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Volume 21, Numbers 9-10


Composite drawing of Plato and vicinity by Mrs. Inez Beck. Based upon the work of the observers in the A.L.P.O. Selected Areas Program. The aspect shown is not necessarily valid at any particular solar lighting. See also text of article on pages 161-166. Lunar south at top and lunar west in I.A.U. sense at right. The control craterlet, "Pico 1", discussed in the text, lies about one-sixth of the way from the northwest corner of Pico to the west edge of Plato, and almost on a line joining them.

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## By: Richard G. Hodgson

In August and September, 1969 the minor planet 1620 Geographos will make a close approach to the Earth. On August 27 Geographos will reach its minimum distance, 0.0606 Astronomical Units or approximately $5 \frac{1}{2}$ million miles from Earth, according to Der Sternenhimel (1969). 1 The orbit of Geographos is unusual since its perihelion is about midway between the orbits of Venus and the Farth, and its aphelion is slightly outside the orbit of Mars. The orbital eccentricity is 0.335 , and its period is 507 days. Geographos will be at perihelion this year on June 29.

The behavior of Geographos will be similar to that of minor planets 1580 Betulia in $1963^{2}$ and Icarus in $1968 .{ }^{3}$ When close to the Earth -- astronomically speaking -- these minor planets can be readily identified by their rapid motion from night to night; often this motion is apparent in a few minutes time. Precise ephemerides are almost impossible to determine for such objects, and magnitude estimates bear some uncertainty. Thus we have an exciting game of astronomical hide-and-seek. In this coming flymby of the Earth, Geographos will be in the southern skies, but visible to observers in moderate latitudes who have a good southern horizon at the end of August and during the major part of September. At its brightest Geographos is expected to be magnitude 12.1 (August 27). This is about as bright as Icarus appeared to be in 1968. This value will decline to 12.2 by September 6, and to 13.4 by September 16. Thus 1620 Geographos should be visible with about five or six inches of aperture, given dark sky conditions.

Besides searching for, and finding Geographos, A.L.P.O. members may wish to estimate its brightness by comparing it with stars of known magnitude. Observations of variations in its brightness would also be of value, perhaps indicating its rotation period. Those members with access to larger instruments might also attempt to secure positional photographs.

According to an ephemeris of S. Herrick, P. A. Thompson, and P. C. Tiffany ${ }^{4}$, the approximate location of 1620 Geographos should be as follows:

| A.D. 1969 | Right Ascension (1950) at $2^{\mathrm{h}} \mathrm{UT}$ | $\begin{aligned} & \text { Declination } \\ & \text { (1950) at } 2^{\mathrm{h}} \text { UT } \end{aligned}$ | Distance <br> from Earth | Estimated Magnitude |
| :---: | :---: | :---: | :---: | :---: |
| Aug. 25 | $15^{\mathrm{h}} 33.5 \mathrm{~m}^{\text {m }}$ | -54 ${ }^{\circ} 43^{\prime}$ | 0.0625 A.U. |  |
| Aug. 27 | 1700.5 | -49 53 | 0.0606 | 12.1 |
| Aug. 29 | 1807.5 | -41 50 | 0.0625 |  |
| Aug. 31 | 1853.5 | -33 02 | 0.0678 |  |
| Sept. 2 | 1924.9 | -25 07 | 0.0759 |  |
| Sept. 4 | 1947.1 | -18 37 | 0.0860 |  |
| Sept. 6 | 2003.4 | -13 27 | 0.0976 | 12.2 |
| Sept. 8 | 2016.0 | -9 23 | 0.1103 |  |
| Sept. 10 | 2026.0 | - 609 | 0.1237 |  |
| Sept. 12 | 2034.2 | - 333 | 0.1378 |  |
| Sept. 14 | 2041.2 | - 127 | 0.1524 |  |
| Sept. 16 | 2047.2 | + 017 | 0.1674 | 13.4 |
| Sept. 18 | 2052.5 | + 143 | 0.1827 |  |
| Sept. 20 | 2057.3 | + 256 | 0.1984 |  |
| Sept. 22 | 2101.7 | + 357 | 0.2144 |  |
| Sept. 24 | 2105.8 | $+449$ | 0.2306 |  |
| Sept. 26 | 2109.6 | $+534$ | 0.2471 | 14.4 |

Thus on August 25 Geographos is located in the constellation of Ara, out of the view of many observers in North America. At the end of August, moving quite rapidly, it is located in Sagittarius. It will enter Capricornus on September 6 and pass into Aquila on September 8. Aquarius will be entered on September 12; and on about September 20 Geographos will cross into Equuleus, where its magnitude and daily motion will greatly diminish.

It would be well to plot the above positions on a good star atlas, such as Atlas Australis or Atlas Eclipticalis (available through Sky Publishing Corporation), recognizing, of course, that these positions are only approximate.

## References

1. p. 117.
2. Cf. The Strolling Astronomer, Vol. 17, Nos. l-2 (published March, 1963), p. 1.
3. Cf. Sky and Telescope, Vol. 36, No. 2 (August, 1968), pp. 75-77, and The Review of Popular Astronony, Vol. 68, No. 555 (February, 1969) for sumnaries of findings on Icarus. Advanced students should also note other items on Icarus appearing in The Astronomical Journal, Vol. 73, No. 8, pp. 747-748, and Vol. 74, No. 2, pp. 297-307.
4. Given in Der Sternenhimmel, p. 117.

## THE TAIL OF COMET TKEYA-SEKI 1965 f

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

Analysis of ALPO Comets Section observations of Comet Ikeya-Seki 1965 f by 24 observers gives a maximum tail length of 0.7 Astronomical Units and a radial velocity of the end of the tail of 32 kilometers per second and further reveals an anomalous tail.

Observations by the following persons were used in this article:

| Leo Boethin, Abra, Philippines | Michael McCants, Houston, Texas |
| :--- | :--- |
| John Bortle, Mount Vernon, N. Y. | David Meisel, Charlottesville, Va. |
| Charles Capen, Wrightwood, Calif. | Dennis Milon, Tucson, Ariz. |
| Darrell Conger, Elizabeth, W. Va. | R. B. Minton, Ias Cruces, N. M. |
| Kenneth Delano, Taunton, Mass. | Don Pearson, New York, N. Y. |
|  |  |
| William Glenn, New York, N. Y. | Tsutomu Seki, Kochi, Japan |
| Bill Grady, Morgantown, W. Va. | Karl Simmons, Jacksonville, Fla. |
| Walter Haas, Ias Cruces, N. M. | Bradford Smith, Ias Cruces, N. M. |
| Alika Herring, Mauna Kea, Hawaii | Douglas Smith, Vinton, Va. <br> Craig Johnson, Boulder, Colo. |
| Gordon Solberg, Ias Cruces, N. M. |  |
| H. W. Kelsey, Fiverside, Calif. |  |
| Steve Iarson, Tucson, Ariz. | David Swann, Dallas, Tex. |

Tail Length. Gordon Solberg of New Mexico State University Observatory has computed actual tail lengths of Comet Ikeya-Seki 1965 from observed visual and photographic angular measures between October 25 and December 4, 1965. The graph drawn by R. B. Minton shows daily averages from the observed lengths given in Table I (Figure 2). The true tail length was calculated from a formulax by Michael McCants (Strolling Astronomer, March -April, 1965, page 41):

$$
I=\frac{\text { Observed length in degrees } x \quad .017 \times \Delta}{\sqrt{1-\frac{\left(r^{2}+\Delta \Delta^{2}-1\right)^{2}}{(2 r \Delta)^{2}}}}
$$

Here, $I, r$, and $\Delta$ are in Astronomical Units, with $r$ the comet's distance from the sun and $\Delta$ its distance from the earth. This formula was developed with the use of the Law of Cosines of plane trigonometry. It assumes that the tail of the comet is directed radially away from the sun in the plane defined by sun, earth, and comet.

After perihelion passage on October 2l, 1965, the first tail measures were by Solberg and Alika Herring on October 25. The length was $12^{\circ}-15^{\circ}$, equal to about 0.2 Astronomical Units. The tail continued to grow to more than $\frac{1}{2}$ A.U. in November and December. For comparison, maximum tail lengths for other comets in the same comet family (having similar orbital elements) are given here in millions of kilometers:

| 1843 I | 330 |  |
| :--- | ---: | :--- |
| 1882 II | 100 |  |
| 1963 V Pereyra | 90 | ALPO measures |
| 1965 f | 105 | ALPO measures |

It is also of interest to mention Donati's Comet of 1858 ( 70 million kilometers), Halley's Comet in 1910 (30), Arend-Roland 1957 III (45), Mrkos 1957 V (42), and Seki-Iines 1962c
*The reader who works through the derivation of Mr. McCants' formula will see that it involves several approximations, which are ordinarily fully compatible with the accuracy of the observed tail length.
(48).

The radial velocity of the end of the tail relative to the head was determined as $31.7 \pm 3$ kilometers per second by Solberg, using a least squares analysis of 75 observed lengths (both photographic and visual) from October 25 th to November 7th.

Position Angle. From 14 photographs, Gordon Solberg and R. B. Minton measured the position angle (taken in the usual sense as east $90^{\circ}$ from north at $0^{\circ}$ ) of the central spine of the tail of Ikeya-Seki. One of these angles was obtained with a Mann measuring machine, using the original negative, while the others were determined with a protractor and the Atlas Eclipticalis and Atlas Australis. Then the position angle was compared to the predicted angle computed by Michael McCants, who employed the following procedure:

In Figure 5 on page 151 consider a spherical triangle on a sphere centered on the earth. Let $P_{n}$ be the north celestial pole, $S$ the sun at right ascension $A_{S}$ and declination $D_{S}$, and $C$ the comet at right ascension $A_{C}$ and declination $D_{C}$. Then the observed angular distance $\mathcal{C}$ between the sun and the comet is given by:

$$
\cos \epsilon=\sin D_{c} \sin D_{S}+\cos D_{C} \cos D_{S} \cos \left(A_{S}-A_{C}\right)
$$

The comet's tail $\widehat{C T}$ is assumed to be directed radially away from the sun. The angle

$$
\cos \theta=\frac{\sin D_{S}-\cos \epsilon \sin D_{C}}{\sin \epsilon \cos D_{c}} .
$$

This equation will uniquely determine $\theta$ as between $0^{\circ}$ and $180^{\circ}$. Next choose:
$\Delta R A=$ right ascension sun - right ascension comet, when necessary increased by $360^{\circ}$ in order to lie between $0^{\circ}$ and $360^{\circ}$.

If $\triangle \mathrm{RA} \leqq 180^{\circ}$, then the sun is east of the comet, and the position angle PA of the tail is $\theta+180^{\circ}$. Angle PA is measured from $0^{\circ}$ at north through $90^{\circ}$ at east, all the way around.

If $\Delta \mathrm{RA}>180^{\circ}$, then the sun lies west of the comet; here $\mathrm{PA}=180^{\circ}-\theta$.
Thus the difference between the measured and the predicted position angles shows how much the central spine was leading or following the radius vector extended from the


Figure 1. Comet Ikeya-Seki 1965 f photographed on December 4, 1965 by Lee McDonald and Dennis Milon. A 5 -minute exposure with mid-time $11^{h} 57^{m} 30^{s}$, U.T. and a $50-\mathrm{mm}$. f/2.8 lens. Mr. Steve Larson employed a copying process to enhance contrasts. The tail is about $25^{\circ}$ long and $4^{\circ}$ wide. Reproduced from Lunar and Planetary Laboratory Communications No. 68.

## COMET IKEYA-SEKI 1965ł



Figure 2. Above: Visual and photographic angular tail lengths of Comet Ikeya-Seki 1965 f are reduced to true lengths and are plotted against time. Black dots are daily means, and open circles are single observations. The greatest observed tail length was about 0.7 Astronomical Units, or 65 million miles, and was obtained from a photograph on November 29, 1965. Graph drawn by Mr. R. B. Minton, New Mexico State University Observatory.

Below: Observed position angle of central spine of tail of Comet 1965 f minus predicted position angle. The latter assumes that the tail lies in the plane of the orbit. Perihelion occurred on October 21, U.T.; the spine caught up with the radius vector 15 days later, according to the graph. Graph drawn by R. B. Minton.

sun. The graph drawn by R. B. Minton (Figure 2) shows that the tail was following the radius vector from October 25 th to November 4th, 1965, not unexpected because of the very close approach to the sun. As the comet whipped around the sun, the tail could not keep up, and the outer sheath took on a curved shape. Solberg felt that the inner spine was


Figure 3. A photographic record of the growth of the tail of Comet IkeyaSeki 1965f. Photographs by Kent De Groff of Flagstaff, Arizona.


Figure 4. New Mexico State University Observatory photographs of Comet 1965 f showing the second, or anomalous, tail. Both pictures are from the same original negative, but the right one has undergone a photographic enhancement of about 40 times. The comet's head is below the horizon, and the Zodiacal Light brightens the sky to its left. Photograph taken by Bradford A. Smith on October 29, 1965, $11^{h} 49{ }^{9} 5$ to $12^{h} 2{ }^{m} 5$, Universal Time, using a Speed Graphic camera with a $150-\mathrm{mm} ., \mathrm{f} / 4.5$ lens and $103 \mathrm{a}-\mathrm{D}$ emulsion.

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the most clearly defined part for measurements. He notes that the outer sheath eventually caught up with the radius vector.

