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The Strolling Astronomer

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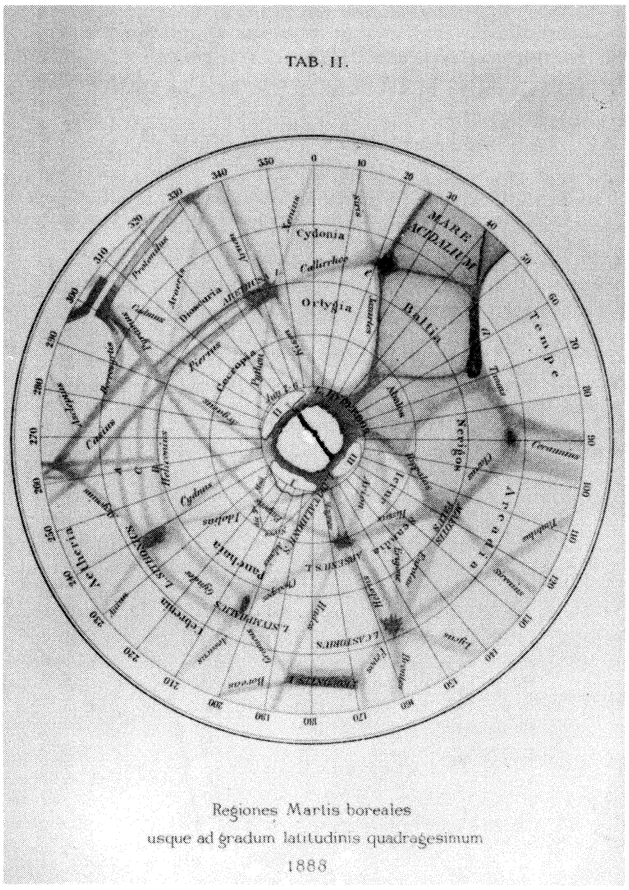

Classical Mars chart by G. V. Schiaparelli from Memoria Sesta, Roma, 1899. Note the very dark RIMA TENUIS (thin or fine fissure) dividing the North Polar Cap into two unequal parts along the 150° W - 325° W areographic meridians. Discovered by Schiaparelli during the Martian northern late spring in 1888, RIMA TENUIS was last well observed by M. Maggini in 1918. It unexpectedly appeared again across the North Polar Cap before the Martian northern summer solstice in February, 1980, when it was photographed for the first time by Mars observers in the ALPO. Contributed by Mars Recorder Charles F. Capen.

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ASSOCIATION OF LUNAR & PLANETARY OBSERVERS
ALPO

Founded In 1947

IN THIS ISSUE

OBSERVING MARS X - REPORTING MARS OBSERVATIONS

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

Abstract

The A.L.P.O. International Mars Observing Program is introduced. Many and varied types of Mars observations that are possible with modest sized telescopes are presented. The standard Mars Observing Report Form is described. The use of this efficient report form allows large volumes of observing data to be processed, cataloged, measured, and analyzed by computer by the Mars Recorders team.

The A.L.P.O. Mars Observing Program

The A.L.P.O. Mars Section Observing Program is an international cooperative effort by planetary observers located around the Earth, which makes possible a 24-hour surveillance of all Martian longitudes. The Mars Section Recorders coordinate and instruct the cooperating astronomers in using similar visual, photographic, photometry, and micrometry techniques employing color filters and standard methods for reporting their observations, which results in homogeneous sets of observing data which have good analytic value. Especially important to the understanding of Mars are color filter photographic and visual observations of the locations and the seasonal occurrences of white water clouds, yellow dust storms, bright patches of frosts and ice-fogs polar cap sizes, and the mysterious surface albedo feature changes. These observed Martian phenomena are compared to the classical telescopic observational record dating as far back as the 1700's and to modern observational data; and then they are interpreted according to the Mariner and Viking space missions' results and are reported in The Journal Of The Association Of Lunar and Planetary Observers (J.A.L.P.O.).

During each Martian apparition there are 45 to 80 individual astronomers and several astronomical societies with Mars Observing Sections or Groups registered as participants in the A.L.P.O. International Mars Observing Program. Refer to Figs. 1 and 2. These observers of the planet Mars range from beginners to advanced amateurs to professional astronomers. For each apparation since 1969, the A.L.P.O. Mars Section has received over 1,000 individual observations consisting of visual disk drawings made with the aid of filters of all colors of the spectrum and also of color photographs and black and white photographs made in integrated (white) light and in red, yellow, blue, and violet light. Several hundreds of intensity estimates of light and dark albedo features, many color contrast estimates, and micrometer measurements of polar caps, cloud boundaries, and changing albedo features have also been contributed during the 10- to 12-month observing period. As a result of the intense interest in studying the Red Planet, it is important that the observational information obtained for each night (U.T. Date) be recorded on one standard observing form. The back of the report form or an additional sheet can be used if more space is required. Do not report different dates of observation on the same sheet. This format and method for reporting observational data is kindly requested by the Mars Recorders in order to assist in the chronological assembly of the data in loose-leaf volumes, in assimilation of the data, and in final analyses of large quantities of observational data for Mars Reports in J.A.L.P.O. and for comparative studies in computer programs.

It is in this regard that a simple and efficient standard Mars Observing Report Form has been prepared by the A.L.P.O. Mars Section. This standard report form, or a similar copy format, can be used for reporting all types of telescopic observations; e.g., visual disk drawings, photometric intensity estimates of albedo features (G. de Vaucouleurs Scale: 0 = bright polar cap; 10 = black night sky), micrometry of polar caps, and transit timings of albedo feature boundaries or cloud boundaries. Photographs may be taped across the top of the form over the three drawing disks or in the remarks column. The Standard Report Form consists of three drawing disks, each with a 42 mm. diameter, a listing of necessary conditions of observation blanks to be filled in at the telescope, and planetary aspect blanks which can be filled in at other (later) times than while observing. The form is so designed to be folded in three places so that it can be mailed in a standard size business envelope. Refer to Figure 3.

The drawing disks. The three drawing disks may be used as needed for each night's (U.T. Date) observations. They can be used for recording homogeneous or mixed types of observational data. Some suggestions are: 1) three visual drawings of Mars in three different colors of light; e.g., red, green, and blue; or any other color filters which are desired. 2) One drawing disk of albedo surface features, one of atmospheric clouds and limb brightenings, and the third showing intensity estimates. 3) A disk showing high contrast albedo features with fine details, or a color drawing, and opposite, a schematic presentation of the features with color contrast estimates. This observing report form was designed for maximum versatility - for ease of use by the planetary astronomers. Refer to examples shown in Figures 3, 4, and 5.

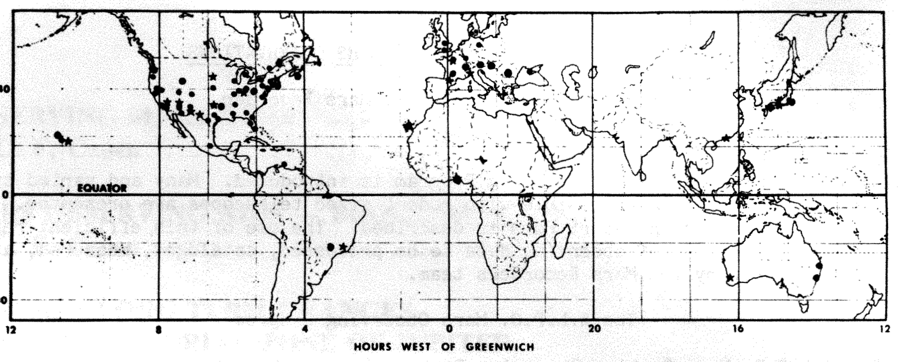


Figure 1. A world map showing the terrestrial position of each observing locale and the longitudes covered. Poor coverage lies between 18 and 22 hours west. Dots indicate visual locales, and stars photographic ones. By C. F. Capen.

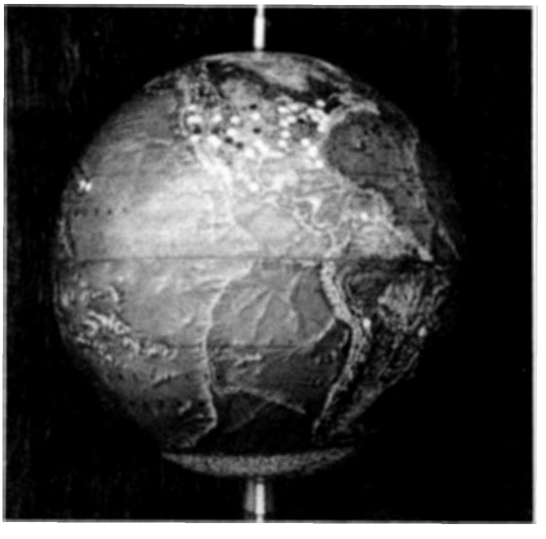


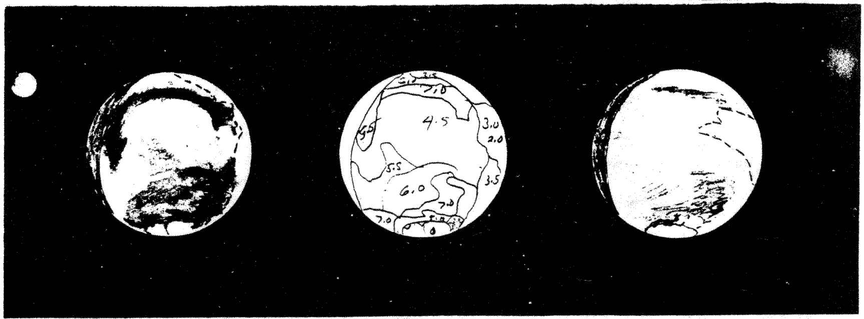
Figure 2. A large globe of the Earth used in the office of the ALPO Mars Section to display and evaluate the current locations of Mars observers. Shown is the hemisphere of the Americas. Light dots represent visual locales, and dark dots are photographic-visual observatories. By C. F. Capen.

The planetary observer, even with the skill of a draftsman or the talent of an artist, finds it difficult to transfer the delicate details of the albedo features which are seen on the small, bobbing, ocher telescopic image of Mars to paper or to a 3 X 5-inch record card. The beginning observer has often used too large a drawing disk relative to the planetary image he has to work with through the telescope for him to make a proper perspective drawing. The 42 mm. diameter drawing disk used on the Standard Mars Report Form was carefully tested and was empirically chosen to assist the astronomer in preparing a useful perspective drawing of the globe of Mars with modest aperture telescopes using 150X to 600X oculars. The 42 mm. diameter drawing disk is a proper size for efficient publication and for undergoing a reduction of 20% when published in the J.A.L.P.O. Because of the 20% reduction in size, photographic prints of Mars which are contributed to the A.L.P.O. Mars Section should have at least 1 inch (25 mm.) diameter images for measurement and publication.

Conditions of Observation. The Universal Time Date (U.T. Date) is used for each night's observation; and the Universal Time (U.T.) is used to record the beginning and ending of each observing period, photography series, set of micrometry measurements, etc. The U.T. and U. T. Date of observation (0^h U.T.) begin in the late afternoon in the U.S.A. according to the following standard p.m. civil times: EST @ 1900; CST @ 1800; MST @ 1700; and PST @ 1600. The Central Meridian (CM) given in degrees of West Longitude that is crossing the center of the Martian disk during the period of observation is calculated from the known U.T. by use of the CM Tables found in the Mars Observing Kit.

Figure 3. Example of a contributed observation on STANDARD REPORT FORM.

ALPO MARS OBSERVATION NO. 56



Red, yell, GR (332°) INT. EST. BLUE, VIOLET (332°)

Fold on Line

DATE (by UT) Dec 27, 1981.

TIME (UT) 0830 – 0920 CM 320.23° – 332.43°.

TELESCOPE 12½ CASS f/16.

MAGNIFICATION X, 740 X.

FILTERS W23A, 25, 30, 47, 57, 58, 38A, W47, 47B.

SEEING (0-10 scale) 8-9 TRANS. (0-6^{m}) 5.5

OBSERVER Jeff Beish

ADDRESS 9460 Toni Dr

Miami, FL

OBSERVING STATION

*L_s 63.9°. MD May 25. D_E 23.8°.

*Data not necessary

OBSERVING NOTES (below and over)

1) RIMA TENUIS REDISCOVERED AND CONFIRMED @ 1000 UT BY DON PARKER (PHONE)!!!!!!!

[DETAILED DRAWING OF NPC:]

NOTE: RIFT MAY NOT EXTEND COMPLETELY TO OTHER SIDE.

2) OBSERVATION NOTES ON BACK.

MARS RECORDER
223 W. SILVER SPRUCE
FLAGSTAFF, AZ. 86001
USA

The type and size of the telescope should be recorded. The diameter of the objective glass (Refr.) or primary mirror (Refl.) is given, e.g., 10cm (4") Refr., 15cm (6") Newt., 20cm (8") Sch/Cass., or 32cm (12.5") Cass. The minimum and maximum eyepiece magnification (X) used for the observation should be given to the nearest 5X. Each color filter employed should be recorded. Each color filter listed should state its dominant color or wavelength and manufacturer's ID number. The color regimes are: UV (ultraviolet), V (violet), B (blue), BG (blue-green), G (green), YG (yellow-green), Y (yellow), O (orange), OR (orange-red), R (red), IR (infrared), and I (integrated) light.

The astronomical seeing (0-10 with 10 best) and sky transparency (0-6 mag), according to the faintest stellar magnitude which can be seen in the vicinity of Mars by the naked eye, should be recorded.

Planetary Aspects. The position of Mars in its orbit relative to the Sun or areocentric longitude (L_s) is important information to the observer and to the Mars Recorders for understanding the seasonal conditions and observed behavior of the Red Planet. The northern hemisphere Martian Date (MD) and the tilt of the Martian rotational pole relative to the terrestrial observer (D_e) are not required data. The tabular values for L_s, from which the MD is calculated, and the axial tilt or subearth point (D_e) are found in the latter part of The Astronomical Almanac (formerly the AENA) under "Ephemeris For Physical Observations of Mars". The axial tilt D_e of the globe of Mars is useful to the

Figure 4. The ALPO standard report forms are versatile for contributing various kinds of Mars observation data, as seen in these two examples prepared by C. Capen and D. C. Parker. The left form represents an observation made in Red, Green, and Violet light using color filters. White clouds are outlined by dash lines and bright frosts are encircled by dotted lines. The right form shows first a Red light disk drawing, and second photometric estimate values in red light, and third the Martian disk seen in Blue light. A brief description of what was noted and happening upon the Martian globe is given under Observing Notes.

ALPO MARS OBSERVATION NO. 40

RED-Light W-25 GREEN-Light W-57 VIOLET-Light W-47

@ 0600UT. 325°CM

Fold on Line

DATE (by UT) 23 Feb. 1980.

TIME (UT) 0434 - 0605 CM 303 ° 327 °

TELESCOPE 24" & 12" Clark Refrs.

MAGNIFICATION 810 X, 250 X.

FILTERS W-64, W-38, & W-47 W-30(magenta), W-25, W-15, W-57,

SEEING (0-10 scale) 5-8 TRANS. (0-6m) 6

OBSERVER C. F. Capen

ADDRESS Lowell Obs. Flagstaff, AZ. USA.

OBSERVING STATION Same

*Ls ° . MD June 1 . DE ° .

*Data not necessary

OBSERVING NOTES (below and over)

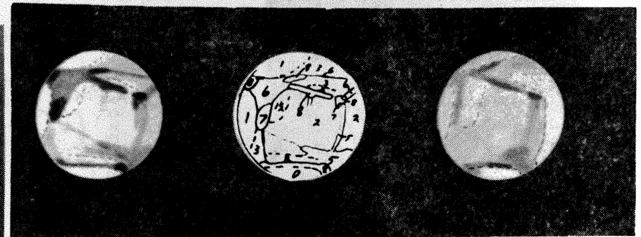
Med. Blue-Clearing (2)Gen.

Rima Tenuis well seen.

p.m. cloud in Libya.

Patrick Moore sharing 24" Refr. with observer.

ALPO MARS OBSERVATION # 46



W25 0740-0810 INTENSITIES W25 W38A 0920-0930

Fold on Line

DATE (by UT) 12-31-77.

TIME (UT) 0740 - 0830 CM 318 ° 330 °.

TELESCOPE 12½-inch f6.5 Newtonian.

MAGNIFICATION 360 X, 435 X.

FILTERS W25, 22, 15, IL 58, 38A.

SEEING (0-10 scale)____ TRANS. (0-6m)____

OBSERVER DONALD C. PARKER, MD

ADDRESS 12911 LERIDA ST. CORAL GABLES, FLORIDA 33156

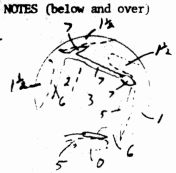
OBSERVING STATION Same (80°16.6'W; +25° 39')

*Ls 269 °. MD April 17 . DE +15.2 .

*Data not necessary

OBSERVING NOTES (below and over)

1) INTENSITIES (BLUE)



2) Again (see 12-29-77 0920 UT), Libya-Isidis not as bright in blue light as it was when CM was 290.

3) E. Aeria narrow & bright (=1) c W15; dull c W58.

4) Dioscuria bright (=1 c W15). Deucalionis bright c all filters - ½-1 c I.L.

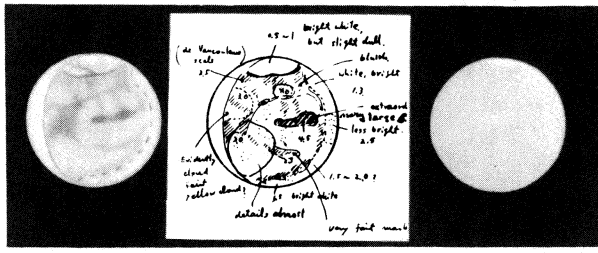
5) Hellas bright but dustier than previously; Noachis dusky.

6) Sinus Pa. very conspicuous. Aram Meridiani S. separated from Sabaeus S. (E. lat extended south?)

MARS RECORDER
223 W. SILVER SPRUCE
FLAGSTAFF, AZ. 86001

Figure 5. Shows two more standard observing forms used to report visual and photographic information. The left form presents a disk drawing with a second sketch that gives its photometric intensity estimate values and related comments by T. Osawa of Japan. His discovery of the Daedalia-Claritas darkening is indicated within the Eye-of-Mars, and a bright a.m. limb haze is outlined by a dashed line. The right form presents two photographic views of Mars taken in Red vs. Violet light. The red image(3) shows well the surface albedo features and the beginning of Mts-of-Mitchel on the left periphery of the South Polar Cap. The violet image(4) shows a moderate Blue-Clearing of intensity 2, and a north polar hood at the bottom. These fine composite images were contributed by R. Horiguchi of Tokyo, Japan.

ALPO MARS OBSERVATION No. 8



Fold on Line

DATE (by UT) June 30, 1973.

TIME (UT) 18h12m - CM 94°- °.

TELESCOPE 20 cm (8 inch) Refl.

MAGNIFICATION 266X, X.

FILTERS None.

SEEING (0-10 scale) 4~5 TRANS. (0-6m) 2.5-3, misty

OBSERVER T. OSAWA

ADDRESS NARA, JAPAN.

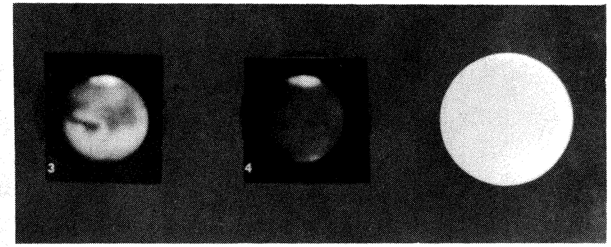
OBSERVING STATION

*Ls °. MD . DE .

OBSERVING NOTES (below and over)

Mars Recorder's Note: This observation made by Mr. T. Osawa is an independant discovery of the new feature Daedalia—Claritas Darkening also made this same year by S.Miyamoto, S. Ebisawa, C. Capen, and possibly a couple of other observers.

ALPO MARS OBSERVATION No. 10



Red-light Violet-light

Fold on Line

DATE (by UT) Jul. 31, 1971.

TIME (UT) 1613 & 1627 CM 11.5°- 14.9°.

TELESCOPE 25cm Newtomian refl.

e.f/260 eyepiece projection Or. 4mm.

MAGNIFICATION X, X.

FILTERS Red 23A, Violet 47B.

SEEING (0-10 scale) Gd. TRANS. (0-6m) 5

OBSERVER Reichi Horiguchi

ADDRESS Tokyo, Japan

OBSERVING STATION

*Ls °. MD . DE.

OBSERVING NOTES (below and over)

Each print is a composite of 6 to 12 original negative images.

observer at the telescope in order to locate the Martian latitude seen across the image and to position albedo surface features upon the drawing disk. The Martian Date MD is useful to the advanced student of Mars in anticipation and evaluation of seasonal changes observed upon Mars.

Observer Identification and Location. The name and address of the astronomer(s) should appear on each observing report form that is mailed to the Mars Recorder for proper identification, communication, and individual recognition. The name of the observing location or observatory should be given if different from the astronomer's address.

Mailing Standard Observing Report Forms and Material. All observational data, drawing disks, and photographs submitted should be copies of the original data, which therefore will remain in the A.L.P.O. Mars Section files for study and reference, and will not be returned to the contributor. All observational material received is subject to analysis and may be quoted or used as illustrations in Martian Apparition Reports published in The Journal of the Association of Lunar and Planetary Observers.

Standard Observing Report Forms may be collected and mailed at regular intervals of one or two months throughout the Martian apparition. Special reports of unusual Martian phenomena, e.g., secular changes in albedo features, yellow dust clouds, or unusual bright, white H_2O clouds should be mailed immediately or telephoned to the Mars Recorder. This practice allows us to keep cognizant of interesting happenings and unusual phenomena as they occur on Mars and to alert other astronomers located around the world for further confirmation and possible further changes. If you wish acknowledgment of your contributed Mars reports, kindly accompany your correspondence with a self-addressed post card. If your letter contains questions to the Mars Recorders, please include a self-addressed and postage-stamped envelope for a reply.

Figure 3 illustrates the standard A.L.P.O. Mars Observation Report Form. Figures 4 and 5 illustrate the various types of telescopic observations which can be reported on the versatile standard Mars Observation Report Forms.

Twenty standard A.L.P.O. Mars Observation Report Forms are available at cost and postage for $3.50. An updated Mars Observing Kit for the 1982 and 1984 aphelic apparitions is available at cost for $5.95 pp. from the Mars Recorder, C. F. Capen, 223 W. Silver Spruce, Flagstaff, AZ 86001.

