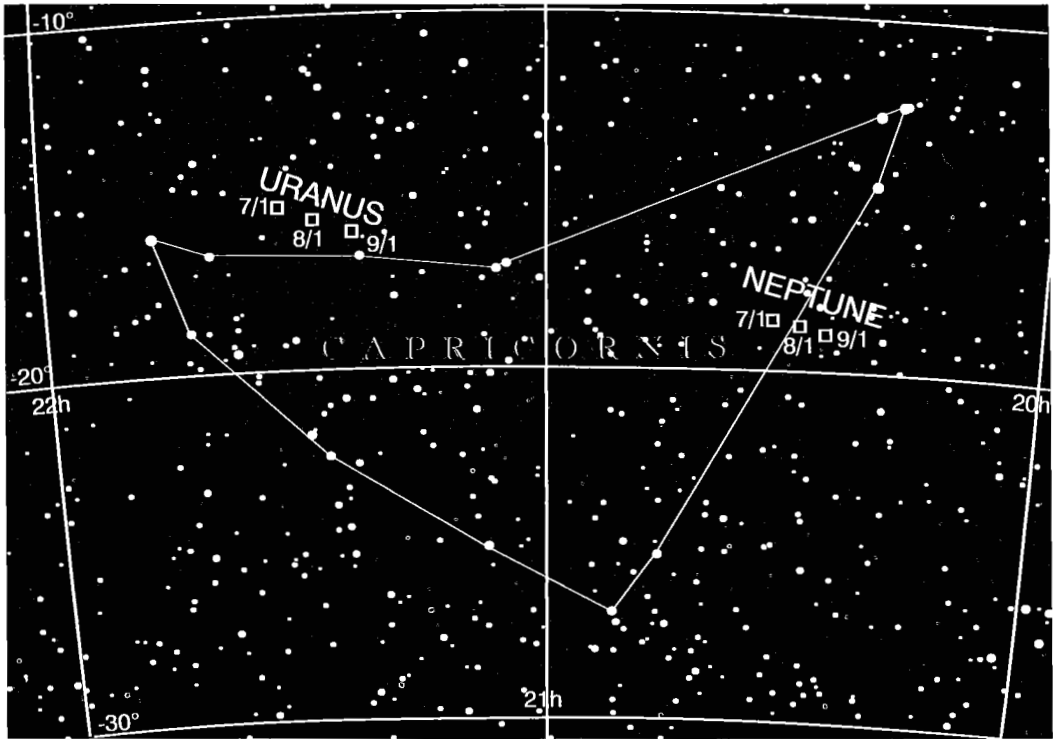


The Journal Of The Association Of Lunar And Planetary Observers

The Strolling Astronomer

Volume 42, Number 1

January, 2000 (Published June, 2000)



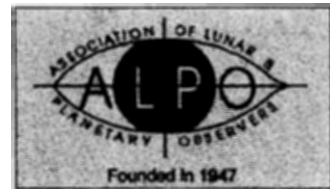
The apparent paths of the Remote Planets Uranus and Neptune in the constellation Capricornus during July and August, 2000, when they will be well-presented for observation. The 1998 report of the A.L.P.O. Remote Planets Section, appearing on pages 13-17 of this issue, illustrates several useful forms of observation that can be made of these planets.

THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

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The Strolling Astronomer. Journal of the A.L.P.O.

VOLUME 42 NUMBER 1. JANUARY, 2000

OBSERVATIONS OF SATURN DURING THE 1996-97 APPARITION

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

ABSTRACT

Visual, photographic, and CCD observations were submitted to the A.L.P.O. Saturn Section by program participants in the United States, Canada, Germany, and the United Kingdom during the 1996-97 Apparition, covering the period 1996 JUN 23-1997 FEB 17. Telescopes that were employed ranged in aperture from 11.4 cm (4.5 in.) to 51.0 cm (20.0 in). A.L.P.O. observers called attention to recurring festoons and other dusky disturbances among the belts and zones of the Southern Hemisphere of Saturn during the apparition, but the main highlight of 1996-97 was the emergence of a series of relatively bright but somewhat diffuse white ovals in the southern Equatorial Zone (EZs) in late 1996 September. As the apparition progressed, the EZs white features spread out across the Globe at that latitude, resulting in an EZs that remained elevated in brightness through the end of the observing season. Saturn observers attempted central meridian (CM) transit timings of bright and dark global phenomena to try to establish rotation rates for different latitudes. During the 1996-97 Apparition, the inclination of the Ring system to our line of sight, B , reached a maximum value of $-6^{\circ}.198$ on 1996 JUL 12. With the Rings gradually beginning to open up following the edgewise ring presentations of 1995-96, more and more of the Southern Hemisphere of Saturn's Globe and the South face of the Rings are becoming visible. Accompanying this report are references, drawings, photographs, graphs, and tables.

INTRODUCTION

Members of the A.L.P.O. Saturn Section contributed a meaningful collection of visual, photographic, and CCD observations of the planet and its Ring system during the 1996-97 Apparition. This analytical synopsis, which is enhanced by drawings, photographs, and CCD images, is based upon data received for the observing period 1996 JUN 23-1997 FEB 17 (here referred to as the 1996-97 observing season or Apparition). All dates and times in this report are in Universal Time (UT).

**Table 1. Geocentric Phenomena for Saturn
During the 1996-97 Apparition**

Conjunction	1996 MAR 17 19h UT
Opposition	1996 SEP 26 19
Conjunction	1997 MAR 30 22
Opposition Data:	
Visual Magnitude	+0.5
Declination	$-0^{\circ}.83$
B	$-4^{\circ}.47$
B'	$-4^{\circ}.70$
Globe	
Equatorial Diameter	$19''.47$
Polar Diameter	$17''.39$
Rings	
Major Axis	$44''.39$
Minor Axis	$3''.46$

Table 1 (lower left) lists geocentric data in Universal Time (UT) for the 1996-97 Apparition of Saturn. Throughout the observing season the numerical value of B , the saturnicentric latitude of the Earth referred to the Ring plane (negative when south), ranged between the extremes of $-6^{\circ}.20$ (1996 JUL 12) to $-3^{\circ}.03$ (1996 Nov 29). The value of B' , the saturnicentric latitude of the Sun, ranged from $-6^{\circ}.80$ (1997 FEB 17) to $-3^{\circ}.30$ (1996 JUN 23).

Table 2 (p. 2) lists the 17 individuals who submitted a total of 160 observations to the A.L.P.O. Saturn Section for the 1996-97 Apparition, along with their observing sites, number of dates of observations, and descriptions of their telescopes.

Figure 1 (p. 2), a histogram, gives the distribution of observations by month, showing that most of the data were amassed during the months of 1996 September through 1997 January (85.0 percent), with a decline in the number of observations on either side of this peak. Of the submitted observations, 23.2 percent were made before opposition (1996 SEP 26), 1.3 percent actually on that date, and 75.5 percent were made after opposition. While an intense scrutiny of Saturn in the

Table 2. Contributing Observers, 1996-97 Apparition of Saturn.

Observer & Location	No. of Obser.	Telescope Data*	Observer & Location	No. of Obser.	Telescope Data*
Barton, Johnny Waco, TX	1	31.8 cm (12.5 in) NEW	Niechoy, Detlev Göttingen, Germany	33	20.3 cm (8.0 in) SC
Benton, Julius L., Jr. Wilmington I., GA	40	25.4 cm (10.0 in) REF	Nowak, Gary T. Hinesbury, VT	2	25.4 cm (10.0 in) SCHF
Boyar, Dan Boynton Beach, FL	2	15.2 cm (6.0 in) REF	Parker, Donald C. Coral Gables, FL	4	40.6 cm (16.0 in) NEW
Cave, Thomas R. Long Beach, CA	2	32.5 cm (12.8 in) NEW	Plante, Phil Poland, OH	5 3	20.3 cm (8.0 in) REF 20.3 cm (8.0 in) SC
Cole-Arnal, Oscar Waterloo, Ontario Canada	1 3	12.7 cm (5.0 in) REF 15.2 cm (6.0 in) REF 25.4 cm (10.0 in) SC	Post, Cecil Las Cruces, NM	1	40.6 cm (16.0 in) CAS 20.3 cm (8.0 in) NEW
Haas, Walter H. Las Cruces, NM	8	31.8 cm (12.5 in) NEW	Schmude, Richard W. Barnesville, GA	1 2	25.4 cm (10.0 in) NEW 51.0 cm (20.0 in) NEW
Heath, Alan W. Nottingham, UK	16	30.5 cm (12.0 in) NEW	Will, Matthew Springfield, IL	5	20.3 cm (8.0 in) NEW
Hernandez, Carlos E. Miami, FL	2 1	20.3 cm (8.0 in) NEW 40.6 cm (16.0 in) SC	<i>Total Observations:</i>	160	
McAnally, John W. Waco, TX	10 12	11.4 cm (4.5 in) NEW 20.3 cm (8.0 in) SC	<i>Total Observers:</i>	17	
Melillo, Frank J. Holtsville, NY	4	20.3 cm (8.0 in) SC	* CAS = Cassegrain, NEW = Newtonian, REF = Refractor, SC = Schmidt-Cassegrain, SCHF = Schiefspiegler.		

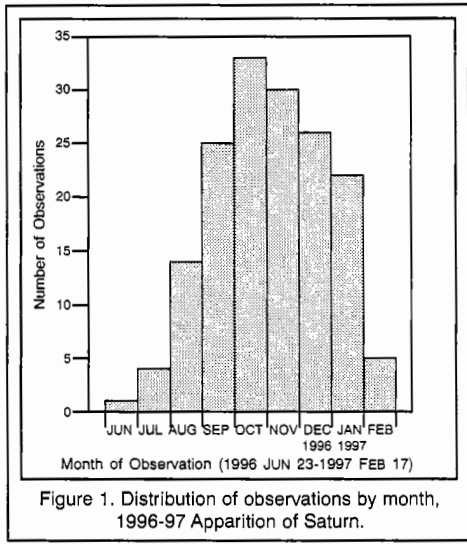


Figure 1. Distribution of observations by month, 1996-97 Apparition of Saturn.

al coverage of the planet throughout any given apparition. Therefore, we strongly encourage observers to begin viewing the planet when it first appears in the eastern sky before dawn and continue their investigations until Saturn approaches conjunction with the Sun.

Figure 2 (below) depicts the observer base (total of 17) of the A.L.P.O. Saturn Section for 1996-97, as well as the international distribution of the 160 observations that were contributed. During the apparition, the United States accounted for 66.3 percent of the submitted observations and about four-fifths of the participating observers (82.4 percent). International participation in our programs continued during 1996-97, with observers in Canada, the United Kingdom, and Germany submitting reports. As always, it is the desire of the A.L.P.O. Saturn Section to enlist as many dedicated observers throughout the world as possible.

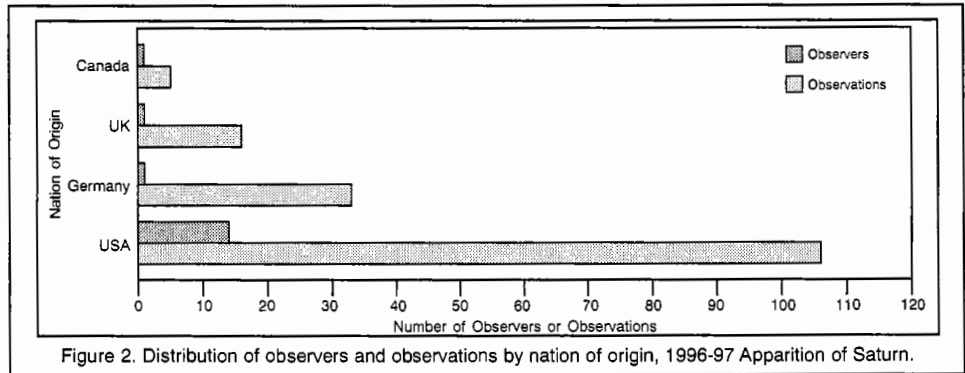


Figure 2. Distribution of observers and observations by nation of origin, 1996-97 Apparition of Saturn.

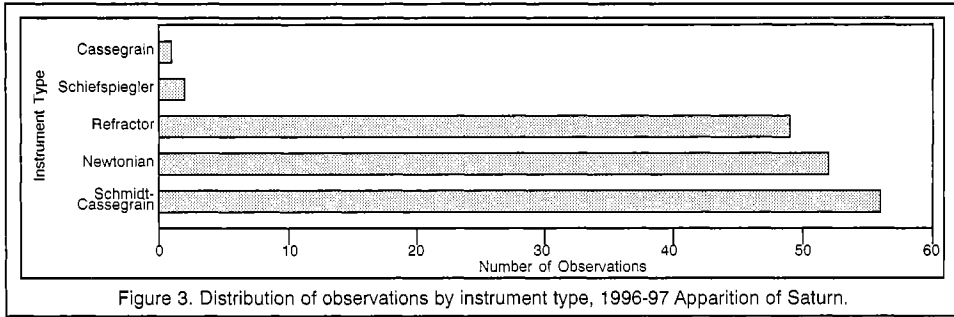


Figure 3. Distribution of observations by instrument type, 1996-97 Apparition of Saturn.

Figure 3 (above) graphs the number of observations by instrument type, showing that telescopes of classical design (i.e., refractors, Newtonians, and Cassegrains) were used for nearly two-thirds (63.7 percent) of the 160 total observations in 1996-97. The exceptional image contrast and resolution of such instruments frequently make them the telescopes of choice for many individuals seeking an optical system purely for planetary work. Also, 93.1 percent of the total observations were made with instruments equal to or greater than 15.2 cm (6.0 in) in aperture. In recent years, there has been a growing percentage of larger apertures used for A.L.P.O. observations of Saturn, and based on the comments of our more experienced planetary observers, there appears to be more emphasis now on aperture when selecting a telescope than there is on any specific design. Of course, optical quality should always be the main prerequisite for any lunar and planetary telescope. Note, however, that observers using smaller apertures of the order of 10.2 cm (4.0 in) can still contribute useful work on Saturn.

The writer expresses his gratitude to all of the dedicated individuals mentioned in Table 2 who faithfully submitted their work to the A.L.P.O. Saturn Section for the 1996-97 Apparition. Those interested in Saturn studies throughout the United States and elsewhere are encouraged to become part of our observing team in future apparitions as we continue our efforts to maintain an international comprehensive surveillance of the planet. Beginning observers are also welcome, and the A.L.P.O. Training Program and Saturn Section will be pleased to jointly provide instructive guidance for newcomers to our programs.

THE GLOBE OF SATURN

This article is derived from a reduction of 160 observational reports that were

contributed to the A.L.P.O. Saturn Section by the 17 observers in Table 2. To preserve brevity, names of observers are necessarily omitted from the text except when the identity of an individual is pertinent to the discussion. Tables, graphs, drawings, photographs, and CCD images accompany this observational summary, and we urge readers to refer to them as they study this analysis. Also, features on the globe of Saturn are described in south-to-north order and can be identified by reference to the nomenclature diagram in Figure 4 (p. 5).

The continuing policy of the A.L.P.O. Saturn Section is to prepare apparition reports by comparing and contrasting data between successive apparitions for global atmospheric features. This tradition maintains continuity and helps the reader understand the often subtle, but discernible, variations that may be occurring seasonally on Saturn. Observational results suggest that the constantly changing inclination of Saturn's axis of rotation relative to the Sun and Earth contributes to any perceived variations in belt and zone intensities, which are listed in Table 3 (p. 4). Recent photoelectric photometry of Saturn has demonstrated that the planet exhibits oscillations of about ± 0.10 visual magnitude with time, and these data have prompted some investigators to postulate that transient and long-enduring atmospheric features in Saturn's belts and zones may help produce such brightness fluctuations. Regular photoelectric photometry of Saturn in conjunction with visual intensity estimates is a valuable project for suitably-equipped observers to initiate and maintain.

The intensity scale employed is the A.L.P.O. Standard Numerical Relative Intensity Scale, where 0.0 is total black and 10.0 is the brightest possible condition. This scale is normalized by setting the outer third of Ring B at a standard brightness of 8.0. The arithmetic sign of an intensity change is found by subtracting a fea-

Table 3. Visual Numerical Relative Intensity Estimates and Colors for the 1996-97 Apparition of Saturn.

Globe/Ring Feature	1996-97 Relative Intensities			"Mean" Derived Color in 1996-97
	Number of Estimates	Mean & Standard Error	Change Since 1995-96	
ZONES, HEMISPHERES, REGIONS AND CAPS:				
SPC	1	4.00 ----	-0.06	Grey
SPR	15	4.72 ±0.91	-0.54	Yellowish-Grey
SSTeZ	14	5.96 ±0.30	+0.01	Yellowish-White
STeZ	10	5.88 ±0.41	-0.43	Yellowish-White
STrZ	10	5.52 ±0.94	-0.28	Dull Yellowish-White
SEBZ	2	6.50 ±0.50	+2.50	Pale Yellowish-White
EZs	46	7.33 ±0.71	+0.77	Bright Yellowish-White
Globe S of Rings	9	5.96 ±0.57	+0.04	Dusky Yellowish-Grey
Globe N of Rings	11	4.59 ±0.45	+0.14	Dusky Yellowish-Grey
EZn	24	6.65 ±0.85	-0.24	Pale Yellowish-White
NTZ	12	6.04 ±0.92	+0.47	Yellowish-White
NTeZ	6	5.92 ±0.19	-0.07	Yellowish-White
NNTeZ	1	5.50 ----	-0.43	Dull Yellowish-White
NPR	18	4.42 ±1.04	-0.51	Dull Yellowish-Grey
BELTS:				
SSTeB	1	5.00 ----	-0.12	Greyish
STeB	11	4.82 ±0.57	-0.08	Greyish
SEB (entire)	45	3.30 ±0.58	-1.01	Greyish-Brown
SEBs	2	3.00 ±0.00	-1.88	Dark Grey
SEBn	2	3.00 ±0.00	-2.18	Dark Grey
EB	1	3.00 ----	-1.09	Dark Grey
NEB (entire)	46	3.89 ±0.61	+0.00	Greyish-Brown
NTeB	7	5.00 ±0.00	-0.14	Light Grey
RINGS:				
A (entire)	15	6.83 ±0.34	+2.14	Yellowish-White
A0 or B10	10	1.65 ±1.02	-3.35	Greyish-Black
B (outer 1/3)	<i>STANDARD</i>	8.00 ±0.00	---	White
B (inner 2/3)	3	6.33 ±0.47	---	Yellowish-White
C (ansae)	2	4.50 ±0.50	---	Dull Greyish
Crape Band	11	2.64 ±1.17	---	Dark Greyish
Sh G on R	24	0.33 ±0.62	-1.08	Dark Greyish-Black
Sh R on G	29	0.26 ±0.54	-0.95	Dark Greyish-Black
TWS	1	8.50 ----	---	White

Notes: For nomenclature see text and Figure 4. A letter with a digit (e.g., A0 or B10) refers to a location in the Ring specified in terms of units of tenths of the distance from the inner edge to the outer edge. Visual numerical relative intensity estimates (visual surface photometry) are based upon the A.L.P.O. Intensity Scale, where 0.0 denotes complete black (shadow) and 10.0 refers to the most brilliant condition (very brightest Solar System objects). The adopted scale for Saturn uses a reference standard of 8.0 for the outer third of Ring B, which appears to remain stable in intensity for most Ring inclinations. All other features on the Globe or in the Rings are compared systematically using this scale, described in the *Saturn Handbook*, which is issued by the A.L.P.O. Saturn Section. The "Change Since 1995-96" is in the sense of the 1995-96 value subtracted from the 1996-97 value, "+" denoting an increase in brightness and "-" indicating a decrease (darkening). When the apparent change is less than about 3 times the standard error, it is probably not statistically significant. Note that several of the Ring components were not visible in the 1995-96 Apparition, so their intensities cannot be compared with those for the 1996-97 Apparition.

Table 4. Saturnian Belt Latitudes in the 1996-97 Apparition

Saturnian Belt	Form of Latitude (all values are in degrees)					
	Planetocentric		Eccentric		Planetographic	
S edge SEB	-21.2 ±0.6	(+8.2)	-23.5 ±0.6	(+8.2)	-26.0 ±0.7	(+8.9)
N edge SEB	-15.7 ±0.6	(+7.8)	-17.5 ±0.6	(+8.2)	-19.5 ±0.7	(+9.1)
S edge NEB	+14.3 ±3.6	(-0.6)	+15.9 ±4.0	(-1.4)	+17.7 ±4.4	(-1.6)
N edge NEB	+19.0 ±4.2	(-3.8)	+21.1 ±4.6	(-4.1)	+23.3 ±5.0	(-4.5)

Notes: For nomenclature see Figure 4. Latitudes are calculated using the appropriate geocentric tilt, B, for each date of observation. Planetocentric latitude is the angle between the equator and the feature as seen from the center of the planet. Planetographic latitude is the angle between the surface normal and the equatorial plane. Eccentric, or "Mean," latitude is the arctangent of the geometric mean of the tangents of the other two latitudes. The change shown in parentheses is the result of subtracting the 1995-96 latitude value from the 1996-97 latitude value.

any real significance. Likewise, a perceived intensity fluctuation is not considered really important unless it surpasses roughly three times its standard deviation.