Four position angles not shown in the graph indicate the tail's later behavior. The differences were: Nov. 15, Bortle, visual, $-3^{\circ}$; Nov. 20, Haas, visual, $+12^{\circ}$; Nov. 29, Milon photo, $+19^{\circ}$; Dec. 4, Milon photo, $+14^{\circ}$. These observations refer to an average of the entire tail's direction, and they show that the tail was lagging behind the radius vector when last seen.

Comet Ikeya-Seki 1965f. Position Angle of main tail spine measured from photographs.

| UT Date (1965) | Photographer | Position Angle |
| :--- | :--- | :---: |
| Oct. 25.64 | Herring | $278^{\circ} .0$ |
| 27.51 | Milon | 273.5 |
| 28.51 | B. Smith | 273.0 |
| 29.50 | B. Smith | 272.0 |
| 30.51 | Milon | 270.5 |
| 31.49 | B. Smith | 269.0 |
| Nov. 1.49 | B. Smith | 270.0 |
| 2.52 | Milon | 268.0 |
| 3.54 | Capen | 268.5 |
| 4.52 | Capen | 268.0 |
| 5.50 | B. Smith | 268.5 |
| 6.52 | Capen | 268.0 |

Ikeya-Seki's Second Tail. In addition to the main bluish tail with spiral features, a straight tail was photographed after perihelion. Referring to R. B. Minton's prints of October 29th reproduced here as Figure 4, the secondary tail becomes visible where the main tail breaks toward the north (left). Minton has suggested that this straight section is a prolongation of the central spine's north component, but it also matches the curve


Figure 5. Rough diagram to illustrate spherical triangle used in development of equations for computing theoretical position angle of a comet's tail. Corresponding text on page 147 . Diagram and equations based on it developed by Mr. Michael McCants

of a major helical feature. This tail is also shown on photographs taken on October 27 th and 30th by Dennis Milon.

References. For additional data on Comet 1965f, see these Strolling Astronomer articles based on A.L.P.O. Comets Section observations:

```
March-April, 1965, page 62 General, photos, drawings.
May-June, 1965, page }9
Nov.-Dec., 1965, page 206
    Photos, drawings.
    Daylight observations.
Sept.-Oct., 1966, page 165 Nucleus, coma, tail magnitudes.
John Bortle summarized his personal observations in "Ikeya-Seki -- East" in the
March-April, 1966 issue, page 64.
```

Table I. Observed post-perihelion tail length of Comet Ikeya-Seki 1965f. The entries with an asterisk were measured from a photograph.

| U.T. Date 1965 | Observer | Length in Degrees | U.T. Date 1965 | Observer | Length in Degrees |
| :---: | :---: | :---: | :---: | :---: | :---: |
| Oct.2526 | Solberg | 15.0 | Oct. 30 | Glenn | 20.5* |
|  | Herring | 12.0* |  | Bortle | 21.0* |
|  | Herring | 12.0* |  | Herring | 19.0\% |
|  | Solberg | 15.0 |  | Delano | 20.0 |
|  | Minton | 15.0\% |  | Meisel | 18.0 |
| 27 | Larson | 15.3* |  | Bortle | 19.0 |
|  | Herring | $14.0 \%$ |  | Milon | 20.5* |
|  | Capen | 17.5* |  | McCants | 16.0 |
|  | Milon | 15.0* |  | Grady | 15.0* |
|  | Milon | 17.0 | 31 | Glenn | 15.0 |
|  | Minton | 17.5* |  | Solberg | 20.0 |
|  | Solberg | 17.5 |  | Herring | 22.0* |
|  | Johnson | 20.0 |  | Bortle | 20.0 |
| 28 | Iarson | 16.5* |  | Pearson | 22.0* |
|  | Herring | 15.0* |  | Grady | 18.0* |
|  | Solberg | 15.0 |  | Meisel | 20.0 |
|  | Wooten | 15.0 | Nov. 1 | Bortle | 18.0 |
| 29 | Herring | 18.0* |  | Solberg | 21.0 |
|  | Minton | 21.0 |  | Seki | 20.0 |
|  | Simmons | 17.5 |  | Smith | 23.0 |
|  | Johnson | 20.0 |  | Meisel | 20.0 |
|  | Kelsey | 20.0 |  | Johnson | 20.0 |
|  | Minton | 17.0 | 2 | Solberg | 22.0 |
|  | Bortle | 19.0 |  | Milon | 19.5* |
| 30 | Glenn | 18.0 |  | Swann | 25.0 |
|  | Solberg | 16.0 |  | Boethin | 24.0 |
|  | Minton | 16.0\% |  | Delano | 20.0 |


| U.T. Date 1965 |  | Observer | Length in Degrees | U.T. Dat | e 1965 | Observer | Length in Degrees |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Nov. | 2 | Herring | 24.0 | Nov. | 5 | Solberg | 27.0 |
|  |  | Bortle | 21.0 |  |  | Delano | 22.0 |
|  |  | Smith | 17.5 |  |  | Bortle | 20.0 |
|  |  | Simmons | 18.5 |  | 6 | Bortle | 25.0 |
|  |  | Conger | 22.0 |  |  | Solberg | 25.0 |
|  | 3 | Johnson | 22.0 |  |  | Glenn | 26.0 |
|  |  | Solberg | 22.0 |  |  | Has | 25.0 |
|  |  | Herring | 25.0* |  | 7 | Solberg | 22.0 |
|  |  | Simmons | 21.3 |  | 20 | Solberg | 20.0 |
|  |  | Conger | 24.0 |  | 21 | Boethin | 23.0 |
|  | 4 | Simmons | 23.0 |  | 23 | Boethin | 30.0 |
|  |  | Solberg | 22.0 |  | 29 | Milon | 29.0* |
|  |  | Haas | 22.5 | Dec. | 4 | Milon | 25.0\% |

SOME VISUAL OBSERVATIONS OF MARKINGS ON URANUS
By: Eugene W. Cross, Jr.
Many skilled observers have argued that nothing but the vaguest markings, if any markings are to be seen at all, are present on the small disk which Uranus presents to Farthbound telescopists. Other observers have argued that markings are indeed present, but that such markings are beyond the equipmental resources of the amateur. Mr. Stanley M. Shartle's very informative paper, "The Ellipicity of Uranus" (see Volume 20, pp. 197200, of The Strolling Astronomer), prompts me to describe my own observations of the distant planet, made in 1965 , in the hope of shedding further light on the subject.

Telescopic observations during the 1964-65 apparition of Uranus began on March 20, 1965, and ended on May 22, 1965. (All dates and times are by Universal Time.) All observations of Uranus were made at the Whittier College Observatory, Whittier, California, using the l9-inch aperture $\mathrm{f} / 7$ Newtonian reflecting telescope. Altogether, useful observations were made on ten separate dates, and drawings were made on six of those dates. However, four of the drawings can be well sumarized in the drawing made on April ll, 1965 (Figure 6). The following determinations resulted from the observations:

Belts: dark green, but on two occasions ( $4-15-65$ and $5-3-65$ ) the N. and S. equatorial belts had a subtle brownish color.

Zones: The most obvious feature of the green planet was the equatorial zone, which consisted of a very light, almost creamy (greenish?) band across the planet's middle, and perpendicular to its axis of rotation; other zones (spaces between belts) consisted of a rich green-blue color.

Li,imb Darkening: Much more pronounced than in the case of either Jupiter or Saturn. That is, if the apparent telescopic sizes of Jupiter, Saturn, and Uranus were made closely the same, one would notice that the fall-off in illumination from the center of the planetary disk to the limb would be more rapid in the case of Uranus than for either Jupiter or Saturn. The dimness of Uranus, however, may complicate this interpretation.

Oblateness: My purely visual observations of Uranus indicate that the planet differs from a sphere by an amount quite similar to that for Jupiter. Therefore, my best determination is that Uranus' oblateness is $1 / 17$. The oblateness measures were made from drawings made at the telescope since a filar micrometer was not available. Another possible scheme is to use an illuminated finely divided glass recticle (Edmund Scientific Co. sells these for use in magnifiers) placed at the focus of a positive eyepiece in order to measure directly the planet's dimensions (and hence oblateness).

The two drawings shown in Figure 6 reveal belts with widths as small a.s 0.5 sec . of $\operatorname{arc}(4-11-65)$ and even 0.1 sec . of arc ( $4-15-65$ ). It should be noted, however, that such fine belt detail is an expression of line resolution, which is considerably different from a telecope's ability to separate double stars, the common criterion by which telescopic resolution is determined.

Magnifications of from 180X to 650X were employed for observations with the 19-inch Newtonian reflector; but usually the best compromise between contrast, image intensity, and scale resulted in using relatively low magnifications of 300 X to 390 X , 390 X being the most useful.


Figure 6. Drawings of Uranus by Eugene W. Cross, Jr., using the 19-inch, f/7 Newtonian reflecting telescope at Whittier College Observatory, Whittier, California. South is at the top with the standard astonomical orientation. The contrast of the features has been greatly increased for purposes of reproduction. Left drawing on April ll, 1965 at $6 \mathrm{~h} 5^{\mathrm{m}}$, U.T. Sky transparency 4. Seeing highly variable; seeing blur varied from 0.8 to 0.5 seconds of arc. 325X. Right drawing on April 15, 1965 at $6 h_{4} 8^{m}$, U.T. Sky transparency 3. Seeing blur varied from 0.5 to 0.4 seconds of arc. 390X.

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Uranus is a difficult subject for the telescopist. However, the fact that the aforedescribed observations were made with a 19-inch aperture telescope should not deter any enthusiasts since very comparable results can be obtained with smaller apertures under good skies. It is my opinion that considerable useful work can be done in observing markings on Uranus with apertures (10, 12, 16 inches) likely to be found at the disposal of the amateur, provided that the users of such apertures are of a patient temperament.

The author wishes to thank Mr. James W. Young, A.L.P.O. Remote Planets Recorder, for his very penetrating and scholarly criticism, which has substantially improved the content of this paper.

JUPITER IN 1964-65: ROTATION PERIODS
By: Phillip W. Budine, A.L.P.O. Assistant Jupiter Recorder
The highlights of the 1964-65 apparition were: the development of a SEB Disturbance, a revival of the $\mathrm{NTB}_{s}$ current, the continued observational evidence for an abnormally slow portion of the $N$. Equatorial Current, the prominence of the three long-enduring white South Temperate Zone ovals, and the prominence of the Red Spot.

Some data pertinent to the apparition follow:
Date of Oppostion: 1964, November 13.
Dates of Quadrature: 1964, August 17; 1965, February 6.
Declination of Jupiter: $+16^{\circ} \mathrm{S}$ (at opposition).
Equatorial Diameter: 49.1 seconds (at opposition).
Zenocetric Declination of Earth: $+3: 3$ (at opposition).
Magnitude: -2.4 (at opposition).
This report is based on 2,786 visual central meridian transit observations submitted by five observers. Sixty-nine per cent of these transits (1,925) form usable drifts for 142 Jovian spots distributed in 13 different atmospheric currents. The contributing observers are listed below by name and by number of transits submitted, along with station of observation and telescope(s) employed.

Budine, Phillip W.
Heath, Alan W.
Ma.ckal, Paul K.
McIntosh, Patrick S.
Reese, Elmer J.

Binghamton, N. Y. 4-in. refr. 445 t .
Long Eaton, Nottingham, England

12-in. ref1. 12t
Mequon, Wisc. 6-in. refl. 18 t .
Sunspot, N. M.
New Mexico State
University Observatory

6-in. refl. 7t.
8-in. refl. 2304t.

The distribution of transit observations by months is as follows:

| 1964, | June | 24 | 1964, October | 571 | 1965 , February | 258 |
| :--- | ---: | ---: | ---: | ---: | :--- | ---: |
| July | 110 |  | November | 616 | Narch | 57 |
| August | 164 | December | 338 | April | 26 |  |
| September | 321 | 1955, | January | 291 |  |  |

In the tables which follow, the first column gives an identifying number or letter to each object. The second column indicates whether the object was dark (D) or bright ( $W$ ) and whether the preceding end ( $p$ ), center ( $c$ ), or following end ( $f$ ) was being observed. The third column gives the first and last dates of observation; the fourth column, the longitudes on those dates. The fifth column gives the longitude at opposition, November 13, 1964. The sixth column gives the number of transits. The seventh column indicates the number of degrees in longitude that the marking drifted in 30 days, negative when the longitude decreased with time. The eighth column shows the rotation period in hours, minutes, and seconds.

