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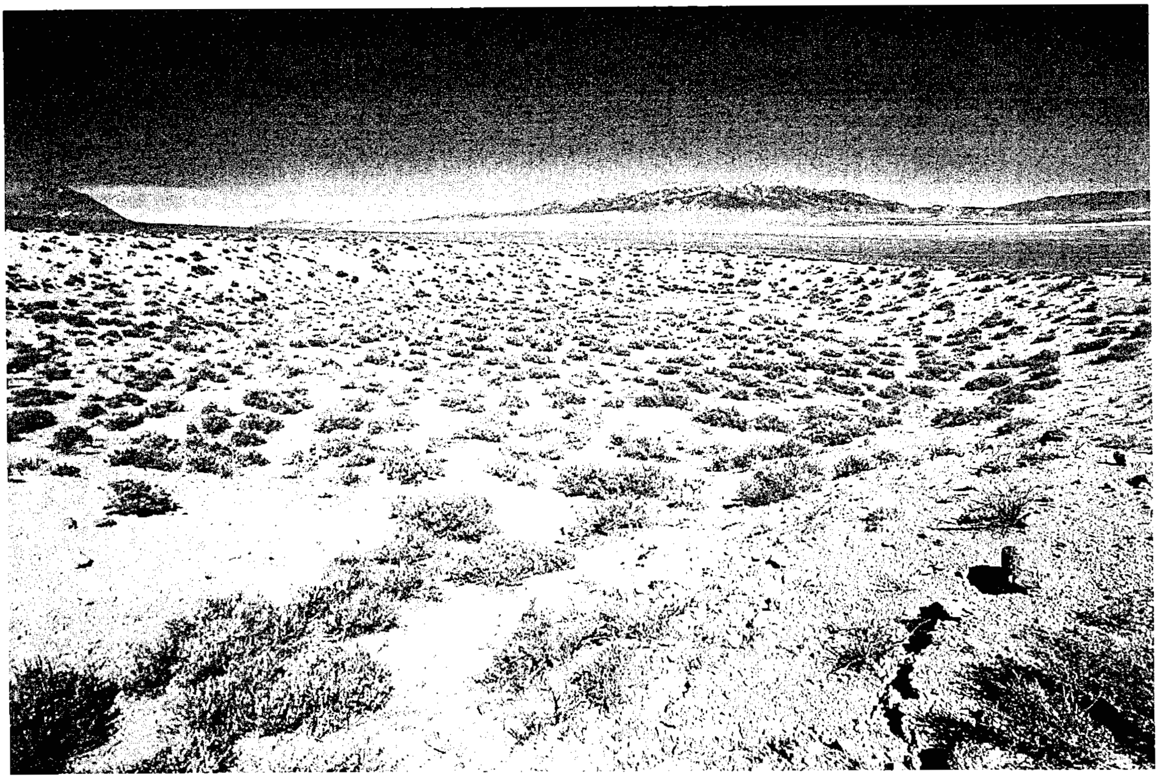

Irwin Crater, Nye County, Nevada; a possible meteorite crater. Photographed in March, 1997, looking northeast from the crater's southeast rim. The opposite rim is about 300 feet (90 meters) distant. In the background is Railroad Valley with the White Pine Mountains on the skyline. Note rocks and tilted stratum in right foreground.

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IN THIS ISSUE

A SUSPECTED IMPACT CRATER NEAR DUCKWATER, NEVADA

By: Richard W. Schmude, Jr. and John E. Westfall
(addresses in staff listing)

ABSTRACT

Results of recent expeditions to a possible impact crater in central Nevada are summarized in this report. This feature has a mean diameter of 299.6 feet (91.3 m), a mean depth of 16.7±0.4 feet (5.1±0.1 m), a volume of 867,300 cubic feet (24,560 cubic meters) and a rim height of up to 2 feet (0.6 m). Preliminary geological and topographic maps of this crater are presented.

INTRODUCTION

A large, circular depression was briefly investigated in the 1920s by Mr. Ralph Irwin of Duckwater, Nevada [Rinehart and Elvey, 1951; McCracken and Howerton, 1996, 304-305]. Thus this feature has often been called "Irwin Crater", the designation we use in this paper [Jamieson, 1992]. During the 1920s, Ralph Irwin and his brother dug a large hole near the center of the crater in the hope of finding a meteorite. No meteorite was recovered. Subsequent searches for meteorites with metal detectors and alnico magnets also turned up negative [Rinehart and Elvey, 1951, p. 211]. Mr. C.C. Boak, an amateur mineralogist, examined the crater in 1936 and concluded that volcanic activity was not responsible for the crater. More recently, Rinehart has studied the crater and summarized a few results along with others in a brief report [Rinehart and Elvey, 1951]. There is also the possibility that Irwin crater may be a sink hole [Graham *et al.*, 1985, p. 428]. Panamint Crater, located in California, is similar in size to Irwin Crater and it appears that Panamint crater formed from underground collapse [Dietz and Buffington, 1963]. Thus we believe that Irwin Crater may be: 1) a sink hole, 2) an impact crater, or 3) an impact crater which was later modified by some type of underground collapse.

The possible impact crater is at an altitude of 5250±10 ft (1600±3 m) and is located at 115°40′.643 W and 38°43′.203 N. The longitude and latitude were measured 11 times by Schmude with a Global Positioning Satellite (GPS) receiver and the mean value is reported here; the coordinates agree well with those determined from a 1990 topographic map (115° 40′.53 W, 38° 43′.27 N) and from an independent GPS fix by Westfall (115° 40′.63 W, 38° 43′.23 N).

The crater lies on a gently sloping alluvial fan with an inclination angle of 3°.7 sloping downward in an eastern direction in the vicinity of the crater [U.S. Geological Survey, 1990]. The alluvium consists of material eroded and transported from the Pancake Range, a mountain ridge about 1.3 mi (2.0 km) to the west, overlooking Railroad Valley to the east. The aerial photograph in *Figure 1* (p. 98) shows the terrain in the vicinity of the crater (see also our front cover). Although the aerial photograph is of only medium scale, several of the crater's features can be seen—the southerly lighting highlights the crater's northern rim and shades its southern rim, while a deposit of fine sediment on its eastern floor appears as a light patch; note also the gully entering the crater from the west.

The possibility of this feature being a meteorite crater was the motivation for each author separately to undertake two expeditions to central Nevada.

PRELIMINARY GEOLOGICAL MAP

A preliminary geological map of Irwin Crater is shown in *Figure 2* (p. 99). The lowest portion of the crater is filled with fine-grain sediment and is located near the eastern wall. Two artificial holes are located within the area of fine-grain sediment; one of these, closest to the crater center, is

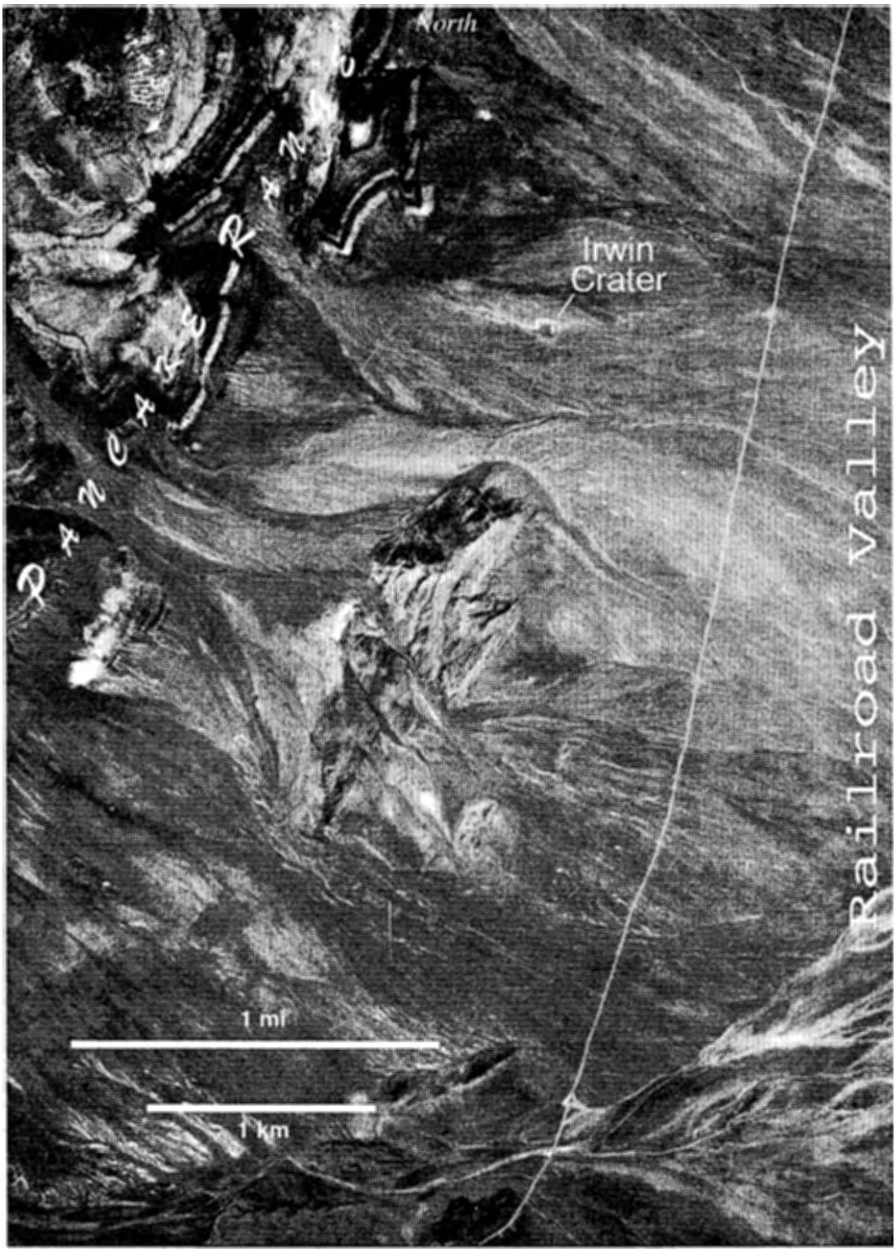

Figure 1. Area of Irwin Crater. From vertical aerial photograph NAPP 7313-207 (National Aerial Photography Program, U.S. Geological Survey), March 29, 1994.

11.5 ft (3.5 m) deeper than the surrounding crater floor and about 14 ft (4.3 m) below the top of the excavated material piled around the hole; its sides have apparently partially collapsed as its original depth is cited as 25 ft [Boak, 1936, p. 4]. The other hole is kidney-shaped and is 3 ft (0.9 m) deep. Both holes have a low relief mound of dirt nearby. Two more holes, outside the fine-grain sediment region are present and have depths of 0.7 ft (0.2 m).

Boulders and Rocks.—The crater interior, particularly the inner wall, contains several boulders having diameters of up to 4 ft. Boulders having estimated masses exceeding 220 pounds (100 kg) are plotted in *Figure 2*. The largest boulder has a light gray color which is different from the nearby mountains which are made up of reddish

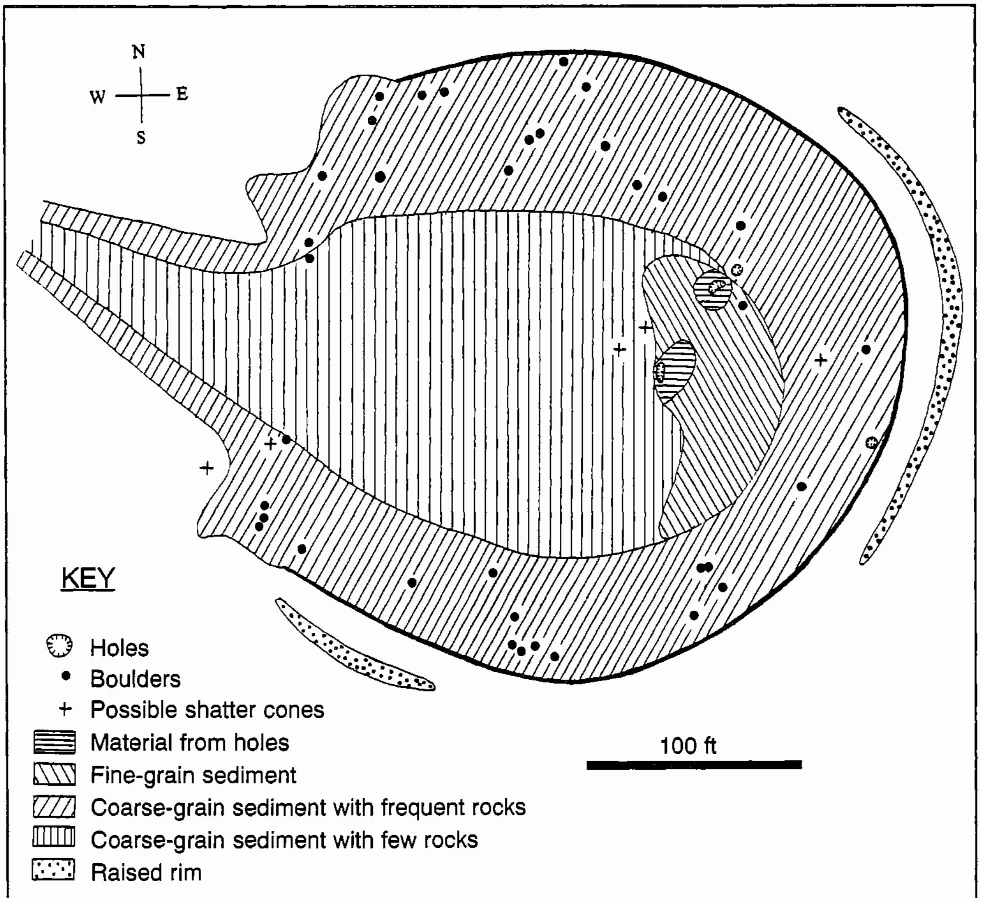

Figure 2. Preliminary geological map of Irwin Crater prepared by R. Schmude in 1997.

rock. Many rocks inside the crater have sharp edges and appear to have been broken while others have a more rounded appearance.

Several white rocks were present both inside and outside of the crater. One of these rocks has a specific gravity of 2.61±0.02, which is similar to quartz. A few of these rocks also had a distinctive radial pattern (see *Figure 3a*, p. 100). The radial patterns are probably cross sections of acircular crystals in quartz; however, they may be shatter cones. Several transparent grains of soil were present near the crater rim. These grains were up to 5 mm long and had an average specific gravity of 2.63±0.03, again close to that of quartz. These grains contained tiny dark spheres (see *Figure 3b*, p. 100) which is similar to the spheres found in Philippinites [Vorob'yev, 1965] and at the Sikhote-Alin fall [Heide, 1964, p. 75]. The average diameter of 52 dark spheres embedded in these quartz grains is 0.037 mm. The soil near Irwin Crater contains a few small spheres with diameters of 0.01 to 0.1 mm. A summary description of these spheres will be given in a future report.

Topography

A topographic map of Irwin Crater is shown in *Figure 4* (p. 101), based upon a survey conducted by John Westfall, aided by Derald Nye, on July 30, 1997. The survey was made using a 1-minute 30X transit and a stadia rod graduated at 0.01-ft intervals. Horizontal angles were converted to magnetic north, which currently lies 15°.5 east of true north at this location. Horizontal and vertical angles and distances for 85 sightings were converted to x,y,z coordinates in feet with the origin at the initial station, which was located at the lowest point on the east rim of the crater, defined as the elevation datum. The positive x-axis was defined by magnetic east and the positive y-axis by magnetic north.

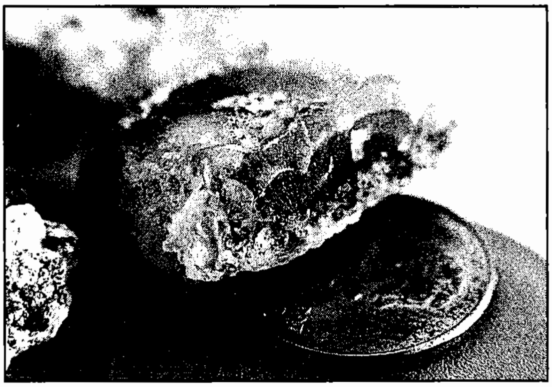

Figure 3a (left). Possible shatter cone discovered in Irwin Crater, lying on a penny to indicate scale.

Figure 3b (below). Quartz grain from Irwin Crater containing small dark spheres.

Two additional stations were occupied, and sightings on the same point from different stations gave a mean error estimate of 1.4 ft in horizontal position and 0.3 ft in vertical distance, typical for a stadia survey.

On *Figure 4,* contour lines are at 2-ft intervals based on the arbitrary datum of the initial survey station. The dashed line represents the crater rim in the portion of the crater's periphery where it can be identified. Four trenches are on the western rim and one of them is several hundred feet long, making it impossible accurately to trace the western portion of the crater rim. These trenches undoubtedly formed as a result of water running down the sloped terrain.

The large trenches on the western rim are evidence of erosion which has resulted in the deposition of large amounts of sediment in the crater. Furthermore, material near the rim has obviously fallen into the crater. Deposition of sediment and rim collapse would cause the crater to become more shallow as well as wider.

Analysis of the three-dimensional coordinates from the Westfall-Nye survey showed that the points on the crater rim, on the crater floor, and on the outside surface all fell closely upon three respective planes, whose slopes and orientations are summarized in *Table 1* (below).

The difference in amount of slope between the rim and the outer surface is

Table 1. Morphometry of Irwin Crater.

Zone	No. of Points	Slope Orientation Amount °	Slope Orientation Azimuth ° M °	RMS Error ft
Outer Surface	21	3.66±0.06	089.6±0.7	±0.55
Crater Rim	14	3.21±0.18	088.9±1.9	±0.81
Crater Floor	8	3.34±0.38	070.0±4.9	±0.47

Notes: RMS = root-mean-square; azimuths are magnetic; the crater floor excludes the fine-grain deposit area and the base of the wall.

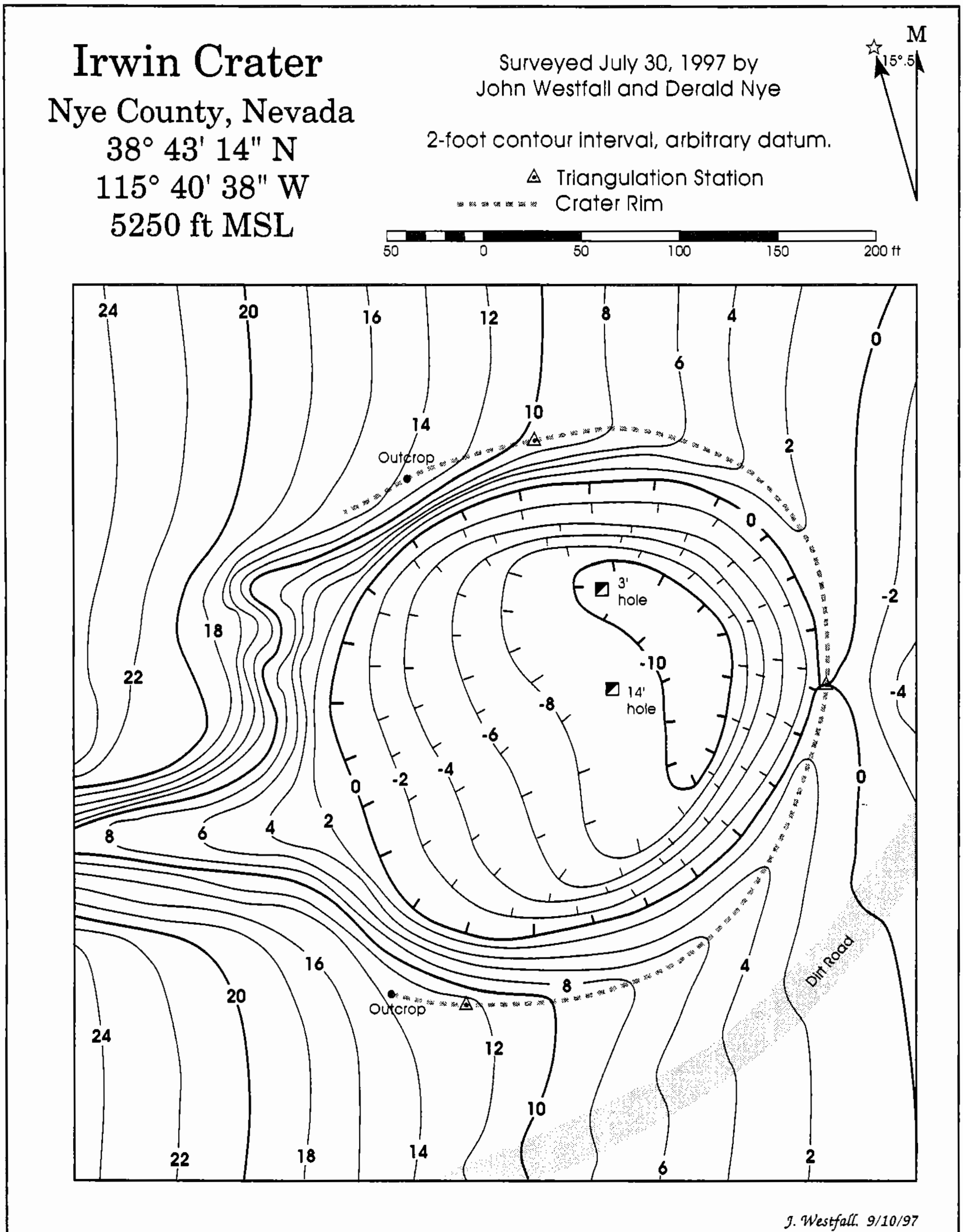

Figure 4. Contour map of Irwin Crater.

significant (5-percent level) and reflects the observed fact that the rim is highest in its eastern portion. The slope amount of the floor does not differ significantly from either rim or outside surface. On the other hand, the orientation of the floor's slope does differ significantly (1-percent level) from those of the rim and the outer surface.

