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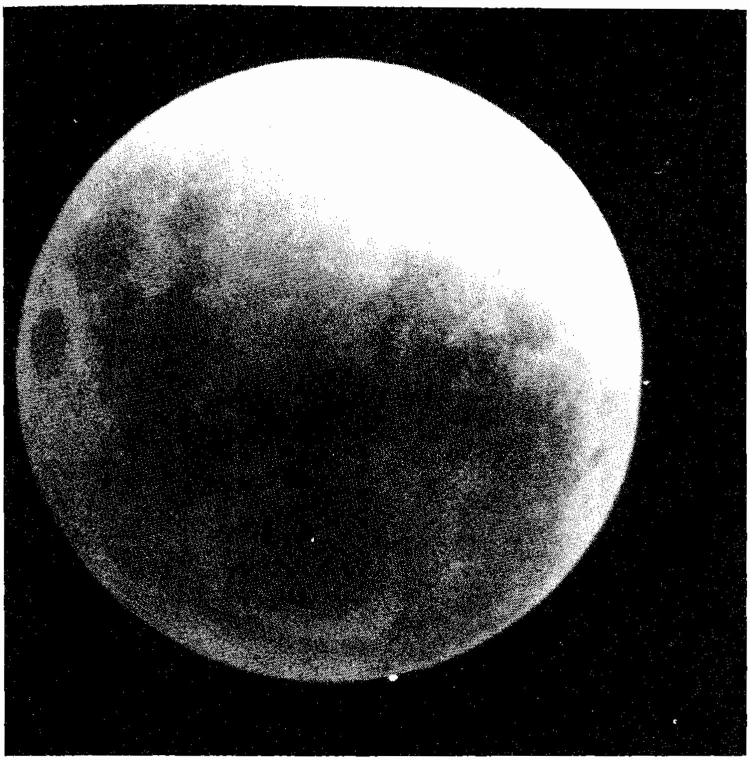

The Moon near the end of totality during the lunar eclipse of 1993 Nov. 29, as photographed by Dermeval Carneiro from the Observatório Astronomico do Colégio 7 de Setembro in Fortaleza, Brazil. Taken on 1993 Nov. 29, 06h50m UT, with a 20-cm f/10 Schmidt-Cassegrain telescope, using a 110-second exposure on Kodak ISO 400 film. South is at the top; the star at the right that is about to disappear behind the Moon is 53 Tau (magnitude +5.25), while the star near the north limb is 51 Tau (magnitude +5.65).

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In This Issue

The 1992-93 Apparition of Saturn: Visual and Photographic Observations

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Abstract

A.L.P.O. Saturn Section observers conducted visual and photographic studies of the planet Saturn and its Rings between 1992 APR 06 and 1993 JAN 04, using telescopes ranging in aperture from 8.3-cm. (3.3-in.) to 40.6-cm. (16.0-in.). Some observers submitted evidence of recurring white-spot activity in the Equatorial Zone (EZ) of Saturn during 1992-93. A few individuals made central meridian (CM) transit timings of atmospheric detail on Saturn, but these did not permit derivation of reliable rotation rates. There was a limited number of photoelectric photometric observations of Saturn and its brighter satellites during 1992-93. The inclination of the rings to our line of sight, B, reached a value of +17°.642 during 1992-93. The Northern Hemisphere of Saturn's Globe and the north face of the Rings were visible during 1992-93, with the gradually diminishing inclination of the rings to our line of sight affecting the appearance of features near Saturn's north and south limbs. Increasingly, regions of the Southern Hemisphere of the planet began to emerge during this apparition. Accompanying this report are references, drawings, photographs, graphs, and tables.

Introduction

Good observer participation during the 1992-93 Apparition generated a respectable sample of visual and photographic observations of the planet Saturn and its Rings. These data, submitted for dates from 1992 APR 06 through 1993 JAN 04, form the basis of this analytical report, which includes selected drawings and photographs. All dates and times in this report are in Universal Time (UT).

Table 1, below, gives pertinent geocentric data in Universal Time (UT) for the 1992-93 Apparition of Saturn. Throughout the observing season the numerical value of B, the Saturnicentric latitude of the Earth referred to the ring plane (positive when north), ranged between the extremes of +14°.770 (1992 MAY 26) to +17°.642 (1992 OCT 17). The value of B', the Saturnicentric latitude of the Sun, ranged from +17°.580 (1992 APR 06) down to +14°.452 (1993 JAN 04). **[4]**

Table 1. Geocentric Phenomena for Saturn in the 1992-93 Apparition. [4]

Conjunction	1992 JAN 29, 22^h
Opposition (in Capricornus)	1992 AUG 07, 10
Conjunction	1993 FEB 09, 16

Opposition Data:

Visual Magnitude	+0.2
B	+16°.302
B'	+16°.209
Declination of Saturn	-17°.27
Globe Diameter: Equatorial	18".63
Polar	16".78
Rings: Major Axis	42".47
Minor Axis	11".92

Table 2 (below and on p. 98) lists the 15 persons who submitted a total of 163 observations to the A.L.P.O. Saturn Section for the 1992-93 Apparition, together with their observing sites, number of dates of observations, and descriptions of their telescopes.

Table 2. Contributing Observers, 1992-93 Apparition of Saturn.

Observer & Location	No. of Dates	Telescope Data*
Julius L. Benton, Jr.	6	15.2-cm (6.0-in) R
Wilmington Island, GA	4	8.3-cm (3.3-in) R
Donald H. DeKarske	1	10.2-cm (4.0-in) R
Colorado Springs, CO		
David L. Graham	8	15.0-cm (5.9-in) R
North Yorkshire, UK	1	40.0-cm (15.8-in) N
Walter H. Haas	6	20.3-cm (8.0-in) N
Las Cruces, NM	25	31.8-cm (12.5-in) N
Alan W. Heath	11	30.5-cm (12.0-in) N
Nottingham, UK		
Andrew P. Johnson	1	15.2-cm (6.0-in) R
North Yorkshire, UK	9	21.0-cm (8.3-in) N
Clinton Lower	2	40.6-cm (16.0-in) C
Port Deposit, MD	1	20.3-cm (8.0-in) N
Michael Mattei	2	15.2-cm (6.0-in) R
Littleton, CO		
Frank J. Melillo	5	20.3-cm (8.0-in) S
Holtzville, NY		
Detlev Niechoy	17	20.3-cm (8.0-in) S
Göttingen, Germany	2	10.2-cm (4.0-in) R
Gary T. Nowak	10	25.4-cm (10.0-in) SS
Essex Junction, VT	1	20.3-cm (8.0-in) N
Phil Plante, Poland, OH	4	20.3-cm (8.0-in) R
Richard W. Schmude, Jr.	6	35.6-cm (14.0-in) S
College Station, TX		
Samuel R. Whitby	15	20.3-cm (8.0-in) N
Hopewell, VA	20	15.2-cm (6.0-in) N
	1	17.8-cm (7.0-in) R
Matthew Will	5	20.3-cm (8.0-in) N
Springfield, IL		

— *Table 2 continued on p. 98* —

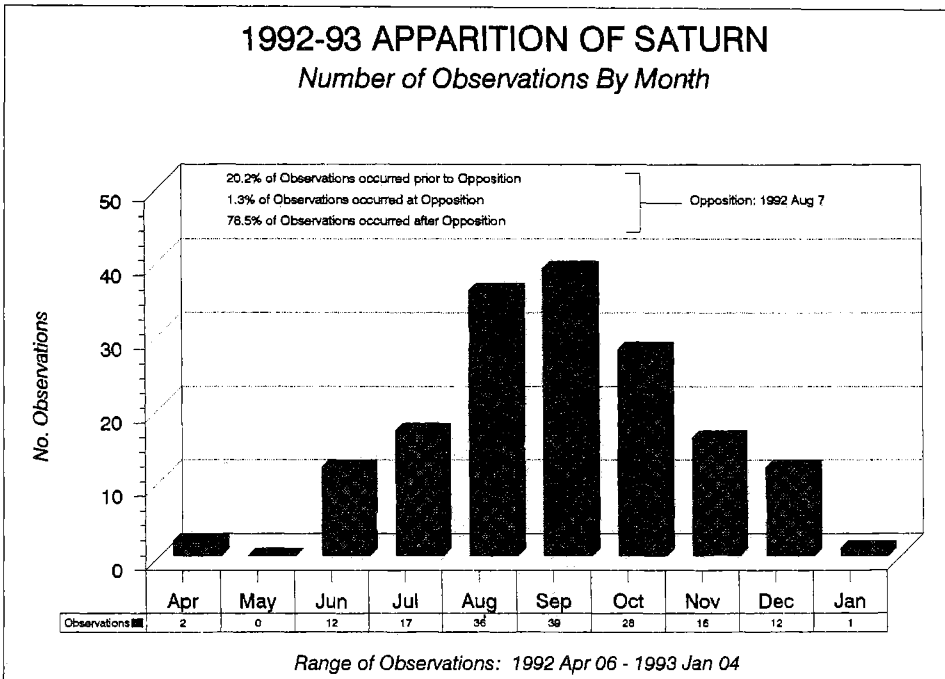

Figure 1. Distribution of observations of Saturn by month during the 1992-93 Apparition .

Table 2—Continued.

Total Observations 163

Total Observers 15

*** Notes: C = Cassegrain; N = Newtonian; R = Refractor; S = Schmidt-Cassegrain; SS = Schiefspiegler.**

Figure 1 (above), a histogram, gives the distribution of observations by month, showing that most of the data were accumulated during the months of 1992 August through October (63.2 percent), with a decline in the number of observations on either side of this peak. It is also worth noting that 20.2 percent of the observations were made before opposition (1992 AUG 07), 1.3 percent on that date, and 78.5 percent were made after opposition, a pattern that has been common in recent observing seasons. Thus, maximum observational coverage of Saturn appears traditionally to cluster around the months nearest, and including, the date of opposition. Observers are reminded that, in order to have a relatively uninterrupted surveillance of the planet during any given observing season, consistent monitoring of the planet is very important. Observations should begin as early in the apparition as possible and following through until Saturn approaches conjunction with the Sun.