## S. S. Temperate Belt, System II

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Wc | Dec. 21 - Jan. 19 | $61^{\circ}-40^{\circ}$ | -- | 4 | -21.7 | 9:55:11 |
| 2 | Wc | Dec. 4 - Jan. 17 | 101-62 | -- | 5 | -26.6 | 9:55:04 |
| 3 | Dc | Dec. 21 - Jan. 22 | 95-65 | -- | 4 | -28.1 | 9:55:02 |
| 4 | Wc | Dec. 28 - Feb. 15 | 141 - 101 | -- | 故 | -24.5 | 9:55:07 |
| 5 | De | Dec. 21 - Mar. 23 | 193-117 | -- | 10 | -24.8 | 9:55:07 |
| 6 | Wc | Dec. 21 - Jan. 18 | 346-323 | -- | 4 | -23.0 | 9:55:09 |
| 7 | Wc | Dec. 22 - Jan. 20 | 321-303 | -- | 5 | -18.0 | 9:55:16 |
|  |  |  |  | Mean rotation period: 9:55:06 (Without No. 7) |  |  |  |

S. Temperate Current (S. edge STB, STeZ), System II

| No. | Mark | Limiting Dates | Simiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| F | Wp | Jun. 19 - Apr. 16 | $49^{\circ}-222^{\circ}$ | $315^{\circ}$ | 51 | -18:7 | 9:55:15 |
| 1 | Wc | Jun. 19 - Apr. 16 | 58-230 | 324 | 47 | -18.8 | 9:55:15 |
| A | Wf | Jun. 19 - Apr. 16 | 67-240 | 333 | 43 | -18.7 | 9:55:15 |
| 2 | Dc | Oct. 13 - Nov. 21 | - - 335 | 340 | 8 | -19.2 | 9:55:14 |
| B | Wp | Jun. 20 - Mar. 24 | 169-7 | 80 | 47 | -17.6 | 9:55:17 |
| 3 | Wc | Jun. 20 - Mar. 24 | 177-15 | 88 | 49 | -17.6 | 9:55:17 |
| C | Wf | Jun. 20 - Mar. 24 | 186-24 | 97 | 44 | -17.6 | 9:55:17 |
| D | Wp | Jun. 5 - Mar. 20 | 304-125 | 204 | 38 | -18.6 | 9:55:15 |
| 4 | Wc | Jun. 5 - Mar. 20 | $312-132$ | 212 | 44 | -18.8 | 9:55:15 |
| $\pm$ | Wf | Jun. 5 - Mar. 20 | 321-134 | 221 | 48 | -19.5 | 9:55:14 |
| 5 | Df | Jul. 28 - Nov. 28 | 338-233 | 246 | 5 | $-25.6$ | 9:55:06 |
|  |  |  |  | ```Mean rotation period: 9:55:15 (Without No. 5)``` |  |  |  |

The three long-enduring white ovals of the $S T e Z_{n}$ remained prominent throughout the apparition. The mean length of the ovals was as follows: $\mathrm{FA}, 18^{\circ}$; $\mathrm{BC}, 17^{\circ}$; and $\mathrm{DE}, 17^{\circ}$. The center of the Red Spot was in conjunction with the center of FA on August 19, 1964 at longitude $17^{\circ}$ (II); see later graph. Heath noted $B C$ as "bright and well defined" on January 15 and DE as "not especially bright" on January 16.

Middle STB, System II

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Wp | Jul. 15 - Aug. | $216^{\circ}-203^{\circ}$ | -- | 6 | -17:7 | 9:55:16 |
| 2 | Wc | Jul. 15 - Sep. | 229-198 | -- | 6 | -18.6 | 9:55:15 |



Nos. 1, 2, and 3 was a bright small nodule preceding the long-enduring oval $B C$. No. 4 was the preceding end of a very dark section of the STB preceding the long-enduring oval BC. No. 7 was a bright small oval in the STB near the preceding end of the long-enduring oval DE. No. 8 was a dark mass of material located on the border of the long-enduring oval FA. It was usually located between the preceding end and center of the long-enduring oval; see graph in Figure 7.

Red Spot Region, System II

| Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RSp | May 31 - Apr. 20 | $2^{\circ}-11^{\circ}$ | 8 | 83 | $+0.83$ | 9:55:41.8 |
| RSc | May 31 - Apr. 20 | 15-22 | 20 | 93 | +0.65 | 9:55:41.5 |
| RSf | May 31 - Apr. 20 | 28-34 | 32 | 82 | +0. 56 | 9:55:41.4 |
|  |  |  | Mean rotation period: |  |  | 9:55:41.6 |

The Red spot wes usually dark and appeared as a dark ellipse throughout the apparition. Most of the time it was recorded as a uniformly shaded ellipse with no dark border. Some observers reported the center slightly lighter in shade at times.
A. W. Heath made an excellent series of color filter comparisons of the Red Spot on October 27. He reports the following: "The Red Spot appears to be a fawn color or a warm tone, but I cannot see any definite red, orange or pink colors. The intensity of the Red Spot is nearly the same as the NEB with no filter. It is barely visible with a red filter, but is dark and well defined in the blue filter, being as dark as the NEB. At times I felt it may even have been darker than the NEB in the blue filter, but this may have been a contrast effect with the bright South Tropical Zone."
S. Component S. Equatorial Belt, System II

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Dc | Nov. 14 - Jan. 29 | $74^{\circ}-107^{\circ}$ | -- | 15 | +13.0 | 9:55:58 |
| 2 | Dc | Dec. 17 - Jan. 22 | 121-133 | -- | 5 | +10.0 | 9:55:54 |
| 3 | Dp | Aug. 17 - Oct. 27 | 232-219 | -- | 8 | - 5.1 | 9:55:34 |
| 4 | Dp | Aug. 6-Oct. 3 | $242-242$ | -- | 6 | 0.0 | 2:55:41 |
|  |  |  |  | Mean rotation period: $9: 55: 56$ <br> (Without Nos. 3 and 4) |  |  |  |

The major highlight of the $1964-65$ apparition was the development of a SEB Disturbance, which was first observed by Elmer J. Reese at $232^{\circ}$ (II) on June 14, 1964. Extrapolating back on the drift charts, Mr. Reese says: "The initial outbreak must have taken place on June 10,1964 at $250^{\circ}$ (II)." It is assumed this Disturbance originated from a small dark spot in the SEB Z between the two components of the SEB. Nos. 3 and 4 in the table above were near the source of the SEB Disturbance. The table below represents the two dark spots marking the $\mathrm{SEB}_{\mathrm{S}}$ retrograding branch of the SEB Disturbance. The general development of this SEB Disturbance is illustrated by Figure 8.
S. Component S. Equatorial Belt, System II. Retrograding Branch of SEB Disturbance.

| No. | Mark | İmiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Dc | Aug. 25 - Sep. 4 | 2520-285 ${ }^{\circ}$ | -- | 3 | $+100: 6$ | 7:57:59 |
| 2 | Dc | Oct. 3-Oct. 8 | 259-275 | -- | 3 | +92.4 | 9:57:48 |
|  |  |  |  | Mean rotation period: 9:57:53 |  |  |  |

S. Edge $\mathrm{SEB}_{\mathrm{n}}$, SEB Z Branch of Disturbance, System II

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 1 | Dc | Jun. $14-$ Aug. 30 | $233^{\circ}-313^{\circ}$ | -- | 10 | $-109: 1$ | $9: 53: 12$ |


N. Equatorial Current (S. edge NEB, N part EZ), System I

| No. | Mark |
| :---: | :---: |
| 1 | Dc |
| 2 | Wc |
| 3 a | Dc |
| 3 b | Dc |
| 4 | Wc |
| 5 | Dc |
| 6 a | Wc |
| 6 b | Wc |
| 7 a | Dc |
| 7 b | Dc |
| 8 | Dc |
| 9 | Wc |
| 10 | Dc |
| 11 | Wc |
| 12 | Dc |
| 13 | Wc |
| 14 | Dc |
| 15 | Dc |
| 15 | Wc |
| 16 | Dc |
| 17 | Dc |
| 18 | Dc |
| 19 | Wc |



| Limiting L. | L. |
| ---: | ---: |
| $9^{\circ}-9^{\circ}$ | -- |
| $22-17$ | -- |
| $45-26$ | - |
| $26-34$ | - |
| $47-43$ | - |
| $56-65$ | - |
| $357-44$ | - |
| $44-90$ | $60^{\circ}$ |
| $10-67$ | -- |
| $67-105$ | 70 |
| $39-141$ | - |
| $50-$ |  |
| $85-69$ | - |
| $110-86$ | - |
| $116-95$ | - |
| $121-110$ | - |
| $129-126$ | - |
| $136-139$ | - |
| $148-150$ | - |
| $179-162$ | - |
| $157-164$ | - |
| $211-208$ | 216 |

Transits
Drift
Period

| 13 | $0: 0$ | $9: 50: 30$ |
| ---: | ---: | ---: |
| 7 | -3.1 | $9: 50: 26$ |
| 8 | -8.3 | $9: 50: 19$ |
| 5 | +3.8 | $9: 50: 35$ |
| 7 | -1.7 | $9: 50: 28$ |
| 5 | +4.0 | $9: 50: 35$ |
| 16 | +15.0 | $9: 5050$ |
| 22 | +6.4 | $9: 50: 39$ |
| 16 | +13.0 | $9: 50: 48$ |
| 21 | +6.4 | $9: 50: 39$ |
| 5 | +2.4 | $9: 50: 33$ |
| 6 | +2.6 | $9: 50: 34$ |
| 4 | -12.3 | $9: 50: 13$ |
| 9 | -7.0 | $9: 50: 21$ |
| 5 | -6.6 | $9: 50: 21$ |
| 7 | -4.5 | $9: 50: 24$ |
| 12 | -0.8 | $9: 50: 29$ |
| 10 | +1.0 | $9: 50: 31$ |
| 7 | +0.6 | $9: 50: 31$ |
| 6 | -5.3 | $9: 50: 23$ |
| 8 | +4.6 | $9: 50: 36$ |
| 12 | -0.7 | $9: 50: 29$ |



Figure 7. Graph drawn by Phillip W. Budine to show longitude as a function of time for a number of important features observed on Jupiter during its 1964-65 apparition. See also text of Mr. Budine's report in this issué.

| N. Equatorial Current (cont.) |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| No. | Mark | Limiting Dates | Limi | ing L. | L.: | Transits | Drift | Period |
| 20 | Dc | Oct. 16 - Mar. 3 | $222^{\circ}$ | - $218^{\circ}$ | $224^{\circ}$ | 17 | - 0.9 | 9:50:29 |
| 21a | Wc | Jun. 14 - Nov. 13 | 195 | - 240 | 240 | 28 | +8.9 | 9:50:42 |
| 21b | Wc | Nov. 13 - Mar. 15 | 240 | - 248 | 240 | 15 | + 2.0 | 9:50:33 |
| 22a | Dc | Jun. 21 - Nov. 13 | 212 | - 251 | 251 | 20 | + 8.1 | 9:50:41 |
| 22b | De | Nov. 13 - Mar. 31 | 251 | - 261 | 251 | 17 | + 2.2 | 9:50:33 |
| 23 | Wc | Aug. 6 - Oct. 23 | 242 | - 250 | -- | 6 | + 3.1 | 9:50:34 |
| 24 | Dc | Jul. 21 - Oct. 23 | 269 | - 257 | -- | 8 | - 3.8 | 9:50:25 |
| 25 | Wc | Jun. 26 - Oct. 30 | 282 | - 272 | -- | 13 | - 2.4 | 9:50:27 |
| 26 | Dc | Jun. 17 - Jan. 10 | 294 | - 275 | 287 | 21 | - 2.8 | 9:50:26 |
| 27 | Wc | Jul. 26 - Nov. 18 | 305 | - 296 | 296 | 13 | -2.3 | 9:50:27 |
| 28 | Dc | Jul. 3 - Feb. 4 | 324 | - 291 | 305 | 26 | - 4.6 | 9:50:24 |
| 29 | Wc | Jun. 8 - Aug. 18 | 328 | - 345 |  | 5 | + 7.2 | 9:50:40 |
| 30 | Dc | Jun. 15 - Aug. 11 | 340 | - 349 | -- | 15 | - 8.1 | 9:50:19 |
| 31 | Dc | Sep. 17 - Dec. 11 | 335 | - 312 | 316 | 15 | - 8.1 | 9:50:19 |
| 32 | Dc | Feb. 18 - Apr. 12 | 350 | - 354 | -- | 9 | + 2.3 | 9:50:33 |
| 33 | Dc | Jul. 17 - Aug. 18 | 0 | - 4 | -- | 5 | + 3.8 | 9:50:35 |
| Mean rotation period: 9:50:29 <br> (Without Nos. 6a, 7a, 21a, and 22a) |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  | Mear | otation pe | iod of | 9.50:45 |
|  | Nos. 6a, 7a, 2la, \& 22a: 9:50:45 |  |  |  |  |  |  |  |

During the preceding 1963-64 apparition of Jupiter an abnormally slow current was observed in the North Equatorial Current of Jupiter for the first time. In 1963-64 the "slow" current had a mean rotation period of $9: 50: 48$. During the $1964-65$ apparition the "abnormally slow" current had a mean rotation of 9:50:45. Observers in 1964-65 who also had observed the slow current in 1963-64 were Reese and Mackal. Congratulations to Paul Mackal on his fine observations of this "current" from 1963-1965! Comparing the graphs for these two apparitions, we find that \#30 (bright spot) of the 1963-64 apparition was still observed in 1964-65 as \#6a (bright spot), while feature \#31 (dark spot) of the 196364 apparition was still observed in $1964-65$ as \#7a (dark spot). The rotation period of \#31 in 1963-64 was 9:50:48 and in 1964-65 as \#7a was 9:50:48. Also, see table above for details of the "abnormally slow moving portion" of the North Equatorial Current objects Nos. 6a, 7a, 2la, and 22a. Other observers who observed this current in 1964-65 were Heath and Budine.

