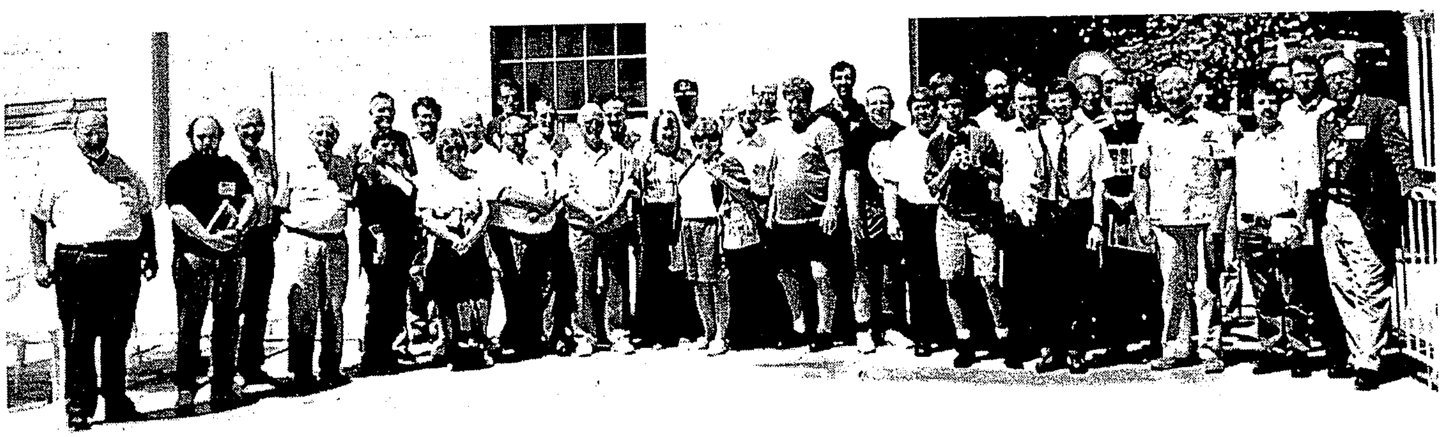
PROCEEDINGS OF THE 45TH CONVENTION OF THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

WICHITA, KANSAS, AUGUST 1 - 5, 1995



Edited by John E. Westfall, A.L.P.O. Editor

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Preface

The Association of Lunar and Planetary Observers held its 45th Convention at the Days Inn East Hotel in Wichita, Kansas, on August 1 - 5, 1995. We thank Jose Olivarez and the staff of the Omnisphere and Science Center for local arrangements and making our meeting a memorable experience. We also thank the staff of the Lake Afton Public Observatory for hosting us on our Thursday evening field trip.

We also thank the many A.L.P.O. members who gave papers or workshops or who brought exhibits to this meeting, and to Elizabeth Westfall for taking care of registration and numerous other tasks.

The following *Proceedings* include all the papers or abstracts that have been submitted to the Editor. "Editing" is a generous term here; for the most part consisting of placing the papers in order and assigning page numbers—except for unmounted illustrations, the papers that follow have been copied directly from the manuscripts supplied by their authors, who are solely responsible for their contents and appearance.

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The 1995-96 Edgewise Presentation of Saturn's Rings: An Observational Update

By: Julius L. Benton, Jr.
Recorder
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Abstract

The 1995-96 edgewise presentation of the ring system is the last triple crossing of the Earth through Saturn's ring plane until 2038-39. The first ring passage occurred during late May 1995, but Saturn was not well-placed for the best views of the event. Observers are watching Saturn with increasing frequency as early August approaches and the next ring crossing occurs. This will be the most favorable of the three events, and amateur astronomers everywhere are reminded of the more important specialized and routine observational programs that should be carried out for the remainder of the observing season.

Initial Observations

NASA's *Hubble Space Telescope* and instruments at several major observatories throughout the world have already started monitoring Saturn during the 1995-96 edgewise apparition, but these professional studies are mostly restricted to the dates of the three ring crossings. Amateur astronomers, on the other hand, have been encouraged to watch Saturn on every possible clear night during the apparition to afford comprehensive coverage of the planet.

The first observation of Saturn received by the A.L.P.O. Saturn Section during the 1995-96 edgewise apparition was for 1995 May 13, about nine days prior to the ***first ring passage by the Earth*** on 1995 May $22^d05^h18^m$ UT. Here is a brief summary of the first few observations:

1995 May 13^d 09^h 45^m UT — "In integrated light, the rings were just barely perceptible on either side of Saturn's globe, and they were of equal brightness. The shadow of the rings on the globe appeared as a dark line running across the globe from limb to limb immediately south of the ring plane. The globe south of the ring plane was slightly darker than the globe north of the rings."

Observer: J.L. Benton using a 15.2 cm (6.0 in) refractor at 152X in fair seeing.

1995 May 15^d 09^h 35^m UT — CCD images clearly show the rings on both side of the globe in red, green, and blue light.

Observer: D.C. Parker using a 41.6 cm (16.0 in) Newtonian and CCD camera.

1995 May 19^d 09^h 30^m UT — "Rings were intermittently visible on either side of the globe in poor seeing conditions at 152X in integrated light."

Observer: J.L. Benton using a 15.2 cm (6.0 in) refractor at 152X in poor seeing.

1995 May 21^d 09^h 50^m UT — "Rings were definitely not visible on either side of Saturn's globe at 244X in integrated light; shadow of the rings on the globe was a dark, thin line across the globe from limb to limb."

Observer: J.L. Benton using a 15.2 cm (6.0 in) refractor at 244X in fair seeing.

1995 May 22^d 10^h 00^m UT — "Saturn's rings were not visible. Shadow of rings on globe was clearly visible south of the ring plane."

Observer: M. Will using a 20.3 cm (8.0 in) Newtonian at in good seeing.

1995 May 23^d 09^h 38^m UT — "Some bright spots in the EZ. CCD image of Saturn did not show rings on either side of the globe."

Observer: D.C. Parker using a 41.6 cm (16.0 in) Newtonian and CCD camera.

1995 May 23^d 10^h 01^m UT — "Rings are faint, but visible. Preceding part of the rings is much more distinct than the following edge."

Observer: R.W. Schmude using a 9.0 cm (3.5 in) refractor at 170X in integrated light and good seeing.

1995 Jun 06^d 11^h 35^m UT — "No trace of the rings except for the shadow on the ball. This is with CCD exposures ranging from 0.05 to 10 seconds .... Mimas, Dione, Tethys, Rhea, and Titan visible."

Observer: J.E. Westfall using a 35.6 cm (14.0 in) Schmidt-Cass and CCD camera in poor seeing.

1995 Jul 04^d 06^h 07^m UT — "Rings not visible in integrated light, infrared, red, green, or blue light in CCD images."

Observer: D.C. Parker using a 41.6 cm (16.0 in) Newtonian and CCD camera.

After 1995 May 22, the north face of the rings remained illuminated by the Sun, but the Earth, having now passed through the ring plane, was situated on the opposite darkened south side of the ring plane. Observers would see only those regions of the rings that are illuminated by forward scattering (i.e., light passing through the rings). The Earth is now on the south side of the ring plane, and will remain there until the next ring crossing on 1995 August 10, just a few days from now. The theoretical value of **B** reached a maximum southerly value of only –0°.616 on 1995 July 2.

Remaining Edgewise Ring Phenomena in 1995-96

Observers are reminded that, while less spectacular, single-event edgewise presentations of the rings will occur in 2009 and 2025, the next truly favorable triple-event apparition will not occur for some 43 years, in 2038-39! It is obvious, therefore, that no opportunity to witness the 1995-96 orientation of the rings should be missed. *Table 1* gives geocentric phenomena in Universal Time (UT) for Saturn throughout the 1995-96 edgewise apparition.

The ***second ring passage by the Earth***, which will be headed again to the north side of the ring plane, occurs on 1995 August $10^d20^h54^m$ UT, which happens only about a month before Saturn, located in the constellation of Aquarius, reaches opposition to the Sun on 1995 September 14^d15^h UT. The Earth and Sun will again be on the same side of the ring plane, and the illuminated north face of the rings should become visible to observers. The maximum northerly value of **B** during this period becomes +2°.670 on 1995 November 19.

The ***Sun's passage through the ring plane*** occurs on 1995 November $19^d15^h09^m$ UT, going southward, with the Earth remaining on the opposite north side of the ring plane. This means that the northern face of the ring plane will no longer be illuminated by the Sun, and they will be theoretically invisible from Earth after 1995 November 19 until 1996 February 11, when both the Earth and Sun lie south of the ring plane.

The *third ring passage by the Earth*, now headed southward for the last time during the 1995-96 apparition, will take place on 1996 February $11^{d}23^{h}34^{m}$ UT. The Earth will then join the Sun to the south of the ring plane, and the illuminated south face of the rings will become visible to us. This final ring passage of the Earth through the plane of the ring system will probably be the most troublesome to observe because Saturn will be only a little more than a month away from conjunction with the Sun and very near the horizon when skies become dark.

Table 1.

Geocentric Phenomena in Universal Time (UT) for the 1995-96 Apparition of Saturn

Conjunction	1995	Mar	$06^{d}02^{h}$ UT
Stationary		Jul	07 11
Opposition		Sep	14 15
Stationary		Nov	22 14
Conjunction	1996	Mar	17 15

Data for Opposition Date
1995 Sep $14^{d}15^{h}$ UT

Constellation	Aquarius
Stellar Magnitude	+0.67
Equatorial Diameter (Globe)	19″.24
Polar Diameter (Globe)	17″.16
Major Axis (Rings)	43″.62
Minor Axis (Rings)	00″.90
B	+1°.187
B′	+0°.974

For Saturn, **B** is the planetocentric latitude of the Earth referred to the plane of the rings, positive (+) when north (when **B** is +, the visible surface of the rings is the northern face); **B′** is the planetocentric latitude of the Sun referred to the ring plane, positive (+) when north (when **B′** is +, the north face of the rings is illuminated by the Sun.

Therefore, the intervals when the ring system should be theoretically invisible to observers on Earth are:

1995 May $22^{d}05^{h}18^{m}$ UT through 1995 August $10^{d}20^{h}54^{m}$ UT
and
1995 November $19^{d}15^{h}09^{m}$ UT through 1996 February $11^{d}23^{h}34^{m}$ UT

Following 1996 February 11, the Earth and Sun will remain south of the ring plane until the next edgewise presentation beginning on 2009 August $10^{d}13^{h}$ UT, so that observers will be able to study the southern face of the rings and south hemisphere of the globe for about 13 years.

The apparent disappearance of Saturn's rings, which occur several times during a short interval, is due to one or more of the following geometric circumstances:

1. The Earth may be in the plane of the rings so that only their edge is is presented to viewers. Since the rings are quite thin, they might be temporarily invisible in even the largest apertures.

2. The Sun may be in the plane of the rings so that only their edge is illuminated.

3. The Sun and Earth may be on opposite sides of the ring plane, so that what observers see from Earth are areas that are illuminated only by light passing through the ring system, called forward scattering.

In a cooperative effort between NASA, the European Space Agency, and the Italian Space Agency, the *Cassini* spacecraft is scheduled to begin its mission to Saturn during 1997. As preparations continue for launch, more data about the density and location of material in or near the rings is extremely valuable. For instance, when *Cassini* reaches Saturn in 2004, it will fly through a narrow gap between Rings F and G, then pass over Ring C, and afterwards make a couple of passes through Ring E. Data gleaned from amateur and professional observations in 1995-96 on the boundaries of ring components and gaps, combined with *Voyager* spacecraft data, can help contribute to the success of the mission. While the rings are the principal target for *Cassini* during it's four-year mission, the spacecraft will deploy the *Huygens probe* to study the atmosphere and surface of Titan.

Observing Programs Specific to Edgewise Ring Presentations

Some of the more important observing programs that should be carried out throughout 1995-96 may be summarized as follows:

1. ***Ring Visibility vs. Date of Theoretical Edgewise Orientation.*** Because Saturn is considerably dimmer at smaller ring inclinations, and because the exceedingly thin rings are normally difficult to see at or near edgewise orientation, observers are strongly encouraged to use the largest apertures available to them during 1995-96. In good seeing and under dark, transparent skies, instruments with apertures in the range of 30.0 cm (12.0 in) to 41.0 cm (16.0 in) have typically permitted views of the sunlit side of the ring system up to within a few days or even hours of the times of actual edgewise presentation. Thus, establishing just how close to the theoretical dates of edgewise orientation the rings can be seen in various apertures is extremely valuable. The invisibility of the dark side of the rings may last several days or possibly weeks before and after the predicted dates of edgewise presentation. There seems to be a general asymmetry to the critical dates with respect to the extent, appearance, and brightness of Saturn's ring system. Non-uniformity in brightness may be seen as one or more condensations of light along the otherwise dark ring surface, especially near the time of the exact edge-on alignment.

2. ***Visual Numerical Relative Intensity Estimates of Sunlit and Dark Ring Surfaces.*** Measurements should be made of the surface brightness of the sunlit and unilluminated ring surfaces at varying distances from Saturn's globe throughout 1995-96. Observers must use the globe as the reference point for visual numerical relative intensity estimates, employing the ***A.L.P.O. Visual Numerical Relative Intensity Scale***, where 0.0 denotes black shadows and 10.0 refers to the most brilliant objects of all, with intermediate values assigned as they apply. Because the outer third of Ring B, which is the conventional standard of reference for Saturnian features at an assigned intensity of 8.0, is not seen to advantage when the value of **B** $\leq\pm5°.0$, a secondary standard is employed. For 1995-96, the point of reference is the Equatorial Zone (EZ) on the globe, and although this feature has been known to fluctuate in intensity in recent years, the value of 7.0 will be used as the reference intensity, based on average intensity values from several apparitions. Measurement of the brightness of the rings along their linear extent during edgewise presentations can help shed light on vertical ring thickness of the ring system.

3. ***Intensity of Ring Components as a Function of Particle Density.*** Observers have discussed for many years the perceived relationship between the intensity of the ring system at different inclinations to the Earth and its particle density. In such a correlation, the light passing through a ring component from the illuminated surface is complementary, where the intensity of the dark side would be the opposite of the sunlit side (an effect that was firmly established in 1980-81 by *Voyager*). For instance, the outer third of Ring B (usually the brightest component on the sunlit face of the rings) would appear as the darkest area, Ring A would be somewhat brighter than Ring B, and Ring C would be the brightest component of all. Light reflected from the globe of Saturn would affect the brightness of the "dark" side of the rings, but corrections could be made for this illumination.

4. ***Evaluating the Visibility of Ring E.*** The very elusive, but vast, dusky component outside Ring A, known as Ring E, has elicited mixed impressions during previous edgewise apparitions of Saturn, periods when it

ought to be easier to see from Earth. *Voyager* missions confirmed Ring E, but controversy persists as to whether it can truly be seen by Earth-based telescopes.

5. ***Bright Star-like Points of Light on the Dark Ring Surface.*** Anytime the unilluminated side of the rings is presented to Earth, brilliant star-like points of light may be detected along the extent of the rings. This phenomenon is typically seen when the rings are edgewise, but care must be taken to ascertain whether any known satellites of Saturn may be contributing to the visibility of these points of light. If present, satellites will also look like beads of light along the plane of the rings. Points of light will sometimes twinkle in poor seeing, resulting in very beautiful spectacle. If it can be established (using ephemerides of their positions) that no known satellites contribute to the existence of these points of light, observers should carefully denote the position of such phenomena on drawings, recording the precise time that they are seen and their visual numerical relative intensity.

6. ***Searching for Extra-planar Ring Particles.*** If extraplanar ring particles truly exist, as suggested in the past by Earth-based observations and more recently by *Voyager* spacecraft, the optimum time to detect them would be at edgewise presentations of the rings. Such particles would appear as a "haze" above or below the ring plane, but one must be careful not to be fooled by the imposing glare of Saturn's globe, particularly when seeing is bad.

7. ***Satellite Phenomena.*** When the plane of the rings passes close to the Earth and Sun, the best opportunity occurs for observing transits, occultations, shadow transits, and eclipses of those satellites of Saturn which orbit near the planet's equatorial plane. These observations involve the precise timing of events to the nearest second. The larger the instrument, the better will be one's chances of capturing satellite phenomena. Controversy persists as to the visibility of shadow transits of satellites other than Titan. It has been theoretically established that nearly all of the inner satellites of Saturn are far too small to cast umbral shadows onto the globe of the planet, but some observers with rather large telescopes have reported shadow transits of Tethys. Also, it may just be possible to detect penumbral shadows of some of the satellites with sufficient aperture.

Visual magnitude estimates of the Saturnian satellites are worthwhile, and when the rings are edgewise, the brightness correction for scattered light that must be applied is then only a function of the satellite's apparent distance from the globe of the planet.

8. ***Photography and CCD Imaging.*** Supplementing visual observations outlined above with photography at different wavelengths of light and CCD imaging will add tremendous objective value to the data acquired during 1995-96. For example, photography at ultraviolet wavelengths may prove useful in detecting the UV light emitted by a thin gaseous envelope known to exist around Saturn's ring system. This gas, partially composed of hydrogen (H) atoms, is thought to come from water-ice particles making up the rings as they are eroded by micrometeoroids, sunlight, and energetic particles in Saturn's magnetic field.

In recent years, the introduction and increasing availability of CCD cameras at fairly reasonable prices has allowed more efficient light detection than is possible with photographic film, plus CCD's generate digital information which can be manipulated by image processors. Their enormous dynamic range and high sensitivity to visual and near-infrared wavelengths makes them a valuable tool in studying Saturn.

Routine Saturn Observations

In addition to monitoring the events and phenomena associated with the edgewise ring presentations of 1995-96, observers should not fail to maintain routine systematic studies of Saturn. The following are the main categories of routine Saturn observations:

1. Full-disk and sectional drawings of Saturn and its accompanying ring system.

2. Visual numerical relative intensity estimates (visual photometry) of the belts,

zones, and ring components, to include broad and localized variations in brightness.

3. Visual colorimetry using color filters for a comparative investigation of the reflectivity of various regions of the globe and rings at different wavelengths of light.

4. Determination of latitudes of global features.

5. Central meridian (CM) transit timings of discrete detail in belts and zones of the globe, with accompanying sectional sketches to show morphology of the feature(s).

6. Visual photometric and colorimetric studies of the bicolored aspect of the ring ansae.

7. Visual magnitude estimates of the satellites of Saturn using appropriate reference standards.

8. Absolute color estimates of global and ring features using an accepted color reference standard.

9. Simultaneous observations of all Saturnian phenomena by several observers (i.e., working independently from more than a single geographic location, and viewing Saturn at the same date and time using similar methods and equipment).

10. Photography of Saturn at various wavelengths of light, ideally in conjunction with visual observations. Simultaneous visual and photographic observations are extremely valuable.

11. CCD imaging of Saturn in conjunction with simultaneous visual and multi-wavelength photography.

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July 28, 1995
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A.L.P.O. Saturn Recorder

JUPITER IN 1994-95
A JUPITER UPDATE

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

ABSTRACT

The appearance of the planet Jupiter in 1994-95 is discussed. Outlined are the changes since 1993-94 including "highlights" of the South South Temperate Belt (the "Impact Belt"), the South Temperate Belt, the South Tropical Zone, the South Equatorial Belt, the Equatorial Zone, the North Equatorial Belt, the North Temperate Belt, the Great Red Spot, STB White Ovals "BC", "DE", and "FA", and Special Features. Also, a Summary of Rotation Periods and Statistics for the apparition to date.

Descriptive Report

Period 1: 1994, Late December-1995, March 31:

SSTB: This is the "Impact Belt". The "suspected remanents" of five impacts were observed during the apparition. In this period impact regions L and G were observed near 232°(II) and 273° (II) respectively. Impact R was observed from mid-March to the end of March. The belt was generally dark and bluish in color.

STB: The South Temperate Belt was generally dark. Usually a blue in color. The three STB White Ovals (BC, DE, and FA) were observed. STB white spots No. 1 and No. 2 were observed near 133° (II) and 147°(II) respectively.

STrZ: The South Tropical Zone was very bright and white. A bright oval was seen near 130°(II).

RS: The Great Red Spot was rather dark and dusky around it. By late March it was dark. It was usually a yellowish-orange in color.

SEB: (South Equatorial Belt); the SEBs was blue and the SEBn was brown. The SEBZ was orange. The SEBs was usually darker than the SEBn.

EZ: The Equatorial Zone was a prominent blue in color!

NEB: The North Equatorial Belt was dark and wide.

NTBs: Dark rapid-moving spots were observed on the south edge of the NTB.

Note: Generally, the belts and activity were rather subdued during this period.

Period 2: 1995, April 1-1995, May 31:

SSTB: Impact region R continued to be observed from early April to late April near 345°(II). Impact KW was observed from early April to mid-May near 155°(II). Impact H was observed from mid-May until late May near 52°(II). A white oval was observed from about mid-May until late May. It was approaching STB Oval DE.

STB: White Ovals Nos. 1, 2, and 3 were observed along with BC, DE, and FA. A dark section was observed near 343°(II). Another one was seen at 330°(II) on the STBs.

STrZ: Bright white. Bright Oval No. 2 observed near 304° (II).

RS: The Red Spot was yellow in early April, yellow-orange during the middle of the period, and light orange late in the period.

SEB: This belt had a very dark south component - the SEBs. The belt was active since early April with dark spots - moving in a increasing (+) longitude direction. Quite prominent SEBs spots were seen from 192°(II)-250°(II). SEBZ was light. Parker CCD images show in mid-May festoons in the SEBZ preceding the RS in the SEBZ (north channel) and following the RS. SEBZ was yellow preceding the RS. Festoons are active following the RS. SEBs dark spots are very prominent up to 310°(II). By May 16 dark spots are almost to RSc. The RS northern portion was bright (faded)! Dark SEBs spots are completely around the planet!

EZ: Blue in color.

NTB: Dark and bluish.

NPR: Usually darker than the SPR.

Period 3: 1995, June 1-1995, July 15:

SSTB: White Oval No. 1 continued to be observed near DE.

STB: All features in Period 2 continued to be followed. Also, a white oval near 290°(II).

STrZ: Bright white. A bright oval near 305°(II).

RS: Slightly darker by mid-June. It was orange in color. Early June it was partly gone (northern portion) - appeared as a streak!

SEB: In early June SEBs spots are active (dark and bright). By mid-June prominent red retrograding SEBs spots are observed following the RS. SEBZ is reddish-orange. SEBn is usually brownish-red. Sometimes orange was recorded preceding the RS and uently. After mid-June festoon activity decreased following the RS. Dark SEBs spots preceding the RS were blue and following the RS they were red according to Don Parker's CCD images!

EZ: Still Blue!!

NEB: Brownish-red. Dark elongated features on the north edge.

NTBs: Active - with rapid moving dark spots.

Note: SPR is darker than NPR.

Conspicousnesses of the Belts and Zones

Belts: NEB, SEBs, NTB, STB, SEBn, and SSTB.

Zones: STrZ, EZ, NTrZ, STeZ, SEBZ, and NTeZ.

Rotation Periods and Statistics

SSTB(II):

No.	Mark	Limiting Dates	Limiting L.	Drift	Period
1	Dc(R)	Mar.22-Apr.20	346°-345°	-01.°0	9:55:39
2	Dc(KW)	Apr.01-May 14	155-152	-06.0	9:55:32
3	Dc(H)	May 12-Jun.11	053-050	-03.0	9:55:37
4	Wc	May 13-Jun.16	051-020	-28.2	9:55:02
			Mean rotation period: (Nos. 1-3)		9:55:36

Nos. 1-3 are possible remanents of the Impacts R, KW, and H. No. 4 is a SSTB Oval. It was in conjunction with the Red Spot on May 16 at 49°(II). Also, this feature reached conjunction with the STB Oval DE on June 1 at 46°(II).

STB(II):

No.	Mark	Limiting Dates	Limiting L.	Drift	Period
BC	Wc	Dec.26-Jun.18	080°-003°	-13.°3	9:55:22
DE	Wc	Dec.26-Jun.18	105-028	-13.3	9:55:22
1	Wc	Feb.05-Jun.18	132-054	-17.7	9:55:16
FA	Wc	Dec.26-Jun.18	175-068	-18.8	9:55:16
2	Wc	Apr.30-Jun.18	146-089	-15.3	9:55:20
3	Wc	Apr.16-Jun.18	044-014	-14.3	9:55:21
4	Dp	Apr.22-Jun.18	344-336	-04.2	9:55:35
5	Dp	May 22-Jun.03	330-330	00.0	9:55:41
			Mean rotation period:		9:55:19
			(Nos.4-5):		9:55:38

The order of conspicousnesses of the STB White Ovals was: BC, DE, and FA. Their mean length was 9°, 9°,and 6°respectively. This is compared to 10°, 09°, and 10° for the 1993-94 apparition. Last apparition none of the STB White Ovals were in conjunction with the Red Spot. This apparition BC was in conjunction with the RS on March 24 at 45°(II) and DE was in conjunction with the RS on May 7 at 51°(II).

Great Red Spot (II):

Mark	Limiting Dates	Limiting L.	Drift	Period
RSp	Dec.26-Jun.18	034°-039°	-0°.8621	9:55:42
RSc	DEC.26-Jun.18	042-047	-0.8621	9:55:42
RSf	Dec.26-Jun.18	051-056	-0.8621	9:55:42
		Mean rotation period:		9:55:42

The Great Red Spot had a mean length of 17° during the apparition. During the early part of the apparition it was located at 42°(II), by the middle of the period it was near 51°(II), by late June it was at 47°(II), and by early July it was near 51°(II). It's movement was influenced by the passage of STB White Ovals BC and DE; and the retrograding SEBs dark spots to it's north.

STrZ(II);

No.	Mark	Limiting Dates	Limiting L.	Drift	Period
1	Wc	Feb.05-Apr.02	131°-127°	-02°.1	9:55:38
2	Wc	May 12-Jun.18	302-306	-03.3	9:55:36
			Mean rotation period:		9:55:37

NEBs-EZn(I):

No. Mark	Limiting Dates	Limiting L.	Drift	Period
OL-1(83)Dc	Dec.26-Jun.16	060°-060°	0°.0	9:50:30
OL-6(91)Dc	Dec.26-Jun.16	191-191	0.0	9:50:30
OL-4(86)Dc	Dec.26-Jun.17	244-243	-0.2	9:50:30
OL-5(88)Dc	Dec.26-Jun.16	296-297	-0.2	9:50:30
		Mean rotation period:		9:50:30

The above features are Olivarez (OL) Blue Features which are long-lived markings of the North Equatorial Current.

NEBn-NTrZ(II):

No.	Mark	Limiting Dates	Limiting L.	Drift	Period
1	Dc	Feb.12-Jun.18	038°-021°	-4°.1	9:55:35

2	Dc	Feb.08-Jun.12	180°-177°	-3.2°	9:55:36
3	Dc	Mar.05-Jun.17	248-234	-4.0	9:55:35
4	Wc	Apr.11-Jun.18	327-327	0.0	9:55:41
5	Dc	Apr.11-Jun.18	336-336	0.0	9:55:41
6	Wc	Apr.11-Jun.18	347-348	0.4	9:55:41
7	Dc	Apr.11-Jun.18	358-359	0.4	9:55:41
			Mean rotation period:		9:55:39

The dark markings above are very dark elongated condensations or "barges" on the north edge of the NEB.

NTBs(I):

No.	Mark	Limiting Dates	Limiting L.	Drift	Period
1	RMS-1	Apr.02-Jun.12	256°-100°	-65.0°	9:49:03
2	RMS-2	May 22-Jun.09	054-009	-75.0	9:48:49

JUPITER UPDATE: THE IMPACTS AND THE DAYS AFTER

By: Phillip W. Budine, A.L.P.O. Jupiter Recorder; and Comet/Jupiter Encounter Coordinator.

ABSTRACT

The story of the A.L.P.O. and it's preparation for observing the Impacts of Comet Shoemaker-Levy 9 with the planet Jupiter. Including: First Day of the Crash, The Influx of Observations, Letters, and Hype, The Crash, Evolution of the Impact Spots, Impact Drifts, and Observations and Reflections.

The ALPO Story

Preparing for the Great Crash

The A.L.P.O. started planning for the "Great Event" in the summer of 1993 when at our meeting in San Jose, CA. a group of A.L.P.O. Staff including: Dr. John Westfall, Jose' Olivarez, Harry Jamieson,and myself met with Cindy Jalife-Computer & Membership Services Manager for The Planetary Society concerning what was the A.L.P.O. going to do concerning this rare event? We decided around the "breakfast round table" that the A.L.P.O. would act as world wide coordinator for amateur observations. The Planetary Society would implement "Jupiter Watch" and promote and handle publicity and public events around the "event". Also, the A.L.P.O. would produce a new handbook preparing observers for the event. We would distribute the handbooks to A.L.P.O. observers and observers internationally and The Planetary Society would also distribute a number of the A.L.P.O. Guides to interested observers and to people who requested such a guide. At the meeting I was appointed: Recorder; Coordinator Comet P/Shoemaker-Levy 9/Jupiter Encounter Observing Program.

The first handbook preparing for the event was produced by myself and was a 36 page soft cover/bound book of good quality. It was titled "Jupiter Chronicle-The Great Crash of 1994". It's contents included: The Comet, The Encounter, Visibility of Jupiter, Telescopes for Observing the Event, Getting Familiar with Jupiter, Observing Projects, Submitting Observations, and Communicating Networks. It also included all Observing Forms and Predictions for the event. The book was available in December, 1993 - and a hugh responce was a result of the availibility of the book. Inquiries were received from many including: Dr. Clark Chapman - Planetary Science Institue and Richard Hill - University of Arizona; both in Tucson. The book got an excellent review in the Astronomical League's "Reflector" Newsletter by Rollin P. VanZandt. As the weeks flew by the need was apparent for a "Monthly Newsletter" or "Bulletin Service to keep observers informed of changes in predictions, observing procedures, and current observations. This was implemented by myself in January, 1994. Also, the A.L.P.O. needed a more complete "guide" for the event. To fullfill this project I solicted the help of Dr. Carlos E. Hernandez of Miami - a A.L.P.O. Mars Recorder who had expressed a keen interest in the project and had excellent Journalism and Computer Graphics skills; as well as beind a top-notch Jupiter observer.I appointed Carlos Assistant Coordinator of the event; and later a Acting Assistant Jupiter Recorder.

By May, 1994 we had available the new guide titled: A.L.P.O.'s Periodic Comet Shoemaker-Levy 9 Observer's Guide. It was a handsome soft cover/bound book of high quality with outstanding graphics by Carlos. The main contents included: Introduction, Jupiter: The Mighty Gas Giant, Observing Jupiter, Comet Shoemaker-Levy 9, and The Impact: What To Expect. This handbook was well received and praised by the professional community. The Planetary Society had several hundred copies printed for distribution to interested persons. The two A.L.P.O. Guides were the only books published and available on the Crash Event prior to the impact!

Meanwhile observers world-wide were preparing for the event by observing Jupiter actively and applying various technigues. The A.L.P.O. was receiving many observations. Particularily; observers were studying the SSTB latitude at all longitudes tracking the small ovals and dark spots visible in that region. The A.L.P.O. Drift-Charts included: 22 bright white spots and 16 dark spots being tracked in the SSTB!

The First Day of the Crash

In anticipation of the Great Event - one prayed for clear skies - well, in Walton, NY (foothills of the Catskill Mts.) the Lord answered our prayers - it was a beautiful clear day in the mountains! I started looking for Jupiter as early as 23:00 UT and Jeff Beish of Miami, FL had been observing the planet in the afternoon with his 16-in reflector. At 23:30 UT Jeff called me and said: "Did you see it? I have never seen anything as dark and as weird as this on Jupiter before!" I told him I was just finding the planet at my location. I called him back at 23:45 UT and said I had confirmed his sighting of the Fragment A impact! Carlos had observed it at 23:40 UT. All of us made sketches of the feature.

The Influx of Observations, Letters, and Hype.

The first week of the "Crash" was hectic, active, rewarding, and the experience of a lifetime! Mail was heavy for days, phones were ringing "off the wall", and the Internet was very busy! Communication was active; even with the professionals - Heidi Hammel, Rik Hill, and others. Also, with A.L.P.O. observers. Then there was the local papers and radio interviews. Even a rather lengthy interview with BBC Radio - London; and another with U.S. New and World Report. Along with requests to speak on the events by church groups, social organizations, schools, and colleges. One rewarding experience was speaking at Princeton University in the "Einstein Hall"! All this - and try to observe the events as actively as possible! Fortunately, the weather was the clearest week of the summer; and the seeing some of the best in the area! Also, the availibility of A.L.P.O. Observing Guides for the event was made aware to many by the TV coverage on: BBC TV, The NASA Channel, The Astronomy Channel, Science Fiction Channel ("Inside Space"), and The Mind Extension Channel.

After about two months one could see the "impact" of observations, interest, and letters that the A.L.P.O. had received!

A total of 752 letters had been acknowledged; consisting of inquiries, notes, and correspondence. A total of 552 disc drawings and/or sectional sketches. In regards to photos; about 100 photos and several hundred CCD images; besides, Parker along had about 1000! About 300 observers had corresponded fom the A.L.P.O. The drawings enabled us to track the evolution and location of the impacts. Most valuable were 938 visual transit observations from 73 A.L.P.O. observers. When plotted on graph paper 716 transits were usuable to establish drift-rates for the Impact Spots.

Some observers had done outstanding quality work with excellent drawings: Jeff Beish, Carlos Hernandez, Jose' Olivarez, Richard Hill, Jim Fox, Daniel Troiani, Richard Schmude, Jr., and Cecil Post among others.

Masterpieces of CCD Imaging and photos were received from: Isao Miyazaki, Dan Burton, and Donald Parker. Excellent photometric work was submitted by: Dr. John E. Westfall and Dr. Eugene S. Lopata. Also, an excellent video was submitted by Alan MacFarlane on the impacts.

Observations were pouring in from all over: India, Australia, England, France, Holland, Belgium, Malasia, Spain, New Zealand, Hong Kong, Hungary, Canada, South America, Russia, and the U.S.A.!

"Reliving The Crash", Evolution of the Impact Spots, Impact Drifts - Questions and Reflections - .

The Crash

The impacts of some of the fragments were observed on the dark -side (9 beyond the terminator) of Jupiter as seen from Earth by the Galileo Spacecraft which was 1.6 AU from Earth. Galileo's Photopolarimeter Radiometer and Mapping Spectrometer observed impacts B, H, L, and Q.Excellent results were obtained for H, L, and Q. The brightness of the fireballs moving at 60 km/s increased 3-5% brighter than Jupiter. There was a rising in brightness then a slow decline. A total of 35 seconds duration.

Fragment G was observed at a estimated 10 km to produce a temperature of 7500 K (Sun is 5800 K). It created a impact 5,000 mi. wide and a plume 1200-1600 miles in altitude with a force of 6 million megatons of TNT (100,000 X large nuclear bomb).

The CCD camera aboard Galileo observed Impacts K and N. It saw a 5 second flash - a decline for 10 sec. - and rebrightning for 30 it saw the meteor flash, comet fragment, and fireball.

The Hubble Space Telescope (HST) had the same viewing position as Earth-based observers. HST observed impact plumes above the limb. All plumes were the same altitude at 3300 km. Also, large amounts of Ammonia and Ammonia/Hydrosulfide clouds - not water clouds were seen. Observations by HST and Galileo suggests small fragment size. Large amounts of Ammonia and Sulfer in the resulting debris clouds. There was a lack of observations of seismic waves. HST with the Kuiper Airborne Observatory indicate the fol-following results: Comet/Jupiter mixture forming debris clouds. Kuiper saw water (Jupiter) and ground - based observations: carbon monoxide (Comet) in the plumes. Much less sulfer. The particles are very fine. Debris blasted at 10-15 km/s - debris struck atmosphere causing heat. HST astronomers and amateurs, were tracking the debris.

Evolution of the Impact Spots and Impact Drifts

In the period after the crash and the weeks after - the Impact Spots changed in appearance, size, and intensity. Some fine work by the "Miami Team" of Hernandez, Beish, and Parker revealed inter-esting changes in evolution of the dark spots. Sectional Drawings and CCD imaging of the impact latitudes reveals the evolution phenomena. See the sequence of drawings which follow at the end of this paper. Also, turn to the next page for the "Impact Tables" illustrating the drifts and rotation periods for the Impact Features and Summary.

