# The Journal Of The Association Of Lunar And Planetary Observers

## *The Strolling Astronomer*

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Presentation of New Mexico State University Regents medal to Dr. Clyde W. Tombaugh on February 18, 1980, the 50th anniversary of the discovery of the planet Pluto. Left to right: Dr. Bradford Smith, University of Arizona; Dr. Donald Roush, Acting President N.M.S.U.; Dr. Tombaugh; and Dr. Reta Beebe, N.M.S.U. Dept. of Astronomy. Photograph by Chuck Williams, N.M.S.U. Information Services. See pg. 128.


**THE STROLLING ASTRONOMER**
**Box 3AZ**
**University Park, New Mexico**
**88003**

Residence telephone 522-4213 (Area Code 505)
in Las Cruces, New Mexico



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## IN THIS ISSUE

## GUIDE FOR CONTRIBUTORS TO THE JOURNAL OF THE A.L.P.O.

By: John E. Westfall, Associate Director A.L.P.O.

The A.L.P.O. welcomes articles from its members that report observational or theoretical studies of the astronomy of the solar system. Articles on related subjects like instrumentation, historical astronomy, and methods and procedures are also acceptable. This "Guide for Contributors" is intended to do the following: (1) maintain and enhance the quality of the Journal of the A.L.P.O., (2) increase the likelihood that a manuscript will be accepted for publication, and (3) make the editorial task more manageable and less time-consuming, thus aiding in the publication of current material.

Text. Manuscripts ranging in length from two to twenty double-spaced typewritten pages (including tables and illustrations) are the most desirable. Longer articles will be published only when they are of exceptional interest, and they will often need to be divided among two or more issues. Manuscripts should be typed double-spaced on white 8½ by 11-inch bond paper, with a black ribbon, allowing 1-inch margins on all sides.

It is preferred that references be embedded in the text - e.g., "Jones, 1973, p. 81", with the full reference at the end of the article. All references should be complete enough to allow the reader easily to check sources. Footnotes should be minimized; when used, they should be placed at the bottom of the appropriate page.

Articles more than about four typewritten pages in length should begin with an abstract of from 100 to 200 words. Even shorter articles will often be improved by the inclusion of an abstract of a few sentences.

Tables. These should be camera-ready, cleanly typed and with no obvious erasures or "typos". Rows and columns should be clearly labeled. The largest table which can be accommodated on a single published page is 7½ by 12 inches in original size, to which should be added a 1-inch margin on all sides.

Illustrations. All illustrations should be camera-ready: neat and clear. As with tables, the largest original illustration which can be handled is 7½ by 12 inches, but a maximum of 7½ by 10½ inches is preferable in order to allow a descriptive caption.

Line work (e.g., on graphs, diagrams, or charts) should be in india ink on white drafting paper. Acceptable lettering or numbering can be done by: (1) typing with a carbon ribbon, (2) using a "LeRoy" or similar lettering device, or (3) using "Press-Type", "Zip-a-Tone", or a similar transfer medium.

Shaded drawings should have their contrasts exaggerated. For planetary drawings a disk diameter of 2 inches or 50 mms. is recommended, reduced somewhat for Saturn in order to include the rings. A black or gray background makes a planetary drawing more attractive.

Photographs should be printed on high-contrast glossy paper. The author should remember that all illustrations will be reduced to about 80 percent of their original length and width in publication. Therefore, relatively high degrees of enlargement are appropriate.

Illustrations should be referred to in the text (though figure numbers must usually be altered in publication) and in addition should have individual captions which are concise while giving all relevant information. For example, drawing and photograph captions should state the observer, the telescope size and type, the date and time in Universal Time, the seeing, and the transparency. Any filters used should be indicated. For drawings the magnification(s) should be given, while photograph captions should supply the equivalent focal length or focal ratio, film type, and exposure time. Depending on the body illustrated, other relevant data include the Moon's colongitude, the central meridian of longitude of a planet, the planetocentric latitude of the Earth, etc. These physical data are functions of time and should be carefully checked - we do not want to publish blunders.

The captions for the illustrations should be typed on one or more separate sheets attached to the manuscript, with the corresponding illustrations always clearly identified.

Units. The metric system should be used for all physical quantities. In cases where the English system remains in common use, English equivalents should be given in parentheses - e.g., "a 15-cm. (6-inch) reflector".

## THE 1975-76 AND 1977-78 WESTERN (MORNING) APPARITIONS OF VENUS: VISUAL OBSERVATIONS AND PHOTOGRAPHS

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

### Abstract

Observations, both visual and photographic, of the planet Venus throughout the

1975-76 and 1977-78 western (morning) apparitions are discussed in summary form. The report emphasizes the data sources and the instrumentation employed to amass the information on Venus. A roughly statistical investigation of the types of features seen on Venus' apparent surface at visual wavelengths of light is included for both apparitions mentioned, followed by similar treatment of the cusps, cusp-caps, and cusp-bands. Discussions pertaining to the bright limb band on Venus, as well as terminator irregularities, dark side phenomena and the Ashen Light, and dichotomy estimates, are included within the text of the report. Comparative studies are introduced with respect to observers, instrumentation, visual and photographic data, etc. Illustrations accompany the report to enhance one's appreciation and comprehension of Venus' atmospheric phenomena as assembled by A.L.P.O. Venus observers in 1975-76 and 1977-78, mostly in written form in association with drawings.

## Introduction

The present paper deals with the results of a rather exhaustive analysis of visual and photographic observations of the planet Venus throughout the time periods below, for which geocentric phenomena are presented in Universal Time (U.T.): [1,2,3,4]

| | | | |
|---|---|---|---|
| Inferior Conjunction | 1975 Aug $27^d 13^h$ | | 1975-76 Western (Morning) Apparition |
| Stationary | Sep 16 15 | | |
| Greatest Brilliancy | Oct 3 17 | (-4.3) | |
| Greatest Elongation West | Nov 7 06 | (47°) | |
| Superior Conjunction | 1976 Jun 18 04 | | |
| Inferior Conjunction | 1977 Apr 6 06 | | 1977-78 Western (Morning) Apparition |
| Stationary | Apr 24 21 | | |
| Greatest Brilliancy | May 11 23 | (-4.2) | |
| Greatest Elongation West | Jun 15 07 | (46°) | |
| Superior Conjunction | 1978 Jan 22 05 | | |

A total of 62 observations were amassed for the 1975-76 period, and a sum of 124 observations were accumulated for the 1977-78 apparition. A histogram (Figure 1) is presented herewith to help illustrate the distribution of observations by month for the two apparitions covered by the present report. Examination of the data presented in Figure 1 reveals that observational coverage of the planet started rather early in each of the two apparitions, with greatest attention being paid to Venus from 1975, October through 1975, December for the 1975-76 period; greatest frequency of observation during the 1977-78 apparition took place from 1977, May through 1977, September. In both instances, Venus was not followed for very long after the date of maximum elongation.

Numerous drawings and a limited variety of photographs of Venus were submitted during each apparition, although the best and most consistent data were assembled for 1977-78. Simultaneous observations were practically non-existent during both apparitions, but throughout peak observational periods in 1975-76 and in 1977-78 almost daily coverage of the planet was secured. Also, ultraviolet photographs of Venus were lacking among the submitted material on Venus, a program which would have much merit if pursued faithfully.

The following eleven dedicated individuals sent in observations of the planet Venus during the apparitions in question:

| Observer | Location | Number of Observations 1975-76 | 1977-78 | Instrumentation |
|---|---|---|---|---|
| Bennett, John H. | Richmond, VA | - | 1 | 17.8 cm. (7.0") Refractor |
| Dragesco, Jean | Bénin, W. Africa | - | 3 | 20.0 cm. (8.0") Schmidt-Cassegrain |
| Heath, Alan W. | Nottingham, England | 14 | - | 30.0 cm. (12.0") Newtonian |
| Horvath, Evelyn | South Bend, IN | 2 | - | 25.0 cm. (10.0") Newtonian, 6.4 cm. (2.5") Refractor |
| Horvath, Joe | South Bend, IN | 3 | - | 25.0 cm. (10.0") Newtonian, 6.4 cm. (2.5") Refractor |

| Observer | Location | Number of Observations 1975-76 | 1977-78 | Instrumentation |
|---|---|---|---|---|
| O'Meara, Stephen J. | Harvard, MA | - | 6 | 23.0 cm. (9.0") Refractor |
| Patton, Chet | Buchanan, MI | 18 | - | 25.0 cm. (10.0") & 15.0 cm. (6.0") Newtonians, 6.4 cm. (2.5") Refractor |
| Porter, Alain | Narragansett, RI | 2 | - | 10.0 cm. (4.0") & 15.0 cm. (6.0") Refractors |
| Smith, Michael B. | Alamogordo, NM | 18 | 111 | 10.6 cm. (4.25") Newtonian, 8.3 cm. (3.25") Refractor |
| Stelzer, Harold J. | River Forest, IL | - | 3 | 20.0 cm. (8.0") Schmidt-Cassegrain |
| Widman, David | Brooklyn, NY | 5 | - | 23.0 cm. (9.0") Refractor |
| Total Observations | | 62 | 124 | |

Warmest gratitude is due to each of the above mentioned colleagues for their continued support and participation in the programs of the A.L.P.O. Venus Section.

## Visual Observations of Surface Details

The conventional methods and techniques of making visual studies of the somewhat vague, elusive "markings" on the apparent surface of Venus have been outlined in previous reports in the Journal, as well as in various Venus Section pamphlets.[5,6,7] Study of these publications is highly recommended for the individual who is untutored in making observations of the planet for the A.L.P.O. Venus Section.

No ultraviolet photographs were obtained during either apparition; consequently, the bulk of the report is based on descriptive notes accompanying visual wavelength drawings. The rest of the observational material was photographic in nature, a little of it used herein as illustrative material in addition to the drawings depicted. Evaluation of the data as a whole indicated a reasonable degree of continuity among methods used to carry out observations.

Appraisal of visual and photographic data for 1975-76 and 1977-78 showed that nearly all categories of dusky markings and bright atmospheric phenomena on Venus, as discussed in the literature cited earlier in this report, were represented. A quantitative treatment of the material, in keeping with the procedure in foregoing apparition reports, appears in Table I.[7] An attempt has been made here to show the percentages of the 62 observations in 1975-76 and of the 124 observations in 1977-78 which comprise specific categories.

Admitting a reasonable level of subjectivity inherent in the rather limited qualitative notes accompanying drawings of Venus, some possible conclusions might be drawn from the data in Table I. We shall examine these in the forthcoming paragraphs for both apparitions.

* * * * * * * *

TABLE I.

Frequency of Occurrence of Types of Surface Markings on Venus' Apparent Surface During 1975-76 and 1977-78 Western (Morning) Apparitions

| Marking Categories | 1975-76 Apparition % of 62 Observations | 1977-78 Apparition % of 124 Observations |
|---|---|---|
| Banded Dusky Markings | 1.6% | 2.4% |
| Radial Dusky Markings | 0.0 | 2.4 |
| Irregular Dusky Markings | 0.0 | 0.0 |
| Amorphous Dusky Markings | 11.3 | 11.3 |
| Terminator Shading | 54.8 | 88.7 |
| No Markings | 72.6 | 82.3 |
| Bright Spots or Regions (exclusive of the cusps) | 12.9 | 1.6 |
| | k = 0.110 (1975,Sept. 14) through 0.895 (1976, March 5) | k = 0.008 (1977, Apr. 7) through 0.878 (1977,Sept. 30) |

Notes:

1. Assuming that the bright illuminated hemisphere of Venus (all areas devoid of any markings) was typically assigned a numerical relative intensity of 8.5 to 8.8 in 1975-76 and 7.9 to 8.2 during 1977-78 (scale of intensity is the standard A.L.P.O. system whereby 0 is the black shadow condition and 10 is most brilliant), it was noticed that the average assigned intensity for the dusky features in integrated light was about 7.7 to 8.5 in 1975-76 and 7.5 to 7.7 in 1977-78 (first five items in Table I); the last category had an assigned intensity value of 9.0 to 9.2 in the 1975-76 period, with 8.6 to 8.8 common in 1977-78.

2. The scale of conspicuousness was not utilized effectively and consistently in either apparition to yield reliable or even useful figures; yet it was clear from verbal reports and drawings that the dusky features were quite vague and poorly contrasted with the rest of the disc of Venus. The bright areas (last category) were more definite, but not particularly significant during either apparition.

3. Seeing conditions, appraised on the A.L.P.O. 0-10 scale (where 0 is poorest seeing and 10 perfect seeing), were found to be near 6.5 throughout most of 1975-76 and 6.0 in 1977-78. Observations were made almost entirely in twilight or daylight, and the overall atmospheric transparency for both apparitions was fair to good. It is important to realize that such conditions were highly variable from location to location, among instruments, etc.; and the figures cited are mean or average values for observations submitted from the individuals noted in the list of contributors. Obviously, owing to the subjectivity of the seeing scale employed, our results can possess only marginal reliability.

* * * * *

All of the photographs at visual wavelengths submitted for each period, together with a great multitude of drawings of Venus, depicted the disc of the planet as being totally devoid of any shadings or markings of any category cited. Although most novice observers fail to see anything on Venus' apparent surface, it is not uncommon for the ill-defined atmospheric phenomena, when present, to elude even the most advanced student of Venus. Such is not surprising, however, when it is learned that such dusky features or bright spots, as listed in Table I, emerge more conspicuously on ultraviolet photographs, especially radial dusky markings. Comparative studies of visual wavelength markings with those "seen" in ultraviolet light are important indeed.

Terminator shading was the most common feature on Venus' disc at visual wavelengths in both apparitions, but particularly in the 1977-78 season. Remarks accompanying drawings indicated that the intensity of the terminator shading was graded toward a lighter tone (toward 10 on the intensity scale) as the distance from the terminator toward the illuminated limb of Venus became greater. At a point about midway between terminator and bright limb, along the imaginary equator of Venus, no such shading could be detected (aside from specific dusky features and patches not directly associated with the terminator shading). Photographs did not show terminator shading as an established phenomenon on Venus in either apparition.

The dusky features on Venus' disc during each observing season were assigned predominantly to the category "Amorphous Dusky Markings," owing to their indefinite pattern and form. A very few dusky features were seen running roughly parallel to one another and perpendicular to the terminator, and these were assigned to the category "Banded Dusky Markings" in Table I during the two apparitions. Evidence of the "Radial Dusky Markings," which are more commonly detected at ultraviolet wavelengths, was lacking in 1975-76 and was infrequently recorded during 1977-78. The category "Irregular Dusky Markings" was devoid of assigned features in both periods, although it is possible that some of the markings assigned to "Amorphous Dusky Markings" could have been placed within this group of atmospheric phenomena.

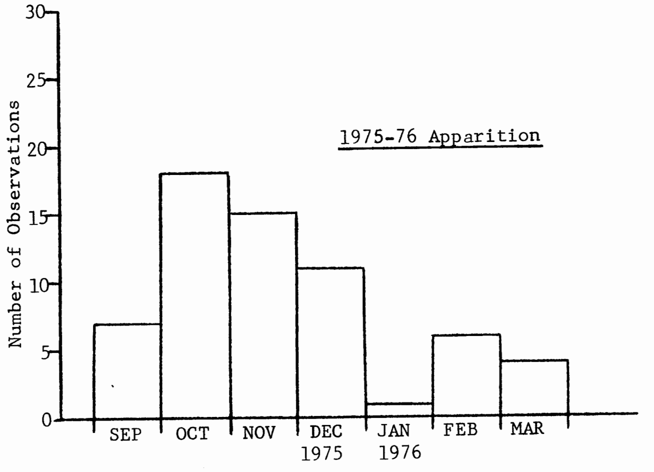
Bright spots and regions, exclusive of the cusp regions and the bright limb band area, were more commonly seen in 1975-76 than in 1977-78. These markings were more definite than the dusky shadings from the standpoint of conspicuousness ratings in both apparitions. Photographs did not show bright spots or regions on Venus.

At times during either apparition color filters enhanced the overall visibility and contrast of specific features on Venus, but the observing program with color filters was not carried out systematically enough to yield completely useful data. The need for consistency and standardization in colorimetric work on Venus must be stressed very strongly, including the use of color filters of known and precisely determined transmissions.

Several drawings and photographs accompany the discussion (Figures 2,3, and 4), and reference to them should enlighten the reader as to the great diversity and vagueness of the phenomena generally seen on Venus' apparent surface in 1975-76 and 1977-78.

Frequency of Observations During Each Month:

1975-76 Western (Morning) and
1977-78 Western (Morning)
Apparitions of Venus.



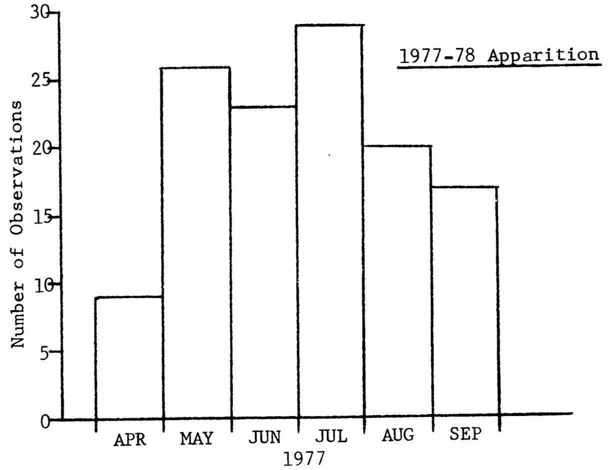



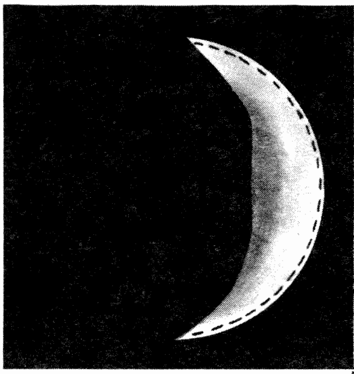

Figure 1. Histogram to show monthly frequency of observations of Venus during 1975-76 and 1977-78 morning apparitions. Re-drawn for publication in this journal by John E. Westfall. See also text.

* * * * *

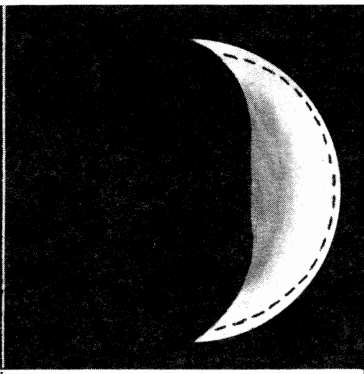
## Cusps, Cusp-Caps, and Cusp-Bands

The most conspicuous and contrasting features on the planet Venus are seen near or at the cusps, usually when the phase of the planet lies between k = 0.8 and 0.1 (where k is the phase value as determined from an ephemeris).[5] The cusp-caps appear from time to time; and on occasion they are bounded by dark, frequently diffuse cusp-bands.[5]

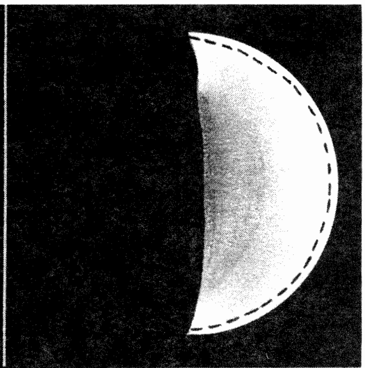
Referring now to Table II on page 92, we note that the cusp-caps were seen far more frequently in 1975-76 than in 1977-78, even though there were more Venus observations in the latter period. When the cusp-caps were seen in 1977-78, both southern and northern caps were observed simultaneously. No evidence existed of the single appearance of either cap. In the 1975-76 apparition the single appearance of either the northern or southern



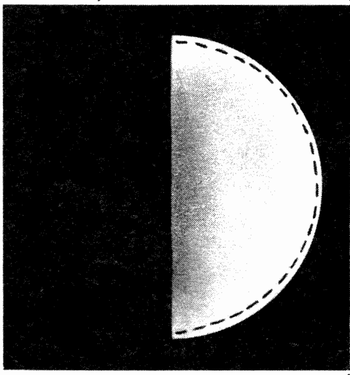
1975 OCT 07  15:40 U.T.
M.B. Smith. 4.125 in. RL.
95, 127, 140X. Neutral, Orange, Violet filters.
S = 7, T = 5 (Daylight).
D = 36".7, K = 0.307



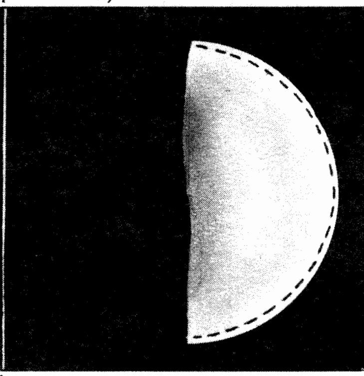
1975 OCT 09  15:00 U.T.
M.B. Smith. 3.25 in. RR.
102, 152X. Neutral, Red, Yellow, Blue filters.
S = 8, T = 5 (Daylight).
D = 35".1, K = 0.323



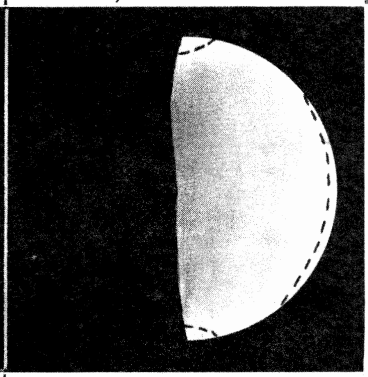
1975 NOV 02  18:00 U.T.
M.B. Smith, 4.125 in. RL.
127, 190X.
Yellow, Neutral filters.
S = 5, T = 3 (Daylight).
D = 25".6, K = 0.481



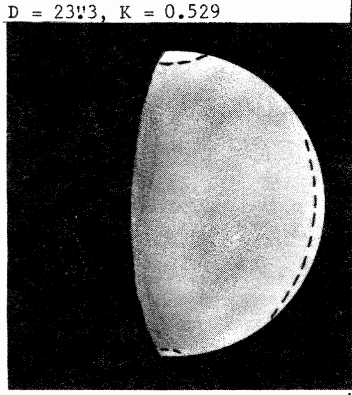
1975 NOV 11  16:15 U.T.
M.B. Smith. 3.25 in. RR.
152X. Orange, Green, Neutral, Yellow filters.
S = 7, T = 4 (Daylight).
D = 23".3, K = 0.529



1975 NOV 13  16:55 U.T.
M.B. Smith. 4.125 in. RL.
190X. Orange, Green, Blue filters.
S = 7, T = 4 (Daylight).
D = 22".8, K = 0.539



1975 NOV 27  17:30 U.T.
M.B. Smith. 2.4 in. RR.
100, 150X.
Green filter.
S = 4, T = 3 (Daylight).
D = 19".9, K = 0.604



1975 DEC 10  17:20 U.T.
M.B. Smith. 4.25 in. RL.
144, 215X. Red, Green, Violet filters.
S = 7, T = 4 (Daylight).
D = 17".9, K = 0.657

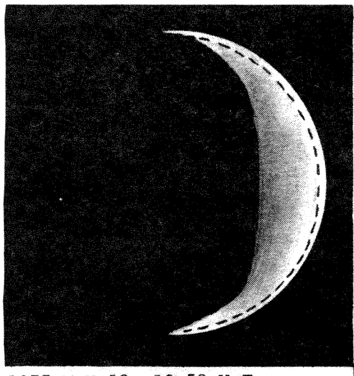
Figure 2. Selected A.L.P.O. drawings of Venus during the 1975-76 morning apparition. Prepared for publication in this journal by John E. Westfall. See also text.