Because all spacecraft missions to Mars have run out of gas or are broke, the only future knowledge of Martian phenomena to mankind will be via Earthbound telescopes-from You, the Planetary Astronomer.

Captions for Figure 6 on page 139.

Top left to bottom right:

1. Prof. Jean Dragesco (1979), Republique Populaire du Bénin, Equatorial Africa and his 42 cm. (16-in.) reflector. Note that the polar axis of his equatorial mount is horizontal on the Earth's Equator.
2. H. Saito (1975), Tokyo, Japan. Hi-performance optics are in this 20 cm. (8-in.) Newtonian f/8 reflector.
3. The Mars Section's youngest planetary observer. 10-yr. old Regulus Capen (1980) by the planetary camera on the 61 cm. (24-in.) Clark Refractor, Lowell Observatory. Rex usually uses the auxiliary 30 cm. Clark Refractor at 250X for color filter observations of Mars and Jupiter.
4. Richard J. Wessling (1981), Pines Observatory, Milford, Ohio. His 51 cm. (20-in.) f/5.6 Newtonian Reflector is used for visual color filter observations of Mars.
5. The charming Mrs. R. Wallace is seen photographing with the 32 cm. (12.5-in.) Cass. reflector of the R. S. Wallace Observatory, Anaheim, CA.
6. The 32 cm. (12.5-in) Cass. reflector of the Jeff Beish Observatory, Miami, FL. Hi-quality optics of this telescope are being used during this 1981-1982 Martian apparition for North Polar Cap micrometer measurements, planetary photography, and color filter visual observations of Mars.

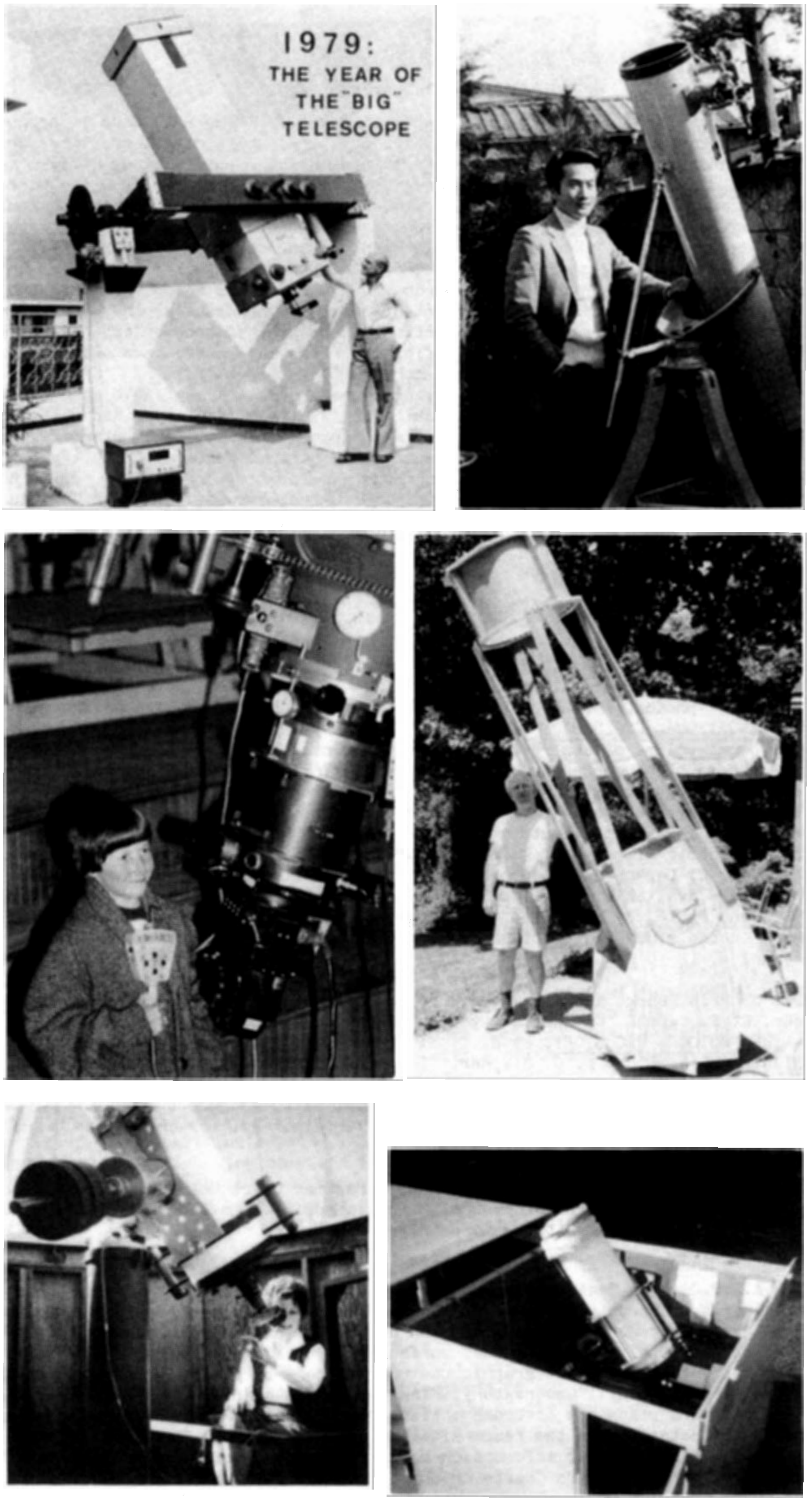
MARS OBSERVING AIDS - BOOKS, KITS, GRAPHS, AND CHARTS

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

Abstract

This short article describes various Mars observing aids, useful planetary guides, ephemeris graphs, seasonal event tables, charts, and reference books which are available to the planetary astronomer from the A.L.P.O. Mars Section Recorder, C. F. Capen, 223 W. Silver Spruce, Flagstaff, AZ 86001. The availability and basic costs of the items listed may vary without notice.

Figure 6. A.L.P.O. Mars Section astronomers and their telescopes.



Practical Observing Aids

During each Martian apparition a Graphic Ephemeris For Mars is usually produced by the A.L.P.O. Mars Recorder and shows graphically the apparent diameter of the Martian disk as observed from Earth and the sub-Earth and subsolar points along a given areographic parallel vs. the seasonal position of Mars in its orbit as measured from the Martian Vernal Equinox (L_s) and the terrestrial date. Also, a Calendar of Martian Seasonal Events is published for each apparition as a guide for the observer of Mars. Both of these items are distributed via the "Martian Chronicle" and the current Mars Observing Kit.

A Martian News Service entitled the "Martian Chronicle" is available each apparition to active observers of the planet Mars from the A.L.P.O. Mars Recorder. This publication provides rapid notification of important observed phenomena as they are received from astronomers, useful seasonal event predictions, Mars graphic ephemerides, and an exchange of observing ideas. Active and contributing observers may send 6 to 8 self-addressed and stamped long envelopes to the Mars Recorder, C. F. Capen.

Twenty Standard A.L.P.O. Mars Observing Report Forms are available at cost for $3.50 pp. An updated Mars Observing Kit for the coming 1982 and 1984 apparitions is also available at cost for $5.95 pp. It contains an introduction to Mars, standard report forms, many useful reprints, observing techniques, Central Meridian computing tables, planet photography information, graphs, several Mars charts, and Martian nomenclature lists. The Mars Observing Kit material and the current issues of Martian Chronicles are most useful when filed in a 3-ring note book for ready reference. Also, current apparition observing notes and records can be filed in this book.

Books For Learning, Reading, and Reference

ASTRO-FILTERS For Observation And Astrophotography, by R. F. Barbera, C. F. Capen, G. B. Carvalho, and R. A. Steeg. $7.95 pp. Highly recommended for modern observing techniques at the telescope.
LOWELL AND MARS, by Wm. Hoyt. $10.50 pp. Excellent historical study of P. Lowell, his observations and mathematical intuition about the planets, and his Flagstaff Observatory. Many new "old" photos. See P. Lowell planting and hoeing in the Djihoun and Oxus canals.
THIRD INTERNATIONAL COLLOQUIUM ON MARS - Aug. 31-Sept. 2, 1981. 307 pages. $7.00 pp. A large format volume of abstracts of papers presented at the colloquium held at Cal. Tech., Pasadena. The conference, attended by 215 invited Mars scientists, surveyed the current state of analysis of data obtained from Viking and Mariner space missions and telescopic observations of Mars. Most interesting to the observer are the new Mars Consortium 18 Global Maps, contour mapping of Olympus Mons, water vapor maps, IR Albedo Map vs. Telescopic Albedo map, Martian Polar Region explorations, etc. Two papers by Mars Recorder C. Capen, are also present in this most up to date volume about Mars. A few copies are available of this well illustrated publication.
PLANETS X And PLUTO, by Wm. Hoyt. $11.50 pp. P. Lowell's observational and mathematical influence on the study of the planets. The classical reference to the outer planets and beyond!

* * * * *

Out of Print Books about Planetary Science are available at times from the Mars Recorder, C. F. Capen. Communicate your wishes with a SASE. For example:
MARS - THE PHOTOGRAPHIC STORY, by E. C. Slipher, Lowell Observatory.
THE BRIGHTER PLANETS, by E. C. Slipher. Text and an excellent selection of the best planetary photos in the files of the Lowell Observatory.
Biography Of Percival Lowell, by A. Lawrence Lowell (the younger brother).
LA PLANÈTE MARS 1659-1929, by E. M. Antoniadi. Original edition or English translation by P. Moore.
THE PLANET MARS, by G. De Vaucouleurs.

The Charles F. Capen Classical and Modern Martian Chart Collection and Library is available to students and researchers of Mars via copies from the originals or by personal consultation. The Martian Library is nearly complete.

Mars Charts

The A.L.P.O. Mars Section has acquired from the Lowell Observatory Mars Charts which were originally constructed for use by the professional astronomer and astrogeologist working with the Mariner and Viking Mission data. These charts are useful to the Mars observer for plotting seasonal clouds, surface albedo changes, and general reference. The basic map artwork and cartographic control was done by planetary authorities and areographers at the Lowell Observatory, Flagstaff. The charts were rendered by the renowned lunar and planetary airbrush artist, Jay L. Inge. Martian nomenclature and fine albedo feature details were the responsibility of C. F. Capen. The charts have overlaid grids, while names and other information have been deleted so as to provide a clear view of the albedo features. Mars Charts or Chart Sets are $3.50 postpaid and folded and

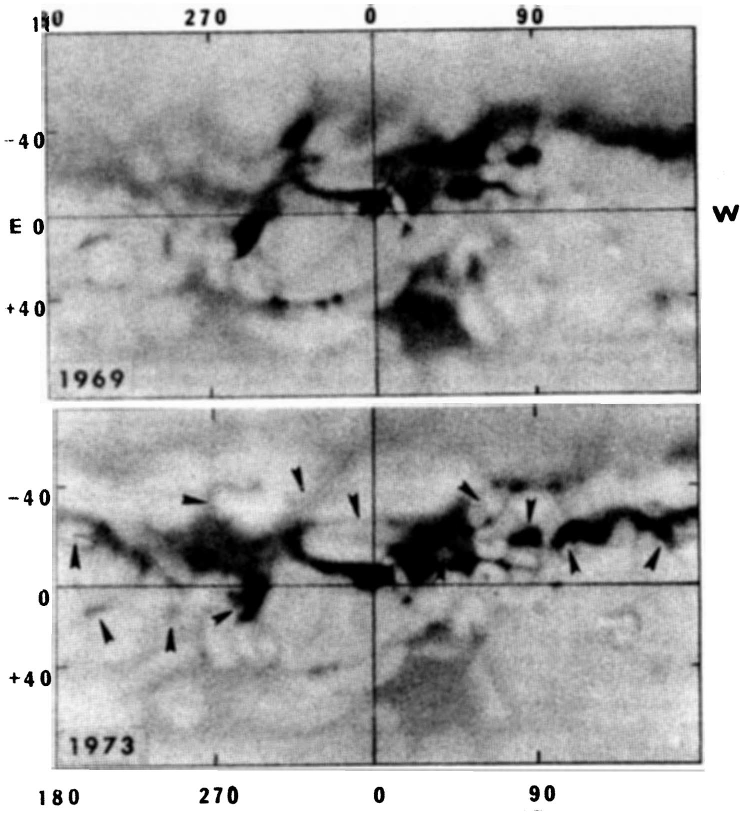


Figure 7. Two Mercator charts of Mars prepared by the staff of the Lowell Observatory to show changes in the visible surface albedo features. Upper chart: the aspect during Martian September (beginning of autumn in northern hemisphere) in 1969. Lower chart: the aspect during Martian January (early winter in northern hemisphere) in 1973. Arrows indicate major seasonal and secular changes.

are available from the Mars Recorder, C. F. Capen, 223 W. Silver Spruce, Flagstaff, AZ 86001. Three or more charts are $2.50 each.

MARS - TOPO/ALBEDO Chart. Excellent reference map showing telescopic albedo features and Mariner relief features. Scale 1:25 million.

MARS - 1969-1971 Albedo and Mariner Topo Relief 3-Chart Set. Rendered on a Lambert azimuthal equal-areas projection designed for plotting observed phenomena and large scale terrain-albedo studies. The scale of 1:32 million is sufficient to read to Mariner 9 A-Camera resolution. This desk size 13 inch diameter aesthetic projection shows all of Mars from pole to pole and all topographic features in correct relative sizes.

MARS - 1969. Scale 1:35 million. Martian season shown September (159°-184°L_s). A 3-map format with nomenclature. First modern accurate chart of Mars useful for all aphelic apparitions with northward axial tilt. Refer to Figure 7.

MARS - 1967. Scale 1:25 million. Martian season shown is July (109°-131°L_s). Useful for comparison of aphelic apparitions with a north axial tilt toward the Earth.

MARS - 1973. Scale 1:25 million. Martian season is January (283°-301°L_s). This chart shows the perihelion apparition aspects with a southern axial tilt. See Figure 7.

MARS - 1975/76. Scale 1:25 million. Martian season is March (342°-010°L_s). Another perihelic apparition aspect.

A GENERAL CHART OF MARS with complete nomenclature, by S. Ebasawa. This chart is an excellent map for the location of fine surface albedo features which have been recorded by planetary astronomers over several past decades. This chart is highly recommended to observers of Mars. $1.50 pp., 2 for $2.00 pp.

POSSIBLE LONG TERM CHANGES IN THE EQUATORIAL ZONE OF JUPITER

By: Randy Tatum, A.L.P.O. Assistant Jupiter Recorder

In the new Atlas Jupiter, by Garry Hunt and Patrick Moore (p. 28-29), the authors discuss the plume or festoon-like features in the Equatorial Zone (EZ) observed by the Voyager spacecraft. They note that the festoons were only observed on the northern edge of the E.Z. and that there were no similar features in the $E.Z._s$. The authors present a possible cause for the asymmetry with the presence of the Red Spot and South Temperate

Belt white ovals disrupting subsurface flows.*

Voyager detected about 12 festoons in the E.Z.$_n$ at 10°N latitude. The festoons originate with dark bases on the (North Equatorial Belt) N.E.B.$_s$. They curve in a south-following direction with the E. B. White ovals are frequently found between festoons, often following them. The E.Z.$_n$ is rarely active with ovals and projections at all longitudes, though it was in 1976 and again during the Voyager flyby. Usually only a few longitudes show activity.

If the planet were symmetric on both sides of the equator, we would expect to see dark projections from the (South Equatorial Belt) S.E.B.$_n$ curving in a north-following direction merging with the E. B. We should also see bright sections and ovals accompanying festoons in active longitudes.

This major S.E.B.$_n$/E.Z.$_s$ activity does not display itself in modern drawings and photographs. True, E.Z.$_s$ white ovals are occasionally observed and followed for a whole apparition. These appear to be stable features, isolated and few in numbers. During many apparitions the E.Z.$_s$ is shaded or dark enough to be considered part of the S.E.B. Such was the case in the early 1970's. Rarely the entire E.Z. is dark and appears as a single belt. This was the case in 1879, the early 1960's, and also in 1972. Usually, E.Z.$_s$ activity is not at the same level as in the E.Z.$_n$.

Does the E.Z. asymmetry still exist when we look into the past? Several drawings from the late 19th century and early 20th century show a reverse asymmetry with ovals and dark projections in the S.E.B.$_n$/E.Z.$_s$. Many times the N.E.B.$_s$/E.Z.$_n$ activity is non-existent.

The following are descriptions of several old observations showing strong E.Z.$_s$ activity:

1870 - A strip sketch by Gledhill[2] (p. 345) shows the Red Spot as a faint ring. Several large E.Z.$_s$ white ovals are equally spaced with dark columns in between. No E.Z.$_n$ activity was seen.

1872 - A disk drawing by N. E. Green[3] shows S.E.B.$_n$ projections within the E.Z.$_s$.

1873 - Three Green[3] disks show E.Z.$_s$ white spots. Several northern festoons were also observed.

1882 - A strip sketch by Denning[2] (p. 345) shows a dark R.S. and two S.E.B.$_n$ dark projections forming long festoons in the E.Z.$_s$. There was no N. Equatorial activity.

1883 - Another Green[3] disk has several faint E.Z.$_s$ festoons from the S.E.B.$_n$ dark projections with white clouds between. Again no E.Z.$_n$ activity.

1886 - In this Denning[2] drawing (p. 345) in Figure 8, fine S.E.B.$_n$ projections form festoons with thin bright clouds in between. The E.Z.$_n$ is quiescent.

1887 - 88 - Quoting from A. S. Williams[4]: "The general appearance of the South equatorial spots in 1888 was very similar to what it had been in 1887. As in the latter year, there were numerous irregular, dark masses or spots on the northernmost component of the coarsely double S.E.B., most of them projecting to a greater or less extent into the bright E.Z. Between these dark spots were brilliant white areas; which usually appeared to indent or encroach upon the dark S.E.B."

There were also complimentary ovals and projections on the N.E.B.$_s$ with dark wisps connecting dark condensations on opposite sides of the E.Z.

1906 - A disk drawing by Denning[2] (p. 344) shows the Red Spot Hollow, three E.Z.$_s$ white ovals, and five hook-like projections from the S.E.B.$_n$. The E.Z.$_n$ is clear.

1938 - This disk by L. Rudaux[5] has five dark projections from the S.E.B.$_n$ with faint festoons. Several E.Z.$_n$ festoons were drawn.

From published B.A.A. Reports for apparitions between 1887 and 1906-07, Williams[4] finds about 285 E.Z.$_s$ spots compared to only 125 E.Z.$_n$ spots which were followed well enough for rotation periods to be found. Peek[6] records 330 E.Z.$_s$ spots and 203 E.Z.$_n$ features for the same period. E.Z.$_s$ activity appears to decrease suddenly after about 1910.

Admittedly these meager observations do not prove any long term cyclic behavior, but do show that complimentary S.E.B.$_n$/E.Z.$_s$ activity can exist. It may have been more frequent in the past. Possibly more old observations can be found which show these phenomena.

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* Some readers may find it helpful to refer to the Jupiter nomenclature diagram in J.A.L.P.O., Vol. 29, Nos. 5-6, pg. 97.

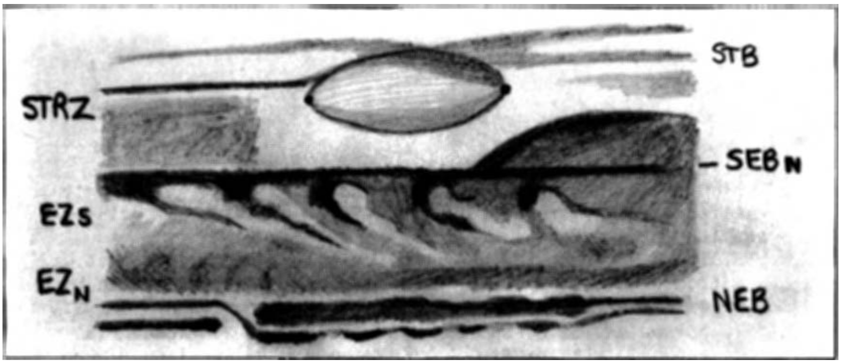

Figure 8. This drawing by W. F. Denning on 1886, October 11, shows strong E.Z.$_s$ activity, while the E.Z.$_n$ is quiescent. The Red Spot is faded and has dark spots on its preceding and following ends. Copied by hand from Splendour of the Heavens by Randy Tatum.

SOME EUROPEAN VISUAL OBSERVATIONS OF SATURN IN 1981

By: G. Adamoli,Director, Saturn Section of the Unione Astrofili Italiani

Abstract

A discussion of about 50 visual observations of Saturn, covering the first half of 1981, is presented. They were made by Italian and British amateurs employing 10-30 cm. aperture telescopes. The NEB and SEB were the only dark belts easily seen on the globe. The rings, nearly edgewise, were duller than usual. In June, the N. equatorial region was the site of some activity; however, too few data are at hand.

General Remarks - In 1981 our Section underwent some difficulties, owing to the change of the Director, which have adversely influenced scientific output. Fewer observations were received than in preceding years. Table 1 gives a summary of contributing observers, their sites, instruments, and number of observations. The important contribution of A. W. Heath, B.A.A. Saturn Section Director, is apparent. There were only six active members in Italy, bringing the total of observations to 48. A statistical analysis of these data has been made; however, our results are only sufficient for a check of the usual Saturn phenomenology.

The observations cover a half-year period (1981, January 19 - June 27); however, almost all were made after opposition (March 27). During this period, the tilt of the planet's equator to the ecliptic (=Saturnicentric latitude of center of disc) varied between +4° and +7° so that the rings were not far from edgewise, as in 1979-80; hence, the entire N. hemisphere and almost all the S. one were visible on the globe.

Intensities, Colors, Latitudes - Italian observers totalled 218 visual estimates of features' intensity, 117 of color, and 148 latitude measures from drawings; we can add the material sent in by A. W. Heath (232 intensity estimates and some conclusive remarks on colors). Data were analysed in the usual manner[2, 3, 4], and a summary of the results appears here as Tables 2 and 3. Observer means and total weighted means are reported for all features, observers' weighting being made by taking into account their number of estimates of a feature. The number of estimates from which a mean is computed is recorded in parentheses.

Aspect of Ring System - As stated, the ring system was somewhat closed to our view, so rendering its observation difficult; moreover, it appeared less bright than when fully open.

Ring A, not easily distinguishable, was estimated of very different intensity by various observers, who saw no color on it.

Cassini's Division was seen by all observers with some difficulty, and only on the ansae. Ring B was brighter than Ring A but was duller than usual and probably darker than the EZ. It was consistently found to be white or yellow. Ring C was seen by only two observers, and not with certainty.