In the Impact Rotation Tables below the columns contain the following data: a letter ID for each "impact", number for each marking (or part of), D for Dark, first date of observation, last date of observation, first longitude observed, last longitude observed, drift of marking in 30 days, and resulting rotation period for that drift.

H:

1	Dp	Jul 18-Sep 18	020-000	-09.5	9:55:28
2	Dc	Jul 18-Aug 02	025-025	00.0	9:55:40
3	Df	Jul 18-Sep 08	031-031	00.0	9:55:40

Mean Rotation Period:9:55:36

E:

1	Dp	Jul 18-Jul 23	075-072	-15.0	9:55:20
2	Dc	Jul 18-Aug 21	080-080	00.0	9:55:40
3	Df	Jul 18-Jul 24	085-082	-15.0	9:55:20

Mean Rotation Period:9:55:27

A:

1	Dc	Jul 17-Aug 14	113-105	-08.9	9:55:28
2	Df	Jul 17-Aug 14	116-110	-06.7	9:55:31

Mean Rotation Period:9:55:30

C:

1	Dc	Jul 18-Aug 19	149-148	-00.9	9:55:39
2	Df	Jul 18-Jul 31	158-159	-02.0	9:55:43

Mean Rotation Period:9:55:41

K:

1	Dp	Jul 19-Aug 22	187-180	-06.4	9:55:32
2	Dc	Jul 19-Aug 17	191-185	-06.0	9:55:32
3	Df	Jul 19-Aug 17	196-193	-03.0	9:55:37

Mean Rotation Period:9:55:34

W:

1	Dp	Jul 19-Aug 05	204-199	-08°.3	9:55:29
2	Dc	Jul 19-Aug 22	210-202	-06.7	9:55:31
3	Df	Jul 19-Aug 12	214-211	-03.8	9:55:35

Mean Rotation Period:9:55:32

L:

1	Dp	Jul 20-Aug 27	265-242	-17°.7	9:55:16
2	Dc	Jul 20-Sep 18	269-246	-11.5	9:55:25
3	Dc	Jul 20-Aug 02	276-270	-03.0	9:55:37
4	Df	Jul 20-Sep 18	280-263	-08.5	9:55:29

Mean Rotation Period:9:55:27

G-D-S:

1	Dp	Jul 18-Sep 01	294-292	-01°.3	9:55:39
2	Dc	Jul 18-Sep 03	298-297	-00.6	9:55:40
3	Dc	Jul 18-Aug 19	310-305	-04.6	9:55:34
4	Dc	Jul 18-Aug 28	320-311	-06.4	9:55:32
5	Df	Jul 18-Sep 04	325-320	-03.1	9:55:36

Mean Rotation Period:9:55:36

R:

1	Dc	Jul 21-Jul 25	331-330	-00°.2	9:55:40

Q2:

1	Dc	Jul 22-Jul 25	345-345	00°.0	9:55:40

Q1:

1	Dp	Jul 27-Aug 16	349-335	-20°.0	9:55:13
2	Dc	Jul 20-Aug 18	353-349	-04.0	9:55:35
3	Df	Jul 22-Aug 11	355-355	00.0	9:55:40

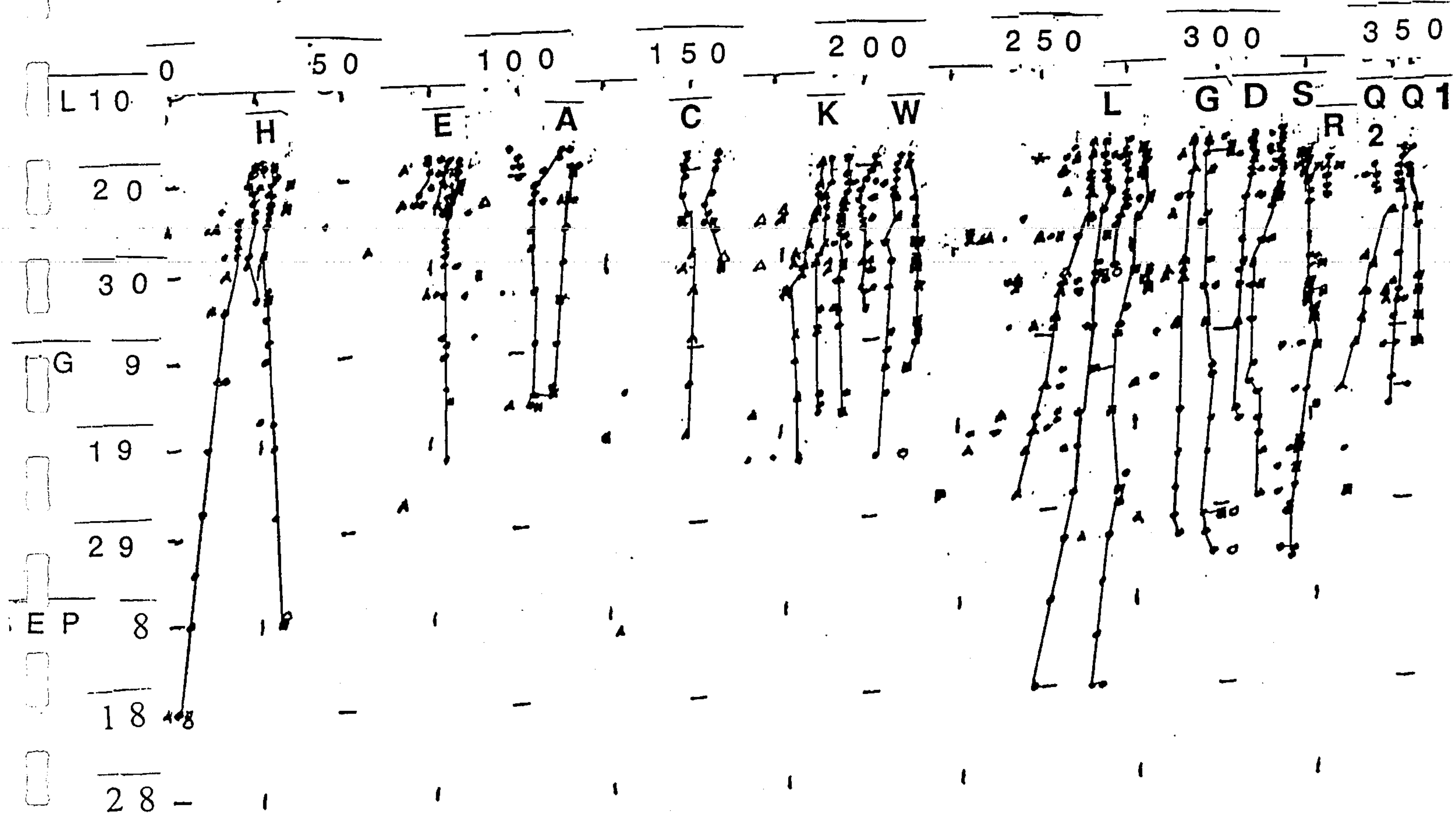
Mean Rotation Period:9:55:29

Mean Rotation Period:9:55:34
(All Impacts)

SUMMARY

Even a casual glance at the tables indicates the fairly close agreement of the mean values for the rotation periods of these impact spots. The mean period for the SSTB latitudes for 39 apparitions: 1952-1994 was in the range of 9:55:04-9:55:06 in System II. The mean period for the radio system (sub-surface regions near the core) is 9:55:29.710 in System III. The mean periods for each impact spot; as well as the mean rotation period for all spots (9:55:34 in System II) agrees quit well with the radio period of 9:55:29.710 in System III.

JUPITER 1994 ALPO (II)



P W B

Observations and Reflections

Most experts agree that the fragments were smaller than orginally predicted; a range of 0.1-1.0 km. However, some were larger than others - therefore, why did all the plumes rise to about the same height (3,300 km)? How far did the fragments pentrate? Where did the dark material (dark spots) come from - (Jupiter, Comet, or both)? How high did the material (ejecta debris) reach? A.L.P.O. transit observations and their drifts indicate a general linear; or slightly negative, drift. Linear would mean fairly stationary in System II. Some changes in appearance (evolution) was noted. Were the "eyebrows" or "arcs" noted on many drawings and CCD images a result of the impact-material shotting into the the upper atmosphere and raining back down or some other phenomena? Do the dark spots (dark blue or black in color) lie deeper in the atmosphere - then earlier believed? Are we looking at a "vortex" material or high debris clouds moving near the System III rotation period of 9:55:29-.710. Comparison studies by the A.L.P.O. and Cecil Post of Las Cruces, A.L.P.O. of the observed impact spot locations (longitudes) in System II with calculated positions of impacts in System III indicate quite good agreement in locations of impact spots. Strengthning the theory that the impact debris spots are locked-in with the rotation of the magnetic field!

During the current apparition of Jupiter (1994-95) the SSTB (45 S) was dark and possible "impact remanents" were observed near 133 (II), 147 (II), 345 (II), 158 (II), and 52 (II). by

A.L.P.O. observers. The belt is was still dark and had become somewhat curved in appearance. In closing we might say: "More questions are raised, than answered; but that is the nature of researching this unique event of our lifetime!

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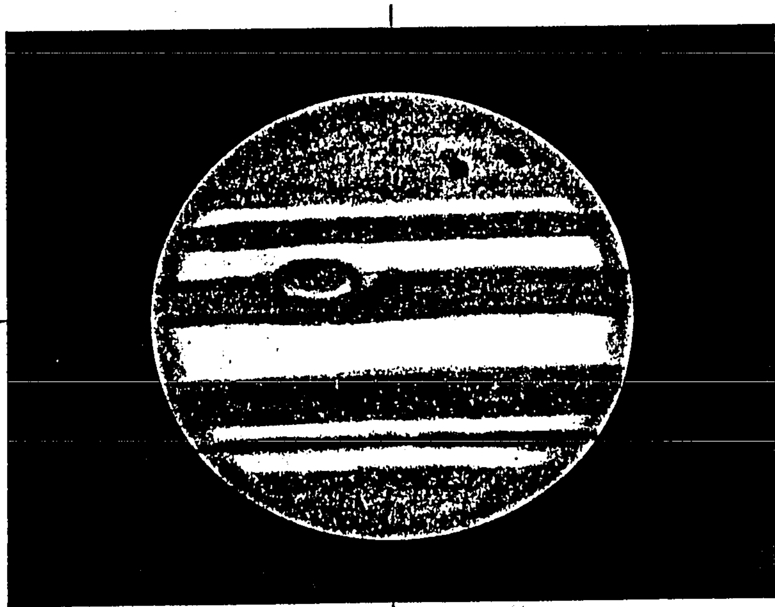
Jupiter Drawing Form

South   Two dark spots are comet impact sites.

Preceeding —  — Following

North

Date (UT) July 18, 1994 U.T.

Observer Mr. Jose Olivarez

Address 1469 Valleyview Court

Wichita, Kansas 67212

Telescope: Aper. 10-inch Type Reflector (f/7)

Magnification(s) 195X

Filter(s) None

Seeing (0-10 scale) 5

Transparency (lim. mag.) Variable clouds (cirrus) goinf by

UT Start ______ UT End ______

CM(I): Start ______ End ______

CM(II): Start ______ End ______

The comet impact site on the left was very dark & appeared to have a plume as shown, The impact site on the right was a liitle larger, not as intense and a little further south than the darker one preceeding it, The dark impact site was so intense that I felt that it could be seen even with a 4-inch aperture! It was reminescent of a satellite shadow!

"A.L.P.O. JUPITER SECTION VISUAL OBSERVATION FORM"

Filter *None*

DATE (UT) *July 20, 1994*

TIME (UT) *01:12*

TELESCOPE *10" Newt. Reflector f/..*

MAGNIFICATION *197x*

SEEING *6-7* TRANS. *Twilight-..*

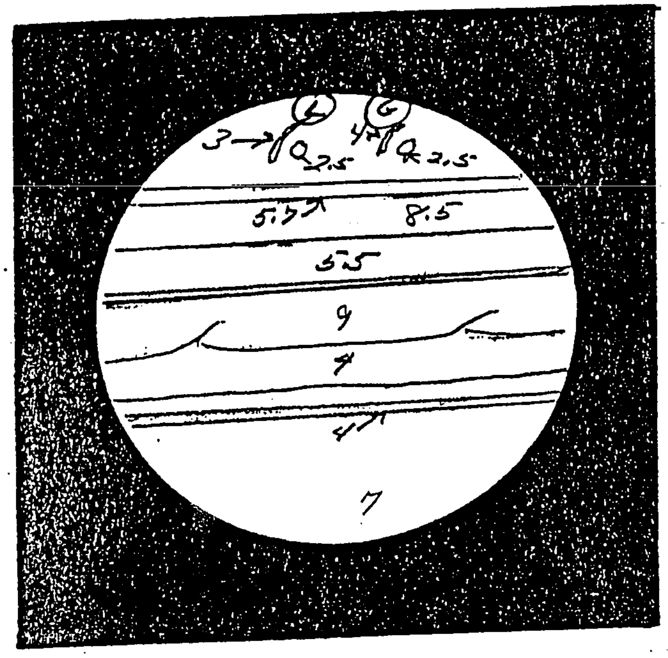
OBSERVER *Robert L. Robinson*

ADDRESS *1126 Valley View Ave.*
Morgantown, West Virginia

SYSTEM I *230°.35* II *281°.45*

NOTES

D spot p. CM probably due to L fragment (≈ 2.30 hr old).
Dspot f. CM probably due to G fragment (≈ 41 hr old). } *2:01 DC Spot*
SPR 311°.1 (II)
Partial rings distinctly seen



Filter

DATE (UT)

TIME (UT)

TELESCOPE

MAGNIFICATION

SEEING TRANS.

OBSERVER

ADDRESS

SYSTEM I II

NOTES

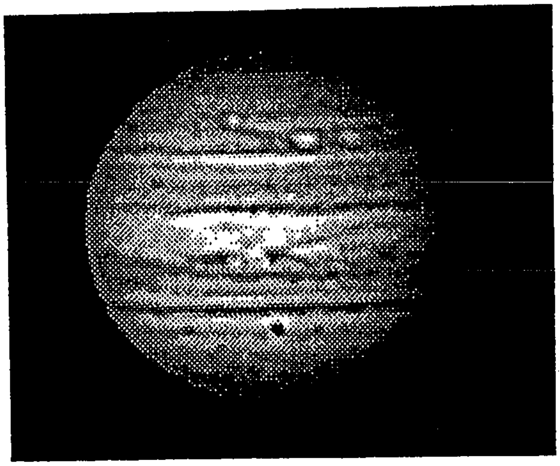


Figure 1. CCD image of Jupiter as it appeared on 14 July 1994 before comet fragment 'A' impact occurred. Image by Don Parker, 41cm f/6 reflector in Coral Gables, Florida.

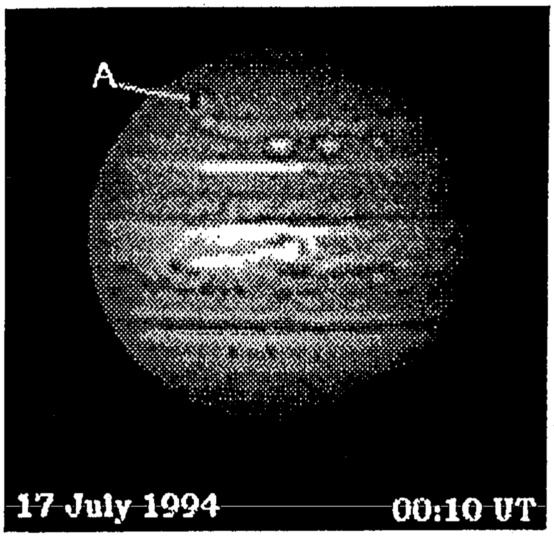


Figure 3. CCD image of Jupiter as it appeared on July 17, 1994 at 0006 U.T. (CMI = 77°, CMII = 151) after the fragment 'A' impact occurred. Image taken by Don Parker with a 41 cm reflecting telescope coupled to a Lynxx CCD camera.

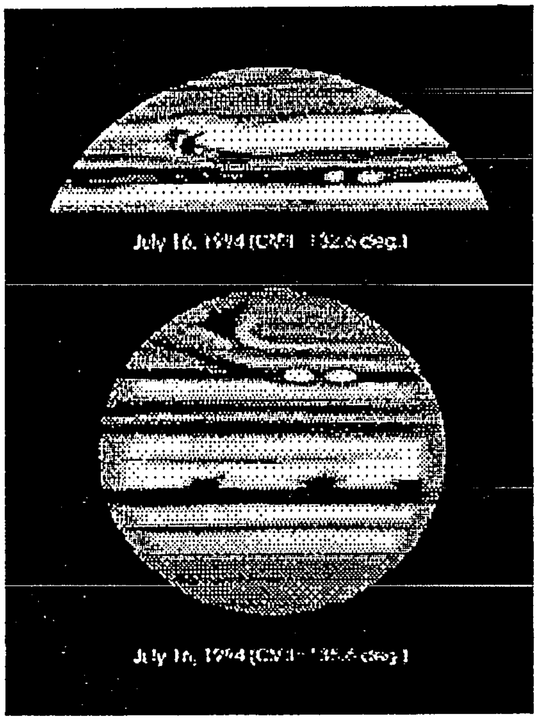


Figure 2. Drawing at the top by Jeff D. Beish is a sectional sketch of Jupiter's southern hemisphere made on July 16, 1994 at 2335 U.T. using a 16-inch (41cm) f/6.9 reflector at 225x 382 x (CMI = 58°, CMII = 132.6°). The bottom drawing was made by Carlos E. Hernandez shortly after Beish at 2340 U.T. on the same date with the same instrument.

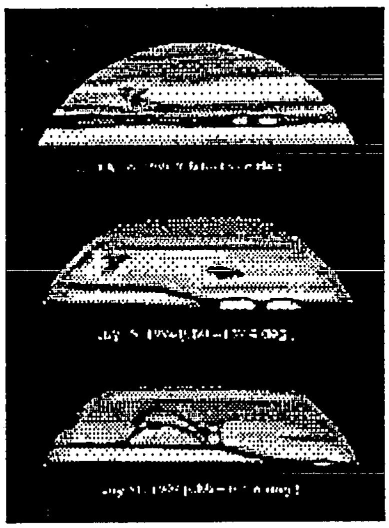


Figure 4. Top sketch by Jeff Beish on July 16, 1994 at 2335 U.T., center sketch by Carlos Hernandez on July 19, 1994 at xxxx U.T., and bottom sketch by Hernandez on July 31, at xxxx U.T., all using 16-inch (41 cm) reflecting telescope at 225 x to 382x.

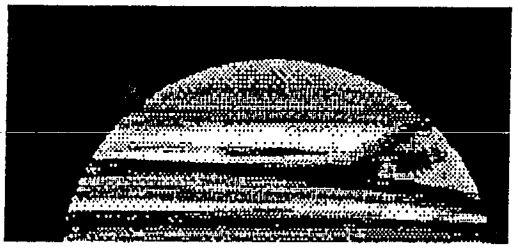


Figure 5. Fragment 'B' as sketched by Jeff Beish on July 17, 1994 at 0335 U.T. (CMI = 204°, CMII = 277°).

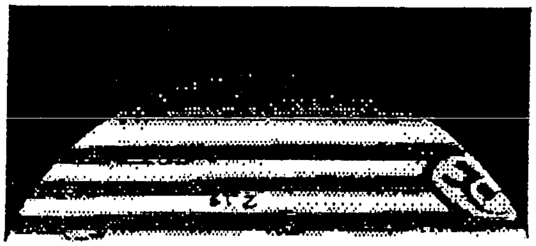


Figure 1. Drawing of impact fragment F (16) by Tippy D'Auria on July 18,1994 at 0239 U.T. (CMII = 34°).

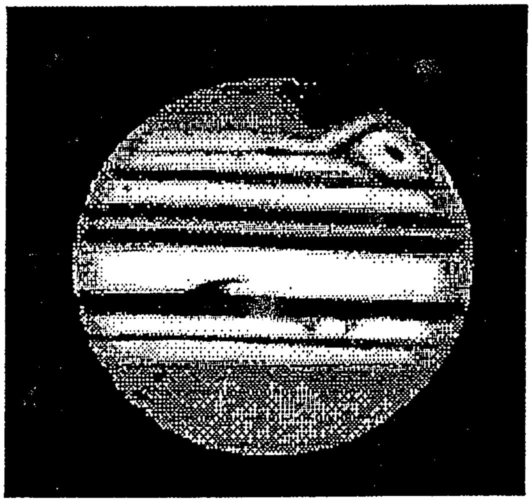


Figure 6. Fragment 'B' as sketched by Carlos Hernandez on July 17, 1994 at 0335 U.T. (CMI = 204°, CMII = 277°).

Figure 2. Robert L. Robinson on July 19, 1994 at 0043 U.T., (CMI = 55° , CMII = 114°), fragments E (17), A (21), and C (19). White ovals BC and DE shown in STB.

Figure 3. Phillip Budine on July 21, 1994 at 0100 U.T. (CMI = 20°), CMII = 58°) ,showing fragments Q (7), H (14), E (17), and the Great Red Spot (43°W).

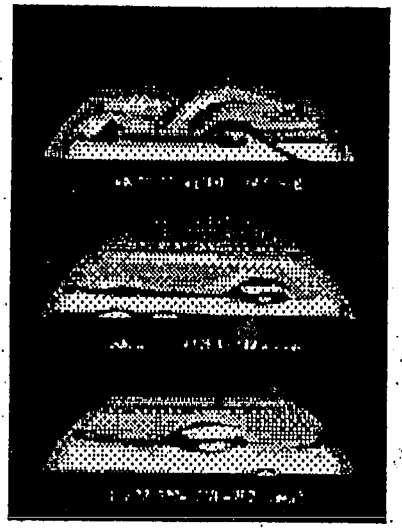


Figure 4. Three sketches made by Hernandez from July 22 to 27 showing the evolution of complex located between 190°-214°W . The top figure on July 22 at 0010 U.T. (CMII=185°) shows impact fragments U, W , and K. Middle sketch on July 24, 0155 U.T. (CMII=188°W) shows further development of complex that now has dark filaments between impact sites. Bottom was made on July 27, 0000 U.T. (CMII=209°W) shows complex enlarged in area with merging impact sites of fragments U and W and a westward (increasing longitude) extension of K.

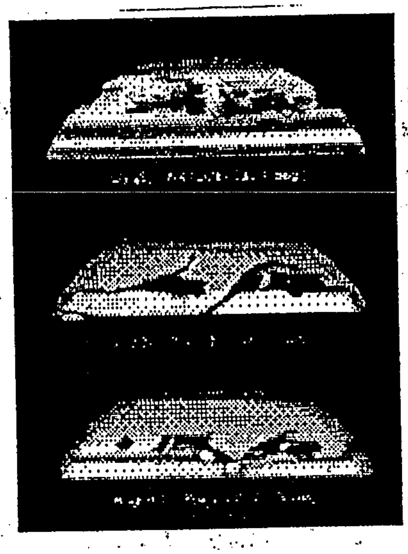


Figure 5. Composite of three figures drawn by Béish and Hernandez from July 16 to 31 showing evolution of fragment A impact site. Top figure by Beish is the discovery sketch made on July 16, 1994 at 2335 U.T. (CMII=133°W) showing dark crescent-shaped impact site. Middle figure by Hernandez on July 19, 0125 U.T. (CMII=139°W) shows fragment A impact site towards the preceding (left) limb. Lightened in appearance and now exhibits a more prominent ray system to the south and to the north. Bottom figure by Hernandez on July 31, 0020 U.T. (CMII=102°W) shows longitude of fragment A impact site but is now not visible and area only has dark filaments projecting from the South South Temperate Belt (SSTB) towards south as well as two small, bright ovals.

ALPO

Through the Telescope

Newsletter of the Association of Lunar and Planetary Observers

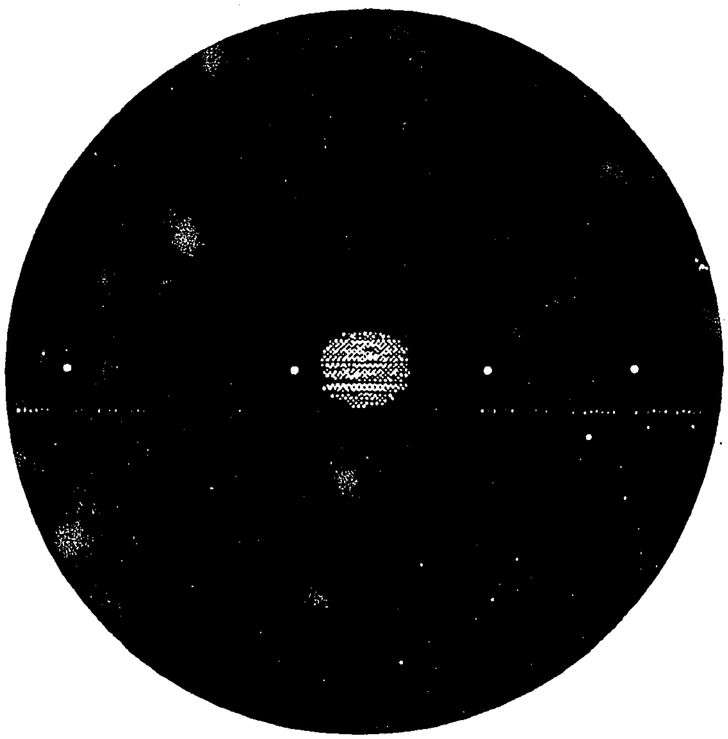
9460 Toni Drive, Miami, Florida 33157

OBSERVING JUPITER: JOVIAN NOMENCLATURE, CENTRAL MERIDIAN TRANSITS, ROTATION PERIODS, AND STATISTICS

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

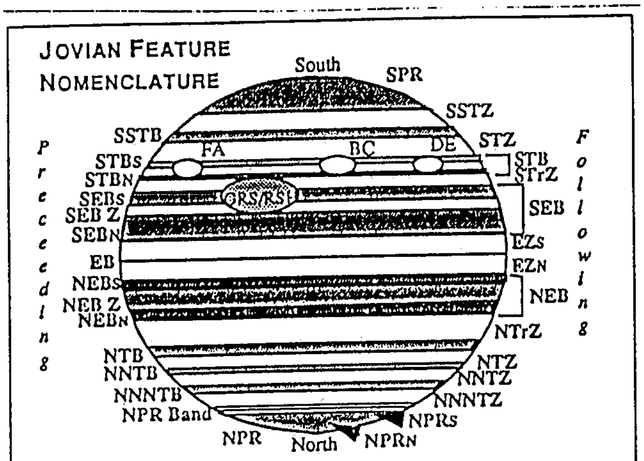
Abstract

The nomenclature for the visible features on Jupiter's cloud surface are outlined. The procedure for recording central meridian transits of these features is discussed along with their reduction to determining drift rates and rotation periods. Finally, "statistics" are listed in table format for the Great Red Spot (including size, intensities, and colors); the STB long-enduring white ovals; the SL-9 Impact Sites of 1994 and a complete Summary of Rotation periods of Jovian Currents and important features for the fourty year period: 1952-1993.



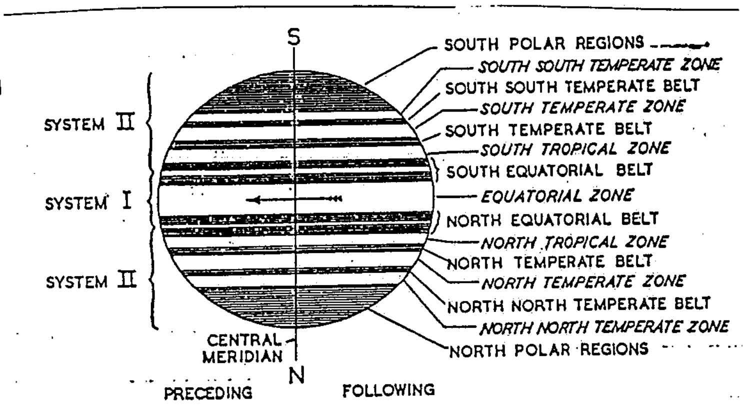
Jupiter and its satellites (Galilean) through the eyepiece

An artist's conception of the appearance of Jupiter and the four Galilean satellites as viewed through an eyepiece at approximately 200 times magnification (200X). At this magnification detail upon the disk of Jupiter becomes apparent. South is at the top and north at the bottom since we are viewing through an inverting telescope (without a star diagonal). The North Equatorial Belt (NEB) is prominent over the bottom, or northern, half of the disk. The two polar regions appear rather dusky and the Great Red Spot (GRS) is visible over the South Tropical Zone (STrZ) just following (f), to the right of, the central meridian, an imaginary line between the poles that bisects the disk into halves. The Galilean satellites appear as bright points and if the atmosphere, or seeing, is steady enough then small disks may become visible. A photograph attempting to show both Jupiter and its satellites would show an overexposed image of the planet. This is a good magnification to begin observing detail upon the disk of Jupiter. CCD image of Jupiter courtesy of Donald C. Parker. Illustration by Carlos E. Hernandez.

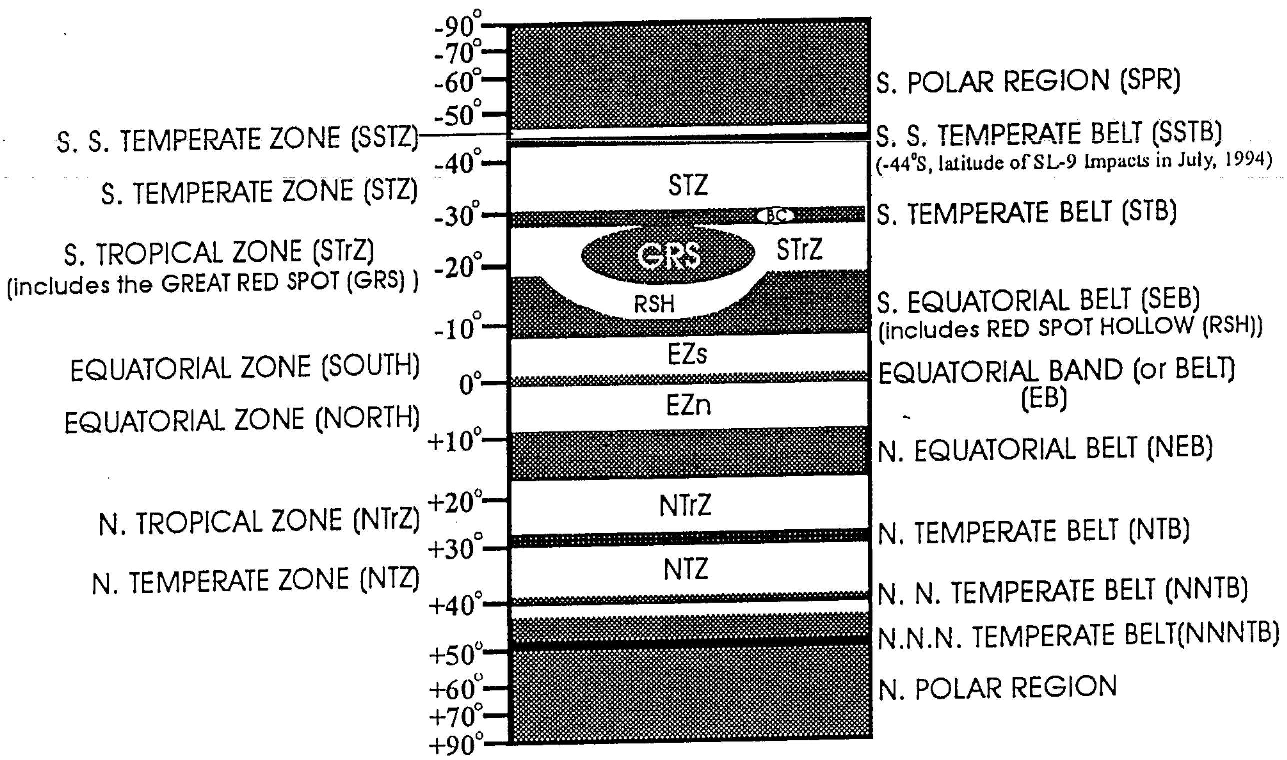


Abbreviation Key:

S, s = South	B = Belt
N, N = North	Z = Zone
E = Equatorial	R = Region
P = Polar	RS = Great Red Spot (Long. Var.)
T = Temperate	RSH = Red Spot Hollow
Tr = Tropical	(FA, BC, and DE are long-term white spots whose longitudes vary)



Standard nomenclature for the belts and zones of Jupiter, shown in a typical simply inverted view. Also shown are the nominal ranges of the rotational Systems I and II.



Nomenclature of Jupiter's Belts and Zones

Depicted are the major **belts**, dark bands, and **zones**, light bands, of Jupiter. South is at the top to conform to the view of an inverting telescope. The two most prominent belts are the *North Equatorial Belt (NEB)* and the *South Equatorial Belt (SEB)*. The characteristic bay, or large depression, of the SEB, the *Red Spot Hollow (RSH)* is visible partially enclosing the *Great Red Spot (GRS)* itself to the south. A thin,dusky belt (or band) is sometimes seen across the Equatorial Zone (EZ) appearing to divide it in two called the *Equatorial Belt (or Band)*, but it is not always visible. The *Great Red Spot (GRS)* lies over the *South Tropical Zone (STrZ)* and it moves mostly in longitude and minimally in latitude. The *South Temperate Belt (STB)* is visible south of the SEB and within this belt the *long-enduring white ovals (BC, DE, and FA)* are located. The *North Temperate Belt (NTB)* is usually prominent below, to the north of, the NEB. The *South South Temperate Belt (SSTB)* at -44°S is the approximate latitude of the impacts of the fragments of Periodic Comet Shoemaker-Levy 9 (1993e) between July 16 to 22, 1994, but this thin, faint belt is not always visible so the amateur astronomer should monitor the region between the South Temperate Belt (STB) and the *South Polar Region (SPR)* instead. The *North Tropical Zone (NTrZ)* as well as the *South Temperate Zone (STZ)* and *North Temperate Zone (NTZ)* are usually prominent as well. The other smaller belts and zones may or may not be present during an apparition, the period of visibility of a planet, but if visible they should be reported to the respective Jupiter Recorder. The width of the belts and zones above +20° and -20° are exaggerated due to the mercator projection used to represent them. This schematic is to be used only as a guideline as far as what to expect when observing the planet Jupiter. Illustration by Carlos E. Hernandez..

transits of visible markings during the period of observation. To do this, all you need is a good timepiece. You will have to become acquainted with Jovian nomenclature. (Whenever you observe the planet, south is at the top of the field of view. Here is the order of presentation of the major belts and zones of Jupiter: The SPR, SSSTB, SSTeZ, SSTB, STeZ, STB, STrZ, SEBs, SEBZ, SEBn, EZs, EB, EZn, NEBs, NEBn, NTrZ, NTB, NTeZ, NNTB, NNTeZ, NNNTB and the NPR). Once the beginner has become familiar with this terminology, he or she may go to the telescope and locate features for the purpose of

No.	UT	Object	Location	CM I	CM II
1	2:58	Wp oval	center STB	–	241°
2	3:09	Wc oval	center STB	–	247°
3	3:10	Wp rift	n. side NEB	–	248°
4	3:20	Wf oval	center STB	–	254°
5	3:33	Dc dusky column	NTeZ	–	262°
6	3:36	Dc low projection	s. edge SEB	–	264°
7	3:47	Wc notch	n. edge NEB	–	271°
8	4:00	Dc base of festoon	s. edge NEB	62°	–

A List of Transits

making CM transits. If the marking is dark, we shall identify it with the letter D. If the marking is bright, we shall identify it with the letter W for white. Also, use p for preceding end, c for center, and f for following end. All features crossing the central meridian tend to move in the preceding direction away from the following half of the disc of Jupiter. (Hence, east is to the left and west is to the right.)