The elevation difference between the two respective planes gives a mean rim-to-floor depth of 16.73±0.35 ft (5.10±0.11 m); taking the entire crater, including the inner wall, into account, the mean depth is approximately 12.30 ft (3.75 m).

The crater outline is clearly non-circular, and an elliptical outline was found

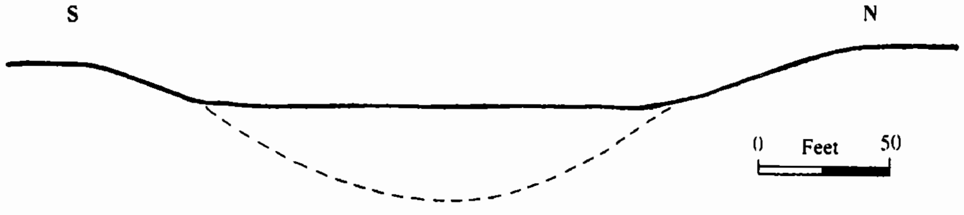

Figure 5. North-south profile of Irwin Crater by R. Schmude based on his survey.

visually to give a good fit to the actual crater outline where the latter was intact, with the ellipse major axis measuring 320.7 ft (97.8 m) in length, oriented at magnetic azimuth 065°.4/245°.4, and the minor axis 279.8-ft (85.3-m) long at magnetic azimuth 155°.4/ 335°.4, with the ratio of the axes 1.146:1 The geometric mean of the two axes (which is equal to the diameter of a circle with the same area as the ellipse) is 299.6 ft (91.3 m), giving an area within the rim of 70,480 ft^2 (6548 m^2).

Combining the above area with the previously determined mean depth gives a crater volume of 867,300 ft^3 (24,560 m^3).

To provide a useful comparison, R. Schmude independently surveyed Irwin Crater in 1997, using a quite different procedure. He measured one diameter with a length of string tied to posts at opposite edges of the crater, obtaining a diameter of 290 ft (88.4 m). He then measured the same diameter with an odometer, obtaining a result of 299 ft, adjusted to 293 ft (89.3 m) for the slope of the inner wall; this provided a correction factor of 290:293 (0.990) for the odometer distance. He then measured nine crater radii with the odometer, at azimuth intervals of 30°. These revealed the ellipticity of the crater, with the radii ranging from 134 ft (40.8 m) at azimuth 150° (magnetic azimuth 134°.5) to 153 ft (46.6 m) at azimuth 330° (magnetic azimuth 314°.5). The ratio of the maximum:minimum radii was 1.142:1, very close to Westfall's value. Schmude's measures yielded a mean radius of 144±2 ft (43.9±0.6 m), or a mean diameter of 288±4 ft (87.8±1.2 m), about 4 percent smaller than Westfall's estimate, a difference that is not surprising given the irregular and damaged outline of the crater. Schmude's measurements implied that the crater's area is 65,140±1810 ft^2 (6052±168 m^2). Assuming that the trenches on the western portion of the crater occupy one-third of the crater's volume, he calculated a mean depth, based on over 400 measurements of the wall slope, of 19.3±1.0 ft (5.9±0.3 m). The mean wall slope was found to be 15°, with a maximum of 32°. Using his mean diameter and depth, Schmude estimated an approximate volume of 950,000 ft^3 (27,000 m^3), about 10 percent greater than Westfall's.

Both diameter estimates are much larger than the 225 ft (68.6 m) quoted in previous literature [Rinehart and Elvey, 1951, 109; Boak, 1936, 1]. The mean depths found by both Schmude and Westfall are greater than the 10-15 ft cited by the same sources, which again do not describe how either the diameter or the depth were found.

The large trenches on the western rim are evidence of erosion which has undoubtedly led to the deposition of large amounts of sediment in the crater. Therefore, the original crater may have been both smaller and deeper. A blast energy of 1.7×10^{12} J (equivalent to 400 tons of TNT) is estimated for Irwin Crater based on Schmude's diameter and the diameter-energy relationship reported by Dence *et al.* [1977]. This blast energy would create about 280 tons of impact melt if assumptions in Dence *et al.* [1977] are correct.

The north-south cross section of Irwin Crater is shown in *Figure 5* (above) If this feature is an impact crater then the original depth was probably 70 feet (21 meters) and this is illustrated as a dashed line.

Irwin Crater has a small raised rim on its eastern side which is up to 2 ft (0.6 m) high. A slight rim on the southwestern side is also present; the rims are drawn in *Figure 2*. There is no raised rim to either the south or the northwest. The lack of a rim on the southern edge may be due to the nearby dirt road. Explosion craters with diameters of 288 feet have raised rims of about 14 feet [Baldwin, 1965, 64-73].

Irwin Crater may also be compared with several terrestrial chemical or nuclear explosion and meteorite craters [Baldwin, 1963; 439, 442], summarized in *Table 2* (p. 103). These indicate explosion energies, depths and rim heights that are the same order of magnitude as those values estimated or assumed above for Irwin Crater.

Table 2. Terrestrial explosion- and meteorite-crater analogies to Irwin Crater.
(from Baldwin, 1963; pp. 439, 442)

Crater No.	Apparent Diameter ft	Appar. Depth ft	Rim Height ft	Explosion Energy J
326	279	50	4	9.15×10^{10}
333	285	43	4	1.48×10^{11}
341	306	53	13	2.76×10^{11}
364	275	60	12	5.03×10^{12}
Kaali Järv	319	53	17	-------------

Note: Craters 326-341 were caused by chemical explosions, 364 by a 1.2-kiloton nuclear device, and Kaali Järv is a meteorite crater.

Nature of Possible Impacting Body

A 34,000-kg boulder moving at 10,000 m/s would have a kinetic energy equal to the estimated blast energy of 1.7×10^{12} J. If the density of this boulder was 2700 kg/m^3 (2.7 g/mL) then its volume would be 12.6 m^3. Assuming a more typical higher velocity of 20.000 m/s, however, the mass needed would drop to 8,500 kg, with a volume of 3.15 m^3. Given an initial excavated volume of perhaps twice the present crater volume, or roughly 50,000 m^3, it is clear that any meteorite fragments would form a very small proportion of the ejecta and be correspondingly difficult to find.

An extensive search for meteorite material was not carried out by the authors; however, others have searched for metallic meteorites with negative results [Rinehart and Elvey, 1951; Jamieson, 1992; McCracken and Howerton, 1996, 204-205]. This result should not be surprising since over 90 percent of meteorites recovered from falls have a stony composition [Heide, 1964, p. 54].

Acknowledgements

Author Schmude would like to express his gratitude to Martha Leake for examining a sample of the rocks collected from the Irwin Crater site. Author Westfall thanks Derald Nye for his indispensable help in conducting the stadia survey of the crater.

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A.L.P.O. OBSERVATIONS OF VENUS DURING THE 1994-95 WESTERN (MORNING) APPARITION

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

ABSTRACT

This synoptic report is based on visual and photographic data received from A.L.P.O. Venus Section observers in the United States, Belgium, Germany, and United Kingdom during the 1994-95 Western (Morning) Apparition, including instrumentation and data sources used 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, including cusps, cusp-caps, and cusp-bands, seen or suspected at visual wavelengths, both in integrated light and with color filters. Terminator irregularities and the apparent phase are discussed, as well as coverage based on results from the continuing monitoring of the dark hemisphere of Venus for the Ashen Light.

INTRODUCTION

A useful quantity of visual and photographic observations of Venus were submitted by A.L.P.O. Venus observers during the 1994-95 Western (Morning) Apparition. The overall geocentric parameters for the apparition are given in *Table 1* (right).

Visual drawings and photographs comprised a total of 127 observations received for the 1994-95 Apparition, and *Figure 1* (p. 105) shows the distribution of observations for each month during the observing season.

Coverage of Venus was satisfactory during this apparition. Individuals began their observing programs less than three weeks after Inferior Conjunction, and they continued to pursue Venus until only 10 days before Superior Conjunction. The "observing season," or observation period, extended from 1994 Nov 20 to 1995 AUG 11, with the distribution of observations spread fairly evenly throughout the apparition. [All dates and times in this report are in Universal Time or "UT."] So, unlike the case with a number of previous apparitions, the observational activity in 1994-95 remained fairly stable from 1994 December to 1995 August, with the traditional "peak" not occurring during the time when Venus was near greatest brilliancy and maximum elongation from the Sun.

Nine individuals submitted visual and photographic observations of Venus during the 1994-95 Apparition. These observers are listed in *Table 2* (p. 105) with their observing sites, number of observations, and instruments used.

Table 1. Geocentric Phenomena with Universal Times (UT) for the 1994-95 Western (Morning) Apparition of Venus

	1994
Inferior Conjunction	Nov 02d 23h
Initial Observation	Nov 20d 08h
Greatest Brilliancy[a]	DEC 09d 11h
	1995
Greatest Elongation West[b]	JAN 13d 12h
Dichotomy (predicted)[c]	JAN 13d 05h
Final Observation	AUG 11d 01h
Superior Conjunction	AUG 21d 00h

[a] mv = -4.7. [b] 47°. [c] JAN 13d 05h 16m 48s.

Observed Range:

Apparent Diameter : 54".46 (1994 Nov 20)- 9".65 (1995 AUG 11)

Phase Coefficient, k: 0.090 (1994 Nov 20) - 0.999 (1995 AUG 11)

Figure 2 (p. 106) shows the distribution of observers and contributed observations by nation of origin for this apparition. One-third of the participating observers were located in the United States, but those individuals accounted for only one-sixth of the total observations received. The welcome and continuing international flavor of our programs was again demonstrated during 1994-95.

The types of telescopes used to perform observations are graphed in *Figure 3* (p. 106). In addition,the great majority (98.4 percent) of the observations were made with telescopes of 15.2 cm (6.0 in) aperture or greater. Roughly two-thirds of the observations (66.1 percent) were made with

Table 2. Participants in the A.L.P.O. Venus Observing Program During the 1994-95 Western (Morning) Apparition.

Observer and Observing Site	No. Obs.	Telescope(s) Used*
Benton, Julius L. Wilmington Island, GA	14	15.2-cm (6.0 in) REF
Bosselaers, Mark. Berchem, Belgium	1	11.5-cm (4.5 in) REF
	3	25.4-cm (10.0 in) NEW
	1	40.6-cm (16.0 in) CASS
Cuppens, Wim. Gruitrode, Belgium	1	20.3-cm (8.0-in) SC
Graham, David L. Brompton-on Swale, UK	3	15.2-cm (6.0-in) REF
Graham, Francis G. East Pittsburgh, PA	6	16.0-cm (6.3-in) NEW
Heath, Alan W. Nottingham, England	3	30.5-cm (12.0-in) NEW
Niechoy, Detlev. Göttingen, UK	82	20.3-cm (8.0-in) SC
	11	30.5-cm (12.0-in) NEW
Schmude, Richard W. College Station, TX	1	9.0-cm (3.5-in) REF
Vandenbulque, P. Berchem, Belgium	1	28.0-cm (11.0-in) SC
Total No. of Observations	127	
Total No. of Observers	9	

* CASS = Classical Cassegrain; NEW = Newtonian, REF = Refractor, SC = Schmidt-Cassegrain.

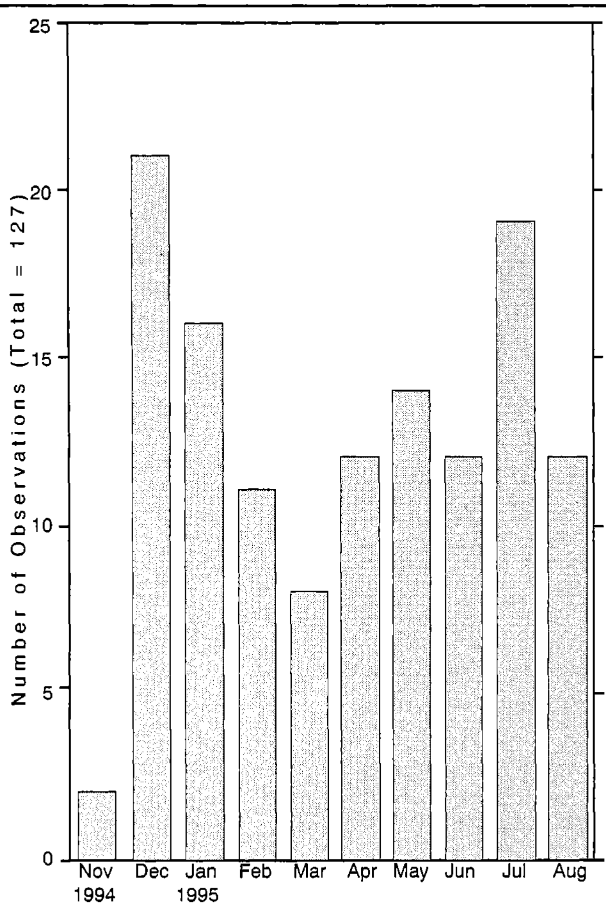

Figure 1. Distribution of Observations by Month During the 1994-95 Western (Morning) Apparition of Venus.

catadioptric telescopes, with the remaining 33.9 percent carried out using classical designs.

As regards atmospheric conditions, the mean Seeing was 3.0, or "fair," on the standard A.L.P.O. Seeing Scale that ranges from 0.0 (worst seeing conditions) to 10.0 (perfect); the mean Transparency, expressed as the limiting stellar magnitude, was about +4.3. During 1994-95, most observations (76.1 percent) were made against a dark or dull twilight sky.

As mentioned earlier, international participation in our programs is always gratifying, as exemplified by the valuable work contributed by the nine individuals noted in this report. This Coordinator extends his warmest thanks to those observers for their support during 1994-95. Readers interested in studying the planet Venus are urged to join us in our observational pursuits in future observing seasons.

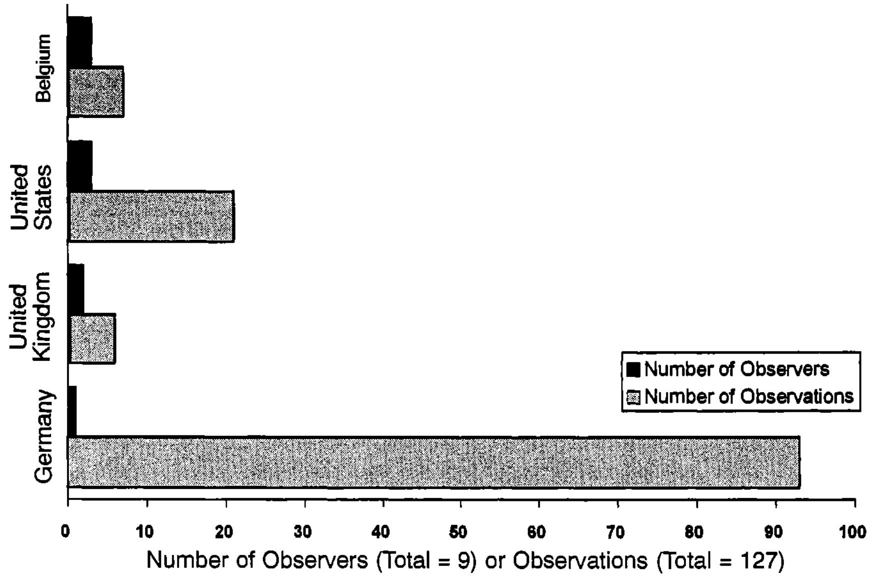

Figure 2. Distribution of Observers and Observations by Nation of Origin During the 1994-95 Western (Morning) Apparition of Venus.

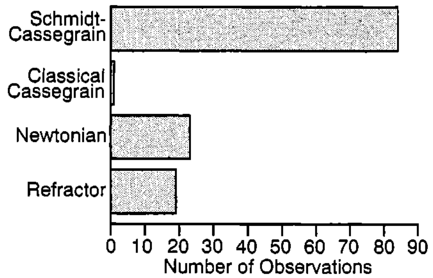

Figure 3. Number of Observations by Type of Telescope, 1994-95 Western (Morning) Apparition of Venus.

Observations of Venusian Atmospheric Details

As pointed out in preceding Venus reports, the procedures and techniques for conducting visual studies of the vague and elusive "markings" in the atmosphere of Venus have been carefully outlined in *The Venus Handbook* as well as other A.L.P.O. Venus Section publications. It is suggested that new observers refer to these sources, especially the previous apparition reports.

All of the observations used for this report were made at visual wavelengths, and several samples of these observations in the form of drawings and photographs appear in this report in order to assist the reader in interpreting the phenomena reported in the atmosphere of Venus in 1994-95 (see *Figures 6-25*, pp. 111-113).

The visual and photographic data for the 1994-95 observing period represented all of the typical categories of dusky and bright markings on Venus, as described in the literature referenced earlier. *Figure 4* (p. 107) summarizes the frequency by which the specific forms of markings were reported. It is worth mentioning that many observations showed more than one type of marking or feature, so that totals of over 100 percent are possible. As always, there is a subjective element in the reporting of the elusive, vague markings of Venus, and these must certainly have affected the values in *Figure 4*. Even so, our conclusions deduced from these data appear reasonable and acceptable.

Dusky markings in the atmosphere of Venus are characteristically difficult to see, regardless of whether one is a complete novice or an experienced visual observer. Ultraviolet (UV) photographs of Venus are often preferred in order to reveal these subtle shadings. The A.L.P.O. Venus Section always seeks good UV photographs because the morphology of features at these short wavelengths of light is usually considerably different from those seen in the visual region of the electromagnetic spectrum, particularly the radial dusky patterns. *Figure 4* calls attention to a surpris-

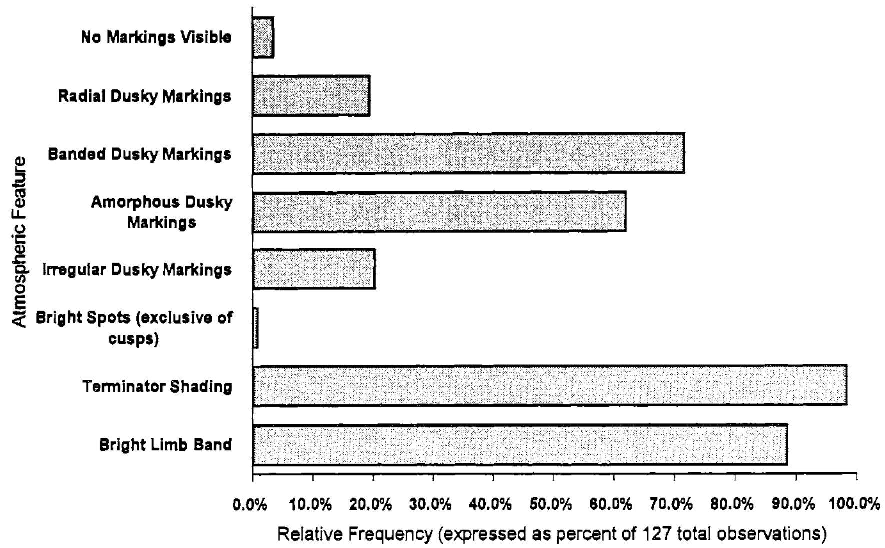

Figure 4. Relative Frequency of Specific Forms of Atmospheric Markings on Venus During the 1994-95 Western (Morning) Apparition.

ingly small percentage (3.5 percent) of submitted visual drawings with Venus depicted as a totally blank disk during 1994-95. This result contrasts substantially with the observational results gleaned from several recent apparitions of the planet. Although the reason for this is not immediately apparent, perhaps the smaller-than-usual statistical sample of observational reports received for the 1994-95 apparition is a contributing factor. In all of the photographs taken at visual wavelengths, no atmospheric markings were revealed, despite the fact that visual observers sometimes recorded banded, radial, irregular, and amorphous dusky markings with reasonably good confidence. One factor that came into play here may have been the use of more standardized, systematic techniques with variable-density polarizers and color filters during recent years.