For estimating Saturnian global latitudes in 1996-97, observers utilized the visual method pioneered by Haas during the 1960s. Using his method, estimates are made of the fraction of the polar semidiameter of the planet's disk that is subtended on the central meridian (CM) between the limb and the feature whose lat-

ture's 1995-96 intensity from its 1996-97 intensity. Variations of only ±0.1 mean intensity points are not considered to be of

polar semidiameter of the planet's disk that is subtended on the central meridian (CM) between the limb and the feature whose lat-

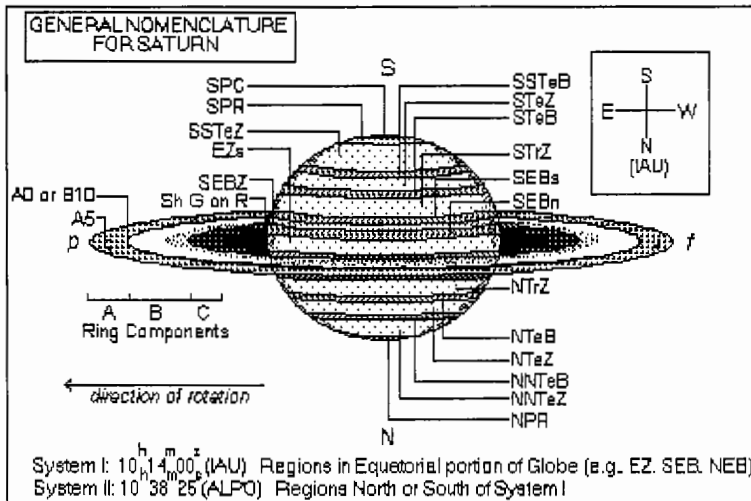


Figure 4. The schematic appearance of Saturn soon after opposition, where the numerical value of B is negative (-) when the Southern Hemisphere of the Globe and south face of the Rings is inclined toward Earth. Nomenclature appears for the major Globe and Ring features that may be visible with moderate apertures in good seeing. South is at the top, and features on Saturn's Globe move across the planet's disk from right to left in the normal inverted view (i.e., as seen in an astronomical telescope near culmination in the Earth's Northern Hemisphere without a star diagonal or other device that would reverse the image). The text discusses the Globe and Ring features shown here, with emphasis on the Southern Hemisphere of Saturn. Some minor features that are not depicted include the: South Polar Belt (SPB) encircling the SPR; South South Temperate Belt (SSSTeB), immediately south of the SSTeZ; Shadow of the Rings on the Globe (Sh R on G); Terby White Spot (TWS), adjacent to the shadow of the Globe on the Rings (Sh G on R); and any intensity minima in several Ring components. The easternmost and westernmost extensions of the Rings are called the ansae.

itude is desired. Haas' procedure is easy to use and produces results that compare favorably with latitude values measured with a bifilar micrometer. After mathematical reduction, latitudes of Saturn's global features during 1996-97 appear in *Table 4* (p. 4), but one must be cautious not to place too much confidence in data generated by only one or two observers. Haas and others have been employing the technique for many years with excellent and reliable results. Observers are encouraged to use this very simple procedure whenever possible, even if a bifilar micrometer is available; comparison of latitude data gathered by both methods is always useful. A full discussion of Haas' visual technique can be found in the *Saturn Handbook*. In discussing each feature on Saturn's globe, notes regarding latitude data are incorporated into the text where appropriate.

SOUTHERN PORTIONS OF THE GLOBE

Improved views of the Southern Hemisphere of Saturn occurred during 1996-97 as these regions increasingly tilted into our line of sight following the 1995-96 edgewise apparition. Of course, correspondingly less of the Northern Hem-

isphere of the planet is now visible, but belts and zones at corresponding latitudes in both hemispheres could still be compared with one another in 1996-97. As a whole, observers reported that the Southern Hemisphere of Saturn appeared very slightly brighter than the planet's Northern Hemisphere in 1996-97 (by +1.37 mean intensity points), and this impression was similar to that in the immediately preceding apparition. Intermittent sightings of wispy festoons and

transient dark features occurred among the belts and zones of the Southern Hemisphere of Saturn in 1996-97, although the most noteworthy activity seen in the observing season was a series of fairly prominent but diffuse white ovals in the Equatorial Zone (EZs), first appearing in late 1996 September. More will be discussed about this feature in the later section dealing with Saturn's Equatorial Zone. Also, other less prominent whitish spots were suspected in the SSTeZ during 1997 January and February.

South Polar Region (SPR).—The SPR showed a uniform yellowish-grey hue during 1996-97, with no discernible activity reported. The SPR had a mean intensity that differed by a factor of -0.54 from that of 1995-96, a variance that is considered to be of no real consequence. There was only one sighting in 1996-97 of an ill-defined, greyish South Polar Cap (SPC), which was slightly darker than its surroundings and of roughly the same mean intensity as in 1995-96. The South Polar Belt (SPB) encircling the SPR was not reported at all throughout the apparition.

South South Temperate Zone (SSTeZ).—The SSTeZ was sighted on several occasions during 1996-97, certainly far more frequently than the NNTeZ in the Northern Hemisphere. A derived mean intensity difference between the SSTeZ and NNTeZ of +0.46 is considered unimportant. The SSTeZ was described as a yellowish-white feature of consistent uniformity in intensity, at least until McAnally reported whitish spots from 1997 JAN 16-FEB 17. These white spots appeared most prominent using a W58 (green) Filter, but they were also quite evident in integrated light, according to McAnally. Unfortunately, no other observers confirmed his reports.

South South Temperate Belt (SSTeB).—There was only one instance in which the SSTeB was seen during the 1996-97 Apparition. This belt was then described as a narrow, greyish feature, similar in appearance and prominence to what it had been in 1995-96.

South Temperate Zone (STeZ).—The yellowish-white STeZ was similar in mean intensity to the more southerly SSTeZ, and the STeZ varied an insignificant -0.43 mean intensity points from 1995-96 to 1996-97. Comparing the STeZ with its counterpart in the Northern Hemisphere (the NTeZ), both zones were essentially the same average intensity during the apparition. The STeZ showed uniformity in intensity during 1996-97, with no clearly-defined activity recorded.

South Temperate Belt (STeB).—The STeB was described in 1996-97 as greyish in color, extending uninterrupted across the Globe from one limb to the other, and unchanged in mean intensity since 1995-96. The STeZ was suspected of being slightly darker than its Northern-Hemisphere complement, the NTeB, and no activity was reported in the STeB in 1996-97.

South Tropical Zone (STrZ).—The dull yellowish-white STrZ was a meager -0.52 mean intensity points duller than the NTrZ during 1996-97, displaying about the same mean intensity reported in 1995-96. The STrZ remained stable in brightness and inactive throughout the observing season.

South Equatorial Belt (SEB).—The SEB was observed during 1996-97 as a sin-

gle, greyish-brown feature with limited differentiation into SEB_n and SEB_s components, where *n* refers to the North Component and *s* to the South Component. When both the SEB_s and SEB_n were seen, observers described an intervening pale yellowish-white South Equatorial Belt Zone (SEBZ). With the exception of an isolated report of an Equatorial Band (EB) during 1996 November, the SEB was the darkest and most obvious belt in the Southern Hemisphere of Saturn in 1996-97, darker by a factor of -1.01 mean intensity points since 1995-96. The SEB showed a difference of -0.59 mean intensity points when compared with its northern counterpart, the NEB, during 1996-97. Activity in the SEB occurred periodically throughout the apparition, with sightings of dark spots and festoon-like projections from the extreme northern edge of the SEB extending into the EZs. When the diffuse bright ovals were first detected in the EZs in late 1996 September, the *f* (following) northern edge of the SEB (SEB_n?) appeared fragmented and incomplete across Saturn's Globe, with obvious interaction with the whitish features of the EZs. Parker submitted CCD images of the fragmented SEB and a bright EZs on 1996 SEP 25.

Equatorial Zone (EZ).—With Saturn's Rings opening up following their edgewise orientation in 1995-96, the EZs was the portion of the EZ seen to greatest advantage during the 1996-97 Apparition. The EZ could still be viewed on either side of the Ring plane during 1996-97, where the EZ_n denotes the region of the EZ between where the Rings cross the Globe and the NEB and the EZ_s is the portion of the EZ between where the Rings cross the Globe and the SEB. The bright yellowish-white EZs was only +0.77 mean intensity points brighter than it appeared in 1995-96, and the EZs was always the most brilliant zone on Saturn during the 1996-97 Apparition, lighter than Ring A and sometimes closely approaching the intensity of the outer third of Ring B. The elevated brightness of the EZs during the apparition was attributable mostly to the emergence of diffuse white spots, which were first reported to the A.L.P.O. Saturn Section on 1996 SEP 25. Convection processes uplift ammonia (NH₃) into Saturn's frigid outer atmosphere, where bright ice clouds condense and become visible as brilliant white spots. After the EZs spots were reported, an alert was issued by the A.L.P.O. Saturn Section

so that observers could attempt CM transit timings to facilitate calculation of a rotation period for the features. The white spots of 1996-97 were not nearly as prominent as those witnessed in the EZ by Saturn observers during the great outbursts of 1960 and 1990 (evidence suggests that the really big storms tend to recur at these latitudes at intervals of one Saturnian year), nor were they as conspicuous as the EZn white ovals seen in 1994. Nevertheless, the 1996-97 spots were visible with most apertures, and observers found that they could see them best when using a green (W58) filter. The brilliant EZs spots also appeared to interact with the SEB, producing fragmentation along its north following (f) edge. Throughout 1996 September and October, the entire EZs-SEB region displayed a complex morphology (see CCD images accompanying this report; *Figures 9, 10, 12, 13*). As observers continued to monitor the progress of the white spots in the EZs through late 1996 October, the white spots gradually spread out along the zone, resulting in an EZs that remained elevated in brightness for the rest of the apparition. Using a very small number of CM transit timings, calculations suggested a rotation period of $10^{\text{h}} 22^{\text{m}}$ (drift rate in CM(I) longitude of roughly $+11^{\circ}$ per day), significantly slower than the established System I rotation period of $10^{\text{h}} 14^{\text{m}} 00^{\text{s}}$.

The pale yellowish-white EZn was barely perceptible to observers during 1996-97 because of the Rings crossing Saturn's Globe at that latitude. Observers recorded a difference of -0.68 mean intensity points between the EZs and EZn during the apparition. Perhaps the shadow of the Rings on the Globe contributed to any diminished intensity of the EZn as well. Although it was apparent that the diffuse EZs white spots extended across Saturn's Ring plane into the EZn, much of the EZ north of the Rings was blocked from view.

The Equatorial Band (EB) was suspected only once during 1996-97, described as a dark grey, poorly-defined linear feature running across Saturn's Globe. A single intensity estimate suggested that the EB was a little darker in 1996-97 than in 1995-96 (by -1.09 mean intensity points). Thus, it would have been classified as the darkest belt on Saturn during 1996-97 if any confidence could be placed in this interpretation.

NORTHERN PORTIONS OF THE GLOBE

During the 1996-97 Apparition the Northern Hemisphere of Saturn was virtually unchanged in mean intensity since 1995-96 (an increase of only +0.14 mean intensity points). From time to time during the observing season, observers suspected elusive, short-lived dusky features among Saturn's northern belts and zones. We have already discussed the white spots that were seen in the southern Equatorial Zone (EZs) of the planet and how these bright features probably extended into the EZn, contributing to elevated intensity of that zone north of the Rings during 1996 September and October.

North Equatorial Belt (NEB).—

The greyish-brown NEB during 1996-97 was always reported as a single feature undifferentiated into an NEBn and NEBs. Occasional dusky features, all barely perceptible to observers, were suspected along the NEB in favorable seeing during the apparition. On the basis of intensity estimates in 1996-97, the NEB was unchanged in mean intensity since 1995-96. A difference of only -0.59 in mean intensity between the SEB and NEB during the 1996-97 observing season was considered negligible. Aside from an isolated glimpse in 1996-97 of an apparent Equatorial Band (EB), the NEB was second only to the SEB in being the darkest belt on Saturn.

North Tropical Zone (NTrZ).—

After the EZ and SEBZ, the yellowish-white NTrZ was the third brightest zone on Saturn's Globe in 1996-97. The NTrZ showed a mean intensity difference of only +0.47 from 1995-96 to 1996-97, and observers described it as a dull yellowish-white zone, uniform across the Globe from limb to limb.

North Temperate Belt (NTeB).—

The light-greyish NTeB was very poorly defined and infrequently seen during the 1996-97 observing season. The intensity of the NTeB remained stable throughout 1996-97, and it was practically unchanged in intensity since the immediately preceding apparition.

North Temperate Zone (NTeZ).—

In 1996-97 the yellowish-white NTeZ showed no meaningful change in intensity since 1995-96, nor was it easily detected in the Northern Hemisphere of Saturn for most of the apparition. The NTeZ and STeZ exhib-

ited basically the same mean intensity during the 1996-97 observing season.

North North Temperate Belt (NNTeB).—Observers did not report this feature during the 1996-97 Apparition.

North North Temperate Zone (NNTeZ).—The dull yellowish-white NNTeZ was suspected only once during 1996-97, with a trivial mean intensity difference of -0.43 from 1995-96 to 1996-97. The SStTeZ in the South differed only by +0.46 mean intensity points from the NNTeZ, also a negligible difference.

North Polar Region (NPR).—The brightness of the dull yellowish-grey NPR was invariable throughout 1996-97, and the region showed a meager change of -0.51 in mean intensity since 1995-96. The North Polar Cap (NPC) nor North Polar Belt (NPB) were reported during the 1996-97 Apparition. Comparatively, the NPR and SPR were essentially the same intensity during 1996-97.

RING SHADOWS

Shadow of the Globe on the Rings (Sh G on R).—The Sh G on R was seen by observers as a dark greyish-black feature on either side of opposition during 1996-97, with regular form. Any perceived departure from a true black (0.0) intensity was a result of poor seeing conditions or scattered light.

Shadow of the Rings on the Globe (Sh R on G).—Observers in 1996-97 described this shadow as a dark greyish-black feature south of the Rings where they crossed the Globe. Reported variations from an intrinsic black (0.0) condition were due to the same causes listed in the preceding paragraph.

SATURN'S RING SYSTEM

This section of the 1996-97 Apparition report concerns studies of Saturn's Ring system, including an ongoing comparative investigation of mean intensity data that has been a tradition in previous observing seasons. Views of the southern face of the Rings were increasingly favorable during 1996-97 as the value of B increased.

Ring A.—Considered as a whole, Ring A displayed a yellowish-white coloration throughout 1996-97, and a mean intensity change of +2.14 in mean intensity suggested a brightening of the Ring component since 1995-96. No observers reported Encke's Division (A5) at the Ring ansae, nor did individuals apparently detect any other intensity minima in Ring A during the apparition.

Observers did not report obvious outer and inner halves of Ring A in terms of intensity.

Ring B.—The outer third of Ring B is the adopted standard of reference for the A.L.P.O. Saturn Intensity Scale, with an assigned value of 8.0. For the entire 1996-97 Apparition, this region of Ring B was white, remained stable in intensity, and was always the brightest feature on Saturn's globe or in the Ring system, with the possible exception of brilliant EZs white spots (of mean intensity 8.5) in 1996 September and October. In 1996-97, the inner two-thirds of Ring B, which was yellowish-white in color and uniform in intensity, showed no change in brightness since the immediately preceding observing season. During 1996-97, Ring A was considered to be slightly brighter than the inner two-thirds of Ring B by most observers, but this difference was quite subtle as the mean intensity difference between Ring A and inner two-third of Ring B was only +0.50.

Cassini's Division (A0 or B10).—Most observers remarked that Cassini's division was rather difficult to see anywhere other than the ansae in 1996-97, and this same impression persisted even in excellent seeing. With a Ring inclination during 1996-97 that was still quite small (values of B did not surpass $-6^{\circ}.20$), views of Cassini's Division were far from optimal. Cassini's division was described as greyish-black during the 1996-97 Apparition, and it appeared darker by -3.35 mean intensity points since 1995-96, a change that was most likely due to the difference in angle of view from Earth since the 1995-96 edgewise apparition. Usually, a divergence from a totally black intensity for this feature is due to the scattering of light, unfavorable seeing, and other factors.

Ring C.—Only two reports of a dark greyish Ring C at the ansae were received during 1996-97, and even then, observers

were unsure that they had actually seen Ring C off the Globe. The Crape Band (Ring C across the Globe) was described as uniform in intensity and extremely dark grey in color. Partial coincidence of the Crape Band with the shadow of Ring C on the Globe (when B and B' are approximately equal at small Ring inclinations, as in 1996-97) yields a Crape Band that appears slightly darker than usual.

Terby White Spot (TWS).—The TWS is a brightening of the Rings occasionally seen immediately adjacent to the Sh G on R. In one instance an observer suspected a bright TWS (intensity of 8.5) during 1996-97. The TWS is of no real importance, since it is almost certainly a spurious contrast phenomenon, not some intrinsic feature on Saturn. Nevertheless, it is considered worthwhile to try to determine if there is any connection between the visual numerical relative intensity of the TWS and the changing tilt of the Ring system, as well as its visibility and brightness in color filters and variable-density polarizers.

Bicolored Aspect of the Rings.—

This phenomenon is a reported difference in color between the East and West Ansaes when compared with W47 (Wratten 47), W38, or W80A (all blue) Filters and W25 or W23A (both red) Filters. Haas was the only observer during 1996-97 who noticed a bicolored aspect of the Ring ansae. Table 5 (below) lists the circumstances of Haas' observations, and the reader should note that the directions in the table refer to Saturnian or IAU directions, where West is to the right in a normally-inverted telescope image for an observer located in the Northern Hemisphere of the Earth with South at the top.

Table 5. Observations of the Bicolored Aspect of Saturn's Rings During the 1996-97 Apparition.

UT Date and Time (entire observing period)	S	Tr	Filter		
			Bl	IL	Rd
1996 Oct 30 04:17-04:28	3.0	+4.5	E	=	=
1996 Nov 12 04:06-04:33	3.5	+3.5	W	=	=
1996 Nov 26 02:38-03:14	4.0	+4.0	W	=	=
1996 Dec 04 02:35-02:58	3.5	+2.5	E	=	=

Notes: All observations are by Haas with a 31.8-cm (12.5-in) Newtonian reflector at 321X. Seeing (S) is on the 0-10 A.L.P.O. Scale, and Transparency (Tr) is the limiting visual magnitude in the vicinity of Saturn. Under "Filter," Bl refers to the blue W47 or W80A Filters, IL to integrated light (no filter), and Rd to the red W25 or W23A Filters. E means the East ansa was brighter than the W, W that the West ansa was brighter, and = means that the two ansae were equally bright. East and West directions are as noted in the text.

To get a better understanding of the cause of the bicolored aspect of the Rings, there remains a great need for observers to strive to conduct simultaneous observing programs which stress a systematic study of this phenomenon, among other projects. The greater the number of persons taking part in this effort, making independent, systematic visual estimates with color filters and doing CCD work and photography in the corresponding wavelengths, all at the same time, the better will be the chances of shedding some new light on this intriguing and poorly-understood phenomenon.

SATURN'S SATELLITES

As in the last three preceding apparitions, no observers in 1996-97 contributed systematic visual estimates of Saturn's satellites using the methods outlined in *The Saturn Handbook*. Photoelectric photometry and systematic visual magnitude estimates of Saturn's satellites are strongly encouraged for future apparitions.

SIMULTANEOUS OBSERVATIONS

Several simultaneous, or near-simultaneous, observations of Saturn were submitted during 1996-97, where individuals worked independently of one another but observed at the same time and on the same date. As in the 1995-96 Apparition, the occurrence of simultaneous observations was entirely fortuitous, and the A.L.P.O. Saturn Section would like to receive reports from individuals who participate in a routine simultaneous observing effort. Simultaneous observations provide much-needed verification of ill-defined phenomena on Saturn's Globe and in the Ring system, greatly strengthening the confidence level in the interpretation of the data. Readers are urged to inquire about how to pursue simultaneous observations in future observing seasons.

CONCLUSIONS

Our analysis of the submitted observations of Saturn and its Ring system during 1996-97 suggests that atmospheric activity remained moderate, somewhat consistent with the outcome of the two immediately preceding observing seasons. With Saturn's Rings opening up more and more since the edgewise presentation of 1995-96, optimum views of the Southern Hemisphere of Saturn and South face of the

Rings are becoming possible. Our apparition reports, at least until the next edgewise Ring presentation in 2009, will correspondingly stress observations of these regions of Saturn. As the reader can appreciate from the foregoing discussion that the highlight of the 1996-97 Apparition was the emergence of fairly prominent, diffuse white spots in the EZs during 1996 September and October. Observers tracked their evolution, which resulted in an EZs that remained brilliant throughout for the rest of the apparition. Other noteworthy features of the Saturn's Southern Hemisphere were the periodic festoons and dark projections associated with the SEB, plus intermittent white spots suspected in the SStEZ near the end of the observing season.

We once again extend our sincere gratitude to all of the dedicated observers mentioned in this report who contributed data during 1996-97. Readers in the United States and abroad, who may not already be participating observers, are encouraged to submit their work to the A.L.P.O. Saturn Section, joining us as we further our international systematic study of the planet. Individuals just getting into lunar and planetary astronomy for the first time, including enthusiastic youngsters, are also encouraged to take advantage of the A.L.P.O. Training Program, but feel free to concurrently participate in our section. One of our responsibilities is to encourage development of special talents a particular novice observer might bring to the program.