Middle of N. Equatorial Belt, System II

| No. | Mark | Limiting Dates | Limiting L. |  | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Wp | Jul. 26 - Aug. 29 | $89^{\circ}$ | - $68^{\circ}$ | -- | 4 | -18:5 | 9:55:15 |
| 2 | Wc | Jun. 18 - Mar. 3 | 106 | - 2 | $47^{\circ}$ | 42 | -12.1 | 9:55:24 |
| 3 | Wf | Jul. 26 - Sep. 17 | 99 | - 78 | -- | 12 | -11.9 | 9:55:24 |
| 4 | Wc | Jun. 23 - Feb. 19 | 137 | - 33 | 75 | 13 | -12.9 | 9:55:23 |
| 5 | Wc | Jul. 3 - Aug. 3 | 21.9 | - 207 | -- | 3 | -11.6 | 9:55:25 |
| 6 | Wc | Aug. 6 - Sep. 18 | 250 | - 223 | -- | 4 | -18.8 | 9:55:15 |
| 7 | Wc | Aug. 13 - Oct. 7 | 262 | - 230 | -- | 4 | -17.5 | 9:55:17 |
| 8 | Dp | Jun. 25 - Aug. 19 | 59 | - 27 | -- | 6 | -17.5 | 2:55:17 |
|  |  |  |  |  | Mea | tation pe | iod: | 9:55:20 |

N. Tropical Current (N. edge NEB, NTrZ), System II



Figure 8. Graph drawn by Phillip W. Budine to show change of longitude with time for features moving in the 1964-65 South Equatorial Belt Disturbance. See also text of Mr. Budine's Jupiter Report. The numbers on the graph for the different features correspond to those in the pertinent tables in his article.

No. 14 was a very dark streak located on the north edge of the NEB. It was observed well by Heath.

$$
\mathrm{NTB}_{S} \text { Current, S. Edge } \mathrm{NTB}_{S} \text {, System I }
$$

| No. | Mark | Limiting Dates | Iimiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Dp | Nov. 9 - Feb. 15 | $328^{\circ}-149^{\circ}$ | $322^{\circ}$ | 9 | -54:8 | 9:49:17 |
| 2 | De | Nov. $13-$ Dec. 11 | 346-295 | 346 | 6 | -54.6 | 9:49:17 |
| 3 | Dp | Feb. 6-Mar. 30 | 198-100 | -- | 8 | -56.5 | 9:49:14 |

The table above represents a rarely observed current along the southern edge of the North Temperate Belt (NTB) of Jupiter which rotates more rapidly than any other part of the planet's complex atmosphere. Although located within the domain of System II (rotation period 9:55:40.632), this particular current in $1964-65$ had a mean rotation period of 9:49:17, making a complete rotation in even less time than the equatorial region, represented by System I, which in 1964-65 had a period of 9:50:29.

The $\mathrm{N}^{\prime} T B_{S}$ current was first recognized in 1880 when several dark spots were found to be rotating with an average period of 9:48:00. Other groups of spots with similar periods were observed in 1891, 1929, and 1939. The only documented occurrence of a single spot in the $\mathrm{NTB}_{s}$ current was a dark feature that appeared in 1926, rotating with a period of 9:49: 03. The spots in the above table represent the first manifestation of the $\mathrm{NTB}_{\mathrm{S}}$ current in nearly a quarter of a century. The spots were first observed by Elmer Reese and others at New Mexico State University Observatory when they were examining photographs of Jupiter taken in blue light. The $\mathrm{NTB}_{\mathrm{S}}$ was very orange in 1964-65, and Reese found that the belt and the spots were nearly invisible in red light photographs but were very dark in blue light photographs. Therefore, the dark spots must have been a prominent red in color.
N.N. Temperate Current (NNTB, NNTeZ), System II

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Dp | Nov. 7 - Dec. 11 | $40^{\circ}-38^{\circ}$ | $39^{\circ}$ | 7 | - 1.8 | 9:55:38 |
| 2 | Dc | Nov. 7 - Dec. 11 | $53-50$ | 52 | 6 | - 2.6 | 9:55:36 |
| 3 | Dp | Dec. 28 - Mar. 18 | 60-73 | -- | 12 | + 4.9 | 9:55:47 |
| 4 | Dc | Jan. 14 - Mar. 27 | 77-86 | -- | 12 | $+3.8$ | 9:55:46 |
| 5 | Df | Jan. 3 - Mar. 18 | $93-95$ | -- | 13 | $+0.8$ | 9:55:42 |
| 6 | Wc | Jul. 14 - Oct. 16 | 77-84 | -- | 8 | + 2.2 | 9:55:44 |
| 7 | Wf | Jun. 29 - Nov. 8 | 135-129 | -- | 10 | - 1.4 | 9:55:39 |
| 8 | Dc | Jun. 29 - Aug. 3 | 164-156 | -- | 4 | - 6.9 | 9:55:31 |
| 9 | Df | Sep. 18 - Dec. 22 | 199-199 | 199 | 8 | 0.0 | 9:55:41 |
| 10 | We | Aug. 3-Dec. 30 | 208-208 | 208 | 10 | 0.0 | 9:55:41 |
|  |  |  |  | Mean | otation pe | iod: | 9:55:41 |

N.N.N. Temperate Current (NNNTB, NNNTeZ), System II

| No. | Mark | Limiting Dates | Limiting L. | $\underline{L}$ | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | De | Sep. 29 - Nov. 7 | $34^{\circ}-8^{\circ}$ | -- | 9 | -20.0 | 9:55:13 |
| 2 | Dp | Jul. 27 - Sep. 18 | 224-205 | -- | 4 | -10.8 | 9:55:26 |
| 3 | Dc | Jul. 20 - Sep. 18 | 240-223 | -- | 8 | - 8.5 | 9:55:29 |
| 4 | Dp | Jun. 27 - Nov. 2 | 32-337 | -- | 7 | -12.9 | 9:55:23 |
| 5 | Dc | Jun. 27 - Nov. 29 | 46-339 | $346^{\circ}$ | 20 | -13.0 | 9:55:23 |
| 6 | Df | Jul. 7-Oct. 14 | $57-11$ | -- | 7 | -13.9 | 9:55:22 |
|  |  |  |  | Mean | tation pe | od: | 9:55:23 |

No. 5 was a very dark condensation located on the north edge of the NNNTB. It was observed well by A. W. Heath; and he recorded it on a fine drawing which he made on October 27, 1964.

Comments by the Recorder: I would like to thank each of the contributors for their very valuable observations. It was very unfortunate that much of the material of the 1964-65 apparition was not available for the Recorder to analyze and report on, and therefore I am most grateful to those ALPO observers who came to our aid in this time of crisis. Without these observations this report of the $1964-65$ apparition would not have been possible.

A special "thank you" must go to Elmer J. Reese and the New Mexico State University

Observatory who supplied most of the material in this report. Also, thank you to A. W. Heath for his valuable observations and comments, particularly on the Red Spot region, to Patrick McIntosh for his fine observations, and to Paul Mackal for his most valuable contributions upon the "Slow Current" of the North Equatorial Current.

ALPO SELECTED AREAS PROGRAM: PLATO

By: Charles L. Ricker and H. W. Kelsey, A.L.P.O. Lunar Recorders
In this continuing series of reports on the activities and findings of the ALPO Se lected Areas Program, we shall examine in detail 131 observational reports of Plato which were submitted by twenty-two observers. Of these, 105 reports were available from sunrise at Plato through the next seven days. Only 26 reports were available from noon to sunset on Plato. The observers who participated in observations of Plato were as follows:

Inez N. Beck Wadsworth, Ohio
Carl F. Dillon, Jr. Lowell, Mass.
Ronald Domen 4.25" RI. Warren, Ohio
Chet B. Eppert Philadelphia, Pa.
Greg George $4.5^{\prime \prime} \mathrm{Rl}$. Watertown, Conn.
Ann Haralambie Larchmont, N. Y.
H. W. Kelsey Riverside, Calif.
Richard Krezovich Syracuse, N. Y.
Rick Leach Brandon, Manitoba, Canada
Eugene M. Lonak Chicago, Ill.
Dan Louderback South Bend, Wash.

| 6" Rl. 6" Rl. | Paul Pokusa <br> Hanmond, Ind. Greg Redfern Garden Grove, Calif. | 4.5" Rl. 6" Rl. |
| :---: | :---: | :---: |
| $4.25{ }^{\prime \prime} \mathrm{Rl}$. | William H. Richrath Westchester, Ill. | 6"R1. |
| $3^{\prime \prime} \mathrm{Rr}$ 。 | Charles L. Ricker Marquette, Mich. | $10^{\prime \prime} \mathrm{Rl}$. |
| 4.5' Rl. | Martin Senour Rochester, N. Y. | $6{ }^{\prime \prime} \mathrm{Rl}$. |
| 4" R1. | Karl Simmons Jacksonville, Fla. | 10" R1. |
| 8" R1. | Douglas Smith Vinton, Va. | 6" Rl. |
| 3" Rr. | Zoltan Tiroler Taberg, Sweden | 3" Rr. |
| 2.4" Rr. | Bruce Waddington Iong Beach, Calif. | 8' R.l. |
| $10^{\prime \prime} \mathrm{Rl}$. | Nick Weis Galena, Ill. | 6"R1. |
| 8' R1. | Gary Wood Galesburg, Ill. | 6" R1. |

It goes without saying that no report would have been possible without the splendid cooperation of these observers.

For many years, Plato has been reported by various observers as displaying a more anomalous behavior than any other formation on the Moon. $1,2 \mathrm{~W}$. H. Pickering carried on systematic studies of the floor, and called it "one of the most continuously active volcanic regions on the Moon." Walter Haas and his associates conducted a survey of this object and other formations in the late 1930's, accumulating 73 observations of Plato, while using methods very similar to those of our present program. ${ }^{3}$ In his report, Haas remarked on the great difference between the previous map of Beer and Maedler and the 1935-1940 appearance. A map based upon the 73 observations in 1935-40 of Plato by Haas' group is reproduced here as Figure 9. It will be instructive at this point to compare this map with our key chart, Figure 10, based upon 131 observations from the present program. A more detailed discussion will follow below.

Our method of recording observations in the Selected Areas Program is quite simple. A sketch is made on one of the program forms used by all observers; then intensity estimates are made of all interesting features in integrated light, and in the blue, red, and green by means of Wratten Filters. As can be expected, a scatter exists among individual observers' reports; but by carefully weighting the various intensity values, and plotting all the observations together, one can obtain meaningful curves. As mentioned in previous articles, one failing of amateur lunar studies in general is the great paucity of lunar observations after Full Moon. In addition, some observers seem to have great difficulty in detecting detail which is quite evident to others. This remark is particularly true of low contrast detail.

There follows a detailed discussion of various marks, which we have lettered on the key chart for the sake of clarity. See Figure 10.

Marks I, K, and O. Here 0 is the general floor tone, and I and $K$ are slightly brighter areas on the floor. Reference to the intensity graphs (Figure 11) will show that
these marks all indicate a definite trend to increasing brightness as the lunation proceeds. Additionally, they all show a tendency to being brighter in the red than in the blue. However, the differential between red and blue is not so great with mark 0 as with marks I and K. In a recent photoelectric study of Plato by Peacock, ${ }^{4}$ the general redness of the floor is discussed as well as the increasing brightness as the lunation progresses. This result demonstrates dramatically the value of visual colorimetric studies if they are carefully made and interpreted.

One of the anomalies which has been reported in the past is the shape and extent of mark I (The Sector), which has been suspected of variability. Our analysis of the drawings of this feature appears to indicate that these differences can be ascribed to the subjective interpretation of mark I's form at any given time by any individual observer. This is not surprising since the form of mark I is difficult to detect because it blends into the floor with an ill-defined border. Many observers who habitually record delicate craterlets and spots fail to detect "The Sector" at all, while the opposite is true for other observers.

Marks A and C. These bright spots on the west wall (IAU) are by far the brightest features in Plato. Reference to the graphs in Figure 11 shows that these marks decrease in red intensity as the lunation proceeds, while showing a slight increase in blue. One consequence of this is a marked reddening just past sunrise which diminishes as the lunation proceeds. As a result, "permanent" blinks are often recorded in these features just after sunrise. The converging of the blue and red curves is difficult to explain, and at this time can only be attributed to the reflective properties of the lunar surface.

Marks $F, G$, and $H$. These are true floor craterlets, and were detected at times by almost all the observers. Of course, it is the visibility or non-visibility of these craterlets (and others) and their comparative conspicuousness which has occupied the attention of selenographers for many years. Here the comparison of our chart with that of Haas' group is of considerable interest. Since our chart agrees very well with the objective Orbiter photos, it is assumed that our chart fairly represents the appearance of the floor during the period covered. Now assuming a comparable competence of our group to that of the earlier workers, it indeed appears that the comparative conspicuousness of these floor spots and craterlets has changed in the past 30 years. It should be noted that Haas remarked that at no time during their observations were these spots seen as definite craterlets, while several of our observers detected these craterlets with apertures as small as 6 inches. It is important to note that the craterlets, marks $F, G$, and $H$, were frequently observed to have interior shadows. The inconsistencies between these two studies are not easily explained, and the conclusion may be advanced that change has indeed occurred. Now during the period of our program, thirty observations of marks $F$, $G$, and $H$ were compared to the visibility or non-visibility of a similar craterlet just north of Pico (ALPO "Pico 1"). The Pico 1 "coritrol craterlet" is depicted by Inez Beck in her excellent drawing on the front cover of this issue. It must be understood that Mrs. Beck's drawing was created as a composite of all our observed features, and isn't intended to represent the appearance of Plato at any particular time. In Figure 12 the visibility of "Pico l" is first compared with that of marks $F, G$, and $H$, and is then plotted as a function of seeing and transparency. Close inspection of the data reveals that the visibility or non-visibility of these features is usually dependent upon seeing and transparency. However, there are exceptions, some of which will now be discussed. Dr. James C. Bartlett conmented upon the complete lack of detail on the floor on Oct. l, 1968, while wall detail at the same time was easily resolved. Dr. Bartlett habitua.lly records much floor detail. An independent observation by Inez Beck at practically the same time confirms this lack completely. She also usually easily detects the floor detail.