Figure 4 also graphically depicts that nearly three-fourths of the dusky features that were reported fell in the category of "Banded Dusky Markings," indicated in 71.7 percent of the total observations. Other dusky shadings were distributed among the categories of "Amorphous Dusky Markings" (62.0 percent) and "Irregular Dusky Markings" (20.4 percent), plus a reasonably high incidence (19.5 percent) in 1994-95 of reported "Radial Dusky Markings," when compared with past apparitions.

Terminator shading was evident during the 1994-95 Apparition, visible in no less than 98.2 percent of the observations, as shown in *Figure 4*. The terminator shading appeared to lighten (i.e., assume a higher intensity value) as one progressed from the terminator region toward the illuminated limb of the planet, and most of the time this gradation in brightness ended in the Bright Limb Band. The terminator shading typically extended from one cusp region to the other. No photographs in 1994-95 showed any hint of terminator shading.

The mean relative intensity for all of the dusky features on Venus in 1994-95 ranged from 7.9 to 8.7, on the Standard A.L.P.O. Scale that ranges from 0.0 for completely black to 10.0 for the brightest possible feature.

Ranging from 0.0 for "definitely not seen" to 10.0 for "certainly seen," the A.L.P.O. Scale of Conspicuousness was also used routinely during the 1994-95 observing season. The dusky markings in *Figure 4* had a mean conspicuousness of about 4.5 during the apparition, meaning that these features fell somewhere between indistinct impressions and strong indications of their actual presence on Venus.

Figure 4 also shows that "Bright Spots or Regions," exclusive of the cusp areas, were virtually absent in the reports; evident in only 0.9 percent of the total submitted observations with a mean relative intensity of 9.5. At visual wavelengths, almost no drawings showed these bright spots or mottlings, and photographs were totally devoid of any of these features.

Color-filter techniques were regularly employed during the 1994-95 Western (Morning) Apparition. These methods produced good results, and when compared with studies in Integrated Light, the usage of Wratten color filters and variable-density polarizers improved the visibility of the elusive atmospheric phenomena on Venus.

The Bright Limb Band

For the 1994-95 Western (Morning) Apparition, *Figure 4* shows that 88.5 percent of the contributed observations called attention to the "Bright Limb Band" on the sunlit hemisphere of Venus. When this dazzling band along the limb of Venus was reported, the feature extended uninterrupted from cusp to cusp 82.0 percent of the time, and was broken or partially visible in 18.0 percent of the positive reports. The mean numerical intensity of the Bright Cusp Band was 9.9, and its visibility was substantially improved with the use of color filters and variable-density polarizers. It was never apparent in any photographs of Venus submitted during 1994-95.

Terminator Irregularities

The geometric curve that separates the sunlit and dark hemispheres of Venus is known as the terminator. About two-fifths (39.8 percent) of the observations in 1994-95 called attention to an irregular or asymmetric terminator. Also, amorphous, irregular, and banded dusky markings, and to a lesser extent radial dusky shadings, appeared to merge with the terminator shading, possibly contributing to the reported deformities. As with other observations during the 1994-95 Western (Morning) Apparition, filter techniques enhanced the visibility of terminator irregularities and associated dusky atmospheric features. Of course, irradiation may cause bright features adjacent to the terminator to take on the appearance of bulges, while dark features may appear as dusky hollows.

Cusps, Cusp-Caps, and Cusp-Bands

The most contrasting and conspicuous features periodically seen in the atmosphere of Venus appear at or near the planet's cusps, usually when the phase coefficient, *k*, lies between 0.1 and 0.8 (the phase coefficient is the fraction of the disc that is illuminated). These cusp-caps are periodically bordered by what appear as dark, often diffuse, peripheral cusp-bands. *Figure 5* (below) graphically depicts the visibility statistics for Venusian cusp features in 1994-95.

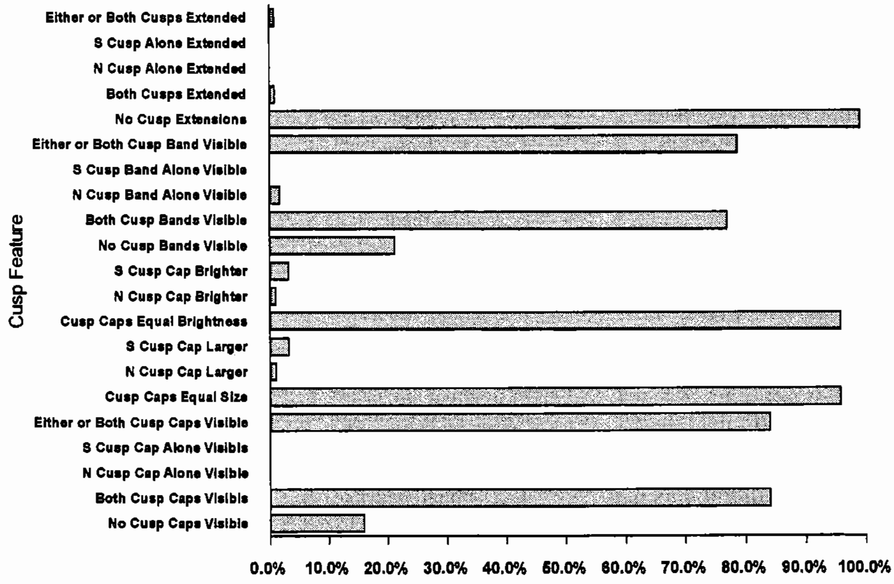

Figure 5. Visibility Statistics of Cusp Features of Venus During the 1994-95 Western (Morning) Apparition.

Figure 5 shows that when the northern and southern cusp-caps were recorded, they were usually equal in size and brightness. In a very few cases, however, either the northern or southern cusp-cap was larger brighter, or both. In about one-fifth (15.9 percent) of the observations, neither cusp-cap could be seen. The mean relative intensity of the cusp-caps was about 9.7 during the 1994-95 Apparition.

The cusp-caps were without bordering dusky cusp-bands in slightly more than one-fifth of the submitted observations (21.3 percent; see *Figure 5*), with a mean relative intensity of about 7.7.

Cusp Extensions

As illustrated in *Figure 5*, 99.1 percent of the observations, reported no cusp extensions beyond the 180° expected from simple geometry, in integrated light and with color and polarizing filters.

As Venus passed through crescentic phases during the apparition, however, two reports of cusp extensions were received, one with one extension about 2° and the other about 15°. Similar to the situation in the 1993-94 Western (Morning) Apparition of Venus (but unlike the majority of other recent observing seasons), there were no reported instances in 1994-95 of both cusps joining, forming a spectacular halo encircling the entire dark hemisphere of the planet. The two cusp extensions that were detected during the apparition were shown on drawings, enhanced by color filters and polarizers, but were never visible on any photographs that were contributed. Not surprisingly, cusp extensions are very difficult to capture on film, since they are significantly fainter than the sunlit regions of the disk of Venus. Observers with video cameras or CCDs might try their hand at recording cusp extensions in coming apparitions.

Estimates of Dichotomy

The "Schröter Effect" on Venus, a difference between the predicted and the observed dates of dichotomy (half-phase), was reported in 1994-95. The predicted half-phase occurs when k = 0.500, and the phase angle, *i*, between the Sun and the Earth as seen from Venus equals 90°. The observed-minus-predicted discrepancies for the 1994-95 Apparition are given in *Table 3* (upper right).

Table 3. Observed Versus Predicted Dichotomy of Venus, 1994-95 Western (Morning) Apparition.

	Observer	
Dichotomy (k = 0.500)	J. Benton	D. Niechoy
Observed (O)	Jan 19.10	Jan 18.25
Predicted (P)	Jan 13.22	Jan 13.22
Difference (O-P, days)	+5.88	+5.03

Dark Hemisphere Phenomena and Ashen Light Observations

The Ashen Light, which was first reported by G. Riccioli in 1643, is an extremely elusive, faint illumination of the dark hemisphere of Venus. It resembles Earthshine on the dark portion of the Moon, but cannot have the same origin. Many argue that Venus must be seen against a dark sky in order to perceive the Ashen Light, but these circumstances usually occur when the planet is very low in the sky where poor seeing prevails. Also, significant glare in contrast with the surrounding dark sky affects such observations. Reports of the Ashen Light continue to be received by the A.L.P.O. Venus Section when the planet is viewed against a twilight sky.

During the 1994-95 Apparition there were a few occasions in 1994 December when two observers, in Integrated Light and with color filters, either suspected or were fairly certain of the presence of the Ashen Light on Venus (see *Table 4*, p. 110). Unfortunately, these reports were never simultaneous and thus remain unconfirmed. There were no instances when observers had the impression that the dark hemisphere of Venus was actually darker than the background sky; but when seen in the past, this phenomenon was almost certainly a contrast effect.

Conclusions

Evaluation and analysis of the observations of Venus during the 1994-95 Western (Morning) Apparition, including the few instances when Venus was reported to display a completely blank disk, suggest that the level of atmospheric activity had increased since the immediately preceding observing season. Because of a smaller number of observations, and with almost two-thirds of the observations coming from one observer, such a conclusion must be at

Table 4. Ashen Light Observations: 1994-95 Western (Morning) Apparition of Venus

1994 Dec UT Date and Time d	hh:mm	Observer	Instrument	Filter	Ashen Light
02	05:03-05:36	D.Niechoy	20.3-cm SC, 225X	IL W25 W15 W47	DS DS NS NS
02	06:00	P. Vandenbulque	28.0-cm SC, 280X	IL W11	NS NS
05	06:04-06:36	D. Niechoy	20.3-cm SC, 225X	IL W25 W15 W47	DS DS DS DS
05	06:55	M. Bosselaers	11.5-cm REF, 100X	IL	NS
07	05:56 -06:33	D. Niechoy	20.3-cm SC, 225X	IL W25 W15 W47	DS DS DS DS
08	05:42-06:28	D. Niechoy	20.3-cm SC, 225X	IL	DS
10	06:35-07:07	D. Niechoy	20.3-cm SC, 225X	IL W25 W15 W47	StS StS StS StS
16	05:32-06:03	D. Niechoy	20.3-cm SC, 225X	IL W25 W15 W47	StS StS StS StS
17	06:34-07:02	D. Niechoy	20.3-cm SC, 225X	IL W25 W15 W47	StS StS StS StS
20	05:55-06:30	D. Niechoy	20.3-cm SC, 225X	IL W25 W15 W47	DS StS StS StS
22	07:50-08:00	D. Graham	15.2-cm REF, 166X	IL	NS
22	10:50-11:00	F. Graham	16.0-cm REF, 650X	IL W47	S S
23	11:35-11:50	F. Graham	16.0-cm REF, 650X	IL W25	S S

Notes

Filters are: W11 = yellowish-green, W15 = yellow, W25 = red, and W47 = dark blue. Under "Ashen Light," the visibility codes are: NS = nothing seen or suspected, S = suspected, StS = strongly suspected, and DS = definitely seen by the observer. Telescope types are: SC = Schmidt-Cassegrain, and REF = refractor.

best tentative. Of course, it is valuable to try to compare these results with those of previous morning observing seasons, as well as with evening apparitions of the planet. Improved confidence in our results would be possible if there were a substantial number of observations by more that just one or two individuals, with such reports rather uniformly distributed throughout the apparition. Also, a higher incidence of simultaneous observations would probably be a result of more participation by more observers. Our studies of the Ashen Light, which peaked in terms of effort during the Pioneer Venus Orbiter Project, are continuing each apparition. Constant monitoring of the planet for the presence of this phenomenon by a large number of observers is important as a means of improving our chances for simultaneous observations of dark-hemisphere events. An active international cooperation of individuals making continuous, systematic, and simultaneous observations of Venus remains our primary objective. The A.L.P.O. Venus Section always needs more good observers, and interested readers are welcome to join us in our efforts.

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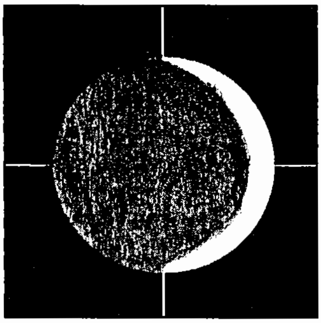

Figure 6. D. Niechoy. 1994 Dec 02, 05h03m UT. 20-cm Schmidt-Cassegrain, 51×, no filter. k = 0.203, diameter = 45".10.

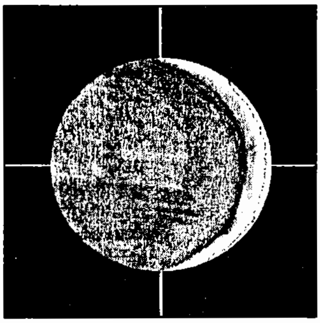

Figure 7. D. Niechoy. 1994 Dec 02, 05h09m UT. 20-cm Schmidt-Cassegrain, 112×, no filter. k = 0.203, diameter = 45".10. Mr. Niechoy comments: "AL [Ashen Light] is very possible."

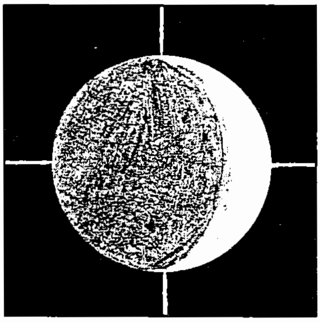

Figure 8. P. Vandenbulque. 1994 Dec 02, 06h00m UT. 28-cm Schmidt-Cassegrain, 280×, yellow filter. k = 0.203, diameter = 45".07.

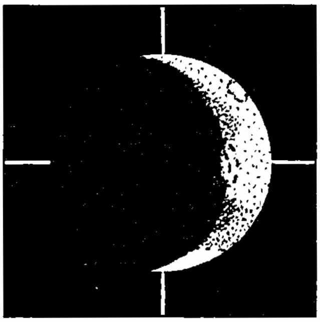

Figure 9. M. Bosselaers 1994 Dec 05, 06h55m UT. 11.5-cm refractor, 100×, no filter. k = 0.231 estimated phase = 0.24), diameter = 42".91. (Original drawing reversed; rectified here.)

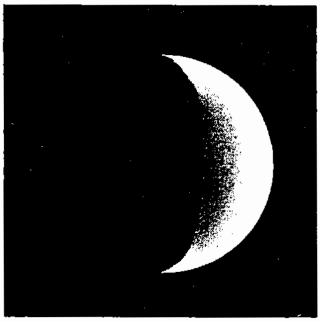

Figure 10. D. Graham. 1994 Dec 22, 08h00m UT. 15-cm refractor, 166×, no filter. k = 0.366, diameter = 32".94. Polar hoods and terminator shading were noted.

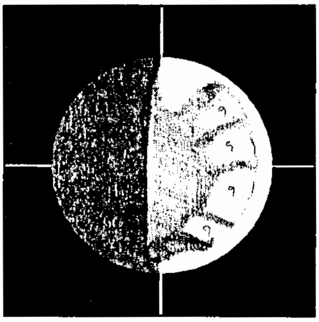

Figure 11. D. Niechoy. 1995 Jan 17, 06h10m UT. 20-cm Schmidt-Cassegrain, 225×, W15 (yellow) Filter. k = 0.521, diameter = 23".78. Twilight observation.

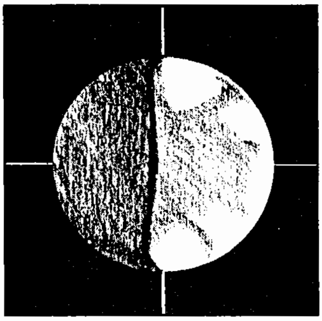

Figure 12. D. Niechoy. 1995 JAN 17, 06h16m UT. 20-cm Schmidt-Cassegrain, 225X, W25 (red) Filter. k = 0.521, diameter = 23".78. Twilight observation.

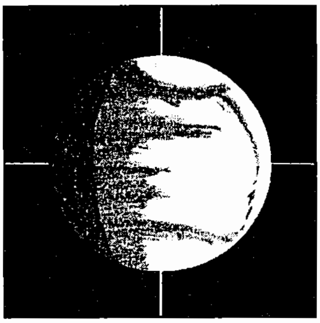

Figure 13. D. Niechoy. 1995 MAR 10, 06h55m UT. 20-cm Schmidt-Cassegrain, 112X, no filter. k = 0.727, diameter = 15".39. Daylight observation.

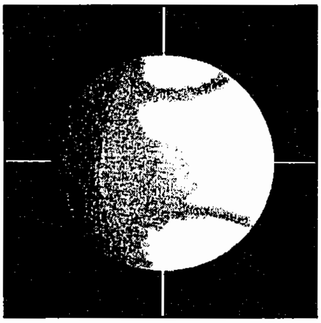

Figure 14. D. Niechoy. 1995 MAR 10, 07h00m UT. 20-cm Schmidt-Cassegrain, 225X, no filter. k = 0.727, diameter = 15".39. Daylight observation.

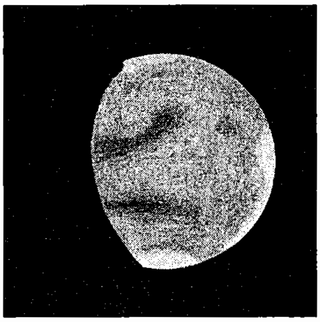

Figure 15. R.W. Schmude, Jr. 1995 APR 16, 10h58m - 11h12m UT. 9-cm refractor, 258X, W58 (green) Filter. Seeing = 4-1/2. k = 0.832, diameter = 12".59.

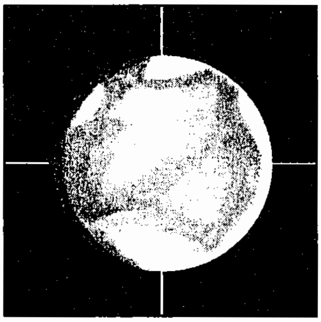

Figure 16. D. Niechoy. 1995 MAY 22, 04h35m UT. 20-cm Schmidt-Cassegrain, 225X, W15 (yellow) Filter. k = 0.909, diameter = 11".01. Daylight observation.

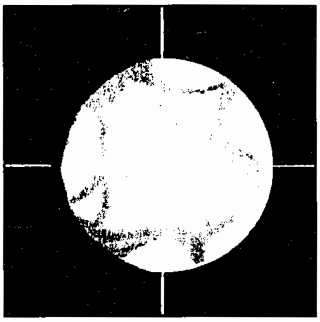

Figure 17. D. Niechoy. 1995 MAY 22, 04h41m UT. 20-cm Schmidt-Cassegrain, 225X, W25 (red) Filter. k = 0.909, diameter = 11".01.

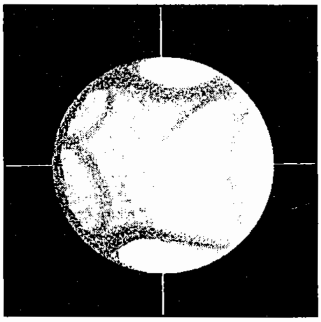

Figure 18. D. Niechoy. 1995 JUN 25, 04h21m UT. 30.5-cm Newtonian, 250X, no filter. k = 0.964, diameter = 10".12.

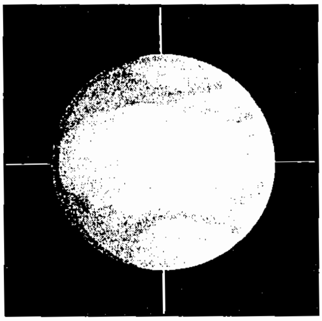

Figure 19. D. Niechoy. 1995 JUN 25, 04h39m UT. 30.5-cm Newtonian, 250X, W47 (dark blue) Filter. k = 0.964, diameter = 10".12.

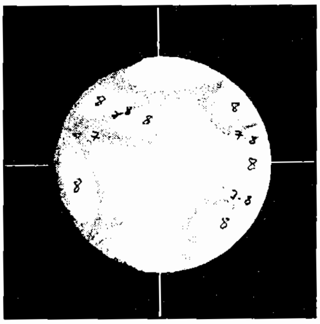

Figure 20. D. Niechoy. 1995 JUL 21, 04h54m UT. 20-cm Schmidt-Cassegrain, 225X, no filter. k = 0.989, diameter = 9".77. Numerical intensities shown on drawing.

