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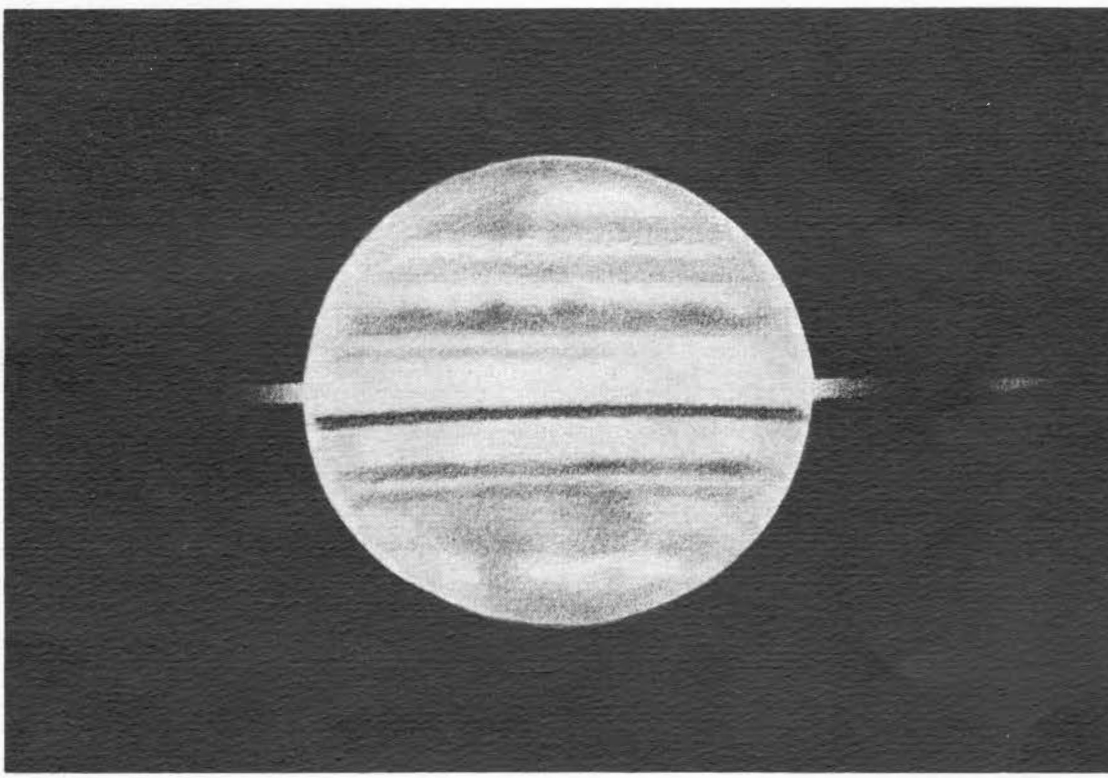

Drawing of Saturn on November 8, 1966 at 10 hrs., 15 mins., Universal Time by Toshihiko Osawa. 6-inch reflector, 230X. Seeing 4-6 (fairly good), transparency 4.5 (fairly clear). Earth on unilluminated side of rings in this view. Saturnicentric latitude of earth 0.17 degrees North, Saturnicentric latitude of sun 2.17 degrees South. See also page 72.

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A WORKING LIST OF STEEP PLACES ON THE MOON

By: Joseph Ashbrook

This paper is an annotated check list of 142 places on the moon for which slope angles of more than 30° to the horizontal have been reported. It has been prepared to aid ALPO observers who are sharing in Charles L. Ricker's coöperative program to detect and study lunar steep places.[1] This provisional list is not complete, and contains some doubtful and controversial cases. It is intended only to suggest some formations warranting systematic shadow observations.

The practical test for a steep place is black shadow far from the terminator. If shadow is seen, the angular altitude of the sun at that place gives a lower limit to the slope angle there; in the absence of black shadow, the solar elevation is an upper limit.[2]

In this check list, all angles are solar altitudes, unless otherwise specified. Thus, "shadow at 38°" means the presence of a slope angle of more than 38°. The directions E. and W. refer to east and west in the new (IAU or astronautic) sense; in quoting from observers using east and west in the old sense, I have always made the necessary inversion. The formation names accord with current IAU usage (except that the familiar Schröter's Valley, Straight Range, and Straight Wall are preferred to their Latin equivalents). For craters, "wall" always means inner wall, with one exception noted in connection with Tycho.

To keep the listing from becoming too bulky, with few exceptions craters smaller than about 10 miles across have been excluded, since steep slopes are the general rule for them. No special search of the literature was made, and most of the data are from four sources:

1) JA: Unpublished visual observations by the writer with a 10-inch reflector in 1959-1961.
2) PBM: H. Pohn, B. C. Murray, and H. Brown, "New Applications of Lunar Shadow Studies," PASP, 74, 93-105, 1962. Study based upon photographs with large telescopes; deals with Mösting and Piton in great detail.
3) Pohn: H. Pohn, "New Measurements of Steep Lunar Slopes," PASP, 75, 186-188, 1963. During a program of photoelectric photometry of craters with the 60-inch Mt. Wilson reflector, Pohn kept records of shadow visibility. His printed table gives for each of 19 craters the greatest solar altitude at which he saw shadow, but unfortunately no descriptions. With a 60-inch aperture, Pohn's results are particularly valuable.
4) Schm.: J. F. J. Schmidt, Charte der Gebirge des Mondes, Erläuterungsband, 1878. Schmidt's slope observations were made chiefly in the 1850's with a 5-inch refractor. Because Schmidt's book is unindexed, I always cite the page number. As a rule, I select only the observations corresponding to his mu-shadows, defined on page 95 as "first or last traces of true black shadow...." Schmidt's crater names have been replaced by their modern equivalents, whenever needed.

1. Agarum, Promontorium. W tip holds shadow with sun 38° up (JA); on 1854 Sept. 27 shadow seen at 48°, and next night even traces at 60°! (Schm. p. 214)

2. Agatharchides A. Much E wall shadow at 31° (JA).

3. Agrippa. E wall has much inner shadow at 42°, strong crest-line shadow at 43°, none at 51°; W wall may be less steep, for crestline shadow seen at 38° was once missed at 34° (JA).

4. Alfraganus. E wall shadow at 46° (Schm. p. 136).

5. Aliacensis. E crestline shadow at 32° and 31° (JA); W shadow at 37° (Schm. p. 190).

6. Anaxagoras. Shadow seen on E wall at 40° and on W wall at 38° (Pohn).

7. Apianus. W wall shadow at 34° (Schm. p. 190).

8. Arago. E wall shadow at 40° (Schm. p. 135).

9. Aratus. Much E wall shadow at 31° (JA).

10. Archimedes. W wall has rim shadow at 35° (JA), at 41° (Schm. p. 153).

11. Archimedes C. W wall shadow at 42° (Schm. p. 153).

12. Aristarchus. W wall shadow at 31° (Pohn).

13. Aristillus. E rim has a little shadow at 39° (JA); W wall shadow seen at 48° (Pohn); both E and W at 37° (Schm. p. 153).

14. Aristoteles. E wall shadow at 32° (Pohn and Schm. p. 231); W wall shadow at 32° (Schm. p. 243) but only a very little along crest at 33° (JA).

15. Arzachel (central peak). E and W sides show some shadow at 38° and 40°, respectively (Schm. p. 190).

16. Atlas A. E inner slope has much shadow at 32° (JA).

17. Autolycus. E wall shadow at 37° (Schm. p. 153).

18. Bellot. On 1854 March 4, at 33°, interior shadow of E wall long enough to measure with micrometer (Schm. p. 32).

19. Bernoulli (central peak). Shadowed "by an already very high sun" (Schm. p. 223) on 1851 Feb. 7.

20. Berosus. E wall shadow at 35° (Schm. p. 222).

21. Bessarion. W wall shadow at 55° (Schm. p. 169).

22. Bessarion E. W wall shadow at 55° (Schm. p. 169).

23. Bessel. E wall has some shadow on its upper reaches at 38° and 39°, a small spot left at 45°, but all gone at 51°. The W wall may be less steep, having little or no shadow at 36° and none at 40° (JA).

24. Biot. W wall shadow at 45° (Schm. p. 206).

25. Birt. Much E wall shadow at 32°, much W at 42° (JA); some on W wall at 46° (Pohn).

26. Blanc, Mont. W flank showed a good deal of black shadow at 32° (JA).

27. Bode. E inner slope had much shadow at 34° on two dates (JA); some W wall shadow at 38° (Schm. p. 126).

28. Boscovich Beta. This peak on the E wall of Boscovich casts a shadow on the crater floor at 30°; its E flank holds distinct shadow at 33° and 36°; a speck of black at 43° marks a cliff face; no shadow at 49° (JA).

29. Bradley, Mt. E face shadowed at 31°, W at 39° (Schm. p. 153).

30. Bullialdus. W wall shadow seen by Schm. (p. 183) at 35°, by Pohn at 46°.

31. Bullialdus A. W wall shadow at 34° (Schm. p. 183).

32. Bulliaidus B. W wall shadow at 34° (Schm. p. 183).

33. Burckhardt. Inner E wall and central peak both show shadow at 31° (Schm. p. 222).

34. Bürg. E wall shadow at 35° (Schm. p. 231).

35. Calippus. E wall shadow at 32° (Schm. p. 243).

36. Calippus Alpha. W face shadowed at 38° (Schm. p. 243).

37. Carlini. E wall shadow at 39° (Schm. p. 169).

38. Capuanus. W wall shadow at 38° (Schm. p. 183).

39. Cassini. Significant E wall shadow at 32° (JA).

40. Cassini A. Significant E wall shadow at 32° (JA).

41. Cichus. W wall shadow at 38° Schm. p. 183).

42. Cichus B. A good deal of E wall shadow at 35° (JA).

43. Cleomedes. SE inner wall holds shadow at 35°, central peak at 32° (Schm. p. 221).

44. Condamine A. W slope well shadowed at 32° and 35° (JA).

45. Conon. E wall has much shadow at 31°, crest-line at 32° (JA), shadow at 31° (Schm. p. 153). W wall has much shadow at 32° (JA), some at 40° (Schm.).

46. Copernicus. The steepest parts of the E wall are along the rim, where an interrupted line of shadow is seen at 36° and 37°; by 42° this line has dwindled to a few dark beads, and is gone by 44° (JA). On the W wall there are shadows to 42° (Schm. p. 178) and even 52° (Pohn). The great steepness of the upper part of the inner north wall is vividly shown in a close-up photograph by Lunar Orbiter 2, reproduced in Sky and Telescope for January, 1967, page 25.

47. (Mare) Crisium Psi. This mountain is at the SE end of Mare Crisium Tau, which is at Xi and Eta coordinates +.795, +.395. On 1868 May 28 it had a distinct shadow at 55° and also on June 26 at 50° (Schm. pp. 62, 218, 224, where he calls this feature "t" in places). Schm. measured the height as about 1800 meters.

48. Darney. E wall shadowed strongly at 37° (JA).

49. Darney C. E wall shadowed strongly at 35° (JA).

50. Dawes. E wall has much shadow at 32° (JA).

51. Delisle. E wall shadow at 30° (Schm. p. 169).

52. Dionysius. W wall has much shadow at 31° (JA); E wall shadow still visible at 46° (Pohn).

53. Diophantus A. E wall shadow at 32° (Schm. p. 169).

54. Diophantus B. E wall shadow at 32° (Schm. p. 169).

55. Eimmart. E wall shadow at 32° (Schm. p. 222).

56. Eratosthenes. E wall has crest-line shadow at 38° (JA), W wall shadow visible at 47° (Pohn).

57. Euler. E wall shadow at 31° (Schm. p. 169).

58. Eudoxus. As the sun climbs, the conspicuous shadow on the upper E wall at 32° and 34° dwindles away until only a little patch remains at 41° and 42°, on a line from the center of Eudoxus toward Luther. This patch is gone at 45° (JA). Schm. reports shadow on the E wall at 35° (p. 231) and on the W at 36° (p. 243).

59. Gambart A. Much E wall shadow at 37° (JA).

60. Gambart B. E wall shadow at 44° (JA).

61. Gambart C. E wall shadow at 44° (JA).

62. Gay-Lussac A. E wall shadow at 37° (Schm. p. 169), much at 34° (JA).

63. Geminus (central peak). Holds shadow under a very high morning sun (Schm. p. 223).

64. Godin. E wall shadow at 41° (Schm. p. 126); E rim has thin shadow line at 35°, gone at 42° (JA).

65. Hadley, Mt. W face holds shadow at 32° (Schm. p. 153).

66. Heinsius B. W wall has shadow at 36° (Schm. p. 278).

67. Heinsius C. W wall has shadow at 36° (Schm. p. 278).

68. Hell. W wall has shadow at 37° (Schm. p. 190).

69. Herschel. W wall shadow at 38° (Schm. p. 126), only on crest-line at 40° (JA).

70. Herschel C. Some E wall shadow at 41° and 46° (JA).

71. Hind. Much shadow on E wall at 33° and 39°, on W at 30° (JA).

72. Kant. Much E wall shadow at 33° (JA), that of W wall seen at 46° (Schm. p. 135).

73. Kepler. Pohn saw shadow on W wall at 42°.

74. Kies A. Much E wall shadow at 34° (JA).

75. Kirch. A good deal of shadow on W wall at 34° and 36°, on E wall at 30° and 39° (JA).

76. Klein. E wall shadow at 34° (Schm. pp. 126, 190).

77. König. W wall shadow at 34° (Schm. p. 183).

78. Lahire. The W side of this isolated peak holds shadow at 31°. (Schm. p. 169).

79. Lambert. E wall shadow at 34° (Schm. p. 169).

80. Langrenus. On the E wall, below the peak Delta, is a notable black spot with interesting structure, repeatedly seen by JA at solar altitudes up to 38°. Schm. still saw it at 48° and even reported a trace at 60° (p. 214). Of the two main central peaks, the southern (Alpha) had W-face shadow at 35°, when the northern (Beta) had none (J A). The west face of the central peak (presumably Alpha) is 37° steep (Schm.).

81. Langrenus M. This crater at +.903, -.170 is about 3000 meters deep, according to Schm. (p. 210). Under morning illumination, the floor was still shadow-covered at 28° (p. 32); the E wall held shadow at 48° and even a trace at 60° (p. 214).

H. P. Wilkins (Strolling Astronomer, 1, No. 8, p. 6, 1947) noted R. W. Potts' rediscovery of M as an apparently bottomless pit, M in early morning illumination being a bright-rimmed crater with a black center. Wilkins on 1947 July 22, 23, and 24 drew a black center of steadily diminishing size.

