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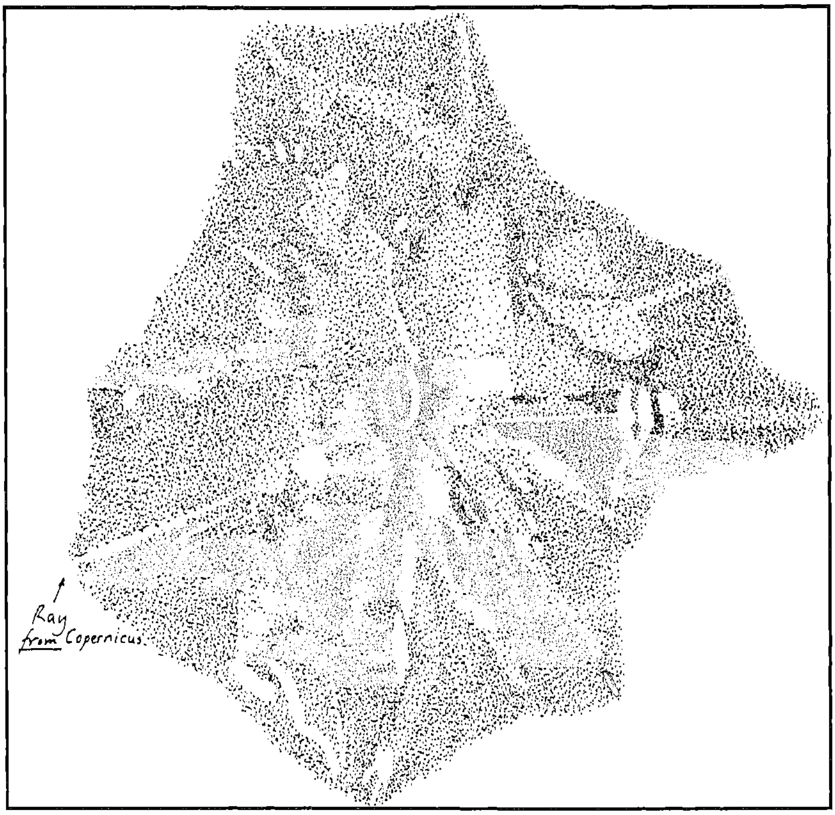

The ray system of the lunar crater Kepler. A sketch by Colin Ebdon of London, England on 1999 Jan. 03, 00h-01h UT. Colongitude 096°.51-097°.02. 25-Cm (10-in) Newtonian reflector 183-236X. Seeing III-IV (Antoniadi; moderate-poor). South at top.

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IN THIS ISSUE

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THE 1989/90 APPARITION OF JUPITER

By: David J. Lehman, Acting Coordinator, Jupiter Section; John McAnally, Acting Assistant Coordinator, Transit Timings; Craig MacDougal, Acting Assistant Coordinator; Damian Peach, Acting Assistant Coordinator, CCD Imaging

ABSTRACT

Jupiter is a fascinating planet for observers who take the time to study it. Much work can be done by the amateur Jupiter observer, and his or her work continues to be of significant value to professional astronomers. This report evaluates the observations submitted to the A.L.P.O. Jupiter Section for the 1989/90 Apparition, describing methods, citing observations, and presenting results. Included are drawings, photographs, graphs, and tables.

INTRODUCTION

In late July 1989, the first observers of the 1989/90 Apparition of Jupiter reported a faded SEB (South Equatorial Belt) with barely discernable north and south components. The STB (South Temperate Belt) remained faded as it had been in 1988/89. The GRS (Great Red Spot) was prominent throughout the apparition, with color descriptions using terms such as pink, orange, and reddish-orange throughout the apparition. The South Temperate Ovals BC, DE, and FA were monitored. Numerous NEBs/EZn (North Equatorial Belt, South Component/Equatorial Zone, North Component) blue/gray projection features were also followed. Dark NEBn (North Equatorial Belt, North Component) barges continued from 1988/89. In addition, the NTB (North Temperate Belt) darkened following a spot outbreak on the NTBs (North Temperate Belt, South Component) jet stream in February and March of 1990.

Observations received by the A.L.P.O. Jupiter Section included transit timings, disk drawings, strip sketches, photographs, and video images. Transit timings are done by visually observing Jupiter and noting the exact time, to within one minute, that a feature is on the central meridian of the planet. This method has been proven accurate to within one minute for a skilled observer. Telescopes used should be at least 15 cm in aperture for reflectors and 10-cm aperture for refractors.

The geocentric conditions for the 1989/90 Apparition are given in *Table 1* (right).

CONTROLS

The A.L.P.O. Jupiter Section is a self-controlled group of amateur astronomers from around the world. Observers monitor atmospheric seeing and transparency, and record telescope size, magnification, and filters used. Standard nomenclature is used for transit timing (Lehman, 1999). All timings are visual with an average accuracy of one minute. This method is quite accurate due to the rapid rotation of Jupiter. Timings measured from photographs are noted in the text. Accuracy of results is also dependent on a large quantity of self-controlled data.

Table 1, Geocentric Conditions, 1989/90 Apparition of Jupiter.

Beginning Conjunction	1989 JUN 09
Date of Closest Approach	1989 DEC 26
Date of Opposition	1989 DEC 27
Ending Conjunction	1990 JUL 15
Stellar Magnitude at Opposition	-2.3
Declination at Opposition	+23°.2
Equatorial Diameter at Closest Approach	47".3

OBSERVATIONS

The Jupiter Section received transit timings from 34 observers, for a total of over 4600 visual central median transit timings. (The exact total could not be verified, for reasons given under "Conclusions and Discussion" on p. 54.) From these data 112 drift rates were plotted within 9 atmospheric currents and jet streams. Six observers submitted film photographs. Other forms of observations included drawings, strip

Table 2, Contributing Observers, 1989/90 Apparition of Jupiter.

Observer	Location	Telescope(s)	Type
Adock, B.	Glen Waverley, Australia	31-cm N	P
Benninghoven, Claus	Burlington, IA	20-cm N, 30-cm R	T, D, S, P
Bock, Paul H., Jr.	Hamilton, VA	12.7-cm R	T, D
Boyar, Dan	Boynton Beach, FL	25-cm N	D
Brunkella, James R.	Thousand Oaks, CA	20-cm N	T, D
Buchanan, Roger	Joplin, MO	15-cm N	D
Buda, Stefan	Glen Waverley, Australia	20-cm N	T
Budine, Phillip W.	Walton, NY	8.6-cm SC, 10-cm R	T, S
Graham, David L.	Brempton-on-Swale, UK	15-cm R	T, D
Haas, Walter H.	Las Cruces, NM	15-cm N, 32-cm N	T, S
Heath, Alan W.	Nottingham, UK	30-cm R	T
Hernandez, Carlos E.	Woodbridge, NJ	25-cm R	T, S
Himes, Don	*n.a.*	*n.a.*	D
Joyce, Dan P.	Chicago, IL	25-cm N	D
Kruijshoop, Alfred	Mt. Waverley, Australia	20-cm N	T, D
Lerner, Eric J.	Lawrenceville, NJ	15-cm N	T
Lantz, Steve	Englewood, CO	25-cm N	T, D
Lux, Barbara	McKeesport, PA	10-cm R	T, D, S
MacDougal, Craig	Tampa, FL	15-cm N	T, D
Manner, Olli	Helsinki, Finland	13.5-cm R	T, D, S
MacFarlane, Alan	*n.a.*	*n.a.*	V
McNamara, Geoff	Viewbank, Australia	15-cm N	T
Melillo, Frank	Franklin Square, NY	20-cm SC	T, D, P
Miyazaki, Isao	Okinawa, Japan	41-cm N	T, P, G
Modic, Bob	Richmond Hts., OH	20-cm N	T, D
Morris, Woodie F.	Manahawkin, NJ	15-cm N	T, D
Morrow, Michael	Oahu, Hawaii	40.6-cm N	T, D
Nelson, P.	Nilma, Australia	*n.a.*	D
Nowak, Gary	*n.a.*	7.6-cm R	D
Olivarez, Jose	Wichita, KS	32-cm N	T, D, S
Olsen, Frank	Cedar Rapids, IA	27.5-cm SC	D
Park, Jim	Glen Waverley, Australia	20-cm N	T, D
Parker, Donald C.	Coral Gables, FL	40-cm N	D, P
Richardson, James	San Jose, CA	20-cm N	T, D
Robinson, Robert L.	Morgantown, WV	25-cm N	T, D
Robotham, Rob	Ontario, Canada	15-cm N	T, D
Rogers, John H.	Linton, UK	25-cm N	T, D
Schmude, Richard W.	College Station, TX	25-cm N	T, S
Siegel, Elisabeth	Malling, Denmark	20.3-cm N	T, D, S
Talaga, Bob	Tucson, AZ	15-cm R, 20-cm N	T, D, S
Tatum, Randy	Richmond, VA	10-cm R, 17.8-cm R	T, S
Teichert, Gerard	Hattstatt, France	28-cm N	T, D, G
Terrance, Gregg	Lima, NY	17.8-cm R, 40-cm N	P
Troiani, Daniel M.	Schaumburg, IL	25-cm N	T, D, S, V
Whitby, Samuel R.	Hopewell, VA	15-cm N	T, D, S

Key: N, Newtonian reflector; R, refractor; SC, Schmidt-Cassegrain.
D, disk drawings; G, graphs; P, photographs; S, strip sketches; T, transit timings; V, videos.

sketches, graphs, and videos. Note, though, that most observing forms used during the 1989/90 Apparition did not have a space provided for filter used. As a result, filters, if used, were rarely noted. Counting all forms of observations, 45 observers submitted data for the 1989/90 Jupiter Apparition, who are listed in *Table 2* (above), with information on their locations, telescopes, and types of observations. Selected drawings and photographs are shown in *Figures 3-7* at the end of this report (pp. 55-56).

BELT AND ZONE INTENSITY ESTIMATES

Intensity estimates for belts and zones are shown in *Table 3* (p. 51) from three selected observers (they are on the Standard A.L.P.O. Intensity Scale, where 0 represents sky black and 10 stands for totally

Table 3, Intensity Estimates by Selected Observers, 1989/90 Apparition of Jupiter.
(Number of estimates in parentheses.)

Belt or Zone	Observer M.J.M.	J.R.	J.H.R.
SPR	4.9 (8)	7.6 (13)	7.7 (5)
SSTB	--	7.5 (4)	5.8 (5)
STeZ	--	--	9.5 (2)
STB	4.7 (2)	8.0 (1	8.3 (3)
STropZ	6.3 (7)	9.4 (13)	9.6 (4)
SEB	6.3 (7	9.2 (14)	8.2 (7)
EZ	6.3 (8	9.1 (12)	9.2 (6)
NEB	3.6 (8)	5.4 (13)	3.6 (5)
NTropZ	5.8 (8)	9.1 (4)	8.5 (4)
NTB	4.8 (8)	7.0 (12)	6.2 (5)
NTe	5.4 (5)	8.9 (7)	9.0 (2)
NNTB	4.8 (1)	8.4 (6)	5.7 (4)
NPR	5.0 (8	8.1 (13)	7.1 (5)

Key: M.J.M., Michael Morrow, 1990 Feb 13 - Mar 30.
J.R., James Richardson, 1990 Feb 20 - Apr 27.
J.H.R., John H. Rogers, 1989 Aug 17 - Sep 07.

reflective bright white). Belt and zone identifications are given in *Figure 1* (below).

Although the SEB remained pale throughout the apparition, it was darker at the beginning of the apparition than after opposition, as indicated in Table 3 and as reported in a number of observations.

Most drawings and photographs appear to depict the EZ as darker than the SEB, especially after opposition. However, the intensity estimates indicate otherwise.

The intensity estimates indicate the STB was darker than the SEB after opposition, and that the NTB darkened after opposition. Here the drawings and photographs are in agreement.

The NEB was clearly the darkest belt in the estimates and on drawings and photographs.

RESULTS

North and South Polar Regions (NPR, SPR).—No transit timings were made in the North or South Polar Regions. Drawings, photographs, and intensity estimates were inconsistent as to which region was the darker. For the most part, the NPR and SPR closely matched the intensity of the NNTB and SSTB.

South South Temperate Belt (SSTB).—The SSTB was visually easy to see; it was wide and dark in appearance. Numerous white ovals were at the threshold of detection. Transit timings were recorded on only one white oval. The timing placed

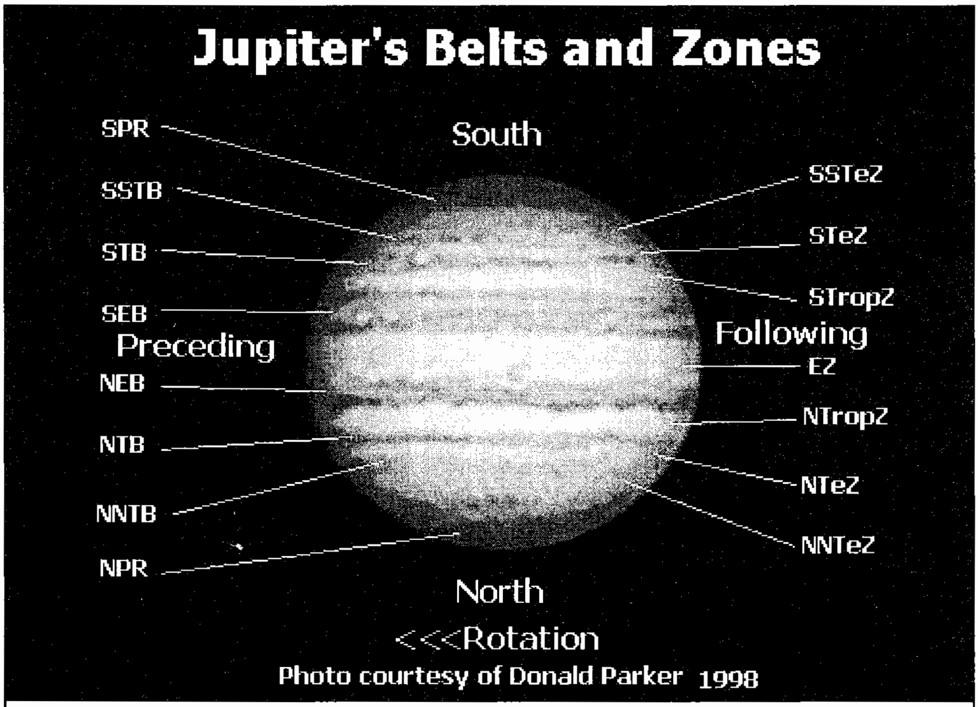

Photo courtesy of Donald Parker 1998

Figure 1. Nomenclature of Jupiter's Belts, Zones, and Regions. B = Belt, E = Equatorial, N = North, R = Region, S = South, T or Te = Temperate, Trop = Tropical, Z = Zone.

it at L2 (i.e., System 2 longitude) 293° at opposition. This oval, and a preceding one, were measured from a 1990 Jan 05 photograph by Isao Miyazaki (see *Figure 4,* p. 55), placing these ovals at L2 273° and L2 307° respectively (± 2°).

South Temperate Belt (STB).—The STB was faint, but noticeable to most observers as a thin, faded, gray band. Many intensity estimates make the STB intensity as roughly equal to the NTB, NNTB, and SSTB; however, drawings and photographs show the STB as clearly fainter than the others. The STB was faint in 1988/89 and for the most part remained faint in 1989/90. There were short dark sections following oval BC and oval DE, as was the case in 1988/89. A few short dark sections were observed in the STB.

Long Enduring South Temperate Ovals (STO).—Long-enduring STO DE was the most conspicuous, followed by BC and FA respectively (conspicuousness indicated by the number of transits). Their mean lengths were: DE, 8°; BC, 7°; FA, 5°. The centers of ovals BC and DE were about 17° apart in System 2 longitude throughout the apparition. This means that less than 10° separated BCf and DEp throughout the entire apparition (f = following edge, p = preceding edge). Dark sections defined the outline of ovals BC and DE and short dark sections followed both. At opposition, the ovals were located in System 2 at: BC, 125°; DE, 142°; FA, 267°. BC and DE each had a drift rate of -10°.6/30 days, giving a period of 9h55m26s. FA's drift rate was -15°.5/30 days, with a period of 9h55m19s; 152 transits were used in this analysis.

Great Red Spot (GRS).—The GRS had a mean longitudinal length of 20°. By the end of the previous apparition (1988/89), the GRS extended 27° in longitude. The "shrinking" of the GRS was possibly due, in part, to the fading of the SEB, which made the RSH (Red Spot Hollow) difficult to discern. Therefore, timings of the preceding and following ends of the RSH may not be reliable. The center of the GRS was at L2 025° at opposition. The GRS drift rate was +0°.62/30 days, giving a rotation period of 9h55m41s. This drift rate was consistent throughout the apparition. Observers submitted 269 transit timings of the GRS.

Observer comments regarding the appearance and color of the GRS were as follows:

1989

Jul 28. D. Parker; extremely faded, small.
Sep 06. J. Rogers; slight pinkish gray.
Oct 15. R Robinson; had a pale green hue.
Nov 04. R. Robotham; dark orange/ brown, prominent.
Nov 23. D. Boyar; salmon/orange.
Dec 24. S. Lantz; very prominent and distinctly reddish.

1990

Jan 16. P. Bock; smaller than expected.
Jan 25. D. Boyar; GRS rose pink.
Feb 18. D. Boyar; GRS rose-pink.
Mar 17. D. Graham; GRS gray .
Mar 25. F. Olsen; light reddish-orange.

South Equatorial Belt (SEB).—The most outstanding visual impression of the apparition was the fading of the SEB. A fading like this had not occurred since 1957/58 (Rogers, 1995). Therefore, this was a new experience for most observers. The SEB appeared mostly faint from the first observation after conjunction with the Sun and continued with a faded appearance throughout the apparition. However, decreases in conspicuousness of the SEB are not unusual, 13 occurred preceding SEB revivals from 1919 through pre-1989 (Rogers, 1995).

Toward the end of the previous apparition (1988/89), the SEB changed from a broad, dark, continuous belt to a distinctly fainter and divided belt. Historically, this transition has preceded a fading of the SEB, and indeed that was the case this time. Furthermore, a fading of the SEB is a harbinger of a SEB revival, and the SEB did revive early in the 1990/91 Apparition. Therefore, although this phenomenon caught many observers by surprise, it fitted a rather standard pattern during the 1900s.

In August 1989, the SEBn was a gray, thin band and the SEBs was similar but fainter. Following the GRS, the SEBn was little disturbed, but the SEBs was distinctly darker with an elongated condensation just following the GRS. Subsequently, the thin south component faded for a length of about 45° and darkened again (Miyazaki photograph, 1989 Aug 09; see *Figure 3*, p. 55). By October 1989, both thin components had faded further with the SEBs following the GRS considerably fainter. In January 1990, both components of the SEB were very faint. Disk drawings from March and April 1990 show that a gray condensation had formed preceding the GRS from the SEBn and southward toward the SEBs.

Some observer comments regarding the SEB were:

1989

Jul 28. D. Parker; SEBs—very thin, faint (L2 045°); SEBz—very light, narrow (L2 045°); SEBn—barely visible, thin, broken.
Jul 29. J. Olivarez; south component...a little darker than north component (L2 217°), faint except for a dark section following the GRS.
Aug 12. R. Robotham; SEB...I have never seen it so faint! (L2 150°).
Oct 12. C. MacDougal; darker section of SEBs on f. side (L2 096°).

1990

Mar 03. R. Robinson; SEB: light, faint.
Mar 13. D. Troiani; not easily visible.
Mar 19. D. Graham; SEB very faint but visible.

Equatorial Zone (EZ).—The blue/gray projections and associated white features of the NEBs/EZn returned to prominence after being subdued in 1988/89. At least ten of these features fit the definition of blue/gray arching festoon projections into the EZn. These features can change morphology in a few weeks or months, making them especially interesting. One projection complex located at about L1 046° changed considerably from 1989 Oct 06 to 1990 Jan 06. At opposition, there were festoons at L1 030°, 077°, 158°, 191°, 215°, 241°, 262°, 289°, 320°, and 352°. Numerous other low projections were also observed.

As the 1989/90 Apparition progressed, the EZ became more shaded in appearance. Two especially interesting shadings occurred at L1 130°, photographed on 1989 Oct 04; and at L1 240°, photographed on 1990 Jan 10. Observations showed many white patches within the EZ. The Equatorial Band developed into an almost continuous band around Jupiter.

North Equatorial Belt (NEB).—The north edge of the NEB (NEBn) displayed an array of dark oblong features, called "barges" by amateurs, and accompanying white ovals, called "portholes" by some amateurs. These features formed in the previous apparition; however, the NEB had then enlarged and thus veiled these features to some extent. In 1989/90, the NEB retreated at its northern edge and the features were seen prominently again. Eight features could be confirmed as definite candidates for barges, located at L2 024°, 054°, 117°, 145°, 180°, 261°, 295°, and 336°. Their mean period of rotation was 9h55m38s (± 1.2 s). The barge at L2 145° had both preceding and following transits timed; its longitudinal length averaged 12°.

There was an interesting double complex of barge-like features at about L2 170° to 190° (at opposition), that had a long rift to the south that turned southward to the NEBs at the preceding end. Numerous rifts were shown on sketches, three of which were well confirmed; besides the one mentioned above. Their centers were at L2 031°, 107°, and 196° at opposition.

North Temperate Belt (NTB).—The NTB had been faint for several years. In February 1990, it began a return to prominence with a jet stream outbreak. Phillip Budine, Jupiter Recorder in 1989/90, described this with the following account.

> "It all started when on February 10, 1990, Isao Miyazaki, of Japan, observed and photographed a white spot on the NTBs...rapid-moving spot in the North Temperate Current...
>
> "The event was communicated to your recorder when Mr. Miyazaki sent a letter on February 15, 1990 with a strip sketch showing a small bright spot (eruption?) on the NTBs, which he also photographed... On February 18, he sent a Fax-Telex to your Recorder concerning [another] bright white spot on the NTBs that was at that time moving at a rate of -5.0 degrees per day in System I... He had observed and photographed the same spot on dates of February 10, 12, and 15, 1990, with his 16-in. (40cm) reflector... [Therefore,] there were two leading white spots.
>
> "On February 18, the first leading spot was recorded on a video by Alan MacFarlane! Observers noted that during the period February 15 - 18, the spot was the brightest on Jupiter!
>
> "By February 19, the leading white spot was observed by Claus Benninghoven with a 12-inch Clark refractor. On February 25, it was 10 degrees in length as observed by your Recorder with his 4-inch refractor. Next, it was sketched by Jose Olivarez on February 26. He also observed a second leading spot on that date. Following this date other white and dark spots developed and were followed into late March and early April."