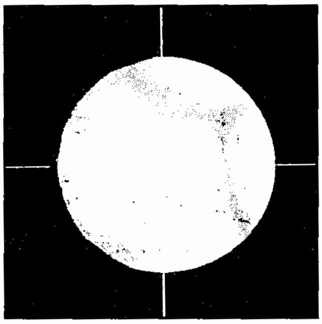

Figure 21. D. Niechoy. 1995 JUL 21, 05h04m UT. 20-cm Schmidt-Cassegrain, 225X, W47 (dark blue) Filter. k = 0.989, diameter = 9".77.

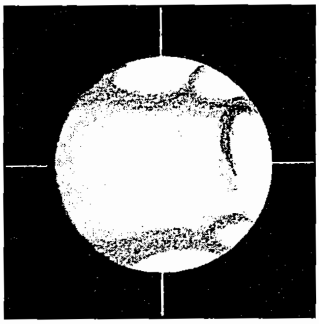

Figure 22. D. Niechoy. 1995 AUG 02, 04h57m UT. 20-cm Schmidt-Cassegrain, 225X, W25 (red) Filter. k = 0.996, diameter = 9".68.

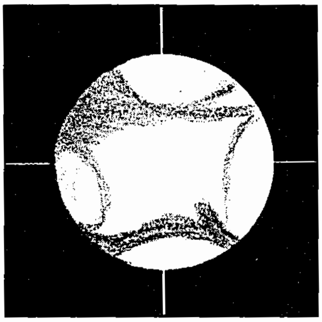

Figure 23. D. Niechoy. 1995 AUG 02, 05h02m UT. 20-cm Schmidt-Cassegrain, 225X, W15 (yellow) Filter. k = 0.996, diameter = 9".68.

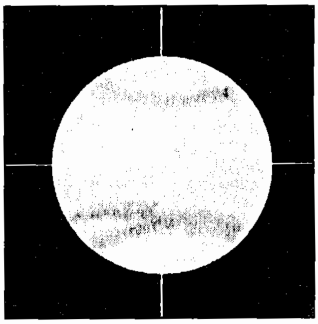

Figure 24. D. Niechoy. 1995 AUG 10, 05h16m UT. 20-cm Schmidt-Cassegrain, 225X, W25 (red) Filter. k = 0.999, diameter = 9".65.

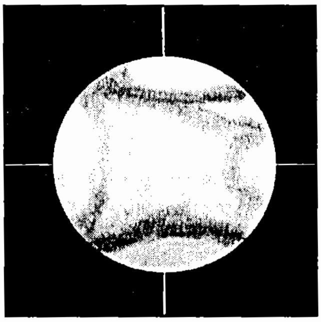

Figure 25. D. Niechoy. 1995 AUG 10, 05h19m UT. 20-cm Schmidt-Cassegrain, 225X, W15 (yellow) Filter. k = 0.999, diameter = 9".65.

SOME CONSTRAINTS ON LUNAR TRANSIENT PHENOMENA

By: Frank Smith

ABSTRACT

This article discusses physical and geological constraints on the observation of Lunar Transient Phenomena; especially those involving the physical size of reported events, the Moon's lack of atmosphere and minimal seismic activity, and the fact that crater central peaks are not volcanic structures.

The A.L.P.O. and the British Astronomical Association are the only organizations that conduct ongoing scientific investigations into Lunar Transient Phenomena (LTP). Despite the overall high quality of both programs, some of the reported data (especially in pre-Apollo times) appear to have been influenced by the terrestrial biases of the observers.

An observer who wishes to submit high-quality data on LTP must be aware of some basic physical and geological facts. The human brain works by relating to past experiences the information reported by the senses. This tends to cause the well known psychological effect of experiencing the expected. This "finding what you are looking for" effect is a result that must be strongly guarded against, and an observer who reports impossible or improbable events only confuses the situation. A good lunar observer should be cognizant of the physical and geological constraints on LTP.

LUNAR EVENTS MUST BE LARGE

The observer must be aware that any lunar event observable from Earth must be, by definition, a very large and energetic event. At the mean lunar distance, with 1 arc-second resolution as good seeing, the smallest event visible in amateur telescopes would be about 1.8 km. Since most reported LTP are inherently low-contrast events, the "average" LTP must be significantly larger. [Although a highly luminous event, like a star, could be seen however small its angular size. Ed.] In fact, most reported events are huge by terrestrial standards. For example, observers have frequently reported that the floor of the crater Plato experiences "obscurations" or "mists." However, Plato has a diameter of about 100 km and an area of almost 8000 km^2! LTP that appear and disappear over such large areas within minutes must be very suspect. The corollary of this fact is that any physical process able to produce a LTP visible from Earth must be very energetic.

THE MOON HAS ALMOST NO ATMOSPHERE

Many pre- and some post-Apollo observers appear to have reported events which are not possible due to the nearly total lack of a lunar atmosphere. Direct measurement by the Apollo astronauts gave a result of about 2×10^5 molecules/cm^3 during the lunar night and 10^4 molecules/cm^3 during the day. This is a very hard vacuum. The total ambient lunar atmosphere is estimated to be only 10^4 kg. [Heiken *et al.*, 1991, p. 40] Each Apollo landing released as much gas as the total preexisting lunar atmosphere!

Apollo Missions 12, 14, and 15 placed cold cathode gauge experiments on the lunar surface which measured the status of the lunar atmosphere [Heiken *et al.*, 1991, p. 41]. No increases in the density of the atmosphere were recorded that would suggest an outgassing event. These instruments were sensitive enough to detect emissions from the lunar lander itself. Any outgassing large enough to be visible as a LTP would surely have been recorded as a spike in the volume of the lunar atmosphere. No significant spikes were ever recorded. [French, 1977, p. 207]

Another problem for LTP is that the same experiments found that what little lunar atmosphere there is consists chiefly of neon, helium, hydrogen and argon. [Heiken *et al.*, 1991, p. 45] Terrestrial volcanoes emit chiefly water vapor, CO, CO_2 and SO_2. It appears that no water ever existed on the lunar surface, but it is difficult to imagine a lunar outgassing event that did not include some of the above gasses.

Another type of frequently reported LTP involves ground-hugging "mists" or "fogs". Classical observers may have been visualizing lunar analogs of the "steams and smokes" of terrestrial volcanic events. During a terrestrial eruption, gasses and smoke tend to hug the ground because the heat generated by the volcanic material causes the overlying air to rise, causing a thermal updraft which sweeps smoke and steam along the ground. On the Moon, this is impossible. There is no water to produce steam and no organic material to produce smoke. Other gasses released into a near vacuum would obey Boyle's Law and dissipate. There does not appear to be any physical mechanism to keep any gaseous emission concentrated.

Possibly the most often-reported LTP are "red" or "blue" events. Once again we appear to have a phenomena without a physical process to create it. The most likely origin of such events is located closer to the observer than to the Moon. The cause of localized, quick-changing color events is terrestrial atmospheric refraction.

THE QUIET MOON

An additional serious obstacle to LTP is the low level of seismic activity in the Moon's crust. The Apollo missions placed four passive seismic experiments on the Moon. These instruments were very sensitive, easily detecting the seismic noise generated by the astronauts moving around on the lunar surface and outgassing from the LEM. The seismic experiments had a total monitoring life of almost eight years. The results of these experiments showed that the Moon's lithosphere was very static, releasing seismic energy at the rate of about 2×10^{13} ergs/year. [Wagner, 1991, p. 227] This is a very small amount! In *The Moon Book*, B.M. French states that the annual release of seismic energy by moonquakes is one million-millionth of the total energy released annually by the Earth. French also relates that a moderate-sized Fourth of July fireworks display releases more energy than the Moon does in one year. [French, 1977, p. 228]

This is a serious impediment to large, energetic LTP. How could the large events of the type being reported occur without generating considerable seismic noise? No such noise was observed by the Apollo instruments. The quiet Moon means that it is unlikely there are any volcanic "hot spots" in the lithosphere of the Moon, leaving "outgassing events" with no apparent source.

THE CENTRAL PEAKS OF LUNAR CRATERS ARE NOT VOLCANIC EDIFICES

A disturbing number of LTP involve the central peaks of lunar craters. This result shows a lack of understanding of Post-Apollo lunar geology. During classical times, lunar craters were thought to be volcanic features and the central peaks to be analogs of terrestrial stratovolcanos. This view has proved false. The vast majority of lunar craters are of impact origin.

Lunar observers should be familiar with standard lunar geologic works such as *The Geologic History of the Moon* by Wilhelms (1987) and *Impact Cratering: a Geologic Process* by Melosh (1989). Simply put, the central peaks of lunar craters are blocks of bedrock that have been fractured and uplifted by the cratering event. Apollo photographs clearly show that many central peak complexes have layered strata. This may be obscured in older craters by mass wasting, but central peaks remain cratering constructs, not volcanic ones.

During pre-Apollo times many central peaks were thought to have "craterlets" on their summits. Analysis of Lunar Orbiter photographs showed this to be false, ".. the 'craterlets' are merely the effects of shadows cast by parts of the peaks, which, in a large crater, cluster around a depression as do the points of a molar tooth." [Wilhelms, 1993, p. 14] A 1994 article in this publication mentions such a summit crater on the central peak of Tycho in relation to a LTP. [Darling and Weier, 1994] I have looked at Lunar Orbiter photographs of Tycho and I see no such crater.

Incidentally, this fact raises serious difficulties with the most famous LTP of them all, Russian astronomer Nikolai Kozyrev's event of November 2-3, 1958. According to one account, Kozyrev was observing the crater Alphonsus when the central peak became strongly washed out and took on a reddish hue. He then took a spectrum which showed an emission line of carbon. [Cameron, 1991]

However, there is a major problem with this event. The central peak of Alphonsus is not a volcanic feature! One of the objectives of the Ranger 9 Mission was to investigate Alphonsus. On March 24, 1965, Ranger 9 sent back a series of images covering the central peak of Alphonsus. The last frame showing the central peak was taken at a altitude of only 58.5 km. These views clearly show the central peak of Alphonsus to be a standard uplift massif with absolutely no volcanic features. [Carrington, 1969, pp. 57-61; from Ranger 9 images, 1966] The peak has been partially buried by plains material and debris from the Imbrium event and its own mass wasting, but shows no central peak crater, no vents, and no dark halo deposits. Whatever happened on the morning of November 2-3, 1958, it is difficult to imagine that the central peak of Alphonsus had anything to do with it.

Electrostatic Events

Electrostatic levitation is one of the few LTP to have a solid physical foundation. However, there are some problems in relating this effect to LTP. First, the original literature suggests levitation heights of about 10 meters. [Heiken *et al.*, 1991, p. 536] This is far below the height needed to obscure topographical relief as visible from Earth. Second, reports on this type of phenomena describe localized events. It appears that this type of event should be visible all along the sunrise terminator.

Another problem with large-scale electrostatic levitation is that no deposition is visible in lunar images at any resolution. Most large lunar craters are over a billion years old. This would provide plenty of time for a deposit to accumulate if electrostatic levitation was moving dust in concentrations sufficient to be visible from the Earth.

Conclusion

The Association of Lunar and Planetary Observers and the B.A.A appear to have skilled and dedicated observers. Their analysis of data also appears to be first rate. However, the author is less confident of some of the data being reported. In the opinion of the author, all pre-Apollo observations, even those by professional astronomers, are strongly suspect due to the poor understanding of lunar geology and the terrestrial mindset of the observers. An observer wishing to obtain good data should be strongly grounded in physics and current lunar geology.

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An Upcoming Occultation of a Star by Uranus

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Abstract

Observers in the British Isles, southwestern Europe, Africa, South and Central America and the eastern United States and Canada should mark their calendars for 1998 Aug 27 UT, when there will occur a rare occultation of a +9.5-magnitude star (PPM 237981 in Capricornus) by Uranus.

This event is not to be missed! A.L.P.O. members and amateur astronomers in general throughout the visibility region—the British Isles, southwestern Europe, Africa, South and Central America, and the eastern United States and Canada—can make a major contribution to the planetary science community with moderate-size telescopes. Whether observing visually, videotaping, or conducting photoelectric photometry or CCD imaging, we can learn a great deal about Uranus' dark rings and, with larger instruments, its atmosphere. This is certainly an opportunity for collaboration between amateur and professional astronomers.

A 9.5-magnitude star named PPM 237981 in Capricornus will appear to approach Uranus from the west and then slip behind the planet and its rings. [Note that *The Guide Star Catalog* lists this star's magnitude as +11.4. Ed.] Unlike Saturn's, the rings of Uranus cannot be seen visually due to their low reflectively and small dimensions. During the occultation, though, the star will dim and brighten or even flicker in and out as it passes behind the dark rings. A real contribution would be to determine how much dimming is involved for each ringlet. In addition to that, from timing the star's brightness changes, you can calculate the positions and widths of the ringlets and how far apart they are from one another.

When the initial occultations by the ringlets are over, get ready for Uranus itself. The star will slowly fade behind the atmosphere, allowing us to determine the atmospheric density and scale height. [Observing the occultation by the planet will be considerably more difficult than for the ringlets; the most promising approach is to do CCD imaging with a methane-band filter and a fairly large aperture. Ed.] The star itself will then be occulted by Uranus for about 42 minutes. It will then reappear and the ringlet occultations will then recur in reverse order. Therefore we will have two chances to witness these events! On the other hand, no occultations will take place involving any of Uranus' satellites.

Keeping track of the time is very critical! When this star approaches the Uranian ring system, every second will count! [*Note:* Detailed predicted times are given in the Appendix on pp. 119-120. Ed.] If you blink your eyes often or turn them away from the eyepiece during the occultation of the ringlets, you may miss something entirely! According to past occultations and Voyager II images, Uranus has nine ringlets. It is possible that we should see nine dimmings. One ringlet, ε (epsilon), will be far more noticeable than the others. However, even it can cause dimming for no longer than about 2 seconds. The other ringlets can cause noticeable effects also but these could last for only a split-second. After the rings' occultation, there will be only about six minutes before the star fades behind the atmosphere. So don't take your eyes away yet! If you are able, watch how long it takes the star to reach the atmosphere and take notice when the star starts to dim. When the star disappears, you will have a real 42-minute break. Don't get too comfortable; you will have to get ready when the star reappears.

At about 01h36m UT, the star will gradually reappear from Uranus' disk on the east side. Once it regains its brightness, get ready for another occultation by the ringlets. Again, time the dimmings of the star behind each ringlet. This is one additional contribution you can make. Most of the ringlets are not circular, so that the timing intervals may be a little different compared with results before Uranus occulted the star. The ε ring will possibly cause a different amount of dimming due to its varying thickness.

Uranus will reach opposition on 1998 AUG 03 and the occultation will occur only three weeks later, so that daylight or twilight will not be problems for most of the visibility zone; neither will the waxing-crescent Moon.

Uranus' polar axis is inclined 98° to its orbit, and will be tilted about 39° toward the Earth at the time of the occultation. Could we see the ringlets, they would appear elliptical to us. In 1985, they were nearly face-on to us and in 2007 will appear edge-on.

In the Americas, the event will occur on Wednesday evening August 26th right after the beginning of darkness, low in the eastern sky. Disappearance events will be visible east of the lower Mississippi River, central Indiana and central lower Michigan. Reappearance events will be visible east of central Texas and Oklahoma western Missouri and central Iowa and Wisconsin. Farther west, all events will occur below the eastern horizon. In South America, the event will be visible much higher in the sky than in North America, near the meridian. In Europe and Africa, it will occur later in the local morning of August 27th, hours before Uranus sets

Uranus and the star differ by about 3.8 magnitudes, so that the star will be only about 3 percent as bright as the planet. With a moderate-size aperture, for the ringlet events the star shouldn't be overwhelmed by Uranus' glare.

The best way to participate in this event begins with preparation. It is far easier to record your observation in a visual method instead of using complicated equipment. The whole event will happen quickly and you don't want.to lose time. But, if you want your observation to be more meaningful, a tape recorder and a WWV shortwave time signal will be very helpful. You record what you see through the eyepiece on tape while the time signal is ticking in the background. Another good method is to videotape the event. You can constantly record the event on the TV screen, watch it live at a more comfortable level, and simultaneous record the time signals on the audio track. However, the +9.5-magnitude star is a little on the faint side. If the star is not visible, you will not record anything significant. If it is faintly visible, it may be hard to see the disappearances and reappearances of the star during the events. The star should be at a comfortable brightness level so you can be more sure of what you are recording. And of course, you can always play the videotape back if you miss something on the screen.

At a more advanced level, photoelectric photometry or CCD imaging is the best choice. Photometry is the best way to monitor the brightness of the star; however, because of the proximity of the rings (much less the atmosphere) to the planet, you will have to include the star and the planet in the same photometer aperture. Thus, the photometric readings will fall only slightly due to the dimming of the star itself. The integration time is also very important. During the ring occultation, you will need a high-speed photometer in order to record the split-second events. For the planet's atmosphere, a one-second integration time will be sufficient time resolution. Another important photometry method is to use a near-infrared filter. Observation in the near-infrared will dim Uranus due to the methane absorption bands [At 5430Å, 6190Å, 7260Å, 8650Å, and 8900Å. Ed.]. This will increase the brightness difference between the star and Uranus.

Another advanced method is CCD imaging, a great way to capture the event, again preferably with a methane-band filter. You can constantly click to image the event while it is happening. But, during the ring occultation, you must be aware of the time exposure and the speed of downloading the image on your computer. You must be sure that the exposure time is short enough to capture the quick disappearance of the star, of the clarity of the images, and of the tracking ability to keep the target dead center. Secondly, you don't want lose too much time in downloading each image. The faster your computer, the better.

The weather plays an important role in observing this event. Naturally, if it is cloudy, forget it—this event won't happen again. Otherwise if there are some clear skies within driving distance, you might want to take a chance in traveling. Keep watching the weather satellite image in your area on the Internet. Your success also depends on the seeing conditions. If there is turbulence, you may have some difficulty in identifying the disappearances and reappearances of the star. Don't forget that, from the United States, events will occur low in the eastern sky after darkness. There is a chance that you may run into some turbulence. During a heat wave or if the sky is hazy, you may have a good chance for steady seeing. Again, keep track of the weather, especially if a cold front is approaching your area. All in all, just pray for good weather!

In conclusion, record the event using whatever means is easier for you. Uranus infrequently occults a star this bright. The safest bet is for you to see the ring occultations visually. Then if you are equipped with photoelectric photometry or CCD, you may want to record when the star is shinning through Uranus' atmosphere in order to monitor the brightness. This event is much slower and the timing is less critical than the ringlet occultations. For the atmospheric events, though, remember that the larger the aperture the better, and a methane-band filter will be really useful.

Finally, if your observations are successful, you should share with others and especially with the professionals in this field. Send your report to Richard Schmude, Jr., our Remote Planets Coordinator (address in staff listing). You never know whether we might discover something more about Uranus and its rings!

Appendix by Editor

Because of the rapid time scale of the occultation, *Table 1* (upper right) gives the *geocentric* Universal Times predicted for the ring and planet events. Approximate time corrections for different areas in the visibility zone are given in *Table 2*, following *Table 1*. *Figure 1* (p. 120) is a finding chart for Uranus at the time of the occultation, while *Figure 2* (p. 120) is a large-scale plot of the geocentric apparent movement of PPM 237981 relative to Uranus.

PPM 237981 will appear to move centrally behind Uranus on a line stretching southwestward from Mozambique—Zambia—Namibia in southern Africa, then across the South Atlantic Ocean to a line from Golfo San Jorge (southern Argentina) to Golfo de Penas (southern Chile). It is possible that a central flash will be observed at mid-occultation from stations near this line.

Table 1. Geocentric event UT predictions for the occultation of PPM 237981 by Uranus and its rings, 1998 Aug 27 UT.

Object	1st Event h m	2nd Event h m
Ring ε	00 42.5	01 48.7
Ring δ	00 44.4	01 46.8
Ring γ	00 44.8	01 46.4
Ring η	00 45.1	01 46.1
Ring β	00 46.1	01 45.1
Ring α	00 46.7	01 44.5
Ring 4	00 48.1	01 43.1
Ring 5	00 48.3	01 42.9
Ring 6	00 48.5	01 42.7
Uranus Limb	00 54.7	01 36.5

Table 2. Approximate topocentric corrections to Table 1.