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Caption Information for Figures 5-14 (pp. 11-12).

Unless otherwise stated for these illustrations: Telescope types are as given in Table 2; **Seeing** (S) is given on the 0-10 A.L.P.O. Scale, where 0 is the worst possible and 10 is perfect; **Transparency** (Tr) is the limiting naked-eye visual magnitude in the vicinity of Saturn; **CM(I)** is the central-meridian longitude in rotational system I (844°.3/day, applying to the NEBs, EZ, and SEBn); **CM(II)** is the same in rotational system II (812°.0/day, applying to the remainder of the Globe); **B** is the saturnicentric latitude of the Earth; **B'** is the saturnicentric latitude of the Sun; **Globe** is the apparent diameter of the Globe in arc-seconds (equatorial and polar); and **Rings** is the apparent major and minor axes of the Rings in arc-seconds. The source of ephemerides was *The A.L.P.O. Solar System Ephemeris* (1996 and 1997 editions), except for **B'**, which was taken from the *Astronomical Almanac* for the same years. Saturnicentric south is at the top, with celestial east (following) to the right, unless otherwise stated. The sky background has been made black for all illustrations when it was not already so, and contrasts have been exaggerated.

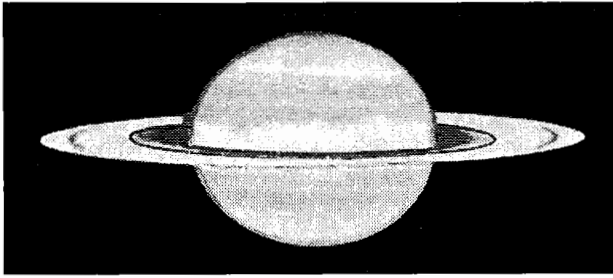


Figure 5. Saturn drawing: 1996 SEP 02, 05^h33^m UT. P. Plante. 20.3-cm (8.0-in) SC, 416X, Integrated Light. S = 6.5, Tr = +1.5. CM(I) = 313°.6, CM(II) = 238°.9. B = -5°.30, B' = -4°.31, Globe = 19".3 × 17".2, Rings = 43".7 × 4".0. Northern edge of SEB shows irregularities; bright EZs.

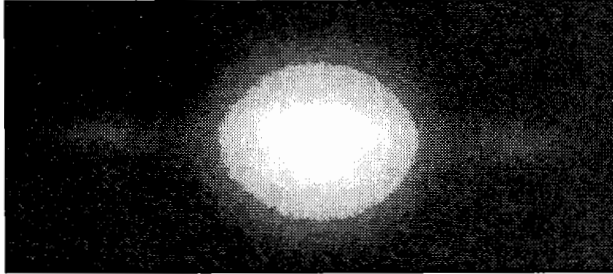


Figure 6. Saturn image. 1996 SEP 20, 04^h30^m UT. F.J. Melillo. 20.3-cm (8.0-in) SC, CCD Camera, Integrated Light. S = 8.0, Tr = +4.5. CM(I) = 355°.6, CM(II) = 235°.8. B = -4°.68, B' = -4°.58, Globe = 19".5 × 17".4, Rings = 44".1 × 3".6. Bright EZs quite apparent in CCD image.

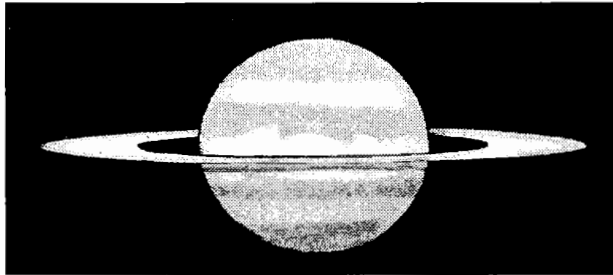


Figure 7. Saturn drawing. 1996 Oct 06, 19^h20^m UT. D. Niechoy. 20.3-cm (8.0-in) SC, 225X, Integrated Light. S = 2.5, Tr = +2.5. CM(I) = 346°.9, CM(II) = 235°.8. B = -4°.09, B' = -4°.83, Globe = 19".4 × 17".4, Rings = 44".1 × 3".1. Considerable activity along northern edge of SEB; brilliant EZs.

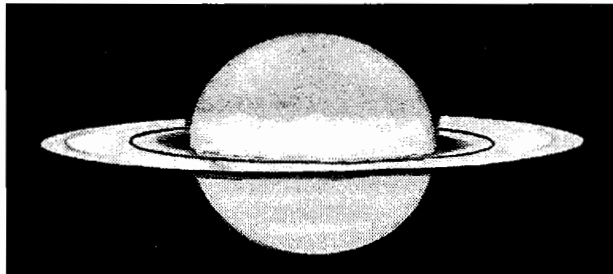


Figure 8. Saturn drawing. 1996 Oct 16, 03^h50^m UT. P. Plante. 20.3-cm (8.0-in) REF, 375X, Integrated Light. S = 5.5, Tr = +4.0. CM(I) = 325°.6, CM(II) = 271°.9. B = -3°.78, B' = -4°.97, Globe = 19".3 × 17".3, Rings = 43".9 × 2".9.

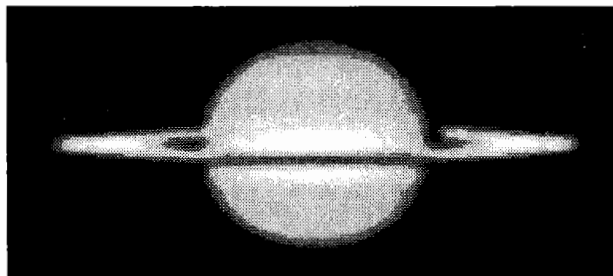


Figure 9. Saturn image. 1996 Oct 28, 01^h11^m UT. D.C. Parker. 40.6-cm (16.0-in) NEW, CCD Camera, Integrated Light. S = Good, Tr = Good. CM(I) = 284°.1, CM(II) = 206°.5. B = -3°.45, B' = -5°.15, Globe = 19".1 × 17".1, Rings = 43".4 × 2".6. Bright EZs.

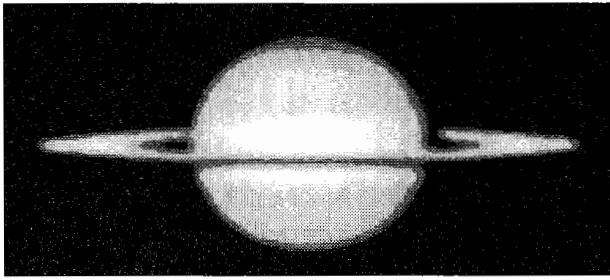


Figure 10. Saturn image. 1996 OCT 29, 01^h08^m UT. D.C. Parker. 40.6-cm (16.0-in) NEW, CCD Camera, Integrated Light. S = Good, Tr = Good. CM(I) = 046°.6, CM(II) = 296°.8. B = -3°.42, B' = -5°.16, Globe = 19".1 × 17".1, Rings = 43".4 × 2".6. Bright EZs.

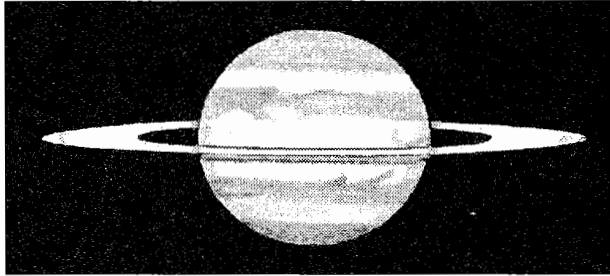


Figure 11. Saturn drawing. 1996 Nov 22, 16^h54^m UT. D. Niechay. 20.3-cm (8.0-in) SC, 225X, Integrated Light. S = 2.5, Tr = +2.5. CM(I) = 344°.0, CM(II) = 157°.8. B = -3°.04, B' = -5°.53, Globe = 18".5 × 16".5, Rings = 41".9 × 2".2. Activity along northern edge of SEB; activity also apparent along southern edge of NEB; bright EZs.

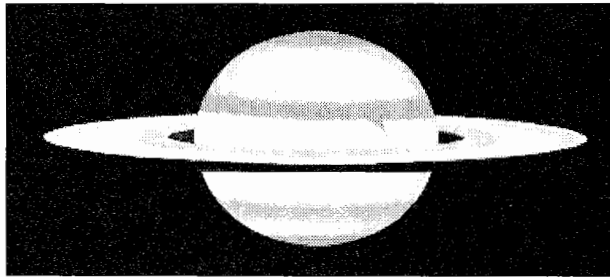


Figure 12. Saturn drawing. 1996 Dec 06, 01^h30^m UT. C.E. Hernandez. 20.3-cm (8.0-in) NEW, 179X, Integrated Light. S = 7, Tr = +5. CM(I) = 101°.5, CM(II) = 203°.9. B = -3°.04, B' = -5°.73, Globe = 18".1 × 16".1, Rings = 41".0 × 2".2. Festoon-like projection from northern edge of SEB.

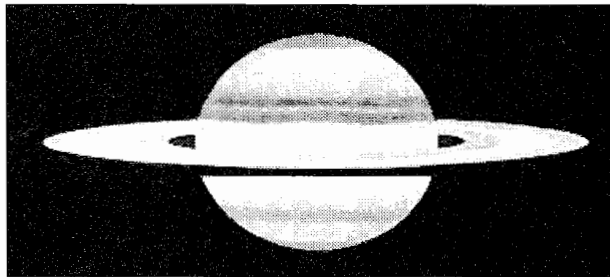


Figure 13. Saturn drawing. 1996 Dec 09, 01^h30^m UT. C.E. Hernandez. 20.3-cm (8.0-in) NEW, 179X, Integrated Light. S = 5.5, Tr = +6. CM(I) = 114°.2, CM(II) = 119°.6. B = -3°.06, B' = -5°.78, Globe = 18".0 × 16".1, Rings = 40".8 × 2".2. Bright EZs, SEBs and SEBn visible with SEBZ separating the two components.

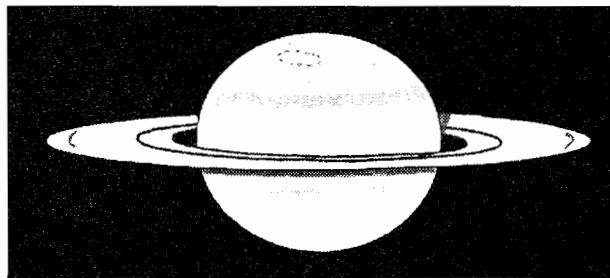


Figure 14. Saturn drawing. 1997 FEB 05, 00^h50^m UT. J.W. McAnally. 11.4-cm (4.5-in) NEW, 272X, Integrated Light, W11, W21 Filters. S = 8.5, Tr = +5.0. CM(I) = 093°.2, CM(II) = 026°.3. B = -4°.76, B' = -6°.64, Globe = 16".5 × 14".9, Rings = 37".2 × 3".1. Suspected bright spot in SStEZ; best view using W11 filter.

OBSERVATIONS OF THE REMOTE PLANETS IN 1998

By: Richard W. Schmude, Jr.,
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ABSTRACT

Photoelectric magnitude measurements were made for Uranus and Neptune in 1998 and the selected normalized magnitudes for Uranus are: $B_{(1,0)} = -6.66 \pm 0.02$ and $V_{(1,0)} = -7.16 \pm 0.01$; the corresponding values for Neptune are: $B_{(1,0)} = -6.62 \pm 0.02$ and $V_{(1,0)} = -6.98 \pm 0.01$. Unfiltered CCD images made on 1998 AUG 01-02 are consistent with Titania being 0.1 magnitudes brighter than Oberon. The brightness of Pluto changed by 0.40 ± 0.10 magnitudes over an 11-day period according to unfiltered CCD images. Telescopic studies revealed few or no albedo features on Uranus and Neptune except for limb darkening.

INTRODUCTION

During 1998, several developments took place, related to the Remote Planets—Uranus, Neptune and Pluto. For example, results of a recent occultation of a star by Neptune's largest moon, Triton, revealed that Triton may be getting warmer [Elliot, 1999, 46; Elliot *et al.*, 1998, 1107]. Karkoschka and Tomasko [1998, 1097] reported that red and infrared images of Uranus taken by the Hubble Space Telescope exhibited distinct albedo variations. It was also suggested that Uranus may display a large seasonal change in albedo due to changing orientation; an infrared picture of Uranus is shown in *Sky & Telescope* [Feb. 1999, 20]. Lockwood and Thompson [1999, 2] reported that the brightness of Uranus had changed between 1972 and 1996, using the Stromgren y filter. Hammel and Lockwood [1997, 466] reported that several atmospheric features on Neptune had changed in the mid-1990s. Finally Hubble Space Telescope pictures showed that Neptune is constantly changing its appearance in the infrared [Sromovsky *et al.* 1998, 1098]. In addition, changes in the atmospheres of Uranus and Neptune may lead to changes in the brightness and appearance of these two planets in the visible portion of the spectrum. During 1998, ten people participated in the observing

programs of the A.L.P.O. Remote Planets Section. During 1998, the appearance and brightness of Uranus and Neptune were monitored, the light curve of Pluto was measured and the relative brightness of Titania and Oberon was measured.

Table 1 (lower left) lists the characteristics of the 1998 Apparitions of Uranus, Neptune and Pluto. The names, locations and forms of observations of the individuals who conducted observations or other measurements of the Remote Planets in 1998 are summarized in *Table 2* (p. 14).

PHOTOELECTRIC PHOTOMETRY

Four persons either submitted, or assisted in the gathering of, photoelectric magnitude measurements of the Remote Planets in 1998. In all cases, an SSP-3 solid-state photometer was used; this instrument is described elsewhere [Optec, 1988; Schmude, 1992, 20]. Brian Loader carried out a series of photoelectric measurements from the South Island of New Zealand ($172^\circ 41' 54''$ E/ $43^\circ 28' 46''$ S). He used a 0.20-m Schmidt-Cassegrain telescope. Frank Melillo of Holtsville, New York, also used a 0.20-m Schmidt-Cassegrain, while the author used a 0.51-m Newtonian near Villa Rica, Georgia. In addition, Frank Melillo submitted unfiltered charged-coupled device (CCD)

images of Titania and Oberon in 1998. These magnitude measurements have added to our knowledge of the color and brightness of Uranus and Neptune and have also yielded a light curve of Pluto. The magnitudes and

Table 1. Characteristics of the 1998 Apparitions of Uranus, Neptune and Pluto.

[Data were taken from the 1997, 1998 and 1999 *Astronomical Almanac*.]

Parameter	Uranus	Neptune	Pluto
First conjunction date	1998 JAN 28	1998 JAN 19	1997 NOV 27
Opposition date	1998 AUG 03	1998 JUL 23	1998 MAY 28
Angular diameter (opposition)	3".71	2".30	0".11
Right ascension (opposition)	20 ^h 54 ^m	20 ^h 12 ^m	16 ^h 28 ^m
Declination (opposition)	-18°.2	-19°.6	-9°.2
Second conjunction date	1999 FEB 02	1999 JAN 22	1998 NOV 30

Table 2. Contributors to the A.L.P.O. Remote Planets Section in 1998.

Observer and Location	Type of Observation*
Normal Boisclair; South Glenn Falls, NY	V
Tom Faber; Villa Rica, GA	PP
Lawrence Garrett; Fairfax, VT	V
Robin Gray; Paradise Hill, NV	V, VP
Rick Hill; Tucson, AZ	CCD
Brian Loader; New Zealand	PP
Raffaello Lena; Italy	V
Frank Melillo; Holtsville, NY	PP, CCD
Richard Schmude, Jr.; Villa Rica, GA and Barnesville, GA	PP, VP
Roger Venable; Wrens, GA	V

* CCD = CCD image, PP = photoelectric photometry, V = visible, VP = visual photometry.

positions of the comparison stars used in the photoelectric studies are listed in *Table 3* (upper right).

Individual photoelectric magnitude measurements of Uranus are listed in *Table 4* (p. 15) while individual measurements for Neptune are listed in *Table 5* (p. 15); all magnitudes have been corrected for extinction and transformation. The transformation coefficients were calculated using the two-star method as outlined in Hall and Genet [1988, 199]. On 1998 JUL 19 and 22, the author also measured the B and V magnitudes of a check star, θ Capricornis, and the resulting measured magnitudes were: B = $+4.07 \pm 0.01$ (mean of three measurements) and V = $+4.08 \pm 0.01$ (mean of six measurements). The corresponding literature magnitudes for θ Cap are: B = +4.06 and V = +4.07 [United States Naval Observatory, 1999, H28]. The mean normalized magnitudes of Uranus and Neptune for 1998 are listed in *Table 6* (p. 16). The average $V_{(1,0)}$ value for Uranus is consistent with results from previous years; however, the $B_{(1,0)}$ value is a little brighter than expected. The $V_{(1,0)}$ magnitude for Neptune is about the same as the values for the three previous years; however, the $B_{(1,0)}$ magnitude is a little brighter than values in 1995 and 1996. [The $V_{(1,0)}$ and $B_{(1,0)}$ magnitudes are visual and blue magnitudes, respectively, reduced to a Sun-planet and planet-Earth distance of 1.0 astronomical units. *Ed.*]

VISUAL PHOTOMETRY

A total of 117 visual magnitude estimates of Uranus and Neptune were made in 1998. The mean normalized visual magnitude for Uranus is $V_{\text{vis}(1,0)} = -7.1 \pm 0.02$ based on 64 measurements, while the corresponding value for Neptune based on 53 estimates is $V_{\text{vis}(1,0)} = -7.0 \pm 0.01$. The

Table 3. Comparison Stars used for B, V and I Photoelectric Photometric Measurements of Uranus and Neptune in 1998.

Star	Position (2000.0)		Magnitude		
	R.A.	Dec.	B	V	I
HD196078	20h 35.5m	-16°32'	6.39	6.19	-----
θ Cap	21h 05.9m	-17°14'	4.06	4.07	4.06
Hip 102780	20h 49.4m	-18°02'	7.61	6.21	-----
19 Cap	20h 54.8m	-17°55'	6.90	5.78	-----
ν Cap	20h 40.1m	-18°08'	6.81	5.15	-----
SAO 163261	20h 06.2m	-19°30'	(7.6)	7.67	-----
Hip 99391	20h 10.4m	-19°23'	7.86	7.28	-----

Notes: HD refers to the Henry Draper Catalog, Hip to the Hipparchus Catalog, and SAO to the Smithsonian Astrophysical Observatory Catalog.

uncertainties were calculated from σ/\sqrt{N} where σ is the standard deviation and N is the number of estimates (64 for Uranus and 53 for Neptune). The uncertainties do not include possible systematic errors arising from differences in comparison-star and planet color or in atmospheric extinction.

URANUS AND NEPTUNE DISK APPEARANCE

Four individuals submitted visual observations of Uranus and Neptune during 1998 and their observations are summarized in *Table 7* (p. 16). Uranus usually did not show much detail. However, on 1998 OCT 24 Robin Gray observed a vague spot on Uranus, slightly brighter than its surroundings. The A.L.P.O. Remote Planets Coordinator welcomes visual studies of both Uranus and Neptune; note that high magnifications and good seeing are required because of the small angular sizes of these two planets. Spots are occasionally visible on Uranus; one was seen on 1988 JUL 16 by the author [Schmude, 1988, 86].

OBERON AND TITANIA

Frank Melillo made a series of CCD images of both Uranus and Neptune during July and August 1998. He used a Starlight Xpress MX5 16 CCD camera, which has a Sony chip with a peak spectral response at 550 nanometers. The chip has 510×290 pixels with a pixel size of $12.6 \times 9.8 \mu\text{m}$. Each image had a total exposure time of 60 seconds. In two of the CCD images, the relative brightness of Titania and Oberon were measured, with the results listed below:

- 1998 AUG 01, 05^h00^m UT: Oberon is 0.14 magnitudes fainter than Titania.
- 1998 AUG 02, 05^h00^m UT: Oberon is 0.07 magnitudes fainter than Titania.

Table 4: Photoelectric Measured and Normalized Magnitudes of Uranus in 1998.

