by introducing libration terms and calculating local tides, showed a significantly improved correlation between tidal extremes and the onset of events for a single site (Aristarchus); but out of 27 sightings, seven anomalies remained, of which five occurred within one day of perigee.

In the following sections, the question of tidal cycles, the distribution to the tidal cycles of the new event reports for the Gassendi area and other sites, and some seismological implications, including the possibility of moonquakes, will be discussed.

Tidal Cycles

Substantially all parameters of the lunar orbit and, consequently, local tides at all lunar sites go through a complete cycle in the period of a saros (18 years and 11 days). A saros is divisible into two important cycles. During each one-third of a saros, the cycle of local tides tends to be repeated. This cycle of approximately 6 years results from resonance between the 27.21-day nodical month and the 27.55-day anomalistic month. Another important cycle results from resonance between the anomalistic month and the 29.53-day synodic month (Full Moon to Full Moon). After a given Full Moon occurs in phase with perigee, the seventh Full Moon afterward is in phase with apogee, since this one-sixteenth of a saros (412-day cycle) has a duration of nearly 14 synodic months. These half-cycle phasing conditions are synchronous with the times of maximum orbital eccentricity (maximum departure of lunar orbit from circularity) that were noted by Green (ref. 1) as having influenced lunar events. Examples of the cycle of 14 synodic months are shown in Table I.

*These were the professional positions of the co-authors in the summer of 1968.

Modern Tides at Gassendi and Aristarchus

In 1966 and 1967 members of the Lunar Section of the British Astronomical Association (Moore, Moseley, Ringsdore, Sartory, Whippey, and others) conducted a regular check of Aristarchus and Gassendi. Because historical observations of Gassendi events were rare compared to events at other active sites, Gassendi was rated as 10th in frequency of activity by Middlehurst and Moore (ref. 3), who show a ratio of approximately 1 to 10 for Gassendi activity relative to Aristarchus activity. As a result of additional reported events, mostly recent (ref. 6), Gassendi is now rated as fourth in frequency of activity, as is shown in Table II. Although this provisional rating of active sites may undergo additional changes, the approximately 1-to-10 Gassendi-to-Aristarchus ratio can be interpreted as a real and persistent long-term ratio.

In spite of the long-term ratio and in spite of the fact that Aristarchus has been consistently the most active area on the moon throughout at least 200 years, Gassendi events actually outnumber Aristarchus events during the period from April, 1966 to June, 1967. The implications for this change in location of activity with respect to observational and tidal causes are now considered.

Over such a short interval, complications such as observational bias limit the validity of comparison for two randomly placed sites; but the positions of Gassendi and Aristarchus on the moon are such that the sunrise terminator reaches Gassendi on the tenth day after New Moon and reaches Aristarchus on the eleventh day after New Moon. The two craters are approximately equidistant from the mean center of the lunar disk, and the diameters (Gassendi, 70 miles, and Aristarchus, 25 miles) are large enough that both craters are conspicuous objects. Aristarchus, though smaller, is brighter than Gassendi. Observational bias between the two sites, therefore, is relatively unimportant. Therefore, the changes in frequency of the reports for both Aristarchus (less by a factor of 2 from April, 1966 to June, 1967, compared to the previous 14 months) and Gassendi (greatly increased activity in the same period) represent real trends.

The Gassendi reports resulted from a systematic watch kept by the observers at a time when the amplitudes of the tides were increasing steadily, culminating during the special librations that occurred in the summer of 1967. Thus, unusually large variations in local tides at Gassendi and unusually small variations in local tides at Aristarchus resulted from these special librations, which are similarly effective and are repeated during approximately 1 year out of every cycle of 5.99 years.

Tides at Aristarchus and Gassendi are shown in Figures 23, 24, and 25. These are the tidal-gravity change (in acceleration units), that is, the vertical force change per gram of lunar material. Although solar terms contribute less than 3 percent, the solar terms are included in the computer-plotted tides.

Events are indicated at the corresponding local tides in Figures 23 and 24 where onsets of the activity exhibit correlations of two types: (1) Local tide correlations imply that local tidal stresses have triggered events. (2) Perigee correlations (also apogee correlations), which are evidently independent of local tides, imply that other processes trigger events. Of the 41 days of activity at Aristarchus in Figures 23 and 24, sixteen events occurred within 2 days of either a local tidal-gravity maximum or minimum; and similarly, 18 events occurred within 2 days of either a perigee or an apogee (only four events at apogee). Therefore, of the 41 Aristarchus events, six remain with either marginal or unclear relations to tides. Of the 15 days of activity at Gassendi in Figure 24, four events occurred within 2 days of a local tide, and seven events occurred within 2 days of either a perigee or an apogee. Therefore, of the 15 Gassendi events, four remain with either marginal or unclear relations to tides.

In considering the perigee and apogee events that occurred at widely different times from local tidal extremes, it is admitted that recent knowledge of apogee and perigee correlations (e.g., refs. 1 and 2) can have introduced a perigee bias in the recent observations. However, a possible interpretation is that many recent, as well as historic, events have been independently triggered by perigee. It is now suggested that such a perigee, through tide triggering of a seismic disturbance elsewhere (perhaps at great depth) within the moon, can account for such a perigee event. It can also be seen in Figures 23 and 24 that groups of such events occur at consecutive perigees. This is also true for sets of events at times of tidal-gravity maximum and minimum. The most pronounced tide-induced gravity decrease at Gassendi since January 31, 1961, occurred on March 22, 1967. Events were observed on March 22 and 23 by Moseley and Sartory (ref. 6). Although occurrence of this tide was known in advance, the occurence of an extensive series of events that were

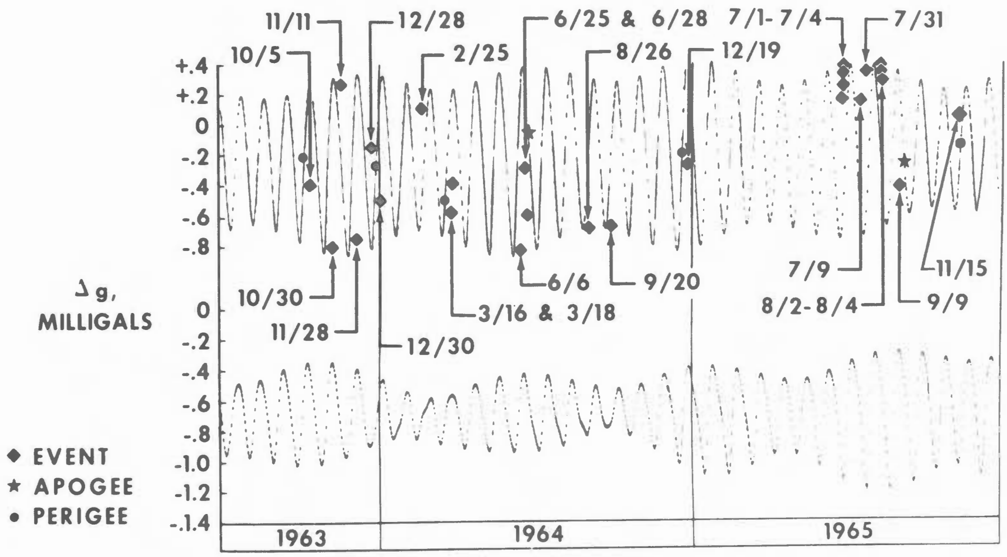

Figure 23. Tidal-gravity change and local tide-raising vertical force change per gram of lunar material are presented for July, 1963 to December, 1965. Upper tides at Aristarchus, lower tides at Gassendi, and events (diamonds) at local Aristarchus tidal-gravity values are presented for given observation dates. Each apparent event-triggering perigee (dot) and apogee (star) is indicated. See also text of "Tidal Mechanisms and Cycles in Lunar Events".

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already in progress at Gassendi was not well known. Also, the systematic watch by the British Astronomical Association observers was put into operation as a result of the Sartory-Moore observations of an early, and spectacular, sighting of the series on April 30 and May 1 and 2, 1966 (ref. 7), and not because of the Chapman predictions, which were unknown to the observers. The observations and the theoretical predictions were independent.

It was predicted (ref. 5) that increased tides would increase activity in the first quadrant, which contains Mare Crisium; and increased activity at Gassendi in the third quadrant has been noted. Recent events in Mare Crisium are unknown. However, six events were recorded in Alphonsus; four events were recorded in Plato; two events were recorded in Ross D; and one event each was recorded in Archimedes, in Copernicus, in Kepler, in Messier, in Sabine, and in Triesnecker.

Possible Nature of Lunar Events

One of the oldest explanations for transient lunar events is that they result from internal lunar processes, and appropriate descriptions in the catalog assembled by Middlehurst, et al. (ref. 6), are plentiful. In 1715, De Louville and Halley reported "lightning" on the face of the moon. Also, O'Keefe (ref. 8) suggested that lightning-like electrical discharges may originate from within the moon. In 1783 and 1787 Herschel reported lunar "volcanoes". Nevertheless, the endogenic hypothesis has also been disputed, at least since Herschel's time; and early alternatives ranged from regarding the events as manifestations of extraterrestrial life to rejecting all events as erroneous reports.

Controversy about the nature of the transient events continues because there is not yet sufficient information to settle all doubts. Neither have questions such as what is the exact cause of the increased local brightness been satisfactorily explained. Events have been linked with luminescence of lunar materials through energization by solar activity. The timing of some events has coincided with exceptional displays of the aurora borealis. For example, Botley (refs. 9 and 10) notes that Herschel's 1787 events occurred at a time when auroral displays were seen as far south as Padua, Italy. Ricker (ref. 11) notes that on May 29, 1967 (the date of an event) major auroral displays also took place. Thus,

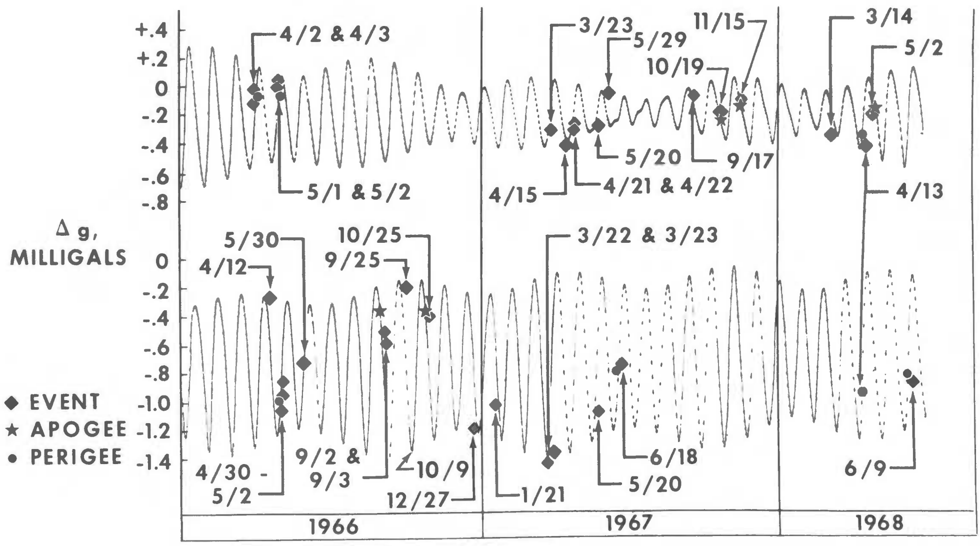

Figure 24. Tidal-gravity change and local tide-raising vertical force change per gram of lunar material are presented for January, 1966 to June, 1968. Upper tides at Aristarchus, lower tides at Gassendi, and events (diamonds) at respective local tidal-gravity values are presented for given observation dates. Each apparent event-triggering perigee (dot) and apogee (star) is indicated. See also text.