(+ = later than geocentric UT, - = earlier)

	minutes
Cent. America, W South America	+3
SE & Midwest United States, Caribbean	+2
NE United States, Central South America	+1
NE Canada, W Brazil	0
NW Africa, British Isles, Iberian Peninsula, South Africa	-3
W Sahara, France, Italy	-4
Central Africa	-5

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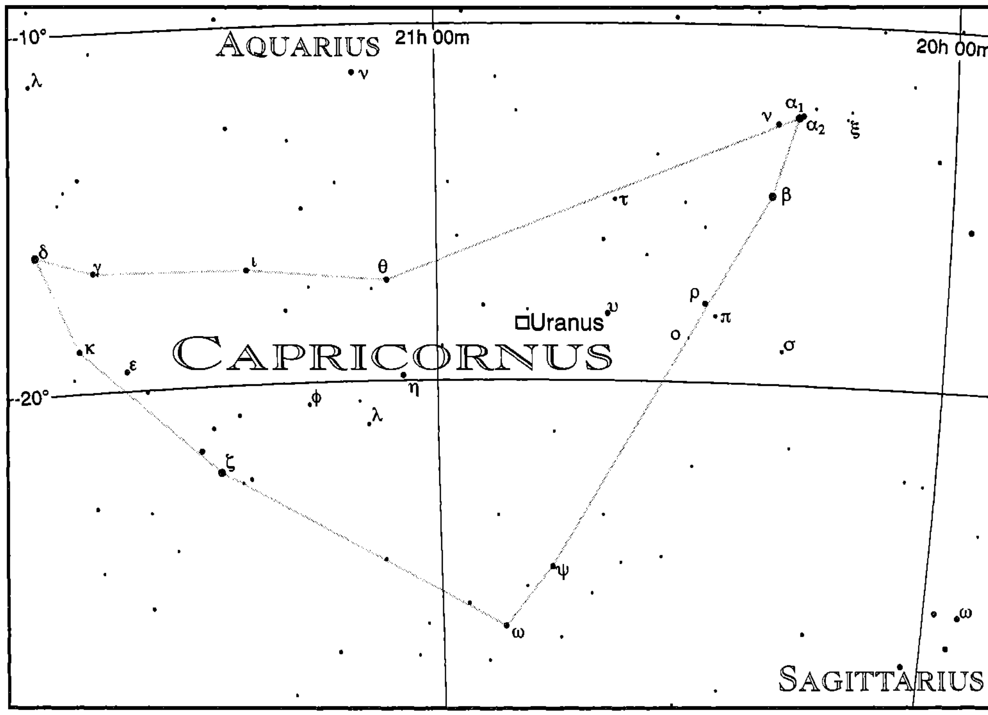

Figure 1. Finding chart for Uranus, 1998 AUG 27 UT. Limiting magnitude +6.5; Uranus' magnitude is approximately +5.7.

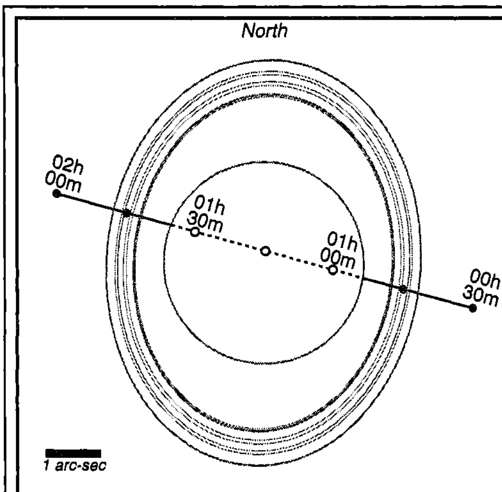

Figure 2. Apparent geocentric path of star PPM 237981 relative to Uranus and its ring system. Times are in UT for 1998 AUG 27. Path may differ for actual locations by up to 0.46 arc-seconds and times by up to ±5 minutes. From the outside inward, the ringlets are named: ε, δ, γ, η, β, α, 4, 5, and 6.

THE 1996 APPARITIONS OF URANUS AND NEPTUNE

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A.L.P.O. Remote Planets Coordinator

ABSTRACT

Members of the A.L.P.O. Remote Planets Section submitted 57 photoelectric magnitude measurements, 119 visual magnitude estimates, and 1 drawing of Uranus and Neptune during 1996. The selected normalized magnitudes based on the photoelectric measurements are: $V(1,0) = -7.14\pm0.03$ for Uranus and $V(1,0) = -6.94\pm0.01$ for Neptune. Photoelectric data over the last few years suggest that Uranus may have become slightly dimmer in 1996. The selected normalized magnitudes for 1996 based on visual magnitude estimates are: $V_{vis}(1,0) = -7.1\pm0.04$ for Uranus and $V_{vis}(1,0) = -7.0\pm0.04$ for Neptune.

INTRODUCTION

Table 1 (to right) lists the characteristics of the 1996 apparitions of Uranus and Neptune. The southerly declinations of these two planets meant that they were at best relatively low in the sky from the United States. In addition, useful observations were difficult within roughly two months of conjunction. Therefore, the observing period for both planets was about eight months long. Six individuals assisted with or submitted measurements of the remote planets during 1996; their locations and other information are listed in *Table 2* (to right). All photoelectric and visual magnitude measurements made in 1996 are described later in this report.

Table 1: Characteristics of the 1996 apparitions of Uranus and Neptune.

Parameter	Uranus	Neptune
1996 Conjunction date[a]	1996 JAN 21	1996 JAN 16
Opposition date[a]	1996 JUL 25	1996 JUL 18
Angular diameter[a,c]	3".7	2".3
Right Ascension[a,c]	20h 20m	19h 53m
Declination[a,c]	-20°.2	-20°.4
1997 Conjunction date[b]	1997 JAN 24	1997 JAN 17

[a]Manske and Weier, 1996, p. J1; [b]Schaaf, 1997, p. 81);[c]At opposition.

Table 2. People who contributed Uranus/Neptune observations in 1996.

Observer	Type of Observation	Location (U.S.A.)
Gus E. Johnson	P, VP	Swanton, MD
Eugene Lopata	PP	Digger Pines, CA
Jens Rummler	VP	Oscar, LA
Richard W. Schmude, Jr.	D, VP, PP	Villa Rica, GA
Eric Shelton	PP*	Villa Rica, GA
Kemper Smith	PP*	Villa Rica, GA

*Assisted in the collection of photoelectric data. PP = photoelectric photometry, D = drawing, VP = visual photometry, P= photographic

PHOTOELECTRIC PHOTOMETRY

All photoelectric measurements were made with the SSP-3 solid-state photometer along with Johnson B, V, R and I filters (Blue, Visual, Red and Infrared, respectively). Eugene Lopata used a 20-cm (8-inch) Schmidt-Cassegrain telescope for his measurements while the author used a 51-cm (20-inch) Newtonian telescope at Barber Observatory (in Villa Rica, GA) for his photoelectric measurements. The SSP-3 photometer is described elsewhere [Optec, 1988; Schmude, 1992, p. 20]. A summary of the comparison and check stars used in this study is given in *Table 3* (p. 122).

The transformation coefficients to convert measurements to the standard Johnson photometric system for the photometers used by E. Lopata and R. Schmude were evaluated, using the two-star method described elsewhere [Hall and Genet, 1988, pp. 199-200]. E. Lopata used ξ Cyg and ν Cyg while the author used χ Peg and γ Peg in the evaluation of the transformation coefficients. As it turned out, transforma-

Table 3. Summary of comparison stars used for photoelectric photometry of Uranus and Neptune in 1996.

Star Name	Coordinates (2000.0)[a]	Magnitude[b] B	V	R	I	Spectral Type
o Sgr	19h 04.7m; -21°45'	4.78	3.77	3.13	2.59	G9
50 Sgr	19h 26.3m; -21°47'	6.81	5.59	——	——	K3
56 Sgr	19h 46.4m; -19°46'	5.79	4.86	——	——	K1
β Cap	20h 21.0m; -14°47'	3.87	3.08	2.53	2.03	G5
ρ Cap	20h 28.9m; -17°49'	5.18	4.80	4.46	4.26	F2

[a](Hirshfeld *et al.*, 1991).
[b]Magnitudes of o Sgr, β Cap and ρ Cap are from: (Iriarte *et al.*, 1965) while magnitudes of 50 Sgr and 56 Sgr are from (Hirshfeld *et al.*, 1991).

tion corrections for the V and R filters were well below 0.01 magnitudes but corrections of 0.01 to 0.05 magnitudes were necessary for the B and I filters. Transformation coefficients for R. Schmude's instruments are described elsewhere [Schmude, 1997b].

All photoelectric measurements of Uranus are listed in *Table 4* (p. 124) while those of Neptune are in *Table 5* (p. 124). In each of these two tables, the first column lists the date and time as a fractional day in Universal Time. The filter, measured and normalized magnitudes, comparison star, difference in air mass and the temperature are listed in the second through the seventh columns respectively. The normalized magnitude, designated as X(1,0), describes the brightness of a planet when it is exactly 1.0 Astronomical Units from both the Earth and the Sun (one Astronomical Unit is the mean distance between the Earth and the Sun; 149.6 million km). The normalized magnitude is calculated as:

(1) $X(1,0) = X - 5 \log[r\,\Delta] - c_V\alpha - 2.5 \log[k]$,

where X is the measured magnitude, c_V is the solar phase coefficient, α is the solar phase angle, k is the fraction of the disc that is illuminated, r is the planet-Sun distance and Δ is the Earth-Sun distance; both r and Δ are in Astronomical Units (A.U.). The $c_V\alpha$ and 2.5 log[k] terms are below 0.01 magnitude for Uranus and Neptune and have not been included in this study. All of the measurements in *Tables 4* and *5* have been corrected for atmospheric extinction and transformation. On most dates, extinction coefficients were measured and applied to the measured magnitudes. On nights when no coefficients were measured, extinction coefficients (in magnitudes/air mass) of 0.40, 0.26, 0.19 and 0.16 for the B, V, R and I filters respectively were used; these are mean values measured near sea level at Texas A&M University Observatory [Schmude, 1994b, p. 15]. On 1996 JUL 11 the V-filter magnitudes for Uranus were measured several times over a time period of a few hours. The purpose of these measurements was to look for any short-term variations in the brightness; the results are plotted in *Figure 1* (below; top half). The bottom half of *Figure 1* shows a similar set of measurements for Neptune. Uranus does not show any obvious trend in brightness whereas there are hints of a change for Neptune; if real, presumably due to rotation. The results are preliminary and suggest that further studies should be undertaken in 1997.

The mean normalized magnitude for Uranus in 1996 was V(1,0) = -7.14±0.03; about 3 percent dimmer than in previous years [Schmude, 1992, p. 22; Schmude, 1994a, p. 118; Schmude, 1996, p. 66;

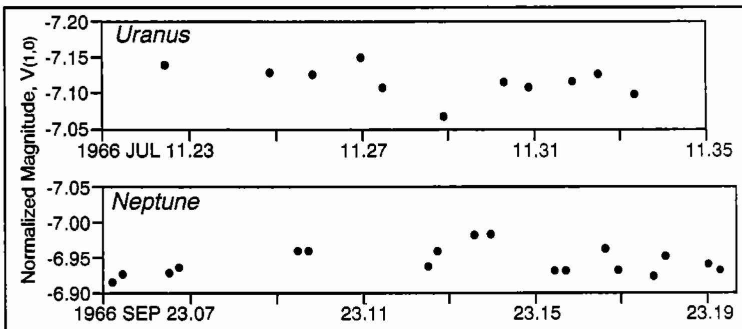

Figure 1. Normalized magnitude versus UT date for Uranus (upper) and Neptune (lower).

Schmude, 1997a, p. 130]. This change may be related to possible long-term weather changes on Uranus [Flanagan, 1997, p. 54]. The 1996 value for Neptune was V(1,0) = -6.94±0.01, which is close to the 1995 value [Schmude, 1997a, p. 130] but is a few percent brighter than the 1992 value [Schmude, 1995, p. 139]. This change may also be due to long-term weather changes [*Sky & Telescope*, 1997, p. 15].

VISUAL PHOTOMETRY

A total of 70 visual magnitude estimates of Uranus and 49 of Neptune was made by A.L.P.O. members during 1996. The mean normalized magnitudes for Uranus and Neptune for 1996 are -7.1±0.04 and -7.0±0.04 respectively. The uncertainties are equal to $2\sigma/N$ where σ is the standard deviation and N is the number of estimates. The uncertainties include only random errors and do not include possible systematic errors arising from differences between star and planet color. The Vvis(1,0) values for Uranus and Neptune during past apparitions are summarized in *Table 7* (p. 125), where Vvis(1,0) designates the normalized magnitude based on eyeball magnitude estimates, not to be confused with the more precise V-filter photoelectric measurements. However, the visual results are very close to V-filter photoelectric results.

DRAWING

One drawing of Uranus was made during 1996 and is shown in *Figure 2* (upper right). The most distinct feature was a bright limb spot at the southern edge of the disc. A similar feature was drawn over 40 years ago [Abbey, 1958, 147].

CONCLUSIONS

A total of 57 photoelectric and 119 visual magnitude measurements were made of Uranus and Neptune. The selected normalized V (visual) magnitudes based on the photoelectric measurements are: V(1,0) = -7.14±0.03 for Uranus and V(1,0) = -6.94±0.01 for Neptune. Normalized B, V, R and I magnitudes for both planets are given in *Table 6* (p. 124). The data suggest that Uranus may have become a little dimmer in 1996. The normalized magnitudes based on visual estimates are: Vvis(1,0) = -7.1±0.04 for Uranus and Vvis(1,0) = -7.0±0.04 for Neptune.

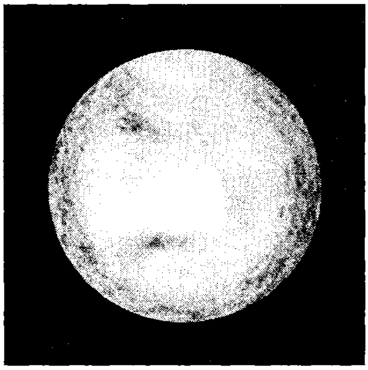

Figure 2. Drawing of Uranus by R.W. Schmude, Jr. 1996 AUG 18, 03h20m-03h38m UT. 46-cm Newtonian, 480X. Seeing = 1.5 arc-sec or 5 on the standard A.L.P.O. Scale (0 = worst to 10 = perfect). Observing site near Jackson, GA.

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(References continued on p. 125)

Table 4. Photoelectric magnitude measurements of Uranus made in 1996.

1996 Date (UT)	Filter	Magnitude Measured	Magnitude Normalized	Comparison Star	Δ Air Mass	Temperature (°C)
JUL 11.224	V	5.71	-7.14	ρ Cap	.117	20
11.248	V	5.72	-7.13	"	.067	"
11.258	V	5.72	-7.13	"	.080	"
11.269	V	5.70	-7.15	"	.080	"
11.275	V	5.74	-7.11	"	.079	"
11.289	V	5.78	-7.07	"	.077	"
11.303	V	5.73	-7.12	"	.082	"
11.309	V	5.74	-7.11	"	.086	"
11.319	V	5.73	-7.12	"	.090	"
11.325	V	5.72	-7.13	"	.089	"
11.333	V	5.76	-7.10	"	.092	"
SEP 06.060	V	5.75	-7.15	β Cap	.252	"
06.092	B	6.42	-6.47	o Sgr	-.018	"
06.094	V	5.63	-7.26	"	-.027	"
06.098	R	6.02	-6.87	"	-.035	"
06.101	B	6.38	-6.51	ρ Cap	.107	"
06.103	V	5.81	-7.08	"	.106	"
06.105	R	6.05	-6.85	"	.106	"
06.108	I	7.28	-5.61	ρ Cap	.106	"
08.102	B	6.16	-6.74	56 Sgr	.024	"
08.104	V	5.62	-7.27	"	.019	"
08.125	B	6.01	-6.88	"	-.017	"
08.128	V	5.65	-7.25	"	-.016	"
08.132	B	6.14	-6.75	"	-.008	"
08.134	V	5.79	-7.10	"	-.006	"
15.151	V	5.76	-7.13	50 Sgr	-.428	16
15.175	V	5.76	-7.14	"	-.486	"

Table 5. Photoelectric magnitude measurements of Neptune made in 1996.

1996 Date (UT)	Filter	Magnitude Measured	Magnitude Normalized	Comparison Star	Δ Air Mass	Temperature (°C)
JUL 13.331	B	8.04	-6.68	56 Sgr	.05	—
13.367	V	7.76	-6.95	"	.05	—
AUG 10.241	B	8.12	-6.60	"	.05	—
10.281	V	7.76	-6.96	"	.05	—
SEP 08.110	B	8.33	-6.42	"	.038	20
08.113	V	7.81	-6.94	"	.029	"
08.115	B	8.23	-6.51	"	.036	"
08.118	V	7.90	-6.85	"	.037	"
08.143	B	8.00	-6.76	"	.045	"
08.145	V	7.74	-7.01	"	.055	"
15.161	V	7.84	-6.91	"	-.199	16
15.166	V	7.84	-6.91	"	-.382	"
23.052	V	7.84	-6.92	"	.037	"
23.054	V	7.83	-6.93	"	.037	"
23.065	V	7.83	-6.93	"	.035	"
23.067	V	7.82	-6.94	"	.037	"
23.095	V	7.80	-6.96	"	.035	"
23.097	V	7.80	-6.96	"	.041	"
23.125	V	7.82	-6.94	"	.030	"
23.127	V	7.80	-6.96	"	.050	"
23.136	V	7.78	-6.98	"	.005	"
23.139	V	7.78	-6.98	"	.031	"
23.154	V	7.83	-6.93	"	.046	"
23.157	V	7.83	-6.93	"	.089	"
23.166	V	7.80	-6.96	"	.025	"
23.169	V	7.83	-6.93	"	.081	"
23.177	V	7.84	-6.92	"	.006	"
23.180	V	7.81	-6.95	"	.079	"
23.190	V	7.82	-6.94	"	.022	"
23.193	V	7.83	-6.93	"	.126	"

Table 6. Mean B, V, R and I magnitudes for Uranus and Neptune in 1996.

Filter	Normalized Magnitude Uranus	Normalized Magnitude Neptune	Number of Measurements Uranus	Number of Measurements Neptune
B	-6.67±0.14	-6.59±0.12	5	5
V	-7.14±0.03	-6.94±0.01	19	25
R	-6.86±0.02	——	2	—
I	-5.61	——	1	—

(References continued from p. 123)

Schmude, R. W. Jr. (1992) "The 1991 Apparition of Uranus." *J.A.L.P.O.*, Vol. 36, No. 1 (March), pp. 20-22.

________. (1994a) "The 1992 Apparition of Uranus." *J.A.L.P.O.*, Vol. 37, No. 3 (February), pp. 116-119.

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Table 7. Normalized visual magnitude estimates for Uranus and Neptune from 1989 through 1996.

The uncertainties were calculated from $2\sigma/\sqrt{N}$ where σ is the standard deviation and N is the number of estimates. The N value is given in brackets.

Apparition	Vvis(1,0) Uranus	Vvis(1,0) Neptune
1989	-7.3±0.04 [16]	——
1991	-7.2±0.05 [29]	——
1992	-7.2±0.04 [66]	-6.8±0.05 [3]
1993	-7.2±0.04 [30]	-6.7±0.12 [15]
1994	-7.1±0.02 [394]	-6.8±0.04 [21]
1995	-7.2±0.03 [73]	-6.9±0.05 [54]
1996	-7.1±0.04 [70]	-7.0±0.04 [49]

________. (1997b) "Observations of Mars in 1996-97." Manuscript in preparation and will be submitted to *J.R.A.S.C.*

Sky & Telescope (1997) "Neptune's Tempestuous Temperament." Vol. 93, No. 3 (March), pp. 15-16.

50 Years Ago: A Selection from The Strolling Astronomer, July 1, 1948 (Vol. 2, No. 7), "Notes," p. 3.

On pg. 5 of our March issue we discussed observations of the occultation of Mars by the moon on January 28, 1948, with especial reference to the lunar limb band sometimes seen at planetary occultations. Two belated reports on this event deserve mention here. One is from R.R. LaPelle of Longmeadow, Mass., who used a 6-inch reflector at 96x. He observed only the immersion; this event occurred at the dark limb of the moon, though the width of the unilluminated lune was not more than 10″. The view of Mars was good enough to reveal the polar caps and some other markings. Mr. LaPelle saw no limb band nor any other effects attributable to a lunar atmosphere.

Mr. M.B.B. Heath writes that he observed the occultation with a 10-inch reflector. He says : "I saw no lunar limb band at disappearance on the bright limb, though conditions here were very favorable for a prolonged view of it, the planet taking quite 3/4 minutes to be completely covered. The north polar cap was bright, white, and even irradiating a little, bordered by dark shadings and with Mare Acidalium dark on the terminator. Reappearance was very beautiful on the dark limb; but the width of the dark lune was, at the point of emersion, only about 1/4 the diameter of the planet [about 3″.4]. Hence there was a narrow black band between the emerging points on the planet and the bright terminator but even so no appearance of any limb band."