In all, drift rates were calculated for 17 dark spots and 11 white spots on the NTBs jet stream from 1990 Feb 10 though Mar 21. A drift chart for these features is given in *Figure 2* (p. 54). The dark spots elongated in April, which gave the NTB a more structured, but knotted appearance.

North North Temperate Belt (NNTB).—The NNTB was active in 1988/89 and continued so in 1989/90 with jet stream spots. It often appeared knotted

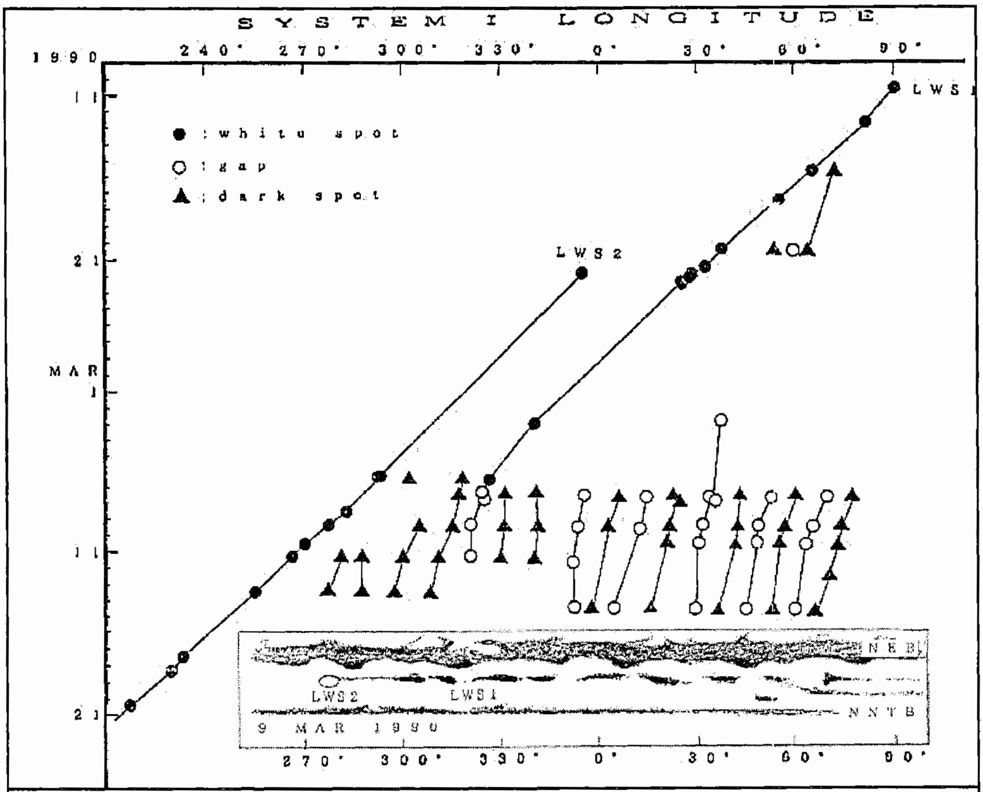

Figure 2. Drift-line graph of NTBs jet stream spots by Isao Miyazaki, from his photographs for the period 1990 Feb 10 - Mar 21.

with dark spots, which made the belt conspicuous at times. However, no timings of these spots could be found in the Archives.

Currents.— *Table 4* (to the right) summarizes the periods found for eleven atmospheric currents in 1989/90.

CONCLUSIONS AND DISCUSSION

Thirty-four observers submitted over 4600 visual central-meridian transit timings to the A.L.P.O. Jupiter Section for the 1989/90 Apparition. From these, 112 drift rates were plotted. This compares with the 1988/89 Apparition, in which 19 observers submitted 1782 transit timings and 75 drift rates were plotted (Budine, 1991b). There was a definite increase in observer participation in 1989/90. This was possibly due to the increase in activity on Jupiter as a whole.

The Jupiter Recorders at the time of the 1989/90 Apparition (Phillip Budine and

Table 4, Rotation Periods of Atmospheric Currents, 1989/90 Apparition of Jupiter.

	Number of		
Current	Features	Transits	Period (6)
SSTC (1)	1	40	9h55m08s
STC (1)	10	280	9h55m26s ±3.5
STropC (1)	1	25	9h55m39s
SEBs (1) (3)	5	60	9h55m43s ±10.6
NEC (1) (4)	41	1374	9h50m30s ±1.1
NTropC (1)	28	1095	9h55m37s ±3.7
NTC (1)	1	32	9h55m51s
NTBs Current D (1) (5)	2	41	9h46m52s ±1.5
NTBs Current C (1) (5)	9	65	9h49m43s ±16.8
	11	58	9h50m16s ±6.8
NTBs Current D (2) (5)	2	43	9h46m52s ±1.5
NTBs Current C (2) (5)	11	58	9h49m56s ±8.0
	18	92	9h50m38s ±16.9

Notes: (1) From visual transit timings. (2) Scaled by Miyazaki from his photographs from 1990 Feb 10 - Mar 28. (3) Component of STropC. (4) The NEC is usually called a jet stream. (5) Jet stream. (6) Standard deviations between features when there are more than one. Drift rates calculated by Phillip Budine (Budine, 1991a). Reference rotation periods: System I, 9h50m30.0s; System II, 9h55m40.6s.

Jose Olivarez) are no longer with the Jupiter Section . This report was produced from the observations in the Section Archives and the reports written by Budine and Olivarez. One report in particular, written by Budine, titled "The 1989-90 Apparition of Jupiter: Rotation Periods" (Budine, 1991a) was the basis for drift rates and period of rotation calculations reported here. Phillip Budine did essentially all transit timing analysis. Unfortunately, many of the original timings were missing from the archives. For that reason, the authors used the Budine report as a main source of drift rates, and used observations and photographs to confirm them as much as possible. The authors are confident that this report correctly depicts the 1989/90 Apparition of Jupiter according to the records within the A.L.P.O. Jupiter Section Archives.

ACKNOWLEDGEMENTS

The A.L.P.O. Jupiter Recorders at the time of the 1989/90 Apparition, Phillip Budine and Jose Olivarez, did the original collection and evaluation of observations used for this report. Their work was very valuable to the production of this report, and their efforts are greatly appreciated.

We thank all the observers of the A.L.P.O. who contributed observations. The value of the work of the Jupiter Section is dependent upon their careful effort to make observations.

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Figures 3-7. Sample photographs and drawings of Jupiter for the 1989/90 Apparition. All figures have south at the top, with contrasts enhanced for reproduction. When given, Seeing is in the standard A.L.P.O. Scale (ranging from 0 = worst to 10 = perfect); Transparency is the limiting visual stellar magnitude in the vicinity of Jupiter. UT = Universal Time.

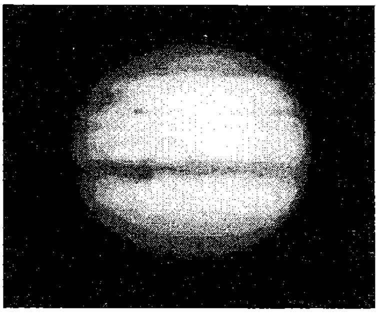

Figure 3. Photograph of Jupiter by Isao Miyazaki, 1989 AUG 09, 20h18m UT.
CM1, 282°; CM2, 067°.
40-cm Newtonian reflector.

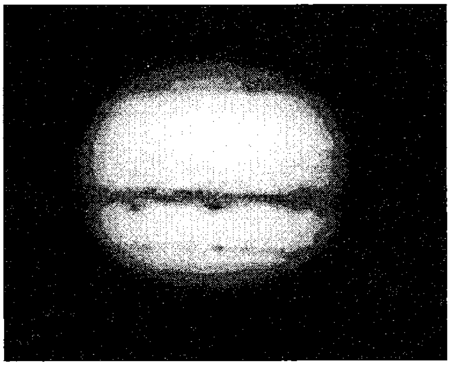

Figure 4. Photograph by Isao Miyazaki, 1990 JAN 05, 1990, 14h34m UT.
CM1, 205°; CM2, 294°.
40-cm Newtonian reflector.

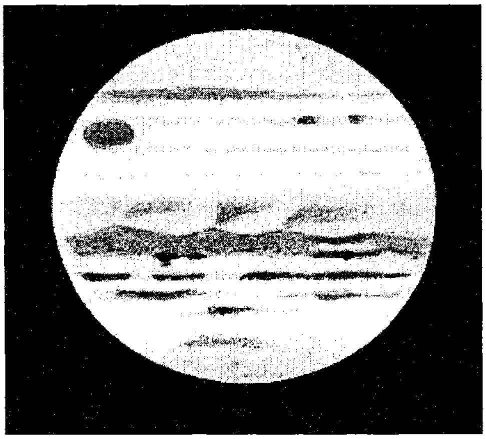

Figure 5. Drawing of Jupiter by Dan Boyar, 1990 Mar 29, 02h30m UT, 25-cm Newtonian reflector. CM1, 265°; CM2, 086°. Seeing, 6-7; Transparency, +4+.

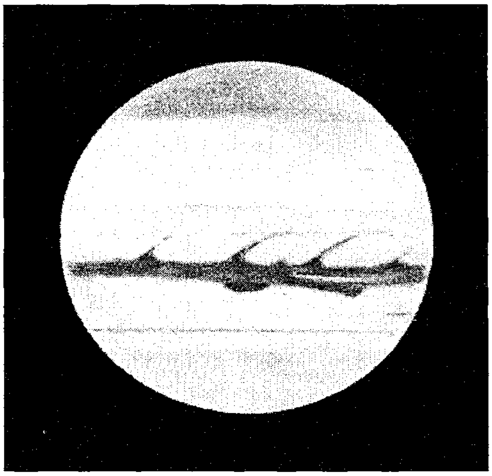

Figure 6. Drawing of Jupiter by Robert L. Robinson, 1989 Nov 25, 04h52m UT, 25-cm Newtonian reflector. CM1, 210°; CM2, 256°. Seeing, 7; Transparency, +4.5.

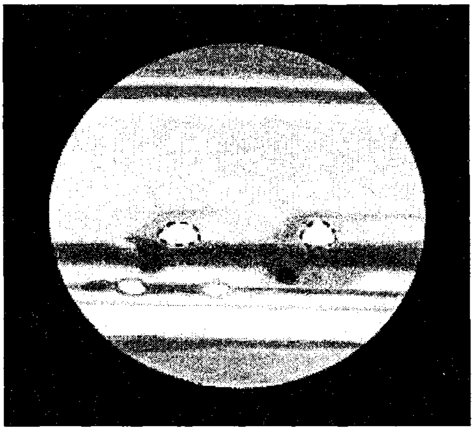

Figure 7. Drawing of Jupiter by Woodie F. Morris, 1990 Apr 11, 23h37m UT, 15-cm Newtonian reflector, yellow filter. CM1, 209; CM2, 283. Seeing, 6; Transparency, +5.

A.L.P.O. OBSERVATIONS OF VENUS DURING THE 1995/96 EASTERN (EVENING) APPARITION

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

ABSTRACT

This report summarizes visual and photographic data submitted by A.L.P.O. Venus Section observers in the United States, Canada, Italy, Germany, Austria, and the United Kingdom during the 1995/96 Eastern (Evening) Apparition, including instrumentation and data sources utilized in compiling those observations. Comparative studies deal with observers, instruments, and visual and photographic data. The report includes illustrations and a statistical analysis of the categories of features in the atmosphere of Venus, such as cusps, cusp-caps, and cusp-bands, seen or suspected at visual wavelengths, in integrated light and with color filters. Terminator irregularities and the apparent phase are discussed, as well as coverage based on results from continued monitoring of the dark hemisphere of Venus for the Ashen Light.

INTRODUCTION

A total of 201 visual drawings and photographs of Venus were amassed by the A.L.P.O. Venus Section during the 1995/96 Eastern (Evening) Apparition. Geocentric phenomena in Universal Time (UT) for the 1995/96 are presented in *Table 1* (right), while *Figure 1* (p. 58) illustrates the distribution of observations by month during the observing season.

Observational monitoring of Venus was reasonably good throughout the 1995/96 Eastern (Evening) Apparition. In what appears to be a growing trend, individuals began their observing programs soon after Venus emerged from Superior Conjunc-tion, and they continued to follow the planet up to two days prior to Inferior Con-junction. The "observing season," or observation period, ranged from 1995 SEP 02 to 1996 JUN 08, with the majority of the observations (84.1%) submitted for the interval from 1996 January through May. As has been the case in many previous apparitions, peak observational activity in 1995/96 was centered on the time when Venus was near greatest brilliancy and maximum elongation from the Sun.

Fourteen individuals contributed visual and photographic observations of Venus during the 1994/95 Apparition, and *Table 2* (p. 58) gives their observing sites, number of observations, and apertures and types of instruments used.

Figure 2 (p. 59) shows the distribution of observers and contributed observations by nation of origin for the 1995/96 Eastern (Evening) Apparition. Almost two-thirds of the individuals taking part in A.L.P.O. Venus programs (64.3%) resided in the United States, yet those individuals accounted for only slightly more than two-fifths (39.8%) of the total observations received. During 1995/96, as in recent previous apparitions, international participation in our programs continued, supporting our efforts to foster heightened cooperation among lunar and planetary observers worldwide.

Table 1. Geocentric Phenomena in Universal Time (UT) for the 1995/96 Eastern (Evening) Apparition of Venus

	1995
Superior Conjunction	AUG 21d 00h
Initial Observation	SEP 01d 10h
	1996
Maximum Elong. East (46°)	APR 01d 01h
Dichotomy (predicted)	APR 02d 22h
Greatest Brilliancy (m_V = -4.5)	MAY 04d 14h
Final Observation	JUN 08d 11h
Inferior Conjunction	JUN 10d 16h
Observed Range:	
Apparent Diameter:	9".68 (1995 SEP 02)- 55".50 (1996 JUN 08)
Phase Coefficient, k:	0.998 (1995 SEP 02)- 0.003 (1996 JUN 08)

The types of telescopes used to carry out Venus observations are depicted in *Figure 3* (p. 59). Roughly three-fourths (76.1%) of the observations were made with telescopes above 15.2 cm (6.0 in) in aperture. Classical designs (refractors and Newtonians) were employed in making slightly more than half (53.2%) of the

Table 2. Participants in the A.L.P.O. Venus Observing Program During the 1995/96 Eastern (Evening) Apparition.

Observer and Observing Site	No. Obs.	Telescope(s) Used*
Benton, Julius L.; Wilmington Island, GA	30	15.2-cm (6.0-in) REF
Braga, Raffaello; Milano, Italy	6	9.0-cm (3.5-in) REF
Cave, Thomas R.; Long Beach, CA	2	32.5-cm (12.8-in) NEW
	1	20.3-cm (8.0-in) SC
Gonzi, Siegfried; St. Paul, Austria	10	10.2-cm (4.0-in) REF
Haas, Walter H.; Las Cruces, NM	5	20.3-cm (8.0-in) NEW
	2	31.8-cm (12.5-in) NEW
Heath, Alan W.; Nottingham, UK	11	30.5-cm (12.0-in) NEW
Lehman, David J.; Fresno, CA	5	10.2-cm (4.0-in) REF
Lohvinenko, Todd; Winnipeg, Canada	10	20.3-cm (8.0-in) SC
Louderback, Daniel; South Bend, WA	4	8.0-cm (3.2-in) REF
Melillo, Frank J.; Holtsville, NY	14	20.3-cm (8.0-in) SC
Niechoy, Detlev; Göttingen, Germany	3	6.0-cm (2.4-in) REF
	6	7.9-cm (3.1-in) REF
	13	10.2-cm (4.0-in) REF
	62	20.3-cm (8.0-in) SC
Nowak, Gary T.; Essex Jct., VT	7	20.3-cm (8.0-in) SCHF
Rummler, Jens A; Oscar, LA	7	20.3-cm (8.0-in) NEW
Schmude, Richard W.; Barnesville, GA	1	9.0-cm (3.5-in) REF
Total Number of Observers	14	
Total Number of Observations	201	

* NEW = Newtonian, REF = Refractor, SC = Schmidt-Cassegrain, SCHF = Schiefspiegler.

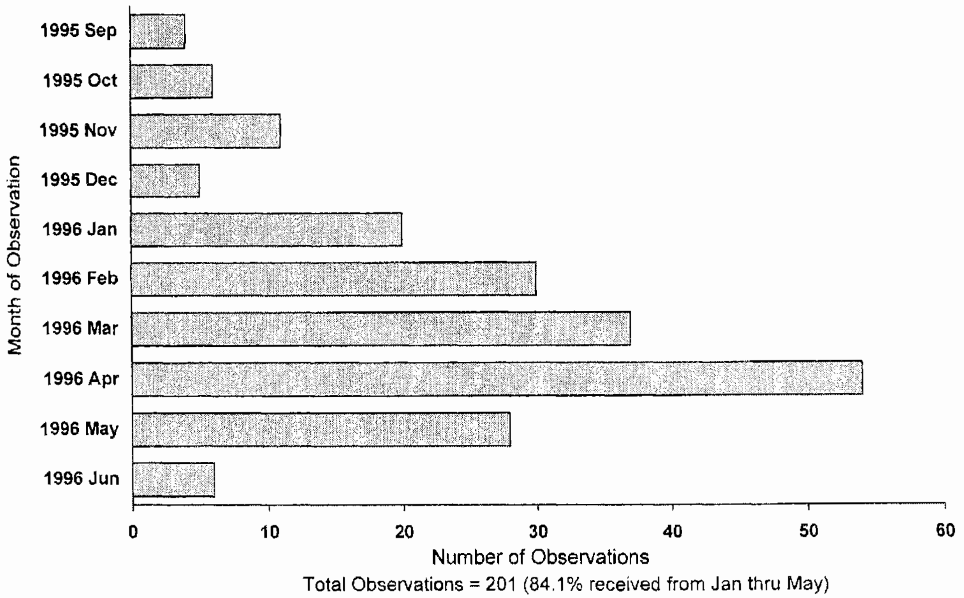

Figure 1. Distribution of observations by month during the 1995/96 Eastern (Evening) Apparition of Venus.

observations, while most of the remaining Venus reports were generated using Schmidt-Cassegrains, although seven observations were made with a Trischiefspiegler. Also, during 1995/96, a little more than half of the observations (55.0%) occurred under dark sky conditions, and more individuals than in earlier apparitions tried to find and study Venus in daylight or twilight to avoid the overwhelming glare associated with the planet. Also, viewing Venus higher in the sky helped minimize

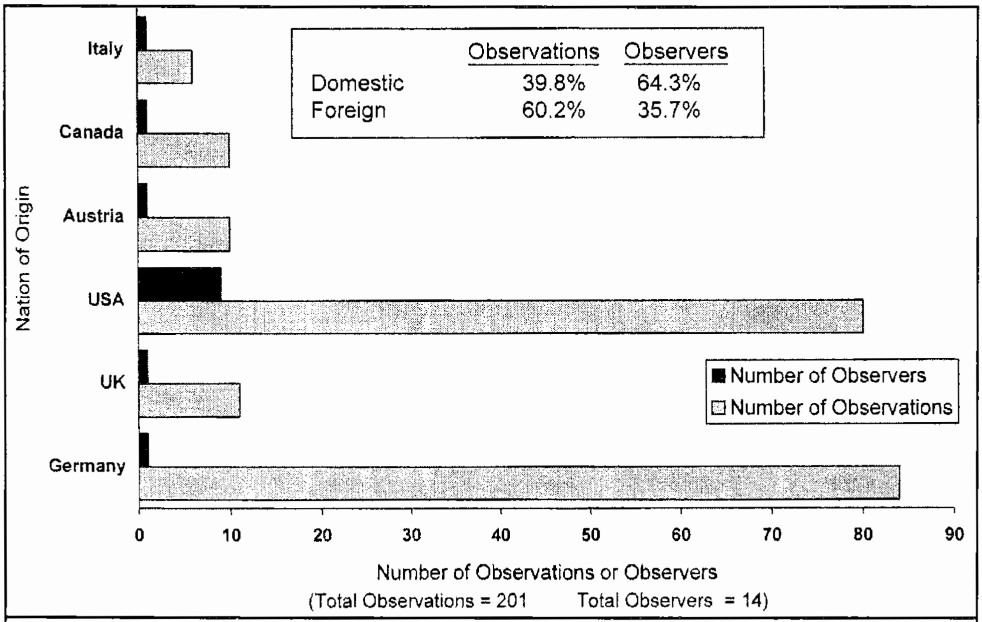

Figure 2. Distribution of observations and observers by nation of origin during the 1995/96 Eastern (Evening) Apparition of Venus.

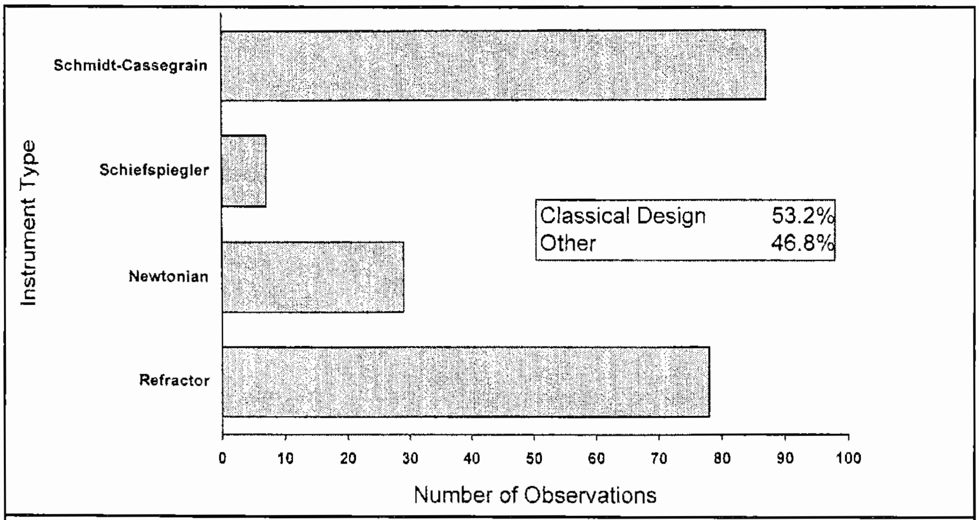

Figure 3. Types of telescopes used for observing Venus during the 1995/96 Eastern (Evening) Apparition.

the effects of atmospheric dispersion and image distortion near the horizon.

The A.L.P.O. Venus Section Coordinator extends his sincere gratitude to the fourteen individuals mentioned in this report for their observational support during 1995/96. Readers interested in learning more about the planet Venus are urged to join the A.L.P.O. and become regular contributors to our observational pursuits in forthcoming apparitions.

