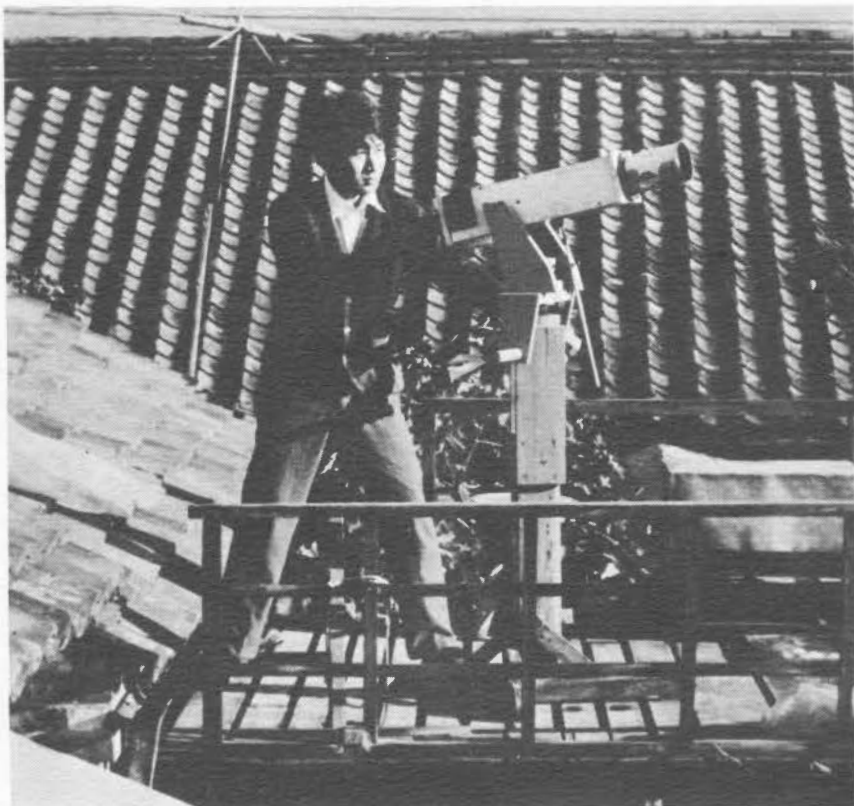


# *The* **The Journal Of** **The Association Of Lunar** **And Planetary Observers** *Strolling Astronomer*

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Mr. Tsutomu Seki of Kochi, Japan. The co-discoverer of Comet Ikeya-Seki 1965f is shown with his comet-seeking telescope, a 3-inch 17X hand-made refractor which he has used since 1961 for sweeps of the morning and evening sky. Its field is 3.5 degrees. Star charts used are Norton's and Skalnate-Pleso. Mr. Seki is also a teacher of classical guitar.

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## SATURN'S EDGEWISE RING PRESENTATION DURING 1966

By: Thomas A. Cragg and Larry C. Bornhurst, A.L.P.O. Saturn Recorders

During 1966 the Earth will pass through the plane of the rings of Saturn three times: on April 2, October 29, and December 17-18. It will mark the first time that this event has been observable since 1936. On April 2 the southern face of the ring system will become observable from the Earth, but the Sun will still be shining on the northern face. The rings will open out to nearly  $3^\circ$  inclination by June 15, when the Sun, passing through the ring plane, will begin to illuminate the southern side of the rings. Soon after July 7 the rings will begin to close, and the Earth will then pass through the ring plane again on October 29. After that date, we shall be presented the dark or northern side of the rings. However, at best, the rings will be inclined only about  $\frac{1}{2}^\circ$  before returning to edge-wise on December 17. We shall then again see the illuminated southern side, to remain so for roughly 15 years. The geometry just described is shown graphically in Figure 1.

Various interesting phenomena of the rings, which are presented at such a time, have received little study as a result of the comparative rarity of edgewise presentations.

One obvious problem is: how close to the theoretical edge-on position can the rings be seen with various apertures? Larger apertures, 10 inches and above, have in the past followed the rings up to within a few days of edge-on (The Planet Saturn by A.F.O'D. Alexander) in 1921 and 1936. This result is for looking at the sunlit side; but when we see the dark side, the ring can be invisible for a week or so before and after edge-on presentation. Perhaps the indicated asymmetry of the appearance can conceivably be a crude measure of the relative brightness of the sunlit and dark surfaces. Of course, this is a photometric problem; but it should be of interest to try to see how our visual results compare with photometric ones.

Another worthwhile program is to measure the surface brightness, say on a scale of 0 to 10, of the ring surface. Comparing the rings to the ball features should be of interest, even though we previously have been using the ring as a reference for intensity estimates of the ball!

Of great importance are brightness estimates of the dark side of the ring at various distances from the ball. If the intensity of the ring at different positions is proportional to the particle density, then the light leak through the ring should be exactly complementary. If this be true, then the intensity of the dark side should be directly opposite to that of the bright side; that is, the outer part of Ring B should be the darkest, while Ring A should be much brighter, and the Crape Ring the brightest of all! Of course, this will be complicated by the light reflected onto the ring by the ball, which illumination should fall off essentially as the inverse square of the distance from the ball.

Also of interest will be any observations of bright star-like points in the ring anytime during the dark side presentation. This phenomenon is observed especially when the ring is nearly edge-on. When making observations of the stellar-like points in the ring, one must be very careful that none of the satellites is in the area at the time. When the rings are very near edge-on, but not exactly, so that the rings appear as a very thin line, the inner satellites, when not near an elongation, will appear like beads of dew on a spider's web. Although of little scientific value, such a view should be very awe inspiring. It can be used, of course, to check how close to the ring plane these inner satellite orbits really are.

Another interesting discussion which may have some light shed on it at edgewise angles is the character of Ring D, a dusky ring reported outside Ring A. Although this subject is very controversial to those who have never seen Ring D, there does exist the argument: is Ring D a cloud of extra-planar particles (Fourmier phenomenon) or co-planar, just like an exterior Crape Ring (Schaer phenomenon)? Obviously, if we have extra-planar particles, their best presentation would be at edgewise presentation, above and below the ring plane. However, if Ring D is an exterior Crape Ring, it should be seen best at rather low ring inclinations but would be invisible at the edge-on presentation.

Of course, when the ring plane passes through the Sun, the best possibility is offered for observing transits, shadow transits, and eclipses of those satellites which are in or very near Saturn's equatorial plane. Iapetus, being inclined some  $15^\circ$ , passed through its eclipse season in 1963. Titan's eclipse season starts in 1966. The question still exists as to whether shadow transits of any satellites, other than Titan's, are ob-

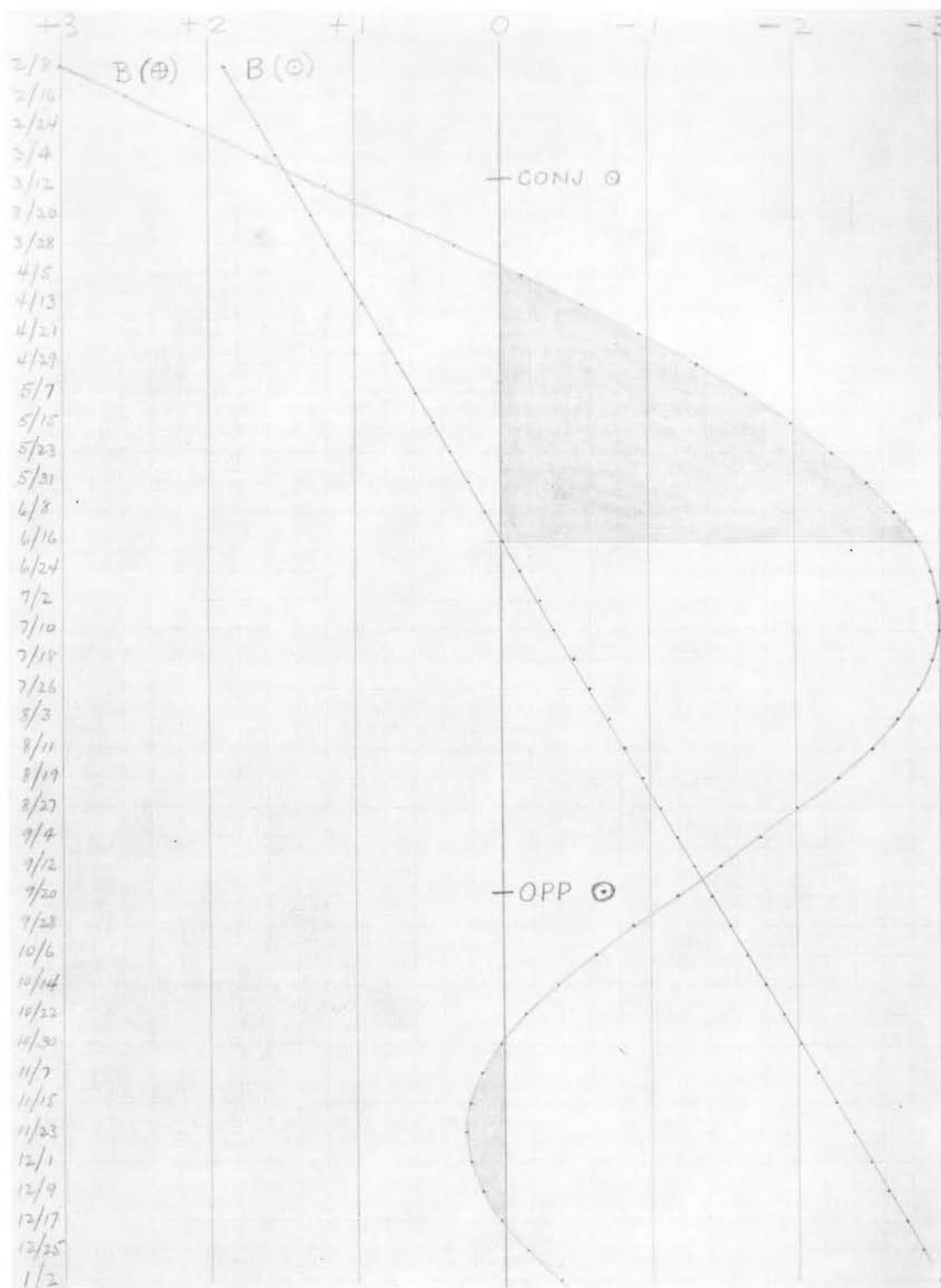


Figure 1. The geometry of the rings of Saturn from February 8, 1966 to January 2, 1967. Dates on left margin. The Saturnicentric latitude of the earth in degrees, plus when north, is shown as  $B(\oplus)$ ; that of the sun is  $B(\odot)$ . The earth is in the plane of the rings on April 2, October 29, and December 17; the sun passes from the north to the south side of the rings on June 15. See also text.

servable. That of Tethys has been reported once to us. Nearly all of Saturn's inner moons are too small to cast an umbral shadow on Saturn, which makes such observations most difficult.

This should also present the best opportunity to acquire magnitudes of the satellites, as their brightness correction would then be a simple function of their apparent distance from Saturn. Otherwise, the asymmetric background light scatter of Saturn's rings has to be corrected for when the rings are more open. Ordinarily, visual estimates of satellite magnitudes are little better than useless unless the observed satellite is rather far from the planet. Very sophisticated photometry is necessary to get any idea of a proper correction to apply for the scattered light correction due to Saturn and the ring.

Every effort should be made to obtain observations during the 1966-67 Saturn apparition due to the rarity of edgewise presentations. All observations should be forwarded promptly to the Saturn Section for reduction.

Postscript by Editor. We invite a most hearty participation in the projects described above. We strongly recommend for further reading on this subject The Edgewise Presentation of Saturn's Rings by Joel W. Goodman in Sky and Telescope, Vol. XXX, No. 3, pp. 128-131 (September 1965).

The B.A.A. Saturn Section continues to be interested in the visibility of transits of satellites and their shadows. More intensive A.L.P.O. efforts in this direction would be helpful. Our British friends are also using color filters to estimate the relative brightnesses of the satellites in different wavelengths, a program probably requiring at least 10 inches of aperture.

#### LUNAR TERMINATOR DEFORMATIONS

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

(Modified from a paper delivered by the author  
to the 1965 A.L.P.O. Convention in Milwaukee)

The study of lunar terminator deformations described here is an exploratory one only, but enough has been found to justify bringing this topic to the attention of other observers.

A lunar terminator deformation is any deviation of the moon's terminator from its theoretical elliptical shape. If the moon were a smooth, geometrically perfect sphere, the terminator would always be an ellipse. Actually, of course, the elevations and depressions on the moon's surface make the terminator irregular. Less obvious are the very gradual and extended deformations due to the slight deviation of the moon from a spherical figure, which deformations have been analyzed by Mainka (1901) and Ritter (1934), who derived formulae for computing the local lunar radius from terminator position measures. This paper is concerned with those deformations caused by elevations and depressions intermediate in size between local relief and the overall lunar figure; in particular, this study treats elevation differences in the maria, over distances, typically, of a few hundred kilometers.

All observations were photographic. During the period from October, 1964, to March, 1965, the writer took some eighty-one prime-focus lunar photographs with a four-inch, f/15 refractor. Four films were used--Tri-X, Kodachrome-X, High-Speed Ektachrome, and Anscochrome-200. These photographs were "overexposed" by a factor of from four to sixteen times so that the dimly-lit terminator would be correctly exposed. This so-called overexposure was very important because it was essential that the terminator itself be clearly identified, and not confused with local tonal variations or with shadows cast by elevated relief. Gradual elevation variations in the maria were then clearly indicated by a positive or negative curvature of the terminator.

The three photographs that accompany this article show the appearance of terminator deformations. A positive curvature ("bulge") indicates local relative elevation, as is illustrated by the Copernicus and Aristarchus uplifts (Figures 3 and 4, respectively). Negative curvature (a "dent") is caused by a local depressed area, such as Roris Trough (Figure 5). The photographs show how surprisingly obvious these deformations are, at least when one knows what to look for; they are well within the capabilities of even the smaller amateur instruments.