In contrast, mark $G$ has been recorded on four occasions by Kelsey with conditions of colongitude, libration, and atmosphere nearly duplicating those of Oct. 1, 1968. Since these records indicate that mark $G$ should have been clearly visible on Oct. 1 , 1968, it is probably correct to assume that an anomalous condition existed on this date. This argument is strengthened by Dr. Bartlett's examination of the area on Oct. 1, 1968 at powers ranging from 79 X to 437 X , a procedure that is very effective in revealing craterlets which at first sight are thought to be non-visible, particularly if they contain an interior shadow that nearly matches the tone of their surrounding area.

The following unusual or seldom seen conditions were recorded as existing at various times in Plato:

For many years the presence of two moderately bright beams of light extending across Plato's floor has been reported in the literature. This natural result of a brief and infrequent lighting condition was reported by Kelsey on April 18, 1967 at Col. 11:0. In the records it was found that Ricker and Smith on Sept. 23, 1966 at Col. 10.99 and 10.59 just missed this lighting effect by a few minutes as indicated by their drawings.


Figure 9. A map of Plato which was produced by Walter H. Haas and his group during their 19351940 program. This map originally appeared in The Journal of the Royal Astronomical Society of Canada. See also text. South at top and IAU east at left.


Figure 10. A key chart to various features of interest in Plato, based upon the 131 current reports which are on file, and with which this article is concerned. See also text. South at top and IAU east at left.

Senour--Jan. 20, 1967-Col. $18^{\circ}$. Large bright (intensity 8) oval area on W. central floor.

Simmons--Apr. 24, 1967--Col. 83:9. Large bright (6.5) oval area near central floor.
Simmons--May 20, 1967--Col. 40:6. Large bright (6.5) oval area near central floor.
Kelsey---Feb. 24, 1967--Col. 85:7. A red brightest blink on N.N.E. wall summit, duration 10 minutes (IAU east and west here).

Kelsey--Aug. 1, 1966--Col. $85 \% 5$. The wall from the south point to the N.N.E. point was ill-defined. At the same time, marks $F, G$, and $H$ were clearly seen, as was mark $I$.

On May 20, 1967, Col. 43:2, an Orbiter photograph (Frame H-127) of Plato was obtained. This photograph appeared on the front cover of Str. A., Vol. 21, Nos. 1-2. It appears of interest now to compare this photo with ALPO records of Plato.

Simmons-May 20, 1967, Col. $40: 6$ to $40: 7$, seeing 7 and transparency 3. He recorded only mark G as craterlet detail seen on the floor but indicated the presence of a rather large bright oval area centrally located west of mark $G$ on the floor. It is not difficult to confirm all of the recorded bright spots indicated on the ALPO composite drawing of Plato (front cover) by comparing it with the Orbiter photo mentioned. However, it should not be overlooked that Orbiter provides a multitude of craterlets to choose from! It is unfortunate that the scan-lines in Orbiter photos often hide or create confusion in the interpretation of delicate shading on the lunar surface, and this defect is evident in the Plato photo. Mark I is reasonably distinct and in agreement with our records, as is also mark K, but to a lesser degree since 3 scan lines intersect it at a critical point. It is very difficult definitely to confirm the existence of the remaining bright floor areas recorded by the ALPO, although it is thought that portions of these areas can be discerned.

It appears evident from the above discussions that our labors have not been in vain! It can be seen that a systematic patrol of Plato is urgently needed, and that patient routine observations can well be continued for an extended period of time. By doing this, we may attract attention to, and possibly explain, some of the apparent anomalies. In addition, of course, we may hope that any Lunar Transient Phenomenon which occurs will be detected by our team of experienced observers. It is hoped that this article will serve its purpose of informing our readers of our progress, and in addition inspire some of you to


Figure 11. These intensity graphs of visual colorimetric estimates indicate that a normal red enhancement of the Plato marks can be expected. See discussion in text of article. The intensities are on a scale of 0 (shadows) to 10 (most brilliant features). The different marks are identified on Figure 10.

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participate in this fascinating project. Correspondence from interested persons is warmly welcomed.




> Visibility Scale: A=Clearly Seen
> $B=$ Seen At Intervals $C=D o u b t f u l$ or Not Seen


Figure 12. In this comparison of the visibility of three Plato marks on thirty occasions with the control craterlet Pico l, it is shown that the unrelated but nearly identical objects are very similarly affected by prevailing atmospheric conditions. See discussion in text of article. The seeing is on a scale of 0 to 10 , with 10 best; and the transparency is the estimated naked-eye limiting stellar magnitude. The diagrams in the top row compare the visibility of each of F, G, and H to the visibility of Pico 1.

## References

1. Firsoff, V. A., The Strange World of the Moon, pp. 80-81.
2. Wilkins, H. P., and Moore, Patrick, The Moon, pp. 234-235.
3. Haas, W. H., "Does Anything Ever Happen on the Moon?" Journal of the Royal Astronomical Socjety of Canada, July-August, 1942, et seq.
4. Peacock, Keith, "Multicolor Photoeloctric Photometry of the Lunar Surface," Icarus, 9, 1968, pp. 16-66.

Postscript by Editor. It must be flattering to those of us in our middle years to find that work we performed and published when young is still occasionally read, and thus the reference to Plato studies in $1935-40$ by myself and others may excuse this note. Messrs. Ricker and Kelsey could have referred to many other past observational projects on Plato. Indeed, maps by Reese, McIntosh, Wilkins, and others have appeared in past volumes of this journal. I think that the differences between the 1935-40 map (Figure 9) and the current map from Selected Areas Program observations (Figure lo) must in large measure represent the use of larger and optically better telescopes by the recent observers. It may be worth remembering that most amateur reflecting telescopes were 6 inches in aperture a generation ago and that a 10 - or 12 -inch amateur reflector was regarded as really large.

Mr. Ricker does not fully agree with this opinion, and readers should reach their own conclusions. I would also hope that many more of them would take part in the enjoyable projects of the A.L.P.O. Lunar Section.

## A REFORT AND ANALYSTS OF SEVENTPEN RECENT LUNAR TRANSIENT PHENOMENA, ADDENDUM

By: Charles I. Ricker and H. W. Kelsey, A.L.P.O. Lunar Recorders
Since the appearance of our previous articles in this Journal, ${ }^{l}$ we have received much comment, both favorable and unfavorable. Enough valid criticisms have been made to warrant our correcting the record, and clarifying some points. The major criticisms boil down to the following points:

1. The source and method of selection of the 17 events.
2. The histogram (Figure 2 on pg .4 ) depicting events vs. anomalistic period.
3. The inclusion of solar flares of importance 1 .
4. The importance of observational selection in the data.
5. The "Correlation" Table (pg. 43).

Now, considering each in some detail:

1. The 17 events were selected on the basis of confirmed sightings, which was the case when more than one observer is listed, with the person making the original observation being listed first. Any unconfirmed observations were selected on the basis of the known experience and reputation of the observer. All the selected events were published either in Str. A. or the BAA Lurar Section Circulars.
2. Our attaching significance to the fact that 10 of the 17 events occurred near maximum orbit eccentricity has been questioned. The critic sees no statistical significance to this ratio. Perhaps our tentative conclusion that "some LTP are related to lunar tidal conditions" was too unqualified. Since the data are all listed in Table I on pg. 5. the reader may draw his own conclusions as to the degree of correlation.
3. As we pointed out, flares of importance 1 are relatively commonplace. It has been suggested that these flares are so common that one could always find a flare which could correlate with an observed JTP. Unfortunately, this is true, but it is also true that flares of importance $l$ have been demonstrated to be the cause of terrestrial communication interference. The whole question of solar influence is so incompletely understood at this time that the question as to whether there is a relationship between solar activity and LTP's is open and unsettled.
4. In our data, we included the Farth's Magnetic Tail and its bow shock front of 4 days before and after Full Moon as being the possible focusing agent of solar corpuscular radiation. Most of the 17 events fell within the Farth's Magnetic Tail. It has been pointed out that this is precisely the time when the vast majority of lunar observations are being made of these formations. We cannot argue with this, and can only say that the apparent correlation could well be a result of observational selection. This, unfortunately, is an ever-present problem in many other observational programs and their inter-
pretation.
5. Our choice of the term "correlation" in our Table II on pg. 43 was unfortunate. The term "possible relationship" would have been more precise. There are too many unresolved parameters, some of which have been discussed above, to demonstrate true correlation. The table was designed merely to demonstrate that there is a possibility that a relationship exists between the events and the listed parameters.

These articles and the criticism thereof sadly reflect the "state of the art" in observing, reporting, and analyzing LTP's. It has been strongly suggested that a LTP not be reported unless there is independent confirmation. While this is certainly desirable, we feel that many important events would go unreported if this criterion were rigidly adhered to. Surely we can place some confidence in the report of an experienced observer with an established reputation and adequate instrumentation. Omissions of reports can distort the statistics as much as erroneous reports. At this time the only answer appears to lie with the skill, judgment, and experience of the persons doing the analyzing.

One very serious problem is that reports of LTP's are scattered throughout a number of agencies and publications. There is a crying need for one agency to collect reports of every LTP and to publish them at regular intervals. They should certainly be published in sufficient detail to enable the user to make his own judgment as to the reality of the event.

One thing is certain; there is presently an "LTP craze" among observers, both professional and amateur. It should be kept constantly in mind that the formations of the moon can present a multitude of odd appearances which can easily be misinterpreted by the inexperienced observer, or by one using insufficient aperture. Also, the number of lunar students who have been observing the moon at every opportunity for many years without ever suspecting a LTP should be testimony to the rarity of these events and the difficulty of detecting them. A LTP is a rare pkenomenon, which can only be identified with certainty by experienced observers using adequate instrumentation.

In future analysis of LTP's, the worker should take all factors into consideration, including observational selection, subjectivity of data, and any other factors which may tend to distort the statistics. It appears that the present writers failed to do so in their report. It appears that there is scope for much future work in this field; and it is hoped that experienced lunar workers will join in a systematic program for the patrol, detection, and accurate reporting of these enigmatic events. If our articles did no more than stimulate useful discussion of the problems, then they were at least successful to that extent.

## Reference

1. Kelsey, H. W., and Ricker, Charles L., "A Report and Analysis of Seventeen Recent Lunar Transient Phenomena", Str. A., Vol. 21, pp. 2-5 and 39-44 (published in two parts), 1968.

## URANUS IN EARIY 1969

By: Richard G. Hodgson

## 1. Introduction

The planet Uranus was observed on sixteen nights between February 7 and May 14 (U. T.) in early 1969 at the writer's Green Mountain Observatory in Westford, Vermont. The telescope used was a $12 \frac{1}{2}-i n c h(31.8-c m$.$) Cave Newtonian reflector. Westford is a rural$ hamlet in northern Vermont where the sky is usually quite dark, a condition necessary for any search for faint satellites.

The observing program on Uranus called for the following:

1) Study of the disc of Uranus for any possible belts, spots, or other detail.
2) Search for the Uranian satellites to determine their visibility with $12 \frac{1}{2}$ inches of aperture.
3) Comparison of the brightness of Titania and Oberon when they are at approximately equal distances from Uranus.
Some success can be reported on all three of these objectives.
The 16 nights involved, and the satellites seen on those nights are given in the table below. The satellite position angle ("PA") and distance from the planet (in seconds of arc) are given for those occasions when the satellite was observed. In two cases when identification was doubtf'ul these data are followed by a question mark. Positional
data have been derived from The American Ephemeris and Nautical Almanac for 1969, not from positibnal measures made at the time of observation.

| l969 Date (UT) |  | Magnificationi | Ariel | Titania |
| :--- | :--- | :--- | :--- | :--- |

The magnifications used indicate something of the seeing conditions on a particular night since the highest magrification which gives a crisp, steady irage is that usually employed.

## 2. The Disc of Uranus

Oblateness. The first thing one notices about the disc of Uranus (at least in its present orientation) is its oblateness or polar flattening. This was readily apparent in early 1969. The larth passed through the equatorial plane of Jranus in 1966; three years later the poles of the planet are still near the planetary limb. ${ }^{1}$

Limi Darkening. fimb darkening was evident whenever the disc of Uranus was well seen. This has always been this writer's impression of Uranus -- the limb darkening is if anything more pronounced than in the case of Jupiter or Saturn.

Fquatorial and Temperate Latitudes. No equatorial or temperate belts or bands such as were reported by hartle ${ }^{2}$ were seen on Uranus; indeed this observer has never seen them. The tiry apparent disc of Uranus -- slightly less than 4 seconds of arc in diameter -- would make any belts present very hard to see; the low temperatures present on Uranus may well freeze out of its atmosphere most of those constituents which provide the dark belts characteristic of Jupiter, and to a lesser degree, Saturn.