The shadow of the globe on the rings appeared normally black and, starting 15 days after opposition, it was widening. The shadow of the rings on the globe was also well marked, though apparently not black. Visible S. of Ring A over the globe, it was taken at times for a very dark belt of the planet.

The ring system displayed no unusual phenomenon, except for a Terby Spot seen by Heath (a well known optical effect due to contrast between the rings and the planet's shadow[1]), and not confirmed by other observers.

Aspect of the Globe - The very closed rings occulted on the globe only the S. part of the EZ (Equatorial Zone). With respect to the 1979-80 apparition[5], both polar regions looked weaker and less extended.

The SPR, South Polar Region, somewhat dull, was seen often, but did not exhibit details nor evident coloration. The STB (South Temperate Belt) was seen by only two observers, who agree in confirming its 1979-80 aspect and position. The STZ (South Temperate Zone) appeared yellow and of normal aspect. The SEB (South Equatorial Belt), very near the rings' shadow, was seen with difficulty owing to contrast. It appeared very thin, and the latitude measures indicate that only the N. component was seen.

The EZ_n (Equatorial Zone north) appeared quite bright and devoid of details, and various observers remarked its tendency to be deep yellow or, sometimes, golden, or even creamy yellow. The NEB (North Equatorial Belt) was without doubt the most interesting belt. Seen double by various observers, with the S. component slightly darker, it did not show a strong color, if exception is made for brown-ochre tints occasionally reported. As in 1979-80, it appeared indisputably darker than the SEB, and was the site of atmospheric activity late in the apparition, as reported by Heath and confirmed by a drawing of Stomeo. The few observations at our disposal do not permit us to go into details.

For NTZ and NPR (North Temperate Zone and North Polar Region) one can repeat the considerations made about the analogous S. regions: weak coloration and contrast, no detail. The NTB (North Temperate Belt) was not seen.

Conclusion - After the Voyager flybys, Saturn phenomenology is still worth investigating and monitoring regularly by Earth-based telescopes; however, more observers, hopefully objective and scientifically minded, are needed. It is the aim of the U.A.I. Saturn Section to raise interest in Saturn among Italian amateurs and to coordinate their efforts.

Table 1. Observers and Instruments Used

Observer	Locality	Telescope*	Number of Observations
G. Adamoli	Verona	108-mm. OG	5
S. Baroni	Milano	200-mm. Spec	5
S. Gargano	Corsico (MI)	210-mm. Spec	6
M. Giuntoli	Pieve a Nievole (PT)	114-mm. Spec	3
A. W. Heath	Long Eaton, Great Britain	300-mm. Spec	27
G. Macario	Cava dei Tirreni (SA)	200-mm. Spec	1
E. Stomeo	Venezia lido (VE)	250-mm. Spec	1

* Objective aperture and telescope type are indicated (OG = objective glass or refractor; Spec = speculum or reflector).

Table 2. Saturnicentric Latitudes from Drawings

	S. Edge	N. Edge
South Polar Region		-51°0 (13)
South Temperate Belt	-36°0 (6)	-27.8 (6)
South Equatorial Belt	-15.2 (7)	-11.2 (7)
North Equatorial Belt South	+11.4 (20)	+14.8 (12)
North Equatorial Belt North	+18.9 (12)	+23.8 (20)
North Polar Region	+62.1 (11)	

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Table 3 - Intensity Estimates*

	Adamoli	Baroni	Gargano	Giuntoli	Heath	Macario	Total Mean
Ring A	5.5 (5)	0.6 (5)	2.0 (5)	3.5 (1)	2.7 (26)	2.0 (1)	2.7 (43)
Cassini Division	9.5 (5)	6.0 (1)	9.0 (6)	9.8 (1)	8.9 (13)		8.8 (26)
Ring B	3.0 (5)	0.6 (5)	2.1 (6)	3.0 (3)	1.0 (27)	1.0 (1)	1.7 (47)
Sh. Ring on Globe	7.1 (5)	4.8 (5)	4.3 (6)	7.3 (3)	10.0 (17)	7.5 (1)	7.0 (37)
Sh. Globe on Ring	10.0 (3)	8.5 (5)	8.8 (6)	10.0 (2)			9.2 (16)
SPR	3.6 (4)	2.0 (5)	2.4 (6)	2.5 (1)	3.4 (27)	3.0 (1)	2.9 (44)
STB	4.3 (5)		3.0 (1)				3.9 (6)
STZ	2.2 (3)		2.0 (2)	1.7 (3)		2.5 (1)	2.0 (9)
SEB			4.0 (6)	3.0 (1)	5.0 (9)	4.5 (1)	4.4 (17)
EZ_n	1.0 (5)	0.6 (5)	0.5 (6)	0.5 (3)	1.9 (27)	0.7 (1)	1.0 (47)
NEB_s	4.5 (5)	3.2 (5)	5.7 (6)	3.2 (2)	4.9 (27)	5.5 (1)	4.6 (46)
NEB_n	4.5 (5)	2.5 (5)	4.8 (6)	3.2 (2)	4.9 (27)	5.5 (1)	4.3 (46)
NTZ	2.5 (5)		3.0 (1)	1.7 (3)	2.3 (23)	2.0 (1)	2.3 (33)
NPR	3.8 (3)	1.2 (4)	2.6 (5)	2.7 (3)	3.4 (27)	2.8 (1)	2.8 (43)

* Scale used: 0 = maximum brightness, 10 = sky background

** Only one observer reported the following:

Adamoli:	Ring C	5.1 (5)
	SSTZ	2.1 (4)
Macario:	Rings A-B on Globe	0.5 (1)

A NEW TWIST IN PLANETARY PHOTOGRAPHY - UNSHARP MASKING

By: Jeff D. Beish and Donald C. Parker, A.L.P.O. Assistant Mars Recorders

Abstract

The use of Kodak Litho Pan-Masking film and contact printing are discussed. Results from tests in unsharp masking the North Polar Region of Mars, in search of the elusive "Rima Tenuis", are given.

Introduction

Recently, in an effort to enhance a photograph of the North Polar Cap of Mars, an old but proven method in contact-printing was used by the authors to bring out a very faint line in the bright Cap. This line was first observed by Schiaparelli in 1888, who named it the "Rima Tenuis". The rift was re-discovered during the 1979-80 Mars apparition and was photographed by several A.L.P.O. astronomers. To our knowledge, this feature has never before been photographed.

The old method of printing is referred to as "continuous-contrast printing" or "unsharp-masking". Faint details are sometimes lost in the brighter areas of planets due to light scattering, film grain, turbidity, etc., and are almost impossible to reproduce using standard printing methods. The authors used various methods, including composite printing, in an attempt to bring the Rima Tenuis to surface. We were still not satisfied with the results; and after many hours in the darkroom, we had come to the end of our rope.

During this time, we had discussed the possibility of some kind of masking process and had decided to investigate the use of a process used in deep-sky astrophotography called "unsharp-masking". However, after searching through many publications, we found that information on the subject is very limited, but that the process may have merit. Basically, unsharp-masking consists of making an out-of-focus contact transparency of the original negative. This positive image is then placed exactly over its negative, and this "stack" is placed in the enlarger. In the final print, the unsharp mask holds back the highlights and allows fine details, which would otherwise be drowned in their highlights, to come through.

There are many ways to make an unsharp mask, using a variety of films and special devices (ref: 1 and 2). However, we were primarily interested in speed and simplicity. After many long discussions with a professional lithographer, we decided to employ the techniques described below.

Equipment and Film

Contact printing goes back to the early 1800's [1900's? - Editor] and is still in use today. Most of the equipment should be easy to find, and the process is fairly straightforward.

A spring-back printing frame or "proofer" can be used to hold the original negative in direct contact with the mask film. Be sure that the frame has a clear glass front. Also, a sharp paper cutter or knife will come in handy to cut the 8x10 sheets into 35mm. size sheets. The rest of the equipment should include the standard equipment for printing.

The film used in the tests is the type 4753 Kodak Litho Pan-masking film. This film is structured so that any contact print made upon it will automatically be unsharp, thus obviating the need for special devices such as thin glass spacers, special diffusers, etc. Kodak 4753 must be handled in complete darkness and is notched in the upper right hand corner, indicating emulsion up. Your equipment should be laid out in proper order for working in complete darkness.

We used a 500 watt (B1) lamp at first, but this proved to be unsatisfactory. After some discussion, we decided on a 250 watt white lamp (3200°K) at a distance of three feet from the frame. This worked out very well.

Exposures and Developing

It was recommended that we use either DK-50 or Litho MP-2 developer; however, both were unavailable at the time. A good substitute was found in using HC-110, Solution "F", at 68°F. Also, Kodalith developer should work. We found that gentle continuous agitation for four (4) minutes works well. The rest of the process (stop, fix, and wash) is standard.

A word about exposures. A very strange thing happens to this film as exposure time is increased. We started with times of 5, 10,and 20 seconds and found that sometime after the 5 second exposure, the image started to reverse from positive to negative! After adjusting our times down to 1, 3, and 5 seconds, we found that the 1- and 3-second exposures produced an acceptable mask. Watch out for this reversal. A two (2) second exposure using a 250 watt white lamp at three feet appears to produce very good results.

Filters

The use of color filters during any printing process is recommended. The unsharp masking process used in our tests was primarily for black and white reproduction; however, faint details are enhanced even more through the use of filters. The following is a guide to exposure time increases using filters:

Red (W25)	4x
Green (W58)	5x
Blue (W38A)	6-8x

Reproduction

After the exposed mask has been developed, you will notice that the image will be fuzzy and low in contrast. The secret in a good mask is to produce low-contrast images. If you have access to a densitometer, a reading of 0.85 will produce very good results in the mid-contrast range. We used a gray scale strip with a pre-determined density range of 1.15, 0.85, and 0.30 values in density to compare the original with the developed strip. Adjusting the process, we used the low density portion of the strip to determine the exposure time and the high density portion to determine the development time.

Now, the masked image can be reproduced. You will have to place the original negative in direct contact with the mask and in good register. This will be difficult at first, but with a little practice it will become easy. Remember that a good register is very important. We used the ratchet holes to register the two films. Also, we found that pin holes worked well. With both films in register and with emulsions up, place them into the enlarger and reproduce. The mask will not necessitate much increase in exposure time. Depending on the enlarger type, bulb, etc. used, a three (3) second exposure placed at a distance of 11 cm at F/8 should work well. You can now use your safe-light and make all the prints you want. In fact, we advise making several more prints than you think you will need in order to avoid going to the trouble of re-registering at a future date.

Step-by-Step Process

1. Arrange equipment in good order, since we must work in total darkness.
2. Place original negative in direct contact with the mask film, emulsions up, in printing frame; and then close frame securely.
3. Direct 250 watt lamp (white) on to frame for 2 seconds. You may bracket your times, but remember that the film will reverse at some time during extended exposures.
4. Develop the masking film in HC-110, solution "F" at 68 degrees F or in a similar developer, as described above. You may use a safe-light after fixing has started.
5. Now, with finished negative mask, place original negative on to the mask in good register and enlarge. REmember, the finished mask will look fuzzy and generally is a poor quality image. Low contrast is our goal in this process.

Summary

At first it seems that this process is unnecessarily troublesome and time-consuming. However, when you have spent a good deal of time in getting a good planetary photograph, it would surely appear that an equal amount of time should be spent in the reproduction of your work. Of course, you must start with a good quality negative!

In our quest to bring out the faint "Rima Tenuis", we have re-discovered an old technique which may be of considerable value to the planetary photographer, who is always striving for better resolution and tonal range.

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A PROPOSED PHOTOMETRIC PROGRAM FOR A.L.P.O. LUNAR OBSERVERS

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Abstract

In this paper I wish to call the attention of A.L.P.O. lunar observers to a very interesting selenological phenomenon, the investigation of which is strongly recommended. A cooperation among all interested persons appears to be highly desirable.

In 1980 the "Georgiana" Observatory received a polarizing filter from W. H. Haas of the A.L.P.O. as a gift. This kind of filter is advertised often in Sky and Telescope. I intended to apply the filter in question to the photometry of the lunar surface, since with its help the intensity of the light, entering into the eyepiece, can be altered optionally until the final stage when the light goes entirely out and the image of the observed object becomes invisible in the field of view. To measure the variation of the intensity of the light, a large-sized angle-meter was attached to the polarizing filter; and the instrument was placed upon the 152/762 mm refractor of the Observatory. Selected lunar craters, e.g., Tycho, Copernicus, Aristarchus, etc., were the targets of the test.

It is regrettable that it soon became clear: this kind of instrument cannot be used for photometry. The method is not objective enough, and the result depends largely on the sensitivity of the human eye. In addition, the decrease of the light, seen through the polarization filter, is not linear but instead exponential; and therefore to determine exactly the point when the object disappears from the field of view, or when it appears again, is extremely difficult. Therefore, I was forced to cease this experiment. Now the polarizing filter is combined with my Hydrogen Alpha prominence filter. This combination turned out to be a very good idea since I now can regulate the intensity of solar light entering into the Hydrogen Alpha filter. The income of too strong and blinding radiation thus is easily avoidable. In the photometry of the lunar surface I also tried to use optical wedges, by which so-called wedge photometers can be constructed (such tools were used at the turn of the century in Hungary, in observing variable stars); but my experiences were similar to the ones that were obtained when the polarizing filter was applied.

Considering these negative results, I came to the conclusion that only industrially produced photometers, for example photoelectric photometers, can be used to good advantage for the photometry of selected lunar areas. Fortunately my Observatory had just received a Solid State Stellar Photometer, Model SSP, Optec INC, and I hope very much that I can carry out future lunar studies with its use. I feel, however, that it is reasonable now to call the attention of the readers of Journal A.L.P.O. to this proposed program. Members of the A.L.P.O. Lunar Section, when they have good photometers, may be participants in this project which would become one of the official programs of the A.L.P.O. The results would later be published in Journal A.L.P.O.

R. B. Baldwin in his book "The Measure of the Moon", Chicago, 1963, has written as follows (p. 253):

"Wirtz first and then Fedoretz established the fact that the peaks of the reflection for various objects [on the Moon] did not always occur at full moon but that certain features gave curves reaching maximum somewhat before or after full moon. The earlier observations indicated a tendency for a formation in the eastern hemisphere to attain maximum brightness before full moon and after full moon for objects in the western hemisphere. All later observations have indicated that a formation reaches maximum brightness at or after full moon, regardless of location. In 1946, Minnaert made a series of calibrated photographs with the 40-inch refractor at Yerkes Observatory.

"Recently van Diggelen, of Utrecht Observatory, investigated photometric properties of the floors of thirty-eight craters on these photographs. Lunation curves relating reflected light intensity to phase angle were accurately derived by combining his own work with that of several other observers, all reduced to the same photometric system. In general, the results confirmed those of Barabashov and Fedorets. In all cases, the maxima of these lunation curves occurred close to phase angle 0° -- at full moon, irrespective of the crater's location on the lunar disk.

"However, several craters were found with maximum intensity occurring slightly after zero phase. Tycho and Aristarchus have 10° lags, Proclus has a 5° lag, for example. Nearly all the craters showing this anomaly have bright rays visible at full moon and presumably are of relatively recent formation. Older features, including Alphonsus and Grimaldi, habitually have naxima precisely at full moon. Grimaldi was one of the formations found by Wirtz to have a maximum before full moon.

"The shapes of the surves are functions of the selenographic longitudes of the craters, as is necessary, but the forms are independent of latitude. This was shown in 1949 by Tschunko. The amplitudes are dependent to a large extent on the albedos."

Consulting van Diggelen's original work ("Photometric Properties of Lunar Crater Floors," by J. van Diggelen, Recherches Astronomiques de l'Observatoire d'Utrecht, Vol. XIV, No. 2, 1959), we found altogether 51 light-curves (and not only 38 as mentioned by Baldwin). The craters are as follows:

Albategnius, Alphonsus, Archimedes, Aristillus, Billy, Bonpland, Bullialdus, Campanus, Cassini, Clavius, Copernicus, Cleomedes, Cyrillus, Marius, Gassendi, Grimaldi, Guerikė, Hevelius, Landsberg, Manilius, Mercator, Plato, Pytheas, Posidonius, Ptolemaeus, Petavius, Pitatus, Reinhold, Macrobius, Aristarchus, Tycho, Firmicus, Lyell, Maraldi, Le Monnier, Julius Caesar, Lubiniesky, Riccioli, Aristoteles, Autolycus, Theophilus, Catherina, Langrenus, Vendelinus, Fracastorius, Menelaus, Hipparchus, Kepler, Arzachel, Schickard, Proclus.

The observations of these craters, however, were not the work of van Diggelen alone; but he has used data from measurements carried out by other authors as well, namely, Markov, Sharonov, Öpik, Goetz, Bennett, and Fedoretz. In Figure 9 we present van Diggelen's three original curves (his Figs. 21, 22, and 23 respectively) for Albategnius, Alphonsus, and Archimedes respectively. We can see that the maxima for Albategnius and Alphonsus appear just at Full Moon, while there is a shift towards the positive values of g (the phase angle, see below) from the zero [Full Moon] for Archimedes.

Studying van Diggelen's data further, we find similar shifts for the following craters:
Aristillus, Billy, Clavius, Copernicus, Cyrillus, Posidonius, Ptolemaeus, Aristarchus, Tycho, Lubiniesky, Catherina, Kepler, and Proclus

There are a few other craters where such a shift can also be suspected; however, these other cases are not perfectly certain.

The horizontal axis of the coordinate system used in Figure 9 means the phase angle, denoted as g. It is the angle between the two lines which join the center of the Moon to the Sun and to the Earth. That is:

at First Quarter, $g = -90$ degrees,
at Full Moon, $g = 0$ degrees,
at Third Quarter, $g = +90$ degrees,
at New Moon, $g = \pm 180$ degrees.

That is, g is not the same as colongitude.

The vertical axis means the "radiance" of a lunar area, which was formerly called brightness. If the observed area is in shadow and therefore practically invisible, then the radiance $R = 0$. For a better definition I quote here van Diggelen's original text in his work cited above:

"The radiance of a lunar area [formerly called: brightness] is the radiation of a unit projected surface in the direction of the Earth, measured per unit solid angle. It is the direct result of the observation and it depends on the phase angle g. If the radiance is plotted as a function of the phase angle, we find a lunation curve for the area considered" (p. 13).

In the text of this paper when the term light curve is used, it is identical with the lunation curve of van Diggelen.

The magnitude m and the radiance R are related to one another by the equation:

$$m = -2.512 \log R.$$

For example:

R	m
R = 150,	m = -5.47,
100,	-5.02,
50,	-4.27,
10,	-2.51,
0,	0.

If we have two stars, A and B, and their apparent magnitudes are m(A) = -2.51 and m(B) = 0, then we receive approximately ten times more light from A than from B. Similarly, if there are two areas on the Moon and the brightness of one of them is ten times greater than that of the other, the difference of their brilliancy corresponds to a relative magnitude difference of -2.51. Note that all the values have negative signs except for R = 0. Furthermore, all the given magnitude or R values are relative ones as compared to a point which is in shadow and for which R = 0. Let us consider that in practice the darkest points of the lunar surface, even in shadow, are not absolutely black and perfectly invisible. Therefore, we can measure such areas on the Moon with our photometer; and we shall obtain a certain, low value on the light-meter, corresponding to such areas for which R can be regarded as equal to zero. This reading, that is, this small value, must be regarded as our base to which all of the other measured values must be compared. Of course, not just a single measurement should be made but more than one, particularly in establishing our base value. The average should then be used.

In the course of a series of observations a few corrections must be made. First: according to the altitude of the Moon above the horizon, from the beginning of the observation until its end, because of the existence of atmospheric extinction. For simplicity I should like to suggest calculating all the data to H = 90°, that is, to the zenith. No measurements are advised when the altitude of the Moon is 20° or smaller. At 20° the extinction is as large as 0.45 magnitudes, while between the altitudes of H = 75--90° the extinction is nearly zero.

Considering the fact that all illuminated lunar features reflect the light of the Sun and that the distance between the Sun and the Moon is always changing and furthermore that the distance between the Moon and the Earth is also changing continuously, two further corrections are necessary. For the Earth--Moon distance it appears to be reasonable to calculate all the data for the mean value, that is 384,395 kms. For the Sun--Moon distance again the mean value is suggested, namely 149,598,700 kms., which is the average distance between the Earth and the Sun. The Moon is at about this same distance from the Sun at the time of First Quarter and Last Quarter.

Taking into consideration the large number of lunar craters which have not been measured as yet, it is suggested that all the participants in the project should select a few--say 5-10--craters for themselves, the photometric investigation of which will be their own work. The project, as a whole, should belong to the A.L.P.O. Lunar Section and should be coordinated by its Recorders. It is important that the method of observation and all the needed corrections should be the same for all observations and for all participants. Therefore, as a first step, the plan of a uniform methodology should be developed by the Recorders of the Lunar Section. The main goal of the project is the determination of the photometric behavior of different lunar craters with a particular emphasis on the problem of which are those ring-mountains that reach their maximum brilliancy not at Full Moon but either before or after Full Moon. Is there really a relationship with the relative age of the craters? Is or may there be any correlation with the geology of the craters?

An additional goal within the project would be research on the photometric behavior of lunar craters, domes, and other features in different wavelengths, using different interference filters.

Generally speaking: I am convinced that this is a very interesting program and at the same time a very broad one. And last, but not least, this is a program which may have real scientific value and which is not influenced by the fact that the manned lunar expeditions have revealed so much new information about the Moon. Such lunar photometry, which is suggested here, may represent a new area for all the fields of selenology.

Notes by Editor. In a letter on October 4, 1981 Dr. Hedervari added several suggestions to his manuscript above. First, he calls attention to the book, Photoelectric Photometry of Variable Stars - A Practical Guide for the Smaller Observatory, I. A. P.P.P. Communications, by Dr. D. S. Hall, Dyer Observatory, Vanderbilt University, Nashville, TN 37235 and Mr. Russell M. Genet, Fairborn Observatory, 1247 Folk Road, Fairborn, OH 45324. Our Hungarian colleague states: "Although this book is written primarily for variable star observers, it contains much useful advice and information about photometric work in general. Therefore, I suggest very strongly to anyone who wants to do photometry of the Moon, planets, or other celestial bodies that he become acquainted with this brilliant booklet. In my opinion it is of fundamental importance!"

Dr. Hédervári further urges that those who undertake to do lunar photometry as recommended in his paper will find that a certain period of preparation is required. Obviously, one must acquire a photometer and practice until one is proficient in its use. An accurate motor drive for the telescope is needed.

Those interested in this project are requested to write to the Editor, Walter H. Haas, Box 3AZ, University Park, NM 88001. Here is something that should prove challenging and rewarding to the advanced amateur observer. If there is enough response, the photometric study will be set up as a regular program of the A.L.P.O. Lunar Section.