Figure 2 shows the distribution of photography by 10° colongitude intervals. Fairly

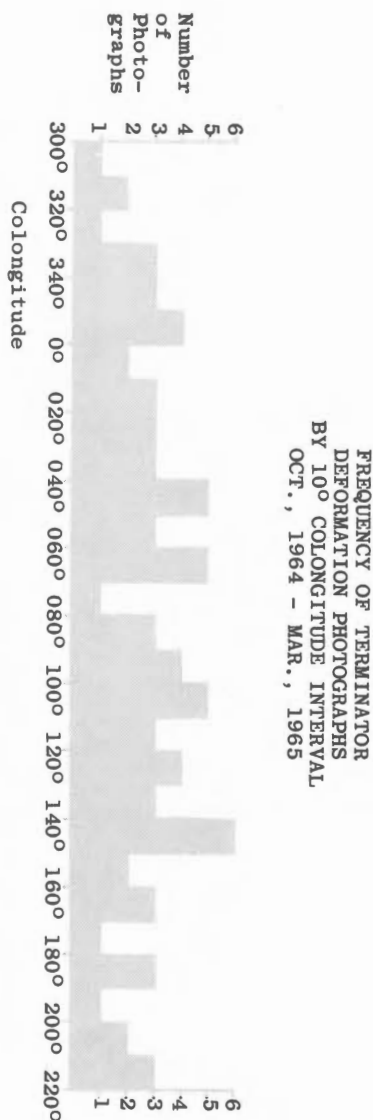


Figure 2. (above).



Figure 5 (left). The arrow points to the Roris Trough, evidenced as a terminator dent. December 16, 1964.  $1^h34^m$ , U.T. 4-inch refractor,  $f/15$ .  $1/25$  sec. on Tri-X. Seeing 3, transparency 3. Colongitude  $53^{\circ}9$ , solar latitude  $0^{\circ}0$ . "Overexposed" about 16 times.

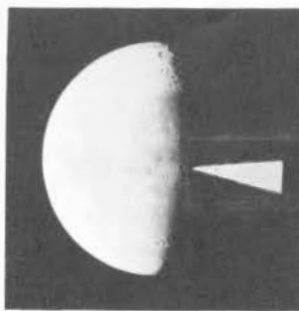
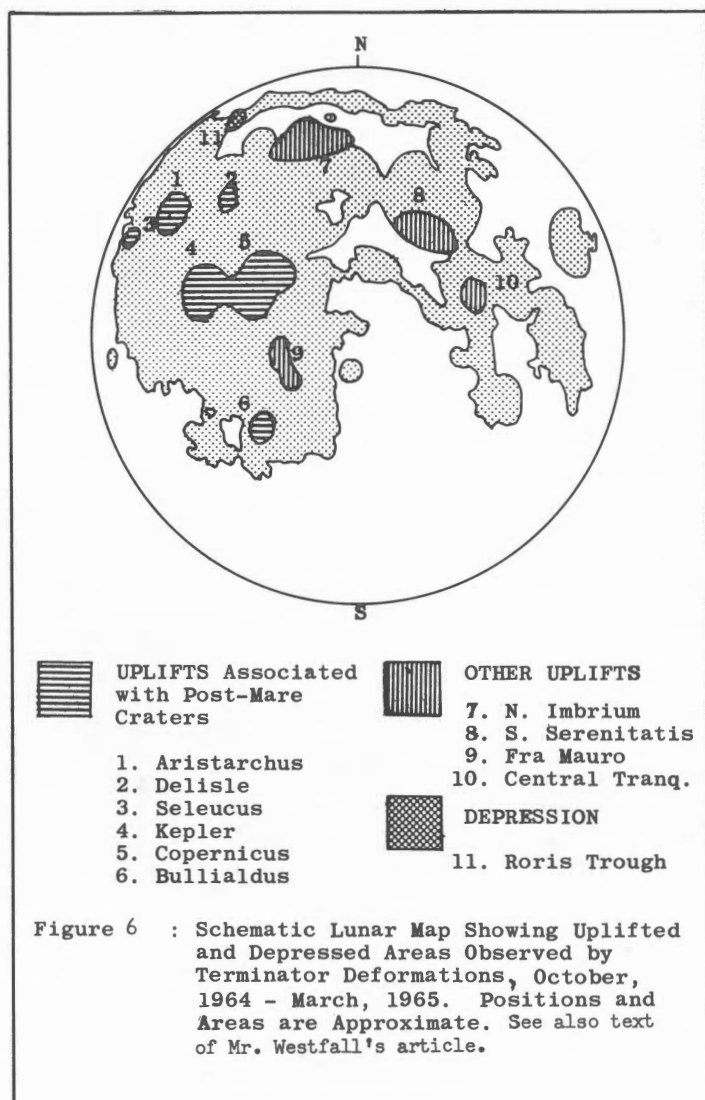


Figure 3. (above). The moon, showing the Copernicus uplift to which the arrow points. The lunar terminator is deformed by a bulge at this position. January 12, 1965,  $1^h10^m$ , U.T. 4-inch refractor,  $f/15$ .  $1/25$  sec. on Tri-X. Seeing 5, transparency 3. Colongitude  $22^{\circ}0$ , solar latitude  $-0^{\circ}7$ . "Overexposed" about 8 times.



Figure 4 (above). The Aristarchus uplift is well shown at this phase as a terminator bulge. January 14, 1965,  $5^h35^m$ , U.T. 4-inch refractor,  $f/15$ .  $1/25$  sec. on Tri-X. Seeing 3, transparency 3. Colongitude  $48^{\circ}5$ , solar latitude  $-0^{\circ}8$ . "Overexposed" about 16 times.



complete coverage of all colongitudes was attempted, but chance factors--such as cloudy weather--caused some colongitude intervals (such as  $70^{\circ}$ - $80^{\circ}$  and  $170^{\circ}$ - $180^{\circ}$ ) to be covered less well than others.

When all eighty-one photographs in the series were examined, a total of ten elevated areas ("uplifts") and one depression (the "Roris Trough") were definitely located. Figure 6 shows the approximate locations and extents of these eleven areas.

It is interesting that six uplifts are roughly centered in post-mare craters in the western (by I.A.U. convention) maria--Seleucus, Aristarchus, Delisle, Kepler, Copernicus, and Bullialdus. Two other uplifts are on the margins of maria--Imbrium and Serenitatis--indicating that their interiors are depressed in relation to their outer portions. Finally, two uplifts are associated with ghost or ruined craters in maria interiors--Nubium (Fra Mauro) and Tranquillitatis.

It should be emphasized at this point that this study is a qualitative rather than a

quantitative one. The purpose here is merely to locate elevated and depressed areas, and not to determine how high or how low they are in relation to their surroundings. Moreover, the observed elevations and depressions are relative, not absolute. For example, an area not particularly elevated or depressed in terms of the moon's mean radius would appear as an elevation if surrounded by a depressed area. It thus makes little difference if one considers a given mare (for example, Serenitatis) to have an elevated margin or a depressed interior.

Quantitative, absolute, contour maps of the moon have been compiled, however; and it is interesting to compare them with the findings of this study. There is little agreement with contour maps compiled by stereoscopic means, examples of which are Franz's map, published in 1899 and based on 55 measured points, and Baldwin's, published in 1963 and using 696 points. The fact that such maps disagree with the present study's findings is not surprising because they are portrayals of absolute elevations, based on widely-scattered measures (with high individual probable errors). On the other hand, this study is concerned only with elevation differences. Baldwin does, however, show depressed maria interiors, together with the Copernicus and Aristarchus uplifts, agreeing with this paper. Unfortunately, the maps of Franz and Baldwin do not agree well; and they do not agree with other lunar contour maps.

One map that does not agree with Franz or Baldwin is that of Ritter (1934), who agrees fairly well with this writer, perhaps because Ritter also based his altitudes on terminator measurements. Furthermore, the present study agrees in general with the elevations and depressions indicated by the contour lines on the published Air Force LAC maps, which are derived by photointegration—a method of which terminator observations form a special case. All six crater-centric uplifts found here are shown on published LACs, according to which their altitudes range from about 600 to about 1500 meters above the surrounding mare, with slopes extending from 100 to 200 kilometers. Thus, their average slopes are of the order of  $\frac{1}{4}^{\circ}$  or  $\frac{1}{2}^{\circ}$ .

In summary, some points should be made clear. First, this study is qualitative and preliminary. There is much left to be done, but this is a field well suited to amateur astronomers and their instruments. The writer's equipment consisted of a four-inch refractor and a standard-make 35-millimeter single-lens reflex camera used with commercial film. Those interested in the study of terminator deformations are advised to concentrate on a single mare, photographing it at small intervals of colongitude. Among specific problems to be investigated are the association of uplifts and depressions with other features—such as post-mare, ghost, and ruined craters, ridges, and domes. Finally, some further experimentation with films and exposures would be wise. The writer favors High-Speed Ektachrome exposed for ten to sixteen times longer than a "normal" lunar exposure—but others may prefer different combinations of film and exposure. What is clear is that the study of lunar terminator deformations is a field to which the amateur can make a real contribution, and be assured of getting interesting and rewarding results with modest equipment.

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## THE DOUBLING OF JOVIAN SATELLITE SHADOWS

By: Richard E. Wend, A.L.P.O. Assistant Jupiter Recorder

(Paper read at the Thirteenth A.L.P.O. Convention at Milwaukee, Wisconsin, July 4, 1965.)

This discussion is based upon three photographs of Jupiter taken by Mr. Philip R. Glaser on October 26, 1963, 18 days past opposition. The film was Ektachrome X, ASA 64. Exposure was two seconds, by eyepiece projection (approximately  $f/70$ ) with an 8-inch  $f/7$  reflector, mirror made by Frank Vaughn.

On the original photographs the polar diameter of Jupiter was 3.8 mms., and the equatorial diameter was 4.1 mms. The diameter of the satellite shadow, Jupiter I (Io), was 0.1 mms. on the first and third photographs made.

The instrument was well cooled down, and seeing was suitable for photography.

The first photograph (not published here) showed the black shadow of Io on the limb of Jupiter. The shadow was round. To an observer positioned so that the Jovian terminator was near his central meridian, the low angle of the sun would produce an oval shadow. From Earth Jupiter is nearly "full", and our line of sight is only a few degrees away from the Sun's so that the shadow appears round. The belts, the Red Spot, and good limb definition were also present on this photograph.

The second photograph was taken 16 minutes later ( $3^h20^m$  U.T.), and the shadow of Io was now doubled! It measures  $0.1 \times 0.2$  mms. on the original. The original shows this doubling more clearly than the copy published here as Figure 7.

Again, note the belts, the Red Spot, and limb areas. With an 8-inch at  $f/70$ , seeing must be good to get image quality like this; and if the odd satellite shadow were due to poor seeing, other detail in the photograph would suffer, and a poor photograph would result\*. Similarly, if the mechanical system were accidentally bumped during the exposure, the entire planetary image would be degraded; the limb region particularly would be noticeably affected. Critical examination of the original transparency under high magnification does not indicate an emulsion defect at this point; such defects are usually more contrasty and sharper edged than a true image.

The ephemeris for this date indicates that Io itself crossed Jupiter's limb 27 minutes ahead of its shadow, and was well ahead of the shadow at  $3^h20^m$  U.T. so that this is not a case of a satellite and its shadow being close together, a phenomenon that can happen only at opposition.

The third photograph was taken three minutes after the second (and 19 minutes after the first); the shadow of Io again presented its normal aspect (Figure 8).

This phenomenon of doubling has been observed visually in the past (although I haven't heard of its being photographed). In the book "The Planet Jupiter" by Peek, the author describes on page 268 a visual observation of his own: "For minutes together, except for a few seconds now and again of normal vision, the shadow of Io was traversing the  $SEB_n$  accompanied by a companion shadow quite as sharply defined and only a little smaller, on the  $SEB_s$ ." Note that this object is the same satellite shadow we are discussing here.

If the effect is spurious, it wouldn't be surprising to find one of the images less intense than the other since a random effect would be less likely to duplicate exactly the conditions creating the undistorted image. The photograph, however, shows both components with the same intensity.

It should be pointed out here that color film does not have unlimited latitude. Correctly exposed for the bright surface detail, the film's threshold of sensitivity is above the inky blackness of a satellite shadow. Thus there is room for some variation of intensity, as long as the brightest variation is still below the film's threshold at the particular exposure.

Since the immediately preceeding and following photographs don't show the effect, it doesn't seem likely that the angle of vision is responsible; the effect would be observed more often, too, if such were the case.

\*Readers will appreciate that it is not possible to preserve in reproduction (Figures 7 and 8) all of the finer detail on the original color transparencies which Mr. Wend is here discussing.

One suggestion that has been made from time to time is that the two shadows are both real, and one is located on a lower Jovian cloud level. If this is so, the upper layer must be dense enough to record a dark shadow on the film, but thin enough to transmit sufficient light to illuminate the lower layer to approximately the same brightness as the upper layer. These requirements appear incompatible. Also, if the upper layer is dense enough to provide a dark image, scattering of light by this layer should prevent the shadow on the lower layer from being as sharp-edged as the one above. The lower shadow would be much less contrasty, and more spread out. This also does not appear to be true.

Thus we are left, for the time being, with the reluctant conclusion that the doubling of satellite shadows must be an effect of seeing. Since Jupiter's disk is only about 50" in diameter, and the area of shadow doubling only about 2" in diameter, it is difficult to account for such precise localization of a seeing effect.

Atmospheric seeing is not likely to be the cause because it is too gross, moving across larger areas of the field. The haphazard doubling would not hold still long enough to register on a photograph, particularly with an exposure longer than a second. Variable air density in the telescope itself is Mr. Peek's nomination for the culprit. In a reflector, perhaps a small cell of air, precisely located and of the correct density and affecting a small area of the field for approximately half of the exposure time, could by refraction produce a satellite shadow of significant contrast. It really doesn't seem likely, but the alternatives are even less attractive.

If this can happen, then one would think that people who observe large numbers of double stars, or variable stars (and their comparison stars), would notice an occasional spurious doubling of stellar images. I have personally questioned four of the top AAVSO observers, and they have not noticed any doubling.

Photographs should also turn up some false stellar images, particularly during a hunt for faint novae, comets, or other objects not on star charts. It is assuredly uncomfortable to have to accept the possibility that some detail in astronomical photographs is spurious, and it will not always be possible to identify such false images.