* * * * *

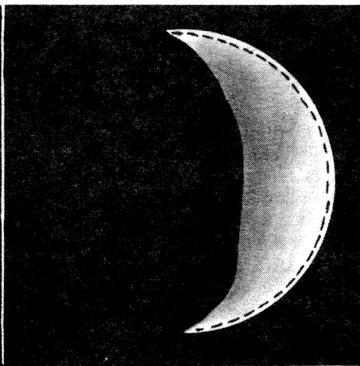
cusp-cap took place with about the same frequency as simultaneous appearances of both caps. In the 1977-78 apparition, the low incidence of visibility of the cusp-caps is of particular interest.

During the 1975-76 period, both cusp-caps were usually the same size when such comparisions were actually made; on a few occasions, the south cap appeared the larger of the two. In 1977-78, the northern cusp-cap was commonly the larger, with a few instances existing where the caps were of equal size or the southern cap was larger.

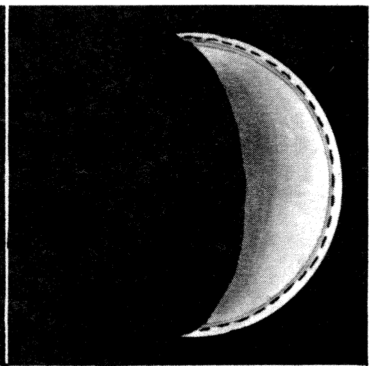
In 1975-76, the cusp-caps were more often of the same overall brightness than not; but when the two caps were of a different intensity, it was more usual for the southern cusp-cap to be the brighter. During the 1977-78 apparition, the cusp-caps were of equal intensity when such observations were carried out in conjunction with the visibility of the cusp-caps. On a few occasions the brightness of the cusp-caps showed a marked difference in the north and the south; the southern cusp-cap at the time of such impressions was always the brighter.



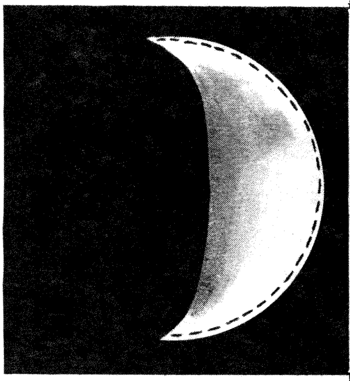
1977 MAY 10  13:58 U.T.
M.B. Smith.  10.6 cm. RL.
138X.  Violet, Blue, Green, Yellow, Neutral filters.
S = 7, T = 6 (Daylight).
D = 39″.3, K = 0.247



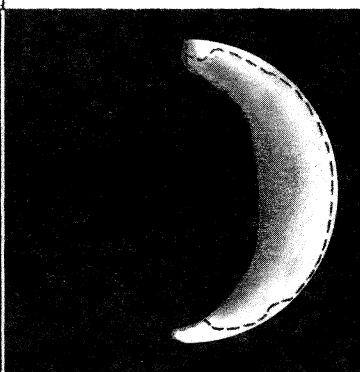
1977 MAY 14  17:25 U.T.
M.B. Smith.  10.6 cm. RL.
133X.  W8, W82A, Neutral filters.
S = 5, T = 6+ (Daylight).
D = 36″.9, K = 0.281



1977 MAY 18  13:58 U.T.
M.B. Smith.  10.6 cm. RL.
123, 143X.  Apodizing mask; Orange, Green, Blue, Neutral ftrs. S = 8, T = 5 (Daylight).
D = 34″.8, K = 0.315

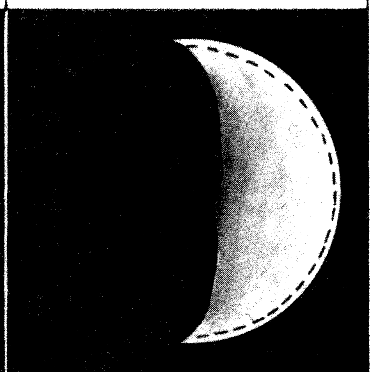


1977 MAY 23  13:55 U.T.
M.B. Smith.  10.6 cm. RL.
140X.  Blue, Yellow, Neutral filters.
S = 9, T = 5 (Daylight).
D = 32″.2, K = 0.352

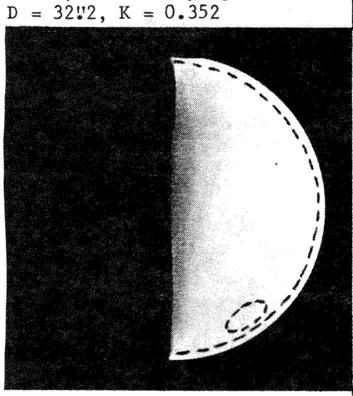


1977 MAY 23  21:00 U.T.
S. O'Meara.  9 in. RR.
No filters.

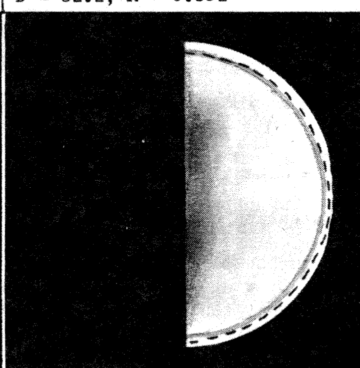
S = 8, T = 3.
D = 32″.2, K = 0.352



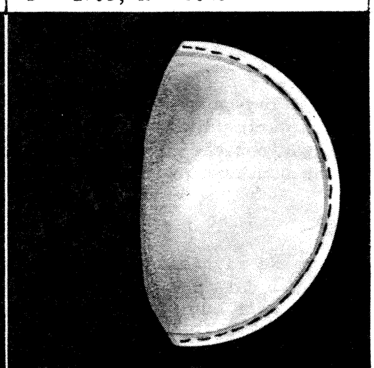
1977 JUN 04  13:45 U.T.
M.B. Smith.  10.6 cm. RL.
107, 126, 165X.  W8, W56, N.D., Polarizer filters.
S = 8, T = 6 (Daylight).
D = 27″.3, K = 0.434



1977 JUN 18  13:48 U.T.
M.B. Smith.  10.6 cm. RL.
156X.  Green, Yellow, Orange, Neutral filters.
S = 7, T = 4 (Daylight).
D = 23″.1, K = 0.514



1977 JUN 19  15:08 U.T.
M.B. Smith, 10.6 cm. RL.
107, 164X.  W8, W56, N.D. filters.
S = 9, T = 5 (Daylight).
D = 22″.8, K = 0.519



1977 JUL 18  13:48 U.T.
M.B. Smith, 10.6 cm. RL.
153X.  W21, W12, W8, W58, W80A, Polarizer filters.
S = 9, T = 4 (Daylight).
D = 17″.4, K = 0.652

Figure 3.  Selected A.L.P.O. drawings of Venus during the 1977-78 morning apparition. Prepared for publication in this journal by John E. Westfall.  See also text.

TABLE II.

Cusp-Cap and Cusp-Band Statistics: 1975-76 and 1977-78 Western

(Morning) Apparitions of Venus

| Category | % of 62 Observations in 1975-76 | % of 124 Observations in 1977-78 |
|---|---|---|
| South Cap Alone Visible | 29.0% | 0.0% |
| Both Caps Visible | 24.2 | 10.5 |
| North Cap Alone Visible | 32.2 | 0.0 |
| Neither Cap Visible | 14.6 | 89.5 |
| South Cap Larger | 3.2% | 0.8% |
| Both Caps Equal Size | 20.0 | 0.8 |
| North Cap Larger | 0.0 | 9.7 |
| South Cap Brighter | 6.4% | 3.2% |
| Caps of Equal Brightness | 16.0 | 6.3 |
| North Cap Brighter | 1.6 | 0.0 |
| South Cusp-band Alone Visible | 3.2% | 0.0% |
| Both Cusp-bands Visible | 1.6 | 0.0 |
| North Cusp-band Alone Visible | 1.6 | 0.0 |
| Neither Cusp-band Visible | 93.6 | 100.0 |

Notes:

1. Assuming that the bright illuminated hemisphere of Venus, as in Table I, was typically of an intensity somewhere between 8.5 and 8.8 in 1975-76 and between 7.9 and 8.2 in 1977-78, it was determined that the mean numerical relative intensity of the cusp-caps in 1975-76 was about 9.6 and about 9.7 in 1977-78. The value for the cusp-bands for the 1975-76 apparition was about 8.0 (cusp-bands were not seen in 1977-78).

2. Seeing and transparency conditions in both apparitions are considered in the "Notes" for Table I, and reference to these data is suggested.

3. Some of the numerical figures in the two columns, by category, do not add up to 100%; specifically, this pertains to the size and brightness of the cusp-caps. This apparent discrepancy is due to the fact that observations of size and brightness of the cusp-caps did not necessarily occur at the time cusp-caps were noticed in 1975-76 and 1977-78.

* * * * * * * * * *

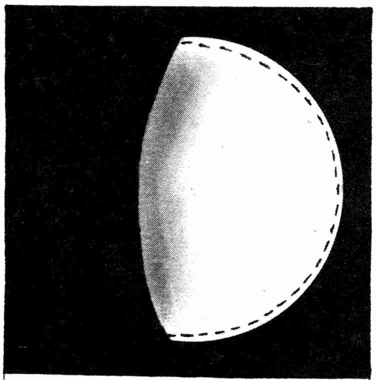
The rather dusky cusp-bands, sometimes seen bordering the cusp-caps, were not seen at all during the 1977-78 observing season. In 1975-76 they were rare indeed. On a few occasions the cusp-bands were both seen in 1975-76, but these observations were not usual. The southern cusp-band was the more common one of the two during the apparition in question.

## Extension of the Cusps

No significant extensions of the cusps of Venus could be derived from the observational data for either apparition. Drawings were carefully examined, as was photographic material; but obvious examples of cusp extensions did not emerge. The infrequently observed "twilight halo" encircling the dark hemisphere of Venus was not evident in either apparition, either in whole or in part.

## Bright Limb Band

In the 1975-76 apparition, 67.6% of the submitted observations drew attention to a bright limb band on Venus' disc opposite the terminator; in 1977-78, 90.2% of the accumulated observations revealed a conspicuous limb band. In both periods, the intensity of the bright limb band was about 9.5 to 9.7, and the feature was normally thin and continuous from cusp to cusp. The visibility of the bright limb band appeared to be independent of the appearance of the cusp-caps, although this observation should not be taken too seriously. Filter data on the limb band did not reveal anything consistently worthwhile



1977 JUL 29 13:45 U.T.
M.B. Smith. 10.6 cm. RL.
155X. Orange, Blue, Violet,
Neutral filters.
S = 8, T = 5 (Daylight).
D = 16".1, K = 0.695

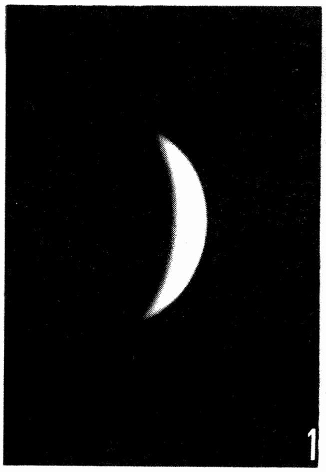
regarding the intensity or overall visibility of the feature.

Terminator Irregularities

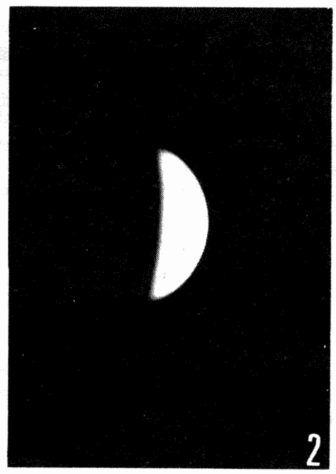
Venus' terminator, the geometric curve separating the illuminated and dark hemispheres of the planet, displayed an occasional degree of deformity in each apparition. In the earlier period (1975-76), only 8.1% of the total observations revealed any irregularities in the terminator; in 1977-78, only 3.2% of the observations drew attention to undulations or other deformities along the otherwise regular boundary.

Ashen Light and Various Dark-Side Phenomena

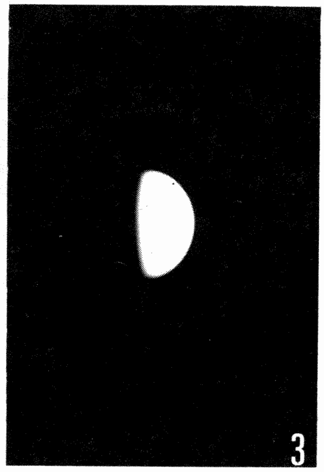
During both the 1975-76 and 1977-78 apparitions there were no instances of darkside illumination of any kind, either seen or suspected. In each period observers did note, however, that the background sky was not so dark as the dark hemisphere of Venus. Virtually all observations in both apparitions were made in daylight or twilight. These impressions




1977 MAY 13 05:30 U.T.
D = 37".7, K = 0.272




1977 JUN 02 05:30 U.T.
D = 28".1, K = 0.419




1977 JUL 07 05:20 U.T.
D = 19".2, K = 0.604

Photographs by Jean Dragesco, 8 in. RL., 16mm eyepiece, Rekordak film, ½ sec., good seeing.

Figure 4. Selected drawing and photographs of Venus during its 1977-78 morning apparition. Arranged for publication here by John E. Westfall.

* * * * * * * * * * *

were obtained with both large and small apertures, throughout all kinds of seeing and transparency conditions, and among observers of varying experience.

Estimates of Phase and Dichotomy

The "Schroeter Effect" on Venus,[5] a discrepancy noted between the predicted and observed dates of dichotomy or half-phase, was reported in the 1975-76 and 1977-78 apparitions. The predicted dates of dichotomy (k = 0.500 and i = 90°, where k is the theoretical phase value found in an ephemeris and i is the phase angle) calculated by the author from the appropriate ephemeris for each apparition, were:[1,2,3,4]

1975-76 Apparition:
1975 November $6^d05^h20^m$U.T.

1977-78 Apparition

1977 June $16^d00^h00^m$U.T.

The observed dates of dichotomy in both apparitions were:

1975-76 Apparition:

1975 November $11^d$ (Michael B. Smith, Alamogordo, New Mexico, 8.3-cm. refractor, 152X, daylight sky, no filter)

1975 November $9^d$ (Alan W. Heath, Nottingham, England, 30.3-cm. reflector, 190 - 318X, daylight sky)

1977-78 Apparition:

1977 June $19^d$ (Michael B. Smith, Alamogordo, New Mexico, 10.6-cm. reflector, 107 - 164X, no filter)

The discrepancy between the predicted and observed dates of dichotomy turns out to be, to the nearest day, for each apparition:

1975-76 Apparition: $3^d$ and $5^d$

1977-78 Apparition: $3^d$

## Conclusions

Observations of the planet Venus throughout the two morning apparitions of 1975-76 and 1977-78 were greater in number than is the usual case for such observing seasons. Activity in the atmosphere of Venus was not particularly significant during either period, although it is important to remember that all methods of investigating the planet (e.g., ultraviolet photographs, simultaneous observations, and filter studies) were not undertaken or were not pursued systematically. Our data, then, is to be trusted to only a limited degree, with the hope that at least some light has been shed on Venus' phenomena during the two apparitions. One must take this opportunity to encourage strongly studies of Venus on a more consistent, systematic basis throughout all apparitions, with attention paid to those observations which have the necessary combination of data yield and suitability to instrumentation employed. The A.L.P.O. Venus Section is open to anyone who desires to participate, but particularly to individuals who want to pursue specialized studies of Venus on a regular basis (e.g., ultraviolet photography). Thus observers, regardless of experience, are urged to write to the author for information on how to get underway with serious work on the planet; we must all start somewhere, and those with limited equipment and knowledge are encouraged to join with us in an educational endeavor, leading hopefully into later more sophisticated pursuits.

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1. U.S. Naval Observatory, American Ephemeris and Nautical Almanac, 1975. Washington: U.S. Government Printing Office, 1974.

2. U.S. Naval Observatory, American Ephemeris and Nautical Almanac, 1976. Washington: U.S. Government Printing Office, 1975.

3. U.S. Naval Observatory, American Ephemeris and Nautical Almanac, 1977. Washington: U.S. Government Printing Office, 1976.

4. U.S. Naval Observatory, American Ephemeris and Nautical Almanac, 1978. Washington: U.S. Government Printing Office, 1977.

5. Benton, Julius L., An Introduction to Observing the Planet Venus. Savannah: Review Publishing Co., Inc., 1973.

6. Benton, Julius L., "The Planet Venus: A Summary of Five Morning Apparitions, 1967-1974," J.A.L.P.O., 26 (7-8): 150-154, 1977.

7. Benton, Julius L., "The 1976-77 Eastern (Evening) Apparition of the Planet Venus: Visual and Photographic Observations," J.A.L.P.O., 26 (11-12): 240-251, 1977.

# SKY COLOR AND DARKNESS AT THE TOTAL SOLAR ECLIPSE, 10 JULY 1972 - PART III

By: William H. Glenn, York College of the City University of New York, Jamaica, New York 11451

[Note by Editor. Part I of Mr. Glenn's paper appeared in Journal A.L.P.O., Vol. 28, Nos. 1-2, pp. 33-35; and Part II appeared in Vol. 28, Nos. 3-4, pp. 50-55. Some of our readers have had, or will have, opportunities to make similar observations of the sky and the Moon's shadow during total solar eclipse. These would be of much interest to our author; his address is William H. Glenn, 2411 Webb Ave., Bronx, New York 10468.]

## D: T.S.S. *Olympia*

In Parts I and II of this paper, observations of sky color and darkness made in Canada were discussed. Far to the southeast, in the North Atlantic Ocean, the cruise ship T.S.S. *Olympia* was located at latitude 40° 18' N, longitude 54° 31' W, five miles northeast of the central line. Observations made from the ship were received from the following:

George Lovi
George G. Manning
Edward G. Oravec
John Pazmino
Patrick Rizzo

Skies were clear, but cumulus clouds were present in all directions on the horizon up to an altitude of 1°, except in the west where they extended up to 15°. A very thin cirrus cloud was present over the Sun just before totality.

The most complete description of the eclipse sky as seen from the *Olympia* was provided by John Pazmino. He divides events before, during, and after totality into a series of "sequences", which give a lucid picture of the entire phenomenon; but unfortunately in most cases he was not able to make timings of the events reported. The following description is abridged and edited from his report.

### Sequence 1

The first phenomenon noticed was a diffuse darkening in the northern sky which welled up from the horizon over a 30° or so span in the north and northwest. Pazmino did not note the time of first appearance of this "pre-umbra", since it took him quite a few seconds to realize that this was indeed something more than just part of the overall diminution of skylight. However, this feature was visible at least several minutes before second contact. Its color was merely a darker shade of the deep sky blue.

### Sequence 2

By a minute or two before second contact, the upwelling and expanding pre-umbra had deepened in darkness, had increased in prominence, and had acquired a touch of gray, although it had no definite shape. The clouds along the horizon under it retained their pre-totality appearance, pale yellowish white on the top and pale yellowish gray below, the yellow tinge coming from the horizon haze.

### Sequence 3

About 30 seconds before totality the umbra itself appeared. It swiftly rose up in a front along the northern horizon, sharp of outline and steel blue-gray in color; and most other observers quickly began to take notice of it. At first the umbra formed a dark backdrop for the horizon clouds, making these clouds stand out a little more clearly. Suddenly, however, the farthest clouds darkened as they were shadowed over by the umbra; and in a few seconds all the horizon clouds were in shadow (Figure 5).

### Sequence 4

The approaching darkness of the umbra resembled a long, low wall approaching the ship. The wall came up from beyond the horizon and loomed higher and higher in the sky. Then, a few seconds before second contact, it appeared to halt and then to increase further in height by swelling upward and "hooding" over the ship. The leading edge of the umbra was definite, the transition zone between it and the rest of the sky being about 2-3° in width. As nearly as Pazmino could tell, the leading edge of the shadow crossed the Sun at second contact. As the leading edge swept over the wisps of cirrus cloud overhead, their color turned from brilliant white to bright golden yellow. By now, the pre-umbra had deteriorated in outline too far to be delineated with any accuracy.

Sequence 5

Some time after second contact, but before mid-totality, Pazmino looked north and saw that the trailing edge of the umbra had risen and was now uncovering the farthest clouds on the horizon (Figure 6). He did not note when this edge rose, but his best guess is that it did so very soon after second contact.

Sequence 6

At approximately mid-totality, when the umbra centered itself on the solar meridian, Pazmino first noticed the pinkish blue borders marking the edges of the umbra, extending from the horizon up out of the horizon haze and blending into the sky background somewhere about 20° above the horizon. They could not be discerned above this altitude (Figure 7). Clouds in front of the umbra were dark gray and were sharply silhouetted against the background sky. Clouds far off and to either side of the solar meridian were outside the zone of totality and were in full sunlight. The sky on either side of the umbral borders was a brilliant wax-like yellow near the horizon, the yellow extending up to the top of the horizon haze and then blending rather abruptly into the pale grayish blue sky between it and the edges of the umbra.