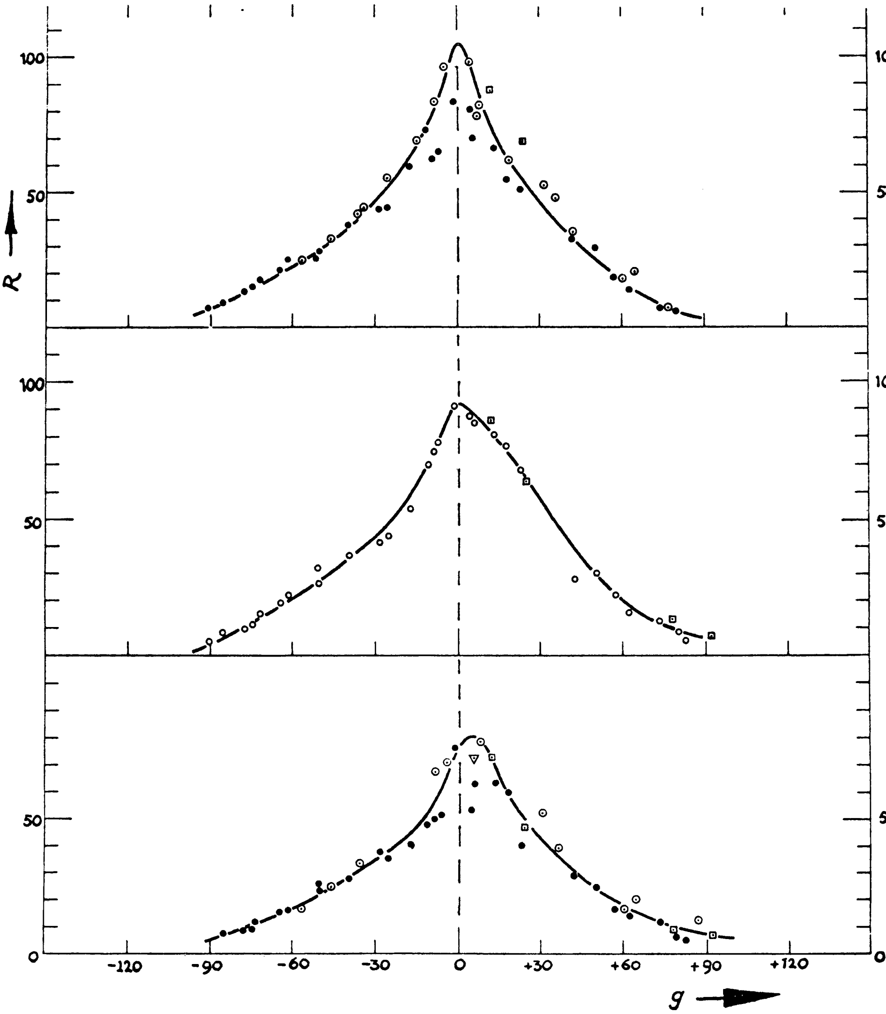

Figure 9. Graphs of observed radiance R as a function of phase angle g for three lunar craters: Albategnius (top), Alphonsus (center), and Archimedes (bottom). Taken from "Photometric Properties of Lunar Crater Floors" by J. van Diggelen and based on measures by himself and others (Markov, Skaronov, Öpik, Goetz, Bennett, and Fedoretz). See discussion in text by Dr. Peter Hédervári on pg. 147 et seq.

THE LIGHT CURVE OF COMET KOHLER 1977 XIV*

By: Daniel W. E. Green, A.L.P.O. Comets Section

Abstract

An analysis of the total visual magnitude estimates made of Comet Kohler is presented. The observations of A.L.P.O. members were merged with non-A.L.P.O. data published in the International Comet Quarterly (ICQ), and least-square-fitted parameters from 287 selected observations are presented.

John D. Sabia (1979) recently has provided a fairly detailed description of the visual appearance of Comet Kohler 1977 XIV (= 1977m), as compiled from the file of observations received by the A.L.P.O. Comets Section. Those observations of this comet made by A.L.P.O. members which were not contributed directly to the ICQ (and therefore published at an earlier date) have been published in the July, 1981 issue of that publication.

More than 1,000 computer card images representing observations of Comet Kohler have been published in the ICQ. The scatter in the total magnitude estimates for this comet is extremely large, due to various problems as described by the author and Charles Morris (1981)

* Communicated by A.L.P.O. Comets Recorder Dennis Milon.

in a recent paper. Morris (1980) has outlined some recommended procedures for making magnitude estimates, which, when followed, should make visual estimates much more valuable scientifically.

Due to the extreme ranges in total magnitude estimates made by different observers on a single night (up to 2-3 magnitudes in difference!), some criterion is clearly needed to choose the more valuable data. This author decided to eliminate: 1) all approximate magnitude estimates (i.e., those published with a colon (:) in the ICQ); 2) all photoelectric magnitudes; and 3) all estimates which were not accompanied by a specific reference to a source catalogue for comparison star magnitudes.

Following this selection procedure, 287 observations by 37 observers (see Table I) were used in a least-squares program (written by the author) with the VAX 11/780 computer at the Harvard-Smithsonian Center for Astrophysics. This program reduces the total magnitude estimates to a standard instrument aperture of 6.78 cm after Morris (1973), and finds a least squares solution, with probable errors, using the methods described by this author (Green 1980a, b).

The standard power law formula generally used to describe cometary brightness behavior is:

$$m_1 = H_o + 5 \log \Delta + 2.5n \log r, \qquad (1)$$

where m_1 is the total visual (aperture-corrected) magnitude; H_o is the absolute magnitude of the comet, n is a parameter, characteristic of an individual comet, which describes how a comet's brightness varies with heliocentric distance; and Δ and r are the comet's geocentric and heliocentric distances, respectively.

This study utilized 287 observations from 1977, September 8 (r = 1.45 A.U.) to 1978, February 8 (r = 1.75 A.U.). According to Marsden (1979), perihelion occurred on 1977, November 10.6 E.T. (q = 0.991 A.U.). The observations for this comet covered the time of perihelion, and 207 pre-perihelion and 80 post-perihelion observations are represented in this study.

Figure 10 presents all 287 observations, with the following least-squares line:

$$H_\Delta = 6.82 + 12.48 \log r. \qquad (2)$$

Here, H_Δ is the comet's heliocentric magnitude, plotted as the ordinate; log r is the abscissa in Figure 10. The following parameters were derived to produce equation (2):

$$H_o = 6.82 \pm 0.02 \text{ (p.e.)}$$
$$n = 4.99 \pm 0.23 \text{ (p.e.)}. \qquad (3)$$

The 207 pre-perihelion observations yield (see Figure 11):

$$H_o = 6.87 \pm 0.03 \text{ (p.e.)} \qquad (4)$$
$$n = 4.49 \pm 0.19 \text{ (p.e.)},$$

while the 80 post-perihelion observations yield (see Figure 12):

$$H_o = 6.83 \pm 0.03 \text{ (p.e.)} \qquad (5)$$
$$n = 5.42 \pm 0.14 \text{ (p.e.)}.$$

Figure 11 indicates the high degree of scatter, which is difficult to reduce for this comet.

For comparison, 46 observations made by two very experienced and consistent observers, Bortle and Morris, were chosen for a least-squares analysis. While these observers' observations complement one another quite well, even these data reveal varying total magnitude estimates with differences of half a magnitude or even slightly more near the time of perihelion, indicating problems at that time. Perhaps some real physical changes were occurring near perihelion to cause varying estimates of brightness; the comet was moving southward at that time, slightly south of the celestial equator, and at 61° elongation from the Sun.

These observations by Morris and Bortle cover the periods 1977, September 9 to November 1 U.T. (r = 1.44-1.00 AU) and 1977, November 11 to 1978, January 2 U.T. (r = 0.99-1.32 A.U.). The 46 data points yield (see Figure 13):

$$H_o = 6.88 \pm 0.03 \text{ (p.e.)} \qquad (6)$$
$$n = 3.38 \pm 0.15 \text{ (p.e.)}.$$

The 34 pre-perihelion observations yield (see Figure 14):

$$H_o = 6.80 \pm 0.03 \text{ (p.e.)} \qquad (7)$$
$$n = 3.72 \pm 0.16 \text{ (p.e.)}.$$

The 12 post-perihelion observations were not enough to produce meaningful parameters.

The absolute magnitude for Comet Kohler 1977 XIV in this study is consistently near H_o = 6.9. However, the large amount of observational scatter makes the determination of n very difficult (between 3.4 and 5.4). This comet is, statistically, a photometrically average comet, according to results by Meisel and Morris (1976).

Acknowledgements

Dennis Milon, A.L.P.O. Comets Recorder, supplied the A.L.P.O. Comet Kohler observations which were used in this study. Dr. Brian G. Marsden, Smithsonian Astrophysical Observatory, generously provided computer time for the analysis of the magnitude data.

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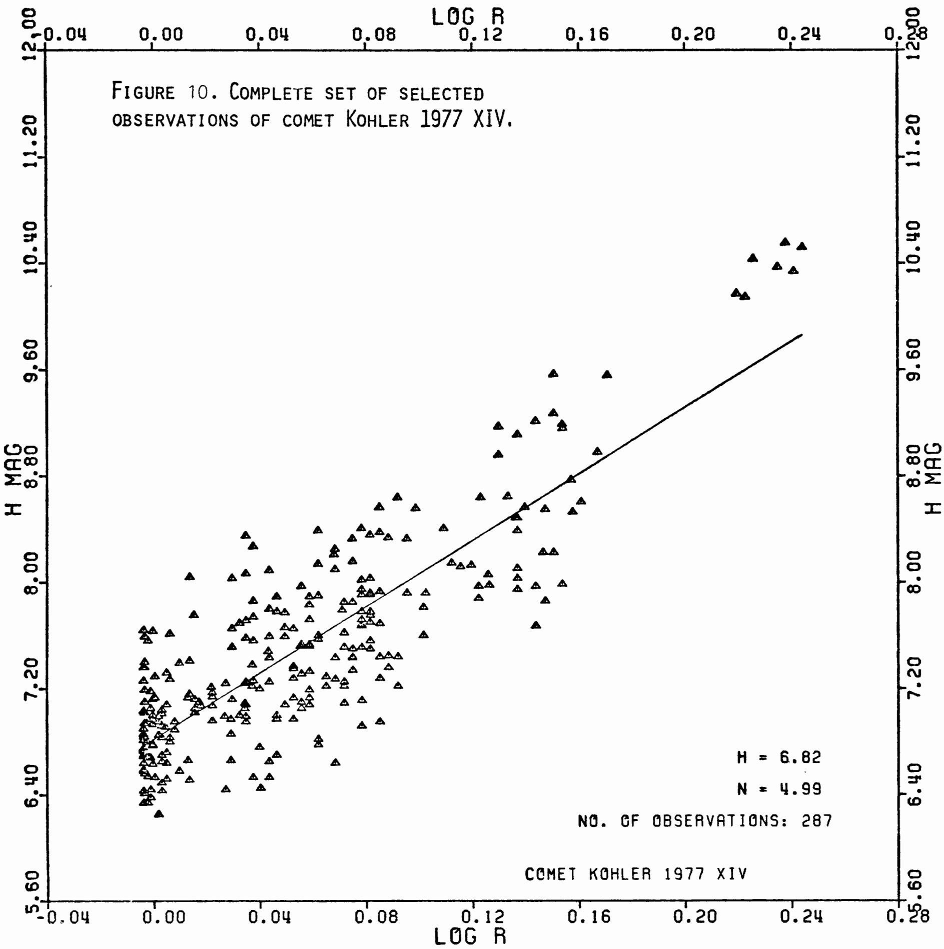


FIGURE 10. COMPLETE SET OF SELECTED OBSERVATIONS OF COMET KOHLER 1977 XIV.

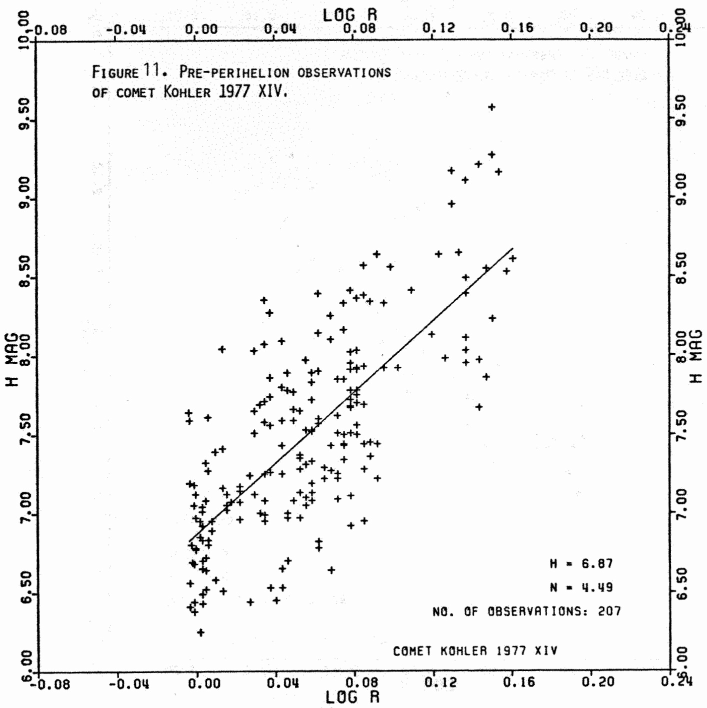


FIGURE 11. PRE-PERIHELION OBSERVATIONS OF COMET KOHLER 1977 XIV.

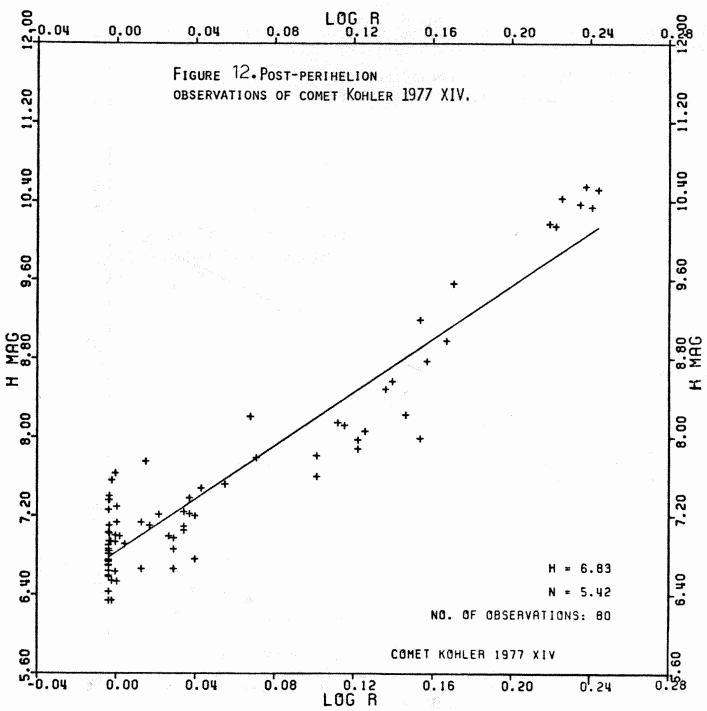


FIGURE 12. POST-PERIHELION OBSERVATIONS OF COMET KOHLER 1977 XIV.

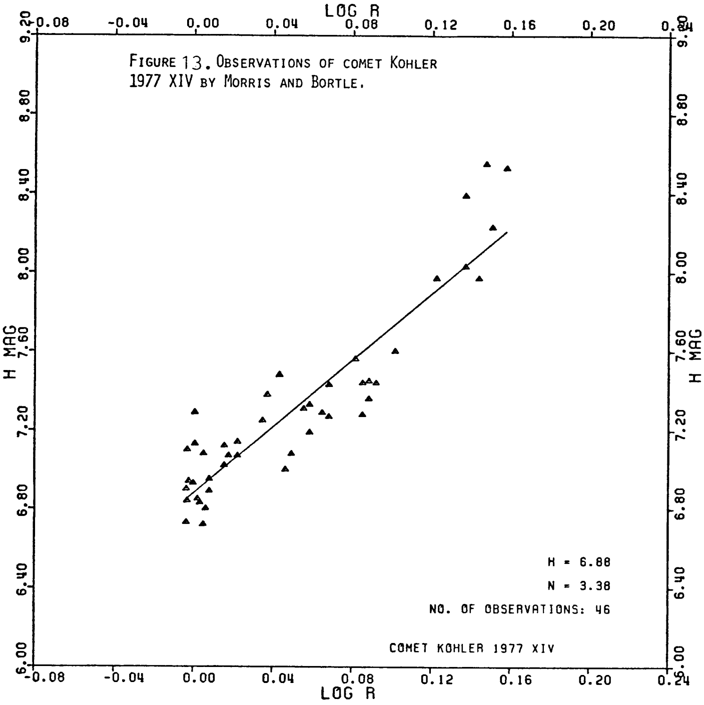


FIGURE 13. OBSERVATIONS OF COMET KOHLER 1977 XIV BY MORRIS AND BORTLE.

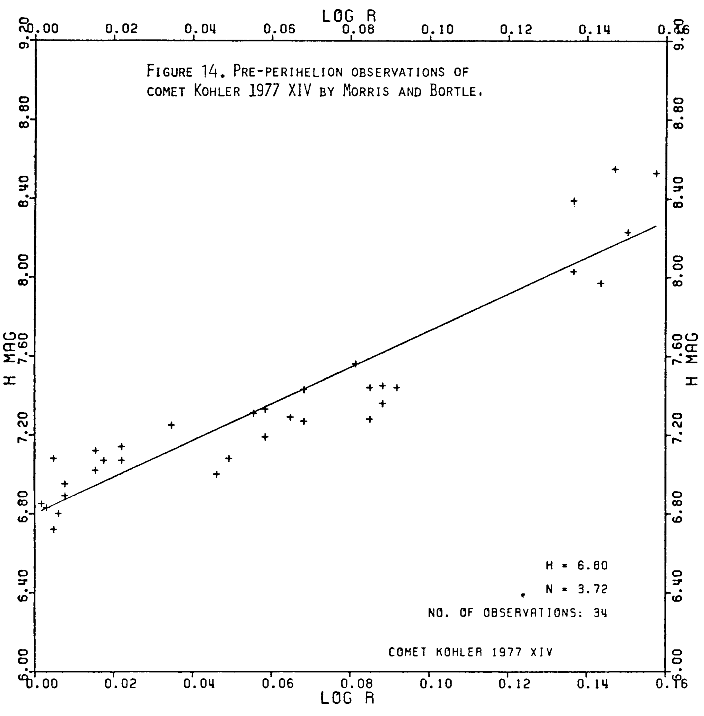


FIGURE 14. PRE-PERIHELION OBSERVATIONS OF COMET KOHLER 1977 XIV BY MORRIS AND BORTLE.

TABLE I. OBSERVERS OF COMET KOHLER 1977 XIV.

BAR		Sandro Baroni, Italy	MAT02	05	Leonard Matuszewski, NJ, USA
BEN01	07	Julius L. Benton, SC, USA	MCE	05	Claude McEldery, MI, USA
BOE	05	Leo Boethin, The Philippines	MIL	05	Dennis Milon, MA, USA
BOR		John E. Bortle, NY, USA	MIL01	07	S.W. Milbourn, England
BOU	11	Reinder J. Bouma, the Netherlands	MOR		Charles S. Morris, MA, USA
			MOR02		James A. Morgan, WI, USA
BUS01	11	E. P.Bus, the Netherlands	OME	05	Stephen O'Meara, MA, USA
CAV		Marco Cavagna, Italy	RID	07	Harold B. Ridley, England
COL		Peter L. Collins, MA, USA	ROB	05	Timothy Robertson, CA, USA
COM	05	Georg Comello, the Netherlands	SHA02	07	Jonathan D. Shanklin, England
DIE	11	D. Dierick, Belgium	SHE	05	Clay Sherrod, AR, USA
			STE01	05	Chris Stephan, OH, USA
ENT	07	L. Entwisle, England	STU	01	K. M. Sturdy, England
FEI	11	H. Feijth, the Netherlands	TUB	12	Vince Tuboly, Hungary
GLI		Gunnar Glitscher, West Germany	USV	01	A. Ujvarosy, Hungary
HEN	07	Michael J. Hendrie, England	VAN	11	N. A. Van Der May, the Netherlands
HEY	11	B. Heyndrickx, Belgium			
			WAL	05	Derek Wallentinsen, NM, USA
HOS	01	J. G. Hosty, England			
HUR	01	Guy M. Hurst, England			
JON	09	A. F. Jones, New Zealand			
KRO	05	Bruce A. Krobusek, OH, USA			
KRO02	05	Gary W. Kronk, IL, USA			

COMET WEST 1976 VI: OBSERVATIONS OF THE GREAT COMET OF 1976 (continued)

By: Derek Wallentinsen, A.L.P.O. Assistant Comets Recorder
and James-Mims Observatory

[This paper is a continuation of Mr. Wallentinsen's detailed report on an extraordinary comet. The first installment appeared in J.A.L.P.O., Vol. 29, Nos. 3-4, pp. 69-79. We regret the need to divide this paper into several installments, but its length allows no choice.]

f. Tail

In early March, 1976, the tail of Comet West commanded attention in the pre-dawn sky. This is the image that made this comet particularly remarkable.

The tail first began to develop in January. Thompson only glimpsed a 2' tail on January 26; but better conditions on the 29th revealed 50' of tail, corresponding to 8.1 million kms. true length (see Table V). He reported 2° of faint and narrow tail on February 19, six days before perihelion passage. This modest appendage would soon grow to spectacular proportions.

During the last ten days in February, the tail truly came to life. Even though the comet could only be seen in brilliant twilight or daylight, a tail was reported by most observers during this remarkable period. On February 23.95 (bright twilight) Bortle first sighted Comet West and suspected ray structure in its tail with 15X80 binoculars. He likened its appearance to that of 1963 III Seki-Lines, a sungrazer (q=0.03 A.U.) Daylight tail observations have already been discussed.

After perihelion, as the comet moved into morning sky darkness, the true extent and complexity of the tail became increasingly apparent. Sandel (March 1.46, 1976) described a 1.25 degree tail in PA 335° with a "veil-like appearance." (PA is position angle.) Two days later (March 3.46), he could see 8° of tail with his unaided eye, and it "had the appearance much like that of a train of smoke from a bright meteor. Very tenuous looking with definite signs of mottling structure. . . .A gas tail much fainter arched away from the main dust tail." Mayo remarked on the "very wide and broad" 5° long structure he called a Type II dust tail (March 2.57), and on March 6.55 he reported 8° of tail in PA 300° with the unaided eye (three dust streamers) and one Type I gas tail in 10X50 binoculars. Tim Robertson was impressed by the tail's brilliance (March 4.56): "Very bright--can even see it in bright street light glare, has a dark lane running up its side....[March 6.46]. Type II tail broad and diffuse....slightly curved." He gave the color as blue to pink across the tail, while to others the color was variously yellow-white (Lukas), grey-brown (Wallentinsen), and milky-white (Sandel).