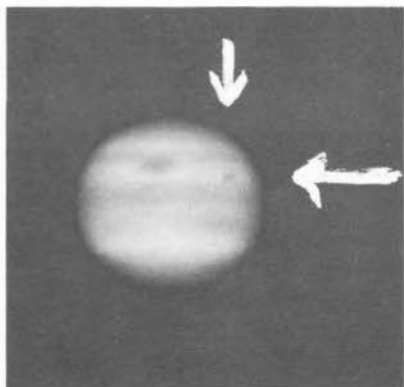


Figure 7. Photograph of Jupiter by Philip R. Glaser with an 8-inch reflector on October 26, 1963 at  $3^h20^m$ , U.T.  $C.M._1 = 9^\circ$ ,  $C.M._2 = 27^\circ$ . The Red Spot is a prominent dark oval near the C.M. The arrows point to the shadow of Io, which was doubled in this view. See also discussion in text. Figures 7 and 8 are black-and-white prints specially copied from the original color transparencies by Mr. Philip R. Glaser for publication in this journal.

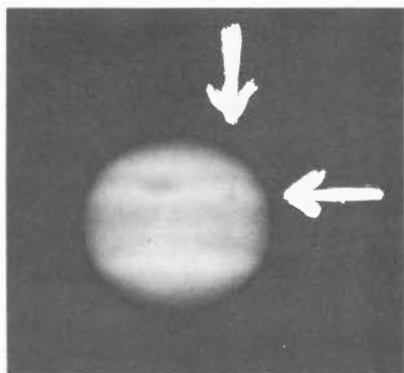


Figure 8. Photograph of Jupiter by Philip R. Glaser with an 8-inch reflector on October 26, 1963 at  $3^h23^m$ , U.T.  $C.M._1 = 11^\circ$ ,  $C.M._2 = 28^\circ$ . The arrows point to the shadow of Io (Jupiter I), which now showed its normal single and round appearance. See also text.

## STRANGE SIMILARITIES BETWEEN FRAME 11 OF THE MARINER IV

### PHOTOGRAPHS OF MARS AND THE LUNAR REGION CLAVIUS

By: Antonio Ribera, Vice-President of the Centro de Estudios Interplanetarios, Barcelona, Spain,  
and José M. Oliver, Secretary of the Agrupación Astronómica de Sabadell, Sabadell, Spain.

It was quite a shock for the scientific world at large to look at the photographs of Mars sent back by the space probe Mariner IV and to note the great similarity they presented with the surface of the Moon. At first sight these photographs dealt quite a blow to the old school of thought which conceived of Mars as a world of sandy deserts and barren landscapes, more or less dead but far removed from any similarity with our satellite, the Moon. It was, then, when studying these similarities, that we chanced upon a photograph of the lunar region Clavius (Figure 9), which when compared with Frame 11 of the Mariner IV photographs (Figure 10) had in store for us one of the biggest surprises in our lives: at first sight, the similarities between both photographs were extraordinary. When they were shown to a layman, he dubbed them as photographs of the same region unhesitatingly. But the layman's evidence wasn't enough for us, of course; and we hence undertook the task of making a scientific study of both photographs, comparing them after the most foolproof methods, and then summing up our findings.

The photographs. Frame 11 was taken in green light from a slant range of 7,800 miles. The region is probably Atlantis, between Mare Sirenum and Mare Cimmerium (Lat.  $-31^{\circ}$ , Long.  $163^{\circ}$ ). The extent of this frame is E.-W. 170 miles, N.-S. 150 miles. The American magazine Sky and Telescope, in the September, 1965, issue, most surprisingly states (Page 160): "Here the gigantic circular feature covering most of the left side resembles the lunar crater Albategnius (sic)." We checked with Albategnius, and the similarity is remote compared with that to Clavius.

We noted the similarity at first sight of the above photograph with a standard photograph of Clavius (Figure 9); but noting also that the lunar photograph has a slanting perspective since it belongs to a southern region of the Moon (Lat.  $-59^{\circ}$ , Long.  $-15^{\circ}$ ) with an extent of 155 miles E.-W., 380 miles N.-S., we proceeded then to make an orthographic projection of this photograph in order to be able to compare both photographs on the same perspective. To make our drawing we used the booklet Moon Maps by H. P. Wilkins (Map XXIII), obtaining the chart of Figure 11. The dotted line corresponds to the area of Figure 9.

Cartographic method used. The first thing to do in order to compare successfully the topography of the two photographs was evidently to draw a map from the Mars photograph; and in the second place, to superimpose both maps; and in the third place, to note all the similarities existing between both maps. The cartographic work with the Mars photograph was not too easy, to begin with. The details in it are generally not clear; some of them, however, are clear enough to be recognized as craters and mountains. According to several scientists, the white areas of Figure 10 can be caused by snow or mist. Assuming that both mist and/or snow are found near and in the summit of crater walls and mountains, we are reasonably safe in using these white areas as topographical accidents, and recording them accordingly in our map. The result of this cartographic work can be seen as Figure 12; please compare it with Figure 10.

Since all the details in the Clavius photograph do not correspond with those in the Mars photograph, but only the most important ones, we drew another map of the Clavius region, retaining only the largest details, namely those which might be expected to correspond with details in the Mars photograph, which necessarily shows only much coarser details than we can resolve upon the moon.

It is necessary to note that the photograph taken from the Mariner IV was taken from near the zenith of the region photographed. We can thus consider this photograph as practically a vertical projection of the Mars surface since slanting would be negligible. We now adjusted our orthographic projection of the Clavius region (Figure 11) to have the same perspective as the Mars map (Figure 12). Making this correction and using only the corresponding details and features, we secure Figure 13. We put numbers on the Mars features and letters on the Moon features in order to draw a list of corresponding features. We also thought it proper to establish an arbitrary scale from 1 to 10, according to the degree of similarity in the features compared, where 10 denotes the closest resemblance.



Figure 9. Photograph of lunar walled plain Clavius and vicinity taken with the Palomar Mountain Hale 200-inch reflector. South at top, west (I.A.U. sense) at right.

Table I

	Mars	Moon	Score	Remarks
1	1-2	A	3	The two Mars craters correspond to the NW wall of the Moon crater.
2	3	B	2	Similarity only by position.
3	4	C	9	Surprising similarity between Moon and Mars craters.
4	5	D	7	Confused Mars area similar in shape and position to lunar crater.
5	6	E	2	Ibid.
6	7	E	5	Same features, same shape in both craters, but displaced.

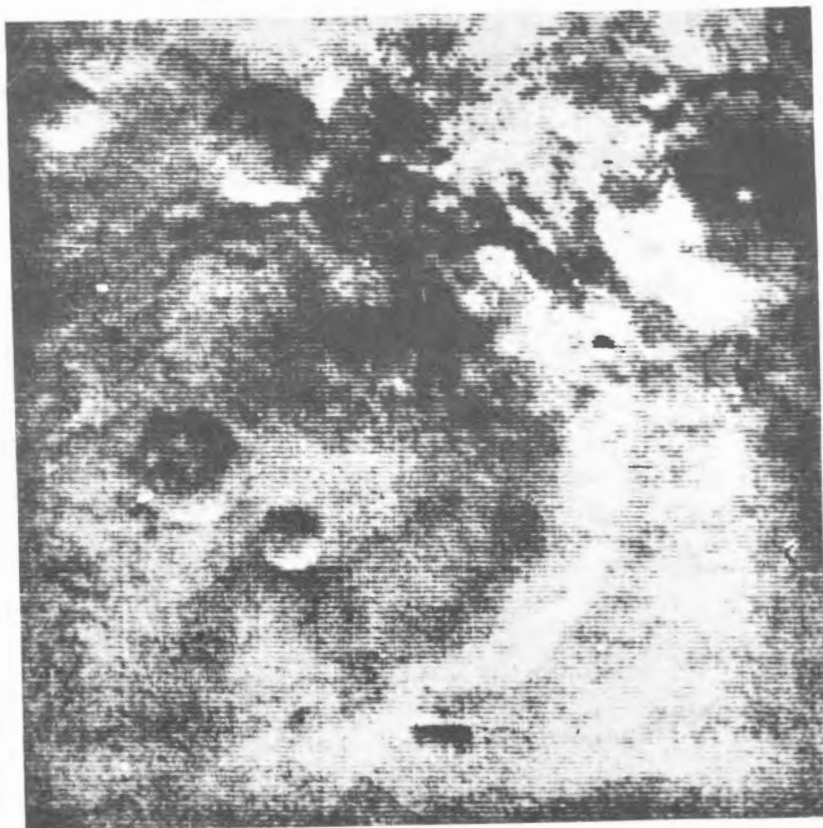


Figure 10. Number 11 frame of the Mariner IV photographs of Mars, taken on July 15, 1965 at 0<sup>h</sup>30<sup>m</sup>33<sup>s</sup>, U.T. Shows area at latitude 31°S., longitude 163° (over Atlantis). Green filter. Readers can borrow Mariner IV photographs of Mars from the A.L.P.O. Lunar Photograph Library by writing to Lunar Recorder John E. Westfall.

Table I (cont.)

Mars	Moon	Score	Remarks
7	8	F	7
8	9	G	9
9	10	I	9
10	11	H	9
11	12	K	4
12	13	L	7
13	14	P	10
14	15	O	7
15	16	M	6
16	17	J	5
17	18	R	7
18	19	S	6
19	20	T	8
20	21	U	10

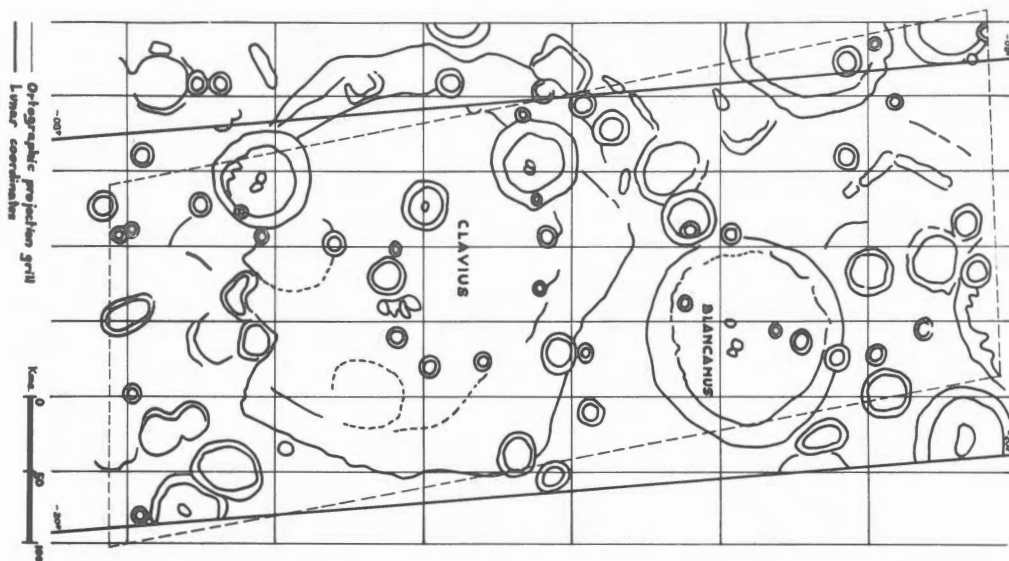


Figure 11. Orthographic projection of the Clavius region of the moon constructed by A. Ribera and J. Oliver from H. P. Wilkins' Moon Maps. The dotted lines bound the area shown in Figure 9. Lunar south at right, west (I.A.U. sense) at bottom.

Table I (cont.)

Mars	Moon	Score	Remarks
21	22 N	7	Great correspondence between walls of big cirques.
22	23 Q	7	Ibid.
23	24 Y	9	Ibid.
24	25 W	3	West area of the great Martian cirque resembles vaguely East wall of Clavius.
25	26 Z	1	Featureless zone on Mars corresponding to lunar crater.
26	27 AA	6	Fragment of walls of both cirques.
27	28 BB	7	Open wall in both cirques.
28	29 V	5	Bright zone on Mars corresponding to rugged area on the Moon.
29	30 EE	8	Two similar craters; difficult to see the Mars crater.
30	31 FF	8	Ibid.
31	32 DD	8	Fragments of the wall of both cirques.
32	33 GG	6	Two craters (the Mars one very weak) very similar but slightly displaced.
33	34 X	9	Curious similarity between a Mars depression and a Moon depression.
34	35 CC	8	Similarity between two curved sections of both walls.
35	Clavius and Great Martian Cirque	10	Note the extraordinary similarity between the two big features.

These 36 similarities score 6.5 on the average, applying the qualifications system we have used. This result means that more than 50 per cent of similarity was found between all the features examined. What is the probability that so many similarities occurred by chance, corresponding to the same number of similarities on the above percentage? We have developed logarithmically the result, with the help of Señor Don Feliu Comella, President

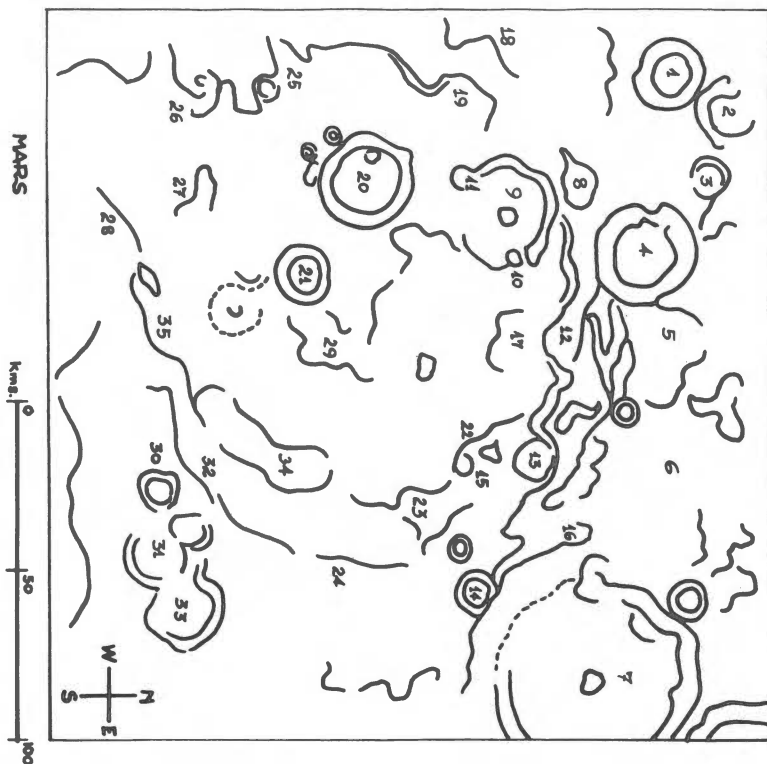


Figure 12. Cartographic map constructed from Frame 11 of the Mariner IV photographs of Mars by A. Ribera and J. Oliver. See also text of their article in this issue. The numbers on the features are those of Table I.