The procedure for recording a CM transit is as follows: (1) Record the universal time (U.T.) when the object is on the imaginary meridian that bisects the planet into two halves. (Add 5 hours to EST, 6 hours to CST, 7 hours to MST, and 8 hours to PST.) Record this time to the nearest minute. (2) Write down in your notebook all of the information that identifies the feature that you have timed. (D or W, p, c, or f, etc.) (3) Write a description of the marking. If it is a dark marking, is it a condensation, an elongated condensation, a rod, a low projection, a short hook, a tall festoon, a loop festoon, a column, a veil (or shading), a disturbance, or a darker section of a belt (or component)? If it is a bright marking, is it a notch, a gap, a rift, a streak, a nodule (or a small patch), a large patch, a closed oval, or a bay (or an open oval)? (4) Locate this marking on the planet. In which belt or zone can it be found? Write it down. (Jupiter, because it is gaseous, requires two systems of longitude, since the equatorial region rotates about five minutes faster than the rest of the planet. System I includes the north edge of the SEBn, all of the EZ, plus the south edge of the NEBs. System II includes the remainder of Jupiter, with a few exceptions. For example the chief one is this: the south edge of the NTB moves in System I). (5) Indicate in which system of longitude the marking is located. The numerical value of this transit may be completed later on. (Note down the result.)

How should you compute the System I (or II) longitude? (1) Look up the longitude in System I (or II), whichever applies, for 0h dynamical time in the Astronomical Almanac for the date of the observance. (To convert this to U.T., longitudes, increase the value given by 1/2 a degree.) (2) Write down this longitude on a sheet of scrap paper. Compute the time difference and add it to this value. Consider the delta below:

1m	0.6 degrees I	0.6 degrees II
2m	1.2	1.2
3m	1.8	1.8
4m	2.4	2.4
5m	3.0	3.0
6m	3.7	3.6
7m	4.3	4.2
8m	4.9	4.8
9m	5.5	5.4
10m	6.1	6.0
20m	12.2	12.1
30m	18.3	18.1
40m	24.4	24.2
50m	30.5	30.2

60m	36.6	36.3
2h	73.2	72.5
3h	109.7	108.8
4h	146.3	145.1
5h	182.9	181.3
6h	219.5	217.6
7h	256.1	253.8
8h	292.7	290.1
9h	329.2	326.4
10h	5.8	2.6
11h	42.4	38.9

(For 2h 19m in System I: we have 73.2 + 6.1 + 5.5 = 84.8 degrees, etc. For 5h 05m in System II: we have 181.3 + 3.0 = 184.3 degrees, etc.) If it is necessary, subtract 360 degrees from the combined value, whenever it is too large.

It is also important to make strip sketches of the belts and zones, whenever they are very active. Include all markings in proper scale, of course. You may also make detailed sectional drawings of disturbances, the long enduring ovals, and the GRS region.

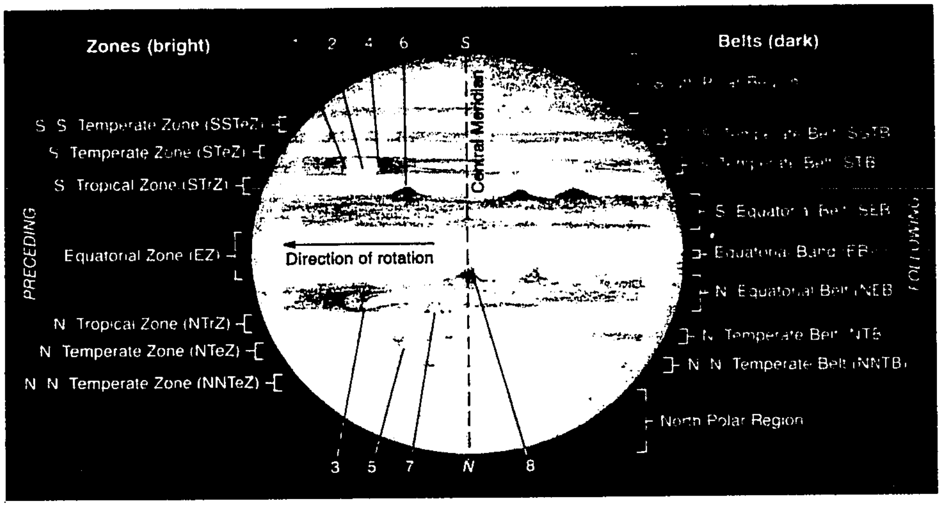
Jovian Nomenclature and Transit Observations

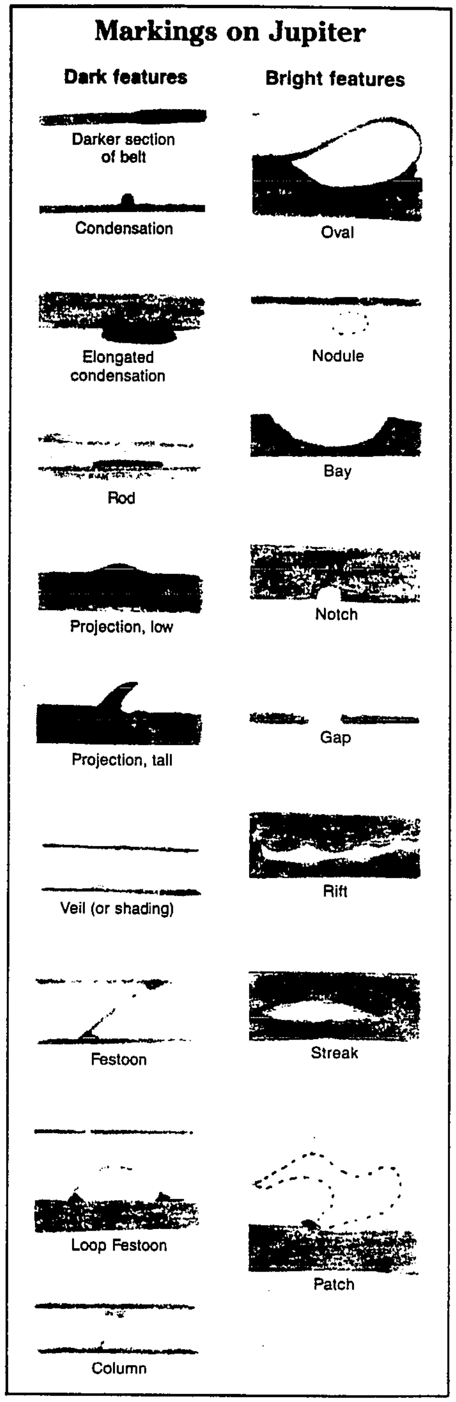
There is perhaps a need to standardize our nomenclature of Jovian surface detail if for no other reason than to expedite and clarify the recording of central meridian transit observations. Anyone who has compiled several hundred transit observations during an apparition will appreciate the task of copying a long list of transits containing very lengthy descriptions. He or she will also appreciate the desirability of abbreviating these descriptions as much as possible without sacrificing necessary information. It is also desirable that the recorder will be able to determine at a glance whether the object observed was a white or bright marking (W) or a dark marking (D), and whether the preceding end (P), center (C) or following (F) was on the central meridian.

Thus, if the observer will begin each description of a transit with the capital letter (W) or (D) with the proper subscript (P, C, or F) the all-important part of the description will have been recorded! If these letters are followed by an abbreviation indicating the type of marking observed, the recorder is frequently aided considerably in identifying and following the marking from day to day. A useful nomenclature classification was developed by the author and Elmer J. Reese of the A.L.P.O. thirty-one years ago. This nomenclature is as follows:

C. Nomenclature for Transits

Nomenclature	Abbreviation
Dark Marking	D
White or Bright Marking	W
Center	C
Preceding	P
Following	F
North	N
South	S
Very	V
Large	L
Small	Sm
Projection	Proj.
Condensation	Cond.
Elongated	Elong.
Conspicuous	Conspic.
Indefinite	Indef.
Section	Sect.
Festoon	Fest.
Column	Col.
Disturbance	Dist.
Central Meridian	C.M.
System I	(I) or CM1
System II	(II) or CM2





No.	UT	Object	Location	CM I	CM II
1	2:58	Wp oval	center STB	–	241°
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4	3:20	Wf oval	center STB	–	254°
5	3:33	Dc dusky column	NTeZ	–	262°
6	3:36	Dc low projection	s. edge SEB	–	264°
7	3:47	Wc notch	n. edge NEB	–	271°
8	4:00	Dc base of festoon	s. edge NEB	62°	–

The drawing of Jupiter at top refers to this log of transit times. Each number feature refers to an entry in the log.
CMI and CMII are the System I and II longitudes of the planet's central meridian at the times noted. This drawing and log are hypothetical examples.

Standard nomenclature for Jupiter's Dark and Bright features. Prepared by Phillip W. Budine

(1) Dark Markings (D)

Darker Section of a Belt: The temperate belts frequently display darker sections having well-defined preceding and following ends.

Condensation (Cond.): A small round or somewhat elongated spot which is intensely dark. Condensations range is size from tiny specks to spots comparable to the shadow of Satellite III (Ganymede). If elongated, the long axis is usually parallel to the equator.

Rod or Bar: A very elongated condensation with its major axis usually parallel to the equator. In some instances, a rod may be an isolated short section of an otherwise invisible belt. Rods are quite common along the north edge of the NEB and in north temperate latitudes. Intensely dark rods are frequently seen embedded in the NEB.

Projection (Proj.): A dark protuberance on the edge of a belt. The protuberance may or may not be darker than the main body of the belt. Projections vary in form from low, rounded humps to tall, spike-like objects. Frequently seen on the south edge of the NEB.

Veil or Shading: A uniform dusky area of large size sometimes found in the polar regions and in the zones.

Festoon (Fest.): A dusky filament crossing a zone or looping out into a zone. One or both ends of a festoon may terminate at a dark condensation or projection on the edge of a belt. (Photographic and visual observations with large telescopes indicate that at least some festoons are merely the background duskiness in a zone seen around the edges of numerous, closely packed, bright oval areas). The base (or bases) of a festoon should be selected when timing its transit across the central meridian. Frequently seen in the EZ, NEB zone, and on the South edge of the NEB.

Column (Col.): A columnlike dusky area in a zone. A column may be either vertical or somewhat inclined. Columns appear most often in the STrZ and the SEBZ. Thinner columns are sometimes classified as festoons.

Disturbance (Dist.): A dark or dusky area of large size, more or less sharply defined, and usually mottled with smaller detail which may assume unusual shapes. True disturbances seem to be limited to the STrZ and SEBZ.

(2) White or Bright Markings (W)

Oval: Medium to large, round or oval-shaped area that is fairly bright and well-defined. Very common in the EZ.

Nodule: Small, very bright spot, usually round and not much larger than the disc of Satellite III (Ganymede); frequently much smaller. Occasionally seen in the SEB, NEB, and the polar regions.

Bay: A large, usually semi-oval indentation in the edge of a belt. Frequently seen along the south edges of the NEB and STB, and occasionally on the North edge of the NEB. The outstanding example is the famous Red Spot Bay in the southern part of the SEB.

Notch or Nick: Small, semi-circular indentation in the edge of a belt. Usually somewhat brighter than the adjacent zone. Some notches are produced by nodules situated along the edge of a belt. Notches are found most frequently along the north and south edges of the NEB.

Gap: A rather wide break in a belt. A very faint or missing section of a belt.

Rift: A long, usually thin, bright streak extending more or less horizontally along the interior of a belt. Most common in the SEB or NEB when the belt is dark and prominent.

Streak: A very elongated white spot. When situated within a belt, a streak may be a fragment of a rift.

Patch: Irregular whitish area of large size and indefinite outline. Sometimes found in the polar regions and the EZ.

Procedures for Making and Reducing CM Transits of Jupiter

The visible detail of the Jovian atmospheric surface takes place in its extensive, complex, and always changing belts, components and zones. Each of the many permanent or temporary Jovian currents rotates in a sharply bounded, often narrow region of latitude. Visual CM transit observations provide almost all that is known about the rotational characteristics of Jupiter.

An observer soon discovers that rotation periods derives from markings near the equator of the planet are about five minutes faster than those that are located in temperate and polar latitudes. And this difference is great enough to render the use of a single zero meridian quite unsuitable as a line of reference for both classes of objects. Two systematic references are used: system I and system II. System I objects tend to be within ten degrees of latitude north or south of the Jovian equator. It is defined for one rotation of the equatorial region of Jupiter to be 9h 50m 30.003s. System II objects tend to be elsewhere. It is defined for one rotation of the planet to be 9h 55m 40.632s. Most features observed on Jupiter conform to these two periods with variations on the order of seconds. Both periods are arbitrary, the respective base points of the two 0.0 degree lines of longitude are referred to a single point in time, July 14, 1897.

If a spot is recorded on the CM (the imaginary line of division midway between the preceding and the following lines normal to the equator), then its longitude is simply equivalent to same. Recording as many of these spots as one can perceive is a chief occupation of the Jupiter Section. The means for observation is very simple. Nothing more than a pencil, notebook and a reliable timepiece is required in addition to a telescope with some resolving power. The timepiece should be accurate to within 30 seconds and the seeing should be very good, at least seven on a scale of zero to ten. The rotation of the planet is rapid and causes a noticeable displacement near the CM within several minutes, which is equivalent to some few degrees of longitude. A mark may seem to be on the CM for as long as three minutes or less depending on the time of the initial observation. If a first judgment is made when it is on same and a second one when it is off, then the midpoint of these two timings is the very best estimate.

Every observer must learn how to describe the features he (or she) observes on the CM. Transit features need to be placed in latitude in relationship to the belts and zones of Jupiter. The observer must become familiar with the nomenclature listed above, because it is the best framework for his (or her) observations. When recording transits on the A.L.P.O. form one needs to be methodical. Abbreviation will facilitate the effort. All of the Jovian markings can be classified either as bright spots or as dark ones. Use W for white, D for dark. p for preceding end, c for center and f for following end, followed by a brief description of the feature. The special nomenclature for specific markings can be found above, as well. If the color of the marking tends to be distinct from that of the belt or zone in which it is situated, this too should be noted. This will facilitate analysis.

When the transit times have been reduced to longitudes, the results are plotted on graph paper against the dates of observation. The most satisfactory scale is twenty days to one inch, plotting time vertically rather than horizontally. This is valuable since it reminds one of the proper orientation of Jovian markings. As the eye runs down the diagram, the history of the various positions becomes apparent, just as one might have actually observed them consecutively. The number of observations and the tendency for these to be lined up along a least squares line will determine the significance of an individual's transit observation. Owing to error on the part of the observer, the times judged to represent the true CM position will be off by one to three minutes. An error of this sort spread over a long period of time should not be too significant, however. If sufficient observations are available, then extreme errors can be discarded from a sample. Identification of spots and drawing in the correct drift lines for them is an exacting task for me. I must be cautious about interpreting graphs whenever too few points are available. It is good to have continuity in a chart and at least three decent observations for every six days or less is desirable. (For a useful distribution of observations, one needs only fifteen points for a thirty day period.) The average drift rate for thirty days is used to calculate the rotation period from the limiting dates and longitudes of the spot in question. If

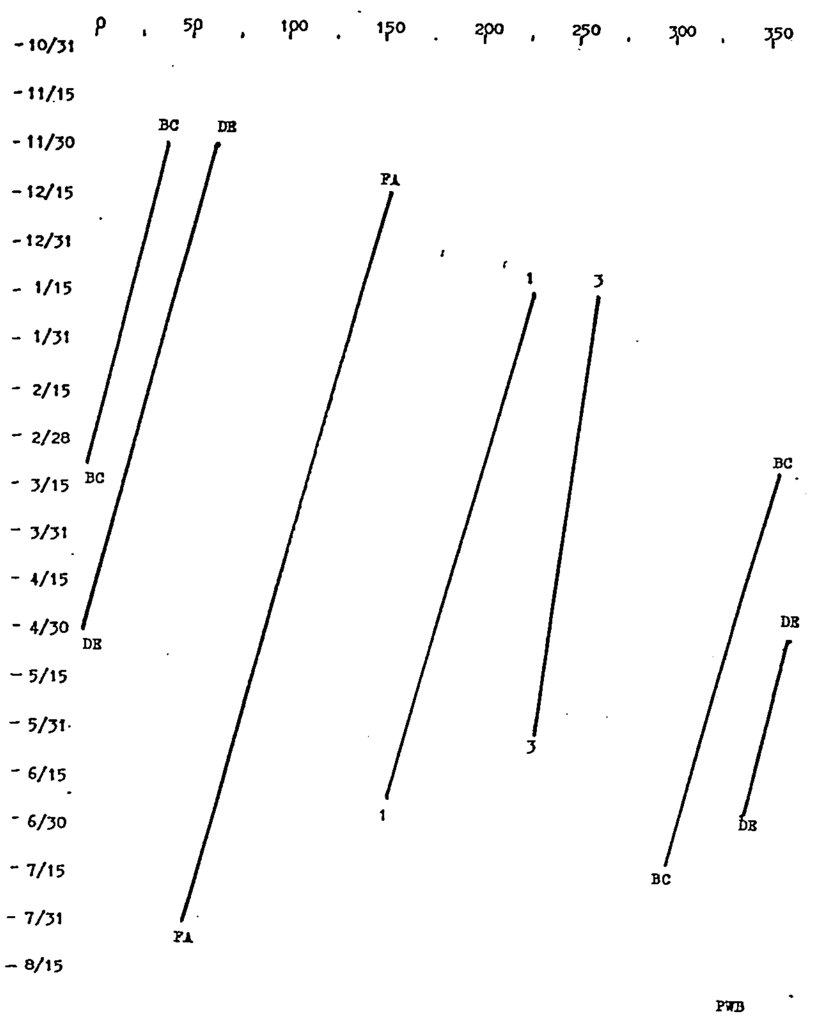
$$\frac{\text{delta x degrees}}{\text{30 days}} = \frac{\text{delta y degrees}}{\text{m}}$$

then

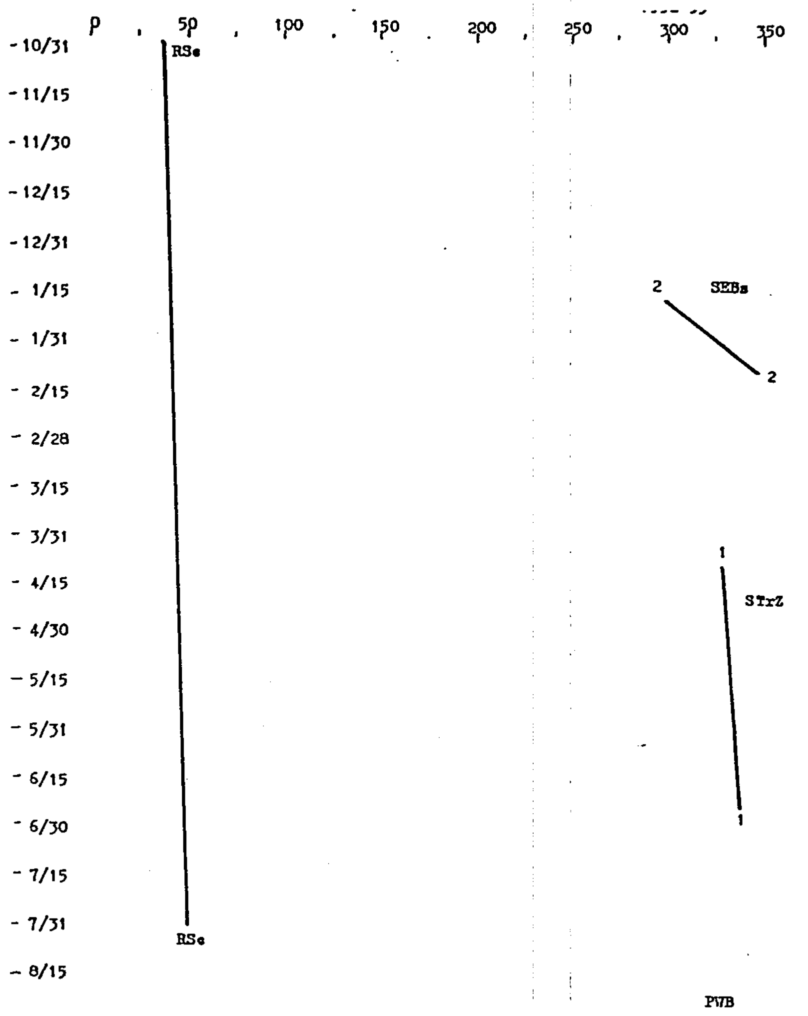
$$\text{delta x degrees} = \frac{30}{\text{m}} \cdot \text{delta y degrees}$$

When the drift has been determined, a rotation period may be ascertained. The result is then published along with every other feature.

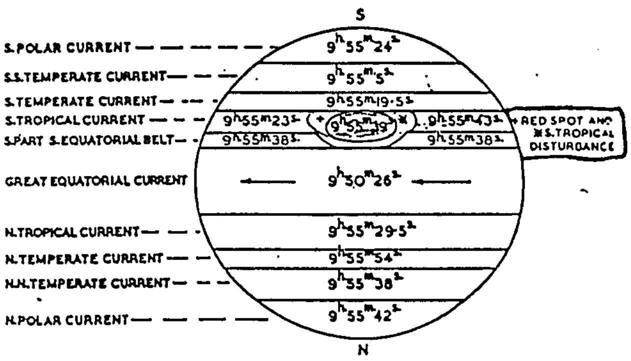
Important Features in System II STeZ—STB—S-STB 1992-93

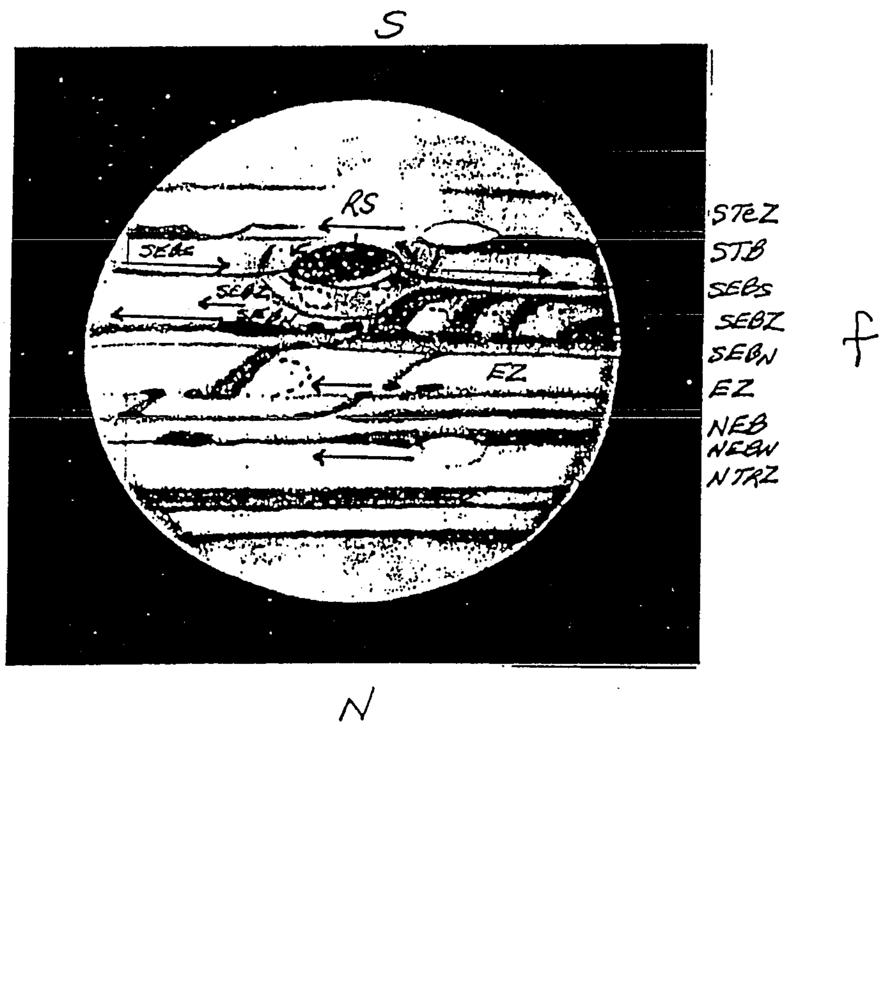


Important Features in System II STrZ—SEBS 1992-93



Drawing and Diagram showing motion and direction of movement for features on Jupiter and mean rotation periods for currents.





Change of Longitude in Intervals of Mean Time.

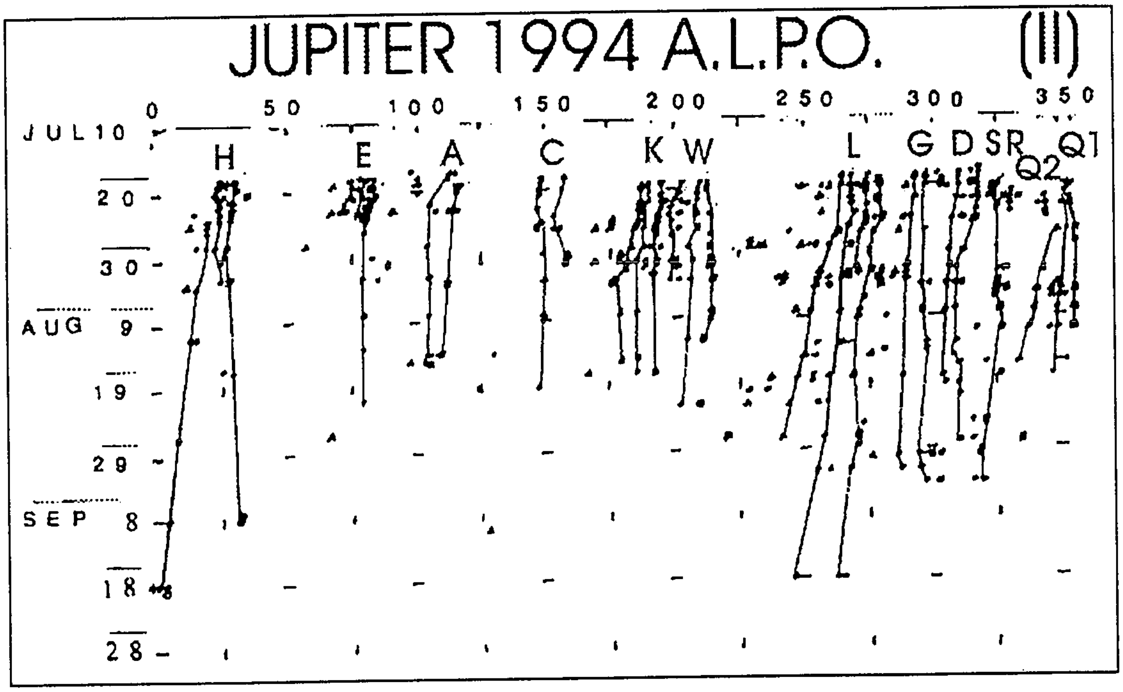
System I

HOURS	DEGREES	MINUTES	DEGREES	MINUTES	DEGREES
1	36.58	10	6.10	1	0.61
2	73.16	20	12.19	2	1.22
3	109.74	30	18.29	3	1.83
4	146.32	40	24.39	4	2.44
5	182.90	50	30.48	5	3.05
6	219.48			6	3.66
7	256.06			7	4.27
8	292.64			8	4.88
9	329.22			9	5.49
10	5.80				

System II

HOURS	DEGREES	MINUTES	DEGREES	MINUTES	DEGREES
1	36.26	10	6.04	1	0.60
2	72.52	20	12.09	2	1.21
3	108.79	30	18.13	3	1.81
4	145.05	40	24.18	4	2.42
5	181.31	50	30.22	5	3.02
6	217.57			6	3.63
7	253.83			7	4.23
8	290.10			8	4.84
9	326.36			9	5.44
10	2.62				

A.L.P.O. SL-9 Impact Sites Drift Rates
(System II)



A drift chart of the Shoemaker-Levy 9 (SL-9) fragment impact sites produced by A.L.P.O. Jupiter Section Recorder Phillip W. Budine from transit observations obtained by A.L.P.O. Jupiter Section members and other contributors.

Transit observations of the SL-9 impact sites and complexes were reduced by the A.L.P.O. Jupiter Section in order to determine the drift rates (or rotation periods) of the SL-9 impact sites and complexes visible between the period approximately two months after the impacts, July 16-September 18, 1994. The SL-9 impact sites and their longitudes (System II) are plotted against time showing an overall drift towards the east (jovian, or decreasing longitude) over the time interval indicated. The following are the mean rotation periods derived for the SL-9 impact sites according to longitude (System II; the 4th column (longitude) refers to the longitude of the feature indicated (SII) on the first and last dates indicated in column 3 as well as the 30 day drift of the feature (- = decreasing longitude (or eastward) and + = increasing longitude (or westward)) ;

SL-9 Impact Site	Object	Dates	Longitude (°) (S II, First date-last date, 30 day drift (- = < long., + = > long.)) FD	LD	D_{30d}	Rotation Period (hours:minutes:seconds)
H (14):	Dp	Jul 18-Sep 18	020	000	-09.5	9:55:28
	Dc	Jul 18-Aug 02	025	025	00.0	9:55:40

	Df	Jul 18-Sep 08	031	031	00.0	9:55:40
			Mean Rotation Period			9:55:36
E (17):	Dp	Jul 18-Jul 23	075	072	-15.0	9:55:20
	Dc	Jul 18-Aug 02	080	080	00.0	9:55:40
	Df	Jul 18-Jul 24	085	082	-15.0	9:55:20
			Mean Rotation Period			9:55:27
A (21):	Dc	Jul 17-Aug 14	113	105	-8.9	9:55:28
	Df	Jul 17-Aug 14	116	110	-6.7	9:55:31
			Mean Rotation Period			9:55:30
C (19):	Dc	Jul 18-Aug 19	149	148	-0.9	9:55:39
	Df	Jul 18-Jul 31	158	159	-2.0	9:55:43
			Mean Rotation Period			9:55:41
K (12):	Dp	Jul 19-Aug 22	187	180	-6.4	9:55:32
	Dc	Jul 19-Aug 17	191	185	-6.0	9:55:32
	Df	Jul 19-Aug 17	196	193	-3.0	9:55:37
			Mean Rotation Period			9:55:34
W (1):	Dp	Jul 19-Aug 05	204	199	-8.3	9:55:29
	Dc	Jul 19-Aug 22	210	202	-6.7	9:55:31
	Df	Jul 19-Aug 12	214	211	-3.8	9:55:35
			Mean Rotation Period			9:55:32
L (11):	Dp	Jul 20-Aug 27	265	242	-17.7	9:55:16
	Dc	Jul 20-Sep 18	269	246	-11.5	9:55:25
	Dc	Jul 20-Aug 02	276	270	-03.0	9:55:37
	Df	Jul 20-Sep 18	280	263	-08.5	9:55:29
			Mean Rotation Period			9:55:27
G (15)/D (18)/S (5):	Dp	Jul 18-Sep 01	294	292	-01.3	9:55:39
	Dc	Jul 18-Sep 03	298	297	-00.6	9:55:40
	Dc	Jul 18-Aug 19	310	305	-04.6	9:55:34
	Dc	Jul 18-Aug 28	320	311	-06.4	9:55:32
	Df	Jul 18-Sep 04	325	320	-03.1	9:55:36
			Mean Rotation Period			9:55:36
R (6):	Dc	Jul 21-Jul 25	331	330	-00.2	9:55:40
Q2 (7b):	Dc	Jul 22-Jul 25	345	345	00.0	9:55:40
Q1 (7a):	Dp	Jul 27-Aug 16	349	335	-20.0	9:55:13
	Dc	Jul 20-Aug 18	353	349	-04.0	9:55:35
	Df	Jul 22-Aug 11	355	355	00.0	9:55:40
			Mean Rotation Period			9:55:29

Mean Rotation Period (All impact sites) 9:55:34

Summary:

Even a casual glance at the tables indicates the fairly close agreement of the mean values for the rotation periods of these (SL-9) impact sites. The mean period for the South South Temperate Belt (SSTB) for 39 apparitions (1952-1994) was in the range of 9:55:04-9:55:06 in System II. The mean period for the radio system (sub-surface regions near the core) is 9:55:29.710 in System III. The mean periods for each impact spot; as well as the mean rotation period for all the spots (9:55:34 in System II) agrees quite well with the radio period of 9:55:29.710 in System III. This apparent association between the mean rotation periods of the impact sites and the radio period may be due to the fact that the SL-9 impact debris from each fragment explosion was thrown very high, estimated to lie hundreds of kilometers above the visible cloud layer, into the jovian atmosphere and therefore would rotate more closely with Jupiter's magnetic field (System III) than with the local zonal current (or jet) below it.

Phillip W. Budine
A.L.P.O. Jupiter Recorder

Carlos E. Hernandez
A.L.P.O.

The Long-Enduring White Ovals

Three long-lived white spots are surviving as little vortices in Jupiter's South Temperate Belt. They are the second longest-lived features on Jupiter; next to the Great Red Spot. They were first observed in 1939 as extended bright areas in the South Temperate Zone. As time went on, the bright sections shrank and became much brighter. By 1947 they had become well formed and appeared as long shallow bays on the south edge of the STB. At that time, for identification purposes, Elmer J. Reese assigned two letters for each white oval. Namely: BC, DE, and FA. The first letter represented the feature's preceding edge and the second letter the following edge. In the following forty years these bays shrank into bright ovals that today are white round spots in the middle of the STB.

From an analysis of how BC, DE, and FA shrank over the last forty years, Elmer J. Reese predicted several years ago that these spots could shrink from existence by 1985. However, their shrinking rate has decreased as they have gotten smaller, and they continue to exist. In 1991 they appeared as "doughnuts" in the very faint STB and were very difficult to observe.

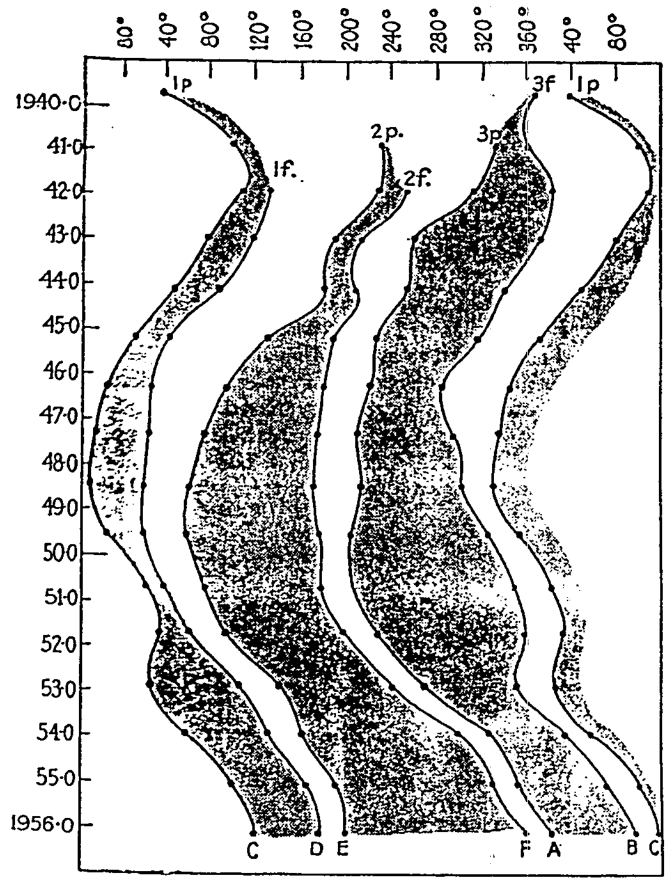
As a comparison of the shrinking behavior, in 1939 the white oval BC covered 30 degrees in area, DE covered 90 degrees in area, and FA spanned 70 degrees in area. However, by 1941 BC had covered 80 degrees in area. By 1951 all three ovals averaged 30 degrees in length. In 1991 BC is 6 degrees long, DE is 6 degrees long, and FA is 5 degrees in length. DE is presently the brightest.

By 1993 all three ovals had increased slightly in length and had a mean length of 8°! BC was the brightest and FA was the faintest in 1993. However, all three ovals had become slightly more conspicuous in the darkening STB.

Note the DRIFT-CHART TABLES for the motions and drift-lines for the STB White Ovals and their conjunctions with the Great Red Spot.

THE LONG-ENDURING WHITE OVALS

CHART OF WHITE OVALS



Graph showing decreasing longitudinal lengths for the STEZ-STB long-enduring white ovals: DE, FA, and BC for the period: 1939-1956

The Great Red Spot

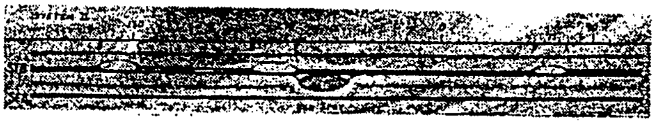
The Great Red Spot (GRS) is the most outstanding large-scale, long-lived feature on Jupiter. Having been observed for over 300 years. It was most likely first seen by Giovanni Cassini in 1665 and was definitely observed in 1831 by Heinrich Schwabe of Germany. The GRS is an immense anti-cyclone; a long-lived high pressure storm in Jupiter's South Tropical Zone. The Red Spot's cloud tops are usually reddish and are cool and complete one counter-clockwise rotation every six days. The GRS has not been real dark since it faded in 1976 after twelve consecutive apparitions. In 1960-61 when it appeared as a dark ellipse, it could easily be seen in small telescopes.

