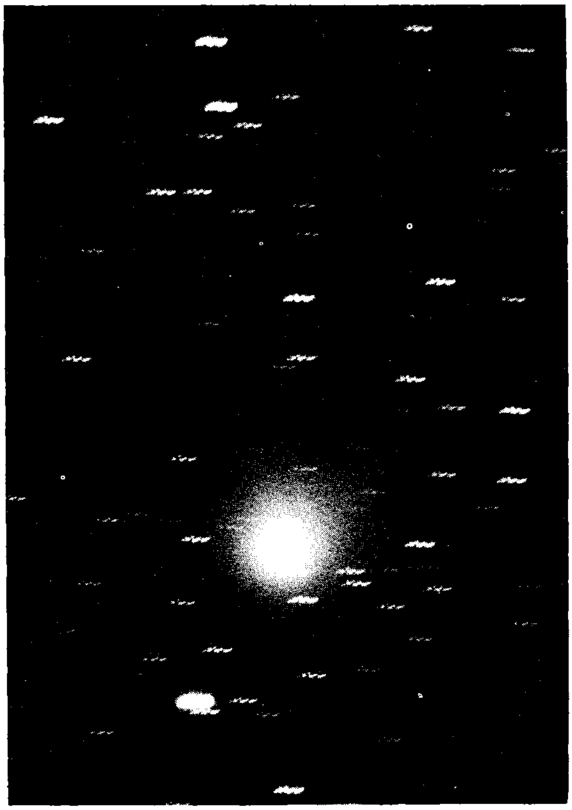
ISSN 0039-2502

The Journal Of The Association Of Lunar And Planetary Observers

The Strolling Astronomer

Volume 35, Number 4 | Published December, 1991



Comet Levy (1990c), photographed by Milt Hay, Jr. on 1990 Aug. 20, 03h40m-03h55m UT, with a 140-mm (5.5-in) Schmidt-Newtonian telescope using Fujicolor 200 Film. South is at the top; the field measures 1°.39 vertically by 0°.95 horizontally. See pages 145-152 inside for an article on the history of the A.L.P.O. Comets Section.

THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS
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ASSOCIATION OF LUNAR & PLANETARY OBSERVERS
A L P O
Founded in 1947

IN THIS ISSUE

THE FIRST 25 YEARS OF THE A.L.P.O. COMETS SECTION

By: Daniel W. E. Green, David D. Meisel, and Dennis Milon, A.L.P.O. Comets Section

ABSTRACT

This report provides a brief history of the A.L.P.O. Comets Section's first 25 years and summarizes the results obtained during this time, when David Meisel and Dennis Milon were Section Recorders. The data compiled during this time period have been reduced and published in the *International Comet Quarterly* (*ICQ*), and are now available to researchers in machine-readable form as part of the *ICQ* Archive of Photometric Comet Observations. Included in this report is a tabulated comet-by-comet index of these compiled data, listing specific sources for summary articles published in the *J.A.L.P.O.* and tabulated data published in the *ICQ*.

The A.L.P.O. Comets Section has had an interesting history, aided by the energetic contributions of numerous observers whose names are well known to long-time readers of the *Strolling Astronomer* (*J.A.L.P.O.*) and *Sky & Telescope*. The Comets Section played an important role during the 1960s and 1970s, in that it introduced standardized procedures to improve the quality of data obtained by observers, and the results of the Section thereby led directly to the development of the computerized archive of cometary data begun in the late 1970s under the direction of co-author Green at the Smithsonian Astrophysical Observatory. Comets Section Recorders Meisel and Milon developed observing procedures that enabled the Section to collect what is perhaps the world's most comprehensive archive of visual and photographic data on comets that were visible during the two decades following the Section's founding in 1957.

I. BACKGROUND AND ORGANIZATION

The remarkable appearance of two naked-eye comets (Arend-Roland 1957 III and Mrkos 1957 V) in one year sparked David Meisel's interest in these objects (during his senior year in secondary school) and produced numerous observations by others in the Western Hemisphere. Meisel's observations of Comet Arend-Roland started a number of months before it became a naked-eye object. In addition to sketches and magnitude estimates, crude astrometric positions were also secured, which were then used to calculate a rough orbit for the object using Olbers' and Gauss' methods. All of this material (some of which is in the A.L.P.O. archives) was collected together as an entry in the West Virginia State Science Fair. It turned out that the Science Fair was held the same week that Comet Arend-Roland was first sighted as a naked-eye object. With photographs of the comet on the pages of *Life* and *Time* magazine, Meisel's project won first prize and a modest scholarship to college.

Meisel founded the A.L.P.O. Comets Section in 1957 to address the need for compiling visual and photographic observational data on comets (Haas 1957). Since amateur interest in comets in North America at this time was quite low, much of Meisel's early work was inspired by the first edition of J. B. Sidgwick's book *Observational Astronomy for Amateurs* (1955), published just two years earlier. The precepts cited in this book were based on methods used by the British Astronomical Association's Comet Section and included a most valuable list of references. It was evident, however, that Sidgwick's book was not yet widely available in the Western Hemisphere, where only a few potential observers belonged to the B.A.A. The A.L.P.O. Comets Section thus filled an early need by disseminating information on standards for observing, as well as collecting observations (see *Figure* 1, p. 150).

In the early days of the Comets Section, much time was spent on the methodology of making total magnitude estimates. Meisel favored the Bobrovnikoff method over Sidgwick's own recommendation since the former appeared more objective (see Meisel and Morris 1976, and also Morris 1980, for detailed discussions of these methods). The opportunity to test the various photometric methods came in 1959-60 with the appearance of Comet Burnham 1960 II. At this same time, Meisel was made aware of the Levin photometric reduction formula, which claimed a more physical basis than the normal power law, and the Comet Burnham work included this formula in the analysis. Unknown to Meisel at the time, Bobrovnikoff (1951) showed that from a purely mathematical standpoint, the results of the two formulae are nearly identical over the usual range. The physical basis of the Levin formula was later discredited and disavowed by Levin himself, so interest in the power-law formula has been maintained in most comet total magnitude analyses.

In 1961, Meisel went on to do graduate study at Ohio State University and worked directly with N. T. Bobrovnikoff, culminating in a Master's Degree in astronomy; Bobrovnikoff retired in 1965, and Meisel finished his Ph.D. with work in stellar spectroscopy.

Dennis Milon assumed the position of Comets Recorder in 1964 (see Milon 1964), upon the resignation of Meisel, and he continued as Recorder until 1984. During the 1960s and 1970s, Milon regularly issued Section bulletins to alert observers to the existence of new comets, providing ephemerides (and sometimes star charts with comparison-star magnitudes) to aid observers. One of Milon's important contributions as Recorder was in getting observers to communicate with each other. He also encouraged various individuals to perform analyses of the data. In the summer of 1972, he sent all of the original Section files to Charles S. Morris in Michigan for a study of aperture correction, from which an important paper was written (Morris 1973). While nothing was lost in the shipping process, this action emphasizes Milon's interest in making good use of the collected data.

Milon (1968) also revised the standard observing report form; this form, which was used for many years, consisted of an 8.5X11-inch sheet of paper that requested observing times, local observing conditions, magnitude information, instrumentation, and coma and tail information. All of the Section report forms under Meisel (1960; see *Figures 2* and *3*, pp. 150 and 151) and Milon (see *Figure 4*, p. 152) were designed to hold information for only one night's observing of a single comet (see section III, below). Many of the comets studied by A.L.P.O. observers in the 1960s and 1970s were described in detailed reports in the *Strolling Astronomer*, and some papers were published elsewhere that also made heavy use of A.L.P.O. Comets Section data (cf. Meisel 1970; Morris and Bortle 1973; Kleine and Kohoutek 1977; and numerous articles in *Sky & Telescope*, such as Morris 1975). On the editorial staff of *Sky & Telescope* during most of his tenure as Comets Section Recorder, Milon was able to collect more information on comets (particularly from overseas observers) than a Recorder located elsewhere might have been able to find; this synthesis of data by Recorder and Assistant Editor shows up in many (often anonymous) *Sky & Telescope* notes and articles from the 1960s and 1970s [e.g., *Sky Telesc. 35*, 247 (1968); *36*, 121 and 348 (1968); *39*, 196 (1970); and *40*, 248 (1970)].

II. THE *INTERNATIONAL COMET QUARTERLY* (*ICQ*)

The *ICQ* now publishes recent observations of comets as well as older unpublished data, the tabulated portion being maintained in computer format for efficient use by researchers (Green 1980). *ICQ* Editor Daniel Green and Associate Editor Charles S. Morris, who together founded the *ICQ* in 1978 to establish this useful archive of cometary data, were both active in the A.L.P.O. Comets Section in the 1970s, and former Section Recorder Meisel is on the *ICQ*'s Editorial Advisory Board; the Comets Section thus had a most significant influence on the development of the *ICQ*. The *ICQ* has coordinated the efforts of groups such as the A.L.P.O. Comets Section, the Comet Section of the British Astronomical Association, the Dutch Comet Section, Hoshino Hiroba (Japan), the Comet Section of the Royal Astronomical Society of New Zealand, and others, so that researchers can access, in one convenient location, cometary data from observers worldwide. Standards have been established to make the data more uniform and valuable, such as requiring the observer to state the magnitude method, the comparison-star reference, and full instrumentation for each observation.

Green *et al.* (1986) have discussed the development of the *ICQ* Archive. The fifth edition of the Archive is now available on 9-track magnetic tape, and contains nearly 50,000 observations on hundreds of comets from 1909 to 1991 (cf. Morris and Green 1992). An important part of compiling cometary data for this single large archive has been sifting through the valuable old files amassed by the A.L.P.O. Comets Section. (The *ICQ* also publishes articles and general news concerning comets, and issues an annual Handbook of comet ephemerides; for further information on the Archive or on subscribing to the *ICQ*, write to Daniel W. E. Green, *ICQ* Editor, at: Smithsonian Astrophysical Observatory, 60 Garden St., Cambridge, MA 02138.)

III. COMPUTERIZING THE COMETS SECTION DATA

Co-author Green has compiled, tabulated, and published virtually all of the usable magnitude data from the Comets Section's first 25 years of files, which had been collected first by Meisel and then by Milon. The A.L.P.O. data from this time period have proved invaluable to the *ICQ* Archive, providing data of many comets not well observed elsewhere. It is evident from a perusal of *Table 1* (pp. 148-149) that the Comets Section was in its prime for about fifteen years, ending in 1976. The last big contribution to the Comets Section archives involved the observations of the bright comet West 1976 IV; only a handful of observers continued to contribute data to the Section after 1976. As a dropoff had occurred in analysis of Section data in the J.A.L.P.O., some Section observers stopped sending data to the Section and began sending instead to the *ICQ* for immediate publication. For some reason, however, there appeared as well to be a decline in activity and interest among comet observers in the U.S. during 1977-1980, with again only a handful of U.S. observers that were active in the early- to mid-1970s being still active in the early- to mid-1980s. (Of course, the pending apparition of Halley's Comet brought in many new regular observers in the period 1980-1986. And this late-1970s slump in the U.S. does not appear to be reflected among observers of other countries.)

Beginning in the late 1970s, Green has gradually sifted through the Section's files and put appropriate data in tabulated form for publication in the *ICQ*. The majority of reports in the A.L.P.O. files consist of one observation per comet per night per report form, using the standard report form that was employed by the Comets Section during most of its first 25 years (e.g., see Milon 1968). In numerous instances where comparison stars were carefully listed by the observers on the report forms (and the comet's brightness described with respect to them), total visual magnitudes were either computed for the first time or were recomputed using more modern comparison-star magnitude data. For brighter comets that were quite well observed, such as Kohoutek 1973 XII, some 10-20 percent of reports were excluded from publication in the *ICQ*, a level that is similar to the current level of exclusion among reports received for publication in the *ICQ*; this judgment usually involves either a severe lack of useful data or very inexperienced observers who obviously were not quite sure of what they were doing. This procedure of extracting data for publication in the *ICQ* was finished in 1991, with the exception that descriptive information of numerous comets provided by John E. Bortle is still being compiled for publication in the *ICQ*.

IV. THE OBSERVERS OF THE COMETS SECTION

In the files of the Comets Section's first 25 years, one finds reports from scores of individual observers. However, close inspection of these files will turn up the names of a few observers year after year, comet after comet—individuals such as Leo Boethin, Darrell Conger, Albert Jones, Vic Matchett, Michael McCants, R. B. Minton, Doug Smith, Derek Wallentinsen, and especially John Bortle, Karl Simmons, and Charles S. Morris. Morris was a significant contributor to the work of the Comets Section in the 1970s, both as an observer and as one who reduced Section data and contributed summary articles to the *Strolling Astronomer*. One observer who sent copies of much of his observational data for inclusion in the Comets Section files was Albert Jones of New Zealand. His data were not extracted from Comets Section files, because Jones made a special compilation of his data for publication in the *ICQ* [cf. Nos. 56 (1985), 63 (1987), 64 (1987), 66 (1988), 67 (1988), and 68 (1988)].

The most significant observer contributing to the Comets Section's files, however, was John E. Bortle of New York. Again, Bortle made a special compilation of his data for publication in the *ICQ*, and this compilation appeared in October 1982 (Whole Issue No. 44). Bortle's Comets Section reports are being mainly used for the plentiful descriptive information that he wrote about most comets, and such information is still being published in the regular "Descriptive Information" section of the *ICQ*.

V. INDEX TO THE COMETS SECTION DATA

The tabulated index (*Table 1*, pp. 148-149) lists each comet for which there existed observational information in Comets Section files. Each comet's name (and Roman-numeral designation for long-period comets) is listed, along with the source of published data in the *ICQ* and any relevant summary articles that may have appeared in the *Strolling Astronomer*. Note that Bortle's data were published in the October 1982 *ICQ* and Jones' observations were published over several *ICQ* issues (see section IV, above)–and are not included in the present index. This index should prove useful to those who are seeking out information on particular comets.

VI. ACKNOWLEDGEMENTS

A look at A.L.P.O. data in either of these two publications (*J.A.L.P.O.*, *ICQ*) will reveal the tremendous amount of time logged by the observers over 25 years, all of whom deserve thanks for their contributions to this fine set of comet data. Charles S. Morris also provided useful comments from a critical reading of this manuscript prior to publication.

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Table 1. Index to Reports and Specific Data: Comets Section Observations.

(References are given as Volume:page.)

Comet	ICQ reference(s)	J.A.L.P.O. reference(s)
Arend-Roland 1957 III	13:9, 13:97	12.57
Mrkos 1957 V	13:98	---
Burnham 1958 III	13:98	13:15
Burnham-Slaughter 1959 I ***	---	13:117
Bester-Hoffmeister 1959 III	13:98	15:87
Alcock 1959 IV	13:99	14:108
Alcock 1959 VI	13:99	14:32, 15:86
Burnham 1959 VII ***	---	15:90
Burnham 1960 II	13:99	14:111, 15:183,16:116, 16:154
Candy 1961 II	13:101	15:89, 16:166
Wilson-Hubbard 1961 V	13:101	16:167, 17:228
Seki 1961 VIII	13:101	15:220, 16:170, 17:228
Seki-Lines 1962 III	13:101	17:232, 18:55
Humason 1962 VIII	13:104	16:171, 17:232, 18:52
Ikeya 1963 I	13:105	17:232, 18:99
Alcock 1963 III	13:106	17:232, 18:160
Pereyra 1963 V	13:107	17:178, 18:159
Tomita-Gerber-Honda 1964 VI	13:107	18:42, 18:220
Ikeya 1964 VIII	13:107	19:37
Everhart 1964 IX	13:107	19:1
Ikeya-Seki 1965 VIII	13:3, 13:9	19:62, 19:90, 19:94, 19:206, 20:64, 20:165, 21:146, 21:201
Alcock 1965 IX	13:11	19:92
Barbon 1966 II	13:12	---
Ikeya-Everhart 1966 IV	13:12	20:194
Kilston 1966 V	13:4, 13:12	19:216
Rudnicki 1967 II	13:5, 13:13	20:164, 23:99
Wild 1967 III	7:74	21:11
Seki 1967 IV	7:74	21:11
Mitchell-Jones-Gerber 1967 VII	7:74	20:128, 20:161
Ikeya-Seki 1968 I	10:97	21:26, 21:109, 24:219
Tago-Honda-Yamamoto 1968 IV	12:77	21:28, 21:101
Whitaker-Thomas 1968 V	12:78	21:53
Honda 1968 VI	11:5, 11:10, 12:118	22:106, 22:124
Bally-Clayton 1968 VII	11:6, 11:12	---
Honda 1968 IX	12:118	---

—Continued on p. 149 with notes. —

Table 1—Continued.

Comet	ICQ reference(s)	J.A.L.P.O. reference(s)
Thomas 1969 I	12:112, 12:119	---
Fujikawa 1969 VII	10:99	24:75
Tago-Sato-Kosaka 1969 IX	11:6, 11:12	25:94
Daido-Fujikawa 1970 I	12:119	---
Bennett 1970 II	12:119	28:246
Kohoutek 1970 III	10:99	---
White-Ortiz-Bolelli 1970 VI	12:119	---
Suzuki-Sato-Seki 1970 X	12:119	---
Abe 1970 XV	12:120	---
Toba 1971 V	10:99	24:68
Bradfield 1972 III	10:100	---
Heck-Sause 1972 VIII	10:100	---
Kojima 1973 II	10:100	---
Kohoutek 1973 VII	12:122	---
Kohoutek 1973 XII	10:100, 12:122	24:177, 24:208
Bradfield 1974 III	10:107*	28:134
Kobayashi-Berger-Milon 1975 IX	2:7, 2:28, 2:55; 3:15, 10:107, 12:122	25:200
Suzuki-Saigusa-Mori 1975 X	3:19, 3:48, 10:107, 12:123	28:134, 29:12
Bradfield 1975 XI	10:107	---
Mori-Sato-Fujikawa 1975 XII	2:75, 10:108	28:134, 28:217
West 1976 VI	10:108	26:33, 26:48, 26:128, 26:172, 29:69, 29:155
Kohler 1977 XIV	3:78	27:124, 28:26, 29:150
Bradfield 1978 VII	3:83	---
Seargent 1978 XV	3:83	---
Meier 1978 XXI	3:83	---
Bradfield 1979 X	2:36, 3:49	29:45
P/Borrelly	---	15:88
P/Encke	7:78, 10:120, 13:128	15:89, 16:167, 20:164
P/d'Arrest	**	26:125, 27:51, 27:88
P/du Toit-Neujmin-Delporte ***	---	13:12
P/Faye	10:122	24:22
P/Finlay	13:130	15:88
P/Giacobini-Zinner	10:121, 13:130	15:87, 24:198
P/Grigg-Skjellerup	3:86, 7:98	26:259
P/Haneda-Campos	3:87	---
P/Honda-Mrkos-Pajdusáková	2:83; 10:121	13:117, 28:134, 28:197
P/Kearns-Kwee	12:167	---
P/Klemola	13:8	---
P/Schaumasse	13:134	---
P/Schwassmann-Wachmann 1	---	15:88
P/Reinmuth 2 ***	---	20:164
P/Tempel 1	12:163	---
P/Tempel 2	7:79	---
P/Tuttle	7:82	20:193
P/Wild 1	13:140	15:90
P/Wild 2	3:88	---

Notes:

*The majority of observations of Comet 1974 III will be published in the January, 1992 issue of the *ICQ*.

**Many A.L.P.O. observations appeared in the October 1976 issue of the *Comet Quarterly* (the predecessor to the *ICQ*).

***comet not seen.

HARVARD COLLEGE OBSERVATORY
CAMBRIDGE 38, MASSACHUSETTS

May 15, 1959

Mr. David D. Meisel
Comets Section
The Association of Lunar and Planetary Observers
800 Eighth Street
Fairmont, West Virginia

Dear Mr. Meisel:

Thank you for your letter of March 30. We believe that you can do a real service to astronomers and to amateurs by your proposal.

We enclose a copy of the cipher code which is used for Astronomical Telegrams so that you may decode future telegrams for your members. Satellites have taken many astronomers away from comet-discovery and hence reduced the number of astronomical telegrams. Sometimes there are long intervals between telegrams. However, we shall be glad to place you on our list for telegrams. Telegrams are always sent Collect. Is this satisfactory?

We give official permission for you to send the information to your members by way of airmail mimeographed cards and also to use the information for transmission over your amateur radio set. Communicate with Dr. F. W. Wright here about any questions which you may have.

In addition, we give our permission for you to request that amateurs send airmail copies of all initial discovery reports to you for possible confirmation. This confirmation would be a great help to us, but the time element must be stressed here, since our Harvard Observatory acts as a clearing house and reporter for astronomical discoveries for the whole country, and the discoverer who reports to us first will have his name attached to the comet. Professionals are much more experienced and it seems best to leave our arrangements with them as they were, and have you help in cases of amateurs only. This can be a real and important service to us. We should be happy to designate you as an official amateur clearing house for amateur cometary reports.

Sincerely yours,

Donald H. Menzel

Fred L. Whipple

DHM
FLW:ewm
Enclosure (1)

Figure 1. Letter acknowledging the role of the A.L.P.O. Comets Section as a communications node for amateur comets observations.

A.L.P.O. COMETS SECTION - A.L.P.O. - 800 8th. St.
D. Meisel, Recdr. Fairmont, W.Va., U.S.A.
Candy 1960n OBSERVATION OF COMET Jan. 10, 1961 1:35 UT
DATE (and decimal U.T.) JAN. 10, 1961 1:36 PLACE 20 miles NW Houston
Approx. R.A. 22h 58m Dec. +39°50'
Observing Conditions
Transparency 4 very clear for Houston
40° above horizon
MAGNITUDE ESTIMATES AND COMPARISON STARS
mag 8 compared to NGC 205 M32
M 14 and stars on Skalnate Pleso
Description (Coma diam, degree of condensation; nucleus; tails, length and position angle.) and other REMARKS
Coma diameter 8', hard, star-like nucleus
Tail 15' P.A. 33°
DENNIS MILON
2118 HULDY
HOUSTON 19, TEXAS
Instrument (and X.) 21X
6" Cave Richest Field Reflector
Observer and Station
(continue over with field sketch. BE SURE TO INCLUDE THE SCALE AND FIELD ORIENTATION.)

Figure 2 (below). First version of A.L.P.O. Comets Section observation report form, designed by David Meisel. Contains sample observation of Comet Candy 1961 II by Dennis Milon.

Figure 3. Second version of A.L.P.O. Comets Section observation reporting form, designed by David Meisel, containing a sample observation of Comet Everhart 1964 IX by Rev. Kenneth J. Delano.

(1)

A. L. P. O. COMETS SECTION
DAVID MEISEL RECORDER
800 EIGHTH STREET,
FAIRMONT, WEST VIRGINIA

OBSERVATION OF COMET Everhart 1964h

1:40 U.T. DATE(and U.T.): October 4,1964   Place New Bedford

Approx.R.A. 16hrs46min DEC. +28°48'   Dist from horz. 25°

Obs.Cond.(seeing,trans.,moonlight,sky light,and etc.):

Seeing = fair, transparency = good, but brightly lit sky in w.

Magntude: Total 9.5 Nucleus ______ Method compared with M57

Comp.Stars:

DESCRIPTION(coma dia.,degree of cond.,0=diffuse,9=sharply condensed;haloes;jets;tail,p.a.and length.)and REMARKS:

central condesnation was 3' of arc in diameter and the degree of condensation was 4. The total diameter of the visible halo was 8' of arc. No tail.

Rev. Kenneth J. Delano
St. Mary's Rectory
343 Tarkiln Hill Rd.
New Bedford, Mass.

A 12.5" Newtonian Reflector was used at 96X with half degree field of view.

Continue on the reverse with a sketch-scale and orientation included-also additional remarks about unusual features.

Observer,Inst.,and X.:

ALPO COMETS FORM A.

(2)

A. L. P. O. COMETS SECTION
DAVID MEISEL, RECORDER
800 EIGHTH STREET
FAIRMONT, WEST VIRGINIA

OBSERVATION OF COMET Everhart 1964h

DATE(and U.T.):Oct.11,1964, 1:00   Place New Bedford, Mass.

Approx.R.A. 16hr55m   DEC. +31°07' Dist from horz. 30°

Obs.Cond.(seeing,trans.,moonlight,sky light,and etc.):

Seeing = poor, transparency exeellent, but city lights.

Magnitude: Total 10.5 Nucleus ______ Method compared with

Comp.Stars: 9.4magn. NGC205

Description(coma dia.,degree of cond.,0=diffuse,9=sharply condensed;haloes;jets;tails,p.a.and length.) Remarks:

Seen just as a diffuse spot. Too windy for details.

Rev. Kenneth J. Delano
12.5" Reflector, 96X

Continue on the reverse with a sketch-scale and orientation included-also additional remarks about unusual features.

Observer,Inst.,and X.:

ALPO COMETS FORM A.

Figure 4. Third version of A.L.P.O. Comets Section observation reporting form, designed by Dennis Milon, with a sample observation of Comet Ikeya-Seki 1965 VIII by John E. Bortle (not including an attached drawing).