The edges of the umbra were quite clearly set against the sky throughout their entire lengths from the region of the solar meridian around the sky to the eastern horizon. In the east the edges diffused somewhat and could not be followed into the horizon itself. Likewise, the horizon glow could be followed around to the east, where it faded off into the surrounding sky. Everywhere along the horizon, except directly toward and away from the Sun, the clouds were in full sunlight, with yellowish white tops and yellowish gray bottoms.

The entire expanse of sky covered by the umbra was a steel blue-gray, uniform throughout, with a decisive turning toward a charcoal gray low down in the east. Indeed, the east point of the horizon was occupied by a vague patch of charcoal gray haze which could be described as the "sink" of the umbral edges and a circum-horizontal light. The few clouds within the patch were overall a dark charcoal gray, and were for the most part featureless and flat. This region was rather ill-bounded; its extent was approximately 15° in altitude and 20° in azimuth.

Sequence 7

The trailing edge of the umbra crossed the Sun at third contact, and shortly after this the leading edge of the umbra was seen sinking rapidly toward the horizon in the south. (The pinkish blue border shown in Figure 7 had by now vanished through a shrinking of its breadth and a blending of its color into the surrounding sky.) Behind the trailing edge there was a slowly darkening zone of uncertain boundaries (the "post-umbra"), similar to the pre-umbra described in sequences 1 and 2. The last observation was a view of the trailing edge of the umbra receding beyond the horizon, and thereafter the post-umbra shrinking and finally fading out altogether.

Only one other observer, Edward G. Oravec, reported seeing the V-shaped shadow. Oravec did not see the shadow before totality, although he looked for it. At second contact, however, the shadow edges made sharp angles with the horizon, the base of the inverted truncated cone on the horizon being 40-50° in width. The shadow itself was very diffuse, with no border, and was very light. The truncated cone was light blue near the horizon, and a darker shade of light blue overhead. The east, west, and southern sky outside the shadow were all bright yellow; and the thin cirrus clouds overhead appeared white.

George Lovi, who had the opportunity to look in all directions during totality, reported that the shadow was first seen quite spread out and covering a good portion of the northern sky about 20-30 seconds before totality. It was surprisingly inconspicuous compared to what he had expected to see, and appeared as only a general darkening of the deep blue of the sky. At totality the sky overhead resembled the sky about 20 minutes after sunset, the horizon areas being much brighter. No motion of the shadow was noticeable; and except for an increase of horizon brightening in the north, the overall sky brightness remained relatively constant throughout totality. During totality the clouds merely appeared less illuminated than normally. The disappearance of the shadow was virtually a reverse process in time and direction from its appearance. No reference to a V-shaped shadow appears in Lovi's report.

Patrick Rizzo also looked completely around the horizon, but did not see any sharp shadow at all. The western horizon sky appeared very light orange-yellow, the clouds

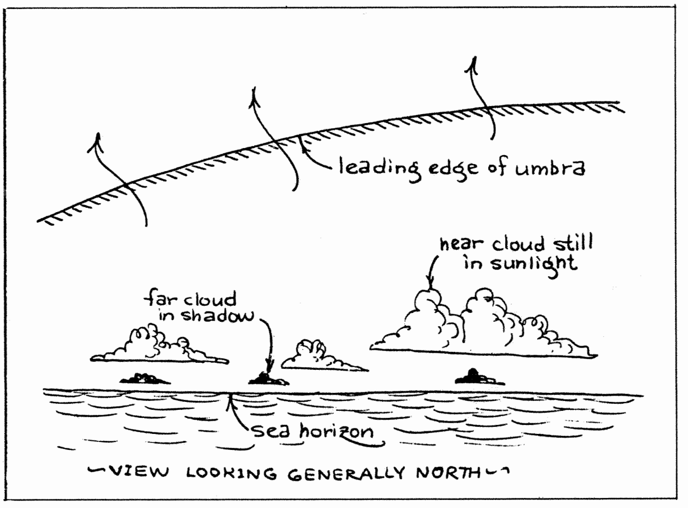



Figure 5. View looking north, showing clouds being covered over by umbra before second contact (Pazmino). See also text.

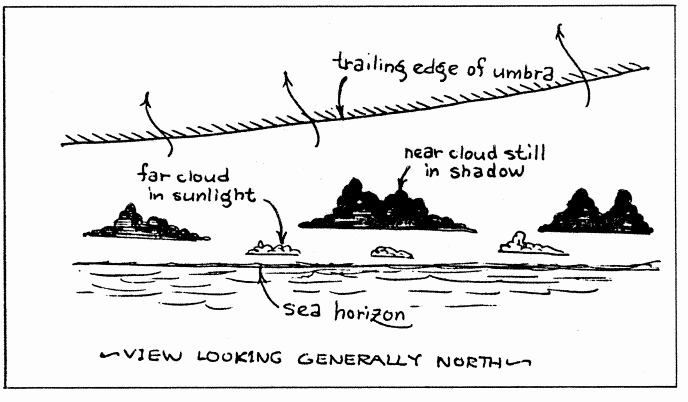



Figure 6. View looking north, showing trailing edge of umbra rising in sky some time before third contact (Pazmino). See also text.

outside the path of totality remaining light, with those in the path darkening just before, during, and after totality.

George Manning reported that daylight on the horizons remained undiminished, just as it would appear immediately after sunset; and a photograph he took one-half minute before totality, facing north, shows a low cloud layer to an altitude of about $2\frac{1}{2}^{\circ}$ and above that a thin pale orange-red region surmounted by light blue beginning below an altitude of $5^{\circ}$.

## Degree of Darkness

Of six reports received concerning the visibility of stars and planets during totality, four were negative, although in three cases (Manning, Oravec, and Pazmino) special efforts were made to see them. One observation (Rizzo) reported Mercury visible, and one (Lovi) reported Procyon. At the ship's position Venus would have been very close to the western horizon, which perhaps explains why it was not seen.

All persons who reported agreed that ordinary newsprint (2 reports), the printing on the questionnaire (3 reports), second hands of watches (3 reports) and hour hands of watches (2 reports) were visible during totality. One observer (Oravec) likened the sky brightness to conditions 10-15 minutes after sunset.

## Color of the Moon's Disc

Five observers described the color of the lunar disc during totality. The colors reported were as follows:

Oravec: Pitch black. The darkest black possible with the naked eye and 12x40 binoculars.

Manning: Black with naked eye. Darker than the sky surrounding the corona. Silver gray and relatively bright in a telescope.

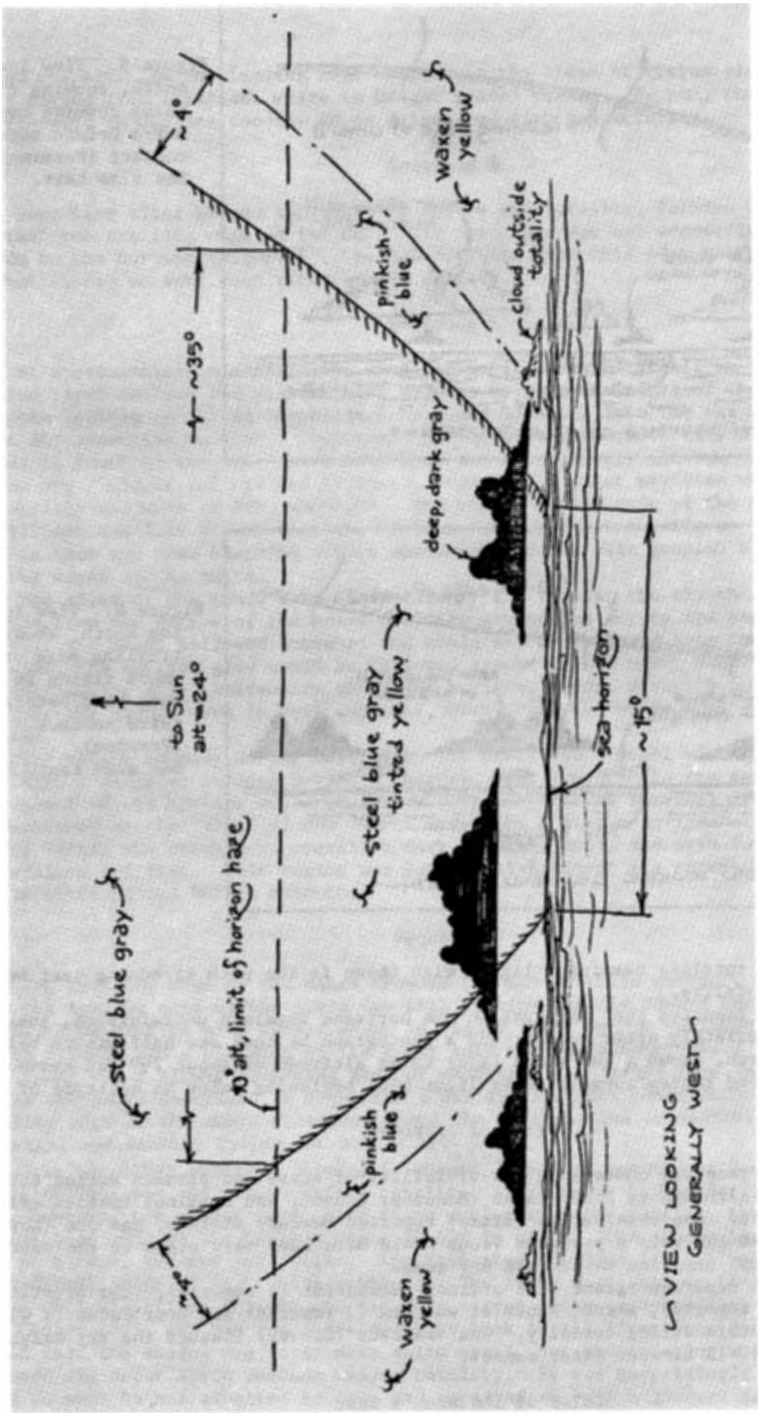



Figure 7. View looking west at approximately mid-totality (Pazmino). Compare to description under "Sequence 6" on page 96 in Mr. Glenn's text.

Lovi: Not quite black. Charcoal. Definitely darker than sky near Sun.
Rizzo: Very black. Nothing visible on disc. Grayish black sky around Sun.
Pazmino: Very dark deep gray. Off black.

In this three-part report an attempt has been made to summarize observations of sky color and darkness made at locations along the path of totality from Cap Chat, Quebec, to the North Atlantic Ocean. It is hoped that such a report may provide a guide to the appearance of the sky at totality for future eclipse observers.

# JUPITER IN 1977-78: ROTATION PERIODS

By: Phillip W. Budine, A.L.P.O. Jupiter Recorder

The highlights of the 1977-78 apparition were: an eruption of the South Equatorial Belt in early March, 1978, the fading of the Red Spot in late March, and observations of a new "red spot" feature on the north edge of the North Temperate Belt.

Some data pertinent to the apparition follow:

Date of Opposition: December 23, 1977
Solar Declination of Jupiter: +2°19 (at opposition).
Equatorial Diameter: 47"44 (at opposition).
Zenocentric Declination of Earth: +2°24 (at opposition).
Stellar Magnitude of Jupiter: -2.3 (at opposition).

This report is based on 1005 visual central meridian transit observations submitted by 16 observers of the A.L.P.O. When plotted on graph paper, 874 transits form usable drifts for 85 jovian spots distributed in 8 different atmospheric currents. The contributing observers are listed below by name and number of transits submitted along with the station of observation and telescope(s) employed:

Berry Scott. Orangeburg, S.C. 6-in. refl. Strip sketches.
Budine, Phillip W. Walton, N.Y. 3½-in. cat. 4-in. refr. 392t.
Cragg, Tom. Coonabarabran, Australia. 12½-in. refl. 15t.
Curtis, W. John. Richmond, Va. 7-in. refr.* 22t.
Doel, Ron. Evanston, Ill. 18½-in. refr.** 22t.

Gordon, Rodger. Nazareth, Pa. 3½-in. & 4-in. cat. 40t.
Hull, Richard. Richmond, Va. 7-in. refr.* Strip sketches.
Mackal, Paul. Mequon, Wisc. 6-in. refl. 7t.
O'Meara, Steve. Cambridge, Mass. 9-in. refr.*** 19t.
Reese, Elmer J. Las Cruces, N.M. 24-in. refl.**** Photos.

Rogers, John. Los Angeles, Ca. 12½-in. refl. 24t.
Sherrod, Clay. Little Rock, Ark. 5-in. refr. 24t.
Smith, Michael B. Alamogordo, N.M. 6-in. refl. 184t.
Sydnor, Gary. Richmond, Va. 7-in. refr.* 24t.
Tatum, Randy. Richmond, Va. 6-in. refl. & 7-in. refr. 231t.
Travnik, Nelson. S. Paulo, Brazil. 12-in. refl. 1t.

*Richmond Astronomical Society Observatory.
**Dearborn Observatory, Northwestern University.
***Harvard College Observatory.
****New Mexico State University Observatory.

The distribution of transit observations by months is as follows:

| | | | | | |
|---|---|---|---|---|---|
| 1977, July | 17 | 1977, November | 6 | 1978, March | 403 |
| August | 99 | December | 167 | April | 4 |
| September | 102 | 1978, January | 90 | May | 8 |
| October | 45 | February | 54 | | |

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, December 23, 1977, when the feature existed at that time. The sixth column gives the number of observed 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.

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

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
|---|---|---|---|---|---|---|---|
| D | Wp | Aug.6-Mar.30 | 145°355° | 49° | 20 | -18°9 | 9:55:15 |
| 1 | Wc | Aug.6-Mar.30 | 150- 2 | 54 | 26 | -18.7 | 9:55:15 |
| E | Wf | Aug.6-Mar.30 | 155- 9 | 59 | 14 | -18.5 | 9:55:15 |
| 2 | Wc | Aug.6-Mar.30 | 158- 12 | 64 | 21 | -18.5 | 9:55:15 |
| 3 | Df | Dec.18-May 2 | 229-157 | 227 | 14 | -16.0 | 9:55:19 |

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

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
|---|---|---|---|---|---|---|---|
| F | Wp | Jul.31-May 2 | 310º160º | 229º | 16 | -16º3 | 9:55:18 |
| 4 | Wc | Jul.31-May 2 | 315-166 | 235 | 20 | -16.2 | 9:55:18 |
| A | Wf | Jul.31-May 2 | 320-172 | 241 | 12 | -16.1 | 9:55:19 |
| 5 | Wc | Dec.11-Jan.12 | 272-252 | 266 | 5 | -18.2 | 9:55:16 |
| B | Wp | Aug.8-Mar.10 | 16-252 | 297 | 14 | -17.5 | 9:55:17 |
| 6 | Wc | Aug.8-Mar.10 | 22-258 | 303 | 16 | -17.5 | 9:55:17 |
| C | Wf | Aug.8-Mar.10 | 28-264 | 309 | 11 | -17.5 | 9:55:17 |
| 7 | Dp | Mar.11-Mar.24 | 265-256 | - | 5 | -22.5 | 9:55:10 |
| | | | Mean rotation period: | | | | 9:55:15 |

The long enduring white ovals of the $STeZ_n$ still continue as long-lived features of the Giant Planet. In recent years they have not been as conspicuous as before; however, they are still being observed. In the 1976-77 apparition they had shrunk to their record minimum length of: DE-10°, FA-11°, and BC-9°. In 1977-78 the mean lengths were: DE-14°, FA-12°, and BC-12°. This is an increase of +4°, +1°, and +3° respectively. Oval DE was in conjunction with the center of the Red Spot on December 7, 1977 at 50° (II). Oval #2 continues to be observed well for the fifth consecutive apparition. This oval was in conjunction with the center of the Red Spot on January 14, 1978 at 52° (II). By March 30 it had approached to within 3° of the following end of Oval DE. The location of FA was best marked from December 17 to May 2 following a very dark section of the South Temperate Belt. Tom Cragg, observing from Australia, observed FA as a prominent feature which he called: "a white cloud and it obscured a major section of the STB. When first seen on April 3 parts of the belt could still be seen in areas where the white cloud was least strong." Other observers also noted these white clouds between FA and BC. No. 5 in the table above is one of the white clouds. Tom Cragg also noted: "the cloud disturbance had so befouled the STB by May 2 I could see no evidence of the belt at all under those white clouds. I got my wife out to look at the STB disturbance on May 2; she could see the disturbance quite well in the 12½" and stated she didn't see any evidence of the belt all the way over to the other edge of the planet - all covered up by those big white clouds."

Great Red Spot, System II

| Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
|---|---|---|---|---|---|---|
| RSp | Jul.15-May27 | 41º47º | 43º | 40 | +0º57 | 9:55:41 |
| RSc | Jul.15-May27 | 50-56 | 52 | 39 | +0.57 | 9:55:41 |
| RSf | Jul.15-May27 | 59-65 | 61 | 32 | +0.57 | 9:55:41 |
| | | Mean rotation period: | | | | 9:55:41 |

During the middle of the apparition a definite darkening of the Red Spot was noted by observers Tatum, Smith, Sherrod, and Budine. The color usually reported was orange-pink. This darkening may have been the forerunner of activity to develope in the SEB in early March. A fading of the RS was seen in the early part of the apparition following the outburst of SEB activity in late August, 1977. Again the Red Spot started to fade in late March, 1978 after an upsurge of SEB activity (Doel noted a fading on March 20). By the end of the apparition the RS was becoming quite difficult to observe. Evidence of this fading was received from Tom Cragg who states: "It took me a while to realize that a fancy cloud coming out of the STrZ and going into the SEB was actually where the RS should be! On April 29 this cloud was so bright and strong it seems to have hidden the RS and the RSH as well! I have to conclude that this is a developement right on top of the RS-RSH area!" The Red Spot had a mean length of 18° during the apparition.

South Equatorial Belt Current, (S.edge $SEB_n$, SEB Z), System II

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
|---|---|---|---|---|---|---|---|
| 1 | Wc | Aug.23-Sep.18 | 117º67º | - | 8 | -55º6 | 9:54:25 |
| 2 | Wc | Sep. 4-Sep.28 | 111-74 | - | 9 | -46.3 | 9:54:37 |
| 3 | Wc | Dec.15-Jan.26 | 65-65 | 65 | 9 | 0.0 | 9:55:41 |
| | | | Mean rotation period: (without No. 3). | | | | 9:54:31 |

During the early part of the apparition Randy Tatum observed an upsurge of SEB activity within 3° of the source outbreak of 1975C, and within 9° of similar activity in 1976. This activity was in the form of two bright ovals: the first one seen on August 23, 1977 and the second oval observed on September 4. See Nos. 1 and 2 in the table above. No. 3 was a bright oval immediately following the Red Spot.

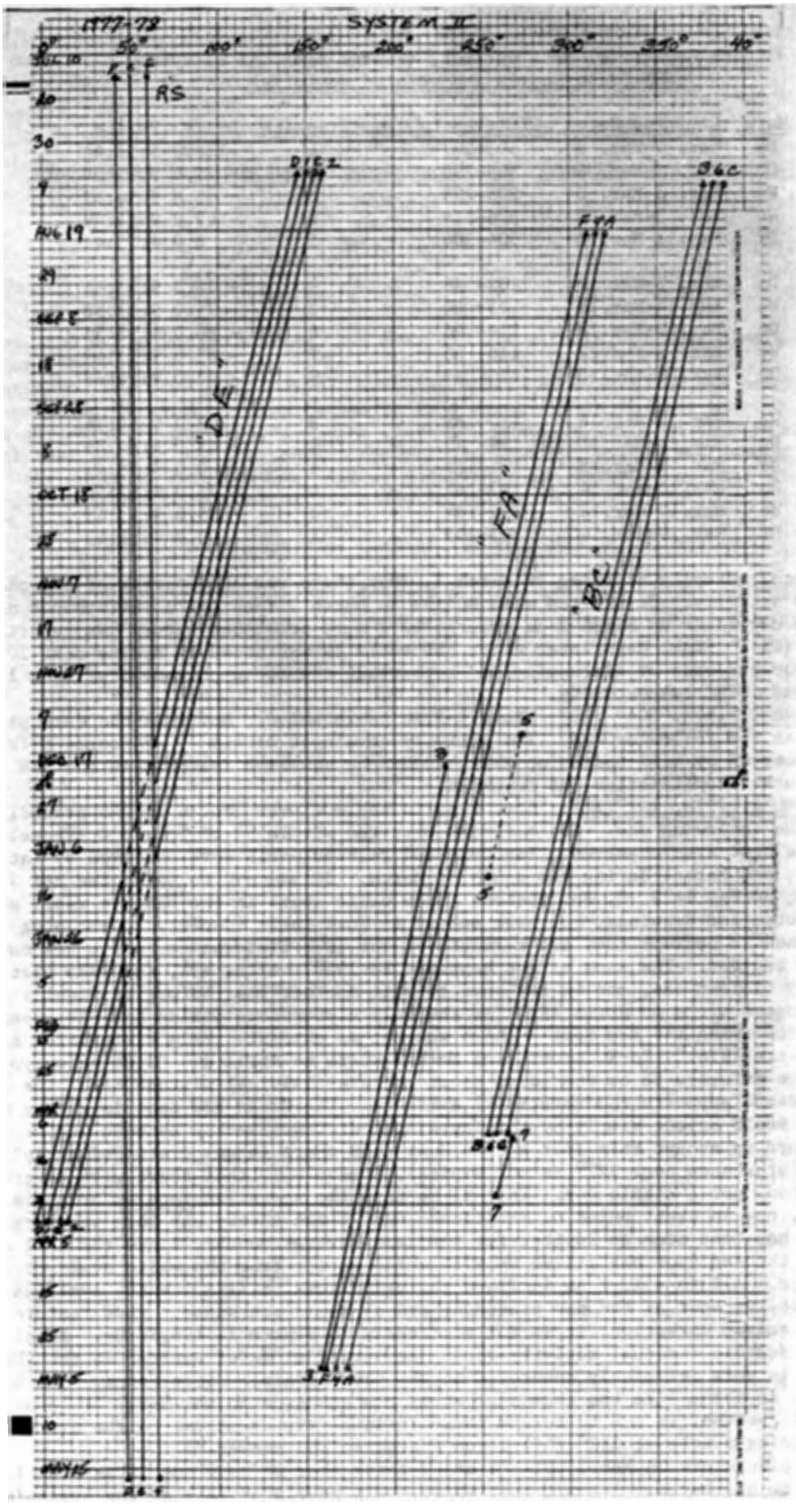



Figure 8. Graph of longitude in System II vs. time for the Great Red Spot and some important South Temperate Zone features on Jupiter during the 1977-78 apparition. Drawn by Phillip W. Budine on the basis of observations by the A.L.P.O. Jupiter Section. See also text on pages 99 and 100.