OBSERVATIONS OF VENUSIAN ATMOSPHERIC DETAILS

For new observers especially, procedures and techniques for conducting visual studies of the vague and elusive "mark-

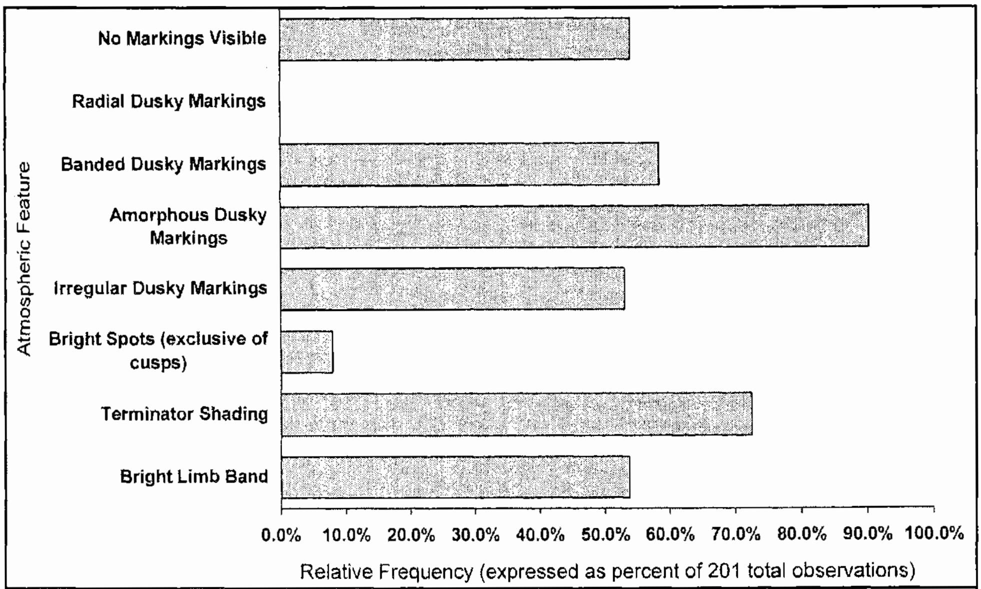

Figure 4. Relative frequency of specific forms of atmospheric markings on Venus during the 1995/96 Eastern (Evening) Apparition.

ings" in the atmosphere of Venus are thoroughly outlined in *The A.L.P.O. Venus Handbook* [Benton, 1987]. Readers with access to earlier issues of this Journal may find it beneficial to refer to previous apparition reports for a historical perspective on our studies of the planet [e.g., Benton, 1998].

Most of the observations used in this analysis were made at visual wavelengths, and several examples of these observations in the form of drawings and photographs appear in this report to assist the reader in interpreting the phenomena reported in the atmosphere of Venus in 1995/96 (see *Figures 6-15* on pp. 63-65). One observer, Frank Melillo, conducted ultraviolet photography of Venus, and some of his observations are also published here.

The visual and photographic data for the 1995/96 Apparition represented all of the usual categories of dusky and bright markings on Venus, as described in the literature cited above. *Figure 4* (above) summarizes the frequency for which the specific forms of markings were reported. Many observations depicted more than one type of marking or feature, so that totals over 100 percent are possible. Readers should also be aware that some subjectivity exists when describing the extremely elusive markings of Venus, which undoubtedly affected the values in Figure 4. Despite this limitation, it is believed that conclusions deduced from these data are reasonable.

The dusky markings in the atmosphere of Venus are notoriously troublesome to see, a characteristic of the planet that is often independent of the experience of the visual observer. Filter techniques have proven helpful in revealing the subtle cloud phenomena on Venus at visual wavelengths, but the A.L.P.O. Venus Section also actively encourages observers to attempt UV (ultraviolet) photography. The morphology of features revealed at UV wavelengths is typically different from that seen in the visual regions of the spectrum, especially the radial dusky patterns.

Figure 4 shows just over half (54.0%) of the observations of Venus in 1995/96 referred to a brilliant disc that was completely devoid of markings. When dusky features were seen or suspected, most fell in the category of "Amorphous Dusky Markings," indicated in 90.3 percent of the total observations. Other dusky shadings were distributed among the categories of "Banded Dusky Markings" (58.4%) and "Irregular Dusky Markings" (53.1%), but there were no reports in 1995/96 of any "Radial Dusky Markings."

Terminator shading was apparent during much of the 1995/96 observing season, reported in 72.5 percent of the observations, as shown in Figure 4. The terminator shading typically extended from one cusp region to the other, and the shading appeared to lighten (have a higher relative intensity) as one progressed from the region of the terminator toward the bright limb of the planet. This gradual variation in brightness usually ended with the Bright Limb Band. No photographs in 1995/96 showed any hint of terminator shading.

The mean relative intensity for all of the dusky features on Venus in 1995/96 ranged from 8.0 to 8.8, when 0.0 represents the sky background and 10.0 the brightest possible condition. The A.L.P.O. Scale of Conspicuousness (which runs sequentially from 0.0 for "definitely not seen'" up to 10.0 for "certainly seen") was also used regularly during 1995/96. On this scale, the dusky markings in Figure 4 had a mean conspicuousness of about 4.0 during the apparition, which suggests that these features fell within the range from indistinct impressions to reasonably good indications of their actual presence on Venus.

Figure 4 also shows that "Bright Spots or Regions," exclusive of the cusp areas, were seen or suspected in only 8.0 percent of the total submitted observations, and these areas had a derived mean relative intensity of 9.8. At visual wavelengths, few drawings depicted such bright spots or mottlings, and these features were completely absent on submitted photographs.

Observers routinely employed color filter techniques during the 1995/96 Eastern (Evening) Apparition, and when results were compared with studies in integrated light, the use of color filters with precisely defined wavelength transmissions and variable-density polarizers enhanced the visibility of the elusive Venusian atmospheric phenomena.

THE BRIGHT LIMB BAND

Figure 4 shows that in 53.8 percent of the observations for 1995/96 noted a "Bright Limb Band" on the Venus' illuminated hemisphere. When the Bright Limb Band was detected during the observing season, it appeared as a continuous, brilliant arc extending from cusp to cusp 80.4 percent of the time, and interrupted or only partially visible along the limb of Venus in 19.6 percent of the positive reports. The mean numerical intensity of the Bright Limb Band was 9.9, which became more obvious when color filters or variable-density polarizers were used. Despite the dazzling brilliance of this feature to visual observers, it was not apparent in any photographs of Venus submitted in 1995/96.

TERMINATOR IRREGULARITIES

The terminator is the geometric curve that divides the sunlit and dark hemispheres of Venus. Observers described an irregular or asymmetric terminator in slightly more than one third (36.8%) of the observations in 1995/96. Amorphous, banded, and irregular dusky atmospheric markings appeared to blend with the shading along the terminator, possibly contributing to reported deformities. Filter techniques enhanced the visibility of terminator irregularities and dusky atmospheric features closely associated with it during the 1994/95 Eastern (Evening) Apparition. Because of irradiation, bright features adjacent to the terminator may sometimes look like bulges, and dark features may appear as dusky hollows.

CUSPS, CUSP-CAPS, AND CUSP-BANDS

Usually, when the phase coefficient, *k*, (the fraction of the disc that is illuminated) lies between 0.1 and 0.8, features on Venus having the most contrast and prominence are repeatedly sighted at or near the planet's cusps. These cusp-caps are sometimes bordered by what are described as dark, usually diffuse, cusp-bands. *Figure 5* (p. 62) shows the visibility statistics for Venusian cusp features in 1995/96.

Figure 5 shows that, when the northern and southern cusp-caps of Venus were observed in 1995/96, these features were equal in size and brightness most of the time. There were a very few instances when either the northern or southern cusp-cap was the larger, the brighter, or both. Also, in roughly a third of the observations submitted (32.8%), neither cusp-cap was visible. The mean relative intensity of the cusp-caps was about 9.8 during the 1995/96 Apparition. Dusky cusp-bands bordering the bright cusp-caps were not reported in 42.1 percent of the observations when cusp-caps were visible, and the cusp-bands displayed a mean relative intensity of about 7.6 (see Figure 5).

CUSP EXTENSIONS

As one can see from Figure 5, in 83.6 percent of the observations no cusp extensions were reported (in integrated light and with color filters) beyond the 180° expected from simple geometry. But, as Venus

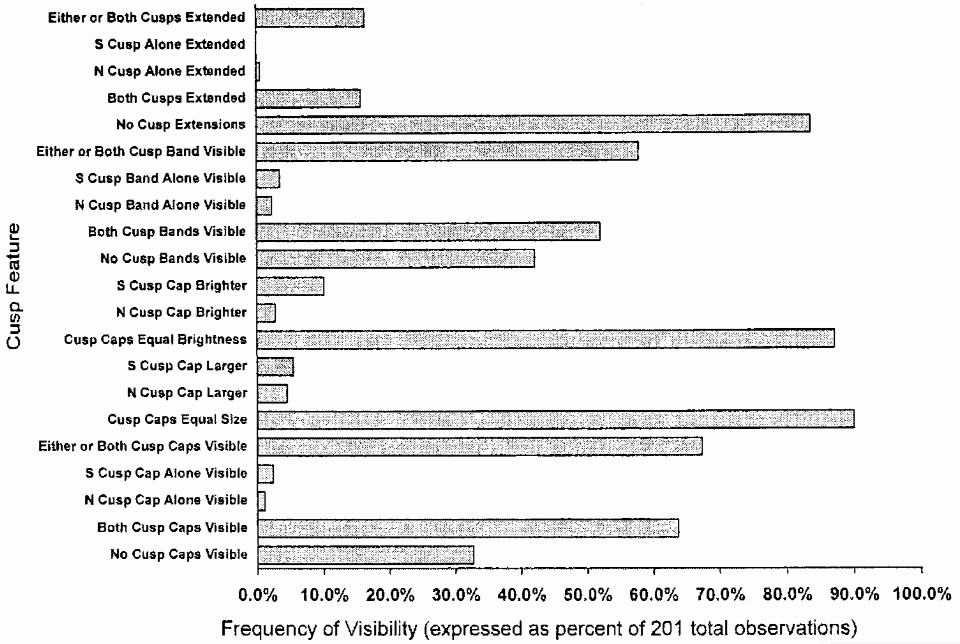

Figure 5. Visibility statistics of cusp features of Venus during the 1995/96 Eastern (Evening) Apparition.

progressed through its crescentic phases nearing inferior conjunction in 1995/96, several observers saw cusp extensions ranging from 2° to 20°. Very close to inferior conjunction, a few individuals were awed when the cusps joined along the planet's unilluminated limb, resulting in a splendid halo encircling the dark hemisphere of Venus. Reported cusp extensions were shown on drawings, with their appearance enhanced by color filters and polarizers, but none were photographed successfully. Experience has shown that cusp extensions are exceedingly difficult to catch on film because the sunlit regions of Venus are overwhelmingly brighter than these faint phenomena. It may be worthwhile, however, for observers to try to capture cusp extensions with video cameras or CCDs in coming apparitions.

Estimates of Dichotomy

A discrepancy between the predicted and the observed dates of dichotomy (half-phase), known as the "Schroeter Effect" on Venus, was reported by observers during the 1995/96 Eastern (Evening) Apparition. The predicted half-phase occurs when k equals 0.500, and the phase angle, i, between the Sun and the Earth as seen from Venus, equals 90°. The observed-minus-predicted discrepancies for 1995/96 are given in *Table 3* (below).

Table 3. Observed versus Predicted Dichotomy of Venus, 1995/96 Eastern (Evening) Apparition.

(UT Dates, 1996)

	Observer	
Dichotomy (k = 0.500)	J. Benton	D. Niechoy
Observed (O)	Mar 30.90	Mar 28.81
Predicted (P)	Apr 02.92	Apr 02.92
Difference (O-P, days)	-03.02	-05.11

Dark-Hemisphere Phenomena and Ashen-Light Observations

First reported by G. Riccioli in 1643, the Ashen Light is a very elusive, faint illumination of Venus' dark hemisphere, and it resembles, but does not have the same origin, as Earthshine on the dark portion of the Moon. There are many individuals who insist that Venus must be viewed against a completely dark sky in order to detect the Ashen Light, but these circumstances usually occur only when the planet is very low in the sky where adverse terrestrial atmospheric conditions conspire to produce bad seeing. In addition, substantial glare in contrast with the surrounding dark sky influences such observations. Thus the A.L.P.O. Venus Section Reports continues to receive reports of the Ashen Light when Venus is viewed against a twilight sky.

During 1995/96, 98.8 percent of the observations did not report the Ashen Light on Venus, whether using Integrated Light (no filter), color filters, and variable-density polarizers. In the rarest of occasions when observers had vague suspicions of the phenomenon, there was no confirmation of their impressions. There were no instances when observers believed that the dark hemisphere of Venus was actually darker than the background sky; but when seen, this phenomenon is almost certainly a contrast effect.

CONCLUSIONS

Analysis of the observations of Venus contributed during the 1995/96 Eastern (Evening) Apparition suggested moderate activity in the atmosphere of the planet as described in this report. However, with visual observations of Venus, it is perennially troublesome to differentiate between what constitutes real atmospheric phenomena and what is merely illusory. Confidence in our results will certainly improve as the number of observers and simultaneous observations increases. The Venus Section also needs more ultraviolet photographs of Venus, as well as CCD images of the planet at different wavelengths. We are attempting to standardize and improve observational techniques and methodology so that comparison of our results with those of previous evening observing seasons, as well as with morning apparitions of Venus, is more reliable.

Our studies of the Ashen Light, which peaked during the Pioneer Venus Orbiter Project, are continuing each apparition. Constant, ideally simultaneous, monitoring of the planet for the presence of this phenomenon by a large number of observers remains important as a means of improving our chances of capturing dark hemispheric events.

Active international cooperation by individuals making routine systematic, simultaneous observations of Venus remains our main objective, and the A.L.P.O. Venus Section invites interested readers to join us in our projects and challenges ahead.

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The drawings and photographs that follow (Figures 6-15) have had their contrast enhanced and are oriented with the South Pole of Venus at top. Any that were originally drawn reversed have been rectified, as noted in their captions. Unless otherwise stated, Seeing is in the Standard A.L.P.O. Scale (0 = worst, 10 = perfect) and Transparency is the limiting visual stellar magnitude in the vicinity of Venus. Ephemeris data from *The A.L.P.O. Solar System Ephemeris: 1996.*

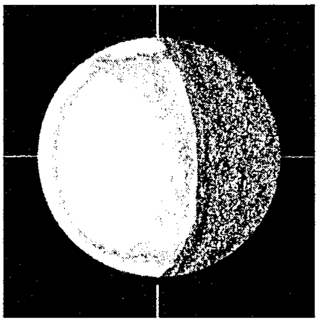


Figure 6. Drawing by D. Niechoy.
1996 Feb 07, 15h34m UT. 20.3-cm (8.0-in) Schmidt-Cassegrain, 112X, integrated light
Seeing = 2.5, Transparency = +3.0.
Phase = 0.739, Diameter = 15".2.
Drawing originally reversed; here rectified.

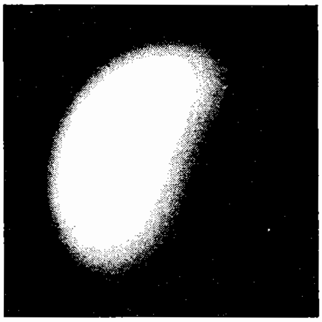
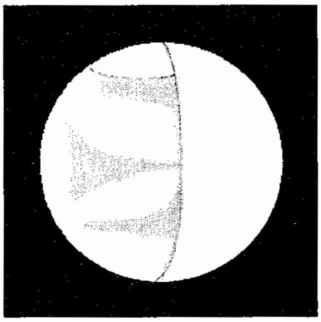


Figure 7. Photograph by F. Melillo. 1996 Feb 18, 23h05m UT. 20.3-cm (8.0-in) Schmidt-Cassegrain, stopped to 6.35 cm (2.5 in), 12-mm eyepiece projection using Adaptive Optics. 60-sec exposure, W47 (deep blue) Filter, Kodak TP2415 Film. Seeing = 4.0, Transparency = +3.5. Phase = 0.702, Diameter = 16".2.

Figure 8, Drawing by J. Rummler. 1996 Feb 26, 01h40m-01h50m UT. 20.3-cm (8.0-in) Newtonian, 136X, W80A (blue) Filter. Seeing = 6.0, Transparency =+4.5. Phase = 0.672, Diameter = 17".2.



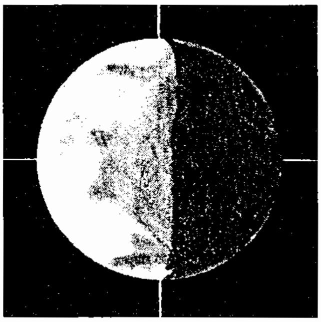
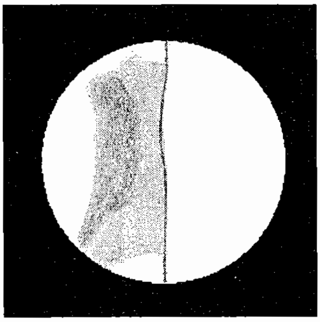


Figure 9. Drawing by D. Niechoy. 1996 Mar 27, 12h36m UT. 20.3-cm (8.0-in) Newtonian, 225X, integrated light. Seeing = 2.5, Transparency =+2.5. Phase = 0.538, Diameter = 22".3. Drawing originally reversed; here rectified.

Figure 10. Drawing by J. Rummler. 1996 Apr 02, 00h48m-01h510m UT. 20.3-cm (8.0-in) Newtonian, 136X, W80A (blue) Filter. Seeing = 8.0, Transparency = +4.0. Phase = 0.505, Diameter = 23".7.



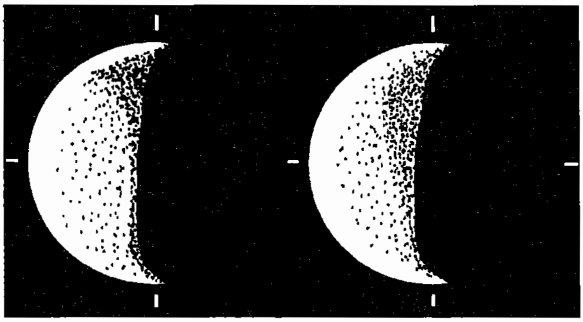


Figure 11. Drawings by R. Braga. 1996 Apr 09. 9.0-cm (3.5-in) refractor, 200X. Seeing = III (Antoniadi scale; "moderate"). Phase = 0.464, Diameter = 25".7.

(left) 19h00m UT, W56 Filter (light green).

(right) 19h22m UT, W80A Filter (blue).

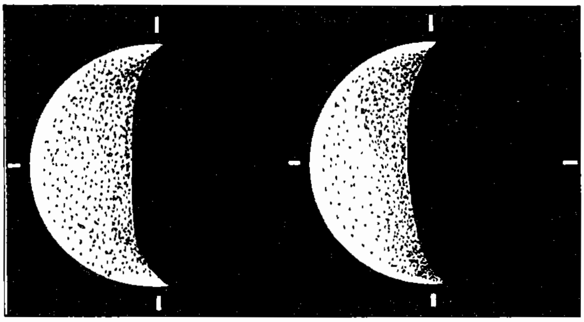
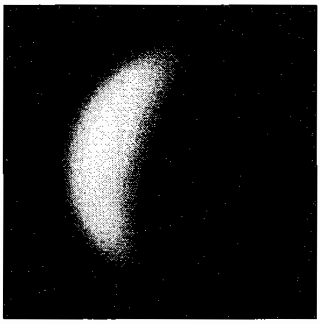


Figure 12. Drawings by R. Braga. 1996 Apr 18. 9.0-cm (3.5-in) refractor, 149X. Seeing = III (Antoniadi scale; "moderate"). Phase = 0.406, Diameter = 28".9.

(left) 18h57m UT, W56 Filter (light green).

(right) 19h26m UT, W23A Filter (light red).

Figure 13. Photograph by F. Melillo. 1996 Apr 21, 23h45m UT. 20.3-cm (8.0-in) Schmidt-Cassegrain, 2X Barlow lens with 10-mm eyepiece projection. 7-sec exposure, Schott UG-1 (ultraviolet) Filter, Kodak TP2415 Film. Seeing = 8, Transparency = +4.5. Phase = 0.385, Diameter = 30".1.



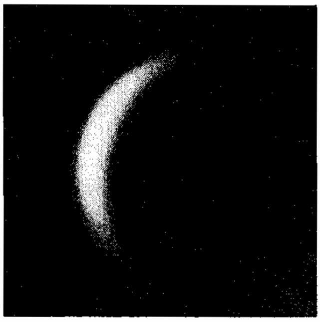
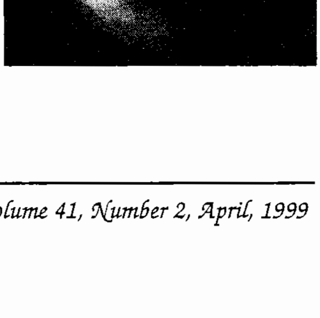


Figure 14. Photograph by F. Melillo. 1996 May 17, 23h45m UT. 20.3-cm (8.0-in) Schmidt-Cassegrain, 2X Barlow lens with 10-mm eyepiece projection. 7-sec exposure, Schott UG-1 (ultraviolet) Filter, Kodak TP2415 Film. Seeing = 5, Transparency = +4.5. Phase = 0.164, Diameter = 44".9.

Figure 15. Photograph by F. Melillo. 1996 Jun 06, 00h30m UT. 20.3-cm (8.0-in) Schmidt-Cassegrain, 2X Barlow lens with 10-mm eyepiece projection. 10-sec exposure, integrated light (no filter), Kodak TP2415 Film. Seeing = 3, Transparency = +3.5. Phase = 0.008, Diameter = 57".1. The solar elongation of Venus was 7° at the time of this photograph; note cusp extension.



OBSERVING THE MOON: BRIGHT RAYS

By: Bill Dembowski , Coordinator, A.L.P.O. Lunar Topographical Studies

Conventional wisdom says that the worst time for lunar observing is near Full Phase. It is at these times that shadows disappear and most lunar features are difficult, if not impossible, to observe. But conventional wisdom does not always apply. When the Sun is high in the lunar sky some of the Moon's most fascinating features, the bright lunar rays, blaze into view.

Lunar rays, those beautiful splash patterns that cover the face of the Full Moon, were once quite a mystery. Some early observers thought that they were cracks in the lunar crust that were later filled by dust or ice; others considered them to be salt deposits from extinct oceans. One of the more persistent theories was that they were volcanic in origin, similar to the Hawaiian features known as Pele's Hair. We know now that rays are the ejecta of meteoric and asteroidal impacts.