A.L.P.O. COMETS SECTION — COMET ____IKEYA - SEKI 1965 f____

Observer ____Mr. John E. Bortle____ Date (UT) ____October 31/November 1,1965____

Address ____29 East Fourth Street____ Time (UT) ____09:40 - 10:20 UT____

____Mount Vernon,N.Y.____ Dist. from horizon ____~8°____

Place of Observation ____29 East Fourth Street,Mount Vernon,N.Y.____

Approximate R A ____12h 18m____ Approx. declination ____-18° 40'____

Sky conditions (Transparency, haze, moonlight, twilight, city lights, faintest naked eye star near comet):

Seeing 3 Sky 5.6 city lights (Sky near head ~ 4-4½)

MAGNITUDE ESTIMATES (state methods and telescopes used): Instr. 10x50 bin. Met. extra-focal star images

Total magnitude ____4.2____ Tel. ____10x50____ Magnitude of nucleus ____-____ Tel ________

Comparison stars, magnitudes, and catalog used: CBS Yale U. Obs.

4757 δ Crv 3.11
4775 η Crv 4.42

DESCRIPTION (State methods and instruments used--i.e., photo, visual, micrometer, etc): Instr. 5"refr.(Coma) NE (Tail) Method. reticle eyepiece(coma)

Tail length ~18° Pos. angle of tail (plot on an atlas and measure) ____270° ±3°____

Remarks on tail (detail, color, shape, etc.): It is rather difficult to get a good PA value as the tail is gentley curved along its entire length. No detail in 10x50,south edge of tail better defind than north. (over)

Coma description (diameter, shape, jets with P.A., etc.): Diameter ~1½',nucleur condensation 40"-1'in diameter. NC deffenently less well bounded than before, it is no longer evenly brilliant but in creases steadily in brightness (over)

Degree of condensation of coma. Scale: 0=diffuse, 9=stellar. ____8____
(A sketch will be of value)

FIELD SKETCH: (Draw on an atlas if possible and recopy.)

See Attached Drawing

Power ____________

Diameter of field ____________

Note: Drawing paper may be used instead. If the sketch is intended for publication, it should not be folded.

THE REMOTE PLANETS: 1987-1990 REPORT

By: Richard W. Schmude, Jr., A.L.P.O. Remote Planets Recorder,
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ABSTRACT

This report describes photometric, visual, and color studies of Uranus and Neptune in 1987-1990, and photographs of Pluto taken in 1985. Photoelectric photometry of Uranus gave V(1,0) = -7.16±.005 in 1989 and V(1,0) = -7.22±.005 in 1990. For Neptune, V(1,0) = -6.87±.023 in 1989 and V(1,0) = -7.01±.007 in 1990. The geometric albedos of Uranus and Neptune are computed based on their V(1,0) values. Magnitudes of Neptune in the red and infrared are also reported. Visually, the most commonly suspected albedo irregularities on Uranus in 1987-90 were limb darkening, bright limb spots, and a bright area near the disk center, which may have been the South Polar Cap. The colors of Uranus and Neptune were both estimated to be a pale blue-green.

INTRODUCTION

A.L.P.O. observers made photometric, visual, photographic, and color observations of Uranus and Neptune during 1987-1990. The individuals who so participated are listed in *Table 1* (below), along with the type of observation that they made. *Table 2* (p. 154) describes the characteristics of the 1987-1990 oppositions of the Remote Planets. **[1-4]** The positions of both Uranus and Neptune were favorable for observers in the Southern Hemisphere, whereas Pluto was favorably located for both hemispheres.

PHOTOMETRY

Whole-disk photoelectric measurements of Uranus and Neptune were made during 1989 and 1990. Such information can detect small changes in magnitudes and albedos and can be used to draw light curves. Westfall and Melillo used SSP-3 photometers to measure magnitudes and their results are summarized in *Table 3* (p. 154). Harris **[5]** gives a good review of V(1,0) values for Uranus and Neptune, choosing V(1,0) = -7.19 for Uranus and V(1,0) = -6.87 for Neptune, based on visual and photoelectric data collected during 1864-1954. The quantity **V(1,0)** is the magnitude of an object when it is 1.0 astronomical units from both the Earth and the Sun.

The 1989 V(1,0) magnitudes of Uranus and Neptune as measured by Westfall compare well with the above values, but his 1990 measurement of Neptune was 0.14 magnitudes brighter than Harris' value. Lockwood **[6-9]** showed that the brightnesses of Uranus and Neptune vary by small amounts (*ca.* 0.002 Mag./year) over periods of several years. Furthermore, Joyce and his co-workers **[10]** reported a large change in Neptune's infrared brightness between April, 1975, and March, 1976. These studies show the need for photometric data over a period of several years, a current goal of our Remote Planets Section.

In 1989 JUN 23-JUL 14, the writer made 16 visual estimates of the brightness of Uranus with 7×35 binoculars. The comparison stars used were 13-16 Sgr, and HD 166767. **[11]** From these, he found V(1,0) = -7.31±.15 and Vo = +5.40±.14, where **Vo** is the magnitude at mean opposition. A similar procedure was carried out by the B.A.A. during 1954-1986, which reported Vo = +5.32±.21. **[12]** Within their uncertainty limits, both the

Table 1. A.L.P.O. Remote Planet Observers, 1987-1990.

Observer (Location)	Planet	Type	Instrument(s)
Francis Graham & Thomas Mohney (PA, USA)	N	V*	41 New
Walter H. Haas (NM, USA)	U	V	31.8 New
Richard G. Hodgson (IA, USA)	U,N	V*	32 & 44.5 New
Richard McKim (France)	U	V	83.8 Refractor
Frank J. Melillo (NY, USA)	U,N,P	V,P,PP	20 S-C
Richard Schmude, Jr. (TX, USA)	U	V,VP,C	35.6 S-C; 15.2 New; 3.5(7×) Bino
Cristofer Tobal (Spain)	U,N	V*	22 New; 10.2 Refr
John E. Westfall (CA, USA)	U,N	PP	25.4 Cass

Notes: Planet— U = Uranus, N = Neptune, P = Pluto. Type of Observation— C = Color, P = Photographic, PP = Photoelectric Photometry, V = Visual (V* = discussed in reference **[31]**), VP = Visual Photometry. Instrument— Aperture in cm., followed by type; Bino = Binocular, Cass = Cassegrain, New = Newtonian, Refr = Refractor, S-C = Schmidt-Cassegrain.

Table 2. Summary of the 1987-1990 Oppositions of Uranus, Neptune, and Pluto.

(Values refer to the date of opposition only.)

Planet	Parameter	1987 [1]	1988 [2]	1989 [3]	1990 [4]
URANUS	Opposition Date	JUN 16	JUN 20	JUN 24	JUN 29
	Equatorial Diameter	3".85	3".84	3".82	3".81
	Sub-Earth Latitude	-80°	-77°	-73°	-70°
	Visual Magnitude	+5.5	+5.5	+5.6	+5.6
	Declination	-23°.5	-23°.7	-23°.7	-23°.5
NEPTUNE	Opposition Date	JUN 28	JUN 30	JUL 02	JUL 05
	Equatorial Diameter	2".29	2".29	2".29	2".30
	Sub-Earth Latitude	-26°	-27°	-27°	-28°
	Visual Magnitude	+7.9	+7.9	+7.9	+7.9
	Declination	-22°.2	-22°.2	-22°.1	-21°.9
PLUTO	Opposition Date	APR 29	MAY 01	MAY 04	MAY 07
	Visual Magnitude	+13.7	+13.7	+13.6	+13.6
	Declination	+1°.6	+0°.6	-0°.4	-1°.4

Table 3. Summary of Uranus and Neptune Photometry, 1989-1990.

Year	Planet	No. Obser.	Band	Vo	V(1,0)	Person	Comparison Stars
1989	Uranus	19	V	+5.55	-7.16±.005	JW(a)	1, 13 Sgr
	Neptune	7	V	+7.89	-6.87±.023	JW(b)	28, 30 Sgr
	Neptune	2	R	---	-6.56±.075	JW(c)	BS 7116
1990	Uranus	1	V	+5.49	-7.22±.005	JW(d)	22 Sgr
	Neptune	1	V	+7.75	-7.01±.007	JW(d)	32 Sgr
	Neptune	29	I	---	-5.75±.14	FM(e)	35 Sgr

Notes. Band: V = Visual, R = Red, I = Infrared. BS = Yale Bright Star Catalog.
Person: JW = John Westfall; FM = Frank Melillo.
Time spans of observations: (a) JUL 20-AUG 02; (b) JUL 21-AUG 02; (C) JUL 22; (d) SEP 08; (e) JUL 03-AUG 02.
The tabulated values of V(1,0) in the visual band are -7.19 for Uranus and -6.87 for Neptune. **[32]**

B.A.A. and my visual estimates agree with the photoelectric measurements and the Vo value reported in the B.A.A. *Handbook.* I have also reduced the visual estimates made by Harris **[13,14]** and Markwick **[15-18]** to mean opposition magnitudes; these results are listed in *Table 4* (p. 155). The visual estimates are relatively consistent but suggest uncertainties of about 0.2 magnitudes. Also, these values are lower (brighter) than the 13 mean values of visual estimates during 1864-1954, with an overall mean Vo = +5.68±.21. **[19]**

The geometric albedo of a planet can be calculated from the expression **[20]**:

$$\mathrm{Log}(P) = 0.4(M_s - M_p) - 2\ \mathrm{Log}[\sin(\sigma)]$$

where **P** is the geometric albedo, M_s and M_p are the visual magnitudes of the Sun and the planet respectively at a distance of 1.0 A.U. from the Earth (and from the Sun for the planet), and σ is the angular semidiameter of the planet at a distance of 1.0 A.U. A magnitude of -26.72 at 1 A.U. is used for the Sun **[20]**, while semidiameters (σ) of 35.02 and 35.50 arc-seconds are used for Uranus and Neptune respectively **[21]**. The resulting geometric albedos, in visible light, are given in *Table 5* (p. 155). The uncertainties listed there are those due to the V(1,0) values only and do not include the uncertainty of the magnitude of the Sun. Therefore, the uncertainties for the geometric albedos should be considered as lower limits. [*Geometric albedo* is "..the ratio of the illumination of the planet at zero phase angle to the illumination produced by a plane, absolutely white Lambert surface of the same radius and position as the planet." {32}. Ed.]

The albedos for Uranus agree with those reported in the *Astronomical Almanac* **[21]**, but the geometric albedo of Neptune is 5-20 percent higher than 0.41, the value reported in the same source. This increased brightness is consistent with observations made by Lockwood and his co-workers **[22]**, who reported that Neptune was brighter in 1990 than at any time between 1972 and 1989. There is evidence that such brightenings are due to discrete clouds on that planet. **[23]**

Melillo attempted to measure the light curve of Neptune photoelectrically in the infrared band on the dates of 1990 JUL 03, JUL 25, and AUG 02. On each of these dates, the measurements cover a time interval of 3-3.5 hours and there is evidence of some variation. Judging from his data, an amplitude of about 0.2 magnitudes is estimated. One possible cause of this is methane clouds on Neptune, similar to those imaged by Hammel. **[24]** Melillo's measures give a mean $V(1,0)$ = -5.75 in the infrared band. Again, this is consistent with the findings of Lockwood and his co-workers, who report that the diurnal variations of Neptune increase as that planet becomes brighter. **[25]** However, the amplitude reported here is a factor of 2-3 times higher than the value reported elsewhere. **[23]**

Table 4. Summary of Visual Estimates of Vo for Uranus.

Year(s)	Number of Estimates	Vo	Reference(s)
1907	1	+5.4	13, 14
1916	11	+5.68±.12	15, 16
1917	22	+5.61±.10	15, 17
1918	1	+5.32	15, 18
1954-86	>100	+5.32±.21	12
1989	16	+5.40±.14	Current work
---	--	*+5.52*	*32*

Table 5. Geometric Visual Albedos Based on Photometry Presented in This Report.

Planet	Geometric Albedo	Observer	Year
Uranus	0.518±.002	Westfall	1989
Uranus	0.60 ±.08	Schmude	1989
Uranus	0.550±.002	Westfall	1990
Uranus	*0.51*	*[32]*	---
Neptune	0.437±.009	Westfall	1989
Neptune	0.495±.003	Westfall	1990
Neptune	*0.41*	*[32]*	---

PLUTO PHOTOGRAPHS

Although taken somewhat before this reporting period, it is worth nothing that Melillo took two photographs of Pluto; on 1985 MAY 08 and MAY 11. Both photographs were inspected with a magnifying glass and the 1985 MAY 11 photograph showed a northern bulge which may be Charon, the satellite of Pluto.

VISUAL OBSERVATIONS

Besides those observations discussed in the recent report by Hodgson **[31]**, three persons submitted visual drawings, notes, or both. Limb darkening on Uranus was reported by two observers, including Richard McKim who used the fine 33-inch (83.8-cm) refractor at Pic du Midi Observatory in France. Another frequently reported irregularity on Uranus was bright areas near the limb. The writer studied Uranus and Neptune with the 35.6-cm telescope at Texas A&M University on 1988 JUL 16 and observed a bright spot on Uranus. **[26]** This was independently confirmed by two other persons. Haas suspected bright limb spots three and six days after my sighting. Because the sub-Earth latitude was near -77° during 1988, the bright spot observed by myself and possibly by Haas would correspond to a region near Uranus' equator. **[27,28]** Another irregularity that I often suspected during 1987-1989 was a bright area near the center of Uranus' disk **[29]**; a similar feature was imaged by the Voyager spacecraft **[30]**. This appearance may be due to either limb darkening or to the South Polar Cap, since Lockwood **[9]** reported that the polar regions of Uranus are brighter than their surroundings.

COLOR MEASUREMENTS

The writer prepared a grid containing 56 different shades of mixtures of blue, green, and white. The colors of Uranus and Neptune were then estimated by studying each planet for several minutes at 325X through the 35.6-cm telescope at Texas A&M University Observatory and then looking at this grid under a light. Both planets had a pale blue-green color with a typical mixture of 1 part blue, 1 part green, and 10 parts white. There were fluctuations of color among different nights, probably due to variations in the Earth's atmosphere.

CONCLUSION

The remote planets Uranus and Neptune were studied by several individuals during 1987-1990. Photometry suggests that the visual magnitudes of Uranus and Neptune were close to those reported in earlier studies. Within its uncertainty, the geometric albedo of

Uranus lay near the value reported in the *Astronomical Almanac* **[21]**, but the value for Neptune was slightly higher than the tabulated value. Two types of suspected albedo irregularities on Uranus were bright limb spots and a bright central area which may be the South Polar Cap. The colors of these two planets were a pale blue-green.

More photometric data, however, are needed in order to monitor any seasonal changes in these planets. Color data on the remote Planets, especially (B-V), V-R), and (I-V) color indices, are needed to monitor long-term color changes.

ACKNOWLEDGEMENTS

I wish to thank all the participants listed in *Table 1* whose observations and measurements made this report possible, along with the Texas A&M University Observatory for the use of their facilities, and William and Helen Stanbro for the use of their word processor in preparing this manuscript.

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THE 1989-90 EASTERN (EVENING) APPARITION OF THE PLANET VENUS: VISUAL AND PHOTOGRAPHIC OBSERVATIONS

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

ABSTRACT

This report summarizes visual and photographic observations of Venus for the 1989-90 Eastern (Evening) Apparition, based on data submitted by A.L.P.O. Venus Section observers in the United States and eight other countries, including the instrumentation and sources of data used in obtaining those observations. Comparative studies deal with observers, instruments, and visual and photographic data. The report includes illustrations and a statistical analysis of the categories of features in the atmosphere of Venus, including cusps, cusp-caps, and cusp-bands, seen or suspected at visual wavelengths, both in integrated light and with color filters. Terminator irregularities and the apparent phase are discussed, together with the cooperative A.L.P.O.-Pioneer Venus Orbiter Ashen Light Monitoring Program.

INTRODUCTION

Observers submitted a welcome and reasonably large collection of visual and photographic observations of Venus during the 1989-90 Eastern (Evening) Apparition. The geocentric parameters of that apparition are given in *Table 1* below.

Table 1. Geocentric Data in Universal Time (UT) for the 1989-90 Eastern (Evening) Apparition of Venus. [U.S. Naval Observatory, 1988, 1989]

		d	h
Superior Conjunction........................	1989 APR	04	23
Dichotomy (predicted)......................	NOV	07	18
Greatest Elongation East (47°.2).....	NOV	08	17
Greatest Brilliancy (-4.7)..................	DEC	14	09
Inferior Conjunction..........................	1990 JAN	18	23
Apparent Diameter (observed range)	9".7 (1989 APR 28)- 62".4 (1990 JAN 18)		

A total of 626 observations consisting of visual drawings and photographs taken at visual wavelengths was received for the 1989-90 Apparition. *Figure 5* (p. 158) illustrates the distribution of observations for each month during that apparition.

Observational coverage was excellent, with individuals initiating their programs early in the apparition and following through until Venus was in conjunction with the Sun. The "observing season," or observational period, was from 1989 APR 28 through 1990 JAN 18, with the maximum emphasis during the months of August and November, 1989, but coverage was usually good during most of the apparition.

Twenty-three individuals submitted visual and photographic observations of Venus during the 1989-90 Apparition. These observers are listed in *Table 2* (p. 158), with their observing sites, number of observations, and instruments used.

Figure 6 (p. 159) shows the distribution of the 626 observations by country, while *Figure 7* (p. 159) does the same for the 23 observers. The final diagram, *Figure 8* (p. 160), shows the number of observations by type of instrument. In addition, we note that almost three-quarters (73.3 percent) of the observations were made with instruments 15.2 cm (6.0 in) in aperture or greater. It is also worthwhile to note that one person, D. Neichoy of Göttingen, Germany, contributed over half the observations received!

In terms of atmospheric conditions, the mean Seeing was about 4.8, or "fair," on the standard A.L.P.O. Scale that ranges from 0.0 for worst to 10.0 for perfect. Transparency conditions, normally expressed as the limiting stellar magnitude, were quite difficult to evaluate because nearly all the observations were carried out against a twilight or daytime sky.

This Recorder expresses his sincere gratitude to all the dedicated colleagues mentioned in this report who carried out observations for the A.L.P.O. Venus Section. Observers everywhere are cordially invited to join, or to continue, with us in future observing seasons. The effort to encourage and coordinate intensified and more comprehensive coverage of Venus in coming apparitions is paying dividends, as the observer response during 1989-90 shows. Our cooperation with such groups as the British Astronomical Association, the Royal Astronomical Society of Canada, the Vereinigung der Sternfreunde in Germany, and with similar organizations in Belgium, France, Hungary, Spain, and now Italy and Czechoslovakia, is extremely encouraging. These endeavors to maintain an expanded international observer base in the coming years will continue. We have, for example, received expressions of interest from observers in the

—Text continued on p. 159—

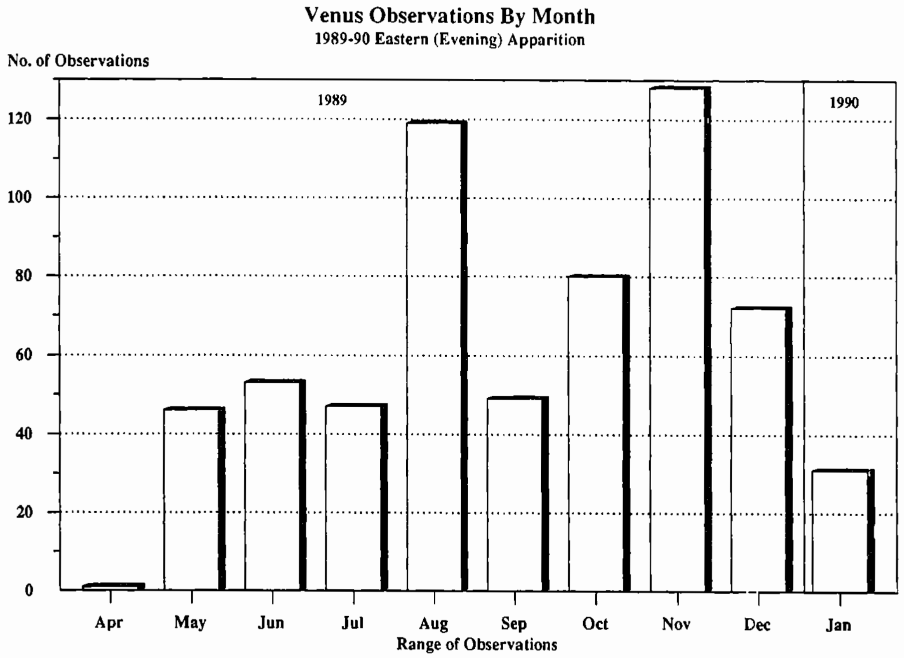

Figure 5. Number of observations contributed to the A.L.P.O. Venus Section by month during the 1989-90 Eastern (Evening) Apparition.

Table 2. Participants in the A.L.P.O. Venus Observing Program during the 1989-90 Eastern (Evening) Apparition.

Observer	Observing Site	Number of Observations	Telescope(s) Used
Benton, J.L.	Wilmington Island, GA	17	15.2-cm (6.0-in) Refractor
Daniels, T.	Antwerp, Belgium	5	15.2-cm (6.0-in) Refractor
Dils, D.	Antwerp, Belgium	2	15.2-cm (6.0-in) Refractor
Fabian, K.	Chicago, IL	19	10.2-cm (4.0-in) Schmidt-Cass
Gélinas, M.A.	Ile-Perrot, Que., Canada	19	15.2-cm (6.0-in) Refractor
		8	20.3-cm (8.0-in) Schmidt-Cass.
Graham, D.L.	N. Yorkshire, U.K.	14	15.0-cm (5.9-in) Refractor
Haas, W.H.	Las Cruces, NM	4	20.3-cm (8.0-in) Newtonian
		27	31.8-cm (12.5-in) Newtonian
Heath, A.W.	Nottingham, U.K.	2	30.5-cm (12.0-in) Newtonian
Kratschmar, R.	Göttingen, Germany	1	20.3-cm (8.0-in) Schmidt-Cass.
Lorenzen, D.H.	Bovenden, Germany	16	11.4-cm (4.5-in) Newtonian
Melillo, F.J.	Franklyn Square, NY	15	20.3-cm (8.0-in) Schmidt-Cass.
Neichoy, D.	Göttingen, Germany	330	20.3-cm (8.0-in) Schmidt-Cass.
		31	10.0-cm (3.9-in) Refractor
Nowak, G.T.	Essex Junction, VT	4	20.3-cm (8.0-in) Newtonian
Quarra, G.S.	Florence, Italy	12	10.0-cm (3.9-in) Refractor
			30.0-cm (11.8-in) Cassegrain
Petti, R.	Lyndhurst, OH	20	10.2-cm (4.0-in) Cassegrain
Sarocchi, D.	Florence, Italy	12	10.0-cm (3.9-in) Refractor
			20.3-cm (8.0-in) Schmidt-Cass.
Simon, V.	Hranice, Czechoslovakia	3	8.0-cm (3.2-in) Newtonian.
		1	12.8-cm (5.0-in) Refractor
Szabo, S.	Szombathely, Hungary	2	7.0-cm (2.8-in) Refractor
Tobal, T.	Barcelona, Spain	3	10.2-cm (4.0-in) Refractor
Tonazzini, E.	Florence, Italy	4	10.2-cm (4.0-in) Refractor
van Hellemont, D.	Antwerp, Belgium	2	15.2-cm (6.0-in) Refractor
van den Eijnde, P.	Antwerp, Belgium	9	15.2-cm (6.0-in) Refractor
Viens, J.-F.	Charlesbourgh, Que., Canada	44	11.4-cm (4.5-in) Newtonian

Total Number of Observations.............................626

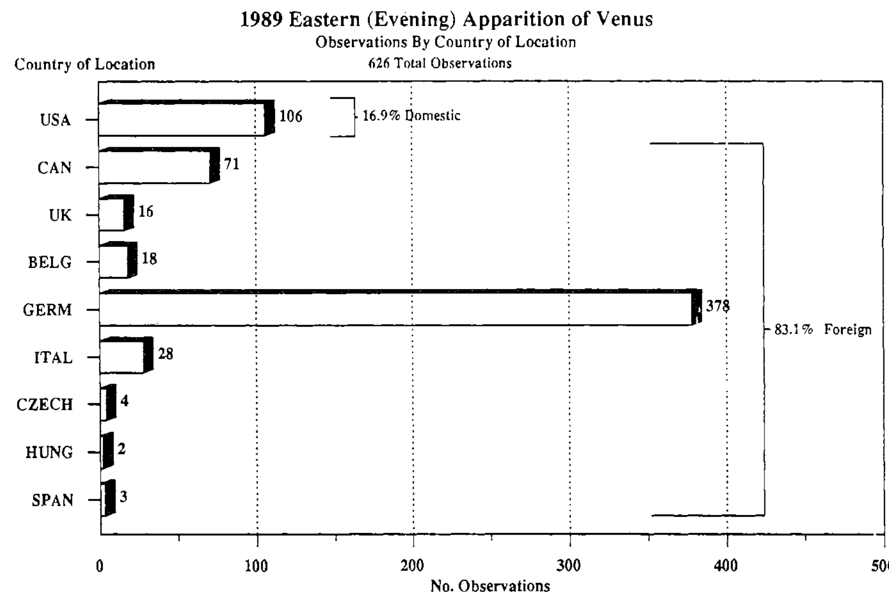

Figure 6. Observations by Country, 1989/90 Eastern (Evening) Apparition of Venus.