Figure 2 (p. 99) graphically depicts the observer base (total of 15) of the A.L.P.O. Saturn Section for 1992-93, as well as the international distribution of the 163 observations that were amassed. The United States was responsible for a little more than two-thirds of the contributed observations (69.9 percent) and about three-fourths (73.3 percent) of the observers during the 1992-93 Apparition. Yet, there was a very respectable number of individuals who participated in our programs from abroad, contributing about one-third of the total observational database. This continues to exemplify the international scope of the A.L.P.O. Saturn Section programs in 1992-93.

Figure 3 (p. 99) graphs the number of observations by instrument type. Telescopes of classical design dominated the scene once again in 1992-93, with 76.1 percent of all observations, chiefly due to their overall proven performance and soundness of design, and consistent favorable image contrast and resolution for planetary work. Also, 95.7 percent of the total of 163 observations were made with instruments equal to or greater than 15.2-cm (6.0-in) aperture.

Seeing conditions during the 1992-93 Apparition averaged 4.7 on the A.L.P.O. Seeing Scale (where 0.0 is the worst possible seeing and 10.0 denotes perfect seeing). Atmospheric transparency (normally the faintest star visible to the unaided, dark-adapted eye near the object being observed) averaged about +3.8 during the 1992-93 observing season.

The writer extends his sincere gratitude to all the dedicated A.L.P.O. colleagues mentioned in Table 2 who conducted routine and specialized observations of Saturn. We encourage observers in this country and abroad to continue working with us in coming apparitions. Efforts are continuing to stimulate intensified and more comprehensive international coverage of Saturn throughout coming observing seasons. Interested observers, regardless of experience, are invited to join us in our endeavors.

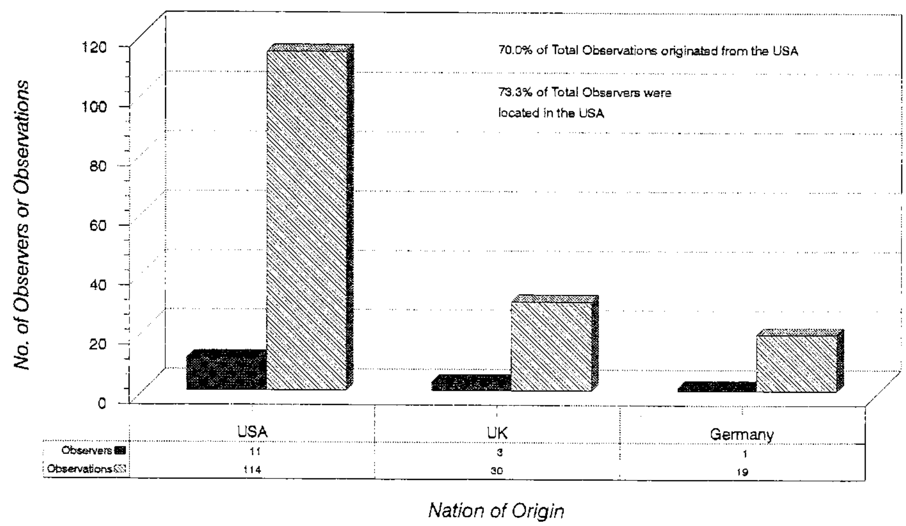

Figure 2. National distribution of Saturn observers and observations for the 1992-93 Apparition.

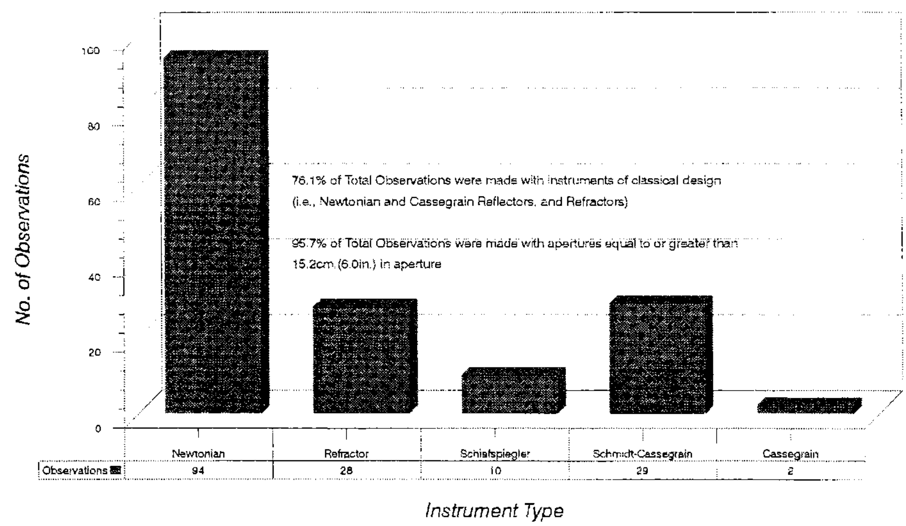

Figure 3. Distribution of observations of Saturn by type of instrument in the 1992-93 Apparition.

THE GLOBE OF SATURN

The following discussion is the result of an analysis of the 163 reports contributed to the A.L.P.O. Saturn Section throughout the 1992-93 Apparition. In the interest of brevity, except when the identity of a specific individual is viewed to be pertinent to the discussion, the names of observers are not given in the text. Tables, graphs, drawings, and photographs accompany this report, and we encourage readers to refer to them as they study this analysis. Features on the globe of Saturn are discussed in north-to-south order and can be identified by the nomenclature diagram in *Figure 4* (p. 100).

Northern Portions of the Globe

Extremely noteworthy outbursts of white-spot activity, reminiscent of that which occurred in the 1990-91 Apparition, were reported during 1992-93. In addition, several individuals recorded whitish ovals and patches in the Equatorial Zone (EZ) periodically during the apparition, and attempts were made to obtain central-meridian transit timings. Also, observers were successful in detecting subtle variations in the appearance and/or brightness of the belts and zones in the Northern Hemisphere of Saturn during 1992-93. Most readers are well aware that the atmospheric features on Saturn are characteristically ill defined, and spots and disturbances are usually transient in nature. Obviously, it requires a great amount of patience and continuous visual monitoring in order to recognize any delicate variations in features.

The following summary of the Northern-Hemisphere atmospheric features compares data between apparitions, as in prior Saturn observing reports, in order to help the reader to appreciate the subtle but recognizable variations that may be underway both seasonally and longer-term. Similar comparisons will soon be possible for Southern-Hemisphere features as more and more of that region comes into our view.

There is good evidence to suggest that the varying tilt of Saturn's rotational axis with respect to the Sun and Earth plays a significant role in any recorded changes in belt and zone intensities, which are given in *Table 3* (p. 101). The intensity scale used 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 calibrated by setting the outer third of Ring B at a standard brightness of 8.0. The sign of an intensity change is found by subtracting a feature's 1991-92 intensity from its 1992-93 intensity. A change of only ±0.1 mean intensity points is not considered significant; indeed, a change is not considered significant unless it exceeds about 3 times its standard deviation.

With respect to latitudes of features in the Northern Hemisphere of Saturn's globe, observers utilized the visual method developed by Haas in the 1960's. Using this method, one estimates the fraction of the polar semidiameter of the planet's disk that is subtended on the central meridian (CM) between the north or south limb and the feature whose latitude is sought. This method is easy to use, and its results compare well with similar values obtained by filar micrometers. After mathematical reduction, the resulting latitudes of Northern-Hemisphere features appear in *Table 4* (p. 102). It must be remembered, however, that it is often risky to place too much confidence on data from only a few observers. Worth noting, however, is the fact that Haas has been employing this technique for many years with excellent and reliable results. Use of this method is growing among observers, and it is strongly recommended that individuals use this very simple procedure whenever possible, even if a filar micrometer is available. This advice is given because data from both methods would be useful for comparison. A full discussion of this visual technique can be found in the *Saturn Handbook* [2]. In discussing each feature in the Northern Hemisphere of Saturn, notes regarding latitude data are incorporated into the text where appropriate.

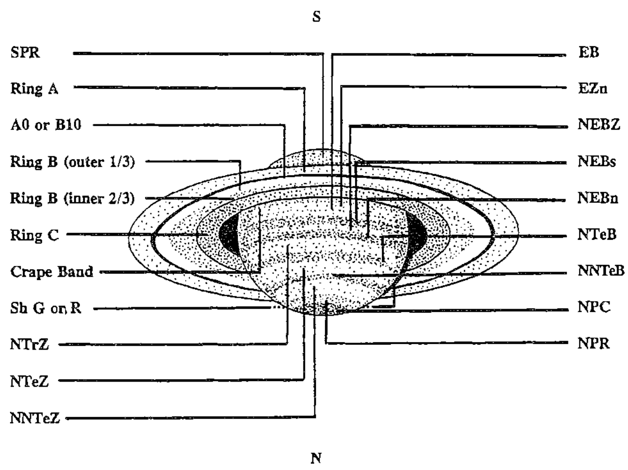

Figure 4. The general appearance of Saturn slightly after opposition (1992 AUG 07), with nomenclature of the major Globe and Ring features that were easily detected with moderate apertures in good seeing. South is at the top; and global features move across the planet from right to left in this normal inverted view (i.e., as seen in an astronomical telescope near culmination in the Earth's Northern Hemisphere without a prismatic diagonal or other device that would reverse the image). The numerical value of **B** is +16°. The text discusses the Globe and Ring features shown here. Some minor features that are not depicted include the: North Polar Belt (NPB), encircling the NPR; North North North Temperate Belt (NNNTeB), immediately north of the NNTeZ; 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); Encke's Division (A5), when detected about midway between Cassini's Division (A0 or B10) and the outer edge of Ring A; and any intensity minima in several Ring components, as mentioned in the text. The easternmost and westernmost extensions of the Rings are called the *ansae*.