By the end of the first week, and through the second week, of March, the great length--both apparent and actual--of Comet West's tail was undeniably in evidence. On the morning of the 5th Minton saw a naked-eye tail 25° long, creamy-white in color; Morris (March 6.46) reported a straight 15° gas tail (PA 320°) and a strongly northwards curving 25° dust tail (PA 335°), both easily visible to the unaided eye--"a beautiful sight!" The latter feature was extremely broad with a dark region, many streamers and other details too numerous to record. Dennis Bohn and David D. Weier, observing at the same time from Mt. Horeb, Wisconsin, both saw a dust tail of 20-26 degrees length and 10° width, and a gas tail of 6°-7° with the eye and 7X50's. The author saw a 10° dust tail with several dark lanes visible in the first several degrees (March 6.52). Bortle (March 7.41) reported a "highly complicated multiple tail" with at least five components in PA's 295° through 330°. The 25° long dust tail was 10° wide and terminated across Zeta Cygni (10X50's and eye). On March 8.41, Bortle watched the tail rise over distant hills well before the comet's head rose. There were four identifiable tails behind the 2' coma: an ion tail 8.5 degrees long in PA 298°, fairly broad, possibly slightly curved to the south; a fairly narrow, sharply defined straight ray 11° long in PA 307°, separated from the first tail by dark sky; the brightest tail, straight and fairly narrow, approximately 1°-2° wide, 16° long in PA 310°; and finally, a huge dust tail 25° in length curving gently to the north, PA 320° at midpoint. Daniel Costanzo (March 7.44) observed two tails of 16° and 22° length in PA's 311° and 327°, respectively, apparently dust tails. Four tails and streamers were seen with 7X50's, and he noted that the preceding side of the comet was more distinct. The tail in the proximity of the coma was yellowish in the binoculars, but "this could be due to the low altitude (2°-10°) of the comet." Charles Hughes also noted a yellow color in the 8° fan-shaped tail (March 7.43). Bruce Krobusek observed the comet at a higher altitude (20 degrees) an hour and a half later and reported a bluish-white, fan-shaped, and thin tail in PA 300° in a sky of patchy cloudiness. McEldery saw a broad 15° naked eye tail extending westwards from the comet's head to Delphinus, curving northwards in a wide, broad arc passing between this constellation and Kappa Pegasi, with the northern half of the tail looking brighter (March 7.46). O'Hara reported a 5° long (twilight and city lights interfering) silver, straight, bilaterally symmetrical tail in PA 265°, which he designated as a Bredichin Type II tail of dust composition. However, he saw no gas tail (March 7.56). Slobins remarked on the three-part tail he observed with the unaided eye (March 8.40): "White-yellow gas tail visible plainly to 10° and extended 15°--straight along radius vector with Sun. Dust tail to north and west--curving to 24° into Cygnus and to south and west 10°." O'Meara at first observed two tails of 10 and 16 degrees (March 8.41), and then four tails on the 9th and 11th: PA 292°, 7° long, 325°, 20°; 310°, 6°; and 335°, 12° (March 9.38). On the 9th he noted "one synchrone [visible] with naked eye." Sabia observed two tails in a 7-cm. refractor at 17X on March 8.43: a 15° brighter, broader tail "arching" slightly northwards, and a narrow, faint, and straight tail in PA 295°. Capen observed Comet West through filters, noting red, yellow, and blue coloration (March 8.53). The dust tail (20° long) was red (Bortle and Sabia also saw a dull red hue, while Porter reported faint orange-yellow), "transition tail yellow (Type III?). Ion tail well defined blue."

Around this time the tail became so long that determining its length became difficult because of superposition of it upon the Milky Way. John West found the 15° tail blending into the galaxy on March 9.47; Bohn and Weier had difficulty estimating the 20°-26° of tail on March 6 because of Milky Way interference. The greatest apparent length was reported by Slobins on the 12th--30° of dust tail. In true measure, Slobins' observation of March 12 is also first--93 million kms. or more than half an Astronomical Unit. On March 14, O'Hara saw two components, five degrees of straight, featureless Type II tail (dust), and a shorter "fanned out" Type III (dust) tail with streamers (7X35's). He noted that the south boundary of the comet was quite sharp and distinct.

A noticeable decrease in the tail's splendor was discernible to McEldery and Sabia on March 11 and 12. McEldery saw only 10° (versus 15° on the 7th) and remarked that it was not as broad, while Sabia reported that coloration of the tail near the coma was less extensive than on the previous dates. On the 15th, McEldery saw only 1° of tail with his unaided eye, whereas he had seen 10° on the 11th. Colors had become less prominent in the tail, only red in the dust and blue in the ion tail being reported by Capen (15th). The Full Moon's coming into the morning sky on the 16th also diminished tail descriptions. By March 18, most observers were reporting only one dust tail with its southern part brighter and more prominent. On March 20.40, Bortle saw a straight 4° tail in PA 286°. O'Hara (March 20.52) observed a 3° tail with a straight southern edge in PA 288°. Its northern border was concave with some greenish color visible (7X35's, 6-cm. refractor). Mayo, observing from the Malibu Mountains in clear skies, saw a long 15 degree tail, with a 35° fan, 280°-315° in PA, reaching into the Milky Way (March 20.54).

(Text continued on page 162.)

TABLE V. COMET WEST TAIL AND COMA OBSERVATIONS

	1975 UT	Observer	Tail (°)	kmx10^6	Instr	Coma (')	kmx10^3	DC	Instr	r	Notes
1.	Nov 25.45	Boethin				4	415	vd	20S	2.06	
2.	Dec 4.46	Boethin				8	819	vd	20S	1.91	
	1976 UT										
3.	Jan 26.43	Thompson	2	0.3	8L	2	149		8L	0.90	
4.	27.43	Thompson	2	0.3	8L	2	147		8L	0.87	
5.	29.42	Thompson	50'	8.1	8L					0.83	
6.	Feb 13.31	Thompson	1	4.8	20S					0.46	
7.	15.31	Thompson	1	4.1	8L					0.40	
8.	17.32	Thompson	1.5	5.3	5,8L					0.35	
9.	18.30	Thompson	1	3.2	8L					0.32	
10.	19.31	Thompson	2	6.0	8L,10S					0.29	
11.	22.09	Townsend	25'	0.6	5L					0.23	
12.	23.01	Marcus	1'	0.04	15S	0.75	30	1?	15S	0.21	
13.	23.95	Bortle	0.5	1.3	5L	0.5	19	8	5L	0.20	
14.	24.94	Collins				2-3	74-111		23L	0.20	
15.	24.95	Bortle				0.5	19	8	5L	0.20	
16.	25.09	Townsend	0.75	2.2	5L					0.20	
17.	25.81	O'Meara	1	3.3	23L	10	361		23L	0.20	
18.	25.92	O'Meara	1	3.4	23L					0.20	
19.	25.94	Bortle	40'	2.3	5L	0.5	18	7-8	5L	0.20	1*
20.	27.76	Bortle	0.05	0.16	8L	0.5-1	17-35		8L	0.22	10"cc,6x10 km
21.	27.97	Matuszewski	1.5	5.3	5L	10	347	9	5L	0.22	
22.	29.47	Bortle	1	2.9	5L	0.5	17	8	5L	0.25	
23.	Mar 1.22	Mühle	3.5	8.9	E,5L					0.27	
24.	1.46	Sandel	1.25	3.2	E			2-3	5L	0.28	
25.	2.22	Mühle	6	13.9	5L					0.30	
26.	2.57	Mayo	5	11.5	5L			8	5L	0.31	
27.	3.20	Lukas	10-15	22-32	7L	4	141	9	7L	0.32	
28.	3.23	Mühle	4	9.0	3.5L					0.32	
29.	3.46	Sandel	2.8-8	6.2-18	E,15S			2-3	15S	0.33	
30.	3.52	Wallentinsen	10-14	22-29	E,3.5L					0.33	
31.	3.54	Minton	25	46.7	E	0.3	11	8?	15S	0.33	
32.	4.46	Sandel	3-5	6.7-11	E,5L			5	15S	0.36	
33.	4.53	Minton				0.15	5		15S	0.36	
34.	4.55	Mayo	6	13.2	E,5L			8	5L	0.36	
35.	4.55	Townsend	10	21.6	E,5L					0.36	
36.	4.56	Robertson	4	8.8	5L	6	216	8-9	5L	0.36	
37.	4.57	Hillward	7	15.3	E			7	E	0.36	
38.	5.22	Mühle	7	15.7	3.5L					0.38	
39.	5.48	Kronk	1	2.2	15S					0.39	Less than 1°tl
40.	5.51	Wallentinsen	7-10	15-22	E,3.5L					0.39	
41.	5.52	Minton	25	54.5	E	5"x7"	4		15S	0.39	cc
42.	5.55	Mayo	7	15.3	5L			8	5L	0.39	
43.	5.58	Louderback	6.5	14.3	5L					0.39	
44.	6.44	Kussner	4.5-11	10-24.4	E,5L					0.41	
45.	6.46	Morris	15-25	33-57	E	2-3	74-111	9	5.2L	0.41	15° gas
46.	6.47	Bohn	20-26	45-59	5L			7	5L	0.41	
47.	6.47	Weier	20-26	45-59	5L			7	5L	0.41	
48.	6.50	Maag	10	23.3	5L					0.41	
49.	6.52	Wallentinsen	6-10	13-22	E,3.5L					0.41	
50.	6.55	Mayo	8	17.8	E,5L			8	5L	0.41	
51.	6.55	Robertson	7	15.6	5L			8-9	5L	0.41	
52.	7.41	Bortle	19	58.7	5L	3	113	8	5L	0.44	1'cc
53.	7.41	Delano	5	11.3	4L	3	113		8S	0.44	1'
54.	7.42	Matuszewski	5-12	11-25	E,5L	1.5	56	9	5L	0.44	
55.	7.42	Collins	5	11.3	5L					0.44	
56.	7.43	Hughes	8	18.1	E?					0.44	
57.	7.43	Slobins	7.5	16.9	E	30	1128	7	E	0.44	
58.	7.44	Costanzo	16-22	36-51	E			8	5L	0.44	16° gas
59.	7.45	Sabia	5	11.3	E			8	10L	0.44	
60.	7.46	McEldery	15	34.2	E			2	15S	0.44	
61.	7.47	Kronk	15	34.2	E,15S					0.44	
62.	7.49	Krobusek	3	6.8	3.5L			8	3.5L	0.44	
63.	7.52	Mayo	10	22.7	E,5L			8	5L	0.44	
64.	7.55	Robertson	6	13.6	5L			8	5L	0.44	
65.	7.56	O'Hara	5	11.3	3.5L			8	3.5L	0.44	

Key to Table V: L = refractor (aperture in cms.), S = reflector (aperture in cms.), E = eye, cc = central condensation, c = condensation, nucl = nucleus.

TABLE V. COMET WEST TAIL AND COMA OBSERVATIONS (cont.)

	1976 UT	Observer	Tail (°)	$kmx10^6$	Instr	Coma (')	$kmx10^3$	DC	Instr	r	Notes
66.	Mar 7.57	Townsend	10-20	23-45	Var					0.44	10° gas
67.	8.40	Slobins	24	58.5	E	30	1146	7	7.6L	0.47	15° gas
68.	8.41	Bortle	25	61.3	5L	2	76		5L	0.47	$6x10^3$nucl c
69.	8.41	O'Meara	16	37.7	E					0.47	
70.	8.41	Delano	5	11.5	E	4	153		20S	0.47	40"c;$25x10^3$km
71.	8.43	Morris	20-28	48-70	E	3	115	9	15S	0.47	20° gas
72.	8.43	Sabia	15	35.2	23L			9	23L	0.47	
73.	8.46	Clyde	3	6.9	15S	10	382	5	15S	0.47	
74.	8.53	Capen	20	48.1	5,8L					0.47	
75.	9.19	Mühle	4	9.3	4L					0.49	
76.	9.38	O'Meara	6-20	14-50	E					0.49	Four tails
77.	9.47	West	15	36.5	3.5L					0.49	
78.	9.52	Capen	18	44.5	8L					0.50	
79.	9.52	Minton	26	64.4	E?	4"x8"	4		15L	0.50	false nucl
80.	9.54	Robertson	3	7.0	5L			8	5L	0.50	
81.	10.19	Mühle	4	9.6	4L					0.51	
82.	10.42	Kronk	7	17.0	5L					0.52	
83.	10.43	Sills	0.5	1.2	15S					0.52	
84.	10.45	Stephan	2	4.8	3.5L			7	3.5L	0.52	
85.	10.51	Capen	17	37.7	5L?					0.52	
86.	10.51	R. Capen	17	37.7	5L?					0.52	
87.	11.19	Mühle	6	14.8	4L					0.54	
88.	11.42	McEldery	10	25.2	E			8		0.55	
89.	11.44	Morris	13-20	33-54	E			9	5.2L	0.55	13° gas
90.	11.44	Sandel	3-5	7-12	15S	6"cc	4	0-1	15S	0.55	
91.	11.45	Bohn	15	39.0	5L?	10	400	7	5L	0.55	
92.	11.45	Weier	15	39.0	5L?	10	400	7	5L	0.55	
93.	11.52	Minton	20	53.9	E?	3"x6"	3		15L	0.55	false nucl
94.	12.40	Matuszewski	7-20	18-56	E,5L	5	203	8-9	5L	0.57	
95.	12.40	Slobins	30	92.9	E	30	1218	6	7.6L	0.57	
96.	12.41	Sabia	15	40.3	Var	0.1cc	4	9	23L	0.57	
97.	12.41	Bortle	26.5	78.8	5L	1.5	61		5L	0.57	2**
98.	12.41	Delano	3.5	8.8	20S	3	122	20	20S	0.57	1'cc;$4x10^3$km
99.	12.42	Porter	12	31.6	E			4	10S	0.57	
100.	12.50	Mayo	20	56.1	E			8	5L	0.57	
101.	12.53	O'Hara	2.5	6.3	3.5L?			8	6L	0.57	
102.	13.50	Mayo	20	58.3	E			8	5L	0.60	
103.	13.50	Maag	9	24.0	5L					0.60	
104.	13.53	O'Hara	3	7.8	3.5L	2.5	103	7	6L	0.60	45"cc;$3x10^4$km
105.	14.40	Bortle	10.5	29.1	5L	2	83		5L	0.62	
106.	14.42	Matuszewski	13	36.7	5L	5	209	8	5L	0.62	
107.	14.44	Simmons	8	21.8	E					0.62	two tails
108.	14.50	Maag	9.75	27.7	5L					0.63	
109.	14.53	Mayo	16	46.5	E			7	5L	0.63	
110.	14.54	Robertson	4	10.6	5L			7	5L	0.63	
111.	14.54	O'Hara	5	13.4	3.5,6L			8	6L	0.63	45"cc=$31x10^3$km
112.	15.42	Matuszewski	7.5	22.4	5L	8	338	8	5L	0.65	
113.	15.44	Gliba	4	10.9	E			8	20S	0.65	
114.	15.44	McEldery	1	2.7	E			5	15S	0.65	
115.	15.51	Wallentinsen	5-6	7-17	3.5L					0.65	
116.	15.52	O'Hara	3	8.1		0.75	32	8	6L	0.65	cc
117.	15.53	Robertson	2.5	6.8	5L			8	5L	0.65	
118.	15.54	Mayo	20	62.8	E			7	5L	0.65	
119.	16.55	Mayo	3	8.3	E,5L			7	5L	0.68	Moon
120.	17.41	McEldery	0.5	1.4	5L	1	43	3	15S	0.70	
121.	17.42	Matuszewski	2-5	6-14	E,5L	10	434	8	5L	0.70	
122.	18.35	Sabia	2.25	6.5	5L			9	15S	0.72	
123.	18.35	O'Meara	5	14.7	E					0.72	
124.	18.40	Collins	4.5	14.7	E					0.72	
125.	18.40	Bortle	5.5	16.3	5L	2.2	96		5L	0.72	
126.	18.54	Mayo	4	11.7	E,5L					0.73	
127.	19.18	Cavagna	0.5	1.4	7L	5	155		7L	0.74	
128.	19.47	Maag	2.75	8.9	5L					0.75	
129.	19.54	Mayo	10	31.2	5L			7	5L	0.75	
130.	20.39	Matuszewski	2.5	7.6	5L	7	314	7-8	5L	0.77	

TABLE V. COMET WEST TAIL AND COMA OBSERVATIONS (cont.)

	1976 UT	Observer	Tail (°)	kmx10^6	Instr	Coma (')	kmx10^3	DC	Instr	r	Notes
131.	Mar 20.40	Bortle	4	12.2	5L	3	134	7	5L	0.77	
132.	20.52	O'Hara	3	9.1	3.5L	3	135	8	5L	0.77	
133.	20.54	Mayo	15	52.0	E,5L			7	5L	0.78	
134.	21.18	Mühle	3	9.3	4L					0.79	
135.	21.18	Cavagna	0.45	1.4	7L	3.5	161	5	7L	0.79	
136.	21.38	Matuszewski	4	12.5	5L	7.5	362	6	7L	0.79	
137.	21.51	O'Hara	3	9.3	3.5,6L	4	181	6	6L	0.80	also 3.5L
138.	21.53	Mayo	15	53.4	E,5L			7	5L	0.80	
139.	22.17	Mühle	4	12.7	4L					0.81	
140.	22.39	Bortle	6.5	21.3	5L	3	137	7-8	5L	0.82	
141.	22.40	Matuszewski	1.5-5	5-16	E,5L	6	274	8	5L	0.82	
142.	22,40	Delano	2.5	7.9	20S	2.5	114		20S	0.82	3***
143.	22.41	Porter	6	19.6	15S	4	183	6	15S	0.82	
144.	22.45	McEldery	0.5	1.5	5L					0.82	
145.	22.53	Mayo	15	34.9	E,5L			7	5L	0.82	
146.	22.54	O'Hara	3	9.5	3.5L	4	183	8	3.5L	0.82	
147.	23.38	Sabia	1.5	4.8	5L			8	15S	0.84	
148.	23.38	O'Meara	6	20.0	E?					0.84	
149.	23.39	Bortle	6.5	21.8	5L	3/5	161	6?	5L	0.84	
150.	23.42	Porter	4.5	14.7	15S	4	184	7	15S	0.84	
151.	23.43	Gliba	3	9.7	E					0.84	
152.	23.51	O'Hara	3	9.7	3.5L	4	185	8-9	6L	0.84	
153.	23.53	Mayo	15.5	60.9	E,5L			7	5L	0.85	
154.	24.33	O'Meara	6	20.4	E					0.86	
155.	24.38	Matuszewski	0.75-3	2.4-9.9	E,5L	7	326	6	5L	0.86	
156.	24.40	Bortle	7	24.1	5L	4	186		5L	0.87	
157.	24.40	Sabia	4	13.3	5L					0.87	
158.	24.44	Clyde	1	3.2	5L?	10	466	5	5L?	0.87	
159.	24.44	Maag	1.25	4.0	5L					0.87	
160.	24.52	Capen	4.5	15.1	3.5L					0.87	
161.	24.53	Minton	4	13.4	E					0.87	
162.	24.53	Mayo	15	57.8	E,5L			7	5L	0.87	
163.	25.17	Cavagna	0.4	1.3	7L	3	140	1	7L	0.88	
164.	25.38	Matuszewski	2	6.6	5L	5.5	281	5-6	5L	0.89	
165.	25.39	Bortle	6	20.8	5L	3.5	164		5L	0.89	
166.	26.17	Cavagna	25'	1.4	7L	3	142	1	7L	0.91	
167.	26.37	Matuszewski	1-4	3.3-14	E,5L	10	473	7	11S	0.91	
168.	26.38	Bortle	4.5	15.6	5L	3.5	165	5-6	5L	0.91	
169.	26.40	Sabia	2	6.8	13L					0.91	
170.	26.41	McEldery	2'	0.11	20S	0.5	24	0	20S	0.91	
171.	26.44	Clyde	1	3.3	15S	10	473	5	15S	0.91	
172.	26.51	O'Hara	2	6.8	3.5L	3	142	7	6L	0.91	
173.	26.53	Mayo	3	10.3	E,5L			7	5L	0.91	
174.	27.39	Matuszewski	1-4	3.4-14	5L	5.5	262	5-6	6L	0.93	
175.	27.41	Porter	3	10.4	3.5L	3	143	4	15S	0.93	
176.	27.52	Mayo	3	10.5	5L			7	5L	0.94	
177.	28.17	Cavagna	25'	1.4	7L	3.5	168	1	7L	0.95	
178.	28.37	Bortle	5.5	20.1	5L	4	192		5L	0.96	
179.	28.45	Maag	1°50'	6.4	20S					0.96	
180.	28.47	O'Hara	1	3.5	6L	4	192	9?	6L	0.96	
181.	28.52	Mayo	3	10.6	5L			7	5L	0.96	
182.	29.17	Mühle	3	10.8	4L					0.97	
183.	29.33	O'Meara	5	18.4						0.98	
184.	29.38	Matuszewski	1-4.5	3.5-17	E,6L	8	387	6	6L	0.98	
185.	29.39	Bortle	6	22.5	5L	4	193	6-7	5L	0.98	
186.	29.39	Sabia	2	7.1	13L			9	23L	0.98	
187.	29.51	Mayo	12	49.4	E,5L			8	5L	0.98	
188.	30.16	Cavagna	34'	2.0	7L	3	146	2	7L	0.99	
189.	30.52	Mayo	12	50.4	5L			8	5L	1.00	
190.	31.16	Mühle	3	11.1	4L					1.02	
191.	31.38	Bortle	4	15.1	5L	5	245	6	5L	1.02	
192.	31.51	Minton	3	11.2	E	4	196		15S	1.02	
193.	31.52	Mayo	10	41.4	E,5L			8	5L	1.02	
194.	Apr 1.16	Cavagna	20'	1.2	7L	2.5	123	2	7L	1.04	
195.	1.16	Mühle	3	11.3	4L,15S	4	197		15S	1.04	

TABLE V. COMET WEST TAIL AND COMA OBSERVATIONS (cont.)