South Equatorial Belt Current, (S.edge $SEB_n$,SEB Z),System II
(SEB Disturbances and related activity).

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
|---|---|---|---|---|---|---|---|
| 1 | Dp | Mar. 1-Mar. 8 | 303°277° | - | 6 | -130°0 | 9:52:44 |
| 2 | Dc | Mar. 1-Mar. 8 | 305-290 | - | 5 | - 75.0 | 9:53:58 |
| 3 | Wc | Mar. 1-Mar. 8 | 308-295 | - | 5 | - 65.0 | 9:54:12 |
| 4 | Wc | Mar. 3-Mar. 8 | 326-314 | - | 6 | - 60.0 | 9:54:19 |
| 5 | Df | Mar. 1-Mar. 8 | 304-304 | - | 5 | 0.0 | 9:55:41 |
| 6 | Dp | Mar. 2-Mar.18 | 102- 56 | - | 9 | - 78.3 | 9:53:54 |
| 7 | Wc | Mar.14-Mar.18 | 75- 60 | - | 7 | - 75.0 | 9:53:58 |
| 8 | Dc | Mar. 2-Mar.18 | 114- 66 | - | 6 | - 80.0 | 9:53:51 |
| 9 | Wc | Mar. 2-Mar.22 | 118- 60 | - | 7 | - 83.0 | 9:53:47 |
| 10 | Dc | Mar. 2-Mar.18 | 120- 83 | - | 9 | - 62.0 | 9:54:16 |
| 11 | Wc | Mar. 8-Mar.18 | 110- 85 | - | 8 | - 63.0 | 9:54:16 |
| 12 | Dc | Mar.14-Mar.18 | 99- 90 | - | 6 | - 45.0 | 9:54:39 |
| 13 | Df | Mar. 2-Mar.18 | 122-122 | - | 5 | 0.0 | 9:55:41 |
| 14 | Dp | Mar.10-Mar.14 | 197-182 | - | 4 | - 75.0 | 9:53:58 |
| 15 | Wc | Mar.10-Mar.14 | 201-184 | - | 3 | - 85.0 | 9:53:45 |
| 16 | Df | Mar.10-Mar.14 | 203-203 | - | 3 | 0.0 | 9:55:41 |

During March, actually starting on March 1, 1978, there was an outbreak of SEB phenomena and related activity. It started when Budine on March 1 recorded a Disturbance near 304° (II). One day later on March 2 an upsurge of a more prominent nature was reported by Budine at 122° (II). Eight days later minor SEB activity was noted by Budine near 203° (II) on March 10. For purposes of discussion and reporting, the above phenomena will be labeled 1978A, 1978B, and 1978C respectively.

1978A (March 1, 1978, 304° (II): Nos. 1-5 in table above. No. 1 is the dark preceding end, and No. 5 is the following end. The activity developed within 1° of Source B (Reese). Activity was observed by Bill Shenan on March 7 when he observed festoons in the SEB near 304° (II). No other confirmation was reported.

1978B (March 2, 1978, 122°(II): Nos. 6-13 in table above. No. 6 is the preceding end, and No. 13 is the following end. The outbreak occurred within 3° of Source C (Reese). This activity was the best area observed. Festoons and related ovals were observed by Tatum, Sherrod, Gordon, and Mackal during the month of March. In regard to 1978B the BAA Jupiter Recorders wrote; on May 14 W. E. Fox stated: "The white spots in the SEB are real, showing very well on photos and drawings, but have seemed to lose their identity on reaching the RS. I am inclined to believe they are remnants of the 1975 Disturbance, not a new one as Budine seems to suggest. The same effect happened in 1968. After all, the 1975 Disturbance was a very violent one, and we may have to wait another year before it finally subsides". John Rogers wrote on April 29: "so the only disturbance inside the SEB appears to have been that following the Red Spot - which was not as extensive as a disturbance in the same region in late 1976." Co-Recorder Paul Mackal wrote on April 1: "I do think you, Phil, have enough evidence to be confident about the pre-classical disturbance. The observational evidence supports the rotational evidence. The Great Red Spot is fading much faster than one would expect simply by the increasing distance vector between Jupiter and Earth. It is hard to accept this fact and to deny that there is any disturbed activity on Jupiter. The disturbance near 122° is not typical, I mean only that there were several points of eruption, not a single one. That is to say, the so-called fons et origo is only a mean position, not an exact point of eruption. And, I can safely say that the large white oval that has been seen on Jupiter for the last several months, since the fall of 1977, just past the Red Spot has filled up with white matter from the white ovals of our March disturbance. All in all, I am inclined to regard this brilliant white oval just past the center of the Red Spot as the new preceding end of the disturbance. This feature is moving in the required direction; it is not stationary in System II longitude. Finally, there is a considerable residual activity about the entire globe of Jupiter in the SEB Z latitude, which is very definitely connected to the pre-classical disturbance. Not since 1964 have I seen anything like the turmoil that is now going on in the SEB. It is a real sight to behold! Whether we are to regard these residual events as due to the events of 1975, or to on-going events at 122° (II) I won't suggest the answer."

Mr. Mackal also wrote on April 15: "I still think that we have one large pre-classical disturbance on our hands. I admit that white ovals near 304° (II) at the beginning of March were moving in the required fashion. But, I am inclined to view this as the following end of the disturbance. Hence our disturbance extends from 118°5 to 304° , as of March 1 and March 2. Curiously, the following end of a 1975 disturbance erupted sporadically, too."

1978C (March 10, 1978, 203° (II)): Nos. 14-16 in table above. No. 14 is the preceding end, and No. 16 is the following end. This was a very minor surge of material at 203° (II) within 1° of Source A (Reese). No confirmation was obtained.

$SEB_s$ Current (S. edge $SEB_s$), System II

SEB Disturbance

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
|---|---|---|---|---|---|---|---|
| 1 | Dc | Mar. 2-Mar. 8 | 298°-303° | - | 4 | +25°.0 | 9:56:15 |
| 2 | Dc | Mar. 3-Mar. 18 | 306-337 | - | 5 | +62.0 | 9:57:06 |
| 3 | Dc | Mar. 1-Mar. 3 | 337-344 | - | 5 | +70.0 | 9:57:17 |
| 4 | Dc | Mar. 2-Mar. 14 | 121-164 | - | 5 | +108.0 | 9:58:09 |
| 5 | Dc | Mar. 2-Mar. 14 | 117-146 | - | 4 | +73.0 | 9:57:21 |

Nos. 1-3 are **markings in** 1978A, and nos. 4-5 are with 1978B. There were no markings timed for 1978C.

Summary: The question remains: were the events of 1978 a new SEB event, or were they the re-eruption of material from the major 1975 event? Data we have are too limited to come to any definite conclusions. Most observing stations (both in this country and abroad) had inclement weather and poor seeing conditions; however, Budine had superb seeing during most of the month of March, 1978. All we definitely can agree on is that there was considerable activity in the SEB during the early Spring of 1978!

North Equatorial Current (S. edge NEB, $EZ_n$), System I

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
|---|---|---|---|---|---|---|---|
| 1 | Dc | Aug. 16-Sep. 3 | 60° 64° | - | 6 | +6°.7 | 9:50:39 |
| 2 | Wc | Dec. 11-Jan. 8 | 60- 69 | 63 | 7 | +10.0 | 9:50:43 |
| 3 | Wf | Dec. 11-Dec. 25 | 66- 76 | 74 | 4 | +20.0 | 9:50:57 |
| 4 | Wc | Aug. 16-Sep. 1 | 80- 88 | - | 4 | +16.0 | 9:50:52 |
| 5 | Dc | Jul. 15-Nov. 12 | 105- 88 | - | 16 | -4.3 | 9:50:24 |
| 6 | Wc | Feb. 4-Mar. 18 | 106-105 | - | 9 | -0.7 | 9:50:29 |
| 7 | Wf | Feb. 4-Mar. 18 | 110-110 | - | 6 | 0.0 | 9:50:30 |
| 8 | Wc | Jul. 31-Sep. 6 | 140-144 | - | 8 | +3.1 | 9:50:34 |
| 9 | Dc | Aug. 7-Nov. 1 | 150-135 | - | 11 | -5.0 | 9:50:23 |
| 10 | Dp | Jan. 22-Mar. 18 | 114-113 | - | 9 | -0.6 | 9:50:29 |
| 11 | Dc | Nov. 12-Mar. 18 | 117-119 | 119 | 24 | +0.5 | 9:50:31 |
| 12 | Df | Dec. 30-Mar. 18 | 124-126 | - | 12 | +0.8 | 9:50:31 |
| 13 | Wc | Dec. 30-Jan. 15 | 132-132 | - | 5 | 0.0 | 9:50:30 |
| 14 | Wc | Aug. 7-Aug. 29 | 161-164 | - | 6 | +4.3 | 9:50:36 |
| 15 | Dp | Dec. 5-Dec. 21 | 176-175 | 175 | 4 | -2.0 | 9:50:27 |
| 16 | Dc | Aug. 14-Oct. 30 | 177-222 | - | 19 | +18.1 | 9:50:54 |
| 17 | Dc | Aug. 28-Sep. 19 | 173-198 | - | 8 | +35.7 | 9:51:18 |
| 18 | Wc | Sep. 2-Sep. 29 | 199-209 | - | 6 | +11.1 | 9:50:45 |
| 19 | Wc | Dec. 10-Dec. 28 | 226-224 | 224 | 6 | -3.3 | 9:50:26 |
| 20 | Wc | Aug. 17-Sep. 4 | 252-245 | - | 5 | -11.7 | 9:50:14 |
| 21 | Dc | Jul. 16-Sep. 29 | 263-252 | - | 11 | -4.4 | 9:50:24 |
| 22 | Wc | Dec. 26-Jan. 2 | 266-268 | - | 4 | +10.0 | 9:50:43 |
| 23 | Wc | Jan. 27-Feb. 7 | 267-280 | - | 5 | +32.5 | 9:51:14 |
| 24 | Dc | Aug. 5-Sep. 28 | 296-284 | - | 12 | -8.3 | 9:50:19 |
| 25 | Dc | Dec. 8-Mar. 1 | 284-292 | 285 | 13 | +2.9 | 9:50:34 |
| 26 | Wc | Dec. 8-Mar. 21 | 302-291 | 302 | 18 | -3.2 | 9:50:26 |
| 27 | Wf | Dec. 15-Mar. 16 | 311-297 | 310 | 16 | -4.7 | 9:50:24 |
| 28 | Dp | Dec. 15-Mar. 16 | 312-300 | 312 | 14 | -4.0 | 9:50:25 |
| 29 | Dc | Jul. 28-Mar. 16 | 325-305 | 320 | 27 | -2.6 | 9:50:26 |
| 30 | Df | Dec. 6-Mar. 16 | 326-312 | 324 | 16 | -4.2 | 9:50:24 |
| 31 | Wc | Dec. 6-Mar. 16 | 336-330 | 333 | 13 | -1.8 | 9:50:28 |
| 32 | Wf | Dec. 6-Mar. 9 | 343-338 | 342 | 9 | -1.6 | 9:50:28 |
| 33 | Wc | Aug. 5-Sep. 19 | 342-344 | - | 11 | +1.3 | 9:50:32 |
| 34 | Dc | Jul. 28-Nov. 2 | 0- 3 | - | 15 | +0.9 | 9:50:31 |
| 35 | Dc | Dec. 27-Mar. 3 | 345-330 | - | 12 | -6.8 | 9:50:21 |
| 36 | Dc | Mar. 1-Mar. 8 | 350-343 | - | 5 | -35.0 | 9:49:43 |
| 37 | Dc | Feb. 24-Mar. 8 | 3-346 | - | 7 | -42.5 | 9:49:33 |
| 38 | Wp | Dec. 4-Jan. 3 | 25- 14 | 17 | 5 | -11.0 | 9:50:15 |
| 39 | Wc | Dec. 4-Jan. 3 | 30- 26 | 28 | 7 | -2.2 | 9:50:27 |
| 40 | Wc | Aug. 27-Sep. 10 | 46- 52 | - | 9 | +12.0 | 9:50:46 |
| | | | Mean rotation period: | | | | 9:50:31 |
| | | | Nos. 17 and 23: | | | | 9:51:16 |
| | | | Nos. 36 and 37: | | | | 9:49:38 |

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

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
|---|---|---|---|---|---|---|---|
| 1 | Dc | Jul.19-Aug.14 | 275°-258° | - | 6 | -18.°9 | 9:55:15 |
| 2 | Dc | Aug.14-Aug.27 | 233-226 | - | 5 | -17.5 | 9:55:17 |
| | | | Mean rotation period: | | | | 9:55:16 |

No. 1 was a dark "barge-like" feature on the north edge of the NEB.

North Temperate Current A (N. edge NTB, NTeZ), System II

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
|---|---|---|---|---|---|---|---|
| 1 | Dp | Dec.12-Mar.14 | 87°-119° | 91 | 9 | +10.°3 | 9:55:55 |
| 2 | Dc | Dec.12-Mar.14 | 93-128 | 97 | 17 | +11.3 | 9:55:56 |
| 3 | Df | Dec.12-Mar.14 | 99-137 | 103 | 7 | +12.3 | 9:55:57 |
| | | | Mean rotation period: | | | | 9:55:56 |

Nos. 1-3 was a dark prominent feature similar to the Great Red Spot. We will call this object the NRS (New Red Spot). The NRS was located on the north edge of the NTB (actually attached to this belt) and protruded into the NTeZ. The shape was narrower than that of the Great Red Spot, but the color and length were similar during the later part of the apparition. On December 12 the length was 12°, and by March 14 it was 18° (the same as the Great Red Spot). The rotation period from March 2 to 14, 1978, was the same as for the GRS (9:55:41). Most of the data in the table above is based upon observations by Smith, Sherrod, Tatum, and Budine.

## THE PLANET JUPITER DURING THE 1976-77 APPARITION

By: Giancarlo Favero and Paolo Zatti, Unione Astrofili Italiani - Jupiter Section

Abstract. During the 1976-77 apparition outbreaks of activity were observed in the NTeZ and in the parallel STeZ. Two little red spots in the NTrZ were observed during the apparition, and a third one formed about November from material of the NEB$_n$. The SEB showed the residuals of the 1975 revival in the form of white spots in the SEB Z and dark spots on the south edge of the SEB$_s$. The Red Spot was rather inconspicuous; meanwhile, the STB was a prominent feature. This belt was double between the ovals FA and BC.

This paper collects the results of 140 visual observations of Jupiter carried out between July 20, 1976, and March 21, 1977, by the following observers:

Agnesoni, Claudio, 6-in. refl.
Baroni, Sandro, 8-in. refl.
Camaiti, Plinio, 4½-in. refl.
Eltri, Maurizio, 8-in. refl.
Favero, Giancarlo, 14-in. refl.
Ferrarese, Roberto, 8-in. refl.
Frosina, Angelo, 3-in. refr.
Gambato, Giampaolo, 3-in. refr.
Milani, Antonio, 6-in. refl.
Ortolani, Sergio, 8-in. and 12-in. refls.
Peloso, Arnaldo, 8-in. refl.
Sassone-Corsi, Emilio and Paolo, 10-in. refl.
Stomeo, Enrico, 8-in. refl.
Zatti, Paolo, 12-in. refl., 6½ in. refr.

About 150 photographic images of very high quality obtained at the S. Vittore Observatory (Bologna, Italy) were measured as an integration of the visual material. The photographs have been taken in the standard planetary photometry (U, B, G, R, and IR). We have focused our attention particularly on blue images because of the useful definition of the planet edge and the good contrast given as far as reddish features are concerned. Bluish features (e.g., the NEB$_s$ festoons) were identified by the comparison of nearly simultaneous B and R photographs.

The position of the most interesting spots was measured on the prints (planet diameter 30-40 mm) with the aid of a micrometric eyepiece. The longitudes thus obtained have not been corrected for photographic and phase defects. This procedure provided figures, the precision of which can well be compared with the precision of the visual estimates. Therefore, in the following notes we will not discriminate between visual and photographic values.

## North Polar Region

Very few and inconspicuous spots were observed on the NPR, NNNTB, and NNTB. The color of the region was estimated as bluish and of higher intensity than that of the SPR. A wide clearing in the NNTeZ was observed between longitudes $100^\circ$ and $200^\circ$ (II), probably synchronized with System II.

## North Temperate Zone and Belt

The NTeZ displayed a number of little festoons or dark spots coming from the $NTB_n$, which we relate to an outbreak of activity which occurred in the NTeZ during the apparition. The observation of these features was rather difficult because of their neutral color and faint contrast with the Zone, so they were best studied on the photographs. A general tendency of the features under discussion to elongate in the direction of their motion was ascertained.

The mean rotation period of three spots (1, 2, and 3, Fig. 9) has been determined as:

$$9^h56^m17^s.0 \pm 1^s.4$$

The NTB appeared split in two components; the northern one was neutral in color, while the southern one was definitely red. In fact, this last component was conspicuous in blue light but completely missing in red light.

## North Tropical Zone: The Little Red Spots

Soon after the beginning of the observations two little red spots were observed near the northern edge of the $NEB_n$. The visual detection of these spots was very difficult, requiring large instruments and skilled observers. They were very easily studied, mainly thanks to the B images on photographs.

The smallest of the spots (length $6^\circ$, height $3^\circ$, longitude $244^\circ$ (II) on October 20) showed a regular drift toward decreasing longitudes (Fig. 9). The rotation period was calculated as:

$$9^h55^m12^s.0 \pm 0^s.8$$

The second red spot ($9^\circ \times 4^\circ$, longitude $335^\circ$ (II) on October 22) showed an irregular motion around a mean rotation period of:

$$9^h55^m23^s.7 \pm 1^s.4$$

During November, red material detached from the northern edge of the $NEB_n$ and moved northwards, giving rise to a third red spot ($7^\circ \times 3^\circ$, longitude $118^\circ$ (II) on February 17). The mean rotation period of this last feature was:

$$9^h55^m31^s \pm 3^s$$

It is to be noted that this figure is substantially different from the values normally found in the NTrZ. Interestingly, it is very near to the decametric rotation period. Moreover, this spot was a dusky feature even in the R images, where the other two were invisible.

## North Equatorial Belt

The northern component of the NEB had many little and poorly defined indentations on its northern edge. Only two large humps were observed enough to derive a rotation period (4 and 5, Fig. 9):

$$9^h55^m9^s.5 \pm 1^s.4$$

The color of the $NEB_n$ was definitely red, in agreement with the frequent invisibility of the belt in R images. In contrast, the color of the $NEB_s$ was estimated as blue owing to its invisibility in B images and darkness in R ones. In blue light even the festoons coming from the $NEB_s$ and going toward the EB were inconspicuous, proving thus their blue color.

The mean rotation period estimated for the features lying between $+7^\circ$ and $0^\circ$ of latitude (festoons and white spots, Fig. 10) was:

$$9^h50^m26^s.6 \pm 2^s.5$$

The comparison of this value with those determined in the previous apparition[1] enables one to place with certainty the minimum velocity of the Great Equatorial Current, Northern Branch as occurring around 1975.

## Equatorial Zone

The northern portion of the EZ was characterized by the features described in the

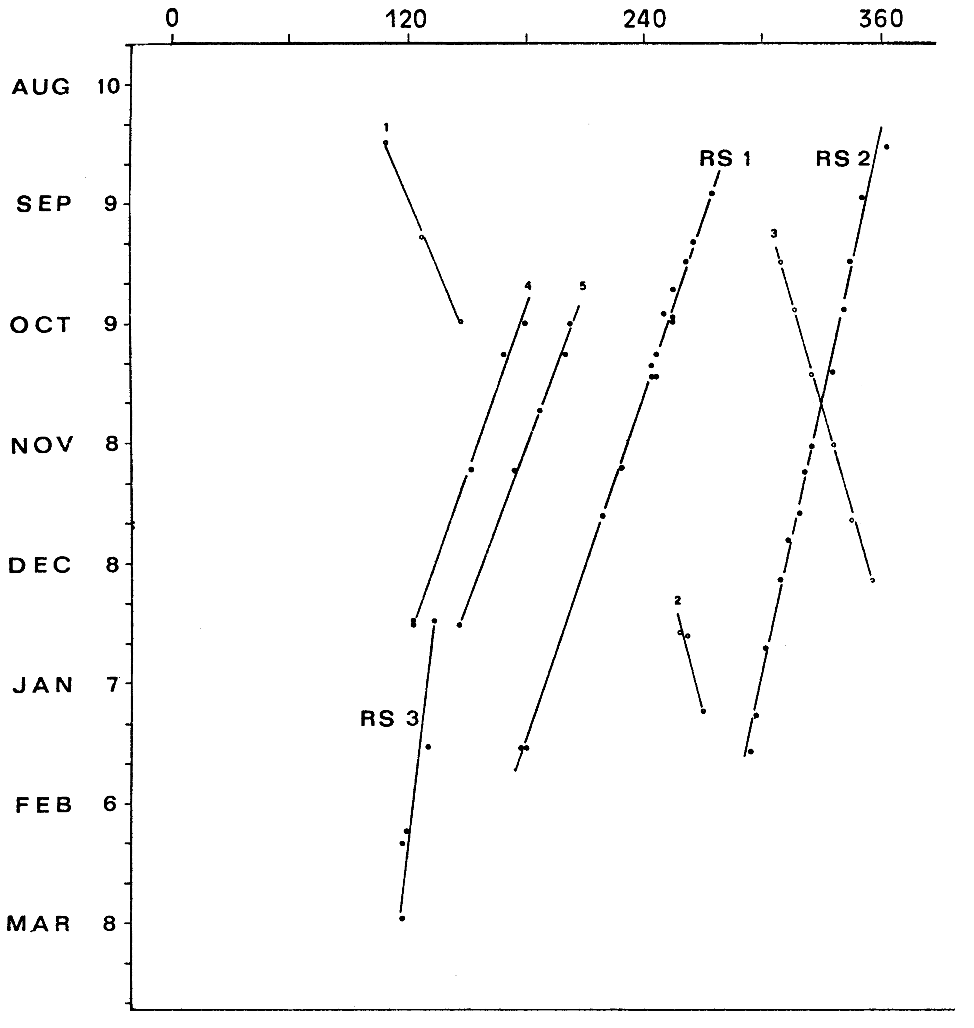



Figure 9. Longitude drift (System II) of the features on Jupiter in 1976-77 observed in the NTeZ (1, 2, and 3), of the two humps on the northern edge of the $NEB_n$ (4 and 5), and of the three little red spots (RS 1, 2, and 3) in the NTrZ. Note the independent drifts of the three little red spots. See also text of article by Messrs. Favero and Zatti.