82. Laplace, Prom. The W face of this cape held shadow at 33° (JA).

83. Leverrier D. Some E wall shadow at 31° (JA).

84. Lick D. Even at 36°, the shadow of the E wall on the floor was long enough to be measured micrometrically (Schm. p. 32).

85. Longomontanus. W wall shadow at 31° (Schm. p. 278).

86. Luther. Some W wall shadow at 31° (JA).

87. Macrobius A. Much E wall shadow at 31° (Schm. p. 38) and at 36° (JA).

88. Macrobius B. Much E wall shadow at 36° (JA).

89. Mädler. Pohn saw E wall shadow at 44°; a good deal of W wall shadow at 36°.

90. Manilius. E wall rim shadow at 31°, localized at E point of rim by 33°, gone by 46°; W rim shadow line at 38° (JA). Shadow on E wall at 36°, on W at 37° (Schm. p. 153).

91. Maskelyne. Much W wall shadow at 31° (JA).

92. Maskelyne B. Much W wall shadow at 33° (JA).

93. Maurolycus. SE wall shadow at 30° (Schm. p. 303).

94. T. Mayer. E wall shadow seen at 38° (Schm. p. 169).

95. T. Mayer A. E wall shadow at 38°, W at 47° (Schm. p. 169).

96. Menelaus. The following all refer to the E inner wall: shadow at 33° (Schm. p. 142); black umbra on upper slopes at 39° (JA); no shadow at 51° (JA); still shadow at 53° (Pohn).

97. Messier A. Shadow cast by the E wall was long enough to be measured with a micrometer at 33° and barely at 40°, still seen at 42° (Schm. pp. 32, 38, 212, 213).

98. Mösting. On a photograph taken at 39°, shadow on upper inner E wall (PBM p. 97).

99. Mösting A. Much E wall shadow at 39° and 45° (JA).

100. Nicollet. W wall shadow at 44° (Schm. p. 183).

101. Peirce. E wall shadow conspicuous at 32° (JA).

102. Peirce B. E wall shadow marked at 31° (JA).

103. Petavius. Schm. (p. 206) found for the W wall shadow at 43°, and on the W face of the S central peak at 36°.

104. Piazzi Smyth. Much E wall shadow at 34° (JA).

105. Picard. Inner slope angle about 40° (W. Beer and J. H. Mädler, Der Mond, 1837, p. 194).

106. Piccolomini. E wall shadow at 43° (Schm. p. 199).

107. E. C. Pickering. Much E wall shadow at 38° (JA).

108. Pico E. E wall shadow at 30° (Schm. p. 243), at 30° and 32° (JA).

109. Pitiscus. E wall shadow at 31° (Schm. p. 303).

110. Piton. According to Schm. (p. 243), the E face of this mountain holds shadow at 30°. PBM (p. 97) on a photograph taken when the sun was 34° high noted shadow at the W foot, and give sketches showing its changes. JA finds a little umbra at the NW foot at 30° and perhaps at 35° but gone at 38°; at 44° the W slope is gray. T. Rackham measured the N-S profile of Piton photographically, finding it nearly flat-topped, but did not measure the N or S lower slopes (Z. Kopal, The Moon, 1960, p. 29).

111. Plato. E wall shadow reported by Schm. (p. 244) at 33°; shadow on W wall around Plato Zeta at 31° and 33° (JA).

112. Playfair. W wall shadow at 35° (Schm. p. 190).

113. Plinius. E wall shadow at 42°, W at 36° (Schm. p. 142). Still some black on W rim at 45° (JA), and much E wall shadow at 37°.

114. Polybius. W wall shadow at 36° (Schm. p. 199).

115. Proclus. Much E wall shadow at 32°, a little W at 33° (JA).

116. Protagoras Zeta. W face has umbra at 30°, gone at 35° (JA).

117. Ptolemaeus A. Interior black shadow of E wall distinct at 36° and 42°, of W wall distinct at 38°. Neate found 50° slope on part of W interior (JBAA, 47, 73, 1936; 64, 190, 1960). Fielder's finding that the inner W slope averages only 10° (JBAA, 70, 190, 1960) is contradicted by the other evidence.

118. Pytheas. E wall shadow at 33° (JA) and 35° (Schm. p. 169).

119. Reinhold. W wall shadow at 38°, E at 37° (Schm. p. 176).

120. Römer. E crestline shadow at 30° (JA).

121. Ross. E wall shadow at 40° (Schm. p. 135).

122. Sabine. W wall shadow at 31° (JA).

123. Schröter's Valley. In the E part of this rille, some black shadow along W inner slope at 32° (JA); a doubtful observation needing confirmation.

124. Silberschlag. Much W wall shadow at 35° (JA).

125. Sosigenes. W wall shadow at 30° (JA).

126. Straight Range. At 32° a little shadow on the E end and on the E side of the W-end summit, Epsilon (JA).

127. Straight Wall. The slope angle of the exposed W face of this fault has been determined by JA as 41° (PASP, 72, 55, 1960). Fielder thought the slope much less (Planetary and Space Science, 9, 929, 1962), but his method -- microphotometric tracings of the very narrow sunlit face -- is not safely applicable.

128. Taylor A. W wall shadow at 33° (JA).

129. Theaetetus. W wall shadow at 32° (JA).

130. Thebit A. E wall shadow seen at 34° (Schm. p. 190), twice at 36° (JA).

131. Theon Jr. Much inner shadow on W wall at 32°, on E at 34° (JA).

132. Theon Sr. E wall shadow at 34°, W at 33° (JA).

133. Theophilus. Along crest of E wall a very narrow non-continuous line of shadow at 30° (JA); Pohn saw E wall shadow at 46°, Schmidt at 45° (p. 135). W wall shadow at 31° (JA), at 39° (Schm.). Schmidt noted that E terrace had shadow at 32°, W terrace at 30°.

134. Torricelli. W wall has shadow at 36° (Schm. p. 135).

135. Timocharis. Shadow on E wall at 35°, on W at 41° (Schm. p. 153).

136. Triesnecker. E wall shadow at 42° (Schm. p. 126).

137. Turner. E wall shadow at 39° (JA).

138. Tycho. At 33° the E wall has crestline shadow, and there is some shadow lower, but the main terrace is sunlit; at 36° true umbra is questionable (JA). Pohn saw shadow on E wall at 46°, on W at 34°. Schm. (p. 294) noted inner E wall shadow at 34°, outer at 26°. The central peak is steep, its E face holding some shadow at 32° (Schm.), its W at 35° (JA).

139. Ukert. W wall shadow at 43° (Schm. p. 126).

140. Vendelinus C. E wall shadow seen at 33° (Schm. p. 206).

141. Vlacq. E wall shadow at 33° (Schm. p. 303).

142. Werner. Strong shadow along E rim at 30° and 31° but none below the principal terrace; gone at 50° (JA). E wall shadow seen at 32° (Schm. p. 190).

References

1. Ricker, Charles L., "Lunar Section: The Steep Places Program," Strolling Astronomer, 20, 1-2, 1966, pp. 4-5.

2. Ashbrook, Joseph, "Steep Places on the Moon," Strolling Astronomer, 17, 7-8, 1963, pp. 136-137.

FUTURE JUPITER PROSPECTS

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

We may look forward to future space shots to the major planets. Hopefully, all of the mysteries now associated with Jupiter, Saturn, Uranus, and Neptune will be solved in this century. Amateur astronomy can still be very fruitful for comparison of earth-based data with space-based data and for the confirmation of theories presented by NASA in the near future. The means of improving the collection of earth-based data in the ALPO Jupiter Section will be touched upon in this note.

The ALPO has divided observations roughly into two main groupings: 1) observations pertaining to major changes--changes over the entire apparition of visual observation--such as, latitude deviation of the belts and zones, intensity deviations of the belts and zones, and major structural changes in prominent surface features from apparition to apparition--for example, the changing aspect of the Red Spot. And 2) small-scale time changes on the surface of the planet over several rotations--such as the drift rates of features in the belts and zones and rotation periods of the belts for several months at a time.

There are two immediate ways in which we can update the techniques we use in our analysis of data from Jupiter. One advance has been made by four ALPO observers of long standing: Mr. P. Glaser, Mr. D. Milon, Mr. T. Osypowski, and Mr. T. Pope. These gentlemen have perfected the photographic technique for Jupiter, and Mr. Glaser has kept a rather constant record of the intensity and color changes of the planet for the last several years. [See Str. A., Vol. 16, Nos. 11-12, 1962 for Mr. Glaser's article: "Photographing Jupiter in Colors"--pp. 247-251. See Str. A., Vol. 19, Nos. 3-4, 1965 for Mr. Osypowski's and Mr. Pope's article: "High Resolution Lunar and Planetary Photography"--pp. 42-44.] From this type of material it would be relatively easy for the Jupiter Section to analyze more objectively the major changes that take place in the major belts and zones. Correction factors for various photographic differences in development and emulsion and weighting factors for the aperture and seeing conditions would be the main problems for integrating such photographic data coherently.

The second advance which the Jupiter Section itself can make is to focus upon the surface changes of the planet in more detail than has ever been done before. More detailed and more temporal descriptiveness of the features on the surface of the planet is needed. This finer descriptiveness would correspond with the detailed rotation periods we provide for the various spots on Jupiter. The history of Jovian features, small and large, is a fascinating matter for our further understanding of the dynamics of the atmosphere of Jupiter. At present we have only discussed the very major changes on the planet--changes which every observer could agree with categorically--regardless of his equipment for observation of the planet. If we began to focus on the detailed appearance of the smaller features of the planet and started to determine which observations of these features are most important, we would be in a position to connect our observations and come to a better agreement on many more of the actual changes taking place from apparition to apparition and on small-scale changes from month to month.

Latitude deviations already have been measured from photographs. [See Mr. F. J. Eastman, Jr.'s article in Str. A., Vol. 19, Nos. 11-12, 1965, pp. 187-191.] Just as photometric techniques can be used to evaluate the changes in intensity of Jupiter, so too can photographs serve to evaluate latitude deviations by direct measurements taken from them. Over any period of time and with any degree of accuracy limited only by the combined resolutions of the optical and photographic equipment, intensity and latitude deviations can be recorded.

As before, the Jupiter Recorder and his Assistant plan to make comments throughout the apparition about the current changes in the planet. In addition, they publish material on past apparitions which summarize a large body of observations. However, in order to be more relevant to future observing situations, in which we shall have more responsibility to NASA, we should get down to the material in a more scientific way and especially be aware of the weekly changes and monthly transformations of the visual surface of Jupiter. For this we will need many more observations and hopefully many more photographs.

Most Jupiter observers agree on the impossibility of keeping track of all the changes which take place on Jupiter in the course of an apparition--even if one is limited to a small reflector with a six to eight-inch aperture. The quality of the detail is so fine and unstable from rotation to rotation and the seeing conditions so limiting that no base line for the quality of visual observations can be established, and thus no statistical analyses of the data can yield consistent results. Nevertheless, major trends should be accurately recorded and reported for at least the minimal in observational continuity, and by and large the ALPO Jupiter Section has been successful in keeping track of these changes.

Although these short-term changes are not periodic or statistical, they are nevertheless causally significant--at least for isolated phenomena which we may be interested in for an apparition. On occasion, I hope to examine some of the current events of these isolated phenomena--the RS, the STeZ white ovals, and the EZ phenomena. Photography is not the only means we have to obtain objective data. As we have always done, we can still do more of, make disc drawings of Jupiter and record as much detail as our eye will permit us to see. CM transits are very accurate for visual estimates, and these will always be most important. Photography should at first be supplemental to our normal program and should by degrees help the visual program and temporarily act as a check on the reliability of the other observations. Eventually it is hoped by the Assistant Jupiter Recorder that photographic material will grow and will be used with success in solving particular projects which Jupiter observers may be inspired to solve for themselves.

It seems that the South Tropical Region of the planet is very active now and should be of considerable interest to those observers looking for South Tropical Streaks and other South Tropical features. The RS is particularly beautiful this apparition, and it should be an impressive sight. Mr. R. Wend refers to it this year as like a "pink fish" with a very bright RSH accompanying it. The RS is several degrees longer and narrower than it was in 1962, 1963, and 1964. I hope that every observer will make a special effort to record his impressions of this region of the planet as I think that some interesting changes shall take place here. These observations can be sent to Mr. Wend or to myself.

I would like to invite all new members of the Jupiter Observing Section, and all old members too, to co-operate with the Recorder and his Assistant in the ensuing apparition and the next apparitions to provide a record number of drawings, CM transits, and comments about Jupiter.

I would like personally to thank Prof. Haas for his assistance in the completion of this article.

OBSERVING URANUS IN 1967

By: Leonard B. Abbey, A.L.P.O. Uranus-Neptune Recorder

On March 13, 1967, 185 years to the day after its discovery, Uranus will be at opposition to the Sun. Located at the eastern edge of Leo, the planet will be stellar magnitude 5.7, barely visible to the unaided eye. Uranus is easily located in a low power finder with the aid of the "finder" charts published in the Handbook of the British Astronomical Association (p. 46 of the 1967 edition), and the Observer's Handbook of the Royal Astronomical Society of Canada (p. 30 of the 1967 edition). Similar charts are published in the January issue of Sky & Telescope each year. The planet is usually recognized in the finder as a fairly bright blue-green star. In the main telescope it will distinguish itself by its small disk. Uranus' apparent diameter at opposition this year will be 3.96 seconds of arc. Theoretically this means that it will appear as a disk in all telescopes larger than 1.8 inches in aperture. However, it will probably take at least three inches to make this fact readily apparent.

Uranus is attended by five known satellites, four of which may be visible in telescopes that are likely to find their way into amateur hands. The primary program of the Uranus-Neptune Section for this apparition will be to determine the visibility of the satellites of Uranus in small telescopes.

Discovered in 1787 by Sir William Herschel, Titania and Oberon are the brightest Uranian satellites at magnitude 14. They would be easy to see in instruments of moderate size were it not for the fact that they are never more than 45 seconds of arc distant from their primary, which is over eight magnitudes brighter. Ariel and Umbriel were discovered by William Lassell in 1851 and are considered by some to be the most difficult objects in the Solar System. Exactly how easily these satellites are seen is open to question. According to the British astronomer W. H. Steavenson, Titania and Oberon may be glimpsed in a 6-inch instrument, while Ariel and Umbriel require at least four times that aperture. Other observers have had great difficulty with apertures much larger than this, while still others have reported them with far smaller instruments.