North Polar Region (NPR).—The brightness of the yellowish-grey NPR diminished only very slightly from 1991-92 to 1992-93 (a change of -0.2 mean intensity points), and it remained essentially uniform in appearance since the immediately preceding apparition. The dusky yellowish-grey North Polar Cap (NPC) was occasionally detected in the extreme north during 1992-93; and since 1991-92, the NPC exhibited no truly recognizable brightness change (a mean intensity change of -0.1). The greyish North Polar Belt (NPB) was occasionally described during 1992-93 as a continuous greyish linear feature encircling the NPR, showing no substantial fluctuation in intensity since 1991-92 (a minor change of +0.1 mean intensity points was noted).

Table 3. Visual Numerical Intensity Estimates and Colors: Saturn, 1992-93.

Globe/Ring Feature	Relative Intensity (1992-93) Number of Estimates	Mean and Standard Deviation	Change Since 1991-92	"Mean" Derived Hue (1992-93)
ZONES AND OTHER BRIGHT AREAS:				
NPC	8	5.1 ± 0.32	-0.1	Dusky Yellowish-Grey
NPR	37	4.8 ± 0.58	-0.2	Yellowish-Grey
NTeZ	6	6.0 ± 0.76	-0.7	Yellowish-White
NTrZ	13	5.3 ± 0.33	-0.8	Dull Yellowish-White
NEB Z	15	4.7 ± 0.29	-0.3	Yellowish-Grey
EZn	41	6.9 ± 0.70	0.0	Pale Yellowish-White
Globe North of NEB (entire)	31	4.9 ± 0.15	-0.4	Dusky Yellowish-Grey
Globe South of Rings (entire)	30	5.0 ± 0.03	0.0	Dusky Yellowish-Grey
SPR	4	5.3 ± 1.09	+0.2	Yellowish-Grey
BELTS:				
NPB	18	4.1 ± 0.19	+0.1	Greyish
NTeB	15	4.4 ± 0.83	+0.2	Greyish
NEB (entire)	20	3.8 ± 0.66	-0.2	Greyish-Brown
NEBn	29	3.4 ± 0.41	+0.2	Dark Greyish-Brown
NEBs	31	3.2 ± 0.65	+0.1	Dark Greyish-Brown
EB	8	4.2 ± 0.10	0.0	Greyish
RINGS:				
Ring A (entire)	43	6.4 ± 0.75	-0.2	Dusky White
Ring A (outer half)	9	6.9 ± 0.96	-0.1	Dusky White
Encke's Division (A5; ansae)	6	3.1 ± 1.56	+0.2	Dark Grey
Ring A (inner half)	9	6.7 ± 0.05	-0.1	Dusky White
Cassini's Division (A0 /B10; ansae)	30	1.4 ± 0.73	+0.7	Greyish-Black
Ring B				
Ring B (outer third)	-	8.0 **[Standard]**		White.
Ring B (inner two-thirds)	46	7.2 ± 0.43	0.0	Yellowish-White
Ring C (ansae)	36	0.6 ± 0.39	-0.5	Dark Greyish-Black
Crape Band	39	2.9 ± 0.79	-0.5	Dark Grey
Sh G on R	34	0.3 ± 0.20	+0.1	Dark Greyish-Black
Sh R on G	6	1.1 ± 0.66	+0.9	Dark Greyish Black
Terby White Sport (TWS)	33	7.9 ± 0.50	0.0	White

Notes: For nomenclature see text and *Figure 4* (p.100). A letter with a digit (e.g., A5) refers to a location on 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. [2] The "Change Since 1991-92" is in the sense of the 1991-92 value subtracted from the 1992-93 value, "+" denoting an increase in brightness and "-" indicating a decrease (darkening). When the apparent change is less than about 3 times the standard deviation, it is probably not statistically significant.

North North Temperate Zone (NNTeZ).—This feature was not referred to in observational reports submitted during 1992-93.

North North Temperate Belt (NNTeB).—Observers did not submit reports of this feature during the 1992-93 Apparition.

North Temperate Zone (NTeZ).—When reported during 1992-93, the yellowish-white NTeZ showed a slight diminution in intensity (by -0.7 mean intensity points) since the immediately preceding apparition. Ill-defined

Table 4. Latitudes of the Equatorial andNorthern-Hemisphere Belts of Saturn in the 1992-93 Apparition.

Saturnian Belt	Type of Latitude (Change from 1991-92 in parentheses)					
	Planetocentric		Eccentric		Planetographic	
	°	°	°	°	°	°
Center EB	+4.8 ±2.1	(+1.6)	+5.4 ±2.4	(+1.8)	+6.0 ±2.7	(+2.0)
South edge NEB	+18.4 ±1.0	(- 2.4)	+20.5 ±1.1	(- 2.6)	+22.7 ±1.2	(- 2.8)
North edge NEB	+23.8 ±1.3	(- 3.4)	+26.3 ±1.4	(- 3.6)	+29.0 ±1.5	(- 3.7)
Center NTeB	+30.9 ±3.7	(- 1.0)	+33.8 ±3.9	(- 1.1)	+36.9 ±4.0	(- 1.1)
South edge NPB	+73.1 ±2.4	(- 2.1)	+74.8 ±2.2	(- 1.9)	+76.3 ±2.0	(- 1.8)

Notes: For nomenclature see *Figure 4* (p. 100). 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 arc-tangent of the geometric mean of the tangents of the other two latitudes. The change shown in parentheses is the result of subtracting the 1991-92 latitude value **[3]** from the 1992-93 latitude value.

features could sometimes be sighted in the NTeZ, and observers agreed that it was difficult to tell whether these suspected mottlings were real atmospheric phenomena. Other than the EZ, the NTeZ was the brightest of Saturn's zones during the 1992-93 Apparition.

North Temperate Belt (NTeB).—This belt was always seen as a narrow, usually uniform feature, greyish in hue, and extending uninterrupted across the globe from limb to limb. The NTeB was suspected to be a little lighter (by +0.2 mean intensity points) during 1992-93 than it had been in 1991-92.

North Tropical Zone (NTrZ).—The NTrZ in 1992-93 exhibited a slight drop in brightness compared with 1991-92 (-0.8 mean intensity points). Observers assigned a dull yellowish-white color to this zone in 1992-93, and it was largely stable in intensity as it extended across the planet from limb to limb throughout the observing season.

North Equatorial Belt (NEB).—The greyish-brown NEB was often seen differentiated into the **NEBn** and **NEBs**, where **n** refers to the North Component and **s** to the South Component, separated by the **NEBZ** (North Equatorial Belt Zone). This aspect was fairly common in 1992-93, but the NEB was also recorded as a single feature frequently during the apparition. Intensity estimates suggested that the NEB, taken as a whole, showed no really significant brightness changes since 1991-92 (darker by only -0.2 mean intensity points).

The greyish-brown NEBn was suspected to have brightened only slightly from 1991-92 to 1992-93 (+0.2 mean intensity points). Individuals were able to perceive poorly defined transient features within the NEBn, but none lasted long enough to obtain good CM transit timings.

The greyish-brown NEBs was the darkest belt on the Globe of Saturn in 1992-93; as a component, it was darker than the NEB as a whole, which had been the case in 1991-92 and for several other recent observing seasons. The NEBs exhibited practically no change in brightness since 1991-92 (a change of only +0.1 mean intensity points). There were several instances when dark blotches or condensations were suspected in the NEBs, but CM transit timings were hampered by the short-lived and poorly-defined nature of these features.

The yellowish-grey NEBZ was sometimes observed during 1992-93, exhibiting a slight mean intensity decrease of-0.3 since 1991-92. As in several past apparitions, the NEBZ remained one of the darkest zones on Saturn in 1992-93. While it might be expected that the NEBZ was difficult to scrutinize in contrast with its environment, the location of this zone between the darker NEBn and NEBs made it easier to distinguish the feature. The NEBZ showed no confirmed activity during the 1992-93 apparition, and it remained uniform in intensity throughout the observing season.

Equatorial Zone (EZ).—Based on mean intensity estimates by our observers, the pale yellowish-white EZ (chiefly the EZn in this report) showed no brightness changes when compared with the 1991-92 apparition. The EZn was always the brightest zone on Saturn during the 1992-93 apparition, closely matching the outer portions of Ring A and the inner third of Ring B in overall intensity. There were several interesting reports of a general brightening of the EZ during 1992 August and September, concurrent with other reports of bright, diffuse areas and sporadic white-spot activity during those same months. A few observers considered that the EZ remained brighter than it had been in the earlier months of the apparition all the way into 1992 November. No one, however, was able to capture sufficient numbers of CM transits of these vague features to generate drift charts so that rotation periods could be computed. Short-lived wispy festoons, projecting from the NEBs, were also suspected in 1992-93.

The Equatorial Band (**EB**) was seen several times during the 1992-93 Apparition as a yellowish-grey, very narrow and discontinuous linear feature, and of the same intensity as it had been in 1991-92.

Shadow of the Rings on the Globe (Sh R on G).—This feature was sometimes visible as a dark greyish-black marking on either side of opposition during 1992-93, the deviation from the actual black (0.0) intensity being due to poor seeing and scattered light.

Shadow of the Globe on the Rings (Sh G on R).—This feature was always seen as dark greyish-black during 1992-93 and was regular in form, although any deviation from the true black (0.0) intensity was for the same reasons as noted in the preceding paragraph.

Southern Portions of the Globe

As the rings of Saturn continue to decrease their tilt to our line of sight (i.e., as the value of **B** becomes smaller), more and more of the Southern Hemisphere of the planet is tilted into our view. Of course, at the same time less of the Northern Hemisphere is correspondingly visible.

South Polar Region (SPR).—The SPR appeared yellowish-grey during the 1992-93 Apparition, and it was only very slightly lighter in intensity than in 1991-92 (by +0.2 mean intensity points).

South Equatorial Belt (SEB).—There were no reports of this feature during 1992-93.