But even though the GRS has not been dark lately, the Red Spot region can still be seen because of the Red Spot Hollow which forms a bay into the southern edge of the SEB. The GRS is located within the large oval area called the RSH. The RSH is usually dull and difficult to see when the Red Spot is dark, but it becomes bright and white when the Red Spot fades.

The movement of the Great Red Spot and its hollow has generally been in a increasing longitude direction, but the motion is eratic. The GRS can move forward or backward and drift ahead or behind other Jovian features.

THE GREAT RED SPOT

STRIP SKETCH OF THE GREAT RED SPOT

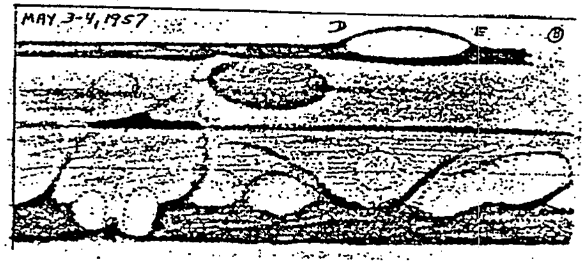


Strip Sketch of Red Spot & Vicinity
January 8, 1955
Elmer J. Reese, 15cm Refl. 320X
CMII=160°80°
Note: RS, BC, DE, and FA

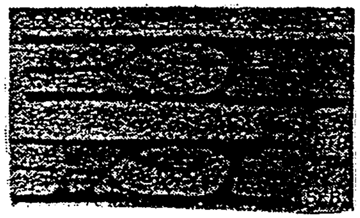
Intensities and Colors

The Great Red Spot

Apparition	Intensity	Color
1952-53	5.2	Yellowish-Ochre
1953-54	5.2	Yellowish-White
1954-55	4.3	Tan
1955-56	3.8	Reddish-Orange
1956-57	3.7	Red
1957-58	3.9	Orangish-Ochre
1959	5.5	Orange
1960	3.5	Orange
1961-62	2.9	Orange
1962-63	3.2	Orange
1963-64	3.5	Reddish-Orange
1964-65	3.5	Reddish-Orange
1965-66	3.7	Orange
1966-67	3.3	Reddish-Orange
1967-68	3.0	Red
1968-69	3.3	Reddish-Orange
1969-70	3.0	Red
1971	3.0	Red
1972	3.0	Red
1973-74	3.5	Reddish-Orange
1974-75	5.2	Reddish-Orange
1975-76	5.2	Orange
1976-77	5.0	Red
1977-78	4.3	Reddish-Orange
1978-79	3.8	Orange
1979-80	4.5	Reddish-Orange
1980-81	5.2	Orange
1981-82	5.2	Orange
1982-83	4.5	Orange
1983-85	4.2	Orange
1985-86	3.8	Orange
1986-87	3.5	Orange
1987-88	4.5	Orange-Pink
1988-89	4.3	Orange
1989-90	4.8	Orange
1991-92	5.2	Pink
1992-93	4.5	Orange
1993-94	5.2	Light Orange
1994	7.0	Orange-RSH-White



Strip Sketch of Red Spot & Vicinity
May 3-4, 1957
Elmer J. Reese, 15cm Refl.320X
CMII=311°
Note: RS and DE

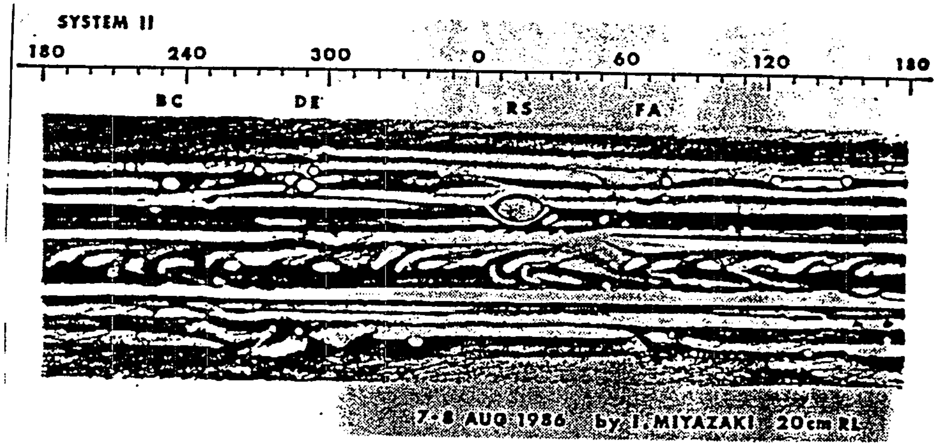


Sectional Sketches of Red Spot Hollow and Vicinity
June 29, 1959 (top) and July 4, 1959 (bottom)
Elmer J. Reese, 15cm Refl. 320X
CMII=300°-340°

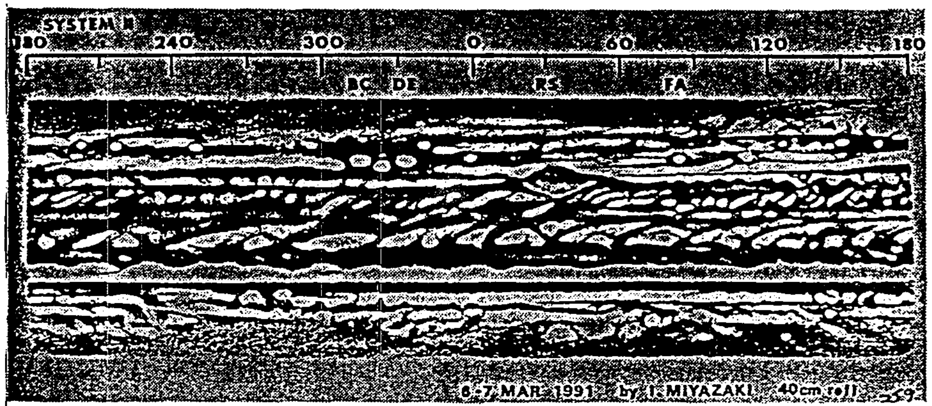
Table of Lengths

of the Great Red Spot

Apparition	Length
1952-53	26°
1953-54	20°
1954-55	22°
1955-56	28°
1956-57	26°
1957-58	27°
1959	29°
1960	23°
1961-62	25°
1962-63	24°
1963-64	25°
1964-65	26°
1965-66	22°
1966-67	24°
1967-68	20°
1968-69	23°
1969-70	20°
1971	20°
1972	22°
1973-74	22°
1974-75	21°
1975-76	24°
1976-77	20°
1977-78	18°
1978-79	16°
1979-80	22°
1980-81	17°
1981-82	20°
1982-83	21°
1983-85	19°
1985-86	19°
1986-87	25°
1987-88	25°
1988-89	23°
1989-90	20°
1990-91	20°
1991-92	18°
1992-93	20°
1993-94	20°



Strip map by I. Miyazaki on Aug. 7-8, 1986. Note: RS, STB ovals, STB Fade, and STrB.



Strip map by I. Miyazaki on Mar. 6-7, 1991. Note: RS, STB ovals, STrZB, and STr Dislocation.

A SUMMARY OF JOVIAN ROTATION PERIODS—ALPO 1952-1993

By: Phillip W. Budine

Apparition	SSTeC	STeC	STB-Middle	STrZ (Prec. RS)	STrZ (Fol. RS)	SEB-Middle	SEBs-Normal	SEC-A	SEC-B	
1 1952-53	--	9:55:11	9:55:08	9:54:53	9:55:49	-*	--	9:50:27	--	(1
2 1953-54	--	9:55:13	--	9:54:40	9:55:41	--	--	--	--	(2
3 1954-55	--	9:55:12	--	--	--	--	--	--	--	(3
4 1955-56	9:55:04	9:55:09	--	--	--	9:55:31	--	--	--	(4
5 1956-57	9:55:04	9:55:09	--	--	--	--	--	--	--	(5
6 1957-58	--	9:55:08	--	--	--	--	9:55:41	--	9:51:11	(6
7 1959	9:55:05	9:55:09	9:55:08	9:55:01	--	--	9:55:45	9:50:57	--	(7
8 1960	9:55:12	9:55:11	9:55:05	--	--	--	9:55:40	9:50:47	--	(8
9 1961-62	9:55:08	9:55:13	9:55:13	--	--	--	9:55:42	9:50:31	9:51:00	(9
10 1962-63	9:55:04	9:55:11	9:55:07	9:54:47	--	--	--	9:50:25	--	(10
11 1963-64	9:55:11	9:55:15	9:55:10	--	--	9:55:41	9:55:41	--	9:51:04	(11
12 1964-65	9:55:06	9:55:15	9:55:14	--	--	9:55:22	9:55:37	--	--	(12
13 1965-66	--	9:55:15	--	--	--	--	--	--	--	(13
14 1966-67	9:55:06	9:55:14	9:55:12	--	9:55:34	9:55:40	9:55:40	9:50:30	--	(14
15 1967-68	9:55:02	9:55:13	9:55:15	9:54:45	9:55:43	9:54:39	--	9:50:31	--	(15
16 1968-69	9:55:04	9:55:14	--	--	--	--	9:55:40	9:50:30	--	(16
17 1969-70	--	9:55:13	--	--	--	--	--	--	--	(17
18 1971	--	9:55:15	--	--	--	9:55:38	--	--	--	(18
19 1972	--	9:55:11	--	--	--	9:55:29	--	9:50:27	--	(19
20 1973	--	9:55:13	--	--	--	--	--	--	--	(20
21) 1974-75		9:55:17						9:50:24 9:50:37		(21
22) 1975-76		9:55:16		9:55:01			9:55:44			(22
23) 1976-77	9:55:07	9:55:15						9:50:40		(23
24) 1977-78		9:55:15						9:50:19		(24
25) 1978-79		9:55:17				9:54:37		9:50:53		(25
26) 1979-80		9:55:19								(26
27) 1980-81	9:55:07	9:55:22				9:55:45	9:55:41	9:50:59	9:51:03	(27
28) 1981-82		9:55:19				9:55:21	9:55:40		9:51:06	(28
29) 1982-83		9:55:19								(29
30) 1983		9:55:20			9:55:37					(30
31) 1983-85	9:55:06	9:55:22				9:55:39				(31
32) 1985-86		9:55:21								(32
33) 1986-87	9:55:05	9:55:22				9:55:25				(33
34) 1987-88		9:55:20			9:55:39			9:49:32		(34
35) 1988-89	9:55:06	9:55:16			9:55:45			9:50:06		(35
36) 1989-90		9:55:26			9:55:39					(36
37) 1990-91		9:55:23								(37
38) 1991-92	9:55:06	9:55:24			9:55:44		9:55:42			(38
39) 1992-93		9:55:25		9:55:37	9:55:25		9:55:00			(39

	NEC	NEC-Slow	NEC-Fast	NEB-Middle	NTRC-A	NTrC-B	NTeC-A	NTeC-B	NTeC-C	NNTeC-A	
1	9:50:21	--	--	--	9:55:24	--	9:55:57	--	--	--	(1
2	9:50:38	--	--	--	9:55:31	--	--	--	--	--	(2
3	9:50:16	--	--	--	9:55:31	--	--	--	--	--	(3
4	9:50:32	--	--	--	9:55:25	9:55:03	9:56:10	--	--	--	(4
5	9:50:30	--	--	--	9:55:30	--	--	--	--	--	(5
6	9:50:31	--	--	--	9:55:34	--	--	--	--	--	(6
7	9:50:27	--	--	--	9:55:27	--	--	--	--	9:55:38	(7
8	9:50:27	--	--	9:52:55	9:55:26	--	--	--	--	9:55:40	(8
9	9:50:31	--	--	9:55:18	9:55:28	9:55:05	--	--	--	9:55:39	(9
10	9:50:31	--	--	9:55:23	9:55:28	--	--	--	--	9:55:30	(10
11	9:50:27	9:50:48	--	9:55:22	9:55:27	9:55:10	--	--	--	9:55:38	(11
12	9:50:29	9:50:45	--	9:55:20	9:55:26	--	--	--	9:49:17	9:55:41	(12
13	9:50:32	9:50:53	--	--	9:55:22	--	--	--	--	9:55:37	(13
14	9:50:30	--	--	9:55:20	9:55:23	9:55:06	9:55:56 9:56:13	--	--	9:55:36	(14
15	9:50:29	--	--	--	9:55:18	9:55:09	9:55:54 9:56:09	--	--	9:55:38	(15
16	9:50:27	--	9:50:17	9:54:57	9:55:13	--	--	9:52:50	--	9:55:39	(16
17	9:50:32	--	--	--	--	--	--	--	--	--	(17
18	9:50:29	--	--	--	--	9:55:01		--	--	--	(18
19	9:50:28	--	--	--	9:55:14	9:54:53 9:55:06	--	--	--	9:55:41	(19
20	9:50:28	9:50:53	--	--	9:55:25	9:54:48 9:55:10	9:56:10	--	--	9:55:35	(20
21)	9:50:30	9:50:50	9:50:10	9:54:39	9:55:24	9:55:03			9:46:27		(21
22)	9:50:20		9:50:09		9:55:30	9:55:14			9:46:18		(22
23)	9:50:27	9:50:49	9:50:11		9:55:23	9:55:08	9:55:46 9:56:07			9:55:43	(23
24)	9:50:31	9:51:16	9:49:38		9:55:16		9:55:56				(24
25)	9:50:24	9:50:42	9:50:04		9:55:18	9:55:00					(25
26)	9:50:26		9:50:10		9:55:26	9:55:17					(26
27)	9:50:27		9:50:18		9:55:35	9:55:00					(27
28)	9:50:28	9:50:42	9:50:17		9:55:31						(28
29)	9:50:24				9:55:34						(29
30)	9:50:29				9:55:35		9:55:04				(30
31)	9:50:31			9:54:29	9:55:34	9:54:49	9:55:04			9:55:42	(31
32)	9:50:30			9:52:55			9:56:28				(32
33)	9:50:30						9:56:04				(33
34)	9:50:30				9:55:39		9:55:57 9:56:07 9:55:56			9:55:27	(34
35)	9:50:29	9:50:50			9:55:35		9:56:10 9:55:54		9:46:52		(35
36)	9:50:30				9:55:37		9:55:51		9:49:43		(36
37)	9:50:30			9:53:47	9:55:40		9:56:02			9:55:49	(37
38)	9:50:30				9:55:40				9:49:12		(38
39)	9:50:30				9:55:37				9:49:17		(39

	NNTeC-B	NNNTeC	DE	FA	BC	RS	STrZ-DIST (p-end)	STrZ-DIST (f-end)	SEBs-DIST	
1	--	9:55:23	9:55:13	9:55:13	9:55:10	9:55:42	--	--	9:58:10	(1
2	--	--	9:55:13	9:55:14	9:55:11	9:55:43	--	--	--	(2
3	--	--	9:55:12	9:55:13	9:55:10	9:55:44	--	--	9:58:08	(3
4	--	--	9:55:07	9:55:14	9:55:09	9:55:41	9:55:30	9:55:32	--	(4
5	--	--	9:55:13	9:55:08	9:55:06	9:55:42	9:55:21	9:55:18	--	(5
6	--	--	9:55:11	9:55:08	9:55:06	9:55:42	--	--	9:58:02	(6
7	--	--	9:55:11	9:55:05	9:55:10	9:55:41	--	--	--	(7
8	--	--	9:55:14	9:55:07	9:55:14	9:55:43	--	--	--	(8
9	--	9:55:21	9:55:12	9:55:13	9:55:16	9:55:42	--	--	--	(9
10	--	9:55:22	9:55:12	9:55:11	9:55:14	9:55:42	--	--	9:58:12	(10
11	--	9:55:15	9:55:14	9:55:18	9:55:13	9:55:41	--	--	9:57:53	(11
12	--	9:55:23	9:55:15	9:55:15	9:55:17	9:55:42	--	--	--	(12
13	--	9:55:12	9:55:16	9:55:13	9:55:15	9:55:42	--	--	--	(13
14	--	9:55:21	9:55:10	9:55:15	9:55:15	9:55:41	9:55:29	9:55:35	--	(14
15	9:53:54	--	9:55:13	9:55:15	9:55:15	9:55:41	9:55:29	9:55:33	--	(15
16	--	--	9:55:14	9:55:15	9:55:14	9:55:40	--	--	--	(16
17	--	--	9:55:15	9:55:12	9:55:13	9:55:40	9:55:27	9:55:31	9:58:17 9:58:15	(17
18	--	--	9:55:12	9:55:15	9:55:17	9:55:40	9:55:29	9:55:31	--	(18
19	--	--	9:55:12	9:55:12	9:55:14	9:55:38	--	--	--	(19
20	--	--	9:55:14	9:55:16	9:55:15	9:55:41	--	--	--	(20
21	9:53:57		9:55:17	9:55:17	9:55:17	9:55:43			9:56:56 9:57:33	(21
22			9:55:17	9:55:17	9:55:17	9:55:43	9:55:25	9:55:34		(22
23			9:55:17	9:55:14	9:55:16	9:55:41			9:58:31	(23
24			9:55:15	9:55:18	9:55:17	9:55:41			9:57:17 9:58:09	(24
25			9:55:18	9:55:17	9:55:16	9:55:42	9:55:20	9:55:27		(25
26			9:55:22	9:55:15	9:55:19	9:55:40	9:55:23	9:55:34		(26
27			9:55:22	9:55:17	9:55:23	9:55:39	9:55:24	9:55:37		(27
28			9:55:22	9:55:15	9:55:21	9:55:41	9:55:37	9:55:36		(28
29			9:55:24	9:55:23	9:55:24	9:55:39	9:55:29	9:55:40		(29
30			9:55:21	9:55:18	9:55:21	9:55:41	9:55:24	9:55:42		(30
31			9:55:24	9:55:22	9:55:22	9:55:39	9:55:29	9:55:33	9:58:20	(31
32			9:55:20	9:55:24	9:55:21	9:55:40	9:55:23	9:55:37		(32
33			9:55:23	9:55:15	9:55:25	9:55:41	9:55:25	9:55:38	9:58:03	(33
34			9:55:22	9:55:13	9:55:20	9:55:40				(34
35			9:55:24	9:55:18	9:55:27	9:55:42			9:57:24 9:58:20	(35
36	9:55:08		9:55:26	9:55:19	9:55:26	9:55:41		9:55:43		(36
37			9:55:23	9:55:24	9:55:23	9:55:40	9:55:32	9:55:24		(37
38			9:55:25	9:55:25	9:55:23	9:55:42			9:58:10	(38
39			9:55:25	9:55:22	9:55:22	9:55:42			9:57:17 9:57:37	(39

	SEBZ-DIST (p-end)	SEBZ-DIST (f-end)	CCs	CCn
1	9:53:44	9:55:43	--	--
2	--	--	--	--
3	9:54:13	9:55:41	--	--
4	--	--	--	--
5	--	--	--	--
6	9:54:02	9:55:41	--	--
7	--	--	--	--
8	--	--	--	--
9	--	--	--	--
10	9:54:53	9:55:41	9:53:43	9:56:28
11	9:54:34	9:55:41	--	--
12	--	--	--	--
13	--	--	9:54:08	9:56:55
14	--	--	9:53:41	9:58:05
15	--	--	9:53:39	9:57:49
16	--	--	--	--
17	--	--	--	--
18	9:54:41	9:55:41	--	--
	9:54:52	9:55:41		
19				
20				
21				
22	9:54:47	9:55:41	9:53:24	9:57:35
	9:54:36			
23	9:53:57	9:55:41		
24	9:54:19	9:55:41		
25	9:54:31			
26			9:53:34	9:57:40
27				
28				
29	9:54:37	9:55:41		9:58:18
30	9:53:58	9:55:41		9:58:19
31				9:58:02
				9:57:34
32	9:54:25	9:55:18		
	9:54:18	9:55:43		
33	9:54:35	9:55:18		
34	9:54:45	9:55:40		
35				9:58:34
				9:57:26
36				
37	9:54:31	9:55:40		
	9:54:40			
38				
39	9:54:30	9:55:41		
	9:53:30			

A.L.P.O. JUPITER TRANSIT FORM

NO.	TIME (U.T.)	SYSTEM	LONGITUDE (°)	DESCRIPTION

DATE (U.T.) : ______________________

U.T. : BEGIN : __________ END : __________

TELESCOPE :__________ (CM. / INCH), (RL / RR / SC)

MAGNIFICATION : ________ X ________ X

FILTERS : ______________________ (W / S)

TRANSPARENCY (1-6): ______________

SEEING (1-10): ______________

NAME :______________________

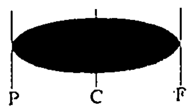
ADDRESS :______________________

(LEGEND: RL=Reflector, RR=Refractor, SC=Schmidt-Cassegrain; W=Wratten, S=Schott)

NOMENCLATURE :

DARK MARKING (D)
WHITE/ BRIGHT MARKING (W)
PRECEDING (P)
FOLLOWING (F)
PROJECTION (Proj.)
CONDENSATION (Cond.)
ELONGATED (Elong.)
CONSPICOUS (Conspic.)
INDEFINITE (Indef.)
DISTURBANCE (Dist.)
CENTRAL MERIDIAN (C.M.)
SYSTEM I ((I) or CM1)
SYSTEM II ((II) or CM II)

NORTH (N)
SOUTH (S)
VERY (V)
LARGE (L)
SMALL (Sm)
SECTION (Sect.)
CENTER (C)
FESTOON (Fest.)
COLUMN (Col.)



Oppositions of Jupiter

Year	Date	Diameter, seconds of arc.	Magnitude
1991	Jan.28	45.7	-2.1
1992	Feb.28	44.6	-2.0
1993	Mar.30	44.2	-2.0
1994	Apr.30	44.5	-2.0
1995	June 1	43.6	-2.1
1996	July 4	47.0	-2.2
1997	Aug. 9	48.6	-2.4
1998	Sep.16	49.7	-2.5
1999	Oct.23	49.8	-2.5
2000	Nov.28	48.5	-2.4

The ALPO Jupiter Section

Jupiter Recorders

Phillip W. Budine
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Walton, N.Y. 13856

Responsible for: transit observations, satellite phenomena, drift-charts, rotation periods, latitude measurements, and strip sketches.

José Olivarez
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Responsible for: disc drawings, photos, intensity estimates, color estimates and descriptive reports.

Recorder, Galilean Satellites

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A Near Perfect Planetary Telescope

by Thomas R. Cave

In today's world of amateur astronomy, and for some years past, there has been an ever-increasing desire for a very large number of amateurs to be suffering from aperture fever. Years ago, a working, observing amateur was fortunate to have a fine quality 12-1/2" mirror of F/7 or F/8, and sometimes of longer focus.

In the present world of amateur observing, apertures of F/4 or F/5, with 17-1/2", 20", 24", and even up to 40" sizes, usually made of thin mirrors with, to be kind, say of indifferent figure, often poor, with results from these instruments being light buckets which have exceedingly large secondary or diagonal mirrors and only form images with low powers. Many of these possessors of gigantic aperture instruments of 18" to 30" aperture try to obtain good planetary images by cutting off-axis diaphrams, avoiding too large central diagonal and the usual four spider vanes. If the primary mirror is of sufficient thickness and well-supported, and the diagonal is truly flat, on occasions, planetary views of some quality can be obtained. However, good views are decidedly the exception.

Many years ago, in 1948, the speaker, with much mechanical help from his father, a most gifted woodworker, planned a 12-1/2" long-focus planetary reflector with a focal length of 137" or F/11.4, mounted on a 1" thick plywood cell. No sheet metal shop in the Long Beach area could roll a tube over 12 feet in length. However, using a 15-foot brake, a galvanized tube could be made, 18 inches in diameter. A hardwood lumber company supplied us with fine-milled oak for the English Double-York mounting, similar to the Mount Wilson 100" reflector. The tube was lined inside with 1/8th casket cork and glued. End rings for the tube were provided by the metal shop, one riveted and the other drilled, with the rivets left loose. The yoke for the tube and the base were all made of oak. A local machine shop, which had already done much work for our early telescope for commercial sale, made a large friction clutch using a sell-lapped 100-tooth Boston gear and worm gear. At the south end of the polar axis of 2-1/2" diameter, the clock-drive, with reduction gear, were mounted in a box with two doors or lids. The 2-1/2" inside diameter bearings were Fafner ball bearings. My father had a large band saw among his several power tools and, from one-inch plywood, circles were cut, with two fitted snuggly on the outside of the tube. Two-layer diameter plywood rings were cut and metal roller-skate wheels were mounted on the outside rings, which allowed the large tube to fully rotate easily.

Four thin bicycle spokes, screwed into a central plug, were used as spider vanes, which in turn held an adjustable diagonal holder and morror of 1.4" mirror-axis diagonal. The entire tube, double yoke mounting and supports all of oak were multicoat-plated, and with optics installed, a final balance was made. A 3-inch-wide field finder was mounted with two strong brackets; the finder was easily adjustable and a first-class rack and pinion focuser were installed.

It was obvious from the design that a bridge six feet or more in length and five geet wide would have to be built with a height of six feet, very sturdy in construction, but as light-weight as feasible, together with an aluminum ladder which could be hooked at the South, East and West ends of the bridge. The bridge itself had 8"-diameter wheels, two mounted on the two front legs, so that the entire bridge could be moved as required for the most comfortable observing position. It was possible, for very little money, to purchase alloy extrusions from the Douglas Aircraft surplus yard, thus forming the bridge and observing platform of very light weight and easy mobility.

In 1948, we had a very large back yard, with only a tree obstruction to the far Northwest. After the completion of the long-focus scope, great care was taken to align the instrument throught North at an angle of 33.5 degrees; sighting was done along each side of the double yoke, rolling the observing bridge to the telescope, plugging in the extension cord and grounding it. The sope was ready for "first light". We built a box affair on top of the bridge with four levels for seating at any elevation. Fortune was with us that first night. On that evening, Jupiter and Saturn were observed under extraordinary seeing. Using five Brandon-Ortho eyepieces, giving power from a bit over 100x to 700x, the views were breathtaking. In 1941's Mars apparation, I had use of a 10" F/11.2 reflector, which I had built, with a crude equeatorial mount and without clockdrive; I made over 260 sketches of Mars, in great detail. The new, much more sophisticated 12-1/2" reflector gave planetary views that were truly awesome. Looking back over nearly fifty years, this surely was the finest performing telescope I have ever owned. From late 1948 until 1954, the scope attracted many friends from all over the Los Angeles Basin and from as far away as the Bay Area, and at least two adjoining states. Finally, in late 1954, a man of great wealth and head of L. A.'s largest law frim, a Mr. Sam Barchus, amateur astronomer, with a collection of books comprising perhaps the largest private library in America, with over 5000 volumes and a value of more than $1,000,000, who frequently visited my long 12-1/2" telescope and did much observing with it, kept offering me an ever-increasing price. Finally, with a price I couldn't refuse, I sold the instrument to Mr. Barcus; he arranged for delivery to his extensive Bel Air estate and paid me extra to install it. Since its construction, i had purchased a 12-foot by 18-foot waterproof tarp, which covered the instrument in inclimate weather. To this day, I wish I had never sold the scope. My current 12.8" F/6 reflector, in a waterproof dome, has performed very well, but still there was something abouth the 12-1/2" F/11.4 that could never be equalled.

Long-focus, larger aperture telescopes are probably not for everyone, due to their personal living circumstances, such as apartments, town homes, trailer parks, etc. However, at the same time, those living in suburbs, rural and farm areas where room for such a long-focus large-size instrument exists, there is nothing like possessing one. The primary mirror, if homemade, has an enormous tolerance for figure error. Take a 12-1/2" F/10 PYREX mirror of 125" focal length; the figuring tolerance on a mirror for excellent performance, according to Franklin Wright (ATM I), is about 40% under- or over-corrected. Jean Tereruea's figure is about 20%, and when compared with a 12-1/2" F/6, is only near 5% or a bit less. The main consideration is that the primary must be very smooth, free of turned edge, zonal errors, and figured to as well as the ATM can do, even if more-experienced assistance is required. The tiny percentage of central diagonal is very small, with its central obstruction totally negligible.

Where good seeing conditions are realizably frequent, a mirror with and aperture larger than 12" is an excellent choice. If your situation is such that only a 6", 8", or 10" is feasible and portable, consider this alternative. Such a scope as described under good seeing will very noticably out-perform any refractor of equal aperture, giving better contrast, perfect achromatizm, convenience of use, and most of all, a tremendous joy and satisfaction for a lifetime.

DARLING CLEMENTINE
LUNAR TRANSIENT PHENOMENA PROGRAM
By David O. Darling

It was during the ALCON 93 National Astronomical League convention in July that information about the Clementine mission was learned. This was accomplished when Ralph Winrich, a N.A.S.A. representative asked me if I was aware of this mission after my talk on the Tycho Lunar Transient Phenomena paper. After careful consideration I decided that this would be an excellent opportunity to monitor the Moon for L.T.P. during the Clementine mission.

I contacted Winifred S. Cameron, A.L.P.O. Lunar Transient Phenomena Recorder on October 29, 1993. She agreed that it was a good idea to monitor the Moon during the Clementine mission and she made the initial contact with Dr. Eugene Shoemaker, the Principle Investigator for the Clementine Science Team. On November 6, 1993 Winifred Cameron contacted me informing me that she had discussed the proposal with Dr. Shoemaker. He liked the idea and requested that we draft a proposal of our observing program and what we expected to accomplish with it.

The Mission Statement was the first thing that needed to be done. I enlisted the expertise of Bob Manske and Dave Weier to assist me in this grand undertaking and we hammered out the Mission proposal. After several drafts and rewrites we submitted the Mission Statement to Dr. Shoemaker on December 15. We then received word through Winifred Cameron that Dr. Shoemaker had presented our proposal to N.A.S.A. and the B.M.D.O. and gained their approval. During this time we were scrambling to assure ourselves that we could provide the information on the project to observers around the world in a timely manner.

On January 25, 1994 the Clementine spacecraft was successfully launched into space.

Winifred Cameron had provided me names of one hundred observers all over the world and we completed our mailing with the registration process on February 7, 1994. Out of this mailing, 48 forms were returned expressing a desire to participate.

On February 5, 1994 a planning meeting was held by Bob Manske , David Weier and myself to assemble the observing forms that would be used for reporting observations. The forms were constructed to establish consistency in the observing program and the reporting format, and to enable easy computerization of the data.

On February 21, 1994 the Clementine spacecraft was placed into Lunar orbit.

On March 8, 1994 we received the orbital ephemerides for the Clementine Spacecraft from the Jet Propulsion Laboratory.

Upon receiving this information, Bob Manske began to develop a computer program that would compute the times when the spacecraft would be over the selected L.T.P. sites and generate a listing of times when our observers should observe the target area. Without this program it would have taken months to generate the predictions. Our first mailing to our observers was sent on March 25, 1994 and included the observing windows they had elected on their registration form. We knew that many observers located outside the United States would not get their observing schedules in time to enable them to participate for the entire mission. Everything seemed to be going well until we had the opportunity to download a image from the Clementine mission off the Internet. On April 11, 1994 we discovered to our horror, that the photograph did not match the spacecraft position that we had been given. Dave Weier contacted Chuck Aton at the Jet Propulsion Laboratory and it was found that the Navel Research Lab had change the orbit of the spacecraft and failed to inform them. He promptly recomputed the spacecraft's orbits and downloaded the new ephemerides to Dave Weier's computer. Bob Manske recomputed the observing schedules and we all did a second mailing on April 14, 1994. The observing program remained uneventful during the remainder of the mission, except for occasional phone calls on how a certain observational technique should be accomplished.

Observations started coming in after a few weeks and continued to arrive for many months after the end of the observing period. What we found from our preliminary analysis of the data was both interesting and surprising considering the limited time the Moon was observed. The summary of the observing program is as follows: The total number of observers who registered for the program was 48; of these 28 submitted observations. This gave us a 58% response rate. The total number of observations submitted was 235. The total number of combined days covered was 112. The total number of combined hours was 163. From all this activity we had 13 possible Lunar Transient Phenomena events reported.

Suspected Lunar Transient Phenomena events reported during the Mission by type:

Bluish=0	Reddish=2	Brightening=2
Contrast Effect=0	Obscuration=0	Starlike Flashes=2
Gaseous=.0	Darkening=7	Shadow Effects=0

Suspected Lunar Transient Phenomena events in chronological order as follows:

Event #1
1994, March 24 3:20 U.T.: Starlike flash observed past sunrise terminator. Observer: Pierrette Jean, Quebec, Canada.
Event#2
1994, April 03 11:23 U.T.: Copernicus showed a red spot on the west wall (I.A.U.) using moon blink filter W#25 and W#38. Observer: David O. Darling, Sun Prairie, Wisconsin U.S.A.
Event #3
1994 April 17 2:00 U.T.: Aristarchus and surrounding region glowing in Earthshine. Observer: David D. Weier, Madison, Wisconsin U.S.A. (See Event #4)
Event #4
1994, April 17 2:00 U.T.: Aristarchus and region glowing in Earthshine. Observer: Ray Zit, Madison, Wisconsin, U.S.A. Event was observed during the observation of a lunar grazing occultation.
Event #5
1994, April 18 14:40 U.T.: The wall of Picard changed to dark. Observer: Chen Dong Hua, Republic of China.
Event #6
1994, April 19 00:00 U.T.: Dark patch surrounding Picard. Observer: Paul Kursewicz, Epping New Hampshire U.S.A.
Event #7
1994, April 19 22:00 U.T.: Atlas, darkening of interior of the crater. Observer: Dr. Rainer Knopp, Berlin, Germany.

Event #8
1994, April 20 1:31 U.T.: Picard was surrounded by a dark nebulous patch, observer unable to resolve crater within dark region. Observer: David O. Darling, Sun Prairie, Wisconsin, U.S.A.
Event #9
1994, April 21 6:00 U.T.: Reddish color detected on Cape Laplace. Observer: Winifred S. Cameron, Sedona, Arizona, U.S.A.
Event #10
1994, April 23 2:41 U.T.: Alphonsus, a starlike flash. Observer: Dr. Dennis Fryback, Madison, Wisconsin, U.S.A.
Event #11
1994, April 24 3: 50 U.T.: Cobra Head appeared to have obscuration on top Eastern (I.A.U.) half of the formation. Observer: Bob Manske, Waunakee, Wisconsin, U.S.A.
Event #12
1994, April 24 8:15 U.T.: Mare Frigorius appeared darker than the day before possible LTP. Observer: Albert T. Brakel, Act, Australia.
Event #13
1994, April 25 11:08 U.T.: Darkening detected on the North (I.A.U.) floor of Copernicus. Observer: Byron Soulsby, Act Australia.

All of the observations have been computed using Harry D. Jamieson Lunar ToolKit program. This program generates an abundance of data such as colongitude, true anomaly, anomalistic phase etc. Extra features were added to the program to enhance the data the program generated so Winifred S. Cameron would have an easier time analyzing the observations.

The entire observing program was a great success with observers located in seven different countries all over the world. The nations represented by this combined observing team was the United States of America, United Kingdom, Germany, India, Australia, Canada, and The Republic of China.

We are presently examining the images taken by Clementine during the reported L.T.P. events to see if any anomalies were detected.

The program could not have been accomplished with out the technical skills of Bob Manske and Dave Weier. As well as the assistance and input on the project by Winifred S. Cameron.

This project went so well that I am now planning on ground based observing run in conjunction with the Lunar Prospector Mission that lifts off in June 1997.

Was the ALPO Necessary? Is the ALPO Necessary?

By: Walter H. Haas, ALPO Founder

In a strict literal sense the answer to both questions must be "no, certainly not". If Columbus had not discovered America when he did, some other European almost certainly would have done so soon thereafter. We honor Sir Isaac Newton's discovery of the calculus as a major advance in mathematics, but Leibnitz made the very same discovery independently. Perhaps, however, this audience will indulge a few thoughts on the goals of the ALPO at its beginning and on what it may be offering to the science of astronomy at the present time.