	1976 UT	Observer	Tail (°)	$kmx10^6$	Instr	Coma (')	$kmx10^3$	DC	Instr	r	Notes
196.	Apr 1.38	O'Meara	7	28.1	E?					1.04	
197.	2.15	Mühle	2	7.5	4L	4	198		4L	1.06	
198.	2.48	Mayo	5	19.8	5L			8	5L?	1.07	
199.	3.15	Mühle	1.7	6.5	4L					1.08	
200.	3.16	Cavagna	0.05	0.14	7L	2.5	124	2-3	7L	1.08	
201.	3.33	Simmons	3	11.7	5L	5	249	5	5L	1.08	
202.	3.43	Clyde	2	7.7	5L	10	499	4	5L	1.09	
203.	4.15	Mühle	1	3.8	4L					1.10	
204.	4.35	Kronk	0.5	1.9	5L,15S					1.11	
205.	4.43	O'Hara	2	7.8	3.5L	4	200	7	3.5L	1.11	
206.	5.36	Matuszewski	2	7.9	5L	5	252	4	5L	1.13	
207.	5.37	Bortle	5.5	22.9	5L	5	252	6	5L	1.13	
208.	5.39	Morris	3.5	14.1	5L			8	5L	1.13	
209.	5.41	McEldery	1	3.9	5L	1	52	0	15S	1.13	
210.	5.52	Mayo	3	12.1	5L			8	5L	1.13	
211.	6.37	Bortle	5.5	23.3	5L	6.9	349	6-7	5L	1.15	
212.	6.47	Wallentinsen	2	8.0	11S	5.2	263	4	11S	1.15	
213.	7.15	Cavagna	22'	1.4	7L	2	102	2	7L	1.16	
214.	7.40	Mayo	2.0	8.1	5L			8	25S	1.17	
215.	7.40	O'Meara	1.5	6.0	E					1.17	
216.	8.31	O'Meara	1.5	6.1	23L?					1.19	
217.	8.34	Matuszewski	2	8.2	5L	5	255	3	5L	1.19	
218.	8.35	Collins	1	4.1	5L					1.19	
219.	8.37	Bortle	4.5	19.3	5L	4.6	235	6	5L	1.19	
220.	8.39	Morris	3.5	14.8	5.2L			8	5.2L	1.19	
221.	8.40	Mayo	2	8.2	5L			8	25S	1.19	
222.	9.15	Cavagna	0.45	1.8	7L	2.4	123	1-2	7L	1.20	
223.	9.28	Collins	0.5	2.0	5L					1.21	
224.	9.31	Clyde	0.5	2.0	15S			2	15S	1.21	
225.	9.38	Morris	3.5	15.0	5.2L			7-8		1.21	
226.	10.32	Stephan	3	12.9	3.5L			7		1.23	
227.	10.37	Bortle	4	17.5	5L	5.3	273	6	5L	1.23	
228.	10.37	Sabia	1.5	6.3	13L			9	23L	1.23	
229.	10.38	Morris	2.5	10.7	5.2L			7	5.2L	1.23	
230.	10.38	Matuszewski	3	12.9	5L	5	257	7	5L	1.23	
231.	10.40	Mayo	2	8.5	5L			8	25S	1.23	
232.	10.40	Clyde	0.75	3.1	15S			2	15S	1.23	
233.	11.34	Collins	0.5	2.1	4L					1.25	
234.	12.13	Mühle	1	4.2	4L					1.26	
235.	12.30	Kronk	10'	0.7	15S					1.27	
236.	12.37	Bortle	3	6.4	5L	3.8	249	5-6	5L	1.27	
237.	12.38	Matuszewski	2.5	10.9	5L	5	259	4	5L	1.27	
238.	13.37	Bortle	1.5	6.5	5L	4.8	250	5-6	5L	1.29	
239.	13.41	Clyde	0.25	1.1	15S	5	260	2	15S	1.29	
240.	14.38	O'Meara	2.5	11.2						1.31	
241.	14.39	Mayo	1	4.4	5L			8	25S	1.31	
242.	15.38	O'Meara	2.5	11.3	E?					1.33	
243.	16.39	Mayo	1	4.5	5L			8	25S	1.35	
244.	17.35	Bortle	0.6	1.9	5L	5.5	290	5	5L	1.37	
245.	18.14	Cavagna				3	158	1	7L	1.38	
246.	18.35	Collins	0.25	1.1	12L					1.39	
247.	18.39	Green	40'	3.0	5L			1	20S	1.39	
248.	19.32	Clyde	10'	0.7	15S	5	265	4	15S	1.40	
249.	20.34	Collins	0.6	1.9	12L					1.42	
250.	20.39	Mayo	2	9.6	5L			8	20S	1.42	
251.	22.13	Cavagna	0.2	0.9	7L	3	160	1-2	7L	1.46	
252.	23.31	Bortle	2.3	11.2	5L	4	214	5	5L	1.48	
253.	23.32	Matuszewski	1	4.9	5L	10	535	3	5L	1.48	
254.	23.38	Clyde	20'	1.6	5L?	5	268	1	5L?	1.48	
255.	23.38	McEldery				1.6	86	0	15S	1.48	
256.	24.29	O'Meara	1	4.9	6L					1.50	
257.	24.29	Bortle	2	10.0	5L	4	214	6	5L	1.50	
258.	24.33	Matuszewski	1	4.9	5L	8	428	4	5L	1.50	
259.	26.23	Kronk	0.5	2.5	15S					1.53	
260.	27.12	Cavagna	0.3	1.5	7L	3.5	189	3-4	7L	1.55	

TABLE V. COMET WEST TAIL AND COMA OBSERVATIONS (cont.)

	1976 UT	Observer	Tail (°)	kmx10^6	Instr	Coma (')	kmx10^3	DC	Instr	r	Notes
261.	Apr 29.39	Morris	2	10.8	5L			4	5L	1.59	
262.	30.26	Kronk	0.5	2.6	5L					1.61	
263.	30.29	Bortle	1.8	9.8	5L	7.5	407	5	5L	1.61	
264.	May 1.06	Mühle	25'	2.2	8,23L	4	217		8L	1.62	also 23L
265.	1.09	Cavagna	29'	2.6	7L	4	217	2-3	7L	1.62	
266.	1.25	O'Meara	0.5	2.7	23L?					1.62	
267.	2.01	Mühle	1	5.5	5L,15S					1.64	
268.	3.12	Cavagna				4	218	2	7L	1.66	
269.	5.28	Bortle	1.7	9.9	5L	5.6	307	4	5L	1.70	
270.	7.68	Jones	0.25	1.5	8L					1.74	
271.	8.03	Mühle				2	110		15S	1.74	
272.	8.07	Cavagna	22'	2.1	7L	3.7	204	2-3	7L	1.74	
273.	8.29	Stephan	0.5	2.9	15S			2	15S	1.75	
274.	9.25	O'Meara	0.5	3.0	23L					1.76	
275.	9.70	Jones	50'	5.1	32S					1.77	
276.	May 10.72	Jones	0.5	3.1	32S					1.79	
277.	11.33	Bortle	0.8	5.0	5L	6	330		5L	1.80	
278.	13.32	Bortle	0.7	4.5	5L	6	334	4-5	5L	1.83	
279.	14.06	Cavagna				3.5	195	2	7L	1.85	
280.	19.16	Kronk	0.05	0.4	8L,15S					1.93	
281.	21.26	Bortle	0.4	3.0	5L	5.3	302	4?	5L	1.97	
282.	23.08	Cavagna	0.3	2.3	7L	4	229	2	7L	2.00	
283.	23.26	Bortle	0.8	6.3	5L	7.0	402	3?	5L	2.00	
284.	23.27	Morris	1.5	12.1	5L	10	574	5	5L	2.00	
285.	24.26	Bortle	0.6	4.8	5L	6.8	392	4-5	5L	2.02	
286.	24.27	Morris	1	8.1	5L	8	461		5L	2.02	
287.	25.17	Kronk	7'	0.9	8L,15S					2.03	
288.	28.27	Bortle	0.5	4.4	5L	7.2	421	4-5	5L	2.08	
289.	Jun 1.03	Cavagna	20'	3.2	7L	3	179	1	7L	2.14	
290.	3.21	Kronk	10'	1.7	15S	4	241		15S	2.17	
291.	4.28	Morris	0.5	5.3	5L	15	908	3	5L	2.19	
292.	5.27	Bortle	0.5	5.5	5L	8.5	517	5	5L	2.21	
293.	5.30	Matuszewski				3	183	0-1	11S	2.21	
294.	6.14	Sabia				4	245	1	32S	2.22	
295.	6.22	Kronk				2	122		15S	2.22	
296.	8.04	Cavagna				3.5	217	1	7L	2.25	
297.	17.19	Kronk				2	132		15S	2.39	
298.	20.91	Cavagna	20'	5.5	7L	3.8	258		7L	2.45	
299.	21.12	Bortle				12	816	3	5L	2.45	
300.	22.16	Kronk				2	137		15S	2.47	
301.	23.14	Bortle	0.4	7.0	5L	12	830	3	5L	2.48	
302.	27.13	Bortle	0.25	4.6	5L	17	215	3	5L	2.54	
303.	27.14	Morris				10x16	[717x1146]	0	15S	2.54	
304.	27.23	Sabia				29	2072	3	20S	2.54	
305.	28.09	Matuszewski				2	145	0-1	11S	2.55	
306.	28.13	Bortle	10'	3.1	5L	12	868	3	5L	2.55	
307.	28.14	Morris				9	651	0	15S	2.55	
308.	Jul 1.17	Morris				10	744	0	15S	2.60	
309.	2.22	Green	7'	2.3	20S	7	526	2	20S	2.61	
310.	3.15	Bortle	0.2	4.0	5L	9.6	727	3	5L	2.63	2'cc
311.	3.21	Morris				11	834	0	15S	2.63	
312.	3.23	Sabia				25	1918	0	23L	2.63	
313.	3.48	Jones				2	152		32S	2.63	
314.	4.21	Morris				15	1148	0	5L	2.64	
315.	5.25	Bortle	20'	6.8	5L	11.5	889	2	5L	2.66	
316.	5.27	Morris				20	1547	1	5L	2.66	
317.	6.26	Bortle	0.2	4.1	5L	9.6	750	2	5L	2.67	
318.	6.28	Morris				10x15	[781x1172]	1	5L	2.67	
319.	16.11	Bortle				4	345	1-2	32S	2.81	
320.	18.10	Bortle				11	968		5L	2.84	

TABLE V. COMET WEST TAIL AND COMA OBSERVATIONS (cont.)

1976		UT	Observer	Tail (°)	kmx10^6	Instr	Coma (')	kmx10^3	DC	Instr	r	Notes
321.	Jul	18.10	Bortle	8'	2.8	32S	5.5	484	2-3	32S	2.84	
322.		18.18	Morris				15	1321	0	15S	2.84	
323.		19.10	Bortle				8.6	764		5L	2.85	
324.		19.10	Bortle	0.2	4.3	32S	6.1	542	2	32S	2.85	
325.		19.16	Morris				15x20	[1334x1779]		15S	2.85	DC=2
326.		19.43	Jones				2	178		32S	2.86	
327.		23.10	Bortle				11	1019		5L	2.91	
328.		23.10	Bortle	0.2	4.3	32S	4	371	2	32S	2.91	
329.		25.22	Morris				15	1420	0	5L	2.94	
330.		26.10	Bortle				10	955		5L	2.95	
331.		26.10	Bortle	10'	3.6	32S	6.7	640	1-2	32S	2.95	
332.		26.18	Morris				10x20	[956x1912]	1	5L	2.95	
333.		27.10	Bortle				13	1255		5L	2.96	
334.		27.10	Bortle	11'	4.0	32S	10	965	1-2	32S	2.96	
335.		27.15	Morris				7x20	[713x1932]	3	5L	2.96	
336.	Aug	2.19	Morris				8x20	[821x2053]	3	15S	3.04	
337.		3.17	Bortle				4.3	446	0	32S	3.06	
338.		3.18	Morris				10x15	[1037x1555]		15S	3.06	DC=1
339.		4.22	Morris				6x10	[629x1048]	0	15S	3.07	
340.		17.12	Bortle				4	475	0	32S	3.24	
341.		18.07	Bortle				5.5	660	0	32S	3.26	
342.		25.09	Bortle				2.5	320	0	32S	3.35	

NOTES: 1* 32S, cc 10"-15", 6-9X10^3 kms.
2** 80"X50" cc 61X38X10^3 kms.
3*** 32S, 5" nucl c, 3X10^3 kms.

(Text continued from page 156.)

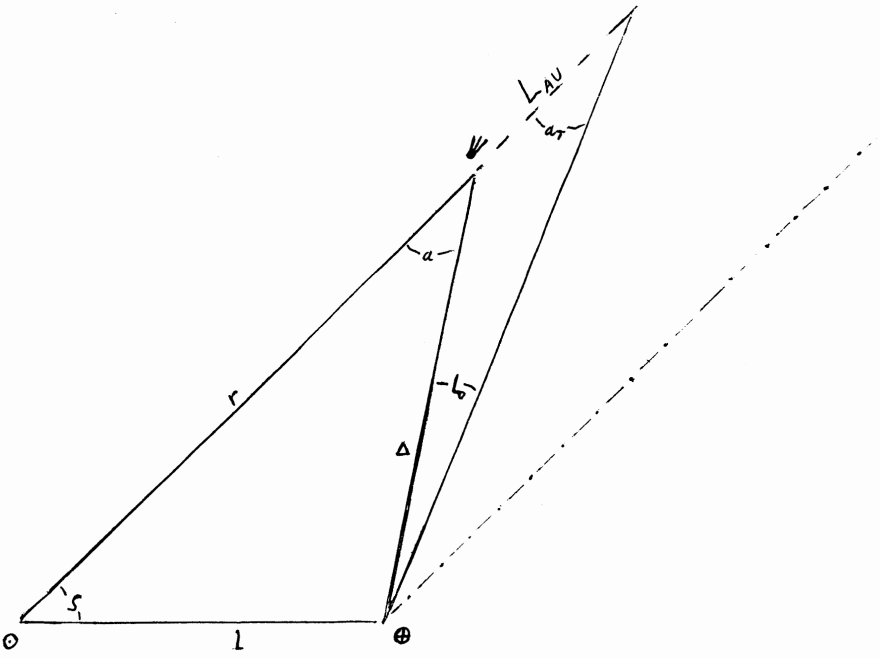
However, in late March Bortle did see two tails, ranging from 4 to 7 degrees in length. The first tail, around PA's 280°-290°, was usually straight, narrow, and the brighter of the pair. The second tail was broad and diffuse--approximately half as wide at its terminus as it was long--and curved to the north in PA's 300°-320°. On the 28th, he saw a "dull, pale orange!" color in the tail system with 20X80 binoculars. Porter also observed two tails--gas in PA 275° and a 3° dust tail in PA 286° (March 27.41).

During April and May the tail retained much the same basic form, though fainter and smaller. Morris remarked that the 3.5 degree tail on April 5 curved strongly to the north as in early March but was much fainter. There were some indications of streamers in the tail, and it was 20' wide at maximum. I saw a 2° long, 25° PA fan centered on 290° with the southern edge the better defined (11-cm. reflector, April 6.47). On May 2.09 Muehle could still see 1° of tail in 7X50 binoculars. The PA was 255 degrees. Jones on the 10th saw a 30' tail pointing due west, which he described as "faint, wispy, diffuse, broad" in a 32-cm. reflector at 86X.

By late May many observers could no longer see a tail on the 8th magnitude comet. Tail and diffuse coma were becoming indistinguishable. Morris reported what was probably such a feature on June 27.14 in a 15-cm. reflector at 24X. The feature was short, 10' long, white and straight in PA 266°. However, on the 28th Morris saw no tail but noted an elongation in the coma along PA's 90°-270°: "The exact shape was very difficult to determine." Dan Green also had the same situation on July 2.22, when he saw a 7' fanned "tail." Bortle was reporting comparable tail and coma scales from late June until his last tail observation in late July (11', PA 330°, July 27.10, 32-cm.), usually in westward PA's, again possibly indicating an elongated coma rather than a "tail." It is significant to note that PA's from mid-May through the last observations are the only ones in substantial disagreement with the predicted PA's.

Table V gives the observed angular and true tail lengths. True lengths are mostly based on TL quantities from the A.L.P.O. ephemeris (see Marsden, 1975 for elements). Incidentally, these TL coefficients (millions of kms. per degree of observed tail, though some of the A.L.P.O. ephemerides, including the one for Comet West, commit metric sin by using miles) are based on the following McCants formula (Milon, 1965a, 1969):

$$L_{AU} = L_o 0.017\Delta \left[1 - \frac{(r^2+\Delta^2-1)^2}{(2r\Delta)^2}\right]^{-0.5},$$



$$L_{AU} \sim L_o \, 0.017 \Delta \left[1 - \frac{(r^2 - \Delta^2 - 1)^2}{(2r\Delta)^2} \right]^{-\frac{1}{2}} \quad \text{(McCants)}$$

$$L_{AU} \sim \Delta \frac{\sin L_o}{\sin a}$$

$$L_{AU} = \Delta \frac{\sin L_o}{\sin (a - L_o)}$$

Figure 15. Diagram and notes to indicate development of McCants Formula and other relations for computing the length of the tail of a comet. Contributed by Derek Wallentinsen.

which is in practice virtually the same as:

$$L_{AU} = \Delta \sin L_o / \sin a, \qquad (1)$$

where L_{AU} is the actual length in astronomical units, L_o the observed length in degrees, and a is the solar phase angle (the angle between the Earth and the Sun as seen from the comet). The tail is assumed to be directed along the radius vector away from the Sun in the comet-Earth-Sun plane. It should be pointed out that the above formulae are approximations to the correct formula, which is:

$$L_{AU} = \Delta \sin L_o / \sin (a - L_o). \qquad (2)$$

It is seen that when L_o is large and/or large relative to a, significant error can arise in equation (1). Thus, equation (2) has been applied to certain of the longer apparent tails. It would be convenient to include angle a in future A.L.P.O. ephemerides whenever the comet may be expected to have a long tail. The same phase angle is also useful in the measurement and reduction of other cometary physical properties.

(to be continued)

BOOK REVIEWS

Discovering Astronomy, by Wm. H. Jeffreys and R. Robert Robbins, John Wiley & Sons, Inc., Somerset, N.J. 1981. 466 pages. Price $25.95.

Reviewed by Terry E. Schmidt, University of Colorado, Colorado Springs and Tiara Observatory

This book is intended as a two-semester text for college students with limited or no mathematical background. The text starts off with explanations of fundamental observing techniques and the relationships associated with them. The authors then move from Solar System astronomy through stellar astronomy. Indoor and outdoor activities are sprinkled throughout the book with each chapter ending with a short review with a listing of objectives that should have been learned. The hands-on approach to the subject matter is stressed with various experiments emphasized. Each chapter contains a series of questions interspersed throughout the text which are expected to be answerable by reading the entire text. Answers to selected questions are given at the end of the chapter. I found this question sprinkling throughout the chapters rather distracting and not really serving a distinct purpose. This opinion may be personal bias, but I feel that the text should illuminate itself and not be subservient to a distracting theme. I also found the text to be rather dry and lacking in any form of an imaginative approach. Many concepts could have been explained better or in more detail to fledgling students. Erroneous concepts are often presented as if taken from other sources without checking for accuracy or updating due to modern findings. An example can be found on page 113 when reference is made to how a meteor shines in the sky when "friction with the air heats it to a high temperature." This type of concept went out with high button shoes as did the idea that the aurora was the reflection of the polar ice caps. Excitation of the rarefied gases by the bow shock wave of the meteoroid body should have been presented. I find that college students bore easily if not motivated by strong, imaginative material. This responsibility should not fall solely upon the teacher. The text should be a constructive aid which acts as a base for the learning experience.

Mathematics has been kept to a minimum but is employed to advantage when its application alone best uncovers or reveals the answer to the questions. Ratios frequently are used to provide quantitative comparisons which greatly aid the visualizations for the student. Simple arithmetic is used at all times.

The cornerstone of the book may prove to be its undoing. The authors stress direct observations by the students as a focus for the learning experience. The major problem with this approach is that the weather rarely cooperates with the textbook schedule. This unsynchronized routine in time would tend to confuse and frustrate the student. Even though the authors say to delete observations whenever prudent to do so, the emphasis is still there and is hard to undo. A double standard then exists.

I would recommend this book to the university professor as a supplemental aid to teaching, but I feel the book's rhythm, timing, and style make it unsuitable as a course text. The approach to the subject is sometimes unique but is very difficult to implement. High school and junior high teachers will also find this book a useful reference work. I am assuming prior knowledge of the subject when I say this.

* * * * *

A New List of 450 Deep-Sky Objects for Amateur Telescopes, by Fred W. Klein. Published by Fred W. Klein, Hawaii Volcano Observatory, Hawaii Volcanoes National Park, HI 96718. 1981. 31 pages. Price $6.75.

Reviewed by Don Machholz

There is more to this large-format booklet than the title would indicate. Here the author compiles, from other published sources, a list of 450 astronomical objects down to -62° declination. Included are double and multiple stars, red stars, open and globular star clusters, planetary, gaseous, and dark nebulae, and galaxies.

The author gives much detailed information for each object. He lists: the object's name or number, the constellation it's in, type of object, R.A. and Dec. for both 1950 and 2000, the magnitude, size, the maps on which it is found (using the "Tirion" and the "Atlas of the Heavens" series), his impression of the object, space for you to write your impressions, and something known as "visibility" of the object. This last item is most interesting and helpful; for each extended object he has graphed the stellar magnitude vs. size to determine the surface brightness. The higher the surface brightness, the easier it is (theoretically) to see, and the higher the "visibility" rating. (One minor problem with this visibility rating is that a diffuse object of a given rating would be a bit harder to see than a condensed object of a similar rating.) Usually, however, this should not present much of a problem. For double stars the visibility rating depends upon magnitude difference between the stars and separation.

For his impressions of each object he used an 8", f/10 telescope. He assigned to each object a letter (A, B, C, D, or F) to indicate how it appeared to him--or if it appeared at all.

Following eight pages of adequate introduction and explanations with graphs and formulae, there follow computer printout lists of the objects. The first list is of all 450 objects in order of Right Ascension. Next the objects are repeated, but grouped according to class. In each class the objects are ordered by visibility rating, from easiest to the most difficult. Finally, the author lists 187 objects under the heading "List of the Best Objects."

Exactly how many objects of each class are involved? His 450 objects consist of:

119 galaxies,
67 open clusters,
37 globular clusters,
30 gaseous nebulae,
6 dark nebulae,
47 planetary nebulae,
43 equal-magnitude double stars,
48 double stars,
22 multiple stars,
24 colored double stars, and
7 red stars.

All in all, this 31-page booklet is quite handy. The beginner can use it to discover which types of objects to start with. The advanced amateur can use it as a checklist of observable objects. The "armchair" astronomer can use it as a comparison reference in conjunction with other lists which have surfaced in recent years. This list is one of the best.