THE RINGS OF SATURN

This section covers the analysis of the observations of Saturn's Ring System that were submitted throughout the 1992-93 Apparition, together with a continuing comparative study of the mean intensity data as has been done for previous apparitions. As noted in the Introduction, the northern face of the Rings was very well presented to our view during the 1992-93 observing season.

Ring A.—Considered as a whole, Ring A was dull white throughout the 1992-93 Apparition, showing no substantial change in brightness since 1991-92 (dimmer by only -0.2 mean intensity points). There were only a few sightings of Encke's Division (**A5**) made during the apparition, at the Ring ansae in favorable seeing; there were no other intensity minima confirmed in Ring A in 1992-93.

On some occasions, Ring A was described as having distinct outer and inner halves in terms of intensity. In 1992-93, the perceived outer and inner halves of Ring A were dusky white and exhibited virtually the same intensity as in 1991-92 (a difference in both cases of only -0.1 mean intensity points).

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. Throughout 1992-93, this portion of Ring B appeared white, stable in intensity, and easily the brightest feature on either Saturn's Globe or Rings. The inner two-thirds of Ring B, chiefly yellowish-white in color, was of the same mean intensity in 1992-93 as it had been during the immediately preceding observing season. It was also mostly uniform in intensity throughout 1992-93, although observers called attention to intermittent sightings of wispy "spoke" features which were always at the threshold of vision and were unconfirmed.

Cassini's Division (A0 or B10).—This feature was usually visible at the ansae in 1992-93, extending all the way around the Rings in favorable seeing. It had a greyish-black appearance during the 1992-93 Apparition and it had a slightly lighter intensity when compared with 1991-92 (a difference of +0.7 mean intensity points). As with the Sh G on R described earlier, the deviation from a true black appearance is attributable to scattered light and poor seeing.

Ring C.—In contrast with 1991-92, observers in 1992-93 reported seeing Ring C easily at the ansae, noting its greyish-black appearance, and remarking that it was a little darker (by -0.5 mean intensity points) when compared with 1991-92. Normally, faint or narrow Ring features are easier to see, and they typically appear darker, at greater ring inclinations.

The Crape Band, or Ring C as projected onto the Globe, was -0.4 mean intensity points darker in 1992-93 than in 1991-92. Observers described this feature as mostly uniform in intensity and very dark grey in hue. Except when they are near the Ring Plane, the Saturnicentric latitudes of the Sun and Earth conspire to bring about the partial coincidence of the Crape Band with the Shadow of Ring C on the Globe.

Ring Components Other Than A, B, or C.—Neither Ring D (inside Ring C) or Ring E (outside Ring A) was reported in 1992-93. Of course, these Ring components are exceedingly difficult to observe except under the best conditions and with large apertures.

Terby White Spot (TWS).—The TWS is an occasionally-reported brightening of the Rings adjacent to the Sh G on R. Several observers during 1992-93 recorded a bright, whitish TWS, curiously not nearly so conspicuous in recent years as in the early to mid-1980's. Nonetheless, it was the brightest object in Saturn's Rings or on the Globe except for the EZn this apparition. Most astronomers assign little or no importance to the TWS, since it is most likely nothing more than a contrast phenomenon, not an intrinsic Saturnian feature. It remains of possible value, however, to try to determine whether there is any correlation between the brilliance of the TWS and varying Ring inclinations, as well as its prominence or appearance in color filters.

Bicolored Aspect of the Rings.—This phrase refers to reported differences in color between the two ansae of the Rings. A few people attempted observations of this phenomenon in 1992-93, and variations were seen in the brightness of the East and West ansae (IAU direction system) when compared with the blue W47 (Wratten 47), W38, or W80A Filters and the red W25 or W23A Filters. *Table 5* (p. 104) lists the circumstances of

Table 5. Observations of the Bicolored Aspect of Saturn's Rings in 1992-93.

Notes: Telescope types are as in *Table 2* (pp. 97-98). Seeing is on the 0-10 A.L.P.O. scale. Transparency is the limiting visual magnitude in the vicinity of Saturn. Under "Filter," **B** refers to the blue W47, W38, or W80A filters, **IL** to integrated light (no filter), and **R** to the red W25 or W23A Filters. **E** means that 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.

Observer	UT Date and Time (entire observing period)			Telescope Type and Aperture		Magnification	Seeing	Transparancy	Filter B	IL	R
	1992										
Whitby	JUN	01	08:40-09:20	N	15.2 cm (6.0 in)	310X	6.0	+3.0	E	=	=
Haas		03	10:31-11:27	N	31.8 cm (l2.5-in)	366X	3.5	+3.5	E	=	=
Whitby		06	08:55-09:05	N	15.2 cm (6.0-in)	205X	5.0	+3.0	E	=	=
Haas		08	11:21-11:50	N	20.3 cm (8.0-in)	231X	6.0	+3.5	E	=	=
Haas		18	10:11-11:01	N	31.8 cm (l2.5-in)	366X	4.0	+4.0	E	=	=
Haas		28	10:33-11:39	N	31.8 cm (l2.5-in)	366X	4.0	+3.0	E	=	=
Haas	JUL	06	09:59-10:53	N	31.8 cm (l2.5 in)	366X	3.5	+3.5	E	=	=
Haas		09	11:18-11:41	N	31.8 cm (l2.5 in)	366X	4.0	+3.0	E	=	=
Haas	AUG	04	07:12-08:05	N	31.8 cm (l2.5 in)	366X	4.0	+3.5	E	=	=
Haas		08	08:02-08:40	N	31.8 cm (l2.5 in)	366X	3.5	+3.5	E	=	=
Whitby		09	03:05-03:17	N	20.3 cm (8.0 in)	203X	5.0	+2.5	E	=	=
Haas		14	03:45-04:50	N	20.3 cm (8.0 in)	231X	3.0	+3.0	E	=	=
Haas		25	03:55-04:25	N	20.3 cm (8.0 in)	231X	4.0	+3.0	E	=	=
Haas		27	04:56-05:22	N	31.8 cm (l2.5 in)	366X	4.0	+3.0	W	=	E
Haas		31	04:25-04:49	N	31.8 cm (l2.5 in)	321X	3.5	+3.0	E	=	=
Haas	SEP	02	04:35-05:29	N	31.8 cm (l2.5 in)	366X	3.0	+3.5	E	=	=
Whitby		02	01:25-01:56	N	20.3 cm (8.0 in)	203X	4.5	+2.5	E	=	=
Lower		03	01:00-01:30	N	20.3 cm (8.0 in)	271X	8.0	+6.0	W	=	W
Will		08	04:53-05:18	N	20.3 cm (8.0 in)	231X	3.5	+3.0	E	=	=
Haas		11	04:12-04:40	N	20.3 cm (8.0 in)	271X	4.0	+3.0	E	=	=
Haas		13	03:31-05:39	N	31.8 cm (l2.5 in)	366X	4.0	+3.5	E	=	=
Whitby		13	00:55-01:17	N	20.3 cm (8.0 in)	203X	3.0	+5.0	E	=	=
Haas		22	03:39-04:54	N	31.8 cm (l2.5 in)	366X	3.5	+2.5	E	=	=
Haas		23	02:13-03:29	N	20.3 cm (8.0 in)	271X	3.5	+4.0	E	=	=
Haas		26	04:22-04:46	N	31.8 cm (l2.5 in)	321X	3.5	+3.0	E	=	=
Haas		29	03:09-03:53	N	31.8 cm (l2.5 in)	366X	4.0	+2.5	E	=	=
Haas	OCT	02	02:14-03:10	N	31.8 cm (l2.5 in)	366X	4.0	+3.0	E	=	=
Haas		08	03:24-04:32	N	31.8 cm (l2.5 in)	321X	3.0	+3.5	E	=	=
Whitby		10	00:05-00:18	N	20.3 cm (8.0 in)	203X	3.0	+4.0	E	=	W
Haas		14	03:11-05:04	N	31.8 cm (l2.5 in)	366X	3.5	+3.0	E	=	=
Plante		22	23:45-23:57	R	20.3 cm (8.0 in)	333X	4.0	+4.0	E	=	=
Will		25	02:00-02:10	N	20.3 cm (8.0 in)	270X	5.5	+3.5	E	E	=
Haas		26	02:24-03:25	N	31.8 cm (l2.5 in)	366X	4.0	+2.5	E	=	=
Haas	NOV	02	02:12-02:33	N	31.8 cm (l2.5 in)	321X	3.0	+3.5	E	=	=
Haas		15	01:50-03:00	N	31.8 cm (l2.5 in)	366X	3.5	+3.5	E	=	=
Haas		16	01:00-02:47	N	31.8 cm (l2.5 in)	366X	3.5	+3.5	E	=	=
Haas		19	00:57-03:02	N	31.8 cm (l2.5 in)	366X	4.0	+3.5	E	=	=
Haas	DEC	17	00:38-00:59	N	31.8 cm (l2.5 in)	366X	3.5	+3.5	E	=	=
Haas		20	00:29-00:41	N	31.8 cm (l2.5 in)	366X	3.5	+3.5	E	=	=
	1993										
Whitby	JAN	04	22:40-22:49	N	15.2 cm (6.0 in)	205X	3.0	+2.0	E	=	=

these observations. The reader should note that the directions in *Table 5* refer to Saturnian or IAU directions, where West is to the right in a normally-inverted Northern-Hemisphere telescope image which has South at the top.

There is a significant need for observers to participate in simultaneous observing programs which stress, among other projects, a systematic study of the bicolored aspect of the ring system ansae. Observer participation in this program during 1992-93 was modest, yielding a few near-simultaneous sightings of the bicolored aspect. The greater the number of persons taking part in this effort, making systematic visual and photographic filter estimates, the better will be the chances of shedding some new light on this intriguing and poorly understood phenomenon.