* * * * *

previous section connected with the $NEB_s$. The $EZ_s$ appeared veiled by bluish material (or the clear sky, free from clouds, was visible there, following a recent interpretation of the blue color in the Equatorial Zone of Jupiter[2]) and contained some large white clouds of oval shape; their dimensions ranged from 15° to 20° in length and from 5° to 10° in height. The most conspicuous of these (center at 235° (I) on October 25) showed a mean rotation period of:

$$9^h50^m51^s.5 \pm 1^s.4$$

The motion (Fig. 11) showed a sudden variation around October which is significantly higher than the mean visual error[1].

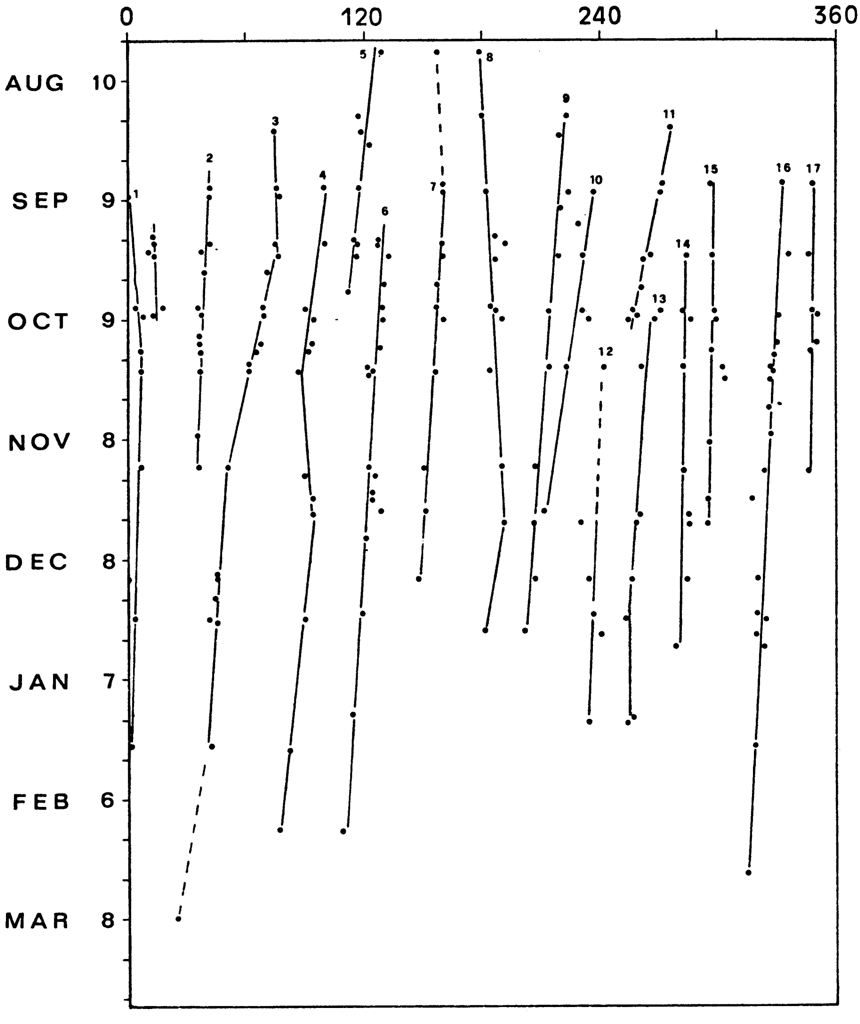



Figure 10. Behavior of the projections coming from the $NEB_s$ and going into the $EZ_n$. The general drift toward decreasing longitudes is evident.

* * * * *

South Equatorial Belt

The SEB appeared barely distinguishable from the veiled $EZ_s$ and displayed the residuals of the 1975 revival. White spots elongated in the SE-NW direction rapidly drifted inside the belt (SEB Z) with a rotation period of (Fig. 12):

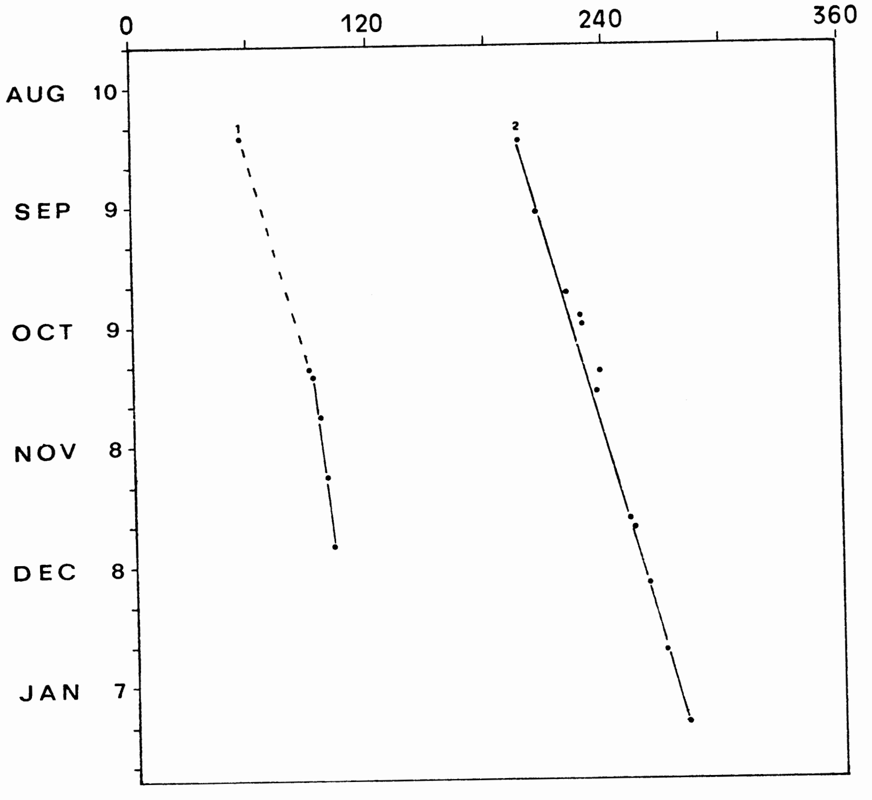
$$9^h54^m42^s \pm 3^s$$

This value is nearly identical with the mean value we observed during the 1975 revival[1], thus confirming our results as compared with the ones more or less different computed by the BAA[3] and ALPO[4] Recorders.

On the south edge of the $SEB_s$ some dark spots (or indentations) were observed which moved under the influence of the Circulating Current, Northern Branch. The relevant rotation period was estimated as (Fig. 12):

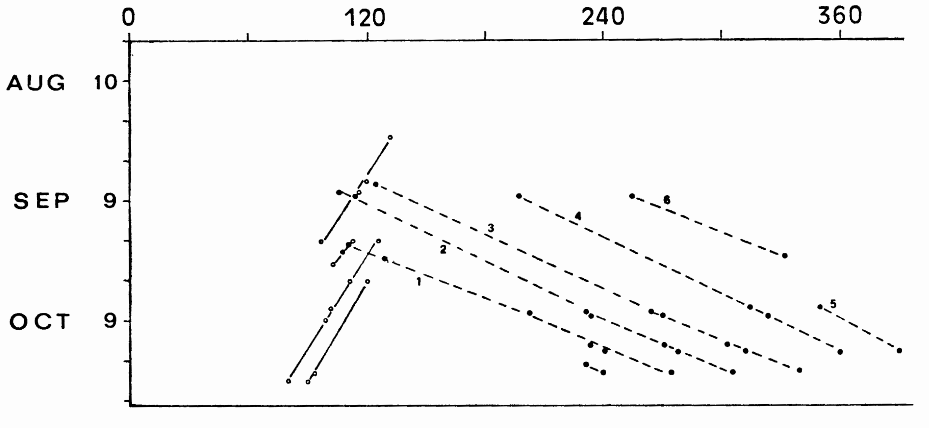
$$9^h58^m37^s \pm 3^s$$

This value too is in very good agreement with the relevant 1975 value determined by us[1].




SYSTEM I LONGITUDE

Figure 11. Movement of two light ovals in the $EZ_S$ (dashed line for proposed identification). Note the large deviation from the linear drift near mid-October, 1976.




SYSTEM II LONGITUDE

Figure 12. Drift of the features observed in the SEB: open circles, white spots in SEB Z; dark circles, dark spots on the southern edge of the $SEB_S$.

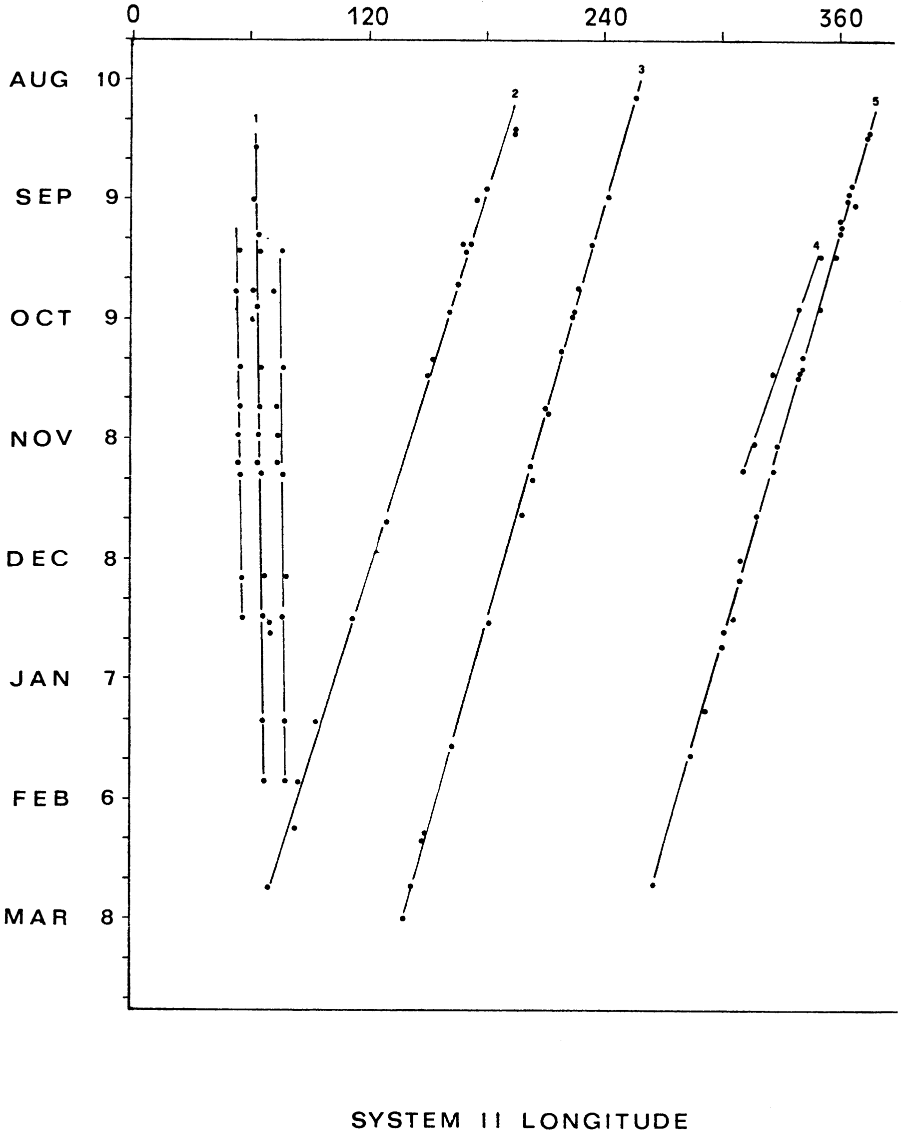



Figure 13. Movement of the Red Spot (1) and of the white oval spots FA (2), BC (3), DE (5) and the little spot in the STeZ (4) (also 7 in Fig. 14).

* * * * *

As far as the "soliton theory" is concerned[5], we wish to call attention to the marked tendency displayed by the spots on the south edge of the $SEB_s$ to appear in groups of three-four individuals. On every occasion in which we could obtain reliable measures, the mean distance between the individual spots was remarkably constant around a mean value of $31^o \pm 4^o$.

The color of the $SEB_n$ was estimated as bluish, while the $SEB_s$ looked warmer, probably reddish. Finally, we want to mention the fact that the $SEB_s$ was wide and dark in the region preceding the Red Spot, while following this feature the belt component was barely different from the SEB Z.

Great Red Spot

Barely contrasted with the STrZ, the RS displayed a light orange hue. It appeared dark in B and more so in UV, but it faded to invisibility in R and IR images. Many observers were able only to detect the whitish Red Spot Hallow, which appreared well defined on

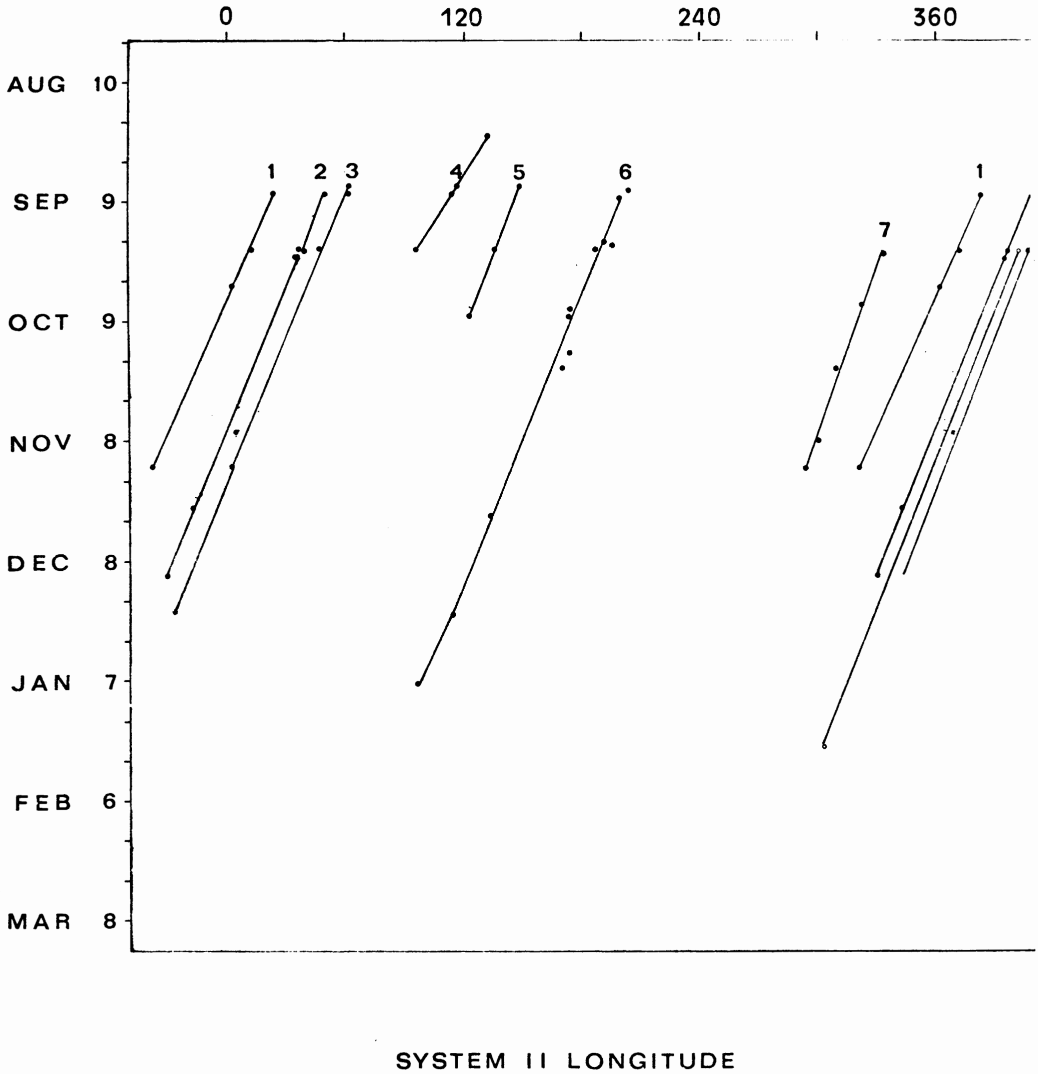



Figure 14. Longitude (II) vs. date for features in the STeZ of Jupiter during the 1976-77 apparition.

* * * * *

the photographs. The RS drift toward increasing longitudes was extremely slow and regular, and the rotation period was estimated as (1, Fig. 13):

$$9^{h}55^{m}42^{s}.3 \pm 0^{s}.3$$

The longitude of the center was $45^{\circ} \pm 1^{\circ}$ (II), and the latitude $-23^{\circ} \pm 1^{\circ}$, on November 17. Length $20^{\circ}.5 \pm 1^{\circ}$, height $10^{\circ} \pm 1^{\circ}$ on that date in 1976.

### South Temperate Belt

The STB had undergone a noticeable increase in intensity with respect to the previous apparition so as to appear one of the most interesting features of the planet. Moreover, the ovals FA, BC, and DE had regained conspicuousness even if oval FA was now definitely smaller than the other two spots. The new oval observed in the period 1974-1976 was no longer observed during 1976-77. In the region comprised between FA and BC the STB was double, with components very thin and quite distinct.

Table II shows the rotation periods obtained. The value determined for DE is rather unusual, considering its distance from the RS, if compared with the mean motion of the ovals observed during recent years[1]. The cause might be the presence, near its preceding

PHOTOGRAPHS OF JUPITER IN 1976-77 AT THE S. VITTORE OBSERVATORY, BOLOGNA, ITALY.

See also text of article by Messrs. Favero and Zatti on pg. 104 et seq.

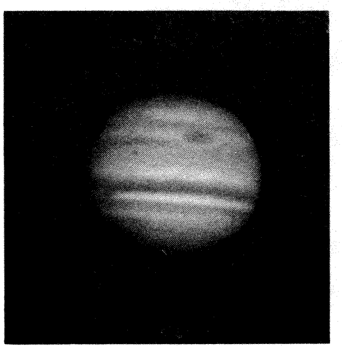


Figure 15. September 25, 1976. $0^h45^m$, U.T. Blue light. CM(I) = 357°, CM (II) = 16°. Note the light area in the STeZ (1-3, Fig. 14), the Great Red Spot, the white spot in the SEB Z (Fig. 12), and little red spot No. 2 in the NTrZ (Fig. 9).

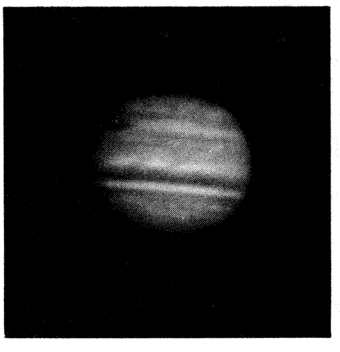


Figure 16. September 8, 1976. $3^h31^m$, U.T. CM (I) = 293°, CM (II) = 81°. Blue light. Note the Red Spot, the two components of the SEB, one white spot in the SEB Z, and two projections in the $EZ_n$.

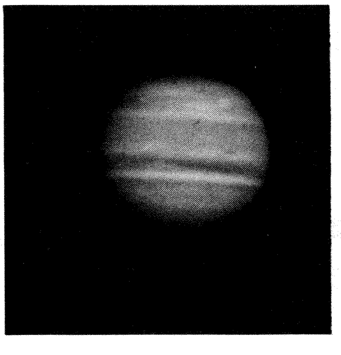


Figure 17. September 21, 1976. $2^h4^m$, U.T. Blue light. CM (I) = 133°, CM (II) = 183°. Features of interest include the preceding end of the dislocated portion of the SSTB (6 in Fig. 14), the double STB between ovals FA and BC, the region of the $NEB_n$ from which the third little red spot will detach (see Fig. 20), and a visible section of the NNTB.

Images are all simple inversions with south at the top.

end, of a little white spot lying in the STeZ (Fig. 13). After the disappearance of this spot in November, DE had a mean rotation period in agreement with its new distance from the RS.

### South Temperate Zone

The STeZ was characterized by intense activity in the form of large shaded portions interrupted by clearings similar to white ovals. In the region comprised between FA and BC (6, Fig. 14) a dislocated portion of the SSTB was observed, mainly thanks to the photographs. The features observed had a mean rotation period of:

$$9^h55^m8\overset{s}{.}5 \pm 1^s$$

### South Polar Region

Without any definite features.

### References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### Acknowledgements

The authors wish to thank the S. Vittore Observatory staff for the excellent photographs which they made available.


Table I. Mean zenographical latitude of the belts on Jupiter in the 1976-77 apparition. Observations by Unione Astrofili Italiani.

| Belt | Latitude | ±Standard Deviation |
|---|---|---|
| Center NNNTB | +43°.8 | 2°.0 |
| South edge NNTB | +36.6 | 1.5 |
| North edge $NTB_n$ | +30.9 | 1.0 |
| South edge $NTB_s$ | +23.8 | 0.5 |
| North edge $NEB_n$ | +18.0 | 0.5 |
| South edge $NEB_s$ | + 8.2 | 0.5 |
| Center EB | - 0.9 | 0.5 |
| Center $SEB_n$ | - 9.2 | 0.5 |
| South edge $SEB_s$ | -20.2 | 0.5 |
| Center STB | -30.9 | 1.0 |
| Center SSTB | -40.6 | 1.5 |

Table II. Rotation periods of the STB-STeZ white ovals in 1976-77. Observations by Unione Astrofili Italiani.

| White Oval | Longitude (II) on Nov. 18, 1976 | Monthly Drift | Rotation Period |
|---|---|---|---|
| FA | 115° | -18°.9 ±0°.5 | $9^h55^m14\overset{s}{.}7 \pm 0\overset{s}{.}7$ |
| BC | 183 | -17.0 ±0.5 | 17.4 ±0.7 |
| DE | 305 | -17.4 ±0.5 | 16.8 ±0.7 |
| 4 | 291 | -22.0 ±1.5 | 10.5 ±2.0 |

## MUTUAL PHENOMENA OF SATURN'S BRIGHTER SATELLITES: JULY - AUGUST, 1980

By: John E. Westfall

The Earth will cross Saturn's ring plane for the third and last time during this present apparition on July 23, 1980. A variety of events involving Saturn's ball, rings, and satellites occur near the time of ring passage (see previous predictions: Journal A.L.P.O., Vol. 28, Nos. 1-2, pp. 5-13 and Journal A.L.P.O., Vol. 28, Nos. 3-4, pp. 55-61 and 61-63); this report concerns the close approaches, including mutual occultations, that will occur among the four brightest satellites--Tethys, Dione, Rhea, and Titan--for the 3½ weeks centered on the date of ring passage.