1998 UT Date	Filter	Magnitude		Comparison Star	Δ Air Mass: Planet- Star	1998 UT Date	Filter	Magnitude		Comparison Star	Δ Air Mass: Planet- Star
		Meas.	Norm.					Meas.	Norm.		
JUL						AUG					
19.228	V	5.76	7.11	HD 196078	+0.106	01.208	V	5.72*	7.15*	6 Cap	-0.01
19.237	V	5.72	7.15	"	+0.091	02.208	V	5.71*	7.16*	"	-0.01
19.243	V	5.66	7.21	"	+0.086	03.208	V	5.69*	7.18*	"	-0.01
19.252	V	5.67	7.20	"	+0.071	04.208	V	5.71*	7.16*	"	-0.01
19.262	V	5.71	7.16	"	+0.060	20.208	V	5.73*	7.14*	"	-0.01
19.272	V	5.70	7.17	"	+0.047	SEP					
19.310	V	5.71	7.16	"	+0.016	12.375	V	5.72	7.18	Hip 102780	-0.01
19.325	V	5.72	7.16	"	-0.009	12.382	V	5.75	7.15	19 Cap	-0.01
19.340	V	5.76	7.11	"	-0.025	16.347	V	5.75	7.15	Hip 102780	0.00
19.363	V	5.83	7.04	"	-0.095	16.358	V	5.72	7.18	19 Cap	-0.02
19.380	V	5.69	7.18	"	-0.089	21.345	V	5.77	7.14	Hip 102780	-0.01
22.173	B	6.15	6.71	"	+0.287	21.350	V	5.75	7.15	u Cap	0.00
22.176	V	5.72	7.15	"	+0.271	21.358	V	5.76	7.15	Hip 102780	-0.01
22.204	B	6.25	6.62	"	+0.112	22.372	V	5.80	7.11	"	-0.01
22.207	V	5.72	7.15	"	+0.118	22.375	V	5.78	7.13	"	-0.01
22.220	B	6.29	6.58	"	+0.114	22.380	V	5.75	7.16	"	-0.01
22.223	V	5.77	7.10	"	+0.107	OCT					
22.243	B	6.19	6.68	"	+0.076	17.384	V	5.77	7.18	Hip 102780	-0.01
22.245	V	5.70	7.17	"	+0.072	17.389	V	5.76	7.19	"	-0.01
22.260	B	6.19	6.68	"	+0.057	24.388	V	5.75	7.22	"	-0.01
22.263	V	5.68	7.18	"	+0.054	NOV					
22.286	B	6.22	6.65	"	+0.035	09.417	V	5.87	7.12	Hip 102780	-0.02
22.289	V	5.69	7.18	"	+0.035	09.423	V	5.86*	7.13*	"	-0.05
22.328	V	5.66	7.21	"	+0.012	*Extinction coefficient assumed to equal 0.26 magnitude/air mass.					
22.331	B	6.13	6.74	"	+0.008						
22.350	B	6.23	6.64	"	-0.050						
22.352	V	5.71	7.16	"	-0.054						
22.378	B	6.27	6.60	"	-0.061						
22.381	V	5.74	7.13	"	-0.056						
22.397	B	6.20	6.67	"	-0.150						
22.400	V	5.69	7.18	"	-0.133						

Table 5: Photoelectric Measured and Normalized Magnitudes of Neptune in 1998.

1998 UT Date	Filter	Magnitude		Comparison Star	Δ Air Mass: Planet- Star	1998 UT Date	Filter	Magnitude		Comparison Star	Δ Air Mass: Planet- Star
		Meas.	Norm.					Meas.	Norm.		
JUL						SEP					
19.307	V	7.66	7.06	HD 196078	+0.198	12.389	V	7.80	6.94	SAO 163261	0.00
19.322	V	7.73	6.99	"	+0.236	12.394	V	7.81	6.93	"	0.00
19.336	V	7.69	7.03	"	+0.287	16.369	V	7.76	6.99	"	0.00
19.347	V	7.80	6.92	"	+0.340	16.374	V	7.80	6.95	"	0.00
19.376	V	7.73	6.99	"	+0.378	16.378	V	7.78	6.97	Hip 99391	0.00
22.160	B	8.07	6.65	"	+0.052	21.368	V	7.76	7.00	SAO 163261	0.00
22.163	V	7.75	6.97	"	+0.050	21.372	V	7.78	6.97	"	0.00
22.184	B	8.12	6.60	"	-0.040	22.359	V	7.66	7.09	"	0.00
22.187	V	7.81	6.91	"	-0.035	22.361	V	7.68	7.07	"	0.00
22.198	B	8.1	6.58	"	+0.050	OCT					
22.200	V	7.79	6.93	"	+0.053	17.371	V	7.82	6.96	SAO 163261	-0.01
22.214	B	8.14	6.57	"	+0.079	17.375	V	7.86	6.93	"	-0.01
22.217	V	7.76	6.96	"	+0.079	24.376	V	7.83	6.96	"	-0.02
22.237	B	8.16	6.55	"	+0.093	24.381	V	7.83	6.96	"	-0.01
22.240	V	7.75	6.97	"	+0.094	NOV					
22.254	B	8.05	6.67	"	+0.110	09.405	V	7.88*	6.93*	SAO 163261	-0.07
22.257	V	7.73	6.99	"	+0.112	09.410	V	7.85*	6.96*	"	-0.06
22.278	B	8.09	6.62	"	+0.139	*Extinction coefficient assumed to equal 0.26 magnitude/air mass.					
22.281	V	7.78	6.94	"	+0.143						
22.322	B	8.0	6.72	"	+0.250						
22.234	V	7.68	7.04	"	+0.254						
22.344	B	8.21	6.51	"	+0.302						
22.347	V	7.73	6.99	"	+0.317						
22.370	B	8.00	6.72	"	+0.483						
22.373	V	7.70	7.02	"	+0.525						
22.391	B	8.12	6.60	"	+0.784						
22.393	V	7.69	7.03	"	+0.848						

Both relative brightness measurements were made from unfiltered CCD images. The 1999 *Astronomical Almanac* lists Titania as being 0.21 magnitudes brighter than Oberon in the V band. Oberon

and Titania are gradually showing their equatorial regions and thus their relative brightness may be different than in 1986 when Voyager 2 flew past Uranus.

Table 6. Selected Normalized Magnitudes for Uranus and Neptune in 1998.
(The number of measurements is given in brackets.)

Planet	Normalized Magnitude		B - V
	B(1,0)	V(1,0)	
Uranus	-6.66±0.02 [10]	-7.16±0.01 [41]	+0.50±0.02
Neptune	-6.62±0.02 [11]	-6.98±0.01 [31]	+0.36±0.02

PLUTO

Richard Hill submitted CCD images showing the path that Pluto followed during May and July 1998. Frank Melillo took several unfiltered CCD images of Pluto with a 0.20-m Schmidt-Cassegrain telescope over an 11-day period. He measured the brightness of Pluto with respect to a ca. +12.5-magnitude comparison star at R.A. 16^h28^m09^s (±2^s), Dec. -9°11'46" (±30"). Pluto was just north of the comparison star on 1998 MAY 26, which is shown in a Pluto finder chart [MacRobert, 1998, 97]. Frank Melillo's results are plotted in *Figure 1* (p. 17); the dashed curve is a fit to the data based on a rotational period of 6.3872 days. Based on his data, Melillo suggests that Pluto changed in brightness by 0.40±0.10 magnitude as it rotated in late May-early June, 1998. The corresponding changes in brightness for Pluto during rotation in previous studies were 0.12 magnitudes (1953-55) and 0.25 magnitudes (1985) [Cruikshank and Morrison, 1990, 204]. The steady increase in the brightness change

from the 1950s to 1998 is consistent with the disappearance of snow and frost on the surface of Pluto over the last 45 years.

CONCLUSIONS

Members of the A.L.P.O. Remote Planets Section submitted photoelectric magnitude measurements of Uranus and Neptune along with visual observations and CCD images of all three planets. The V_(1,0) magnitudes of Uranus and Neptune are consistent with values in previous years. The disk of Uranus did not show much detail. The light curve of Pluto was measured with a CCD camera and the total change in brightness is estimated to be 0.40±0.10 magnitudes.

ACKNOWLEDGMENTS

The author wishes to thank each person who submitted observations of the Remote Planets for their 1998 Apparitions.

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Table 7. Summary of Visual Telescopic Studies of Uranus and Neptune in 1998.

1998 UT Date	Telescope		Mag.	Filter	Seeing	Comments
	Aper.	Type				
JUL 16.923	0.25 m	S-C	200X	none	-	Uranus had an asymmetric area of unusually high albedo which is consistent with CCD images taken in 1995.
AUG 13.173	0.51 m	New	640X	W8	3	The limb of Neptune appears moderately stable. The planetary disk shows very pronounced limb darkening. No dusky belts or bright zones are suspected.
AUG 13.198	0.51 m	New	508X	W8	3	Uranus shows little limb darkening and no dusky belts, bright zones, faint variations or albedo irregularities. Uranus has a yellow to greenish color.
AUG 17.210	0.15 m	Rfr	253X, W8, IL 310X *		4	Central area of Uranus is brighter than limb with and without #8 filter; no other disk details are visible.
AUG 21.306	0.15 m	Rfr	375X* W8, IL		5	No details or irregularities are visible on the disc of Uranus even though the limb of the planet is sharp for brief instances.
SEP 15.069	0.15 m	Rfr	375X* W8, IL		6	The limb of Uranus is sharp even at 375X, no details are visible; uniform brightness across the disk.
SEP 26.188	0.40 m	New	320X	W80A	9	Suspected a trace of darkening near the ENE limb of Uranus—this is residual chromatic dispersion. Limb darkening was evident.
OCT 24.144	0.15 m	Rfr	310X	IL	6	One vague, slightly bright spot was visible on the disk of Uranus—this spot was not seen all of the time.
OCT 27.219	0.15 m	Rfr	310X	W82A, IL	5	No details are visible on the disc of Uranus either with or without filter.

Notes: * = other magnifications were used. IL = Integrated light, New = Newtonian, Rfr = refractor, S-C = Schmidt-Cassegrain. Seeing is in the A.L.P.O. Scale, ranging from 0 = worst to 10 = perfect. Wratten filters: W8 = light yellow, W80A & W82A = blue.

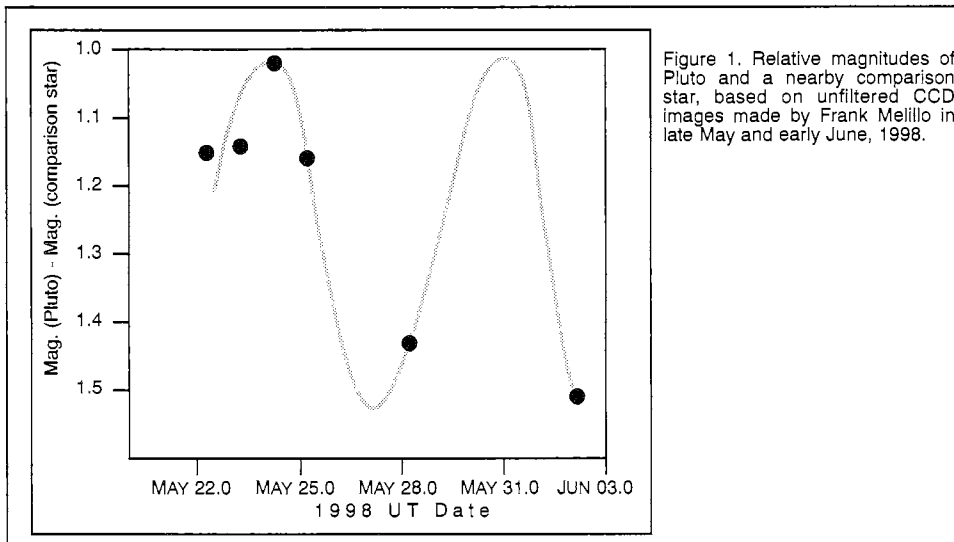


Figure 1. Relative magnitudes of Pluto and a nearby comparison star, based on unfiltered CCD images made by Frank Melillo in late May and early June, 1998.

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ILLUMINATED EXTENT: A TELLTALE MEASURE OF AN INFERIOR PLANET'S DISK

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ABSTRACT

A descriptive parameter dubbed "illuminated extent" is proposed, defined as the total solid angle subtended, from an astronomer's eye view, by the illuminated portion of an object. A celestial body exhibiting wide variance in both phase and angular size—an inferior planet, primarily—is well characterized by this parameter, for its peak value ("greatest illuminated extent" or GIE) denotes when the luminous image maximally covers a telescope's focal surface, a prime viewing circumstance. The relevance of a kindred apparitional occurrence, greatest brilliancy, also is discussed.

DEFINITION AND JUSTIFICATION

Forecasting the ideal date to inspect a superior planet [i.e., one whose orbit lies outside the Earth's. *Ed.*] has long been a simple matter: It is best spied at opposition. That, of course, is when the orb reigns above the horizon throughout the evening, subtends its largest (or nearly so) angular width, and when it reveals a fully sunlit disk—a welcome concurrence of optimal aspects for Earth-bound planet watchers.

But with the inferior planets [those that orbit between the Earth and the Sun. *Ed.*], these very same aspects are never simultaneously favorable. It is by fiat of the Solar System's arrangement and an unavoidable dictate of geometry that both Mercury and Venus span their widest angular diameters near inferior conjunction, just as their disks are minimally illuminated, if not altogether unlit. Conversely, when these planets realize full phase at superior conjunction, angular diameters are at low ebb. [*Conjunction* occurs when the planet, the Sun, and the Earth are closely aligned; *inferior conjunction* pertains when the planet lies between the Earth and the Sun; *superior conjunction*, when the Sun is between the Earth and the Planet. *Ed.*]

Now toss elongation into the mix. [*Elongation* is the angular distance between the planet and the Sun as seen from the Earth. *Ed.*] Alas, inopportune timing again befalls us, for when either angular size or phase is most propitious, the Sun drowns the planet in glare. That leaves one seemingly optimal configuration—greatest elongation. Yet whenever an inferior planet camps at maximum angular separation from Sol, we must settle for well-below-

maximum values of apparent diameter and phase.

From our perspective, then, the sunward planets' cyclical aspects appear to be perfectly ill-timed, a situation that will remain forever so. Given this predicament, when is the "best" moment to view an inferior planet? Which instant during a Mercurian or Cytherean apparition is akin to opposition, in the sense of the joint effect of angular size, phase, and elongation being most advantageous?

The paramount viewing date is not necessarily at greatest elongation, oddly enough. As observers, we want a planet's illuminated region to project over the largest spread of retina possible for a given magnification. Or, equivalently, we wish the visible image to blanket the greatest number of CCD pixels for a given effective focal length. As it turns out, this optimal circumstance can be defined for every apparition: the instant of "greatest illuminated extent" (*GIE*).

Let's give illuminated extent a quantitative definition. Simply, it is the total solid angle subtended, from the observer's vantage point, by the celestial object's sunlit portion. (Think of it as the apparent disk's illuminated surface area; a square arcsecond is a convenient measurement unit.) If an orb of negligible oblateness has angular diameter d and illuminated fraction k , the illuminated extent (*IE*) is given by:

$$(1) \text{ IE} = \frac{\pi k d^2}{4}$$

Thus *IE* is readily computed upon looking up values for d and k in, for example, *The Astronomical Almanac* (USNO, 1999, E52-

E63). An equivalent formula can be used as well, this one employing distances between the three involved celestial bodies:

$$(2) \text{ IE} = \frac{\pi s^2 (r + \Delta + R) (r + \Delta - R)}{4r \Delta^3}$$

Here, s is the planet's semidiameter at 1 astronomical unit (Mercury: $3''$.36, Venus: $8''$.41); r , R , and Δ are the planet-Sun, Earth-Sun, and Earth-planet distances in astronomical units, respectively. [One astronomical unit, or AU, is the mean distance from the Earth to the Sun; 149,597,870 km. *Ed.*]

For all practical purposes a superior planet's opposition coincides with its GIE; thus the event does not distinguish itself for Earth's outer siblings. By contrast, happenstances of GIE for Mercury and Venus are independent of conjunctions and greatest elongations; for these planets GIE merits recognition as a singular apparitional milestone. But despite a similarity of geocentric phenomena, the timing of GIE relative to conjunctions and greatest elongations is different for each inferior orb, as is made plain in the accompanying figures.

One typical Mercurian synodic cycle is sketched in *Figure 1* (below), a plot of illuminated extent versus the ecliptic component of elongation. Note the steep drop in IE toward inferior conjunction (2000

MAR 01); IE later ascends, then it levels off between greatest elongation west (MAR 28) and superior conjunction (MAY 09), the quantity of sunlit square arcseconds holding steadfast on the "back side" of Mercury's apparent orbit. But this orbit is famously ovate. (Of the planets, Mercury has the second-highest eccentricity.) Hence the Earth-Mercury distance—and hence Mercury's angular width—varies flagrantly from one cycle to the next for any one particular phase angle. What this means is, over the long haul, the IE curve might peak anywhere along a wide range on that high "plateau," perhaps a scant one week from superior conjunction, or within a few days of, before or after, greatest elongation. (*Figure 3*, p. 20, shows the actual distribution of elongation angles at GIE.) The event appears fickle. But more often than not, GIE lands on the wider angular separations, closer than a week from greatest elongation in 72 percent of Mercury's apparitions.

Venus, on the other hand, is a model of consistency. Its GIE recurs like clockwork, midway in time between inferior conjunction and greatest elongation, five weeks distant from each, with the planet perched 40 degrees from Sol, exposing a 27-percent-sunlit crescent that is 39 arcseconds from cusp to cusp. (These nominal values waver by the merest amounts with each GIE, a

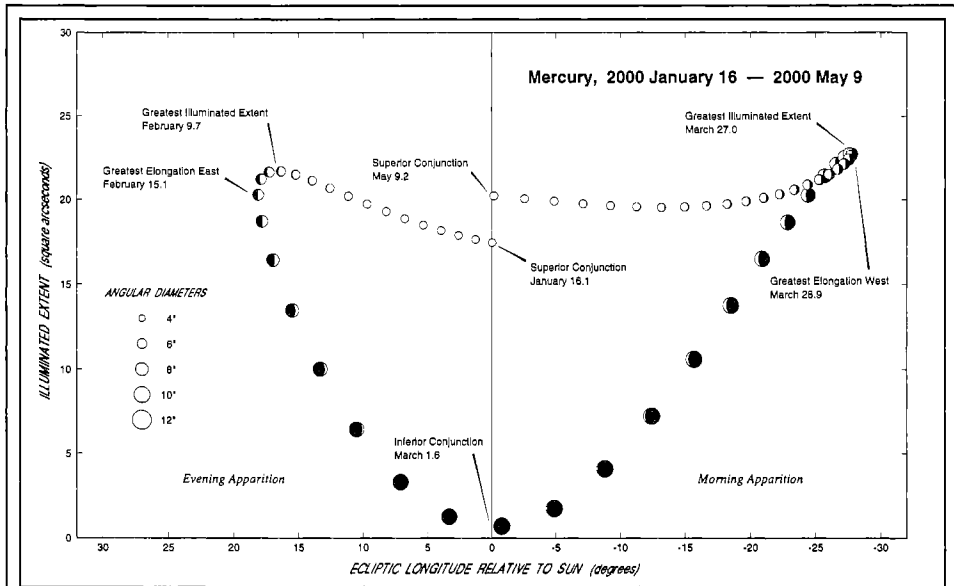


Figure 1. Mercury's illuminated extent is plotted at 0 hours UT [Universal Time] every two days over one synodic cycle—two apparitions—versus the component of solar elongation along the ecliptic. Phase and relative disk size also are shown. The curve's roughly heart-shaped pattern is similar across synodic cycles, yet the locations of GIE differ capriciously with each.

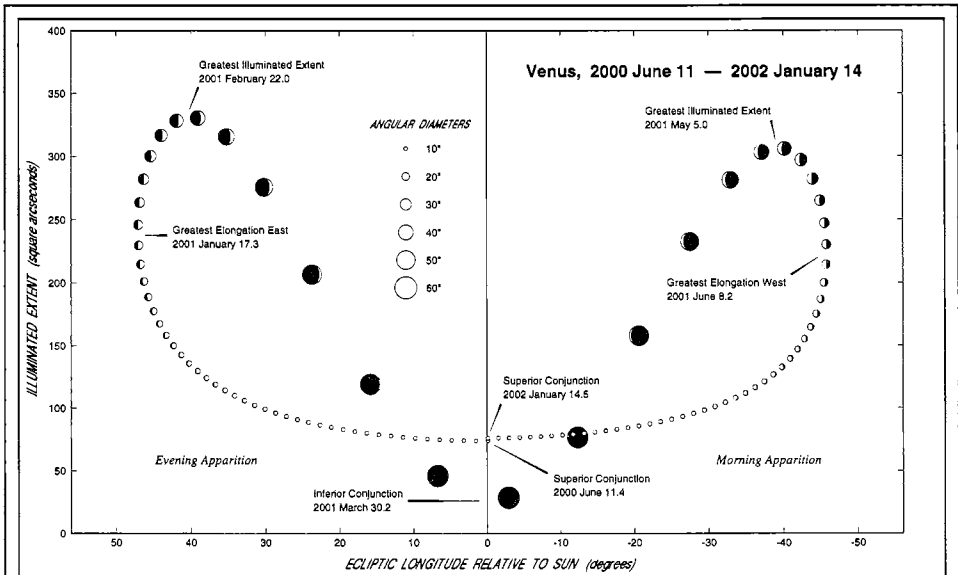


Figure 2. In a like manner as Figure 1, Venus's illuminated extent is plotted at six-day intervals. The orbit brings it both closer and farther away than Mercury, so the resulting plot departs radically in shape from that of the innermost planet. Of particular interest are the short-lived peaks of illuminated extent—the most auspicious viewing times.