NEW BOOKS RECEIVED

By: J. Russell Smith and Gail O. Clark

Galaxtic X-ray Sources, edited by Peter W. Sanford, Paul Laskarides, and Jane Salton. John Wiley and Sons, Inc., 605 3rd Avenue, New York, N.Y. 10158. 1982. 450 pages. Hardbound. Price $45.00. Notes by J. Russell Smith.

This book is definitely not for the beginner. It is based on the Proceedings of the NATO Advanced Study Institute on Galactic X-Ray Sources held in Greece.

Part 1 is X-ray Binary Stars, Part 2 is X-ray Pulsars and the Physics of Accreting Material, Part 3 is Soft X-ray and UV Measurements of Stars and Nebulae, Part 4 is Globular Clusters and Burst Sources, and Part 5 is Recent Results. Part 5 is followed by a Subject Index and a Source Index, which make the book a handy reference.

* * * * *

The Friendly Stars, by Martha Evans Martin. Revised Edition by Don Rice and Dr. Craig Foltz. Van Nostrand Reinhold, 135 West 50th Street, New York, N.Y. 10020. 140 pages. 1982. Softbound. Price$7.95. Notes by J. Russell Smith.

The authors of this elementary text devote a few pages to each of the following subjects: "The Rising and Setting of the Stars", "Concerning the Brightness of Stars", "Capella", "Arcturus", "Spica", "Vega", "Deneb", "Altair", "Fomalhaut", "Aldebaran", "Orion's Bright Stars", "The Heavenly Twins", "The Dog Stars", "The Number of the Stars", "The Names of the Stars", "The Light of the Stars", "The Distance of the Stars", "Double Stars", "The Constellations", "The Little Bear and Polaris", "The Great Bear and the Seven Stars of the Dipper", "Cassiopeia, Cepheus, and the Dragon", "From the Hunting Dogs to the Arrow", "From the Winged Horse to the Bull", "The Mystery of the Pleiades", "From the Twins Back to the Hunter", "Constellations Wholly or in Part South of the Equator", "Individuality of the Stars", and the Index.

* * * * *

Galaxies, by Timothy Ferris. Stewart,Tabori, and Chang, Publishers, 300 Park Avenue South, New York, N.Y. 10010. 192 pages. Size 9.75 X 10 inches. 1982. Paperbound $16.95. Clothbound $27.50. Notes by J. Russell Smith.

If you are interested in the galaxies, here is the book for you. It could have been called "A Picture Book of the Galaxies" because it is so well illustrated with excellent photographs made with large telescopes.

After an "Introduction", the author treats his subject with the following chapters: "The Milky Way: A Spiral Galaxy Viewed From Within", "The Local Group of Galaxies", "The Form and Variety of Galaxies", "Interacting Galaxies", "Clusters and Galaxies", and "Galaxies and the Universe".

The photographs are so well reproduced that one is tempted to remove some of them for framing.

The final pages of the book contain a selected bibliography, a list of periodicals and textbooks, a list of atlases and catalogues, a suitable glossary, and an Index.

* * * * *

Searching Between the Stars, by Lyman Spitzer, Jr. Yale University Press, New Haven, CT. 179 pages, 1982. Price $25.00, hardbound. Notes by Gail O. Clark.

Up to date, occasionally semi-technical, and written in an authoritative manner, this volume brings together at a popular level the latest extant knowledge about the near-emptiness of interstellar space. The author, a leading authority on interstellar matter, draws upon his extensive knowledge to provide a crisp, readable account of this fascinating topic.

* * * * *

Amateur Astronomer's Handbook, Fourth Edition, by J. B. Sidgwick, revised by James Muriden. Enslow Publishers, Hillside, N.J. 07205. 1980. 568 pages. Numerous line drawings. Price $7.95. Notes by J. Russell Smith.

This is a paperback of the fourth edition, which was published in 1980. As the title indicates, this book contains much of what the amateur needs to know; and he will find it informative and useful. It deserves a place on his bookshelf. An excellent review of the fourth edition was published on page 255 of The Journal of the A.L.P.O., Volume 28, Numbers 11-12, published March, 1981.

SOME CURRENT EVENTS ON JUPITER

This article has been composed from notes and sketches contributed by Mr. Randy Tatum, an A.L.P.O. Assistant Jupiter Recorder, and Mr. Jose Olivarez, a long-time active observer of the Giant Planet. Material was also contributed by Mr. Phillip Budine, an A.L.P.O. Jupiter Recorder. These notes are in no way intended to take the place of the more comprehensive Jupiter Report which will eventually appear. However, they can deal with some current Jovian phenomena. Readers are encouraged to monitor the events described during the brief remainder of the current 1981-82 apparition and also, if possible, when Jupiter appears in the morning sky late in the year after conjunction with the Sun.

Readers not familiar with the terminology of the belts and zones of Jupiter are invited to refer to Figure 11 on page 97 of Journal A.L.P.O., Vol. 29, Nos. 5-6.

What appears to be a minor South Equatorial Belt Disturbance was observed in April, 1982. Activity was first noted by Phillip W. Budine and Benjamin P. Vandermark on April 15, when both observed a dark festoon in the South Equatorial Belt Zone (SEB Z) near longitude (II) 108°. Early observations of this SEB activity were also carried out by Geoff McNamara and Rob Robotham. Budine has found periods of $9^h55^m11^s$ and $9^h54^m58^s$ for two of the dark features. As recently as July 3, 1982 Tatum observed a bright SEB Z white oval at 108° (II).

Observers continue to follow activity in the South Tropical Zone (STrZ). An STrZ Disturbance has been observed since late 1978. The preceding end was at longitude 90° (II) on June 9. The following end was at 280° (II) on May 10. During the 1981-82 apparition only the ends of the Disturbance have been visible. The preceding end has been rotating with a period of $9^h55^m36^s$; the following end, $9^h55^m39^s$. Observers should watch for projections from the south edge of the SEB and for shaded areas and white ovals in the STrZ.

The Red Spot in 1981-82 has been readily visible but not dark nor colorful. The rim of the Red Spot Hollow is a more conspicuous feature. Dark, thick shoulders on both sides of the Hollow appear to touch both ends of the Red Spot. The centers of the Red Spot and Red Spot Hollow lie at 51° (II).

The long-enduring South Temperate Zone north white ovals continue to exist. $STeZ_n$ Oval DE is the most conspicuous of the three, and its center was at 271° (II) on June 3. Oval BC, the second brightest, was at 152° (II) on June 2. The South Temperate Belt darkens following BC. Oval FA was at 40° (II) on June 11. A large telescope and good seeing have been necessary to perceive FA. The $STeZ_n$ ovals are about 10° long in longitude.

During the 1981-82 apparition the South Equatorial Belt has been much darker and more colorful than the North Equatorial Belt. The Equatorial Zone is wide and bright. The activity along the south edge of the North Equatorial Belt has usually been low. (Often this latitudinal current is the most active one on Jupiter.)

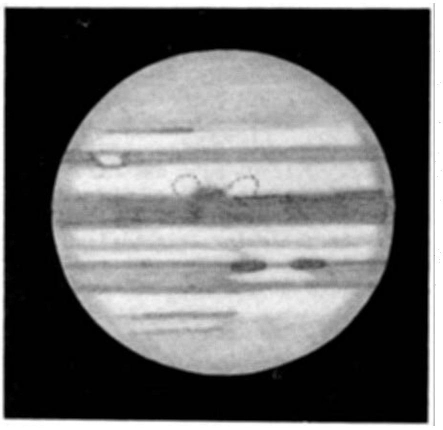


Figure 16. Drawing of Jupiter by Jose Olivarez on July 4, 1982 at 3^h45^m, U.T. 8-inch reflector, 179X. Seeing 6 (scale of 0 to 10 with 10 best). Transparency 5 (scale of 1 to 5 with 5 best). CM(I)=166°. CM(II)=301°. Note hump on SEB_s and two white ovals on either side of it, $STeZ_s$ oval DE, and two dark rods on NEB_s. Simply inverted image.

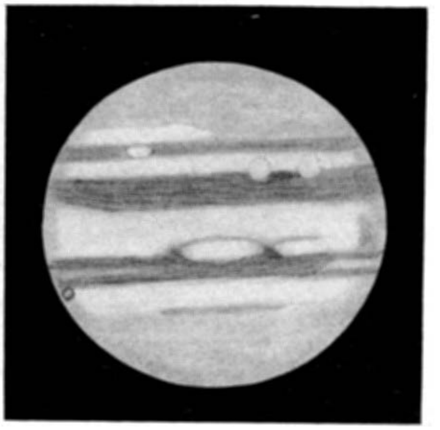


Figure 17. Drawing of Jupiter by Jose Olivarez on June 29, 1982 at 2^h48^m, U.T. 6-inch Maksutov, 245X. Seeing 5-7. Transparency 4. CM(I)=63°. CM(II)=236°. Note: Image has south at top but is reversed right for left. Note two bright notches on south edge of SEB, Oval DE, and Jupiter I just beginning to transit.

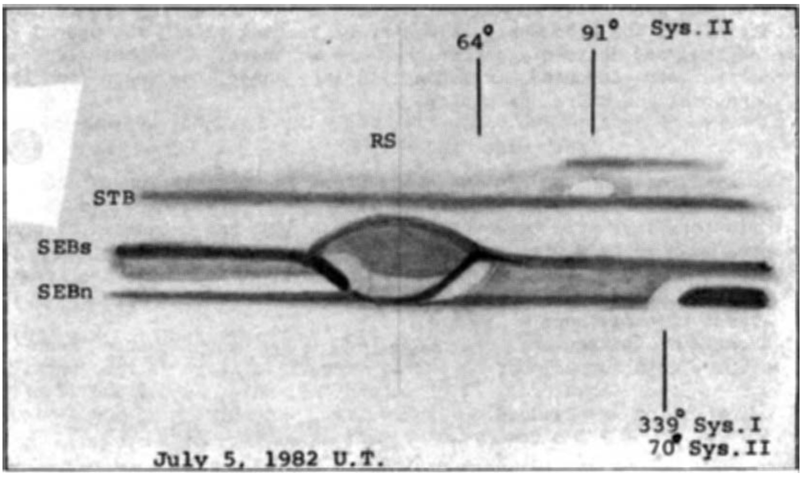


Figure 18. Sketch of Red Spot and its vicinity on Jupiter by Jose Olivarez on July 5, 1982 at 3^h0^m, U.T. Seeing 5. Transparency 5. 10-inch reflector, 255X. Note detail within Red Spot oval. Dusky material within RS ellipse pink in color. SEB_s preceding RS ellipse the darkest belt. Following end of RS ellipse very dark.

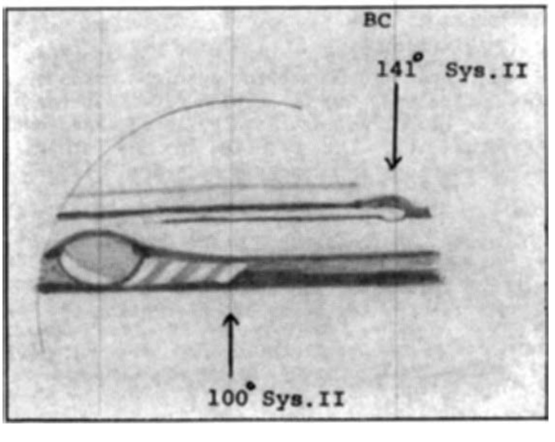


Figure 19 (left). Red Spot, $STeZ_n$ Oval BC, and neighboring features on Jupiter. Sketch by Jose Olivarez on July 15, 1982, 2^h0^m-3^h0^m, U.T. 10-inch reflector, 170X. Seeing 2-4. Transparency 3. Note dark spot at each end of RS oval. SEB Z dusky matter appears to be clearing up following RS.

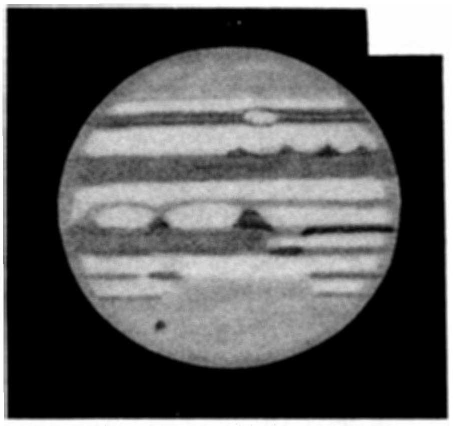


Figure 20 (left). Drawing of Jupiter by Jose Olivarez on July 16, 1982 at 2^h10^m, U.T., 10-inch reflector, 170X. Seeing 6. Transparency 3. CM (I) = 202°. CM (II) = 246°. Simply inverted image. Dark spot in North Polar Region is Jupiter III (Ganymede) in transit. North Temperate Belt and North North Temperate Belt present only in fragments. $STeZ_n$ Oval DE near central meridian. Four projections on south edge of SEB_s. The darkest features on Jupiter were a section of the NEB_s near the following (right) limb, the large projection from the NEB_s near the C.M., and a small section of the NEB_n following that projection.

PHOTOELECTRIC PHOTOMETRY OF THE JULY 6, 1982, TOTAL LUNAR ECLIPSE

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

Introduction

The July 6, 1982, total lunar eclipse was exceptional in several ways. Some aspects were predictable, such as a near-central passage through the umbra, an exceptionally long totality duration of 1 hour, 46 minutes, and, less certainly, an unusually dark totality due to volcanic dust in the Earth's upper atmosphere. These predictions were borne out, although the eclipse was definitely not pitch black as some newspaper accounts predicted!* What was not predicted was the pronounced asymmetry of shading within the umbra, with the northern portion of the Moon decidedly darker than the southern. The photoelectric observations summarized here describe, in a quantitative manner, the degree and the distribution of penumbral and umbral darkening.

Instruments and Methods

The observing site, east of the Sierra Nevada crest at an elevation of 1604 meters, had exceptionally clear skies the night of this eclipse, with a limiting visual magnitude of about +6.5 at mid-totality. The telescope used was a 35.6-cm. catadioptic, normally at f/11, but stopped down to f/28 with an off-axis diaphragm during the brighter portions of the eclipse (before 5:49 and after 9:03 U.T.). An Optec SSP photoelectric photometer was used, with a 0.5-mm. aperture (26.1 arc-seconds with this telescope) and a V filter with a peak 75-percent transmittance at 5550 Å.

Three bright craters, Anaxagoras, Copernicus, and Tycho, were measured repeatedly throughout the eclipse, with comparisons to nearly comparison stars as time permitted. In all 29 measures were made of Anaxagoras, 28 of Copernicus, 34 of Tycho, and 17 of comparison stars. The observing period was 04:36.8 - 10:25.6 U.T., with timing to a 0.1-minute accuracy.

During the course of the eclipse, several comparison stars were used, the choice depending on the Moon's brightness and its proximity to the star. Table 1 lists the stars so used.

In the reduction of measurements, readings made when the craters were outside the penumbra were used to calibrate readings made when they were in the penumbra or the umbra so that results are expressed in terms of the magnitude reduction as compared to full sunlight.

Sources of Error

Probably the most serious source of error was inaccurate centering of the aperture on the crater, which was often the case for Anaxagoras (surrounded by a bright ray system). When they were in the umbra but near its edge, glare made identification difficult for all three craters. Due to their faintness in the umbra, Anaxagoras and (to a lesser extent) Copernicus were difficult to locate throughout totality. This resulted in some data gaps during totality, and some scatter among the observations which were made, particularly when within the umbra.

A second problem was the low altitude of the Moon (the range of air mass was 2.22 - 5.33). Fortunately, the altitude difference between the comparison stars and the Moon never exceeded 2°7, and was usually 1° - 2°. An approximate extinction coefficient of 0.20 m_v/ unit air mass (determined previously for this site) was used, with a maximum extinction correction of 0.14 stellar magnitudes (at the beginning of observation), uncertain by perhaps ± 0.03 magnitudes.

*The writer estimated the Danjon luminosity as 1.5 to 2 near mid-totality (7:31 U.T.), using 11X80 binoculars.

Table 1. Photometric Comparison Stars, Total Lunar Eclipse, 6 July, 1982.

Star and Period[a]	Visual Mag.[b]	Focal Ratio	U.T.	Star Altitude	Lunar Altitude	Star Reading[c]
ξ^2 Sgr (04:36.8 - 04:52.7)	+3.50	f/28	04:36.8	12°6	10°8	0.84
	"	"	04:46.8	14.1	12.2	0.87
π Sgr (04:54.2 - 05:48.7)	+2.89	f/28	05:01.7	14°5	14°1	1.40
	"	"	05:18.4	16.8	16.1	1.70
	"	"	05:32.5	18.6	17.7	1.80
	"	"	05:44.9	20.0	19.0	1.40
π Sgr (05:54.6 - 06:17.3	+2.89	f/11	05:54.6	21°1	20°0	17.5
	"	"	06:03.8	22.1	20.9	23.0
	"	"	06:14.1	23.2	21.8	24.5
ν^2 Sgr (06:26.7 - 08:54.5)	+4.99	f/11	06:26.7	24°0	22°8	3.2
	"	"	07:00.5	26.2	25.0	3.2
	"	"	07:28.3	27.3	26.2	3.0
	"	"	07:55.3	27.7	26.8	3.0
	"	"	08:24.4	27.4	26.7	3.2
π Sgr (09:03.1 - 10:25.6)	+2.89	f/28	09:03.1	28°2	25°5	2.3
	"	"	09:32.3	26.6	23.9	2.4
	"	"	10:25.6	21.9	19.3	2.1

[a] Period during which star readings were interpolated to reduce lunar readings.

[b] From: Blanco, V.M.; Demers, S.; Douglass, G.G.; & Fitzgerald, M.P. Photoelectric Catalog. Magnitudes and Colors of Stars in the U, B, V and Uc, B, V Systems. Publications of the United States Naval Observatory, 2nd. Ser. Vol. XXI. Washington, D.C.: U.S. G.P.O., 1968. (Note that the Arizona-Tonantzintla Catalog gives ξ^2 Sgr as +3.49 and π Sgr as +2.87 .)

[c] Arbitrary units; sky background subtracted.

The third source of error was "drift" in the photometer, combined with the relatively infrequent measurement of comparison stars. This source may have caused errors of the order of 0.1 stellar magnitudes, or even 0.2 magnitudes in extreme cases.

In conclusion, total errors of as much as ± 0.2 stellar magnitudes may have occurred near the beginning of the eclipse, while the general level of error is probably in the range of ± 0.05-0.10 magnitudes.

Results

Although the accuracy of these results if low when compared with that of "normal" stellar photometry, it is high when compared with the gross brightness changes which occurred during this eclipse; and thus several conclusions can be made.

Figure 21 maps the photometric results, expressed in terms of visual magnitude reduction relative to full sunlight, with positions in arc-minutes N-S and E-W of the umbral center. The light fall-off in the penumbra appears to fit the expected regular pattern predicted by simple geometry. The umbral darkness, however, was decidedly asymmetrical, with the northern portion of the Moon much darker than the southern. Rounding to 0.1 visual magnitudes, the maximum magnitude reduction experienced by Tycho was 12.4 magnitudes (1.10 X 10^{-5} of full sunlight), by Copernicus, 13.6 magnitudes (3.63 X 10^{-6} and note that Copernicus passed only 0.12 arc-minutes south of the umbral center), and by Anaxagoras, 14.9 magnitudes (1.10 X 10^{-6}). Hence, the center of the Moon was only about 33 percent, and the northern limb only 10 percent, as bright as the southern limb. This implies the existence of a considerable amount of obscuring matter in the upper atmosphere of the northern hemisphere of the Earth. An approximate numerical integration gives the mean visual dimming of the entire Moon as 13.1 magnitudes (5.73 X 10^{-6}), implying an apparent lunar magnitude of + 0.5 (+ 0.4 when reduced to mean distance).

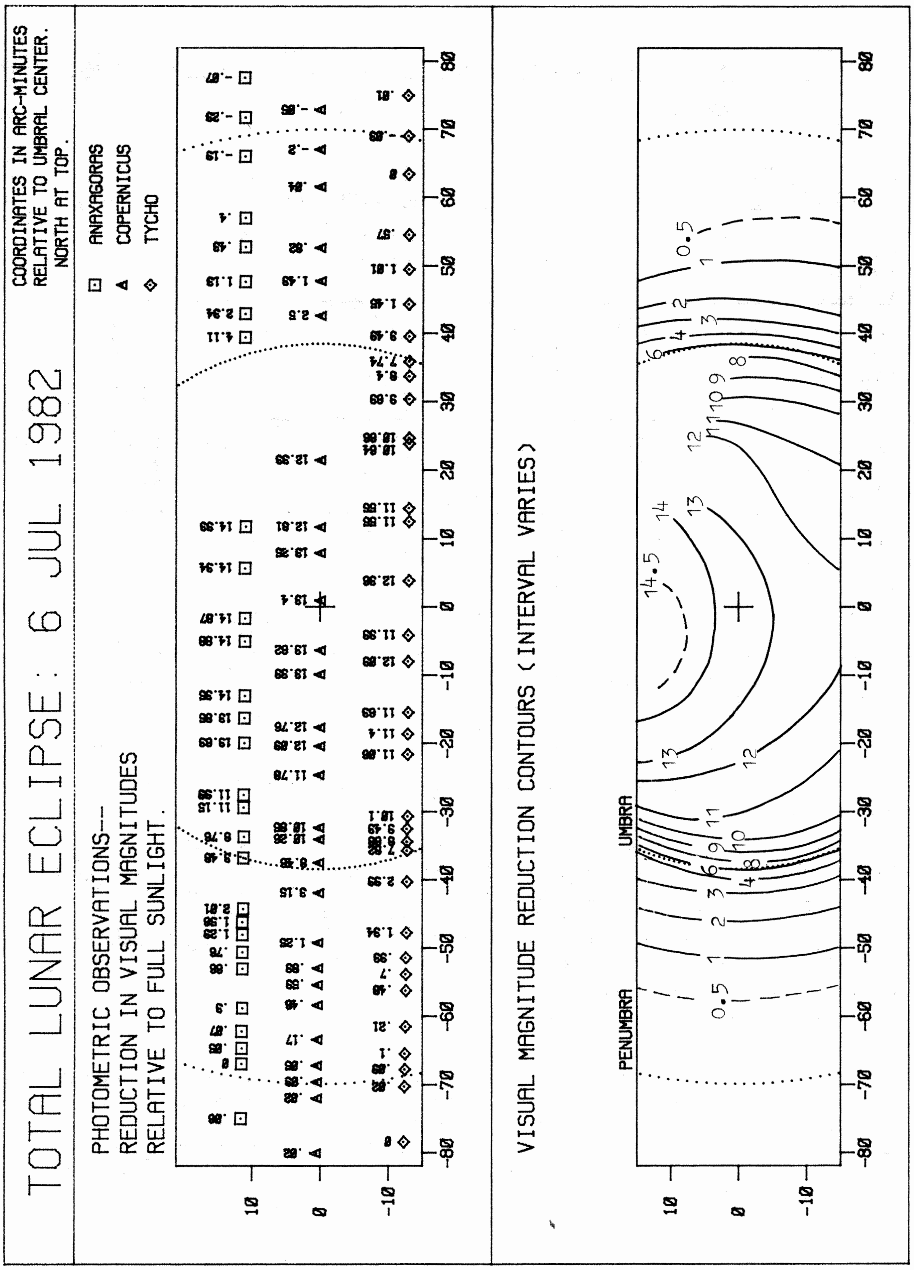


Figure 21. Prepared and contributed by John E.Westfall. See also text on pages 168-170.