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auroral activity might provide a useful index to an energy source for some lunar events.

In addition to citing evidence for the triggering of volcanic activity by earth tides, Green (ref. 1) suggested that lunar events are related to seismic activity. This suggestion agrees with the possible tide-triggered endogenic processes that were considered by Burley and Middlehurst (ref. 2), and especially with the subsurface faulting that was emphasized by Middlehurst (ref. 4).

Earthquake correlations with various phenomena are cited by Ryall, Van Wormer, and Jones (ref. 12), who conducted a detailed study of earthquake aftershocks. Because aftershocks take place under optimum conditions for triggering by earth tides, they found a significant correlation between aftershock occurrences and times of tide-induced maximum values in vertical gravity. Vertical-gravity values on the moon were found by Chapman (ref. 5) to correlate with the onset of observed lunar events. On the basis of this correlation, Chapman forecast conditions favorable for more Aristarchus events to occur on January 16 and February 12, 1970. A forecast of conditions favorable for events to occur on June 27 and July 25, 1969, and on January 6 and February 2, 1970, is based on a correlation with minimum tides. In spite of some differences in detail, the similarities between lunar and terrestrial tide correlations imply that terrestrial analogies of lunar events include earthquakes. Furthermore, a close association is likely between seismic activity and the more plausible internal lunar processes to which lunar events have been attributed.

Seismic Activity on the Moon

The term "lunar event" has been used to refer to observed phenomena involving color changes, obscurations, and bright spots radiating anomalous amounts of light from unilluminated areas of the moon. Although these phenomena are usually transient, the Aristarchus violet-glare phenomenon observed by many people during solar illumination has been reported by Bartlett (ref. 13) as being present more often than it is absent and thus may be a more frequently occurring phenomenon than the majority of other events. Bartlett (ref. 13) recorded visual observations from 1949 to 1966 and reported nights on which he saw nothing unusual, as well as those on which he saw violet glare. The ratio of positive to negative observations is greater at times of perigee and also at times of tidal-gravity maximum and

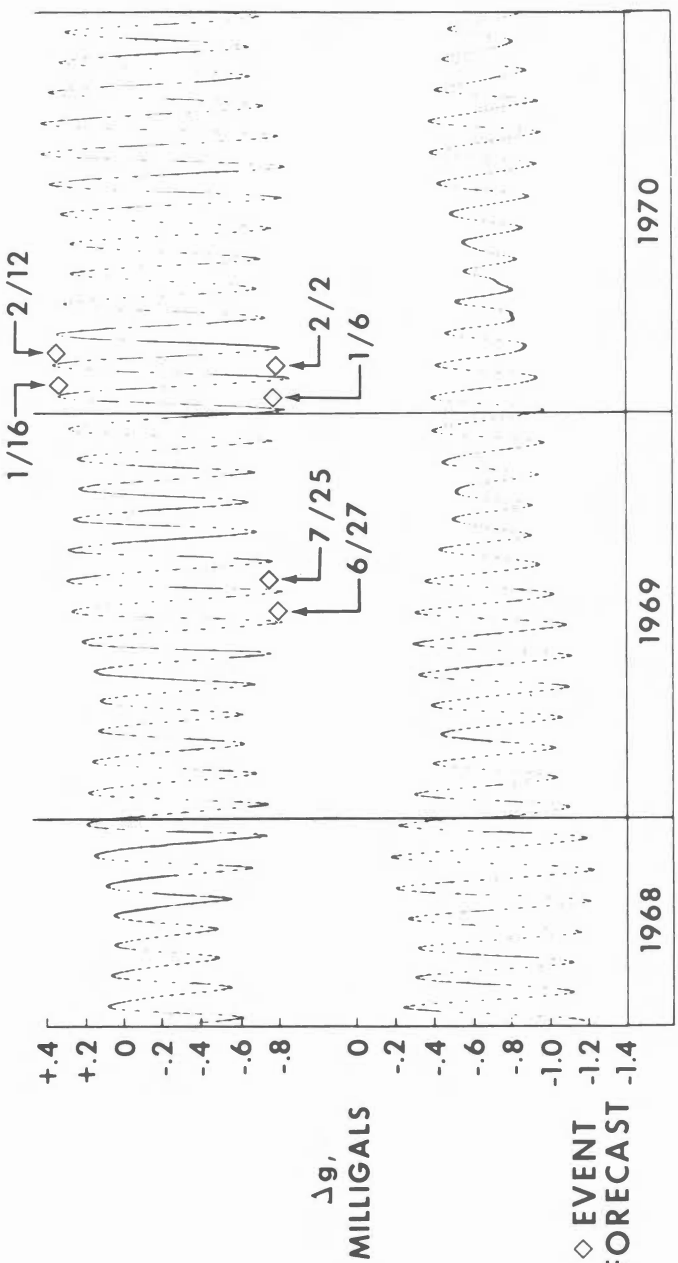

Figure 25. Tidal-gravity change and local tide-raising vertical force change per gram of lunar material are presented for July, 1968 to December, 1970. Upper tides at Aristarchus, lower tides at Gassendi, and favorable tidal-gravity values for triggering of Aristarchus events (diamonds) on preselected dates are presented. This figure was a forecast of future behavior when Mr. Chapman read the paper here published.

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minimum at Aristarchus.

Earthquakes are transient seismic events. Earthquake waves originate from a point termed the "focus". (Hypocenter is sometimes used synonomously to mean focus.) The "epicenter" is the geographic surface location of the focus. These terms can be applied to moonquakes for use in discussion of the assumption that moonquakes are associated with lunar events.

Although moonquakes alone may fail to account fully for the light emitted by dark-side events, moonquakes may account readily for color changes and obscurations since color changes and obscurations may be simply clouds of gas and dust released in the epicentral areas of intense moonquakes. The description of the April 2, 1955 event reported by Capen (ref. 6) is consistent with such an explanation. During this event, craterlets on the east side of the fault were continually observed, and craterlets on the downthrown side of the fault were obscured. It can be inferred from the description that a moonquake focus was on the fault plane underlying the west side of the fault and that the epicenter was about 15 kms. from the Straight Wall. Thus, if the fault dips with a 2-to-1 slope, the depth of the "focus" would be approximately 30 kms.

The validity of such conjectures can be evaluated when a seismograph is operated on the lunar surface. Although surficial changes on the moon may be insignificant relative to changes on earth, boulders that have recently rolled on the lunar surface and thus provide independent evidence for recent lunar ground motion are shown in Orbiter photographs (ref. 14). The boulder tracks are numerous and occur on the central peak of Vitello, in the Hyginus Rille, and at the craters Copernicus, Gassendi A, and Sabine A — all of which are areas associated with lunar-event reports. A correlation among the phenomena, sinuous rilles, and lunar-event occurrences is qualitatively suggested; but this correlation needs to be established quantitatively.

Measurement of the previously discussed activity, as well as of meteoritic impacts, is the purpose for which lunar seismographs are being developed. When evidence for lunar activity was less acceptable than it is now, it was considered important that lunar seismographs would also record meteorite impacts. Even then, the seismographs were theoretically expected to record moonquakes. Since the average number of recent sightings of events is about two sightings per month, most of the moonquakes will lack associated transient-event sightings. However, the question now arises concerning what the seismograph will record during transient events.

Intensified astronomical observations and the operation of lunar seismographs may mutually supplement each other. Then, if lunar events are seismic in origin, simultaneous monitoring of the events from the earth and the moon would produce more useful information than telescopic monitoring alone. Lunar seismographs offer possibilities for fruitful coöperation with an existing network of lunar observers.

This report closely follows a paper given at the Southwestern Astronomical Conference, August 21-24, 1968, at Las Cruces, New Mexico. Further evidence that has been obtained since that time reinforces our conclusions.

The periodicity, Meissner et al. (ref. 15), that identifies the moonquakes recorded by the Apollo 12 seismic experiment supports the tidal theory outlined above. A report presented by Dr. Gary Latham to the 1971 Lunar Science Conference, January 11, 1971 at Houston, Texas is summarized below.

Results from the Apollo 12 Passive Seismic Experiment. The Apollo 12 passive seismic experiment has recorded 208 lunar seismic events from November 19, 1969 through August, 1970, or 23 events per month, which include meteorite impacts and moonquakes. Moonquake activity is strongly concentrated near times of perigee and, to a lesser extent, near times of apogee. The moonquakes are believed to occur at not less than 10 different locations within 300 miles of the Apollo seismograph. Cumulative strain at each location is inferred. Thus, the moonquakes appear to be releasing internal stress of unknown origin, the release being triggered by superimposed tidal stresses. The most active zone, accounting for nearly 80 per cent of the total seismic energy release within the 300 miles of the seismograph, is tentatively placed in the vicinity of the well developed set of rilles which transect the crater Fra Mauro. If this tentative association of moonquake foci with linear rilles is correct, such rilles express faults along which displacements presently occur. The correlation between maxima in the frequency of sightings of lunar transient events and times of perigee and apogee suggests a possible relationship between these events and moonquakes.

Acknowledgements. We gratefully acknowledge contributions and helpful suggestions by numerous co-workers. We are indebted to J. Winston Blackmon of the Computation and Analysis Division at NASA-Manned Spacecraft Center in Houston, Texas for writing the program for computing the tides. The work by B. M. Middlehurst was partially supported by National Science Foundation grants GP-5940 and GP-6709.