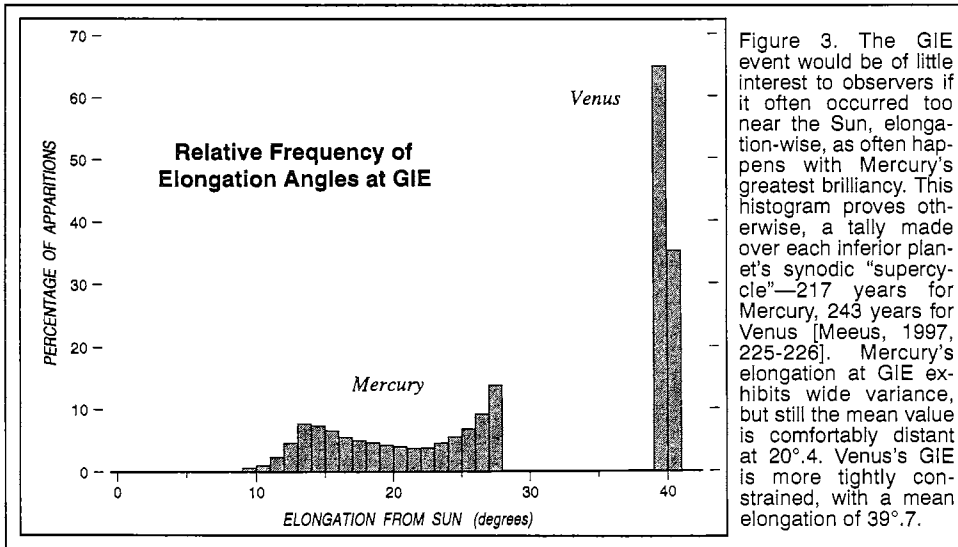


Figure 3. The GIE event would be of little interest to observers if it often occurred too near the Sun, elongation-wise, as often happens with Mercury's greatest brilliancy. This histogram proves otherwise, a tally made over each inferior planet's synodic "supercycle"—217 years for Mercury, 243 years for Venus [Meeus, 1997, 225-226]. Mercury's elongation at GIE exhibits wide variance, but still the mean value is comfortably distant at 20°.4. Venus's GIE is more tightly constrained, with a mean elongation of 39°.7.

monotony attributable to Venus's almost-circular orbit. Indeed, any meager deviations are chiefly a side effect of the more eccentric orbit of Earth.) The IE curve (Figure 2, above) is forged into its characteristic "moose antler" shape by Venus's more pronounced distance extremes: The backside plateau straddling superior conjunction becomes squat; moreover, during the swift dash toward and away from inferior conjunction, Venus's angular diameter expands then shrinks apace, and this, convolved with rapid change in the fraction of

its disk illuminated, gives rise to conspicuous short-term peaks in illuminated extent.

There are two main points that a planetary observer should glean from these figures. (1) The period commencing a few days prior to greatest elongation west [for a morning apparition], through superior conjunction, until several days beyond greatest elongation east [in an evening apparition], roughly an eleven-week stretch, keeps Mercury within the top 25 percent of its illuminated-extent range. The planet shines

at its eye-ful best on the date of GIE, obviously, yet illuminated extent is not unfavorable over that entire interval. However, when solar interference is weighed, the wider elongations near the ends of the plateau are preferable. (2) For Venus, the five-week spell anchored to GIE—skewed such that three weeks of which are on the side of greatest elongation, two weeks are toward inferior conjunction—is the “prime time” viewing opportunity.

WHEREFORE GREATEST BRILLIANCY?

A parenthetic word needs to be said about a related apparitional event. If either equation (1) or (2) is scaled by the factor $1/r^2$ (r being the planet’s heliocentric distance), then the moment when the maximum value is reached flags the object’s so-called greatest brilliancy (HMNAO, 1961, 209). Venus’s low-eccentricity orbit implies a nearly constant $1/r^2$; as a consequence, greatest brilliancy and the pinnacle of illuminated extent are almost simultaneous—always less than a half-day apart, in fact. Tight pairings of these maxima also occur for Mercury, but not consistently so, as its elongated orbit may conduce a gap of up to seven weeks between greatest brilliancy and GIE.

It is a misconception to think that greatest brilliancy marks the instant of brightest visual magnitude. Such would be rigorously true if planets exactly mimicked Lambertian surfaces, reflecting sunlight uniformly in all directions. The fact is, they don’t. Formulas for prognosticating planetary magnitudes have long been codified to take into account reflectivity change as a function of phase angle (Harris, 1961, 276-288), a complication that does not factor into the expression for “brilliance.” Hence greatest brilliancy and the peak *predicted* magnitude are distinct moments, differing by up to three days for Venus, and sometimes weeks apart for Mercury. (Furthermore, the magnitude formulas ignore temporal variations unrelated to phase. So the observed magnitude does not, in general, agree precisely with the value prophesied in a planet’s physical ephemeris.)

Curiously, greatest-brilliance dates are listed only for Venus in *The Astronomical Almanac*. The old (1961) edition of the *Explanatory Supplement* confesses as to why Mercury gets short shrift (HMNAO, 1961, 209):

In the case of Mercury the dates of greatest brilliancy occur after greatest elongation west, and before greatest elongation east; but Mercury is not always readily observable at the time of its greatest brilliancy and this phenomenon is not tabulated.

In other words, Mercury’s greatest brilliancy on occasion falls too near its difficult-to-observe superior conjunction.

As presently defined, greatest brilliancy is an idealized concept; it is not an immediately detectable event; it is usually noted for just one planet, an *ad hoc* phenomenon. Instead, why don’t almanacs report the dates of peak predicted magnitude (“greatest luminosity”), which is what greatest brilliancy is often mistakenly thought to signify?

SUMMARY

Venus, at its closest, attains a greater angular breadth than does Jupiter at opposition. But when both are at GIE, Jupiter casts a gleam with a five-fold greater areal swath onto the observer’s retina (*Table 1*, below). This is one of Jupiter’s traits that makes it a more compelling sight in a telescope. And this is why illuminated extent is a more telling indicator of “viewability” than angular-width or fraction-illuminated numbers alone. IE serves as a direct appraisal for how much can be seen. Wouldn’t it make sense, then, if sky almanacs and planetarium software adjoined illuminated-extent values to their ephemerides? Wouldn’t the utility of celestial calendars and observers’ handbooks be enhanced, if only slightly, by juxtaposing

Table 1. Illuminated-Extent Ranges for Solar System Objects.

Object	Illuminated Extent (square arcseconds)	
	Minimum	Maximum
Mercury	0	22.8
Venus	0	348
Mars	9.6	495
Jupiter	683	1820
Saturn*	160	650
Uranus	8.7	12.8
Neptune	3.6	4.2
Pluto	0.003	0.010
Moon	0	3,180,000

* Allows for the illuminated extent of both A and B Rings, edge-on and at maximum tilt, respectively, in addition to the Globe.

Table 2. Instances of Greatest Illuminated Extent, 2000 - 2002.

Planet	Date/Hour (UT)	Elongation From Sun (degrees)	Visual Magnitude	Angular Diameter (arcsec)	Illuminated Fraction	Illuminated Extent (sq. arcsec)	
Mercury	2000	FEB 09 17	16.7 E	-0.9	6.2	0.727	21.7
		MAR 27 00	27.7 W	+0.3	7.7	0.484	22.8
		MAY 17 20	10.4 E	-1.4	5.4	0.906	20.6
		AUG 08 21	13.6 W	-1.1	5.7	0.815	20.8
		OCT 08 23	25.4 E	+0.1	7.0	0.559	21.8
	NOV 17 14	19.1 W	-0.6	6.4	0.677	21.5	
	2001	JAN 24 12	17.6 E	-0.8	6.3	0.705	21.7
		MAR 08 16	27.3 W	+0.2	7.5	0.513	22.8
		MAY 04 08	12.5 E	-1.2	5.6	0.857	20.9
		JUL 25 00	13.1 W	-1.2	5.6	0.835	20.7
		SEP 21 10	26.4 E	+0.2	7.2	0.536	21.9
		NOV 02 05	18.0 W	-0.7	6.2	0.699	21.4
	2002	JAN 09 03	18.7 E	-0.7	6.4	0.683	21.7
		FEB 18 19	26.4 W	+0.1	7.3	0.541	22.6
		APR 19 19	13.4 E	-1.2	5.7	0.828	21.1
JUL 10 08		12.3 W	-1.2	5.5	0.860	20.5	
SEP 03 11		27.1 E	+0.3	7.4	0.510	22.0	
OCT 18 00		17.0 W	-0.8	6.1	0.722	21.3	
DEC 24 13		19.8 E	-0.6	6.5	0.661	21.7	
Venus	2001	FEB 22 01	40.4 E	-4.6	39.2	0.274	331.1
		MAY 05 00	39.3 W	-4.5	38.6	0.263	306.5
	2002	SEP 26 07	39.3 E	-4.6	40.0	0.256	321.2
		DEC 06 20	40.1 W	-4.7	40.5	0.265	341.4

the dates of greatest illuminated extent with those of conjunctions and greatest elongations? And if the frequently misconstrued phenomenon called greatest brilliancy warrants continued mention in the astronomical annuals, then why not also GIE? The latter event, I would argue, is of more practical significance to observers.

It may take a while for the notion of illuminated extent to catch on, if it ever does. Meantime, *Table 2* (above) is offered as a stopgap reference, a tally of each instance of GIE over the next three years.

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Errata for Volume 41, Number 4.

In the last previous issue (Vol. 41, No. 4), the Universal Times, or possibly the dates, of two illustrations in the article, "Observing the Moon: Mountains," are incorrect, as evidenced by the solar illuminations they exhibit; unfortunately we do not at present know their correct UT times/dates. The first case is *Figure 1* (p. 173), as brought to our attention by Walter Haas; its stated colongitude of 213°.5 is consistent with the UT date and time cited (1998 Nov 14, 10h10m UT), but the actual appearance is consistent with a colongitude near 180°. The other case is *Figure 4* (p. 175); the stated UT (1996 Aug 24, 02h06m UT) implies a colongitude of 030°.7, but the shadows of features are more consistent with a colongitude of about 015°.

THE COMING APPARITION OF COMET LINEAR (C/1999 S4)

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

DISCOVERY

This summer a new comet should be visible in our northern sky. Named Comet LINEAR (C/1999 S4), it was discovered on 1999 SEP 27, while still 400 million miles from Earth. The discovery equipment was an Air Force-sponsored 1-m telescope, supplied with a large CCD chip to capture the images, which are then input into a program that subtracts all the known objects. What remains are the new objects: asteroids and comets. C/1999 S4 was at first suspected to be a new asteroid, but further investigation revealed it had a coma and short tail. Early brightness estimates placed the nucleus at magnitude +17.

ORBIT

This comet will get closer to the Sun than does Earth, at about 0.77 AU [1 AU is the mean Earth-Sun distance; 149,597,870 km]. This occurs on 2000 JUL 26. [The closest approach to Earth, at 0.37 AU, is on 2000 JUL 22.] Its orbit is *retrograde*, meaning it circles the sun in the opposite direction as does Earth. The orbital elements, calculated by Dr. Brian Marsden from 181 observations between 1999 SEP 27 and OCT 25, are from *Minor Planet Circular 36213* (Equinox 2000.0):

Perihelion date: 2000 JUL 26.3979 UT
Perihelion distance: 0.766182 AU
Argument of Perihelion: 150°.9998
Ascending Node: 083°.1500
Inclination: 149°.3473
Eccentricity: 1.0

By graphing the comet's distance to the Sun we see how the comet approaches and recedes from the Sun. Meanwhile the earth's orbit around the Sun varies the comet-earth distance. These variations are plotted in *Figure 1* (below).

BRIGHTNESS

On the assumption that the absolute magnitude is +7.0, and the rate of brightening (n) is 4.0, the apparent magnitude of the comet would vary as shown in *Figure 2* (p. 24).

OBSERVING PROSPECTS

Comet LINEAR will be behind the Sun in late April, 2000. Before that some amateurs may be able to find it in the evening sky as it brightens to magnitude +12. By late May the comet emerges into our morning sky when, if it lives up to expectations, it will be roughly magnitude +10.0. The comet will then move slowly against the background stars for the next month. But its northward movement, later

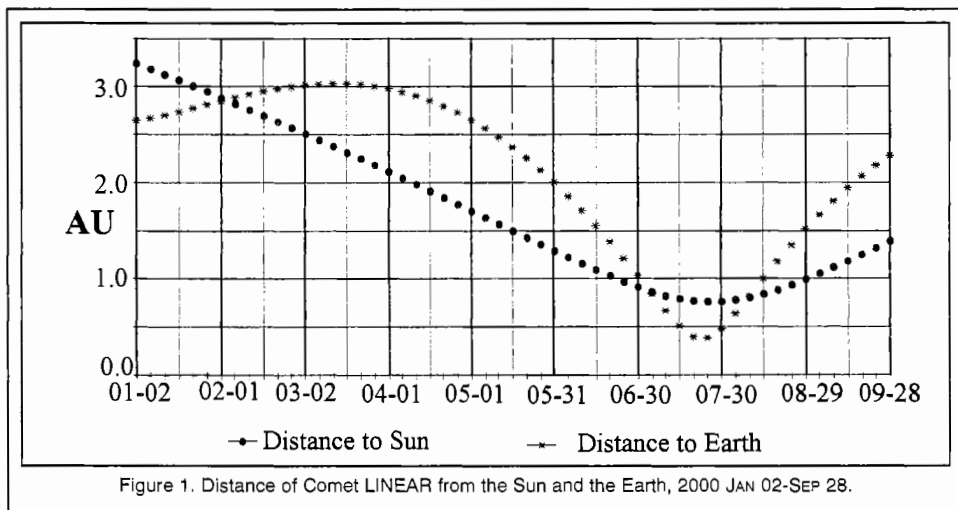


Figure 1. Distance of Comet LINEAR from the Sun and the Earth, 2000 JAN 02-SEP 28.

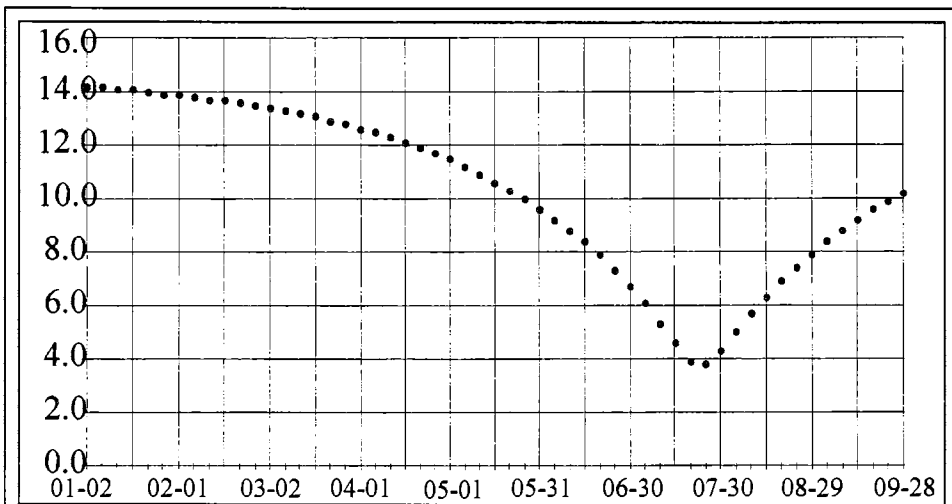


Figure 2. Predicted apparent visual magnitude for Comet LINEAR, 2000 JAN 02-SEP 28.

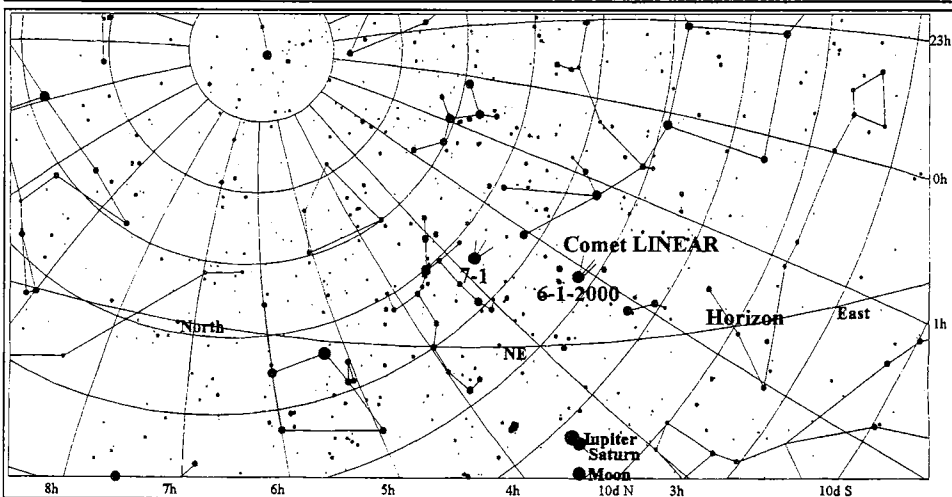


Figure 3. Position of Comet LINEAR, 2000 JUN 01. The morning horizon is for 40° N latitude on 2000 JUN 01.

succeeding twilights and the diurnal eastward motion of the Sun will cause the comet to be higher in the sky each morning. On *Figure 3* (above) we see the scene awaiting astronomers on 2000 JUN 01.

Those who continue observing the comet in the morning should see it not only higher in the sky, but also brightening by about 2.5 magnitudes during June, and by two more magnitudes over the following two weeks. It will continue moving northward, but its eastward motion will drag it into the evening sky. During early July the comet will no longer climb higher each morning even though it will rise at about the same time. *Figure 4* (p. 25) demonstrates these motions. At this time Southern Hemisphere observers will lose the comet.

On 2000 JUL 19 Comet LINEAR will pass north of the Sun and into the evening sky. *Figure 5* (p. 25) shows that it will be visible just above the northern horizon after sunset by 2000 Jul 10. For those north of about 35°N latitude, the comet will be above the horizon all night long.

While the comet is in the evening sky in the last part of July it should be at its brightest. Then, as it continues to move south, it will pull away from both the Sun and Earth, and become fainter. For observers in the mid-northern latitudes, Comet LINEAR will be lost to the evening twilight in mid-August, while it is still magnitude +6-7. Southern-Hemisphere observers will be able to observe the comet until it enters the Sun's glare in late September. When it emerges into the dark

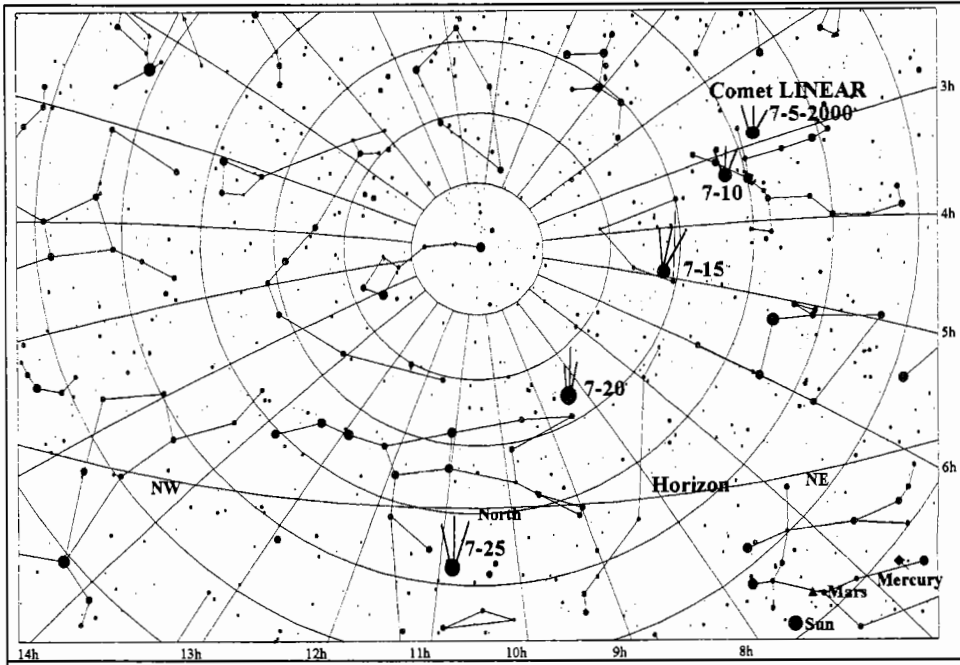


Figure 4. Comet LINEAR in the morning sky, 2000 Jul 5-25. Horizon drawn for 15 Jul, 40°N latitude.

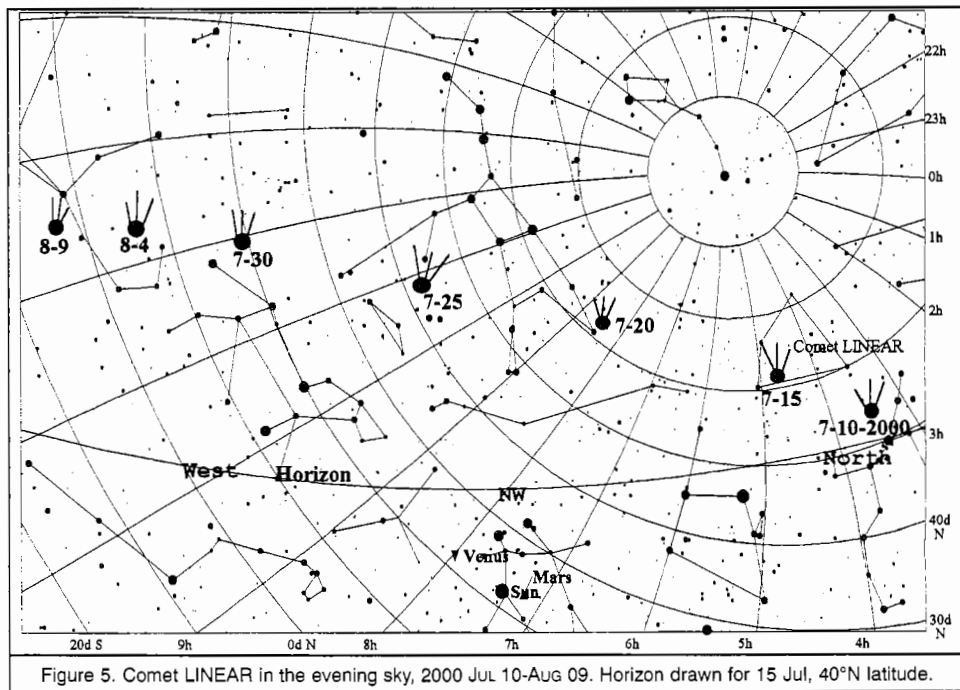


Figure 5. Comet LINEAR in the evening sky, 2000 Jul 10-Aug 09. Horizon drawn for 15 Jul, 40°N latitude.

sky in early December it should be at magnitude +12-13.