Rays appear to be distributed randomly across the lunar disc, although those on the dark maria tend to show up most dramatically because of the contrast effect. Although often quite extensive, they have no appreciable height and are never seen to cast a shadow. They typically are uninterrupted by mountains, crater walls, or rilles but there is some observational evidence that this may not always be the case.

Rays are thus best seen under high illumination. It is advisable to begin your observing session with a relative low power eyepiece (20-50X) to get an overall view of the larger ray systems and their relationship to one another. Move next to a medium power (100-200X) to study individual systems. You may wish then to use more magnification, but some observers find that magnifications in excess of 200X are more of a hindrance than a help when studying the rays. Also, observing the brighter regions of the Moon will usually require some measures to reduce the glare. Reducing the aperture of your telescope is one method of glare reduction but most observers prefer the use of filters; either colored, neutral density, or polarizing. While using such devices a few rays can actually be traced nearly to the terminator.

The most extensive lunar ray system is that associated with the crater Tycho. Long and straight, the rays of Tycho reach halfway across the face of the Moon and are so bright that they are highly visible even in the relatively bright highlands where they originate. One ray from Tycho appears to divide Mare Serenitatis in half. If this is in fact a ray from Tycho, and not from Menelaus as some believe, the span of the Tycho system exceeds 2,000 km. Interestingly, the Tycho rays do not begin at the crater walls. There is a dark halo surrounding the crater which may be the result of darker, heavier ejecta piling up around the crater walls. Also, the Tycho ray system is far from symmetrical. Some of its longest rays do not radiate from the center of the crater but rather from points on the crater walls. In addition, there is about a 120° gap in the system to the west. This gap is not totally devoid of rays but it lacks the major streaks that typify the rest of the system.

Far north of Tycho are the craters Copernicus and Kepler. Their ray systems, though prominent, are rather different than Tycho's. Whereas the rays of Tycho are straight and narrow, the Copernicus and Kepler rays are broader and more featherlike. They appear to spread like ostrich plumes, sometimes doubling back upon themselves to form oval loops. The two systems often overlap in a complex pattern that is difficult, if not impossible, to decipher. Both of these rays systems are also dimmer than that of Tycho, an indication that they predate their southern neighbor. It is usually accepted that rays are bright when originally formed but darken as they are bombarded by micrometeorites and cosmic rays. Kepler and its ray system are shown in a CCD image in *Figure 1* (p. 67), and in a drawing on this issue's front cover. One puzzling aspect of the Copernicus rays is that they are brighter than their age suggests they should be. At 810 million years old, theory says that they should have faded by now but at Full Moon they are second only to Tycho's in brilliance and extent.

Northwest of Copernicus and Kepler is Aristarchus. Recognized as the brightest crater on the Moon, Aristarchus is not often

Figure 1. Kepler (to left). CCD image by Bill O'Connell of Whitman, MA. 1998 Nov 06, 02h10m UT. 20-cm Schmidt-Cassegrain f/20. Colong. 112°.1. North at top.

thought of as the center of a ray system. However, inspection of the area surrounding Aristarchus will reveal a dim but definite ray system, complex in nature and quite widespread. Obviously there is a relationship between the brightness of the crater and the existence of rays.

One of the most interesting ray systems is the one associated with the crater Proclus just west of the western shore of Mare Crisium, shown in *Figure 2* (lower right). Proclus, incidentally, is the Moon's second brightest crater. This system has a most definite gap of 180° that includes the entire Palus Somni. There is some observational evidence to suggest that a ridge in the area interrupted the trajectory of the low-flying ejecta, but this explanation is controversial. Regardless of the cause, this gap in the ray pattern is an echo, in miniature, of the Tycho system.

The pair of rays emanating from the twin craters of Messier and Messier A are truly unique as they stretch comet-like from the center, to the western shore, of Mare Fecunditatis, shown in *Figure 3* (p. 68). Closer inspection will reveal that both rays actually emanate from only one of the twins, Messier A, formerly called "Pickering." Current thinking is that both of the craters, and the rays, were formed by the glancing impact of a meteor that struck the lunar surface at a shallow angle of 5°. These rays are visible even under a relatively low sun angle and make interesting viewing anytime they are sunlit.

Near the western shore of Oceanus Procellarum is one of the most extraordinary features on the Moon, Reiner Gamma. Reiner Gamma is a swirl of bright ray-like material that has no known source. It appears brighter than most rays under a low Sun. However, like lunar rays it never casts a shadow. Where did it come from? A similar feature exists on Mare Marginis on the Moons eastern limb. It has been theorized that the latter is the result of ejecta emanating from the impact that formed Mare Orientale, converging from all directions on the exact opposite side of the Moon. But no such impact site exists to account for the presence of Reiner Gamma. Is it, in effect, a ray without a crater to call home or a feature in a class by itself? (See also *Figure 1*, p. 69.)

Table 1 (p. 68) lists the lunar coordinates for 34 selected craters having prominent ray systems, with Reiner Gamma thrown in for good measure. The positions of these craters are plotted in *Figure 4* (p. 69). In addition to conventional ray systems there are literally hundreds of bright spots on the lunar surface. These are, of course, simply rays of limited extent, and often without any apparent internal structure. A listing of these bright spots would have to be made primarily on the basis of their coordinates since most of the craters are so unremark-

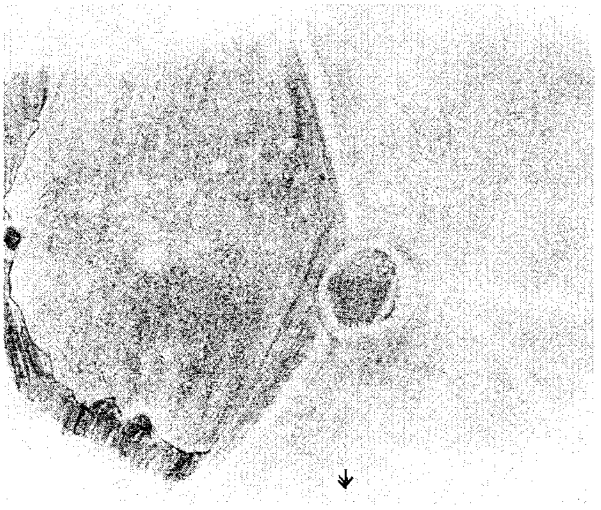


Figure 2. Sketch of Proclus by Daniel del Valle of Aguadilla, Puerto Rico. 1998 Oct 01, 22h27m-22h45m UT. 9-cm Maksutov-Cassegrain, 120X, Wratten 80A (blue) Filter. Seeing 5 (0 = worst to 10 = perfect). South at top.

able as not to have names or even letters. Rays themselves, unlike all other major features on the Moon, do not have a standard nomenclature to identify them.

Bright lunar rays are so intriguing that the Association of Lunar and Planetary Observers, the British Astronomical Association, and the American Lunar Society are conducting a joint program to catalog, map, and study them in detail. Anyone wishing to participate in the program should contact the A.L.P.O. Coordinator of Lunar Topographical Studies (address in staff listing on p. 96). As always, your sketches, photographs, and electronic images of the Moon are encouraged and welcomed by the Coordinator. In addition to observations of rays, those of wrinkle ridges are especially welcomed since they will be the subject of the next installment of our "Observing the Moon" series.

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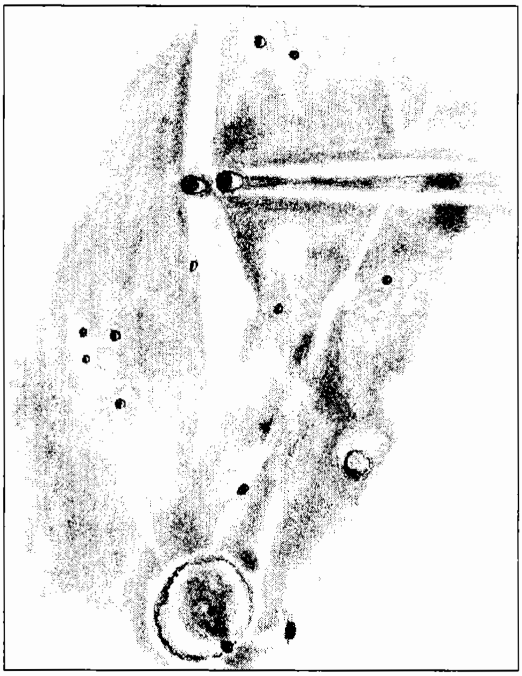

Figure 3. Sketch of Messier and Messier A (above center) by David Lehman of Fresno, CA. 1998 JUN 30, 04h40m-05h30m UT. 15-cm Newtonian, 220X. Seeing 3 (0 = worst to 10 = perfect). Colong. 339°.2-339°.6. South at top.

Table 1. Selected Ray Craters.

	°	°
Anaxagoras	73.4N	10.1W
Aristarchus	23.7N	47.4W
Aristillus	33.9N	01.2E
Autolycus	30.7N	01.5E
Bessel	21.8N	17.9E
Birt	22.4S	08.5W
Byrgius A	24.5S	63.8W
Copernicus	09.7N	20.0W
Euclides	07.4S	29.5W
Furnerius A	33.5S	59.1E
Geminus C	33.9N	58.7E
Glushko	08.3N	77.5W
Godin	01.8N	10.2E
Hind	07.9S	07.4E
Kepler	08.1N	38.0W
Lalande	04.4S	08.6W
Langrenus	08.9S	60.9E
Manilius	14.5N	09.1E
Menelaus	16.3N	16.0E
Messala B	37.4N	59.8E
Messier A	02.0S	46.9E
Olbers	07.4N	75.9W
Petavius B	19.8S	57.1E
Proclus	16.1N	46.8E
Reiner Gamma	08.0N	58.0W
Sirsalis	12.5S	60.4W
Snellius	29.3S	55.7E
Stevinus A	32.1S	51.9E
Strabo	61.9N	54.3E
Taruntius	05.6N	46.5E
Thales	61.8N	50.3E
Theophilus	11.4S	26.4E
Timocharis	26.7N	13.1W
Tycho	43.3S	11.2W
Zucchius	61.4S	50.3W

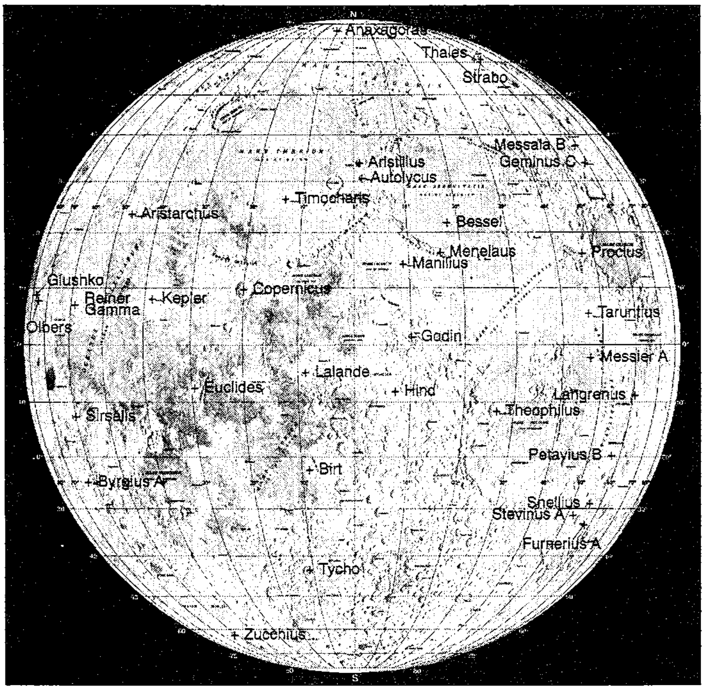

Figure 4. Locations of selected lunar ray craters listed in Table 1 (p. 68). Lunar north at top. The base map is taken from a 1:10,000,000-scale lunar mosaic prepared by the USAF Air Chart and Information Center.

A TOOL FOR LUNARIANS: CLEMENTINE IMAGE MOSAICS

Selenographers now have convenient access to Clementine-Mission images in the form of fifteen CD-ROMs of image mosaics covering the Moon under local-noontime lighting at 100-meter pixel size in the near-infrared (750-nm). The 100-m resolution images are arranged in one CD-ROM for each polar region; twelve disks, each covering a 30°-longitude strip from 70°N to 70°S; and a final disk showing the entire Moon at pixel sizes of 0.5, 2.5, and 12.5 km. The mosaics are plotted in the Sinusoidal Equal-Area Projection. Part of a sample mosaic is shown in *Figure 1* below.

Titled "Clementine Lunar Digital Image Models (LDIM), Vols. 1-15", the CD-ROM set contains software to read the images and their documentation for a variety of computer systems (e.g., IBM/PC-compatible, Macintosh, Sun). The set may be purchased for $150.00 from: National Space Science Data Center/World Data Center-A for Rockets and Satellites, Goddard Space Flight Center, Code 633, Greenbelt, MD 20771 (Telephone 301-286-6695; Fax 301-286-1635, E-mail request@mssdca.gsfc.nasa.gov).

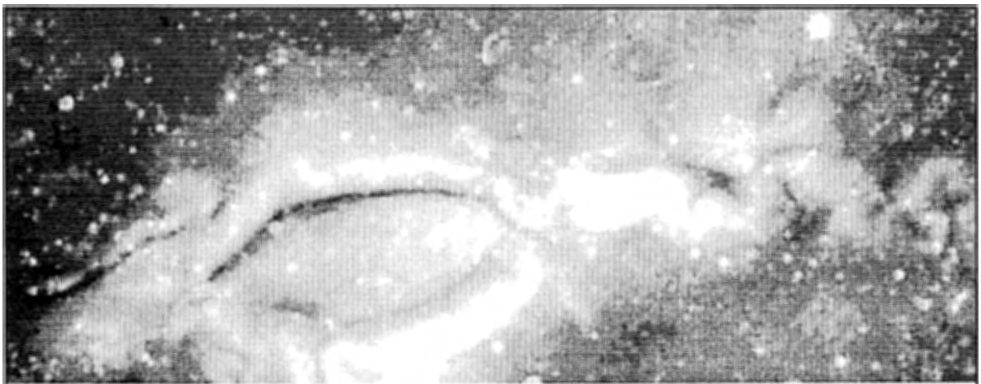

Figure 1. Clementine Image Mosaic showing the Reiner Gamma albedo formation in Oceanus Procellarum at 100-meter resolution. Assembled from 750 nm (near infrared) images. North at top. The area shown measures approximately 100×40km.

ADAPTIVE OPTICS: A REVIEW OF STELLAR PRODUCTS AO-2

By: Frank J. Melillo

When we see stars twinkling, most couples feel romantic. But, when it comes to planetary observations, it is a curse!

Usually, most astronomers are hampered by our turbulent atmosphere. Due to the Earth's rotation, our atmosphere is constantly moving; a motion associated with fronts, unstable air masses, jet streams and cold and hot air mixing together. Our success in planetary observations depends heavily on how stable our atmosphere is. When we talk about the sharpness of the images we are concerned with how much turbulence is in our atmosphere. Planetary astronomers are among the hardest hit in this area.

This problem is not new. Since 1609 when Galileo pointed his telescope toward Jupiter, we are still battling to see the planets through our murky atmosphere. We have come up with one solution: Put the telescope above the earth's atmosphere. We finally did it in 1990 when we launched the Hubble Space Telescope. It brought us incredibly sharp images that would be impossible to obtain from ground-based observatories. However, it is expensive to operate the Hubble Space Telescope! Thus, astronomers must come up with an alternate way in order to minimize the cost.

Back in 1953, the astronomer Horace Babcock at Mt. Wilson Observatory began the development of an alternate approach to possibly reduce the effect of turbulence when he put a movable mirror with oil in a telescope's optical path. He activated the mirror to compensate the image motion that is caused by our atmosphere. The mirror responded to the starlight movement very well and the image appeared to be quite still at the focus point. Adaptive optics was born! However, with 1950s technology, it was too difficult to build an operational version. Unfortunately, no one paid much attention to this approach.

The military service gained a great deal of knowledge about optical equipment during the Second World War. Afterward, during the Cold War, they built the first truly adaptive optics system and mounted it on the surveillance telescope at Haleakala Observatory in Maui to spy on Russian satellites as they moved across the sky. At the same time, most astronomers knew something about this system although it was supposedly secret. In 1989, the Cold War ended. The military was able to share their adaptive optics technology with the astronomical community. Astronomers knew all the time that this equipment could benefit their research. As time progressed, most observatories have purchased adaptive optics systems and installed them on their telescopes. At best, they can achieve nearly the same resolution as the HST with far less expense. By now, they have confirmed that this equipment can revolutionize ground-based observatories.

With technology much improved over earlier units, smaller and less complicated adaptive optics is available to amateur astronomers. This has the potential of revolutionizing amateur astronomy, especially for planetary photography and CCD imaging. Planetary images are often blurry and smeared, with a loss of contrast and resolution. Even high-resolution Kodak 2415 black-and-white, and fine-grained color, films couldn't deliver sharp photographs. The AO-2 adaptive optics system, manufactured by Stellar Products in San Diego, California, can steady a planet's image during a time exposure. Besides combatting "seeing", the unit corrects for clock drive error and telescope vibrations. When you look at a star or a planet through a telescope with a clock drive running, after, say, a minute you will notice that an object has moved gradually to the left or right or up or down. That will result in a blur on film. An AO-2 unit operating during a time exposure can actually stabilize the image's motion and, in my experience, will double the telescope's effective resolution nearly down to the diffraction limit! In addition, the AO-2 unit is quite small and lightweight.

Inside the unit is a relay lens, with a cubical beamsplitter that diverts one-half of the incoming light to a light detector in order to keep the planet's disk centered. The active input lens is mounted on a leaf spring. There is a hand-control box with an on/off switch to activate the relay lens. The

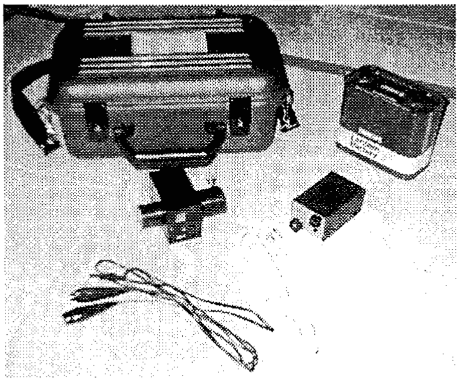

Figure 1. Components of the adaptive optics unit, which are stored in the small briefcase (left background). The hand control unit is in right center. The relay lens is in left center; the dark cable in the left foreground connects the battery (right background) to the hand control box, while the white cable in the right foreground connects the hand control unit to the relay lens. The 12-volt battery is not included.

system requires a 12-volt power source, such as a battery. When the switch is on to activate the unit, the input lens' leaf spring shifts to balance and to compensate the image's motion so it will remain steadily at the output lens' focus. This unit also has four LED lights on the side to help you to guide the object to the focal point if you cannot tell visually through the eyepiece. Unless you activate the relay lens, the planet's disk will jump to the sensitive area where it can be controlled. The hand-controlled box also has a gain knob to adjust the sensitivity of the unit according to the planet's brightness. This unit doubles the focal length so it is like putting a 2X Barlow lens to boost the photographic magnification. The components of the adaptive optics unit are shown above in *Figure 1*.

The adaptive optics system (AO-2) has some advantages and disadvantages. The advantages are greatest in photography and CCD imaging, especially when using filters. We increase exposure time considerably by using dense filters. The Wratten 47 (dark blue) and 25 (red) or even the UG-1 ultraviolet filter can be easily used in conjunction with an AO-2 unit. Even if the exposure time runs into many seconds, one can still produce valuable images. Also, any kind of vibrations due to the winds, ground motion (not earthquakes!), and clock-drive errors are controlled by the AO-2. You don't even have to worry about camera shutter vibration! Although this problem is easily corrected by using the "hat trick", even that is totally unnecessary when using this unit. While you trip the shutter, the AO-2 unit steadies the image automatically. You don't need a larger telescope to produce excellent photographs. At any photographic magnification, you will always double and sometimes more than double the effective resolution of the telescope.

Photographically, smaller telescopes can be used successfully as well as larger telescopes. In fact, at least a 4-in telescope is usually recommended for this unit to photograph all five bright planets. Planetary photography through the Celestron 8-in telescope with filters can now achieve the resolution of a 12.5- to 16-in telescope. Larger telescopes are totally unnecessary. Thus, even after buying the adaptive optics unit for planetary imaging, you can save money by not buying a larger scope! (Don't feel discouraged if you already have a large telescope. Your results will still probably be even better!) The unit is light and portable and it can easily be carried around. I also believe that using this unit make the quality of film photographs more competitive with CCD images. Two sample pairs of planetary photographs, with and without the unit turned on, are shown here as *Figure 2* (below) and *Figure 3* (p. 72).

The list of disadvantages may be important as well. Stellar Products was the first company to produce the AO-2. Just recently, SBIG came out with the Adaptive Optics AO-7, which is strictly for deep-sky imaging. Unfortunately the AO-2 is now available only on special order at a substantially higher price. [Currently the waiting time is about 8 months and the price $4900. *Ed.*]

The AO-2 unit has certain limitations on how well it can correct any image's

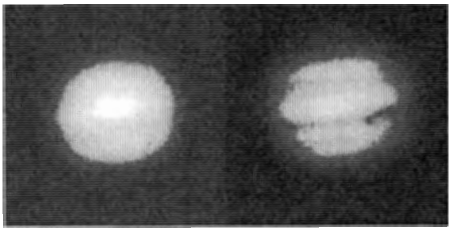

Figure 2. The planet Jupiter photographed on 1995 JUN 10 with the adaptive optics unit off (left) and on (right). A 20-cm (8-in) Schmidt-Cassegrain was used with a 12-mm eyepiece for projection; Kodak TP 2415 Film, 18 seconds exposure. Notice the blurring on the left, caused by seeing and clock drive error. The planet's apparent equatorial diameter was 45.4 arc-seconds at this time.

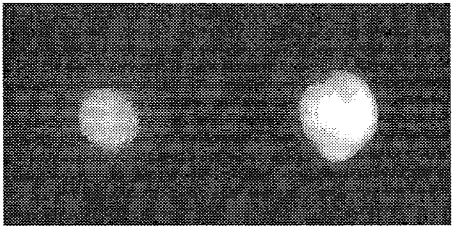

Figure 3. Mars photographed on 1994 Dec 30 with the adaptive optics unit off (left) and on (right). A 20-cm (8-in) Schmidt-Cassegrain was used with a 9-mm eyepiece for projection; Kodak TP 2415 Film, 10 seconds exposure. This view is at considerably higher magnification than Figure 2; Mars' apparent diameter was 10.9 arc-seconds when these photographs were taken.

motion. It cannot work with the Moon or the Sun. Both objects' apparent diameters are just too large to be controlled by the detector. In addition, it won't work with Uranus and Neptune when using an amateur-sized telescope; they are simply too faint. Only the five brighter planets can be used by this unit. Naturally, it won't work with deep-sky objects.