Figure 21 shows the extremely steep brightness gradient near the umbral edge, which is more plainly shown in Figure 22, which plots visual magnitude reduction against distance from the umbral center. The reduction of light at the edge of the geometric umbra appears to be approximately 6 magnitudes (4. X 10^{-3} of direct sunlight) and about 4.5 magnitudes (1.6 X 10^{-2}) at the apparent umbral edge. What the eye detects as the umbral edge appears to be the zone of steepest gradient, where the rate of brightness change is about 3 magnitudes (a factor roughly of 16 times) per minute of arc. Figure 22 also shows the considerable difference in brightness of the three different locations within the umbra, an effect that made this eclipse even more memorable than predicted.

Postscript by Editor. A pleasing if modest number of reports by other observers on the July 6, 1982 total lunar eclipse have arrived. It is planned to discuss their results in an article in our next issue, Vol. 29, Nos. 9-10.

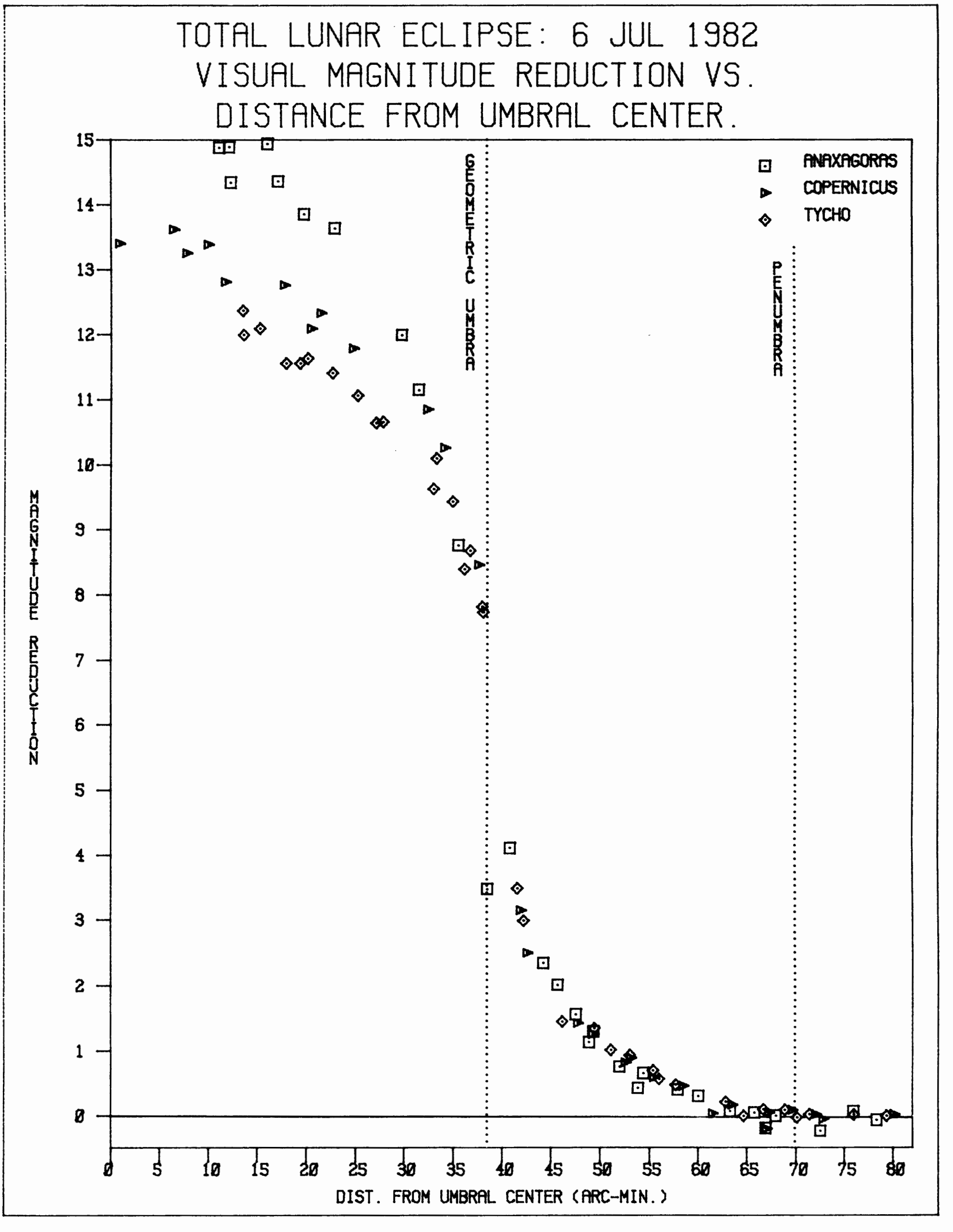


Figure 22. Prepared and contributed by John E. Westfall. See also text on pages 168-170.

THE FIRST TEXAS STAR PARTY

By: Walter H. Haas

It is natural that telescope makers, amateur observing astronomers, and others interested in the sky should like to meet with each other to look at celestial objects together and to examine telescopes of various optical and mechanical designs. Stellafane, Vermont long ago became the site of the first annual gathering of this kind, presided over by Russell Porter; and it is still the best known of these meetings. For about 15 years Clifford Holmes and his friends have offered a similar service to California enthusiasts with the Riverside Telescope Makers Conference, which has become extremely popular. Now David Cross and George Ellis have initiated what they hope will become an annual regional

Figure 23. Three astronomers at the first Texas Star Party, May 26-30, 1982. Left to right: Walter H. Haas; Dr. Clyde W. Tombaugh, the discoverer of the planet Pluto; and Raleigh Crausby of Las Cruces, N.Mex. All photographs on this page were taken by Mr. Raleigh Crausby and were prepared for publication here by Mr. John Womack.

Figure 24. Assembly of amateur telescopes at the Prude Ranch near Fort Davis, Texas during the Texas Star Party. The instruments shown are only a small sample of those which were present on the ranch.

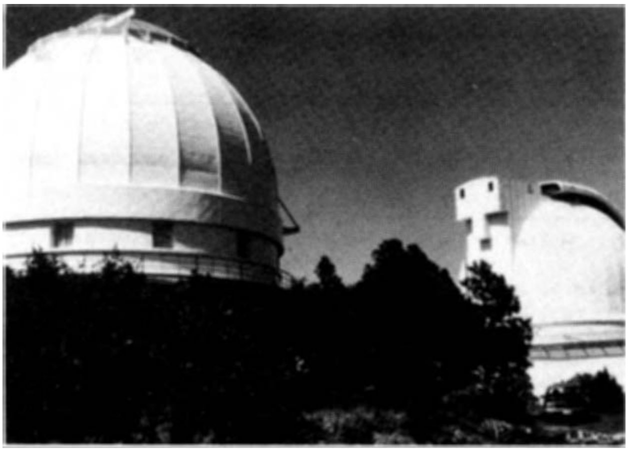


Figure 25. The domes of the 82-inch reflector and the 107-inch reflector (to the right) of the McDonald Observatory on Mount Locke. During the Texas Star Party there were many bus tours to the Observatory from the Prude Ranch.

meeting for amateurs in the Southwest, who are rather distant from both Stellafane and Riverside. The first Texas Star Party was held on May 26-30, 1982. The site selected was the Prude Ranch, five miles from Fort Davis,Texas and only 12 miles from the McDonald Observatory. The site's advantages include the dark skies in a part of West Texas where towns are few and small, very clear skies in a dry climate, and a low latitude of 31° North.

The description of the first Texas Star Party here is partly based upon an article composed by Mr. George Ellis for the Astronomical League's bulletin, The Reflector; but that account is supplemented by what the writer and his wife observed when they attended.

The response to the invitation to the Prude Ranch was in truth most enthusiastic. More than 440 amateurs from 29 states attended. They brought along more than 150 telescopes. Clouds cleared at sunset on May 25, and the skies were excellent for the five-day gathering in the Davis Mountains. Many persons came in recreational vehicles of all kinds, and others used the camping facilities of the Prude Ranch. Informality in dress and the program was the order of the day. It was a hands-in-pockets meeting with informal chatting among invited professional scientists and the freshest novices alike.

Tours were a popular feature of the Texas Star Party. Buses went to the McDonald Observatory with its 82-inch and 107-inch reflectors; and on one night 100 amateurs viewed Saturn in the 82-inch, but unfortunately with bad seeing. Other tours visited the 80-foot dish at the Harvard Radio Astronomy Station, the interferometer at the University of Texas Radio Astronomy Observatory, and even the Sacramento Peak Observatory in southern New Mexico.

Messrs. Clark and Ellis and their hard-working helpers of the Southwest Region of the Astronomical League did an outstanding job of finding professional scientists as speakers and panel members at the first Texas Star Party. The invited lecturers included:

Reta Beebe, New Mexico State University astronomer and Voyager Imaging Team member.

Karl Henize, Space Shuttle astronaut.

Ulrick Herrmann, stellar colorimetry specialist from the University of Texas at Arlington.

Clyde W. Tombaugh, Professor Emeritus of Astronomy at New Mexico State University and the discoverer of the planet Pluto.

Dr. Bart J. Bok, Milky Way pioneer and always a most delightful speaker.

Harlan Smith, the Director of the McDonald Observatory. He told of plans for a 300-inch Texas Telescope in the Davis Mountains, to be constructed within the decade once funding is assured. (A sum of $700 was raised for this purpose during the meeting.)

Dick Sramek, Very Large Array radio astronomer.

Evenings naturally stressed observing for the arsenal of telescopes at the Prude Ranch, and a ban on local lighting gave deep-sky observers and astrophotographers a unique opportunity. The first major ATM Conference ever hosted in the Southwest stressed telescope design and construction. Prizes were awarded for individual contributions to telescope-making.

Mornings during the Texas Star Party were kept free of scheduled activities. The afternoons and early evenings featured amateur papers, invited speakers, workshops on astrophotography and photoelectric photometry, and panel discussions-including an informative 90 minutes dealing with the Space Telescope and planned future larger Earth-based telescopes.

The five-day gathering came to a climax on the evening of Saturday, May 30. Consecutive lectures by Clyde Tombaugh and Bart Bok were followed by The Great Texas Giveaway books to binocular to filters to Dobsonian telescopes. The first "Lone Stargazer Award" was given to Walter H. Haas "for his many years of outstanding service to amateur astronomy." The writer expresses his deep thanks.

Those who planned the Texas Star Party deserve the warmest congratulations for making an experimental dream come true. Those who attended went home with happy memories of green mountains, black skies, and astronomical fellowship. A repeat performance is being planned for early June, 1983. Details will be given in this journal as they become known.

NEW COMET AUSTIN 1982g

The material in this article is taken from an A.L.P.O. Comets Section Circular mailed by Recorder Dennis Milon on July 15, 1982. We regret that some of the data is already dated but hope that the comet will still be observable when this issue reaches our readers.

Comet Austin was discovered at the tenth magnitude on June 18, 1982 by Mr. Rodney Austin of New Plymouth, New Zealand. The period of best visibility will probably be the week following August 14, 1982 in the evening sky. New Moon falls on August 19. The ephemeris in Figure 26 was supplied by Mr. George East of the ATM's of Boston, using elements by Dr. Brian Marsden on IAU Circular 3708.

The columns in Figure 26 give the Right Ascension and Declination on selected dates at 0 hrs., U.T. for the epoch 1950; Delta, the distance of the comet from the Earth in

AUSTIN 1982 G 1950 COORDINATES

Aug, 1982

	R	A	Dec		Delta	R	CES	TL	Mag	5logD	logR	P A	Alt	Time	
1	6	5.29	-15	24.1	.441	.814	51.1	1.2	5.3	-1.78	-.089	309.8	.0	3	50
3	6	22.83	-10	31.6	.400	.791	45.9	1.1	5.0	-1.99	-.102	307.7	.0	3	52
5	6	43.73	- 4	28.9	.366	.768	39.4	1.1	4.7	-2.18	-.115	304.3	.0	3	55
7	7	8.47	2	46.2	.340	.747	31.8	1.2	4.4	-2.34	-.127	297.9	.3	3	57
9	7	37.26	10	57.0	.326	.727	23.7	1.5	4.2	-2.43	-.138	285.3	1.8	3	59
11	8	9.73	19	21.0	.325	.709	17.2	2.0	4.1	-2.44	-.149	279.9	3.2	4	2
13	8	44.74	27	2.5	.338	.694	15.7	2.2	4.1	-2.35	-.159	318.3	4.2	4	4
15	9	20.37	33	18.4	.364	.680	19.2	1.9	4.1	-2.19	-.168	349.1	4.7	4	7
17	9	54.47	37	54.7	.400	.668	24.3	1.7	4.3	-1.99	-.175	7.0	7.4	19	60
19	10	25.31	41	1.6	.444	.659	29.0	1.6	4.4	-1.76	-.181	17.9	13.2	19	56
21	10	51.94	42	59.0	.494	.653	32.7	1.5	4.6	-1.53	-.185	25.1	17.5	19	53
23	11	14.20	44	7.0	.548	.649	35.6	1.6	4.8	-1.31	-.187	30.0	20.7	19	50
25	11	32.42	44	41.3	.604	.649	37.7	1.7	5.0	-1.09	-.188	33.3	23.1	19	46
27	11	47.17	44	53.1	.662	.651	39.3	1.8	5.2	-.90	-.187	35.4	24.7	19	43
29	11	59.04	44	49.9	.720	.655	40.3	1.9	5.5	-.71	-.183	36.6	25.8	19	40
31	12	8.58	44	36.6	.779	.663	41.0	2.0	5.7	-.54	-.179	37.0	26.4	19	36

Sep, 1982

	R	A	Dec		Delta	R	CES	TL	Mag	5logD	logR	P A	Alt	Time	
3	12	19.54	44	4.9	.866	.679	41.6	2.3	6.0	-.31	-.168	36.7	26.8	19	31
8	12	31.70	42	55.5	1.007	.717	41.7	2.8	6.6	.01	-.144	34.3	26.4	19	22
13	12	39.30	41	38.5	1.138	.767	41.3	3.4	7.1	.28	-.115	30.3	25.2	19	13
18	12	44.40	40	21.4	1.259	.825	40.9	4.1	7.7	.50	-.083	25.4	23.6	19	5
23	12	48.12	39	7.9	1.368	.890	40.5	4.9	8.2	.68	-.051	19.9	21.7	18	56
28	12	51.05	37	59.8	1.466	.959	40.5	5.6	8.6	.83	-.018	13.9	19.7	18	48

Oct, 1982

	R	A	Dec		Delta	R	CES	TL	Mag	5logD	logR	P A	Alt	Time	
3	12	53.52	36	58.2	1.554	1.031	40.8	6.4	9.1	.96	.013	7.8	17.7	18	39
8	12	55.69	36	3.5	1.631	1.104	41.6	7.1	9.5	1.06	.043	1.7	15.6	18	31
13	12	57.64	35	15.8	1.698	1.179	42.8	7.7	9.9	1.15	.072	355.6	17.9	5	9
18	12	59.40	34	35.2	1.756	1.255	44.4	8.3	10.2	1.22	.098	349.8	21.3	5	14
23	13	.96	34	1.9	1.804	1.330	46.4	8.7	10.5	1.28	.124	344.3	25.0	5	19
28	13	2.30	33	35.7	1.844	1.405	48.8	9.1	10.8	1.33	.148	339.1	28.9	5	24

Nov, 1982

	R	A	Dec		Delta	R	CES	TL	Mag	5logD	logR	P A	Alt	Time	
2	13	3.38	33	16.7	1.877	1.481	51.6	9.3	11.1	1.37	.170	334.3	33.0	5	29
7	13	4.16	33	4.9	1.901	1.555	54.7	9.5	11.3	1.40	.192	329.8	37.3	5	35
12	13	4.60	33	.4	1.919	1.630	58.1	9.7	11.5	1.42	.212	325.6	41.9	5	40
17	13	4.64	33	3.2	1.930	1.703	61.8	9.9	11.7	1.43	.231	321.6	46.6	5	45
22	13	4.21	33	13.6	1.936	1.776	65.8	10.0	11.9	1.43	.249	317.8	51.4	5	50
27	13	3.23	33	31.3	1.937	1.849	70.0	10.1	12.1	1.44	.267	314.2	56.4	5	55

Figure 26. Data on Comet Austin 1982g. Contributed by Dennis Milon. See text on page 173 *et seq*. for description of columns.

Astronomical Units; R, its distance from the Sun in the same units; CES, the comet-Earth-Sun angle in degrees; TL, the tail length in millions of kilometers per degree at the position of the comet (see pages 162 and 163 of this issue for the assumed geometry); Mag., the *estimated* stellar magnitude from the relation:

$$m = 8.0 + 5 \log \text{Delta} + 10 \log R;$$

PA, the position angle of the tail, with the same simplified geometry as above; ALT, the altitude of the comet above the horizon at latitude 40°N when the Sun is 102° from the zenith (end or beginning of nautical twilight); and Time, the corresponding local time. The time correction needed when one is east or west of a reference longitude is explained in the Graphic Ephemeris on page 55 of the January, 1982 *Sky and Telescope*.

The elements of the orbit are:

Perihelion passage	August 24.5640, 1982, E.T.
Perihelion distance	0.648590 A.U's
Longitude of perihelion	33°7190
Ascending node	325.3660
Inclination	84.5180
Eccentricity	1.000000

The mailing of July 15 also included a star chart with the magnitudes of many convenient comparison stars near the path of the comet marked thereon. It further included an outline form for reporting visual observations of Comet Austin and a different form for reporting photographic observations. Observers are strongly encouraged to use such forms in reporting their observations; such a practice will tend to insure completeness of needed accompanying data and to minimize blunders. (Readers at Alcon '82 may recall John Westfall's description of several good photographs of Luna Incognita in his file at reported times when the Moon was below the observer's horizon!) The forms also much simplify the Recorder's job of analyzing the observational data.

Mr. Milon points out that the length of the tail of Comet Austin 1982g can be estimated by comparing to known angular distances separating circumpolar stars in its part of the sky. A few such distances are:

Alpha Cassiopeiae to Gamma Cassiopeiae - 4.7 degrees.
Gamma Cassiopeiae to Epsilon Cassiopeiae - 7.3 degrees.
Alpha Ursae Majoris to Delta Ursae Majoris - 10.2 degrees.
Beta Cassiopeiae to Epsilon Cassiopeiae - 13.3 degrees.

Those wishing to receive future mailings of current comet news from Dennis Milon should send him a packet of self-addressed, stamped envelopes. His address is on our back inside cover. If you last sent stamped envelopes a few years ago, the postage will have been increased.

ANNOUNCEMENTS

Response to Questionnaire. We thank all readers who filled out and returned the questionnaire mailed out with our preceding issue, Vol. 29, Nos. 5-6. The questionnaire invited opinions on the proposed new Sections on the Sun and on meteors. A few colleagues answered in great detail, and their time and interest are appreciated. As of August 12, 1982, we have received 115 replies, thus from about 16% of the membership. A tabulation of the responses received up to July 19 came out as follows:

Should the A.L.P.O. establish a Solar Section? Yes = 82. No = 20.

If yes above, would you plan to participate in Solar Section activities? Yes = 50. No = 34.

Should the A.L.P.O. establish a Meteor Section? Yes = 67. No = 31.

If yes above, would you plan to participate in Meteor Section activities? Yes = 40. No = 33.

Slight inconsistencies in the numbers above were caused by partial, ambiguous, or contradictory answers. The action of the A.L.P.O. Business Meeting on the questionnaire and possible later developments will be reported in our next issue.

Sustaining Members and Sponsors. The persons listed below support the work of the A.L.P.O. by voluntarily paying higher dues, $40 per volume for Sponsors and $20 per volume for Sustaining Members. Their generous assistance and meaningful support are here gratefully acknowledged. This financial aid is even more valuable in the present period of inflation and ever-rising costs. If there are errors in the list, the fault is that of the Editor, who would appreciate being told of them.

Sponsors. Philip and Virginia Glaser, Dr. John E. Westfall, Dr. James Q. Gant, Jr., Ken Thomson, Reverend Kenneth J. Delano, Frederick W. Jaeger, Harry Grimsley, Darryl J. Davis, Dr. A. K. Parizek, Raleigh Crausby, Oscar Monnig, and Dr. David D. Meisel.

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"Everything in the Universe." Such is the name of a business conducted by Mr. Norman Sperling, formerly on the Sky and Telescope staff, and offering a great variety of items to the amateur astronomer. The address is 429 43rd St., Oakland, CA 94609.

Free Subject Index to Astronomy Articles in Mercury Magazine. A complete subject index to astronomy articles in the first ten volumes of Mercury is being made available by the Astronomical Society of the Pacific. To receive a copy of the index, send two first-class stamps with your name and address to Mercury Index, A.S.P., 1290 24th Ave., San Francisco, CA 94122. Mercury is a bimonthly illustrated magazine for the general reader, providing clear, authoritative information about recent developments in astronomy.

Availability in Europe of Back Issues of this Journal. Mr. Roger Laureys, Flammarion Sterrenwacht, Herestraat 5,B-3721 Vliermaalroot, Belgium has been able to purchase many back issues of Journal A.L.P.O. (long called The Strolling Astronomer). He hence has an extensive file of this magazine, though not a complete set for the early issues. Mr. Laureys kindly offers to make copies of requested old articles for European lunar and planetary astronomers. In addition, they are welcome to consult his file at his home.

New Advertising Rates. The current economic climate requires us, regretfully, to increase the price of advertisements in this journal. We are sure that anyone who checks will be amazed at how long the old rates have been in effect! The new rates become effective on October 15, 1982; ads can be accepted at the older and lower rates before that date. The new rates are given on the back inside cover.

The Strolling Astronomer

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