CONCLUSIONS

No one yet knows how well this comet will perform. The best way to find

out is to get out there and look at it for yourself. Share it with others. If you have observations of the comet, or photographs, you should send them to the new A.L.P.O. Comets Coordinator, Gary Kronk, at 1117 Troy-O'Fallon Rd., Troy, IL 62294, or E-mail him at kronk@amsmeteors.org.

MEMORABLE MOMENTS AT THE PEACH STATE STAR GAZE

By: Ken Poshedly, A.L.P.O. Publicist

Held April 6 - 9, 2000 at a state park about 40 miles southeast of Atlanta during a young-crescent-Moon weekend, the 7th annual Peach State Star Gaze (PSSG) provided a three-night venue for both lunar and deep sky observers, with considerable emphasis on promoting lunar observing. Almost 300 persons registered for the event.

The high points of the weekend for many were appearances by noted author Antonín Růkl, whose book, *Atlas of the Moon*, is probably his most famous work in the United States and remains perhaps the most-cited such publication by an amateur [Figure 1, below]. His other works include poster-size wall-maps of the Moon and Mars, as well as books on the Moon, Mars, Venus and astronomy for beginners. He recently retired from his position as Director of the Prague Planetarium (Czech Republic).

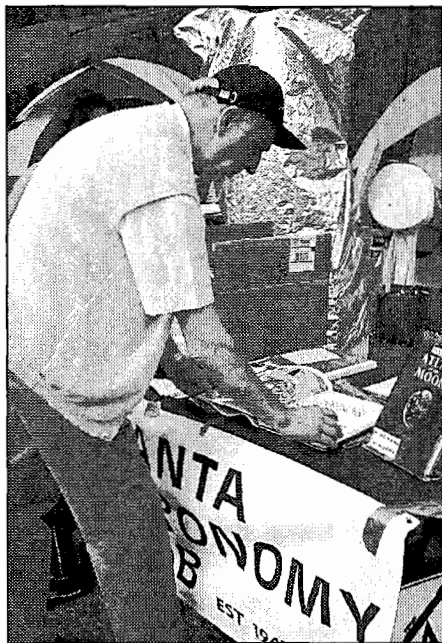


Figure 1. Antonín Růkl autographing a copy of his book, *Atlas of the Moon*, at the Atlanta Astronomy Club table on the main observing field at the 7th annual Peach State Star Gaze. (Photograph by Carlos Flores, AAC)

Mr. Růkl and his wife, Sonja, were visiting the United States specifically for the PSSG, sponsored each year by the Atlanta Astronomy Club (AAC).

Besides his three talks on lunar cartography, illustrated



Figure 2. Mr. Růkl (second from left) flanked by Harry Jamieson (far left), then Walter Haas (center), Julius Benton, Brian Cudnik and Ken Poshedly. (Atlanta Astronomy Club photograph)

with slides, Mr. Růkl was presented with two awards. The first was a pin and certificate from the Astronomical League for "completing" that association's observing list of lunar objects. All agreed that, in reality, it was Mr. Růkl's work that helped so many others complete the AL lunar list.

The second award was a lifetime membership in the Association of Lunar and Planetary Observers, again for his many contributions to the hobby of lunar observing [Figure 2, above]. The presentation was made by A.L.P.O. Founder and Director Emeritus Walter Haas and also attended by the A.L.P.O.'s Harry Jamieson (Membership Director), Julius Benton (Lunar Selected Areas Program Coordinator), Brian Cudnik (Lunar Meteoritic Impact Search Program Coordinator), and Ken Poshedly (A.L.P.O. Publicist and PSSG founder and chairman).

Other slide-and-talk presentations included:

- Walter Haas—"Those Unnumbered Reports of Lunar Changes—Were They All Blunders?" A brief historical outline, a consideration of some basic concepts in lunar observations, and a number of examples of reported changes or unusual temporary

appearances on the surface of the Moon.

- Julius Benton—The A.L.P.O. Lunar Selected Areas Program.
- Brian Cudnik—The A.L.P.O. Lunar Meteoritic Impacts Search Program .
- Phil Sacco (AAC member and extremely active lunar observer)—The lighter side of lunar observing.
- Panel discussion with all of the above plus Harry Jamieson, taking questions from the audience on the value of continued Earth-based lunar observing (*Figure 3*, to right).



Figure 3. Panel discussion on lunar observing with (left to right) Phil Sacco, Mr. Růkl, Brian Cudnik and Walter Haas.

Besides the talks and workshops, all were treated to fairly good skies plus a rare display of the aurora borealis—hardly ever seen as far south as Atlanta—and a pleasant grouping of the young crescent Moon and

planets Mars, Jupiter and Saturn on the first night of the event.

This marks the first time a local astronomy club in the U.S. has brought in a speaker from outside the country. Next year, the Atlanta Astronomy Club will feature noted deep-sky author Wil Tirion.

About Antonín Růkl

Mr. Růkl was born in Caslav, Czechoslovakia (now the Czech Republic), in 1932. In 1956, he graduated from the Czech Technical University, Faculty of Geodesy, branch geodetic astronomy. Then he joined the Institute of Geodesy in Prague as a staff member of the astronomical department.

Since 1960, Mr. Růkl has been working in the Prague Planetarium holding responsible functions, particularly, on merging the Planetarium with the Stefanik Observatory in Prague in 1979, becoming deputy director of the Observatory and Planetarium of Prague and the Head of Planetarium Prague.

Now retired since the end of 1999, Mr. Růkl still works at the Observatory and Planetarium of Prague. Mr. Růkl lives in Prague with his wife, Sonja. They have a daughter, Jane, and son, Mike.

Mr. Růkl is a prolific popularizer of astronomy, author of many audio-visual planetarium programs for the schools and general public, co-organizer of international planetarium conferences, and was vice-president of the International Planetarium Directors Conference (IPDC) from 1996 through 1999.

He is a skilled cartographer, illustrator, writer, author of great number of astronomical maps, atlases and pictorial publications which are translated into many languages. He authored several lunar maps and as well as the highly popular book, *Atlas of the Moon*, published in 1991. Today, it is available from both Kalmbach Publishing and Sky Publishing corporations.

Mr. Růkl himself designs and illustrates his own books. He has worked out the original drawing techniques of the lunar maps as well as the techniques of the photo-accurate drawing of celestial objects with airbrush. In recent years he has been preferentially using computer graphics.

Selected Cartographic Works:

Maps of the Moon and Mars (Kartografia Praha, Scientifics, and others, since 1964 several different wall maps and other maps enclosed into publications, e.g., as the annex to the *Photographic atlas of the Moon* by Z. Kopal et al., Academic Press, N.Y. and London, 1965). New wall map of the Moon published 1999 in Prague.

Maps of Lunar Hemispheres (Reidel Publishing, Dordrecht, Holland, 1972)—to this day a unique mapping of the Moon from six cardinal directions.

Atlas of the Moon (Aventinum Publishers, Prague 1991), probably the best known in the world of Růkl's cartographic works; published several times since 1991 in English, German, French, Japanese and Czech.

Other illustrated books and atlases:

Constellations (Artia, Prague 1971, later Aventinum Publishers, Prague), a popular pocket atlas published and distributed since the 1970s in many editions and in eleven languages. Recently, completely re-written, new illustrated and updated editions of this book, namely *Constellation Guidebook* (Aventinum for Sterling Publishing Co. Inc., New York, 1998; reprinted in April 1999), also in Czech, French, Italian and German in 1996-1998.

Moon, Mars and Venus (Artia, Prague 1979), a pocket atlas of the nearest celestial bodies of our solar system, edited in seven languages.

Welten, Sterne und Planeten (Artia, Prague 1979), also in English as *The Amateur Astronomer*, then *Stars and Planets* etc., a popular richly illustrated survey of astronomy for the beginners.

Pictures from the Depth of the Universe (Artia, Prague, 1988, later Aventinum, Prague), published also in English as *The Hamlyn Encyclopedia of Stars and Planets* and in other languages - an atlas of the celestial objects with numerous astronomical maps.

THRIFT STORE COMPUTERS VERSUS SUPERCOMPUTERS

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

The March, 1987 issue of *Sky & Telescope* published "Astronomical Software Benchmarks" containing a few short Basic programs to test the speed and computational accuracy of existing computers (Kelso, 1987). These are called "Savage" benchmarks, and measure the time required to reach the correct answer of 2500. For example, an 8-MHz 8086 processor (CPU) required 119 sec., an 8-MHz 80286 needed 54 sec.; and a Cray X-MP/24 supercomputer did it in 0.7463 sec. (but in Fortran).

Since 1987 we now have new models—386, 486, Pentium, Celeron, to mention only Intel's CPUs—other brands are comparable. One now reads of benchmarks to test business and game applications with no mention of computational accuracy or of the original Savage benchmark. How do these newer CPUs rate using the Savage benchmark?

I have tested the following CPUs using the double-precision Savage program with QBasic, and here are the results:

CPU Type/Name	Speed MHz	Benchmark sec
8086	5	215
8088	5	192
8088 Turbo	8	74
80286	12	34
80386 SX	16	19.3
80486 DX	25	14.5
80486 DX	33	6.9
80486 DX	66	3.7
Celeron	366	0.522
Celeron	433	0.422

I have not tested the Pentium II or III CPUs in the 500-800 MHz range; but they should benchmark in the range of 0.3-0.2 seconds. I invite readers who might own these faster computers to make their own tests and write me with their results. It is necessary to add an extra FOR-NEXT outer loop to repeat the test 1000 times to obtain timing accuracy; so if it took 222 seconds the correct answer is 0.222 sec.

These tests also reveal that anyone who owns a Celeron or equivalent CPU with a speed of 300 MHz or more is the proud owner of a Supercomputer! Today's definition of a Supercomputer may have

changed upward from the 1980s definition used by Mr. Kelso; but I like the thought of owning a supercomputer. This distinction may be a moot point, but such a computer is nevertheless a "classical supercomputer" and is very fast for astronomical applications.

Now comes the tearful news—a computer that cost \$1000 in the early 1990s (a 386 or 486) can now be found in thrift stores for \$10 or less. In recent trips to Albuquerque (New Mexico) I have found dozens of 286/386/486 computers for \$5 to \$20—complete with floppy drives, hard drives, sound cards; and a few with CD-ROM drives.

This is a great opportunity for the amateur to beef-up his computing power. If you are like me, you always need another computer for another job at hand—call this multi-tasking. I like to dedicate a different computer to each and every requirement, using one with just enough power for the task. Such tasks might include grabbing or manipulating CCD imagery, running your favorite star chart or planetarium graphics program, computing look angles for a Dob, sending a Fax, connecting to the Internet, storing data from another instrument (e.g., photometer or radio telescope), computing orbits, running burglar alarms, doing statistics, storing observing data, writing letters, running the observatory; the list is almost endless. Even the lowly 8088 can output pulses from 10 Hz to 10 KHz and drive a stepper motor. To me, a computer is a valuable astronomical adjunct and tool.

A trip to your local thrift store can fill these needs and provide a good home to an otherwise lost and orphaned computer. One will develop a good eye for spotting a functional computer, but even the bad ones are useful for parts. Quite often, a computer that is scruffy-looking will be the least expensive, but functional. The same is true for one with an empty bay because of a missing disk drive. It is also fun and educational to assemble working computers from parts, or resurrect a dead computer. (Chances are good that you'll get a working computer since one big reason for donating a computer is to get a \$1000 tax donation write-off for something now

worth only \$10). The thrift store I use even has a working CPU, monitor, and keyboard on a bench so the buyer can test any of these three components.

If there is sufficient reader interest, I can summarize my experiences in swapping-out boards, drives, and other parts to revive or optimize a thrift store computer. The first reference (Glover and Young, 1992) is an excellent first step in learning. It contains power-up audio/video error codes, motherboard switch settings, 73 pages of hard drive specifications; and much more. My '92 copy was given to me in '93 so I don't know its current availability or cost. Readers may feel free to write

me with questions, and I will answer them as best I can, but please include a SASE.

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THE A.L.P.O. HISTORICAL SECTION

By: Richard W. Schmude, Jr., A.L.P.O. Remote Planets Coordinator and Acting Assistant Coordinator, A.L.P.O. Historical Section; and Gary L. Cameron, Acting Coordinator, A.L.P.O. Historical Section

ABSTRACT

A brief overview of the goals of the A.L.P.O. Historical Section is summarized in this report., which also describes specific examples of relevant historical documents.

Our Historical Section was formed in 1996 (*J.A.L.P.O.*, 39, No. 2, Oct., 1996, p. 93) and is one of the newest sections in the Association of Lunar and Planetary Observers (A.L.P.O.). The goal of the A.L.P.O. Historical Section is to publish historical papers related to one of these three topics:

- 1) history of the A.L.P.O.;
- 2) history of Solar System studies;
- 3) evaluation of unpublished data for scientific purposes.

Each of these areas is described below.

The A.L.P.O. was founded by Walter Haas in 1947 and thus already has an extensive history. Historical documents of interest include photographs of events connected with the A.L.P.O., letters to and from members and oral and written documents pertaining to the organization. Documents related to such areas as telescope making or the history of amateur astronomy may also be of interest to the section coordinators.

The A.L.P.O. Historical Section welcomes historical documents, letters and

photographs related to Solar System studies. Documents describing early observations of the f-Ring of Saturn or of the Great Red Spot on Jupiter, for example, are welcome. Short biographies of Solar System astronomers or historical documents related to famous telescopes, rocketry and photography would also be gratefully received.

The authors believe that there is a large amount of old, published and unpublished data out there that could still yield useful scientific data. This provides an opportunity to publish relevant data from pre-existing observations. For example, one of the authors is planning to convert photoelectric magnitude measurements of Neptune made in the 1930s to the standard Johnson B and V system. In this way, photoelectric magnitude measurements made in the 1990s on the Johnson B and V system can be compared to measurements made six decades earlier.

In conclusion, the Coordinator and Assistant Coordinator are very excited about the A.L.P.O. Historical Section. We welcome correspondence from all interested parties.

SOME RECOLLECTIONS OF YOUTH, THE A.L.P.O., AND OBSERVATIONS OF SATURN

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

ABSTRACT

The writer's roots in observational astronomy and eventual involvement in the work of the A.L.P.O. are discussed, with emphasis on the stimulus that the A.L.P.O. provided for his long-term involvement in lunar and planetary astronomy. Personal interpretations of accomplishments by A.L.P.O. Saturn observers during the first 50 years of the existence of the organization are discussed. The linkage between amateur and professional work is cited, and recommendations for the continuance and refinement of observational programs, methods, and techniques are presented. Systematic and simultaneous observations are stressed, and suggestions are given for encouraging youth to participate in A.L.P.O. educational and observational endeavors as a foundation for the future of the organization.

INTRODUCTION

With the new millennium quickly approaching, and in keeping with ASTROCON '99's theme of "A Thousand Years of Stars and Space," it is perhaps appropriate to discuss some my personal foundations in observational astronomy and how I eventually got involved in the work of the Association of Lunar and Planetary Observers, directing Saturn observing programs for almost thirty years. It may also be fitting to reflect upon some of the accomplishments of amateur Saturn observers since 1947, the year that the A.L.P.O. was founded by Walter Haas, with suggestions for continued studies of the planet and its satellites in 2000 and beyond.

ASTRONOMICAL AWAKENINGS

I fondly recollect my excitement on that special Christmas morning in 1960, just a month before my 10th birthday, when I awoke to find my first telescope set up "under" the tree—a new Unitron 2.4-inch refractor! As fate would have it, skies were overcast for nearly a week following that eventful morning, but those circumstances afforded ample time for me to read the instruction manuals that came with the instrument and to learn how I could use setting-circles and a clock drive to locate and follow the stars. That first clear night finally arrived, but no words could adequately describe the overwhelming joy of my first celestial adventures with this small telescope. Armed with excellent star maps published in *Sky and Telescope* and

Norton's Star Atlas, I whiled away countless hours over the ensuing years learning the constellations and tracking down every celestial object within the grasp of my tiny Unitron. I was also fortunate, for most of my childhood years, to be blessed with a dark, unobstructed observing site from which to pursue my celestial explorations.

By the time I entered high school, I had already become quite familiar with the night sky, and it was not long before I was bitten by the "bug" to move up to a larger aperture. Working part-time jobs, I raised enough funds to purchase a Unitron 4-inch photo-equatorial refractor. Almost immediately, I began taking advantage of its increased resolution and light-grasp to hunt down new, fainter deep-sky objects or to get better views of many of my favorite ones. After finding and sketching virtually all the Messier objects and splitting numerous double stars, my interests shifted to observations of the Moon and the brighter planets. The wealth of lunar detail I could see with the 4-inch Unitron thoroughly fascinated me, and I enjoyed making my own drawings of interesting lunar features such as Alphonsus, Aristarchus, Clavius, Copernicus, and Plato as they changed appearance at different phases of the Moon. Even though I had observed all of the planets except Pluto, Venus and Saturn eventually became my enduring favorites. Continuing the habit I acquired with lunar studies, I kept careful records of my planetary observations in a logbook for future reference.

My passion for planetary astronomy followed me into my college years,

although I wound up majoring in physics and environmental science due the scarcity of potential employment opportunities in astronomy. After completing undergraduate studies in 1969, my interest in lunar and planetary astronomy had become a virtual obsession, ushered in by the unprecedented events of July 20, 1969 when *Apollo 11* touched down on the Moon in the Sea of Tranquillity. The following year I attended my first A.L.P.O. convention, where I met Walter Haas for the first time, and I discussed with him my interest in contributing lunar and planetary observations. His enthusiasm, encouragement, and guidance helped stimulate my involvement in A.L.P.O. activities. But, for a few more years, the rigors of graduate school occupied most of my time as I finished work on advanced degrees and began a collegiate teaching career. Even so, I somehow managed to set aside a few hours a week to spend time at the telescope and get more acquainted with others in the A.L.P.O. who shared similar interests.

THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

The congenial, informal atmosphere of the A.L.P.O. proved to be refreshing and wonderfully captivating, and I soon developed a real appreciation for the great diversity of backgrounds and experience of the small, but close-knit, membership. Sharing many different philosophical and scientific viewpoints about instrumentation and observing has been very meaningful over the years. I found serious observing endeavors to be synonymous with fun, and I welcomed the opportunity to contribute my own observations to a collective pool of data that had the potential for enhancing our knowledge about the Solar System. Through an active exchange of information and ideas, many individuals have improved as observers, including myself. Also, I had not been a member of the A.L.P.O. very long before I discovered that *The Strolling Astronomer* (now also called the *Journal of the Association of Lunar and Planetary Observers*) and the information contained within its pages seldom existed elsewhere. This publication has helped establish and preserve a vital link between the amateur and professional communities. Annual conventions, often held jointly with the Astronomical League and other national and international groups, have always been

enjoyable events as well as intellectually stimulating gatherings. I can attribute many lasting friendships to such meetings.

During the early 1970s, I was appointed Recorder (now "Coordinator") of the A.L.P.O. Saturn, Venus and Lunar Sections. I valued the confidence placed in me by Walter Haas and fellow staff members in heading up these posts. Throughout my nearly thirty years as a Section Coordinator for the A.L.P.O., the guiding principle established back in 1947 continues to be my principal focus: to encourage and coordinate regular, systematic investigations of the principal planets and other constituents of our Solar System with instrumentation normally available to amateur astronomers.

We have all witnessed the space program ushering in enormous progress in professional lunar and planetary astronomy, transforming our nearest celestial neighbors from virtually unknown and inaccessible objects into much more familiar worlds. Such advances might tempt one to assume that the work of amateur astronomers has been relegated to insignificance from Earth's limited vantage point in space. Of course, the lunar explorations by the Apollo astronauts or the close surveillance of planets and satellites by orbiting or impacting spacecraft are clearly beyond the domain of the Earth-based amateur astronomer. Yet, there are still many areas of lunar and planetary observing that are ideal for the amateur astronomer, fields that can still be pursued without any immediate threat of obsolescence by the onslaught of imposing professional equipment. Also, in recognition of the excellent scientific work some amateur astronomers have done over the years, members of the professional community have solicited amateur participation in specialized projects, such as observations involving the Hubble Space Telescope. A.L.P.O. observers have also been involved in NASA programs such as the International Ashen Light Patrol of the Pioneer Venus Orbiter mission and the Lunar Prospector mission. Unlike most professionals, amateurs still enjoy the freedom of studying Solar System objects of their choice for extended periods. Constant monitoring of surfaces and atmospheres of moons and planets by diligent observers increases the likelihood of recording important features and phenomena by means of drawings, photographs, and CCD images.