Observers who have access to telescopes larger than 10 inches in aperture which are equipped with filar micrometers are asked to attempt the measurement of the oblateness of the planet's disk. Since the Earth passed through the plane of Uranus' equator in 1966, this type of observation is most feasible at the present season. Such favorable circumstances will not recur until the year 2008.

All interested observers are asked to observe Uranus on certain nights during the present apparition. The dates for these concerted efforts are:

March 31 May 5 June 2 June 30 August 4

These dates are spaced about a month apart. They all occur when the Moon is in the morning sky so as to facilitate the observation of dim objects in the evening. Participating observers are asked to observe the planet on the nights indicated, paying particular attention to faint stars located within about 15 radii of the planet's disk. A simple sketch of these stars should be made. Each report should include the observer's name and address, the date of the observation, time of observation, seeing and transparency conditions, size and type of telescope(s), power, and types of eyepieces used. Note should also be made of any unusual (or usual!) conditions which may have had an effect on the observation. Such conditions might include aurora, reflected city lights, dew on optics, and low lying fog. If you are using uncoated eyepieces, or if the mirror of your reflector is heavily tarnished, please make note. If any of the Friday nights listed above are cloudy in your location, please try to observe on the following Saturday or Sunday. Enterprising observers will want to observe on all three nights! Observers who turn in reports for all 15 nights in this program will qualify for membership in the Uranus-Neptune Section Legion of Puissant Honor. (Your dictionary may help you decide if you want to be a member.) As reports are sent to the Recorder they will be checked against the predicted positions of the satellites. If you own more than one telescope, try as many of them as possible. Observers with small telescopes should not be hesitant to engage in this work. If we are to determine the smallest aperture useful for these observations, we must have some contributions from observers who were unable to detect the satellites. But who knows, you may be surprised.

Separated from Uranus by the width of the constellation Virgo, Neptune comes to opposition on May 14, when its apparent diameter will be only 2.5 seconds of arc. Neptune's brightest satellite, Triton, is brighter than any of Uranus' satellites; and ALPO observers participating in this program are encouraged to look for it on nights when observing Uranus. At opposition Neptune is stellar magnitude 7.7, and Triton 13.5, a difference of 5.8 magnitudes. Reports similar to those for Uranus' satellites should be submitted by interested observers.

The results of these projects will be published in this journal at the end of the apparition.

AIMS OF THE VENUS SECTION IN 1967

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

The current evening apparition of Venus will be favorable for (northern hemisphere) observers who wish to contribute to the A.L.P.O. Venus Section. The Recorder wishes to urge observers to begin their programs early in the apparition while the phase is large and a substantial fraction of the disk is displayed.

As reported in the Section Report for the evening apparition of 1963-1964, there is frequently a high degree of correlation among the features shown on drawings made simultaneously by different observers. In order to provide further statistical data on this aspect of visual observations of Venus, those who contribute to the Section are urged to concentrate their efforts on prescribed times. The Recorder made a similar request prior to the 1963-1964 apparition, and this resulted in considerable coöperation so that a large number of simultaneous reports were received. A similarly fruitful 1967 apparition is hoped for. Weekend afternoons and evenings are usually most convenient for the majority; and observers are requested to concentrate their visual studies on Fridays, Saturdays, and Sundays throughout the apparition.

The Venus observing forms currently in use provide spaces for noting the appearance of the cusps, dark side, etc.; and the continued use of these forms will help provide further statistics for studies of the relevant problems.

Dichotomy (half phase) occurs sometime in mid-June, 1967; and the determination of the exact date (and its difference from the predicted date, if any) is of interest in statistical investigations which may relate to the optical properties of the Venus atmosphere. The method devised a few years ago and described in an article by Cruikshank, et al. (Str. A., 18, Nos. 11-12, pp. 222-231, 1964) is recommended because it not only helps fix the date of observed dichotomy but also permits a quantitative determination of the error of observation. Special forms for the reports of dichotomy observations will be sent to the regular observers, and others may request them at any time. In order to avoid bias, observers should not look up the date of dichotomy in the ephemeris prior to beginning their series of observations. Also, it is important that during a series of dichotomy observations the same telescope and eyepiece combination should be used so that the effective surface brightness of the image of the planet is the same at all times.

A few copies of the ditto edition of the Venus chapter for the ALPO Observing Manual (nearing completion) are still available on request to the Recorder.

ADDITIONS TO THE A.L.P.O. LUNAR PHOTOGRAPH LIBRARY: ADDITIONAL ORBITER-I PHOTOGRAPHS

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

NASA has generously given the A.L.P.O. thirty additional Orbiter-I photographs of the equatorial region of the moon (for the previous Orbiter I photographs, see Strolling Astronomer, Vol. 20, Nos. 1-2, pp. 8-11, 1966.) Following a list of these photographs, a selection of five of them is reproduced as Figures 1-5 to illustrate the wealth of detail which they show.

All photographs listed are 8 x 10-inch prints. If they are oriented so that north is at the top, the sun will usually be to the right (IAU east); the sun will be to the left (IAU west) in photographs 66-H-1289, -1293, -1294, -1331, -1336, and -1349. With the exception of three high-resolution photographs (66-H-1174, -1293, and -1294), all photographs listed are "moderate resolution" photographs; those whose scales are in the range 1/165,000-1/220,000 have ground resolutions of about 10 or 20 meters.

In the list below, all directions are in the IAU sense. Solar altitudes, when given, refer to the center of the area photographed. Scales are given as follows: "200T" = 1/200,000, "170TEW/210TNS" = 1/170,000 east-west and 1/210,000 north-south.

Code No.: 66-H-	Description	Lat./Long.	Solar Altitude	Scale
1174	Large-scale view of crescent Earth and lunar east limb	----------------	--------	-----
1288	West of Dionysius	2°51'N/16°48'E	--------	280T
1289	Earth and lunar limb west of Tsiolkovsky	----------------	--------	-----
1290(1)	Gambart and area to north	1°25'N/15°10'W	--------	220T
1291	Gambart rho (West of Gambart)	0°15'S/20°00'W	--------	170T
1293	Crater pair about 150 miles north of Tsiolkovsky on averted hemisphere	12°5 S/128°9 E	--------	350T
1294	Crater with fractured floor between Tsiolkovsky and Mendeleev on averted hemisphere	4°5S/145°8E	--------	400T
1302	Central Sinus Medii	0°15'S/1°26'W	--------	290T
1324	Area east of Lansberg pi (East of Lansberg)	0°20'S/23°26'W	20°	165T
1327	Hills in Sinus Medii south of Pallas phi	0°20'N/2°30'W	20°	185T
1328(2)	NE portion of Flamsteed P	2°20'S/43°00'W	26°	165T
1329(1)	Gambart and area to northwest	1°20'N/15°40'W	12°	200T
1330	West margin of Mare Foecunditatis, west of Secchi X	1°00'S/42°15'E	29°	190T
1331	Heavily cratered area near equator and 150°E on averted hemisphere	ca. 0°/150°E	16°	6500T

Code No.: 66-H-	Description	Lat./Long.	Solar Altitude	Scale
1332	Encke C	0°20'N/36°30'W	14°	195T
1333	Dome west of Maskelyne D	2°08'N/33°45'E	16°	230T
1334	Maskelyne R	3°00'N/31°40'E	8°	310T
1335	Southwest of Dembowski	2°00'N/8°10'E	9°	270T
1336	Centered north of Tsiolkovsky	ca.10°S/130°E	20°	6300T
1337	Lade A	0°43'N/12°50'E	20°	190T
1338	Hilly area NW of Lansberg A	1°30'N/30°45'W	12°	200T
1339	Area NW of Fra Mauro B	3°20'S/22°30'W	33°	175T
1340	West margin of Mare Smythii	ca.0°/85°E	24°	780T
1341	Gambart E and Gambart F	0°45'N/17°15'W	15°	175T
1342	Gambart theta (W of Gambart) (Photograph tilted and foreshortened)	1°20'N/19°40'W	13°	400TEW 300TNS
1343(3)	E portion of Flamsteed P	2°50'S/42°20'W	29°	165T
1345	Mare Tranquillitatis southwest of Maskelyne X	0°30'N/26°45'W	21°	185T
1347	Réamur A	4°20'S/0°12'W	39°	200T
1348	Ridges in Oceanus Procellarum between Encke and Wichmann	3°20'S/36°00'W	31°	175T
1349	Earth and limb west of Tsiolkovsky	-------------	---	----

LUNAR AND PLANETARY PHOTOGRAPHY - SOME RANDOM THOUGHTS

By: Joseph Vitous

(Paper read at the Fourteenth A.L.P.O. Convention at Tucson, Arizona, August 26-28, 1966.)

The Youthful Amateur and Dark Room Facilities

A good many of our younger members are discouraged from entering the photographic field by the lack of dark room facilities of their own. This is an erroneous impression in view of the fact that good custom services are available at many photo service laboratories. I personally prefer the specialized shop that does custom work for commercial photographers. They are equipped to follow your specific instructions as to development and printing and will supply the amateur with a record of the development and printing process if requested to do so. Prices vary, but I have found custom black-and-white work quite reasonably priced. I also use the services of a firm specializing in color work. Their processing of slides is superb. Good slides which warrant the expense are printed through the Internegative C process. The latter is somewhat expensive. Almost always the color slides are sufficient for the amateur's records, and printing thereof is unnecessary.

The Camera

The use of a Kodak Retina single lens reflex with delayed action Compur shutter is recommended. I find the delayed action facility very good in allowing vibration from mirror slap to die down before the exposure is made. I find the Compur shutter practically free of vibration, and I definitely prefer it to the focal plane shutter.

The Adapter To Scope and Camera

I use a home-made device assembled from old metal tubing. The flange that fits the camera was made from an old Brandon eyepiece. It is part of the adapter assembly attached to the camera. The other part carries eyepieces of any desired focal length and is a clamp-on fit over the eyepiece draw tube. Both parts fit together holding the camera firmly attached to the telescope draw tube and further supported by a strong bracket. The bracket is

(text is continued on page 53)

(1) 66-H-1290 and -1329 overlap; pair may be viewed stereoscopically.

(2) Overlaps 66-H-1301 (previous listing) and -1343; may be viewed stereoscopically with either.

(3) Overlaps 66-H-1328; pair may be viewed stereoscopically.

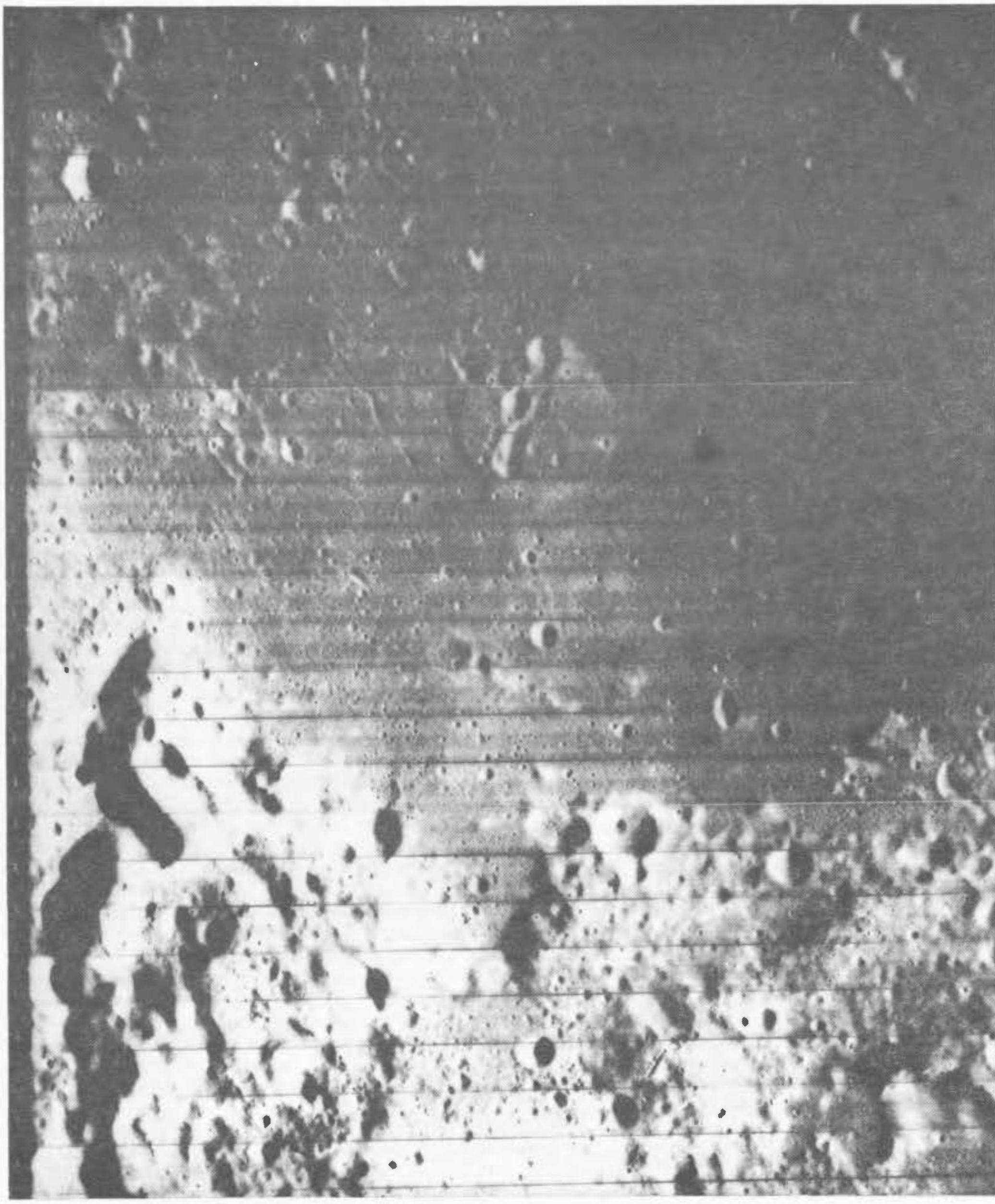

Figure 1. Lunar Orbiter photograph of a dome in southeastern (IAU) Mare Tranquillitatis. This dome is shown on USAF LAC 61 and AIC 61D at 2°20'N and 33°50'E (IAU). The dome is about 7.5 kms. in diameter and appears faulted on the west (left) margin. Note the numerous craterlets on the dome and its northwest border as well as an irregular depression on the southern portion. North is at the top; and the sun is to the right, 16° above the horizon. The above photograph, 66-H-1333, is in the A.L.P.O. Lunar Photograph Library.