Mr. Heath also says that he noted the albedo of Mars to be about equal to that of the lunar terminator. This near-equality may bear upon the limb band; if it is an illusion caused by the differing brightnesses of the moon and a planet, perhaps there was not enough contrast present to produce it at this occultation.

THE APPARITION OF COMET CERNIS-KIUCHI-NAKAMURA (1990b = 1990 III)

By: Don Machholz, A.L.P.O. Comets Coordinator

ABSTRACT

Here we examine a comet discovered in March, 1990 by three amateur astronomers. This comet was observed for only two months; yet these observations indicate that the comet faded very rapidly after perihelion. The comet's orbit, motion, magnitude, and coma and tail size and appearance are also described.

DISCOVERY

When a discoverable comet appears in the evening sky, it is not unusual for it to be discovered by several comet hunters in the course of a few days. That is the case with this comet. [1]

It all began on March 14, 1990, a clear night in Vilnius, Lithuania. Kazimieras Cernis, already the discoverer of two comets, went with a friend to a site 25 km east of the city to comet hunt. His friend, Henryk Selevich, a comet hunter who had accumulated 70 hours of searching since 1988, brought along his 10.1-inch (26-cm) f/3.8 reflector.

Cernis' instrument was a 6-inch (15-cm), f/4.6 refractor, equipped with an eyepiece giving 35X and a field of view of 1°.8. After an hour of sweeping he picked up the Andromeda Galaxy and M32, and "about three sweeps later at the center of the scan" he found "the faintest object I had seen this evening". The comet showed some condensation and was 2 arc-minutes in diameter, 25° above the west-northwest horizon. At this moment, Selevich, sweeping near M1, was asked to confirm Cernis' object, which was then 2° north of the Andromeda Galaxy. He confirmed both the existence and the location of the comet. Before the Moon rose, Cernis also noticed that the comet was moving northeast at about 3 arc-minutes/hour and estimated its brightness at +9.1 visual magnitude.

One would think that the comet would have then been reported, but upon arriving home Cernis thought that he had "discovered" the previously discovered Comet Skorichenko-George, because his comet's location, magnitude and motion appeared similar to the latter's. (Actually, at that time Comet Skorichenko-George was about 5° from Cernis' comet.)

The next morning Cernis began to suspect that perhaps he had swept over an area, missed Comet Skorichenko-George, and had indeed picked up a new comet. At that point he phoned the Kiev Observatory and reported his discovery. He had searched for 631 hours over 358 sessions since his last previous discovery in July 1983.

Thirty-nine hours and thirty-seven minutes later, in Usuda-machi, Nagano, Japan, Tsuruhiko Kiuchi was sweeping for comets with his 25X150 binoculars. Up to that point, he had been searching for 1477.7 hours in 480 sessions, without finding any new comets. Suddenly, in the northwest sky, at an altitude of 20°, he picked up a fuzzy object and knew that it was not Comet Skorichenko-George. He then reported the object to the National Observatory in Japan.

At the same moment, in Yokkaichi, Mie, Japan, Yuji Nakamura was also sweeping for comets with binoculars, his being a pair of 20X120's. He also picked up the new object. He had been searching for 2236.5 hours during 1558 sessions. [2]

Later in the week, also in Japan, Nabou Oshita discovered the same comet. He was using 25X150 binoculars.

In Newberry, South Carolina, Howard Brewington found the same object on March 20th. However, by then the comet had already been named after the first three people to discover it: Cernis, Kiuchi and Nakamura.

ORBIT

Preliminary orbital elements were given in *IAU Circular 4981*. An improved orbit was calculated by Daniel W.E. Green of the Smithsonian Astrophysical Observatory's Central Bureau for Astronomical Telegrams, published in *IAU Circular 5011* and *MPC 16378*. The improved elements are given in *Table 1* (p. 127). Note that a parabolic orbit was adopted for this comet.

Table 1. Orbital Elements for Comet Cernis-Kiuchi-Nakamura. (from *IAU Circular 5011,* Equinox 1950.0)	
Time of Perihelion:	1990 Mar 17.328
Perihelion Distance:	1.06826 AU*
Argument of Perihelion:	100°.624
Longitude of Ascending Node:	347°.751
Inclination to Ecliptic:	048°.135
Eccentricity:	1.000

* AU = *Astronomical Unit*; the mean distance of the Earth from the Sun, 149.6 million km.

Sky Position of Comet Cernis-Kiuchi-Nakamura

From its discovery position in the evening sky at 49° from the Sun, the comet's solar elongation increased slowly as it moved northward to +52° declination in early April before moving slowly southward again. Such an elongation and declination allowed for constant observation by Northern-Hemisphere observers. With no horizon or twilight interference, the comet should have been observable through June.

During the period it was observed the comet's distance from the Earth increased from 1.4 AU to 1.6 AU, while the comet-Sun distance increased from 1.1 AU to 1.5 AU. These moderate changes in distances implied that the comet would not have been expected to dim much during the Spring of 1990.

Magnitude

To better analyze the data, A.L.P.O. member and comet observer Gary Kronk added observations from several other sources to our own collection for a total of 123 visual magnitude estimates. These are plotted in *Figure 1* (p. 128), which shows the apparent magnitude of the coma versus time. [Note that there is a well-known aperture effect in estimating comet magnitudes, where the same comet will appear progressively *fainter* as aperture increases. For this reason, it is normal practice, as is done in this report, to correct comet visual magnitude estimates to a standard aperture of 2.67 inches. Ed.]

Correcting for the comet's varying distance from the Sun and Earth, we calculate the absolute magnitude. This is the brightness of the comet at a standard distance of 1.0 AU from both the Earth and the Sun. Since a comet is almost never at such a distance, we use formula (1) to calculate it:

$$(1)\ m = Ho + 5 \log \Delta + 2.5N \log r,$$

where:

m = apparent magnitude;
Ho = absolute magnitude;
Δ = Comet-Earth distance in AU;
r = Comet-Sun distance in AU;
N = A constant representing the rate of brightness change as the comet-Sun distance changes. A high number indicates much change; the mean for all comets is 3.3.

The comet's absolute magnitude is plotted in *Figure 2* (p. 128). Kronk, after deleting four deviant magnitude estimates, calculated its mean as +6.85, with an "N" value of +10.6. This absolute magnitude is about average for a comet. However, the "N" value of nearly 11 indicates that the comet faded very rapidly as it receded from the Sun. This effect is apparent in *Figure 1*, where the magnitude dropped off quickly during the final month of observation. This is the reason the comet was unobserved after mid-May; it was simply too faint.

Coma and Tail Size and Appearance

No tail was reported for this comet. This is probably due to the distant perihelion location

The apparent size of the coma (head) of the comet averaged 3 arc-minutes. At the relevant distance this implies an actual diameter of about 100,000 mi (162,000 km). The apparent coma diameters that were reported are shown in *Figure 3* (p. 128).

The coma showed a significant degree of condensation when the comet was first discovered, which was just three days before perihelion passage. However, as the comet pulled away from the Sun the coma became more diffuse. Although there is considerable scatter in the observations, this effect is shown clearly in *Figure 4* (p. 128).

Participating Observers

The six individuals who contributed observations used for this report are listed in *Table 2* (p. 128), along with their observing sites and telescope type and aperture. We express our appreciation to them here.

Table 2. Participating Observers, Comet Cernis-Kiuchi-Nakamura.

Observer	Observing Site	Telescope*
Jahn, Jost	Bodenteich, Germany	20-cm N
Kronk, Gary	Troy, IL, USA	33-cm N
Modic, Robert	Richmond Heights, OH, USA	20-cm N
Nowak, Gary	Essex Jct., VT, USA	20-cm N
Pryal, Jim	Kirkland, WA, USA	20-cm SC
Viens, Jean	Charlesbourg, Quebec, Canada	11-cm N

* N = Newtonian, SC = Schmidt-Cassegrain.

FOOTNOTES

[1] Compiled from a letter from K. Cernis to Don Machholz, May 8, 1990.

[2] Central Bureau for Astronomical Telegrams, *International Astronomical Union Circular No. 4980*, issued March 17, 1990 by Daniel W.E. Green.

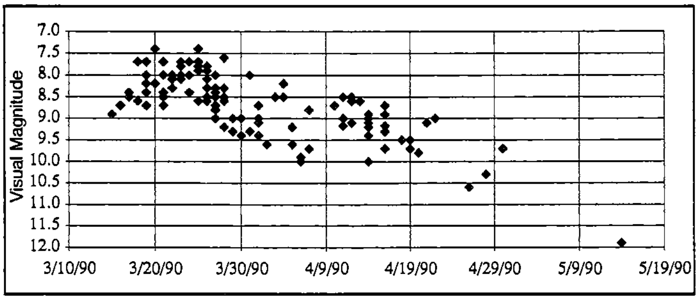


Figure 1. Apparent Visual Magnitude of Comet Cernis-Kiuchi-Nakamura (1990b), corrected to a standard aperture (2.67 in).

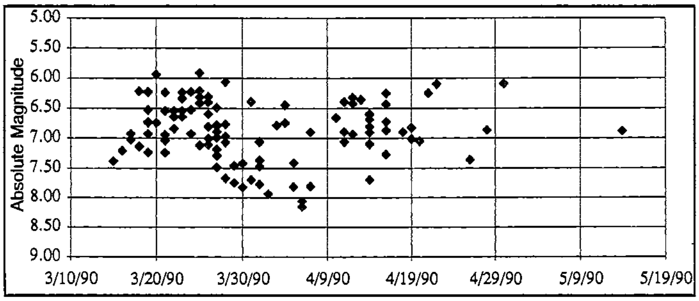


Figure 2. Absolute magnitude of Comet Cernis-Kiuchi-Nakamura (1990b), corrected to a standard aperture (2.67 in).and Earth-comet and Sun-comet distances of 1.0 AU.

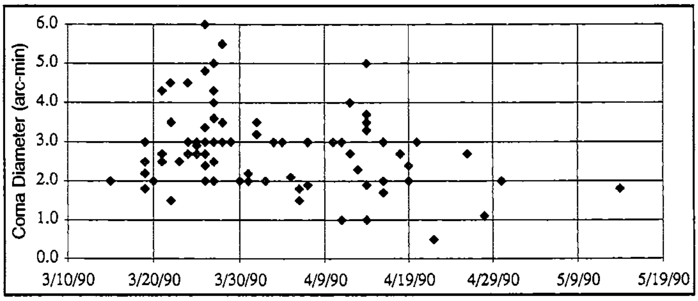


Figure 3. Apparent coma diameter of Comet Cernis-Kiuchi-Nakamura (1990b) in arc-minutes.

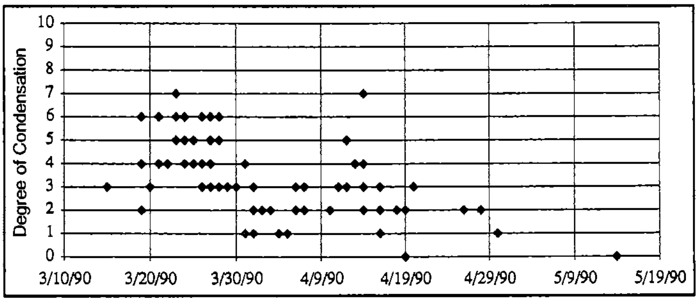


Figure 4. Degree of coma condensation of Comet Cernis-Kiuchi-Nakamura (1990b). The scale ranges from 0-1 = diffuse with very little brightening toward the center to 9-10 = a much-condensed coma.

HIGHLIGHTS OF ACTIVITY ON JUPITER IN 1997

By: Jose Olivarez,

Chabot Observatory and Science Center, Oakland, California

PREFACE TO OLIVAREZ REPORT

By David J. Lehman, Acting Jupiter Coordinator

Jose Olivarez here presents an overview of the 1997/98 Apparition of Jupiter. He uses visual observations from six observers and CCD images from two more. Even though, officially, this report is preliminary and is only a sample of Section observers, it well represents the typical overall appearance of Jupiter in 1997. The report's emphasis is on the Great Red Spot, STB White Ovals, dark "barges" of the NEBn, rapidly moving NTBs spots, Olivarez Blue Features of the NEBs-EZn, and North and South Polar Region activity.

A complete 1997/98 Apparition report is being prepared by the Jupiter Section Staff and will represent all observations submitted to the Jupiter Section. The Olivarez report, however, is representative of the work being done by the A.L.P.O. Jupiter Section, shows the importance of making regular observations and transit timings of Jovian features, and provides an up-to-date sample of recent Jovian activity.

Those interested in joining the team of Jupiter observers are encouraged to get the "Jupiter Observer's Start-Up Kit," receive *Jupiter*, the newsletter of the Jupiter Section, and join "J_Net," the Jupiter observer's E-mail network. Much is happening on the planet Jupiter; those willing to put in the time will be richly rewarded.

OPPOSITION DATA AND CONTRIBUTORS

The planet Jupiter came into opposition on 1997 AUG 09 in the constellation of Capricornus. [All dates and times in this report are UT.] Its declination at that date was -16°.7 and its equatorial disk diameter was 48.6 arc-seconds. The views of Jupiter used for this report spanned the period April-December, 1997, with the principal CCD imaging done by Isao Miyazaki of Okinawa, Japan, and Donald C. Parker of Coral Gables, Florida, who both used 16-in (41-cm) reflectors. Other observers who contributed to this report are Jose Olivarez, Walnut Creek, California; Claus Benninghoven, Burlington, Iowa; John Rodgers, Cambridge, England; Yuichi Iga, Japan; Tom Dobbins, Coshocton, Ohio; and Walter Haas, Las Cruces, New Mexico.

SUMMARY OF SPECIAL AND GENERAL ACTIVITY

The disk of Jupiter was rich in detail with up to nine belts and seven zones, a rich chaos of blue festoons in the Equatorial Zone, a reddish North Equatorial Belt with red "barges" on its north edge, rapidly moving spots on the south edge of the North Temperate Belt (North Temperate Current C), a collision between the Great Red Spot and a STrZ white oval, and belts and spots at high latitudes in both the North and South Polar Regions! The South Polar Region exhibited a belt at a very high latitude and the North Polar Region exhibited a white oval and amorphous gray features. The most notable change in a belt was the SSTB, which was broad and exhibited two components with three white ovals between them. The mid-SEB was also active with a bluish central belt and white spot activity that was especially active in September and October. The Belts most often observed were the NEB, SEBs, SEBn, NTB, NNTB, STB, SSTBn, SSTBs, and the SSSTB. Overall, the five darkest belts throughout the apparition were the NEB, SEB, NTB, SSTB, and NNTB. The seven bright zones were the NNTZ, NTZ, EZ, STrZ, STZ, SSTBZ, and SSTZ. The brightest three were usually the EZ, STrZ, and NTZ.

THE GREAT RED SPOT

The Great Red Spot appeared like a flattened orange ellipse tucked into the southern half of the Red Spot Hollow. Its length was 20° throughout the apparition and the System II longitude of its center increased from 062° on May 29 to 067° on October 12. An unprecedented collision of a STrZ white oval and the Great Red Spot occurred over the time period of May 12 - June 6. According to John Rodgers of the BAA Jupiter Section, the conspicuous anticyclonic white oval had been tracked since 1987, and was the most substantial such feature ever to encounter the Red Spot Region. A CCD image by Isao Miyazaki showed that the white oval encountered the preceding edge of the Great Red Spot on May 12. An image by Parker on May 22 (see *Figure 1*, p. 131) showed the white oval already inside the Great Red Spot at its preceding end; and a final image by Miyazaki on June 6 showed what appeared to be a bright spot just "north-following" the middle of the Great Red Spot. According to Rodgers, this spot may have been the white oval, still proceeding slowly around the Great Red Spot. The STrZ white oval did not survive its encounter with the Great Red Spot, since it does not appear in any subsequent images of the Red Spot Region.

On July 14, CCD images by Parker showed that the Great Red Spot had developed a 15°-long dark extension on its preceding side, but the extension did not survive after August.

South Temperate Belt White Oval Spots "BC", "DE", and "FA"

The South Temperate Belt white oval spots "BC", "DE", and "FA" were prominent throughout the apparition and were seen to transit south of the Great Red Spot from late July through early November as they moved in the direction of decreasing longitude. Of the three ovals, "BC" was the largest (on July 29; see *Figure 3*, p. 132) with a length of 9°; "DE" was 8° long; and "FA" was estimated to be 5° in length. This size proportion continued unchanged throughout the apparition. "BC" was in conjunction with the Great Red Spot on July 29; "DE" on September 18; and "FA" on November 1. By December 28, "BC" and "DE" appeared virtually in contact (an unprecedented occurrence) and their proximity suggested that a merger of the two ovals was likely. (Note: The merger of BC and DE occurred near Jupiter's solar conjunction. A CCD image by Miyazaki on 1998 May 20 showed only two ovals on the South Temperate Belt–"BE" and "FA". "BE" is the new designation for the merger of "BC" and "DE" into one.)

These white oval spots are anticyclonic features, and as of December, 1997, have existed on Jupiter for 57 years (since 1940).

The Remarkable Dark Red Spots ("barges") of the NEBn

Eight remarkably dark and remarkably red spots ("barges") were recorded in CCD images by Miyazaki and Parker throughout the apparition on the north edge of the North Equatorial Belt. Two of these features were so intensely dark that they could have been easily mistaken for satellite shadows! The System II longitudes of these red "barges" in late August and September, 1997, are given in *Table 1* (below). Three of the red" barges" were accompanied by nearby white oval spots, named "portholes" by the International Jupiter Watch.

Table 1. Longitudes of NEBn "Barges," 1997 Aug 24-Sep 20.

Barge Number	System II Longitude	1997 UT Date
1	348°	Sep 10
2	035°	Sep 08
3	115°	Aug 25
4	153°	Sep 20
5	226°	Sep 02
6	269°	Sep 02
7	290°	Aug 24
8	313°	Sep 10

According to John Rodgers of the British Astronomical Association, these reddish spots and white ovals are well-known features of the NEBn and have been shown by spacecraft to be cyclonic and anticyclonic, respectively. These spots usually occur in sets with the "barges" lying near latitude 16° North, and the white spots a little farther north at about latitude 19° North. The lifetime of these spots may last for a full apparition (as in 1997) but in the past some have been tracked for two years. (Note: As of 1998 Jun 25 and 27, the Miyazaki CCD images were still showing four reddish barges in the NEBn which have also been recovered by the A.L.P.O. Jupiter Section.)

Rapidly Moving Spots on The North Temperate Current C

The existence of six rapidly moving dark blue spots on the south edge of the North Temperate Belt (Current C) were reported by Yuichi Iga (A.L.P.O.-Japan

OAA) in the *International Jupiter Watch Newsletter* of July 21, 1997. His analysis of the spots' movement showed that their average drift rate in relation to System I was -60°.67/month and their mean rotation period was 9h 49m 08.6s. The rapidly moving spots were recorded from April 2 until it became difficult to see them in CCD images (due to deteriorating viewing conditions) in late November. Of the six spots, three were prominent and it was these three spots that continually showed up in the CCD images taken by Miyazaki and Parker through November.

The last outbreak of rapidly moving spots on the NTBs was followed by A.L.P.O. observers in 1993-94 and again in 1994-95 when two dark spots were seen speeding at an average System-I drift rates of -66°/month in 1993-94 and -70°/month in 1994-95. According to Phillip W. Budine, the mean rotation period of the two spots in 1993-94 was 9h 49m 01s.

Olivarez Blue Features of the NEBs-EZn

The Olivarez Blue Features (OL) are blue projections and festoons on the NEBs-EZn whose characteristics were first described by Jose Olivarez in 1984 and have been followed by A.L.P.O. Jupiter observers for the last 13 years. These features are long-lived, stay relatively fixed at the longitudes where they form, and are warmer than their surroundings. They are believed to be "holes" in Jupiter's upper cloud deck that permit viewing of the deeper, warmer regions of the planet. Many last for months or years (one feature survived for 10 years!). In a typical apparition, there are 12 such "OL" features somewhat evenly spaced around the planet. But this apparition there was such a "jumble" of festoons from 15 or more of these "OL" sources that it was difficult to identify them. Nevertheless, 15 blue features (blue masses, blue projections, and blue festoon bases) were identified from central-meridian transit timings by Olivarez, Benninghoven, and Haas. These features are identified by their longitude in *Table 2* (above).

Table 2. Olivarez Blue Features (OL) Listed and numbered in order of increasing System I longitude* (NEBn-EZn).