So, the amateur astronomer's greatest potential for making useful contributions to planetary science remains a systematic, long-term, and simultaneous monitoring of the Sun, Moon, principal planets, satellites, comets, and meteors at wavelengths of light to which the eye has greatest sensitivity. A.L.P.O. archives include numerous instances where concentrated efforts by amateurs, when careful records were kept and data subsequently analyzed, helped improve our understanding of lingering mysteries about our Solar System. An enduring advantage of the visual observer is his unique ability to perceive, at intermittent moments of exceptional seeing, delicate, ill-defined detail that often eludes photography or other methods of imaging from Earth.

As mentioned earlier, professional astronomers, in trying to resolve some nagging observational dilemma by relying solely on existing spacecraft photography, have enlisted the services of amateur astronomers. Consider our Moon, for example. By fortuitous improper positioning of spacecraft cameras or because of unfavorable solar illumination, optimum views may not have been afforded of certain lunar features or regions. Fortunately, amateur observers were able to offer assistance by monitoring a specific region of the Moon under the conditions sought by the professional specialist. In some cases, the relevant data already existed in A.L.P.O. observational records, which demonstrates and emphasizes the critical importance of keeping long-term, reliable records. Such cooperative efforts clearly show how meaningful, and sometimes vital, amateur observations can be.

A.L.P.O. OBSERVATIONS OF SATURN

Speaking perhaps best from my own perspective as A.L.P.O. Saturn Coordinator, it may be worthwhile to consider some of the results of amateur studies over the years that have helped shape our understanding of Saturn as a planet, namely:

1. From chiefly visual observations, we have learned that distinct belts and zones are not just occasionally seen on Saturn's Globe.
2. Faint, delicate details are more frequently seen within the belts and

zones of Saturn's Globe, as well as in specific Ring components, if proper observational methods are used, especially employing color filters or variable-density polarizers.

3. Cassini's and Encke's Divisions are not the only such features seen in the Rings of Saturn, and confirmation of several "intensity minima" in the Rings was accomplished prior to the *Voyager* missions.

4. Amateur visual observations have shown that Ring C can be viewed at the ansae as well as in front of the Globe of Saturn with small to moderate apertures.

5. Observations of numerous dark spots or festoons, plus conspicuous white spots, have been accumulated. Most of these have emerged in the equatorial latitudes of Saturn's Globe, but they are not necessarily limited to those regions. Also, several prominent white spot outbreaks have suggested a recurring pattern over many years.

6. Variability has been noticed in the rotation rate of the SEB and NEB through observations of long-enduring spots.

7. Over a Saturnian year (equivalent to 29.5 terrestrial years), subtle variations have been detected in belt and zone intensities that may be linked to a subtle, but definite seasonal effect.

8. Shadow intensity anomalies have been observed on quite a few occasions.

9. Reasonably good confirmation of the very tenuous, elusive Ring E (formerly known in A.L.P.O. literature as Ring D') exterior to Ring A occurred prior to the *Voyager* flybys.

10. Identification of a remarkable series of dusky radial "spokes" in Ring B (and sometimes suspected in Ring A), occurred prior to the views by *Voyager*.

I am confident that, using traditional as well as modern equipment and methods, A.L.P.O. observers will continue to enhance our knowledge of Saturn and the other members of our Solar System. Our challenge for the future as observers is to continually examine, criticize, refine, and

develop our methods and techniques to the point where our work will remain supportive and useful to the professional scientific community. Our endeavors must also be organized in such a way that we can continue to attract and maintain a good team of skillful observers.

Widely-spaced observations or those that are poorly planned are of increasingly limited value, and the importance of systematic observations by many individuals, all using standardized methods, cannot be emphasized strongly enough. Observations should begin early in an observing season after a planet has just emerged from the pre-dawn solar glare and continue until the planet reaches conjunction with the Sun. Our goal must be to achieve a high incidence of simultaneous observations of variable lunar and planetary phenomena to confirm results and increase objectivity in visual data. Simultaneous observations, by definition, are independent, systematic studies of Solar System objects using identical methods, similar equipment, and standardized reporting techniques, all taking place at the same time on a given date of observation. Instrumentation should conform to specific criteria, and telescopes should be well-adjusted, similarly outfitted, and of the highest optical quality possible. Simultaneous observations help visual observers understand what detail on a planet is real or illusory, and although good simultaneous visual work is useful in the form of drawings and descriptive reports, photographic, CCD, or video imaging should be added to the mix. The introduction and increased availability of CCD cameras at fairly reasonable prices has allowed more efficient light detection than is possible with photographic film, and CCDs generate digital information that can be manipulated by image processors. The enormous dynamic range of CCDs and their high sensitivity to visual and near-infrared wavelengths make them a valuable tool in simultaneous lunar and planetary observations.

Although considerable information on observing Saturn can be found in *The Saturn Handbook*, it is worthwhile here to list some of the current observational pursuits by the A.L.P.O. observers:

1. Visual numerical relative intensity estimates of Saturn's belts, zones, and Ring components.
2. Full-disk drawings and sectional

sketches of Globe and Ring phenomena. To assist observers in making drawings, the A.L.P.O. Saturn Section furnishes via mail or on the website templates with the correct Globe oblateness and Ring geometry. All drawings submitted for publication must be originals, not xerox copies.

3. Central meridian (CM) transit timings of details in belts and zones on the Globe of Saturn (utilized to determine or confirm rotation rates in various latitudes). Saturnian CM longitudes will soon be available on the A.L.P.O. website.

4. Latitude estimates or filar micrometer measurements of belts and zones on the Globe of Saturn.

5. Colorimetry and absolute color estimates of Globe and Ring features.

6. Observation of "intensity minima" in the Rings (in addition to observations of Cassini's and Encke's Divisions).

7. Observational monitoring of the bicolored aspect of the Rings of Saturn.

8. Observations of stellar occultations by Saturn's Rings (ephemerides are published in various periodicals, the Saturn newsletter, and the website).

9. Specialized observations of Saturn during edgewise Ring presentations in addition to routine studies.

10. Visual observations and magnitude estimates of the satellites of Saturn.

11. Routine photography, CCD imaging, photoelectric photometry, and videography of Saturn and its Ring system (current images appear on the A.L.P.O. website).

12. Simultaneous observations of Saturn.

The 2000-2001 Apparition of Saturn is now under way [see note at end. *Ed.*], and members of the A.L.P.O. Saturn Section have already resumed their routine studies of the planet. We are always eager to enlist new observers, and anyone interested in our programs should contact this writer for information on how to get started. To aid in planning, *Table 1* (p. 34) gives Universal Times for geocentric phenomena for Saturn during the 2000-2001 Apparition.

Table 1. Geocentric Phenomena in Universal Time (UT) for the 2000-2001 Apparition of Saturn

Conjunction	2000	MAY	10 ^d 20 ^h UT
Opposition	2000	Nov	19 13
Conjunction	2001	MAY	25 13

Data for Opposition:

Constellation	Taurus
Declination	+17°.3
Stellar Magnitude	-0.4
Equatorial Dia. (Globe)	20".43
Polar Dia. (Globe)	18".75
Major Axis (Rings)	46".37
Minor Axis (Rings)	18".55
B	-23°.59
B'	-23°.83

Note: B is the saturnicentric latitude of the Earth referred to the plane of the rings, negative (-) when south (i.e., when the visible surface of the Rings is the southern face); B' is the saturnicentric latitude of the Sun referred to the Ring plane, negative (-) when south (i.e., when the southern face of the Rings is illuminated by the Sun).

THE FUTURE

The foregoing discussion has been chiefly derived from personal reflections about the A.L.P.O.'s past, a bit of philosophy gleaned from my experience as Saturn Coordinator for nearly three decades, and an overview of current Saturn observing programs. Much of what I have said also pertains to amateur observational astronomy as a whole, and I now offer the following concluding remarks about the future:

1. I cannot emphasize enough the need for increased participation of youthful members in the A.L.P.O. observing programs, as well as in activities of astronomical societies on the local level. If our organizations and programs are to endure well into the next Millennium, we have little choice about this.

2. Experienced observers should make it a point to urge as many young people as possible to get "turned on" to astronomy by taking at least one youngster "under their wing" and developing that person as an observer. For example, one of the lasting accomplishments of the A.L.P.O. and the Astronomical League has been to provide challenging projects and guidance for young science enthusiasts, some of whom have gone on to become professional astronomers or scientists in other disciplines. For this to continue, we cannot wait for youth to come to us. We must reach out to our community science centers, our middle schools and high schools, our local

PTAs, our colleges and universities, and our state and national parks, and take an active role in promoting observational astronomy as an enjoyable, worthwhile pastime.

3. No matter where our observational pursuits lead us, I sincerely hope that none of us becomes so consumed by zeal to produce scientifically useful data that we lose sight of the fact that our interest in astronomy is ultimately derived from a love and fascination for the night sky. We should all take a few moments away from organized observing programs to simply appreciate the exquisite beauty of the night sky. Relaxation and fun should remain an ingredient in all of our pursuits.

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[*Note:* The preceding paper was delivered at the 1999 A.L.P.O. Convention, held in conjunction with the ASTROCON Meeting of the Astronomical League in Cheney, Washington. At that time, Dr. Benton referred to the ongoing 1999-2000 Apparition of Saturn. Using the 2000 and 2001 editions of the *Astronomical Almanac*, the editor has updated that portion of this paper to refer to the now-ongoing 2000-2001 Apparition of Saturn.]

CHARLES MORGAN CYRUS—PERSONAL NOTES

By: Carole J. Budosh

[Our readers will recall Walter Haas' note, "In Memoriam: Charles M. Cyrus", in our last previous issue (*J.A.L.P.O.*, 41, No. 4, p. 172). Since then, we received a letter from his daughter, Carole J. Budosh, which is quoted in part below. We have also reproduced here a photograph of Charles Cyrus.]

Dad was born Charles Morgan Cyrus on January 5, 1920 in Lynchburg, Virginia, the youngest of eight children. He grew up in Virginia, studying art in high school and working at the Allen-Morrison Sign Company until he was drafted on November 14, 1942. He served in the Signal Corps during World War II, but was not sent overseas.

During his military service, he met my mother, Della Kazlauski, marrying her in Missouri on January 13, 1945. After his discharge on February 11, 1946, they moved to Baltimore where they lived with my mother's parents. They had two children: Carole, born October 6, 1948 and Barbara, born July 11, 1958. Dad went to work for Bethlehem Steel Company as a marine draftsman on October 11, 1951, working there until he retired on February 28, 1982.

Dad had several hobbies. He enjoyed photography and had his own darkroom equipment. His interests later turned to astronomy. He had several telescopes, and polished his own mirrors. I remember my Mom complaining about the odor of pine tar and the red polish around our home. When he had his telescope out in our backyard, he would often end up with the neighborhood children standing in line to have a look. He always took the time to explain what he was looking at, and let each one have a turn to see. He also belonged to an astronomy club; besides meetings, they had "star parties" at local schools or parks where novices could go and take a look at the stars. He continued this until a few years ago.

My mom passed away in August, 1985, after which Dad started to paint again, first with oils and then with water colors. He attended a few formal classes at the Schuler School of Fine Arts in Baltimore. After that, he became a member of the Maryland Art League as well as the Catonsville Senior Center. He proved to be very talented. His works were often on display in different local public buildings, and he usually sold at least one painting as a result of each showing.

At the time of his death, on October 26, 1999, he was survived by a brother, Royal, and a sister Irene, whom he had just visited in Virginia before his car accident. He has four grandchildren: John M. (28) and Brian C. Budosh (23); and Michael S. (16) and Kristin A. Abrams (6). He has no great-grandchildren.



Figure 1. Charles Cyrus (left) with A.L.P.O. Founder Walter Haas at the A.L.P.O.-Astronomical League Convention in Baltimore, Maryland in 1986.

DRAWING MARS

By: Jeffrey D. Beish, Assistant Coordinator, A.L.P.O. Mars Section

"To be able to acquire new knowledge while reviewing the old qualifies one as an instructor of men."

Confucius

INTRODUCTION

A systematic nightly visual observational program, accompanied with disk drawings and related notes, gives useful information about the physical condition of Mars. One can record the polar regions, meteorological phenomena, and physical conditions and colors of the surface features, which greatly aids in the cognizance, interpretation, and analysis of photographs and CCD images of the planet.

The frequently expressed statement "visual observation is only a subjective method" is a cliché used by some astronomers, indicating that photographs or CCD images are the only valid scientific method to record conditions on a planet. However, if one takes time to think about this, he or she should realize that that same objective photograph, in its final analysis, is interpreted by the subjective eye and subjective mind of an astronomer.

Even at its best, Mars is challenging to observe. The disk is tiny and its markings are blurred by the Earth's atmosphere. A telescope for planetary work should provide sharp images with the highest possible contrast. A long-focus refractor is usually considered the best, followed by a long-focus Newtonian or Cassegrain reflector. Telescopes with large central obstructions do less well. [With the high magnifications often used, a steady clock-driven equatorial mounting is almost essential. *Ed.*]

The remainder of this article summarizes some of the more important aspects of observing the Red Planet.

OBSERVING THE MARTIAN DISK

Mars is one of the more difficult celestial objects to study for several reasons. The apparent angular diameter of Mars is small, being only 14 to 25 arc-seconds even at opposition. For comparison, Jupiter has an apparent disk as large as 50

arc-seconds. When novice observers take their first telescopic view of Mars, they usually see only a bobbing, too-bright, orange globe with perhaps a white patch at one end. The untrained eye requires several nights of patient observing before the low-contrast features become evident. A yellow or orange color filter, or a neutral-density filter, dims the bright image and aids in reducing the irradiation within the observer's eye, thus helping to detect the pale features on the Martian disk.

After several nights of practice using 250X to 300X eyepieces, the observer, referring to a Mars chart, will become familiar with the major Martian surface features. Even the most experienced planetary astronomer requires about two or three weeks of systematic observing at the beginning of each apparition before the finest details become evident on the glowing disk of Mars. So be patient, and practice drawing the larger features which are seen each night. Given a night of excellent "astronomical seeing," when Mars is steady and sharp at the limb, smaller details will suddenly pop out around the larger features as they are drawn. Employ a shorter focal-length ocular or a Barlow lens, and increase magnification to the maximum that your seeing and telescope aperture will allow. Use up to 75X per inch of telescope aperture as a practical rule, especially if your telescope's optics are of high quality.

Note each small feature and carefully place it in its proper position relative to the nearest large feature. Check and sharpen the optical focus at regular intervals, as air parcels pass overhead or temperature changes in the telescope move the focal plane. The use of color filters will improve the quality of "astronomical seeing" in most cases and will increase contrasts among Martian features. The telescopic image will usually be fuzzy, and it will be impossible to obtain a sharp focus when observations are made through the high-altitude jet stream. Check your current television weather map for the location and movement of the jet stream before observation. [Everything else being equal, the seeing improves the higher an object is above the observer's horizon; i.e., near the celestial meridian if possible. *Ed.*]

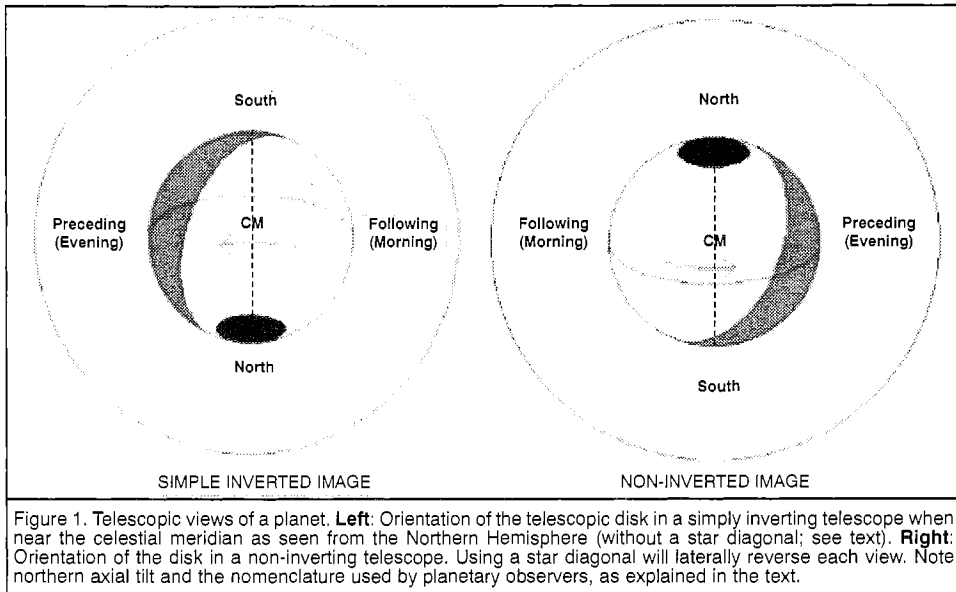


Figure 1. Telescopic views of a planet. **Left:** Orientation of the telescopic disk in a simply inverting telescope near the celestial meridian as seen from the Northern Hemisphere (without a star diagonal; see text). **Right:** Orientation of the disk in a non-inverting telescope. Using a star diagonal will laterally reverse each view. Note northern axial tilt and the nomenclature used by planetary observers, as explained in the text.

Refer to *Figure 1* (above) to identify the following:

The Central Meridian: The Martian Central Meridian (CM) is an imaginary line passing through the planetary poles of rotation and bisecting the planetary disk. This line is used to define the areographic longitude range that is present on the disk during an observing session.

The CM is independent of any phase which may be present—if Mars presents a gibbous phase the CM will appear to be off center. The CM value is the areographic longitude in degrees which is on the central meridian of the disk as seen from Earth at a given Universal Time (UT). A fast adjustment to the UT of observation can be made by adding $0^{\circ}.24/\text{min.}$, or $14^{\circ}.6/\text{hr.}$, to the daily CM value for 0 hours UT as listed in Mars ephemerides.

The Terminator: The terminator (phase defect) is the line where daylight ends and night begins. The terminator phase, or defect of illumination, is given in seconds of subtended arc on the apparent disk, or in degrees (i), or as the ratio (k) of the illuminated disk to the geometric disk. The sunset terminator appears on the east side, or evening limb, before opposition; and after opposition, the terminator becomes the sunrise line on the morning limb on the west side. At opposition there is no perceptible phase defect.

The Axial Tilt: The declination of the planet Earth (D_e) as seen from Mars

defines the axial tilt of Mars relative to Earth. D_e is also equal to the areographic latitude of the center of the Martian disk, which is known as the sub-earth point. The latitude is positive if the North Pole is tilted toward Earth and negative if the South Pole is tilted toward Earth. This quantity is an important factor when drawing Mars or when trying to identify certain features. Mars' axial tilt is $25^{\circ}.2$ with respect to its orbital plane.

DRAWING THE MARTIAN DISK

Anyone who observes Mars will find it rewarding to make a sketch of whatever is seen, both to create a permanent record and to help train the eye in detecting elusive detail. Start with a circle 1.65 inches (42 mm) in diameter, drawn on a 3×5 or 4×6-inch card. Draw the phase defect, if any, and the bright polar caps or cloud hoods. Next shade in the largest dark markings, being careful to place them in exactly the right locations on the disk. At this stage, record the time in UT to the nearest minute. Now add the finer details, viewing through various color filters, starting at the planet's sunset limb. Finally, note the UT date, observer's name, the instrument(s) used, and any other relevant information.

The following discussion is just a suggestion for producing a planetary drawing. Most observers use their own methods which have been derived from their own experiences to render their disk drawings.

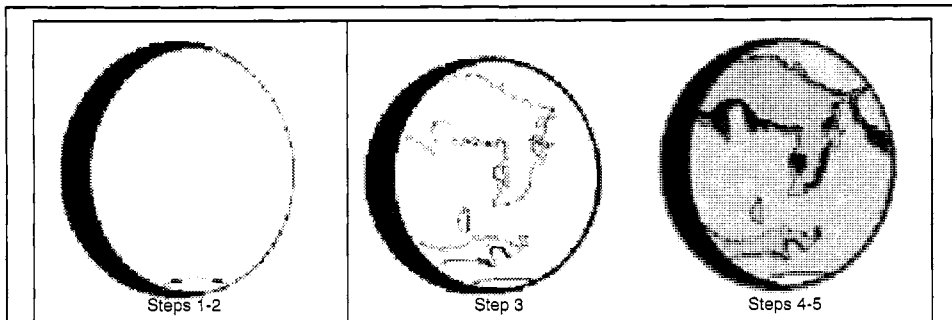


Figure 2. Visual Drawing Sequence of Mars. Suggestions for a five-step drawing sequence of Mars at the telescope: 1) Draw phase terminator, if present; 2) draw polar cap(s), south at the top and north at the bottom, if either or both are visible; 3) fill in rough outline of surface features; 4) darken familiar features and fine details; and 5) draw in detail of new or changing surface features. Drafted by J.D. Beish

At the beginning of an observing session, center Mars in the field of the eyepiece and obtain a sharp focus using the planetary limb, polar cap, or a large, dark, central feature. Make an overview of the general appearance of Mars, and estimate the quality of seeing (standard A.L.P.O. Scale, ranging from 0 for worst to 10 for perfect) and atmospheric transparency (the limiting naked-eye stellar magnitude in the vicinity of the planet). Note the phase and the planet's axial tilt relative to your field of view. Identify familiar surface features with the aid of a yellow or red filter. Locate clouds and limb hazes with a blue filter.