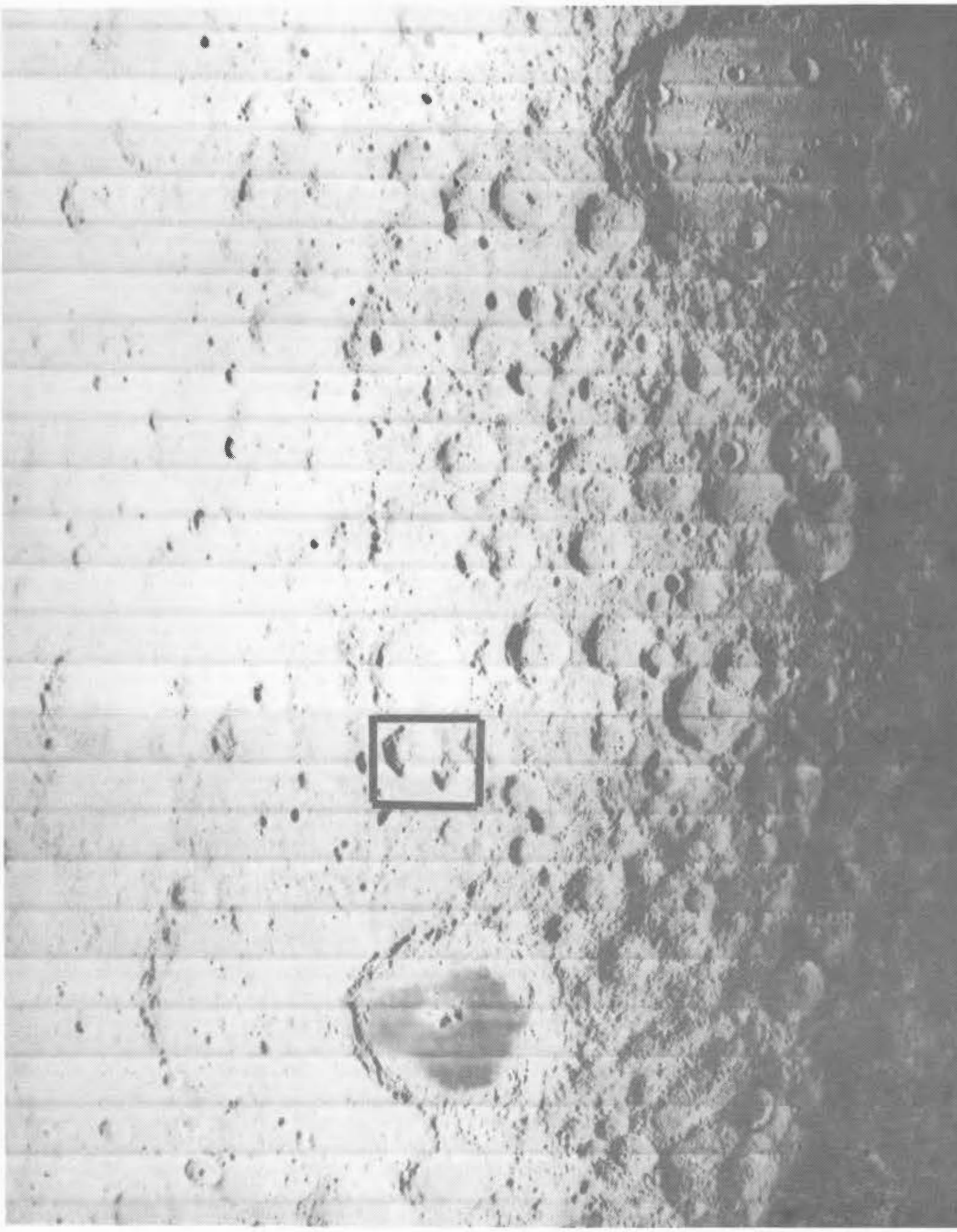

Figure 2. A 650 X 770 miles (1050 X 1250 kms.) area on the moon's averted hemisphere, centered near 10°S, 130°E. The crater in bottom center with a dark floor is Tsiolkovsky, also shown on the earlier Soviet Lunik-III photographs. The large walled plain in the upper right has a diameter of about 200 miles (320 kms.), larger than the largest earthside crater, Bailly, which is about 180 miles across. North is at the top; the sun is to the left. The area within the marked rectangle is shown enlarged in Figure 4. The above photograph, 66-H-1336, is in the A.L.P.O. Lunar Photograph Library.

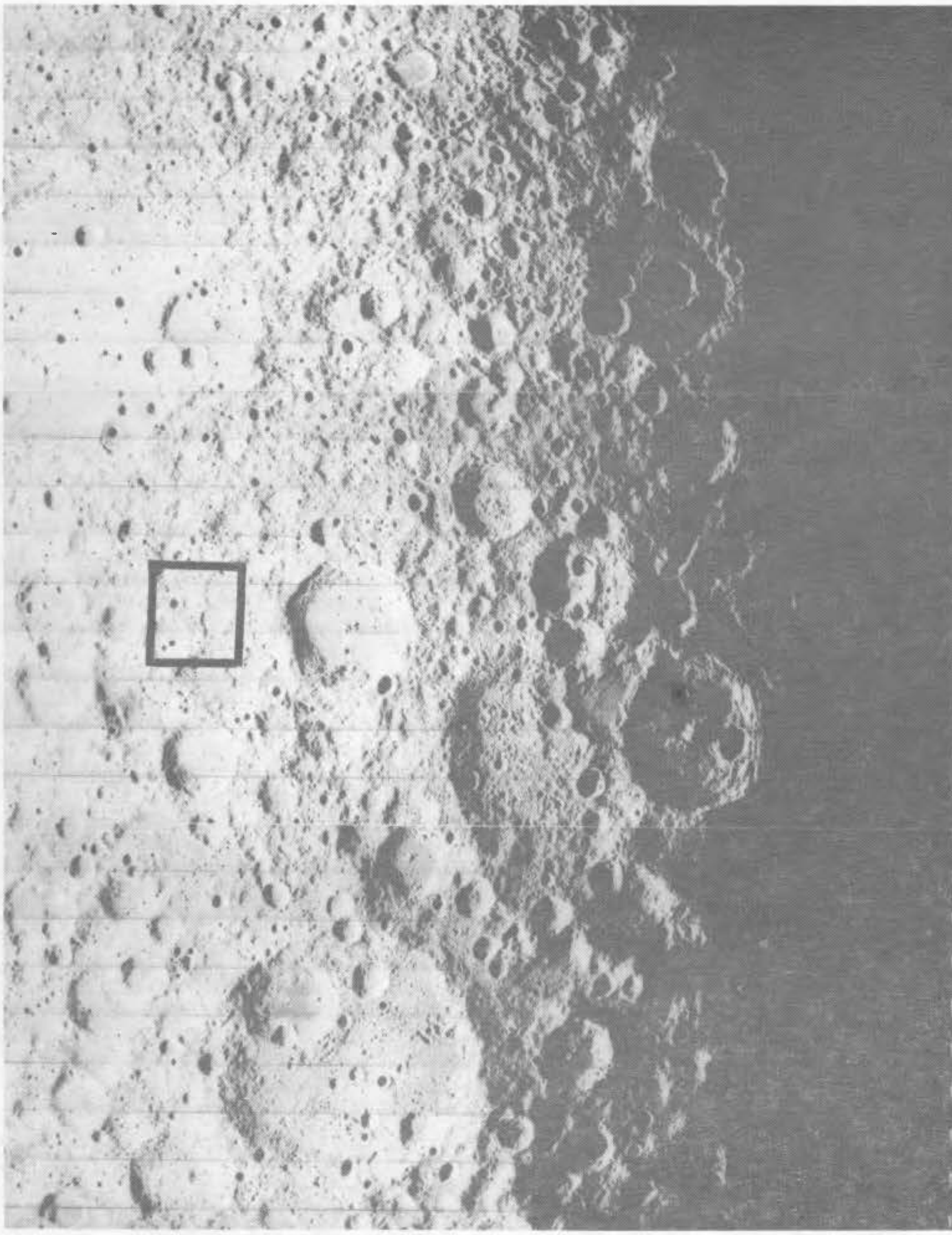

Figure 3. The area immediately to the east (right) of Figure 2, centered roughly on the equator and 150°E longitude, on the averted hemisphere. The area covered is about 810 X 900 miles (1300 X 1450 kms.). North is at the top, the sun to the left. The large unnamed crater in the upper right of Figure 2 is in the upper left of this photograph; the crater on bottom center is of comparable size. The hexagonal crater near the center resembles Copernicus but is larger-about 100 miles (160 kms.) across. The rectangular area left of this crater is enlarged in Figure 5. The above photograph, 66-H-1331, is in the A.L.P.O. Lunar Photograph Library.

Figure 4. A high-resolution view of the area outlined below center in Figure 2. An unusual example of the encroachment of a new, larger crater upon an old, smaller one. The large crater is about 31 miles (50 kms.) in diameter; the smaller is about 25 miles (40 kms.). Note the large scale collapse of the northwest (upper right) wall of the wall of the old, smaller crater. Also interesting is the almost-square crater wall near the top margin. North is at right, the sun to the top. Position: 12°5 south, 128°9 east, on averted hemisphere. The above photograph, 66-H-1293, is in the A.L.P.O. Lunar Photograph Library.

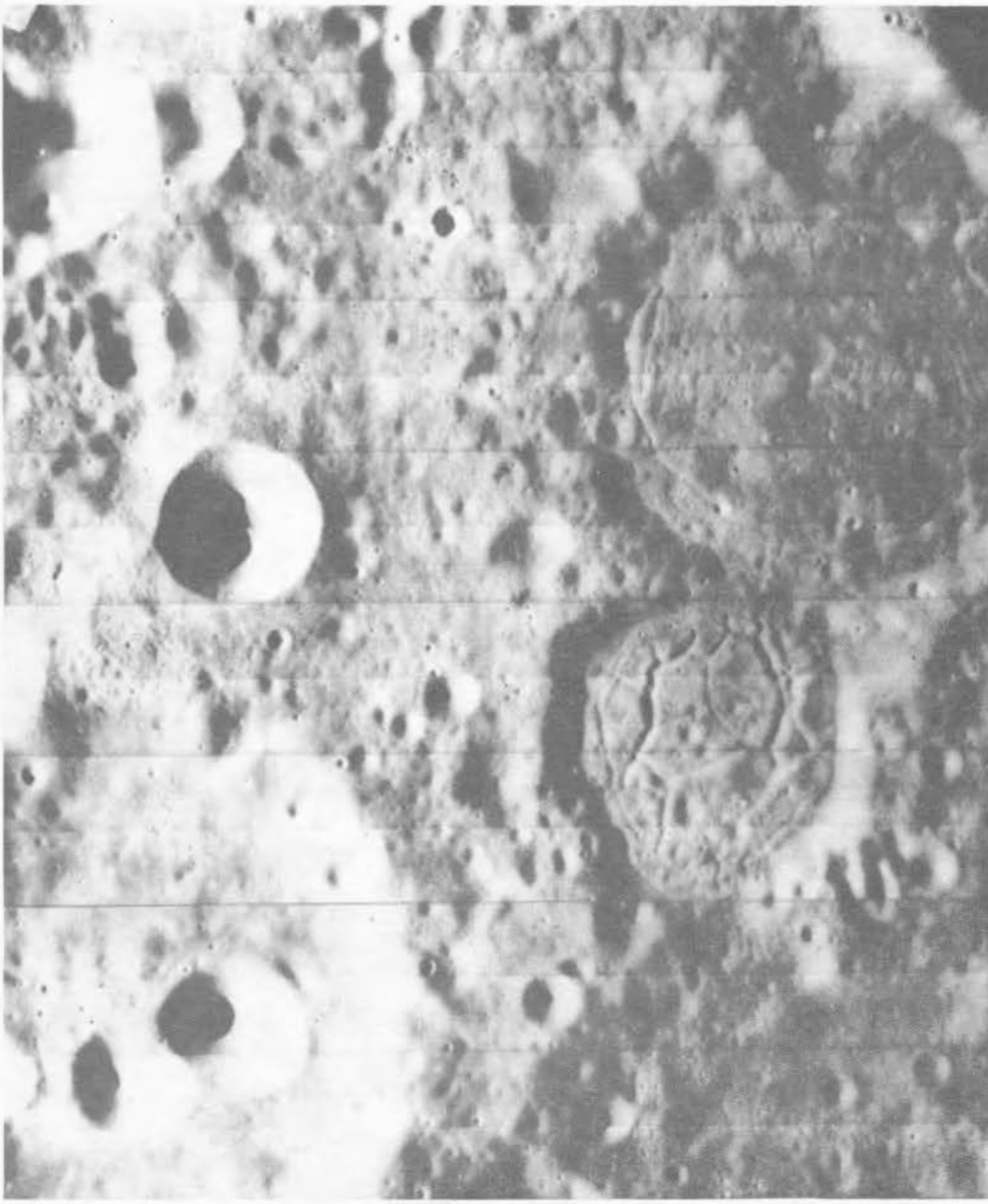

Figure 5. High-resolution photograph of the area outlined left of center on Figure 3. The most interesting feature shown is the 15 mile (24 kms.) diameter crater on the right, with its highly fractured floor and polygonal walls. The crater above it, 24 miles (39 kms.) in diameter, exhibits concentric fracturing in its interior. North at top, sun to the left. Position: 4°5 south, 145°8 east, on averted hemisphere. The above photograph, 66-H-1294, is in the A.L.P.O. Lunar Photograph Library.

equipped with a scissor type support for the camera, allowing the entire setup to be focused as a unit by using the rack and pinion.

The Films

My preference for lunar photography is the Kodak High Contrast Copy film, which is readily available and is very reasonably priced. Being a slow film, it is used under lower projection magnifications with my 8-inch telescope at F:21 to F:63. For planetary work I find Kodak High Speed Ektachrome film quite satisfactory. When it is used at F:90 or higher, exposures can be kept down to one-half to one second with this film. Seeing conditions in the immediate Chicago region are seldom good enough to permit longer exposure, and this film is a compromise.

Slide Enlargements

Experimenting with lenses, I came upon a combination of a Schneider F.2:8 Xenar lens, with a one-inch focal length Erfle eyepiece placed before it. The slide being photographed "rides" on the end of this unit, and focusing is done normally by viewing the enlarged planetary image in the reflex camera. Ektachrome X film is used with blue flash, the exposure being 1/30 second at F:3.5 to F:8, depending on the density of the original slide. CC filters may also be used for further color correction. The enlargement provided by this setup is 1.6X. It will prove amazing how much greater measure of image detail becomes visible. These enlargement slides provide excellent material for internegative C work.