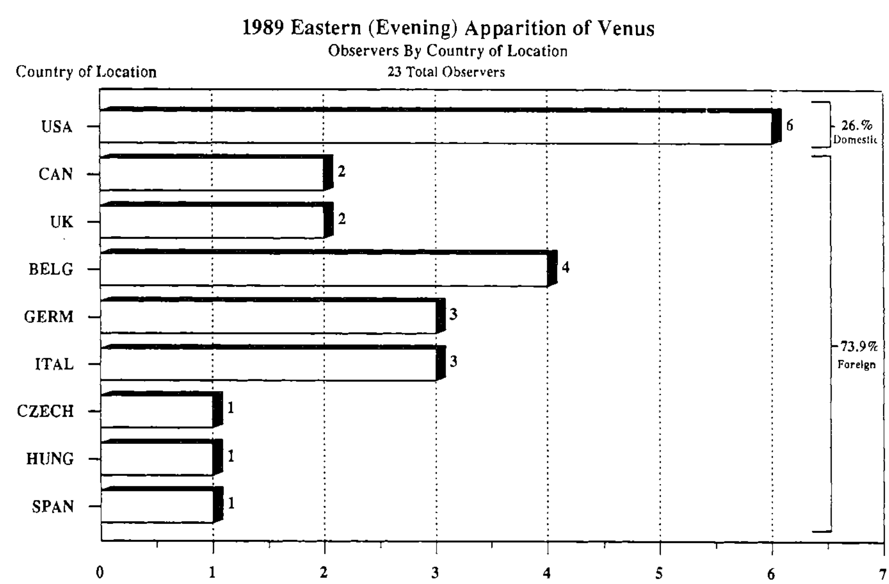

Figure 7. Observers by Country, 1989/90 Eastern (Evening) Apparition of Venus.

—*Text continued from p. 157*—

Soviet Union and Australia, and expect their participation in the next several years.

OBSERVATIONS OF VENUSIAN ATMOSPHERIC DETAILS

As noted in our previous Venus Reports [Benton, 1989, 1990], the methods for conducting visual studies of the somewhat vague, elusive "markings" in the atmosphere of Venus have been outlined in the appropriate Venus Section publications. [Benton 1973, 1987] We recommend that observers of Venus consult these sources as well as previous apparition reports.

All the observations used for this report were at visual wavelengths. A few samples of these drawings and photographs appear in this report (see *Figures 9-24*, pp. 165-167) in order to aid the reader in interpreting the phenomena reported or suspected on Venus in 1989-90.

The visual and photographic data for the 1989-90 Apparition represented almost all of the categories of dusky and bright markings on Venus, as covered in the literature cited above. [Benton 1973, 1987, 1989, 1990] *Table*

1989-90 Eastern (Evening) Apparition of Venus
Observations By Instrument Type
626 Total Observations

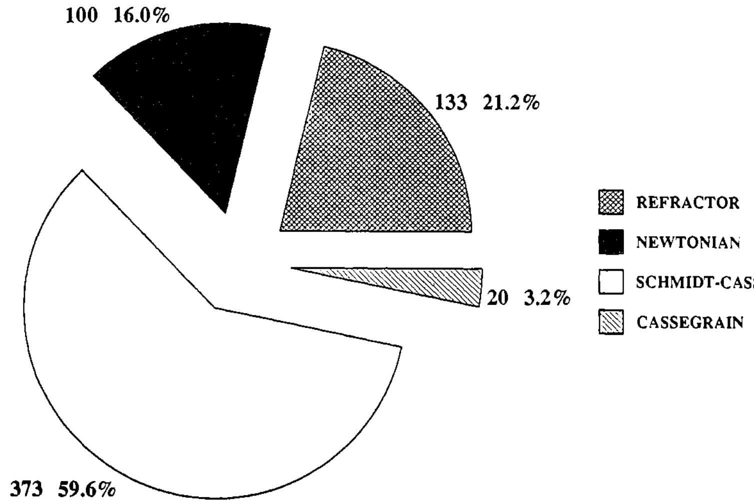

Figure 8. Observations by Type of Instrument, 1989/90 Eastern (evening) Apparition of Venus.

Table 3. Frequency of Occurrence of Types of Markings during the 1989-90 Eastern (Evening) Apparition of Venus.

Marking Category	Percent. of Observations
Radial Dusky Markings	4.0 %
Banded Dusky Markings.	49.5
Irregular Dusky Markings	46.3
Amorphous Dusky Markings	72.9
No Dusky Markings Seen or Suspected	15.3
Terminator Shading	83.3
No Terminator Shading	16.7
Bright Spots or Regions (exclusive of Cusps)	14.4

Notes

1. The geometric phase k ranged from 0.995 (1989 APR 28) to 0.005 (1990 JAN 18).

2. Assuming that Venus' bright illuminated hemisphere (all areas devoid of any shading or other obvious markings) was typically assigned a relative numerical intensity of 8.7-9.2 (using the A.L.P.O. scale ranging from 0.0 for pure black to 10.0 for pure white) in 1989-90, the mean assigned intensity for the first four items above in integrated light (no filter) was about 7.6-7.8. The last category had an assigned intensity value of 9.5 during this apparition.

3. The scale of conspicuousness, ranging from 0.0 for definitely not seen to 10.0 for certainly seen, was used rather effectively in 1989-90, when the mean conspicuousness rating for the first four items and the last item was 5.5, indicating that all the features lay somewhere between vague suspicions and strong indications.

3 (left) summarizes the frequency by which the specific forms of markings were reported; note that many observations showed more than one type of marking, so that totals over 100 percent are possible. Undoubtedly, there is a subjective element in the reporting of the vague and elusive markings of Venus which must affect the values in the table. Nonetheless, our tentative conclusions based on these data appear reasonable.

The dusky markings of Venus' atmosphere are quite elusive, both to the novice and to the experienced observer. It is usually thought that ultraviolet (UV) photographs of Venus are preferred in order to bring out any possible dusky features. We certainly do seek UV photographs because many features' appearances in UV are different than in visual wavelengths, particularly radial dusky patterns. However, it is interesting that during 1989-90 fewer than a sixth (15.3 percent) of the drawings and other visual observations of Venus showed the planet as devoid of shadings or markings of any kind, unlike the result in many of the recent past apparitions. Nearly all the photographs submitted showed a completely blank disk even though visual observers reported banded, irregular, amorphous, and radial dusky markings with a higher frequency than in many previous evening apparitions of Venus. These findings probably resulted from the better coverage of Venus in 1989-90, as well as more standardized, systematic use of polarizing- and color-filter techniques. It may also be the case that Venus was slightly more active in 1989-90 than in the preceding apparitions. However, with Venus any assumption of increased atmospheric activity must be taken with some caution.

Most of the dusky markings that were reported were in the category of "Amorphous Dusky Markings," reported in 72.9 percent of the observations. Other dusky atmospheric features were distributed fairly evenly between the categories of "Banded Dusky Markings" (49.5 percent) and "Irregular Dusky Markings" (46.3 percent), and only 4.0 percent of the observations reported "Radial Dusky Markings" in 1989-90.

Except for the cusp regions, bright areas or mottlings were infrequently observed for the 1989-90 Apparition. At visual wavelengths, a small number of drawings, and perhaps a few photographs, showed these bright spots or regions on Venus. However, no photographs taken in ultraviolet light were received during 1989-90.

Color-filter techniques were again effectively and systematically applied to Venus during the Eastern (evening) Apparition of 1989-90. These gave very promising results when compared with integrated-light observations. The usage of Wratten W47 (violet), W25 (red), W15 (yellow), W58 (green), W80A (light blue) and variable-density polarizing filters enhanced the visibility of atmospheric features on Venus.

Terminator shading was very prominent in this apparition. There was the usual tendency for the terminator shading to lighten (i.e., assume a higher intensity value) as one proceeded from the terminator toward the illuminated limb of the planet. In many reports, this gradation ended in the bright limb band, and usually this terminator shading extended from one cusp region to the other. The terminator shading was most often reported near the time of dichotomy (1989 NOV 07) and later, when Venus had a crescent phase. Only a small fraction of the photographs submitted in 1989-90 suggested terminator shading.

CUSPS, CUSP-CAPS, AND CUSP-BANDS

The most contrasting and conspicuous features sometimes seen in the atmosphere of Venus are found at or near the planet's cusps, usually when the phase coefficient **k** [the fraction of the disk that is illuminated] lies between 0.1-0.8. These cusp-caps are occasionally bounded by dark, often diffuse, peripheral cusp-bands. *Table 4* (below) gives visibility statistics for Venus' cusp features in 1989-90.

When the northern and southern cusp-caps were recorded, they were often seen at the same time. Both cusp-caps were visible alone only a few times in 1989-90. When seen together, the northern cusp-cap was often either as bright as, or slightly brighter than, the southern, and the northern was also usually the larger of the two. In slightly less than half of the observations, neither cusp-cap was reported. Likewise, neither cusp-band was seen half of the time.

In almost half of the 1989-90 observations, dusky cusp-bands were reported as bordering the cusp-caps. At such times, it was more likely for the cusp-bands to be seen at both cusps, rather than just at one.

EXTENSION OF THE CUSPS

In theory, the illuminated portion of the limb of Venus should always subtend very close to 180°, and an extent significantly larger is described as a *cusp extension*, and is presumably an effect of Venus' atmosphere. The great majority (93.7 percent) of the observations submitted in 1989-90 showed absolutely no cusp extensions, with colored filters as well

Table 4. Frequency of Occurrence of Cusp-Caps and Cusp-Bands during the 1989-90 Eastern (Evening) Apparition of Venus.*

Marking Category/Condition	Percent. Obser.
Cusp-Caps:	
No Cusp-Caps Visible	44.5 %
Both Cusp-Caps Visible	48.9
North Cusp-Cap Alone Visible	3.5
South Cusp-Cap Alone Visible	2.9
Either or Both Cusp-Caps Vis.	55.5
North Cusp-Cap the Brighter	6.0 %
Cusp-Caps of Equal Brightness	38.0
South Cusp-Cap the Brighter	4.2
North Cusp-Cap the Larger	11.6 %
Cusp-Caps of Equal Size	30.1
South Cusp-Cap the Larger	9.5

Marking Category/Condition	Percent Obser.
Cusp-Bands:	
No Cusp-Bands Visible	50.9 %
Both Cusp-Bands Visible	41.6
North Cusp-Band Alone Visible	3.0
South Cusp-Band Alone Visible	4.6
Either or Both Cusp-Bands Vis.	49.1

* Assuming that the mean intensity of the illuminated disk was 8.8-9.5 in the 1989-90 observing season, the mean assigned intensity for the cusp-caps was about 9.7 and about 7.6 for the cusp-bands.The percentages above do not always sum to 100. Particularly, when only one cusp-cap was visible, it was not possible to make comparisons of size and brightness.

as in integrated light. However, from October, 1989, through January, 1990, some observers reported extensions of both cusps ranging from 2° to 40° on the average. Indeed, there were reports of the two cusp extensions meeting, forming an exquisitely beautiful halo encircling the entire dark hemisphere of Venus. These cusp extensions were enhanced by color-filters, and were shown on drawings, but were wholly invisible on all photographs submitted. Cusp extensions, as expected, are exceedingly difficult to capture on film, being far fainter than the sunlit portions of the disk.

THE BRIGHT LIMB BAND

In 1989-90, 60.2 percent of the 626 observations submitted referred to a bright band on the sunlit limb of Venus. This feature extended from cusp to cusp, was narrow along the limb, and was uniform in intensity throughout its length. The mean numerical intensity assigned to this band was 9.8. Its visibility was greatly enhanced by the use of selected color and polarizing filters.

TERMINATOR IRREGULARITIES

The terminator of Venus is the geometric curve that separates the sunlit and dark hemispheres. Just 12.5 percent of the observations made during 1989-90 reported obvious terminator irregularities. Amorphous and irregular dusky shadings, and to a lesser extent banded and radial dusky shadings, merged with the terminator shading and with possible reported deformities along the otherwise geometrically regular terminator. [The phenomenon of *irradiation* may cause bright features near the terminator to become apparent bulges; and dark features, apparent hollows. Ed.] As with other observations this apparition, successful filter techniques probably enhanced the visibility of any terminator irregularities and associated dusky atmospheric features.

ESTIMATES OF DICHOTOMY

The "Schröter Effect" on Venus, a discrepancy between the predicted and the observed dates of dichotomy (half-phase), was reported in 1989-90. The predicted half-phase occurs when **k** = 0.500, and the phase angle **i** between the Sun and the Earth as seen from Venus equals 90°. The observed *minus* predicted discrepancies for 1989-90 are given in *Table 5* (below). [The mean results from *Table 5* indicate that dichotomy was reported 4.7±1.8 days early, with a mean phase "underestimation" of -0.023±.009. Ed.]

THE ASHEN LIGHT

The Ashen Light, first reported by the Italian observer G. Riccioli in 1643, is an exceedingly elusive, faint illumination of the dark hemisphere of Venus. It resembles Earthshine on the dark portion of the Moon, but the latter has a completely different origin. It is often argued that Venus must be viewed against a dark sky in order to detect the Ashen Light, but Venus is low in the sky at such times and suffers from poor seeing and glare in contrast with the dark sky background.

The A.L.P.O. Venus Section, in a continuing cooperative effort with several other astronomical associations throughout the world, monitored Venus in 1989-90 for any visibility of the Ashen Light. *Table 6* (pp. 163-164) summarizes the positive Ashen Light sightings for this apparition. Reports of the Ashen Light occurred from 1989 AUG 31 through 1990 JAN 16. During that interval, there was an almost daily coverage of Venus by A.L.P.O. observers, and there were obviously far more negative observations than positive ones.

Nearly all the observations that appear in *Table 6* were made during night or twilight. As one might imagine, this set of observations was very difficult to work with, chiefly due to the variations in instruments, seeing conditions, durations of observation, filters used, occulting devices employed, and variations in judgment by the observers themselves. Even so, we hope that useful information can be derived from these data.

CONCLUSIONS

Sporadic atmospheric activity was reported for Venus in the 1989-90 Apparition. It is worthwhile to compare these results with those of previous evening observing seasons, as well as with morning apparitions of the planet. A significant aspect during the 1989-90 observing season was the continuing cooperation among the A.L.P.O. and various other organizations around the world in conducting

—Text continued on p. 164—

Table 5. Observed versus Predicted Dichotomy of Venus: 1989-90 Eastern (Evening) Apparition.

Quantity		Observer: J.L. Benton	K. Fabian	M. Gélinas	D. Niechoy
Date (1989 OCT/NOV):	Observed (O)	06.70 d	<u>29.50</u> d	04.74 d	02.28 d
	Predicted (P)	07.76	07.76	07.76	07.76
	Difference (O - P)	-1.06	-9.26	-3.02	-5.48
Phase Coefficient:	Observed (O)	0.500	0.500	0.500	0.500
	Predicted (P)	0.505	0.545	0.515	0.527
	Difference (O - P)	-0.005	-0.045	-0.015	-0.027

Table 6. A.L.P.O. Venus Section Ashen-Light Patrol: 1989-90 Eastern (Evening) Apparition.

Date & UT	Ob.	Instrument	Filter	S/T	AL
1989					
Aug 31					
11:58-13:24	DN	20.3 S-C 225	IL	---	S
			OG550	---	S
			VG9	---	NS
			RG610	---	S
			W47	---	NS
			W15	---	S
23:14-23:30	FJM	20.3 S-C 200	IL	6/5	NS
		Photo	IL	6/5	NS
Sep 02					
13:34	DN	20.3 S-C 225	BG28	---	S
22:55-23:10	JFV	11.4 New 150	IL	6/5	NS
Oct 17					
15:57-16:38	DN	20.3 S-C 225	IL	---	NS
			RG610	---	NS
			BG28	---	NS
			OG530	---	VStS*
			VG9	---	NS
			W15	---	NS
Oct 28					
16:04-16:29	DN	20.3 S-C 225	IL	---	NS
			RG610	---	NS
			W15	---	S*
			BG28	---	NS
			W11	---	NS
19:30-20:15	JFV	11.4 New 150	IL	6/5	NS
22:00	FJM	20.3 S-C Photo	IL	---	NS
Nov 02					
00:47-01:01	WH	20.3 New 231	IL	3/3.5	NS
16:10-16:31	DN	20.3 S-C 225	IL	---	NS
			RG610	---	S
			W15	---	S
Nov 13					
16:21-16:56	DN	20.3 S-C 112	IL	---	NS
			RG610	---	NS
			W15	---	S
			BG28	---	NS
			W11	---	S
			OG550	---	StS
Nov 17					
16:00-16:50	DN	20.3 S-C 112	IL	---	NS
			W15	---	S
			RG610	---	NS
			W11	---	NS
			OG550	---	NS
			W47	---	NS
			BG28	---	NS
Nov 19					
00:03-00:23	WH	31.8 New 366	IL	2/3.5	NS
16:02-16:54	DN	20.3 S-C 225	IL	---	NS
			RG610	---	NS
			BG3	---	NS
			BG7	---	S
			BG18	---	NS
			BG28	---	S
			BG39	---	NS
			W47	---	NS
			W25	---	NS
			VG3	---	NS
			W15	---	NS
			W11	---	NS
16:30	DHL	11.4 New 167	IL	---	NS
Nov 20					
16:01-16:26	DN	20.3 S-C 112	IL	---	NS
			RG610	---	NS
			W15	---	S
			BG28	---	S
Nov 22					
16:01-16:40	DN	20.3 S-C 225	IL	---	VStS
			RG610	---	StS
			W15	---	VStS
			W16	---	S
			GG10	---	NS
			GG550	---	NS
			W47	---	NS
			VG9	---	NS
Nov 25					
00:12-00:29	WH	31.8 New 366	IL	2/4	NS
16:02-16:37	DN	20.3 S-C 225	IL	---	NS
			W15	---	NS
			RG610	---	S
			W47	---	VStS
			W11	---	StS
			BG28	---	S
Nov 28					
16:01-16:37	DN	20.3 S-C 225	IL	---	StS
			W15	---	StS
			RG610	---	StS
			W47	---	S
			BG28	---	S
			W11	---	NS
Nov 29					
17:03-17:15	DN	20.3 S-C 225	IL	---	NS
			W15	---	NS
			RG610	---	NS
21:55-22:25	MG	15.2 RR 261	W15	---	S
Dec 03					
00:01-00:30	WH	31.8 New 366	IL	2/3.5	NS
15:00-15:30	DS	30.0 Cass 190	W47	---	NS
			W15	---	NS
15:55	DHL	11.4 New 167	IL	---	NS
16:30-17:10	DN	20.3 S-C 225	IL	---	S
			W15	---	S
			RG610	---	NS
			W11	---	S
			W47•	---	S
Dec 07					
17:00-17:28	DN	20.3 S-C 225	IL	---	NS
22:05-22:30	MG	20.3 S-C 120	W47•	6/4.5	S
Dec 16					
16:08-16:12	DN	20.3 S-C 225	W15	---	S
			IL	---	VStS
			W25	---	VStS
			W47	---	VStS
Dec 23					
14:40-15:40	GQ	30.0 Cass 300	W47	---	S
			W15	---	NS
			W30	---	NS
16:05-16:22	DN	20.3 S-C 225	IL	---	NS
			W15	---	StS
			W25	---	NS
			W47	---	NS
			VG9	---	NS
22:20	RP	10.2 Cass 80	IL	6/5	NS
			W11	6/5	NS

Table 6—Continued.

Date & UT	Ob.	Instrument	Filter	S/T	AL
1989					
DEC 24					
12:29-12:49	TT	10.2 RR 120	W80A	6/5	NS
15:47-16:03	DN	20.3 S-C 225	IL	---	S
			RG610	---	NS
			W15	---	NS
			W47	---	NS
DEC 29					
00:10-00:33	WH	31.8 New 366	IL	2/4	S†
13:45-14:30	GQ	10.2 RR 300	W11	---	NS
		30.0 Cass 166	W12	---	NS
23:30-23:50	RP	10.2 Cass 80	IL	---	S
			W47	---	S

Date & UT	Ob.	Instrument	Filter	S/T	AL
1990					
JAN 02					
00:12-00:29	WH	31.8 New 321	W47	2/3.5	S†
JAN 03					
00:09-00:10	WH	31.8 New 303	W47	2/4	S†
JAN 04					
15:46-15:56	VS	8.0 New 120	IL	---	S
JAN 15					
11:05	TT	10.2 RR 83	IL	---	VStS
23:11-23:25	WH	31.8 New 202	IL	1/3.5	NS
JAN 16					
11:40-12:05	TT	10.2 RR 83	IL	---	VStS

Notes for Table 6

Ob. = Observer as follows: MG, M.A. Gelinas; WH, Walter H. Haas; DHL, D.H. Lorenzen; FJM, Frank J. Melillo; DN, D. Niechoy; RP, R. Petti; GQ, G.S. Quarra; DS, D. Sarocchi; VS, V. Simon; TT, T. Tobal; JFV, J.F. Viens.

Instrument = Telescope aperture in cm; Type (Cass = Cassegrain; New = Newtonian; RR = Refractor; S-C = Schmidt-Cassegrain); Magnification.

Filter = Type of filter, where IL = Integrated Light. A bullet (•) indicates that an occulting bar was used. Wratten series filters are abbreviated W. Other designations indicate Schott filters. The colors of the filters are as follows:

Wratten: W11 = Yellow; W12 = Yellow; W15 = Yellow; W16 = yellow-orange; W25 = Red; W30 = Magenta; W47 = Violet; W58 = Green; W80A = Light Blue.

Schott: BG3 = Blue; BG7 = Blue; BG18 = Blue-Green; BG28 = Blue-Green; BG39 = Blue-Green; GG10 = Yellow; OG530 = Orange; OG550 = Orange; RG610 = Red; VG3 = Green; VG9 = Green.

S/T = Seeing and transparency. Seeing is on the A.L.P.O. scale, ranging from 0 for worst to 10 for perfect. Transparency is the limiting stellar magnitude in the vicinity of Venus.

AL = Ashen Light visibility as follows: NS = Nothing Seen or Suspected; S = Suspected; StS = Strongly Suspected; VStS = Very Strongly Suspected. * = "faint"; † = "vague."

GENERAL: There may be trends related to the filters used for visual observations, although the data are ambiguous. For example, some individuals reported the Ashen Light with a colored filter, but not in integrated light (IL); others as the phenomenon in integrated light, but not when using filters or with an occulting bar.

Virtually all the observations in *Table 6* were made during twilight or night.

Text continued from p. 162—

routine visual and photographic observations of Venus and in monitoring the Ashen Light. Some tentative results appear here, but analysis of the wealth of information gathered by all sources during this Apparition and the western (morning) apparition following it should provide interesting reading in subsequent reports in this Journal.

Although Venus frequently appears devoid of any details at all, at times the patterns of the ephemeral dusky or bright markings become visible to the persistent observer. Continued monitoring of the planet over many years remains our major emphasis, and we cordially invite interested readers to join us in our pursuits to gather reliable information about Venus.

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SELECTED DRAWINGS AND PHOTOGRAPHS, 1989-90 EASTERN (EVENING) APPARITION OF VENUS

Notes: Figures 9-24 are oriented with celestial south at the top and the preceding direction to the left (simple inverted views). Seeing is on the standard A.L.P.O. scale, ranging from 0 for worst to 10 for perfect; transparency is on the standard A.L.P.O. scale, ranging from 0 for worst to 5 for perfect.

Figure 9 (right). Drawing of Venus by David L. Graham. 1989 JUL 03, 19h00m UT. 15.0-cm (5.9-in) refractor, 286X. W15 (yellow) Filter. Phase (**k**) = 0.911. Diameter = 11".0.

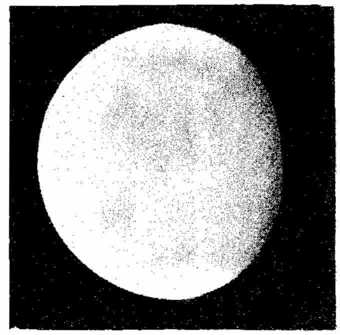


Figure 10 (below). Drawing of Venus by D. Niechoy. 1989 JUL 22, 19h43m UT. 10.2-cm (4.0-in) refractor, 99X. W15 (yellow) Filter. Phase (**k**) = 0.869. Diameter = 11".7.