SATURN'S SATELLITES

No observers in 1992-93 contributed any systematic visual estimates of Saturn's satellites using the methods outlined in *The Saturn*

Handbook. Melillo, however, conducted experiments on Titan with an SSP-3 Optec photometer on five nights during the apparition, which suggested that the satellite's "measured" magnitude was fainter than predicted. Melillo's work during 1992-93 was a planned prelude to a more systematic photometric program for subsequent apparitions, and we will eagerly await his results next apparition. Melillo plans to employ different filters, including work in the near-infrared. Other observers who own photometers are encouraged to contribute any measurements made on Saturn's satellites. Visual magnitude estimates are also of value, and individuals are urged to participate in this phase of Saturn observation.

SIMULTANEOUS OBSERVATIONS

There were several simultaneous, or near-simultaneous, observations of Saturn during 1992-93. This is defined as occasions when participants independently observed at the same date and time. This outcome was purely coincidental, and the Saturn Section badly needs more individuals who will regularly participate in scheduled simultaneous observation programs, carrying out their routine activities, such as making drawings, intensity estimates, satellite magnitude measurements, and central meridian (CM) transit timings, all on the same date and time. Such simultaneous observations would provide better verification of subtle, variable phenomena on Saturn. These supporting observations strengthen the confidence level in our analysis, and readers are strongly encouraged to inquire of us about how to undertake simultaneous observations in future observing seasons.

CONCLUSIONS

The enduring efforts of A.L.P.O. Saturn Section members provided a good database of observations for analysis during 1992-93. The writer is grateful for the enthusiasm and dedication of all of the individuals mentioned in this report. Anyone who desires to become a regular contributor as a member of our team of observers is encouraged to contact the writer for more information (address on inside back cover). Please enclose a self-addressed and stamped envelope for the fastest possible reply.

REFERENCES

1.) Alexander, A.F. O'D. *The Planet Saturn*. London: Faber and Faber, 1962.

2.) Benton, J.L., Jr. *Visual Observations of the Planet Saturn: Theory and Methods (The Saturn Handbook)*. Savannah, GA: Review Publishing Company, 1988 (5th Revised Edition).

3.) ________. "The 1991-92 Apparition of Saturn: Visual and Photographic Observations," *J.A.L.P.O.*, *37*, No. 1 (July, 1993), pp. 1-13.

4.) United States Naval Observatory. *The Astronomical Almanac*. Washington: U.S. Government Printing Office. (Annual Publication; the 1992 and 1993 editions were used for this report, which were published in 1991 and 1992, respectively.)

SELECTED DRAWINGS, 1992-93 APPARITION OF SATURN

NOTE: For the drawings in *Figures 5-14* (below and on pp. 106-107), unless otherwise stated, **Seeing** is given on the 0-10 A.L.P.O. Scale, and **Transparency** is the limiting naked-eye visual magnitude in the vicinity of Saturn. South is at the top in these views, and celestial east to the right. **CM(I)** is the central-meridian longitude in rotational System I; **CM(II)** is the same in System II. (System I applies to the NEBs, EZ, and SEBn, with a rate of 844°.3 per day; System II to the rest of the Globe, at 812°.0 per day.) **B** is the Saturnicentric latitude of the Earth, and **B'** that of the Sun. Contrasts have been exaggerated for reproduction.

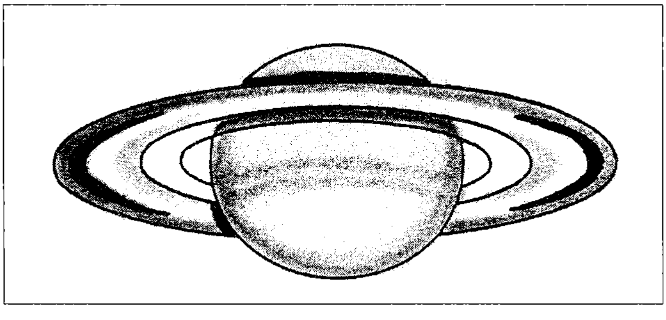

Figure 5. Drawing by Samuel R. Whitby. 1992 APR 08, 10h10m-10h30m UT. 15-cm (6-in) Newtonian, 155X, 310X. No filter. Seeing 5-6, Transparency +3 (estimated; twilight). CM(I) = 079-091°; CM(II) = 097-108°. B = +15°.5; B' = +17°.6.

— *Drawings continued on pp. 106 - 107* —

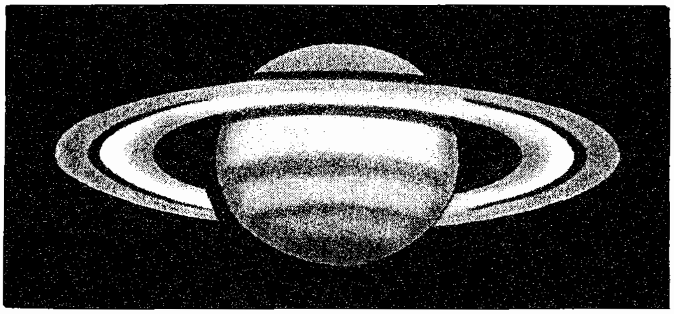

Figure 6. Drawing by David L. Graham. 1992 JUN 27, 01h22m - 01h45m UT. 15-cm (6-in) refractor, 222X. No filter. Seeing Antoniadi III (moderate). CM(I) = 358-012°; CM(II) = 324-337°. B = +15°.1; B' = +16°.7.

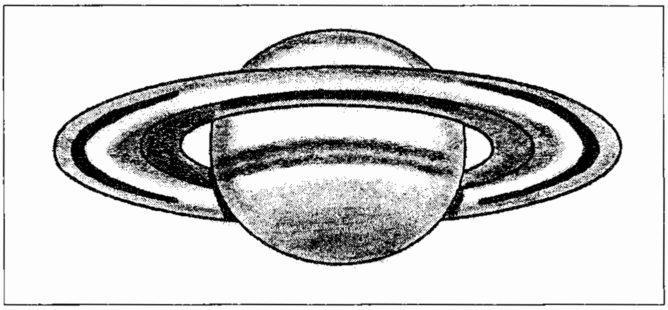

Figure 7. Drawing by Samuel R. Whitby. 1992 JUL 29, 08h40m - 08h45m UT. 15-cm (6-in) Newtonian, 205X and 310X. No filter. Seeing 7, Transparency +2. CM(I) = 275-278°; CM(II) = 278-280°. B = +16°.1; B' = +16°.3.

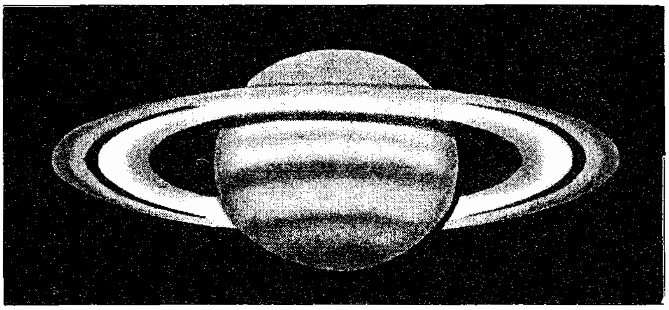

Figure 8. Drawing by David L. Graham. 1992 AUG 18, 22h15m - 22h30m UT. 15-cm (6-in) refractor, 222X. No filter. Seeing Antoniadi II (good). CM(I) = 001-009°; CM(II) = 058-067°. B = +16°.7; B' = +16°.1

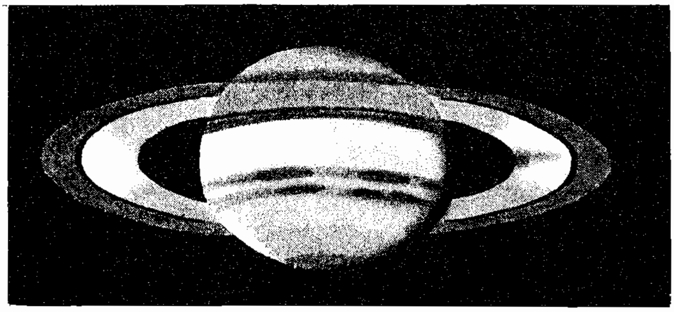

Figure 9. Drawing by Andrew Johnson. 1992 AUG 18, 21h40m UT. 21-cm (8-in) reflector, 195X. Seeing Antoniadi II (good). CM(I) = 340°; CM(II) = 039°. B = +16°.7; B' = +16°.1. Note "spokes" in Ring B.

— Drawings continued on p. 107 —

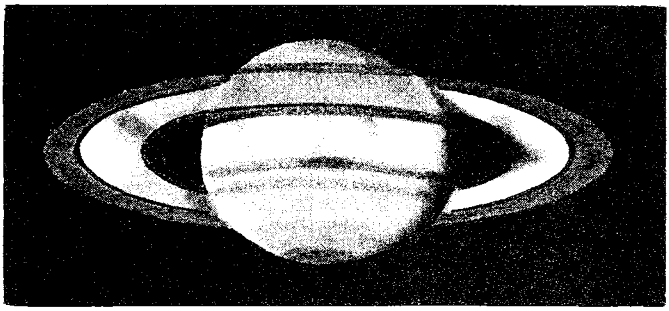

Figure 10. Drawing by Andrew Johnson. 1992 AUG 28, 21h15m UT. 15-cm (6-in) refractor, 222X. Seeing Antoniadi III (moderate). CM(I) = 129°; CM(II) = 225°. B = +16°.9; B' = +16°.0. Note "spokes" in Ring B and festoons in EZ.

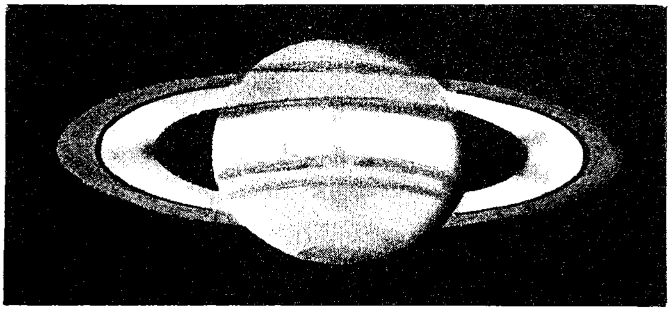

Figure 11. Drawing by Andrew Johnson. 1992 SEP 05, 20h20m UT. 21-cm (8-in) reflector, 195X. Seeing Antoniadi III (moderate). CM(I) = 011°; CM(II) = 210°. B = +17°.1; B' = +15°.9. Note "spokes" in Ring B and festoons in EZ.