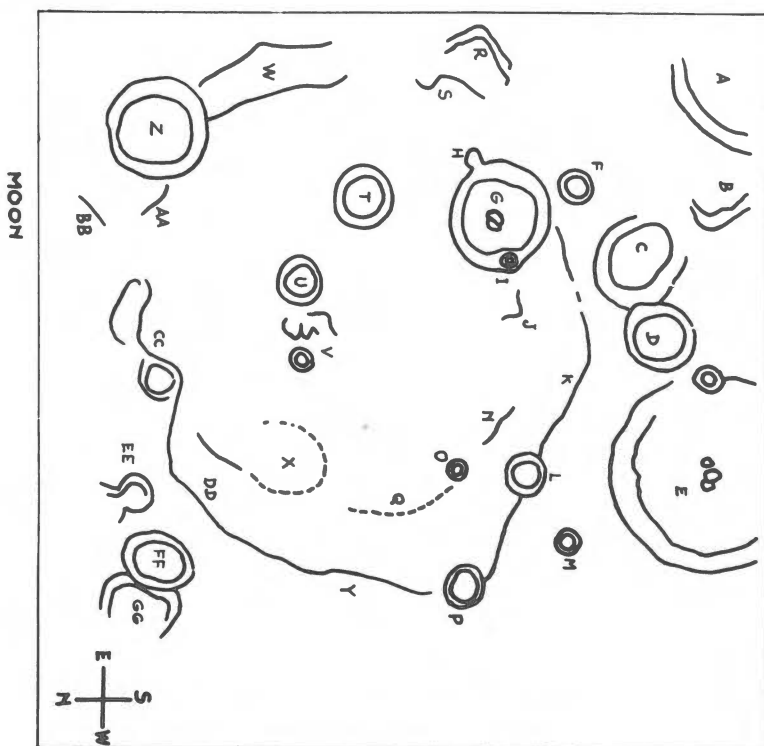


Figure 13. The Clavius region of the moon with the geometric perspective corrected to that of the Mariner IV Frame no. 11 and with the lesser details omitted to permit easier comparison with Figure 12. The letters on the features are those of Table I.

of the AAS, as follows:

$$\log \frac{1}{2} \left( \frac{1}{36} \right)^{36} = \log \frac{1}{2 \times 36^{36}} = \log 1 - [\log 2 + 36 \log 36] = -56.3278$$

The ratio having this logarithm is  $2.127 \times 10^{56}$ ; i.e., among 2,127 followed by 53 zeroes groupings of 36 features, there is only ONE possibility of concordance. This figure amounts to infinity, for all practical purposes.

Conclusion. So far, we have only endeavored to underline some strange similarities between the features of the Martian surface discovered on Frame 11 of the Mariner 4 photographic survey of the Red Planet and the lunar region which exhibits the gigantic Clavius cirque. As noted by the probabilities calculation, this is not only curious but an extremely improbable occurrence. How can astronomers explain these surprising - to say the least - similarities?

It's up to them to answer. But... does this answer lie in mere topographical similarities? We strongly suspect that this is not so.

#### BOOK REVIEWS

Satellites of the Solar System, by Werner Sandner. Translated by Alex Helm. London: Faber and Faber, 1965. Price 36 shillings, 151 pp.

Reviewed by Richard G. Hodgson

Advertised by the publisher as a book given "entirely" to the subject indicated by its title, this book is a disappointment. It is quite elementary, largely rehashing data found in most popular accounts of the Solar System.

Sandner's new book gets off to a slow start with four pages of Copernican theory, followed by an elementary survey of the planets. After one-sixth of the text has been read, one finally gets to the advertised subject. The discovery of the satellites of the other planets is recounted, as are the fruitless searches with respect to Mercury and Venus. There is also an interesting chapter on the appearance of satellites as seen from their primaries and vice versa. Jupiter VIII is erroneously designated XIII in Figure 8b on p. 47. One regrets the prominent attention given to non-existent Themis of Saturn, in view of the thorough satellite search by Kuiper, which passes unmentioned.

The closing "Summary" introduces new material, including, without any explanation whatever, the two most peculiar scientific laws this reviewer has ever read, which Sandner ascribes to Hesselbach of Mexico:

- I. The period of rotation of a planet depends on the sum of the masses of its satellites.
- II. The sum of the masses of the satellites of a given planet is proportional to the mass of the primary." (p. 144)

At 36 shillings (\$5.04) this book is over priced.

Kepler's Dream, by John Lear, with full text and notes of Somnium, Sive Astronomia Lunaris, by Johann Kepler, translated by Patricia Frueh Kirkwood, University of California Press, 1965, 182 pages, \$5.00.

Reviewed by William O. Roberts

Around the year 1609, Johannes Kepler wrote Somnium, Sive Astronomia Lunaris (The Dream, or Lunar Astronomy). Until the past few years, it had existed only in the original Latin, and in a German translation. John Lear, science editor of the Saturday Review, discovered this fact several years ago when he had occasion to refer to the work. With proper enthusiasm, he proceeded to have a translation made, and prepared an accompanying discussion of his own under the title, Kepler's Dream. The subsequent discovery of two previous versions in English does not seem to have interfered with its publication.

Somnium commenced as a brief treatise on the moon, describing its dimensions and



distance, the problems of travelling thereto, the apparent motions of the earth and other celestial bodies as seen from its surface, and a discourse on the nature of the surface itself, all in a rich blend of fantasy and logic, betraying the writer's Swabian antecedents. It was written to be read by educated persons capable of penetrating into the allusions and rejecting the trivial; and no account was taken of the fact that it could get into the hands of ignorant, prejudiced people who would use it to evil purpose. Yet this is exactly what happened. A "garbled version" of this work was responsible for Kepler's mother's being seized and imprisoned for witchcraft. This experience led to the writing of the footnotes which occupy the greater part of Somnium and were worked upon over a ten-year period.

Kepler, a contemporary of Galileo, emerges through his writing as a brilliant intellectual, and as a warmly human person. Those who have read The Sleepwalkers will have an opportunity to compare Koestler's appraisal with the impressions drawn from the present work. Lear takes the position that Kepler wrote his book with the idea in mind that if men would strive to improve their understanding of the vastness and orderliness of Creation, they would be less prone to waste their energies on warring among themselves.

Kepler's Dream provides historical and scientific discussion designed to assist in the understanding of the meaning and purpose of Somnium. Lear writes from a position of professional competence; his meanings are clear, his views are imaginative for the most part, and they appear to fit the evidence well. A few mistakes occur in the writing that do not appear particularly harmful. On page 50, one gets the impression that Saturn was supposed to have appeared in Taurus on two occasions eleven years apart. Again, on pages 53-54, Lear gets into a discussion on the relationship between the old German mile and the modern statute mile. After comparing various figures and showing that there should be 69 modern statute miles in one degree along a great circle on the earth, he states that we now know 60 miles to be the correct figure. Referring to Davidson's Elements of Mathematical Astronomy, I find that there are 60 nautical miles to the degree, and that 38 statute miles = 33 nautical miles.

The translator, Patricia Frueh Kirkwood, deserves mention for her clean, unassuming, and readable prose, an achievement all too rare in historical texts.

Lunar and Planetary Surface Conditions, by Nicholas Weil. 1965, 222 pages. Available from Academic Press, N. Y., \$10.00.

Reviewed by Rodger W. Gordon

This is the sort of book that I wish would have been available about 10 years ago, and unfortunately there are too few works like it available even today. One must read the work several times to comprehend adequately the vast amount of information the author has compiled from over 289 sources, many of which are technical journals, to which no one person usually has access.

The author begins by reviewing the various hypotheses about the origin of the Solar System, and a comprehensive list of tables is included upon the physical constants for the planets. He then describes the methods of acquiring data on the surface conditions of the moon and planets in short, concise paragraphs. The author also points out the fact that the two newest methods (radio and space probes) are likely to yield more significant information than classical methods employed in the past.

A detailed treatment of lunar conditions is given in Chapter II, and the question of the lunar atmosphere is given its due consideration before being rejected. Weil is an advocate of the meteoritic origin of the craters; and so most of the chapter dealing with this hypothesis is of pertinent interest, in as much as space probes are likely to settle the volcanic or meteoritic origin of the craters within the next few years.

Each planet is given a very intensive treatment. One of the most interesting areas is the section on Venus where the author discusses all the theories to account for the very high temperature readings obtained by radio results as well as by Mariner II. The author is a bit prejudiced in this section, but each of us probably has his own pet theory or theories when it comes to the enigma of Venus. The section on Mars is likewise fascinating because the author describes in detail the results of his own experiments upon earth organisms in a simulated Martian environment. While the author did not succeed in these experiments as well as other investigators have reported doing, the fact remains that lower

type forms on earth can survive if transported to Mars either by purpose or by accident. The remaining part of the book is devoted to the Jovian planets, and it is more theoretical than observational. However, this treatment is to be expected.

There are a few minor errors in typing, and on page 191 in the tables for the albedos of the planets Mercury has been transposed for Mars in that column. However, the numerical data are correct.

This book belongs in the library of every amateur and professional. As much of the material is still highly speculative, it will be interesting to see how the results of now-planned space probes confirm or deny the most probable theories advocated in the book. We have already had a few surprises; for Weil supported a smooth Mars with the dark areas as former ocean basins, whereas Mariner IV has shown that both maria and deserts are crater-pitted. We should be on the look out for more surprises when other probes are sent to the nearer planets.

# PREDICTED SHADOW TRANSITS OF THE SATELLITES OF URANUS IN 1966

By Craig L. Johnson  
(all times plus or minus one hour)

2/15 (Feb. 15)	Transit of Titania at 6 <sup>h</sup> 3, Universal Time in whole table.
2/17	Transit of Umbriel at 12 <sup>h</sup> 47.
2/18	Transit of Ariel at 12 <sup>h</sup> 42.
2/23	Transit of Oberon at 7 <sup>h</sup> 42.
2/26	Transit of Ariel at 1 <sup>h</sup> 46.
3/3	Transit of Ariel at 9 <sup>h</sup> 42.
3/6	Transit of Umbriel at 2 <sup>h</sup> 45.
3/8	Transit of Ariel at 3 <sup>h</sup> 46. Uranus at opposition.
3/10	Transit of Umbriel at 5 <sup>h</sup> 49.
3/13	Transit of Ariel at 4 <sup>h</sup> 46. Transit of Titania at 9 <sup>h</sup> 42.
3/14	Transit of Umbriel at 9 <sup>h</sup> 44.
3/18	Transit of Ariel at 5 <sup>h</sup> 46.
3/22	Transit of Titania at 2 <sup>h</sup> 42. Transit of Oberon at 5 <sup>h</sup> 46.
3/23	Transit of Ariel at 6 <sup>h</sup> 46.
3/28	Transit of Ariel at 7 <sup>h</sup> 45.
4/2	Transit of Ariel at 8 <sup>h</sup> 45.
4/4	Transit of Umbriel at 2 <sup>h</sup> 47.
4/7	Transit of Ariel at 9 <sup>h</sup> 45.
4/8	Transit of Umbriel at 6 <sup>h</sup> 42.
4/12	Transit of Umbriel at 9 <sup>h</sup> 47. Transit of Ariel at 10 <sup>h</sup> 45. Possible double transit.
4/17	Transit of Titania at 5 <sup>h</sup> 41. Transit of Ariel at 11 <sup>h</sup> 45.
4/18	Transit of Oberon at 4 <sup>h</sup> 40.
4/30	Transit of Ariel at 2 <sup>h</sup> 40.
5/3	Transit of Umbriel at 3 <sup>h</sup> 40.
5/5	Transit of Ariel at 3 <sup>h</sup> 40.
5/7	Transit of Umbriel at 6 <sup>h</sup> 45.
5/10	Transit of Ariel at 4 <sup>h</sup> 40.
5/11	Transit of Umbriel at 10 <sup>h</sup> 40.
5/13	Transit of Titania at 8 <sup>h</sup> 40.
5/15	Transit of Oberon at 2 <sup>h</sup> 43. Last transit of Oberon at this season.
5/20	Transit of Ariel at 4 <sup>h</sup> 49.
5/25	Transit of Ariel at 5 <sup>h</sup> 49.
5/30	Transit of Ariel at 6 <sup>h</sup> 49. Transit of Ariel at 7 <sup>h</sup> 49.
6/1	Transit of Umbriel at 3 <sup>h</sup> 43.
6/4	Transit of Ariel at 8 <sup>h</sup> 49.

PREDICTED SHADOW TRANSITS OF THE SATELLITES OF URANUS IN 1966 (cont.)

6/5	Transit of Umbriel at 6 <sup>h</sup> 48.
6/17	Transit of Titania at 3 <sup>h</sup> 49. Last transit of Titania at
6/30	Transit of Umbriel at 3 <sup>h</sup> 46. this season.
7/4	Transit of Umbriel at 7 <sup>h</sup> 40.
7/12	Transit of Ariel at 4 <sup>h</sup> 43.
9/13	Uranus in conjunction.
10/23	Transit of Ariel at 12 <sup>h</sup> 43.
11/1	Transit of Umbriel at 11 <sup>h</sup> 42.
11/25	Transit of Ariel at 6 <sup>h</sup> 45.
11/30	Transit of Ariel at 7 <sup>h</sup> 45.
	Transit of Umbriel at 11 <sup>h</sup> 43.
12/5	Transit of Ariel at 8 <sup>h</sup> 44.
12/10	Transit of Ariel at 9 <sup>h</sup> 44.
12/15	Transit of Ariel at 10 <sup>h</sup> 44.
12/20	Transit of Ariel at 11 <sup>h</sup> 43.
12/25	Transit of Umbriel at 8 <sup>h</sup> 40.
	Transit of Ariel at 12 <sup>h</sup> 43.
12/29 (Dec. 29)	Transit of Umbriel at 11 <sup>h</sup> 44.

Postscript by Editor. On December 31, 1965 Mr. Johnson wrote in part as follows: "Enclosed please find my ephemeris for shadow transits of the satellites of Uranus (those visible from the United States) in 1966. The times listed here are actually for the central meridian transit of the satellite itself. Since obviously this will be correct for shadows only at opposition, and since transits can last up to 2<sup>h</sup>24<sup>m</sup> for Ariel and 4<sup>h</sup>10<sup>m</sup> for Oberon (orbital plane is aimed at earth on February 6.742, 1966), observers should preferably watch for no less than an hour before and after the predicted time.