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TABLE I. IMPORTANT TIDAL INFLUENCES RELATED TO FAVORABLE OBSERVING DATES FOR TWO 14-MONTH SEQUENCES

Eccentricity of Lunar Orbit	←MINIMUM→	←MAXIMUM→			←MINIMUM→	←MAXIMUM→
Tidal Influences*		Low & P	P	P & High		A A A
Months, 1966-1967	Nov. Dec. Jan. Feb.	Mar.	Apr.	May	June July Aug. Sep.	Oct. Nov. Dec.
Influence Dates		22 & 26	24	22 & 28		19 15 12
Event Dates at either Aristarchus, Gassendi, or both	27 21	22 & 23	15, 21 & 22	20 & 29	18 17	15
Months, 1970-1971	Apr. May June July	Aug.	Sep.	Oct.	Nov. Dec. Jan. Feb.	Mar. Apr. May
Influence Dates		12 & 17	14	13 & 18		12 8 5

*During five selected days (50-110° colongitudes) for observing Aristarchus or Gassendi, tidal influences are designated: perigee, P; apogee, A; local gravity decrease, low; local gravity increase, high.

TABLE II. LUNAR SITES IN ORDER OF FREQUENCY OF REPORTED LUNAR TRANSIENT PHENOMENA

Feature	Number of events
Aristarchus	more than 200
Plato	43
Schröter's Valley (and Cobra Head)	18
Gassendi	17
Alphonsus	16
Mare Crisium	14
Tycho	13
Ross D	11
Kepler	7
Eratosthenes	6
Posidonius	6

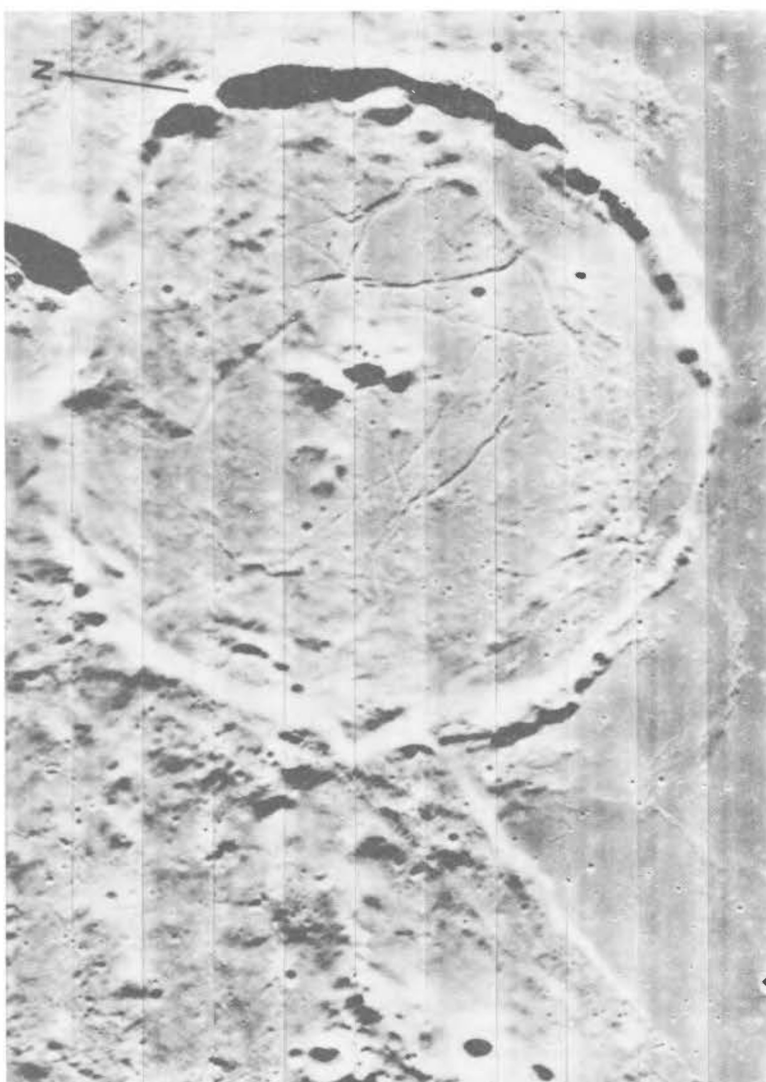

Figure 26. Lunar ring-plain Gassendi on the northern border of the Mare Humorum. A Lunar Orbiter Project Mission IV Photograph, NASA-S-69-1678. Lunar north at left, the direction in which the arrow is pointing; lunar east in the IAU sense at the top. Gassendi has been the site of a number of reported Lunar Transient Phenomena during the last five years. A possible relation to lunar tidal phenomena is discussed by Dr. Chapman and Miss Middlehurst in the text of their article on page 17 *et seq*.

THE TRUE TAIL LENGTH OF COMET BENNETT 1969i

By: Charles Morris

When such a relatively rare opportunity presents itself as the appearance of a bright comet like Comet Bennett, it is difficult for anyone having any interest in research just to let the opportunity pass. As a result, this writer decided to attempt to calculate the variations in the true tail length of Comet Bennett. Here are the results of this effort.

The first problem, of course, was obtaining the observations. The method chosen was photographic because it allowed double checking of the results. Unfortunately, the photographs couldn't be guided so that High Speed Ektachrome was used in order to make the exposures as short as possible. In general, the best results were obtained with exposures of about one minute.

As was expected, the phase of the moon affected the results obtained from the photographs. It can be seen very clearly from Figure 27 that when the moon was full the observed tail length of Comet Bennett was greatly reduced. This circumstance made some of the observations that were taken almost useless. Nevertheless, the true tail length was computed for every day on which data were obtained. The computation was done using the following formula by Michael McCants (Strolling Astronomer, Vol. 21, Nos. 9-10, page 146):

$$L = \frac{\text{Observed Length in degrees} \times .017 \times \Delta}{\sqrt{1 - \frac{(r^2 + \Delta^2 - 1)^2}{(2r\Delta)^2}}}$$

Here L, r, and Δ are in Astronomical Units. Quantities r and Δ are the comet's distance from the sun and the earth respectively. The following results were found using this formula:

Date (1970)	Observed Length (degrees)	True Length (A.U.)
30 March*	4.0	0.048
30 " [1]	10.0	.122
31 "	6.5	.079
5 April	23.0	.299
8 "	15.0	.217
8 " [2]	19.0	.274
9 "	15.0	.223
12 "	13.0	.213
15 " *	9.6	.175
18 " *	7.0	.142
26 " *	9.6	.261
27 " *	7.7	.216
3 May	10.6	.361
4 "	10.1	.360
5 "	10.8	.397
6 "	13.8	.490
7 " *	8.6	.335
10 " *	4.5	.191
11 "	2.8	.122
18 " *	4.3	.226

*Results doubtful because of sky conditions and/or bright moon.
[1]Observation made by Lynn O. Raynor (Sky and Telescope, May, 1970, page 330).
[2]Observation made by John E. Bortle (Sky and Telescope, June, 1970, page 351).

When the values for the true tail lengths are graphed (Figure 28) it is found that Comet Bennett's tail length varied between 0.14 and 0.30 A.U. throughout April, reaching a peak around April 5. It appears quite possible to this writer that the tail length may have been greater than 0.30 A.U. in the very last days of April, but this can't be confirmed because of the lack of reliable observations in the latter part of the month. Comet Bennett's tail length reached its maximum on May 6, 1970 when it was 0.49 A.U., or

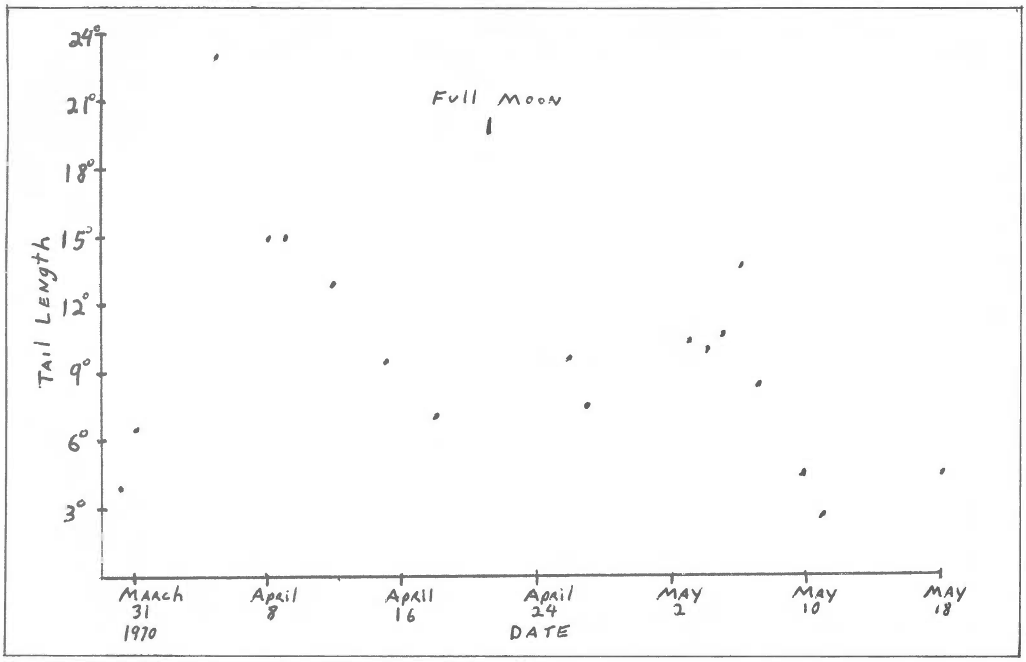

Figure 27. Graph by Charles Morris of the observed length of the tail of Comet Bennett 1969i as a function of time. The observations used were made by Mr. Morris and are tabulated on page 25. The moon was full on April 21, 1970 and was new on April 6 and May 5. See also text.