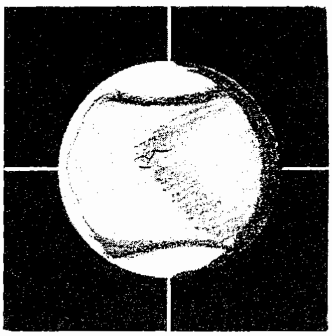


Figure 11 (below). Drawing of Venus by David L. Graham. 1989 AUG 22, 18h30m UT. 15.0-cm (5.9-in) refractor, 166X. W22 (red) Filter. Phase (**k**) = 0.787. Diameter = 13".5.

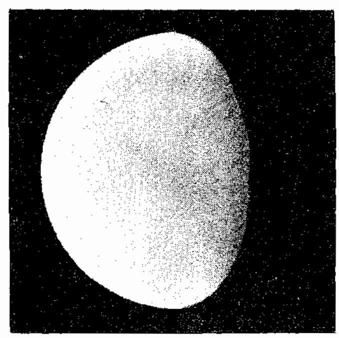


Figure 12 (below). Drawing of Venus by Damiano Sarocchi. 1989 OCT 06, 17h00m UT. 20.3-cm (8.0-in) Schmidt-Cassegrain, 250X. W25 (red) Filter. Seeing 3-4, Transparency medium. Phase (**k**) = 0.639, estimated as 0.54. Diameter = 18".2.

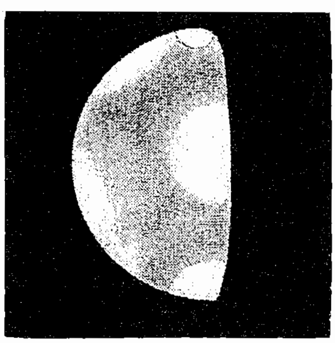
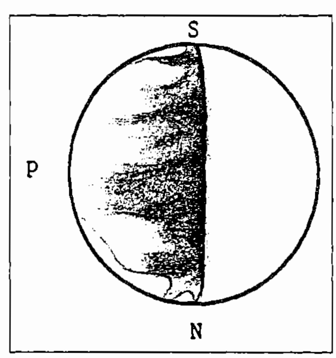


Figure 13 (below). Drawing of Venus by Jean-Francois Viens. 1989 OCT 25, 19h30m UT. 11.4-cm (4.5-in) Newtonian, 150X. Integrated light (no filter). Seeing 5-7, Transparency 5. Phase (**k**) = 0.561, estimated as 0.544. Diameter = 21".6.



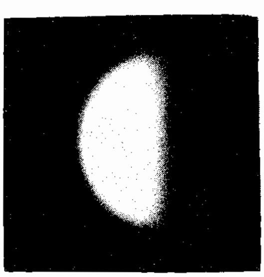


Figure 14 (left). Photograph of Venus by Frank J. Melillo. 1989 OCT 25, 22h00m UT. 20.3-cm (8.0-in) Schmidt-Cassegrain. Integrated light (no filter). Seeing 9, Transparency 4. Phase (**k**) = 0.561, estimated as 0.56. Diameter = 21".6. Compare with *Figure 13*, drawn just 2.5 hours before.

 (See notes on p. 165.)

Figure 15 (right). Drawing of Venus by Damiano Sarocchi, 1989 OCT 28, 16:05 UT. 10.0-cm (3.9-in) refractor, 250X. W15 (yellow) and W58 (green) Filters. Seeing 3.5-4, Transparency medium-high. Phase (**k**) = 0.548, estimated as 0.49. Diameter = 22".2.

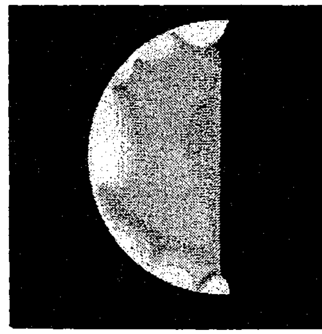


Figure 16 (below). Drawing of Venus by Marc A. Gélinas. 1989 OCT 28, 21h22m-21h38m UT. 15.2-cm (6.0-in) refractor, 305X. W15 (yellow) Filter. Seeing 6, Transparency 3. Phase (**k**) = 0. 547, estimated as 0.55. Diameter =22".3. Compare with Figure *15*, drawn 5 hours earlier.

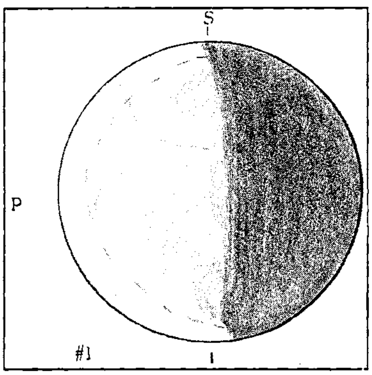


Figure 17 (below). Drawing of Venus by G.S. Quarra. 1989 Nov 15, 14h00m UT. 30.0-cm (11.8-in) Cassegrain, 190X. W80A (light blue) Filter. Seeing 4, Transparency medium. Phase (**k**) = 0.459, estimated as 0.44. Diameter 27".1.

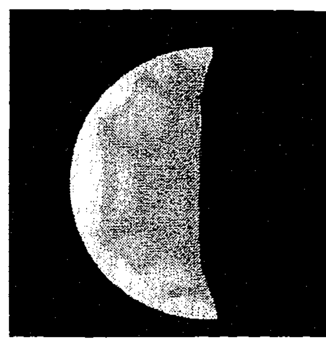


Figure 18 (below). Photograph of Venus by Frank J. Melillo. 1989 DEC 10, 21h30m UT. 20.3-cm (8.0-in) Schmidt-Cassegrain, f/190. Integrated light (no filter). 1/2-second exposure on Kodak 2415 Film. Seeing 9, Transparency 4.5. Phase (**k**) = 0.289, estimated as 0.30. Diameter = 38".8.

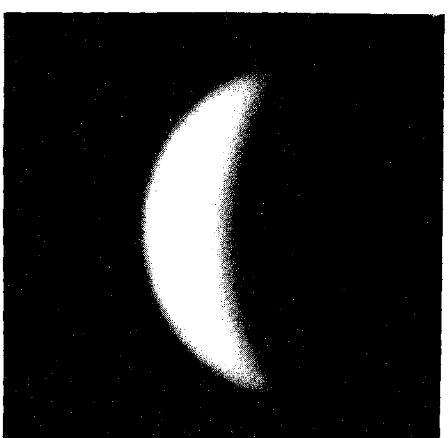
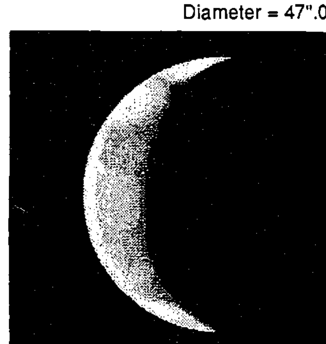


Figure 19 (below). Drawing of Venus by Damiano Sarocchi. 1989 DEC 22, 17h45m UT. 20.3-cm (8.0-in) Schmidt-Cassegrain. 250X. W47 (violet) Filter. Seeing 3-3.5, Transparency high. Phase (**k**) = 0.185. Diameter = 47".0.



SELECTED DRAWINGS AND PHOTOGRAPHS, 1989-90 EASTERN (EVENING) APPARITION OF VENUS—*Continued*. (See notes on p. 165.)

Figure 20 (right). Drawing of Venus by T. Tobal. 1989 DEC 24, 12h29m-12h49m UT. 10.2-cm (4.0-in) refractor, 120X. Blue filter. Seeing 8, Transparency 4.5. Phase (**k**) = 0.165. Diameter = 48".7.

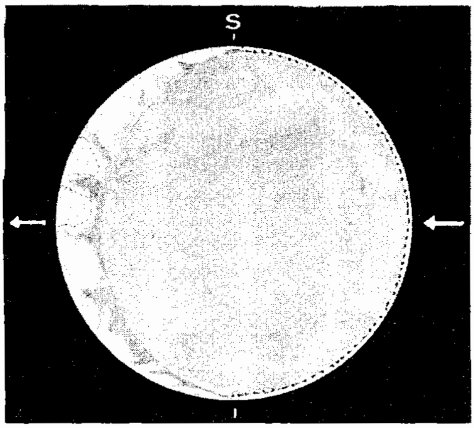


Figure 21 (below). Drawing of Venus by G.S. Quarra. 1989 DEC 29, 14h30m UT. 10.2-cm (4.0-in) refractor, 166X. W30 (magenta) Filter. Seeing 3.5, Transparency medium. Phase (**k**) = 0.122. Diameter = 52".4.

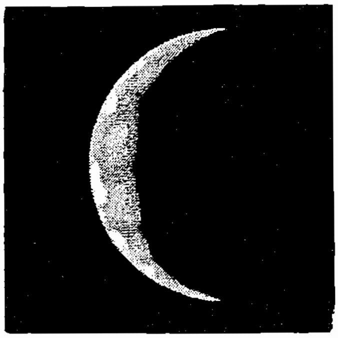


Figure 22 (below). Photograph of Venus by G.S. Quarra. 1989 DEC 29. 30.0-cm (11.8-in) Cassegrain at f/80. Kodak 2415 Technical Pan Film with W12 (yellow) filter, 1/2-second exposure. Seeing 4. Compare with *Figure 21*; note that limb protrusions on photograph correspond with very bright spots on the drawing.

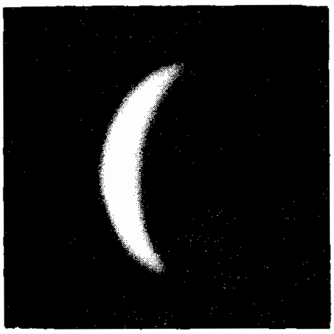


Figure 23 (below). Drawing of Venus by T. Tobal. 1990 JAN 16, 11h40m-12h05m UT. 10.2-cm (4.0-in) refractor, 83X. Red and green filters. Seeing 9.5, Transparency 5. Phase (**k**) = 0.007. Diameter = 62".3. Note visible dark hemisphere and Ashen Light.

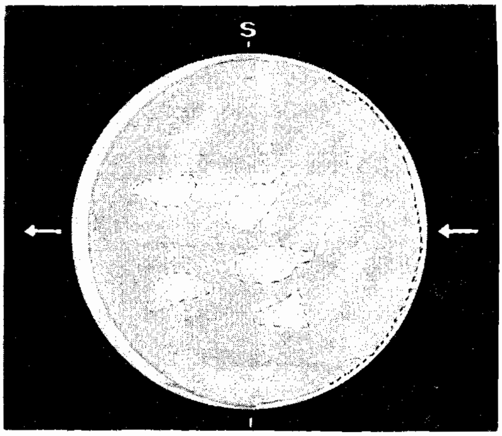
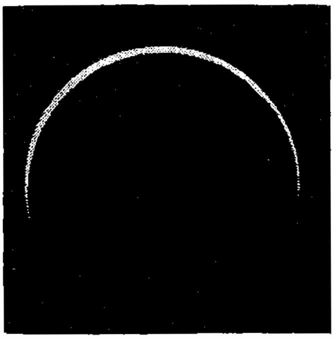


Figure 24 (below). Drawing of Venus by G.S. Quarra. 1990 JAN 18, 14h30m UT. 10.2-cm (4.0-in) refractor, 111X. W15 (yellow) Filter. Seeing 3.5, Transparency medium. Phase (**k**) = 0.005, estimated as 0.03. Diameter = 62".4. Observation made 8.5 hours before Inferior Conjunction at a solar elongation of 6°.1.



A.L.P.O. SOLAR SECTION OBSERVATIONS FOR ROTATIONS 1833-1836 (1990 SEP 01 TO DEC 19)

By: Richard E. Hill, A.L.P.O. Solar Recorder

ABSTRACT

This report summarizes A.L.P.O. Solar Section observations for Rotations 1833-1836, particularly in terms of the morphology and development of sunspot groups. Fourteen observers contributed visual drawings and integrated-light and Hydrogen-α photographs. Solar activity remained moderate in this period, but showed a sharp drop from Rotation 1832.

INTRODUCTION

This reporting period was typified by moderate levels of activity, following the very high level seen in the last rotation of the previous reporting period. There were few days when the sunspot numbers fell below 100, and many days above 150. While these values indicate a good brisk level of activity, the month of July, 1989, remains the maximum for Sunspot Cycle 22. It is interesting to note that the count of sunspot groups alone showed fairly steady decline during this period.

The mean International Sunspot Number, **RI**, for this reporting period was 136.6; with the highest rotational mean being 158.3 in Rotation 1834, followed by the lowest rotational mean of 124.9 in Rotation 1835. In terms of the American Sunspot Number, **RA**, the reporting-period mean was 142.6, with this value ranging from a rotational mean of 163.5 in Rotation 1834 to a low of 126.1 for Rotation 1833. The two statistics agreed more closely for the daily extremes. **RI** had a daily high of 227 on 1990 OCT 15 and a daily low of 77 on 1990 SEP 27 and OCT 31. The corresponding extremes for **RA** were 229 (1990 DEC 08) and 77 (1990 NOV 01). The only unusual note was that the two daily highs were several months apart. For most reporting periods, the two highs for **RI** and **RA** are separated by only one or two days or may actually coincide. [1-5] *Figure 25* (p. 169) graphs the two forms of Sunspot Number for each rotation of this reporting period.

All times used in this report are UT (Universal Time), and cardinal directions will be abbreviated (e.g., N, W). These directions, as well as angular measures, will be heliographic. A *following* feature is to the celestial east and a *preceding* one is to the west. "Groups" refer to white-light collections of sunspots, while "regions" are entire magnetically associated areas in all wavelengths. Active regions (AR's) are designated by number by the National Oceanic and Atmospheric Administration/Space Environmental Services Center (NOAA/SESC) in Boulder, Colorado.

Other general solar nomenclature and definitions of terms may be found in the Astronomical League book, *The New Observe and Understand the Sun*; which is available along with the A.L.P.O.S.S. observing forms from this Recorder (address on inside back cover) for $US 6.00, or without the forms for $US 5.75 from: Astronomical League Sales, c/o Wilma Cherup, 4 Klopfer Street, Pittsburgh, PA 15209. Another source is our own book, *A.L.P.O.S.S. Monochromatic Handbook* (available from Co-Recorder Randy Tatum for $US 6.00; 1108 Ocala Road, Richmond, VA 23229). Sunspot classification is explained in "A Three-Dimensional Sunspot Classification System" (*J.A.L.P.O.*, *33*, Nos. 1-3, Jan., 1989, pp. 10-13) and in the Astronomical League book mentioned above.

Fourteen observers from five countries contributed observations to this report, and are listed in *Table 1* (below), with data about their telescopes and observing locations.. The number of observers is less than in the previous reporting period, even though activity continued at a good pace. In terms of observers, we lost six and gained three. As before, most of the observers that were lost were in the United States, so that we retained sufficient longitude spacing for a potential of 24-hour coverage.

Table 1. Observers Contributing to This Report.

Observer	Telescope Aper.	Telescope f/	Telescope Type	Location
Bartel, W.	6 (2.4)	16	Refr.	B.C., Canada
Clement, D.	15 (6.0)	12	Refr.	Louisiana, USA
Dragesco, J.	36 (14)	10	S.-C.	France
Garcia, G.	20 (8)	10	S.-C.	Illinois, USA
	6.3(2.5)	32	S.-C.	
Garfinkle, R.	25 (10)	10	S.-C.	California, USA
Hill, R.E.	6 (2.4)	13	Refr.	Arizona, USA
	7.5(3)	13	Refr.	
Maxson, P.	15 (6)	10	New.	Arizona, USA
Piorkowski, W.	13 (5)	11.6	Refr.	Illinois, USA
Reese, E.	15 (6)	14.5	S.-C.	Virginia, USA
Rousom, J.	13 (5)	10	New.	Ontario, Canada
Ryder, J.	15 (6)	?	Refr.	Qld., Australia
Tao, Fan-Lin and Chang, Grace	13 (5)	?	Refr.	Rep. of China
Timerson, B.	15 (6)	7.8	New.	New York, USA

Notes: "Aper." is the telescope aperture in the form cm. (in.); "f/" is its focal ratio; "New." is Newtonian; "Refr." is refractor; and "S.-C." is Schmidt-Cassegrain.

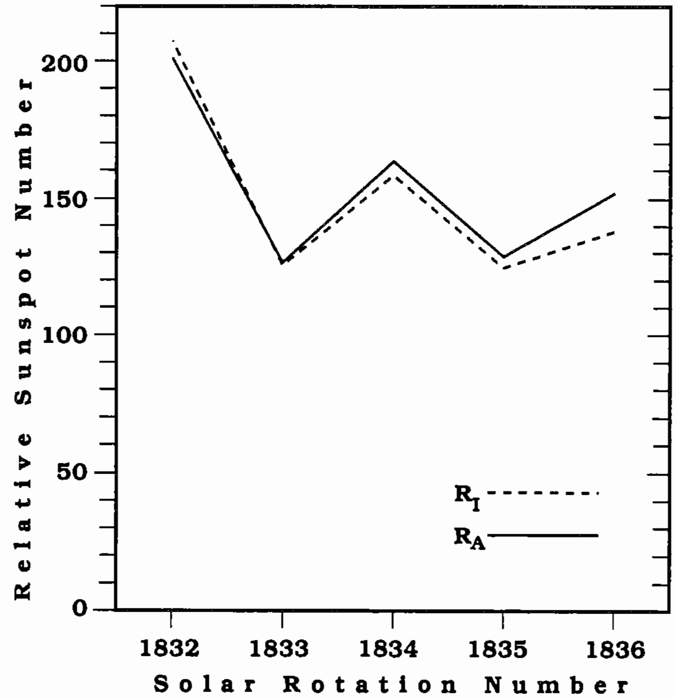


Figure 25. Graph of rotation means of RI (Relative International Sunspot Number) and RA (Relative American Sunspot Number) for Rotations 1832-1836.

ROTATION 1833 [1,2]
(1990 SEP 01.10 to SEP 28.37)

Sunspot Number	Mean	Maximum (Dates)	Minimum (Date)
RI	125.4	178 (SEP 14)	77 (SEP 27)
RA	126.1	162 (SEP 16)	95 (SEP 27)

This rotation saw 61 groups on the Sun, down significantly from the 72 groups of Rotation 1832. Most of this rotation's groups were small with only about a half-dozen reaching Modified Zurich Class E [i.e., a bipolar group 10°-15° in extent. Ed.] The activity level of this rotation had dramatically decreased from Rotation 1832, which had a **RI** mean of 207.0 and a mean **RA** of 201.0; some of its daily highs were over 100 greater than in Rotation 1833!

One of the largest and best-observed groups of this rotation was **AR 6283**, which came onto the disk at a latitude of 8°S. Garcia made the first H-α observation (Hydrogen-alpha; at wavelength 6562.8Å) of this group on SEP 22, showing it as a single fairly round spot with a penumbra. The next day other observers saw it as a large round spot, several degrees across, with a penumbra followed by two smaller spots, one N and one S. Both of the smaller spots had penumbrae, and the entire group was wreathed in faculae. As the group came into better view on SEP 24, drawings by Bartel and Hill showed the larger spot to be composed of several umbrae, elongated N-S, with penumbrae. The Nf spot was moving between the leader and the Sf spot. There were still many faculae around the group. Following all this, and slightly to the S, was a solitary spot surrounded by extensive faculae. Nearly all the observers considered the latter as part of AR 6283, when in reality it was designated **AR 6285** and was a separate magnetic entity.

Piorkowski, who has contributed the finest whole-disk photographs in our files, having resolutions around 2 arc-seconds, photographed the disk on SEP 25, showing the leader of AR 6283 as elongated E-W, possibly due to rotation, with four or five umbrae in a well-organized penumbra. To the S and closely following were two tiny umbral spots. The middle spot, which was the former Nf spot, had two-three umbrae aligned E-W, with penumbra only on the N and S border. Meanwhile, the former Sf spot, now the follower, consisted of 3-4 N-S aligned umbrae with penumbra on all but the preceding side. One day later, the leader was more strongly elongated, with a penumbral extension to the N of the Nf edge. The only other change was that the follower had rotated, with the N portion moving W or clockwise, such that the alignment was now nearly E-W. Also, there were many umbral spots and pores, mainly S of the group.

On SEP 27, the leader was even more elongated, with a chain of 4-6 umbrae strung out E-W in one penumbra. The middle spot was reduced to just a collection of umbral spots and pores in three chains radiating out from the leader, each chain oriented about 30° from the other. The follower was now smaller and was also elongated NE-SW. By SEP 28, a penumbral "bump" had formed on the N side of the leader; while the middle collection, consisting of the three radiating chains of umbral spots, now held only a half-dozen such spots and some pores. The follower was nearly gone, consisting of only a very small spot with a rudimentary penumbra and one detached umbral spot. A photograph by Maxson on SEP 29 showed the leading umbra in the leader to be enlarged and the "bump" to the N as now an elongated penumbral projection extending from the Np edge to the E halfway across the spot. To the S a group of umbral spots were larger and in a rudimentary penumbra, while an umbral spot had detached from the leader and was now preceding it. The remainder of the group was largely unchanged. Excellent photographs by Maxson and Piorkowski on SEP 30 showed the leader as pear-shaped, enlarged on the leading side. This side contained a large umbra and a string of smaller umbrae trailing off to the E. The N appendage had now entirely disappeared. The middle and following spots had been reduced to only a few pores, but the detached spot still preceded the group.

Unfortunately, there were no data for OCT 01. However, on OCT 02, Piorkowski and Rousom saw the leader umbra as shaped as a fat "V" pointing N with no penumbra on the S side. The penumbra that had been on this side had separated, containing two umbral spots, and was still attached to the main penumbra on its Sf corner. The leading "detached spot" was smaller. The last day of observations of this region was OCT 03, when the group left the disk. The S semi-detached portion of the leader was then seen to have completely detached and most of the penumbra surrounding it was gone. Following this spot were only a few pores.

ROTATION 1834 [2,3] (1990 SEP 28.37 to OCT 25.66)

Sunspot Number	Mean	Maximum (Date)	Minimum (Date)
RI	158.3	227 (OCT 15)	113 (SEP 28)
RA	163.5	221 (OCT 15)	118 (Sep 30)

There were 63 groups seen on the Sun during this rotation, only two more than in the previous rotation. However, Rotation 1834's groups tended to be more developed and in general contained more spots, which led to the larger spot counts. Many groups were closely packed, so that observers had difficulty in deciding which spots belonged to which groups! **AR 6327/6331** was just such a group.

Although not the region of chief concern here, **AR 6294** followed AR 6283, and was unremarkable and was not observed particularly well.

AR 6327 was first seen on OCT 06 as a single spot near the limb, with some faculae surrounding it. A day later, it had increased to two spots with penumbrae aligned E-W with several smaller spots between them. This region was not observed on the next day, but on OCT 19 **AR 6331** followed AR 6327 onto the disk, the former consisting of two moderate-size spots with penumbrae. The leader of AR 6327 was seen as four large umbrae, with a few smaller ones, in a complex penumbra that was aligned E-W, followed by several more umbral spots and pores. Following this were three to four umbrae, also in a complex penumbra, invaded by light bridges from the E. Faculae surrounded both groups.

All the penumbra on the f side of the leader of AR 6327 was gone on OCT 20. By then there were also fewer umbral spots and pores in the area. The follower spot was relatively unchanged. In the other group, AR 6331, there were three spots with rudimentary penumbrae in a SW-NE line. Considerable faculae were still in evidence around and following both groups. The maximum area of the two groups was reached on OCT 19. Even so, the maximum development and complexity did not occur until about OCT 21. On that day, AR 6327 had a leader that consisted of three to four umbrae in a circular penumbra followed by two detached spots, one to the N and one to the S. The follower spot was smaller, with a detached spot on the preceding side. AR 6331 still had a leader, but a clear follower had formed with penumbra and with several umbral spots following it.

At this point, it is important to understand the complex situation. The leading group, AR 6327, had a large leader followed by two much smaller spots. Following this was another group, AR 6331, consisting of a large spot leading and some much smaller spots following. These two groups were very close together. In fact, the follower of AR 6327 was much closer to the leader of AR 6331 than to the leader of its own group. As a result, white-light observers tended to lump these two groups together, or to list the leader of the first group as a separate group, and then to lump all the remaining spots together as a single separate group. A H-α photograph by Dragesco helped to sort this out by showing the filaments (magnetic neutral lines between the two polarities) between the regions. This situation demonstrates the importance of magnetic or monochromatic observations in understanding the interactions of the various solar features. Would that we all could have our own magnetographs!

OCT 22 was the beginning of the end for these two regions. The separation between the leader and follower of AR 6327 was over 20°! It is little wonder that there was some confusion. The leader was quite circular by then, and contained only two or three umbrae. This was followed closely by a half-dozen umbral spots. The follower was composed of several spots with penumbrae aligned E-W, along with a few surrounding umbral spots and pores. All that was left of the other region, AR

6331, was a line of umbral spots with only the follower having a rudimentary penumbra. On OCT 23, AR 6327 was much the same, except that all its spots were somewhat smaller and the Ef spot's umbra was dividing. AR 6331 was now one main spot, which may or may not have had a penumbra. (One observer shows it but the other does not.) At any rate, the penumbra must have been rudimentary at best, if it existed at all. The main spot was followed by a few umbral spots.