"Leonard Abbey (who has been sent another copy of this ephemeris) is of the opinion that it would require at least 40 inches of aperture to reveal these shadows. Since I have been able to locate the shadows of Rhea and Tethys on Saturn using a 4-inch without prior knowledge of their location, I would tend to think this opinion conservative; however, there is no denying that it will require what amateurs think of as a large telescope.

"As you may note, transits of Titania and Oberon cease before the 1966 conjunction of Uranus with the sun....Ariel and Umbriel will miss the disc after July and February, 1967 respectively; I therefore hope that all interested observers will make an all-out effort this spring either to confirm or deny the visibility of these phenomena. In Boulder, Colorado, every transit that has occurred so far has been rendered unobservable by clouds, bad seeing, or cold weather."

Readers may wish to study in conjunction with this project the diagram of the apparent orbits of the satellites of Uranus on page 372 of the 1966 American Ephemeris and Nautical Almanac. Mr. Johnson expects the shadows of Ariel and Titania to be the easiest ones to see in transit. The Editor would suspect Mr. Abbey's opinion of the aperture needed to see the shadows of the Uranian satellites to be close to the truth. However, some of our members may have occasional opportunities to observe Uranus during the next few months with large apertures, high powers, and good seeing. We urge them to try and to report their findings.

FIRST ANNOUNCEMENT OF THE 1966 ALPO CONVENTION

By: Charles A. Wood, General Convention Chairman

The Steward Observatory of the University of Arizona and the Tucson Astronomical and Astronautical Association will co-host the Fourteenth ALPO Convention, to be held in Tucson, Arizona on August 26-28, 1966. This will be the second meeting of the ALPO not in conjunction with any other convening astronomical society. There will be field trips to the Observatories of Kitt Peak National Observatory, Steward Observatory, and the Lunar and Planetary Laboratory; an invited lecture by Ranger experimenter E. A. Whitaker on the interpretation of the Ranger photographs; a revival of the "Stump the Experts" question-and-answer session;

informal observing with a 21" (or larger) telescope; hopefully the usual good supply of interesting papers by leading ALPO observers; and the relaxed informality of Tucson.

The tentative schedule is as follows:

Thursday - August 25:

3-10 PM Registration at Kaibab-Huachuca Dormitory.

Friday - August 26:

8-11 AM Registration at Steward Observatory.

9:30-11:30 AM Welcoming speeches and lecture by E. A. Whitaker.

1-5 PM Field Trip to the Observatories of KPNO and Steward Observatory on Kitt Peak, 60 miles south of Tucson.

8-11 PM Informal observing with the Steward Observatory 21" telescope.

Saturday - August 27:

8:30-9:30 AM Tour Kitt Peak Optical Shop (150" mirror).

9:30-12 AM Paper session, group photograph.

1:30-2:30 PM ALPO business meeting.

2:30-3:30 PM ALPO paper session.

3:30-5:30 PM Lectures concerning professional planetary studies in progress at the Lunar and Planetary Laboratory.

6:30-7:30 PM Stump the Experts.

8:30-11 PM Open House at the Lunar and Planetary Lab. and informal observing with Steward Observatory 21".

Sunday - August 28:

8:30-12 AM Paper session.

1:30-5 PM Field trip to Lunar and Planetary Laboratory observing sites atop 8250 ft. Santa Catalina Mountains.

Accommodations will be at the modern, air conditioned Kaibab-Huachuca Dormitory on the University of Arizona campus at a cost of \$2.00 per person, per day, double occupancy. All meals are individually available at University cafeterias, inexpensively and without the bother and restrictions of buying meal tickets.

Members who are conducting interesting observing programs are invited to submit papers to Walter Haas. Perhaps Recorders will find this a very good time to report on past and future work of their Sections. Adequate exhibit space is available, and members are encouraged to prepare representative collections of their best work for the customary ALPO display.

It will be helpful in planning if members who think they might attend will send a postcard to me with the approximate number of people in their "delegation". Additional information will be available as the year wears on, but I will happily answer any inquiries. My address is 1304 East 7th, Tucson, Arizona 85719.

Postscript by Editor. We hope very much that as many members as can will attend what will certainly be a distinctive and instructive meeting. It will help Mr. Wood and his co-workers if we give him early information about our attendance. As usual, we shall need good papers and good and varied display materials. It is not too soon to begin thinking about what to say and what to exhibit. Drawings, photographs, and charts have been found in the past to make the best display material.

Planning is still very flexible, and we welcome all positive ideas upon how to make this gathering a better one.

#### COMETS SECTION NEWS: JANUARY, 1966

By: Dennis Milon, A.L.P.O. Comets Recorder

The last observation of Comet Ikeya-Seki 1965f received by the Comets Section was reported by Gordon Solberg at Las Cruces. On Dec. 19, 1965 at 9:30 UT (2:30 AM MST) he saw



Figure 14. Steward Observatory 21-inch reflector of the University of Arizona. This telescope will be used for informal observing during the A.L.P.O. Convention at Tucson on August 26-28, 1966. Photo by E. D. Howell.

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a star-like nucleus with a faint 4' tail in a 6-inch telescope. The magnitude was about 10 in a 20X120 refractor.

As late as Dec. 4 UT Milon and Lee McDonald photographed a 4-degree wide, 25-degree long tail with a 50 mm. lens. About 7° of tail could be seen with the naked eye from an altitude of 7,000 feet. Around this time the comet was reminiscent of Comet Wilson-Hubbard in Aug. 1961, when Milon saw it from McDonald Observatory. In both comets a section of the tail was visible to the naked eye, while the nucleus required binoculars. Very transparent skies were a must to see the tail of Ikeya-Seki as it became more diffuse. In Mount Vernon, New York, John Bortle could see only 20' of tail in a 5-inch on Nov. 29 UT, the same date on which a 30-degree tail was photographed from Tucson. However, several observers continued to make an excellent series of magnitude estimates of the coma.

John Bortle has published an analysis of visual observations after perihelion in the January, 1966 issue of "The Eyepiece" of the New York City Amateur Astronomers Association. Using observations by members of that group, Bortle investigated solar correlations and presented a photometric graph, obtaining  $m = 6.5 + 9.5 \log r$ ,  $n = 3.9$  for the period from Oct. 20 UT to Nov. 29. Gordon Solberg and R. B. Minton, New Mexico State University Observatory, have written a paper on preperihelion visual observations of Ikeya-Seki in which they found that the corrected heliocentric magnitude equals  $5.8 + 6.3 \log r$ ,  $n = 6.3 + 2.5$  or 2.5. They also studied the relation of the coma diameter to decreasing solar distance.

Comet Alcock 1965h was seen visually in October, 1965 by two members. (Unsuccessful attempts were mentioned on page 70 of the last issue.) On Oct. 8 UT Karl Simmons, Jacksonville, Florida, saw Alcock at about 10th magnitude with a 12½-inch telescope, the comet having a diameter of 5'. Observing on Oct. 18, Michael McCants, Houston, estimated the magnitude at about 11, and described it as a featureless blob, 2'-3' across. He compared the comet's magnitude to that of galaxies.

David Meisel reports that he has a computer program for the reduction of physical observations of comets. At Leander McCormick Observatory, University of Virginia, Meisel uses a Burroughs 5500B and a program written in ALGOL to program orbital elements, magnitudes, sizes, and position angles. This program should speed-up the analysis of the many Ikeya-Seki reports that have been received.

Michael McCants, the computer of comet orbits for distribution to the ALPO, is now working at the Manned Spacecraft Center, involved in the training of Apollo astronauts. McCants will continue to work on comets in Houston with an IBM 1620 computer.

## PLANETOLOGICAL FRAGMENTS - 2

### The Lunar Surface Layer

Dr. Tom Gold of Cornell University recently remarked in a conference on lunar studies that scientists who have long theorized about the nature of the moon's surface are now using the Ranger television photographs as a mirror in which they see their own theories reflected. He means, of course, that the dispute over the lunar surface as a solid or a pulverized (dusty) surface has not been settled even with the phenomenal results of the Ranger project. See, for example, the report of a lunar studies conference in Sky and Telescope, January, 1966.

L. D. Jaffe has used the Ranger 7 photographs and simulated craters in the laboratory to derive a probable value for the thickness of pulverized "overlay", which he regards as the probable cause of the smooth, soft appearance of many small lunar craters. Jaffe made sharp crater impressions in sand and then slowly sifted very fine sand uniformly over them. At several different stages during the covering process photographs were taken. This resulted in a series of views showing the same crater form becoming softer and softer until it was nearly obliterated. At each stage in the series the ratio of the depth of sifted covering material to the crater diameter (about 6 inches) was calculated. Selected craters of known diameters on the last of the Ranger 7 photographs were then compared with the simulated crater under different stages of cover. When a good visual match was found, the depth of cover or overlay on the lunar crater was calculated from the known ratio on the model. In general, this process yielded depths of overlay between 5 and 27 meters.

Such a depth of unconsolidated material presents a picture of the lunar surface very different from that suggested by Kuiper and others using some of the same Ranger data. Jaffe's results rest heavily on certain basic assumptions about the way in which craters were formed on the moon and in what sort of materials. As Kuiper has pointed out, small-scale lunar craters consist of two distinct types: those with sharp and slightly raised

rims, and those with no rim at all and a very smooth and shallow contour. There are also variations on these types, and all varieties can be found in nearly any small area on the lunar maria. The appearance of these distinct types in mutual proximity suggests either a common origin and greatly different ages (the smooth ones presumably being older and more covered with material) or different methods of formation for the two general types. Kuiper views the smooth craters as collapse depressions in the lava-like material on the maria and in the flooded major craters (such as Alphonsus), and the sharp craters with lips as primary and secondary impacts.

In view of the diversity of opinions on the true nature of the lunar surface and the inherent difficulties of the problem, there is no reason to believe that we yet have the true picture, in spite of published allegations to the contrary.

In another paper, Jaffe has estimated the strength of the lunar surface cover from further studies of the simulated craters and thickness of overlay. He finds as a lower limit that the surface will support a mass of 0.1 kilograms/cm<sup>2</sup>. Kuiper, using the assumption that the surface is rigid, estimates approximately 100 times this bearing strength, which value is sufficient to hold a small vehicle.

#### References:

- Jaffe, L. D., "Depth of the Lunar Dust", Jour. Geophysical Research, 70, No. 24, 6129, 1965.
- Jaffe, L. D., "Strength of the Lunar Dust", Jour. Geophysical Research, 70, No. 24, 6139, 1965.
- Kuiper, G. P., "Lunar Results from Rangers 7 to 9", Sky & Tel., May, 1965, 293.
- Kuiper, G. P., "Interpretation of Ranger VII Records", Tech. Report 32-700, Jet Propulsion Laboratory, Feb. 10, 1965.

#### The Rotation of Mercury

The announcement by Pettengill and Dyce that Mercury rotates with a period of about 59 days instead of the previously accepted 88 days has resulted in a large number of papers on this subject. These will be dealt with further in an article in The Strolling Astronomer or in another installment of "Planetological Fragments", but a few remarks appear to be in order at this time. The basic question that observers will ask, is: "How can the visual records of the past century, which were made on the assumption of an 88-day period, be reconciled with the newly determined shorter period?" At least two papers in the literature of 1965 deal with this problem. If one selects two drawings of Mercury with a similar phase made at different apparitions showing the same general pattern of markings, in almost all cases the rotation period of 58.65 days (exactly two-thirds of the 87.9-day period) fits the interval between the drawings better than the 87.9-day period. There are good reasons connected with the dynamics of the orbit of Mercury for the rotation period's being exactly two-thirds of the orbital period of revolution. A careful look at the orbital geometry of the earth and Mercury shows that at the same phase at two successive evening (or morning) apparitions the same markings should not be visible, assuming a 59-day rotation. Rather, in each successive morning (or evening) apparition the planet is rotated approximately 120° in heliographic longitude; and in three successive morning (or evening) apparitions the entire planet would be visible. This opinion is borne out by the fact that inspection of a long and continuous series of Mercury drawings (the Jarry-Desloges observations) discloses three basic patterns of markings that appear in their many drawings at evening apparitions during the period from 1909 to 1941. The librations in longitude discussed in the past by Lowell, Heath, and Cruikshank are now known to have an effect different from that which was described, and this fact somewhat complicates computation of an ephemeris of the positions of markings on the planet. The assembly of visual drawings of Mercury into an accurate map requires such an ephemeris which, when calculated, may eventually be included in The American Ephemeris and Nautical Almanac.

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- Pettengill, G. H., and Dyce, R. B., "A Radar Determination of the Rotation of the Planet Mercury", Nature, 206, 1240, 1965.
- McGovern, W. E., Gross, S. H., and Rasool, S. I., "Rotation Period of the Planet Mercury", Nature, 208, 375, 1965.

Colombo, G., and Shapiro, I. I., "The Rotation of the Planet Mercury", Research in Space Science, Special Report 188 R, Smithsonian Astrophysical Observatory, 1965.

DPC

ADDITIONAL DRAWINGS AND PHOTOGRAPHS OF COMET IKEYA-SEKI, 1965f

By: Dennis Milon, A.L.P.O. Comets Recorder

Note by Editor. We here present some additional drawings and photographs of the "Great Comet of 1965", which will supplement Mr. Milon's article in The Strolling Astronomer, Vol. 19, Nos. 3-4, pp. 62-68. All illustrations were selected and forwarded by Mr. Milon. A photograph of Mr. Seki, the co-discoverer of the comet, is on the front cover. A.L.P.O. members gathered a considerable quantity of data on this comet, and Mr. Milon is planning to report our results in several articles in the coming months. Different articles will deal with different subjects, such as magnitude estimates, daytime observations, tail structure and motions, etc.



Figure 15. R. B. Minton with his comet observing equipment used for the photographs of Comet Ikeya-Seki published in our preceding issue. A 15-inch focal length f/7 camera is hand-guided with a 5-inch apogee telescope. Mr. Minton recently joined the staff of New Mexico State University Observatory, Las Cruces. Photograph by R. B. Minton.