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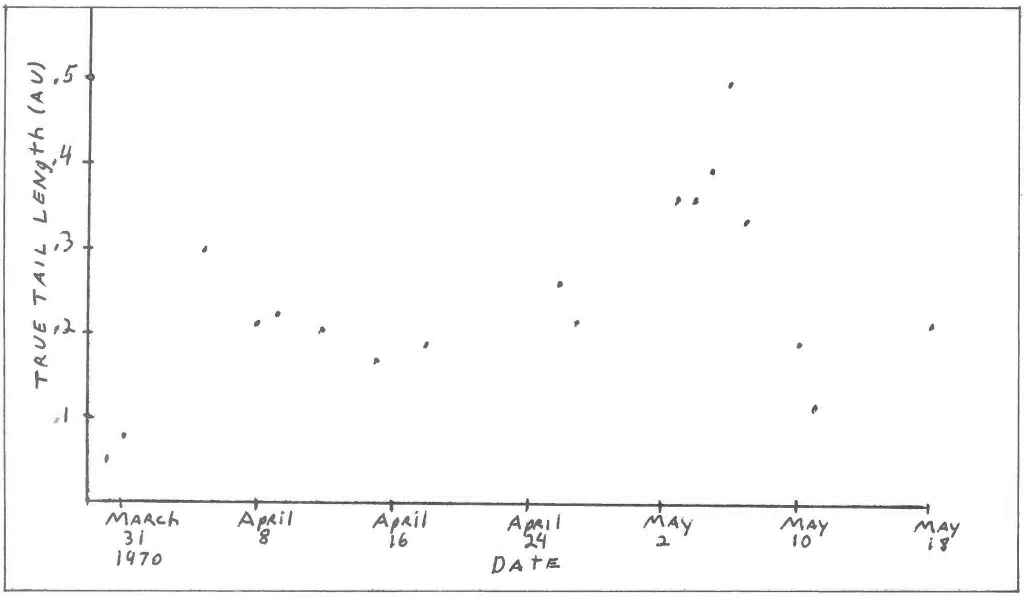
Figure 28. Graph by Charles Morris of the computed true tail length of Comet Bennett 1969i in astronomical units as a function of time. See also text.



about 75 million kilometers. This is about two and a half times the tail length of Halley's Comet of 1910 and about three-fourths as long as the tail of Comet Ikeya-Seki 1965f.

It is very interesting to note that the growth of Comet Ikeya-Seki's tail and

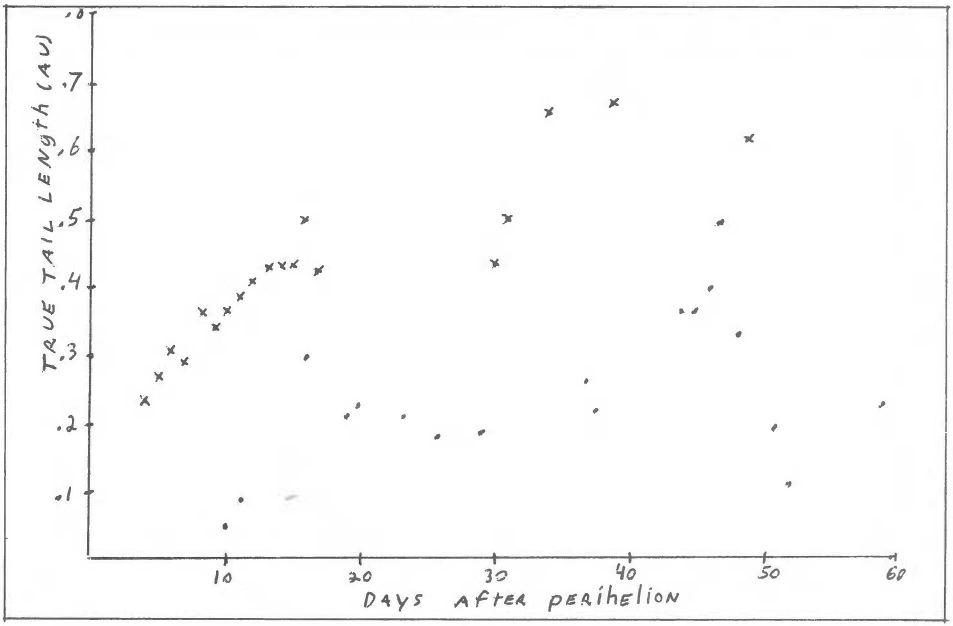


Figure 29. A comparison of the true tail lengths of Comet Ikeya-Seki 1965f (crosses) and of Comet Bennett 1969i (dots) when expressed as a function of days since perihelion passage. The data on Ikeya-Seki are from Str. A., Vol 21, Nos. 9-10, pg. 148. Graph contributed by Mr. Charles Morris.

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Comet Bennett's tail after perihelion is very similar (Fig. 29). Both comets had two distinct peaks in tail length which occurred approximately the same interval of time after perihelion passage. This resemblance may be a coincidence, or there may be a direct connection; only more research will answer the question.

Figure 30. Photograph of Comet Bennett 1969i by Charles Morris on March 31, 1970 near 8 hrs., U.T. Station of observation Michigan State University. No guiding. 150-mm. telephoto lens. Used High Speed Ektachrome film for Figures 30 and 31, developed at ASA160. Exposure about one minute.

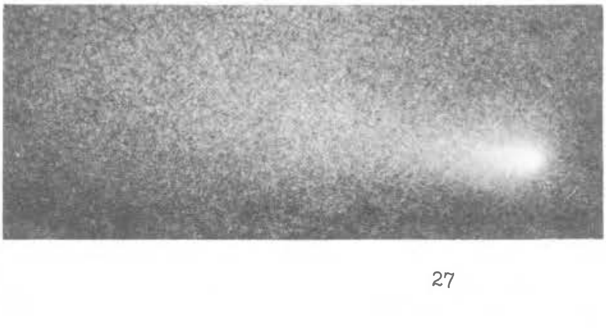

Figure 31. Guided photograph of Comet Bennett 1969i by Charles Morris on March 30, 1970 near 9 hrs., U.T. 150-mm. telephoto lens. Exposure 2 minutes. Seeing very poor. An enlarged copy of the original photograph. Lens setting f 1.8.

BOOK REVIEWS

Der Sternenhimmel, 1971. Kleines Astronomisches Jahresbuch für Sternfreunde. Edited by Robert A. Naef under the auspices of the Schweizerischen Astronomischen Gesellschaft.

Reviewed by Richard G. Hodgson

It is a pleasure once more to review Der Sternenhimmel, now for 1971. For those who can read elementary German this astronomical yearbook is a valuable source of information. In compact, well-indexed form is an abundance of physical and positional data on planets, satellites, and comets for 1971. The diagrams of the elongations of Mercury, the phases of Venus, and the angular size of Mars on various dates are all excellent. Charts are given for locating all of the superior planets (except Pluto) through the course of the year. In this year of perihelic opposition the discussion of Mars is especially complete for such a publication. An astro-calendar gives an account of astronomical events month by month and day by day so that nothing should slip by the observer. Star charts and eclipse charts are provided. Even the predicted maximum of the variable star Mira Ceta in June is noted, and a finder chart is provided!

Der Sternenhimmel 1971 is available from Albert J. Phiebig, Box 352, White Plains, New York 10602 for $5.00 per copy, postpaid. It is well worth having.

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The Atlas of the Universe, by Patrick Moore. Rand McNally and Company, New York, in association with Mitchell Beazley, Ltd., London, 1970. 272 pages. Price $35.00.

Reviewed by Kenneth J. Delano

The Atlas of the Universe, a large, well-bound volume measuring 11 by 15 inches, is the most elaborate book on the general subject of astronomy one can find. On the Acknowledgement Page author Patrick Moore writes: "The Atlas of the Universe owes most to international research and teamwork; and indeed it has been support from the international publishing community which has made it economically viable." The book is a high-priced one, but its excellent quality justifies the price.

I am sure that anyone who reads or just pages through the book will agree with the appraisal given it by Sir Bernard Lovell in the Foreword: "The Atlas of the Universe is original in that it is the first Atlas to draw together astronomical and terrestrial maps of the Earth as seen from Space, the Moon, the Solar System, the Stars, indeed the whole known universe into one volume. It presents all the most exciting discoveries in a new and ambitious form. The beauty of its design and execution is matched by its encyclopedic collection of information to provide a book of great contemporary inportance."

The 272-page Atlas of the Universe has over 1300 maps, diagrams, charts, and photographs in full color, two color, and black and white. Thirty of the illustrations are giant, full-page ones, and another thirty take up half a page each; but the average number of illustrations per page is five. However, the work is by no means merely a picture book with captions; for every illustration was carefully chosen to demonstrate specific points or themes expressed in the different chapters. The truth of the old adage, "a picture is worth a thousand words", is proven again and again on practically every page of Moore's book.

It is difficult enough to give an adequate view of the universe within the pages of a single book; but it is all the more difficult to give, within the limitations of a book review, a fair idea of the contents of a book which does succeed in giving ample treatment to such a broad subject. The book's five chapters, with their numbers of pages given in parentheses, are titled as follows: "Observation and Exploration of Space" (22); "Atlas of the Earth from Space" (48); "Atlas of the Moon" (50); "Atlas of the Solar System" (58); "Atlas of the Stars" (68). Fifteen more pages at the end present a catalog of stellar objects, a glossary of astronomical terms, a beginner's guide to the heavens, and an index.

The Atlas of the Universe opens with an account of the methods and instruments used in the investigation of the heavens from the time of the Greek philosopher Thales (7th century B.C.) right down to the flight of Apollo 13. The next chapter uses photographs taken from Gemini and weather satellites to illustrate treatises on meteorology, geology, geography, vegetation, and land use by man. The chapter on the Moon gives a succinct historical account of lunar cartography and many excellent diagrams of the Moon's movements, phases, librations, and eclipses; but most of the chapter is taken up with interesting Lunar Orbiter and Apollo photographs of the Moon. The Rand McNally Atlas of the Moon has been adapted, and it appears in six double-page sections with sufficient overlaps to eliminate any possible difficulties in relating one sector to an adjacent one. Two pages are allotted to a map of the far side, and one page each to the north and south polar regions of the Moon.

Two maps of Mercury (one by Camichel and Dollfus, the other by C. Chapman), two maps of both Venus and Mars, and a single map of each of the four Jovian satellites, Io, Europa, Ganymede and Callisto, are depicted in "The Atlas of the Solar System". The bands of Jupiter and the belts and rings of Saturn are shown in the good cross-section drawings of those two planets. Particularly noteworthy in this chapter are the six pages of Mariner close-up pictures of Mars and the set of nine color photographs taken by W. S. Finsen at the Republic Observatory in Johannesburg during the 1954 and 1956 apparitions of Mars.

Four pages of seasonal star charts are presented in the final chapter as well as the four large, double-page star charts which depict white stars on dark blue backgrounds, except that the brighter stars are lightly colored according to their spectral classifications. The good selection of photographs, especially the color photos from the Hale Observatories and the U. S. Naval Observatory, makes this chapter the most eye-catching chapter in the entire book; and the accompanying text, as is true throughout the entire book, is no less interesting than the pictures.