OL1 (97)	008°	OL9 (97)	176°
OL2 (97)	015°	OL10 (97)	187°
OL3 (97)	019°	OL11 (97)	222°
OL4 (97)	031°	OL12 (97)	262°
OL5 (97)	036°	OL13 (97)	302°
OL6 (97)	069°	OL14 (97)	320°
OL7 (97)	075°	OL15 (97)	350°
OL8 (97)	092°		

* These features were nearly stationary. Longitudes are based on two or more transit timings over a period of weeks by Benninghoven, Olivarez, and Haas. A partial check of CCD images by Miyazaki taken in May and June, 1998 showed that OL1, OL8, OL10, and OL11 continued to exist. The other OL features probably still exist also, but central-meridian transit timings are needed for their recovery in 1998.

The large number of blue features in the Equatorial Zone gave the zone a bluish cast throughout the apparition.

Below, and following on pp. 132-134 (*Figures 1-9*) are selected CCD images and drawings from the 1997 Apparition of Jupiter. South is at the top in all views. When given, Seeing is in the standard A.L.P.O. Scale, ranging from 0 = worst to 10 = perfect, while transparency ranges from 0 (worst) to 5 (perfect).

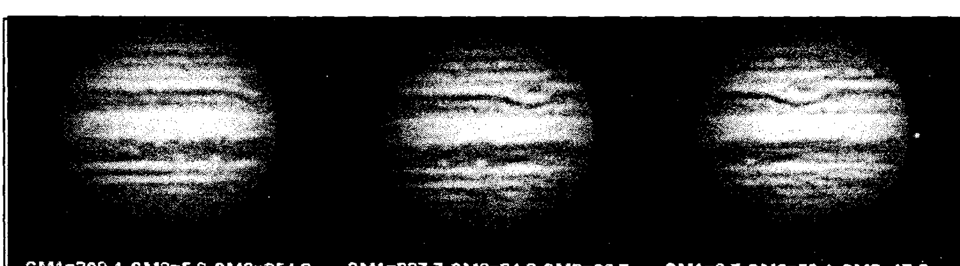


Figure 1. CCD Images by Donald C. Parker, 1997 May 22. 41-cm (16-in) Sch.-Cass. Greyscale versions of RGB images. (Schott Filters: R = RG610; G = VG9; B = BG12; all with IR rejection.)

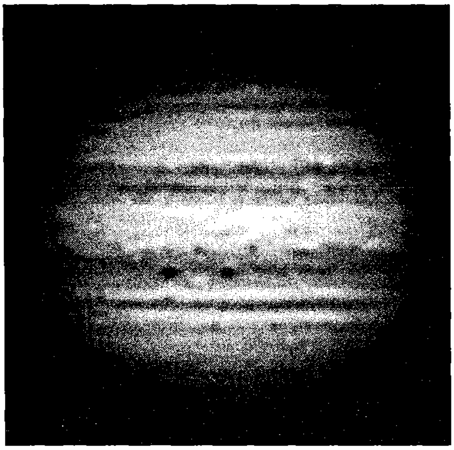
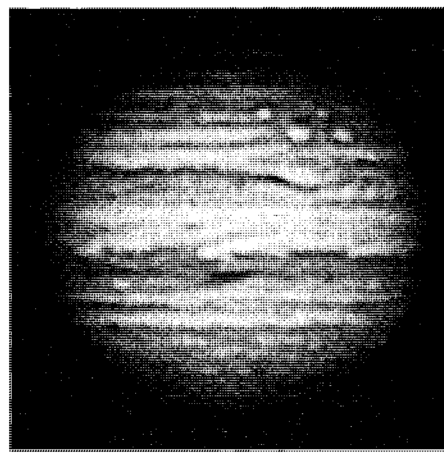


Figure 2 (left). CCD image by Isao Miyazaki. 1997 JUL 26, 14h07m-14h08m UT. 41-cm (16-in) Newtonian. Seeing = 7. Grey-scale version of RGB image. Exposures (filters): R = 0.7 s (R60); G = 0.9 s (PO1); B = 3.5 s (B390); (all with NR400). CM(I) = 011°, CM(II) = 290°, CM(III) = 295°.

Figure 3 (right). CCD image by Isao Miyazaki. 1997 JUL 29, 14h39m-14h40m UT. 41-cm (16-in) Newtonian. Seeing = 8. Grey-scale version of RGB image. Exposures (filters): R = 0.7 s (R60); G = 0.9 s (PO1); B = 3.0 s (B390); (all with NR400). CM(I) = 144°, CM(II) = 040°, CM(III) = 046°.



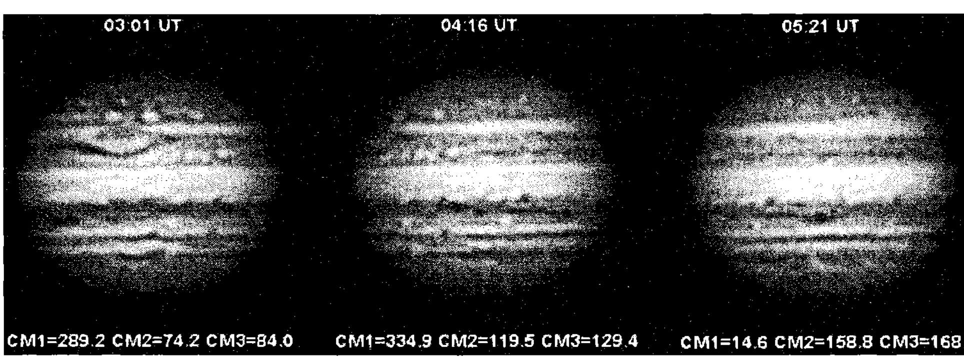


Figure 4 (above). CCD Images by Donald C. Parker, 1997 AUG 13 (times are UT). 41-cm (16-in) Sch.-Cass. Grey-scale versions of RGB images. (Schott Filters: R = RG610; G = VG9; B = BG12; all with IR rejection.)

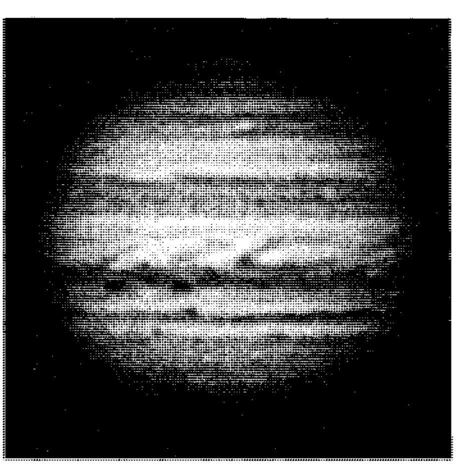


Figure 5 (left). CCD image by Isao Miyazaki. 1997 SEP 12, 14h03m-14h04m UT. 41-cm (16-in) Newtonian. Seeing = 7. Grey-scale version of RGB image. Exposures (filters): R = 0.7 s (R60); G = 0.9 s (PO1); B = 3.2 s (B390); (all with NR400). CM(I) = 033°, CM(II) = 305°, CM(III) = 323°.

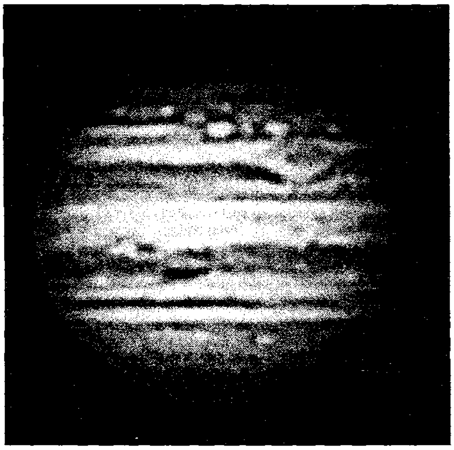


Figure 6 (left). CCD image by Isao Miyazaki. 1997 Sep 25, 12h30m-12h32m UT. 41-cm (16-in) Newtonian. Seeing = 7. Grey-scale version of RGB image. Exposures (filters): R = 0.9 s (R60); G = 1.2 s (PO1); B = 4.2 s (B390); (all with NR400). CM(I) = 229°, CM(II) = 043°, CM(III) = 064°.

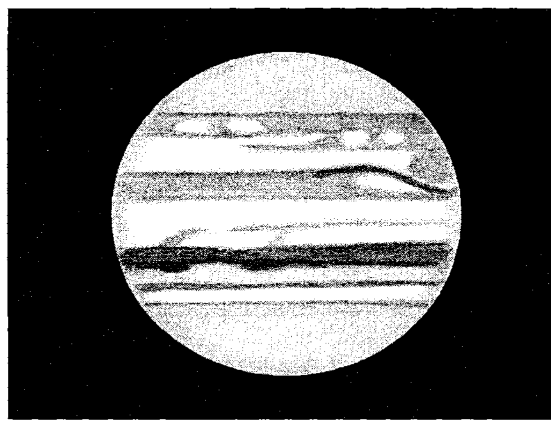


Figure 7 (right). Drawing by Jose Olivarez. 1997 Oct 04, 04h25m UT. 51-cm (20-in) Chabot Observatory refractor, 267X. Seeing = 7, Transparency = 4. CM(I) = 274°, CM(II) = 021°.

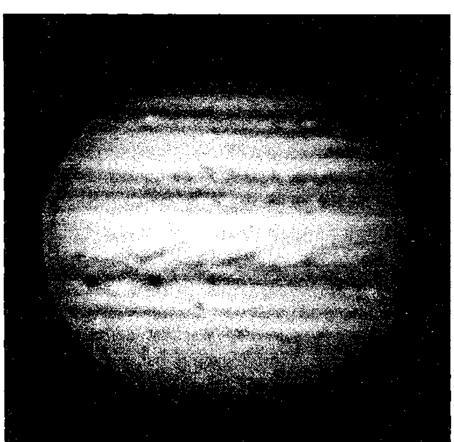


Figure 8 (left). CCD image by Isao Miyazaki. 1997 Oct 19, 09h51m-09h52m UT. 41-cm (16-in) Newtonian. Seeing = 6. Grey-scale version of RGB image. Exposures (filters): R = 0.8 s (R60); G = 1.0 s (PO1); B = 3.5 s (B390); (all with NR400). CM(I) = 320°, CM(II) = 311°, CM(III) = 339°.

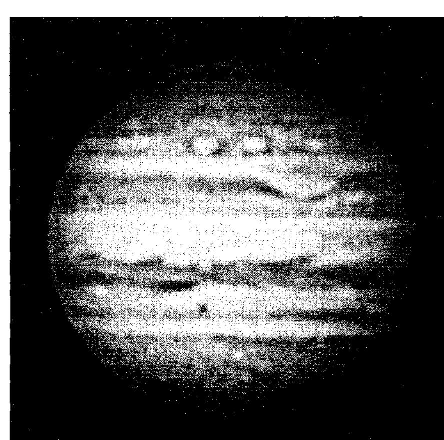


Figure 9 (right). CCD image by Isao Miyazaki. 1997 Oct 19, 12h26m-12h28m UT, about 2h35m later than Figure 8. 44-cm (16-in) Newtonian. Seeing = 7. Grey-scale version of RGB image. Exposures (filters): R = 0.8 s (R60); G = 1.0 s (PO1); B = 3.5 s (B390); (all with NR400). CM(I) = 054°, CM(II) = 045°, CM(III) = 073°.

Some Caribbean Photographs of the February 26, 1998 Solar Eclipse

Our last previous issue had on its front cover a photographic composite of Second and Third Contacts of the 1998 Feb 26 total solar eclipse. We have now received several more photographs from A.L.P.O. members who observed this event from the Caribbean; a sample of these is given on this page. (North is at the top in all the eclipse views.)

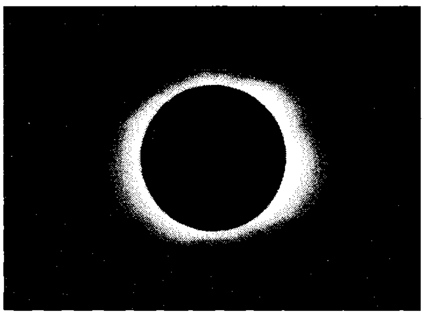


Figure 1 (left). A 1/60-second exposure during totality by Mike Reynolds, Director of the Chabot Observatory and Science Center. Taken from southeast of the island of Aruba on the MV Dawn Princess on Kodak PJM Film. 500-mm focal length, f/11.

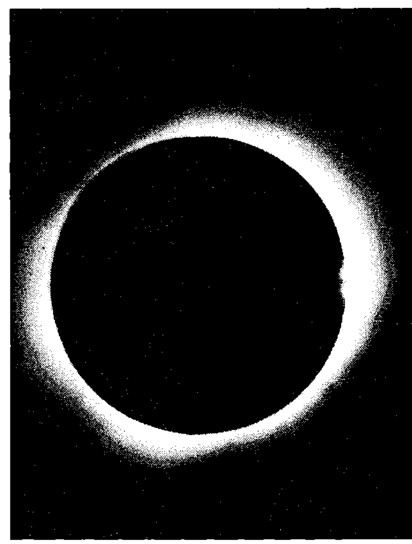


Figure 2 (above). Paul Stegmann was on Aruba, and used an ETX telescope (90-mm aperture, f/13.8) and Kodak Gold 100 ISO Film for this photograph of totality immediately prior to Third Contact, with Baily's Beads forming on the right (west) limb.

Figure 3 (above). Nelson Falsarella set up his 500-mm focal length f/5.6 Tele Pro-Optic telescope at Puerto Escondido on the Paraguaná Peninsula of Venezuela; the inclination of his polar axis shows the site's tropical latitude (12°10'N). Mr. Falsarella's wife Fatima Carnicel is on the left and to her left is their daughter Patricia.

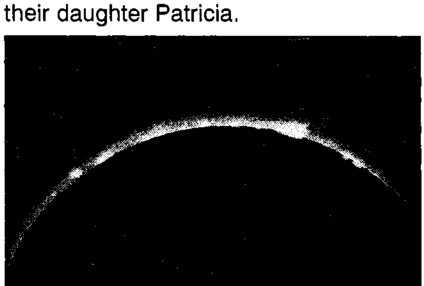


Figure 4 (above). Mr. Falsarella's view of solar protuberances during totality on 1998 Feb 26. Velvia Film; 500-mm f/5.6, 1/1000 second. Image enhanced by him using Adobe Photoshop for image processing.

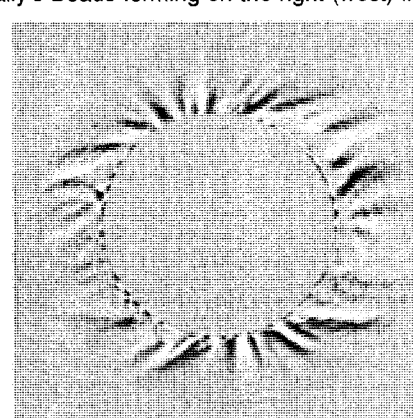


Figure 5 (above). The solar corona during totality; by John Westfall, also at Puerto Escondido, 127-mm aperture f/10, 1/2 second exposure on Kodak Elite II 100 Film. Unsharp masking with radial blurring, followed by contrast stretching, were used in Adobe Photoshop to bring out coronal radial streamers.

The A.L.P.O. Meets in Atlanta: July 9-11, 1998

The Membership Meeting

A.L.P.O. Publicist Ken Poshedly, with some helpers from the Atlanta Astronomy Club, are to be thanked for organizing this event, our 49th meeting, which had 35 attendees. Most participants were lodged in the Holiday Inn Select in Decatur, about 5 minutes' drive from the meeting site, the Fernbank Museum (*Figure 1*), which provided a large meeting room and a dining room for lunches and the Friday-evening Banquet.


Figure 1

For several A.L.P.O. members, the meeting events actually began with an informal get-together on Wednesday evening at the Holiday Inn Select. The formal meeting, however, started at the Fernbank Museum at 9 A.M. on Thursday, July 9, when the new A.L.P.O. Executive Director, Donald C. Parker, called the meeting to order (*Figure 2*), followed by a welcome from Ken Poshedly. The papers given that morning were: (1) "A Remote Place for a Rare Event", by Derald Nye, describing his expedition to Ascension Island to view the simultaneous occultation of Jupiter and Venus by the Moon on 1998 Apr 23 (*Figure 3*). (2) "Spectroscopic Studies of Comet Hale-Bopp's Tail", by Tom Buchanan, giving his results with his home-built slitless spectrograph (*Figure 4*). (3) "Making the Best Lunar Observations", by Matthew Will, regarding preparing for and visual recording of a general lunar observation (*Figure 5*). Then, after a short break, the meeting turned to business, with a brief "State of the A.L.P.O." message by Donald Parker, followed by *in absentia* reports on the Solar Section read by Assistant Solar Coordinator Jeffery Sandel, and the A.L.P.O. Website by Richard Hill, the morning sessions ending with a short A.L.P.O. Business Meeting.


Figure 2


Figure 5


Figure 3


Figure 4

A tasty buffet lunch was held in the Fernbank Museum dining room from 12-1:30 P.M. on Friday, just on the opposite side of the Museum atrium from the meeting hall. This was also an opportunity to tour the Museum itself, our attendees having free admission; the well-stocked museum store was also a temptation.

The Thursday afternoon session commenced with two Jupiter Section papers. The first was by the Acting Coordinator, David Lehman, "Changes in the A.L.P.O. Jupiter Section", and was read *in absentia* by Acting Assistant Jupiter Coordinator John McAnally. Mr. McAnally followed this with his own paper, "Addendum to the Jupiter Section Report" (*Figure 6*), in turn followed by Donald Parker's "A Presentation of Some Jupiter Images Taken from Japan". The

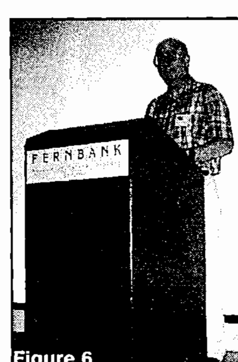


Figure 6

following paper, "Observations of the Remote Planets, 1989-1998", by Richard Schmude, Remote Planets Coordinator," moved the meeting to the fringes of the Solar System (*Figure 7*). The final paper delivered on Thursday was an inspirational presentation, "Enthusiasm in the Amateur Astronomy Community: Is It Contagious?", by Phillip Saco, the President of the Atlanta Astronomy Club (*Figure 8*).


Figure 7


Figure 8

At about 4 P.M. Thursday afternoon the group emerged into the comfortably warm Atlanta outdoors, setting out on a field trip to the nearby Bradley Observatory at Agnes Scott College, hosted by Christopher G. DePree of the College's Department of Physics and Astronomy. Located in a classical-style brick building decorated with zodiacal symbols (*Figure 9*), the observatory houses a 30-inch Cassegrain reflector on a german mounting (*Figure 10*), along with an observing deck with platforms for portable instruments.

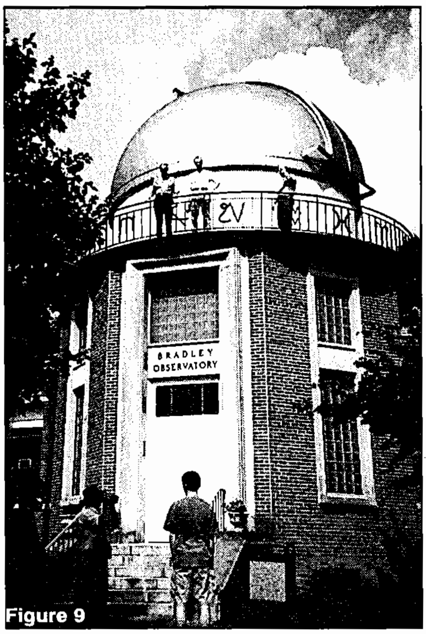


Figure 9

The Fernbank Museum, host of our meeting, has a sister institution, the Fernbank Science Center, holding a planetarium and observatory, which was our destination after dinner on Thursday evening. Upon arrival, the group wended its way past dinosaur replicas and fossils, and came upon a section devoted to spaceflight memorabilia, including the Apollo-6 capsule, which A.L.P.O. founder Walter Haas could not resist visiting (*Figure 11*).

The Fernbank Science Center houses the largest-capacity planetarium theater in the Southeast, with a classical Zeiss projector. The planetarium program that our group attended dealt with black holes. By the end of the presentation, the Sun had set and the adjoining observatory building was only a short walk away; an irresistible attraction with its 36-inch telescope, the largest aperture in this part of the country. Although broken clouds


Figure 10

Figure 11

allowed views only of Arcturus, the telescope itself proved a sufficient attraction (*Figure 12*,).