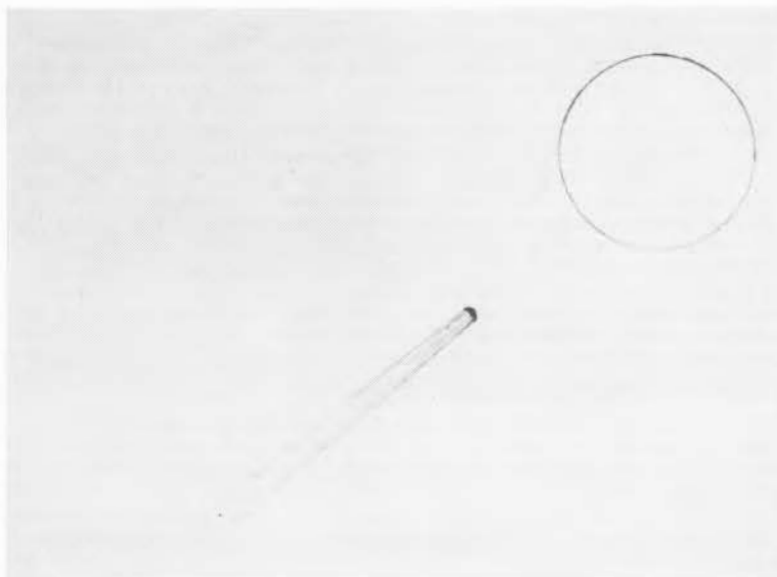


Figure 16. Drawing by Alika K. Herring of naked eye aspect of Comet Ikeya-Seki 1965f beside the sun on October 20, 1965 at 21<sup>h</sup>55<sup>m</sup>, U.T. Made from Mauna Kea, Hawaii. Magnitude about -9. Tail length 1½ degrees. Coma 3 minutes in diameter and crescent-shaped. Position angle of tail 220°. Head appeared elongated at 23<sup>h</sup>, U.T.





Figure 17. Tracings by Steve Larson from three photographs of Comet Ikeya-Seki 1965f on October 27, 1965 and three others on October 28. (Three were required to show the entire comet.) Steward Observatory 7-inch F 7 astrograph, 103a O plates. Note the increase in the tail length in the region between the head and the start of the spiral structure on October 28. Measured tail length 15.3 degrees on October 27 and 16.5 degrees on October 28. Mid-times  $12^{\text{h}}37^{\text{m}}$ , U.T. on October 27 and  $12^{\text{h}}35^{\text{m}}$ , U.T. on October 28.

Drawings of Comet Ikeya-Seki 1965f by Charles F. Capen, Table Mountain Observatory, in November, 1965. 16-inch Cassegrain reflector and 6-inch refractor. Negative shading. Seeing on a scale of 0 to 10, with 10 best. Transparency on A.L.P.O. Scale, or limiting stellar magnitude.



Figure 18. November 5, 12<sup>h</sup>50<sup>m</sup>-13<sup>h</sup>33<sup>m</sup>, U.T. 6-inch at 30X, 16-inch at 105X. Seeing 5-6. Transparency 4-5 (cirrus).



Figure 19. November 9, 12<sup>h</sup>47<sup>m</sup>-13<sup>h</sup>20<sup>m</sup>, U.T. 16-inch at 105X, 6-inch at 30X and 180X. Seeing 1-3, transparency 1-5 (heavy cirrus). A double nucleus was seen.



Figure 20. November 11, 12<sup>h</sup>30<sup>m</sup>-13<sup>h</sup>10<sup>m</sup>, U.T. 16-inch at 666X and 105X, 6-inch at 30X. Seeing 4-6. Transparency 6-8. Bluish head. Nucleus still double.



Figure 21. November 19, 12<sup>h</sup>17<sup>m</sup>-13<sup>h</sup>19<sup>m</sup>, U.T. 16-inch at 666X, 315X, and 105X. 6-inch at 180X. Seeing 1-3. Transparency 0-5. Nucleus remains doubled.



Figure 22. Photograph of Comet Ikeya-Seki 1965f on November 29, 1965, 11<sup>h</sup>52<sup>m</sup>-11<sup>h</sup>57<sup>m</sup>, U.T. Taken by Dennis Milon and Lee McDonald from an altitude of 7,000 feet near Tucson. The original photograph shows the tail to be 29 degrees long (58,000,000 miles) and 3 degrees wide. (Of course, the faintest parts of the tail may be lost in this published reproduction.) Visually, the tail was fifth magnitude and 10 degrees long. Photograph made with a 35 mm. camera hand guided with a 6-inch reflector, 5-minute exposure at f/2.8 on Tri X.

#### ANOTHER BOOK REVIEW

Note by Editor. While we regret publishing this book review apart from others in this issue, we would regret even more delaying another two months before directing the attention of our readers to Dr. Alexander's newest book.

The Planet Uranus. A History of Observation, Theory and Discovery, by A. F. O'D. Alexander. London: Faber & Faber, 1965. 70 shillings. 316 pages.

Reviewed by Richard G. Hodgson

With the publication of The Planet Uranus we have at last the first full study of the planet discovered by William Herschel in 1781. Dr. Alexander has labored well to bring together from widely scattered sources all of the significant information about the planet and its satellites.

In this new work, as in The Planet Saturn published in 1962, Dr. Alexander presents his data in historical order. Most observers would probably prefer a systematic arrangement such as is found in B. M. Peek's The Planet Jupiter (see Dr. Joel Goodman's review of The Planet Saturn in The Strolling Astronomer, Vol. 16, Nos. 7-8, p. 189f), but an excellent index greatly diminishes the force of this objection.

Nearly every significant observation of Uranus is mentioned in this book. Unfortunately, however, a rare spot observed by O. C. Ranck and Walter Haas in 1952, from which a rotation period of 10<sup>h</sup>46<sup>m</sup> was derived, is not included.

Dr. Alexander has performed well the task of gathering and summarizing data from many sources. He does not always seem aware of inconsistencies between sources. For ex-

ample, he cites with approval the observations of satellites Titania and Oberon made by Dr. W. H. Steavenson from 1946 to 1950 as follows:

"Careful comparisons of the brightness of Titania and Oberon 1946-48 showed him, to his surprise, definite differences from night to night which he could only assume as due to rotation. He had often seen such differences 20 years before when the Earth was not far from the plane of the orbits, but in 1946-48 the sightline was nearly at right angles to that plane, when Titania and Oberon might have been expected to be, like Uranus, more or less pole-on to the Earth. He therefore suggested that Oberon and Titania may revolve round Uranus with the axis of rotation lying in or close to the orbit-plane, as is the case with Uranus in its revolution round the Sun. The 1950 observations confirmed this fact, so it seems evident that anything like a polar presentation by these satellites to the Earth does not occur." (The Planet Uranus, p. 292.)

If this interpretation of Dr. Steavenson's observations is correct, Titania and Oberon could not have "captured rotations" as is the case with all other satellites in the solar system whose rotation is known. If true, this result would be quite significant; but Dr. Alexander does not discuss it. No additional observations confirming the work of Dr. Steavenson are mentioned. Nor does the apparent conflict between these observations and a paper by Antoniadi (cf. L' Ast., vol. 43, p. 385) cited by Dr. Alexander (Uranus, p. 250) occasion discussion. Antoniadi, noting that Saturn certainly has had sufficient time to capture the rotation of Iapetus, calculated that the tidal force working on Oberon would be 800 times, and on Titania, 4,500 times as great as the force of Saturn on Iapetus. This should guarantee a captured rotation for the Uranian satellites, unless we suppose that the Uranian system is very much newer than that of Saturn, an assumption for which there is no evidence.

In spite of these weaknesses, Dr. Alexander has provided us with a storehouse of information on Uranus in a work that should be in every astronomer's library.

#### THE 1964-5 APPARITION OF SATURN

By: Thomas A. Cragg and Larry C. Bornhurst, A.L.P.O. Saturn Recorders

The planet Saturn was at opposition on August 24, 1964. The observations by A.L.P.O. members here discussed extended in time from April, 1964 to January, 1965; but naturally the most and the best work fell near opposition. On the date of opposition the declination of the planet was  $-12^\circ$ . The value of B, the Saturnicentric latitude of the earth, was then  $+10^\circ$  so that the rings were less well opened than for a number of years. Observations submitted by the colleagues listed below have made this report possible.

<u>Observer</u>	<u>Station</u>	<u>Telescope (s)</u>
Binder, A.	Tucson, Arizona	4" & 36" refls.
Brasch, K.	Rosemere, Quebec, Canada	8" refl.
Budine, P. W.	Binghamton, New York	4" refr.
Chapman, C. R.	Cambridge, Massachusetts	12" refl.
Cragg, T. A.	Inglewood, California	12" refl., 12" refr.
Cross, E. W., Jr.	La Mirada, California	10" & 19" refls.
Crowe, B.	Whittier, California	19" refl.
Cyrus, C. M.	Baltimore, Maryland	12½" refl.
Delano, Rev. K. J.	New Bedford, Massachusetts	12½" refl.
Dragesco, J.	Le Vesinet, France	10" refl.
	Bucharest, Roumania	6" refr.
Goodman, J. W.	Mt. Hamilton, California	12" refr.
Gordon, R.	Pen Argyl, Pennsylvania	4" refr.
Haas, W. H.	Las Cruces, New Mexico	12½", 6" and 16" refls.
Harris, D. H.	Whittier, California	19" refl.
Heath, A. W.	Nottingham, England	12" refl.
Johnson, C. L.	Boulder, Colorado	10½" refl.
Knauth, P.	Houston, Texas	12½" refl.
Oker, W.	Whittier, California	19" refl.
Richards, A.	Sepulveda, California	6" refl.
Ricker, C.	Marquette, Michigan	8" refl.

<u>Observer</u>	<u>Station</u>	<u>Telescope (s)</u>
Saccone, D.	New Abington, Massachusetts	4 $\frac{1}{4}$ " refl.
Schneller, K.	Cleveland, Ohio	8" refl.

Much better coverage was available for this apparition than for many in the past, most attention being given to making intensity estimates, which if continued will enable us to discuss long term changes of the features much more intelligently. Again it was unfortunate that few long-enduring spots survived to allow determining meaningful rotation periods.

#### The Globe

Equatorial Zone. During this apparition the southern part of the EZ became visible south of the rings after being in the shadow of the rings since 1953. During April, May, and early June, 1964, the southern half of the EZ was the brightest part of the whole Saturnian system; but later it faded to become more like the rest of the EZ. Intensity estimates were made on 60 days of the apparition (distributed from April through January) and showed a definite increase in the brightness of the EZ. During the initial phases the EZ was nearly always fainter than the outer part of Ring B (assumed 8.0 and constant); but by mid-August it was frequently equalling the outer part of Ring B, and after August it was nearly always brighter than any other part of the system. Although it is true that the ring was closing up during the apparition, it appears unlikely that all the observed brightening of the EZ can be attributed to that effect alone.

The color of the EZ was usually called yellow to reddish-orange, but filter observations clearly demonstrated it to be quite red still. Filters used were Wratten 25 (red), 58 (green), and 47 & 48 (blue). In every instance where color filters were used in estimates, the EZ was very much brighter in red than in blue. This fact demonstrates conclusively the continuance of the red nature of the EZ shown so well in Capen's photographs in 1963. Again, the outer part of Ring B was not equally bright in all colors, but there was nothing like the difference observed in the EZ. This difference is illustrated nicely in Capen's photographs in the 1963 report, Str. A., Vol. 18, Nos. 7-8, Figs. 1 and 2 on page 135.

Equatorial Band. This was a very elusive belt during 1964, being observed only occasionally, but rather randomly, throughout the apparition. Evidence is that it was very transitory since observers using large telescopes would miss it sometimes and find it at other times. This variation is further confirmed by the scatter in latitude measures discussed later.

North Equatorial Belt. Although occasionally observed double, once or twice prominently so, this belt was single during most of the apparition. Apparently during most of June and for about a week around Sept. 20, 1964, it was consistently observed double. Of course, it was always the most prominent belt on the planet. Some variation in intensity was observed but no trends larger than the inherent scatter could be traced. When the NEB was observed double, the southern component was always the darker. Belt colors were observed by Chapman and Haas, both calling it predominantly reddish-brown; however, Haas was rather consistently calling it brownish-gray during September and October. Several transitory dark patches and festoons from the NEB into the EZ were observed, and good transits were even obtained for some; but none of these features was recoverable for a long enough time to permit significant rotation rates to be derived. The best pair of observations was that of Budine on September 3 and 6, but his object was unrecoverable subsequently.

North Tropical Zone. This elusive bright zone, which lies just north of the NEB, was reported a number of times during 1964, and virtually never during 1963, clearly indicating increased activity in this area. The zone was never prominent, but intensity estimates indicated it as being helped immensely by contrast with the nearby dark NEB. The color of the NTrZ, when observed, was yellow.

North Temperate Belt. Although this feature was not observed all the time, demonstrating its transitory nature, it was in evidence mostly during the middle of the apparition. On most of the drawings showing the NTB it was fairly narrow and single; it was less often seen wide and diffuse. The intensity measures show it as one of the stronger belts when seen -- rivaling the SEB. Blue-gray was the color ascribed to it by Chapman.

North Temperate Zone. This zone, occupying the region between the NTB and the NNTB, was one of the brighter zones of the planet. The intensity estimates show a definite trend

towards brightening during the apparition, but not by a large amount. Chapman called it blue-white, a color well confirmed by Ricker with color filters — the zone was consistently brighter in blue than in red.

North North Temperate Belt. Evidence is that this belt was not seen during April, only suspected once in May, seen a number of times in June, and seen reasonably consistently from July on, although even then not all the time. It was rather wide, and its edges were very inconsistently defined latitude-wise.

North Polar Region. This region was much more complex during this apparition than in many previous apparitions. During the early part of the apparition Haas consistently observed a small bright north cap as bright as any zone save the EZ, but it was unconfirmed by others. Although reported by most observers, the NPR was less intense than the observed belts. Indeed, it appears that Heath did not observe a darker NPR at any time during his many views, something which is certainly puzzling. Apparently the NPR was most evident during mid-apparition, but had faded noticeably by the end of September. The color estimates were chiefly gray, what little filter work that was done being inconclusive.

Ball north of NEB. Those submitting intensity estimates of the general ball area north of the NEB found a decided darkening near mid-apparition, and largely the same intensity at both ends of the apparition. These estimates were frequently tendered when specific details in that part of the globe were either most difficult or absent. Twice (August 2 & 27) a belt was observed roughly mid-way between the NTB and NNTB.