Few errors were detected. On page 159 Venus is said to transit the sun less often than Mercury because its inclination to the ecliptic is much less than that of Mercury. On page 179 the magnitude of Rhea is given as 9.0, whereas the commonly accepted value is 9.8. A minor typographical error appears in the first sentence at the top right of page 178, where "there" should read "that". An unfortunate type-setting error occurs in the last two sentences of the middle column on page 154. Three lines of print from the third column were inadvertently introduced into the middle column describing Mercury's 58.6-day rotation. The correct words were omitted, and the author's meaning was thereby lost.

The few errors mentioned above in The Atlas of the Universe are not serious enough for anyone to deprive himself of the pleasure of owning such a wonderful book simply because perfection was not attained. A better Atlas of the universe is not likely to be forthcoming until, by means of the orbiting telescopes and instrumented planetary probes of which NASA Administrator Dr. Thomas O. Paine writes in the Epilogue, we "press on into uncharted regions".

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The Lunar Rocks, by Brian Mason and William G. Melson, New York: Wiley and Sons, price $8.95. Photos and diagrams.

Reviewed by William K. Hartmann, Research Scientist, IIT Research Institute

This book might have carried a sub-title, "An Introduction to the Chemistry, Petrology, and General Interpretation of the Lunar Rocks, as Illustrated by Lava Samples from Two Mare Sites". At first, one might suppose that such a book would quickly become obsolete since the text largely depends on Apollo XI published results, supplemented by ongoing analyses of Apollo XII samples. However, Mason and Melson were obviously aware of this handicap in writing their book; and so instead of stressing interpretations which could quickly become dated, they stress fundamental facts and characteristics of the rocks, which teach the reader how such rocks form, what the crystal size patterns mean, what processes affect abundance patterns, etc. Chapter 4, for example, deals with the petrology of the lunar igneous rocks and is excellent introduction for any reader who intends to follow the study of lunar rocks through the next few years. The scientific papers by NASA investigators - e.g., in Science and Geochimica et Cosmochimica Acta - tend to take many of these facts for granted; and it is much harder to try to grasp the significance of lunar glasses, lava viscosity estimates, and isotope ratios from them than from this book.

The Lunar Rocks is aimed at the educated layman. The advanced high school student or (preferably) a reader who has had an introductory college course in geology can follow most of the arguments but must be prepared in Chapter 3 to leap into such terms as "orthorhombic crystal system" and "pleochroism".

Necessarily there are a number of out-dated passages. Chapter 2 describes the Apollo program "through Apollo 19"; whereas Apollos 18 and 19 have regrettably already been canceled, and 17 is threatened at this date of writing. Landing sites such as Tycho, Copernicus, and Censorinus, though discussed by Mason and Melson, are unlikely to be visited by the later Apollos (leading candidate sites now being Hadley/Apennines, Descartes, for terra, and the Marius Hills). Of course, there are facts from Apollo 12 and Luna 16 analyses that should be included. Announced at the 1971 Lunar Science Conference on Apollo 12 samples (known in the trade as the "Rock Festival") were the following important facts: (1) The mysterious "component X" that contaminates the lunar soil, giving it odd composition and age, is identified. It is a brown glassy material high in potassium, rare earth elements, and radioactive elements, hence known by the acronym KREEP; (2) KREEP may reflect the terra or upland composition; (3) The Luna 16 Sample from Mare Fecunditatis was very much like the Oceanus Procellarum Apollo 12 samples, but markedly different from the Tranquillity Base samples. Thus, there is an indication of two major types of lunar magma, as suggested also by the red- and blue-tinted maria.

If the weakness of this book is datedness, its strength is its value as an introduction. The price is a reasonable investment for the student who intends to study the moon and planets.

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Handbook for Planet Observers, by Günter D. Roth. Translation published in 1970 by Faber and Faber, Ltd., London. 205 pages, price $7.95. Translator - Alex Helm.

Reviewed by Rodger W. Gordon

In the past few years several books have appeared which are aimed primarily at the budding amateur astronomer who is looking for a field to specialize in. Roth's book, as its title implies, is intended for those whose interests lie in the Solar System.

Mr. Roth starts off by giving a few essential personal qualifications needed if one is to undertake this branch of observation successfully, and he then proceeds to the delicate question of the proper instrument necessary to undertake these exacting observations. Knowing full well that arguments over "which type of telescope is best" will continue as long as there are telescopes, the author unhesitatingly airs his opinions on this subject. Briefly, he recommends long focus refracting systems and long focus unobstructed reflectors over the more common Newtonian and Cassegrainian systems. Here, one cannot really argue with him. There is no doubt that unobstructed optical systems give better lunar and planetary performance than their equivalent obstructed counterparts. Having used a $4\frac{1}{4}$" F/27 Schiefspiegler some years ago, I can confirm that the unobstructed system gives excellent contrast and a remarkably dark field-essential in lunar and planetary work.

However, the author should have mentioned that long focus unobstructed reflectors should best be left alone until one is pretty knowledgeable around telescopes. Since (at least in the U.S.) there is no commercial manufacturer of unobstructed optical reflectors, if one is interested in this type of telescope, he has no recourse but to make one himself. Unobstructed reflectors, indeed, give remarkable results; but the optical system needs additional corrector lenses in the larger apertures (above $4\frac{1}{4}$"). Furthermore, these systems must be fastidiously aligned if one is to get the full benefits of their potential. It would be better for a novice to stick to a 3"-6" refractor or a conventional 6"-12" Newtonian before advancing to the unobstructed reflectors.

Mr. Roth covers such topics as photometers and micrometers for amateur instruments and gives some excellent diagrams for types which are comparatively easy to construct. The value of color filters in lunar and planetary work is fully treated, but the list of Schott filters recommended will be unfamiliar to most American readers. Hints on observing at the telescope, making drawings, and accessory equipment are adequately covered also. One excellent and badly needed chapter is on "Evaluating Observational Data". This chapter should be read and reread by everyone who is interested in evaluating his results or the results of others. Another excellent chapter is the one on photography, and a long series of photos (mostly secured with an 8" refractor) and drawings are shown. The details in the photos with the 8" are remarkable, but the printer has allowed some to become contrasty and harsh.

There follow separate chapters devoted to each planet (including the asteroids), which give a general description of the planet's appearance and pertinent observational techniques. Lunar observation could have been more adequately covered with more emphasis placed on current needs in lunar observing rather than a rehash of drawing craters. As of now, searching for fine crater detail is practically obsolete with the coverage of the moon so adequately done by the lunar Orbiters from close up. [But see "Observing the Moon: the Spacecraft versus the Telescope" by Dr. John Westfall, Str. A., Vol. 22, Nos.

11-12, pp. 187-192. --Editor.]

There are some errors in the book. Mercury is still listed as having a captured rotation. The diagram on the structure of the Martian atmosphere needs updating in the light of results from Mariner 6 and 7. Since the book is a translation of the original German edition of 1966, it would appear that there has been no updating in the English translation.

For its intended audience, this is a satisfactory book. It can fill an effective gap from the general astronomy book to the long-awaited (and hopefully soon to be published) A.L.P.O. Observer's Manual.

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This Island Earth, National Aeronautics and Space Administration, 1970. Washington, D.C. 182 pages. Edited by Oran W. Nicks. Price $6.00. Sold by Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402 as NASA Publication SP-250.

Reviewed by K. R. Carver, New Mexico State University

This Island Earth, a 7-chapter NASA special publication, is an imaginative and thought-provoking perspective of our planet, emphasizing our unique position within the Solar System and the fragility of the conditions which support human life. Over 140 color space photographs, taken mostly by the Apollo astronauts, are used to provide a synoptic view of the earth which illustrate man's existence and impact on the globe. Separate chapters emphasize the atmosphere, the waters, and land masses as seen from outside the atmosphere.

The final chapter, entitled "Beyond This Island Earth," appears to be a little out of place, emphasizing as it does the plans of NASA for planetary exploration, and detracts from the continuity of the first six chapters devoted to the title topic. However, the book is generally very well done and certainly underscores the usefulness of space imagery in the better understanding of the earth.

LUNAR NOTES

By: Harry D. Jamieson and H. W. Kelsey

The Lunar Section and Its Programs (Harry D. Jamieson, ALPO Lunar Recorder)

More than a year ago the Lunar Recorders reported to the membership on the then current crisis in membership participation in the Section's programs. Several changes were then disclosed and discussed which we hoped would help to reverse the steady downward trend and restore your - the reader's - interest in our activities. These were:

1. The addition of two new programs, to deal with bright and banded craters and the heights, depths, and slope angles of previously ignored features.

2. The expansion of two of our present programs to include a wider range of studies.

3. Regular publication in The Strolling Astronomer of a new feature to be known as "Lunar Notes".

4. An ALPO Lunar Observer's Manual, discussing current programs, methods, and goals.

This writer is happy to report now that these changes and additions have resulted in a definite upswing in the number of our members participating in Section programs. While this rise was not so great as the Recorders would have hoped, it nevertheless is obvious and continues to grow.

In an effort to encourage this recent revival, the Lunar Recorders have of late initiated some further changes which appear to be - from our mail - what the members desire for the Section. These are:

1. The Lunar Dome Survey, perhaps the longest-running program in the Section's history, is being discontinued. It has not shared in the recent surge of new interest, and so it is with considerable regret that we shall soon publish a final paper dealing with its results to date and retire it. Should any member wish to

continue studies of these features, however, this writer will be more than happy to accept his observations. Moreover, should general interest in the program revive (and it still has more than half of its original goals left to be accomplished!), it will be happily recreated.

2. The initiation of a new program to deal with the distribution, number, and origin of craters having dark halos. While the best known examples of these craters may be found within Alphonsus, at least eighty more are known or suspected to exist scattered elsewhere on the Moon.

3. The Vertical Profiles Study has been discontinued for lack of interest. It had been hoped that the Steep Places Program could be revived and made into a part of this larger program; but such has not turned out to be the case, and the Steep Places file has been turned over to the Editor for the safe-keeping of its valuable observations in the ALPO Library.

4. Work will soon start on a new and up-to-date Lunar Observer's Manual, which will cover all of the changes discussed here.

5. While not now an official part of the Lunar Section, the Training Program under the direction of Charles L. Ricker welcomes observers seeking instruction in the art and science of making worthwhile lunar and planetary observations. Also, observations of a general nature not connected with either a Lunar Section official program or one of the official programs of one of the planetary Sections may be sent to Mr. Ricker, who is now caretaker for all general observations not covered by a regular program.

The programs now being offered by the Lunar Section, along with the Recorders in charge of them, are as follows:

1. The Rev. Kenneth J. Delano will now be in charge of our new Dark Haloed Craters Program, on which work has already begun.

2. The writer will continue to direct our Bright and Banded Craters Program, which has grown well since its start one year ago.