Polar Regions. On the night of April 7 (u.T.) -- the best right of the year -- the polar regions of Uranus were seer distinctly and equally dusky in appearance. Thus Uranus seems to be similar to Jupiter and Saturn, having an fi.P.R. ard S.F.R., at least at the time of equatorial presentation. During the time of polar presentation (next in 1985) thermal currents on ïranus might, serve to dissipate polar darkening, in the illuminated hemisphere. This matter would be worthy of careful study in fifteen years.

Unusual Spots or Markings. No spots or other features were seen on Uranus by this writer. It is well, however, to keep looking. In Jariary, 1952 a white spot was observed by Walter H. Haas and O. C. Ranck and suggested a rotation period of $10^{\mathrm{h}} 46^{6}$, which is in good agreement with periods obtained by indirect means. 3 Such spots are very rare, but are therefore all the more important, and should be reported at once to the A.L.P.O. Remote Planets Recorder.

## 3. The Visibility of the Satellites

The second project in the observing program was to determine the visibility of the Uranian satellites in a $12 \frac{1}{2}-i n c h(31.8-\mathrm{cm}$.) reflector. In the early years of the old Ur-anus-Neptune Section of the A.L.P.O. the satellites of Uranus were ignored, and passed unmentioned in reports. 4 In more recent years, beginning in 1961, former Recorder Leonard B. Abbey, Jr. had urged their observation. 5 No observations except for a few of his own of the satellites have ever been reported.

As noted in the introductory section of this paper, Ariel was glimpsed once, Titania


Figure 13. Drawing of Uranus by Richard G. Hodgson on April 7, 1969 at $4^{\text {h }} 30^{\mathrm{m}}$, U.T. with a $12 \frac{1}{2}$-inch ( $31.8-\mathrm{cm}$.) Newtonian reflector at Green Mountain Observatory, Westford, Vermont. 360X ( $16-\mathrm{mm}$. Brandon orthoscopic ocular plus 3X Dakin Barlow). Seeing 6 to 8 on a scale of 0 to 10 , with 10 best. Transparency $6 \frac{1}{2}$ (limiting magnitude). Note dusky poles. See also text of Mr. Hodgson's article about his Uranus observations.

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was seen for certain on three occasions, and Oberon was observed on at least six nights. These sightings were all made when the satellites were fairly near elongation, away from the glare of the planet. Oberon
was seen more often than Titania, probably because of its greater distance from Uranus at elongation (at opposition, $46!7$ compared with $34!9$ ).

Titania and Oberon. According to J. B. Sidgwick, ${ }^{6}$ Titania and Oberon can be seen with about 5 or 6 inches of aperture under ideal conditions, but with average conditions an 8 -inch or larger telescope is advisable. I would agree. With the $12 \frac{1}{2}$-inch reflector both Titania and Oberon were conspicuous with averted vision on good nights when near elongation, and when there was little or no moonlight present. On the best nights they were almost, but not quite, bright enough to be seen with direct vision.

Ariel. On April 7 (U.T.) the satellite Ariel was glimpsed at $4^{\text {h }} 30^{\mathrm{m}}$ without previous knowledge of its position. At the time it was 1.7 hours past torthern elongation, and 15 seconds of arc from Uranus. Sidgwick's statement 7 that 18 to 20 inches of aperture is needed to see Ariel is in error. It may be noted that Vogel is alleged to have observed Ariel twice in 1871 with a 12 -inch refractor, ${ }^{8}$ and that Ariel and Umbriel (which is even fainter were both observed at Paris in 1884 by Paul and Prosper Henry with a 15inch refractor. 9 The observations of the Henry brothers are undisputed. Leonard B. Abbey, Jr. suggests that a lo-inch telescope might show Ariel, 10 but I know of no observation with that aperture, and think that 12 inches is the lower limit unless one has a perfect night on one of the best mountain-tops in the world.

Besides the darkest night of the year (transparency, in terms of limiting magnitude, was $6 \frac{1}{2}$ ), several other factors aided this observation of Ariel: l) Ariel was less than 2 hours from elongation; 2) Uranus was within ló days of opposition, and near its perihelion (1966, May 20); 3) Ariel was very near northern elongation, which, according to Newcomb, Hall, and Holden, is brighter than southern elongation. 11

## 4. The Brightness of Titania and Oberon Compared

The third observing project was to compare the brightness of Titania and Oberon. This is difficult urless they are close together on the same side of Uranus. If one is much closer to the planet than the other, the glare of Uranus invalidates the comparison.

Unfortunately, comparison was possible only on one night -- the superb night of April 7, 1969. Titania and Oberon were found close together, and were readily visible. The writer had no previous knowledge of their location or identity. Titania was estimated to be 0.2 magnitudesbrighter than Oberon, which is in fairly good agreement with the magnitudes determined by Dr. W. H. Steavenson (Titania, 14.0 mag., Oberon, 14.1). ${ }^{12}$ Since there is evidence that Titania and Oberon are slightly variable, and that this variability may be independent of orbital position, ${ }^{13}$ it would be well to secure many more estimates of the relative brightness of Titania and Oberon in the future.

## References

1. Cf. Stanley M. Shartle, "The Ellipticity of Uranus" in The Strolling Astronomer, Vol. 20, Nos. 11-12 (published in March, 1968), pp. 197-200.
2. Ibid.
3. Cf. Patrick Moore, A Guide to the Planets, revised edition (1959), p. 178. Unfortunately, mention of this important observation is not found in subsequent editions,
nor is it found in A. F. O'D. Alexander, The Planet Uranus, which otherwise is fairly complete.*
4. Cf. Leonard B. Abbey, Jr., "The Uranus-Neptune Section Report No. I: Plans for 1957" in The Strolling Astronomer, Vol. 10, Nos. 5-6 (published May-June, 1956), pp. 54, 58-59, and "A Progress Report on Uranus and the A.I.P.O." in Ibid., Vol. 1l, Nos. 1112 (published March, 1958), pp. 145-147.
5. Cf. Leonard B. Abbey, Jr., "Uranus-Neptune Section Report Number Three" in The Strolling Astronomer, Vol. 15, Nos. 5-6 (June, 1961), pp. 82-84; "Uranus-Neptune - 1965 " in Ibid., Vol. 18, Nos. 7-8 (published March, 1965), pp. 153-157; and "Observing Uranus in $\overline{1967}$ ' in Ibid., Vol. 20, Nos. 3-4 (published March, 1967), pp. 44-45.
6. Observational Astronomy for Amateurs, 2nd edition (1961), p. 176.
7. Ibid.
8. Cf. A. F. O'D. Alexander, The Planet Uranus, pp. 143-146.
9. Ibid., pp. 165-166.
10. The Strolling Astronomer, Vol. 15, Nos. 5-6 (published June, 1961), p. 84.
11. A. F. O'D. Alexander, The Planet Uranus, Fp. 140, 146-147.
12. Ibid., pp. 291-292, 297.
13. Ibid.
*The original observations are discussed in The Strolling Astronomer, Vol. 6, No. 4, pg. 46 and pp. 53-54, April, 1952. A visual period, perhaps a unique one, of 10 hrs., 45.6 mins. was determined from apparent reobservations of an equatorial (?) bright area on the limb of Uranus in January and February, 1952. The poles of Uranus then lay far from the limb of the planet. --Editor.

## BOOK REVIEWS

Der Sternenhimmel, 1969. Kleines Astronomisches Jahresbuch fuer Sternfreunde. Edited by Robert A. Naef under the auspices of the Schweizerischen Astronomischen Gesellschaf't.

> Reviewed by Richard G. Hodgson

For those who can read elementary German this astronomical yearbook is a valuable addition to the observer's shelf. Contained in a compact, well-indexed form is an abundance of physical and positional data on planets, satellites, and comets for 1969. It, contains many charts and illustrations, some not found elsewhere.

One helpful feature of the finder charts provided for Uranus and Neptune this year (unlike those in some other publications) is that the movements of the bright planets Jupiter and Mars are also plotted, greatly aiding identification by the amateur astronomer. There is also considerable information on minor planets, including two pages of data and charts on 1620 Geographos, which pays us a close visit in August and September, 1969. One comes away from this yearbook wishing that more people could read German!

One may order a copy from Albert J. Phiebig, Box 352, White Plains, N. Y. 10602, for $\$ 3.95$ per copy, postpaid. Perhaps some readers will wish to place their order for Der Sternenhimmel 1970 soon.

1969 Celestial Calendar and Handbook, Charles F. Johnson, Jr., 1968, by C. F. Johnson, Jr., 48 Roberts St., Watertown, Conn. 06795. 36 pages, paperbound, $\$ 1.25$.
Reviewed by J. Fussell Smith

This useful handbook is now in its fifth year, and many amateurs have found it to be very helpfiul. Information is readily found from a complete table of contents. One of the new items added this year is a listing of events and objects to study with the aid of binoculars and small telescopes. The amateur will find it to be a handy calendar to keep on his desk since it lists, on the calendar, daily celestial events. Among the many top-
ics, one will find information on satellites of the planets, eclipses, asteroids, the moon, variable stars, clusters and galaxies, and occultations.

The spiral binding makes it easily handled around the telescope; and the sketch of Jupiter, on the back cover, showing the belts and zones will be helpful in locating spots and markings on the Giant Planet.

A note on page 36 indicates that the 1970 issue will be $\$ 1.50$. This will still be reasonable for a small handbook crammed with information for the interested observer.
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Mysteries of the Solar System, by R. A. Lyttleton. New York: Oxford University Press, 1968. 261 pages. \$7.00.

## Reviewed by Charles M. Cyrus

Mysteries of the Solar System consists of seven essays based upon a series of lectures given at Brandeis University, Waltham, Massachusetts. It is an excellent book for the professional and for the amateur who has a background in mathematics. The book, notwithstanding its many references to mathematical expressions, is not difficult to read and will be of value to anyone having an interest in theoretical solutions to problems of the Solar System.

The essays are: "The Origin of the Solar System," "The Interior of the Earth," "The Constitution of the Terrestrial Planets," "The Nature of Comets," "Tektites," and "The Discovery of Neptune."

The opening essay discusses the various hypotheses that account for the origin of the Solar System. Those which consider the sun as the source of planetary material such as the Encounter Theory and the Tidal Theory are discarded for reasons that they cannot account for certain associated difficulties. Mr. Lyttleton endorses the theory that the Solar System developed from a gas and dust nebula captured by the sun.
"The Interior of the Earth" describes various levels of the earth's structure from the crustal layers to the inner core. The conclusions reached in this chapter concerning the properties of the different levels lead to reasonable explanations in the next chapter, which deals with interior structure of terrestrial planets. The planets referred to are Venus, Mars, and Mercury, together with the moon. The author's conclusions are based on the assumption that the terrestrial planets and the earth are of similar composition.

The essays on comets are concerned with their origin, periods, and structure and with a possible explanation of the formation of the nucleus and tail.

The source of tektites, small, black glassy objects found in a few regions of the earth, is taken up in chapter six. Mr. Lyttleton asserts that the problem of their origin is not completely solved and that they remain one of the outstanding puzzles of the Solar System.

The last essay should be the most interesting to A.L.P.O. members. It is a detailed account of the discovery of Neptune. Mr. Lyttleton goes to some length to describe the methods used by Adams and Le Verrier to solve the problem of irregularities in the motion of Uranus and to the circumstances of the actual discovery. One can aimost feel the irritation experienced by young Adams over the foot-dragging efforts of George Airy, Director of Greenwich Observatory, to whom Adams had forwarded his predicted elements of the planet. The author provides a more direct method for finding the position of Neptune, a method not involving such extensive calculations as those used by Adams and Le Verrier. Since the distance and period of Neptune are now known, this inclusion may remind the reader of the proverbial Monday morning quarterback. Nevertheless, this step indicates the high degree of technical skill which the author uses to attack the problem, with a minimum of calculation.

Included are eight excellent photographic plates, one of which is part of an original star chart that enabled Galle at the Berlin Ooservatory in 1846 to discover Neptune. The detailed Bibliography and Index add to the value of this work as a reference book.

The Sun and Its Influence, by M. A. Ellison, Sc.D., F.R.A.S., F.R.S.E. Published by American Elsevier Publishing Company, Inc., New York, Third Edition (revised), 1968. 240 pages. $\$ 5.50$.

The late M．A．Fllison was Professor of Astronomy in the Dublin Institute for Ad－ vanced Studies．He was the author of many scientific papers pertaining to the sun＇s ac－ tivity and its effect upon the earth＇s upper atmosphere and magnetic enviroment．Dr． Ellison＇s treatment of his subject is not too advanced for those having a knowledge of elementary phyjics；and this intention has been continued by Patrick Moore，who has re－ vised the text for its Third Edition．The essential plan of the First and Second Edi－ tions has been retained，and all that has been done is to bring the text up to date with regard to recent developments in solar research．

Approximately one－half of the text is assigned to a thorough discussion of the sun and its radiation，as well as its activity and atmosphere．

With the preceding background of information well established，the reader is then introduced to the earth＇s ionosphere and the role it plays in the propagation of electro－ magnetic radiation as it is associated with the communication media．Also a comprehen－ sive treatment is given to the effect of the sun upon the earth＇s magnetic field，as well as solar flares and their terrestrial effects，particular attention being given to the magnetic disturbances and storms．An interesting historical and scientific description of the aurora and the auroral forms is presented，as well as the relatively recent dis－ covery and study of solar radio emission．The closing chapter is concerned with cosmic rays and radiation．

The text is thoroughly illustrated by nine plates and fifty－five line drawings，dia－ grams，and graphs．The author and publisher are to be commended for keeping this descrip－ tive material in proximity to the text with which it is concerned．Additionally，the ap－ pendix contains formulae concerning the sun＇s mass，radiation laws，and temperature．It also includes solar radio power flux data，propagation of radio waves in the ionosphere and corona，calculation of synodic rotation periods for different solar latitudes，and the annual means of the Zuirich Sunspot Numbers for the past two centuries．There is al－ so a bibliography and four pages of index．

It is the reviewer＇s opinion that The Sun and Its Influence can be equally interest－ ing and informative to amateur astronomers and to amateur radio operators．Of course， the interested general reader will find it to be pleasurable reading．The Sun and Its Influence is available for circulation from the A．L．P．O．Library through the courtesy of the publisher．

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Observation in Modern Astronomy，by David S．Evans．American Elsevier Press，New York， 1968.273 pages， 48 plates．$\$ 14.00$.