In the early months of 1947 several of my astronomical friends and I were concerned with sharing our enthusiastic lunar and planetary observations more effectively. A modest news bulletin and the related informal astronomy group were obvious ideas. The response of one colleague to such proposals was clear and definite: Those who want to study the Solar System would do best simply to contribute their results to the proper Sections of the British Astronomical Association. Indeed, he went on to say that, among those amateurs whose work I had shown him samples of, only Elmer J. Reese showed promise of contributions of real scientific value. The years have justified his preference!

Having failed several times in my life to make the decision which many others would consider proper, I ignored the good advice and went on to initiate the Association of Lunar and Planetary Observers and its magazine, *The Strolling Astronomer.* (In later years formal people changed the preferred title to *The Journal of the Association of Lunar and Planetary Observers.*) We gradually imitated the British Astronomical Association organization of different observing Sections and a leader or leaders for each one. Next, let us address this question: What useful things did the ALPO do in 1947 and later which would not have been done otherwise?

We certainly did provide a medium for the communication of lunar and planetary observations, and to a lesser extent, of their interpretation. We did publish papers which would not have been published otherwise. There would have been but few pages for these articles in such journals as *Sky and Telescope* and *Journal BAA*. We may not always have used our *Strolling Astronomer* space to best advantage, and we were willing to publish a few papers which many would consider borderline science. (Rarely, of course, outlandish ideas later become respectable and significant.) We do take considerable pride in such achievements as the ALPO 1954 map of Mars, which received praise from professional astronomers, and in Elmer Reese's interpretation of the recorded South Equatorial Belt Disturbances on Jupiter as the activity of one or two subsurface sources with constant periods of rotation. Perhaps a better measure of the worth of our journal would be the occasional references to it in professional publications, where a new title was sometimes invented to replace *The Strolling Astronomer*. Incidentally, Reese in 1949 found evidence that the Red Spot region on Jupiter is a vortex rotating in a counterclockwise sense in about 10.7 days, thus foreshadowing the discovery of a rotation in six days at the New Mexico State University Observatory in the early 1960's.

We may perhaps claim a small role in improving knowledge of the planets in the general astronomical community. In or near 1950 one well-known author in a semi-popular journal expressed a wish to know exactly where the Red Spot was. To be sure, the information was easily available in our journal and *JBAA*; and at the present time we have regular tables of predicted positions of the Red Spot in *Sky and Telescope*. In the 1940's I was vexed to see a globe of Mars rotating *backwards* in the public displays section of one observatory. The following incident described by a well-known ALPO staff member may not be relevant, but it is a good story. All characters must be nameless. A famous astronomer saw a bright red "star" near Antares in the summer of 1954. He immediately appropriated the use of a giant telescope from a colleague whom he outranked. That new red supernova must be observed at once! The two gentlemen didn't speak to each other for the next week, and the Martians are laughing still!

From our outset international cooperation was a major goal. We corresponded with lunar and planetary observers in Germany and Japan and welcomed their contributions while the hatreds generated in World War II were still strong. We gave complimentary subscriptions to active amateurs who could not pay us because of international financial regulations. Some friends renamed us "The American Association of Lunar and Planetary Observers," but we rejected the *American* as too limiting on our objectives.

While it was not at first clearly realized, one of our goals was the training of new (and often young) observers. After many years we even added a Training Recorder to the volunteer staff. There was ever a need to provide training materials for new and/or inexperienced members. Thus circulars, later pamphlets, and eventually sometimes even a few books were composed by different staff members to explain such techniques as making drawings of planets and lunar features, timing central meridian transits on Jupiter and Saturn, employing seeing and transparency scales, using standardized color filters properly, applying numerical intensity scales to try to describe lunar and planetary features quantitatively, recording correct documentation with each observation, and computing lunar colongitudes and planetary central meridians. Like other teaching, the procedure required endless repetition of basic ideas. Of course, instruction also came via articles in *The Strolling Astronomer* and correspondence with ALPO staff members. The chief problem was probably that the new and/or inexperienced members were often reluctant to seek the available instructing. It seemed to be more fun to draw Saturn and its rings freehand than to acquire our standard outlines and fill in all the blanks.

We can claim some successes in our training efforts. There were persons who began as enthusiastic young amateur observers, sometimes served for a while as staff members, there learned more of proper methods for scientific research, and went on to become professional scientists. We call to mind Clark Chapman, Dale Cruikshank, David Meisel, Alika Herring, John Lankford, and José Olivarez—and apologize to other worthies whom we are doubtless omitting. Contrariwise, as any teacher will know, there were rank beginners who remained rank beginners regardless of lengthy attempted instructing. Yet do not despise their role in the ALPO and other societies. There is a place for members who write scientific papers; and there is a place for members who write papers measuring about 3 by 6 inches, with a signature in the lower right corner. In the real world such members frequently enable learned societies to survive.

Our ideal is to help each member to do his or her best for astronomy, to use his or her abilities and opportunities to fullest advantage.

But in the modern world which seems to think that nothing important happened longer ago than the day before yesterday, what useful role does the ALPO now play?

We clearly now have a flood of publications of all kinds. The role of *Journal ALPO* in calling attention to future events in the sky is lessened when anyone can dial a phone number to get this kind of information. We publish ephemerides of comets, but someone with little background in mathematics can buy software to generate the same ephemeris on his or her own computer. No Earth-based observations will rival the images returned by the Hubble Space Telescope or by space missions of recent years. The striking CCD images obtained with large telescopes and adaptive optics during the last few years go far beyond what any amateur can distinguish with a backyard telescope. He or she can no longer dream of seeing Mars better than it has ever been seen before.

A partial response to justify our existence may be that a dedicated amateur can regularly closely monitor our Solar System neighbors, while a professional astronomer must do research on what is funded, and thus must follow the political winds of the moment. It may be doubted that those will be kind winds for physical science in America in the near future. Our Mars Recorders assert that they expect the ALPO International Mars Patrol to be a major source of current data about the Red Planet as government subsidies for professional research dry up. Let us also recall the five known major outbreaks of activity on Saturn. These were in the years 1876, 1903, 1933, 1960, and 1990. The first discoverers of three of the five events, and indeed of the three most recent ones, were amateurs. Many astronomers accept the reality of at least some Lunar Transient Phenomena, and the majority of the better observations have been made by amateurs. (Also, a very large majority of the poorer ones.)

A further response is that our journal and observational files provide data for research on Solar System bodies. Richard Hill sought advice from solar research astronomers when he founded the ALPO Solar Section, and its Bulletin lists observations in a format useful to them. David Darling has kept up with the times by setting up a database of reported Lunar Transient Phenomena. Articles in *Journal ALPO* and their abstracts are listed in *Astronomy and Astrophysics Abstracts* for interested persons.

We continue to emphasize international cooperation. For the 1992-93 apparition of Mars we received observations from 74 observers in 11 countries. The late "Chick" Capen had done a remarkable job of organizing a worldwide team of Mars observers. Paul H. Bock, Jr. heads an International Solar System Observers' Fund, set up to facilitate financial aid to qualified foreign colleagues. Members outside of the United States constitute about 20 percent of our total membership. We maintain ties with individuals and groups in England, Japan, Canada, Germany, France, Hungary, and other countries.

Some of our projects are certainly on a professional level. John Westfall's timing the eclipse disappearances and reappearances of the Galilean satellites of Jupiter involves the mathematical analysis of hundreds of visual observations from all over the world and the even more sophisticated analysis of a few photoelectric observations. He could not try such a program without a computer! (Curiously, the contributors to this project hardly ever submit regular observations of Jupiter, and conversely.) The CCD imaging of Mars, Jupiter, and Saturn by Don Parker has aroused professional admiration; he, Jeff Beish, and others have been invited to present papers at professional conferences. Dan Trolani and others measure the Martian polar caps with filar micrometers. Our Minor Planets Section works on light-curves with modern photometric techniques. Plenty of statistics is involved in reducing observations of the brightness of a comet or in seeking correlations for the occurrence of Lunar Transient Phenomena.

Yet perhaps these professional efforts make us less "necessary" than our services to ordinary amateurs. It requires a full page in recent issues of our journal to list all the materials available from all our Sections. These include observing forms, observing lists, Section newsletters or bulletins, handbooks with instructions for specific programs, and a few specialized data catalogues or observational reports. Harry Jamieson will even furnish a "Lunar Observer's Tool Kit"; it is a diskette containing an observational-planning program and a lunar dome database with built-in instructions. With all these goodies to choose from, the wise new observer, maybe after some training, will select a *small* number of projects according to his or her interests, skills, instrumentation, and also funds. He or she should not attempt too much; he or she should not be like my young friend who spoke of drawing the whole Moon. Yet there is no substitute for a personal relationship between a novice and a helpful experienced observer. We list in our journal a number of volunteer tutors who are available to help beginners with various observing programs.

A few of our members have written books that can guide the serious amateur observer. *Introduction to Observing and Photographing the Solar System* by Thomas Dobbins, Donald Parker, and Charles Capen can be highly recommended, although it preceded the rise of CCD imaging. *The Jupiter Observer's Guide and Reference Book* by Phillip Budine contains a huge amount of very useful material.

Apart from the scientific merit or lack thereof of its work, the ALPO may be regarded in a larger context. Political decisions will be made about light pollution, education in science, the amount of government support of space programs, etc. Our members hopefully acquire a better understanding of science and its methods than the general public possesses. They can try to help make better decisions.

Is the ALPO *necessary*? The answer must depend on one's personal values. However, we can say that the ALPO is *possible* because of the hard work of many persons, and it is proper in concluding to pay tribute to some of them. There should be listed the considerable assistance of my wife Peggy in producing our journal and the great efforts of two Secretaries, David Barcroft and J. Russell Smith. John Westfall has been an excellent leader as our Director and Editor for 10 years. Beth Westfall played a key role in making our long-discussed incorporation a reality. We welcome Phillip Budine as the new Executive Director; he has been most valuable as an observer and Recorder for many years. We should also appreciate Harry Jamieson, our hard-working Secretary. Besides the obvious chore of computerizing the membership list, he has tried with many ideas to make us a more effective society. As an example, a Membership Directory listed our members in several different ways and coded their expressed fields of interest. We certainly must thank José Olivarez for making this convention possible, and we congratulate him upon his discovery of the Olivarez Blue Projections on Jupiter. An observing group needs outstanding observers, and Don Parker, Dan Trolani, Jeff Beish, Carlos Hernandez, and others are surely such persons. Phil Glaser and others have been generous with financial support, and they carried us through some lean years.

This list of those to whom we owe much could go on and on. It is time, however, to let other speakers tell us by their papers how necessary the ALPO actually is.

2225 Thomas Drive
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July 28, 1995

AVOIDING BABEL:

CLARIFYING OUR ASTRONOMICAL VOCABULARY AMID THE CURRENT REVOLUTION IN SOLAR SYSTEM STUDIES

by Richard G. Hodgson[1]

ABSTRACT. Our Solar System knowledge is undergoing revolutionary change. Recent discoveries of (1) a multitude of Trans-Neptunian objects, many part of the hypothesized Kuiper Belt, (2) the first confirmed asteroid satellite, (3) Lagrangian objects unrelated to Jupiter's orbit, (4) tiny asteroids (or large meteoroids??) whizzing past us in near-Earth space, etc., prompt reexamination of basic astronomical terms. How do we define binary planet, satellite, asteroid, meteoroid, comet, Trojan planet? Sometimes we need broad terms which will straddle boundaries; more often we need precise terms to allow accurate scientific thinking and writing.

INTRODUCTION. Recent discoveries, particularly in the outer Solar System, are challenging some older, traditional definitions used by planetary astronomers. As our knowledge grows, so must we be prepared to let definitions of astronomical terms evolve. There is always a need for some broad terms which will straddle narrow definitional boundaries. For example, the word "object" is splendid because it does not commit us to a particular interpretation at a point in time when we lack the necessary information to do so. Again, the term "worlds" is useful at times because it permits us broadly to talk about physical realities of places without invoking the more precise term "planets" or "satellites" etc. Broad, imprecise terms have usefulness at times.

But today, amid the revolution which has been going on in our knowledge of the Solar System in the 1990's we need to reexamine some basic terms long in use by planetary astronomers. In many cases we need to sharpen our use of terms, for words are the foundations of thought. Muddy definitions lead to muddled discussion and missed insights.

PLANETS. In ancient times it was easy. There were several thousand fixed stars, and five wandering stars or planets, plus the Sun, Earth and Moon. Simple distinctions. Then Philolaus and Aristarchus argued the Earth also was a planet; that issue was debated until the time of

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Copernicus and Kepler. So there were six planets, including Earth. Next William Herschel discovered Uranus in 1781, bringing the total to seven. Still, a fairly simple Solar System.

Then complexity began to break loose. Piazzi and his friends began to find very small planets, starting with Ceres in 1801. In the second half of the nineteenth century for convenience of discussion a distinction was drawn between *major planets* and *minor planets* or *asteroids* (also called *planetoids*). In the light of knowledge today, however, the major planet/minor planet distinction is no longer helpful. We are keenly aware now of the enormous differences between the four giant planets and the terrestrial-type worlds that lumping them together is grossly unfair. If we can lay traditional geocentric cultural bias aside, a strong case can be made that *there are only four major planets*, and Earth is not one of them. Calling Pluto (and Charon?) major planets was the result of our ignorance and cultural bias of an earlier time.

Talk of *major planets* is best left to historical papers examining the past.

How then should we characterize the components of our Solar System? With the results of over 35 years of space missions, and of vastly improved Earth-based astronomical equipment in our hands, we are in a position to speak more clearly than the old major planet / minor planet distinction. Since we know a great deal about the physical conditions on many of the planets and their satellites, we should think about these worlds with a physically-oriented terminology.

The inner worlds which have been largely differentiated internally and have had episodes of the melting of iron and silicate materials, usually early in their histories — Mercury, Venus, Earth and its Moon, and Mars — should be thought of as the *terrestrial worlds*. To this list we may also add 4 Vesta (also classifiable as an asteroid) and Jupiter's satellite Io. All of these at some time have been subject to considerable heating from radioactive decay, and/or from tidal forces, and/or major impacts, and/or proximity to the Sun.

Found largely in a temperature-transition zone between Mars and Jupiter, many thousands of *asteroids* in a cooler enviornment. Many are collision fragments. While they are also called *minor planets* — a term I liked until recently since it emphasized their true planethood to the general public — the term *asteroid* now serves better to differentiate these smaller planets from the host of small icy planets orbiting the Sun beyond Neptune, and I now favor its use. (More will be said about asteroids later.)

The *giant planets*, formed in a cold environment of space beyond the region significantly heated by the Sun, are four in number — Jupiter, Saturn, Uranus, and Neptune. They are giants indeed, with masses ranging from 14.5 times the Earth (the largest terrestrial world) in the case of Uranus, to almost 318 times the Earth in the case of Jupiter. Each of the four giants is distinctive from the other three, but there can be no doubt they are giants.

Generally at still greater distances from the Sun, and forming under even colder conditions, are the *icy worlds*. Some of the icy worlds are satellites of the giant planets. The bulk of them, however, lie in very cold storage beyond the orbit of Neptune. The largest known of those orbiting beyond Neptune are Pluto and its companion Chiron. The large majority of the icy worlds are members of either the *Kuiper Belt* or the *Oort Cloud*. Icy worlds which have been perturbed into highly elliptical orbits which bring them considerably closer to the Sun's heating and begin therefore to outgas their volitiles (at least at intervals) are called *comets*, of course. These are the major component groups of what we may call "the New Solar System."

ASTEROIDS. Since the mid-nineteenth century many European astronomers have used the term *minor planets* for the small, non-cometary objects of the Solar System visible in telescopes; many North Americans have preferred *asteroids* although both terms are interchangeable. But should all the small objects now being found beyond Neptune's orbit be called asteroids (or minor planets)? That seriously stretches the meaning of these terms. If they are included it would mean whenever statements are made in a paper about asteroids we would repeatedly need to add a qualifier or a footnote indicating whether or not trans-Neptunian objects are included.

Our original thinking about asteroids involved the Asteroid Belt objects between the orbits of Mars and Jupiter. *Then our idea of asteroids began to expand.* In 1898 the Mars-crosser 433 Eros was found, followed by a number of *Amor planets*, whose perihelia lie just beyond Earth's orbit. In 1906 the first of the *Trojan planets* in a Lagrangian relationship with Jupiter were found; we now have evidence there are thousands of them, although most have yet to be catalogued. In 1920 planet 944 Hidalgo was found crossing Jupiter's orbit. *The asteroid domain expanded.*

In 1932 planet 1862 Apollo, the first Earth-crosser, was found; we now know of more than 100 Apollo planets, and suspect there are thousands. The number depends upon how the minimum diameter for an asteroid is defined; some astronomers suggest a 100 or 200 meter minimum to distinguish them from large meteoroids — I agree.

In 1976 the first of the Aten planets was discovered. In 1977 the first Centauran planet 2060 Chiron was found (although 2060 Chiron now it is better classified as a giant periodic comet). In the early 1990's planet 5261 Eureka, the first *Lagrangian vassal* of Mars was found. I would urge Eureka *not* be called a Trojan — restrict that language to the Lagrangian vassals of Jupiter for sake of maintaining clarity — and I introduce the term *vassal* for both Eureka and the Trojans here because it reflects a distinctly subordinate type of companionship which is gravitationally accurate.[2] *With each of these discoveries our idea of the term asteroid expanded.*

Yet there must be a limit to this expansion of the term asteroid, even if discussion is aided by recognition of various orbital sub-groups within the term. Otherwise the term will become almost meaningless. *Trans-Neptunian objects* (i.e., objects with mean orbital distances greater than that of Neptune), existing in an extreme cryogenic environment, are a very different class of objects from most asteroids. Until we know them better, I agree with Brian Marsden we should simply call them *TNO's*. It is now strongly suspected most TNO's are members of the hypothesized Kuiper Belt, the source for short period comets. If such is indeed the case, I favor the use of the term *Kuiperoids* suggested by Clyde Tombaugh. Indeed, following this thinking, Pluto and Charon are the largest known Kuiperoids. And that is a better classification for them than the old "major planet" tag that was assigned in the days of our ignorance.

BINARY PLANET AND PLANET / SATELLITE DISTINCTIONS. Confusion exists about the use of "binary" in recent planetary literature. For example, some call the Earth-Moon system binary. Asteroid 243 Ida is now said by some to be binary because of the discovery of Dactyl.[3] On the other hand Charon is often said to be the satellite of Pluto. This is a sloppy use of terms. *Binary character is determined by the location of the barycenter (the center of mass) between the two most massive components in a system. If, when these components are at mean distance separation, the barycenter lies <u>outside</u> the solid or liquid surface, or outside the 1.0 bar pressure gradient of the atmosphere of the more massive component, it is unquestionably a binary system. If the barycenter lies <u>inside</u> the solid or liquid surface or 1.0 bar pressure gradient, then we are dealing with a planet – satellite relationship.* Brian Marsden, a leading expert in astronomcal definitions, concurs in this definition.[4]

Thus, in the case of the Earth / Moon system, since the barycenter lies distinctly inside the Earth, we have a planet–satellite relation, even though the Moon is of large size and mass relative to the Earth. In the case of Pluto and Charon, however, the barycenter lies outside of Pluto in

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[2] The use of the term "vassal" in the case of Lagrangian relationships has much to commend it. W. Kenneth Hamblin and Eric H. Christiansen, in their generally excellent book *Exploring the Planets* (1990, p. 363) use the term "Lagrangian satellites." This is acceptable if one is talking about "Lagrangian satellites of Saturn," but objection should be taken to their statement "Even Tethys has two Lagrangian satellites..." (Ibid) They mean well, but don't satellites orbit (circle around) their primaries? That is not happening in this case. One might better call them companions of Tethys, but certainly not satellites. The term "vassal" is even more vivid and accurate, instantly conveying the idea of subordinate companionship. On the other hand, in the case of the co-orbital satellites of Saturn, Epimetheus and Janus, neither is a satellite nor a vassal of the other; their near-parity in mass and diameter makes them each the "companion" of the other.

[3] Regarding 243 Ida and Dactyl, note usage in *Sky & Telescope*, 1995 January, pp. 20-23.

[4] Private communication, 1994 December 16.

space (actually well outside); therefore Pluto / Charon is a binary planet system, the first to be clearly identified in our Solar System. Thus Charon, more properly, should be referred to as "the *companion* of Pluto" rather than "the satellite of Pluto" although I would not complain about the latter usage in a table of satellites. The word "companion," of course, is a broader term, and might also be used of a satellite, but it is a very good term for a binary situation, not bearing the degree of subordination implied in the word "satellite." It may well be that a number of truly binary asteroid systems will be discovered in the next few decades, but 243 Ida is not one of them: tiny Dactyl, appearing in many of the Galileo photographs with Ida, is clearly a satellite rather than a binary companion since, based upon approximate volume measures and assuming a similar density, Ida is about 6,000 times more massive than Dactyl, and the barycenter lies well inside 243 Ida.

[Two other related terms bear brief mention. *Contact binary* has been used for some time for a two-body system in which the orbits have decayed sufficiently that their surfaces have made, or just are beginning to make, contact with each other.[5] The term *collapsed binary* has long been used of asteroids which had two or more components that are now fused together as a result of orbital decay. The concepts involved in both these terms were used in 1971 by A.F. Cook in connection with 624 Hektor.[6] Several other asteroids give evidence of being collapsed binaries as well. Both of these terms are so widely used now that there is little point in opposing their use. In many cases it might be difficult to know whether they are the result of collapse of a binary system or a planet–satellite system.]

BROWN DWARF STARS & BROWN DWARF PLANETS. Stretching out beyond our Solar System itself for a minute, the term "Brown Dwarf" has come into usage in recent years. I am unhappy with the term because it is often applied to two different kinds of objects, although their masses are in continguous ranges: (1) *extremely low mass red dwarf stars* which glow at optical wavelengths not as a result atomic reactions (with masses of less than 8% that of the Sun they do not have sufficiently high central temperatures to produce nuclear fusion). The smallest mass for a visible extreme dwarf star presently known is about 3.5% that of the Sun, in the binary system UV Ceti A and UV Ceti B. (2) The term "Brown Dwarf" is also used of planetary objects more massive than Jupiter that do not radiate at optical wavelengths. They may orbit other stars or orbit the Galaxy on their own. Only recently has the first case of this latter type been confirmed, although a great many are supposed to exist in our Galaxy.

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[5] "Contact binary" is also commonly used of stars whose outer layers are in contact with each other.
[6] Cf. *Physical Studies of Minor Planets,* ed. by T. Gehrels, p. 160.

It is doubtful the term "Brown Dwarf" will be withdrawn from astronomical vocabulary, but we could sharpen our usage of it by specifying Brown Dwarf *stars* in the first case, and Brown Dwarf *planets* in the second case. Of course there may be situations where both of these groups might be considered together simply as "Brown Dwarfs," but it is important to make that usage clear in the context of our speaking and writing.

THE DISCOVERY AND APPARITION OF PERIODIC COMET MACHHOLZ 2

by Don Machholz, ALPO Comets Recorder

Abstract: Here the author discusses his discovery and the apparition of this strange periodic comet which appeared in the latter half of 1994.

It's always interesting to find an unusual comet. You not only have the satisfaction and joy of discovering a new comet, but the series of surprises that follow. Such a comet is the "gift that keeps on giving". This was the situation for me during the appearance of Periodic Comet Machholz 2.

This comet was discovered on Saturday, Aug. 13 at 2:56 AM PDT. I had been sweeping for only 16 minutes that morning, covering a polar region of the sky with my 10" (25cm) reflector telescope at 36x. The scope is mounted on an English Fork mount in my observatory in Colfax, CA. This was my eleventh comet hunting session of August, the fourteenth in seventeen days. I knew almost immediately that this was a comet. It appeared diffuse with some condensation, and I knew that no clusters, nebulae or galaxies in the area.

After double-checking my star charts, roughing out a position, and making a drawing for motion, I went into the house. There I booted up my old IBM 286 computer, connected to the Smithsonian Astrophysical Observatory, and used their scanning service to see if any known comets were in that area. None were. So I sent them this message:

"I am presently checking out a cometary object at 04h 12m, +63.8 degrees, mag. 10.5. More later. Don Machholz"

I then returned to the telescope and noticed that the comet had indeed moved slightly. Over the next two hours I plotted it's position, in addition to continuing my comet hunting of the polar region.

At twilight I took one last look at the comet, then came back into the house and transmitted three positions for it to the SAO. The comet was moving at greater than two degrees per day. It also changed in appearance during this time, becomming more diffuse. At 7:30 AM I talked to Gareth Williams at the Smithsonian, he said he would try to get someone in Japan to confirm it. By 1:00 PM the following Circular was issued by the Smithsonian Astrophysical Observatory.

Circular No. 6053

Central Bureau for Astronomical Telegrams
INTERNATIONAL ASTRONOMICAL UNION
Postal Address: Central Bureau for Astronomical Telegrams
Smithsonian Astrophysical Observatory, Cambridge, MA 02138, U.S.A.
Telephone 617-495-7244/7440/7444 (for emergency use only)
TWX 710-320-6842 ASTROGRAM CAM EASYLINK 62794505
MARSDEN@CFA or GREEN@CFA (.SPAN, .BITNET or .HARVARD.EDU)

COMET MACHHOLZ (1994o)

Donald E. Machholz reports his visual discovery of a comet. The following observations are available:

1994 UT	R.A. (2000)	Decl.	m1	Observer
Aug. 13.4215	4 12.9	+62 48	10	Machholz
13.80190	4 20 30.42	+62 37 18.1		Kojima
13.80304	4 20 31.66	+62 37 18.1		"

13.80431	4 20 33.44	+62 37 18.6	"
13.80535	4 20 35.32	+62 37 11.6	"

D. E. Machholz (Colfax, CA). 0.25-m reflector. Comet diffuse with little condensation; coma diameter perhaps 3'-4'.
T. Kojima (YGCO Chiyoda Observatory). 0.25-m reflector + CCD. Poor conditions in twilight. Comet diffuse with condensation. Communicated by S. Nakano, Sumoto, Japan.

1994 August 13 (6053) Daniel W. E. Green

Ten days later more news came from the Smithsonian. The comet is periodic, it returns every six years. this is reflected in the following Circular.

Circular No. 6059

PERIODIC COMET MACHHOLZ 2 (1994o)

Additional observations have shown that this comet is of short period, meaning that comet 1986 VIII = 1991 XII now becomes P/Machholz 1. The following orbital elements are from MPEC 1994-Q06:

T = 1994 Sept.17.821 TT   Peri. = 147.547
e = 0.79054   Node = 247.484   2000.0
q = 0.75272 AU   Incl. = 13.266
a = 3.59366 AU   n = 0.144677   P = 6.81 years

1994 TT	R. A. (2000)	Decl.	Delta	r	Elong.	Phase	m1
Aug. 26	7 03.48	+49 41.7	0.417	0.851	56.0	100.0	9.9
28	7 17.83	+47 14.0	0.434	0.836	54.4	100.6	9.9
30	7 30.32	+44 49.9	0.453	0.821	53.0	100.8	9.9
Sept. 1	7 41.36	+42 30.6	0.473	0.808	51.9	100.7	9.9
3	7 51.24	+40 16.5	0.494	0.796	51.0	100.3	10.0
5	8 00.21	+38 07.7	0.515	0.786	50.2	99.6	10.0
7	8 08.46	+36 04.3	0.537	0.776	49.6	98.6	10.1
9	8 16.14	+34 06.0	0.560	0.769	49.2	97.4	10.1
11	8 23.35	+32 12.6	0.583	0.762	48.9	96.0	10.1
13	8 30.18	+30 23.9	0.607	0.758	48.6	94.4	10.2
15	8 36.72	+28 39.6	0.631	0.754	48.5	92.7	10.3
17	8 43.01	+26 59.4	0.655	0.753	48.5	90.8	10.3
19	8 49.09	+25 23.1	0.680	0.753	48.5	88.9	10.4
21	8 55.00	+23 50.3	0.704	0.755	48.6	86.9	10.5
23	9 00.77	+22 21.0	0.729	0.758	48.8	84.8	10.6
25	9 06.40	+20 54.8	0.754	0.763	49.0	82.8	10.7

1994 August 23 (6059) Daniel W. E. Green

By this time I had also heard that the comet had brightened. This occurred while the comet was in moonlit skies, and not observed by me, but others saw and imaged it.

Circular No. 6067

PERIODIC COMET MACHHOLZ 2 (1994o)

The primary component of this comet has evidently brightened since discovery. P. Pravec reports that 120-s CCD images taken through a 2' aperture by M. Wolf and L. Sarounova with the Ondrejov 0.65-m reflector (+ V filter) shows that the total brightness was about 2-3 mag brighter on Aug. 23.07 UT than on Aug. 15.92 and 16.90.

Total visual magnitude estimates (cf. IAUC 6057): Aug. 19.07

UT, 8.2 (L. Szentasko, Veresegyhaz, Hungary, 0.33-m reflector); 23.09, 7.8 (J. Lancashire, Cambridge, England, 10x80 binoculars); 28.12, 8.6 (H. Mikuz, Ljubljana, Slovenia, 0.20-m f/2 Baker-Schmidt camera + V filter + ST-6 CCD); 28.36, 7.7 (J. E. Bortle, Stormville, NY, 20x80 binoculars); 30.36, 7.6 (Bortle).

1994 August 30 (6067) Daniel W. E. Green

So the periodic comet has outburst. That should keep us busy for awhile. Are there any more surprises from this comet? The next Circular nearly knocked my socks off.

Circular No. 6066

PERIODIC COMET MACHHOLZ 2 (1994o)

H. Luthen, Hamburg, reports the discovery by Michael Jager of a second comet in the field of comet 1994o, located about 48' to the northeast of 1994o and appearing to have the same motion as comet 1994o. Additional observations have been reported in response to requests for confirmation from the Bureau:

1994 UT	R.A. (2000)	Decl.	m1	Observer
Aug. 28.03611	7 19.2	+47 53	11	Jager
30.05970	7 31 53.75	+45 24 44.1		Varady
30.09678	7 32 06.78	+45 22 04.5	12.1	"
30.09861	7 32.2	+45 21		Jager
30.46925	7 34 15.52	+44 55 07.2		Balam
30.51247	7 34 30.46	+44 51 59.3		"

M. Jager (Vienna, Austria). 0.20-m Schmidt camera + 2415 Tech Pan film. Diffuse coma 4'-5' in diameter, with little or no condensation.
M. Varady and P. Pravec (Ondrejov). 0.65-m f/3.6 reflector + CCD. Comet has moderate central condensation; m2 = 16.3; coma diameter 2'.2, with a faint halo of diameter 3'.5.
D. D. Balam (Climenhaga Observatory, Victoria). 0.5-m reflector + CCD. Comet very diffuse, with no central condensation; difficult to measure.

The following ephemeris is from the 1994o orbit on IAUC 6059, with T and Peri. changed to 1994 Sept. 18.208 and 147o.497:

1994 TT	R. A. (2000)	Decl.	Delta	r	Elong.	Phase	m1
Aug. 26	7 04.48	+50 29.1	0.408	0.854	56.2	100.4	11.4
28	7 18.97	+47 57.2	0.426	0.838	54.6	101.0	11.4
30	7 31.52	+45 29.3	0.444	0.824	53.2	101.3	11.4
Sept. 1	7 42.56	+43 06.5	0.464	0.811	52.0	101.2	11.4
3	7 52.41	+40 49.2	0.484	0.798	51.0	100.9	11.4
5	8 01.32	+38 37.5	0.505	0.788	50.2	100.2	11.5
7	8 09.49	+36 31.5	0.527	0.778	49.6	99.3	11.5
9	8 17.08	+34 31.0	0.550	0.770	49.2	98.1	11.6
11	8 24.20	+32 35.6	0.573	0.763	48.9	96.7	11.6
13	8 30.95	+30 45.0	0.597	0.758	48.6	95.2	11.7
15	8 37.40	+28 59.1	0.621	0.755	48.5	93.4	11.7

1994 August 30 (6066) Daniel W. E. Green

A third component, found by Petr Pravec and Wayne Johnson was reported. Then this next Circular followed.

Circular No. 6071

PERIODIC COMET MACHHOLZ 2 (1994o)

P. Pravec, Ondrejov, reports his discovery of fourth and fifth components to this comet on CCD images obtained with the 0.65-m reflector on Sept. 4.1 UT. The fourth component -- also independently reported by W. Johnson (Anza, CA), by T. Puckett, J. Armstrong, and M. Marcus (Atlanta, GA), and by M. Jager (Vienna, Austria) -- was then similar in brightness to the third component (IAUC 6070), about a magnitude fainter than the second component (IAUC 6066), sporting a 2'.0 coma with little condensation, and located some 320" north-northeast of the primary component. The fifth fragment (also evidently found by Jager on his films) was nearly 1 mag fainter than the fourth component, consisted of a 1'-2' diffuse coma and little or no condensation, and was located 307" north-northeast of the second component.

1994 September 6 (6071) Daniel W. E. Green

The orbit was refined, yielding a very short period of 5.231 years.

Circular No. 6081

PERIODIC COMET MACHHOLZ 2 (1994o)

Improved orbital elements from MPC 23956:

```
T = 1994 Sept.18.8010 TT          Peri. = 149.2566
e = 0.750261                      Node  = 246.1808  2000.0
q = 0.752551 AU                   Incl. =  12.7877
  a =  3.013353 AU    n = 0.1884209    P =   5.231 years
```

1994 TT	R. A. (2000)	Decl.	Delta	r	Elong.	Phase	m1
Sept.25	9 06.69	+20 55.9	0.731	0.760	49.0	84.5	8.0
30	9 20.42	+17 33.2	0.791	0.777	49.7	79.4	8.3
Oct. 5	9 33.52	+14 26.7	0.848	0.802	50.6	74.6	8.7
10	9 45.99	+11 34.4	0.902	0.834	51.7	70.1	9.1
15	9 57.83	+ 8 54.8	0.953	0.873	53.1	66.0	9.5
20	10 09.01	+ 6 26.4	1.000	0.916	54.7	62.4	9.9
25	10 19.50	+ 4 08.1	1.042	0.964	56.4	59.3	10.3
30	10 29.29	+ 1 59.0	1.080	1.014	58.4	56.5	10.8
Nov. 4	10 38.37	- 0 01.8	1.113	1.067	60.6	54.1	11.2
9	10 46.70	- 1 54.9	1.141	1.121	63.0	51.9	11.5
14	10 54.29	- 3 40.9	1.165	1.176	65.6	50.0	11.9
19	11 01.11	- 5 20.2	1.185	1.232	68.4	48.2	12.2
24	11 07.16	- 6 53.4	1.200	1.288	71.4	46.6	12.5

The orbital elements and ephemeris above refer to the principal nucleus, designated component A. Components B, C, D and E are designated in order eastward from component A and are thus the fourth, third, second and fifth components, respectively, mentioned on IAUC 6071, 6070, 6066, and 6071. Their positions can be described well with the above orbital elements, provided that T is changed to Sept. 18.866, 19.199, 19.206 and 19.267, respectively.

Total visual magnitude and coma-diameter estimates of component B (cf. IAUC 6071): Sept. 9.45 UT, 12.0, 2' (R. A. Keen, Mount Thorodin, CO, 0.32-m reflector); 11.51, 11.9, 1'.4 (C. S. Morris, Pine Mountain Club, CA, 0.26-m reflector).

Total visual magnitude and coma-diameter estimates of component D (cf. IAUC 6074): Sept. 9.45 UT, 11.0, 3' (Keen); 11.48, 11.3, 3'.3 (Morris).

1994 September 21 (6081) Daniel W. E. Green

Finally, as if this wasn't enough, Component A dimmed and Component D brightened, presenting us with a double comet within the same field of view.

Circular No. 6082

PERIODIC COMET MACHHOLZ 2 (1994o)

Several observers have reported that the primary component (A) of this comet has become diffuse and much fainter in the past week, while component D has brightened and become much more condensed. Total visual magnitude estimates of component A (cf. IAUC 6075): Sept. 17.13 UT, 7.6 (A. Diepvens, Balen, Belgium, 0.15-m refractor); 24.50, 9.0 (C. S. Morris, Pine Mountain Club, CA, 0.26-m reflector); 25.49, 9.0 (Morris; 4'.4 coma); 25.83, 9.4 (J. Kobayashi, Kumamoto, Japan, 0.41-m reflector). Total visual magnitude estimates of component D (cf. IAUC 6081): Sept. 16.09 UT, 9.7 (L. Szentasko, Veresegyhaz, Hungary, 0.33-m reflector); 24.50, 8.8 (Morris); 25.50, 8.6 (Morris; 2'.9 coma); 25.83, 9.0 (Kobayashi).