Atmosphere Effects

An experiment was attempted some time ago to seek the filtering effect of the atmosphere upon planetary images on High Speed Ektachrome film. One roll of film was used, and several photos of Jupiter were taken at F:90 with my 8-inch. The seeing conditions and clarity of the atmosphere differed widely, and the results were surprising. On the same roll I found some of the images normal, some bluish, and some with a yellowish cast. One evening with heavy ground haze produced a deep red image of Jupiter. All these different color renditions were on the same roll of film.

Eyepieces

For projection purposes, I find the Orthoscopics excellent at F:50 or higher. The Kellner eyepiece is found quite excellent for lunar work at F:21.

References (All Kodak Publications)

Precise 35 mm. Technique with Kodak Retina Camera
Kodak Wratten Filters
Astrophotography With Your Camera

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BOOK REVIEWS

Solar Radio Astronomy by Mikul R. Kundu, John Wiley & Sons, 1965, 660 pages, $19.75

Reviewed by Dale P. Cruikshank

It is curious that two comprehensive treatises--the first two--on a subject barely twenty-five years old should appear in a single year. Kundu's book has a Soviet counterpart, Radio-emission of the Sun and Planets, by Zheleznyakov (Radioizlucheniya Solntsa i Planyet) that also appeared in 1965. Both Kundu and Zheleznyakov refer often to one another's research, which speaks strongly for the increased scientific communication between East and West in recent years.

Kundu's book is an excellent and authoritative review of an important and heavily populated scientific subject. His systematic treatment begins with a review of optical features of solar activity. The discussion quickly turns to the descriptive and quantitative study of solar radio radiation. The several components of solar radio emission are discussed, beginning with the radiation from the quiet sun, then the slowly varying component, and then solar radio bursts at various wavelengths. Solar radio bursts are classified into several distinctive types, and each of these is discussed in some detail. Modern results on solar X-ray emission are also reviewed. The relationship of solar activity to geomagnetic storms is treated in a chapter which also concerns solar cosmic rays. The outer corona is the subject of another chapter. Radar observations of the sun are relatively recent and are discussed in some detail. The final chapter reviews satellite observations of solar activity.

This book is suitable for a text in a graduate astronomy or physics course on solar radio astronomy. Beginners could find some material and pictures of interest, but an understanding of the text requires a thorough grounding in physics and mathematics. Modern astronomy is characterized by this requirement. Books of this type are extraordinarily important to graduate students who lack the time (or motivation) to review a subject completely through published papers. The price of this book (and many other contemporary texts on technical subjects) will strike fear into the hearts of the graduate students, and these will be the people who need it most.

The utility of this book is greatly enhanced by an extensive list of references to published papers and books. An adequate index is also included. The book is well produced with many diagrams and half-tones. It is to be highly recommended to specialists in the field and to advanced students who need a comprehensive review of a rapidly growing subject. This book will probably see later editions as the field advances.

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An astronomical trilogy by Antonio Paluzíe-Borrell

Reviewed by James C. Bartlett, Jr.

Since the charming publications considered below are all very brief, I have thought it best to include them in a single review under three separate headings as follows:

Names of the Plough; Antonio Paluzíe-Borrell. Irish Astronomical Journal, Vol. 4, No. 5, March, 1957; 7 pages.

Into this small compass the author has packed a surprising amount of information, much of which will be new to those of us only hazily acquainted with the rich folklore underlying constellational nomenclature. Everyone has heard of Charles' Wain, the Plough, the Great Bear, and so on; but is it generally known that our familiar Big Dipper is also a holy cart which conveys the souls of the departed to the Holy Land? Or that in addition to a bear, Ursa Major has also been a moose, a boar, an elephant, and even a porcupine?

Paluzíe-Borrell ranges widely over time and geography to bring us these and other startling tid-bits from many lands and peoples in a pleasantly written paper which should be in every antiquarian's library whether he be an astronomer or otherwise.

The Names of Orion and its Stars; Antonio Paluzíe-Borrell. Annals of the Finnish Academy of Sciences, Helsinki, 1961; 11 pages.

Well printed in English on slick paper and very easy to read. Here we are introduced not only to the various historical names of the constellation but also to those of its principal stars. As in the paper on the Plough, examples are taken from many ages, peoples, and climes; and considerable attention is given to the etymology, especially of Arabic names. Readers of star lore who may have been badly puzzled by the innumerable variants of Betelgeuse will be happy to find the explanation in Prof. Paluzíe's paper. Highly recommended for all who have an interest in the history of this great constellation, particularly as applied to its nomenclature.

The Names of the Minor Planets and their Meanings; Antonio Paluzíe-Borrell. Published by Jean Meeus, Kesselberg Sterrenwacht, Kessl-Lo, Beligum, 1963; 112 pages of text, 2 pages of references.

In this, the most ambitious of the three publications, the author has provided us with a handy compendium of over 1600 asteroids arranged numerically in the order of discovery. A minor fault might be found in the failure to include discovery dates in all but one or two cases; but the work does not profess to be a chronology, only an exposition of the names of the minor planets and their meanings. In this goal it succeeds admirably well.

Some of the explanations seem rather too brief, and in a fair number of cases the names alone are given without comment, presumably because the reasons for so naming these particular asteroids are unknown; but in the majority of cases an exposition is given ranging from brief to full treatment. Along the way a surprising amount of historical, mythological, and literary information is woven into the text to make this a highly desirable addition to anyone's library.

These three publications are equally for the specialist in astronomical nomenclature and for the general reader who feels the magic of antiquity. Moreover, all three are in English. In his preface to The Names of the Minor Planets the author reminds us that this work is but part of a book on "celestial onomastics" which he hopes to publish soon. One can but await it impatiently.

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Mariner IV to Mars, by Willy Ley, The New American World Library, Inc., New York, N.Y., 1966. Price 60¢. Paperback.

Reviewed by Rodger W. Gordon

Mr. Ley is at his best in this easy to read and up to date account of Martian research. He begins by giving us a historical view of the planet as seen by scientists and science-fiction writers. Included are some of the earliest telescopic observations of the planet and also the speculations of men such as Huyghens and Herschel. Next, he introduces us to several novels related to Mars. One is the well-known story by H. G. Wells. All the authors of these novels interlaced their writings of fantasy with a sprinkling of science here and there in order to make their works have an air of authenticity about them.

Ley then gives us a view of the orbit of Mars together with a list of oppositions up to 1975. Another chapter deals with the moons of Mars, their "predictions" by Swift and Voltaire, and also a fair treatment of the orbital decay of Phobos. He presents the fine views of Mars as seen by a famous astronomer or physicist of his era, and a full treatment of the views held by Schiaparelli, Lowell, and Arrhenius. Perhaps the most interesting from the historical viewpoint are those of Schiaparelli and Lowell. Ley argues for Lowell when he states, "Lowell had many interesting things to tell about the canals - statements that are still surprising and which have neither been explained in the meantime nor satisfactorily explained away." After presenting these views, a full description of what occurred during the historic Mariner IV flight is given and in such vivid detail that it makes one almost believe he is sitting in one of the rooms at J P L hearing the data come in. In the last chapter Ley states his views for a "super-Mariner" which would take a set of photos starting at about 50,000 miles from Mars and taking a series every 5,000 miles. Perhaps if this had been done with Mariner IV, we might know what areas were photographed with more precision than one areocentric degree.

Ley states that no canals were photographed despite the fact that Mariner IV crossed some of them, but he adds that we might have such a detailed view of what we call a "canal" at long range that we don't recognize it. He also points out (as many experts on Mars have done since) that the season was wrong. However, several authorities such as Dr. Clyde Tombaugh, a well-known member of the A.L.P.O., and Dr. Frank Salisbury, noted exobiologist, have claimed detection of several canal-like lines in at least seven Mariner IV photos. Thus, Mr. Ley's statement must be treated with reserve.

The appendix contains all the usual numerical data for Mars and also an ingenious calendar devised by Dr. I. M. Levitt of the Fels Planetarium of the Franklin Institute. This calendar is in error by only one day in 10,000 years. A section of photographs by early workers and 16 of the Mariner photos are placed between pages 96 and 97. The book can be enjoyed by anyone with an interest in astronomy.

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The Moon, A Fundamental Survey, by Ralph B. Baldwin, McGraw-Hill, 1965, 149 + viii pages, $4.95.

Reviewed by William O. Roberts

While I was reading Dr. Baldwin's book recently, the daily press announced release of a detailed photograph of the lunar landscape in the vicinity of Copernicus, taken from an elevation of 28 miles. The accompanying picture showed a scene that would do credit to a science-fiction illustrator. This incident underlined a very important question that a reviewer needs to consider when presenting his reasons for reporting favorably on a contemporary technical book. Why should anyone bother to acquire, or even to read, such a work when it is already outdated? Isn't one better off keeping abreast of the times with periodicals? After completing the reading, I got out Baker's Astronomy, 1946 edition, and read the lunar sections. It was worthy of note that there was not one single mention of the meteoritic impact theory of lunar crater formation. This is a rather extreme case of textbook obsolescence, to be sure, but illustrative of the principle involved.

The Moon was written after the completion of the Ranger program and includes a section on the interpretation of the Ranger VII photographs, as well as material on the early Russian pictures of the far side of the moon. It then becomes a relatively simple matter to combine this basic text with an investigation of the results of Surveyor I and the Lunar Orbiters 1 and 2, and to come through with a very up-to-the-minute picture.

The author was one of the earlier modern supporters of the meteoritic impact theory; and he does not hesitate to introduce controversial questions, leaving little room for doubt as to what his opinions are. The book's discussions on impact vs. vulcanism, and on the deep-dust layer bear witness to this. The arguments are clear, persuasive, and decorously presented. One could say that clarity is a conspicuous attribute of this work, and this feature becomes quite evident in the sections on orbital mechanics and the tides.

This book is a survey, fifteen chapters long, covering the essentials of our knowledge of the moon, presented on a college-undergraduate level. There is some math, not necessary to the general understanding of the material, but well worth extra attention from those who would like to penetrate more deeply into the subject. Not much of this material appears to be more than incidentally useful to the techniques of a systematic lunar observer; but for the amateur who would like to extend his horizons beyond the limits of the popularized account, this concise and practical textbook should prove very attractive indeed. And to answer the question posed earlier in this review, a book of this sort does contain enough relevant information to continue to serve very well as the "fundamental survey" it purports to be through many more advances in our knowledge of the moon.

In the attempt to turn out a modernistic looking publication, the publisher has resorted to tricky typographical layouts which tend to be confusing and out of keeping with the text. There are eight half-tone plates and a small reproduction of the USAF Lunar Reference Mosaic, which items prove helpful in illustrating lunar surface features under discussion; and there are a number of useful figures. The index is adequate; there is no bibliography, but a brief list of books for further reading is given in the preface.

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MERSENIUS, A MAJOR CRATER OF PLUTONIC ORIGIN

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

(Paper read at the Fourteenth A.L.P.O. Convention at Tucson, Arizona, August 26-28, 1966.)

Despite the great success of lunar probes, particularly in close-up photography of the moon's surface, the question of whether the moon's craters are largely of plutonic or of meteoritic origin is still debatable. However, one type of lunar formation, the blisters on the moon which are referred to as lunar domes, is clearly non-meteoritic in origin. Lunar domes are generally found in the maria, and there is nothing to suggest that they could be the results of the impacts of meteorites. A meteorite might leave a rebound dome at the center of impact within the crater it produces, but the immediate area of the average lunar dome shows no sign whatsoever of present or past crater walls encircling it. Generally, lunar domes have to be taken to be of an internal origin.

On March 4, 1966 I was observing the moon at colongitude 53°.4, which is about the time when the 51-mile crater Mersenius most favorably reveals its remarkably convex floor. To me it looked like one huge dome occupying the entire crater floor. The only thing distinguishing this dome from the other large lunar domes is the fact that Mersenius' dome is encircled, and to some extent is encroached upon, by crater walls. If lunar domes are of an internal origin, and lunar craters might be either of an internal or external (i.e., meteoritic) origin, then finding an average-looking, large dome within a not much larger crater speaks well for a plutonic origin of the entire crater.

The domically uplifted floor of Mersenius has an approximate diameter of about 33 miles. It is a large dome, but there are comparable ones which lie by themselves outside any crater. The Association of Lunar and Planetary Observers and the British Astronomical Association have been making a study of lunar domes and have compiled a joint catalog of 129 domes. While most of these domes are less than 10 miles in diameter, there are six of them even more than 20 miles in diameter. Most notable are the 40-mile-diameter Rümker formation in Sinus Roris[1] and the 37-mile-diameter dome southeast (IAU) of Vitruvius.[2]

Like all other large domes, the dome occupying Mersenius' floor shows much surface detail, particularly in the form of craterlets and clefts. Unlike the average dome, Mersenius' dome does not have the near-circular outline characteristic of domes, but this difference appears to be due to the encroaching walls or to large masses from the crater's walls having fallen and more or less buried the lower slopes of the dome in places.

It is not merely the existence of a large dome within Mersenius that leads me to favor a plutonic as opposed to a meteoritic origin for the crater. A series of observations and an examination of available photographs revealed further reason for believing in Mersenius' plutonic origin. What follows is a listing of the colongitudes at the times of my own observations and the colongitudes of photographs I have examined. At Mersenius' location lunar sunrise occurs at col. 49°, noon at col. 139°, and sunset at col. 229°. As can be seen from what follows, good coverage of Mersenius under varying conditions of solar illumination was obtained.

Observations

col.	date (1966)
53°.4	Mar. 4
63.3	May 3
64.1	July 1
75.4	May 4
76.9	July 2
82.5	June 3
102.3	Mar. 8
120.1	Apr. 8
152.5	May 10
165.1	July 9
177.4	July 10
190.1	Mar. 15
201.3	July 12
214.5	July 13

Photographs

col.	
53°.4	March 4, 1966 photo by K. J. Delano
57.1	KPLA E6b[3]
63.8	KPAM LXXXVI[4]
67.0	ALPO Lunar Photograph Library - PSM-7
68.4	KPLA F6-f (S-34)
78.8	KPLA F6-b
127.6	KPLA F6-c
172.0	Plate XVII of Lick Observatory series
172.3	KPLA E6-c and E6-f (S-29)
181.9	KPAM CLXIIa
201.9	KPLA E6-a
202.0	Sky & Telescope, Vol. XV, No. 9, p. 395
202.6	KPLA F6-a
203.7	Sky & Telescope, Vol. XXXI, No. 3, center
210.9	KPAM CXLIX
229.1	KPLA F6-d

Figure 6. The crater of Kilauea in Hawaii. The north wall is in the upper right. See also text.