Southern Hemisphere. This is a general term to apply to that portion of the ball observed south of the projected rings, other than the SEB or the SPR. In excess of 40 intensity estimates were submitted of this area, and these show considerable scatter, or perhaps a considerable variation over a large range. The one belt consistently seen was the SEB. Surprisingly, not one report of a South Temperate Belt was made despite the fact that the STB was observed in 1963.

South Equatorial Belt. This feature was better observed during the first 2/3 of the apparition than towards its end; however, when observed and when its intensity was estimated, it had the most consistently unchanging value of any feature. It was always observed single.

South Polar Region. Some evidence of an SPR made its appearance this time, but it was not observed by many persons. In the past the SPR has been a most obvious marking on the planet — even darker than the SEB or NEB when presented advantageously. Note that the only latitude measure made shows it to have a more equatorward limit than the NPR did.

#### Belt Latitudes

A continuation of the study of Saturnian belt latitudes was made in 1964. Haas embarked upon an interesting idea: visual estimation of latitudes at the eyepiece of the telescope! The method consists of estimating the fraction of the polar radius subtended on the CM by the belt in question to, say, two decimal places. Of course, this is a very crude measure; but it is very possible that it is as good as latitudes derived from drawings. In Table I one finds latitudes determined by most of the common methods. A problem exists in determining what drawings to use for latitude measures. Naturally one ordinarily chooses the ones which look the best, but are these necessarily the most accurate just because they look pretty?

Table I. Observed Saturnicentric Latitudes of Belts in 1964-5, as Determined by A.L.P.O. Studies

DATE	N edge	center	center	center	center	center	center	S edge	METHOD	OBSERVER
	SPR	SEB	EB	NEB <sub>s</sub>	NEB <sub>n</sub>	NTB	NNTB	NPR		
1964, May 21		-16:8	+0:7	+10:5	+15:5	+31:3	+48:2	+57:2	MD	Cragg
June 7		-31.8		S+9.4	N+21.6				VE	Haas
June 14		-31.8		S+7.9	N+13.7				VE	"
June 21				+13.5	+18.9			+55.5	MD	Binder
July 9				+6.7	+20.2				Ph	Knauth
July 11	-42:1	-20.7		+13.0	+18.3			+54.1	MD	Binder
July 27				+10.6	+13.5	S+26.7 N+30.0	+48.2	+56.4	MD	Ricker

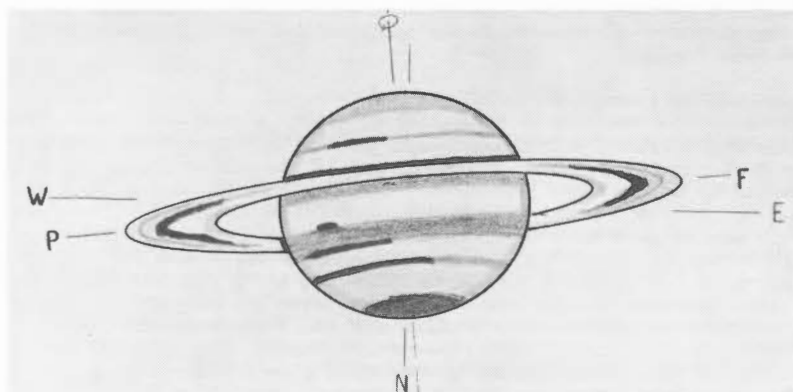


Figure 23.  
Drawing of  
Saturn by  
Phillip W.  
Budine. July  
30, 1964, 4<sup>h</sup>  
15<sup>m</sup>, U.T. 4-  
inch refrac-  
tor, 250X.  
Seeing 7,  
transparency  
6.

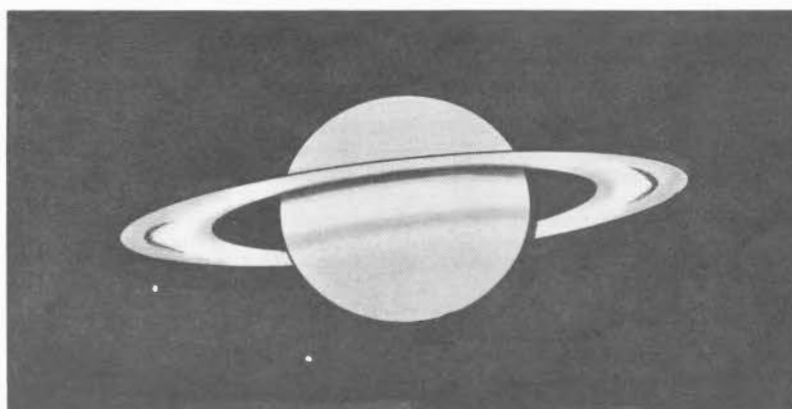


Figure 24.  
Drawing of  
Saturn by  
Alan W. Heath.  
September 10,  
1964, 21<sup>h</sup>35<sup>m</sup>,  
U.T. 12-inch  
reflector,  
190X. Seeing  
7, transpar-  
ency 5.

DATE	<u>N edge</u> <u>SFR</u>	<u>center</u> <u>SEB</u>	<u>center</u> <u>EB</u>	<u>center</u> <u>NEB<sub>s</sub></u>	<u>center</u> <u>NEB<sub>n</sub></u>	<u>center</u> <u>NTB</u>	<u>center</u> <u>NNTB</u>	<u>S edge</u> <u>NPR</u>	METHOD	OBSERVER
1964, Aug. 23			+5.5	+12.1	+22.2		+40.7		MD	Cyrus
Sept. 3		-20.6	0.0	S+10.9	S+18.9		+39.8	+47.7	MD	Binder
				N+16.6	N+21.7					
Sept. 9		-24.6	-0.4		+14.6		+39.2		FM	Cragg
Sept. 30		-22.9	+3.5		+17.6		+45.8		FM	"
Oct. 2				S+8.6	S+18.9	S+33.5			MD	Dragesco
				N+15.2	N+24.2	N+38.8				
Oct. 3					+14.6	+21.8			MD	Heath
Oct. 25		-21.5		S+11.0	N+18.3		+63.9		VE	Haas
Nov. 27		-21.5		S+12.0	N+19.1		+71.6		VE	"
Nov. 29		-21.5		S+11.3	N+19.1		+68.1		VE	"
Dec. 22		-28.8	+5.8	S+9.0	N+16.3		+52.8		VE	"
1965, Jan. 11		-20.8		S+10.3	N+13.8	+21.8	+52.8		VE	"

Under "method", the following are the meanings of the initials:

FM = filar micrometer.

MD = measured from a drawing.

Ph = measured from a photograph.

VE = visual estimate in manner described above.

In places where an "S" or an "N" precedes the value it is to be interpreted as meaning the south edge or north edge. In the case of the NEB this would mean the south edge

of the NEB<sub>s</sub>, north edge of the NEB<sub>s</sub>, south edge of the NEB<sub>n</sub>, and north edge of the NEB<sub>n</sub>. In the September 9 and September 30 measures it was the middle of the NEB complex which was measured rather than each component.

Several comments are in order:

1. The SEB measures on June 7 and 14 are either grossly in error or are actually of the South Temperate Belt. If the latter be the case, this is the only evidence for an STB during this apparition.

2. Accuracy of especially visual estimates appears to be reasonable in the lower to middle latitudes, but is questioned in the higher latitudes. An error of 0.01 radii of Saturn amounts to  $\frac{1}{2}^\circ$  in low latitudes,  $1^\circ$  in middle latitudes, and  $2^\circ$  or more in yet higher latitudes. Estimating a fraction to 0.01 consistently impresses the Recorder as a rather trying task; something closer to 0.05 seems more like what can reasonably be expected, which would clearly mean errors of substantial size. However, it appears that Haas has been able to estimate to the order of 0.01 radii reasonably consistently as his measures of the SEB demonstrate. It should be noted, however, that his measures of the S edge of the NPR have a total scatter range of  $19^\circ$  while those from drawings have a scatter range of  $9\frac{1}{2}^\circ$ . This is probably an unfair test, though, since from evidence on both sides it is clear that the measured region was very inconsistent in its southern extent. With the filar micrometer one feels pretty confident of the third decimal place with variation coming in the fourth. [I would fear in micrometric measures both random and systematic errors in excess of 0.001 radii of Saturn. --Editor.]

3. The variation between measures of individual features, it is felt, is real evidence of their true variation. In 1963 we thought that there was perhaps a tilted belt or something similar to cause the disagreement. It now appears more likely to the Recorders that Saturnian belt edges vary considerably as compared, say, with those of Jupiter.

4. In order somewhat to minimize the effect of the wider scatter associated with visual estimates, if a large number were made their accuracy would increase roughly as a factor of  $\sqrt{n}$  when a sufficient number  $n$  of measures is available for a meaningful average.

For what it's worth, the mean latitudes of the south and north edges of the NEB in 1963 were respectively  $+9^\circ 2'$  and  $+16^\circ 0'$  while in 1964 they were  $+10^\circ 7'$  and  $+18^\circ 6'$  respectively. It might be interesting to pursue this further, but the internal consistency of the data doesn't lend itself to substantiate this small a drift.

### The Rings

In general, as the rings close up their apparent brightness diminishes as does also the arc in the ansae over which intensity minima are observable. Only one observer reported any intensity minima in front of the globe in 1964, and then only several minima as a blend.

As before, the outer part of Ring B was always the brightest part of the ring system, the inner part always being much fainter. Ring A was obvious but had many variations in brightness across it in the best views. Ring C was observed even in the ansae by most of the observers, but its inner limit was quite variable -- depending upon who saw it.

Dimensions of the Rings. Ken Schneller made measures of the dimensions of the ring system yielding the following results:

	<u>Number of</u> <u>Measures</u>	<u>R = 1.00</u>
Radius of ball (equatorial?)	775	1.00
Radius of inner edge of Ring C	198	1.25
Radius of outer edge of Ring C	197	1.51
Radius of outer edge of Ring B	375	1.99
Radius of outer edge of Ring A	226	2.28

Ring Colors and Intensities. Goodman, Haas, and Ricker made intensity measures with Wratten color filters of Ring A, all assuming the outer part of Ring B to be constant and intensity 5.0. Since no general variation throughout the apparition was encountered, it appears proper to give the means of the measures:



<u>No Filter</u>	<u>25(red)</u>	<u>58(green)</u>	<u>47(blue)</u>
4.45 (15)	4.12 (14)	4.40 (13)	4.79 (14)

These values have real meaning from the standpoint of saying that Ring A certainly appears bluer than Ring B. Note the similarity of readings with no filter and with Wratten #58. The numbers in parentheses refer to the number of estimates making up the mean.

Intensity Minima in the Rings. Considerable controversy continues in the professional world over acceptance of intensity minima observed by the ALPO. Despite the lessening ring inclination, a good number of minima were substantiated during 1964. Of course, everyone saw Cassini's and occasionally Encke's. Following are two lists; those minima seen by two or more observers, and those observed by only one observer;

<u>Confirmed by at least two observers</u>	<u>Seen by one observer</u>
Encke	A8
Cassini	A6
B5	A4
B3	B7
B0	C5

All the minima observed by one observer in 1964 have also been observed many other times in previous apparitions. The A6, A4 group is the double Encke observed a number of times in the past.

On September 2, 1964, Schneller measured the actual positions of intensity minima in the rings which he was then able to observe. There follows a table of his measures along with the ALPO (positional) designations for each minimum:

A8 = A 7.94	B3 = B 3.38
A6 = A 5.74	B0 = B 0.00*
A4 = A 2.62	Cassini = A 0.00*
	C5 = C 5.05

Bicolored Aspect of Rings. W. H. Haas independently devoted considerable observation time to this problem in 1964, but most unfortunately he was alone in his researches. His observations show that from April through June the west\*\* ring arm was always brighter than the east arm in blue light, equal in red, and slightly dimmer than the east arm in the green. From the end of September through December they were equal in all colors. Slight differences were observed in January, 1965, and were essentially equally divided as to which ring arm was the brighter. Despite the complete lack of an explanation for this very curious phenomenon, it continues to be observed regularly with color filters and therefore appears to be real instead of illusionary. A photograph clearly showing what the bi-colored aspect looks like is in the 1963 report (Str. A., Vol. 18, Nos. 7-8, Figure 4 on pg. 136).

### The Satellites

C. L. Johnson has made the only reported attempt at observing a satellite transit in 1964. Tethys was predicted to transit on September 6 during 07:05 - 08:43, U.T., its shadow transiting during 07:05 - 09:00. In variable seeing (mostly good but occasionally bad) no shadow nor satellite transit was observed. At 08:04 Johnson observed the satellite off the south limb a little west of the CM in a position indicating that no transit had occurred!

Two items are immediately worth discussing at this point.

1. It is said that the shadow of Tethys was observed in 1891 by Freeman with a 6 $\frac{1}{2}$ " refractor. The evidence is that this is quite an achievement and is worth checking into by ALPO members. The BAA Saturn Section has made a fervent effort to determine once and for all the validity of this observation plus what instrumentation is required for observing each satellite shadow.

2. If transits are predicted and either fail to materialize or are off in their

\* Cassini and B0 are 0.00 by definition.

\*\*Here west is a direction in the earth's sky and is the left arm in a simply inverted view with south at the top.

timing, it would be very worthwhile to make observations of such phenomena as a valuable check on orbital residuals.

### Conclusions

It is evident that estimated intensities of the belts and zones will yield good information as to changes in these details. Especially valuable are intensities of belts and zones estimated with known transmission filters. Those should be Wratten 25 (red), 58 (green), and 47 (blue); then everyone is at least using the same band-passes. Certain inherent differences between individual observers are bound to come up -- especially as to their color perception. With a number of estimates over a fairly long time interval, however, the Recorders can assign to an observer his proper color factor so that all estimates can be reduced to a common scale.

Johnson's work on Tethys is an excellent example of what can be done with the currently occurring satellite phenomena. These will continue in 1966. A little extra effort along this line would be most worthwhile.

Of course, we have our old problem of CM transits of any feature seen in a belt or zone. The increased activity in the northern zones (NTrZ & NTeZ) makes it worth looking for spots there since these regions do not have good known rotation rates.

The most valuable contribution possible with smaller instruments would be intensity measures of the belts and zones both with and without color filters. There appears to be little of value which can be learned by straining vigorously to observe something with a 4" telescope that is a hard test for a 12". Since most users of large telescopes don't use them so often, a persevering observer with a small telescope can make a real contribution in the manner described above.