## Reviewed by Charles L．Ricker

The title of this book implies a greater scope than it actually contains．It is re－ stricted to stellar and galactic Astronomy，with Solar System Astronomy being omitted al－ together．What is covered，though，is covered thoroughly and well．Beginning with As－ tronomy of position，the book proceeds through different types of astronomical techniques in general，then has separate chapters on Variable Stars，Binary Stars，and Galaxies． The large format of the book，excellent printing，and lucid style of writing make it very easy to read and understand．Mathematics is avoided wherever possible．The author＇s ex－ tensive practical experience is evident throughout．His lucid accounts of various obser－ vational problems are both fascinating and easy to read．

Rather than giving merely a treatise on observational methods，astronomical concepts are fully explained in conjunction with the methods used for studying and analyzing obser－ vational data．Great stress is placed upon the innumerable sources of observational and instrumental error，and one finds that observational astronomy is not the cut－and－dried routine that popularizations often imply．It was particularly gratifying that the impor－ tance of visual observations of Variable Stars by amateurs was included along with other methods of studying these stars．Unfortunately，in the next chapter on Binary Stars，it is implied that the minimum useful aperture for the measurement of Binary Stars is 24 in－ ches．It is generally conceded that useful observations can be carried out by skillful observers（even amateurs）with considerably smaller instruments．

Only a few criticisms might be made，which in no way detract from the overall value of the work．In the discussions of various sources of errors in positional astronomy， personal error is barely mentioned．One would have liked to see a discussion of atmospher－ ic seeing and transparency．The fine plates would be far more useful if they were refer－
red to in the text. Many of the other illustrations are likewise not discussed in the text.

After reading this book, one is left with several impressions. These are that observational astronomy is still as much of an art as a science, and far from being the routine gathering of data, offers unlimited scope for imagination and innovation. One also realizes that many observational problems present a great challenge. Students could profitably digest this work to help in their choices of an eventual specialty. Many professionals should find the lucid discussions of observational fields other than their own very useful. Amateurs should find the book very helpful in a better understanding of current astronomical problems and in comprehending articles in technical journals.

Summing up, this is a good book, which should find interest at all levels. It is unfortunate that the rather high price will preclude the wide distribution which it deserves.

The Amateur Astronomer's Handbook, by James Muirden. Thomas Y. Crowell Co., N. Y., 1968. 355 pages. $\$ 6.95$.

## Reviewed by Rodger W. Gordon

In the past few years there have been several books published and titled Amateur Astronomer's Handbook by various authors. Since this reviewer has all of them in his library, he expected this one to be of essentially the same type. In some respects he was right and in others pleasantly surprised. In a book of this nature, which tries to be very comprehensive, it is inevitable that there will be deficiencies and shortcomings. It is remarkable that Mr. Muirden has therefore been able to keep his book relatively free of these deficiencies.

Three main sections dominate the book with 22 chapters. These sections are titled "Equipment", "The Solar System", and "The Stars and Nebulae". Eight comprehensive appendices follow, together with a glossary, bibliography, and a list of amateur astronomical societies. It is unfortunate that this latter list was included since Sky and Telescope gives an up to date list each year, including officers. It is evident that the list in Amateur Astronomer's Handbook will be badly dated in only a few years.

Mr. Muirden covers every conceivable topic likely to interest an amateur and in a very informal, yet erudite, manner. Of particular interest to me was a chapter on "Atmosphere and Observer" which explains that one requires considerable practice before he is entitled to the name Observer. Beginners, who have just acquired a telescope, should read this chapter over and over again. The message is there: There are many who own telescopes and look through them--there are few who see.

Mr. Muirden is not likely to win the hearts of American reflector telescope manufacturers when he tells the amateur to get a $3^{\prime \prime}$ refractor, and if he must get a reflector, it's better to build than to buy. He further warns that to buy any reflector of less than 6" aperture would be a waste of money; and that in buying a reflector of any size, one must be extremely careful. Muirden is somewhat overcautious here because the fact is that an amateur can reliably choose from several manufacturers of high quality reflecting equipment, at least on the American market. I somewhat favor a beginner's starting with a refractor before advancing to any larger equipment. Muirden rightly points out that beginners have a tendency to be aperture happy and to buy the biggest telescope first, thus failing to educate themselves with a smaller, more easily used instrument.

The nearest comparable volume to Muirden's is J. B. Sidgwick's Observational Astronomy for Amateurs, now no longer available. Muirden's work is not quite as detailed in most cases, but it is somewhat broader in scope. Amateurs who missed Sidgwick's work will do well to get Muirden's. Those who possess the Sidgwick volume will be interested in comparing the two works side by side. The advanced amateur will find this an interesting reference and perhaps enjoy comparing his views on many subjects with those of Muirden. For $\$ 6.95$, Amateur Astronomer's Handbook is a worthwhile addition to anyone's growing library.

SIMULTANEOUS MULTICOLOR PLANETARY PHOTOGRAPHY
By: Charles F. Capen, J.P.I. Table Mountain Observatory
(Paper read at the Southwestern Astronomical Conference 168 at Las Cruces, New Mexico, August 21-24, 1968.)

The human eye is a poor color receptor at the low light levels encountered in obser-
ving highly amplified planetary images. Color film can be successfully used to augment the eye in order to record the weak or low-saturated planetary colors at the light levels encountered in astronomical observation because some brands possess a high inherent color contrast which accentuates relative color differences. An invaluable panoramic color record of a planet can be acquired that shows immediately relative color changes by employing color film in a planetary patrol program. A planetary color image has intrinsic fine grain properties due to the composite construction of color film. Color film possesses the unique ability of simultaneous multicolor photography that is so important for colorimetry studies of rotating and revolving bodies. Furthermore, an ultraviolet record may be obtained for comparison in a matter of seconds on the same film strip that contains the color images because most color film is also sensitive to this region of the electromagnetic spectrum.

Successful quality planetary color photography was achieved during the mid-1950's on Kodachrome I daylight-type filn with moderate telescope apertures by Drs. R. Leighton and W. Finsen. ${ }^{1,2}$ The author made a direct three-color filter examination of their positive color images of Mars and found that the three different color emulsion layers did indeed successfully separate from each other. A Wratten 25 red-light filter increased the color contrast of the surface features and showed a sharp planetary limb. A Wratten 57 green-light filter improved the definition of white polar features and bright areas within the ocher regions. The greatest change in the appearance of the planetary disk occurred with the use of a Wratten 47 violet-light filter which enhanced formerly unnoticed patches of atmospheric white clouds, disclosed a bright fuzzy morning limb, and destroyed the definition of the dark surface detail. The appearance and behavior of the positive color image viewed through each color filter was similar to that obtained visually at the telescope or by multicolor spectroscopic photography with the use of the same filters. ${ }^{3}$ Experimental color planetary photography was initiated during the late 1950's with the advent of improved color films, resulting in the selection of two universal-type films for planetary patrol programs and adding a new dimension to direct planetary studies.

## Color Films

Commercial color films are of two types: Negative or non-reversal film is indicated by the suffix "color". A color print has to be made first from the color negative before examination of the planetary image is practical. Positive or reversal film is given the suffix "chrome". It is this type of film that has been found most useful for planetary studies because it gives a color transparency which can be immediately scanned after processing, color-separated by use of filters, and color-balance controlled.

Color films are constructed by coating three emulsion layers, each having different color sensitivities, on the same supporting film base as shown in Figure 14. Each emulsion is approximately 5 microns in thickness. The top emulsion layer is sensitive to blue light only; and therefore, it exposes a blue record. A yellow filter layer is positioned below the blue emulsion layer to absorb any unused blue light. Green and red light is transmitted through the blue emulsion layer. The middle emulsion responds to both green and blue light but not to red light. However, the exposure of the middle layer is made entirely by green light because the above yellow filter blocks any excess blue light. The bottom emulsion layer is sensitive chiefly to red light; consequently, the exposure of this layer is made by red light. 4,5 It is this trilayer construction of color film that produces an integrated light composite color image and has the unique ability of simiultaneous photography in three different colors when the tricolor filter separation technique is spplied.

Color films that are applicable to planetary observational patrol programs for the study of the planets Mercury, Venus, Mars, Jupiter, Saturn, and beyond must have the emulsion characteristics of fine grain, inherent good color contrast, great exposure latitude, and medium speed. Two universal-type color films that have the above characteristics and have been employed for several years in planetary studies are Kodachrome-X (ASA 64) and Agfachrome (ASA 50). The latter brand of film is particularly valuable for recording the weak hues residing in the belts and zones of Jupiter and Saturn because of its high color saturation and color contrast properties. Both of these films readily record the fine linear detail present on the Martian surface and at the same time record atmospheric limb hazes and white recurrent clouds. Due to the great exposure latitude exhibited by these filmp it is possible to obtain a proper exposed record of the Galilean satellites and Jovian disk features in one color photograph. This is similarly true of the Saturnian ring system and the disk of Saturn itself.

Observing with Color Film
It is desirable to obtain a correct color-balanced image while at the telescope.

Because the focal length of the average telescope does not give a large enough scale, it is usually necessary to enlarge the original planetary image with an amplifying Barlow Lens to a diameter of 3 mms . or greater. This process increases the exposure times, which in turn can produce an unbalanced color image due to unequal reciprocity failure of the



Figure 15. The effective spectral color separation obtained from each of the three emulsion layers of color film. See also text.

Figure 14. Cross section of color film showing the film construction. See also text of Mr. Capen's article.

> 长若
green and red emulsions relative to the blue emulsion. If the exposure is longer than 1 second, the reciprocity failure can usually be controlled at the telescope when employing either one of the chosen universal color films by using a light yellow color correction filter, e.g., one of the Wratten CC Y series filters. By this method, the blue emulsion is essentially held back in exposure, thus allowing the red and green emulsions to come up to color balance. Refracting type telescopes have light absorbing qualities and are not completely achromatic by nature, while reflecting types are achromatic. The difference in telescope design and optical quality makes it necessary empirically to determine the proper color correction filter to use for photography of the selected planet. The following table lists the approximate exposure times and suggested color correction filters for the two selected universal color films as a beginning guide for the observer.

| Object | Film | Telescope <br> f-ratio |  | Exposure |
| :--- | :--- | :--- | :---: | :---: |

Tricolor Filter Separation Technique
Tricolor separation of one planetary color image allows precise registering of its three color images for relative positional measurements, colorimetry studies, and atmospheric effects. The color separation can be done with a three-filter set visually on a light table or photographically in a darkroom. Instantaneous multicolor photography of Mars is particularly valuable for determining cloud positions relative to surface features. When a color photograph of Jupiter is made with one of the Jovian satellites on the planetary limb the satellite appears to be clear of the limb in the red light image,
whereas it appears within the atmosphere in blue light.
Visual tricolor separation of a correct color-balanced transparency is accomplished by examining it on a standard color temperature light table first with a Wratten 25 red filter, then with a Wratten 58 green filter, and finally with a Wratten 47 violet filter. A broad blue-light Wratten 38A filter, with minus red characteristics, is also useful for planetary atmospheric studies. Noon daylight has been adopted as a standard color temperature of $5400^{\circ} \mathrm{K} .{ }^{5}$ A 60 watt incandescent lamp plus a Wratten 78 AA filter gives a proper color temperature for scanning transparencies. The light table should be brighter than the room lighting for correct color rendering. An inexpensive plastic slide sorter with a 60- to 75 -watt incandescent lamp with the Wratten $78 A \mathrm{AA}$ filter is excellent for scanning. The Kodak Deluxe Transparency Illuminator model 2 comes complete with a daylight sky filter.

Black and white negatives in each of the three different colors may be made directly from the transparency in the darkroom with an enlarger and the appropriate color separation filter. To separate the blue emulsion from the other two and obtain a black and white negative in blue light, a Wratten 47 B filter is used. Similarly, to obtain direct color separation in green light, a Wratten 61 is used; and a Wratten 29 is employed for red light. Figure 15 shows the effective spectral color separation obtained from each of the emulsions. The percent of transmittance of the three filters is somewhat different so that each filter has to be empirically tested in the darkroom for each planet in order to obtain the filter factors for the proper exposures that will give negative densities of the order of 0.7 to 1 . Once the filter factors have been determined, they should hold for each planet unless the transparency is badly out of color balance. In this case exposure corrections tests have to be made. The negative image should be enlarged to obtain a disk diameter of $1 / 8$ to $1 / 4$ inch, from which black and white prints can be made to any desirable size. Panatomic-X or Dupont low contrast separation Pan film is suitable fine grain film for tricolor separation copy work.