Note on your card the starting and ending times and compute the corresponding the CMs that are on the Martian disk in order to recognize the gross features that you have just seen. Locate and draw the outline of the bright North Polar Cap, normally at the bottom of the drawing disk. If the South Cap is present, locate it at the top. If a polar hood is seen, sketch in a dashed boundary outline of the proper size. Using the centers of both the telescopic image of Mars and the pencil disk as references, carefully draw in the darkest or largest feature relative to the center of the disk. Using the north and south points of the disk and the plotted dark feature as perspective guides, locate and sketch other dark features. This process should take no longer than 10 or 15 minutes with fair seeing. You now have 40 to 50 minutes to study Mars with the aid of color filters for fine surface details, bright frost patches (indicate with dotted outlines), white or blue clouds (use dashed outlines), and yellow dust clouds (dashed outlines). Sketch them at their proper positions on the drawing disk before they rotate off the Martian disk.

The sequence of making a Mars drawing is shown in *Figure 2* (above).

SUMMARY

The ancient art of visual observation at the telescope is still a most useful tool for the modern astronomer, and is the forte of the amateur astronomer. In 2000-2002 we will be fortunate in that Mars will be very favorably positioned for telescopic study. This is especially important in view of the space missions to Mars planned for the near future.

Today's amateurs contribute most of man's knowledge about current weather and surface conditions on Mars. With a set of color filters and a high-quality telescope of 4 to 16 inches (10-40 cm) in aperture, the amateur can conduct professional-quality telescopic work in planetary research. A well-equipped observer using a CCD camera has the further opportunity to produce objective and quantitative records of the changing Red Planet.

[Notes: Observations such as those described above are useful to the planetary science community only if they are made available to others. All Mars observations, of whatever form, should be sent to our Mars Section, whose staff addresses are given on page 48 of this issue.

The 2000-2002 Apparition is the best opportunity since 1988 for observing Mars. The apparition runs between the Mars-Sun conjunctions of 2000 JUL 01 to 2002 AUG 10, with opposition on 2001 JUN 13. Mars' closest approach to Earth occurs on 2001 JUN 21, when the planet's angular diameter will be $20''.8$, although its southerly declination of $-26^\circ.7$ will favor observers in the Southern Hemisphere. *Ed.*]

NEW BOOKS RECEIVED

Comments By: Jose Olivarez, A.L.P.O. Book Review Editor

The Deep Sky, An Introduction.

By Philip S. Harrington.

Sky Publishing Corporation,
49 Bay State Road, Cambridge, MA
02138. 1997. 272 pages.
Price: \$24.95 paper.
ISBN 0-9333346-80-8.

This book is an excellent reference for anyone who owns a telescope or binoculars but doesn't know what to look for amid the stars and constellations. It describes the best double and multiple stars, open and globular clusters, nebulae and galaxies, and then explains how to find them. Detailed descriptions of more than 300 deep-sky objects are included and 100 of these are illustrated by black-and-white photographs. "The book", says the author "is much more than just another observing handbook." It is his hope that it will not only serve to inspire the reader, but also to train the reader to become a deep-sky observer. And true to his goal, Mr. Harrington offers substantial guidance towards making the reader a deep-sky observer. To ease the training, he also includes 36 full-page star charts that permit the finding and identification of all the major deep-sky objects described in the book. The sky charts were especially printed for this volume and occur as a "Star Atlas" at the back of the book.

This is one of the better deep-sky observing handbooks available today because it is both inspiring and engagingly written.

A Sky Watcher's Year.

By Jeff Kanipe.

Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211. 1999.
204 pages. Price: \$19.95 paper.
ISBN 0-521-63405-9.

Through 52 essays, *A Sky Watcher's Year* guides the reader to celestial events

and phenomena that occur and are visible to the naked-eye or binoculars for each week of the year. Covering both the Northern and Southern hemispheres, this book helps readers find many of the more prominent deep-sky objects and constellations and explains how and when to observe the annual meteor showers.

The appendix of this book is also useful for long range planning because it includes information on the general location of the planets through 2010 and a listing of all forthcoming total and annular solar eclipses through 2024.

Jeff Kanipe is a science journalist who knows his astronomy and night sky well. So, *A Sky Watcher's Year* is recommended. It is an authoritative guide to the celestial sights available during each week of the year.

The Monthly Sky Guide, 5th Edition.

By Ian Ridpath and Wil Tirion.

Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211. 1999.
64 pages. Price: \$16.95 Paper.
ISBN 0-521-66771-2.

Over 2000 stars are visible to the unaided eye at any one time under the clearest conditions, but most are faint. Only a few hundred are bright enough to be prominent to the naked eye, and these are plotted on the monthly sky maps in this book. The authors say that the brightest stars of all act as signposts to the rest of the sky and that it is a welcome fact that you need to know only a few dozen stars to find your way around the sky with confidence.

With 50 clear star maps and guidance notes for exploring the sky, *The Monthly Sky Guide* introduces the reader to the stars month by month without the need for optical aid. This is a large and attractive paperback book.

**Meteorites and Their Parent Planets,
Second Edition.**

By Harry Y. McSween, Jr.

Cambridge University Press, 40 West 20th
Street, New York, NY 10011-4211.1999.
310 pages. Price: \$29.95 paper.
ISBN 0-521-587514.

Meteorites and Their Parent Planets provides an engrossing overview of the study of extra-terrestrial materials. This second edition has been thoroughly revised and describes the nature of meteorites—where they come from, and how they get to earth. The first edition was popular with meteorite collectors and amateur astrono-

mers because the writing is accessible; and because Dr. McSween also gives equal emphasis to the meteorites and to what has been learned about the asteroids, comets, and planets from which they have come.

In this edition, all the illustrations have been updated and improved, many sections have been expanded and modified, and a new final chapter on the importance of meteorites has been added.

Meteorites and Their Parent Planets is an authoritative and readable account of the current state of meteoritics and is one of only two books on meteorites recommended by the Curator of Meteorites at the Smithsonian's Museum of Natural History.

*Fifty Years Ago: A Selection from The Strolling Astronomer,
May 1, 1950 (Vol. 4, No. 5), "Some Curious Objects—Meteoritic Perhaps,"
pp. 8-9.*

Writing on April 9, 1950, Mr. Tsuneo Saheki of Osaka, Japan, tells us that "an amateur in Tokyo observed a very brilliant spot appearing on the south-southwest limb of Mars for 2-3 seconds on March 24, 11^h 45^m, with his 15 cm. reflector, 146X." Unfortunately, no one else was observing Mars at the time as far as he knows. Mr. Saheki uses *west* to mean to the right in a simply inverted view with south at the top. The date and time are by U.T. Since the central meridian of Mars at the time was 196°, the brilliant spot must have been at a high southern latitude near longitude 286°—probably over Hellas. Two possible interpretations of such a transient brilliant spot are that it was either the flare caused by the impact on the surface of Mars of a giant meteorite or a fireball of extraordinary brilliance in the atmosphere of the planet. The distance of the planet on March 24 was about 60,000,000 miles; it follows that a luminous object was then 28.9 stellar magnitudes fainter at the distance of Mars than at a distance of 100 miles. This difference may be compatible with a meteoritical interpretation, for there is evidence that terrestrial fireballs and meteoritic impact-flares are very rarely as bright as the sun, or of stellar magnitude -27. An object that bright at a distance of 100 miles would be of stellar magnitude 2 at a distance of 60,000,000 miles and would thus appear to an observer to be "a very brilliant spot."

On the other side of the world Mr. R. Rigollet has communicated an observation of a temporary, stationary, bright spot on the moon by Mr. Albert Hestin, an A.L.P.O. member at Acy-en-Multien (Oise), France. Mr. Hestin was observing with a 31 cm. (12 in.) reflector at 65X on March 26, 1950, at 18^h 56^m, U.T., when his attention was caught by a bright spot not in the lunar region that he was examining. "The brightness of this glow having immediately attracted his attention, he had time to turn his gaze toward it and to look at it directly for a fraction of a second before it disappeared." (This quoted sentence was translated by the editor.) The sky was very clear, and the seeing was fairly good. Mr. Hestin estimated the stellar magnitude at 6 and the angular diameter at 10". The spot was diffuse and nebulous and was yellowish in color. The moon being near the first quarter, the spot appeared on the earthshine in the vicinity of Landsberg [Lansberg]; the lunar coordinates were about 40° East [40° West in the modern IAU system], 4° North. Mr. Hestin "is entirely affirmative upon the objective reality of the object he saw." The appearance and disappearance were rapid but were certainly not instantaneous.

It appears to the editor rather unlikely that a lunar meteor (in a very rare lunar atmosphere, of course) would have an angular diameter of 10". It is more probable, he thinks, that this object was a meteoritic impact-flare, with irradiation perhaps greatly increasing the apparent size. There is also a curious resemblance in appearance to eighteenth and nineteenth century observations of temporary bright spots on the earthlit moon by Herschel and Schroeter, among others. However, these spots of the past endured for a number of minutes, according to the observers, while Hestin's spot lasted for a few seconds or less.

[A final paragraph, interpreting a report of a *dark* object seen crossing the moon, has been omitted here.]

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by Michael Mattei

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 2, April, 1999 pp. 49-96
 3, July, 1999 pp. 97-144
 4, October, 1999 pp. 145-192

(Abbreviations: *I.* = Issue, *IBC* = Inside Back Cover, *OFC* = Outside Front Cover)

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THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

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

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

All payments should be in U.S. funds, drawn on a U.S. bank with a bank routing number, and payable to "A.L.P.O." All cash or check dues payments should be sent directly to: A.L.P.O. Membership Secretary, P.O. Box 171302, Memphis, TN 38187-1302. When you write to our staff, please provide a stamped, self-addressed envelope. 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., "42.1" means Vol. 42, No. 1). We also include a First Renewal Notice in that issue, and a Final Notice in the next one. Please let the Membership Secretary know if your address changes. Dues payments should be made directly to the Membership Secretary.

A.L.P.O. ANNOUNCEMENTS

SECTION CHANGES

New Comets Coordinator—Don E. Machholz, who has served the A.L.P.O. as its Comets Coordinator since 1988, and creator of the well-known "Comet Comments" column, has had to resign his post due to personal reasons. Although Mr. Machholz's contributions will be sorely missed, we are fortunate in being able to fill his position with his colleague, **Gary Kronk**, whose address is: 1117 Troy-O'Fallon Road, Troy, IL 62293. Mr. Kronk's e-mail address is kronk@amsmeteors.org.

Staff Address Changes.—(1) **Brian Cudnik**, Acting Coordinator, Lunar Meteoritic Impacts Search has changed his postal address to 1616 Hollister Road #1616, Houston, TX 77040. (2) **Robert Lunsford**, Coordinator of the Meteors Section, has changed his e-mail address to lunro.imo.usa@prodigy.net. (3) The e-mail address of **Julius L. Benton, Jr.**, A.L.P.O. Board Member, and Coordinator for the Lunar, Venus and Saturn Sections, has changed to: jlbaina@aol.com. (4) The e-mail address of Mars Coordinator **Dan Troiani** is now dantroiani@earthlink.net. (5) History Section Acting Coordinator **Thomas D. Dobbins** and Acting Assistant Coordinator **William Sheehan** are both in the process of moving and thus currently have no postal addresses; Thomas Dobbins' e-mail address has changed to r&d@organitech.com. (6) The postal address of **John E. Westfall**, A.L.P.O. Board member, Editor, Mercury/Venus Transit Coordinator and Assistant Jupiter Coordinator (Galilean Satellites) is now: P.O. Box 2447, Antioch, CA 94531-2447.

OTHER A.L.P.O. NEWS

A.L.P.O. Convention.—Our 2000 Convention will be held at Ventura, California, July 19-22, meeting with the Astronomical League and several other organizations. The meeting is hosted by the Ventura Astronomical Society. For further information, check the webpage: <http://www.vcas.org/astrocon/> (E-mail: astrocon2000@vcas.org). The A.L.P.O. paper session will be held for the entire day of Thursday, July 20, with a Board meeting in the evening. As of May 31, the convention tours were all almost sold out, the speaker slots about filled, but there was still room for the BBQ and the Banquet. Those who wish to attend should delay no longer in registering!

Minor Planet Elmerreese.—Pioneer A.L.P.O. Member and Jupiter Recorder Elmer J. Reese has been honored by having Minor Planet 8377 (1992 SD1) named for him. This was done at the suggestion of T. Sato, W.H. Haas, and I. Hirabayashi. The asteroid was discovered by K. Endate and K. Watanabe on 1992 SEP 23 with a 25-cm f/2.6 Schmidt

camera. For those who would like to seek this object, its Epoch 2000.0 orbital parameters are: T 1997 DEC 18.0, semimajor axis 2.5409325 AU, eccentricity 0.0960145, argument of perihelion 294°.50783, longitude of node 048°.19198, and inclination 9°.74647.

Generous Members.—A gratifying number of our members contribute more than the required dues; the excess is of great help to our organization and may be tax-deductible.

Those who contribute \$100 have the status of **sponsors**, and currently comprise: Julius L. Benton, Leland A. Dolan, Phillip Glaser, Donald C. Parker, James Phillips, Cecil C. Post, John F. Walsh, Matthew Will and Thomas R. Williams.

Members who donate \$50 are designated **Sustaining Members**, who are: Klaus R. Brasch, William Dembowski, Richard D. Dietz, Richard R. Fink, David C. Grosvold, Walter H. Haas, Robert H. Hays, Daniel del Valle Hernandez, Mike Hood, H.W. Kelsey, David J. Lehman, Robert D. Lunsford, Michael A. Nicholas, Arthur K. Parizek, João Porto, Timothy J. Robertson, Takeshi Sato, Mark L. Schmidt, Charles Shirk, Lee M. Smojver, Roger J. Venable and Gerald Watson.

OTHER AMATEUR AND PROFESSIONAL ANNOUNCEMENTS

Double Star Observer. This quarterly amateur/professional scientific journal is devoted to visual double-star astronomy. The annual subscription rates are \$12.00 for the United States, \$16.00 for Canada, and \$20.00 for other countries; contact: Double Star Observer, Editor/Publisher, Ronald C. Tanguay, 306 Reynolds Drive, Saugus, MA 01906-1533.

Roster of Upcoming Meetings

July 9-12, 2000: Catastrophic Events and Mass Extinctions: Impacts and Beyond. At the Institute of Geochemistry, University of Vienna, Vienna, Austria; includes postconference (July 13-16) field trips to impact sites. [Christian Koeberl, Institute of Geochemistry, University of Austria, Althanstrasse 14, A-1090, Vienna, Austria. Telephone: +43-1-31336-1714; FAX: +43-1-31336-781; E-mail: christian.koeberl@univie.ac.at]

July 9-14, 2000: International Planetarium Society Conference. At The Queen Elizabeth Hotel, Montréal, Quebec, Canada. [IPS 2000 Conference, c/o O'Donoughe & Associates Event Management Ltd., 5486 chemin Cote-Saint-Luc, Montréal QC H3X 2C7, Canada. Telephone: +1 514 481-7408; FAX: +1 514 481-7379; E-mail: IPS2000@odon.ca]

July 18-20, 2000: Workshop on Concepts and Approaches for Mars Exploration. At the Lunar and Planetary Institute (LPI), Center for Advanced Space Studies, 3600 Bay Area Boulevard, Houston, Texas. [Website: <http://www.lpi.usra.edu/meetings/robomars/>]

July 19-22, 2000: Astrocon 2000. At the Holiday Inn Ventura Beach Resort, Ventura, California. This national amateur meeting includes the 51st A.L.P.O. Convention. [E-mail: astrocon2000@vcas.org; Website: <http://www.vcas.org/astrocon/>]

August 7-18, 2000: International Astronomical Union General Assembly and Associated Symposia. At Manchester, England. [Website: <http://www.iau.org/ga24.html>] Includes symposia: S202 Planetary Systems in the Universe, Aug. 7-10 (A.C. Penny, e-mail: alan.penny@rl.ac.uk); JD4 The Transneptunian Population, Aug. 11-12 (A. Lemaître, e-mail: alemaître@math.fundp.ac.be); and JD12 Highlights of Planetary Exploration from Space and from Earth, Aug. 5-16 (B. Bezaud, e-mail: bezaud@obspm.fr).

August 21-25, 2000: Second International Conference on Mars Polar Science and Exploration. At the University of Iceland, Reykjavik, Iceland. [Stephen Clifford, Lunar and Planetary Institute, 3600 Bay Area Blvd., Houston, TX 77058-1113. Telephone: 281-486-214;. E-mail: clifford@lpi.usra.edu; Website: <http://www.lpi.usra.edu/meetings/polar2000/>]

August 28-September 1, 2000: 63rd Annual Meeting of the Meteoritical Society. At Chicago, IL. [Andrew M. Davis, department of the Geophysical Sciences, The University of Chicago, 5734 South Ellis Ave., Chicago, IL 60637. Telephone: 773-702-8164; FAX: 773-702-9505; E-mail: a-davis@uchicago.edu; Website: <http://www.lpi.usra.edu/meetings/metsoc2000/>]

October 14-15, 2000: Solar Eclipse Conference 2000. An International Solar Eclipse Conference will be held at the Congress Centre Elzenveld, Antwerp, Belgium on October 14-15, 2000. Three days of lectures will discuss predictions, mathematics, solar physics, weather forecasting, eye safety, diameter measurement, edge and central observing, ancient eclipse research, five years of SOHO, the solar maximum; and the August, 1999, July, 2000, and June, 2001 eclipses. [Patrick Poitevin, 7A The Drift, Rowlands Castle, Havant , Hampshire, PO9 6DG England. Telephone: +44 (0)97901 514 097. E-mail: Patrick_Poitevin@hotmail.com . Webpage: <http://www.eclipsechasers.net>]

October 23-27, 2000: 32nd Division for Planetary Sciences Meeting. At the Pasadena Convention Center, 3000 E. Green Street, Pasadena, California. [Website: <http://www.aas.org/dps2000/>]

PUBLICATIONS OF THE A.L.P.O.

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 publication in our Journal. They should be ordered from our Editor (P.O. Box 2447, Antioch, CA 94531-2447 U.S.A.) for the prices indicated, which include postage. Checks should be in U.S. funds, payable to "A.L.P.O."

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

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

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

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

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

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

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

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

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

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

Order from: A.L.P.O., P.O. Box 2447, Antioch, CA 94531-2447, U.S.A:

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

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

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

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

Back issues of *The Strolling Astronomer (J.A.L.P.O.)*. Many of the back issues listed below are almost out of stock, and it is impossible to guarantee that they will remain available. Issues will be sold on a first-come, first-served basis. In this list, volume numbers are in italics, issue numbers are in plain type, and years are given in parentheses. The price is \$4.00 for each back issue; the current issue, the last one published, is \$5.00. We are always glad to be able to furnish old issues to interested persons and can arrange discounts on orders of more than \$30. Make payment to "Walter H. Haas."

\$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* (1993-94); *1* and *2*, *38* (1994-96); *1*, *2*, and *3*, *39* (1996-97); *1-4*, *40* (1998); *2* and *4*, *41* (1999); *1-4*.

Current Issue [42, 1]; \$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 (next page) unless another address is given below.

Lunar and Planetary Training Program (Robertson): *The Novice Observers Handbook*, \$15.00. An introductory text to the Training Program. Includes directions for recording lunar and planetary observations, useful exercises for determining observational parameters, and observing forms. To order, send a check or money order made out to "Timothy J. Robertson."

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

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

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

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

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

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

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

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

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

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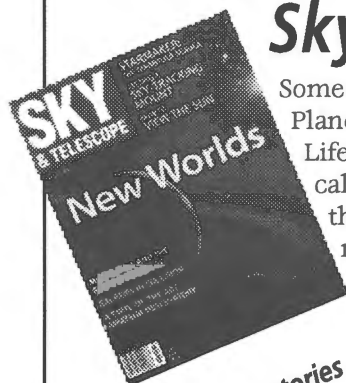
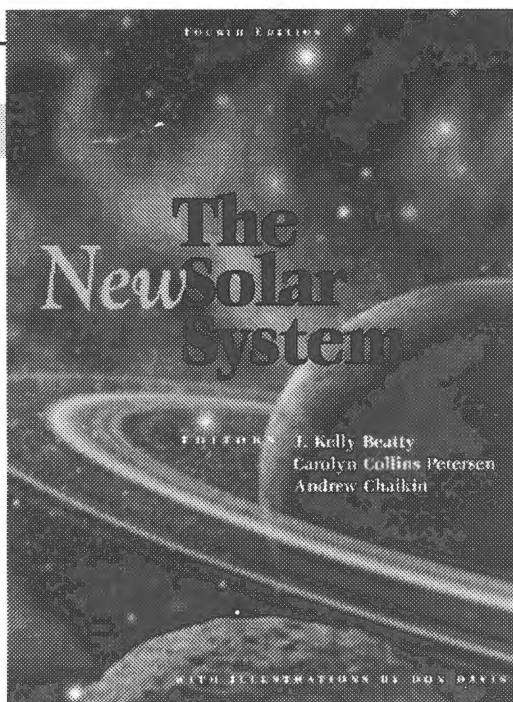
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