### ANNOUNCEMENTS

Sustaining Members and Sponsors. As of February 10, 1966 we have in these special classes of membership:

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Lunar Training Program. We receive frequent expressions of interest in lunar observing from beginning observers and young novices. The attention of such persons and any others interested is directed to the following information recently communicated by Clark R. Chapman, the Lunar Training Program Recorder: "The Lunar Training Program is designed to assist beginning observers in learning the fundamentals of visual observations. A five-page instruction pamphlet was prepared last year, and copies may be obtained by sending a self-addressed stamped envelope to Clark R. Chapman, 94 Harper Rd., Buffalo, N. Y. 14226, U.S.A. Also available are standard crater outline forms for Cassini, Posidonius, Aristarchus-Herodotus, Hesiodus, Thebit, Guericke-Parry-Bonpland-Fra Mauro, Plato, and the Ranger VII impact region. Please specify which forms are desired, and enclose an additional stamp for each five ordered. Available again, for 25 cents, is a photograph illustrating the four steps in making a drawing of a lunar crater. More detailed information on lunar observation will be appearing in the A.L.P.O. Observing Manual, which should be published toward the end of the year."

It should perhaps be stated that the A.L.P.O. Lunar Training Program is designed to

give seriously interested observers the opportunity to train themselves in certain basic techniques. Participating observers will make progress in proportion to how well they follow Mr. Chapman's guidelines. Casual attempts will be no more rewarding here than on other lunar and planetary projects. Neither can Mr. Chapman reasonably be expected to correspond at length on such distantly related topics as telescope making, science fair projects, and space travel.

A.L.P.O. Observing Manual. We hope soon to announce more of the status of this project. We are, however, very glad to say that the co-authors, Clark Chapman and Dale Cruikshank, now have at least initial drafts of all the chapters. Their success is largely a result of considerable efforts which they made during the summer of 1965 in collecting, criticizing, and rewriting the various manuscripts -- a task the magnitude of which will be appreciated only by those who have done something similar.

Chart of the Planet Mars. The U. S. Air Force has prepared a map of the planet Mars in natural colors. The detail and colors were determined through consultation with Dr. E. C. Slipher, the famous observer and photographer of Mars. The map is on a Mercator projection from 60°S. to 60°N., with the polar regions on three northern and three southern hemisphere perspective drawings. The map is based on selected photography. This chart of Mars may be ordered from the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402. The price is 50 cents per copy. The chart of Mars measures 22 by 29 inches and is not folded.

A Note on Lunar Nomenclature. Mr. Patrick Moore has submitted the following comment on the articles about the new lunar nomenclature in Str. A., Vol. 19, Nos. 1-2, pp. 27-29, 1965.

"Perhaps a brief note concerning Clark Chapman's article will be in order. First, nobody supposes that Wilkins' map is as accurate as modern charts. How could it be? Wilkins was a pioneer; he was studying the Moon long before many professionals bothered about it; he was working alone with modest equipment; and let us remember that his map did not cost any Government a very large sum of money! Secondly, some of the names in his map were added in the 1950's by Mr. D. W. G. Arthur, then Librarian of the BAA Lunar Section of which Wilkins was Director.

"Mr. Chapman is very young, and I am sure he did not mean to be offensive. But rather than continue such comments - bearing in mind that Wilkins is no longer with us - let us respect the memory of a pioneer. I am sure that in later years Clark Chapman will come to agree with this view."

If any comment on the comment be needed, the Editor would say, first, that he has long admired that spirit of dedication in which Wilkins, Goodacre, W. H. Pickering, P. Fauth, and others devoted countless hours to studying the moon quite without government subsidies, and, second, that he feels a responsibility to inform our readers of the lunar nomenclature adopted by the I.A.U. as explained by Clark Chapman and others.

The A.L.P.O. Library and Staff Changes. The services of Mr. E. Downey Funck as A.L.P.O. Librarian have ended, and he has agreed to return the Library to the Editor in Las Cruces, New Mexico. We are indebted to Mr. Funck for his help in making this service possible and for his aid in giving physical space to books and magazines. The future of the Library is at present uncertain, and we shall be glad for constructive suggestions from our readers. We would like to try to continue to provide a lending library if it is really helpful to our members. Probably it is chiefly useful to our younger members; those at colleges or universities and those having contacts with professional institutions already possess excellent library facilities. Interest in the A.L.P.O. Library has lagged during the last few years, although we certainly have books of interest and value to most or all of our members. It has also been suggested that the Library should serve to store our older observational records and that Recorders should perhaps have on hand no more than the last five years of observational records on their particular planet or project. The risk of loss of irreplaceable records might thus be reduced.

Mr. Harry Jamieson has asked to be relieved of his duties as an A.L.P.O. Lunar Recorder for a few months, after which he hopes to resume them. In the meantime, the Reverend Kenneth J. Delano will be in charge of the Lunar Dome Survey. All current observations of lunar domes should be mailed to Reverend Delano at 22 Ingell St., Taunton, Massachusetts.

Concerning "Prospects". For several issues we have run a section on lunar and plane-

tary "prospects", giving near-future data and suggested observations. We appreciated an encouraging letter on this new feature from Mr. B. Traucki in Buenos Aires, Argentina dated July 3, 1965. Mr. Traucki wrote in part as follows: "As I understand it, the Str. A. is not a periodical edited exclusively for professional astronomers but also for amateurs, many of whom can use for astronomy only a few spare moments of their available time. Hence, such information about data and positions of the planets, when well presented, is a strong motivation toward observing the planets. For instance, just recently today I had the good luck to observe for the first time in my long life Venus and Mercury in close conjunction together in the field of view of my telescope and to compare their discs easily. And that is thanks to Str. A., your 'experiment'."

#### LUNAR AND PLANETARY PROSPECTS, MARCH - APRIL, 1966

By: Walter H. Haas

Mercury. The Elusive Planet was at superior conjunction on February 6, reaches greatest elongation east  $18^\circ$  from the sun on March 5, and is at inferior conjunction on March 21. This evening apparition of the planet is the most favorable one of 1966 for observers in middle northern latitudes. The planet is at perihelion on March 2 so that its increased brilliance when closer to the sun may offset in some ways the rather small greatest angular elongation. After March 21 Mercury will be in the morning sky. Its position relative to the horizon will then be poor in middle northern latitudes but favorable in the southern hemisphere. The greatest elongation west of fully  $28^\circ$  will occur on April 18, and the following superior conjunction is on May 27. The planet is at aphelion on April 15, and the motion in the orbit near greatest elongation west is thus about as slow as possible.

We would again urge readers to observe the planet carefully with the goal of an optical determination of the period of rotation. Here, of course, one requires a serious effort at intensive coverage; two or three scattered drawings per evening or morning apparition are almost useless. Readers can benefit from a study of the discussion of the rotation of Mercury on pp. 93-94 of this issue. Observers will do well to experiment with color filters of known transmissions as possible aid to detecting detail on Mercury. The writer has often found a red filter helpful. Those with large enough apertures will want to try observing the planet near the middle of the day when it is high above the horizon. Comparisons of the observed phase and the geometrical phase have been discussed in past issues of this journal and are still worth attempting, best of all without foreknowledge at the telescope of what the precise geometry is.

Venus. This planet will be a brilliant morning star during March and April. It is at greatest elongation west,  $46^\circ$  degrees from the sun, on April 6. Greatest brilliancy is attained on March 1.

It is scarcely necessary to remind readers of this journal of the extreme difficulty of observing Venus. Perhaps, however, the poor coverage regularly obtained on morning apparitions as compared with evening apparitions can be an added incentive to observe. The curious visibility of the dark hemisphere may be looked for, both with and without color filters, until perhaps the end of March. (It is seldom recorded at larger phases.) Careful and frequent estimates of the shape of the terminator, whether concave, straight, or convex, may extend from about March 25 to about April 25. It is again best to avoid bias by not knowing the exact geometric phase while observing at the telescope. The method of estimated probabilities is recommended for phase-estimates; for details, please write to our Venus Recorder, Mr. Dale Cruikshank. Estimates of the presence and relative brightness of the north and south cusp-caps continue to be of statistical value, as are also estimates of the presence and relative darkness of the north and south cusp-bands (which border the cusp-caps). Ultra-violet photography of Venus is a worthwhile project for equipped members. The ideas here outlined and others are developed in greater detail in the Venus Reports published in this periodical during the last few years.

Members are reminded that rather high powers should be used on the very brilliant disc of Venus. The general theoretical subject has been discussed by Charles H. Giffen in Str. A., Vol. 17, Nos. 3-4, pp. 59-72, 1963. Dr. Giffen concluded that powers of about 50 to 60 per inch of aperture are required on Venus if one is to achieve optimum contrast sensitivity. Thus, the user of a 6-inch telescope should employ magnifications of, say, 300X to 360X.

Noting recent interest in the question of how well the observed phase of Venus agrees with the theoretical geometric phase, it would appear that an interesting project

for an observer having access to a filar micrometer might be a long series of measures of the observed phase of Venus over almost all the phases attained by the planet. Perhaps one could thus refine the results presented by Mr. Alan Binder, based on drawings of the planet, in *Str. A.*, Vol. 18, pp. 189-192, 1964. One would need to measure the distance from the middle of the limb to the middle of the terminator - the "breadth of phase". If one also measured the distance between the north and south cusps, it would not be necessary to know the scale constant of the micrometer; and since one would be comparing two lengths measured at the same time, there would be the further advantage of a reduction of those systematic errors depending upon the conditions of observation.

Mars. The Red Planet will be in conjunction with the sun on April 29, 1966. Enough said.

Jupiter. The Giant Planet will be placed in the evening sky during March and April. The systematic recording of central meridian transits of surface features is one of the very best amateur planetary observational programs. The technique was recently explained in detail in this journal by Charles H. Giffen, Vol. 19, Nos. 1-2, pp. 29-34. The A.L.P.O. Jupiter Handbook continues to be available for a price of 50¢ from either the Jupiter Recorder or the Editor. Readers are reminded that timing the transits of Jovian satellites and their shadows will give very helpful information upon the random and systematic errors to which transits of surface features are subject.

As of the middle of February, 1966, the Great Red Spot of Jupiter is dark and prominent. The longitude (II) of its center is near 30°; and it will cross the central meridian of the planet near 0 hours, Universal Time on March 15, March 27, April 8, and April 20. Other transits may be found by using the period of rotation of System II, 9 hrs., 55 mins., and 41 secs. The pronounced orange color of the Red Spot has attracted much attention during the 1965-6 apparition, the writer once finding it striking with only a 6-inch telescope. Sketches of the Spot and its vicinity are always of interest. The intensity may be estimated on a numerical scale of 0 (shadows) to 10 (most brilliant features on Jupiter). The color may also be observed, perhaps most objectively with color filters of known transmissions.

Other observations of Jupiter can include drawings of the whole disc, drawings of selected regions or features, intensity and color estimates, observations of the relative conspicuousness of the different belts, precise timings of satellite phenomena, drawings of the discs of the satellites (with sufficient apertures), measures of the latitudes of the belts with a filar micrometer, and photographs in both black-and-white and natural colors.

Saturn. The edgewise phenomena of the rings during 1966 are described on pages 73-75, and the report on the 1964-5 apparition on pages 98-104 will certainly indicate some current lines of interesting study.

The Ringed Planet will be in conjunction with the sun on March 10. Since the rings will be exactly edgewise to the earth on April 2, a serious effort at early recovery of the planet is indicated, even though the position relative to the horizon in middle northern latitudes will be poor. Observers near the equator and in the southern hemisphere will have much better conditions. After April 2 the earth and the sun will be on opposite sides of the plane of the rings. Surely very few active observers have seen the phenomena then presented. In 1950 both earth and sun passed through the plane of the rings with Saturn only a few days from conjunction with the sun. In 1936 the earth moved into the plane of the rings near the end of June from one side and then receded on the same side, although the dark side was presented some months after opposition - between December 28, 1936 and February 21, 1937. Of course, the edgewise aspect of the rings in 1966 constitutes a good opportunity to observe the satellites. Photometry and attempted observations of satellite and shadow transits are recommended.

Uranus. A schedule of shadow transits is presented on pages 88-89, and there is a review of Dr. Alexander's recent comprehensive book about Uranus on pages 97-98. The planet is at opposition on March 8. At that time its angular diameter is 3.796". The reported variations in brightness of satellites Titania and Oberon noted in Reverend Hodgson's review of Dr. Alexander's book would appear worth checking into, but naturally one needs a telescope large enough to show the two satellites clearly. Probably 20 inches of aperture would be necessary. Since the earth is now near the plane of the equator of Uranus, the opportunity is also offered of measuring the oblateness, or polar flattening, of the planet with a filar micrometer. This opportunity is indeed the best for such measures for about 84 years; when the earth is in the plane of the equator of Uranus in 42 years

from now, the planet will be farther from its perihelion than it is now. Of course, large apertures and high powers are needed to make accurate measures of so small a disc as that of Uranus. There is the usual opportunity for drawing any features seen on Uranus; large apertures are preferred, and careful judgement is certainly necessary.

The following table may assist observers having circles on their telescopes in locating Uranus. The positions for the stars will allow differential settings in the two coordinates.

The positions of the planet are at 0<sup>h</sup>, U.T.; those of the stars are 1966 mean places.

<u>Object</u>	<u>Right Ascension</u>	<u>Declination</u>
Uranus, 1966, March 15	11 <sup>h</sup> 14 <sup>m</sup> 36 <sup>s</sup>	+5° 46'
April 1	11 11 59	+6 02
April 15	11 10 09	+6 13
April 30	11 08 42	+6 22
Regulus (Alpha Leonis)	10 06 34	+12 08
Spica (Alpha Virginis)	13 23 24	-10 59

Neptune. This distant planet reaches opposition on May 12, when its angular diameter will be 2450. The following table may help in locating the planet. It will be well placed late in the night during March and April.

<u>Object</u>	<u>Right Ascension</u>	<u>Declination</u>
Neptune, 1966, March 15	15 <sup>h</sup> 20 <sup>m</sup> 31 <sup>s</sup>	-16° 34'
April 1	15 19 30	-16 29
April 15	15 18 19	-16 24
April 30	15 16 48	-16 18
Antares (Alpha Scorpii)	16 27 19	-26 22

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