During the period covered here (July 11 - August 3, 1980 U.T.), Saturn will lie between 63° and 43° east of the Sun, being visible in the evening sky for about 3 hours after sunset. The previous reports cited above have described the type of instrument needed to observe these events, the general appearance of the phenomena, and the magnitudes of the

(text continued on page 114)

PHOTOGRAPHS OF JUPITER IN 1976-77 AT THE S. VITTORE OBSERVATORY, BOLOGNA, ITALY. See also text of article by Messrs. Favero and Zatti on pg. 104 _et seq_. Images are all simple inversions with south at the top.

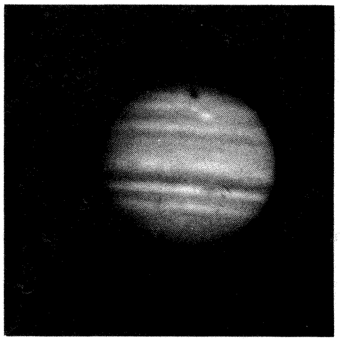

Figure 18. September 24, 1976. $3^h31^m$, U.T. CM (I) = 300°, CM (II) = 326°. Blue light. Note the shadow of satellite III (Ganymede) on the SSSTB, the small white oval in the STeZ (4 in Figure 13 and 7 in Figure 14), the white oval DE (5 in Figure 13), little red spot No. 2 in the NTrZ, and the dark spot on the north edge of the $NTB_n$ (3 in Figure 9).

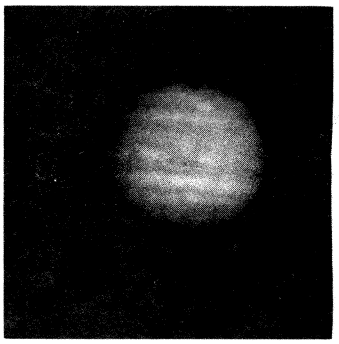

Figure 19. September 24, 1976. $3^h29^m$, U.T. Red light. Compare to Figure 18 in blue light. CM (I) = 299°, CM (II) = 325°. Note the darkening of the $EZ_n$ and the $NEB_s$ projections (which are bluish) and the disappearance of the $NEB_n$, the little red spot No. 2, and the $NTB_s$ (which are reddish).

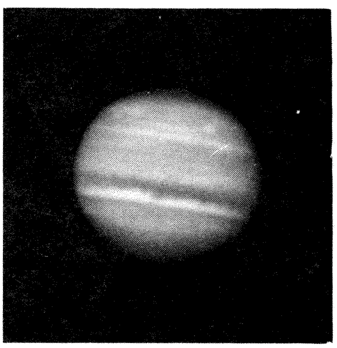

Figure 20. December 23, 1976. $22^h10^m$, U.T. CM (I) = 82°, CM (II) = 136°. Blue light. Compare to Figure 17 on page 111. Note the large negative drift in System II of the dislocated portion of the SSTB relative to white ovals FA and BC and the formation of little red spot No. 3.

combined satellite images. For those observers able to conduct photoelectric photometry (the value of such is described later), Table 1 gives data for reference stars in Saturn's vicinity during this period.

Table 1. Photoelectric Photometry Reference Stars.

| Star | 1980.5 Coord's. R.A. | Dec. | V | (B-V) | (U-B) | Spectrum |
|---|---|---|---|---|---|---|
| HD 100340 | $11^h31^m.9$ | $+5^{\circ}23'$ | +10.19 | -0.24 | -0.94 | B0 |
| 89 Leo | 11 33.5 | +3 10 | + 5.76 | +0.47 | -0.01 | F5 |
| BD+3°2528 | 11 36.5 | +3 23 | +10.72 | +1.55 | ----- | M2 |
| BD+5°2529 | 11 40.8 | +5 15 | + 9.60 | +1.19 | ----- | K8 |

Table 2 gives information on 48 satellite close approaches, including 7 total (or annular) and 3 partial occultations, for Saturn's four brightest satellites during the period of concern. In this table, times are U.T. (corrected for light-time); and the satellites are listed with the one closer to the Earth (the "occulter") first: "T" = Tethys, "D" = Dione, "R" = Rhea, and "Ti" = Titan. "Sep." indicates the center-to-center minimum apparent satellite separation in seconds of arc (measured parallel to Saturn's axis; positive if the first satellite is north of the second and negative if the first satellite is the southernmost). The value for "X" is intended as an identification aid and is the satellites' apparent distance from Saturn's disk center, in arc-seconds measured in the ring plane (positive indicating east and negative west). Under "Notes", "C" = conjunction, "P" = partial occultation, and "T" = either a total or an annular occultation. For occultations, "MD" is the estimated magnitude drop of the satellites' combined image at their closest approach. Here "(ring)" means that the satellites will be near (or even projected upon) Saturn's rings.

Table 2. Mutual Phenomena of Saturn's Four Brightest Satellites, July 11 - August 3, 1980.

| 1980 U.T. Date | Time | Sats. | Sep. | X | Notes |
|---|---|---|---|---|---|
| JUL 11 | 08.00 | RD | +0".37 | +51" | C |
| | 20:30 | RD | +0.57 | -22 | C |
| 12 | 01:07 | DT | +0.40 | -40 | C |
| | 01:14 | RT | +0.26 | -40 | C |
| | 02:21 | RD | +0.68 | -44 | C |
| 13 | 05:25 | TD | +0.17 | +22 | C (limb Sep. = 0".02) |
| | 14:56 | TR | +1.38 | -28 | C |
| | 23:08 | TTi | +1.43 | -39 | C |
| 14 | 01:39 | TTi | +1.26 | -32 | C |
| | 04:09 | DR | +1.20 | +27 | C |
| 15 | 00:52 | TTi | +0.61 | +30 | C |
| | 11:48 | RTi | +1.30 | +59 | C |
| | 12:30 | TD | +0.97 | -29 | C |
| | 22:52 | RD | +0.87 | +21 | C |
| 16 | 18:28 | DT | +0.90 | +40 | C |
| 17 | 20:26 | DR | +0.18 | -52 | P, MD = 0.00 |
| 18 | 18:29 | TR | +0.08 | +34 | P, MD = 0.2 |
| | 19:06 | TD | -0.39 | +32 | C |
| 20 | 07:42 | RT | +0.99 | +35 | C |
| | 23:39 | RD | +0.62 | -30 | C |
| 21 | 02:14 | TD | +0.49 | -18 | C (ring) |
| | 17:29 | TiD | -0.22 | +46 | T, MD = 0.2 |
| 22 | 01:54 | TiT | +0.32 | +23 | T, MD = 0.2 |
| | 06:21 | DT | +0.77 | +38 | C |
| | 17:37 | TiR | +0.28 | -21 | T, MD = 0.3 |
| | 18:32 | DR | +0.27 | -17 | C (ring) |
| | 23:04 | TiD | +0.10 | -36 | T, MD = 0.2 (see text) |
| 23 | 03:27 | TiD | +0.15 | -48 | T, MD = 0.2 (see text) |
| 24 | 08:29 | TD | -0.76 | +38 | C |
| | 15:13 | RD | +0.03 | +51 | T, MD = 0.5 |

Table 2. Mutual Phenomena of Saturn's Four Brightest Satellites, July 11 - August 3, 1980. (continued)

| 1980 U.T. Date | Time | Sats. | Sep. | X | Notes |
|---|---|---|---|---|---|
| JUL 25 | 11:12 | RT | -0."24 | -26" | C |
| | 12:38 | DT | -0.52 | -19 | C |
| 27 | 01:07 | TR | +0.67 | -40 | C |
| | 19:19 | DR | +0.04 | +32 | P, MD = 0.5 |
| | 19:46 | DT | +0.33 | +31 | C |
| 29 | 04:19 | TD | +0.50 | -32 | C |
| | 07:29 | TD | +0.24 | -18 | C (ring) |
| | 13:42 | RT | +0.03 | +16 | T, MD = 0.5 (ring) |
| | 14:05 | RD | -0.37 | +14 | C (ring) |
| | 19:59 | TD | -0.87 | +38 | C |
| 30 | 01:30 | RTi | -1.17 | -32 | C |
| 31 | 02:23 | DT | -0.97 | -29 | C |
| | 10:24 | DR | -0.36 | -50 | C |
| AUG 01 | 03:47 | TR | -0.65 | +16 | C (ring) |
| 02 | 09:29 | DT | -0.24 | +21 | C |
| 03 | 13:43 | TD | +0.33 | -39 | C |
| | 14:50 | RD | -0.50 | -35 | C |
| | 16:11 | RT | -0.90 | -40 | C |

Several restrictions apply to the above table. First, some geometrical alignments are not given because the furthermost satellite will be eclipsed or occulted by Saturn's ball or by Ring A. Second, eclipses of satellites by the shadows of other satellites are not included. Third, small ephemeris and satellite radius errors may cause some "near misses" to become occultations and _vice versa_, while the actual times may differ from the predicted by a few minutes. It is also true that all occultations will be of finite duration; for example, "first contact" may occur up to 5 minutes before mid-occultation. (The two occultations of Dione by Titan on July 22-23 may constitute exceptionally "slow" events and will be described later.)

Of the 48 events in Table 2, the 3 partial and 7 total/annular occultations are of particular interest, especially the three events (R Oc D JUL 24 15:13, D Oc R JUL 27 19:19, and R Oc T JUL 29 13:42) where the magnitude drop of the combined image may reach 0.5 stellar magnitudes. The occultation of Rhea by Titan on July 22 (17:37 U.T.), although the magnitude drop will be only 0.3, is also of interest because these satellites produce the brightest combined image (visual magnitude about + 8.1).

Figure 21 illustrates the two occultations of Dione by Titan on July 22 and 23, when the two satellites will be moving extremely slowly with respect to each other. In the figure, Dione is plotted with respect to Titan at intervals of 1 hour.

Approximate times for the events shown in Figure 21 are given in Table 3.

Table 3. Approximate Times (U.T. corrected for light-time) of Occultations of Dione by Titan, July 22 and 23, 1980.

| | | |
|---|---|---|
| July 22 (74 min. complete duration) | | |
| First Contact | 22:31 | Immersion 11 min. duration |
| Second Contact | 22:42 | Total Phase 47 min. duration |
| Closest Approach | 23:04 | |
| Third Contact | 23:29 | Emersion 16 min. duration |
| Fourth Contact | 23:45 | |
| July 23 (65 min. complete duration) | | |
| First Contact | 02:50 | Immersion 15 min. duration |
| Second Contact | 03:05 | Total Phase 40 min. duration |
| Closest Approach | 03:27 | |
| Third Contact | 03:45 | Emersion 10 min. duration |
| Fourth Contact | 03:55 | |

Finally, observers should know that an extensive table of predictions of Saturn satellite mutual occultations and eclipses was published by K. Aksnes and F.A. Franklin in 1978 ("Mutual Phenomena of Saturn's Satellites in 1979-1980", _Icarus_, _34_, 194-207). Observers with access to _Icarus_ should consult this article because their tables are more

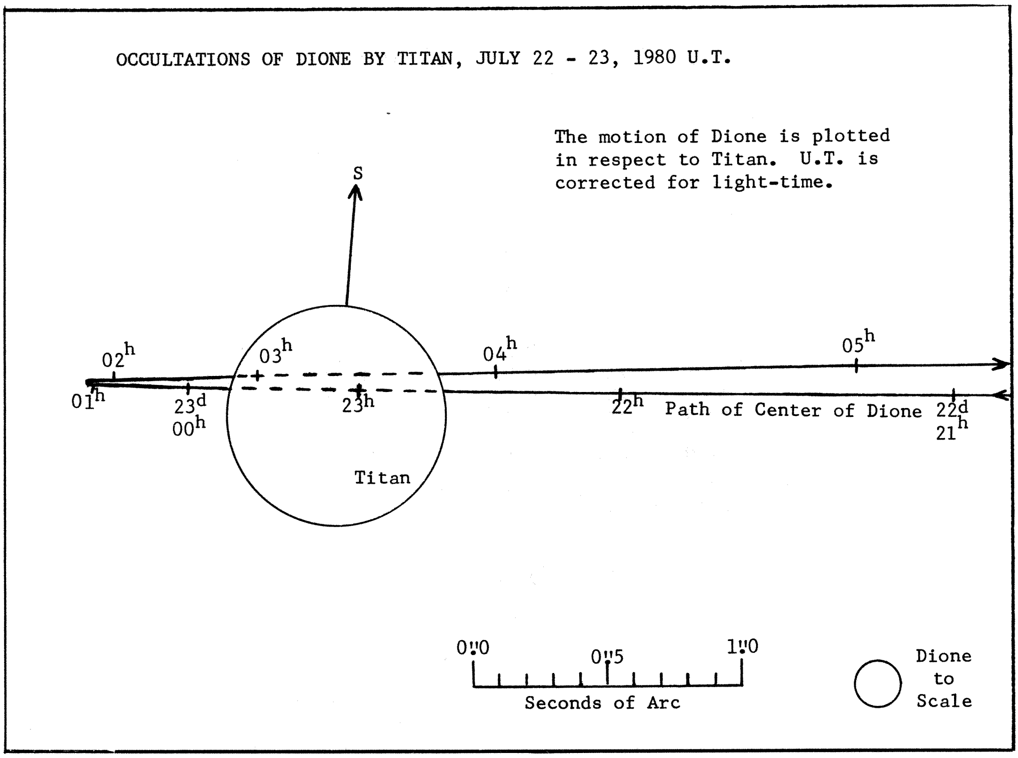


Figure 21. Two curious mutual occultations of Dione by Titan on July 22 and 23, 1980. See also text. Observe as much as your geographical location allows of a rare event!

* * * * *

complete than those published here; they cover a greater time span, deal with all satellites from Mimas (1) through Hyperion (7), and include information for eclipses as well as for occultations; eclipses of satellites by Ring A are also included. Fortunately for this writer's peace of mind, the two sets of ephemerides appear to be in good agreement when they overlap, with a mean deviation of time of ± 1.5 minutes and of minimum separation of ± 0".1.

Aksnes and Franklin stress that photoelectric measures of these events will be essential for correcting satellite orbits and radii in planning for the Voyager flybys. Such observations should be promptly reported to: Dr. R.L. Millis, Lowell Observatory, Flagstaff, Arizona 86001, as well as to the A.L.P.O. Saturn Recorder at his address on the back inside cover.

## PHOTOGRAPHIC PHOTOMETRY OF THE TOTAL LUNAR ECLIPSE OF SEPTEMBER 6, 1979

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

### General

On September 6, 1979 (U.T.), the Moon underwent the first total lunar eclipse in several years which was visible throughout the United States. With an eclipse magnitude of only 1.099, the Moon, even at mid-eclipse, was near the south edge of the umbral shadow. The brightness of the eclipse appears to have created some interest; observers disagreed whether the eclipse's Danjon luminosity was L = 2 or L = 3, while a pronounced and irregular "dark smudge" within the umbra also received attention (Ashbrook 1980, 31-32). This paper concerns an observational project which used photographic photometry to measure the Moon's total brightness during totality, as well as the distribution of brightness within the umbra. The measurement of photographic brightness was done with an Interpretation Systems Inc. (ISI) VP-8 image analyzer (Westfall 1979b).

### Whole-Disk Photometry

The photographic method used for whole-disk photometry is described in the A.L.P.O. Lunar Eclipse Handbook (Westfall 1979a, 6-7). In brief, a short-focal length photograph of the eclipsed Moon was compared with a photograph of a star field taken with the same roll of film, with the same lens, and with equal exposure times, but with the stellar photograph deliberately out of focus so that the stellar images have the same diameter as the Moon.

In this case, a 35 mm camera was used with a 35 mm f/2.0 lens, giving a lunar image 0.34 mm in diameter; the stellar photograph used a distance setting of 1.9 meters to achieve the same image size. Both exposures were 30 seconds (clock-driven) at f/2.0 on Tri-X film, exposed with a K2 (#8) filter to approximate V magnitudes (Hitch 1979, Table 1). The stellar photograph, of the constellation Orion, was exposed at 10:48 U.T., and the lunar photograph at 11:07 U.T.

In establishing the relationship between image density and visual magnitude, a linear least-squares fit was used with the four stars Alpha, Gamma, Delta, and Epsilon Orionis (unfortunately, both Alpha Ori and Delta Ori are variables, but must have been near mean magnitude at the time because they fell near the fitted line). The resulting fit was satisfactory ($r^2$ = 0.988); and, when an assumed visual atmospheric extinction coefficient of 0.35 stellar magnitudes was applied, gave a lunar visual magnitude of -2.79 ± 0.24 (P.E.) at 11:07 U.T. It should be noted that the formal statistical error may be an underestimate because of extrapolation and non-linearity; the lunar image was overexposed. In future applications, bracketed exposures should be used.

This result gave a dimming of 9.9 magnitudes as compared with the sunlit Full Moon (assumed V = -12.7), or a brightness ratio of 1.09 X $10^{-4}$. The magnitude estimate appears to be in fair agreement with this writer's visual estimates of -2.46 at 10:40 U.T. and -2.02 at 11:01 U.T., since the photograph was taken closer to the end of totality than the latter visual estimate.

## Point Photometry

A detailed "map" of the brightness distribution within the umbra can be constructed if one can measure the brightnesses of lunar features at known times and then calculate their positions relative to the umbral center. A series of such measures allows one to map an extensive portion of the umbra in some detail by making use of the Moon's motion.

Three photographs taken during totality were used, exposed at 10:38, 10:53, and 11:09 U.T. All were 15-second exposures on Ektachrome 400 film, taken with a 4-inch (10.2-cm) f/10.0 refractor, giving a lunar image 9.89 mm in diameter. It was assumed that this color positive film accurately responded to visual magnitude. (Earlier experiments showed this to be a fair approximation, with the linear least-squares relationship between visual magnitude and image brightness giving $r^2$ = 0.936 with a probable error of estimated magnitude of ± 0.10.)

The brightnesses of 22 selected bright and identifiable lunar features were measured on a pre-eclipse Full-Moon photograph (taken with the same film and instrument at 1/1000 sec. at 08:20 U.T.) and on the three totality photographs. The features used are listed in Table 1.

Table 1. Lunar Features used for Photographic Photometry of the September 6, 1979, Lunar Eclipse.

| Feature | Selenographic Lat. | Long. | Feature | Selenographic Lat. | Long. |
|---|---|---|---|---|---|
| Stevinus A | -31°.80 | +51°.67 | Proclus | +16°.08 | +46°.95 |
| near Riccius R | -41. | +26. | Manilius | +14.45 | - 9.12 |
| Tycho | -43.42 | -11.30 | Copernicus | +10. | -20. |
| Schickard | -44. | -55. | Kepler | + 8.10 | -37.97 |
| near Nonius L | -33. | - 4. | Reiner Gamma | + 7.5 | -59. |
| Polybius A | -23.03 | +28.03 | Posidonius | +31.65 | +29.48 |
| Langrenus | - 8.87 | +60.78 | Timocharis | +26.62 | -13.05 |
| Censorinus | - 0.40 | +32.67 | Aristarchus | +23.70 | -47.53 |
| Hipparchus C | - 7.40 | + 8.25 | Geminus | +34.5 | +56.5 |
| Guericke B | -14.57 | -15.23 | Anaxagoras | +73.45 | -10.17 |
| Byrgius A | -24.55 | -63.80 | Sharp B | +46.90 | -45.20 |

When compared with the features' Full-Moon brightnesses, these measures gave the relative brightnesses of 66 points within the umbra whose coordinates were computed in terms of arc-minutes north-south and east-west of the umbral center. This process sufficed to plot a map of the relative brightness distribution within the umbra, but these brightness values were expressed in entirely arbitrary units.

Conversion to a more meaningful set of brightness values was done by estimating the integrated brightness of the entire lunar disk at 11:07 U.T.--the time of the whole-disk magnitude estimate described earlier. This estimation was done by randomly sampling 200 points on the preliminary brightness map, giving a whole-disk mean brightness of 0.325 ± 0.018 (P.E.) in the original arbitrary units. This value, when compared with the estimated 9.9-magnitude (1.09 X $10^{-4}$) dimming of the lunar disk, allowed the original arbitrary units to be converted into a more meaningful system, representing the ratio of the brightness of the umbra to full sunlight. Figure 22 is an isophotic plot using these transformed units of measure.