Figure 7. Mersenius and vicinity on Plate F6-b of Kuiper's Photographic Lunar Atlas. Colongitude 78:8. The arrows point out the three dark spots in the now indistinguishable dark ray on the west wall of Mersenius. Lunar south at top, lunar west (IAU sense) at right. See also text.

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Figure 8. Mersenius and vicinity on Plate CXLIX of Kopal's Photographic Atlas of the Moon. Colongitude 210:85. The two pointers bracket the extent of the dark ray on the west wall. Lunar south at top, lunar west (IAU sense) at right.

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Shortly after sunrise on Mersenius, a long, dark shadow is seen running along the interior northwest (IAU) wall of Mersenius. This shadow marks the location of a very prominent terrace, which is also quite evident half-way down the south wall as well. Because the east, and particularly the north, walls of Mersenius have undergone considerable fragmentation from the very top down to the floor, a singularly conspicuous inner terrace is not seen along these walls. A cross section of Mersenius' west wall from the top of the rim to the floor would display 1) a sharp descent at first, 2) then a leveling out at the halfway point where what appears to be a narrow plateau is located, 3) followed by a little rise (which causes the dark shadow at sunrise, 4) and finally a resumption of the descent to the floor at a more gradual angle than the upper wall's slope. Observations suggest a similar profile for the south wall. Thus Mersenius appears to be a crater in which an inner concentric crater, almost but not quite as large, developed within the original crater. The narrow plateau marks the original crater floor, and what is now the floor common to the two concentric craters is entirely occupied by a huge dome. It is easy to imagine that the present dome is the third of three successively smaller domes to have formed at the site, and that if this third dome had erupted and collapsed, a third concentric crater, almost equal in size to its enclosing two, would have been formed. The inner terrace which we see was formed by the upward thrust of the second of two massive eruptions by Mersenius. The first eruption had formed the present rim of Mersenius; and some time later a second explosive event formed yet another rim, which we now see as a terrace, within the crater.

Instead of collapsing and forming a third and slightly smaller concentric crater, the domical uplift of Mersenius' floor appears to have survived the strains of the uplifting magma which caused it. The numerous craterlets and clefts criss-crossing the entire dome appear to have been sufficient escape valves for the release of declining volcanic forces. It is interesting to note that the formation of a dome marks the final stage of volcanic activity here on earth, and we may presume the same for the moon.

Volcanologists also tell us that the final stages of volcanic activity are marked by lesser outbreaks along the periphery of where the most recent major activity took place, i.e., along the edges of a new crater. Mersenius displays this aspect of declining vulcanism also. The several craterlets along its uppermost rim mark the decline of the original crater-causing plutonic activity. In this matter of rim craters, Mersenius compares well with the three-mile-wide volcanic crater of Kilauea in Hawaii (Figure 6). Like Kilauea, Mersenius has a very large rim crater and also a similar breakthrough of its upper walls. The breakthrough of Mersenius' upper wall lies on the west rim and is best shown on Plate F6-a of Kuiper's Photographic Lunar Atlas. The decline of the final thrust of plutonic activity, the thrust which produced the domical floor, might have left the curious dark band peripheral to the dome. The dark band lies along the border between Mersenius' lower west wall and the dome's western base. It is visible from sunrise to sunset (Figure 8) except for a period between col. 78° and col. 160°. Between colongitudes 78° and 160° only three segments of this band, appearing as three round, dark spots, are visible. Immediately before and after this period the three spots can be seen for a time as darker spots within a dusky band (Figure 7). The three dark spots bear much resemblance to dark halo craters such as are to be found in Alphonsus, although I have not been able to see any central craterlet or pit in the Mersenius dark spots. The dark band, which contains the three spots and which can fade from sight almost completely at definite solar elevations, calls to mind the behavior of many dark radial bands within some craters, notably those of Aristarchus. If small, round, dark spots similar to those of Alphonsus are considered to be the locales of the more recent lunar vulcanism, then perhaps the dark bands are also the result of the more recent vulcanism. Mersenius does reveal a relationship between dark spots and dark bands.

Besides a marked terrace on its inner wall, a domical floor, and features indicative of declining, peripheral vulcanism, Mersenius presents still another reason for holding to a plutonic origin. Except for the upper west, south, and southeast walls which are quite steep, the slopes of Mersenius' walls are about 20 degrees, judging by the speckled-grey, ghostly shadows they exhibit at a solar altitude of 20 degrees. Such a speckled-grey appearance could be due to huge boulders both catching sunlight and casting shadows, or the appearance may also be due to minute terracing of the kind displayed by a section of Kilauea's north wall (Figure 6). Part of Kilauea's north wall appears to have sunken in a somewhat step-like manner into an underlying magma chamber no longer able to support the weight of the walls at that point. Mersenius now has steep upper walls in the west, south, and southwest. The other walls show an even, gentle gradation from floor to rim. A sinking of the walls in step-like fashion into a magma chamber once capable of supporting the walls can account for their present appearance. We might even expect such to be the case on the basis of a huge dome's being on the crater's floor - a sign of weakening plutonic forces or of withdrawal of underlying magma.

In presenting this paper, it has been my intention to call attention to a way of approaching the question of the origin of the moon's craters. Instead of speaking of craters in general, or even in general categories, I have chosen to take one crater, to examine it closely, and to see whether it gives evidence strongly favoring either the plutonic or the meteoritic theory of origin. For Mersenius I find strong evidence of a plutonic origin.

Notes

1) cf. The Strolling Astronomer, Vol. 14, Numbers 5-6, pp. 95-6, or Sky & Telescope, Vol. XX, Number 4, p. 219.
2) cf. The Strolling Astronomer, Vol. 13, Numbers 11-12, pp. 137-140.
3) The abbreviation KPLA refers to Gerard Kuiper's Photographic Lunar Atlas, published by the Univ. of Chicago Press.
4) The abbreviation KPAM refers to Zdenek Kopal's Photographic Atlas of The Moon, published by the Academic Press.

Note by Editor on Comet Magnitudes Formula. In Mr. Bortle's article on pages 64 and 65 there are a number of references to equations for expressing stellar magnitudes of comets. He uses M for the stellar magnitude, r for the heliocentric distance in astronomical units, and Δ for the distance from the earth in astronomical units. The coefficient of log r varies for different comets, as does the "absolute magnitude" term for both distances equal to unity.

IKEYA-SEKI, EAST

By: John E. Bortle, A.A.A. Observing Group Comet Recorder

(Paper read at the Fourteenth A.L.P.O. Convention at Tucson, Arizona, August 26-28, 1966.)

Those of us here in the East did not have the thrill of seeing Ikeya-Seki in broad daylight; but I will long remember the cold, clear mornings of October and November, 1965 for presenting before me the type of comet I had so often read of in my astronomy texts. Now when I take these books down from the shelf and glance over drawings made a century or more ago, I have new respect for their creators; for at last I realize that these pictures are not distortions of the truth. Now I believe them, for now I too have seen a great comet.

Like Pons, Brooks, and Peltier, I am a comet observer. Over the last decade I have observed thirteen comets, and each time a new one appeared I realized that no one man could ever hope to cover all the observational and photographic aspects of a comet. Thus with the advent of a great comet I quickly saw that I should choose some specialized subject to which I could devote extra time and around which I could center my regular comet observing program. As I am an experienced variable star observer, I quickly saw that my best approach would lie in the field of total magnitude analysis of the comet, which could be subdivided into the areas of total magnitude, nucleus magnitude, and tail magnitude. Thus for eighteen mornings over a period of two months I and Ikeya-Seki rose together; and when the comet had finally passed from my view, I complied my data and was more than mildly interested at its outcome.

My first subdivision was, of course, total magnitude. My observations covered the comet from $r = .45$ to 1.3 and showed a definite change of value in the comet's magnitude formula when comparing the post-perihelion period with that prior to perihelion. The formula for the pre-perihelion period was $M = 6.2 + 5 \log\Delta + 10.9 \log r$, while that of the post-perihelion period was best expressed as $M = 6.5 + 5 \log\Delta + 9.8 \log r$. These formulas are in rather good accord with those already published and show that Ikeya-Seki was a rather normal comet except for its small perihelion value. It should be noted, though, that the rate of variation fell off one point after perihelion. Such a change may well have been the result of its very close passage of the sun and/or its disruption near the same time. This ability to fade more slowly after perihelion was apparently only a temporary feature; for once the comet was somewhat more than one astronomical unit from the sun, it began to fade far more rapidly than the formula called for and was lost from view much earlier than expected.

The second area of study was the comet's nucleus. Unfortunately, the star-like nucleus was not always present so that my study of it was based on relatively fewer estimates than that of the total object. Even so, a general magnitude parameter could be formed from the observations at hand. Of course, one must keep in mind that the nuclei of comets are notoriously variable, most probably because they are viewed through their own expanding gases, so that observations may not always fit the formulas. In this case my observations presented a parameter following the inverse sixth power law, unlike the total magnitude which had followed the inverse fourth power law. The formula derived for the nucleus was $M = 10.0 + 5 \log\Delta + 15 \log r$ which is notably similar to the parameter followed by faint periodic comets.

By far my most intriguing project was to compile a magnitude parameter for the comet's tail, an idea which I have heard no previous mention of. Since a comet's tail can often be an extensive thing, it is difficult to find any optical aid which can help you. In my case I chose to use only the naked eye to produce extra-focal images of stars to compare with the comet's tail. I have used this procedure to make magnitude estimates of lunar eclipses and find it works quite well; but there is a device available that could do the job better, and I shall mention it presently. Using the procedure just described, I made magnitude estimates of the comet's tail at a point about two and one-half degrees from the head and at another point several degrees in from the tail's end. The results gave a formula of $M = 4.6 + 5 \log\Delta + 8 \log r$ for the point two and one-half degrees from the head but an almost constant value of 4.5 near the tail's end! Thus the tail did not fade as a whole but rather at a parabolic rate outward along the tail. It also appears that when the entire tail reached magnitude five it faded as a whole beyond the threshold of visibility. Thus it appears that a very complicated formula is needed to represent the variations in a comet's tail.

When all three formulas are brought together, an interesting relation appears. It is quickly noted that the brighter the absolute magnitude of each part of the comet, the slower its rate of variation. To be considered also is the fact that the order of brightness of the three sections was tail, total, and nucleus; while in most comets, as in Ikeya-Seki prior to perihelion, the order is total, tail, and nucleus. This leads to the conclusion that close approaches to the sun can change the usual order of brightness as it did with Ikeya-Seki, Wilson, and Pereyra. Then, too, we have the fact that the tail does not fade as a whole while the coma is within the radius of the earth's orbit but does soon after passing this point, a problem which I don't have an explanation for.

My work on Ikeya-Seki has shown me how little we know of comet tails and even how much less we record about them. In reporting a comet observation, we rarely give more than its length, width, and some useless statement about it, like faint or bright. Is it not time we started recording brightness variations in the tails of comets? Photographs of a comet with the same exposure period and under similar sky conditions could be run through a densitometer to form a very accurate record; while visually, for at least the brighter comets, an observer could use the same kind of device employed to measure the brightness of the Gegenschein. Since the visual intensimometer measures in intensity units rather than in magnitudes, it would be much easier to obtain useful values than with the far more difficult procedure that I used.

While comet observing is the oldest form of useful observing, it is a subject which we still know little of. This paper mentions only one small unknown; there are many, but this one may be in our power to answer with just a little extra work.

TABLES FOR COMPUTING JOVIAN LONGITUDES

By: Walter H. Haas, Director A.L.P.O.

The computing of longitudes of features on Jupiter is easily carried out with the help of two tables given in each annual volume of The American Ephemeris and Nautical Almanac. Mr. Richard Wend, the A.L.P.O. Jupiter Recorder, has kindly furnished for reproduction here as Figures 9 and 10 photographic copies of the 1967 versions of these tables.* We are glad to be able to supply this service for our readers. It will be seen that what is tabulated is the longitude of the central meridian at 0 hrs., Universal Time on each day of the year in two different Systems of longitude. In the lower part of each page the rate of rotation of Jupiter in the pertinent system is given in convenient units of time.

System I and System II have arbitrary periods of rotation and arbitrary zero longitudes, but it has been found empirically that most optical features on Jupiter have periods of rotation close to that of either System I or System II. Features located between the south edge of the North Equatorial Belt and the north edge of the north component of the South Equatorial Belt, inclusive of these boundaries, are normally assigned to System I; those located elsewhere are normally assigned to System II. There are some exceptions to these generalities, though they need not trouble the beginner. There is a System I current at the south edge of the North Temperate Belt, for example; and periods intermediate between System I and System II are sometimes found in the interior of the South Equatorial Belt.

It may be worthwhile to give a couple hypothetical examples of the computation of central meridian on Jupiter.

1. An observer using Eastern Standard Time records a dark projection on the south edge of the North Equatorial Belt to be on the C.M. of Jupiter at 10:22 P.M. on March 28, 1967. What is the feature's System I longitude?

The Universal Time is five hours later or 3^h22^m on March 29. Then we look up these values in Figure 9, or our copy of the 1967 A.E.N.A.

C.M. at 0^h, U.T., March 29	235°.0
Increase in 3 hours, 20 minutes	121.9
Increase in 2 minutes ($3.0 \times \frac{2}{5}$)	1.2
Required Longitude (I)	358°.1

Usually this result would be rounded to 358°.

2. An observer employing Pacific Standard Time records the C.M. transit of a small

*The photographic copies of the tables published here were prepared by Mr. P. R. Glaser, formerly the A.L.P.O. Jupiter Recorder.