3. Mr. Julius Benton has taken charge of our Selected Areas Program, which has also prospered well during the past year. He is assisted by Christopher Vaucher.

4. John E. Westfall continues to be in charge of our very fine Lunar Photograph Library and welcomes inquiries from interested members engaged in research where high-resolution Earth-based, Ranger, Apollo, and Orbiter photographs would be helpful.

Further details about any of the above programs and services will gladly be given by the appropriate Recorders on request. The Lunar Section and its research prosper only as our members continue to support them. The last year has shown a gratifying increase in membership support of the Section and its activities, but it must be realized that we can be effective in lunar research only to the degree that our members support us with observations and reports. This writer for one could easily direct and process observations for as many as three programs with the volume presently being received by the Bright and Banded Craters program, and I know that this is true for at least one and perhaps two of our other Lunar Recorders. The Moon has many, many areas of research open to the amateur in which he can make some quite frankly valuable contributions. The opportunity is there; the choice is yours.

The Selected Areas Program (H. W. Kelsey, former ALPO Lunar Recorder)

There have been several valuable observation reports received since the publication of the last Lunar Notes, and it is from these reports that the following interesting excerpts have been selected.

Steven Szczepanski is finding and reporting several interesting features within Atlas. Special notice is given to Steven's sighting of two of the Atlas rille systems with his 10-inch reflector at seeing 5, transparency 5.5, Colongitude 14°.74 and 112°.55.

Mrs. Inez Beck has sent in an almost complete daily observation series on Eratosthenes with only one night missing because of cloudy skies. Additionally, Mrs. Beck asks

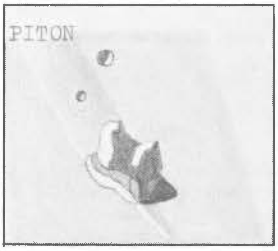

Figure 32. Drawing of Lunar Mountain Piton by Richard J. Wessling. Nov. 7, 1970, 23^h20^m–23^h40^m, U.T. 12.5-inch refl., 356X. Seeing 5, transparency 3. Colongitude 20°.5.

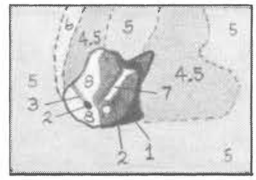

Figure 33. Drawing of Lunar Mountain Piton by Julius L. Benton, Jr. Nov. 8, 1970, 1^h30^m–2^h5^m, U.T. 4-inch refr., 262X. Seeing 6, transparency 4. Colongitude 21°.7.

if there have been any ideas expressed regarding the nature of the small non-shadow dark area adjacent to the east side of the central mountain range of Eratosthenes. This dark area is clearly indicated in Strolling Astronomer, Vol. 22, Nos. 9-10, page 176, Figs. 7-8-9-10. Perhaps comments on this subject can appear in a later Lunar Notes.

Richard Wessling has directed his 12.5-inch reflector at the following formations: Piton, Pico, and Eratosthenes. His Eratosthenes drawing that was made on December 15, 1970 at Colongitude 112°.21 is in fairly close confirmation with Inez Beck's drawing in Strolling Astronomer, Vol. 22, Nos. 9-10, page 176, Fig. 10. Particularly, this is true of the small non-shadow dark area adjacent to the east side of the central mountain range. The apparent existence of a cliff was reported lying adjacent to the east side of Piton and was seen on November 7, 1970 at Colongitude 20°.5. It was also reported that an interesting small "flooded" crater's rim was seen lying adjacent to the southwest side of Piton at Colongitude 82°.4. Regarding Pico, this observer comments that at Full Moon this formation appears to have no form that could conceivably be associated with a mountain mass.

Julius L. Benton, Jr. has also sent us a meaningful series on Piton, with one of his observations complementing Wessling's observation of November 7, 1970. These two drawings are presented for your study as Figures 32 and 33. Since Julius Benton doesn't mention the Piton cliff that was referred to by Wessling, it can be assumed that the two hours separating these reports was sufficient for the changing angle of light to render the cliff invisible in the later observation. Several interesting tonal changes on Piton and the surrounding mare were also a part of this report.

James C. Bartlett, Jr. has reported a typical Plato anomaly, and he is hopeful that another observer working at the same time can contribute a positive or negative correlation. This observation was made on November 8, 1970, between 0131 and 0147 U.T. The condition noted was that Plato's floor, with the single exception of the central craterlet, was completely devoid of detail. However, an unusual aspect of this observation was found in the presence of a minute but distinct shadow within the central craterlet, unusual because it demonstrates a total lack of obscuration over this very small part of the floor. Dr. Bartlett believes that this aspect appears to suggest that some cause other than obscuration must account for the lack of all other detail on the floor. A search of previous observations made at or near this Colongitude of 21°.6 has revealed that several floor spots (craterlets) and bright streaks should be expected. We shall appreciate hearing from any other observer who was looking at Plato at this time and date.

Note by Editor. Since Mr. Kelsey wrote this article, he has found it necessary to resign his Lunar Recordership because of personal reasons. We are sorry to lose his services and want to take this opportunity to thank him for his years of devoted service as a Lunar Recorder.

The Selected Areas Program is now being directed by Mr. Julius L. Benton, Jr., 735 E. 49th St., Apt. A, Savannah, Georgia 31405. All observations in the Selected Areas Program should now be mailed regularly to Mr. Benton. He is being helped by Assistant Lunar Recorder Christopher Vaucher, 6130 S.E. Reed College Place, Portland, Oregon 97202. Mr. Vaucher is another welcome newcomer to our staff and has already shown great enthusiasm and energy as a contributor to ALPO lunar projects.

Definition of Colongitude. This term appears frequently in lunar articles in this journal but may be unfamiliar to some of our readers. The sun's selenographic colongitude is the lunar western longitude (in the IAU sense) of the sunrise terminator, measured along the lunar equator from the center of the lunar disc at mean libration. It measures the solar illumination of a lunar feature. It is approximately 0° at First Quarter, 90° at Full Moon, 180° at Last Quarter, and 270° at New Moon.

OBSERVING MARS II. EVERYTHING YOU WANT TO KNOW ABOUT MARS IN 1971 - BUT DO NOT HAVE TIME TO ASK

By: C. F. Capen, ALPO Mars Recorder

The 1971 Martian apparition is the second of the most favorable perihelic apparitions of this century. The planetary aspects and Martian seasonal conditions are similar to those of the 1956 apparition. Oppositions of Mars occur at an average interval of 2 years and 50 days, or 780 days, which is also the mean synodic period of revolution between Earth and Mars. The 1971 opposition occurs on August 10th at an areographic orbital longitude of 232° (L_s) with an apparent disk diameter of 24.89 arc-seconds. The opposition areographic longitude is only 16° from the perihelion longitude at 248° L_s, which is passed on September 7th, 1971. The distance between Earth and Mars is seldom at minimum at the time of opposition because of the eccentricity of their orbits. During this apparition the closest approach occurs on August 12th with a disk diameter of 24.91 arc-seconds at a distance of only 34.9 million miles.[1] This is the closest that Mars has been to the Earth since August, 1924, when it subtended 25.1 arc-seconds at only 34.66 million miles.

Mars will have a sufficient apparent disk diameter of at least 6 arc-seconds and hence suitable for visual observations for 12 months from mid-February, 1971 to February, 1972. Fig. 34 presents "A Graphic Ephemeris for Mars 1971", which shows the apparent disk diameter (dashed curve) and declination (solid curve) relative to each other, the terrestrial date in 1971, the Martian Date, and the areocentric orbital longitude L_s. Quality visual observations can be acquired from about the first of April to the end of December, 1971, while the disk diameter is 8 arc-seconds and greater for a period of 275 days. It is practical to carry on photographic observations during this time. High-resolution observations are possible with a diameter of 20 arc-seconds or more for a period of 76 days from early July to mid-September.[1,3]

Although Mars has a most favorable apparent disk diameter during this apparition, it will be relatively low on the horizon for observers in North America, Northern Europe, and England. This circumstance will decrease the quality of astronomical seeing, increase prismatic dispersion, and decrease sky transparency from atmospheric absorption and horizon haze. The apparent declination of Mars is a low -23°5 in March, -18°8 in June, and again -23° just after opposition in late August. It does not approach the celestial equator until near the end of the apparition. The relationship between the curves of Figure 34 shows that the best planetary aspects for Mars occur during the months of June, July, October, and November for observers in the earth's northern hemisphere, and are best from May until mid-November for southern observers.

The axial tilt of the globe of Mars relative to the earth favors observation of the southern hemisphere during most of the 1971 apparition. Fig. 35 depicts the relative sizes, axial tilts, and varying phases of the globe of Mars during 1971. Only during February and March, 1971 was it practical to ascertain the small static North Polar Cap and its environs. The sub-earth point D_e moved southward from +07° D_e in February and crossed the Martian equator about March 1st as the south pole tilted toward the earth. The maximum southern tilt occurs on December 23 at -25°8 D_e. Fig. 36 is a graphic ephemeris of the areographic latitude positions of the sub-earth (solid curve) and sub-sun (dashed curve) points during the apparition. These two curves are important to students of Mars because they predict and explain what is observed on the disk of Mars. The sub-earth point curve tells what surface features rotate through the disk center, and the subsolar point curve defines the latitude of the thermal equator. The two curves cross each other twice during this apparition, once on July 23 at an areographic latitude of -16° and again on November 12 at -23°. This event is most important because it is during these times, plus or minus a week, that specular reflections from brightened or whitened areas are possible. When the sub-earth and subpolar points coincided in 1969, the frost areas along the Deucalionis Regio and on the Edom sparkled and scintillated at Martian high-noon. Areographic areas that exhibit seasonal whitenings are discussed in "Mars - A Dynamic World" and are listed in "The Planet Mars in 1969."[4,5] These articles are found in the ALPO Mars observing kit.