There were no data for the next two days. On OCT 26, the leader of AR 6327 was a circular spot, followed by a few umbral spots. AR 6331 was just a few umbral spots. Both regions remained much the same, with only reductions in number and area of spots, until they both left the disk by OCT 31.

ROTATION 1835 [3,4] (1990 OCT 25.66 to NOV 21.96)

Sunspot Number	Mean	Maximum (Dates)	Minimum (Dates)
RI	124.9	209 (NOV 07)	77 (OCT 31 & NOV 01)
RA	128.9	204 (NOV 08)	77 (NOV 01)

This rotation experienced a sudden decrease in both numbers of sunspots and numbers of groups. This decrease was about 20 percent, and was not so great as that between Rotations 1832 and 1833. The largest region of this rotation, indeed of this entire reporting period, was **AR 6368**, which came onto the disk and crossed the central meridian during this rotation.

Piorkowski was the first to observe this group, on NOV 12 at 15h 46m UT, in a remarkable photograph that caught the leader spot on the limb as a notch! While I have seen this phenomenon before, this is the first time that a member of this Section has photographed it. The next day, at 18h 19m UT, he observed the region as being two large spots, the smaller leading, with two more notches on the limb following those spots. Both spots had good penumbral development. In a white-light drawing on NOV 14, Rousom saw the leader to be a medium-sized spot, several degrees across, with two umbrae in one penumbra followed by a huge spot over 5° across, consisting of several large umbrae in a well-organized penumbra. The previous notches were now the follower spot, consisting of a N-S mass of umbrae in a chaotic penumbra some 10° long with two detached umbrae following.

By NOV 15, the region had come onto the disk sufficiently that the first really good view was had by Piorkowski and Rousom. The leader was composed of two spots. The W of these was the medium-sized one, now seen to have three or four umbrae with penumbra in an E-W line. This was closely followed by the huge spot, which now held at least four umbrae, similarly aligned E-W, in a penumbra that was substantially thinner on the leading edge, possibly due to the Wilson Effect. [The Wilson Effect is the apparent displacement away from the limb of the umbra in relation to the penumbra, of a spot near the limb, giving the illusion that the umbra is depressed. Ed.] This thinning suggested that the W spot may have detached from the larger one. The follower was a chaotic mass, twice the size of the larger leader spot, with about a dozen umbrae enclosed in a massive penumbra with appendages to both the N and S. The small umbral spots following this were not evident, but there was a small detached spot with rudimentary penumbra to the SW. Few faculae were noted by either observer. Their observations on this date point out the complementary nature of drawings and photographs, both in white light and in H-α. Piorkowski's photographs showed the nature of the group and surrounding photosphere well, while Rousom's drawings detailed the inner structure of the spots themselves.

Fragmentation began to take its toll on NOV 16. The W leader spot was the same as before, but the larger spot's penumbra was fragmenting to the S and E. In the follower, the N appendage was breaking up while the main body was being invaded by light bridges. On NOV 17, fragmentation continued in the larger leader spot while it became more elongated E-W. To the N of the follower were many detached portions. The umbrae in the center had formed two larger umbrae, separated by a light bridge, aligned N-S. The W side of these umbrae bordered on a broad N-S light bridge. The H-α appearance was much the same, with a filament between the larger and smaller leader spots. Many light patches could be seen in the follower mass, but the light bridge on the W side of the umbra was bright. This was the site of a number of small flares, some recorded by Garcia and Clement. The general appearance of the Sun on this date is well shown by Garcia's H-α photographs, reproduced here as *Figures 26* and 27, respectively (p. 172). The detailed structure of AR 6368 is shown quite well in the white-light photograph by Piorkowski in *Figure 28* (p. 173).

On NOV 18, there was little change in the leader spot. The situation was different for the follower, where a penumbral appendage was reaching back toward the leader. The N side had remained quite chaotic. In H-α the active light bridge of the previous day had dimmed, with a bright but small arc to the N of the follower. The group's maximum area occurred on NOV 19. By then the leader was still relatively unchanged, with 5-6 umbrae in the larger spot arranged in a backwards "S" on its side. The follower was splitting in half along the former active light bridge. The N side was very fragmented, as was the appendage to the W. Dragesco caught a flare in the N portion of the follower at 09h 45m UT, while a photograph by Clement at 16h 37m UT showed the area quiet once more.

A broad penumbral extension had formed to the N of the large leader spot on NOV 20, while umbrae in the follower were consolidating. Dragesco caught a white-light flare

Figure 26. H-α photograph of the Sun by Gordon Garcia on 1990 Nov 17, 17h 53m UT. 6.3-cm Schmidt-Cassegrain telescope at f/32, with a 1/60-second exposure on Kodak Technical Pan 2415 Film. A Daystar© 0.56Å filter was tuned to -2.5Å (blue or shorter-wavelength wing) for this photograph. North is at the top in this unreversed view, and AR 6368 is to the left of center near the E (following) limb.

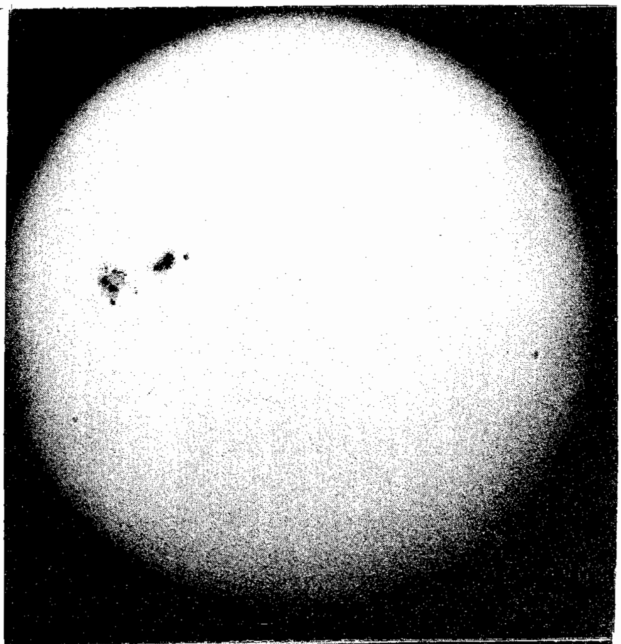
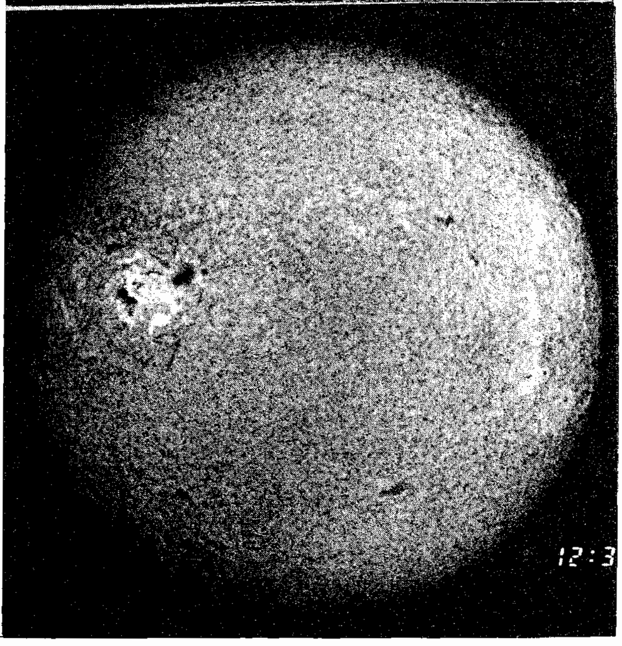


Figure 27. H-α photograph of the Sun by Gordon Garcia on 1990 Nov 17, 18h 30m UT, just 37 minutes later than the view above in *Figure 26.* 6.3-cm Schmidt-Cassegrain telescope at f/32, with a 1/60-second exposure on Kodak Technical Pan 2415 Film. A Daystar© 0.56Å filter was tuned to the centerline for this photograph. North is at the top in this unreversed view, and AR 6368 is to the left of center near the E (following) limb.



(WLF) in the light bridge to the W of the main umbrae in the follower. The entire light bridge was brighter than the photosphere. When checked against the flare lists of NOAA/SESC, it was found that there was indeed a flare in progress. In H-α, Clement caught a flare not listed by the NOAA/SESC; this is not unusual. The listed times of flare commencement, maximum, or ending often will be uncertain. For example, the flare may be caught underway or the true ending missed. It is not surprising, therefore, that some flares will be missed entirely. This only underscores the aims of this Section to fill in gaps in the professional records!

The decay of AR 6368 was well underway by NOV 21, with the penumbral extension in the leader now reduced and separating, while the entire W half of the follower was disintegrating. In the other half of the follower the umbrae were still coalescing in a penumbra that was becoming more organized. On Thanksgiving Day, NOV 22, our observers in the United States were hard at work, although that was a holiday there. Their observations showed that the large spot in the leader was beginning to split in half. The umbra was in two parts, while the overall shape was that of a dumbbell or a figure "8" on its side. The f portion was twice as large as the p portion.

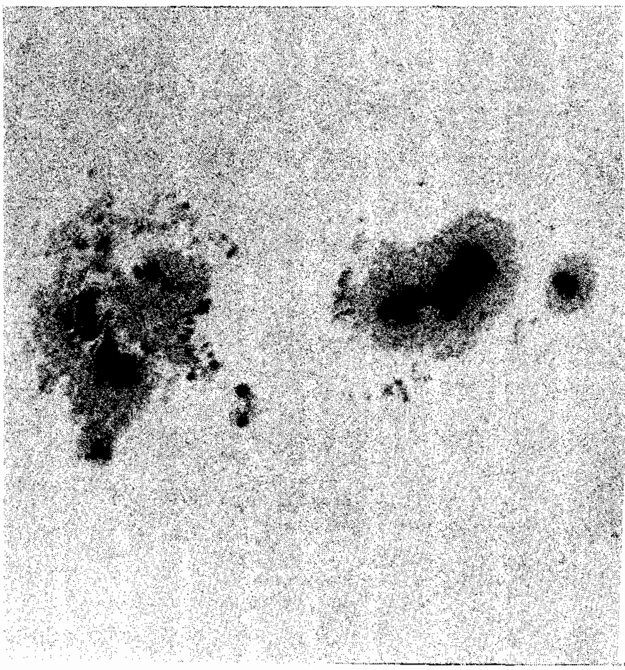


Figure 28. White-light photograph of the Sun by Walter Piorkowski on 1990 NOV 17, 18h 11m UT, thus falling between the times of *Figures 26* and *27*. 13-cm refractor at f/11.6, with a 1/2000-second exposure on Kodak Technical Pan 2415 Film. North is at the top in this unreversed view. AR 6368 nearly fills this view.

The remaining leader spot was now reduced to a single umbra with a penumbra on the leading side only. The process of the previous day continued in the follower with the disintegration of the W half continuing while the rest continued to consolidate.

AR 6368 was nearing the limb on NOV 23, when its leader remained as before. Part of the W side of the follower had detached and had moved S between the leader and follower. The elongation of the leader continued in the larger leader spot on NOV 24. It appeared to be about to split. The new middle spot had broken up into a few umbral spots with rudimentary penumbrae. Only the E side was left of the follower, with penumbral projections to the N and S. In H-α, the fireworks had not stopped. Clement caught a small flare to the N of the follower at 16h 35m UT. Although the region was difficult to make out on the limb on NOV 25, the appearance had changed little. There were few faculae and the S penumbral projection in the follower was now some 5° long.

ROTATION 1836 [4,5]
(1990 NOV 21.96 to DEC 19.28)

Sunspot Number	Mean	Maximum (Dates)	Minimum (Date)
RI	137.9	186 (DEC 04)	88 (DEC 15)
RA	151.9	229 (DEC 08)	102 (DEC 15)

In this rotation, the mean sunspot numbers showed the greatest variation of the reporting period. Note that the maximum daily **RA** was 23 percent greater than the maximum daily **RI**. For the minima, **RA** was 16 percent the greater. It is little wonder that such differences over the course of the rotation led to an overall mean **RA** 10 percent greater than the **RI**.

Even though both mean numbers showed increases over the previous rotation, Rotation 1836 exhibited only 50 groups, which was the lowest for this reporting period and continued the decline from the high of 72 groups in Rotation 1832. Indeed, this was the lowest number of groups seen since Rotation 1829.

The rotation began with a large spectacular region, AR 6368, still dominating the disk. After such a show, the remainder of the rotation was dull by comparison. One of the more interesting regions that followed was **AR 6395**, which came onto the disk at latitude 16°N. It was first seen on 1990 DEC 01 at 18h 00m UT, as three spots in a N-S line. The spots themselves appeared as lines with little detail, and had been completely absent in a drawing made at 01h 41m UT by Ryder in Australia. Some details could be made out on DEC 02, when the N spot, the largest of the three spots, was seen to have a penumbra to the N and a chain of spots extending S, some with rudimentary penumbrae. Two more spots with penumbrae followed the southernmost spot in the chain; these two formed **AR 6397**.

On DEC 03, the N spot of AR 6395 was triangular with its apex pointing N. The S chain consisted of 6-10 spots with rudimentary penumbrae. One day later, the N spot was more irregular but still pointing N, while the chain was now an arc of spots open to the W. Following closely behind these were the two spots of AR 6397, now both elongated N-S.

There were no data for DEC 05, but on DEC 06 AR 6395 had completely changed! It was now two parallel E-W rows of spots, one N and one S. In the N row the largest spot was to the E, with a line of 4-6 umbral spots and some pores extending W. The S row also had its largest spot to the E with another string of 4-6 umbrae in one rudimentary penumbra. South of this, and part of this group, were three isolated umbral spots.

Change was occurring rapidly in this sunspot group, and on DEC 07 it was again completely different. No longer parallel rows of spots, it had become a profusion of umbral spots in an area some 10° across with rudimentary penumbra to the N. It appeared as if the entire group had rotated counterclockwise. The group's area had reduced by DEC 08, and it appeared to have rotated further, but otherwise the group was much the same. Even more rotation was evident on DEC 09, when the N spots with rudimentary penumbrae, seen on DEC 07, had now rotated from the NE to the NW, or about 90°. AR 6395 had lagged in its trip across the disk, so that AR 6397 was due S of it. The latter had a large leader, with about four umbrae followed by a cluster of umbral spots. AR 6395 appeared as a line on DEC 10, when it was composed of two E-W spots with rudimentary penumbrae followed by umbral spots and a few pores. A follower had developed, consisting of two N-S spots with rudimentary penumbrae. To the S, only the leader was left in AR 6397.

Again, we have no data for DEC 11. On DEC 12, AR 6395 was seen near the limb, with a leader of three main spots in a triangle and with the follower unchanged. By DEC 13 it had left the disk.

CONCLUSION

As the recent explosion of activity indicates, dramatic activity can still be expected even though the maximum of Cycle 22 was July, 1989. As recently as 1990 NOV 08, there were still aurorae, sponsored by solar flares, seen as far south as Mexico and Florida! The prediction of such activity has been hampered by changes in the patterns of solar activity. Even now, NOAA/SESC is suggesting that activity may show another outburst about the time of the publication of this report. Take advantage of this, for soon the Sun will be quiet. Be sure to send your observations to our Co-Recorder, Paul Maxson (address on inside back cover), so that they will be included in our catalog of observations that is sent to professional researchers around the world. In this way you can enjoy a hobby and, in addition, make a lasting contribution to science.

REFERENCES

1.) *Solar-Geophysical Data (Prompt Reports)*, Part I, No. 554, October, 1990.
2.) ________, No. 555, November, 1990.
3.) ________, No. 556, December, 1990.
4.) ________, No. 557, January, 1991.
5.) ________, No. 558, February, 1991.

DUES INCREASE NOTICE

As noted in our 1991 Board Meeting Minutes on page 141 of the previous issue (Vol. 35, No. 3, September, 1991), it has been necessary to increase dues for all A.L.P.O. membership categories. This has been a result of increasing expenses, particularly printing and mailing costs. *The increased dues will go into effect on January 1, 1992; prior to that date, you may renew your membership for up to two years at the present rate.* The new dues schedule will be as follows:

United States, Canada, and Mexico .... $16.00 for 1 year or $26.00 for 2 years
All Other Countries* .... $20.00 for 1 year or $33.00 for 2 years
Sustaining Member .... $25.00 (1 year only)
Sponsorship .... $50.00 (1 year only)
Associate membership .... $3.00 (1 year only; excludes *Journal* subscription)

A 20-percent surcharge applies to memberships obtained through subscription agencies or which require an invoice.

* As several overseas members have written that our experiment with a direct mailing service has resulted in much faster delivery for them, we will continue with this method, the additional cost of which is included in the new overseas dues.

Comet Corner

By: Don E. Machholz, A.L.P.O. Comets Recorder

Present Comet Activity

During the first half of 1992, the following comets will be visible in our skies. Please send observations of them to this Recorder (address on inside back cover).

Periodic Comet Schwassmann-Wachmann 1.—This comet will occasionally outburst by several magnitudes. For example, in early August, 1991, it attained magnitude +12. This comet follows a near-circular 15-year orbit more than 5 AU from the Sun. [AU = Astronomical Unit; the Earth's mean distance from the Sun, about 149.6 million km]. Please report all positive *and negative* observations to this Recorder. [*Table 1*, right column]

Periodic Comet Faye (1991n).—This is an old periodic comet with a 7.4-year orbital period. It was recovered on 1991 APR 16 by T. Seki of Japan. This comet put on a good show in late 1991, and is now fading in our evening sky. [*Table 2*, right column]

Comet Helin-Lawrence (1991L).— This comet was found on 1991 MAR 17 with the 18-in (46-cm) Palomar Schmidt telescope. It is much better-placed for Southern-Hemisphere observers than for those in the north. [*Table 3*, p. 176]

Comet Shoemaker-Levy (1991d).—The team of Carolyn and Eugene Shoemaker and David Levy discovered this comet as part of the Earth-crossing comet/asteroid discovery program at Palomar Mountain. This comet was magnitude +15 when it was found on JAN 22. It has now swung around to our northern morning sky, where it will remain visible in amateur-sized telescopes for the first part of 1992. [*Table 4*, p. 176]

Comet Shoemaker-Levy (1991a1).—The same team discovered this comet on 1991 OCT 06. It will be closest to the Sun on 1992 JUL 23 at 0.83 AU. Mainly a Northern-Hemisphere object, this comet will be circumpolar from the northern temperate latitudes during June and July, 1992. It should brighten to near magnitude +6 at that time. [*Table 5*, p. 176].

[Comets are being discovered and recovered all the time, so that there will undoubtedly be additional comets known by the time that you read this. For example, the team of Carolyn Shoemaker, Gene Shoemaker, and David Levy has found yet another comet with the Palomar Schmidt telescope, on 1991 NOV 13. This was Carolyn Shoemaker's twenty-sixth comet, tying her with Jean-Louis Pons for the all-time record of discoveries! Ed.]

Ephemerides

Notes: In the "Elongation. from Sun" column, E refers to visibility in the evening sky, and M to morning visibility. "Total Mag." values are forecasts of visual total magnitudes and are subject to considerable uncertainty.

Table 1. Ephemeris of Periodic Comet Schwassmann-Wachmann 1.

1991-92 UT Date (0h UT)	2000.0 Coörd. R.A. h m	2000.0 Coörd. Decl. ° '	Elongation from Sun °		Total Mag.
DEC 15	03 15.3	+29 04	150	E	+17.2
20	03 13.5	+28 51	145	E	+17.2
25	03 12.0	+28 38	139	E	+17.2
30	03 10.7	+28 25	134	E	+17.3
JAN 04	03 09.8	+28 13	129	E	+17.3
09	03 09.1	+28 02	124	E	+17.3
14	03 08.8	+27 51	119	E	+17.3
19	03 08.8	+27 42	114	E	+17.4
24	03 09.1	+27 34	109	E	+17.4
29	03 09.8	+27 27	104	E	+17.4
FEB 03	03 10.7	+27 21	099	E	+17.5
08	03 12.0	+27 16	094	E	+17.5
13	03 13.5	+27 13	090	E	+17.5
18	03 15.3	+27 11	085	E	+17.6
23	03 17.4	+27 10	081	E	+17.6
28	03 19.7	+27 10	076	E	+17.6
MAR 04	03 22.2	+27 11	072	E	+17.7
09	03 25.0	+27 13	067	E	+17.7
14	03 28.0	+27 16	063	E	+17.7
19	03 31.1	+27 20	059	E	+17.7
24	03 34.5	+27 25	055	E	+17.7
29	03 38.0	+27 30	050	E	+17.8
APR 03	03 41.6	+27 36	046	E	+17.8
08	03 45.4	+27 42	042	E	+17.8
13	03 49.3	+27 49	038	E	+17.8
18	03 53.3	+27 56	035	E	+17.9
23	03 57.4	+28 03	031	E	+17.9
28	04 01.7	+28 11	027	E	+17.9

Table 2. Ephemeris of Periodic Comet Faye (1991n).

1991-92 UT Date (0h UT)	2000.0 Coörd. R.A. h m	2000.0 Coörd. Decl. ° '	Elongation from Sun °		Total Mag.
DEC 15	02 19.5	+01 06	129	E	+10.7
20	02 25.9	+01 27	126	E	+10.8
25	02 32.8	+01 56	123	E	+11.0
30	02 40.2	+02 30	120	E	+11.1
JAN 04	02 48.0	+03 08	117	E	+11.3
09	02 56.3	+03 50	114	E	+11.5
14	03 04.8	+04 35	111	E	+11.6
19	03 13.7	+05 22	109	E	+11.8
24	03 22.8	+06 09	106	E	+12.0
29	03 32.2	+06 57	104	E	+12.2

Table 3. Ephemeris of Comet Helin-Lawrence (1991L).

1991-92 UT Date (0h UT)	2000.0 Coörd. R.A. h m	Decl. ° '	Elongation from Sun °		Total Mag.
DEC 15	13 26.4	-62 56	056	M	+10.0
20	13 41.8	-67 49	058	M	+9.8
25	14 05.1	-72 55	060	M	+9.7
30	14 47.0	-78 03	061	M	+9.6
JAN 04	16 28.2	-82 35	061	M	+9.5
09	19 58.1	-83 44	062	E	+9.5
14	22 27.7	-80 09	061	E	+9.4
19	23 28.2	-74 56	061	E	+9.4
24	23 58.3	-69 24	060	E	+9.5
29	00 16.8	-63 57	058	E	+9.5
FEB 03	00 29.7	-58 42	056	E	+9.6
08	00 39.7	-53 45	054	E	+9.7
13	00 47.8	-49 07	052	E	+9.8
18	00 54.8	-44 48	049	E	+9.9
23	01 00.9	-40 49	046	E	+10.1
28	01 06.5	-37 08	044	E	+10.2
MAR 04	01 11.7	-33 44	041	E	+10.3
09	01 16.5	-30 36	038	E	+10.5
14	01 21.1	-27 43	035	E	+10.6
19	01 25.4	-25 02	033	E	+10.8
24	01 29.6	-22 33	030	E	+10.9
29	01 33.6	-20 14	028	E	+11.1
APR 03	01 37.4	-18 05	026	E	+11.2
08	01 41.1	-16 04	025	E	+11.3
13	01 44.7	-14 10	024	E	+11.5
18	01 48.1	-12 24	023	E	+11.6

Table 4. Ephemeris of Comet Shoemaker-Levy (1991d).

1992 UT Date (0h UT)	2000.0 Coörd. R.A. h m	Decl. ° '	Elongation from Sun °		Total Mag.
JAN 04	16 50.5	+39 59	069	M	+11.0
09	17 08.9	+40 16	069	M	+11.0
14	17 27.0	+40 30	069	M	+11.0
19	17 44.7	+40 42	069	M	+11.0
24	18 01.8	+40 51	069	M	+11.0
29	18 18.3	+40 58	068	M	+11.0

(Continued in right column)

Table 4—*Continued.*

1992 UT Date (0h UT)	2000.0 Coörd. R.A. h m	Decl. ° '	Elongation from Sun °		Total Mag.
FEB 03	18 34.2	+41 04	067	M	+11.1
08	18 49.3	+41 09	067	M	+11.1
13	19 03.7	+41 13	066	M	+11.1
18	19 17.3	+41 18	066	M	+11.2
23	19 30.2	+41 23	065	M	+11.2
28	19 42.3	+41 28	065	M	+11.3
MAR 04	19 53.6	+41 33	064	M	+11.3
09	20 04.2	+41 40	064	M	+11.4
14	20 14.0	+41 48	064	M	+11.4
19	20 23.2	+41 57	064	M	+11.5
24	20 31.6	+42 06	064	M	+11.5
29	20 39.3	+42 17	065	M	+11.6
APR 03	20 46.3	+42 29	065	M	+11.6
08	20 52.6	+42 41	066	M	+11.7
13	20 58.2	+42 54	067	M	+11.7
18	21 03.1	+43 07	068	M	+11.8
23	21 07.4	+43 20	070	M	+11.8
28	21 10.9	+43 33	072	M	+11.9
MAY 03	21 13.7	+43 45	074	M	+11.9
08	21 15.7	+43 56	076	M	+11.9
13	21 17.1	+44 06	078	M	+12.0

Table 5. Ephemeris of Comet Shoemaker-Levy (1991a_1).