1994 September 26 (6082) Daniel W. E. Green

In the middle of September it was rumored that the comet may someday hit the earth. In its present orbit it will never get closer than 10 million miles, but the fragments worried some people. They presently seem to be behaving themselves and staying out of our way.

The comet is expected to return in late 1999, this time it will be in the evening sky and will again get as close to us as last time: 30 million miles. Only time will tell us how it is going to behave next time around.

END

Date 1994 08 13.00 Center: RA = 04 12.0 , Decl. = +62 48. Radius = 3 deg.
Positions are for date specified above and 1 day later.

Object		R.A. (2000) Dec.	R.A. (2000) Dec.
1994d	C	04 26.01 +59 30.0	04 22.39 +59 43.0

I am presently checking out a cometary object at
04h 12m, +63.8 degrees, mag. 10.5. More Later.
Don Machholz

Circular No. 6053

Central Bureau for Astronomical Telegrams
INTERNATIONAL ASTRONOMICAL UNION
Postal Address: Central Bureau for Astronomical Telegrams
Smithsonian Astrophysical Observatory, Cambridge, MA 02138, U.S.A.
Telephone 617-495-7244/7440/7444 (for emergency use only)
TWX 710-320-6842 ASTROGRAM CAM EASYLINK 62794505
MARSDEN@CFA or GREEN@CFA (.SPAN, .BITNET or .HARVARD.EDU)

COMET MACHHOLZ (1994o)

Donald E. Machholz reports his visual discovery of a comet.
The following observations are available:

1994 UT	R.A. (2000)	Decl.	m1	Observer
Aug. 13.4215	4 12.9	+62 48	10	Machholz
13.80190	4 20 30.42	+62 37 18.1		Kojima
13.80304	4 20 31.66	+62 37 18.1		"
13.80431	4 20 33.44	+62 37 18.6		"
13.80535	4 20 35.32	+62 37 11.6		"

D. E. Machholz (Colfax, CA). 0.25-m reflector. Comet diffuse with little condensation; coma diameter perhaps 3'-4'.
T. Kojima (YGCO Chiyoda Observatory). 0.25-m reflector + CCD. Poor conditions in twilight. Comet diffuse with condensation. Communicated by S. Nakano, Sumoto, Japan.

1994 August 13 (6053) Daniel W. E. Green

PERIODIC COMET MACHHOLZ 2 (1994o) Aug. 23, 1994, Cir. 6059

Additional observations have shown that this comet is of short period, meaning that comet 1986 VIII = 1991 XII now becomes P/Machholz 1. The following orbital elements are from MPEC 1994-Q06:

T = 1994 Sept.17.821 TT		Peri. = 147.547	
e = 0.79054		Node = 247.484	2000.0
q = 0.75272 AU		Incl. = 13.266	
a = 3.59366 AU	n = 0.144677	P = 6.81 years	

PERIODIC COMET MACHHOLZ 2 (1994o) Aug. 30, 1994, Cir. 6066

H. Luthen, Hamburg, reports the discovery by Michael Jager of a second comet in the field of comet 1994o, located about 48' to the northeast of 1994o and appearing to have the same motion as comet 1994o.

PERIODIC COMET MACHHOLZ 2 (1994o) Aug. 30, 1994, Cir. 6067

The primary component of this comet has evidently brightened since discovery. P. Pravec reports that 120-s CCD images taken through a 2' aperture by M. Wolf and L. Sarounova with the Ondrejov 0.65-m reflector (+ V filter) shows that the total brightness was about 2-3 mag brighter on Aug. 23.07 UT than on Aug. 15.92 and 16.90.

PERIODIC COMET MACHHOLZ 2 (1994o)   Sep. 3, 1994, Cir. 6070

Independent reports of a third diffuse object moving with the same motion as comet 1994o have been received from Petr Pravec (Ondrejov, 0.65-m reflector) and Wayne Johnson (Anza, CA, 0.56-m reflector) on CCD images obtained Sept. 2.11 and 3.51 UT, respectively. Pravec noted a 1'.0 coma with little condensation, the third companion being located about 43" southwest of the second object reported by Jaeger (IAUC 6066); Johnson noted this third component as being about 1 mag fainter than the second.

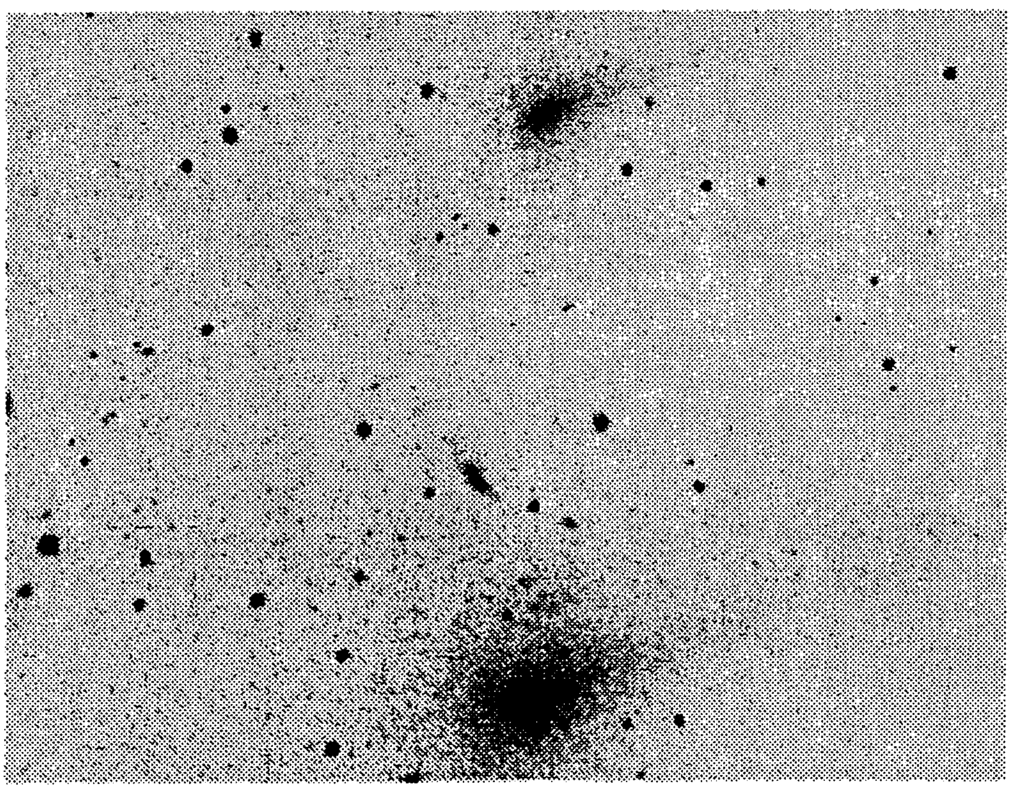
PERIODIC COMET MACHHOLZ 2 (1994o)   Sep. 6, 1994, Cir. 6071

P. Pravec, Ondrejov, reports his discovery of fourth and fifth components to this comet on CCD images obtained with the 0.65-m reflector on Sept. 4.1 UT. The fourth component -- also independently reported by W. Johnson (Anza, CA), by T. Puckett, J. Armstrong, and M. Marcus (Atlanta, GA), and by M. Jager (Vienna, Austria) -- was then similar in brightness to the third component (IAUC 6070), about a magnitude fainter than the second component (IAUC 6066), sporting a 2'.0 coma with little condensation, and located some 320" north-northeast of the primary component. The fifth fragment (also evidently found by Jager on his films) was nearly 1 mag fainter than the fourth component, consisted of a 1'-2' diffuse coma and little or no condensation, and was located 307" north-northeast of the second component.

PERIODIC COMET MACHHOLZ 2 (1994o)   Sep. 26, 1994, Cir. 6082

Several observers have reported that the primary component (A) of this comet has become diffuse and much fainter in the past week, while component D has brightened and become much more condensed.

Below: CCD image of Comet P/1994 P1 taken (details as above) on Oct. 11.145, showing components A (the brightest component), B (faint and diffuse), C (visible as a condensation in the coma of D), and D (the second brightest component). What is evidently an elongated galaxy appears just below center. Integration time 120 sec in a clear filter.



Ludwig Schupmann's Medial Telescope

by: Michael Mattei, A.L.P.O. Instrument Section

Abstract

The uniqueness of this optical system has many benefits when observing the planets. It offers very high contrast, unobstructed light path, and best of all, being a refractor-reflector, it has complete color correction. This feature allows one to correct for atmospheric dispersion which can be an annoyance when observing planets, such as Venus, at low elevations.

Introduction

In 1899 Ludwig Schupmann (1831-1920) applied for a patent of a new optical design, a refracting-reflecting telescope. This design he called "The Medial Telescope". Optics of the time were mostly refractors. There were few reflectors, although reflector's were to become the dominant astronomical telescope. Mirrors were silvered to cause reflection because the method of coating a mirror had not yet been perfected, and would not come about until the 1930's. The idea Schupamnn had was to correct the color that was inherent in all refractors of the time. His marvelous idea was to bring the aberrations of color to one common focus, just like a mirror does. This he did by introducing into the beam, and at the focus of the primary objective, a field lens (today it is easier to use a mirror here). This lens would redirect the beam into another lens-mirror that is coated on the back side, and returned through the lens-mirror a beam that is completely color corrected, in the same way as a mirror. But there are a few other benefits of this design, such as the ability to cancel out atmospheric dispersion, produce spectra of stars, and provide very high contrast of the sun, Moon, and planets. All of this occurs in one optical system.

The Optical System

There are many methods of arranging the configuration of this design, see fig.1. We will be describing the "field mirror type" by Olson, Daley, Mattei. The two most important aspects of these optics is that the objective, and the corrector, be made of BK-7 glass, and must be from the same melt. The optical system consist of three (3) elements. The first is the objective. This element is a single lens, unlike other refractor objectives which are double element. This single element has a focal length the same as any other refractor, long, around f/15. It can be as short as f/10, but not less. An image from the objective is formed on the front surface of a mirror (field mirror), and then directed off the main beam to the corrector. Two things begin to happen here. Because the beam is directed away from the main objective beam, we get astigmatism, and the objective, being a single element, is producing chromatic color. To reduce the astigmatism, the objective is tilted a small amount perpendicular to the offset beam. The problem with color is now corrected with the corrector as shown in fig. 2. Because the axial colors of the objective do not fall in the same plain, that is red focus is long, blue focus is short, and because the axial colors of the corrector are just the opposite, red focus is short, blue focus is long, they cancel out and form a color corrected image at the focal plain. The field mirror must have a cell that can be adjusted so that the beam from the objective can be align exactly with the corrector to give the color correction. One has to adjust this mirror as the telescope moves closer to the horizon to cancel atmospheric effects. The overall view of the optical system is given in fig. 3, with some values for the components. Fig 4. shows us the amount of spherical aberration vs efl/bfl. The dashed line at a ratio of efl/bfl = 1.83 is where the so called super Schupmann all spherical optics fit. At this point you can make all of the surfaces spherical on each element. If you move to either side of this line, then you must correct the objective in order to eliminate the effects of spherical aberration by parabolizing the objective surface.

Constructing of the telescope

The Schupmann telescope can be recognized anywhere because of the unique design of its box shape with the step in the tube. Fig5. The construction is all plywood. After the optics are made it is advisable to lay out the system and take measurements of the spacing of the components before building the tube.
Baffles are set in such a way that when you look into the eyepiece end you can not see light from the main objective. All stray light is prevented from reaching the eyepiece which gives a very dark field at the focal plane. The corrector is mounted such that it can be removed from the tube with out dismantling the tube. The field mirror is removed by taking the eyepiece cover off. Fig 6. is the authors 6 inch f/15 Schupmann. This design has the field mirror placed at 1/3 of the objective focal length in front of the field mirror. This system requires the objective correction of 6 waves, three on the front surface, and three on the back

surface. In Fig 6. you have a good comparison of how long the tube is, here it is 8 feet long, and weighs 29 pounds. It is possible to construct a much lighter tube assembly for this scope.

Observations through a 6 inch Schupmann

For the past 10 years I have been making observations with the telescope shown in fig 6. My observations are of the Moon, Mars and Jupiter for the most part. The eyepiece magnification that I like most is 245x. I use a 3x Barlow with a 28mm Edmund's RKE eyepiece. At times of good seeing this telescope gives the best images of planets I have ever seen. Of course the aperture is 6 inch which does not give the full resolution of the bigger apertures, but does very well for its size. The following figures 7, 8, 9, 10 show some of these results.

References

1. Daley, James A. Amateur Construction of Schupmann Medial Telescopes. Private Publication, 1984
2. Overbye, Dennis. A Night on Breezy Hill, Discover Magazine, October 1983, pp. 84-87.
3. Baker, James G. Planetary Telescopes, Applied Optics, Vol.. 2, No/ 2, February 1963, pp. 111-129.
4. Daley, James A. A Schupmann Medial Telescope, ATM Journal, Issue #1, Fall 1992

Figure 1

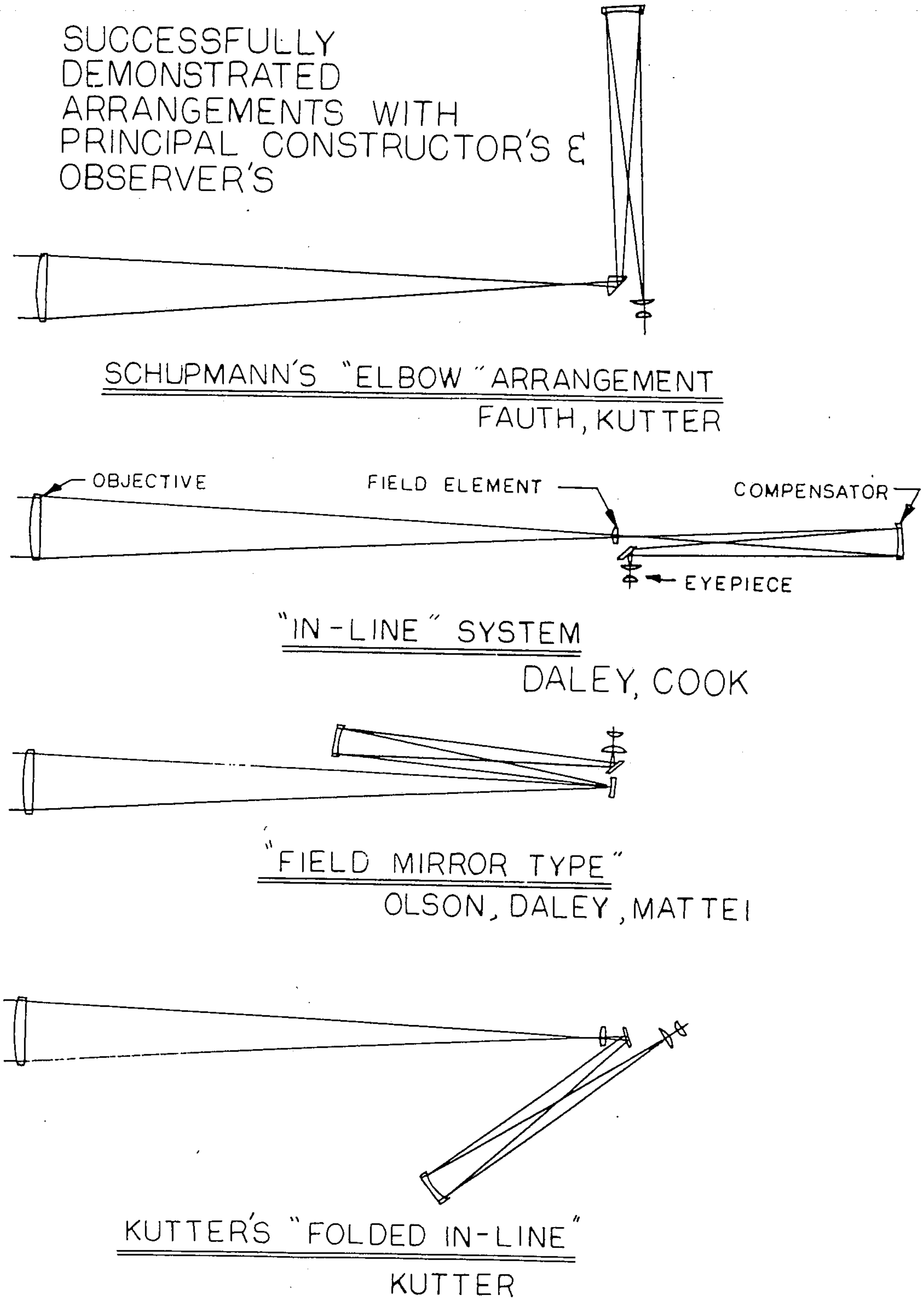
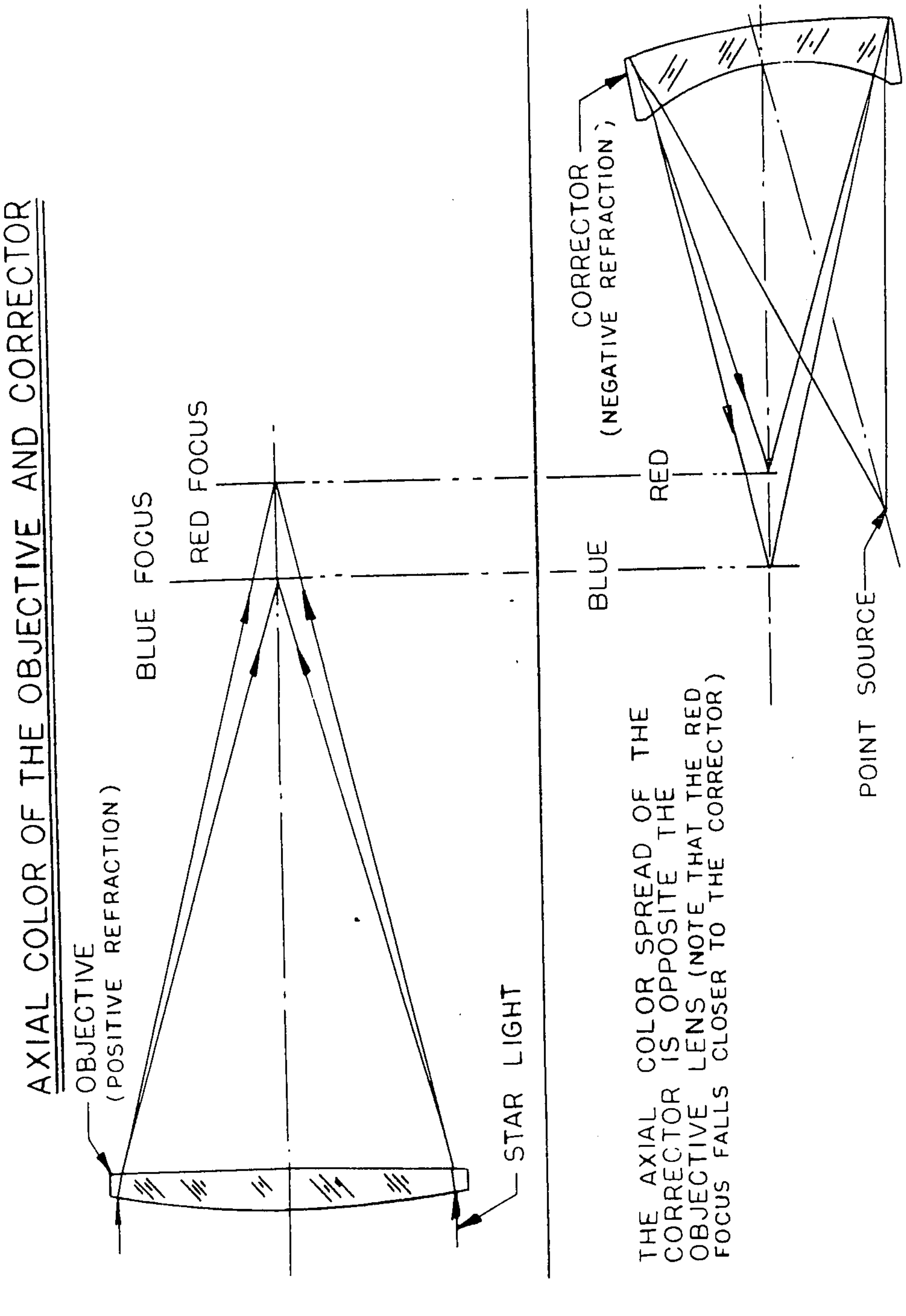

SUCCESSFULLY DEMONSTRATED ARRANGEMENTS WITH PRINCIPAL CONSTRUCTOR'S & OBSERVER'S
SCHUPMANN'S "ELBOW" ARRANGEMENT
FAUTH, KUTTER
OBJECTIVE
FIELD ELEMENT
COMPENSATOR
EYEPIECE
"IN-LINE" SYSTEM
DALEY, COOK
"FIELD MIRROR TYPE"
OLSON, DALEY, MATTEI
KUTTER'S "FOLDED IN-LINE"
KUTTER

Figure 2


AXIAL COLOR OF THE OBJECTIVE AND CORRECTOR
OBJECTIVE
(POSITIVE REFRACTION)
BLUE FOCUS
RED FOCUS
STAR LIGHT
CORRECTOR
(NEGATIVE REFRACTION)
RED
BLUE
POINT SOURCE
THE AXIAL COLOR SPREAD OF THE CORRECTOR IS OPPOSITE THE OBJECTIVE LENS (NOTE THAT THE RED FOCUS FALLS CLOSER TO THE CORRECTOR)

THE STANDARD MEDIAL DESIGN

(100.0 INCH EFL)

EFL/BFL = 1.83
DIMENSIONS IN INCHES

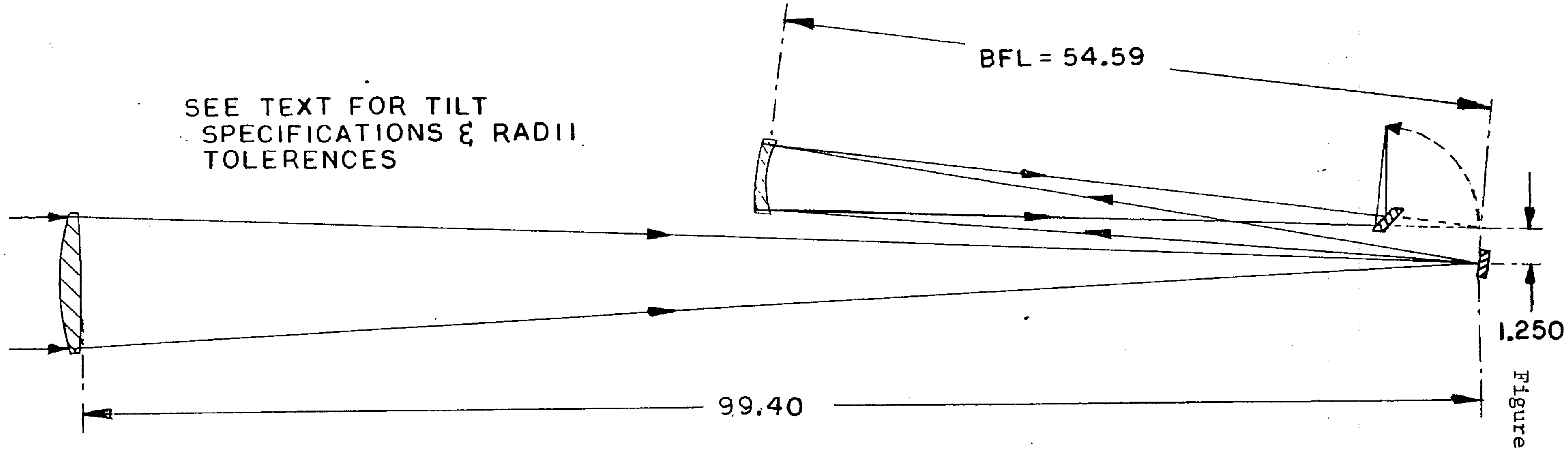


Figure 3

	OBJECTIVE	FIELD MIRROR	CORRECTOR
MATERIAL	BK-7	PYREX	BK-7
RADIUS-FIRST SURFACE	56.648 CV	70.81 CC	14.851 CC
RADIUS-SECOND SURFACE	587.61 CV	—	29.055 CV
THICKNESS-CENTER	1.0	0.5	0.5
CLEAR APERTURE	10.0	1.0	5.459

Figure 4

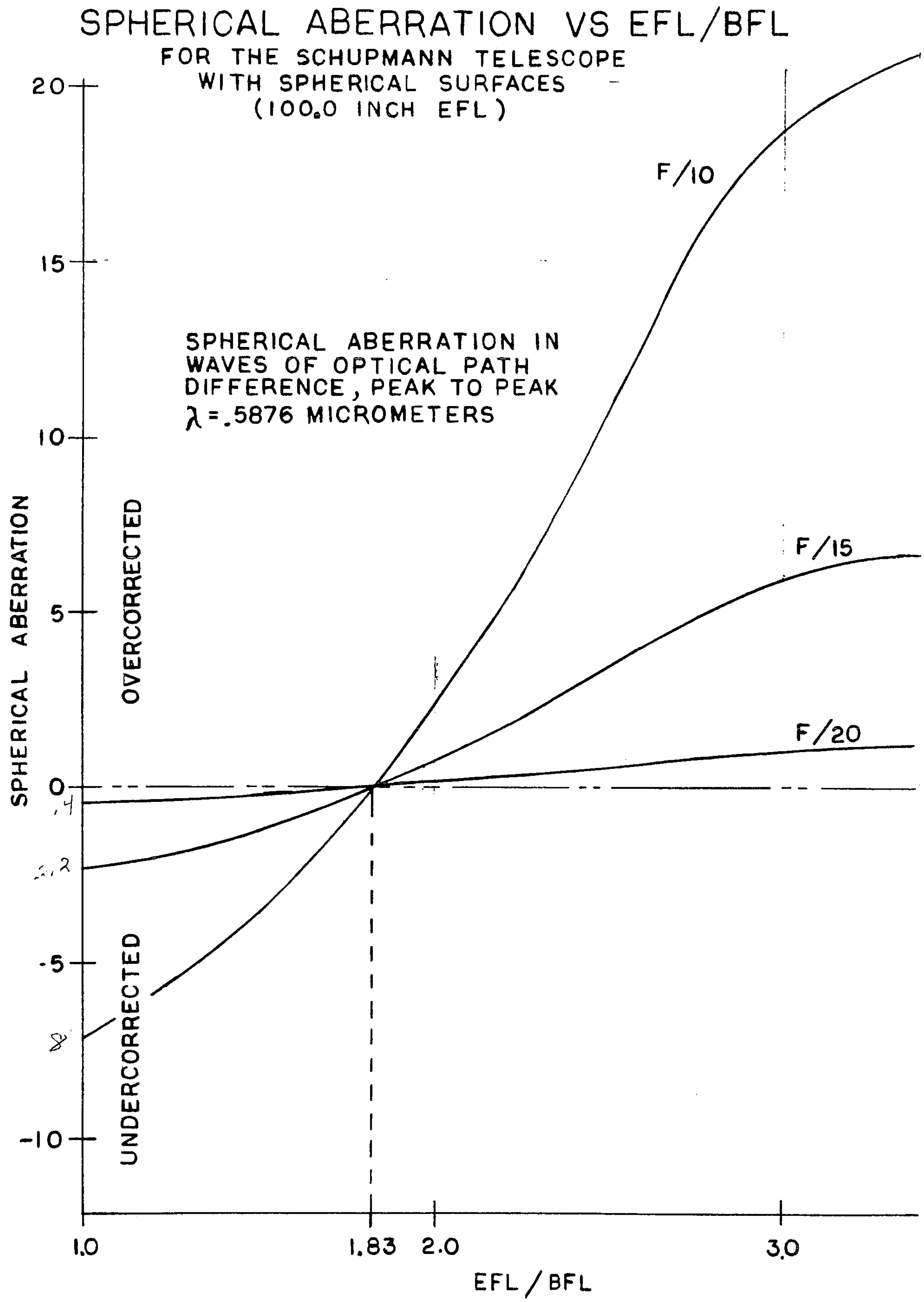

SPHERICAL ABERRATION VS EFL/BFL
FOR THE SCHUPMANN TELESCOPE
WITH SPHERICAL SURFACES
(100.0 INCH EFL)
SPHERICAL ABERRATION IN
WAVES OF OPTICAL PATH
DIFFERENCE, PEAK TO PEAK
λ = .5876 MICROMETERS
F/10
F/15
F/20
OVERCORRECTED
UNDERCORRECTED
SPHERICAL ABERRATION
20
15
10
5
0
-5
-10
1.0
1.83
2.0
3.0
EFL / BFL