The seasons of Mars that occur during an apparition are of particular interest to the observer in denoting meteorological activity and surface changes. The Martian seasons are analogous to the terrestrial seasons; however, they average nearly twice as long, and they are unequal in length because of Mars' orbital eccentricity. The Martian summer solstice of the northern hemisphere occurred in November of 1970, and the autumnal equinox in

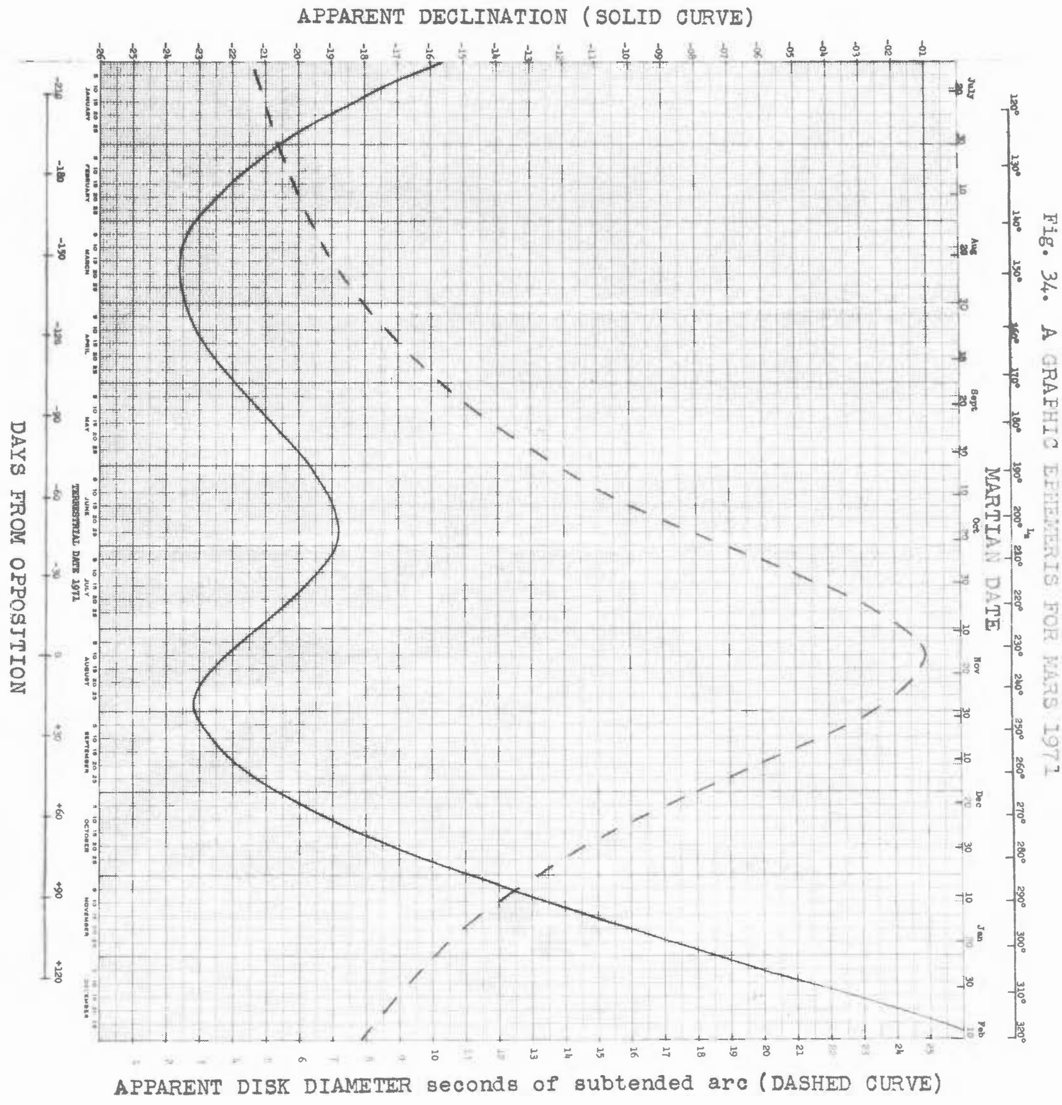

Figure 34. Graph to show apparent angular diameter and declination of Mars during the current 1971 apparition. Contributed by C. F. Capen. See also text of his article on page 34 *et seq*.

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the north comes in May, 1971; consequently, increased seasonal activities should be apparent chiefly in the southern hemisphere. However, from the equator northward to the all encompassing north polar hood there should be many bright aerosol hazes and frost brightenings. Also, this season affords the opportunity to observe the changing appearance of the northern surface features throughout their fall and winter seasons relative to the spring and summer seasons of the southern hemisphere. It will be spring in the Martian southern hemisphere around the time of opposition, and late summer roughly by the time when the disk becomes too small for useful observation in February, 1972. It is most proper to compare the disk aspects on one Martian Date to that on another. Furthermore, the seasonal characteristics of the disk features obtained in 1971 may be compared with those from drawings and photographs obtained during the similar season and disk aspects of the 1956 apparition.[4-11] Table 1 lists a selection of Martian Dates (MD), solstices, and

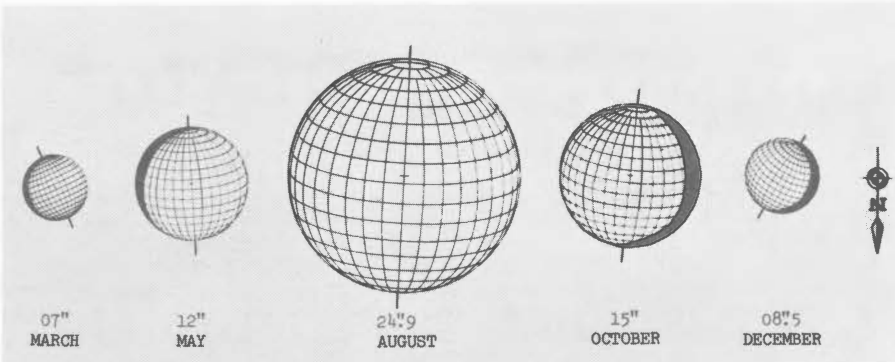

Figure 35. Diagrams to show relative apparent angular diameter, axial tilt to the earth, and phase of Mars during different months in 1971. Parallels of latitude and meridians of longitude are drawn in. Contributed by C. F. Capen; see also his text.

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equinoxes pertaining to the current apparition. The Martian Dates should be intimately studied relative to the apparent disk diameter, celestial declination (Fig. 34), and past seasonal activity.

Table 1. The 1971 Martian Seasonal Dates

TD	L_s	MD	TD	L_s	MD
Jan. 1 '71	112°	15 July	July 1 '71	207°	21 Oct.
N. Summer - S. Winter			Aug. 1	227	10 Nov.
Feb. 1	127	30 July	Sept. 1	246	28 Nov.
Mar. 1	140	13 Aug.	Oct. 1	265	17 Dec.
Apr. 1	156	30 Aug.	Oct. 9	270	22 Dec.
May 1	172	15 Sept.	N. Winter - S. Summer		
May 15	180	23 Sept..	Nov. 1	284	5 Jan.
N. Autumn - S. Spring			Dec. 1	303	23 Jan.
June 1	190	3 Oct.	Jan. 1 '72	321	9 Feb.

The ALPO Mars Recorders have planned a rigorous program chronologically to file, classify, and digest the observational data as it is received from ALPO observers, and to keep cognizant of unusual phenomena and important changes. Interesting observations will be reported as "Observation Notes" in the current issue of The Strolling Astronomer. Furthermore, a Martian News Service will be sustained by Recorder C. Capen throughout the 1971 apparition. It will provide rapid notification, for those interested, of important observations as they are received from observers of Mars, observational aids, and an exchange of observational ideas. Those interested in receiving the "Martian News" should send from 6 to 10 self-addressed and stamped long envelopes to the Mars Recorder. When observational data have been copied on the standard ALPO observing forms, they should be sent in at regular one or two month intervals. Reports of newly discovered changes or unusual Martian events should be sent immediately by fast mail to C. Capen, 223 W. Silver Spruce, Flagstaff, Arizona 86001.

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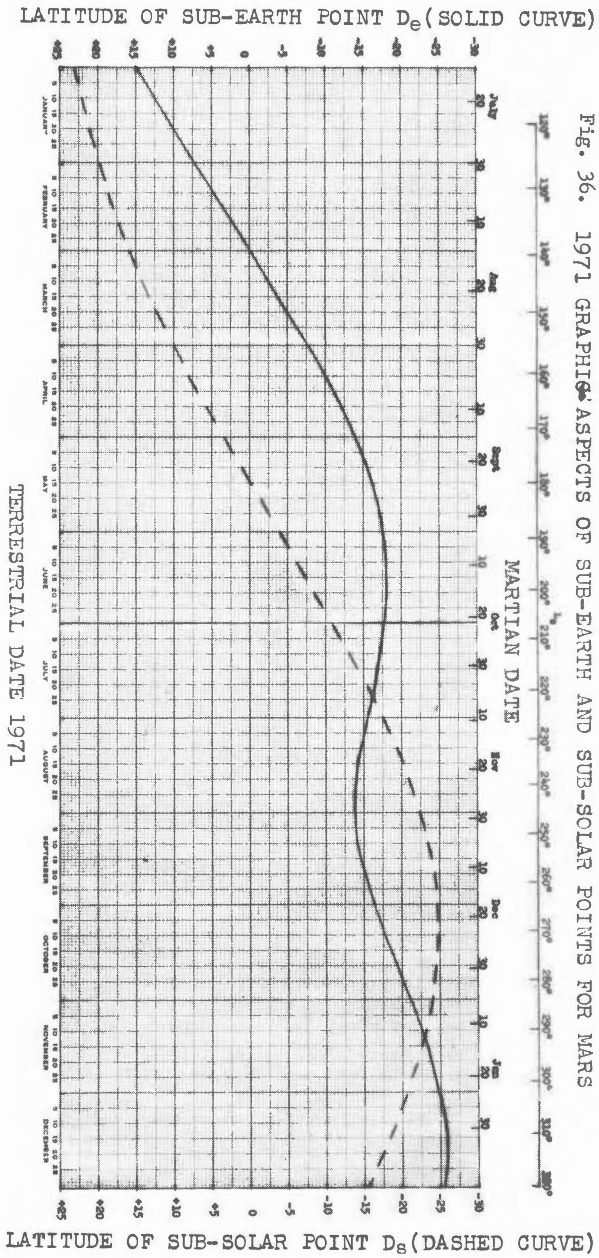

Figure 36. Graphs to show latitudes of sub-earth point and sub-sun point on Mars during the 1971 apparition of Mars. Contributed by C. F. Capen. See also text.

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ANNOUNCEMENTS

Correction of Error in Vol. 22, Nos. 11-12. Mr. Toshihiko Osawa has written to point out an error affecting the top several lines on pg. 193 of Vol. 22, Nos. 11-12 of this journal. He finds that at his station in Japan the predicted time of First Contact for the transit of Mercury across the sun on May 9, 1970 was actually $4^h18^m43^s$, U.T. (not $4^h19^m23^s$, as previously published). With an observed time of $4^h18^m50^s$, U.T. his corrected O-C residual is +7 seconds, both small and in the same sense as for most observers.