1992 UT Date (0h UT)	2000.0 Coörd. R.A. h m	Decl. ° '	Elongation from Sun °		Total Mag.
APR 13	00 41.3	+35 35	028	M	+12.0
18	00 45.0	+36 41	029	M	+11.8
23	00 48.8	+37 54	030	M	+11.6
28	00 52.9	+39 14	032	M	+11.3
MAY 03	00 57.1	+40 44	034	M	+11.0
08	01 01.6	+42 24	036	M	+10.8
13	01 06.4	+44 16	038	M	+10.5
18	01 11.9	+46 21	041	M	+10.2
23	01 17.9	+48 44	043	M	+9.8
28	01 25.0	+51 27	045	M	+9.3

METEORS SECTION NEWS

By: Robert D. Lunsford, A.L.P.O. Meteors Recorder

June, July, and August 1991 were very productive and interesting months for A.L.P.O. meteor observers, whose reports are summarized in *Table 1*, below. In June, A.L.P.O. member John Gallagher was watching for members of the June Lyrid stream when he noticed activity occurring from the area of Beta Cygni (Albireo). Between June 22nd-30th, 20 of these meteors were seen in 9h 45m of meteor watching.

In early July, Mr. Gallagher noticed meteor activity radiating from the vicinity of Delta Cephei. Between July 8th-18th he counted 13 members of this shower. On the morning of July 17th, I was observing with Hal and Katy Povenmire and we verified this radiant's activity. Activity from this radiant was first mentioned by W. F. Denning in his *Monthly Notices*. [1]

While facing to the north in the direction of Cepheus, Mr. Gallagher noticed that the annual Alpha Cygnid radiant was active in mid-July this year. Observations of this shower are infrequent.

I was plotting meteors on the morning of August 7th, facing the active radiants in the southern sky. While analyzing these data that afternoon, I noticed that two sharp radiants had been active, besides the normal Aquarid-Capricornid complex. The "new" radiants were located at 03h 12m right ascension, -05° declination in Eridanus and at 3h 40m, +07° in Taurus. The radiant in Eridanus produced 5 meteors, and the other 6, during 3 hours of observing. The radiants were again active on the next morning, producing 3 meteors each during 3.5 hours of observing. These two radiants are not found in the usual lists of meteor showers, but are both mentioned in Gary Kronk's *Meteor Showers: A Descriptive Catalog*. He points out that the "August Eridanids" have an orbit similar to Comet Pond-Gambart. Kronk also notes that "no visual evidence exists to support this radiant; however, there is strong evidence of activity 8°-10° north among records of the AMS." [2; AMS = American Meteor Society] I believe that the activity seen by AMS observers coincides with my radiant near Xi Tauri and that these two radiants are separate and distinguishable in the August morning sky.

Finally, the Perseids were a disappointment for most observers in North America in 1991 due to a prevalent cloud cover. Even the usually clear western United States was clouded out by Tropical Storm Hilda during the time of maximum activity. From reports that I received, it appears that maximum activity occurred near 1991 AUG 12, 18h 00m UT. Observers in Japan confirmed that Perseid rates reached several hundred per hour at maximum. This is very exciting news because it probably heralds the return of Comet Swift-Tuttle within the next year or two. Should this comet appear next year, a strong display of Perseids will be hampered by a full moon. However, 1993 is a much more favorable year, with little lunar interference. If Comet Swift-Tuttle is indeed approaching the inner Solar System, let us hope for a perihelion date in July, 1993!

1. Denning, W.F. *Monthly Notices*, Vol 1, pp. 410-467.
2. Kronk, Gary. *Meteor Showers: A Descriptive Catalog*, pp. 171-172.

Table 1. Recent A.L.P.O. Meteor Observations.

1991 UT Date		Observer and Location	Universal Time	Number and Type of Meteors Seen*	Comments* (+N = Limiting Magnitude)
Jun	01	John Gallagher, NJ	04:12-04:42	1 τ Her; 1 SP	+5.5
	03	" " "	04:11-05:12	1 τ Her; 3 SP	+5.0
	05	Roger Venable, GA	02:06-03:06	4 τ Her; 1 χ Sco; 3 SP	+5.4; 5% cloudy
	06	John Gallagher, NJ	04:35-06:35	2 τ Her; 1 χ Sco; 2 SP	+5.8
	15	George Gliba, MD	06:55-7:55	7 Lyr; 7 SP	+6.1
	16	" " "	05:57-06:27	3 Lyr; 2 SP	+5.7; 30% cloudy
	18	Robert Lunsford, CA	08:47-10:47	5 SP	+6.6; 65% cloudy
	21	John Gallagher, NJ	04:30-06:00	2 Lyr; 6 SP	+5.5
	22	" " "	05:54-07:09	2 Lyr; 8 Cyg; 2 SP	+5.8
	24	" " "	05:10-06:40	2 Cyg; 7 SP	+5.0

---------- *Table 1 continued on pp. 178-180 with notes* ----------

Table 1—*Continued.*

1991 UT Date		Observer and Location	Universal Time	Number and Type of Meteors Seen*	Comments* (+N = Limiting Magnitude)
JUN	25	John Gallagher, NJ	07:18-08:18	4 SP	+5.7; 10% cloudy
	26	" " "	03:50-04:50	1 Lyr; 2 Cyg; 3 SP	+4.9
	27	" " "	03:51-05:21	2 Lyr; 4 Cyg; 1 Boö; 7 SP	+4.8; 15% cloudy
	28	" " "	03:28-05:53	1 Lyr; 2 Cyg; 1 Boö; 6 SP	+4.7; 10% cloudy
	29	" " "	04:45-05:45	1 Lyr; 2 Cyg; 6 SP	+4.0; 10% cloudy
	30	" " "	03:05-03:30	1 Lyr; 3 SP	+4.0; 30% cloudy
JUL	08	" " "	04:45-06:15	1 o Dra; 2 S. δ Aqr; 5 SP	+5.5
	09	" " "	04:10-06:45	5 δ Cep; 1 α Cap; 2 S. ι Aqr; 4 SP	+5.6
	10	" " "	05:05-06:10	2 δ Cep; 1 α Cap; 2 S. ι Aqr; 1 SP	+6.0; 5% cloudy
	11	" " "	04:50-06:20	5 α Cyg; 1 α Cap; 1 S. ι Aqr; 5 SP	+5.7
	12	" " "	04:15-05:45	6 α Cyg; 3 S. ι Aqr; 2 SP	+5.7
	14	Barbara Hands, NC	01:30-02:30	(none seen)	+3.1
		Dennis Hands, NC	01:30-02:30	1 SP	+3.1
		Mary Krieg, NC	01:30-02:30	1 SP	+4.8
	15	John Gallagher, NJ	03:55-06:09*	5 α Cyg; 2 S. δ Aqr; 1 N. δ Aqr	+5.9; 15% cloudy; *38-minute break
	16	" " "	04:50-07:50	1 o Dra; 3 δ Cep; 2 α Cyg;1 S. δ Aqr; 1 N. ι Aqr; 2 S. ι Aqr; 2 Per	+5.7
		Robert Lunsford, CA	09:17-10:47	8 SP	+6.6
	17	John Gallagher, NJ	04:20-06:25	3 δ Cep; 2 α Cyg;1 S. δ Aqr; 3 υ Peg; 1 S. ι Aqr, 12 SP	+5.7
		Robert Lunsford, CA	09:20-11:50	1 δ Cep; 37 SP	+6.5
	19	John Gallagher, NJ	04:50-06:50	6 α Cyg; 1 α Cap; 9 SP	+5.0
	28	" " "	04:45-06:50	4 α Cap; 1 S. δ Aqr; 1 S. ι Aqr; 1 Per; 2 SP	+5.1
	29	" " "	04:57-05:47	1 N. δ Aqr;1 SP	+2.9
AUG	01	" " "	03:45-05:20	1 α Cap; 2 SP	+5.0
	04	Karl Simmons, FL	06:10-06:45	2 Per; 2 S. δ Aqr; 2 SP	+5.0; 10% cloudy
		Wanda Simmons, FL	06:10-06:45	2 Per; 1 SP	+5.0; 10% cloudy
	05	John Gallagher, NJ	04:15-06:20	1 N. δ Aqr; 3 S. ι Aqr; 10 Per; 7 SP	+5.9
		Richard Sweetsir Moscow, USSR	19:40-20:40	1 Per; 2 SP	+5.0; 25% cloudy
	06	John Gallagher, NJ	03:50-05:40	1 α Cap;4 N. δ Aqr; 4 Per; 1 υ Peg; 1 κ Cyg	---
		Robert Lunsford, CA	08:17-11:47	23 Per; 10 S. δ Aqr; 3 υ Peg; 2 N. δ Aqr; 1 α Cap; 53 SP	+6.6
	07	John Gallagher, NJ	04:35-06:45	2 δ Cep; 3 N. δ Aqr; 1 S. ι Aqr; 9 Per; 7 SP	+6.0
		Robert Lunsford, CA	09:00-12:00	33 Per; 1 N. δ Aqr; 1 υ Peg; 1 S. δ Aqr; 6 ξ Tau; 1 κ Cyg; 3 α Cap; 5 Eri; 1 PsA; 26 SP	+6.7
	08	John Gallagher, NJ	04:30-05:55	7 Per; 3 υ Peg; 1 Eri; 1 SP	+5.3
		Karl Simmons, FL	05:48-06:19	1 SP	+5.0; 10% cloudy
		Wanda Simmons, FL	05:48-06:19	1 SP	+5.0; 10% cloudy
		Robert Lunsford, CA	08:18-11:48	56 Per; 3 Eri; 3 ξ Tau; 4 S. ι Aqr; 2 N. δ Aqr; 6 S. δ Aqr.; 4 υ Peg; 2 α Per; 1 PsA; 23 SP	+6.8
	10	Karl Simmons, FL	06:00-07:05	8 Per; 2 S. δ Aqr; 7 SP	+6.0
		Wanda Simmons, FL	06:00-07:05	6 Per; 3 S. δ Aqr; 11 SP	+6.0
		Daniel Rhone, NJ	06:00-08:00	1 Per; 3 SP	+4.0; 15% cloudy
		Robert Lunsford, CA	09:17-11:17	19 Per; 1 S. δ Aqr; 1 N. δ Aqr; 2 υ Peg; 18 SP	+6.5
		Han-Sub Jung, S. Korea	17:40-19:20	15 Peg; 5 N. δ Aqr; 2 S. δ Aqr; 13 SP	+5.3

------------------------------------- *Table 1 continued on pp. 179-180 with notes* -------------------------------------

Table 1—*Continued.*

1991 UT Date	Observer and Location	Universal Time	Number and Type of Meteors Seen*	Comments* (+N = Limiting Magnitude)
AUG 11	Kristine Larsen, VT	04:00-04:35	8 Per; 1 κ Cyg	+6.0
	John Gallagher, NJ	05:10-07:10	10 Per; 1 υ Peg; 1 PsA; 7 SP	+5.7
	Brian Simmons, FL	05:25-05:55	9 Per; 1 SP	+6.0
	Stephen Simmons, FL	05:25-05:55	7 Per	+6.0
	Karl Simmons, FL	05:25-06:28	5 Per; 1 S. δ Aqr; 1 SP	+6.0
	Wanda Simmons, FL	05:25-06:30	8 Per; 1 S. δ Aqr	+6.0
	George Gliba, VT	05:36-06:36	17 Per; 2 N. δ Aqr; 1 S. ι Aqr; 7 SP	+6.0; 5% cloudy
	Wendy Simmons, FL	05:58-06:28	2 Per; 1 S. δ Aqr; 1 SP	+6.0
	Daniel Rhone, NJ	06:00-08:00	9 Per; 4 SP	+5.2; 15% cloudy
	George Gliba, VT	06:36-07:36	13 Per; 1 α Cap; 3 N. δ Aqr; 2 S. ι Aqr; 9 SP	+6.3
	Mark Davis, VA	07:00-09:00	16 Per; 17 SP	+5.6; 15% cloudy
	J. Kenneth Eakins, CA	07:00-10:00	13 Per; 1 α Cap; 4 S. δ Aqr; 1 SP	+5.1
	John Gallagher, NJ	07:10-08:20	4 Per; 1 N. δ Aqr; 4 SP	+5.9
	George Gliba, VT	07:36-08:10	16 Per; 1 N. δ Aqr; 7 SP	+6.2; 10% cloudy
12	Glenn Piper, NY	02:30-05:30	38 Per; 11 SP	+4.8
	John Gallagher, NJ	04:10-05:10	8 Per; 1 S. ι Aqr; 2 SP	+5.9; 20% cloudy
	Richard Sweetsir, FL	04:30-05:30	1 Per; 3 SP	+4.0; 50% cloudy
	Wanda Simmons, FL	04:35-05:37	2 Per; 2 SP	+4.0; 80% cloudy
	Karl Simmons, FL	04:37-05:37	7 Per; 4 SP	+4.0; 80% cloudy
	Robert Bacon, NJ	05:00-08:00	19 Per; 2 SP	+5.2; 15% cloudy
	Daniel Rhone, NJ	05:00-08:00	12 Per; 7 SP	+5.2; 15% cloudy
	Diane Rhone, NJ	05:00-08:00	7 Per; 3 SP	+5.2; 15% cloudy
	Mark Davis, VA	06:00-08:00	16 Per; 15 SP	+5.5; 20% cloudy
	John Gallagher, NJ	06:45-07:05	2 Per; 1 υ Peg; 1 N. δ Aqr; 3 SP	+5.7; 45% cloudy
	Richard Sweetsir, FL	07:00-08:00	7 Per; 11 SP	+5.0; 25% cloudy
	J. Kenneth Eakins, CA	07:00-10:00	29 Per; 1 κ Cyg; 3 S. δ Aqr; 2 SP	+5.3
	Wendy Simmons, FL	07:02-08:00	9 Per; 3 SP	+6.0; 35% cloudy
	Stephen Simmons, FL	07:02-08:10	13 Per; 8 SP	+6.0; 35% cloudy
	Wanda Simmons, FL	07:02-08:15	10 Per; 10 SP	+6.0; 35% cloudy
	Karl Simmons, FL	07:06-08:00	7 Per; 4 SP	+6.0; 35% cloudy
	John Gallagher, NJ	07:37-08:57	10 Per; 1 υ Peg; 1 N. δ Aqr	+5.7; 45% cloudy
	Doug Smith, TN	07:58-09:03	16 Per; 9 SP	+5.0
13	Kristine Larsen, CT	03:28-05:29	18 Per; 1 κ Cyg; 2 SP	+4.3; 50% cloudy
	Glen Piper, NY	03:40-04:40	12 Per; 2 SP	+4.9; 40% cloudy
	Brian Simmons, FL	03:58-04:43	13 Per; 7 SP	+6.0; 25% cloudy
	Wendy Simmons, FL	03:58-05:02	13 Per; 3 SP	+6.0; 25% cloudy
	Stephen Simmons, FL	03:58-05:03	17 Per; 1 S. δ Aqr; 2 SP	+6.0; 25% cloudy
	Karl Simmons, FL	04:05-05:05	22 Per; 4 SP	+6.0; 25% cloudy
	Wanda Simmons, FL	04:05-05:05	21 Per; 7 SP	+6.0; 25% cloudy
	Richard Schmude, NM	04:34-05:19	5 Per; 3 SP	+4.3; 5% cloudy
	Glen Piper, NY	04:40-05:40	31 Per; 7 SP	+5.0; 15% cloudy
	Robin Hays, IL	05:00-06:00	29 Per; 1 N. δ Aqr; 1 κ Cyg; 1 υ Per; 7 SP	+6.4; 30% cloudy
	Wendy Simmons, FL	05:02-06:16*	33 Per; 10 SP	+6.0; 10% cloudy *12-min. break
	Stephen Simmons, FL	05:03-06:04	27 Per; 3 SP	+6.0; 10% cloudy
	Wanda Simmons, FL	05:05-06:05	28 Per; 4 SP	+6.0; 10% cloudy
	Karl Simmons, FL	05:05-06:07	25 Per; 4 SP	+6.0; 10% cloudy
	Brian Simmons, FL	05:17-06:30*	26 Per; 6 SP	+6.0; 10% cloudy *32-min. break
	Doug Smith, TN	05:35-06:28	16 Per; 5 SP	+5.5
	Glen Piper, NY	05:40-06:40	37 Per; 7 SP	+5.0; 20% cloudy
	George Gliba, MD	06:00-06:30	17 Per; 4 SP	+5.1
	Robert Hays, IL	06:00-07:00	42 Per; 1 κ Cyg; 11 SP	+6.5; 10% cloudy
	Robert Lunsford, CA	06:00-07:00	22 Per; 7 SP	+6.8
	Stephen Simmons, FL	06:04-06:32	6 Per; 1 SP	+5.0; 25% cloudy
	Wanda Simmons, FL	06:05-06:35	12 Per; 3 SP	+5.0; 25% cloudy
	Karl Simmons, FL	06:07-06:30	9 Per; 3 SP	+5.0; 25% cloudy
	Richard Schmude, NM	06:40-07:10	6 Per; 4 SP	+5.0; 15% cloudy
	John Gallagher, NJ	06:50-07:50	21 Per; 1 υ Peg; 3 SP	+5.9; 40% cloudy
	George Gliba, MD	06:55-07:55	31 Per; 7 SP	+5.2
	Robert Lunsford, CA	07:00-08:00	19 Per; 1 SP	+6.8; 25% cloudy

------------------------------------ *Table 1 continued on p.180 with notes* ------------------------------------

Table 1—*Continued.*

1991 UT Date		Observer and Location	Universal Time	Number and Type of Meteors Seen*	Comments* (+N = Limiting Magnitude)
Aug	13	John Gallagher, NJ	07:50-09:00	29 Per; 1 α Cap; 1 SP	+5.9; 10% cloudy
		Robert Lunsford, CA	08:00-10:00	(none seen)	100% cloudy
		" " "	10:00-11:00	29 Per; 2 SP	+6.9; 67% cloudy
		" " "	11:00-12:15	77 Per; 11 SP	+6.8; 10% cloudy
	14	John Gallagher, NJ	04:50-08:35	25 Per; 2 N. δ Aqr; 1 Eri; 9 SP	+5.6
		Robert Lunsford, CA	08:00-12:00	28 Per; 1 α Per; 2 υ Peg; 12 SP	+6.6; 75% cloudy
		Robert Hays, FL	08:45-10:00	40 Per; 2 κ Cyg; 14 SP	+6.0
	16	John Gallagher, NJ	03:50-06:30	7 Per; 2 PsA; 1 S. δ Aqr; 3 N. δ Aqr; 1 υ Peg; 1 Eri	+5.7
	17	" " "	04:45-07:25	5 Per; 3 υ Peg; 4 SP	+5.5
	18	" " "	05:35-08:08	4 Per; 1 υ Peg; 2 Eri; 3 SP	+5.5
		Robert Hays, IL	07:50-09:50	17 Per; 1 κ Cyg; 20 SP	+5.8
	20	John Gallagher, NJ	03:45-05:05	1 Per	+2.0
	22	" " "	02:20-06:27	2 Per; 1 α Cap; 1 κ Cyg; 1 S. δ Aqr; 1 υ Peg; 3 SP	---
	27	" " "	03:35-05:17	1 π Eri; 7 SP	+4.5
	28	" " "	04:35-07:10	1 π Eri; 1 N. δ Aqr; 1 Aur; 1 S. Psc; 7 SP	+4.9
	30	" " "	04:35-06:10	3 SP	+4.0; 50% cloudy

***Notes for *Table 1*:** ; α Cap = Alpha Capricornid; α Cyg = Alpha Cygnid; Boö = Boötid; χ Sco = Chi Scorpid; Cyg = Cygnid; δ Cep = Delta Cepheid; Eri = Eridanid; κ Cyg = Kappa Cygnid; Lyr = Lyrid; N. δ Aqr = North Delta Aquarid; N. ι Aqr = North Iota Aquarid; o Dra = Omicron Draconid; Peg = Pegasid; Per = Perseid; PsA = Piscis Australid; S. δ Aqr = South Delta Aquarid; S. ι Aqr = South Iota Aquarid; SP = Sporadic; τ Her = Tau Herculid; υ Peg = Upsilon Pegasid; ξ Tau = Xi Tau.

REPORT ON THE 1991 OPERATION OF THE INTERNATIONAL SOLAR SYSTEM OBSERVERS' FUND

By: Paul H. Bock, Jr., Coordinator

The International Solar System Observers' Fund (ISSOF), which was organized in 1990, was described previously in an announcement in this Journal (Vol. 35, No. 1, March, 1991, p. 41). The impetus for establishing ISSOF was the periodic receipt of requests for assistance from overseas enthusiasts who needed help in obtaining equipment and supplies. It was decided that it might well be worth the effort to attempt to raise funds to honor some of these requests, with the basic provision that those receiving such assistance participate in A.L.P.O. observing programs.

Since this fund was established, the number of contributions has been small. This has resulted in a limited response to the requests for assistance, with available funds being used to provide partial assistance to several observers, rather than being used up by filling one large request. The list below illustrates how some of the funds have been used.

Other efforts are ongoing to procure equipment and supplies requested by these and other amateur astronomers. In addition, master optician Bob Goff of Tucson, Arizona, has been fabricating a new 8-inch

Recipient	Assistance Provided
Polish Astronomy Group	A.L.P.O. Ephemeris and Training Kit; *Sky Atlas 2000.0*; 1.25-in focuser; 1.52-in diagonal mirror; lunar map, back issues of *Sky & Telescope*
SAAF Planets Section (Sweden)	Seven glass color filters (1.25 in.)
Hungarian observer	5-mm Orthoscopic eyepiece

Cassegrain mirror set for Dr. Matei Alexescu in Romania, to replace equipment destroyed by gunfire in 1989 during the political unrest in his country.

Unfortunately, there have been some request which have so far gone unfulfilled. A Korean observer has requested a 4-inch or larger reflector; a group in the Dominican Republic needs a 102-mm achromatic doublet for refractor construction; and a very skilled British observer and Fellow of the Royal Astronomical Society, who is teaching in Botswana, has requested an 8-inch Schmidt-Cassegrain with accessories. Although the individuals making these requests are potentially valuable to the A.L.P.O. as observers, thus far the resources to meet their needs have not been available.

In addition to the shortage of funds to support ISSOF, efforts to coordinate requests, procure equipment and supplies, and ship material to those requesting assistance have to date been a one-man operation. The writer believes that more could be accomplished if other A.L.P.O. members, particularly those retired or otherwise having occasional spare time available during weekdays, could become involved in the general administration of ISSOF. The fund is currently fairly well organized, with PC-based database lists of equipment, donors, requests for assistance, and so forth, along with up-to-date files of all correspondence. All that is needed in addition to more funds is a greater concentration of effort in procuring equipment and a more timely response to those requests which can be filled with available resources.

Anyone wishing to contribute funds should write directly to Executive Director Westfall. Those who wish to donate equipment or supplies, or who are interested in assisting in the administration of ISSOF, should contact this writer. (Our addresses are on the inside back cover.) Material assistance to ISSOF may well be deductible from your income tax, although you should check with a tax consultant to insure this.

GETTING STARTED: TELESCOPE SELECTION

By: Harry D. Jamieson

INTRODUCTION

Thirty years ago, the amateur's choice about what type of telescope to employ for serious observing was relatively simple. Whether he or she chose to build or buy, a person faced the high expense of a refractor that was small in aperture but large in bulk, or a much cheaper but maintenance-intensive Newtonian reflector that was prone to tube currents. Most amateurs bought reflectors, and still buy them now. The refractor and the Newtonian reflector are still with us, but in addition there is also a new type of telescope to consider—the Schmidt-Cassegrain telescope, or SCT. The purpose of this article is to present—as honestly as possible—the advantages and disadvantages of these three major telescope types from the viewpoint of the serious lunar and planetary observer.

What are the major requirements for a "perfect" lunar and planetary telescope? To begin with, optical quality is *vital*. The serious observer should insist on optics that are accurate to at least within 1/8-wave measured *at the wavefront* [crest]. This is equivalent to 1/16-wave *peak-to-valley*, which is the measurement of optical quality that is widely used in the magazine advertisements. ["Waves" are in terms of the wavelength of visible light; about 5500Å, .00055 mm, or 1/46,000 in. Ed.]