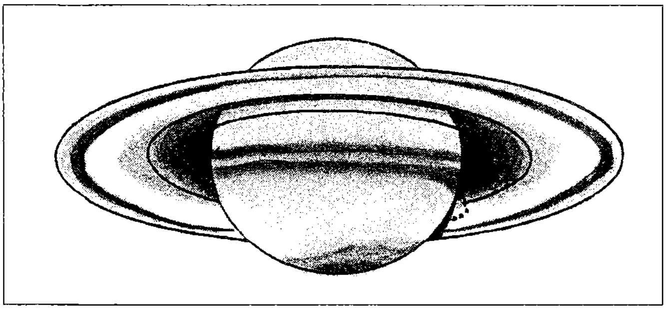

Figure 12. Drawing by Phil Plante. 1992 SEP 24, 04h40m - 04h50m UT. 20-cm (8-in) refractor, 428X. Seeing Antoniadi II- III (good - moderate). CM(I) = 022-028°; CM(II) = 348-354°. B = +17°.5; B' = +15°.7. Note Terby White Spot next to Shadow of Globe on Ring B.

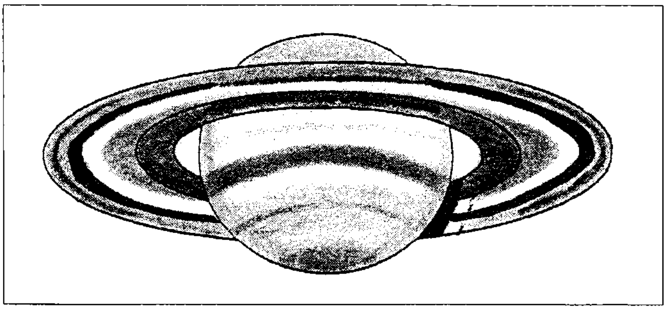

Figure 13. Drawing by Samuel R. Whitby. 1992 OCT 14, 00h00m - 00h15m UT. 15-cm (6-in) Newtonian, 203X and 310X. Seeing 6; Transparency +5. W23A (red) Filter. CM(I) = 183-192°; CM(II) = 229-238°. B = +17°.6; B' = +15°.4. Note Terby White Spot next to Shadow of Globe on Ring B.

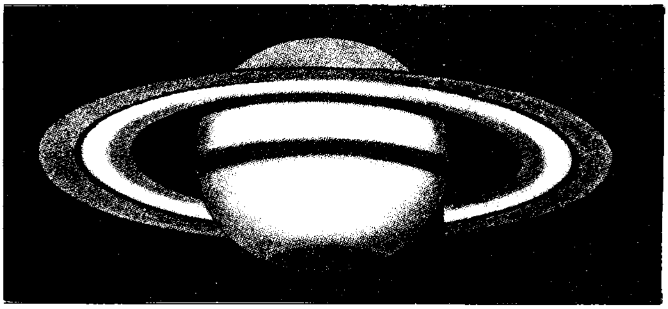

Figure 14. Drawing by Donald H. DeKarske. 1992 Nov 09, 01h17m - 02h05m UT. 10-cm (4-in) refractor, 150X and 227X. Seeing 4-7; Transparency +3.5. No filter. CM(I) = 217-245°; CM(II) = 142-169°. B = +17°.4; B' = +15°.1.

Evidence of an Apparent Dust Levitation or Outgassing in the Crater Tycho

By: David O. Darling and David D. Weier, A.L.P.O. and Madison Astronomical Society, Inc.

ABSTRACT

The authors in continuing research on Lunar Transient Phenomena (LTP), have encountered many intriguing and interesting things during their observations of the Moon. This paper describes a set of four observing runs made on the mornings of December 10, 1990, September 2, 1991, August 21, 1992, and July 12, 1993 (all local time), when anomalous events were observed, apparently involving the central peak of the crater Tycho. All four events occurred shortly prior to sunset on the crater at colongitudes near 185°. The August 21, 1992 event was photographed by Darling with a 27.9-cm (11-in.) f/10 Schmidt-Cassegrain and a Minolta SRT 101 camera. It was videotaped with a Thorr video camera on a 40.6-cm f/19 Cassegrain. The July 12, 1993 event was videotaped with the same video camera and 40.6-cm telescope. On the same date, Gilbert C. Lubcke, a member of the Madison Astronomical Society, was able to obtain 52 images with his C11 and a Santa Barbara Instrument Group ST6 CCD camera. These telescopes are located at the Yanna Research Station of the Madison Astronomical Society, Inc. 9 km (5.5 mi) southwest of Brooklyn, Wisconsin. Lubcke's observing site was in Middleton, Wisconsin, just west of Madison.

The crater Tycho is 90 km (56 mi [Wilkins and Moore, 1955]) in diameter with a prominent central peak. The ramparts of the crater rise 4,460 m (14,633 ft) above the floor, while the central peak is 2,190 m (7,185 ft) high [USAF-ACIC, 1967]. The central peak is thus just 2,270 m (7,448 ft.)below the wall and can be visible when the crater's interior is in deep shadow.

On the morning of December 10, 1990 [local time unless otherwise specified] Darling made the first in a set of four observing runs on the crater Tycho. On that date the Sun was setting on the crater. The central peak of Tycho was visible along with the Eastern rim [IAU directions are used throughout this paper]. The interior was completely shadow-filled. The central peak appeared as a diffuse pearly white glow that looked like the nucleus of a comet. As Darling observed during the next two hours the patch fluctuated in size and brightness. During this time a faint arch or "wishbone" of light formed across that half of the crater floor that was in deep shadow at the time. He attempted photographs of this event, but the phenomenon was too faint to be recorded on film. However, Darling was able to make drawings of the wishbone of light.

Other features along the sunset terminator were observed to see whether the same type of phenomenon was present. No other features along the terminator or on the whole lunar disk exhibited the same behavior. Several mountain peaks north of Tycho were sunlit and were stellar in appearance but showed no evidence of nebulosity or glowing patches. As a next step, the features were monitored for atmospheric effects and it was decided that seeing was not causing the observed appearance.

Using Harry D. Jamieson's *Lunar Scheduling Program*, since updated to the *Lunar Observer's ToolKit*, we computed when similar lighting conditions would again be present for us to observe the sunset on Tycho. These computer programs have proved invaluable to our research. On September 2, 1991 [same UT date] at 07:40 UT, Darling was able to observe a repeat of this type of event with Tycho's central peak appearing as a "star like" point in the center of a glowing patch. (Darling, 1991). As his observation continued, the stellar point sometimes disappeared into the nebulous patch. The central peak varied from a bright point of light to being nearly invisible. There were two faint arches of light observed in the crater; similar to the ones observed in December 1990. Again, other features along the sunset terminator were examined for anomalous behavior with none being found. Darling employed Wratten 25 red and 38A blue Filters (as used for "Moonblink") and found that the luminescence in the crater was enhanced in red and was totally invisible in blue.

After observing these two events Darling purchased a video camera manufactured by Thorr Enterprises of Dracut, Massachusetts, designed for lunar and planetary use. Darling used this combination of cameras and the computer programs mentioned above to obtain a multimedia documentation of the anomalous behavior of the interior and central peak complex of Tycho during its August, 1992 event. Also the members of the American Lunar Society's LTP Network were notified of the predicted August 21, 1992 event and two members participated. One, Paul Castle of Rock Island, Illinois, observed late into the predicted observing window but saw nothing unusual. In private communication with Darling, his reason for not seeing anything unusual may have been that he observed from 12:25 to 12:48 UT when the bright blue sky lowered the contrast. Dawn was breaking, washing out any subtle effects by destroying the contrast for lunar features.

On the morning of August 21, 1992 [same

UT date] between 07:58 - 11:18 UT, Darling was able to document the phenomenon observed in the previous two events. He videotaped with the Thorr video camera on the 40.6-cm f/19 Cassegrain and took film photographs with the C11 [a 28-cm Schmidt-Cassegrain telescope]. These observations were made at the Yanna Research Station of the Madison Astronomical Society, Inc., 9 km southwest of Brooklyn, Wisconsin. The still photographs were made with Kodachrome ISO 64 slide film. Darling's daughters Michelle and Lael helped obtain these data by running the video equipment on the 40.6-cm telescope. Darling moved between both telescopes, taking photographs with the C11 and the 40.6-cm. Because of this schedule, he only viewed the crater visually for a short tune. It wasn't until he reviewed the slides and videotapes that he realized that he had recorded and photographed an LTP in Tycho. Darling then showed the tapes and slides to Weier and suggested collaboration on the analysis of the data, to which Weier agreed. After analysis, the authors were in full agreement. We then proceeded with a detailed study of the three events observed by then.

The videotape showed a nebulous patch on the eastern side of the central peak that developed, fragmented, and then dissipated in a regular fashion. At one point during the observing run Darling could see for several minutes the distinct wishbone-shaped light region in the deep shadow of the crater east of the central peak. In further study of the videotape, and after a telephone conversation with Harry D. Jamieson, A.L.P.O. Lunar Domes Recorder, the authors focused their study on the central peak complex. Jamieson found by going frame by frame through the videotape that it appeared that knots of material were being ejected from the central peak complex and were streaming outward from the peak, forming plumes of nebulous material! We confirmed Jamieson's conclusions by viewing the tape. After viewing the tapes in this manner, Darling decided to take a series of photographs of the video screen using Kodak TRI-X ISO 400 black-and-white film. These photographs showed the nebulous patch and how it changed minute by minute. The recording of the phenomenon by video was enough to pique one's curiosity; but when we heard that the phenomenon was photographed with two other telescopes, one in Wisconsin and the other in Ohio, this agreement fully convinced us of the extraordinary nature of this event.