Visually, you won't see much difference using adaptive optics, because our eyes are capable of detecting planetary details when the object is in motion around the telescopic field. As a matter of fact, visually it is not too important to correct the image's motion. When it comes to photography, it is an entirely different story. Also as it is explained earlier, the unit needs 50 percent of the light to be in control. Actually, this light loss causes no harm, because the planets are so bright anyway.

The unit must be used with great care. It won't tolerate dropping. When not in use, the two dust caps at both ends must be on all the times, otherwise, any foreign objects or even dust can affect the performance and the unit must be sent back to the manufacturer for cleaning. In addition, the system won't work in gusty winds, although it will work well with a slight breeze if you must photograph at such times. And finally, if the atmosphere motion is severe, the unit won't correct the image's motion at all!

You may ask yourself if it is worth owning the adaptive optics system. This entirely depends how big the telescope is, how bright the planet you are imaging, and on your budget. The bigger the telescope, the better. But again, you don't have to use a large telescope if you can't afford one. The brighter the planet is, the better, because more light is entering to the unit. The AO-2 needs plenty of light to work with. Occasionally, Saturn may get a little too dim, but this shouldn't be any problem most of the time.

However, in order for the unit to work at its peak performance, the telescope must be properly collimated. The AO-2 unit won't correct blurring when it is due to a slight misalignment. Naturally, for best results your telescope's optics must be diffraction-limited. Use a good eyepiece or Barlow lens for image enlargement. Wait until the atmosphere turbulence settles down, even though the visual seeing doesn't have to be perfect; the adaptive optics will do the rest. Focus as carefully as possible. The AO-2 makes the image appear still so you can focus much more easily than without it. Make sure your mounting is in accurate polar alignment. Even though the AO-2 unit can correct a north-south motion, we just don't want it to work too hard! Also, make sure the telescope is properly balanced, which prevents the clock drive from running erratically. The AO-2 won't correct an image that moves rapidly back and forth. Your basic knowledge in planetary photography will permit you to operate the unit more easily. Once you become familiar with the adaptive optics system, you can look forward to diffraction-limited planetary photographs! Again, you must consider all the facts listed above to succeed. Then, it is well worth it to own an adaptive optics system if you are considering being a serious planetary photographer or CCD imager.

Finally, this article is just a general introduction to adaptive optics and the AO-2 system. You can request more technical information from: Stellar Products, 7387 Chelata Lane, San Diego, CA 92129 (Telephone (800) 234-7729; website: www.stellarproducts.com). I hope that, some day in the near future, you can own one of the most important observing accessories ever.

Comment by Editor: It is unfortunate that the AO-2 has become less practical for the amateur market since Mr. Melillo acquired his unit. Interested readers may wish to communicate to Stellar Products their desire that the AO-2 be put back in production at a reasonable price, as well as their interest in alternative models, such as the AO-4, that may be planned.

HOW TO BUILD A HEAVY-DUTY BARN-DOOR (SCOTCH) MOUNT

By: R. B. Minton, A.L.P.O. Instruments Coordinator

Most amateur astronomers have a need for a small portable sidereal-driven mount. I recently built one because I needed one, and I was curious how difficult it might be. I also wanted to leave my German equatorial mount free for more demanding tasks. The job was a bit frustrating, but not that difficult. I was surprised to get pinpoint star images on my first astrophoto. No special or expensive tools are required, but a belt-disk sander greatly simplifies grinding and filing. My total cash outlay was less than $5 because I have many junk boxes with wood, metal, motors, gears, nuts, bolts, and so forth. I urge readers to find and use such junk because their cost will be much less.

I first consulted pages 348-351 of the 3rd edition of *The Amateur Astronomer's Handbook* (1983) by James Muirden. He lists the correct hinge-rod distance for 1- and 2-RPM motors using drive screw pitches (threads per inch or TPI) of 16, 18, 20, and 24. I had all the necessary parts, but my 16-pitch rod looked too weak, so I used a rusty rod that was about 1/2 inch in diameter with 11 TPI. It was 6 inches long, so I could expect 30 to 60 minutes (6X11X1 RPM = 66 min) drive time, depending on how the rod was mounted. I also found a couple of large nuts that fit the rod. I removed the rust and burrs by spraying thin oil on the rod, adding some fine dirt, and running the nut back and forth many times. After cleaning it, the threads were as smooth as silk.

The Scotch mount designs I've seen are hand-driven for simplicity and portability, and with the screw turning in the bottom board and bearing on the bottom of the upper board. However, I already live in a pretty dark area and I did not want to turn it by hand throughout long exposures. I opted to use a 1-RPM motor fixed to the underside of the bottom board, run the rod thru a hole in the bottom board; and turn in a nut fixed to the top board. Since the hinge angle varies from 15° to 0° during 60 minutes, something had to give. I decided to firmly mount the motor and rod, and let the nut "float". I ground the nut on a belt-disk sander until it was cylindrical, and crammed it into one end of a hefty spring about 2 inches long. The other end of the spring was epoxied into a hole in the upper board. This arrangement allowed the nut to move a bit, but not rotate. With a five-pound load the spring starts to open, but the nut does not rotate. Thus, the nut is free to move East-West as the hinge angle changes.

I decided to limit my longest exposure to 30 minutes, so the hinge angle varies from 7°.5 to 0°. I found a 3-watt 1-RPM synchronous motor and mounted it on the bottom; but tilted it toward the hinges at an angle of about 4°—so that the nut would be normal to the motor after running 15 minutes. It later occurred to me that I could have mounted the motor flush and put small blocks between the hinges and boards so that the boards were parallel at mid-exposure. This would simplify construction.

I made a coupler to affix the rod to the motor shaft, and found a roller bearing with an inside diameter equal to the rod. I epoxied the outside of the bearing into a hole in the bottom board, with the hole drilled 4° toward the hinges. Thus the rod, bearing, and motor were normal to each other, but tilted 4° to the hinges. Since I used big door hinges, 3/4-inch plywood, a 1/2-inch rod, a 2-inch bearing, and 2-by-6-inch wood blocks for motor supports; the whole arrangement is rock solid.

I wanted the boards to close with time, so the motor would work with gravity (as a speed regulator), and not have to work against gravity. Fortunately, the motor turned the correct way with the hinges toward the East; counterclockwise looking from above.

Now it was time to cut the boards to the proper length (East-West). The North-South length is not critical, but should be large enough to provide a large camera mounting area and put the hinges far apart to reduce wobble. I consulted Muirden's table and calculated a distance of 20.78 inches for 11 TPI on a 1-RPM motor. I cut the boards, mounted the hinges, and decided to give it a load test before making a wedge to point everything at the pole. The motor had an internal clutch on the output shaft so I did not have to worry about striping gears. I ground a square shaft on the end of the rod to slip into the coupler so I could lift the top board and turn the rod back by hand.

With the board open fully and carrying three 35-mm cameras, I plugged in the motor and discovered it was underpowered. The motor strained every 30 seconds as the screw underwent a load change—and it got worse. A few minutes later, the motor stopped. I decided it was time to look for a more powerful motor and check the rod-coupler alignment. The coupler was a bit off alignment on the motor side, so I would have to fix this for the new motor. However, a look in my motor junk box revealed no other 1-RPM motors.

Fortunately, I had a few powerful (1/2 amp) barbeque spit motors that run about 5 RPM and cannot be stopped by hand. They have about 20 times the power of a 3-watt motor (1/2 amp × 115 volts = 57.5 watts). These can be found in many thrift stores for $1 each. I selected one near 5 RPM and measured its RPM precisely. I rigged a 12-volt DC bench power supply, a 12-volt electromechanical counter, and a stiff copper wire to touch the counter's wire on each revolution. I ran the motor for 94 minutes and got 483 revolutions, or 5.1383 RPM. I then checked my gear junk box and found two suitable large spur gears; 12 and 57 teeth, and they meshed well. This gives a reduction ratio of 4.75. Dividing 5.1383 by 4.75 gives 1.08175 RPM. I thus needed a hinge-rod distance for 11 pitch and 1.08175 RPM. I looked at Muirden's table, derived a formula, and wrote the short BASIC program in *Table 1* (below).

This gives a new distance of 22.44 inches instead of 20.78. I wanted to use a longer board so I could fine-adjust the hinge-rod distance by slotting the spacers holes next to the board. I used two strips of sheet aluminum 3 inches wide and 3/16 inch thick. This adjustment later proved unnecessary.

The smaller spur is mounted on the BBQ motor shaft, and the larger spur on the end of the rod. This time I took greater care attaching a coupler to the motor. The motor's output was a square hole about 1 inch deep. I found a threaded bolt that fit snug in the 12 tooth spur gear. I ground one end square, put a little 5-minute epoxy in the hole, inserted the bolt, and put square blocks against the sides of the bolt. I ran the motor, adjusted the blocks, and after 5 minutes there was no wobble. I put nuts, rubber, and metal washers on the bolt to hold the spur gear and serve as a clutch.

Table 1. BASIC computer program to calculate hinge-to-rod distance for scotch mount.

```
100 PI=4*ATN(1): REM VALUE OF PI
110 K=(2*PI)/1436.07: REM SIDEREAL RATE (RADIANS/MIN)
120 INPUT"ENTER RPM OF DRIVE SCREW ";RPM
130 INPUT"ENTER THREADS PER INCH FOR DRIVE SCREW ";TPI
140 HRD=SIN(RPM/TPI)/K
150 PRINT"HINGE TO ROD DISTANCE IN INCHES = ";HRD
160 END
```

The motor is bolted to a 2×9-inch piece of 3/16 inch-thick aluminum, and this bar pivots on one end. Friction holds the other end in place to keep the spur gears meshed. When it is time to rewind the rod, I pull back the bar, rewind it, and push to close. It only takes about 5 seconds and there is no need to turn off the motor (see *Figure 1*, p. 75).

A wedge was constructed for my latitude and epoxied to the bottom board. A surplus elbow telescope was added on the hinge side to align the mount to the pole. Any finder will work, but the elbow can be mounted flush to the board and adjusted left-right to collimate with the hinge axis. I added a fine screw adjustment to the finder to aid collimation (*Figure 2*, p. 75).

I made an L-shaped bracket from two circular wood disks, each 12 inches in diameter and 3/4 inch thick. The lower disk rotates, and the camera pivots near the top of the upper disk. This allows one camera to point anywhere in the sky. I also plan to build another lower disk with an inverted "U". This will allow three cameras to point in three different directions—great for meteor photography.

The Scotch mount sits on a large metal tripod. This tripod has a 12-inch flat, circular, and level surface with a central hole. The mount is easily attached and rotated until the pole is centered in the finder. Any flat, stable surface about waist high will also work well.

Even if the user really needs a portable mount, I recommend building a motorized Scotch mount, and using an inverter when away from home. The convenience is really worth the extra trouble. Now I can aim a few more 35-mm cameras skyward when those great comets or meteor storms pass by, and concentrate on the majesty of the night sky, rather

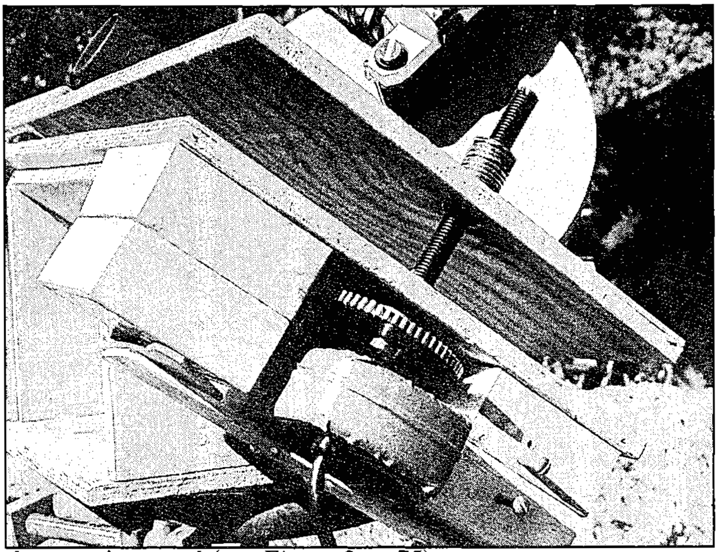

Figure 1. Close-up view of the barbeque motor, shaft, and spur gear of the barn-door mounting described in this article.

than turning a rod (see *Figure 3*, p. 75).

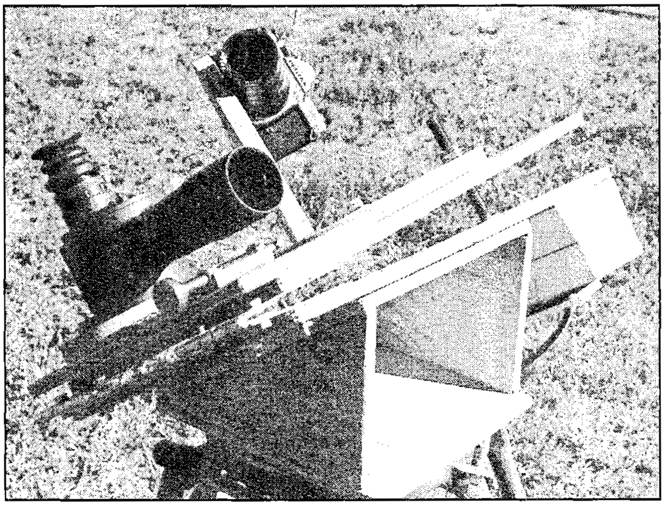

Figure 2. View of the barn-door mounting, showing the equatorial wedge (lower portion), hinges (lower left), elbow telescope for polar alignment (center left), with the camera mounting disk holding one 35-mm camera.

Figure 3. The area of galaxy M31 (to upper right of center), taken with the above barn-door mount on 1998 Sep 16. 10 minute exposure, 50-mm focal-length lens using 200 speed K-Mart brand (3M) Film. Note the sharpness of the images of the stars.

OBSERVATIONS OF MARS IN JANUARY 1996

By: Ted Stryk, Student Intern, Bays Mountain Planetarium.

ABSTRACT

The author made two observations of Mars in January, 1996, in response to reports of a possible dust storm, based on microwave observations by R.T. Clancy. These observations indicate that, if a dust storm was taking place, it was not global in scale.

INTRODUCTION

In early January, 1996, microwave observations by R.T. Clancy indicated that large-scale dust activity was taking place [1]. However, optical observations to confirm this were difficult to obtain, as Mars was rapidly approaching its March 4th solar conjunction. One successful attempt to observe the planet during this period was made by the author, using a 15-cm (6-in) apochromatic refractor at the Bays Mountain Observatory in Kingsport, Tennessee. The observations are presented here in order to show the value of having consistent coverage of Mars even when observing conditions are poor. These observations, when combined with those of Parker and Hernandez [2] a few days earlier, indicate that, although it is likely that there was indeed a dust event, it was not global in scale.

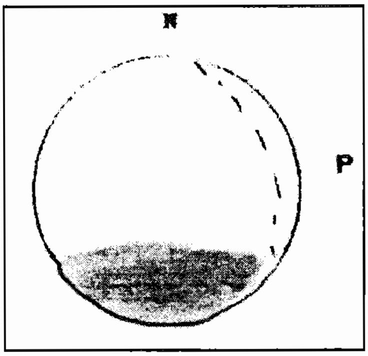

Figure 1. Mars sketch by Ted Stryk, 1996 JAN 15, 20h00m-20h45m UT. 15-cm (6-in) Apochromat. W25 (red) and W80A (blue) Filters. CM = 066°.9-077°.9. Ls = 022°.8 (Ls = areocentric longitude of the Sun). Seeing = 5. Note the haze on the preceding limb. The southern maria as a whole could be seen, although individual maria could not be made out. North at top.

OBSERVATIONS

The observations were obtained in broad daylight during the late afternoon. Attempts were made on several days, but only the two successful attempts will be described here (dates are the same in local and Universal Time):

1996 JAN 15. CM (central meridian) 066°.9-077°.9. The day was clear except for a slight haze. Seeing was fairly average, about 5 on the A.L.P.O. scale [ranging from 0 for worst to 10 for perfect]. Mars did offer some steady moments, during which the dark southern maria could be vaguely seen. Using a Wratten 25 red filter, the preceding limb appeared unusually bright. Nothing else could be seen. This view is shown in *Figure 1* (upper right).

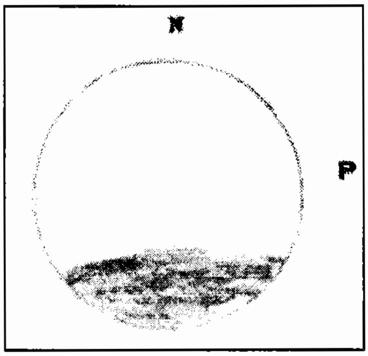

Figure 2. Mars sketch by Ted Stryk. 1996 JAN 20, 20h50m-21h00m UT. 15-cm (6-in) Apochromat. W25 (red) Filter. CM = 015°.1-017°.5. Ls = 023°.1. Seeing = 3. Conditions were extremely poor, making even the southern maria almost impossible to see. North at top.

1996 JAN 20. CM 015°.1-017°.5. Conditions were poorer than before. Just finding the planet took nearly an hour. The image was relatively steady, but with very low contrast. I could barely make out the southern maria with the red filter. Mare Acidalium was absent, but this is most likely due to the poor conditions and not dust. Had there been a limb brightening as before, I would have been unable to see it due to the poorer observing conditions; see *Figure 2* (p. 76).

Since these observations were made during the daytime, the seeing conditions estimates on the A.L.P.O. 0-10 scale were judged by image definition. However, as stars needed to determine a limiting magnitude were, of course, impossible to observe, the transparency could not be estimated.

INTERPRETATION

Due to the poor quality of these observations, they cannot be used to determine conclusively whether or not there was a major dust storm in January of 1996, although the bright limb on 1996 JAN 15 does favor the hypothesis that some dust activity may have been occurring. The observations are good enough, however, to put some rough constraints on the scale at which any dust activity was occurring, as they show that the southern maria were unobscured on both 1996 JAN 15 and JAN 20. Visual and CCD observations by Parker and Hernandez earlier in the month yielded similar results [2]. The writer's sightings of the southern maria rules out the possibility that any dust storm was global in scale, as a global storm have rendered the southern maria invisible.

CONCLUSION

Despite extremely poor conditions, optical observations of Mars during January, 1996 were able to produce meaningful results, as they limited the possible scale of a dust storm detected at microwave wavelengths. In future years, observations like these will be less important, since there will be martian orbiters in place obtaining high-quality images throughout the entire martian year. However, from time to time, gaps in their coverage will occur, often at times when Mars is not in an ideal place for viewing by earthbound observers. A good example of this will be the Fall of 1998, when the Mars Global Surveyor is scheduled to resume aerobraking and temporarily stop taking science data [3]. Coverage during times like this, even if of poor quality, is crucial to our understanding of the martian climate [4]. We hope that A.L.P.O. observers will rise to the challenge of providing this coverage.

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BOOK REVIEWS

Edited by Jose Olivarez

The New Solar System, Fourth Edition.

Editors: J. Kelly Beatty, Carolyn Collins
Petersen, and Andrew Chaikin,
with illustrations by Don Davis.

Sky Publishing Corporation,
49 Bay State Road, Cambridge, MA
02138. 1999. 421 pages, illustrations,
index. Price $39.95 paper
(ISBN 0-933346-86-7 [Sky edition]).

Reviewed by Jose Olivarez

Sky Publishing Corporation and Cambridge University Press have just published what may be the best book on solar-system astronomy! This is *The New Solar System, Fourth Edition*—a visually attractive and thoroughly authoritative work. Since the third Edition of this book was published back in 1990, there have been so many new developments in planetary science that most chapters had to be entirely recast for this edition and several new ones were added. At 421 pages, this Fourth Edition is nearly twice the length of the First! Also for this edition, the editors have attempted to bring together the fruits of recent planetary exploration to the widest possible audience. Therefore, this book is neither a textbook nor a "coffee table" volume—it lies somewhere in between. Editors Beatty, Petersen, and Chaikin also encouraged the authors to avoid sweeping generalizations and incomprehensible details, with the aim of making *The New Solar System*, Fourth Edition, enjoyable reading for those with either casual or professional interest. The book is illustrated throughout with countless color charts, photographs, and beautiful paintings by space artist Don Davis that complement and heighten interest in the text.

Two years in the making, this new edition was accomplished by bringing together 28 specialists in planetary science that include former active A.L.P.O. members Clark Chapman, Dale P. Cruikshank, and William K. Hartmann. The 28 chapters written by these specialists are short models of conciseness which do not average more than 16 pages in length. Some of these authoritative chapters include "Mars" by Michael H. Carr, "The Moon" by Paul D. Spudis, and "Comets" by John C. Brandt.

In this reviewer's opinion, *The New Solar System, Fourth Edition*, is, on the whole, the best edition of the series—its beauty and authoritativeness shine through! No person seriously interested in the bodies of the Solar System should be without a copy of this grand book.

The Heavens on Fire, The Great Leonid Meteor Storms.

By Mark Littmann.

Cambridge University Press, 40 West
20th Street, New York, NY 10011-4211.
1998. 349 pages. Price : $29.95 cloth
(ISBN 0-521 624053).

Reviewed by Jose Olivarez

According to the author of *The Heavens on Fire*, the years 1999 and 2000 will offer the last chance that people on earth will have for a century to see the most spectacular of meteor showers, the Leonids. In 1966, these meteors last filled the sky over the American southwest and then put on a fine show of brilliant fireballs in 1998. Will they storm over Europe or the eastern United States in 1999 or 2000? A detailed answer is found in Chapter 16 of this book.

The Heavens on Fire tells the story of meteors, and especially the Leonids, whose terrifying beauty in 1833 established meteor science. Mark Littmann engagingly traces the history and mythology of meteors, profiles the fascinating figures whose discoveries advanced the field, and explores how meteors have changed the course of life on earth. This book also tells the history of the great Leonid Meteor Storms so vividly that it is hard to put the book down. Like me, you may find yourself reading on and on into the night! There is a good reason, however, why this book is such a great read. The author is a professor in the School of Journalism at the University of Tennessee where he holds the Chair of Excellence in Science, Technology, and Medical Writing. If reading astronomy books for pleasure is something you enjoy, you'll love this book.

Moon Missions.

By William F. Mellberg,
with a Foreword by Harrison H. Schmitt.

Plymouth Press, 101 Panton Road,
Vergennes, VT 05491. 1997. 196 pages,
illustrations, index. Price : $29.95 paper
(ISBN 1-882663-12-8).

Reviewed by John Westfall

It has been a full generation since the Apollo era, and longer since the unmanned probes that preceded the Apollo astronauts. Those who lived through those events may by now be a little hazy about their details, while those who were young then or born later know them only as history.