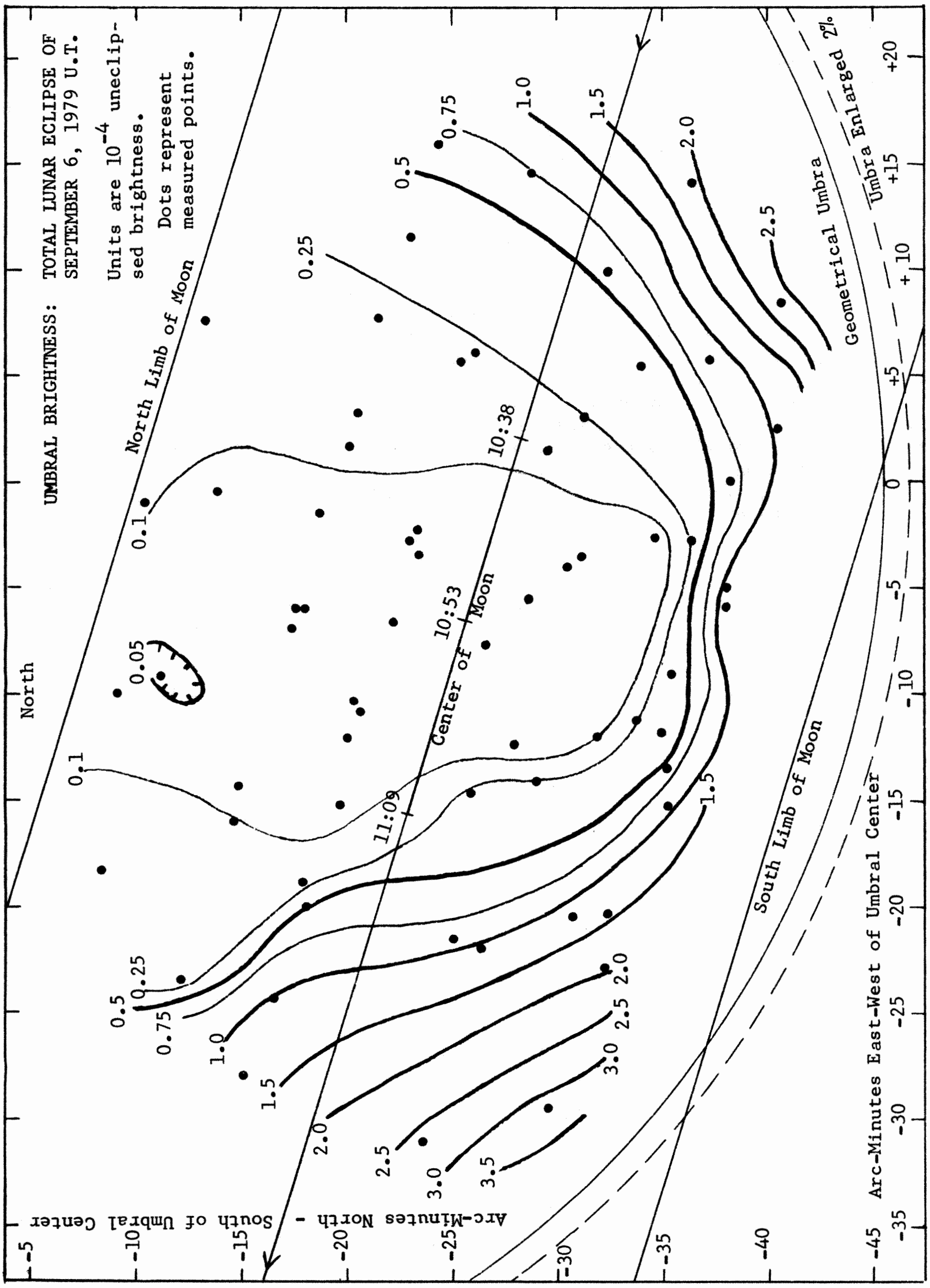


Figure 22. Isophotic plot of umbra during total lunar eclipse of September 6, 1979. The procedure employed is described by Lunar Recorder Westfall on pages 116-118.

* * * * *

The distribution of umbral brightness shown in Figure 22 is, of course, only approximate. Three obvious sources of error are the ± 0.24-magnitude (23 percent) probable error of the full-disk magnitude used, the 5.5-percent probable error arising from sampling the disk brightness at 11:07 U.T., and the imperfect relationship between photographic image brightness and visual magnitude adding about a 10 percent probable error. Any errors are probably greatest for the darker portions of the umbra, which were very underexposed on the three totality photographs, where a linear film response cannot be assumed.

Nonetheless, Figure 22 clearly shows the expected fall-off of umbral brightness as one proceeds inward from the edge of the umbra. It also shows the irregular "dark smudge" widely noted by observers of this eclipse, and depicts the irregular outline and asymmetric location of this feature in a manner which confirms both visual and photographic observations. It is also interesting to compare the isophotes of this eclipse with those of other total lunar eclipses (e.g., Link 1969, 78-79), which highlights the unusual appearance of this recent lunar eclipse.

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## BOOK REVIEWS

Galaxies: Structure and Evolution, by R. J. Talyer. Wykeham Publications Ltd., 10-14 Macklin Street, London WC2B 5NF. 1978. 203 pages. Hard cover Price 7.50 (about $18.00). Paperback Price 4.50 (about $10.80).

Reviewed by Charles S. Morris

Galaxies: Structure and Evolution is one of three books R. J. Talyer has written for the Wykeham Science Series. His other two books in this series are entitled The Stars: Their Structure and Evolution and The Origin of the Chemical Elements. The Wykeham Science Series is designed to provide up to date accounts of various scientific subjects ranging from astronomical topics to water waves. The books are designed to be on the senior high school - freshman undergraduate level.

After a review of some selected basic concepts in Chapter 1, Talyer proceeds in Chapters 2 and 3 to discuss the observational properties of our galaxy and external galaxies, respectively. Topics include the Local Standard of Rest, galactic rotation, interstellar gas and dust, classification of galaxies, distribution of galaxies, and quasars and radio galaxies, to name a few. Although these two chapters, which represent about a third of the book, are supposed to discuss observations, one finds a significant amount of theory and, in some places, mathematics.

Chapter 4 considers stellar dynamics from a statistical standpoint. Stars in a galaxy are equated to molecules in a gas. As the author points out, the material in Chapter 4 is on a more advanced level than the rest of the book. This advanced level is highlighted by more than fifty equations presented in the chapter. Fortunately, Talyer has written the book so that a detailed reading of this chapter can be considered optional.

Talyer returns to his original level of difficulty in Chapter 5 when he discusses how the masses of galaxies are estimated and presents some models of galactic mass distribution. The dynamical properties of that portion of galactic mass not contained in stars are outlined in the next chapter on the interstellar medium. The general chemical evolution of galaxies, especially interstellar gas, is presented in Chapter 7. The logical extension of Chapter 7 is to discuss the formation and evolution of galaxies. Thus, in Chapter 8 Talyer touches briefly on some basic ideas in cosmology, including the Big Bang theory. The final chapter of Galaxies: Structure and Evolution summarizes what is known and what remains to be discovered in each of the subject areas presented in the book.

Tayler's Galaxies: Structure and Evolution is well illustrated. However, this is not a book which gives the reader a lot of pretty pictures. Rather, the illustrations tend to be predominantly diagrams aimed at explaining a particular point or concept. Because of the level of difficulty of this book, it can not be recommended for the general amateur. However, for those people with a strong interest in galaxies and a strong background in physics and mathematics, Talyer's book is worth considering.

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Analysis of the 1978-79 Apparition of Jupiter, by P. Clay Sherrod. Mid-South Astronomical Research Society, P.O. Box 4145, North Little Rock, Ark. 72116. 1979. 40 pages. Price $3.00, paperback.

Reviewed by Phillip W. Budine

The above complete report on Jupiter for the apparition of 1978-79 is a fine group effort of a dedicated group of observers belonging to the Mid-South Astronomical Research Society. It represents a detailed analysis and evaluation of the 1978-79 apparition of Jupiter. The contents include: Section I - Latitude Measures of Jovian Belts and Zones as Determined with a Bifilar Micrometer. Section II - Observations of Jupiter from August 21 - September 25, 1978. Section III - Observations of Jupiter from September 27, 1978 to January 29, 1979. Section IV - Observations of Jupiter from April 10 to June 1, 1979. This section also includes a summary of the complete apparition. Section V is a listing of central meridian tansit timings and the derived longitudes.

The descriptive analysis is very well done, and the booklet is a joy to read. Planetary observers will find this feature the best part of the report and will want it on their bookshelf for a reference item in comparing different Jovian apparitions.

This report is a model piece of work. It would be good if other societies would follow the same type of endeavor or project, giving planetary specialists a larger data base for interpreting planetary observations. These group efforts should also be coordinated with organizations such as the A.L.P.O. The Mid-South Astronomical Research Society does this, and it is a valuable research organization working with the A.L.P.O. for the benefit of increased understanding of planetary research.

This report is easy to read and highlights many of the important aspects of the 1978-79 apparition. These include the Red Spot area, dark bars of the NEB, white ovals of the EZ, interruptions of the $SEB_s$, South Temperate Zone white ovals, and rotational data for many of the features. It would have been good to have the South Temperate Zone white ovals identified by their designation: DE, FA, and BC. Also, because of poor observing conditions there was a gap in the observational records from January 30 to April 9. During this period there was a South Equatorial Belt Disturbance which erupted on March 11, 1979; and therefore the report does not include analysis of this event.

To summarize, I recommend the report to interested planetary observers. It is best suited for active observers wanting a record of a particular planet's observational history for this period. Beginners will find very little to help them (such as observing techniques), and this report was definitely not intended for that purpose. The only diagrams are longitude drift line diagrams. There are no drawings or photographs in the report. Possibly in the future at least some sketches could be included and would reproduce well and still not increase the cost of the publication. This reviewer believes they would be a valuable addition and would help illustrate some of the descriptive and important data in the text. I do highly compliment this group's efforts and enthusiasm in compiling this report. The project is an excellent effort, and I am looking forward to their next publication.

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Graze Observer's Handbook, Second Edition, by Harold Povenmire. J.S.B. Enterprises, 763 Pinetree Drive, Indian Harbour Beach, Florida 32937. 1979. 192 pages. Price $8.50.

Reviewed by Richard Nolthenius

For the past 15 years or so there has been a new area where amateurs with modest equipment and no advanced training can contribute scientifically useful observations. That area is the observation of lunar grazing occultations. Having had experience in two of the more traditional amateur observing programs - variable star and meteor observing, I have found grazing occultations to be much more exciting and varied. Unfortunately, the field has not received the exposure that these other activities have. Povenmire's is still the only book on the subject available in English.

Unfortunately, the second edition shares with the first the problems of poor organization, numerous scientific errors, and a lack of attention to grammatical and typographical errors on the part of the publisher. The work also suffers from too few illustrations. There is space here to note only some of the more serious errors.

Stationing observers along railroad lines should not be recommended under any circumstances. Not only is this dangerous, but the passage of trains vibrates the nearby ground so severely that no observations are possible. Povenmire advocates spacing observers 300 to 500 feet apart. However, observed lunar features can be more accurately compared to predictions if most observers are more or less evenly spaced over a range of one to three miles, depending on the profile. As a rule of thumb (p. 95), set up on the limit line and north of a southern limit. The Watts charts provide lunar limb profile data. They are not projections of topographic maps.

Another problem is the retention of information which was outdated even in the first edition. The description of the University of Texas as a major sponsor of graze work is not correct now that Dr. Dunham has left. The lengthy section on profile plotting will be of little value to new observers since the necessary Watts charts publication is not generally available. Far more reliable computer generated profiles have been available to International Occultation Timing Association members for several years. The description of position reductions by using a slide rule is likewise not particularly useful today. Finally, the list of the 12 most successfully observed grazes omits several very successful grazes during the past 5 years.

Mr. Povenmire has been one of the most prolific graze observers, and his experiences are worthwhile reading for the novice. He also has good sections on weather, equipment, and observing problems. However, his book cannot be considered a handbook. The beginner is better advised to join the International Occultation Timing Association (IOTA) for a year and to subscribe to their quarterly newsletter (both for $7 in the U.S.). Membership will include a set of publications from Dr. Dunham and the U.S. Naval Observatory on observing and reporting grazing and total occultations, as well as on local graze predictions. The address is: IOTA, P.O. Box 596, Tinley Park, IL 60477. IOTA is in the process of preparing a comprehensive graze manual, but its publication will not be soon.

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Red Giants and White Dwarfs, New Edition, by Robert Jastrow. W.W. Norton & Co., Inc., New York, N.Y. 1979. 275 pages. Price $12.50.

Reviewed by Walter Scott Houston

This updating of an earlier and successful book, if anything, results in an even better job which fans of Jastrow will read as if it were a brand new copy. Much of the volume has been rewritten, especially the chapters on Mars, Jupiter, UFO's, and the impacts of astronomy on biological development.

Jastrow is a fierce independent with a passion for communication. Also, it is gratifying to see even more attempts to bridge the gap between layman and scientist. He infers that the "no life on Mars" experiment, logically, did show life on the Red Planet, but that political pressures prompted a rejection of the results. He holds that the UFO data is a proper field for scientific research. Delightful is his statement that the Pleiades cluster is so young the dinosaurs never saw it -- the big reptiles were all extinct before the cluster formed. Jastrow, tring again to link human experience with cosmology, underlines the fact that the young stars in the Orion Nebula were "born" about the same time that man began his long development to his present dilema.

If you don't want to keep your own copy, give it to your local library. The book should be read by a great many people.

## NEW BOOKS RECEIVED

By: J. Russell Smith, Walter Scott Houston, and Dale P. Cruikshank

1980 Yearbook of Astronomy, edited by Patrick Moore. W.W. Norton and Company, New York, N.Y. 10036. 1980. 230 pages. Notes by Mr. Smith.

This annual publication by a well-known English author presents a useful and handy guide for an observer. Part One consists of northern and southern star charts, which show stars down to the fourth magnitude. There is a useful listing of the phases of the Moon for 1980 as well as a Monthly Notes, 1980 section. This part is followed by Eclipses, Occultations, Comets, Meteors, and Minor Planets in 1980. Part Two consists of interesting articles; and Part Three lists interesting variable stars, double stars, nebulae, and clusters, as well as some recent astronomical books.

Any observer will find this to be a very useful book to have on his shelf.

* * * * * * *

Astronomical Calendar 1980, by Guy Ottewell. Department of Physics, Furman University, Greenville, S.C. 29613. 1979. 47 pages. Price $8.00, softcover. Size 11" X 15". Notes by Mr. Smith.

The first part of this handy and useful publication presents a large star chart for each month of the year as well as a diagram which shows the positions of the terrestrial planets for the month. The page following each chart contains a listing of celestial events by date for the month. Next, one finds diagrams with text on the inner planets for 1980. Following this are sections on (1) Mars, Jupiter, and Saturn in 1980, (2) Venus in 1980, (3) comets, (4) eclipses, (5) stellar magnitude, (6) elongation, (7) meteors, and (8) space exploration. This last is followed by a finder chart for Juno, Uranus, Neptune, and Pluto.

Here is a well-planned and useful book for anyone interested in astronomy.

* * * * * * *

The View From the Earth, 1980, by Guy Ottewell. Department of Physics, Furman University, Greenville, South Carolina 29613. 1979. 33 pages. Price $4.00 postpaid. Soft cover. Size 8½" X 11". Notes by Mr. Smith.

This booklet is a simpler and smaller version of the author's Astronomical Calendar for 1980. It consists of a large star map for each month plus notes. The star maps are black with white stars, making them stand out quite well. There are also explanations of a number of astronomical terms which will be helpful to the beginner. On the last page one finds an explanation of how he may use his hand and little finger to measure degrees in the sky.

Protostars and Planets, Tom Gehrels, Editor. University of Arizona Press, Box 3398, Tucson, Arizona 85722. 1978. Illustrated. 756 pages. Price $17.50. Notes by Mr. Houston.

The Editor presents this collection of papers as an effort to stimulate a new discipline - one that develops the interface between studies of star formation and those of the origin of the Solar System. This leads to fascinating ideas such as the contamination of the solar nebula by materials from supernovae. There is discussion and also photos of meteorites where carbonaceous fragments are imbedded in a usual chondrite (Sharps). Supernovae are suggested as essential to star formation and indeed to the spiral arms of our galaxy. T Tauri stars are avidly worked over as are the Herbig-Haro objects. It's a little like a round of drinks with some off-duty astronomers who are doing the real frontier explorations! The book is only for those who have considerable background in modern astrophysics.

* * * * * * *

Radiative Processes in Astrophysics, by George B. Rybicki and Alan P. Lightman. John Wiley & Sons, New York. 1979. 382 pages. Price $29.95. Notes by Dr. Cruikshank.

This is a highly technical book on the physics of electromagnetic radiation from excited atoms and molecules, and the interaction of that radiation with matter. The book is suitable for high-level university courses in radiative transfer and astrophysics. There are many mathematical problems with their solutions.

* * * * * * *

Life in Space, by Dinah L. Moche. A and W Publishers, Inc., 95 Madison Avenue, New York, N.Y. 10016. 1979. 160 pages. Illustrated. Price $10.95 paperback, $25.00 cloth. Notes by Mr. Smith.

If you are interested in an up-to-date outer space book, this is the one for your shelf. The author has chosen the following chapter titles: Riddle of Life, Planet Close-ups, Looking for Other Planetary Systems, Space Travel, Search for Extraterrestrial Intelligence, Puzzling Phenomena, and Space Colonies. There ia also a suitable Index.

As a former teacher of astronomy in high schools and colleges, I can recommend this book for every library from middle grades through college. The book is full of colored photographs which will attract the attention of any reader.

## THE MARTIAN 1979-80 APPARITION - A PRELIMINARY REPORT-I

By: C.F. Capen and D.C. Parker, A.L.P.O. Mars Recorders

### Abstract

A mid-apparition report of observed Martian surface and atmospheric phenomena, made by A.L.P.O. astronomers, that are useful for post-opposition observations is here presented.

There has been great interest shown in observing Mars before and during this current 1979-80 Martian apparition. There are 45 subscribers to the Martian Chronicle '80, an observer's newsletter; and about 70 Mars Observing Kits for 1980-84 and 1800 standard Mars Observing Report Forms have been mailed. By the close of March, 1980, over 300 visual observations and quality photos and many long-distant phone conversations had been received from A.L.P.O. astronomers reporting current events that had occurred upon the Red Planet.

Observations of Mars made during January, February, and March, 1980 by A.L.P.O. astronomers recorded an increasingly active atmosphere, a rapidly shrinking NPC (North Polar Cap), leaving behind a wind-swept dark polar collar, and a strong to moderate, general blue-clearing. While observing with the 12- and 24-inch Lowell Observatory refractors, Patrick Moore and Chas. Capen detected a bright projection bordering on a dark notch within the North Polar Cap at about 320°-330°W. longitude on the nights of Feb 22 & 23 at 70°$L_s$.* This NPC rift was later confirmed by a phone call from Don Parker in March, which indicated that the dark rift line extended completely across the cap, dividing it into two parts. The dark rift, called Rima Tenuis, was also seen across the cap with a 12-inch refractor late in March by C. Capen. The new secular darkening across Aetheria and along the Chaos-Hyblaeus (240°W; 30°N) has been well observed by most astronomers. Late in the 1977-78 aphelic apparition this region was noted to be changing. The Chaos-Hyblaeus, which borders the Elysium volcanic shield on the northwest, was found to be quite dark and somewhat enlarged on 1978 Viking Orbiter photos. So here is an example of telescopic observations that aid in the interpretation of Viking Mission data. White, circular clouds are presently being observed over the volcanoes located on the Tharsis Ridge and Amazonis region.

Albedo dark features have been easily seen in violet-light (W-47) in the south, equatorial, and north latitudes. This Blue-clearing, also called Violet-clearing, is detected by "cross-checking" or "blinking" with violet (W-47) and then orange (W-23) or red (W-25)

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*Note diagram in Figure 24 for meaning of $L_s$.

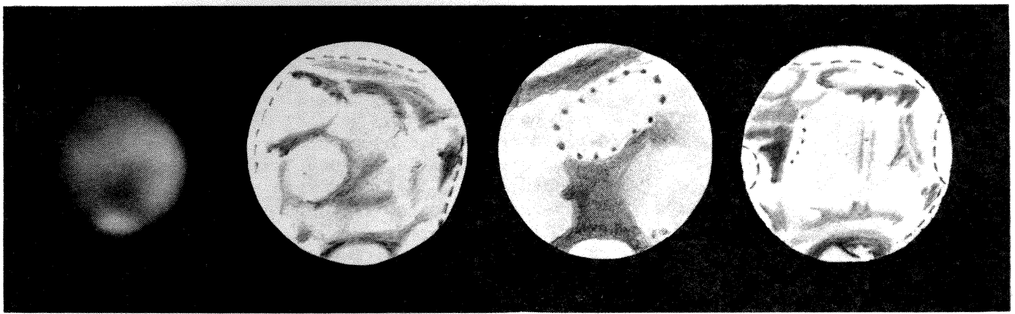

Figure 23. Observations of Mars by A.L.P.O. astronomers during the current 1979-80 apparition. The visual drawings and photograph illustrate some of the seasonal activity now occurring on Mars: frost patches, white clouds, changes in albedo features, and the Rima Tenuis rift in the North Polar Cap. Left to right: (1) photograph by D.C. Parker on January 13, 1980, $8^h57^m$, U.T., 12.5-inch Newtonian reflector, SO-115 film, CM = 12°; (2) Drawing by C.F. Capen on February 1, 1980, $10^h35^m$, U.T., 12-inch refractor, W-30 magenta filter, CM = 224°; (3) Drawing by R. Robotham on February 8, 1980, $2^h10^m$, U.T., 6-inch Newtonian reflector, no filter, CM = 41°; (4) Drawing by C.F. Capen, February 23, 1980, $6^h0^m$, U.T., 24-inch refractor, W-30 magenta and W-38 blue filters, CM = 325°.

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filters. Blue-clearing is rated on a scale of 0-3, where: 0 = no visible features seen in violet light, 1 = some features barely visible (weak B-C), 2 = features easily seen and identified (moderate B-C), 3 = features are about as well defined in violet as in red-light (strong). Blue-clearing can usually be detected with small to moderate aperture telescopes and with below average seeing conditions.

It is indeed exciting to learn that the Rima Tenuis rift has been sighted in the NPC during this 1979-80 apparition. It was Schiaparelli who noted with his 9-inch refractor that the NPC was divided by this dark rift in 1888. Maggini observed this rift during the 1918 apparition. The division was not seen by A.L.P.O. astronomers in the decade of the 1960's, not even with large telescopes of 24 to 82 inches in aperture.

During March, April, and May Mars will be in his most interesting seasonal aspect, that of northern late spring and early summer, when astute observers can detect many daily and weekly changes in the atmosphere, on the surface, and in the north polar region.

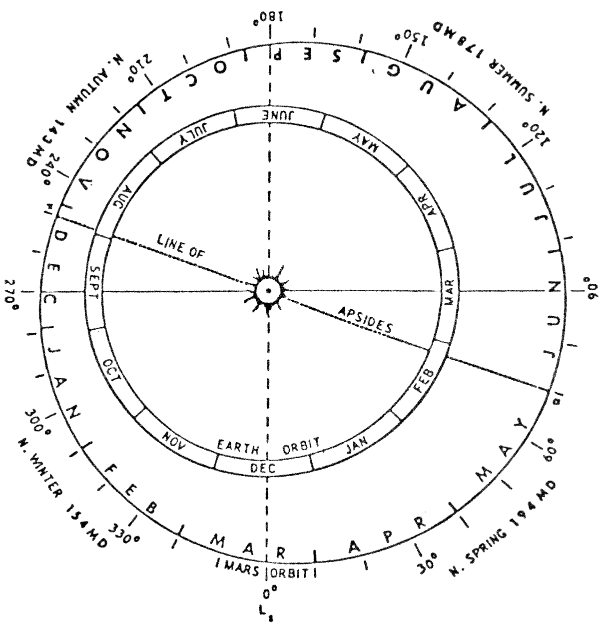



Figure 24. A heliocentric chart of the orbits of Mars and the Earth which defines the relative seasons of both planets in the planetocentric system $L_s$. Note that $0^0$ comes at the vernal equinox of the north hemisphere.