One series of 24 exposures, taken by F. Graham of East Liverpool, Ohio, and two exposures out of 24 taken by Darling, showed the nebulous patch of August 21, 1992. Darling's photographs, taken with the C11, showed the patch in different stages of development. Darling's photograph No. 5, taken at 08:23 UT, showed a nebulous streamer extending away from the central peak complex toward the southeast quadrant of the crater floor. Photograph No. 12, taken at 08:55 UT, showed the central peak to be diffuse with no nebulous patch near it. Photograph No. 13, at 08:56 UT, showed the peak as a bright central spot with no nebulosity. Also, there were no patches evident anywhere in the crater. In this last frame, Tycho had resumed a normal appearance. Graham's photographs were nearly identical to Darling's photographs, showing the nebulous patch. After reviewing all of the data, the authors were convinced that an LTP had been documented at Tycho.

Darling had contacted Arlin P.S. Crotts of Columbia University, at the suggestion of Winifred Sawtell Cameron, A.L.P.O. LTP Recorder. The night before his observing run, Dr. Crotts said he would be conducting a spectrographic run at McDonald observatory with a CCD spectrograph attached to the 76-cm Cassegrain. He was scheduled to image the Moon with this instrument and agreed to try to obtain spectra of Tycho's central peak during the predicted window of opportunity. Unfortunately, Dr. Crotts had software problems and was unable to obtain spectra of Tycho.

We assembled a package of all the data except the videotapes and sent it to the Editor of *Selenology*, the Journal of the American Lunar Society. The package he received contained all the photographs from the C11, the photographs made from the videotapes, along with drawings made by Darling from the videotape stills. We included all these raw data with a rough draft of an article, with no real conclusions about the nature of the phenomenon, which he promptly published in *Selenology* (Darling and Weier, 1992).

This package of data was also sent to Dr. Patrick A. Moore of the B.A.A. Lunar Section T.L.P. Subsection. In the *B.A.A. Lunar Section Circular* (Moore, P.A., 1993), Moore put the B.A.A. Lunar Section on full alert to observe Tycho during all possible occasions, even by earthlight.

The data were also examined by Winifred Sawtell Cameron, the A.L.P.O. LTP Recorder, and one of the foremost authorities in the field of LTP Research. Her response to the data contained by far the most in-depth analysis of this event. She also compared it to the two previous events described above. She found that the Tycho LTP reports correlate with low-angle illumination, and two of the three corresponded with the occurrence of bombardment by solar particles on the Earth-Moon system, known as "magnetic storms". She found a negative correlation with the tidal hypothesis [i.e., the hypothesis that LTP are correlated with the Earth's tidal force on the Moon]. Also, the events were negatively correlated with the Moon's presence in the Earth's magnetic tail; the Moon was not located in the Earth's magnetopause or bow shock front. Cameron thought there were two possible factors; perhaps Solar activity stimulated luminescence of surface materials; dust or gas and then the low-angle illumination rendered this luminescence visible. She believes that the visual observations suggest some medium was involved; gas, dust, or both. The wishbone pattern is puzzling since there are no terrain features to produce such a pattern. The fact that solar particles were then bombarding the

Moon, while a magnetic storm was occurring on Earth, favors the hypothesis of luminescence stimulated by these energetic particles. However, the Moon was not within the magnetopause or near the bow shock front of the magnetic tail which would be the locations for acceleration of the particles to energies sufficient to produce luminescence bright enough to be seen from the Earth. Ordinary solar wind particles, even flare particles, do not have sufficient energies to do this. The low-angle illumination would help to render luminescence visible because of the longer path of light through a medium of levitated dust, which probably can be a kilometer above the surface. W.S. Cameron was surprised by some aspects of the central peak's appearance when she reviewed the videotape. After comments on the astronomical seeing and the effects it had on the central peaks, she states, "At 0420 the lower CP (which has a summit crater) was visible. At 0430 the #1 CP bright patch split down the middle (valley between the 2 CP's?). Due to seeing the CP patch elongated. It is quite surprising to be able to see the 2nd CP as #1's shadow should be over it!" She then went on to remark about the shadow effect saying, "At 0448 W. edge of regular patch was smaller & brighter—the whole patch was fainter than before. I suspected that the CP shadow was darker than the wall's shadow!" Cameron then encouraged us to study Copernicus, Aristarchus, Mt. Piton, and Mt. Pico close to sunrise and sunset to catch possible similar phenomena. (At the time of writing, Cameron had not seen the data for the July 12, 1993 observing run.)

Harry D. Jamieson, the A.L.P.O. Lunar Domes Recorder and author of the computer programs mentioned above, was also sent copies of the tapes and photographs. His comments were in the form of private communication, with his permission to quote from them. After saying he would give the tapes further close scrutiny he made the following comments: "My initial impression is that many of the events listed in the report are due to mediocre seeing conditions at the time. I have no such mundane explanation for the obvious NE and SE streams of light coming from Tycho's central peak, however, and feel at this time that these represent something unusual actually happening on the Moon. Whether this is dust levitating from the crater floor or some outgassing from unseen vents in the central peak is not of course, so obvious now; spectroscopic analysis will be needed to determine this. But whatever the cause, I believe that the two light streams, in any case, are very likely real. I need, of course, to also see this phenomenon visually. While viewing the tape, I looked closely at other shadow-casting areas for similar phenomena and found none, eliminating instrumental effects."

In researching the literature we encountered an interesting additional piece of data when we learned that the Surveyor 7 spacecraft had landed on the Northwest Rim of Tycho. This was one of the three Surveyors which detected that dust is levitated, causing a sunset "twilight" effect where none should be visible because of the lack of atmosphere. This dust is levitated for up to 72 hours as the terminator passes. (Allen, 1969; Gault *et al.*, 1970; and Hughes, 1975). Surveyor 7, due to its southerly landing site [40°.9S] and the consequent greater change in solar azimuth near sunset, observed an apparent shift of bright condensations in the dust cloud as the sunset terminator passed by the spacecraft landing site. While approaching orbital sunrise, the Apollo astronauts also "reported and drew pictures of 'streamers' and bands of coronal/zodiacal light (the result of light scattering by dust?) extending several kilometers above the lunar surface while approaching orbital sunrise." (Heiken, Vaniman, & French, 1991)

While researching the historical LTP in Tycho, we consulted the *Lunar Transient Phenomena Catalog* (Cameron, 1978), finding twelve references to anomalous appearances.

- 10/04/1884—Tycho appeared like a second-magnitude star during a lunar eclipse.
- 01/08/1898—During mid-lunar eclipse the Earth's shadow was so dense details of the lunar surface disappeared except for the bright ray extending SSW from Tycho, which was clearly visible. It's unusual for that ray to remain visible when the ones toward Kepler and Aristarchus are not.
- 04/11/1903—Tycho rays remain visible in the Earth's shadow for 30 minutes until the Moon reached mid-eclipse.
- 08/15/1905—Tycho was visible, even brilliant, in Earth's shadow during lunar eclipse.
- 04/01/1912—Tycho was visible as a bright spot standing out in the slate-grey Earth's shadow,. No other formations were visible during the eclipse.
- 11/07-08/1919—Tycho's long ray in the direction of Longomontanus remained visible as a weak grey-green light throughout the lunar eclipse.
- 03/27/1931—Tycho's central peak shadow appeared a curious grey shade even though the interior was in shadow.
- 07/14/1940—Shadow in Tycho appeared irregular in shape, with ragged margin, and had luminous marks in it. The east wall of Tycho had a milky luminosity.
- 12/09/1940—Tycho had luminosity visible on the west rim of its outer slope.
- 11/17-18/1956—The craters Tycho, Aristarchus, Proclus, Manilius, Byrgius, and Kepler appeared extraordinarily bright.
- 04/15/1970—Tycho had a slightly pulsating white glow on its western (IAU?) external wall.
- 07/24/1975—Copernicus and Tycho were both indistinct in red and blue filters. Fracastorius had a positive blink in the red or blue filter.

The observations in the *Lunar Transient Phenomena Catalog* (Cameron, W.S., 1978), do not quite match what was seen on the videotapes except for the 03/27/1931 event where the central peak was noted as a "curious grey," although the interior of the crater was in full shadow. The 07/14/1940 event was observed by Walter H. Haas, the Emeritus Director of the A .L.P.O., who has supplied us with copies of his observing log for that date. After examination of the sketch he made, we found the "milky luminosity" to be wishbone-shaped but it was positioned up on the crater rim.

We were fortunate to enlist the aid of Sanjay S. Limaye, a planetary scientist at the Space Science and Engineering Center of the University of Wisconsin/Madison, to help us digitize frames from the videotape with the M.C.I.D.A.S. Computer. Dr. Limaye was on the Voyager Imaging Team and has been a great help in reduction of the data. One of his digitized images of the Tycho plume is shown in *Figure 1* (p. 112). These streamers or plumes are faintly visible with an intensity plot line superimposed, showing pixel intensities across the plume. All plots look the same until they encounter the plume area where one can see two peaks as the plume is crossed by the intensity line.

This lunar transient phenomenon has now been documented by us four times. The most recent data were obtained on the morning of July 12, 1993. On that date, the authors observed visually with a 32-cm f/5 Newtonian reflector. The crater was examined with Wratten 25 (red) and 38A (blue) Filters by both Darling and Weier. In the blue filter the crater appeared completely washed out with only the tip of the central peak visible. The red filter showed patches of material in the bottom of the crater in the area where the shadow met the illuminated East Wall. The same effect had been observed on September 2, 1991. Paul Castle, of Rock Island, Illinois observed a brownish cast inside the rim of the crater like a penumbral shadow of the central peak. This may confirm that dust or gas was being illuminated, causing this color-shadow effect. Video images were again obtained with the 40.6-cm. telescope as described above. In addition, Gilbert Lubcke, a member of the Madison Astronomical Society, Inc., obtained 52 images with an ST-6 CCD Camera from the Santa Barbara Instrument Group and an Ultima C11. During at least two of the four events magnetic storms were present in the Earth-Moon System. Dr. Crotts obtained a 20-minute spectrogram on July 12, 1993, and is in the process of analyzing the data. Jeff Peronto of the Madison Astronomical Society, Inc. also obtained black-and-white and color photographs which we are examining. Harry Jamieson and Rocky Togni observed the event from Heber Springs, Arkansas, under less than ideal conditions, and thought that they glimpsed the streamers briefly but state they may have been prejudiced by the August 21, 1992 videotapes so they cannot verify this observation. We are awaiting further data on the 1993 event.