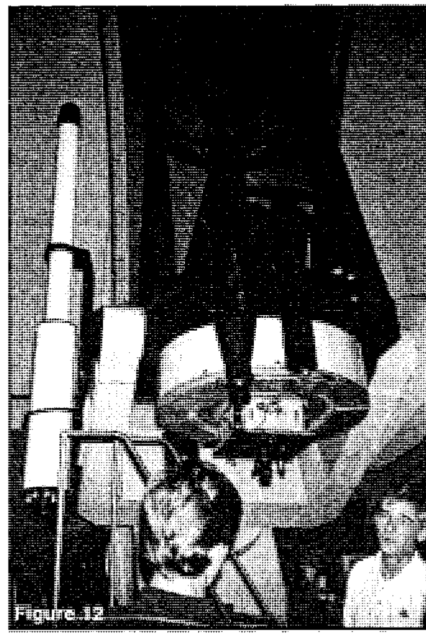


Figure 12

Friday morning began with a paper by Gary Cameron, the A.L.P.O. Acting Historical Section Coordinator, "The A.L.P.O. Historical Section: A Request for Documents. (*Figure 13*). Next on the agenda was the paper, "Amateur Observations of the Moon: The A.L.P.O. Selected Areas Program", by Selected Areas Coordinator Julius L. Benton (*Figure 14*). Following the morning break. Bill O'Connell's paper, "Plato's Hook", delivered by Harry Jamieson, dealt with an occasionally reported curved wall shadow on the floor of the lunar crater Plato. Dr. Benton followed with his second paper, "Saturn Programs and Recent Observations." The A.L.P.O. Founder, Walter Haas, was next heard from, reporting on his statistical analysis, "An Error Study of Jupiter Central Meridian Transits by Taking Transits of the Galilean Satellites and Their Shadows, 1939-1998", clearly the most long-term investigation reported on at this meeting (*Figure 15*). The morning's final paper was by Craig MacDougal, "Useful Observations With a Small Telescope" (*Figure 16*).

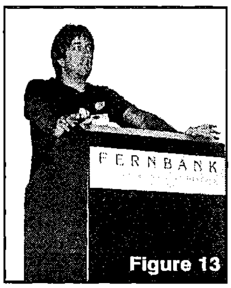


Figure 13

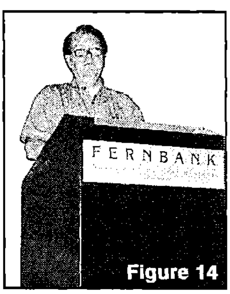


Figure 14

Figure 16

Figure 15

As on Thursday, Friday's luncheon was held in the Museum dining room, just after the convention attendees posed in the Museum atrium for the traditional A.L.P.O. group portrait, centered on A.L.P.O. Founder Walter H. Haas (*Figure 17*).

Figure 17

The last paper session began with a talk by John Westfall, A.L.P.O. Mercury/Venus Transit Coordinator, "A Most Unusual Graze: The Transit of Mercury on 1999 Nov 15" (*Figure 18*). The final presentation was by Daniel Joyce of the Mars Section, "Video Astronomy", with a showing of high-quality video images of Comet Hyakutake, Mars, Jupiter, and the Moon (*Figure 19*).

Figure 19

Figure 18

The remaining A.L.P.O. Convention events were primarily social, beginning with the Annual Awards

Figure 20

Banquet in the Museum dining room on Friday evening. After the meal came the formal transfer of the A.L.P.O. Executive Directorship from Harry Jamieson to Donald Parker. Mr. Jamieson also presented the Association's two awards, the first being the Peggy Haas A.L.P.O. Service Award, presented to John Westfall (*Figure 20*). Next came the traditional Walter H. Haas A.L.P.O. Observing Award, given in 1998 to Alan W. Heath of Nottingham, England. As Mr. Heath could not attend,the Walter Haas Award was accepted for him by Donald Parker, who will mail the award to Alan Heath (*Figure 21*). The evening concluded with the Banquet Paper, "Telescopes I Wish I Had Known", by Leonard Abbey of the Atlanta Astronomy Club, and founder and first Recorder of the A.L.P.O. Uranus and Jupiter Section. His fascinating talk concentrated on the Great Melbourne Telescope, once the largest in the Southern Hemisphere (*Figure* 22).

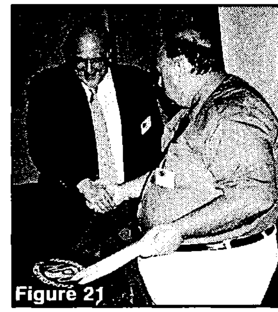


Figure 21

Figure 22

The final Convention day, Saturday, was left largely open. Some attendees toured Atlanta, while others visited the area's excellent secondhand and antique book stores. Several of us accepted Ken Poshedly's kind invitation to his suburban home and projected observatory site (*Figure* 23). The last event was an excellent dinner held at the Yesterday's Café in Rutledge, Georgia, in the Stone Mountain area east of Atlanta (*Figure 24*; the chap in the checkered shirt is Donald Parker, next to Jeffery Beish, in the right foreground is Walter Haas, and behind him is Cecil Post).

Figure 23

The Board Meeting

Figure 24

The A.L.P.O. Board of Directors met at 4 P.M, Friday, July 10th; their decisions are given in "Announcements (p. 140), with staff changes and the 1999 convention site. Board members Julius Benton, Walter Haas, Harry Jamieson, Donald Parker, and John Westfall were present (Elizabeth Westfall was absent). New Board member Matthew Will was also present. For the financial report, Membership Secretary Harry D. Jamieson reported $2752 in our Memphis bank account, while Editor John E. Westfall reported $4175 in the A.L.P.O. San Francisco account.

Our Readers Speak

—An occasional letters column. The opinions expressed are not always those of the Editor, who may edit them slightly for style, but not for content.

Dear Mr. Westfall:

I am writing to you in your capacity as editor of the A.L.P.O. Journal. I have been away from the organization for many years, due to business considerations; also Saturn being in the southern sky.

Upon just recently receiving my latest issue of the A.L.P.O. Journal, there appears an article by Prof. Walter H. Haas (Vol. 40, No. 1, p. 29), in which he states that he feels that a rift is developing amongst the membership.

I feel that I must comment upon this situation, as I perceive it.

New members and younger ones come to us (the A.L.P.O. Organization) with big bright eyes and huge smiles upon their faces. They have seen all the latest movies about space as well as science programs on the television.

Imagine their disappointment on receiving their first A.L.P.O. Journal. No teenager is prepared for the yearly reports as issued by us. They are very dry and uninteresting to the uninitiated.

Perhaps it might better serve the A.L.P.O. organization to modify its level of journal reporting. If we, the A.L.P.O., wish to continue on, and hopefully grow, perhaps we should cater more to the new and beginning membership. Us older hands (50 years myself) can find our own way to advance up the ladder of research.

I hope that the A.L.P.O. will never become so elitist as to outgrow the amateur with the six-inch glass—I would be very sorry to see this.

With Kindest Regards,

Norman Jean Boisclair

38 Harrison Avenue
South Glens Falls, NY 12803-4911

March 17, 1998

To the Editor J.A.L.P.O.:

Dear Sir:

In his editorial comment on my article on the bicolored aspect of Saturn's rings, Dr. Westfall states that my ordering of the filter colors as "1 = no filter, 2 = red filter, and 3 = dark blue filter appears somewhat arbitrary."

The order assigned to the independent variable is an integral part of the hypothesis one is testing. The order should be adjusted to conform to the hypothesis. If readers have not been exposed to this idea before, it is likely because the majority of tests of hypotheses use as the independent variable a series of numerical values with intrinsic order, rather than objects such as filters to which numbers must be assigned.

The experiment in question is my test of the hypothesis that filters affect the visibility of the bicolored aspect. The reason to order the filters as I did is that, historically, the bicolored aspect has been seen seldom in integrated light, occasionally in red light, and most often in violet light. Were the experiment testing something else, some other ordering of the independent variable may be appropriate. The "0 = no filter, -1 = red filter, and +1 = dark blue filter" order that he suggests would be appropriate in testing the visibility of some phenomenon which historically was thought to appear opposite in red from how it appeared in violet. The bicolored aspect isn't like that — it is of the same character in red and violet. Given the historical information on its visibility, it was quite proper to order the filters as I did.

Sincerely,

Roger J. Venable

3405 Woodstone Place
Augusta, GA 30909

June 5, 1998

Postscript to Dr. Venable's letter.

Matthew Will points out in an e-mail of May 25, 1998 that a "News Notes" item in the May, 1977, issue of *Sky & Telescope* (pp. 357-358), titled "Asymmetry of Saturn's Ring A", discusses investigations by K. Lumme and W.M. Irvine, as well as by H.J. Reitsema, using photographs of Saturn. Both studies concluded that the brightness asymmetry was originating from the Rings and was not illusory. The summary mentions a 10-percent brightness variation along the circuit of the Ring, but does not discuss whether the effect varies with wavelength. [See also: Gehrels, T. and Matthews, M.S. , eds. (1984). *Saturn*. Tucson: The University of Arizona Press, pp. 507-509 (a section titled "C. Azimuthal Brightness Variations in Ring A" in the chapter "Saturn's Rings: Structure, Dynamics, and Particle Properties" by L.W. Esposito *et al*.)]

A.L.P.O. ANNOUNCEMENTS

Staff Changes Made at A.L.P.O. Board Meeting, Atlanta, Georgia, July 10, 1998.—A general report on our 1998 Convention begins on p. 136. As always, the Convention included a meeting of the A.L.P.O. Board of Directors, and as usual their business included several staff changes.

Changes Among the Board of Directors.—Donald C. Parker was elected as Executive Director, serving also as Chairman of the Board, with Julius L. Benton, Jr. as Associate Director. Previous Executive Director Harry D. Jamieson is now Treasurer, as well as Membership Secretary, replacing John Westfall in the former position. In addition, Richard Hill (our Solar Coordinator) and Matthew Will (one of our Lunar and Planetary Training Program Coordinators) were elected to serve on our Board of Directors.

Changes Among the Staff.—The following Acting Coordinators/Assistant Coordinators/Editors have become permanent staff members: Richard Hill (Solar Section), James F. Bell (Mars Section), Mike W. McClure (Computing Section), Julius L. Benton, Jr. and Klaus R. Brasch (Publications Section). Related to these personnel changes, the Computing and Publications Sections have ceased to be "Provisional" and have been made permanent Sections.

Changes in the Mercury Section.—Due to other time commitments, Dr. Oscar Cole-Arnal has resigned as Mercury Coordinator. He is succeeded by the new Acting Coordinator, Harry Pulley, who plans to continue the good work accomplished by Dr. Cole-Arnal. Mr. Pulley's address is: Harry Pulley, 22 Liverpool Street, Guelph, Ontario N1H 2K9, Canada. His e-mail address is: hpulley@home.com

Coordinator Benton Changes E-Mail Address.—Effective immediately, Julius L. Benton, Jr., Lunar, Venus, and Saturn Coordinator, has changed his e-mail address to: jlbaina@bellsouth.net

Proceedings of 50th Anniversary Meeting Available.—The Proceedings of our 50th Anniversary Meeting (and our 48th Convention), held in Las Cruces, New Mexico on June 25-29, 1997, are now available as *A.L.P.O. Monograph Number 7*. This 76-page publication, containing 10 articles, is available from: A.L.P.O. Editor, P.O. Box 16131, San Francisco, VA 94116 USA. The price is $12.00 for purchasers in the United States, Canada, and Mexico, and is $16.00 elsewhere.

Proceedings of 1998 Atlanta Convention.—By the time you receive this issue, the Proceedings of our recent Convention should be available from A.L.P.O. Publicist Ken Poshedly; please write Mr. Poshedly regarding the price of this publication.

A.L.P.O./Astronomical League Convention for 1999.—The A.L.P.O. Board has voted unanimously to meet with the Astronomical League in Spokane, Washington, on July 13-17, 1999. We will provide you with further information in future issues of this Journal.

Plans for Amateur-Professional Workshop at Madison Division for Planetary Sciences Meeting.—On the next page is an announcement of this Fall's DPS Meeting. Kelly Beatty of *Sky & Telescope* is organizing a meeting of professionals and amateurs to begin a national registry of advanced amateurs "who are qualified, equipped, and willing to assist professionals in making observations." Tentatively, this meeting will take place on Sunday, October 10th, just prior to the DPS meeting itself. As this is planned to take place before you receive the next issue, we recommend that those interested contact A.L.P.O. Executive Director Donald Parker for further information as that date approaches.

A.L.P.O. Paper Session/Workshop at RTMC/1999.—The 1999 Riverside Telescope Makers Conference theme for 1999 will be the Solar System and the A.L.P.O. will host a Paper Session/Workshop at this regular event. As always, RTMC will be held over Memorial Day Weekend at Cape Oakes, near Big Bear, in southern California at 7200 feet above sea level. More information will follow in subsequent issues.

Change in Use of Credit Cards for A.L.P.O. Dues Payments.—Our arrangement with Chabot Observatory and Science Center has been modified slightly. Effective immediately, users of this service should provide the necessary information (name, address, desired membership category, and credit card number and expiration date) to: ATTN. Dr. Mike Reynolds, Chabot Observatory and Science Center, 10902 Skyline Blvd., Oakland, CA 94619 U.S.A.; Telephone 1-510-930-3480, extension 14; FAX 1-510-930-3499. We take this opportunity to thank Dr. Reynolds and the Chabot Observatory and Science Center for providing this useful service for the A.L.P.O.

Donation.—Mr. Thomas R. Williams has generously donated $150 to the A.L.P.O. Endowment Fund.

FORTHCOMING AMATEUR AND PROFESSIONAL MEETINGS

The following meetings are scheduled in the coming months. Information contacts are given in brackets.

August 10-14: Mars Exploration and the Search for Life. This will be the 10th Planetary Science summer School at CalTech. [California Institute of Technology, Division of Geological and Planetary Sciences, 1200 E. California Blvd., Mail Code 170-25, Pasadena, CA 91125. Telephone: 1-626-395-6123; FAX: 1-626-568-0935]

August 13-16: Founding Convention of the Mars Society. Meeting at the University of Colorado in Boulder, Colorado. [Maggie Zubrin, Mars Society, Box 273, Indian Hills, CO 80454. E-mail: mzubrin@aol.com ; Web: http://www.nw.net/mars]

September 3-4: Exploration of the Kuiper Belt: Where Do We Go from Here? Workshop at Lowell Observatory, Flagstaff, Arizona. [Dr. John Stansberry, 1400 W. Mars Hill Road, Flagstaff, AZ 86001; stansber@lowell.edu; Website: www.lowell.edu]

September 12-13: International Occultation Timing Association. IOTA will hold its 16th Annual Meeting at Dyer Observatory, Vanderbilt University, Nashville, Tennessee; note that there will be a lunar graze occultation of Aldebaran on the morning of September 13th about 20 miles northwest of Nashville, with two other grazes near Nashville that morning. [Scott Degenhardt, 3409 Mary Ave., Murfeesboro, TN 37130; Telephone: 1-615-895-0244; E-mail: dega@nashville.com; Web: http://www.sky.net/~robinson/iotandx.htm]

September 18-20: New Views of the Moon: Integrated Remotely Sensed, Geophysical, and Sample Datasets. Sponsored by the Lunar and Planetary Institute, meeting in Houston, Texas. [Brad Jolliff. Telephone: 1-314-935-5622; FAX: 1-314-935-7361; E-mail: blj@levee.wustl.edu ; Web: http://cass.jsc.nasa.gov/meetings/moon98/]

September 25-26: Chabot Observatory and Science Center Planetary Observing Workshop. This event will include A.L.P.O. Director Donald C. Parker and Director Emeritus Walter H. Haas as guest speakers. [Jose Olivarez; see address in our staff listing under "Book Review Editor".]

October 11-16: 30th Annual Meeting of the Division for Planetary Sciences. To be held at the Monona Terrace Convention Center, Madison, Wisconsin, this year's theme is "Exploring the Solar System." [Sanjay S. Limaye, Space Sciences & Engineering Center, 1225 W. Dayton St., Madison, WI, 53706. Telephone: 1-608-262-9541; E-mail: dps98@ssec.wisc.edu ; Web: www.aas.org/dps/dps98.html]

October 19-22: The First International Conference on Mars Polar Science and Exploration. Sponsored by the Publications and Programs Services Department, Lunar and Planetary Institute, Houston, Texas. [Lunar and Planetary Institute, 3600 Bay Area Blvd., Houston, TX 77058. Telephone: 1-281-486-2166; FAX: 1-281-486-2160; Web: http://cass.jsc.nasa.gov/meetings/polar98/]

October 26-29: Annual Meeting, Geological Society of America. To be held in Toronto. [Telephone: 1-303-447-2020 or 1-800-472-1988; FAX: 1-303-447-0648; E-mail: meetings@geosociety.org ; Web: http://www.geosociety.org/meetings/98]

November 2-4: Martian Meteorites: Where Do We Stand and Where Are We Going? Sponsored by the Publications and Programs Services Department, Lunar and Planetary Institute, Houston, Texas. [Lunar and Planetary Institute, 3600 Bay Area Blvd., Houston, TX 77058. Telephone: 1-281-486-2166; FAX: 1-281-486-2160; Web: http://cass.jsc.nasa.gov/meetings/marsmet98/]

November 2-5: European Southern Observatory Workshop on Minor Bodies of the Outer Solar System. This ESO-sponsored meeting will be held at ESO Headquarters, Garching, Germany. [Alan Fitzsimmons, Department of Physics, Queens University, Belfast BT7 1NN, Northern Ireland. E-mail: a.fitzsimmons@qub.ac.uk; Web: http://www.eso.org/gen-fac/meetings/mboss98 Note that another listing gives this meeting as November 9-12, with the contact as Richard M. West; E-mail: rwest@eso.org ; Web: http://www.eso.org/mboss98]

December 1-3: Origin of the Earth and Moon. At Monterey, California. Sponsored by the Publications and Programs Services Department, Lunar and Planetary Institute, Houston, Texas. [Lunar and Planetary Institute, 3600 Bay Area Blvd., Houston, TX 77058-1113. Telephone: 1-281-486-2158; FAX: 1-281-486-2160; E-mail: simmons@lpi.jsc.nasa.gov ; Web: http://cass.jsc.nasa.gov/meetings/origin98/]

Other Announcements

COMPLEX Reports.—COMPLEX stands for The (U.S.) National Research Council's Committee on Planetary and Lunar Exploration. Their two latest reports, "Exploring the Trans-Neptunian Solar System" and "The Exploration of Near-Earth Objects" are available free of charge from: Space Studies Board, HA-584, 2101 Constitution Ave., NW, Washington, DC 20418. They are also on the Web at: www.nas.edu/ssb/neptmenu.htm and www.nas.edu/ssb/neomenu.htm .

Accessing Basaltic Volcanism.—The widely-cited but voluminous tome *Basaltic Volcanism on the Terrestrial Planets* (Pergamon Press, 1981) is now accessible on line through the NASA Astrophysics Data System (ADS) website: http://adsbit.harvard.edu/books. Extensive additional ADS holding are available at this site.

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. VISA or MasterCard may be used by telephoning Dr. Mike Reynolds at the Chabot Observatory and Science Center, 510-530-3480, Extension 14; or by mail to: Chabot Observatory and Science Center, 10902 Skyline Boulevard, Oakland, CA 94619 U.S.A; you may also FAX to 1-510-930-3499.

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., "40.3" means Vol. 40, No. 3). 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 (unless if by credit card as described above).

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 Schiaparelii, 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.

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 June, 1996.

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, U.S.A:

Back issues of *The Strolling Astronomer (J.A.L.P.O.).* The back issues listed below are still in stock but may not long remain so. 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 $25. Make payment to "Walter H. Haas."

$4.00 each: *1* (1947); 6. *8* (1954); 7-8. *11* (1957); 11-12. *21* (1968-69); 3-4 and 7-8. *23* (1971-72); 7-8 and 9-10. *25* (1974-76); 1-2, 3-4, and 11-12. *26* (1976-77); 3-4 and 11-12. *27* (1977-79); 3-4 and 7-8. *31* (1985-86); 9-10. *32* (1987-88); 11-12. *33* (1989); 7-9. *34* (1990); 2 and 4. *37* (1993); 1 and 2. *38* (1994-96); 1, 2, and 3. *39* (1996); 1, 2, 3, and 4. *40* (1998); 1 and 2.

Current Issue [*40*, 3]; $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."

Solar (Graham): *Solar and Lunar Eclipse Observations 1943-1993;* $25.00 postpaid. (A Handbook for Solar Eclipses is under preparation.)

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 (Graham): (1) *Forms* with explanations (in English or German); send a SASE. (2) *Lunar Photometry Handbook,* $5.00 Ppd. paperbound, $15.00 Ppd. hardbound. (3) Orders are now being accepted for a *Lunar Eclipse Handbook,* $3.00 paperbound plus $1.00 shipping and handling. (4) *Solar and Lunar Eclipse Observations 1943-1993;* $25.00 postpaid.

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 55 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 32¢ 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 .

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