The second requirement is for an unobstructed, or at least minimally obstructed, light path. The telescopic image of a star or any other point-source of light consists of a diffraction disk surrounded by several bright rings. Ideally, this disk contains about 83 percent of the total light, but obstructions in the light path transfer light from the disk to the rings, causing the image to "spread" and to lose contrast. Contrast is important when trying to pick out elusive lunar and planetary details. The most common reason for such an obstruction is to support a secondary mirror. As a rule of thumb, the diameter of your central obstruction, if there is one at all, should not exceed 15 percent of the mirror aperture.

The third requirement is that one's telescope be equatorially mounted, and clock-driven. Your productivity as an observer will not be helped by having constantly to push your telescope to follow an object and then to have to wait for the image to settle down each time. [And, without a clock-driven equatorial mounting, photography is usually out of the question. Ed.]

A fourth requirement is a strong and stable mounting. A telescope that takes a long time to settle down after you tweak the focuser, or is struck by a gentle breeze, is not well-suited for the study of small details under high magnification.

The fifth, and final, consideration is that the telescope have a relatively-long focal ratio, at least f/7, so that the high powers usually required for lunar and planetary work are easily obtained with comfortable, long focal-length eyepieces. You can get the same effect with a Barlow Lens, but this introduces an additional optical component into the system, which is to be avoided if at all possible. Also, most optical aberrations and central-obstruction sizes are reduced as the focal ratio increases.

In addition to the major requirements above, there are a number of minor ones. The telescope should be easy to transport and assemble unless it can be mounted permanently, usually in an observatory. It should be comfortable to use over long observing sessions. Finally, it should give "normal" images (south at the top from our Northern Hemisphere; no lateral reversal) so that your observations can be readily compared to those by others.

The following discussion looks at the advantages and disadvantages of each telescope type in order to help you select the one that is best for you.

SCHMIDT-CASSEGRAIN TELESCOPES

The general form of this form of telescope is shown below in *Figure 29*. The commercial

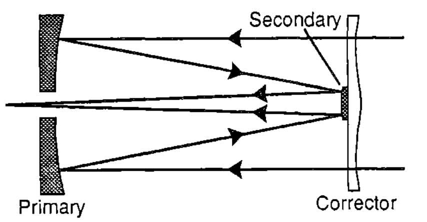


Figure 29. Schematic diagram of the optical system of a Schmidt-Cassegrain telescope.

SCTs available from the two major makers are mechanically well-constructed and moderately priced. They are also typically easy to assemble and set up, and are comfortable to use for long periods of time. These telescopes usually have the long focal ratios needed for lunar and planetary work, but do retain comparatively-large central obstructions; 25 percent of the aperture or more. These designs also add two additional optical surfaces that are not needed in other reflectors—a corrector plate and, for viewing objects high in the sky, a star diagonal; these additional components further degrade the image. The diagonal also reverses the image left-to-right, and the corrector plate suffers greatly from dewing. Finally, the major popular astronomy magazines have recently tested the optical quality of the two major brands of these telescopes, and found them to be inferior to mirrors offered by other commercial makers. They are also more difficult to align optically than are Newtonian reflectors. In conclusion, the SCT is not a good choice for the amateur who is looking for a telescope that delivers the best possible views of the Moon and planets. However, portability considerations may dictate their use by some.

REFRACTORS

The classical refractor has experienced swings in popularity over the years, but recent improvements in objective design have all but erased its most well-known drawback—false color or *chromatic aberration*. The refractor's optical system is diagramed below in *Figure 30*, and offers an unobstructed light path. In

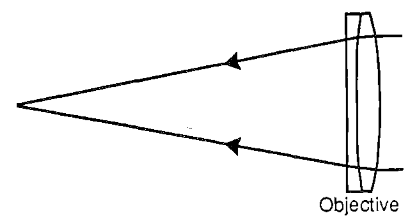


Figure 30. Schematic diagram of the optical system of a refractor telescope.

theory, at least, they offer the very best possible images. The problem with refractors continues to be their price; a 10-inch (25-cm) refractor costs perhaps ten times as much as a 10-inch reflector. Also, a refractor of this size *must* be permanently mounted. These telescopes also require a star diagonal when used to observe high in the sky—or you may be able to lie down and continue to observe directly through the eyepiece. If you can afford the price, are willing to build an observatory for it if the telescope is over 4 inches (10 cm) in aperture, and are willing to settle for a relatively small aperture, then the refractor is unequaled for lunar and planetary astronomy.

NEWTONIAN REFLECTORS

The Newtonian reflector was originally designed by Isaac Newton in order to overcome the severe chromatic aberration plaguing the nonachromatic refractors of his day. Its basic optical design is shown below in *Figure 31*. Since then, the battle for ascendancy be-

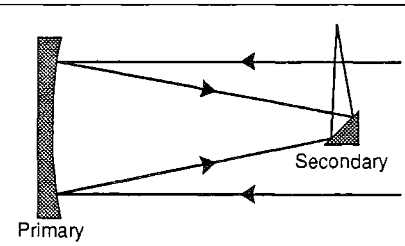


Figure 31. Schematic diagram of the optical system of a Newtonian reflector telescope.

tween it and the refractor has gone on unabated as advances in optics have made first one and then the other the favorite of astronomers. Right now, the advantage in image quality belongs to the refractor, and the advantage in economy belongs to the reflector. Indeed, professional-size reflectors (e.g., 30-inches [75 cm] aperture) can be made or purchased for the price of a rather small (10-12 inch [25-30 cm]) refractor. However, the Newtonian reflector suffers from some drawbacks. While its image quality will surpass that of a SCT, it can only approach that given by a refractor. One reason for this is that the reflector still has an obstructed light path, although this can be made very small if one chooses the long focal ratio (i.e., f/9 or more) that one already desires for a lunar and planetary telescope. Another reason is that the Newtonian reflector has a tube that is open at the sky end and is thus prone to circulating air currents inside the tube, which can destroy image steadiness. This open tube also allows the reflective coating on the mirrors to oxidize, typically over a period of just a few years. Finally, the Newtonian reflector can easily get out of optical alignment, especially if its is used as a portable instrument. When so used, the Newtonian ranks between the SCT and the refractor in its ease of transport and setting-up.

SUMMARY

Table 1 below summarizes the relative advantages and disadvantages of the SCT, refractor, and Newtonian reflector.

Table 1. Relative Advantages of Optical Designs

Criterion	Sch.-Cass.	Refractor	Newtonian
Image Quality	Worst	Best	Medium
Price for Aperture	Medium	Worst	Best
Mechanical Stability	Best	Medium	Medium
Ease of Use	Best	Medium	Worst
Ease of Maintenance	Best	Best	Medium
Portability	Best	Worst	Medium

If we assign 1 for "best", 2 for "medium" and 3 for "worst," it is clear that the low score wins. The SCT comes in with a 9, and the refractor and Newtonian reflector both have 12. However, not all these categories are of equal value. Ease of maintenance, for example, is probably not as important as image quality to someone who is very serious about making a scientific contribution to lunar and planetary research. However, the former criterion may be more important to someone who just doesn't care if his images are perfect, and who really hates to fiddle with telescopes. Also, someone on a budget might consider price to be a vital concern, while a wealthy individual might buy without considering the cost. As an individual, you need to weigh these categories and choose the telescope that best satisfies your own priorities. For the observer with average means and mechanical ability, a Newtonian reflector with an aperture or 6 inches [15 cm] or greater, and a focal ratio of at least f/7, will prove to be an ideal lunar and planetary telescope.

Editorial Remarks.

Unlike our previous "Getting Started" columns, the question of which optical design of telescope is the best is hotly debated. If you have opinions that support or differ from those of Mr. Jamieson, please write. It has been suggested that we publish a letters column in our Journal, and a controversial topic is a good way to start.

To get discussion started, the editor now expresses some of his own opinions.

DIAGONALS

The Editor observes almost solely with "straight-through" types of telescopes—a classical Cassegrain, a refractor, and a Schmidt-Cassegrain. He *never* uses a diagonal for serious observing, preferring to lean back or even to lie down to observe objects high in the sky. Besides the optical degradation that Mr. Jamieson has referred to, this additional reflection reverses the image, making comparison with charts and others' observations much more difficult.

Note that, for some sky locations, the eyepiece orientation can be awkward with the Newtonian design; for example, the eyepiece can point toward the ground. This problem can, of course, be eliminated with a rotating tube.

CLASSICAL CASSEGRAINS

An additional form of telescope that is very popular with professionals is the "classical" Cassegrain. This design is similar to the Schmidt-Cassegrain, except that the former has no corrector lens. Thus, the Cassegrain's tube is open at one end. Cassegrains tend to have longer focal ratios than do Schmidt-Cassegrains. One form that has worked out well is the so-called *planetary Cassegrain*, operating at f/50 or thereabout with a very small secondary obstruction. Unfortunately, I know of no firm that makes these for the amateur market.

SECONDARY SUPPORTS AND OPTICAL WINDOWS

All open-tube reflectors require that the secondary mirror be supported, usually on metal struts. These themselves obstruct the optical path, scattering light in addition to the secondary obstruction itself. One solution to this is the use a plane-parallel glass support, called an *optical window*. Replacing the original "spider" with an optical window notably improved the performance of the Editor's Cassegrain. The lack of an obstructing secondary support is one advantage of the Schmidt-Cassegrain. Note that an optical window will convert a telescope to a closed-tube system, thus eliminating tube currents and slowing mirror-surface deterioration.

REFRACTORS

Although there is no denying that refractors are bulky for their aperture, new optical designs that operate at f/7-f/9 give tubes that are about only half the length of the older f/15 refractors. As Mr. Jamieson points out, the new fluorite and 3-element designs greatly reduce chromatic aberration. They also give wide fields.

The Editor has also found that refractors give much less scattered light than do reflectors; in terms of light that is scattered by many arc-seconds, or even arc-minutes, from a bright object. Every reflecting surface causes such scattering; which is detrimental , for example, in observing the Moon and planetary satellites.

Coming Solar-System Events: December, 1991 - February, 1992

What to Look For

The purpose of this column is to alert our readers about upcoming events in the Solar System; giving the visibility conditions for major and minor planets, the Moon, comets, and meteors. You can find more detailed information in the 1991 and 1992 editions of the *A.L.P.O. Solar System Ephemeris*. (See p. 176 to find out how to obtain this publication.) Celestial directions are abbreviated. All dates and times are in Universal Time (UT). For the time zones in the United States, UT is found by adding 10 hours to HST (Hawaii Standard Time), 9 hours to AST (Alaska Standard Time), 8 hours to PST, 7 hours to MST, 6 hours to CST, and 5 hours to EST. Note that this addition may put you into the next UT day!

Planetary Paucity

There is no denying the fact that there are now few planets to view. Except for Jupiter and Pluto, all the major planets are currently near the Sun.

Mars remains essentially unobservable. Although now pulling slowly away from the Sun in the morning sky, even by the end of February, 1992, it remains only 32° from the Sun, with a tiny 4.3 arc-second disk.

Saturn passes through conjunction with the Sun on 1992 JAN 29, and is thus too close to the Sun for observation throughout this period. The remote planets **Uranus** and **Neptune** are in similar straits, being in conjunction on 1992 JAN 05 and JAN 07 respectively. Indeed, it is ironical that, in the outer Solar System, perhaps 14th-magnitude **Pluto** is the easiest to observe, as it is 107° W of the Sun by the end of February.

We are left with three planets of interest, although we may need to observe them in predawn hours.

If we define a "visibility period" for **Mercury** as when the planet is further than 15° from the Sun, such a period occurs in the morning sky between 1991 DEC 16 and 1992 JAN 19. However, even at Greatest Western Elongation on 1991 DEC 27, it is just 22° from the Sun. It is also then at declination 21° S, unfavorable for Northern-Hemisphere viewers. *Dichotomy* (half-phase) is expected on 1991 DEC 23, 06h, although the date when an inner planet appears half-illuminated often differs from that predicted. The next, and somewhat better, viewing opportunity does not come until March, 1992.

Venus, however, is prominent in the morning sky throughout the current period. Between 1991 DEC 01 and 1992 MAR 01, Venus moves from 44° W of the Sun to 27° W. At the same time its phase increases from 64 percent to 90 percent illuminated, while its diameter shrinks from 18 to 11 arc-seconds. Venus is well S of the Celestial Equator throughout these three months, so it is quite low in the SE predawn sky for observers in the Northern Hemisphere.

Thus, we are left with **Jupiter**, in Leo, in the morning sky. It is becoming visible earlier in the night as it approaches its opposition date of 1992 FEB 29, when it will be up all night. On that date, the Giant Planet's disk will measure 45 by 42 arc-seconds. At magnitude -2.45, it will be the brightest object in the night sky, except for the Moon and Venus. At declination 9° N, it remains well-placed from the Northern Hemisphere, although it is moving S every year now.

Planet Meets Planet: Conjunctions

Because so many planets are currently near the Sun, they are also near each other and there are a number of close conjunctions among the planets Mercury, Venus, Mars, Saturn, Uranus, and Neptune; as follows:

- JAN 10, 20h. **Mercury** (Mag. -0.3) passes 0°.6 N of **Mars** (Mag. +1.4). Both are 19° W of the Sun.
- JAN 20, 03h. **Mercury** (Mag. -0.4) passes 0.6°S of **Uranus** (Mag. +5.8) when 15° W of the Sun.
- JAN 21, 11h. **Mercury** (mag. -0.4) passes 1.9°S of **Neptune** (Mag. +7.9), 14°W of the Sun.
- JAN 29, 21h. **Mars** (Mag. +1.3) passes 0°.4 S of **Uranus** (Mag. +5.8), 24°W of the Sun.
- FEB 01, 08h. **Mars** (Mag. +1.3) passes 1°.5 S of **Neptune** (Mag. +7.9), 24° W of the Sun.
- FEB 07, 07h. **Venus** (Mag. -4.0) passes 0°.9 N of **Uranus** (Mag. +5.8), 32° W of the Sun.
- FEB 08, 15h. **Venus** (Mag. -4.0) passes 0°.3 S of **Neptune** (Mag. +7.9), 31° W of the Sun.
- FEB 19, 22h. **Venus** (Mag. -3.9) passes 0°.9 N of **Mars** (Mag. +1.3), 29° W of the Sun.
- FEB 29, 02h. **Venus** (Mag. -3.9) passes 0°.1 N of **Saturn** (Mag. +0.6), 27° W of the Sun.

The conjunction of a bright planet with a faint one, such as Uranus or Neptune, allows the Remote Planet to be readily found even during twilight. Some of the conjunctions above involve considerable brightness differences; the greatest being the Venus-Neptune event of FEB 08, with Venus then being some 60,000 times as bright as Neptune!

MINOR PLANETS

Ten of the brightest **minor planets** reach opposition in our period. Their 10-day ephemerides are given in the 1991 and 1992 editions of the *A.L.P.O. Solar System Ephemeris*, and their opposition data are given below: Note that all these bodies reach opposition well N of the Celestial Equator, and are thus well placed for observers in the Earth's Northern Hemisphere.

	Opposition Data		
Minor Planet	1991-92 Date	Stellar Magnitude	Declination& Constellation
22 Kalliope	DEC 10	+9.9	26°N Tau
13 Egeria	DEC 13	+9.9	40°N Aur
704 Interamnia	DEC 29	+10.0	25°N Gem
29 Amphitrite	JAN 03	+8.9	33°N Gem
44 Nysa	JAN 16	+8.9	19°N Gem
20 Massalia	JAN 21	+8.5	19°N Cnc
40 Harmonia	JAN 23	+9.8	23°N Cnc
8 Flora	JAN 27	+8.8	21°N Cnc
511 Davida	FEB 06	+10.0	28°N Cnc
14 Irene	FEB 18	+9.0	27°N Leo

Besides the objects above, two of the "Big Four" minor planets, **1 Ceres** and **4 Vesta**, will be brighter than Mag. +10 during at least part of the current period. Indeed, Vesta will reach opposition on 1992 MAR 13 at magnitude +6.0 in Leo (declination 15°N), visible to the naked eye at a dark site.

THE MOON

During the current period, the schedule for the Moon's **phases** is:

New Moon	First Quarter	Full Moon	Last Quarter
DEC 06.2	DEC 14.4	DEC 21.4	DEC 28.1
JAN 05.0	JAN 13.1	JAN 19.9	JAN 26.3
FEB 03.8	FEB 11.7	FEB 18.3	FEB 25.3

The three lunations listed above constitute Numbers 853-855 in Brown's series.

The other significant lunar visibility condition is the Moon's **librations**, or E-W and N-S tilts in relation to the Earth. Extreme librations occur on the following dates:

South	West	North	East
DEC 16	DEC 16	DEC 28	DEC 29
JAN 12	JAN 14	JAN 25	JAN 26
FEB 08	FEB 11	FEB 21	FEB 23

Lunar E and W directions here follow the usage of the International Astronomical Union, with Mare Crisium near the *east* limb. Although there are apparently some favorable combinations of S and W, or of N and E, librations, these occur when the limb areas presented to view are unilluminated

LUNAR ECLIPSE: 1991 DEC 21

The partial lunar eclipse that takes place on 1991 DEC 21 will be seen well from most of the Western Hemisphere, as the visibility diagram in *Figure 32* shows below. At mid-eclipse, the Moon will be nearly overhead from Hawaii. The entire eclipse will be visible from most of North America and the central and N Pacific. The beginning portions only can be seen from most of Asia, Australasia, and NE Europe. The end of the event can be seen from South America.

Although the Moon will be completely immersed in the *penumbra* [outer portion of the Earth's shadow], only its southernmost portion will graze the *umbra* [dark inner shadow], with just 9.3 percent of the Moon's diameter in the umbra at mid-eclipse.

Even a partial umbral eclipse such as this allows the observer to make a useful contribution by timing accurately the moments of contact of the umbral edge with the lunar limb and with selected craters. Although none of the usual list of craters is immersed, possible substitutes are Boguslawsky D, Helmholtz D,

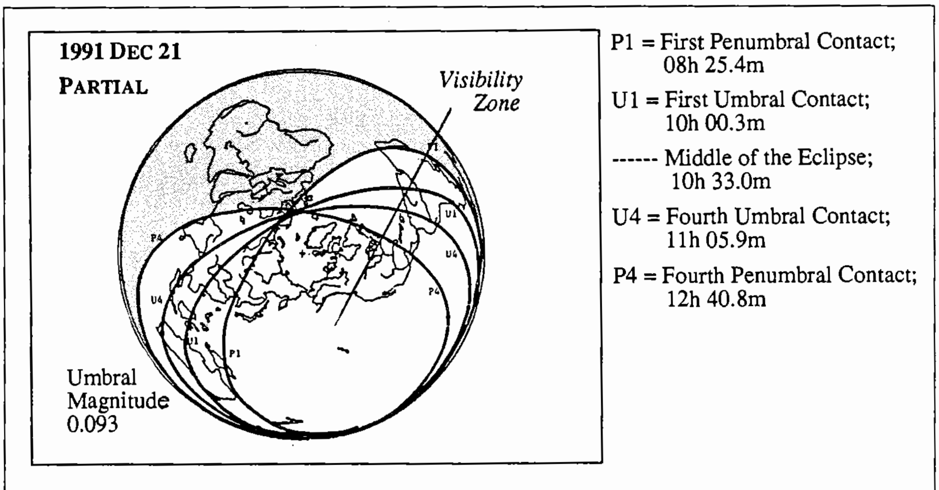


Figure 32. Terrestrial visibility of the partial lunar eclipse of 1991 DEC 21.

Schomberger, and Schomberger A. The positions of these four bright craters are accurately known, but you should firmly identify them from a map prior to first umbral contact.

SOLAR ECLIPSE: 1992 JAN 04-05

This unusual annular eclipse, visible from the W United States, is described in detail in a separate article beginning on p. 187.

PLANETARY AND LUNAR OCCULTATIONS

One major, and seven minor, planets will occult stars in 1991 DEC-1992 FEB, as shown in *Table 1* below which lists the date, occulting object, visual magnitude of planet followed by that of the star, and *possible* zone of visibility for each occultation. Note that a naked-eye star is occulted in the 1991 DEC 27 event.

As for lunar occultations, the Moon passes in front of bright planets twice during the period covered here. The first such event is an **occultation of Mars by the Moon** on JAN 03, 10h, visible from S South America and Antarctica. At that time Mars will be at magnitude +1.4, 17° W of the Sun.

The second event is a **lunar occultation of Venus** on NOV 08, 17h, unfortunately visible only from Antarctica.

Although the Moon occults no bright stars during 1991 DEC-1992 FEB, the series of passages of the Moon across the **Pleiades** open star cluster (M45) continues with these events: **DEC 19**, 10h, 94-percent sunlit Moon, visible from E Australia and New Zealand; **JAN 15**, 21h, 78-percent phase, from Brazil and S Africa; and **FEB 12**, 06h, 56-percent phase, from W Australia.

COMETS

Several telescopic comets will be visible; including Periodic Comets Schwassmann-Wachmann 1 and Faye (1991n); and Comets Helin-Lawrence (1991L), Shoemaker-Levy (1991d), and Shoemaker-Levy (1991a1). For more information, see the column by Don E. Machholz, "Comet Corner," on pp. 175-176.

METEOR SHOWERS

(Contributed by Robert D. Lunsford, A.L.P.O. Meteors Recorder)

In December, 1991, the **Geminids** occur under favorable conditions, as they did last year. Activity may be seen between December 3rd and the 17th. The maximum will occur on the night of the 13th-14th, with more than 100 meteors per hour being visible from a dark-sky site. The strongest rates usually occur between 1 AM and 2 AM local time, when the radiant is near overhead for Northern-Hemisphere observers. The first-quarter Moon sets near midnight on the night of maximum. Many astronomers predict this shower's demise within the next few decades. Your observations can help determine whether or not the strongest of present showers will be around to entertain our children.

The final major shower of 1991 is the **Ursids**, peaking on DEC 22, unfortunately only two days after Full Moon.

In 1992, the **Quadrantids** will reach their maximum under ideal conditions. The International Meteor Organization [*IMO Info.*, 2-92, p. 2] predicts that maximum rates will occur at 05h UT, ideal for W Europe. Should the maximum occur a few hours later, E North America will enjoy a fine show. Maximum rates for this shower are near 100 shower members per hour. The maximum is the briefest of all major showers; 2 to 3 hours at most. Observers should monitor this shower on the morning of both January 3rd and 4th (local time). Face toward the NE and watch for activity from an area 8° N of the star β Boötis. The radiant lies just E of the star 47 Boötis on the morning of maximum activity.

The **Delta Leonid** maximum on 1992 FEB 28 suffers from a 24-day Moon, but shower members may be seen anytime from 1992 FEB 05 through MAR 19.

The **Virginids** become active near 1992 FEB 01 when the radiant actually rises in central Leo. By the end of March, the radiant will have drifted eastward to a point just north of Spica. The maximum rates for this period are no more than 5 per hour. However, the Virginids have been known to produce bright fireballs during February of each year.

Table 1. Occultations of Stars by Minor Planets, 1991 DEC - 1992 FEB.
(For further information, consult the appropriate A.L.P.O. Solar System Ephemeris)

1991-1992 UT Date	Occulting Object	Visual Mag. Occulter	Visual Mag. Star	Predicted Visibility Zone
DEC 21.59	**148 Gallia**	+11.2	+8.3	India, Australia, New Zealand
23.59	**163 Erigone**	+12.7	+7.7	Australia
27.40	**VENUS**	-4.1	+5.5	Caribbean, W South America
31.74	**50 Virginia**	+13.0	+8.0	N Europe, USSR, Japan
JAN 08.37	**13 Egeria**	+11.1	+7.3	Central Siberia, N Pacific
FEB 03.10	**40 Harmonia**	+10.8	+8.9	South America
06.79	**20 Massalia**	+8.9	+9.5	Africa, S India, Indonesia
29.15	**654 Zelinda**	+12.2	+8.2	Africa

THE ANNULAR SOLAR ECLIPSE OF 1992 JAN 04-05

THE ANNULAR PHASE

The solar eclipse of 1992 JAN 04-05 is an *annular* one; the Moon is too distant for its umbral shadow to reach the Earth's surface. Those in the *track of annularity* at maximum eclipse will see the black outline of the Moon entirely surrounded by the rim of the Sun. At most, 84 percent of the Sun's area will be covered, so do not expect to see prominences, the corona, or stars and planets (except possibly Venus from the western Pacific). On the other hand, the "Ring of Fire" visible will itself be a memorable experience, along with the unusual darkness and color of the sky and landscape.

What makes this a remarkable annular eclipse is that millions of persons in southern California will be able to see it poised on the horizon at sunset. The zone where this will occur includes areas with a low southwest horizon: on the Channel Islands; inside the triangle connecting Long Beach, Valencia, and Oxnard; and high terrain to the east of this zone. Even though the low-altitude Sun will be considerably dimmed by the Earth's atmosphere, be sure to use safe solar-viewing techniques; and, even with a filter, do not gaze at the Sun for extended periods. (Note that the forecasts here ignore refraction and assume that the observer is at sea level.)

Table 1, below, gives information for selected locations in the annular track.