## RECENT OBSERVATIONS OF SATURN, WITH PROSPECTS FOR SPRING AND SUMMER, 1980.

By: John E. Westfall

As this is written, the Earth has just passed through the ring plane of Saturn--this is the second of three such occurences this apparition. As pointed out in recent JALPO issues, a number of interesting observations are possible at such times.

This writer's recent observations of Saturn have been made with a 10-inch Cassegrain reflector, an instrument perhaps in the mid-range of capability of those possessed by many A.L.P.O. members. Thus, the accompanying illustration (Figure 25) shows three views of what Saturn observers may currently expect to see. In addition to aperture and optics, seeing and transparency are important in determining just what will be visible.

The view of the satellite system near ring passage is often striking, particularly when the satellites are silhouetted against the ring, producing the famous "beads on a thread" effect (see sketches for March 4th and 9th). Also of interest are transits of satellites and their shadows across the ball (see February 4th sketch), eclipses and occultations of them by the ball, and mutual phenomena involving pairs of satellites. (For predictions, see JALPO, 28, Nos. 3-4 (Jan., 1980), pp. 55-63 and article on pp. 112-116 of this issue).

Observers may also wish to determine under just what conditions they can, or cannot, detect the rings and their shadow on the ball. Table 1 summarizes the recent experiences of the writer, which may, of course, differ for other observers, instruments, and sky conditions.

Table 1. Conditions of Ring Visibility.

| Ring Phenomenon | Critical Parameter(s) | Anticipated Visibility Dates, Spring and Summer, 1980 |
|---|---|---|
| Ring Shadow (on ball) | $\lvert B'\rvert > 0\overset{\circ}{.}4$ | March 29 and later |
| Sunlit ring face (off ball) | $\lvert B\rvert > 0\overset{\circ}{.}03$ | July 24 and later |
| Unlit ring face (off ball) | $\lvert B\rvert > 0\overset{\circ}{.}7$ | April 1 - July 5 (Highly dependent on optics and atmosphere) |
| Unlit ring face (on ball) | $\lvert B\rvert > 0\overset{\circ}{.}7$ | April 1-July 5 |

The three factors critical for ring visibility are: B = Saturnicentric latitude of Earth, B' = Saturnicentric latitude of Sun, and b = apparent minor axis of rings. Table 2 gives these values at 10-day intervals for Spring and Summer, 1980.

Table 2. Ring Visibility Ephemeris, 1980.

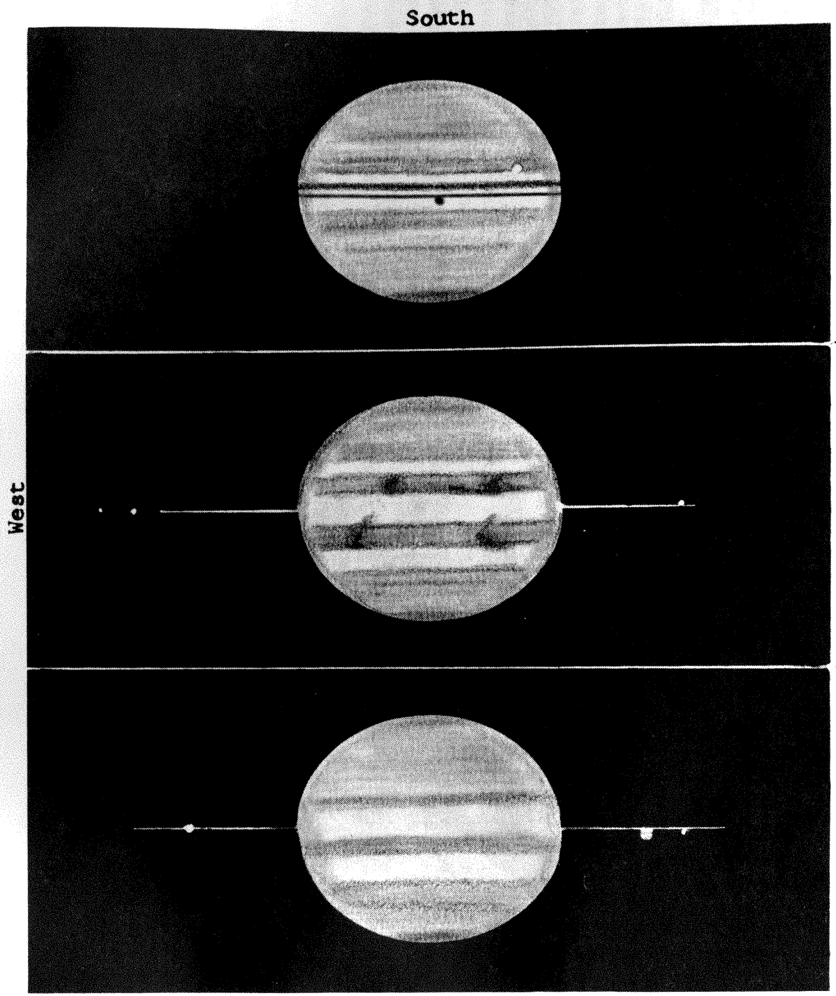
| | B | B' | b |
|---|---|---|---|
| APR 01 | $-0\overset{\circ}{.}70$ | $+0\overset{\circ}{.}44$ | $0\overset{''}{.}54$ |
| 11 | -1.01 | +0.60 | 0.77 |
| 21 | -1.26 | +0.75 | 0.96 |
| MAY 01 | $-1\overset{\circ}{.}45$ | $+0\overset{\circ}{.}90$ | $1\overset{''}{.}08$ |
| 11 | -1.55 | +1.06 | 1.14 |
| 21 | -1.58 | +1.21 | 1.14 |
| 31 | -1.52 | +1.36 | 1.08 |
| JUN 10 | $-1\overset{\circ}{.}39$ | $+1\overset{\circ}{.}52$ | $0\overset{''}{.}97$ |
| 20 | -1.17 | +1.67 | 0.80 |

| | B | B' | b |
|---|---|---|---|
| JUN 30 | $-0\overset{\circ}{.}89$ | $+1\overset{\circ}{.}82$ | $0\overset{''}{.}60$ |
| JUL 10 | $-0\overset{\circ}{.}54$ | $+1\overset{\circ}{.}97$ | $0\overset{''}{.}36$ |
| 20 | -0.14 | +2.12 | 0.09 |
| 30 | +0.31 | +2.28 | 0.20 |
| AUG 09 | $+0\overset{\circ}{.}80$ | $+2\overset{\circ}{.}43$ | $0\overset{''}{.}51$ |
| 19 | +1.33 | +2.58 | 0.84 |
| 29 | +1.88 | +2.73 | 1.18 |
| SEP 08 | $+2\overset{\circ}{.}44$ | $+2\overset{\circ}{.}88$ | $1\overset{''}{.}53$ |
| 18 | +3.01 | +3.03 | 1.88 |

NOTES: Before JUL 23--Unlit ring face visible.
JUL 23.2--Earth crosses ring plane ($B = 0\overset{\circ}{.}00$, $B' = +2\overset{\circ}{.}17$)
After JUL 23--Sunlit ring face visible
SEP 23--Conjunction with Sun.
(All data for $0^h$ U.T.)

It is hoped that this preliminary report will whet other observers' appetites for observing Saturn while these phenomena are still in progress.

Note by Editor. We are very glad to be able to present the current observational material about Mars and Saturn in the last two articles. Of course, we do so only through the cooperation of staff members Capen and Westfall. Perhaps readers would enjoy further current coverage of this kind more than the full reports, which are necessarily delayed until a planetary apparition is ended and all observations have been submitted and analyzed. (Problems of available space also arise.) When readers let us know their wishes, we are glad to try to meet them.




1980 FEB 04, 12:09 - 12:33 U.T.
B = +1°.27, B' = -0°.43
Ball 19".2 X 17".2; Rings 43".3 X 0".96

10 in. (25 cm.) Cass., 220X & 330X.
Occulting Bar, Apodizing Screen.
S = 6, T = 5.

Rhea in transit on SEB near E. limb; Rhea's shadow is near disk center. Above Rhea's shadow is the ring shadow; immediately above the ring shadow is the unlit ring face in silhouette.

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1980 MAR 04, 07:20 - 07:47 U.T.
B = +0°.32, B' = +0°.02
Ball 19".7 X 17".6; Rings 44".4 X 0".25

10 in. (25 cm.) Cass., 220X & 330X.
Occulting Bar, Apodizing Screen.
S = 8, T = 5.

Satellites, from W. to E., are: Mimas and Enceladus (both to W. and off rings), and Tethys (to E. and on rings). Sunlit face of rings visible off ball.

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1980 MAR 09, 06:32 - 06:38 U.T.
B = +0°.13, B' = +0°.09
Ball 19".7 X 17".6; Rings 44".4 X 0".10

10 in. (25 cm.) Cass., 330X.
Apodizing Screen.
S = 5, T = 5.

Satellites, all on rings, from W. to E. are: Rhea (to W.), and Titan and Dione (both to E.). Sunlit face of rings visible off ball.

Figure 25. Three recent views of Saturn during the edgewise apparition. Two critical ring visibility parameters are given: B and B' (see text). For the February 4th view, the "dark" face of the rings was turned toward Earth; the sunlit face is visible in the other two views, but at a very narrow angle of view, giving them the appearance of a bright line.

## ANNOUNCEMENTS

New Addresses for Staff Members. Our Saturn and Venus Recorder now has the following address, to which all correspondence and observations should be sent:

Julius L. Benton, Jr.
Darien 13A
Village 2 at New Hope
New Hope, Pennsylvania 18938

Dr. Benton is employed in optics research by the famous Questar Corporation at New Hope.

Assistant Jupiter Recorder Doel receives his mail at:

Ron Doel
447 S. Prospect St.
Bowling Green, Ohio 43402

Mr. Doel is a graduate student at Bowling Green and is working on some exciting projects for the Jupiter Section, which we hope to announce in due time.

Riverside Telescope Makers Conference. The 12th annual meeting of this very popular Far West gathering will occur on May 24, 25, and 26, 1980, over the Memorial Day weekend. The site is Camp Oakes, five miles east of Big Bear City, California and at a height of 7300 feet in the San Bernardino Mountains. Cheap camping, lodging, and dining facilities are available at Camp Oakes. Those wishing to stay instead at a motel in Big Bear must make their own reservations; the Robinhood Inn and Lodge is recommended. The three days will be full of astronomical activities. These include merit award certificates for displays and telescopes, a $100 award to an outstanding amateur astronomer, a Swap Meet, door prizes, and a Proceedings. The last-named will be sold by the Orange County Astronomers for $7.00. Everyone is welcome to participate as a speaker at the Conference. Those wishing further information should write soon to the Conference Chairman, Mr. Clifford W. Holmes, 8642 Wells Avenue, Riverside, CA 92503 (Phone (714) 689-6893).

AAVSO Meeting at Houston. The 69th Spring Meeting of the American Association of Variable Star Observers will be at Houston, Texas on May 2-4, 1980. The Houston Astronomical Society will be the host. Activities will take place at the Houston Airport Hilton Inn. Highlights of the meeting will include a tour of the NASA-Lyndon B. Johnson Space Center. Variable star observers in Texas seldom have a national meeting like this one so geographically convenient. Further information can be obtained from Tom Williams, 5410 Coral Ridge Road, Houston, TX 77069 (Phone (713) 440-3953).

Special Offer of B.A.A. Jupiter Reports. One of our former active observers, Dr. Eugene Epstein, is offering to sell for $200 his collection of 27 Reports of the Jupiter Section of the British Astronomical Association. The twenty-seven of these often hard-to-find reports include the Second Report (1894), four others from the 1890's, and six from the 1900's. The latest report is the Thirty-Third (1946). Dr. Epstein may be contacted at Radio Astronomy Program, Aerospace Corp., Box 92957, Los Angeles, CA 90009, or at Phone (213) 648-6798, person-to-person, collect. The material described is a unique treasure-house to the Jupiter student.

Valuable Predictions for Minor Planets Observers. Mr. Derek Wallentinsen recently wrote in part as follows: "The A.L.P.O. Minor Planets Section Visual Photometry Predictions for 1980...will be available without charge to interested persons as a supplement to Planetary Astronomy (a new magazine of Solar System astronomy of which I am asteroids and comets columnist and an Associate Editor) from James-Mims Observatory, P.O. Box 15854, Baton Rouge, LA 70895... [Occultation predictions] are available from the J.M.O. as JMO Contribution No. 2, Occultations by Minor Planets, 1979-1982 for $3 at the above address."

Request for Material for Future Handbook. Jupiter Recorder P. Karl Mackal has sent us the following note: "Dr. J. Ashbrook and I would like papers from 1250 words (5 manuscript pages) to 2500 words (10 manuscript pages) for the 1982 (or 1984) Advanced Observer's Handbook. Send one copy of your report to P. Karl Mackal, 7014 W. Mequon Rd., 112 N., Mequon, WI 53092 and a second copy to Dr. J. Ashbrook, 16 Summer St., Weston, MA 02193. The Handbook is to cover space science as related to manned (and unmanned) missions to Jupiter, Saturn, and Uranus. Hence, the Jupiter system is only an incidental topic of interest. Emphasis on space stations and ion propulsion systems will be made, for example, in my own paper, 'Europa and Callisto as Bases for Future Jupiter Research'. The Handbook is to be dedicated to the memory of Dr. Werner von Braun, our great space pioneer."

Aerospace Conference in Florida. The American Society for Aerospace Education is sponsoring the National Convention for Aviation and Space Education on July 19-27, 1980 at the Florida Institute of Technology, Melbourne, Florida and the NASA Kennedy Space Center. For details, write to the American Society for Aerospace Education, 1750 Pennsylvania Ave., N.W., Suite 1303, Washington, D.C. 20006 or Phone (202) 347-5187.

Request for Nominations for 1981 Amateur Achievement Award. The Astronomical Society of the Pacific is soliciting nominations for its annual award to recognize achievement in the field of amateur astronomy. The award includes a citation and a $250 cash prize. Nominations may be made by any individual or group. Nominees must be amateurs (i.e., not employed in the field of astronomy in a professional capacity) who have made significant contributions to astronomy and/or amateur astronomy.

Letters of nomination should include a concise statement (about 100 words) highlighting the qualifications of the nominee for the award. The letter should also be accompanied by a longer description of the nominee's contributions, including (when possible) publications, news clippings, a biography, etc. There is no special form to fill out. All nominations will be read and evaluated by the Awards Committee of the Astronomical Society of the Pacific. The final decision will be made by the A.S.P. Board of Directors.

Nominations should be sent by June 15, 1980 to Amateur Award, A.S.P., 1290-24th Ave., San Francisco, CA 94122.

Apollo Rendezvous. This popular annual amateur gathering is being held at Dayton, Ohio on June 13 and 14, 1980 (Friday and Saturday). This 10th anniversary meeting will include the usual program papers on many subjects, telescope and equipment displays, slide shows, door prizes, and an after-dinner speaker. This meeting is by and for enthusiastic amateurs. Further information can be obtained from the Registration Chairman, Apollo Rendezvous, 2629 Ridge Ave., Dayton, OH 45414. The Miami Valley Astronomical Society sponsors this meeting.

## ASTRONOMY "80", AN UNUSUAL JOINT CONFERENCE

The Astronomical Society of the Pacific, the Western Amateur Astronomers, and the Association of Lunar and Planetary Observers are holding a joint meeting on the campus of the University of Arizona at Tucson, Arizona on July 7 to 12, 1980. It is the first time that the partly professional A.S.P. has ever met with either the W.A.A. or the A.L.P.O., in itself guaranteeing a large number of outstanding professional speakers on the program. The W.A.A.-A.L.P.O. registrants will also enjoy free access to most of the A.S.P. programs, and conversely. An important feature of the Convention will be three different tours: a bus tour (no private cars) to Mount Hopkins and the Multi-Mirror Telescope for $16.50, a bus tour to the Kitt Peak National Observatory for $14.25, and a free on-campus tour of the University of Arizona Laboratories and Planetarium. These tours will be filled on a first-come, first-served basis so that early registration is strongly encouraged. All advance preparations and publicity mailings are being handled by the University of Arizona. The person to contact for information is: Ms. Judith Brown, Conferences; University of Arizona; 1717 E. Speed Way; Tucson, AZ 85719.

The W.A.A./A.L.P.O. registration fee is $33 per person. If this amount may seem large to some readers, it does include a luncheon on Tuesday (July 8) and the banquet on Saturday (July 12). Also, on-campus accommodations are much cheaper than at some other recent similar meetings: the dormitory charges are $5.25 per person for double occupancy and $8.25 per person for single occupancy. Meals can be obtained on-campus in the Student Union dining areas at a reasonable cost on a pay as you go basis. There will be no meal tickets. The Student Union adjoins the Convention Meeting location. The dormitories will provide linen and towels but no blankets. All University buildings will be air-conditioned, which guests will appreciate in Tucson in July.

Experience has shown that, apart from needed attendance by everyone, qualified A.L.P.O. members can add to these meetings by contributing to the papers on the program and to the astronomical display. In this connection we invite attention to the following message from C.F. (Chick) Capen: "This meeting promises to be the biggest held out West for several years to come. Astronomy "80" will be a meeting composed of both professional and amateur astronomers, with representatives from many of the major California Observatories, Universities, and amateur societies. The University of Hawaii and Mauna Kea Observatory will be represented. Also, Arizona astronomers from Lowell Observatory, U.S. Naval Observatory, Kitt Peak Observatory, Steward Observatory, the Lunar and Planetary Laboratory, and five Arizona amateur societies plan to attend.

"Since the theme of the A.S.P. Scientific Symposium is: 'The Importance of Ground-Based Astronomy in the Space Age', it would be most valuable and timely for A.L.P.O. Section Recorders to prepare and to present exhibits which illustrate the expertise and professionalism of the A.L.P.O. planetary observer. Please make your exhibit plans now; and contact Chick Capen, A.L.P.O. Exhibits, 223 W. Silver Spruce, Flagstaff, AZ 86001 for space requirements, i.e., how many square feet of table top and/or wall space. If you cannot attend this important conference, send your exhibits, with return postage, to Chick Capen by July 1, 1980. I am sure that it would be most gratifying to your Section contributing astronomers to see their observations and techniques on display."

The Paper and Program Chairman is Professor Ashley T. McDermott, 7921 Sonora Drive, Palm Desert, CA 92260. Papers should be mailed to him in a "camera-ready" format. However, the Editor (Walter H. Haas, Box 3AZ, University Park, NM 88001) will undertake to forward to Professor McDermott any A.L.P.O. papers which are mailed to him. A word of caution: get that paper ready soon if it is to be included on what may become a very full program.

It may help to give next a preliminary day-by-day program:

Monday, July 7. 9a.m., A.S.P. Educators' Workshop: "The Universe in the Classroom." 8p.m., evening lecture for Workshop.

Tuesday, July 8. 9a.m. to 5p.m. and 7-10p.m., amateur session, papers by amateurs and non-technical lectures by professional astronomers. 9a.m., special bus tour to Mt. Hopkins for professional astronomers only. Noontime luncheon. 7-9p.m., reception for A.S.P. registrants only at Kitt Peak Observatory Offices near University of Arizona campus.

Wednesday, July 9. 9a.m. to 5p.m., A.S.P. Symposium of invited and contributed papers on "The Importance of Ground-Based Astronomy in The Space Age." 9a.m. on, three tours as described above. 8p.m. A.S.P. public lecture.

Thursday, July 10. 9a.m.-4p.m. Symposium and contributed papers. 4-5p.m., A.S.P. membership meeting. 9a.m. on, tours. 7p.m. A.S.P. Banquet and Awards Presentation.

Friday, July 11. 9a.m.-5p.m. Scientific Symposium and contributed papers. 9a.m. on, tours. 8p.m. Joint A.S.P. and W.A.A. public lecture.

Saturday, July 12. 9a.m.-5p.m. and 7p.m., amateur session as on July 8. Noontime, luncheon banquet.

## PLUTO CONVENTION

"Pluto-the Ninth Planet's Golden Year" was the title of an astronomical gathering on the campus of New Mexico State University at Las Cruces, New Mexico, held to commemorate the 50th anniversary of the discovery of Pluto and to honor the discoverer, Dr. Clyde W. Tombaugh. The dates were February 17 and 18, 1980. The technical papers will appear in a special "Pluto issue" of the magazine *Icarus*. Subjects covered included the spectophotometry of Pluto, its possible atmosphere, its physical properties, the discovery and observability of satellite Charon, and the role of Pluto among the planets and satellites in the outer reaches of the Solar System. (Is it just a distant asteroid?) It now appears very clear that the mass of Pluto, somewhere near 0.002 Earth-masses, never perturbed the motions of Uranus and Neptune to the extent assumed by the mathematical predictors like Lowell and W.H. Pickering. The discovery rather resulted from the soundness of the search techniques and the remarkable patience and perseverance of the discoverer.

For Clyde's many friends in Las Cruces and indeed over the whole nation and even internationally, the highlight of the meeting was the evening banquet and the accompanying program. The customary humorous review of the honoree's life included the facetious fantasy that he was a resident of Pluto who was banished because of his puns! In a more serious vein, it was announced that one of the asteroids discovered during the 1928-42 search at the Lowell Observatory (it did not terminate with the discovery of Pluto) now bears the I.A.U.-approved name of "Tombaugh". The climax of the evening was the presentation to Dr. Tombaugh of the Regents Medal of New Mexico State University. He is only the fifth person to be so honored. Please note the front cover photograph.

A delightful feature of the Convention was the presence of Mr. Patrick Moore, the English astronomer and writer, and a news team he headed from the British Broadcasting Corporation. They planned to feature the astronomical discovery in a monthly program.

# The Strolling Astronomer

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## STAFF