International Conference on Education in and History of Modern Astronomy. This meeting is to be held on August 30, August 31, and September 1, 1971 at the American Museum-Hayden Planetarium in New York City. The co-sponsors are the American Astronomical Society and the New York Academy of Sciences. The meeting is being called the Minnaert Memorial Conference in honor of the late Professor M. G. J. Minnaert. A partial list of distinguished speakers includes G. Abell, T. Gold, C. Payne-Gaposchkin, P. Van de Kamp, F.

Whipple, K. Henize, D. Menzel, B. Strömgren, and many others. The Conference Chairman is Dr. Richard Berendzen, Department of Astronomy, Boston University, 725 Commonwealth Avenue, Boston, Massachusetts 02215. A proceedings of the meeting will be published as a bound volume.

Concerning Requests for Back Issues. We receive fairly frequent requests from readers to replace past issues which they lack. We suspect that these requests are often made when back issues, sometimes several volumes of them, are being assembled for binding; and the absence of a particular issue is discovered. While we regularly try to meet such requests, we would point out that many past issues are totally out of stock. If you miss an issue or lose one, it will be best to request the replacement soon, not several years after publication. Thank you.

Changes in ALPO Recorders. Changes in the Lunar Section have already been described in the "Note by Editor" on page 33.

For some time Messrs. Thomas Cragg and Larry Bornhurst have found that their professional work at the Mount Wilson Observatory leaves extremely little time for their efforts as ALPO Saturn Recorders. We greatly appreciate the volunteer work which these two men have done for our Association and thank them. In particular, Mr. Cragg has been on the Saturn Section staff for about 15 years. We certainly warmly invite their needed future contributions to ALPO projects. Nevertheless, it has become imperative to reorganize the Saturn Section.

The new Saturn Recorder is Julius L. Benton, Jr., 735 E. 49th St., Apt. A, Savannah, Georgia 31405. Mr. Benton is a physics teacher, and his picture with a 6-inch Clark objective appears on page 228 of Sky and Telescope, April, 1971. His general plans for the Saturn Section are outlined in "Aims of the A.L.P.O. Saturn Section" on page 10; and his first Saturn Report, on two recent apparitions, is scheduled for our next issue, Vol. 23, Nos. 3-4. We are delighted to have him join our staff.

Changes in Addresses of ALPO Recorders. The present address of Lunar Recorder Harry D. Jamieson is P. O. Box 30163, Middleburg Heights, Ohio 44130.

The current address of Assistant Jupiter Recorder Phillip W. Budine is 65-C Millside Manor, Delran, New Jersey 08075.

WAA Convention in Hawaii. In 1971 the Western Amateur Astronomers will meet in Honolulu, Hawaii on August 24, 25, and 26. The site will be the Princess Kaiulani Hotel, 120 Kaiulani Ave., Honolulu. Persons interested in presenting a paper should write at once to Mr. Maurice V. King, 2536 Olopua St., Honolulu, Hawaii 96822. It is planned to furnish a Proceedings at the start of the Convention. The dates chosen are at the peak of the tourist season in Hawaii so that hotel accommodations should be requested as soon as possible. The host is the Hawaiian Astronomical Society. It is planned to shorten the afternoon paper sessions in order to allow the delegates more time "on the beach" - an arrangement which will surely be popular with the delegates!

Mr. King has kindly given the Editor a modest supply of the 1971 W.A.A. Convention News Bulletin #2. These will be furnished upon request to interested persons while they remain in stock.

Astronomical League—ALPO Convention at Memphis. The 1971 National Convention of the Astronomical League and the 19th Convention of the Association of Lunar and Planetary Observers will be held jointly on August 18-22 on the campus of Southwestern College, Memphis, Tennessee. The host society is the Memphis Astronomical Society. The General Convention Chairman is Mr. William J. Busler, 441 South Reese St., Memphis, Tenn. 38111, to whom all inquiries should be addressed. Of special interest to ALPO members during the meeting will be Mars, which on August 12 will have made its closest approach to the earth since 1924 (see Mr. Capen's article on pages 34-37). The moon will be new on August 20 so that deep-sky enthusiasts should also be happy. Southwestern College's 31-inch reflectors will be available during the Convention, and delegates are also encouraged to bring their own telescopes.

The registration fee before August 1, 1971 is $2.00 for an individual, $3.00 for a couple, and $4.00 for a family group of three or more. After August 1 these rates will be $3.00, $5.00, and $6.00 respectively. Housing accommodations are available on the Southwestern campus for $5.00 per person per night. There are about 300 new rooms with central air-conditioning, carpeting, lounges, and semi-private baths and 400 older rooms somewhat less luxurious. Breakfast and lunch can be bought on campus for $3.50 per day on Thursday, Friday, and Saturday; Sunday breakfast will be $1.50. Delegates will make their own evening dinner arrangements at many excellent restaurants in Memphis. The banquet will be a real novelty: a 4-hour excursion on the Memphis Showboat, dinner choices including catfish and barbecue, and an observing session on a sand bar in the Mississippi River, for a total cost of $7.50. The Proceedings may be ordered in advance for $1.00, and 8x10-inch prints of the Convention Group Photograph will also sell for $1.00. Registration fees and other costs may be sent now to Mr. Busler at the address given above. Checks should be made payable to "Astronomical League—ALPO Convention".

Registration will begin at noon on Wednesday, August 18; and evening activities will include informal socializing, observing, and setting up exhibits. The tentative program assigns the forenoon of Thursday, August 19, to the usual opening welcoming speeches and to League and ALPO business meetings. General paper sessions will follow, and there may be an evening field trip to neighboring observatories. On Friday, August 20, there are to be two ALPO paper sessions, followed by a Junior Session. In the evening there will be a tour of the college facilities. On Saturday there is to be a third general paper session, the group photograph, and the final business meetings. The Banquet-Boat Ride-Observing is to begin at 6:30 P.M. Breakfast and church on Sunday morning, August 22, will conclude the Convention.

Our friends in the League and the W.A.A. have often expressed the thought that a major advantage of ALPO participation in a joint Convention is the many worthwhile papers on a wide variety of subjects which ALPO members then regularly present. We hence strongly urge qualified members to begin to prepare their papers at once. Please send the title, an abstract, an estimate of the reading time, and your projection machine requirements at your very earliest convenience to Walter H. Haas, Box 3AZ, University Park, New Mexico 88001. Mr. Busler informs us that the program is taking shape well. Speakers include Robert Cox, Sol Levy (Kitt Peak National Observatory), Ernest Reuning (University of Georgia), Walter Houston, and Mrs. Winifred Cameron of NASA. ALPO papers have been promised by Leonard Abbey, Julius Benton, Charles Morris, Harry Jamieson, Paul Mackal, Charles Ricker, and others. We need more.

Many members may wish to contribute to the ALPO Exhibit at Memphis. The Exhibit is in charge of Mr. Harry D. Jamieson, P.O. Box 30163, Middleburg Heights, Ohio 44130. Drawings, charts, and photographs of the bright planets, comets, and lunar features have been found to be the most suitable exhibit material. Mr. Jamieson will welcome your inquiries, correspondence, and display contributions. Again, some haste is needed; in order to give Mr. Jamieson time to organize the ALPO Exhibit, he ought to have all the material by July 1, 1971 at the latest.

Journal for the History of Astronomy. This new specialized professional publication may be of interest to some teachers and certain others in the ALPO. To quote: "This important journal covers the history of astronomy, astrophysics and cosmology from the earliest civilizations to the present day. Its subject matter extends to allied fields, including the history of navigation, time-keeping and geography, and the history of relevant branches of mathematics and physics." Further information and prices may be obtained from Purnell Journals, 850 Seventh Ave., New York, N. Y. 10019.

CRAIG L. JOHNSON, 1941-1970

Those who read this journal in the late 1950's and early 1960's must have noticed often the name of Craig L. Johnson in the lists of contributing observers. The Editor and many others made his personal acquaintance at the National Amateur Astronomers Convention in Denver in 1959. It was hence a shock to learn that he was killed in an accident in July, 1970. He is survived by his widow, Kathleen Johnson, a son Brian born in June, 1970, and his parents, to all of whom we extend our sympathy. The biographical details which follow were kindly supplied by Mrs. Kathleen Johnson. The paper "Meteoritic Impacts as Geologic Features", published serially in this issue and the preceding one, was contributed in June, 1970; and we must regret that it could not have been published while the author still lived.

Craig was born in Racine, Wisconsin on December 31, 1941. A very early interest in astronomy was deepened when he read The Glass Giant of Palomar in 1948. He acquired a 4-inch reflector at the age of 12 and soon was a member of several astronomical societies and a regular correspondent of some other observing amateurs. His chief interest was in lunar observations, and in his brief life he accumulated nearly 500 typed pages of observing notes and took nearly 3000 astronomical photographs with full data for each one. The amount of detail which he recorded visually was remarkable for an aperture of 4 inches, and he employed extremely high magnifications for this aperture. While in high school, Craig was awarded a grant from the National Science Foundation for a study of lunar shadows.

He became interested in flying in 1964 and was married in 1966. At the time of his death he worked as a radiation monitor for the Dow Chemical Company near Denver. His interest in astronomy continued high, although time for observing and correspondence was necessarily reduced.

The ALPO has always attracted a large number of enthusiastic, energetic teen-agers in its 24 years of existence. We hope that we have been able to provide them with helpful guidance in learning some subject matter in astronomy, in gaining insight into methods of collecting and studying observational data, and in assisting the maturing of each individual's own scientific thinking. Craig Johnson's article "Meteoritic Impacts as Geologic Features" should indicate the development attained by an ambitious 12-year old who typed all his letters lest his correspondents discover his age. We shall be gratified if this generation of juvenile space enthusiasts imitate his attention to details in observing, his methodical ways, his modesty, and his constant eagerness to learn.

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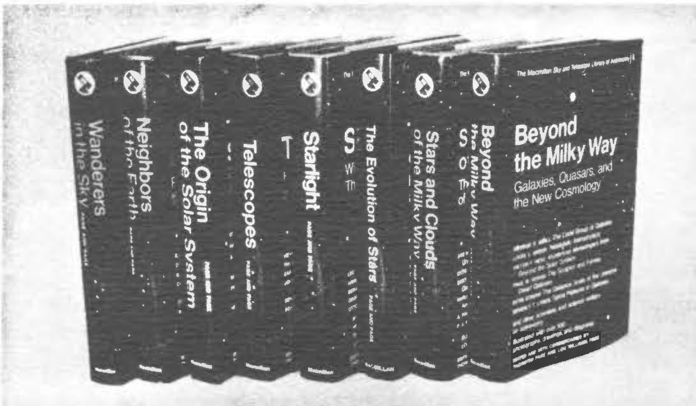

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