Figure 5

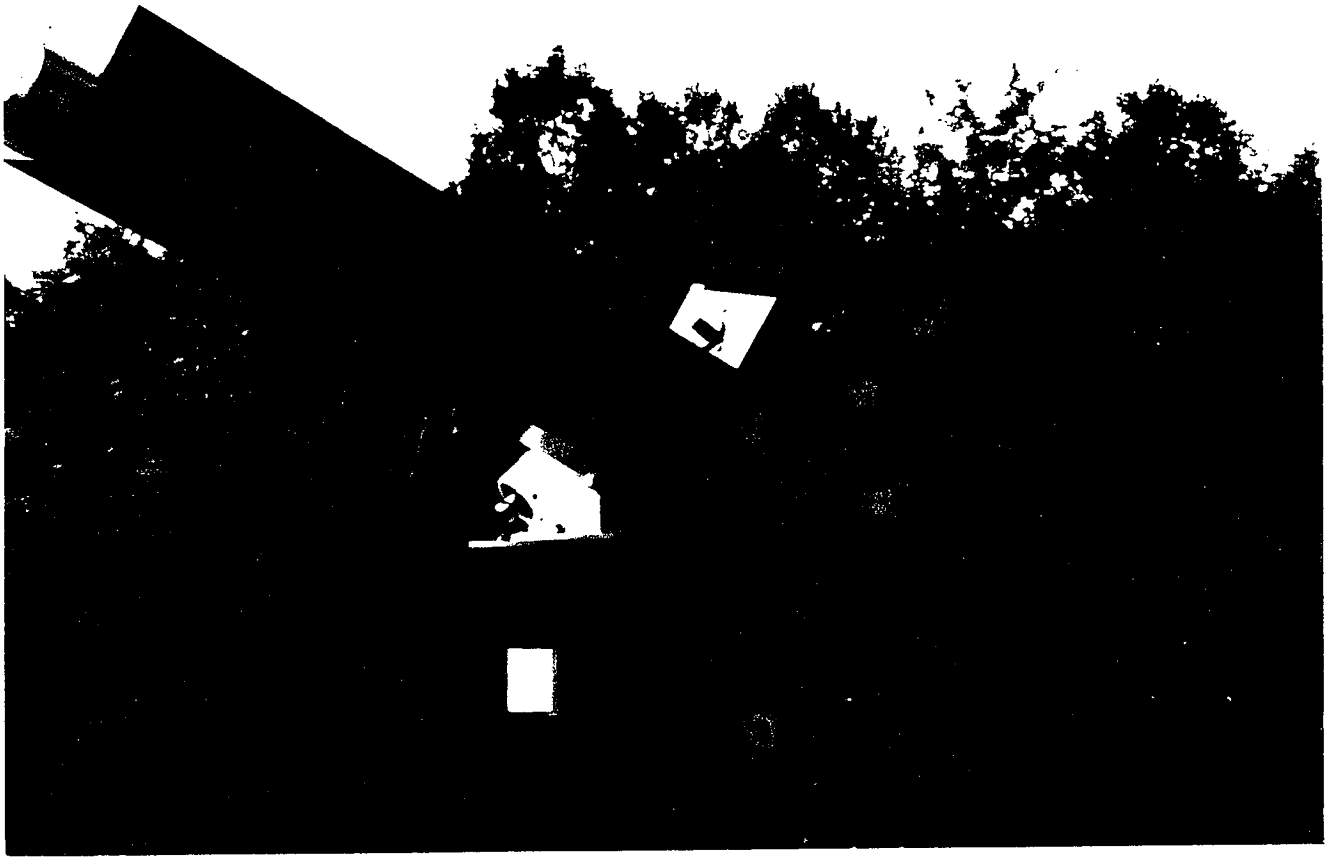


Figure 6

Figure 7

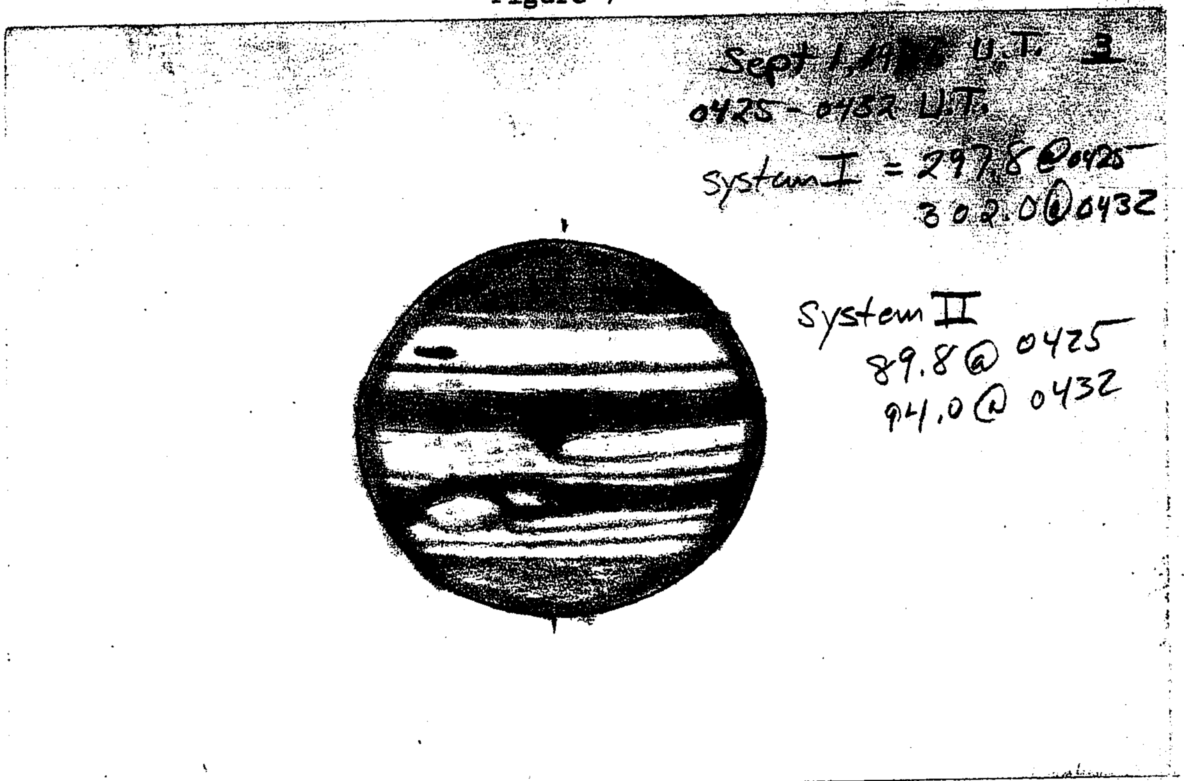


Figure 8

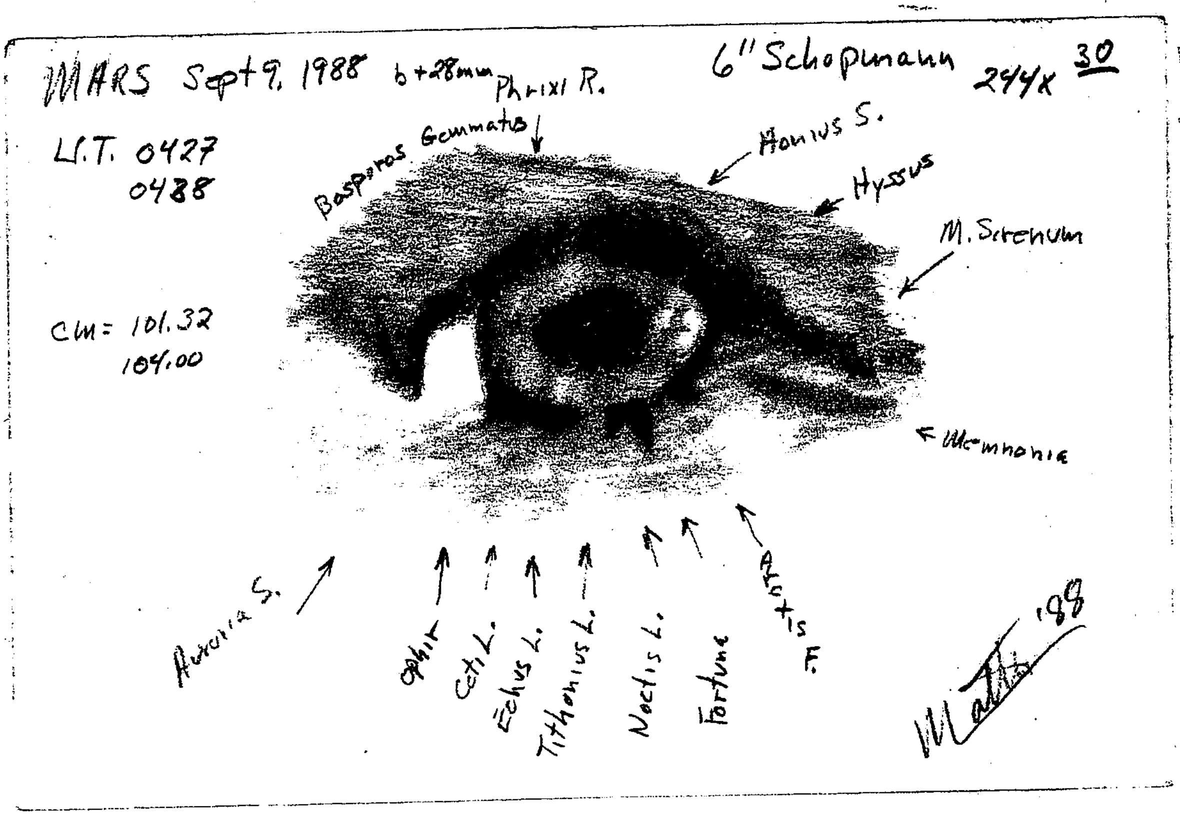


Figure 9

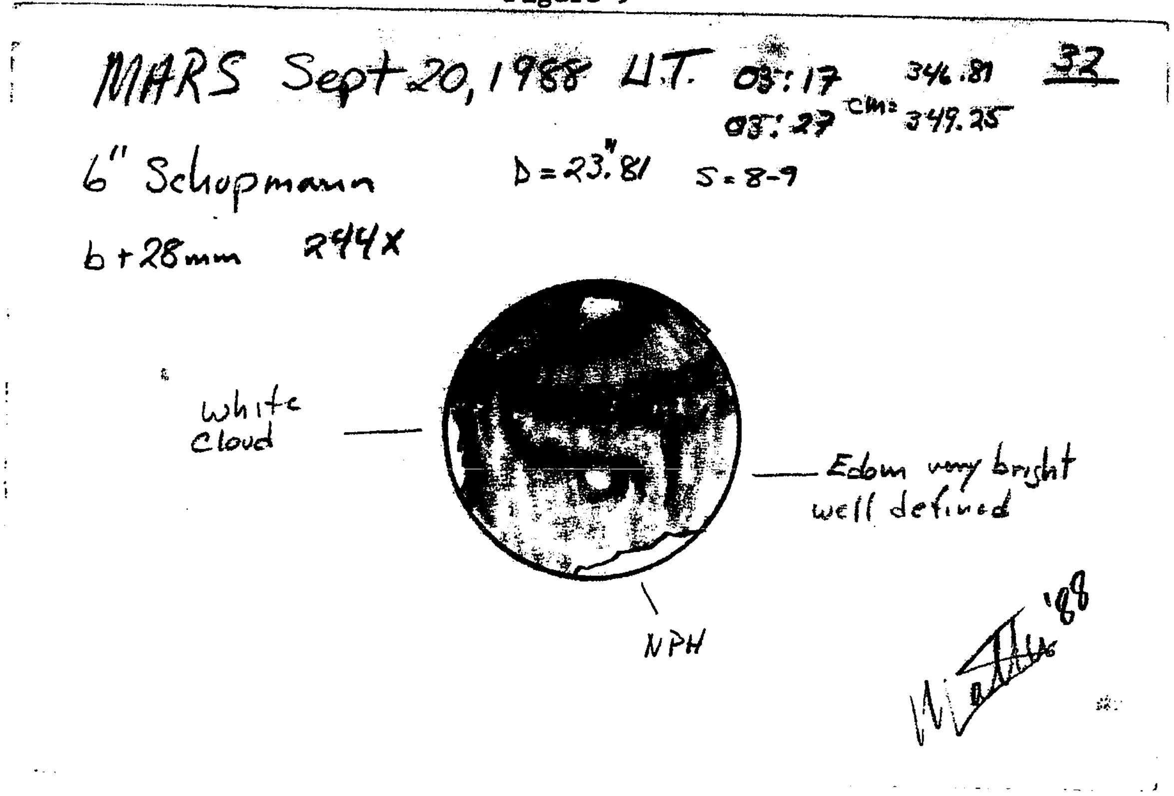
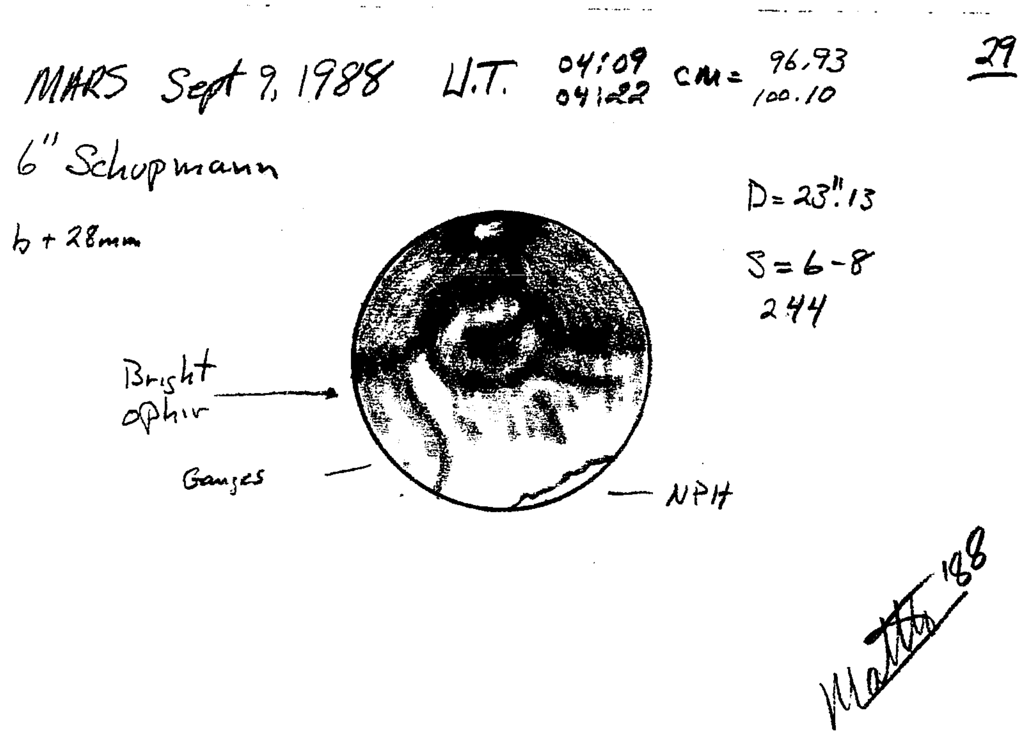


Figure 10



UPDATE ON THE OLIVAREZ BLUE FEATURES OF JUPITER'S EQUATORIAL ZONE-NEBs

By Jose Olivarez, ALPO Jupiter Recorder

ABSTRACT

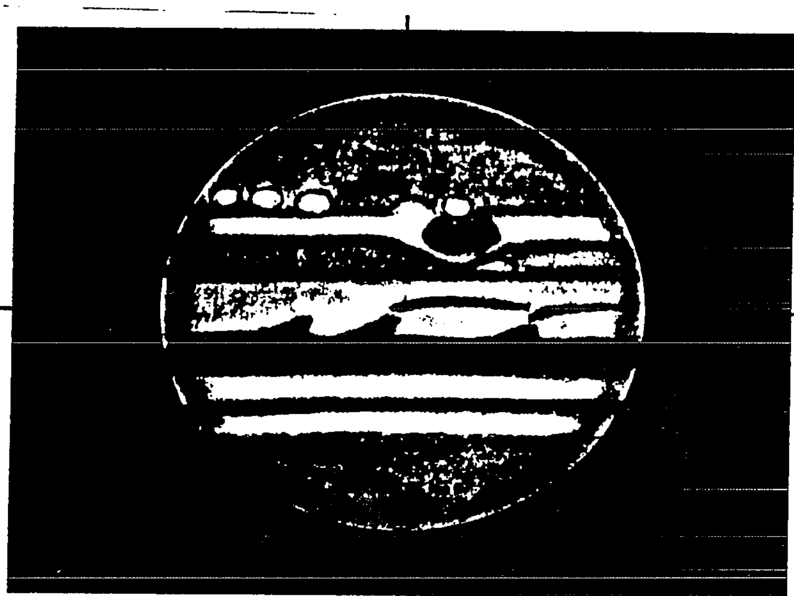
A search in the Jupiter historical record by this author and by John Rogers of the BAA has established that the currently observed "Blue Features Phenomena" of Jupiter's NEBs is now about 84 years old. The bluish projections from the south edge of the NEB, in fact, first made their appearance in 1911-`1912. Before 1911, the projections and festoons eminated from the north edge of the SEB! So, around 1911, there was a dramatic transformation in Jupiter's equatorial region - the projections and festoons seemingly transfered from the north edge of the SEB to the south edge of the NEB !

Since 1911, blue projections have been a familiar feature of the NEBs and the projections have turned out to be of immense interest because of their special chracteristics. They all have rotation periods that are very close to System I's 9hrs. 50min. and 30 secs. and they remain almost stationary at the longitudes they occupy. In all cases, they all appear with their bases adjacent to the south edge of the NEB and look like spots or masses that in time develop graceful bluish festoons that project or loop into the Equatorial Zone. Also, there are usually twelve to fourteen blue features at any one time distributed around the planet at intervals of 25 to 35 degrees at latitude +7 degrees north. One of these blue features has been followed for the past 11 years (OL-1, 1983) by ALPO observers.

Five micron "thermograms" that map the escape of internal heat through Jupiter's cloud layers have shown that the blue features are thermal sources much warmer than their surroundings. This warmth suggests that the observed features are deep cloud-free areas that permit the escape of Jupiter's internal

warmth. It is possible that the "holes" that are the sources of the blue features may extend to a depth of about 100 kilometers below the top of Jupiter's troposphere. Also, the bottom of the "holes" may be about 100 degrees Centigrade warmer than the higher level cloud tops and look bluish because they are filled with upwelling droplets and snowflakes of water-ice.

Jose Olivarez, August 2, 1995



Date (UT) July 27, 1995

Observer Jose Olivarez (with Phillip W. Budine)

Address 1469 Valleyview Court

Wichita, Kansas 67212

Telescope: Aper. 10-in. Type Refractor (D & G Optical)

Magnification(s) 250X (Zeiss Abbe Eyepiece)

Filter(s) None

Seeing (0-10 scale) 5-6

Transparency (lim. mag.) 4

UT Start 2:25 UT End

CM(I): Start 305° End

CM(II): Start 37.6° End

1995 Positions of "OL" blue features (NEBs, +7° N)

Jose Olivarez, Observer

Observation Date	Longitude
June 13 UT	283 degrees
June 15 UT	182 degrees
June 17 UT	141 degrees
June 18 UT	266 degrees
June 18 UT	279 degrees
July 9 UT	257 degrees
July 18 UT	319 degrees
JULY 27 UT	298 degrees
JULY 31 UT	198 degrees

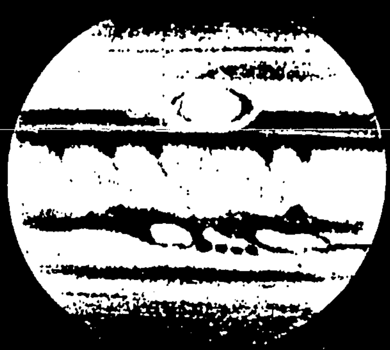
North Equatorial Current (S. edge NEB, EZn), System I
1993- 1994

No.	Mark	Limiting Dates	Limiting L.	Drift	Period
OL-1(83)	Dc	Dec.11-May.14	052°-050°	-0.°4	9:50:29
OL-4(86)	Dc	Dec.04-Jun.27	240-244	-0.6	9:50:31
O1-5(88)	Dc	Dec.09-Jul.02	290-244	-0.6	9:50:29
OL-6(91)	Dc	Dec.20-Jul.06	194-189	-0.6	9:50:29
1	Dc	Jan.09-Jul.01	157-160	-0.5	9:50:31
2	Dc	Jan.10-Jun.18	325-331	-1.1	9:50:31
3	Dc	Feb.17-Jun.19	102-100	-0.5	9:50:30
4	Dc	Feb.19-Apr.20	156-155	-0.5	9:50:30
5	Dc	Feb.13-May.08	307-309	-0.7	9:50:31
6	Wc	Mar.05-May.14	126-126	0.0	9:50:30
7	Wc	Mar.03-May.05	155-155	0.0	9:50:30
8	Dc	Mar.05-Jul.01	149-150	-0.3	9:50:30
9	Dc	Mar.24-May.14	116-115	-0.6	9:50:29
10	Dc	Mar.28-Jun.05	072-074	-0.9	9:50:31
11	Dc	Dec.30-Jun.18	012-010	-0.4	9:50:29
12	Wc	Mar.24-Jun.19	094-092	-1.2	9:50:28
13	Wc	Feb.13-Jun.14	332-335	-0.8	9:50:31

Mean rotation period: 9:50:30

In the table above four Olivarez long-lived blue features were still being observed by A.L.P.O. observers.

PLATE P4

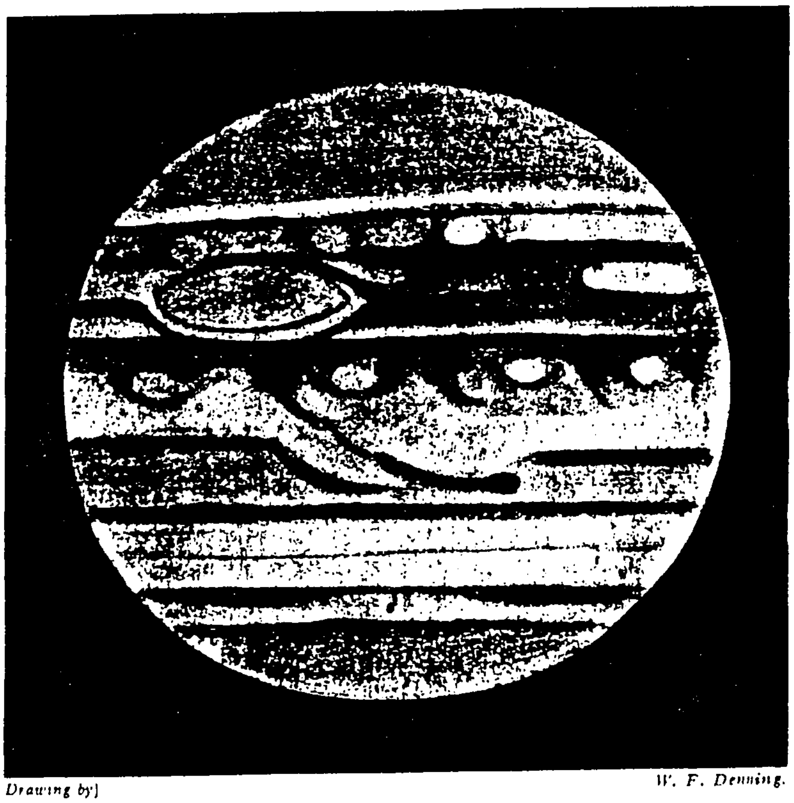


(1) 1893 Oct 30. ω₂ 350.
Antoniadi.
GRS; NEB Revival active.

(2) 1894 Sep 6: ω₂ 21.
Antoniadi.
GRS; NEB very broad.

(3) 1895 Oct 15: ω₂ 270.
Antoniadi.
NEB receding, leaving two dark 'little red spots'.

(1–7) Two successive NEB Revivals are covered by these beautiful early drawings by E.M. Antoniadi and T.E.R. Phillips. The originals are tinted. Nos.1 and 2 are from BAA Memoirs; nos.4–7, previously unpublished, are from BAA archives.



Drawing by] *W. F. Denning.*

JUPITER, 1906, APRIL 15, AT 6h. 30m. G.M.T.

Towards the left in this drawing is seen the old Red Spot as a well-defined ellipse lying in its hollow on the south side of the South Equatorial Belt. To the right of this we see the South Tropical Disturbance. This object was first seen by the late Major Molesworth, in Ceylon, on February 28, 1901, as a small round projection, at the south edge of the South Equatorial Belt. It quickly showed striking developments, spreading across the South Tropical Zone to the South Temperate Belt, and at the same time becoming greatly extended in longitude. At times it has exceeded 180° in length. A white spot has usually been seen at the preceding and following ends.

Plate III.

JUPITER IN 1911.

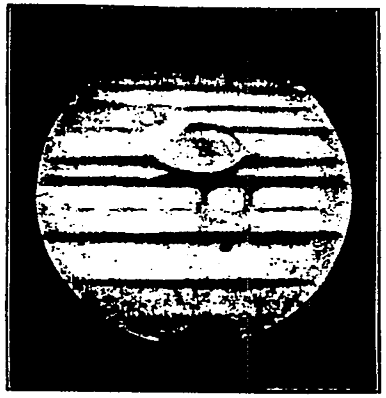


FIG. 1.—April 30^d 12^h 30^m G.M.T.
$\lambda_1 = 194°$, $\lambda_2 = 327°$.
HAROLD THOMSON. 8½-in. spec.

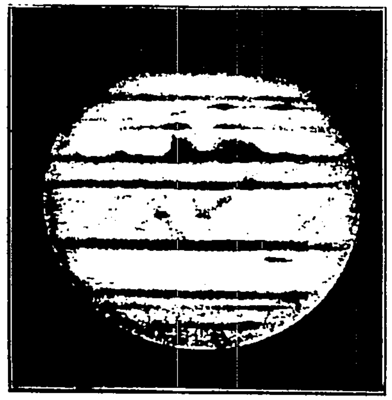


FIG. 2.—May 2^d 10^h 5^m G.M.T.
$\lambda_1 = 62°$, $\lambda_2 = 180°$.
Rev. T. E. R. PHILLIPS. 12¼-in. spec.

FIG. 3.—May 20^d 10^h 25^m G.M.T.
$\lambda_1 = 38°$, $\lambda_2 = 19°$.
C. O'HARA. 8-in. spec.

FIG. 4.—May 29^d 9^h 15^m.
$\lambda_1 = 337°$, $\lambda_2 = 250°$.
HAROLD THOMSON. 8½-in. spec.

FIG. 5.—June 17^d 8^h 50^m G.M.T.
$\lambda_1 = 82°$, $\lambda_2 = 210°$.
Rev. T. E. R. PHILLIPS. 12¼-in. spec.

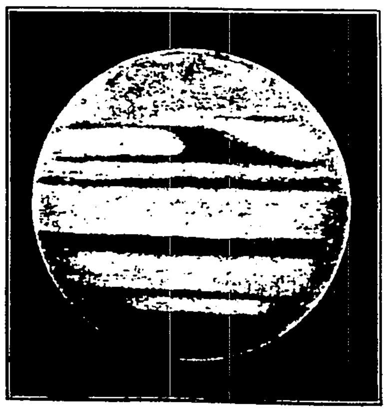


FIG. 6.—June 24^d 2^h 0^m G.M.T.
$\lambda_1 = 217°$, $\lambda_2 = 143°$.
H. P. NEWTON. 3-in. O.G.

FIG. 1.—1914, June 13^d 23^h 50^m G.M.T.
$\lambda_1 = 152°$, $\lambda_2 = 223°$.
H. P. NEWTON. 8½-in. spec. (incomplete).

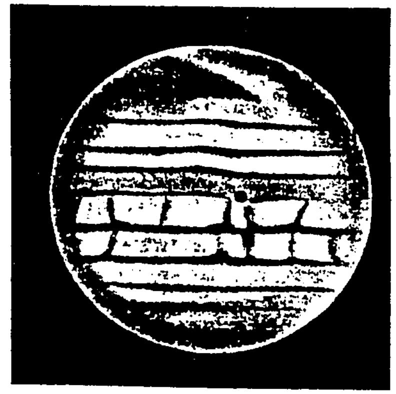


FIG. 2.—1914, July 29^d 14^h 35^m G.M.T.
$\lambda_1 = 241°$, $\lambda_2 = 325°$.
R. L. WATERFIELD. 10-in. O.G.

FIG. 3.—1914, Aug. 11^d 11^h 0^m G.M.T.
$\lambda_1 = 6°$, $\lambda_2 = 351°$.
H. THOMSON. 12½-in. spec.

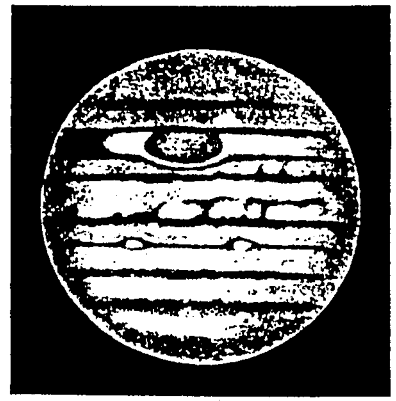


FIG. 4.—1914, Aug. 18^d 18^h 35^m G.M.T.
$\lambda_1 = 309°$, $\lambda_2 = 239°$.
A. THOS. G. APPLE. 11-in. O.G.

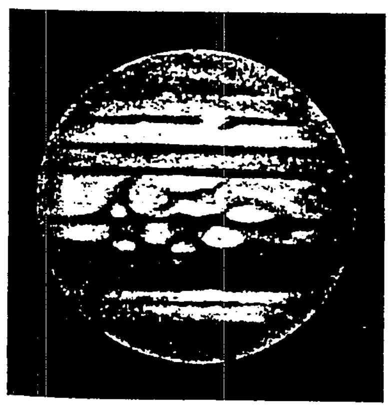


FIG. 5.—1914, Aug. 23^d 11^h 5^m G.M.T.
$\lambda = 78°$ $\lambda_2 = 0°$.
T. E. R. PHILLIPS. 8-in. O.G.

FIG. 6.—1914, Sept. 22^d 8^h 40^m G.M.T.
$\lambda_1 = 160°$, $\lambda_2 = 175°$.
W. H. STEAVENSON. 10-in. O.G.

The Association of Lunar and Planetary Observers Lunar and Planetary Training Program:

A Progress Report and Analysis on the Training Program's First Year Activities Since Its Revision

by

Timothy Robertson and Matthew Will

A.L.P.O. Lunar and Planetary Training Program Coordinators

ABSTRACT

A total of 18 ALPO members have initiated their participation in the Training Program by answering the programs introductory questionnaire. One purpose of this questionnaire is to gather statistical data to arrive at some conclusions about the program's direction at this point in time. Other developments in the program include an examination of the artistic approach to lunar drawing and participation in the newly formed ALPO World Wide Web homepage.

This paper is a progress report concerning the operations of the ALPO (Association of Lunar and Planetary Observers) Lunar and Planetary Training Program over the past year. Included is an analysis of responses to the questionnaire that we, the coordinators, require from each applicant in the program to complete. Even though the database of participants is small, some preliminary results and intriguing conclusions have surfaced in this survey. Also, the coordinators will discuss some future plans for outreach to ALPO members.

INTRODUCTION TO THE ANALYSIS

The questionnaire that was used in the following analysis was designed by the coordinators for the following purposes. First, the answered questionnaire informs the coordinator about a trainee's desire for training in certain areas of Solar System observing and it allows the coordinator to evaluate the adequacy of the trainee's own equipment for the task ahead. Secondly, statistical data can be derived from the questionnaire so that an analysis can be undertaken to review the direction of the program and to make adjustments to meet the changing needs of future trainees. The focus of this paper will be on the analysis of the responses to the questionnaire.

As with all observing programs in the ALPO, there is always a ratio of those who simply inquire about the program and those that actually participate in the full scope of training. Generally, just about everyone that inquires about the program, answers the questionnaire we send them. However, as far as actually submitting observations, only about one out of every three inquirers follow through. In this analysis, we have chosen to review data from both active and non-active participants in the program. This review is not written to "single-out" or admonish those members who have not chosen to commit to the program. It is our viewpoint that just as much can be learned from people who are not active in the program, as it is for members that participate. The coordinators believe that some clues for a person's inactivity may lie in the answers to the questionnaire. In order to make the Training Program more successful in the future, we need to discover these stumbling blocks, to make the program more inclusive to all. So, if a person answers the questionnaire, he or she is included in the data base. We have divided the results into three camps. They are: (1) the active trainees, (2) the non-active trainees, and (3) the total group, both actives and non-actives, that has contributed to the questionnaire's data base. Granted we are working with a small data base at this time. However, it will grow with time and undoubtedly, we will be revisiting this analysis in the near future as our data base accumulates. Also, we will be generalizing the results as much as needed, since numerical data throughout the paper may make the subject matter too tedious to follow.

As of July 15, 1995, there were 18 students in the program that at least answered the questionnaire. Of this total of 18, six are involved in submitting observations to the Training Program. Of the six, two are at the Basic Level, three are at the Novice Level, and one other student at the Novice Level for Jupiter observing has attained Observer Status for Mars observing.

The geographic distribution of the total number trainees in the program is pretty much evenly spread out across the country. There is a clustering of three trainees in California. Otherwise, by region there isn't much variation although looking closely, we have no trainees in the Pacific Northwest or in the Northern Great Plains. We have one international student in Ontario, Canada. The distribution of active trainees pretty well emulate this pattern.

THE RESULTS OF THE ANALYSIS

The questionnaire used for the Training Program was developed by the coordinators and is composed of a total of twenty questions. Some were multiple choice while other were short answer questions. The questionnaire might be better described as being divided into four parts. In the questionnaire we ask the trainee about their areas of interests, experience levels, the telescopes they use and optional questions regarding personal statistics. As stated earlier, the purpose of the questionnaire is to find out from the student observer what they want out of the program and to verify that they are capable of doing the observations with the equipment they have. Using this as a starting point, the coordinators can then advise accordingly.

The first two questions inquired about the trainees interest in the program. The prospective student observer was asked to choose two Solar System subjects on which they would like to concentrate. The moon was the dominant subject of interest among both active and non-active groups in the Training Program. Both Jupiter and Mars were tied for second place among both groups and the Sun and Saturn finished behind these two planets in popularity. Overwhelmingly, participants in the questionnaire answered that they were interested learning visual and drawing skills in the program. A few expressed an interest in learning CCD-Video imaging or photometry. The desire to perfect drawing skills, especially for lunar drawing in this program, has lead Coordinator Matt Will to reevaluate the art of drawing as it applies to scientific studies of the moon. More will be discussed about this particular topic further on in this paper.

When asked about experience level most trainees rated themselves as "beginners" with less than one year of experience in planetary observing. Trainees that are active in the program tended to list themselves as "intermediate" amateurs with 1 to 5 years of experience. It could be said that the active trainees are more self motivated toward observing than others in the program. In the future, the coordinators will have to encourage and further abet beginners to participate in the program. It should be noted that while no one rated themselves as "advanced", we do have a few trainees doing CCD imaging that do have advanced observing skills by way of their amateur backgrounds.

The student observers in the Training Program use a wide variety of telescopes. Three types of scopes used are Newtonian reflectors, refractors, and Schmidt-Cassegrains. Cassegrain reflectors and Maksutovs were absent as well as any less popular types. The Newtonian reflectors predominated with refractors finishing second in popularity among trainees in the non-active and active groups. With the active group, nearly all use reflectors. This group uses reflectors of lower aperture (average aperture of about 8 inches) than the non-active group (average aperture of 10 inches). Also, the active trainees use reflectors of longer focal lengths than there non-active counterparts. There were no active observers with the SCTs (Schmidt-Cassegrain Telescopes).

Equatorial mounts seem to predominate in all telescope categories. Little more than half the telescopes were motorized. When broken down into groups, the active trainees use more reflectors with equatorial mountings and clock drives than did the non-active group. Virtually all the refractors and SCTs in the non-active group have equatorial mounts and clock drives.

One might infer that the active trainees use reflecting telescopes that are more portable and give more contrasty images. Their observing might also tend to be less troublesome by their use of equatorial mounted scopes that are clock driven.

Several questions listed near the end of the questionnaire were optional for the trainee to answer that dealt with collecting information of a personal nature. The trainee could choose not to answer any or all of them. The first question asks for the trainee's age. The statistics of age seem to be very consistent for all groups. The average age of a trainee in all groups fell in the mid forties with an age range for the total group from ages 13 to 80. A third of those who answered the questionnaire were in their forties. One active trainee is female. The rest of the total group is composed of males.

A majority of trainees in all groups are represented by people who make their living in a professional capacity. We have a few retirees and a few others that are either students or maintain "blue collar" jobs.

In all groups a majority of trainees have been apart of the ALPO for less than one year. When asked about how they found out about the ALPO the total group and non-actives were just about evenly split between finding out through astronomy books, another member, or through an article in a magazine. However, the actives were informed about the ALPO through another member or a magazine article and not through any book. One may say that the active observers may be less well read than a non-active observer or that the active participant in the program reads less to make for more time observing!

When asked about how they came acquainted with the Training Program the non-active trainees said they were informed about it through membership literature (i.e. introductory letter to new members from Membership Secretary, Harry Jamieson). Active trainees indicated that they knew of the program by reading the *JALPO* (*Journal of the ALPO*). Apparently, the active observer reads the *JALPO* more closely than do the other trainees.

Most of the trainees are affiliated with one or more organizations outside of the ALPO. While some in the total group are not apart of any outside organizations, the active observers belong to at least one or two other organizations or clubs. Local clubs are most popular among the trainees as a whole. The Planetary Society is second to the local clubs in popularity in the non-active camp. Other national organization memberships are smattered amongst the trainees in the program. It is important to note that a third of the non-active trainees are not affiliated with any kind of an organization outside the ALPO. It will be imperative for the coordinators to encourage these members to continue through the program since they have little or no contact with other counterparts in local clubs or by other networking means.

In general, our trainees subscribe to one or more astronomical magazines or journals beyond the *JALPO*. Many members in the non-active group subscribe to two or three periodicals but there are some that don't subscribe to any at all. Active group trainees all subscribe to one or more additional publications. *Sky & Telescope* was the most popular magazine or journal of all three groups followed by *Astronomy*. Other specialty or lesser general astronomical periodicals rounded the list but none really predominated a ranking. It is interesting to note that 10 of the 18 trainees subscribe to both *Astronomy* and *Sky & Telescope*. Six of these trainees read an additional third publication or more as described above. There are 6 members that subscribe to *Sky & Telescope* but not to *Astronomy*. None subscribe to *Astronomy* without also subscribing to *Sky & Telescope*. These trends pattern themselves in a similar fashion with the active group.

A majority of trainees use personal computers. Half of them use IBM compatibles. A quarter of them use Apple computers. And still another quarter don't use a computer at all.

The non-active group trends in a likewise manner. The active group is split evenly among IBM PC compatible users and non-computer users. Most of the non-computer users are active observers. Again, maybe the active trainees have more time to observe not being in front of the warm glow of a PC in the evening!

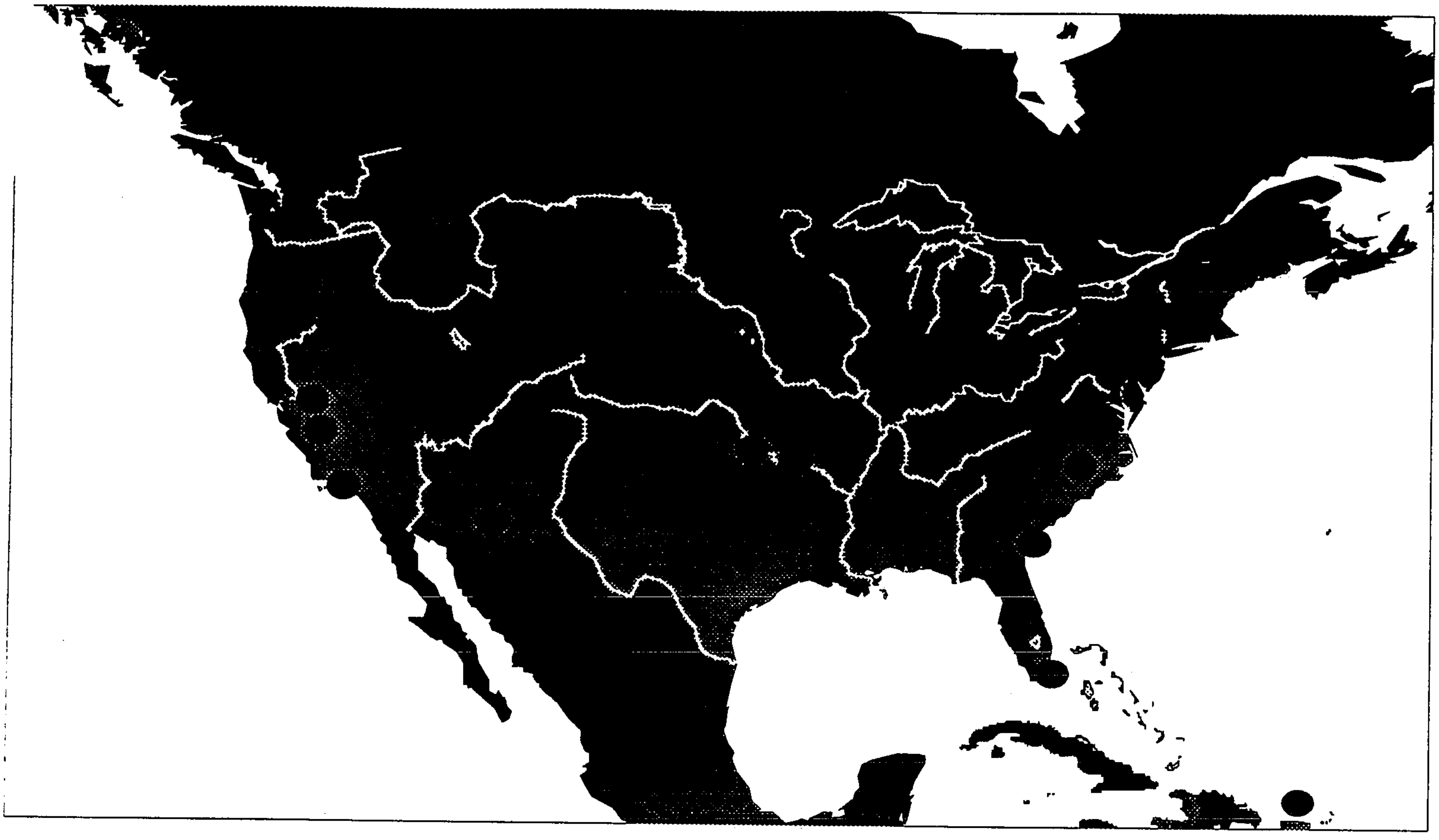
RESEARCH AND DEVELOPMENT

In addition to the routine business that the Training Program coordinators administer, some time is spent planning for improvements in the program. In an analyses such as the one above, it is important to measure the needs of student observers as well as potential problems the program continually faces with changes in the trainee's interest and background in observing. Perhaps the entire process could be better served with an evaluation of the program from graduates to assess the value of the program from their prospective.