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EPHEMERIS FOR PHYSICAL OBSERVATIONS

LONGITUDE OF CENTRAL MERIDIAN OF ILLUMINATED DISK

SYSTEM I

Day (0^h U.T.)	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	°	°	°	°	°	°	°	°	°	°	°	°
1	173.8	32.8	135.4	348.4	40.7	249.0	298.9	146.5	354.9	47.1	258.9	315.2
2	331.8	190.8	293.3	146.2	198.4	46.6	96.5	304.2	152.6	204.9	56.8	113.1
3	129.9	348.8	91.2	304.0	356.1	204.3	254.2	101.8	310.3	2.6	214.6	271.0
4	287.9	146.7	249.1	101.7	153.8	2.0	51.8	259.5	108.0	160.4	12.5	68.9
5	85.9	304.7	47.0	259.5	311.5	159.6	209.5	57.2	265.8	318.2	170.3	226.8
6	244.0	102.7	204.9	57.3	109.2	317.3	7.2	214.9	63.5	115.9	328.2	24.8
7	42.0	260.7	2.7	215.0	266.9	115.0	164.8	12.5	221.2	273.7	126.0	182.7
8	200.1	58.7	160.6	12.8	64.6	272.6	322.5	170.2	18.9	71.5	283.9	340.6
9	358.1	216.7	318.5	170.6	222.3	70.3	120.2	327.9	176.7	229.3	81.7	138.6
10	156.2	14.6	116.3	328.3	20.0	228.0	277.8	125.6	334.4	27.1	239.6	296.5
11	314.2	172.6	274.2	126.1	177.7	25.6	75.5	283.3	132.1	184.9	37.4	94.4
12	112.2	330.6	72.1	283.8	335.4	183.3	233.1	80.9	289.8	342.7	195.3	252.4
13	270.3	128.5	229.9	81.6	133.1	341.0	30.8	238.6	87.6	140.5	353.2	50.3
14	68.3	286.5	27.8	239.3	290.7	138.6	188.5	36.3	245.3	298.2	151.0	208.2
15	226.3	84.5	185.6	37.1	88.4	296.3	346.1	194.0	43.0	96.0	308.9	6.2
16	24.4	242.4	343.4	194.8	246.1	93.9	143.8	351.7	200.8	253.8	106.8	164.1
17	182.4	40.4	141.3	352.6	43.8	251.6	301.5	149.4	358.5	51.6	264.6	322.1
18	340.5	198.3	299.1	150.3	201.5	49.3	99.1	307.1	156.3	209.4	62.5	120.1
19	138.5	356.2	96.9	308.0	359.2	206.9	256.8	104.7	314.0	7.3	220.4	278.0
20	296.5	154.2	254.8	105.8	156.9	4.6	54.5	262.5	111.8	165.1	18.3	76.0
21	94.6	312.1	52.6	263.5	314.5	162.3	212.1	60.2	269.5	322.9	176.2	233.9
22	252.6	110.0	210.4	61.2	112.2	319.9	9.8	217.8	67.2	120.7	334.1	31.9
23	50.6	268.0	8.2	218.9	269.9	117.6	167.5	15.5	225.0	278.5	132.0	189.9
24	208.6	65.9	166.0	16.7	67.6	275.2	325.1	173.2	22.8	76.3	289.8	347.8
25	6.7	223.8	323.8	174.4	225.2	72.9	122.8	330.9	180.5	234.1	87.7	145.8
26	164.7	21.7	121.6	332.1	22.9	230.6	280.5	128.6	338.3	32.0	245.6	303.8
27	322.7	179.6	279.4	129.8	180.6	28.2	78.1	286.4	136.0	189.8	43.5	101.8
28	120.7	337.5	77.2	287.5	338.3	185.9	235.8	84.1	293.8	347.6	201.4	259.7
29	278.7		235.0	85.3	135.9	343.5	33.5	241.8	91.5	145.4	359.3	57.7
30	76.7		32.8	243.0	293.6	141.2	191.1	39.5	249.3	303.3	157.3	215.7
31	234.8		190.6		91.3		348.8	197.2		101.1		13.7

MOTION OF THE CENTRAL MERIDIAN

	0^h	1^h	2^h	3^h	4^h	5^h	6^h	7^h	8^h	9^h	10^h	11^h
m	°	°	°	°	°	°	°	°	°	°	°	°
0	0.0	36.6	73.2	109.7	146.3	182.9	219.5	256.1	292.7	329.2	5.8	42.4
5	3.0	39.6	76.2	112.8	149.4	186.0	222.5	259.1	295.7	332.3	8.9	45.4
10	6.1	42.7	79.3	115.8	152.4	189.0	225.6	262.2	298.7	335.3	11.9	48.5
15	9.1	45.7	82.3	118.9	155.5	192.1	228.6	265.2	301.8	338.4	15.0	51.5
20	12.2	48.8	85.4	121.9	158.5	195.1	231.7	268.3	304.8	341.4	18.0	54.6
25	15.2	51.8	88.4	125.0	161.6	198.1	234.7	271.3	307.9	344.5	21.1	57.6
30	18.3	54.9	91.5	128.0	164.6	201.2	237.8	274.4	310.9	347.5	24.1	60.7
35	21.3	57.9	94.5	131.1	167.7	204.2	240.8	277.4	314.0	350.6	27.2	63.7
40	24.4	61.0	97.6	134.1	170.7	207.3	243.9	280.5	317.0	353.6	30.2	66.8
45	27.4	64.0	100.6	137.2	173.8	210.3	246.9	283.5	320.1	356.7	33.2	69.8
50	30.5	67.1	103.6	140.2	176.8	213.4	250.0	286.6	323.1	359.7	36.3	72.9
55	33.5	70.1	106.7	143.3	179.9	216.4	253.0	289.6	326.2	2.8	39.3	75.9
60	36.6	73.2	109.7	146.3	182.9	219.5	256.1	292.7	329.2	5.8	42.4	79.0

Figure 9. Jupiter System I longitudes in 1967. See text on page 65.

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white bay on the north edge of the South Temperate Belt at 11:48 P.M. on April 19, 1967. What is the System II longitude of this bay?

The Universal Time is eight hours later, or 7^h48^m on April 20. We now use Figure 10 to get the following numbers.

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EPHEMERIS FOR PHYSICAL OBSERVATIONS

LONGITUDE OF CENTRAL MERIDIAN OF ILLUMINATED DISK

SYSTEM II

Day (0h U.T.)	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	°	°	°	°	°	°	°	°	°	°	°	°
1	318.4	300.9	189.9	166.4	349.8	321.5	142.6	113.7	85.5	268.8	244.1	71.4
2	108.8	91.2	340.2	316.5	139.8	111.6	292.6	263.7	235.6	59.0	34.3	221.7
3	259.3	241.6	130.4	106.7	289.9	261.6	82.6	53.7	25.7	209.1	184.5	12.0
4	49.7	32.0	280.7	256.8	80.0	51.7	232.7	203.8	175.8	359.2	334.8	162.3
5	200.1	182.3	70.9	47.0	230.1	201.7	22.7	353.8	325.9	149.4	125.0	312.6
6	350.5	332.7	221.2	197.1	20.1	351.7	172.7	143.9	116.0	299.5	275.2	102.9
7	140.9	123.0	11.4	347.2	170.2	141.8	322.7	293.9	266.1	89.7	65.4	253.2
8	291.3	273.4	161.7	137.4	320.3	291.8	112.8	84.0	56.2	239.8	215.6	43.5
9	81.7	63.7	311.9	287.5	110.4	81.8	262.8	234.0	206.3	30.0	5.9	193.8
10	232.1	214.1	102.2	77.6	260.4	231.9	52.8	24.1	356.3	180.1	156.1	344.1
11	22.5	4.4	252.4	227.8	50.5	21.9	202.9	174.1	146.4	330.3	306.3	134.4
12	172.9	154.8	42.6	17.9	200.5	171.9	352.9	324.2	296.5	120.5	96.5	284.7
13	323.4	305.1	192.8	168.0	350.6	322.0	142.9	114.2	86.7	270.6	246.8	75.0
14	113.8	95.4	343.1	318.1	140.7	112.0	293.0	264.3	236.8	60.8	37.0	225.8
15	264.2	245.8	133.3	108.2	290.7	262.0	83.0	54.3	26.9	210.9	187.3	15.6
16	54.6	36.1	283.5	258.3	80.8	52.1	233.0	204.4	177.0	1.1	337.5	165.9
17	205.0	186.4	73.7	48.5	230.8	202.1	23.1	354.5	327.1	151.3	127.7	316.3
18	355.4	336.7	223.9	198.6	20.9	352.1	173.1	144.5	117.2	301.5	278.0	106.6
19	145.8	127.0	14.1	348.7	170.9	142.2	323.1	294.6	267.3	91.6	68.2	256.9
20	296.2	277.3	164.3	138.8	321.0	292.2	113.2	84.7	57.4	241.8	218.5	47.2
21	86.6	67.6	314.5	288.9	111.0	82.2	263.2	234.7	207.5	32.0	8.7	197.6
22	237.0	217.9	104.7	79.0	261.1	232.3	53.3	24.8	357.7	182.2	159.0	347.9
23	27.4	8.2	254.9	229.1	51.1	22.3	203.3	174.9	147.8	332.4	309 3	138.3
24	177.8	158.5	45.0	19.2	201.2	172.3	353.3	324.9	297.9	122.5	99.5	288.6
25	328.2	308.8	195.2	169.3	351.2	322.4	143.4	115.0	88.0	272.7	249.8	78.9
26	118.6	99.1	345.4	319.3	141.3	112.4	293.4	265.1	238.2	62.9	40.1	229.3
27	269.0	249.4	135.6	109.4	291.3	262.4	83.5	55.1	28.3	213.1	190.3	19.6
28	59.4	39.6	285.7	259.5	81.4	52.5	233.5	205.2	178.4	3.3	340.6	170.0
29	209.7		75.9	49.6	231.4	202.5	23.5	355.3	328.5	153.5	130.9	320.3
30	0.1		226.1	199.7	21.5	352.5	173.6	145.4	118.7	303.7	281.2	110.7
31	150.5		16.2		171.5		323.6	295.5		93.9		261.0

MOTION OF THE CENTRAL MERIDIAN

m	0^h	1^h	2^h	3^h	4^h	5^h	6^h	7^h	8^h	9^h	10^h	11^h
	°	°	°	°	°	°	°	°	°	°	°	°
0	0.0	36.3	72.5	108.8	145.1	181.3	217.6	253.8	290.1	326.4	2.6	38.9
5	3.0	39.3	75.5	111.8	148.1	184.3	220.6	256.9	293.1	329.4	5.7	41.9
10	6.0	42.3	78.6	114.8	151.1	187.4	223.6	259.9	296.1	332.4	8.7	44.9
15	9.1	45.3	81.6	117.9	154.1	190.4	226.6	262.9	299.2	335.4	11.7	48.0
20	12.1	48.4	84.6	120.9	157.1	193.4	229.7	265.9	302.2	338.5	14.7	51.0
25	15.1	51.4	87.6	123.9	160.2	196.4	232.7	268.9	305.2	341.5	17.7	54.0
30	18.1	54.4	90.7	126.9	163.2	199.4	235.7	272.0	308.2	344.5	20.8	57.0
35	21.2	57.4	93.7	129.9	166.2	202.5	238.7	275.0	311.3	347.5	23.8	60.0
40	24.2	60.4	96.7	133.0	169.2	205.5	241.8	278.0	314.3	350.5	26.8	63.1
45	27.2	63.5	99.7	136.0	172.2	208.5	244.8	281.0	317.3	353.6	29.8	66.1
50	30.2	66.5	102.7	139.0	175.3	211.5	247.8	284.1	320.3	356.6	32.8	69.1
55	33.2	69.5	105.8	142.0	178.3	214.6	250.8	287.1	323.3	359.6	35.9	72.1
60	36.3	72.5	108.8	145.1	181.3	217.6	253.8	290.1	326.4	2.6	38.9	75.1

Figure 10. Jupiter System II longitudes in 1967. See text on page 65.

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C.M. at 0^h, U.T. on April 20	138°8
Increase in 7 hrs., 45 mins.	281.0
Increase in 3 minutes $(3.0 \times \frac{3}{5})$	1.8
Required Longitude (II)	421°6

Since the sum exceeds 360°, we must substract 360° and normally then round the result to 62°.

Charles Giffen has given an instructive and illustrated treatment of the general problem of finding longitudes on Jupiter in "Visual Longitude Determinations on Jupiter", Str. A., Vol. 19, Nos. 1-2, pp. 29-34.

ANNOUNCEMENTS

Sustaining Members and Sponsors. As of February 25, 1967, we have in these special classes of membership:

Sponsors - William O. Roberts, David P. Barcroft, Grace A. Fox, Philip and Virginia Glaser, John E. Westfall, Joel W. Goodman, the National Amateur Astronomers, Inc., James Q. Gant, Jr., Ken Thomson, Kenneth J. Delano, Richard E. Wend, and Phillip W. Budine.

Sustaining Members - Sky Publishing Corporation, Charles F. Capen, Craig L. Johnson, Geoffrey Gaherty, Jr., Dale P. Cruikshank, Charles L. Ricker, Alan McClure, Elmer J. Reese, George E. Wedge, Carl A. Anderson, Gordon D. Hall, Michael McCants, William K. Hartmann, Ralph Scott, A. W. Mount, Charles B. Owens, Joseph P. Vitous, Jimmy George Snyder, John E. Wilder, Clark R. Chapman, A. K. Parizek, B. Traucki, Charles H. Giffen, Frederick W. Jaeger, Klaus R. Brasch, P. K. Sartory, Nicholas Waitkus, Patrick S. McIntosh, Lyle T. Johnson, and the Chicago Astronomical Society.

Sustaining Members of the A.L.P.O. pay dues of $10 per year; Sponsors, $25 per year. The surplus above the regular rate is used to support the work and activities of the Association.

Astronomical League National Convention at Washington, D.C. The dates of this meeting are June 30-July 4, 1967; the place is Georgetown University. There will be visits to the Georgetown Observatory, which is more than 150 years old; to the U.S. Naval Observatory, including the new Time Service facility; and to NASA's Goddard Space Flight Center. The program is comprehensive; there will be an A.A.V.S.O. paper session, an A.L.P.O. paper session, a junior session, a session on instruments and accessories, and others. There will be plenty of space for exhibits by either individuals or groups. The General Convention Chairman is G. R. Wright, 202 Piping Rock Drive, Silver Spring, Maryland 20904. The Exhibits Chairman is Dr. James J. Krebs, 3922 Southern Ave., S.E., Washington, D.C. 20020.

Dormitory space will be available at Georgetown University for $3 per person per night. The dormitories are not air-conditioned. Those preferring hotel or motel accommodations in the Washington area should make their reservations early. The registration fee is $2 for an individual or $3 for a family. Early registration is strongly encouraged. The registration fee should be sent to Fred J. Cornelius, Convention Treasurer, 3101 Chichester Lane, Fairfax, Virginia 22030.