Thus Bill Mellberg's book serves a definite need. Its purpose is to inform the reader about the American and Soviet lunar missions, automatic and manned, of the 1960s and early 1970s, their relation to each other, and what they found out about the Moon.

Astronaut Harrison Schmitt's Foreword stresses the motivations for a return to the Moon, which would make practical use of the Apollo-era findings. The body of the book then begins with a five-page summary of pre-space era lunar astronomy; I wish he had devoted a little more space to 350 years of telescopic study, but such curt treatment of "selenography" is normal in modern lunar literature. The remainder of "Part One: The Old Moon" traces the history of rocket development up to May 25, 1961, when President Kennedy committed the United States to a "race to the Moon."

I was somewhat puzzled when "Part Two: The Moon Missions" then moved directly to the planning for the Apollo Missions before discussing the earlier unmanned missions; the American Ranger, Surveyor, and Orbiter series and the Soviet Luna missions. The American unmanned programs receive just 14 pages, the Soviet series only 6 pages. Because these programs, particularly the Lunar Orbiters, provided so much information that is still valuable for research, they should have received more attention.

Where the book excels is in its coverage of the American manned programs, including the Mercury and Gemini flights, but especially the Apollo program, stressing the Apollo-8, -10, and -13 lunar orbit missions (the last unintentional) and the Apollo-11, -12, -14, -15, -16, and -17 lunar landings during the 1969-1972 period. The giant Saturn rockets, the Apollo capsules, the LEMs (Lunar Excursion Modules or "landers") are described in detail. The author also provides a balanced treatment of the missions' activities and experiments, and of course pays due attention to the individual astronauts themselves.

Mr. Mellberg, an A.L.P.O. member and observer, knows his way about the Moon and describes the terrain and geology of each of the landing sites. "Part Three: The New Moon" devotes its first 17 pages to a review of the scientific findings. Again, I found this section too brief, but several other books are available that do a good job of acquainting their readers with Apollo and post-Apollo lunar science (e.g., Don E. Wilhelms' *The Geologic History of the Moon* and *To a Rocky Moon*, or Paul Spudis' *The Once and Future Moon*). However, the Clementine Mission deserves more than a single sentence!

This book has several "frills" that help to make it well worth the purchase price. The most valuable of these are the over 100 illustrations, most of them well-reproduced black-and-white photographs. A photomap shows the Apollo landing sites (but curiously not those of the Rangers or Surveyors, or the Soviet landers). There are several appendices; one is a brief table of lunar statistics, and another presents data on the nine Apollo lunar missions. Lunar geologic history is competently summarized in Appendix C (although not everyone would agree that the Procellarum Basin exists). The last portion of the book includes a list of frequently-used acronyms (a hallmark of NASA programs!), a glossary, a decent bibliography, and an index.

Moon Missions is a valuable and interesting book for any student of the Moon. It is well-written and sets the Apollo era in scientific, historic, and political perspective. It would be more useful yet were the scientific results of the unmanned missions given more space. Nonetheless, this well-produced book is definitely worth having.

The 1981/82 and 1982/83 Eastern (Evening) Apparitions of Venus: Visual and Photographic Observations

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

Abstract

Visual and photographic observations of the planet Venus for the 1981/82 and 1982/83 Eastern (Evening) Apparitions are summarized, emphasizing the sources of data and instrumentation used. For both observing periods, there is a statistical analysis of the categories of features seen or suspected on the disk of Venus at visual wavelengths. A similar treatment is given to the cusps, cusp-caps, and cusp-bands, together with a discussion of the Ashen Light and other curious dark-hemisphere phenomena. Comparative studies refer to observers, instrumentation, visual and photographic data, simultaneous observations, and so forth. Figures accompany the report to illustrate the variable phenomena observed by A.L.P.O. Venus Section members.

Introduction

This report outlines the results of a fairly extensive analysis and evaluation of visual and photographic observations of the planet Venus throughout the 1981/82 and 1982/83 Eastern (Evening) Apparitions. The geocentric phenomena for the two apparitions are given in *Table 1* (below); times are in Universal Time (UT), while *k* is the phase (proportion of disk sunlit).

A total of 39 observations were collected for the 1981/82 Apparition, and a total of 207 reports for 1982/83. A histogram, shown in *Figure 1* (p. 81), gives the distribution of observations by month for the two apparitions covered by this report.

Observational coverage of Venus was quite poor in 1981/82, as revealed in Figure 1. The observational period ranged from 1981 Aug 23 through 1982 Jan 10, with maximum emphasis during 1981 November and December (82.1 percent of the total of 39 observations), when Venus was near greatest solar eastern elongation.

Table 1. Geocentric Phenomena of Venus (times in UT).

i. 1981/82 Eastern (Evening) Apparition.

Superior Conjunction	1981	Apr 07d 09h
First Observation (k = 0.793)		Aug 23d
Greatest Elongation East (47°)		Nov 11d 02h
Greatest Brilliancy (-4.4)		Dec 16d 19h
Last Observation (k = 0.043)	1982	Jan 10d
Inferior Conjunction		Jan 21d 10h

ii. 1982/83 Eastern (Evening) Apparition.

Superior Conjunction	1982	Nov 04d 02h
First Observation (k = 0.914)	1983	Feb 14d
Greatest Elongation East (45°)		Jun 16d 07h
Greatest Brilliancy (-4.2)		Jul 19d 15h
Last Observation (k = 0.016)		Aug 21d
Inferior Conjunction		Aug 25d 05h

Figure 1 indicates that the situation was much better in 1982/83 than in 1981/82, with keener observational coverage from 1983 Feb 14 through 1983 Aug 21. Maximum attention was given to Venus from 1983 May through July (73.4 percent of the 207 observations), centered on the dates of greatest eastern elongation and greatest brilliancy. Observational coverage began earlier in 1982/83 than in 1981/82, with a follow through up until inferior conjunction of Venus with the Sun.

Numerous drawings and a few photographs of Venus were submitted during each apparition, although the most useful data were accumulated for 1982/83. During the periods of maximum observational coverage in both apparitions there was an almost daily scrutiny of Venus, with instances of simultaneous observations, which proved to be of great value in the data sample. However, ultraviolet photographs of Venus were completely absent among the submitted material during either period, and an observational program of consistent ultraviolet photography, together with similar work at visual wavelengths of light would be of tremendous comparative use in future apparitions.

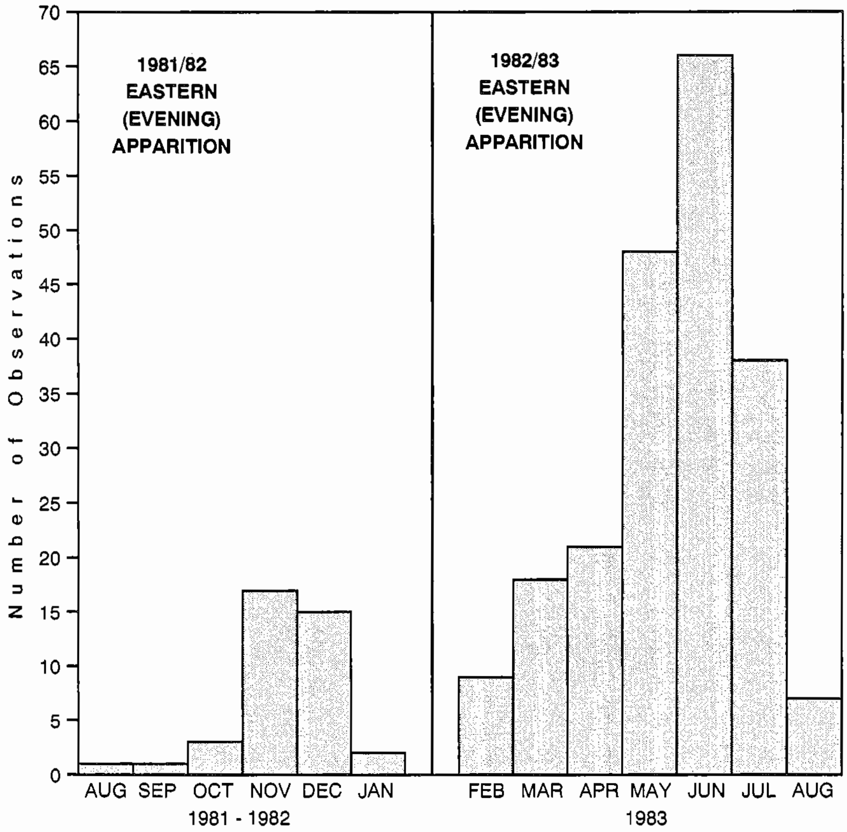

Figure 1. Distribution of A.L.P.O. Venus Observations by Month.

The 25 individuals listed in *Table 2* (p. 82) submitted observations of the planet Venus during either or both of the two apparitions covered in this report.

We sincerely thank each of the above-mentioned friends and colleagues for their continued systematic, dedicated participation in the programs of the A.L.P.O. Venus Section.

VISUAL OBSERVATIONS OF APPARENT SURFACE DETAILS

As pointed out in earlier reports on apparitions of Venus in this Journal, conventional methods and techniques of making visual studies of the somewhat vague, elusive "markings" on the apparent surface of Venus have been outlined in various Venus Section publications. Study of these sources is strongly suggested, as well as of previous Venus reports, for those unfamiliar with nomenclature utilized or basic observational methods. [Benton 1973, 1982]

The present report is based upon descriptive notes, accompanying drawings and sketches, and photographs taken at visual wavelengths. A few of the representative drawings and photographs are reproduced here as illustrations for both apparitions (*Figures 2-20*, pp. 86-89).

Evaluation of visual and photographic data for 1981/82 and 1982/83 revealed that nearly all categories of dusky markings and bright atmospheric phenomena on Venus, as covered in depth in the literature cited above, were represented. A quantitative treatment of the material, following the same procedure as in earlier Venus apparition reports, appears in *Table 3* (p. 83). An effort has been made therein to show the percentages of the 39 observations in 1981-82 and the 207 observations in 1982/83 which comprise specific categories.

Undoubtedly, there is inherent in the qualitative data a certain level of subjectivity, but some possible tentative conclusions may be drawn from the quantitative results in Table 3, as follows:

Table 2. A.L.P.O. Venus Observers, 1981/82 and 1982/83 Eastern (Evening) Apparitions.

Observer and Location	Number of Observations		Telescope(s)
	1981/82	1982/83	
Auclair, R.; Cornwell, Ontario	---	1	15-cm (6-in) NEW
Benton, Julius L.; New Hope, PA	2	22	10-cm (4-in) RR, 15-cm (6-in) RR
Carpentier, D.; St. Hubert, Quebec, Canada	—	1	20-cm (8-in) NEW
Costo, E.; Salina, UT	—	1	20-cm (8-in) NEW
Evans, Charles L.; Hampton, VA	—	21	25-cm (10-in) CAS
Gelinas, H.; Cornwall, Ontario, Canada	—	1	15-cm (6-in) NEW
Gelinas, M.; St. Hubert, Quebec, Canada	—	8	20-cm (8-in) S-C
Graham, Francis G.; East Pittsburgh, PA	—	1	33-cm (13-in) RR
Haas, Walter H.; Las Cruces, NM	—	12	31-cm (12.5-in) NEW
Heath, Alan W.; Nottingham, England	9	11	30-cm (12-in) NEW
Henderson, John J.; Vicksburg, MS	1	—	20-cm (8-in) S-C
Hollis, A.J.; Cuddington, England	4	—	30-cm (12-in) NEW
Lalande, M.; Cornwall, Ontario, Canada	—	1	20-cm (8-in) NEW
Leboeuf, G.; Laval, Quebec, Canada	—	1	6-cm (2.4-in) RR
Lohvinenko, W.; Winnipeg, Manitoba, Canada	—	1	20-cm (8-in) NEW
Louderback, Daniel; South Bend, WA	—	4	8-cm (3.1-in) RR
McNamara, Geoff; Sutherland, N.S.W. Australia	7	—	20-cm (8-in) S-C
Maksymowicz, M.; Moisson, France	1	49	7.5-cm (3-in) RR, 11.2-cm (4.4-in) NEW, 20-cm (8-in) NEW
Malichi, 0.; Missisauga, Ontario, Canada	—	1	20-cm (8-in)NEW
Maxson, Paul; Phoenix, AZ	—	1	20-cm (8-in) S-C
Nowak, Gary; S. Burlington, VT	—	4	7.5-cm (3-in) RR, 20-cm (8-in) S-C, 31-cm (12.5-in) NEW
Robotham, Robert; Springfield, Ontario, Canada	3	15	8.3-cm (3.3-in) RR, 15-cm (6-in) NEW, 31-cm (12.5-in) NEW
Scott, Pete; Indiana, PA	—	10	20-cm (8-in) S-C
Smith, Michael B.; Alamogordo, NM	12	—	5-cm (2-in) RR, 8.3-cm (3.3-in) RR, 10.6-cm (4.2-in) NEW
Spain, Don; Pairdale, NY	—	41	5-cm (2-in) RR, 9-cm (3.5-in) MAK
Total Observations	**39**	**207**	

Telescope Types: CAS = Cassegrain, MAK = Maksutov, NEW = Newtonian, RR = Refractor, S-C = Schmidt-Cassegrain.

About half the drawings and visual observations of Venus, together with the photographs at visual wavelengths, gathered for each apparition depicted Venus as completely without shadings or markings in any categories cited. It is well established that the markings on Venus' apparent surface are highly elusive, both to the novice and to the experienced observer, and it would be helpful to have photographs taken at ultraviolet wavelengths to bring out dusky shadings. Note that markings revealed in the ultraviolet region of the spectrum differ somewhat from those occasionally seen at visual wavelengths, particularly with respect to the radial dusky patterns.

Terminator shading was commonly reported during both apparitions, especially in 1981/82. As in past apparitions, the gradation toward a lighter tone (i.e., an intensity of 10) for the terminator shading was noticed as one proceeded from the region of the terminator toward the illuminated limb of Venus, where in some cases the gradation terminated in the bright limb band. The shading usually extended from one cusp region to the other, and the feature was most common in both apparitions from around the time of dichotomy toward the crescentic phases. No photographs showed appreciable terminator shading in either 1981/82 or 1982/83.

In 1981/82, the majority of the dusky markings were in the category of "Irregular Dusky Markings," with a substantial number also classed as "Amorphous Dusky Markings" (12.8 percent and 7.7 percent, respectively, in Table 3). In the 1982/83 period, the majority of dusky features were classified as "Amorphous Dusky Markings," followed by "Irregular Dusky Markings" (41.1 percent and 37.7 percent, respectively, in Table 3). There happened to be a greater number of "Banded Dusky Markings" and "Radial Dusky Markings" depicted in 1982/83 than in 1981/82.

Excluding the cusp regions, bright regions or mottlings were commonly reported in 1982/83, with a mean intensity of 8.8, but in 1981/82 they were nearly lacking. Note also that the higher incidence of "Banded Dusky Markings" and "Radial

Table 3. Frequency of Occurrence of Types of Markings on the Apparent Surface of Venus During the 1981/82 and 1982/83 Apparitions

Apparent Surface Marking Categories	Percentage of Total Observations 1981/82 (Total = 39)	1982/83 (Total = 207)
Banded Dusky Markings	2.6%	19.8%
Radial Dusky Markings	2.6	8.2
Irregular Dusky Markings	12.8	37.7
Amorphous Dusky Markings	7.7	41.1
Terminator Shading	41.0	33.8
No Markings Depicted	53.9	55.6
Bright Spots or Regions (Excl. cusps)	2.6	19.3

Notes:

1. Assuming that the bright illuminated hemisphere of Venus (all areas devoid of any shadings or obvious markings) was typically assigned a relative numerical intensity of 8.7 in 1981/82 and 8,5 in 1982/83 (the scale of intensity is the standard A.L.P.O. System where 0.0 is totally black shadow and 10.0 is the most brilliant striking features), the mean assigned intensity for the dusky shadings (the first five items listed above) in integrated light was about 8.1±0.3 in 1981/82 and 7.9±0.4 in 1982/83. The last category had an assigned intensity value of 8.8 in 1982/83, with few reported instances of bright spots or regions (exclusive of the cusps) in 1981/82.

2. The scale of conspicuousness was not effectively and consistently utilized in either apparition to provide reliable and comparative figures; even so, it was clear from written notes that the dusky features were quite vague and poorly contrasted with the rest of Venus' disc. The bright areas (exclusive of the cusps) were more definite when seen, particularly so in 1982/83.

3. Seeing conditions, evaluated on the A.L.P.O. scale of 0-10 (where 0.0 denotes the worst possible seeing and 10.0 perfect conditions), had a mean of 5.5 in 1981/82 and 4.5 in 1982/83, or usually mediocre. In the 1981/82 Apparition, seeing averaged better than in 1982/83, but the number of observations in the former apparition was small, and most of the observations for 1981/82 were made at locations favored by usually good seeing conditions. It is important to take into account the variable number of observations from one apparition to the next, and the variation from location to location, from instrument to instrument, and so on, recognizing the subjectivity of the seeing scale employed.

4. Transparency conditions, normally the faintest star seen by the unaided eye on a clear, dark night in the region of the planet (reference objects usually noted), were difficult to appraise owing to the fact that Venus was always observed against a twilight or daylight sky. In any case, most observers were able to get some idea of transparency by carefully evaluating sky clarity in the region of Venus at the time of observation.

Dusky Markings" in 1982/83 makes it difficult to interpret the nature of, let alone categorize, the low-contrast features on Venus during the period. No photographs showed the alleged bright regions or spots.

Color-filter observations with Wratten W21 (orange), W15 (yellow), W25 (red), and W47 (dark-blue) Filters sometimes enhanced bright features and dusky markings, although the colorimetric significance of such impressions were largely indeterminate. Clearly, a systematic employment of filters of known wavelength characteristics, together with observations in integrated light (no filter), can be useful. In addition, studies with variable-density polarizers are important.

The accompanying drawings and photographs will assist the reader in appreciation of the controversial and elusive nature of the features discussed in this section.

CUSPS, CUSP-CAPS, AND CUSP-BANDS

The most contrasting and conspicuous features on the planet Venus are seen at or near the cusps of the planet, usually when the phase of the planet lies between k = 0.8 and k = 0.1. These cusp-caps appear occasionally on Venus, sometimes bounded by darkish, often diffuse cusp-bands.

Table 4 (p. 84) presents cusp-cap and cusp-band statistics for the 1981/82 and 1982/83 Apparitions, from which several conclusions can be drawn.

During 1981/82, when the Southern and Northern Cusp-Caps of Venus were reported they were always seen together, never alone, although it was the usual rule that neither cusp-cap was visible throughout the apparition (see Table 4 for the percentages of visibility). In terms of size, the Southern and Northern Cusp-Caps were most often of equal dimensions, but on occasions the Northern Cusp-Cap was larger than its southern counterpart; the Southern Cusp-Cap was seldom larger than the Northern Cusp-Cap in 1981/82. With respect to brightness in 1981/82, the two cusp-caps were sometimes of the same intensity; and when inequalities were detected in the brightness of the cusp-caps, the southern one was slightly the brighter.

Table 4. Cusp-Cap and Cusp-Band Statistics: 1981/82 and 1982/83 Eastern (Evening) Apparitions of Venus

	Percentage of Total Observations	
Cusp-Cap/Band Category	1981/82 (Total = 39)	1982/83 (Total = 207)
South Cusp-Cap Alone Visible	0.0%	1-9%
Both Cusp-Caps Visible	33.3	36.7
North Cusp-Cap Alone Visible	0.0	2.4
Neither Cusp-Cap Visible	66.7	59.0
South Cusp-Cap the Larger in Size	2.6	5.8
Both Cusp-Caps the Same Size	38.5	23.2
North Cusp-Cap the Larger in Size	17.9	10.6
South Cusp-Cap the Brighter	23.1	14.0
Cusp-Caps of Equal Brightness	17.9	13.0
North Cusp-Cap the Brighter	20 5	13.5
South Cusp-Band Alone Visible	0.0	2.9
Both Cusp-Bands Visible	5.1	17.9
North Cusp-Band Alone Visible	0.0	2.4
Neither Cusp-Band Visible	94.9	76.8

Notes:

1. Assuming the same numerical intensities for the bright illuminated hemisphere of Venus as in Table 3, the mean numerical relative intensity of the cusp-caps was about 9.6 in 1981/82 and 9.5 in 1982-83. The values for the cusp-bands were 7.8 in 1981/82 and 8.0 in1982/83.

2. Seeing and. transparency conditions in both apparitions are given in Notes 3-4 in Table 3.

3. The sums of the percentages are not necessarily 100 percent for the size and brightness of the cusp-caps; when only one cusp-cap was seen, it was not possible to make comparisons of size and brightness.

In 1982/83, the cusp-caps in both hemispheres of Venus were also occasionally reported; and when visible, the cusp-caps were seen simultaneously more often than they were singularly. The most common situation in 1982/83 was as in 1981/82; namely, neither cusp-cap was visible a little more than half of the time. Under most conditions, the cusp-caps were of equal size. When their sizes differed, it was the Northern Cusp-Cap that was the more likely to be the larger of the two; nevertheless, there were instances when the Southern Cusp-Cap was larger than the Northern. In addition, in 1982/83 the cusp-caps showed equal brightness with about the same frequency that they were reported to differ.

With respect to the cusp-bands seen bordering the cusp-caps, Table 4 shows that their visibility was fairly uncommon, particularly so in the 1981/82 Apparition. In both apparitions, when reported, it was most frequently the case that both cusp-bands were visible simultaneously.

EXTENSION OF THE CUSPS

Slight extensions of the cusps beyond the theoretical 180° along the limb of Venus were recorded during 1981/82 and 1982/83. The cusp extensions were seldom clearly depicted on drawings and no photographs revealed them. Near the close of the apparitions several observers noticed that a "twilight arc or halo" encircled around all of part of the dark hemisphere of Venus, and there were a few notes calling attention to an asymmetric distribution of light around the periphery of the dark hemisphere.

BRIGHT LIMB BAND

During 1981/82, 38.5 percent of the submitted observations showed a bright limb band on Venus' disk opposite the terminator; in 1982/83, 27.1 percent of the observations revealed a conspicuous limb band. The bright limb band was most often reported as extending from cusp to cusp throughout both apparitions, and the mean numerical relative intensity of the feature was 9.1 in 1981/82 and 9.0 in 1982/83.

TERMINATOR IRREGULARITIES

The terminator of Venus, the geometric curve separating the illuminated and dark hemispheres of the planet, occasionally was deformed in each apparition. During 1981/82, 10.3 percent of the submitted observations revealed terminator irregularities; in 1982/83, only 3.4 percent of the observations noted deformities along the otherwise-regular boundary. Amorphous and irregular dusky features, and to a lesser extent, banded and radial dusky markings, showed interaction with the terminator shading and possible reported irregularities along the otherwise geometric feature in both apparitions.