Table 1. Solar Eclipse, 1992 JAN 04-05: Annular Eclipse Sites

Place	Annular Duration		Maximum Eclipse UT	Obscuration
1992 JAN 04 UT	m	s	h m	%
Yap I.	2	35	21 15.3	82.1
Tabiteuea I.	10	30	22 04.3	84.0
Palmyra I.	9	48	23 39.8	84.2
1992 JAN 05 UT				
Oceanside	1	28	00 49.4*	~82.5
Anaheim	1	55	00 49.6*	~82.5
San Diego	1	24	00 49.7*	~82.5
Tijuana, Mexico	1	47	00 50.0*	~82.5
Los Angeles†	2	07	00 50.1*	~82.5
Mount Wilson	0	53	00 50.1*	~82.5
Pasadena	1	26	00 50.1*	~82.5
San Fernando	1	45	00 52.3	82.4
Simi Valley	2	30	00 52.3	82.2
Thousand Oaks	3	20	00 52.3	82.3
Malibu	3	45	00 52.4	82.5
Manhattan Beach	3	25	00 52.5	82.6
Redondo Beach	3	32	00 52.5	82.6
Santa Monica	3	00	00 52.5	82.6
Long Beach	3	14	00 52.6	82.6
San Nicolas I.	9	39	00 52.6	82.6
Santa Barbara I.	7	06	00 52.6	82.6
Avalon (Catalina I.)	4	54	00 52.8	82.5
San Clemente I.	6	53	00 53.0	82.5

* Second Contact; Sun sets during annular phase. † Griffith Observatory

THE PARTIAL PHASES

The partial phases of this eclipse can be seen over most of the Pacific Basin. Japan, the Philippines, New Guinea, and north Australia will see a partial eclipse at sunrise on the morning of January *5th*, local time. (Due to the International Date line, this eclipse will begin on the morning of January 5th, local time, and end on the afternoon of January 4th!) The west coast of North America, from Alaska south to central Mexico, will experience a partial eclipse at sunset. The extent of the eclipsed portion of North America is mapped on *Figure 33* (p. 188).

Table 2, below, summarizes information about selected localities that will experience at least some of the partial phases.

Table 2. Solar Eclipse, 1992 JAN 04-05: Partial Eclipse Sites.

Max. Eclipse before Sunrise (JAN 04 UT):

Location	Fourth Contact UT	Sol.Alt.	Max. Obscur.
	h m	°	%
Manila, Philippines	22 27.3	0	0
Pusan, S. Korea	22 42.2	1	3
Tokyo, Japan	22 47.1	9	22

Max. Eclipse Visible (JAN 04-05 UT):

Location	Maximum Eclipse UT	Sol. Alt.	Obscur.
	h m	°	%
Darwin, Australia	21 15.7	3	14.3
Guam I.	21 19.9	7	74.2
Brisbane, Australia	21 33.7	32	2.7
Anchorage, AK	00 02.4	3	5.7
Honolulu, HI	00 09.1	41	56.7
Sacramento, CA	00 49.0	1	68.8
San Francisco, CA	00 49.2	2	69.8
Fresno, CA	00 50.7	0	75.9
Santa Barbara, CA	00 52.0	1	81.3

Max. Eclipse after Sunset (JAN 04 UT):

Location	First Contact UT	Sol.Alt.	Max. Obscur.
	h m	°	%
Fairbanks, AK	23 18.2	1	4
Juneau, AK	23 21.4	4	16
Vancouver, Canada	23 26.7	7	35
Seattle, WA	23 27.4	7	40
Portland, OR	23 27.6	9	48
Calgary, Canada	23 29.2	1	2
Salt Lake City, UT	23 34.8	5	28
Las Vegas, NV	23 35.1	10	62
Denver, CO	23 38.1	1	2
Phoenix, AZ	23 38.4	9	51
Tucson, AZ	23 39.9	9	48
Albuquerque, NM	23 40.5	4	17
Guadalajara, Mex.	23 54.8	6	17
Mexico City, Mex.	23 59.2	2	3

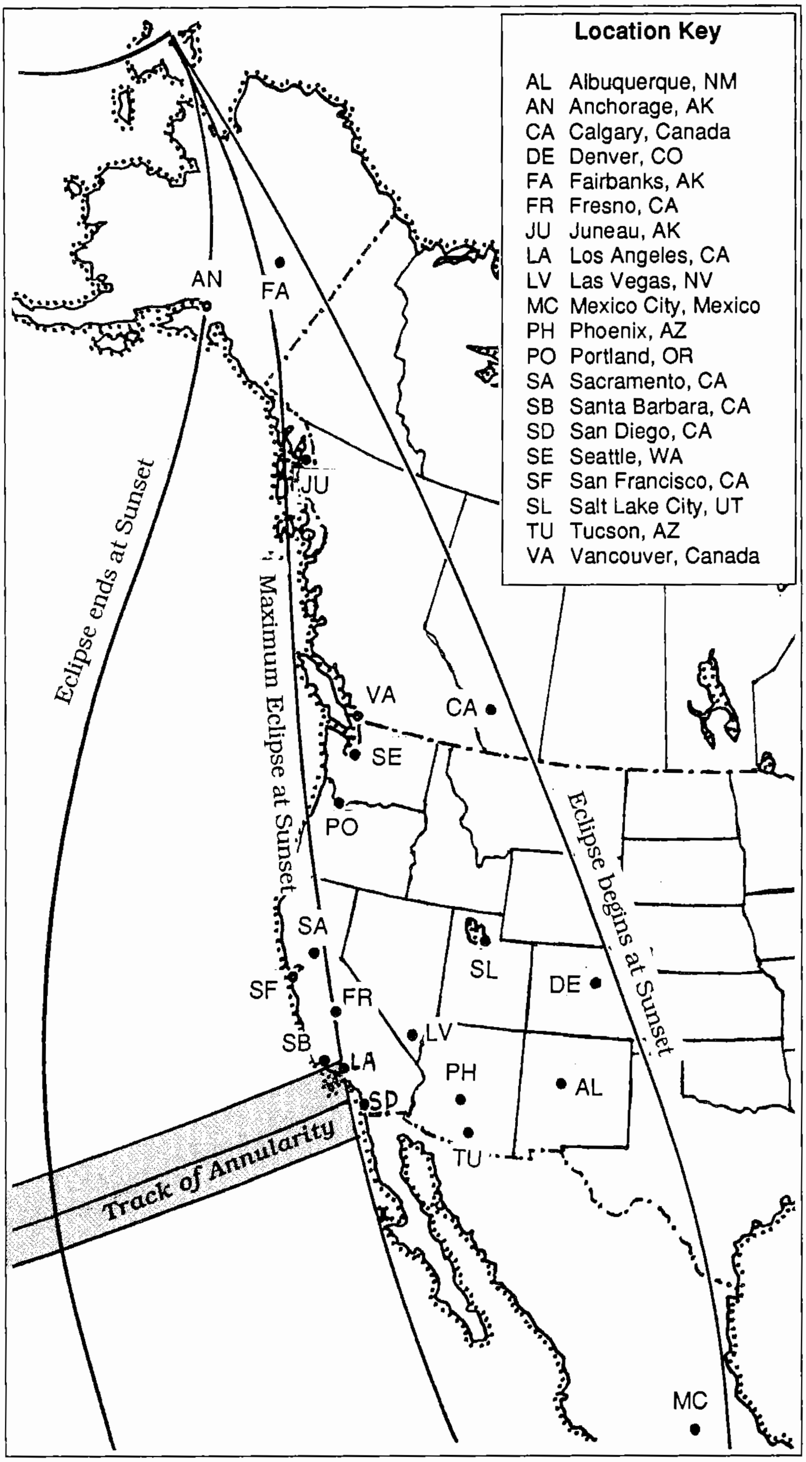


Figure 33. Visibility of the Solar Eclipse of 1992 JAN 04-05 in North America.

NEW BOOKS RECEIVED

Notes by José Olivarez

Messier's Nebulae and Star Clusters. By Kenneth Glyn Jones. 2nd ed. Cambridge University Press, 40 West 20th St., New York, NY 10011. 1991. 427 pages. Price $49.95 cloth (ISBN 0-521-37079-5).

The first edition of this work was published in 1968 by the Faber and Faber Book Publishing Company. Since then, new technology has provided astronomers, both amateur and professional, with at least a threefold increase in telescope power and efficiency. This fact by itself makes the observation of the objects in Messier's Catalogue a much easier exercise and, if one can afford the luxury of digital setting circles or computer-controlled pointing, the task of "bagging" all the Messier Objects may be reduced to a relatively easy exploit. This book, however, is addressed to the observer who is not yet tempted by record-breaking exploits, but instead wishes to make a just acquaintance with the magnificent treasures of Messier's collection, and then to learn how to know them more intimately.

Messier's Nebulae and Star Clusters is a treasure trove of detail about the Messier Objects. Fully 255 pages of the book are devoted to the description of these 110 objects, which are also arranged in the order published by Charles Messier. All of the pertinent details needed to give a full account of each object are given. These include "popular" names, classification according to type, position, a description of its discoverer, current astrophysical data, and drawings. This extensive descriptive section is then followed by a Biographical and Historical section (Chapter 5) that includes a biography of Charles Messier. Especially useful for the beginner are yearly finder maps for the Messier Objects (Appendix 1), a guide to the Messier Objects in the Virgo Group (Appendix 2), and a series of black-and-white photographs of all the Messier Objects (Appendix 5).

I highly recommend Kenneth Glyn Jones' *Messier's Nebulae and Star Clusters*. It is a modern "bible" for all those who wish to take an informed and leisurely tour of Messier's starry harvest!

Lunar Sourcebook, A User's Guide to the Moon. Edited by Grant Heiken, David Vaniman, and Bevan M. French. Cambridge University Press, 40 West 20th St., New York, NY 10011. 1991. 736 pages, Illus., references, index. Price $57.50 cloth (ISBN 0-521-33444-6).

The *Lunar Sourcebook*, a concisely presented collection of data gathered during the American and Soviet missions, is an accessible and complete one-volume reference encyclopedia of current scientific and technical information about the Moon. This book provides a thorough introduction to lunar studies, a summary of current information about the nature of the Moon's surface, the chemical and mineralogical make-up of lunar rocks and soils, and the current state of scientific knowledge about the nature, origin, and history of the Moon.

The book is written and edited by scientists active in every field of lunar research, all of whom are veterans of the Apollo program. The 25 contributors represented in this hefty tome are from universities, national laboratories, industry, and NASA.

Finally, the *Lunar Sourcebook* has two purposes. First, it is intended for the post-Apollo generation of scientists, engineers, teachers, and students. Second, it provides a convenient, accessible sourcebook for planning the future study of the Moon and the eventual use of the Moon by spacefaring humans.

ANNOUNCEMENTS

ASSOCIATION BUSINESS

Dues Increase.—A.L.P.O. membership dues increase January 1, 1992 (00h 00m UT); for details see page 174.

A.L.P.O. Solar System Ephemeris: 1992.- It's time to order your new Ephemeris; for information see page 176.

1992 A.L.P.O. Convention.—Our 42nd Meeting will be held with COSMOCON'92 on July 13-18, 1992, at San Jose State University in San Jose, California, U.S.A. A Teachers' Workshop will be held on July 13-14, with the Amateur Astronomy portion of the conference starting on July 15. A.L.P.O. activities will be on Thursday, July 16, including a paper session, workshop, and Board/Members meeting. This national amateur astronomy convention will include the Astronomical League (AL) and the Western Amateur Astronomers (WAA). The organizing group for the conference is the Astronomical Association of Northern California. *(over)*

A.L.P.O. members are invited to deliver papers on Thursday, July 16th. To do so, send a 75-100 word abstract by May 15, 1992, to: COSMOCON'92 Convention Committee, Chabot Observatory, 4917 Mountain Blvd., Oakland, CA 94619. Please indicate your audio-visual needs. The normal length of papers is 20 minutes, with an additional 5 minutes for questions, but this can be changed for exceptional cases. Poster papers by individuals are also welcome. Naturally, you can also bring your "raw" observations (e.g., drawings and photographs) for the general A.L.P.O. Exhibit.

After the A.L.P.O. Board/Members meeting on Thursday evening is a field trip to Chabot Observatory, which houses a 20-inch Brashear refractor. Another opportunity for observing is a star party Saturday evening at Fremont Peak, a dark-sky site, with a "Star-B-Que" and bus transport provided. There will be a field trip to Lick Observatory, with observing through their 36-inch Alvan Clark refractor and a look at the 120-inch reflector.

Also of interest to our members will be a talk on Tuesday evening sponsored by the Planetary Society, free for conference registrants. In addition, a tour will visit the NASA-Ames Research Center, seeing the Kuiper Airborne Observatory (unless it is airborne).

For a registration packet and further information, write or telephone:

COSMOCON 92
Krebs Convention Management Services
Pioneer Square, Suite 200
555 De Haro Street
San Francisco, CA 94107-2348

Telephone: 415-255-1297.

MEETINGS, MEETINGS

Electronic Oriented Astronomy Seminar 4.—This will be an intensive 1-day conference; 8 AM - 10 PM, Saturday, February 22, 1992, at Hashinger Science Hall, Chapman University, Orange, California. Some of the topics will be CCD and other electronic imagery, image processing, photoelectric photometry, stepper motors, and electronic setting circles. The deadline for papers is January 20, 1992; for information about papers, write: EOA4 Papers Editor, John Sanford, 2195 Raleigh Ave., Costa Mesa, CA 92627 (telephone 714-722-7900; FAX 714-646-7578). (Note that Mr. Sanford can also supply the EOA3 Proceedings for $9.00 postpaid.) Registration is $25, including refreshments and printed Proceedings; for registration, write: EOA4 Registrar, Charlie Oostdyk, P.O. Box 1762, Costa Mesa, CA 92628.

23rd Annual Lunar and Planetary Science Conference.—Every Spring, hundreds of lunar and planetary scientists gather at the Lunar and Planetary Institute at NASA Johnson Space Center in Houston, Texas. Their 23rd conference will be held on March 16-20, 1992. If you wish to be placed on the mailing list concerning this major conference, write to: 23rd LPSC—Attn: Pamela Jones, Lunar and Planetary Institute, 3303 NASA Road 1, Houston, TX 77058-4399. Note that the deadline for abstracts of proposed papers is January 10, 1992.

UNIVERSE'92.—This is the 104th Annual Meeting of the Astronomical Society of the Pacific, and is cosponsored by the A.L.P.O. The conference will be held June 20-25, 1992, at the University of Wisconsin in Madison. The tentative schedule includes nontechnical talks and workshops, a tour to Yerkes Observatory, *The Universe in the Classroom* teachers' workshop, scientific symposia, exhibits, and a banquet.

Because the A.L.P.O. is one of this meeting's sponsors, we hope to supply some exhibits, literature about us for distribution, and several papers on amateur Solar-System observing (which would probably be on the program for Saturday or Sunday, June 20-21). Any A.L.P.O. member who expects to attend this major conference should contact the A.L.P.O. Director fairly soon so we can begin making plans.

International Conference on Neptune and Triton.—This professional-level conference will be held January 6-10, 1992, at the Doubletree Hotel, Tucson, Arizona. As we go to press, the deadlines for paper abstracts, the conference rate at the Doubletree, and prëregistration have all passed; nonetheless you may register for the conference from 6-8 PM on January 5th at the Doubletree; the fee is $110.

This conference includes a banquet talk by Patrick Moore on "The Discoveries of Neptune and Triton" (the banquet charge is $25). Other papers deal with Neptune's interior, atmosphere, magnetosphere, rings, small satellites, and Triton. The proceedings will be published as a bound book.

International Workshop on Variable Phenomena in Jovian Planetary Systems.—This workshop will deal with variable phenomena of the interiors, atmospheres, magnetospheres, rings, and satellites of the Jovian Planets. It will be held at the Governor Calvert House at the Historic Inns of Annapolis, Maryland, July 13-15, 1992. *It is significant that several professionals who have used amateur data on Jupiter and Saturn have explicitly invited A.L.P.O. observers of the Jovian Planets to come in order to report their observations and to plan future observing programs.* We realize that this workshop is in direct time conflict with the A.L.P.O. convention on the opposite coast of the United States. We hope that one or more of our advanced observers who might not be able to attend our West Coast meeting may be able to come to Annapolis and represent us and our work.

For information on this workshop, contact: Dr. Theodor Kostiuk, Jupiter Workshop, NASA Goddard Space Flight Center, Code 693.1, Greenbelt, MD 20771 (telephone 301-286-8481). For general logistical information, call Meta Hutchinson-Frost at 800-333-7567.

GROUPS, EVENTS, BARGAINS

Association of Astronomy Educators.—A number of A.L.P.O. members *are* astronomy educators; all are aware of the need for astronomy education. This U.S. groups was founded in 1977 in order to improve astronomy education at all levels. Members receive the AAE Journal, *Astronomy Education* and periodic special publications, and dues are just $12.00 per year ($13.50 for Canada). To join or to find out more, write: Chaz Hafey, AAE Membership, Science Museum of Virginia, 2500 West Broad Street, Richmond, VA 23220.

Astronomy Day, 1992.—The coming year's Astronomy Day will be on May 9th, marking the 20th successive annual occasion. The A.L.P.O. is proud to continue as a co-sponsor of this event, whose goal is to bring astronomy to the public via publications, lectures, star parties, planetarium shows, and any other means that works. A.L.P.O. members at public star parties should note that Jupiter and the first-quarter Moon will be well-displayed in the evening sky on May 9th. For serious activity-planning, you should obtain the 120-page handbook for Astronomy Day, by sending a check payable to the Astronomical League for $7.00 ($8.00 for first-class postage) to: Gary Tomlinson, Astronomy Day Coordinator, Public Museum of Grand Rapids, 54 Jefferson S.E., Grand Rapids, MI 49503 (telephone 616-456-3987).

Magellan Venus 20-Slide Set.—Some of the dramatic radar images of Venus collected by the Magellan orbiter are now available to the public. The Astronomical Society of the Pacific provides a set of 20 slides, a 24-page booklet, and other information, for $24.95 (California residents must add sales tax), which includes shipping and handling. Some of the types of features shown are troughs and trenches, impact craters, lava flows, volcanoes, "pancake domes," and "arachnoids." Order from: Astronomical Society of the Pacific, Venus Slide Orders Department, 390 Ashton Ave., San Francisco, CA 94112.

Riverside Telescope Makers Conference 91 Proceedings.—This 58-page book covers the papers and activities of the 1991 Riverside Telescope Makers Conference, which may well be "the largest gathering of amateur astronomers and telescope makers in the world" (at least outside a total solar eclipse). To obtain a postpaid copy, send $10.00 to: OCA Publications, 2195 Raleigh Ave., Costa Mesa, CA 92627.

PUBLICATIONS OF THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

(All Section Publications must be ordered directly from the appropriate Recorders.)
(Checks must be in U.S. funds, payable to an American bank with bank routing number.)

◆◆

Order from: Mark A. Davis, 130 Greenway Drive N.W., Christiansburg, VA 24073, U.S.A:

The A.L.P.O. Solar System Ephemeris: 1992. $6.00 in the United States, Canada, and Mexico; $8.50 elsewhere (airmail included). Over 100 pages of tables, graphs, and maps describing the positions and appearances of the Sun, Moon, each major planet, the major planetary satellites, Minor Planets, meteors, and comets. Make payment to "A.L.P.O."

◆◆

Order from: A.L.P.O., P.O. Box 16131, San Francisco, CA 94116, U.S.A:

An Introductory Bibliography for Solar System Observers. *Free* for a stamped, self-addressed envelope. A 4-page list of books and magazines about Solar System bodies and how to observe them. The current edition was updated in June, 1991.

◆◆

Order from: A.L.P.O. Membership Secretary, P.O. Box 143, Heber Springs, AR 72543, U.S.A:

① ***A.L.P.O. Section Directory--1991/92.*** *Free*; just send a stamped, self-addressed envelope. An 8-page description of each Observing Section's personnel, projects, and publications.

② ***A.L.P.O. Membership Directory.*** $5.00 in the United States, Canada, and Mexico; $6.00 elsewhere. Continuously-updated list of members: alphabetically, by location, and by interest or interests. Make payment to "A.L.P.O."

◆◆

Order from: Walter H. Haas, 2225 Thomas Drive, Las Cruces, NM 88001, U.S.A:

Back issues of ***The Strolling Astronomer (J.A.L.P.O.).*** The following are still in stock but may not long remain so. In this list, volume numbers are in ***italics***, issue numbers are not, years are given in parentheses, and prices are $1.50 per issue unless otherwise stated. Discounts can be arranged for purchases over $20. Make payment to "Walter H. Haas."

1 (1947); 6. ***8*** (1954); 7-8. ***11*** (1957); 11-12. ***20*** (1967-68);9-10.
21 (1968-69); 3-4 and 7-8. ***23*** (1971-72); 3-4, 7-8, 9-10, and 11-12.
25 (1974-76); 1-2, 3-4, 7-8, and 11-12.
26 (1976-77); 1-2, 3-4, 5-6, and 11-12 [each $1.75].
27 (1977-79); 3-4, 5-6, 7-8, 9-10, and 11-12 [each $1.75].
28 (1979-81); 3-4 [each $1.75]. ***31*** (1985-86); 5-6, and 9-10 [each $2.50].
32 (1987-88); 1-2, 5-6, and 11-12 [each $2.50].
33 (1989); 1-3, 4-6, 7-9, and 10-12 [each $2.50]. ***34*** (1990); 1, 2, and 4 [each $2.50].
35 (1991); 1, 2, and 3 [each $2.50].

Current Issue [*35*, 4]—$3.00.

KEEPING YOUR MEMBERSHIP CURRENT—

Because all regular A.L.P.O. memberships include a subscription to the *Strolling Astronomer (J.A.L.P.O.),* the top line of your mailing label gives the volume and issue number for which your membership will expire (e.g., "35.4" means Volume 35, Number 4). We also include a *Renewal Notice* in that issue.

Please also let the Membership Secretary know if your address changes.

CONTRIBUTING TO *THE STROLLING ASTRONOMER (J.A.L.P.O.)*—

We welcome reports and observations from our readers and our staff. Please submit typewritten, doubled-spaced copy. For articles longer than two pages, begin with a 75-150 word abstract (our Journal is abstracted). Cite pertinent references in full, including page numbers. Fully document observations with the name and address of the observer; the observing site if different from the observer's address; the date and time in Universal Time; the telescope type, aperture (cm. preferred), and magnification; filters used if any; atmospheric conditions (seeing on the 0-10 A.L.P.O. scale; transparency as the limiting stellar magnitude in the vicinity of the object); and other data as pertinent to the object observed. Illustrations are welcome but we cannot publish color. For low-contrast objects, contrasts should be exaggerated on drawings and photographs. Also, be sure to indicate celestial north or south, as well as celestial east or west if the image is laterally reversed.

With all communications with A.L.P.O. staff, please furnish a stamped, self-addressed envelope.

THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

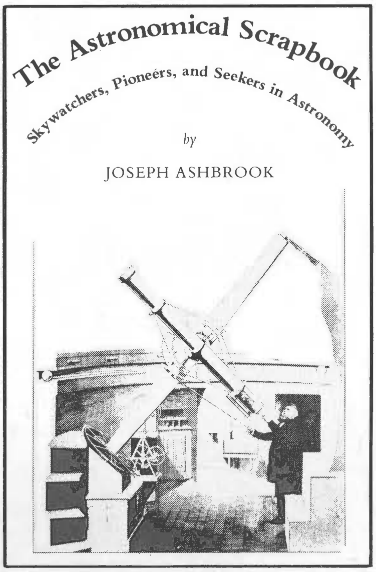
Founded in 1947, the A.L.P.O. now has approximately 700 members. Our dues include a subscription to this quarterly Journal, *The Strolling Astronomer*, and are $14.00 for one year ($24.00 for two years) for the United States, Canada, and Mexico; and $16.00 for one year ($29.00 for two years) for other countries. One-year Sustaining Memberships are $20.00; Sponsorships are $40.00. Associate Memberships, which do not include a Journal subscription, are $3.00 per year. There is a 20-percent surcharge on all memberships obtained through subscription agencies or which require an invoice.

The above rates will increase on January 1, 1992. See page 174 for additional details.

Our advertising rates are $85.00 for a full-page display Ad., $50.00 for a half-page, and $35.00 for a quarter-page. Classified Ads. are $10.00 per column-inch. There is a 10-percent discount for a 3-time insertion on all advertising.

All payments should be in U.S. funds, drawn on a U.S. bank with a bank routing number, and payable to "A.L.P.O." When writing our staff, please furnish stamped, self-addressed envelopes.

The Astronomical Scrapbook Joseph Ashbrook



"A joy . . . a feast of information about controversial figures and landmarks in astronomy, accounts of nonexistent planets, and so on, all together in a relaxed style."

— Archie E. Roy,
New Scientist

"Underlying each story line is Ashbrook's scholarship, exactitude, and love of detail. . . . This is a gem of an anthology which can be savored time and again."

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