Persons wishing to give a paper during the A.L.P.O. paper session should submit this paper soon to Walter H. Haas, Box AZ, University Park, New Mexico 88001. Papers of suitable quality from A.L.P.O. members expecting to attend are heartily invited. Those wishing to contribute to the A.L.P.O. Exhibit should correspond soon with John E. Westfall, 1530 Kanawha St., Apt.110, Adelphi, Maryland 20783. Mr. Westfall plans to include in the exhibit a considerable amount of recent professional space research lunar maps.

Seventeenth Annual Convention of the Mid-States Region of the Astronomical League. A week-end of information, discussion, sharing of mutual interests with astronomical friends, and fun for all is planned for June 9, 10, and 11, 1967 at the Friends University, Wichita, Kansas. The host society is the Wichita Astronomical Society; other sponsors are the Friends University, the Astronomy Club of Kansas City, and the Midland Empire Astronomy Club at St. Joseph. Dormitory rooms and cafeteria meals will be provided on the campus, with family space available. The dormitories are air-conditioned. Bedding and towels will be provided, but delegates should bring their own toilet articles. The Convention Theme is "Observing Programs for the Amateur Astronomer." Papers are expected to emphasize amateur observational activities in various fields. The principal speaker is to be the Editor of this journal. (Please come anyway.) Persons wanting more information about the 1967 Mid-States Regional Convention should write to Russell C. Maag, 1601 Blackwell Road, St. Joseph, Missouri 64505.

Note from the A.L.P.O. Librarian. The Library of the Association of Lunar and Planetary Observers gratefully acknowledges the receipt of the following books from the author, Señor Antonio Paluzíe-Borrell of Barcelona, Spain:

The Names of Orion and Its Stars
The Names of the Minor Planets
Names of the Plough, a reprint from the Irish Astronomical Journal
These books are reviewed elsewhere in this issue.

Please write to Mrs. Haas at 2225 Thomas Drive, Las Cruces, New Mexico 88001 if you want a list of Library books. These books are intended for the use of all members of the A.L.P.O. Information about borrowing books will also be supplied upon request; the procedure is very simple. The Librarian will be glad for any books on astronomy or related sciences which you may have for donation.

An Appeal for Book Reviews. Mr. J. Russell Smith, the A.L.P.O. Book Review Editor, recently wrote as follows: "Every astronomer, amateur or professional, enjoys a good book related to his work or his hobby. Not only does he enjoy reading, but this is one way he keeps up with what is new in his field. Too, by reading, he learns more about a subject in which he is very interested.

"The ALPO is an organization which exists because of the interests and coöperation of its members as well as because of the efforts and money put into it by its members. It does receive a few books from publishers for review, but most of the reviews published are from members who purchase a new book occasionally or who have new books available in one way or another. When you purchase a new book, I'm sure that the other members of the ALPO would appreciate your sharing information on the book with them by submitting a review to our official journal, The Strolling Astronomer.

"Many of our members are specialists in some field, and these members are better qualified than some of the rest of us to review books in their field. This is one area where the specialist could render a great service to the combined membership of the ALPO. I feel that the members would greatly appreciate reviews by these specialists.

"In order that we do not have a duplication of works, as has sometimes occurred, please write me when you decide to do a review. Remember, our ALPO is what we make it!"

LUNAR, PLANETARY, AND COMETARY PROSPECTS: MARCH-MAY, 1967

By: Walter H. Haas, Director A.L.P.O.

Mercury. This planet is at inferior conjunction on March 4, at greatest elongation west (28° from the sun) on March 31, at superior conjunction on May 11, and at greatest elongation east on June 12. It will thus be in the morning sky during most of March and April, but the low tilt of the ecliptic to the horizon makes this apparition an unfavorable one to observe in northern latitudes. The subsequent May-June evening apparition will be much more rewarding for observers in the United States, and Mercury will be at aphelion on June 29. Therefore, the slower motion of the planet in its orbit will allow it to be followed for a longer period of time in May and June than is usually possible.

Observers of Mercury would do well to study Mr. Hodgson's discussion of research projects for this planet in Str. A., Vol. 20, Nos. 1-2, pp. 7-8. The writer would once again invite ALPO observers to make an earnest effort to determine the rotation in optical wavelengths.

Venus. This planet will be a brilliant Evening Star throughout the spring. Intending observers should read Mr. Cruikshank's note on pages 45 and 46 of this issue. The planet will be gibbous; the value of K, the proportion of the disk illuminated by the sun, will be 0.87 on March 15, 0.78 on April 15, and 0.67 on May 15. Members equipped to make photographs of Venus in ultraviolet light are encouraged to do so.

Mars. This planet will be at opposition on April 15. The closest approach to the earth will occur on April 21, when the apparent angular diameter will attain a maximum value of 15".57. Intending observers of Mars will profit from reading Mr. Richard Wend's "The Forthcoming 1967 Apparition of Mars" in Str. A., Vol. 20, Nos. 1-2, pp. 5-6. Observing forms may be obtained from Mr. Brasch, our A.L.P.O. Mars Recorder. Certain physical data about the current apparition are tabulated below.

Date	Diameter	Tilt	Heliocentric Longitude	C.M. at 0 hrs., U.T.
1967, April 1	14".5	+19°	198°	249°
April 16	15.5	+20	205	118
May 1	15.4	+22	212	347
May 16	14.3	+23	219	214

Thus the north pole is tipped toward the earth by almost the maximum amount possible. The summer solstice of the northern hemisphere fell on February 16, 1967 (the heliocentric longitude was then 178°.) The Martian season is hence early summer in the northern hemisphere and early winter in the southern hemisphere. The central meridian increases at a rate of about 14°.6 per hour as the planet rotates; this fact and the values in the table above will allow rough values of the C.M. to be obtained quickly.

Jupiter. This planet was in opposition on January 20. It will hence be advantageously located in the evening sky throughout the spring. The declination of Jupiter will be near +21° in March-May so that the planet is well placed in the sky for observers in the United States. The A.L.P.O. Jupiter Handbook is still in stock and furnishes good guidelines for worthwhile amateur studies. The handbook can be ordered from the Editor; the price is 50 cents.

Writing on February 27, 1967, Mr. Wend calls attention to a Disturbance in the South Tropical Zone at 235°(II), reported by P. Budine and confirmed by W. Moser. It was first seen as a dark diagonal on January 21. The famous Red Spot has been very active in recent months and should be watched closely.

Saturn. The Ringed Planet will be in conjunction with the sun on March 23. It will not be observable to much purpose in the morning sky before the beginning of May. Early risers can then help us by making the kinds of observations discussed in recent Saturn Reports. In the middle of May the earth will be about seven degrees south of the plane of the rings, which will be correspondingly much more widely opened than during the 1966-7 edgewise apparition.

The recent discovery of a tenth satellite of Saturn will already be known to many of our readers. Mr. Alan Heath, the B.A.A. Saturn Section Director, wrote on February 5, 1967 that the B.A.A. Computing Section is satisfied that Mr. Patrick Moore has seen this satellite on about six occasions with a 10-inch refractor at Armagh. This news should encourage possessors of reasonably large apertures to search for the new satellite. It will certainly be more difficult than Mimas, long the innermost known satellite.

Uranus and Neptune. The table below gives the positions of these distant planets in the coming months. Uranus will be at opposition on March 13, when its angular diameter will be 3".96. Neptune will reach opposition on May 14, when its angular diameter will be 2".50. The two star positions given below may help in finding the faint planets by assisting differential settings of telescopes. Readers are reminded of Mr. Leonard Abbey's special project on the satellites of Uranus, pages 44-45 of this issue.

Object	Right Ascension	Declination
Uranus, April 1	$11^h30^m26^s$	+4° 4'
Uranus, May 1	11 26 46	+4 27
Uranus, June 1	11 25 30	+4 34
Beta Leonis (Denebola)	11 47 23	+14 45
Neptune, April 1	15 28 27	-17 3
Neptune, May 1	15 25 43	-16 53
Neptune, June 1	15 22 22	-16 40
Alpha Scorpii (Antares)	16 27 23	-26 22

Moon. A total lunar eclipse on April 24, 1967 will be but poorly and partially observable over most of the United States. The moon enters the umbra at 10^h25^m, U.T.; totality lasts from 11^h27^m to 12^h46^m; and the moon leaves the umbra at 13^h48^m, U.T. Mr. Toshihiko Osawa of Hyogo, Japan has kindly submitted a long list of umbral contact times for lunar features. These will be helpful in reducing whatever observations of this kind are received. Other possible observations are the maximum detectability of penumbral shadow and "lunar transient phenomena" during the eclipse.

Figure 11 is a praiseworthy drawing of a lunar dome by a beginning lunar observer. Mr. Watts' general drawing style is excellent. This dome near Kies will be very well lighted near 4^h, U.T. on April 19 (or on the evening of April 18 by civil time in the United States).

Lunar Recorder Kenneth Delano has again submitted a list of domes favorably positioned for study in the coming months. Local civil time double dates are here employed; March 20/21, for example, is the night which begins on March 20 and ends on March 21.

Date (1967)	xi eta	Long.	Lat.	Remarks
March 20/21	-458+130	-27°30'	+07°29'	One of seven N. of Hortensius.
22/23	-717+345	-49 49'	+20 13'	S. of Herodotus.
23/24	-895+059	-63 37'	+03 23'	One of three E. of Hevelius.
29/30	+593+131	+36 44'	+07 32'	S. of Cauchy. Prominent.
April 2/3	-232-467	-15 13'	-27 51'	N. of Pitatus.
3/4	-458+137	-27 32'	+07 53'	One of seven N. of Hortensius.
6/7	-900+005	-64 10'	+04 05'	SE of Hevelius.
12/13	+777-318	+55 03'	-18 35'	SW of Vendelinus.
14/15	+507+184	+31 04'	+10 38'	One of several N. of Sina.
15/16	+269+300	+16 33'	+17 29'	N. of Menelaus.
17/18	-138+447	-08 53'	+26 37'	S. of Birt.
20/21	-717+345	-49 49'	+20 13'	S. of Herodotus.
21/22	-643+651	-57 55'	+40 38'	Rümker.
22/23	-931-071	-68 58'	-04 05'	On Grimaldi's floor.
28/29	+510+200	+31 22'	+11 34'	One of several N. of Sina.
29/30	+255+304	+15 32'	+17 44'	N. of Menelaus.

Figure 11. Dome west of Kies (IAU directions), about one-half the crater's diameter from the west rim of Kies. Drawing by Donald Watts. 6-inch reflector, 158X. June 28, 1966, 3^h20^m, U.T. Mr. Watts estimated the dome to be 15 kms. in diameter. Seeing 3, transparency 6. Colongitude 28.°6. Note the obvious central craterlet and the flattened top of the dome as revealed by the shape of the shadow. This feature is one of the more conspicuous domes on the moon. Its positional designation is xi = -366, eta = -453.

Cometary Notes. Observers of comets should subscribe to the cards with current news furnished by Mr. Dennis Milon, the A.L.P.O. Comets Recorder. Comet Wild (1967c) will be a faint comet with magnitude remaining near 10.4. Don Wells and Michael McCants have computed these orbital elements: passage of perihelion, March 14, 1967; perihelion distance, 1.207 astronomical units; longitude of ascending node, 311.°885; argument of perihelion, 189.°649 for 1950; inclination, 88.°470; eccentricity, 0.999992. Comet Rudnicki is predicted to be near right ascension $20^h27^m.5$, declination -20°48' on March 21, 1967 and near 20^h $39^m.4$, declination -20°50' on March 31. The predicted magnitude on March 31 is 13.6, much too faint for most amateur telescopes.

OBSERVATIONS AND COMMENTS

Two Tardy Announcements. We regret that these announcements are out of their proper context.

1. Reverend Richard Hodgson, the A.L.P.O. Mercury Recorder, requests observers of Mercury to mail in to him all observations made of the February, 1967 evening apparition.

2. All observations of Jupiter should be submitted to Mr. Richard Wend, the Jupiter Recorder. Mr. Wend will coördinate the analysis of data by himself and the Assistant Jupiter Recorders.

Lunar Haloes. Joseph Ashbrook's note on such haloes in Str. A., Vol. 20, Nos. 1-2, pg. 6 has aroused some reader comment. Philip Glaser writes of intending to pursue this pleasant diversion. Douglas Smith of Vinton, Virginia observed a halo several degrees wide on February 16, 1967 at 3^h0^m, U.T. The inner edge was easily visible and lay just past the Pleiades; plotting on an atlas gave right ascension 3^h50^m, declination +24°. The A.E.N.A. position of the moon at the time was right ascension 2^h27^m, declination +14°31'. Dividers then gave as the radius of the halo 20°.2.

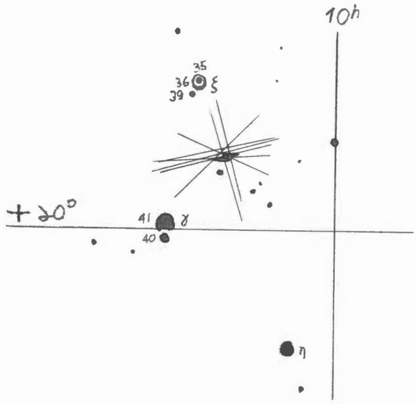

Figure 12. Radiant of Novermber 17, 1966 Leonid meteors derived from photograph by Scott Murrell near 12^h0^m, U.T. Tracing by Douglas Smith from Atlas Coeli. Eight meteors plotted and paths produced backwards. Only intersection of paths is shown.

Leonid Meteor Radiant from Photographs. The Editor suggested in the preceding issue that a photograph of the Leonid radiant region by Mr. Scott Murrell of the New Mexico State University Observatory, Figure 20 on pg. 30 of Str. A., Vol. 20, Nos. 1-2, could be used to determine the radiant by extending meteor trails backward to the area of near-intersection. As shown in Figure 12. Mr. Douglas Smith has done exactly that. His radiant is at right ascension 10 hrs., 11.5 mins., declination +21°.9, epoch 1950. Mr. Smith finds that this position is confirmed by two point meteors photographed by Mr. David McLean and shown in the January, 1967 issue of Sky and Telescope. This radiant has not been corrected for the rotation and gravitational attraction of the earth.

Saturn. The front cover drawing of Saturn by Mr. Osawa perhaps needs little comment. It was made when the earth was on the unilluminated side of the plane of the rings. In due time we hope to report fully on the 1966 edgewise presentation of the rings. The amount of ball detail shown is surprisingly large for an aperture of 6 inches. The very dark band on the ball a little below the ring-arms is the shadow of the rings. Mr. Osawa found the ring-arms both faintly visible near the limb of Saturn but not equally well.

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