The questionnaire has revealed a dominant interest for visual and drawing skills (which has always been at the heart of the program) for of all things, the moon. Lunar features are probably the most difficult items to draw in Solar System observing. Good lunar drawings must possess dimension and appear as realistic as possible. It is a very demanding pursuit considering the practice it takes and the analysis needed to advise these students. The complexity of lunar detail tends to scare some observers when they actually attempt to record them in a drawing. They find this situation especially hard to cope with having had little or no serious drawing experience in the past. These circumstances prompted Coordinator Matt Will to enroll in art courses that teach drawing theory at a local community college in the Springfield, Illinois area. In a forthcoming paper Matt Will will appraise the utility of a formal art training and how it may help some students with elementary problems in sketching lunar features. Andrew Johnson's article *The Art of Making Drawings of the Moon* in Vol. 37 No.1 of the *JALPO* and Richard Wessling, the original author of the program's handbook, were very influential in Matt Will's decision to take these courses. Matt feels that the experience of the courses have improved the quality of his instruction in advising student observers with specific problems that involve possible artistic solutions that may more fully develop their drawing skills.

The ALPO is now apart of the INTERNET through the World Wide Web! The ALPO's Solar, Computing, and Training Sections have worked together to make this happen. Richard Hill, ALPO Solar Recorder offered to manage the ALPO-WWW-Homepage using the computers at the Lunar & Planetary Laboratory in Tucson, Arizona. And thanks to Richard, it has now become a reality and is operational. All sections are invited to participate in contributing information to the homepage. This sort of outreach will help the ALPO become more accessible to its members and provide them with late breaking observational news and offer the public a better understanding of its mission.

And so the work and mission of the ALPO Lunar and Planetary Training Program continues after one successful year under the newly established guidelines. Clearly, one of the major goals of the Training Program has been outreach to the ALPO membership. It is believed that the program will continue to progress as long as the spirit of outreach is maintained.



Tabulations of the Responses to the A.L.P.O Lunar and Planetary Training Program Questionnaire

by

Timothy Robertson and Matthew Will

A.L.P.O Lunar and Planetary Training Program Coordinators

July 15, 1995

Results of Questionnaire

1. What are Solar System subjects are you interested in. (pick one or two, but no more than two).

Object	Total Group	Non-Actives	Actives
Moon	11	8	3
Jupiter	6	4	2
Mars	6	4	2
The Sun	4	4	0
Saturn	3	2	1
Remote Plts.	1	1	0
Asteroids	1	1	0
Comets	1	1	0
Meteors	1	0	1
Mercury	1	1	0
Venus	0	0	0

2. What do you wish to learn from this program? (pick one).

Area	Total Group	Non-Actives	Actives
Visual obs.	15	11	4
Photography	0	0	0
Video-CCD	2	0	2
Photometry	1	1	0
Other	0	0	0

3. How would you describe you experience level.

Description	Total Group	Non-Actives	Actives
Beginner	12	10	2
Intermediate	6	2	4
Advanced	0	0	0

4. How many years of experience have you had as a planetary observer?

Years	Total Group	Non-Actives	Actives
< 1	10	9	1
1 to 2	4	2	2
2 to 5	3	1	2
> 5	1	0	1

5., 6., & 7. Telescopes used by trainees.

Total Group

Type	Telescopes	Avg. Ap.	Range	f/
Newt.	15	8.87	4.5 - 16	6.55
Refr.	9	4.30	2.4 - 6	10.56
SCT	6	8.16	5 - 12	9.57

Non-Actives

Type	Telescopes	Avg. Ap.	Range	f/
Newt.	6	10.00	6 - 10	6.7
Refr.	8	4.11	2.4 - 6	9.90
SCT	6	8.16	5 - 12	9.57

Actives

Type	Telescopes	Avg. Ap.	Range	f/
Newt.	9	8.11	4.5 - 12.5	7.2
Refr.	1	6	6	15.0

TOTALS:
a. 31 Telescope for 18 trainees, approximately 1.7 telescopes per trainee.

8., & 9. Trainee's Telescope Mountings

Total Group

Type	Telescopes	Equat.	Altz.	Clock Dr.
Newt.	15	9	6	7
Refr.	9	6	2	5
SCT	6	6	0	6

Non-Actives

Type	Telescopes	Equat.	Altz.	Clock Dr.
Newt.	6	2	4	2
Refr.	8	6	1	4
SCT	6	6	0	6

Actives

Type	Telescopes	Equat.	Altz.	Clock Dr.
Newt.	9	7	2	5
Refr.	1	0	1	1

a. 22 Telescopes have Equatorial mounts, 8 have azimuth

b. 17 mountings are motor driven and 13 are not.

10. Eyepieces and Filters

	Total Group	Non-actives	Actives
Filters:	10	7	3

11. Binoculars?

Not enough answered for a meaningful numbers.

12. Age?

	Total Group	Non-actives	Actives
Average age:	44	43	46
Range:	13 to 80	13-64	28-80

Total Group Age Ranges:

<18	20-29	30-39	40-49	50-59	60-69	70<
2	1	3	6	2	2	1

13. Gender?

Total Group

Males: 17 Females: 1

14. Occupation?

	Total Group	Non-actives	Actives
Students:	2	2	0
Professionals:	10	7	3
Laborers:	1	1	0
Retirees:	3	2	1

15. Length of Membership?

	Total group	Non-actives	Actives
Less than one year:	15	11	4
One year:	1	1	0
Two years:	2	0	2

16. How did you find out about the ALPO?

	Total group	Non-Actives	Actives
Astronomy books:	5	5	0
Another member:	7	4	3
Article in mag.:	6	3	3

17. How did you find out about the Training Program?

	Total Group	Non-Actives	Actives
Membership lit.:	8	7	1
Another member:	2	1	1
TP Coordinator:	1	1	0
Astronomy books:	1	1	0
JALPO:	6	2	4

18. Club affiliations.

No. of Clubs	Total Group	Non-Actives	Actives
None:	5	5	0
One:	5	3	2
Two:	6	3	3
Three:	2	2	0

	Total Group	Non-Actives	Actives
Local club:	8	6	2
Planetary Soc.:	4	3	1
Ast. Soc. Pac.:	3	2	1
AAVSO:	1	0	1
RASC:	1	1	0
Ast. League:	1	1	0
AMS:	1	0	1
Webb Society:	1	0	1

19. Subscriptions to other astronomical publications.

	Total Group	Non-Actives	Actives
Sky & Telescope:	16	10	6
Astronomy:	10	8	2
AAVSO Pub.:	2	0	1
Stardate:	1	1	0
Amateur Astronomy:	1	1	0
Astrograph:	1	0	1
Mercury:	1	1	0

19. Subscriptions (cont.)

AL Reflector:	1	1	0
ATM Journal:	1	0	1
Observatory Tech.:	1	0	1
CCD Astronomy:	1	0	1
Meteor News	1	0	1

No. of Mag. Subs.	Total Group	Non-Actives	Actives
None:	2	2	0
One:	4	2	2
Two:	5	4	1
Three:	5	3	2
Four:	2	1	1

a. 10 trainees subscribe to both Astronomy and Sky & Telescope.

b. 6 trainees subscribe to Astronomy, Sky & Telescope, and a third publication or more.

c. 6 trainees subscribe to Sky & Telescope but not to Astronomy. None subscribe to Astronomy without also subscribing to Sky & Telescope.

20. Computer use.

Type	Total Group	Non-Actives	Actives
IBM:	9	6	3
Apple:	4	4	0
None:	4	1	3

Wideband Photometry of Uranus and Neptune in 1995

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ABSTRACT

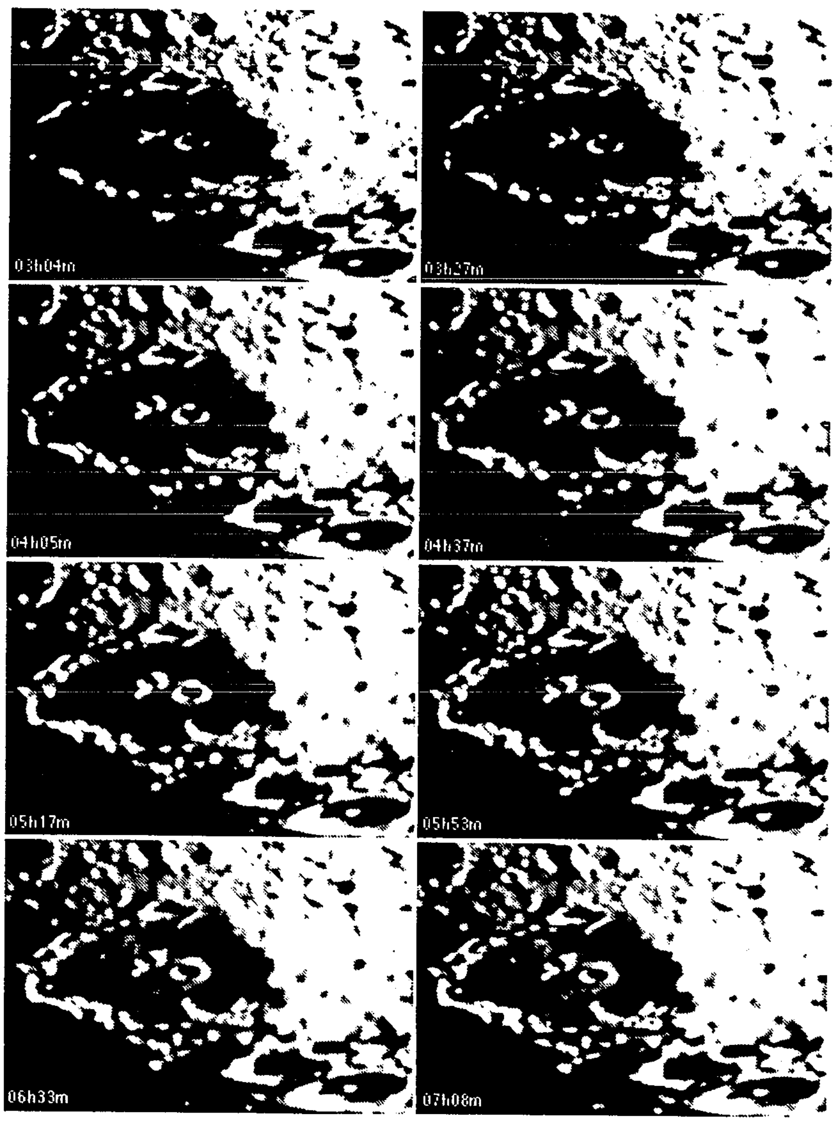
Photometric measurements have been carried out for both Uranus and Neptune during mid-June of 1995. The 36 cm telescope at Texas A&M University Observatory along with an SSP-3 solid-state photometer and Johnson U, B, V, R and I filters were used in all measurements. The resulting normalized magnitudes for Uranus are: U(1,0)=-6.37±0.05; B(1,0)=-6.61±0.03; V(1,0)=-7.13±0.02; R(1,0)=-6.98±0.02 and I(1,0)=-5.72±0.02. The normalized magnitudes for Neptune are: B(1,0)=-6.55±0.02; V(1,0)=-6.92±0.03; R(1,0)=-6.63±0.02 and I(1,0)=-5.43±0.03. The comparison star for all measurements was ρ-Cap with corresponding magnitudes of U=+5.22; B=+5.81; V=+4.80; R=+4.46 and I=+4.26.

A LUNAR TERMINATOR TOUR VIA CCD

by: John E. Westfall

The Moon's terminator is simply the ever-moving great circle where the Sun is either rising or setting. The terminator crosses any particular location on the lunar surface twice in each lunation, and for a few hours the glancing rays of the Sun cast elongated shadows, highlighting low-lying relief features. Such times are the best, often the only, times that such features as lunar ridges, domes, ghost rings, and almost-obliterated impact basins can be clearly seen.

Yet the terminator zone is a difficult area to study, where black shadows and faintly-lit plains contrast markedly with almost-luminous peaks and crater walls. This is the type of situation where the CCD camera excels; sensitive to low levels of light and at the same time capable of a wide brightness range. After the "raw" image has been obtained, background light can be subtracted out and the contrast "stretched" to utilize the full brightness range of the camera. Later, a variety of image-processing techniques can be used, including non-linear contrast adjustment, sharpening, and the mosaicing together of adjoining images. This paper uses samples of the writer's CCD lunar terminator images to illustrate some of these concepts and techniques, along with sample results.



SUNRISE ON CLAVIUS, 1995 FEB 09 28-cm Sch.-Cass., f/10, 0.20 sec. North at top.

Colongitudes: 03h04m, 17°.46. 03h27m, 17°.66. 04h05m, 17°.98. 04h37m, 18°.25. 05h17m, 18°.58. 05h53m, 18°.89. 06h33m, 19°.23. 07h08m, 19°.52.

Solar Latitude +1°.56.

The equipment used for all figures was a Lynxx 2000 CCD camera with 4096 grey levels, a 28-cm Schmidt-Cassegrain (except for one illustration using a 36-cm SCT), either at the f/10 prime focus or with a Barlow lens at f/21. Processing was done with a Macintosh Quadra 8000 using Adobe PhotoShop Version 2.5, and output was on a 600 dpi HP 4M printer.

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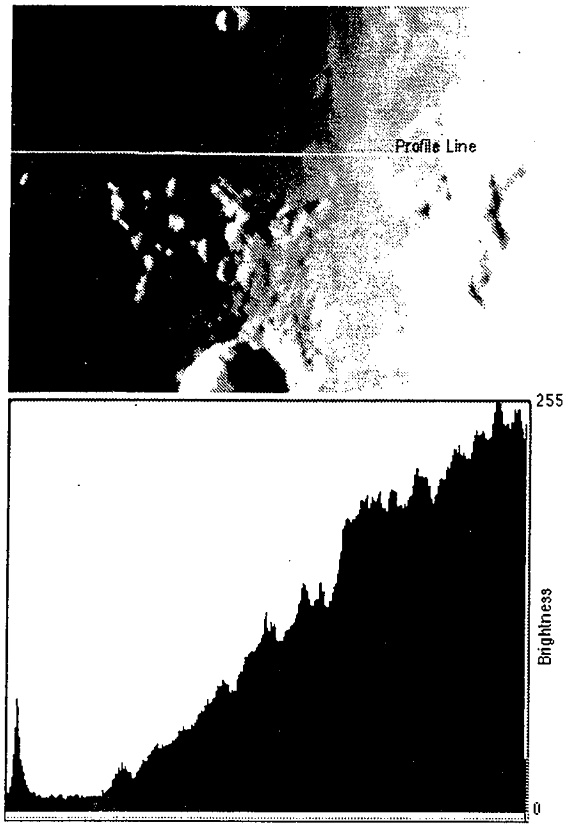
Figures.

Figure 1. The view to the left shows how rapidly a region's appearance changes as the terminator moves across it. Here, sunrise on the crater Clavius is illustrated at eight intervals over a four-hour period.

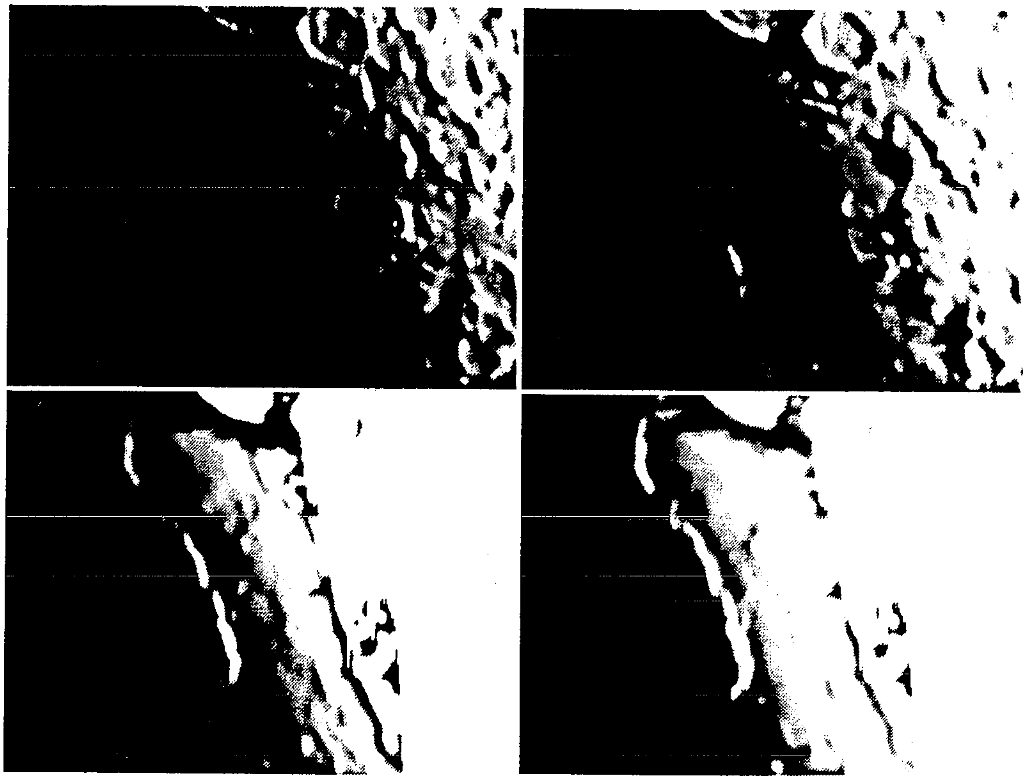
Figure 2. When the lunar surface is relatively smooth, as in a *mare* area, the brightness of the surface is roughly proportional to the distance from the terminator, as the graph below shows. Note, however, that even in *maria* there are large local brightness variations due to relief. For example, the "spike" on the left, beyond the terminator, represents an isolated peak that is sunlit while its base is still in shadow.



Brightness Level Near the Lunar Terminator

(Lenght of profile ca. 350 km)

Figure 3. Even with the wide brightness range of a CCD camera, it is not easy to adequately record the area of the terminator. The frame in the **upper left** was exposed so as not to saturate the sunlit areas on the right of the frame, leaving the ridge along the terminator very feebly exposed. The printed reproduction here shows little else near the terminator, although additional ridges were faintly visible on the computer monitor. Near-terminator detail can be brought out by nonlinear contrast stretching (see also *Figure 4*), with the result seen in the **upper right** frame. Naturally, near-terminator detail can also be brought out by a longer exposure, as in the **lower left** frame, but most of the fully-sunlit area is saturated with loss of detail. With such an "overexposed" frame, a nonlinear contrast stretch (**lower right** frame) makes the situation even worse.



Northeast Mare Serenitatis, 1995 JUL 03, 36-cm Sch.-Cass., f/21, W58 Filter.

Upper Left: 0.50-sec exposure, standard stretch only. 04h14m UT

Upper Right: Upper Left + nonlinear convex stretch

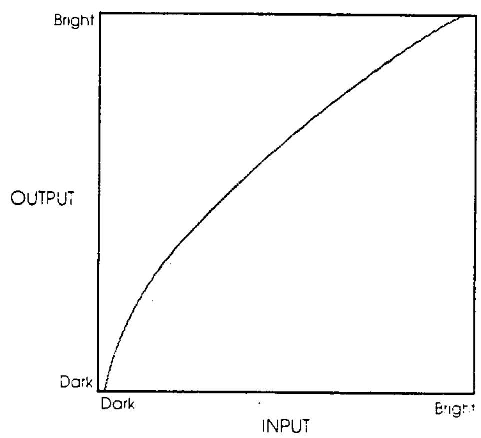
Lower Left: 4.00-sec exposure, standard stretch only. 04h16m UT

Lower Right: Lower Left + nonlinear convex stretch.

(All frames unsharp-masked, right frames also despeckled)

J. Westfall

Stretching the Terminator

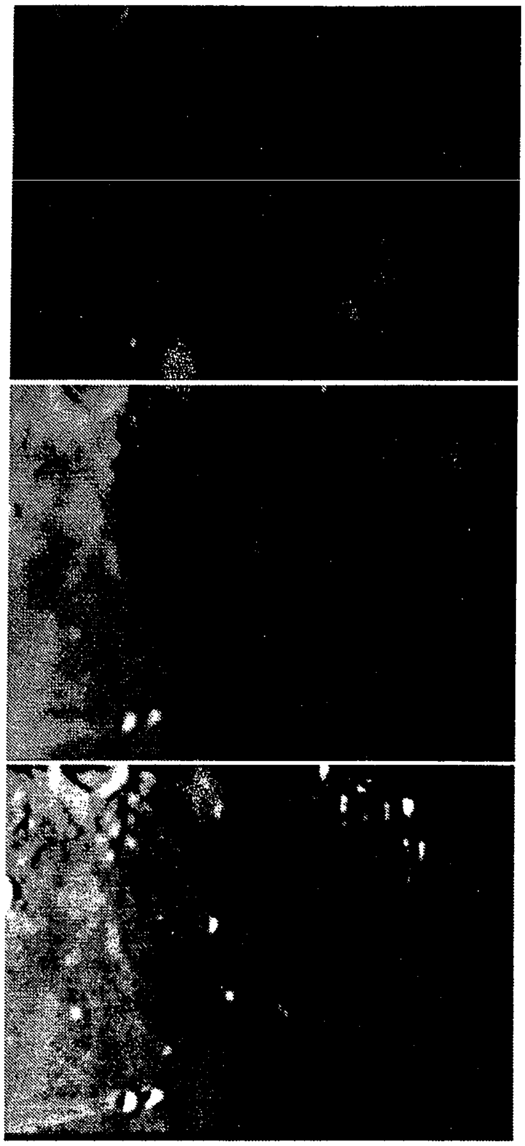


CURVE RULES

1. Higher is Brighter
2. Lower is Darker
3. Steeper means More Contrast
4. Less Steep means Less Contrast
5. Steeper (more contrast) for part of the tonal range means less steep (less contrast) for the rest

Figure 4. An example of nonlinear contrast stretching. The original image brightness is on the "Input" axis, and the new image brightness on the "Output" axis. Note that the Output:Input curve is steeper for low brightness values. In addition, background brightness is removed by the curve being displaced rightwards from the origin. On the computer, this curve is produced manually directly on the graph. To help interpret the graph, some "Curve Rules" are given beneath it.

Figure 5. This shows the effects of successive steps of image processing. The **upper frame** is the "raw" CCD image, which suffers from low contrast because of background (both electronic and scattered light) and the fact that the entire black-to-white range is not represented. The **center frame** is the result of two contrast stretches; the first a linear one to exploit the complete range from black (brightness 0) to white (brightness 255), followed by a nonlinear stretch to bring out low-sun angle detail. Finally, the **lower frame** shows the result of *unsharp masking*, which sharpens the image by enhancing small-scale contrast Note, however, the dark bands created on the top and bottom of the frame, which are artifacts caused by unsharp masking,



Step 1:
"Raw" CCD Image.

Step 2:
Nonlinear Brightness Stretch.

Step 3:
Unsharp Masking.

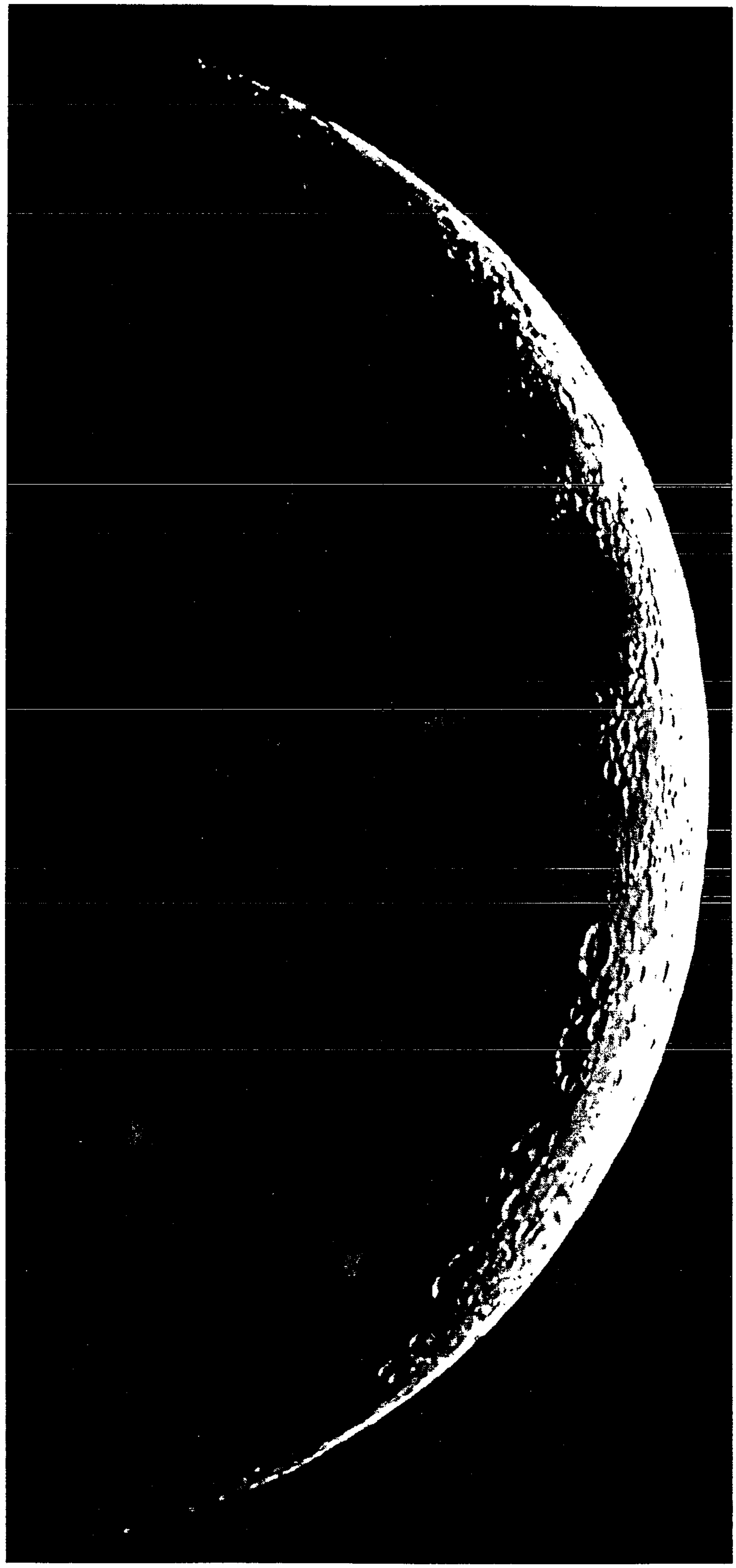


Figure 6. Another step in modifying images is *mosaicing*, the joining together of images of adjoining area of the lunar terminator. This step is done after contrast stretching, but prior to unsharp masking, because the latter creates "artifacts" on the edges of individual images. Mosaicing is done because each frame covers only a small portion of the Moon. Careful mosaicing can make "joins" between frames almost invisible, although occasional small brightness adjustments are necessary to do this. More usually, though, contrast stretching and unsharp masking values must be identical for all the frames to be mosaiced, meaning that these will be "compromise" adjustments and not necessarily the optimal values for individual frames.

This mosaic shows the three-day crescent Moon, with 14 frames, exposed over a 32-minute period, joined together to cover the entire disk from pole to pole. *Technical Data:* 1995 APR 03, 03h53m - 04h25m UT. 28-cm Schmidt-Cassegrain at f/10, 0.25-sec exposure with W58 Filter (green), 1.5-km pixel size. Colongitude = 303°.3, Solar Latitude = +0°.6, Topocentric Longitude Libration = +0°.7, Topocentric Latitude Libration = +1°.7. As in all the images in this article, lunar north is to the top.

Figure 7. (to right) A single CCD frame of the Rümker dome complex, with 1.0-km pixel size. Colongitude = 062°.7, Solar Latitude = +1°.5, Topocentric Longitude Libration = -3°.8, Topocentric Latitude Libration = +5°.9.

Rümker
1993 MAR 06, 03h43m UT.
28-cm Sch.-Cass., f/21, 0.20 sec.

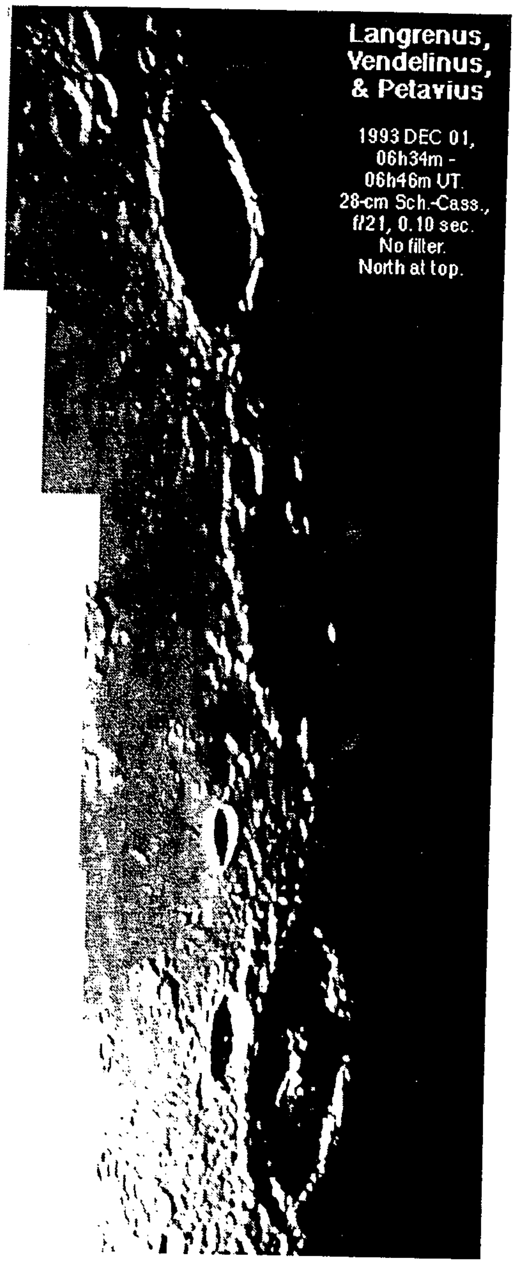
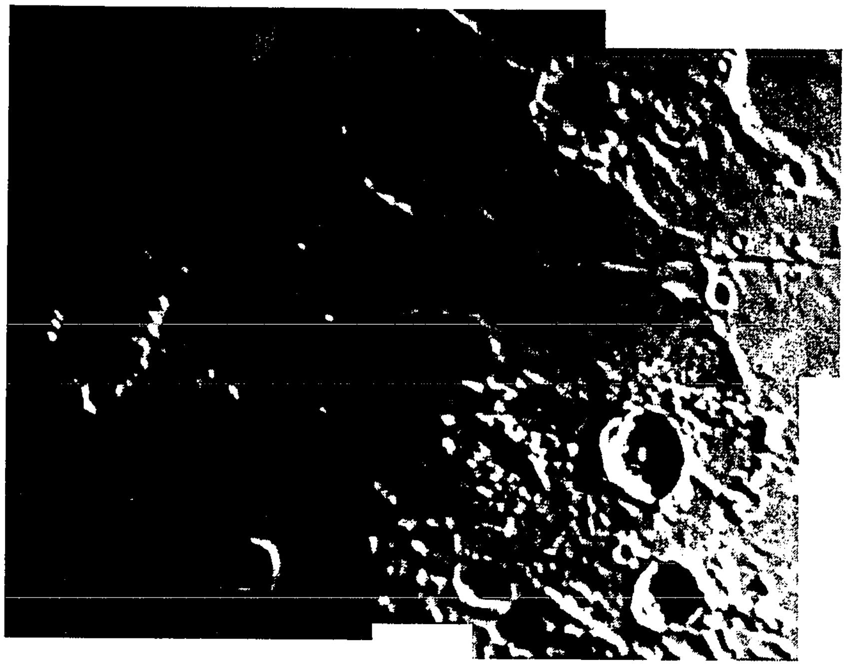


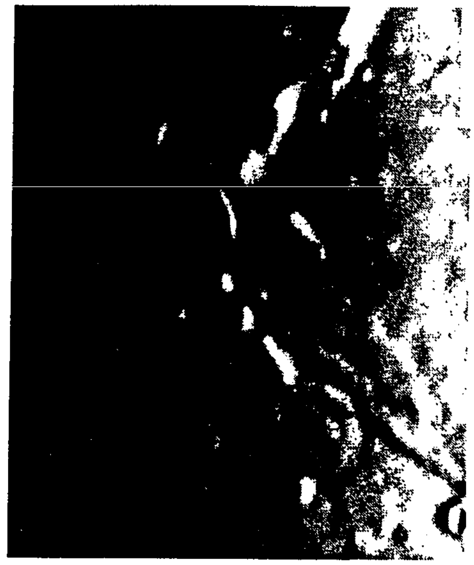
Figure 8. (to left) Six-frame mosaic of the craters Langrenus (top), Vendelinus (middle), and Petavius (bottom); 1.0-km pixel size. Colongitude = 118°.3, Solar Latitude = +0°.2, Topocentric Longitude Libration = -4°.4, Topocentric Latitude Libration = +3°.9.

Figure 9. A six-frame mosaic of the Hyginus area, with 1.0-km pixel size. Colongitude = 356°.5, Solar Latitude = +0°.7, Topocentric Longitude Libration = -8°.3, Topocentric Latitude Libration = +6°.1. The crater Hyginus, bisected by the Hyginus Rille, is left of center.



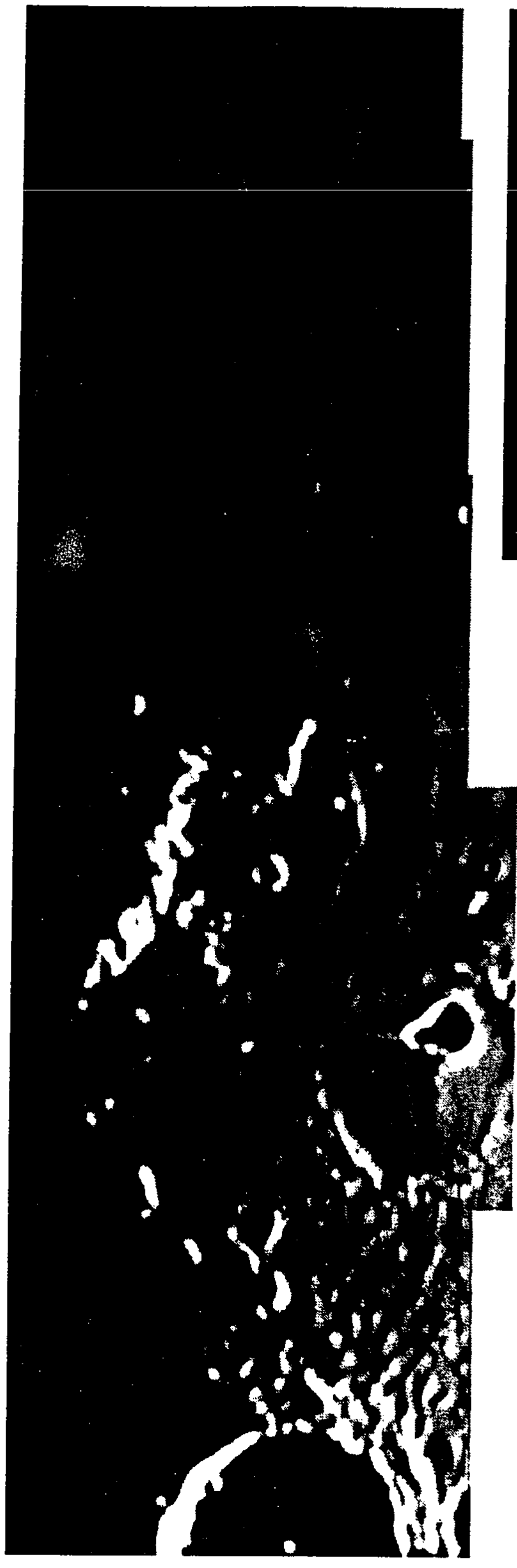
HYGINUS REGION 1994 APR 18, 03h47m-03h58m UT.
28-cm Sch.-Cass., f/21, 0.30 sec No filter. North at top.

Figure 10. A mosaic of five frames showing the region between Lamont (top) and Theophilus (bottom), 1.0-km pixel size. Colongitude = 335°.1, Solar Latitude = +0°.7, Topocentric Longitude Libration = +4°.0, Topocentric Latitude Libration = -6°.1. The inset in the upper right is from the same mosaic, but with the contrast additionally stretched in order to bring out the low relief of the Lamont feature.



Sunrise on Lamont

1993 DEC 19, 02h15m - 02h21m UT.
28-cm Sch.-Cass., f/21, 0.25 sec.
No filter. North at top. Contrast stretched.



Sunrise: Theophilus to Lamont

1993 DEC 19, 01h58m - 02h21m UT.
28-cm Sch.-Cass., f/21, 0.25 sec.
No filter. North at top.