The Ashen Light and Other Dark-Hemisphere Phenomena

There were no instances in 1981/82 and 1982/83 of visible or suspected dark-side phenomena manifest as illumination on Venus. In each period, however, observers recorded an impression that the dark hemisphere was darker than the surrounding background sky, a conclusion reached by observers using both small and large apertures. The sky then was usually brightly illuminated, the observations being made in twilight or daylight.

Estimates of Phase and Dichotomy

The "Schroeter Effect" on Venus, a discrepancy noted between the predicted and observed dates of dichotomy or half-phase, was reported in 1981/82 and 1982/83. The predicted dates of dichotomy (k = 0.500 and i = 90°, where i is the phase angle between the Sun and Earth as seen from Venus), calculated by the author from appropriate ephemerides, together with the observed dates of dichotomy and derived discrepancies, are presented in *Table 5* (below).

Table 5. Theoretical and Observed Dichotomy of Venus, with Discrepancies.

	1981/82 Eastern (Evening) Appar.	1982/83 Eastern (Evening) Appar.
Predicted (P)		
Date (UT):	1981 Nov 10.31	1983 Jun 15.46
Observed (O)		
Date (UT):	1981 Nov 02.02	1983 Jun 10.03
Phase Angle (i)*:	85°.4	86°.6
Phase (k)*:	0.540	0.530
Discrepancy (O - P)		
Date:	8.29d	5 .43d
Phase Angle:	+4°.6	+3°.4
Phase:	-0.040	-0.030

*Values as predicted for date of observed dichotomy.

Conclusions

Limited activity was recorded on Venus during both of the apparitions covered by this report, although the number of observations and observers varied considerably between apparitions. We hope that more individuals will be inspired to participate in the observing efforts of the Venus Section, and the writer cordially invites readers to inquire about membership. Instrumentation for carrying out useful work on Venus ranges from 6.0-cm (2.4-in) aperture for refractors and 15.0-cm (6-in) aperture for reflectors upward, and a great deal can be derived from systematic observations pursued in cooperation with organized efforts of the Venus Section. Ultraviolet photographs of Venus are especially sought, and experienced observers are urged to submit such data. Most of the observing programs of the Venus Section are described in the appropriate leaflets issued by the author upon request.

Finally, the author once again to expresses his gratitude to participating observers for their support and their data during the apparitions covered by this paper. Any questions whatsoever pertaining to observing Venus should be addressed to the A.L.P.O. Venus Coordinator (address on p. 96), who will gladly reply and welcomes potential associates to our programs.

References

Benton, Julius L., Jr. (1973). *An Introduction to Observing the Planet Venus.* Savannah: Review Publishing.

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Meeus, Jean (1980). "Theoretical Dichotomy of Venus, 1960 - 2000," *J.B.A.A., 90* (5): 442-443.

United States. Naval Observatory (1980). *The Astronomical Almanac, 1981.* Washington: U.S. Government Printing Office.

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________ (1982). *The Astronomical Almanac, 1983.* Washington: U S Government Printing Office.

Notes by Editor: The above report was submitted by Dr. Benton in 1984, but was not published at that time. Because Section reports, however overdue in publication, are irreplacable observational records, we are publishing the report at this time. For more recent references pertaining to Venus observation, see the References section in Dr. Benton's 1995/96 Venus report in this issue (p. 63).

The drawings and photographs that follow (Figures 2-20) have had their contrast enhanced and are oriented with the South Pole of Venus at top. Any that were originally drawn reversed have been rectified, as noted in their captions. Unless otherwise stated, Seeing is in the Standard A.L.P.O. Scale (0 = worst to 10 = perfect) and Transparency is the limiting visual stellar magnitude in the vicinity of Venus. Ephemeris data are from *The Astronomical Almanac* for the appropriate years.

1981/1982 Apparition

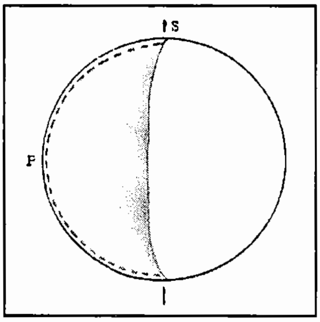
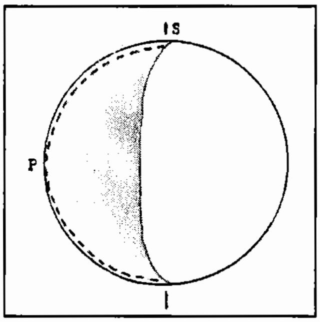


Figure 2. Drawing of Venus by Michael B. Smith. 1981 Nov 22, 22h45m-22h55m UT. 8.2-cm (3.2-in) refractor, 126X, light-orange filter. Seeing = 5, Transparency = 3 (0 = worst, 5 = perfect scale). Phase = 0.462, Diameter = 29".1.

Figure 3. Drawing of Venus by Michael B. Smith. 1981 Dec 06, 20h40m-20h55m UT. 10.6-cm (4.2-in) Newtonian, 99X and 115X, apodizing screen. Seeing = 7, Transparency = 4 (0 = worst, 5 = perfect scale). Phase = 0.339, Diameter = 35".4.



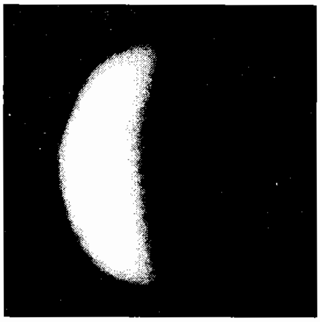
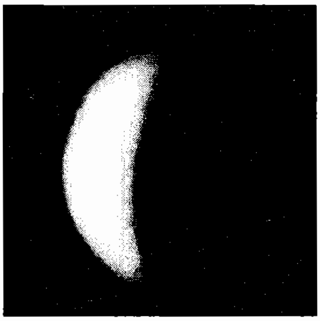


Figure 4. Photograph of Venus by Alan W. Heath. 1981 Dec 08, time not given. 30-cm (12-in) Newtonian, 318X. 1/25-sec exposure on HP5 Film. Phase = 0.330, Diameter = 36".0.

Figure 5. Photograph of Venus by Alan W. Heath. 1981 Dec 12, 16h45m UT. 30-cm (12-in) Newtonian, 318X. 1/25-sec exposure on HP5 Film. Phase = 0.294, Diameter = 38".7.



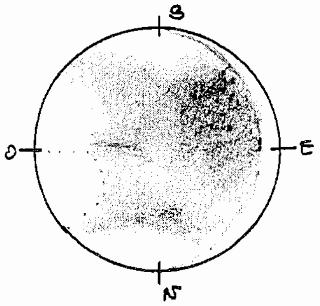
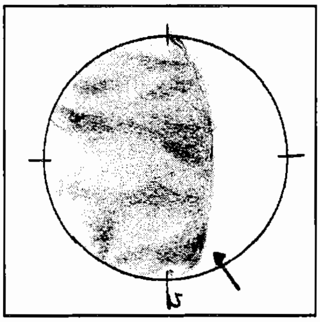


Figure 6. Drawing of Venus by M. Maksymowicz. 1983 Feb 16, 17h30m-17h35m UT. 7.5-cm (3.0-in) refractor, 171×, integrated light (no filter). Seeing = 2-3, Transparency = 8 (0 = worst, 10 = perfect scale). Phase = 0.909, Diameter = 11".3.

Figure 7. Drawing of Venus by M. Maksymowicz. 1983 May 08, 20h00m-20h15m UT. 11.2-cm (4.4-in) Newtonian, 150×, W47 (dark blue) Filter. Seeing = 2-3-4, Transparency = 10 (0 = worst, 10 = perfect scale). Phase = 0.679, Diameter = 16".6. Arrow indicates phase anomaly.



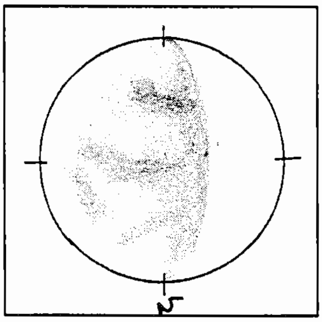
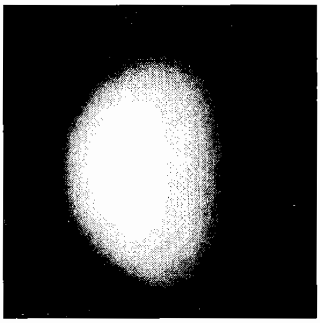


Figure 8. Drawing of Venus by M. Maksymowicz. 1983 May 09, 20h25m-20h40m UT. 11.2-cm (4.4-in) Newtonian, 150×, YG (W8, light yellow) Filter. Seeing = 3, Transparency = 3-4 (0 = worst, 10 = perfect scale). Phase = 0.675, Diameter = 16".8.

Figure 9. Photograph of Venus by Alan W. Heath. 1983 May 14, time not given. 30-cm (12-in) Newtonian. Phase = 0.657, Diameter = 17".3.



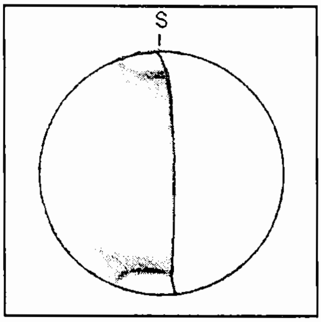


Figure 10. Drawing of Venus by Rob Robotham. 1983 May 22, 01h05m-01h40m UT. 15-cm (6-in) Newtonian, 135×, integrated light (no filter). Seeing = 3-6, Transparency = 4-5. Phase = 0.623, Diameter = 18".5.

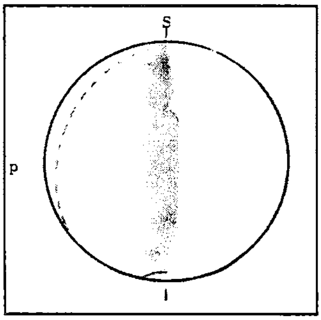


Figure 11. Drawing of Venus by P. Scott. 1983 MAY 24, 15h47m-16h25m UT. 20-cm (8-in) Schmidt-Cassegrain, 194X, W47 (dark blue) and W80A (blue) Filters. Seeing = 4, Transparency = 5. Phase = 0.610, Diameter = 18".9.

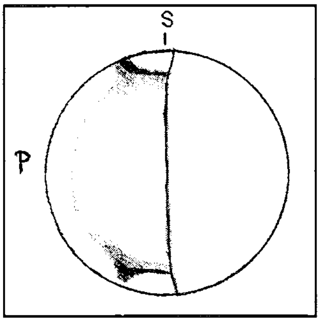


Figure 12. Drawing of Venus by Rob Robotham. 1983 JUN 03, 01h38m-02h09m UT. 8.3-cm (3.3-in) refractor, 115X, integrated light (no filter). Seeing = 5-7, Transparency = 5. Phase = 0.566, Diameter = 20".7.

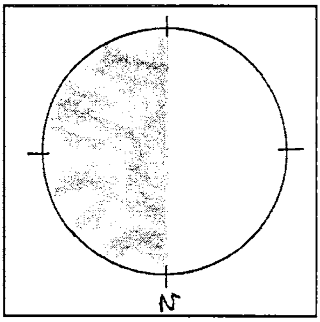


Figure 13. Drawing of Venus by M. Maksymowicz. 1983 JUN 13, 17h35m-17h40m UT. 11.2-cm (4.4-in) Newtonian, 150X and 300X, W21 (orange) Filter. Seeing = 3-6, Transparency = 9 (0 = worst, 10 = perfect scale). Phase = 0.510, Diameter = 23".1.

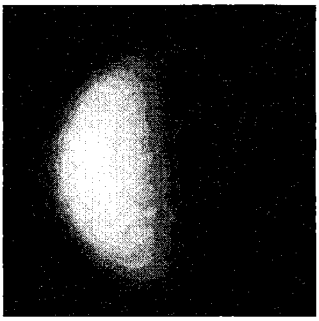
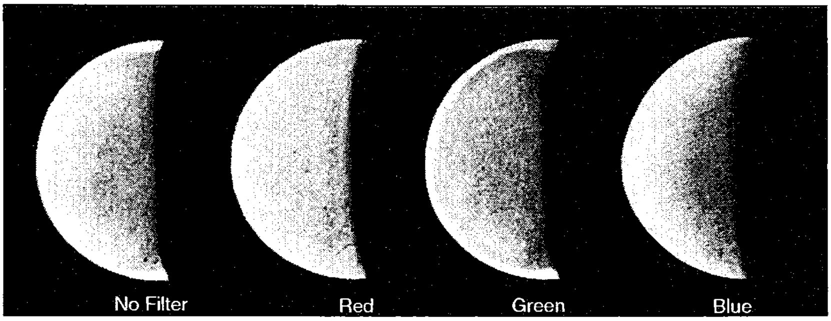


Figure 15. Photograph of Venus by M. Maksymowicz. 1983 JUN 14, 19h50m UT. 11.2-cm (4.4-in) Newtonian, 9-mm eyepiece projection with 2X Barlow; 1/8-sec exposure at f/105 on Tri-X Film. W58 (green) Filter. Seeing = 3, Transparency = 10. Phase = 0.504, Diameter = 23".4.

Figure 16. Four drawings of Venus by Alan W. Heath. 1983 JUN 14, 20h05m UT. 30-cm (12-in) Newtonian, 318X, filters as indicated. Antoniadi Seeing = 3 (fair). Phase = 0.498, Diameter = 23".7.



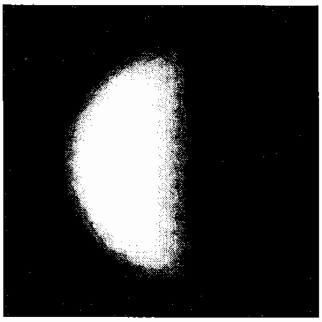
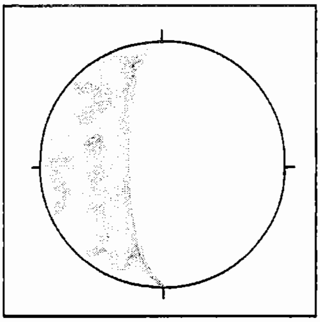


Figure 16. Photograph of Venus by Alan W. Heath. 1983 Jun 18, time not given. 30-cm (12-in) Newtonian, 318×. 1/25-sec exposure on Tri-X Film. Phase = 0.486, Diameter = 24".3.

Figure 17. Drawing of Venus by M. Maksymowicz. 1983 Jul 06, 19h20m-19h25m UT. 11.2-cm (4.4-in) Newtonian, 128×, W58 (green) Filter. Seeing = 3, Transparency = 7-8 (0 = worst, 10 = perfect scale). Phase = 0.352, Diameter = 31".9.



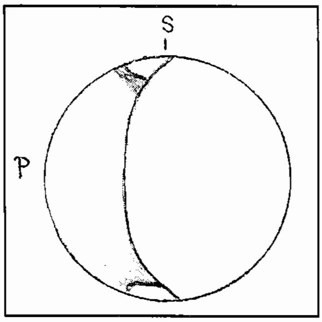
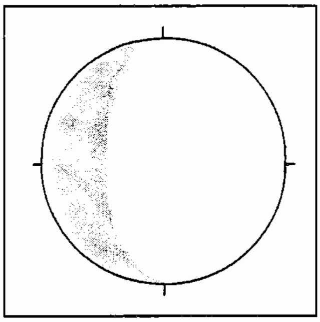


Figure 18. Drawing of Venus by Rob Robotham. 1983 Jul 11, 01h23m-01h55m UT. 15-cm (6-in) Newtonian, 135×, integrated light (no filter). Seeing = 4-7, Transparency = 5. Phase = 0.333, Diameter = 33".0.

Figure 19. Drawing of Venus by M. Maksymowicz. 1983 Jul 19, 16h33m-16h43m UT. 11.2-cm (4.4-in) Newtonian, 100×, W58 (green) Filter. Seeing = 2-3, Transparency = 9 (0 = worst, 10 = perfect scale). Phase = 0.265, Diameter = 37".7.



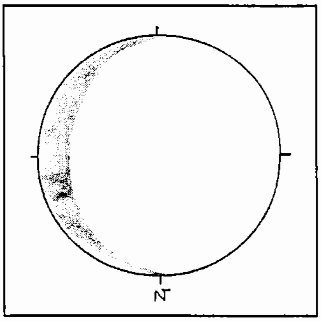


Figure 20. Drawing of Venus by M. Maksymowicz. 1983 Aug 03, 15h45m-15h48m UT. 11.2-cm (4.4-in) Newtonian, 100×, W21 (orange) Filter. Seeing = 2-3, Transparency = 9-10 (0 = worst, 10 = perfect scale). Phase = 0.133, Diameter = 47".9.

IS THE SEEING GETTING WORSE?

By: Walter H. Haas, A.L.P.O. Director Emeritus
and Cecil C. Post, A.L.P.O. Jupiter Section Member

The lunar and planetary observer must surely cooperate with his deep-sky colleague in the latter's ongoing struggle with light pollution. However, the growing artificial illumination of our nighttime skies is not really a major problem in studies of the surfaces of the Moon and the bright planets. It is more serious if we are doing photometry of faint planetary satellites, and it does not matter in the least if we are solar observers.

The lunar and planetary observer is, however, very much concerned with atmospheric steadiness, or seeing. The two authors have been wondering whether we are in a long-term trend toward worse seeing, and if so, what is the cause. They live and observe about 1.7 miles apart, as the crow would fly, and in 1998 very frequently compared their independent impressions of the seeing. They both used 20-cm and 32-cm Newtonian reflecting telescopes. On an admittedly subjective seeing scale of 0 (worst) to 10 (perfect) their visual estimates of the seeing agreed surprisingly well, probably on the average to within half a unit. [Note that this 0-10 scale is the Standard A.L.P.O. Seeing Scale. *Ed.*] They were observing chiefly Jupiter, occasionally Saturn, and rarely other objects.

In 1998 both these observers complained constantly of bad seeing. The average seeing was very probably between 2 and 3; they learned to be pleased with seeing 3, delighted with seeing 4, and ecstatic with very rare seeing 5. Many nights brought seeing 2 or 1, ruling out useful planetary observations.

In what must be a strong impression from memory rather than an actual comparison of recorded numbers, author Haas thinks that the seeing in 1998 averaged the worst he has experienced in more than 60 years of lunar and planetary observing. Author Post considers the seeing worse in 1998 than in other recent years.

It would be helpful to learn the experiences and opinions of others who were active observers in 1998. Are we dealing with a local phenomenon of limited interest: If not, what was the cause of such bad seeing in 1998? El Niño? Was the jet stream more frequently over Las Cruces? Has the growth of the city, and the resulting presence of more radiating houses affected atmospheric steadiness? Or do we just have a random statistical event of little consequence? Since the seeing was much the same for the two observers separated by 1.7 miles, the main atmospheric disturbances must presumably have been high above the ground.

The informed reader can certainly think of many effects on the seeing not mentioned above, and of possible correlation of seeing with various parameters. The authors would welcome comments. Their e-mail addresses are:

haasw@zianet.com
cpost@nmsu.edu

Fifty Years Ago: A Selection from The Strolling Astronomer,
April 1, 1949 (Vol. 3, No. 4), "Observations and Comments," p. 8.

Elsewhere in this issue we have spoken of the value of systematic searches of the moon for possible lunar meteors and/or meteoric impact-flares. We were pleased to learn some months ago that the Glendale, Calif., amateur astronomers were doing group-work on this project. They are the only organization so engaged, to our knowledge. Their results have been indicated by Mr. J.G. Moyen of Hermosa Beach, Calif., in a letter dated February 7, 1949. We quote part of it:

"To date our members have reported two cases of momentary flashes of light on the dim portion of the moon's surface, which probably were evidences of meteors, at the following Pacific Standard Times:

"August 8, 1948. 21 hrs., 35 mins.
"December 6, 1948. 18 hrs., 44 mins.

"We had hoped to have 2 or more observers searching simultaneously so that reports such as these would be substantiated or authenticated should 2 or more observers report witnessing the phenomena at the same time. Unfortunately for each of the cases reported above only one observer happened to be watching, or at least only one reported seeing a flash at that time. In each case the flash was described as about 1/3 of the way from the edge and of magnitude 8 or 9. The telescope used in each case was a 10-inch of good quality. This is the largest reflector owned by any member, and the largest refractor is a 6-inch."

A.L.P.O. ANNOUNCEMENTS

SECTION CHANGES

Mike Reynolds New Acting Eclipse Coordinator.—Francis Graham, Assistant Coordinator of Eclipses in the Solar Section and Assistant Coordinator of Eclipses and Photometry in the Lunar Section, has resigned from both posts due to time pressures. We thank Dr. Graham for serving in these two positions for some 13 years.

Dr. Graham's two previous functions have been converted into that of a single Eclipse Coordinator, responsible for both solar and lunar eclipses, and we are happy to announce the appointment of **Dr. Michael D. Reynolds** as the Acting Coordinator of the Eclipse Section. Dr. Reynolds is the Executive Director of the Chabot Observatory and Science Center, is a longtime eclipse chaser, and, with Richard Sweetsir, has authored the book *Observe Eclipses*. Dr. Reynolds' address is: Dr. Michael D. Reynolds, Chabot Observatory and Science Center, 10902 Skyline Boulevard, Oakland, CA 94619.

New Mars Section Archivist.—Mr. **Robert A. Itzenthaler** has been appointed as an Acting Assistant Coordinator of the Mars Section, serving as the Section's Archivist. His address is: Robert A. Itzenthaler, 3808 W. Irving Park Road, Chicago, IL 60630-3140 (E-mail: ritzenthaler@worldnet.att.net).

Three New Acting Assistant Jupiter Coordinators.—The following three persons have been appointed to the Jupiter Section as Acting Assistant Coordinators: **Craig MacDougal**, 2602 E 98th Ave., Tampa, FL 33612 (E-mail: macdouc@prodigy.net); **Damian Peach**, 237 Hillington Square, Greyfriars House, King's Lynn, Norfolk PE30 5HX, United Kingdom (E-mail: damian.peach@virgin.net); and Professor **Agustin Sanchez-Lavega**, Departmento Fisica Aplicada I, E.T.S. Ingenieros, Universidad del Pais Vasco, Bilbao, Spain (E-mail: wupsalaa@bicc00.bi.ehu.es). Mr. MacDougal will help with the publishing of past apparition reports and writing the Jupiter Section's newsletter. Mr. Peach will receive all CCD images, and will organize and archive them, as well as making longitude measurements from the images. Professor Sanchez-Lavega will serve as Scientific Advisor.