Standard color (CIE) densitomic calibration strips and/or the gray-scale may be applied to either or both ends of the color film for photometric reduction and color balance control.

This paper presents the results of one phase of research carried out at Table Mountain Observatory, which is operated by the Jet Propulsion Iaboratory, California Institute of Technology, under Contract No. NAS 7-100 sponsored by the National Aeronautics and Space Administration.

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THE SURVEYOR VII LASER POINTING EXPERIMENT
By: James W. Young, J.P.L. Table Mountain Observatory
(Paper read at the Southwestern Astronomical Conference 168 at Las Cruces, New Mexico, August 21-24, 1968.)

The entire idea of pointing a laser beam to the site of the Surveyor VII spacecraft on the lunar surface had many drawbacks. A few were overcome by the application of the theory behind the power requirements, others by the good observing conditions during the winter month of January.

The Surveyor spacecraft could see a 5 th magnitude star, which, assuming 680 lumen/ watt (at $5500 \AA$ ), has a visual flux of $3.6 \times 10^{-15}$ watts $/ \mathrm{cm} .^{2}$ (This value is based on Allen's data, Astrophysical Quantities). For a 1 watt laser beam output, collimated to 2 arc secs., the visual flux at the moon becomes approximately $8 \times 10^{-12}$ watts $/ \mathrm{cm}^{2}{ }^{2}$, ne-
glecting diffraction effects of the earth's atmosphere. Thus, the laser appears as a -3 magnitude star.

The 24-inch telescope at Table Mountain, utilizing the coudé focus and its four mirror surfaces, has an aperture efficiency of $45 \%$, considering $90 \%$ reflecting surfaces (the mirrors were re-surfaced just one week before the experiment) and the $13 \frac{1}{2}$-inch secondary obstruction. Assuming an atmospheric transparency of $90 \%$, the laser power required to get 1 watt out of the earth's atmosphere is $2 \frac{1}{2}$ watts.

The 2 -watt Argon Ion laser, so graciously loaned for this experiment by the Hughes Research Laboratories, was positioned at the coudé focus on a special pedestal. The laser was mounted in such a manner that it could be moved linearly along three orthogonal axes. Power was provided by an auxiliary 30 KW power plant. Cooling of the laser was done by the local water supply. In order properly to match the laser beam to the telescope, it was necessary to focus the beam using an $f / 36$ condensing lens ( $f / 36$ being the focal ratio of the 24 -inch coude mode), thus turning the telescope into a collimator for the laser beam. A simple beam-splitter arrangement was placed at the focus point of the out-going beam and the incoming light from the moon.

The following alignment procedure was used to provide for the best laser operation:

1) The laser beam mirrors were "walked" to their extremes and were then geometrically centered for the greatest laser output.
2) The laser was then aligned to the telescope by moving the $x$ and $y$ values of the pedestal to satisfy the following conditions:
a. The laser beam symmetrically intersected the polar axis guide crosswires.
b. The returning beam from the coude secondary was symmetrical about the outgoing laser beam end plate.
c. The shadow of the polar axis crosswires on the laser beam end plate coincided with the laser output beam.
3) The condensing lens was placed in position and was adjusted in $x$ and $y$ to give maximum aperture filling of the 24 -inch mirror. The result could be viewed projected on the inside of the dome wall.
4) The beam splitter was placed in position and was adjusted in $x$ and $y$ until the beam went through the $0!008$ hole.
5) The condensing lens and beam splitter positions were fine adjusted to fill the telescope aperture uniformly.

In order to verify that the laser beam was properly collimated, a test was conducted by aiming the telescope at a near-by hillside, 2750 meters distant. The beam was viewed on a large white panel. With the telescope focused at infinity, the beam on the white panel appeared as a circle 24 inches in diameter, with a central obstruction indicating the secondary mirror cell. With the telescope focused on the panel it appeared about 3 inches in diameter (due to seeing). An optical corner cube was positioned over the beam on the panel, and its reflection back at the telescope coincided with the beam splitter pinhole. As viewed on the panel, the laser beam was centered within 3 cms . of the true center, giving only a 2 arc secs. error. One last check was to measure the focused beam as accurately as possible. Its smallest size corresponded to the visual focus of the white panel, indicating that a similar condition existed when the telescope was focused at infinity.

The near-by hillside test was conducted on a second day after the entire laser setup was completely dismantled and re-set. This was for a repeatability factor, and the result was surprisingly satisfying.

The observer and guider was provided with several photographs of the Surveyor VII area near the crater Tycho. One of them was printed so as to appear like the field viewed through the eyepiece. He was protected from stray laser light by a dark cloth over his head and a filter in front of the eyepiece assembly. The filter's characteristic yellow color also provided an increase in the lunar surface contrast. The telescope at the time of the pointing experiment did not possess a declination drive system so that guiding to keep the pinhole centered over the Surveyor VII area was somewhat of a task.

There were three actual runs made; two on the night of January 20th, and one on the following night. During all three runs, the sky was quite clear, and the seeing was between 1 and 5 arc seconds. The eyepiece power was approximately 800 X . The operational
runs were on and off sequences, and during photographic reduction several weeks later the small starlike objects corresponded exactly to the on sequences, never showed during an off sequence, and were in the proper position corresponding to the location of Table Mountain Observatory.

The entire experiment was under the direction of Dr. Carrol Alley, of the University of Maryland; and the experiment was coordinated through JPL by Michael Shumate for the Table Mountain tests. Electronics and maintenance was handled by Richard Hoffman of JPL and the laser operation by Neil Mercer of the Hughes Research Laboratories. Guiding was done by the author.

## CURRENT NOTES ON MARS IN 1969

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

Seasonal and possible secular changes have been noted in the desert regions and in the fine dark features surrounding the Syrtis Major during May, 1969. The Isidis Regio, Neith Regio, Meroe In., and Nymphaeum were covered with bright morning frost or fog. By early Martian afternoon the white areas dissipated, leaving the fine dark features exposed. When the Syrtis region again becomes visible on the Martian disk in July and August, 1969 the region from $290^{\circ}$ to $340^{\circ}$ long., $+50^{\circ}$ to $-05^{\circ}$ lat., along the following border of the Syrtis Major should be carefully searched for new fine detail and mapped. For example, the Antigones Fons ( $289^{\circ},+20^{\circ}$ ) and the Coloe Palus ( $303^{\circ}$, $+42^{\circ}$ ) were extremely dark, enlarged, and detailed. A new linear feature was seen curving around the Nymphaeum connecting Antigones Fons to Typhonii S. Many old and possibly several new canal-lineaments were exhibiting good contrast in this region. Part of the Thoth Canal and the Nubis Lacus had appeared quite weak in 1967 and again in 1969. However, the Nodus Laocoôntis region from $240^{\circ}$ to $255^{\circ}$ long., $+35^{\circ}$ to $0^{\circ}$ lat., has remained active. The Laocoontis was one of the most color-saturated features on the disk in 1967, according to multicolor spectroscopic and color film photographs. Current photographs show it dark and enlarged toward the southeast connecting with the M. Cimmerium at Tritonis S. A enlarged dark structure was photographed in the Fastigium Aryn ( $0^{\circ}$, $+05^{\circ}$ ) connecting the two promontories of Meridiani $S$. Telescope apertures of about 10 inches or larger should resolve most of the details during good seeing.

## ANNOUNCEMENTS

New Lunar and Planetary Training Program. It has been decided to institute an A.L.P.O. training course in the methods of lunar and planetary observation. Although the program is strictly voluntary, all new members will be strongly encouraged to complete the program shortly after they join; and current members--particularly those who have not already been actively observing for several years--are invited to participate also.

The training program consists of a series of 4 observations: at least 2 observations of a lunar crater or a planet and at least l observation of each of two additional objects. That is; each observer must make at least one lunar observation and at least 2 planetary observations, with at least 2 observations being of the same object. For instance, a satisfactory set would be an observation of the crater Plato, two of Jupiter, and one of Mars. The kinds of observations to be made are described in detail on a set of instruction sheets which will be supplied to each new member of the A.L.P.O. and which otherwise are available (send self-addressed, stamped envelope) from the Lunar and Planetary Training Program Recorder, Mr. Clark R. Chapman, 94 Harper Road, Buffalo, N. Y. 14226. Completed observations are to be sent to Mr. Chapman for criticism and suggestions for improvement. (The observations will be returned to the observers, or if of sufficiently good quality will be forwarded to the appropriate A.L.P.O. Recorder for analysis.)

If after four observations, an observer has demonstrated the ability to make accurate and reliable observations, he will be considered to have passed the training program and his name will be published in the "Announcements" section of The Strolling Astronomer. Publication of the names of graduates of the training program will inform all Section Recorders that observations by those observers may be expected to be reliable and may be given greater weight in analysis.

Lunar Trainees. Mr. Clark R. Chapman announces that an up-dated set of instruction and information sheets is available from the Lunar Training Program. They discuss how to train the eye for observing, how to make a sketch of a crater, list available outline forms for craters, and answer frequently-asked questions about the moon. Mr. Chapman regrets past delays in correspondence during the preparation of these new materials. Please send self-addressed, stamped envelopes.

New Address for Phillip W. Budine. Effective at once, the mailing address of this Assistant Jupiter Recorder is:

Fhillip W. Budine<br>22 Mayfair Circle<br>Willingboro, New Jersey 08046

Mr. Budine tells us that this address is that of his new home in suburban Philadelphia and that observing conditions there should be highly favorable. He is on the staff of the Franklin Institute in Philadelphia.

Sustaining Members and Sponsors. As of June 27, 1969, we have the following people in these special classes of membership. Sponsors pay dues of $\$ 25$ per year; Sustaining Members, \$10 per year. The surplus above the regular rate supports the work and activities of the A.L.P.O.

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W.A.A.-A.L.P.O. 1969 Convention. This year's meeting of the A.L.P.O. will be another joint convention with the Western Amateur Astronomers. The site is the Stardust Motor Hotel in San Diego, California; and the dates are August 21, 22, and 23, 1969. It is requested that reservations be made directly with the hotel no later than August 13, 1969. The host society is the San Diego Astronomy Association. There will be a sprinkling of papers by outstanding professional scientists and a substantial number of amateur papers on a wide variety of subjects. There will be field trips to Palomar Observatory and to San Diego State College's new Laguna Mountain Observatory. There will be the customary astronomical exhibits, both commercial and non-commercial, and the expected banquet on Saturday evening, August 23.

The Program Chairman is Mr. Larry See, 6665 Tiffin Ave., San Diego, Calif. 92114. The Registration Chairman is Mr. Wilbur Will, 3905 Violet St., Ia Mesa, Calif. 92041. The Exhibits Chairman is Mr. Colin Macdonald, 3933 St. James Place, San Diego, Calif. 92103. These gentlemen will be glad to furnish additioral information upon request.

As for the A.L.P.O. portion of the program, the Editor heartily invites all members who can to attend and to participate in this meeting. Those having drawings, photographs, and charts to exhibit should correspond directly with Mr. Macdonald about arrangements and their space requirements. Papers by A.L.P.O. members so far received or promised include "Astronomy on Maui" by Richard Wend, a description of the discovery of water vapor on Mars by Fred Lazor, a sample of "nearest-neighbor analysis" by Dr. John E. Westfall, "A Simple Procedure for Combining Jovian Intensity Estimates for an Intensity Report" by Paul K. Mackal, and a report from Dr. George W. Rippen on the recent meeting at Bologna, Italy to consider founding an amateur International Astronomical Union (Dr. Rippen attended). More papers from qualified A.L.P.O. members are needed, though they will be too late for inclusion in the published Proceedings of the Convention--the deadine is July 24.

We hope to see a generous sample of our A.L.P.O. at San Diego soon!
New Address for Richard G. Hodgson. After August 20, 1969 our A.L.f.O. Mercury Recorder will have the following address:

Reverend Richard G. Hodgson
Dordt College
Sioux Center, Iowa 51250
Reverend Hodgson will be teaching astronomy on the staff of Dordt College. We wish him every success in his new work and locale.

In Memoriam. We have learned with sorrow of the death of Dr. R. C. Melville in Feb-


Figure 16. Photograph of occultation of Jupiter by the moon on October 19, 1968. Taken by R. B. Minton at 11h 59 $\frac{1}{4}$ m Universal Time. 6-inch, F:5 R. F.T. Tri-X film. Exposure 6 seconds. The sunlit crescent of the moon is greatly overexposed. The projecting of the bright disc of Jupiter over the earthlit part of the moon is, of course, an effect of irradiation. Jupiter IV may be seen on the sky below Jupiter, to its left, and several diameters of Jupiter away.

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ruary, 1968. He was a dentist in Kingston, Jamaica for many years. In his astronomical hobby he was a president of the Jamaica Astronomical Society and a frequent contributor to reports in this journal. "Cornie" also refigured the late G. H. Hamilton's 21-inch mirror, known to many of us from the pages of Amateur Telescope Making. Those of us who knew Dr. Melville personally, as the Editor and his wife were fortunate enough to do, will long miss his kindness, helpfulness, delightful conversation, and unfailing courtesy.

OBSERVATIONS AND COMMENTS
Occultation of Jupiter by the Moon on October 12, 1968. Mr. R. B. Minton of the staff of New Mexico State University Observatory privately observed this phenomenon and


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