Staff Address Changes and Corrections.—The e-mail address of Acting Assistant Solar Coordinator **Jeff Medkeff** was previously listed incorrectly and is actually **medkeff@c2i2.com** ; also, Mr. Medkeff's postal address has changed and is now: **6081 S. Cavalry Lane, Hereford, AZ 85615**.

Julius L. Benton, Jr. A.L.P.O. Distributing Editor and Lunar, Saturn, and Venus Coordinator, has changed his e-mail address to **jlbaina@aol.com** .

OTHER A.L.P.O. NEWS

Generous Gift from Jim Phillips, M.D.—In our last previous issue we announced that the Wilbur Smith Foundation had presented the A.L.P.O. with a check for $3000. We need here to state that the actual contribution was by Dr. Jim Phillips, made through the Foundation. We apologize that Dr. Phillips was not named in our previous announcement; he has made similar generous gifts to our organization in past years. This gift was added to the A.L.P.O. Endowment Fund, and we here remind our readers that this Fund allows members to make tax-deductible gifts to the A.L.P.O. with the ultimate goal of purchasing or leasing a permanent organizational headquarters with paid staff.

Mercury Transit Observer's Guide.—The *Observer's Guide to the Transit of Mercury, 1999 Nov 15* is available from the A.L.P.O. Mercury/Venus Transit Coordinator, John E. Westfall, P.O. Box 16131, San Francisco, CA 94116 U.S.A. The price, including first-class mailing, is $4.00 for readers in the United States, Canada, and Mexico, and $7.00 for those in other countries. (Note that the transit will be visible from most of the Americas, the Pacific Basin, Australia, and New Zealand, but not from Europe, Africa, or most of Asia. An article on observing this event should appear in our next issue.) The Coordinator will also compute your local circumstances (UT, Position Angle, and Solar Altitude for each of the four contacts and for mid-transit) if you supply a stamped self-addressed envelope along with your latitude, longitude, and approximate elevation above sea level.

OTHER AMATEUR AND PROFESSIONAL ANNOUNCEMENTS

Year 2000 Peach State Star Gaze to Host Antonin Rükl.—The Atlanta Astronomy Club is proud to announce that Antonin Rükl, author of the widely-acclaimed and best-selling book *Atlas of the Moon*, will be the featured speaker of the Year 2000 Peach State Star Gaze (PSSG). The event will open Thursday afternoon, April 6, and officially close at noon, Sunday, April 9.

To quote from the dust jacket of *Atlas of the Moon* (available in the United States through Kalmbach Publishing), Mr. Rükl was born in Caslav, Czechoslovakia, in 1932. "His keen interest in astronomy began as a student hobby. He joined the Czech Technical University as a staff member in 1960 and is now director of the Prague Planetarium." He will be retiring later this year.

Mr. Rükl is a skilled cartographer and selenographer— as any reader of his *Atlas of the Moon* can attest. This book is cited regularly by expert lunar observers when detailing their observations. It is a wealth of knowledge with various tables and charts. The detailed drawings of the Moon are accompanied by full-page listings that provide data about the size and namesake of craters and other features on the facing page.

In recognition of Mr. Rükl's appearance, the Year 2000 PSSG will be held during a young Moon weekend and include various lunar observing talks and workshops. The Moon will be a 2.6 day-old waxing crescent on the first day of the event and will set at 22:18 Eastern Time (10:18 P.M.). This will allow for lunar observing the first part of each evening before turning the event over to the "deep sky" crowd for the remainder of each night.

Presentation and workshop topics being considered include the mapping of the Moon (i.e., its history and cartographic background), IAU nomenclature rules, large projects and contemporary methods using space-probe imagery. Also, possible topics are his personal work on the mapping of the Moon, using the astronomical almanac, computer programs, or both for preparing the observation and lunar data useful for an observer (illumination, rotation, libration of the Moon, colongitude, and so forth).

Besides the general amateur astronomical community, especially invited are members of the Association of Lunar and Planetary Observers (A.L.P.O.), the American Lunar Society (ALS), The Planetary Society and online amateur astronomy discussion groups, such as the Shallow-Sky listserve, that are geared primarily towards solar-system observing.

The PSSG has drawn some of the biggest names in amateur astronomy to Georgia each spring since the event was founded in 1994, including Winter Star Party founder and Newtonian telescope collimation expert Tippy D'Auria, author and astrophotography expert Michael Covington (who lives and teaches at the University of Georgia in Athens, a relatively short drive from the PSSG site), noted astrophotographer Donald C. Parker, and many, many more.

The PSSG is held each year at Indian Springs State Park's Camp McIntosh, just south of Jackson, Georgia, about midway between Atlanta and Macon. The site offers moderately dark skies, bunkhouse and cabin lodging—each with heat, indoor flush toilets and hot water showers—and a dining hall for meals and formal presentations. Onsite lodging at Camp McIntosh is limited; additional lodging is available both at the park itself directly adjacent to Camp McIntosh and at a Days Inn in Jackson.

Preregistration will be required. Registration packets will be mailed towards the end of this year. To ensure that you are on the mailing list, contact:

Ken Poshedly
1741 Bruckner Court
Snellville, GA 30078-2784
(Phone) 770-979-9842 (after 5:30 p.m. Eastern Time weekdays; all weekends)
E-mail: ken.poshedly@mindspring.com

Alpha Space Fund.—The Alpha Space Fund (ASF), in Bath, Maine, is a new private funding organization and is collaborating with Dr. Alan Hale, co-discoverer of Comet

Hale-Bopp, to create a series of information centers to raise funds for a program to find and track potentially threatening near-earth asteroids. The funds will help support Hale's detection and tracking program at the Southwest Institute for Space Research in Cloudcroft, New Mexico. For more information, write the Alpha Space Fund, 24 Oak Grove Ave., Bath, Maine 04530, or address either of these web sites: (ASF) http://www.gwi.net/asf ; (Southwest Institute) http://www.swisr.org .

A.L.P.O. Convention

July 13-17, 1999: ALCON 99, The Astronomical League Convention. At Cheney, Washington (near Spokane), including the **A.L.P.O.**, IDA, IOTA, AAVSO, ASP, Planetary Society, and Pacific Science Center. A.L.P.O. activities include an all-day bus field trip on Thursday (July 15) through the nearby Channeled Scablands, caused by catastrophic flooding in the Pleistocene, the best earthly analog of the martian outwash channels. The A.L.P.O. Paper Session is on Friday morning (July 16), with the A.L.P.O. Board Meeting Friday afternoon. [Web: http://www.SpokaneAstronomical.org/astrocon99]

Roster of Upcoming Meetings

July 26-30, 1999: Asteroids, Comets, & Meteors Conference. At Cornell University, Ithaca, New York. [Beth E. Clark, ACM Conference, Space Sciences Building, Cornell University, Ithaca, NY 14853-6801. Telephone: 1-607-254-8895; FAX: 1-607-255-9002; E-mail: acm@scorpio.tn.cornell.edu ; Web: http://scorpio.tn.cornell.edu/ACM]

August 1-22, 1999: Thirty-fifth International Astronomical Youth Camp. In a castle near Vep (near Szombathley), Hungary. Includes observing the 1999 Aug 11 total solar eclipse. [IWA e.V., c/o Gwendolyn Meeus, Parkstraat 91m 3000 Leuven, Belgium. E-mail: info@iayc.org]

August 2-6, 1999: Sixth Bioastronomy Meeting: Bioastronomy 99: A New Era in Bioastronomy. At the Kohala Coast, Hawai'i. [Karen Meech, Institute for Astronomy, 2680 Woodlawn Dr., Honolulu, HI 96822. Telephone: 808-956-6828; FAX: 808-956-6828; E-mail: meech@ifa.hawaii.edu ; Web: http://www.ifa.hawaii.edu/~meech/bioast/]

August 4-8, 1999: Fourth Meeting of (not only) European Planetary and Cometary Observers (MEPCO'99). At the Black Sea coast near Varna, Bulgaria—one of the premier sites for observing the August 11 total solar eclipse, shortly after the meeting. [E-mail: astro@ms3.tu-varna.acad.bg (Veselka Radeva); Web: http://aibn91.astro.uni-bonn.de/~dfischer/mepco.html]

August 5-11, 1999: Eighteenth European Symposium on Occultation Projects (XVIII ESOP). Hosted by the International Occultation Timing Association–European Section (IOTA-ES) at Stuttgart, Germany, in the totality path of the 1999 AUG 11 solar eclipse. [Otto Farago, Schwaebische Sternwarte e.V., Organisation ESOP-99, Seestrasse 59/A, D 70173 Stuttgart, Germany. Telephone: +49 711 2260893; FAX: +49 711 2260895; E-mail: esop-99@sternwarte.de ; Web: http://sternwarte.de/esop-99]

August 7-13, 1999: Solar Eclipse August 1999 Symposium: Research Amateur Astronomy in the VLT Era. At Garching (near Munich), Germany, within the totality zone for the August 11 total solar eclipse. Sponsored by the Vereinigung der Sternfreunde, VdS and the European Southern Observatory. [Klaus Reinsch; E-mail: reinsch@neptun.uni-sw.gwdg.de ; Web: http://neptun.uni-sw.gwdg.de/sonne/eclipse99_conference.html]

August 18-20, 1999: The Solar System and Circumstellar Dust Disks: Prospects for SIRTF. Workshop at Dana Point, California (near San Juan Capistrano); limited attendance. [Web: http://www.sji.org]

August 22-26, 1999: The Origin of Elements in the Solar System: Implications of Post-1957 Observations. At the Annual Meeting of the American Chemical Society, New Orleans, Louisiana. [Oliver K. Manuel, Department of Chemistry, University of Missouri, Rolla, MO 65401. Telephone: 573-341-4420; FAX: 573-341-6033; E-mail: oess@umr.edu ; Web: http://www.umr.edu/~oess/]

August 22-27, 1999: Ninth Annual V.M. Goldschmidt Conference. An international geochemistry and cosmochemistry conference at Harvard University, Cambridge, Massachusetts. [Stein B. Jacobson, Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA 02138. Telephone: 617-495-5233; FAX: 617-496-4387; E-mail: goldschmidt@eps.harvard.edu ; Web: http://cass.jsc.nasa.gov/meetings/gold99/]

September 23-24, 1999: Pluto and Charon: Comparison and Evolution Over Time. This is the Lowell Observatory's 1999 Fall Workshop, and may possibly continue to September 25. [E-mail: grudy@lowell.edu ; Web: http://www.lowell.edu/workshop]

October 10-15, 1999: 31st Annual Meeting of the Division for Planetary Sciences, AAS. At the University of Padova, Abano Convention Center, Italy. [Millie Durbin, AAS Executive Office, 2000 Florida Ave., NW, Suite 400, Washington, DC 20009-1231. Telephone: 202-328-2010; FAX: 202-234-2560; E-mail: durbin@aas.org ; Web: http://www.aas.org.dps99]

THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

Founded by Walter Haas in 1947, the A.L.P.O. now has about 500 members. Our dues include a subscription to our quarterly Journal *(J.A.L.P.O.), The Strolling Astronomer,* and are $23.00 for one year ($40.00 for two years) for the United States, Canada, and Mexico; and $30.00 for one year ($54.00 for two years) for other countries. One-year Sustaining Memberships are $50.00; Sponsorships are $100.00. There is a 20-percent surcharge on all memberships obtained through subscription agencies or which require an invoice.

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

All payments should be in U.S. funds, drawn on a U.S. bank with a bank routing number, and payable to "A.L.P.O." All cash or check dues payments should be sent directly to: A.L.P.O. Membership Secretary, P.O. Box 171302, Memphis, TN 38187-1302. When writing to our staff, please provide stamped, self-addressed envelopes. Note that the A.L.P.O. maintains a World-Wide Web homepage at: http://www. lpl.arizona.edu/alpo/

Keeping Your Membership Current.—The top line of your *J.A.L.P.O.* mailing label gives the volume and issue number when your membership will expire (e.g., "41.2" means Vol. 41, No. 2). We also include a First Renewal Notice in that issue, and a Final Notice in the next one. Please let the Membership Secretary know if your address changes. Dues payments should be made directly to the Membership Secretary.

A.L.P.O. MONOGRAPH SERIES

A.L.P.O. monographs are publications that we believe will appeal to our members, but which are too lengthy for our Journal. Order them from our Editor (P.O. Box 16131, San Francisco, CA 94116 U.S.A.) for the prices indicated, which include postage; make checks to "A.L.P.O."

Monograph Number 1. ***Proceedings of the 43rd Convention of the Association of Lunar and Planetary Observers. Las Cruces, New Mexico, August 4-7, 1993.*** 77 pages. Price: $12.00 for the United States, Canada, and Mexico; $16.00 elsewhere.

Monograph Number 2. ***Proceedings of the 44th Convention of the Association of Lunar and Planetary Observers. Greenville, South Carolina, June 15-18, 1994.*** 52 pages. Price: $7.50 for the United States, Canada, and Mexico; $11.00 elsewhere.

Monograph Number 3. ***H.P. Wilkins 300-inch Moon Map.*** 3rd Edition (1951), reduced to 50 inches diameter; 25 sections, 4 special charts; also 14 selected areas at 219 inches to the lunar diameter. Price: $28.00 for the United States, Canada, and Mexico; $40.00 elsewhere.

Monograph Number 4. ***Proceedings of the 45th Convention of the Association of Lunar and Planetary Observers. Wichita, Kansas, August 1-5, 1995.*** 127 pages. Price: $17.00 for the United States, Canada, and Mexico; $26.00 elsewhere.

Monograph Number 5. ***Astronomical and Physical Observations of the Axis of Rotation and the Topography of the Planet Mars. First Memoir, 1877-1878.*** By Giovanni Virginio Schiaparelli, translated by William Sheehan. 59 pages. Price: $10.00 for the United States, Canada, and Mexico; $15.00 elsewhere.

Monograph Number 6. ***Proceedings of the 47th Convention of the Association of Lunar and Planetary Observers, Tucson, Arizona, October 19-21, 1996.*** 20 pages. Price $3.00 for the United States, Canada, and Mexico; $4.00 elsewhere.

Monograph Number 7. ***Proceedings of the 48th Convention of the Association of Lunar and Planetary Observers. Las Cruces, New Mexico, June 25-29, 1997.*** 76 pages. Price: $12.00 for the United States, Canada, and Mexico; $16.00 elsewhere.

Monograph Number 8. ***Proceedings of the 49th Convention of the Association of Lunar and Planetary Observers. Atlanta, Georgia, July 9-11, 1998.*** 122 pages. Price: $17.00 for the United States, Canada, and Mexico; $26.00 elsewhere.

OTHER PUBLICATIONS OF THE A.L.P.O.

(Checks must be in U.S. funds, payable to an American bank with bank routing number.)

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

An Introductory Bibliography for Solar System Observers. Free for a stamped, self-addressed envelope. A 4-page list of books and magazines about Solar System bodies and how to observe them. The current edition was updated in October, 1998.

Order from: A.L.P.O. Membership Secretary, P.O. Box 171302 Memphis, TN 38187-1302 U.S.A:

A.L.P.O. Membership Directory. $5.00 in North America; $6.00 elsewhere. Continuously updated list of members on 3.5-in MS-DOS diskette; either DBASE or ASCII format. Make payment to "A.L.P.O." Also available as an e-mail downloaded file, given the requester's e-mail address. Provided at the discretion of the Membership Secretary.

Order from: Walter H. Haas. 2225 Thomas Drive. Las Cruces. NM 88001. USA (E-mail: haasw@zianet.com):

Back issues of *The Strolling Astronomer (J.A.L.P.O.)*. Many of the back issues listed below are almost out of stock , and it is impossible to guarantee that they will remain available. Issues will be sold on a first-come, first-served basis. In this list, volume numbers are in italics, issue numbers are not, and years are given in parentheses. The price is $4.00 for each back issue; the current issue, the last one published, is $5.00. We are always glad to be able to furnish old issues to interested persons and can arrange discounts on orders of more than $30. Make payment to "Walter H. Haas."

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Current Issue [*41*, 2]; $5.00.

PUBLICATIONS OF THE SECTIONS OF THE A.L.P.O.

Order the following directly from the appropriate Section Coordinator;
use the address in the staff listing unless another address is given below.

Lunar and Planetary Training Program (Robertson): *The Novice Observers Handbook,* $10.00. An introductory text to the Training Program. Includes directions for recording lunar and planetary observations, useful exercises for determining observational parameters, and observing forms. To order, send a check or money order made out to "Timothy J. Robertson."

Lunar (Benton): (1) *The ALPO Lunar Section's Selected Areas Program (SAP),* $17.50. Includes a full set of observing forms for the assigned or chosen lunar area or feature, together with a copy of the *Lunar Selected Areas Program Manual.* (2) *Observing Forms Packet,* $10.00. Includes observing forms to replace the quantity provided in the Observing Kit above. Specify the Lunar Forms. (See note for Venus.)

Lunar (Dembowski): *The Lunar Observer,* a monthly newsletter, is available online at the A.L.P.O. Homepage, http://www.lpl.arizona.edu/alpo/ . Hard copies may be obtained by sending a set of self-addressed stamped envelopes to Bill Dembowski at his address in our staff listing.

Lunar (Jamieson): *Lunar Observer's Tool Kit,* consisting of a 3-1/2-in. MS/DOS diskette containing an observation-planning program and a lunar dome data base with built-in instructions. Price $25.00.

Venus (Benton): (1) *The ALPO Venus Observing Kit,* $17.50. Includes introductory description of A.L.P.O. Venus observing programs for beginners, a full set of observing forms, and a copy of *The Venus Handbook.* (2) *Observing Forms Packet,* $10.00. Includes observing forms to replace the quantity provided in the Observing Kit above. Specify the Venus Forms. (To order the above, send a check or money order made out to "Julius L. Benton, Jr." All foreign orders should include $5.00 additional for postage and handling; for domestic orders, these are included in the prices above. Shipment will be made in two to three weeks under normal circumstances. NOTE: Observers who wish to make copies of observing forms have the option of sending a SASE for a copy of forms available for each program. Authorization to duplicate forms is given only for the purpose of recording and submitting observations to the A.L.P.O. Venus, Saturn, or Lunar SAP Section. Observers should make copies using high-quality paper.)

Mars (Troiani): (1) *Martian Chronicle;* send 8-10 SASEs; published approximately monthly during each apparition. (2) *Observing Forms;* send SASE to obtain one form which you can copy; otherwise send $3.60 to obtain 25 copies (make checks out to "J.D. Beish").

Mars (Astronomical League Sales, P.O. Box 572, West Burlington, IA 52655): *ALPO's Mars Observer Handbook,* $9.00.

Jupiter: (1) "Jupiter Observer's Start-Up Kit" is available for $3.00 from David J. Lehman. (2) *Jupiter,* the newsletter of the Jupiter Section is available on the Internet at the Jupiter Section Web page or by mail: send SASEs to David J. Lehman. (3) To join the Jupiter Section's E-mail network, "J_Net," send an E-mail message to David J. Lehman at DLehman111@aol.com, write "subscribe J_Net" in the subject field. (4) *Timing the Eclipses of Jupiter's Galilean Satellites;* send a SASE with 56 cents in stamps to John Westfall. This is the project "Observing Kit" and includes a report form.

Saturn (Benton): (1) *The ALPO Saturn Observing Kit,* $20.00. Includes introductory description of ALPO Saturn observing programs for beginners, a full set of observing forms, and a copy of *The Saturn Handbook.* (2) *Observing Forms Packet,* $10.00. Includes observing forms to replace the quantity provided in the Observing Kit above. Specify the Saturn Forms. (See note for Venus.)

Comets (Machholz): Send SASEs to the Coordinator for monthly installments of *Comet Comments,* a one-page newsletter reviewing recent comet discoveries and recoveries, and providing ephemerides for bright comets.

Meteors (Astronomical League Sales, P.O. Box 572, West Burlington, IA 52655): (1) The pamphlet, *The A.L.P.O. Guide to Watching Meteors* is available for $4.00 (price includes postage). (2) The *Meteors Section Newsletter* is published quarterly (March, June, September, and December) and is available free of charge if you send 33¢ in postage per issue to Coordinator Robert D. Lunsford, 161 Vance Street, Chula Vista, CA 91910.

Minor Planets (Derald D. Nye, 10385 East Observatory Dr., Corona de Tucson, AZ 85641-2309): Subscribe to: *The Minor Planet Bulletin;* quarterly, $9.00 per year for the United States, Mexico and Canada; or $13.00 for other countries (air mail only).

Computing Section (McClure): A Computing Section Newsletter, *The Digital Lens,* is available via e-mail. To subscribe or to make contributions, contact the editor, Mike W. McClure, at: MWMCCL1 @ POP.UKY.EDU .

Mercury/Venus Transit Section (Westfall): (1) *Observer's Guide to the Transit of Mercury, 1999 Nov 15.* $4.00 for orders from the United States, Canada, and Mexico; $7.00 for orders from other countries (price includes first-class postage). (2) The Coordinator will also compute your local circumstances (Universal Time, Position Angle, and Solar Altitude for each of the four contacts and for mid-transit) if you supply a stamped self-addressed envelope along with your latitude, longitude, and approximate elevation above sea level.

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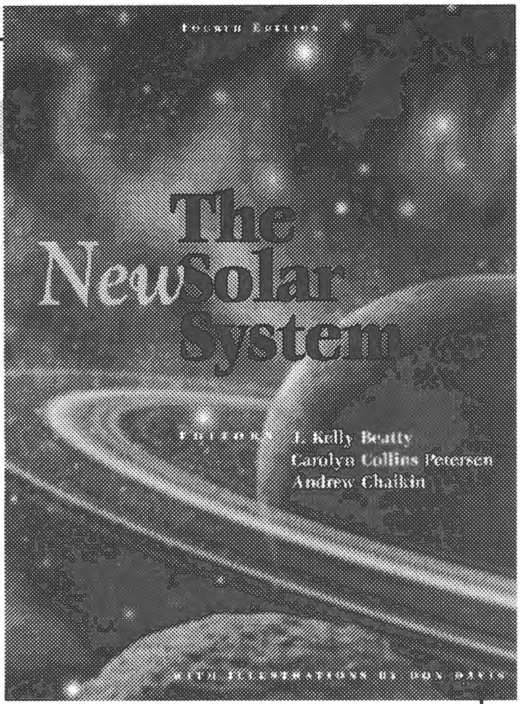
Fourth Edition
The New Solar System
Editors J. Kelly Beatty
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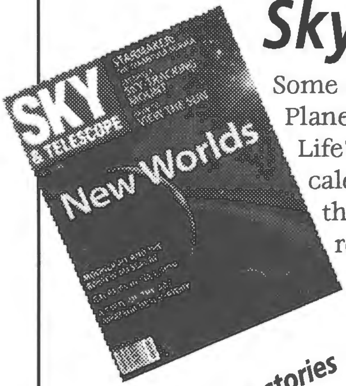
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