CONCLUSIONS

All our data lead us to conclude that there were transient phenomena present in Tycho on four separate dates. These phenomena may occur at all sunsets because of the low Sun angle and the high contrast that occurs within the crater that is then in deep shadow. Any spurious reflections from the illuminated crater wall would not make the central peak complex and plumes appear as they do without gas or dust being present in the bottom of the crater. The "Wishbone" feature may be caused by the material that is being levitated or expelled and is interacting with the solar wind, and with the central peak blocking such material, causing a bow-shock effect. This enhancement may have been heightened by the magnetic-storm conditions present during two of the events. The final answer will only be made after spectroscopic data have been obtained. We await Dr. Crott's reduction of his data. With the new interest in the sodium lunar atmosphere (Stern, 1993), we will expand our program to observe other craters at both sunrise and sunset to learn whether this phenomenon occurs over the whole Moon. This paper was presented at ALCON 93, and generated a great amount of interest.

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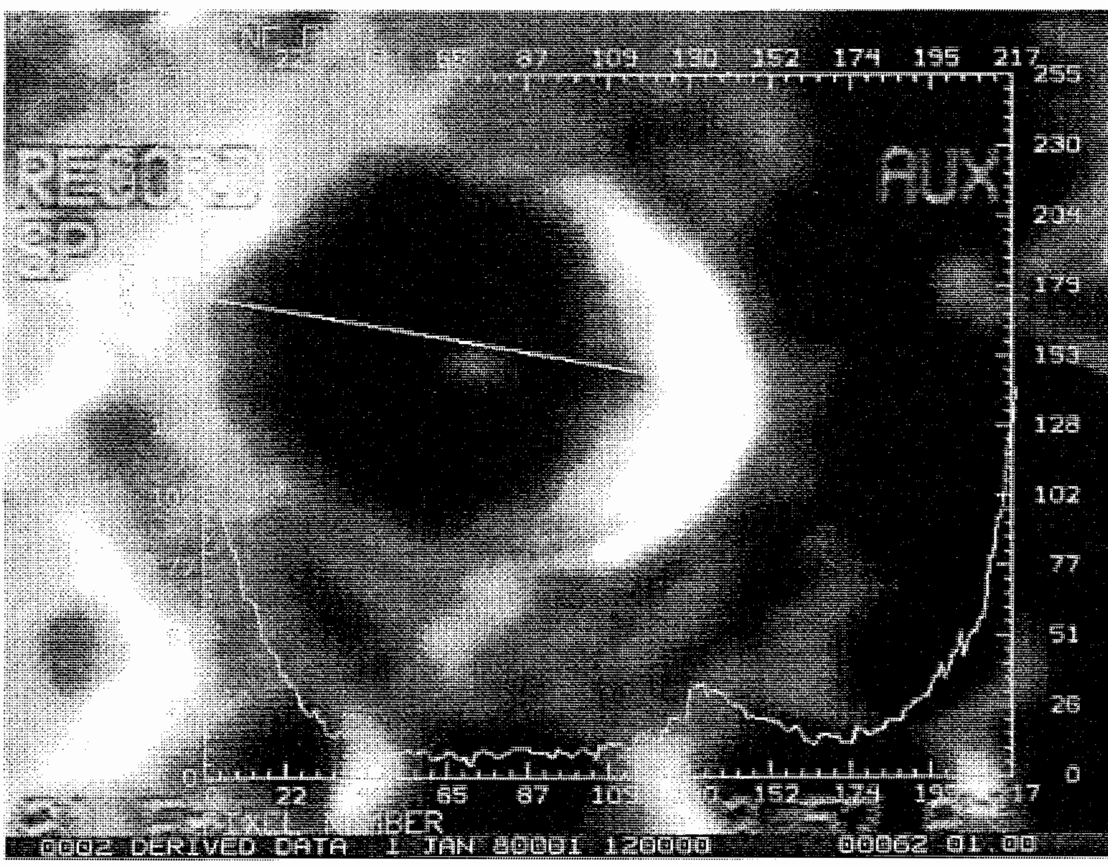

Figure 1. Sample videotape frame of the Tycho LTP observed on 1991 Aug 21. Image obtained by David, Michelle, and Lael Darling with a Thorr video camera and a 40.6-cm f/19 Cassegrain telescope. This image has been digitized and analyzed by Sanjay S. Limaye, who generated the intensity profile shown. The graph of intensity below the crater portrays brightness along the diagonal white line running near Tycho's central peak. The suspected "plume" appears on the graph to the right (east) of the central peak, near pixel numbers 140-160. North at top. Image highly enhanced.

TELESCOPE EYEPIECES FOR LUNAR AND PLANETARY OBSERVING

By: Rodger W. Gordon

Thirty or 40 years ago, an amateur starting out might buy a 2.4- or 3-inch f/15 refractor or a 4- to 6-inch f/8 or f/10 reflector; which came with two or three eyepieces, usually Huygenians, Ramsdens, or Kellners. A few manufacturers provided an Orthoscopic eyepiece with their wares and one manufacturer, Questar, offered a 75°-apparent field Erfle as standard equipment. However, these were the exceptions and not the rule. War-surplus Kellners, Symmetricals and Erfles abounded, but purchasers of these chiefly used them in low-power, richest-field instruments that they were building; the commercial instruments then available could not handle the 2-inch and larger diameter (OD) sizes in their 0.965-inch (24.5-mm) or 1-1/4 inch (31.75-mm) focusers.

By the mid-1960's, producers began furnishing higher-quality eyepieces such as Orthoscopics and various Symmetrical types. Such oculars were available as options before this, but few amateurs bothered to upgrade because the long focal ratios then common were forgiving to the usual ocular of that day. Most eyepieces had apparent angular fields of view of only 35°-50° and wide-angle eyepieces in a 1-1/4 inch format were virtually unknown.

This situation began to change as firms started offering Erfles with 65°-75° fields, a popular focal length being 20mm. Another wide-angle eyepiece, the 16.3-mm "Galoc," with only four elements and a claimed field of 90°, was well received. This ocular used a mild aspheric surface on one component and its performance was superior to most Erfles, although the field was actually only 75°.

The middle 1960's to late 1970's was the era of the Abbé Orthoscopic, with many firms offering them at reasonable prices and with excellent performance. This ocular is of the classic form; a triplet field lens and a singlet eye lens. Its popularity dropped off somewhat as various Symmetrical types, often erroneously called "Plössls," came to the forefront in the 1980's, but it is still widely available despite its typically higher manufacturing costs.

The biggest change, however, was in the last decade when eyepieces giving apparent fields of 75°-84°, using seven or eight elements, became available in a variety of focal lengths. They often used a 2-in OD format. Legions of deep-sky observers wished to observe with the widest field possible on telescopes of ever-shortening focal ratios. These new eyepieces gave substantial performance increases at large field angles compared with the more commonly used Erfles. However, the prices of eyepieces increased markedly due to their greater complexity and the use of more exotic glass types. Indeed, the purchase of several oculars could now cost more than the instrument they were to be used with.

The advertising claims accompanying these new oculars were nothing short of sensational. By the use of newer types of coating and multicoatings, and claims of better aberration control both on- and off-axis, prospective purchasers hearkened to the beat of the new drummers who promised great increases of image fidelity over older, less complex types.

Unfortunately, while claims of better off-axis images were proving true, claims of on- or near-axis superiority were proving false or greatly exaggerated. The large number of elements increases transmission losses and light scattering in the general field, and is often accompanied by internal reflections and ghost images of a most annoying nature. Tests, published and unpublished, convincingly demonstrated that for the detection of faint contrasts or minute details, these newer oculars were often much inferior to older, less complex types. This was much to the consternation of the owners of the newer designs, who had been led to believe otherwise.

More than most sciences, optics is a science—some say an art—of compromise. To get something, you must be willing to give up something else. Thus, if you wish a wide field with great image quality over all or most of it, you must increase the number of elements and the design complexity of the eyepiece, or use costly aspheric surfaces. By increasing the number of elements, you slightly reduce the image fidelity at every new surface, increase transmission losses, and multiply the effects of internal reflections and ghosts. There is no getting away from this and even the best coatings or multicoatings only partially help.

To obtain the *maximum* image contrast, coupled with the best image quality, we must go in the opposite direction—use fewer elements, consistent with reasonably good aberration control on- or near-axis, and a smaller field size such as 25°-50°. Thus, the two main specialties of amateur observing activity, lunar-planetary and deep-sky, have incompatible eyepiece requirements. We can't have it both ways, at least not until aspherics are more widely employed and brought down in price.

If possible, we should restrict our eyepieces for lunar and planetary work to those which have no more than five elements and six air/glass surfaces; better yet, three or four elements and only two or four air/glass surfaces. In short, keep the number of elements and air/glass surfaces in the optical system to as few as possible within reason. There is no need to introduce additional optical elements into the system. An example of this is as follows: If I choose to use my 3-1/2-inch Questar in its "normal" observing mode, the light must traverse a built-in prism diagonal, having one element with two air/glass surfaces, a built-in Barlow lens with two elements and two air/glass surfaces, and the standard eyepiece with four elements and four air/glass surfaces. The optics of the telescope itself contribute four air/glass surfaces, two with metallic coatings. However, I use an axial eyepiece adapter which eliminates the prism/Barlow combination and a Monocentric eyepiece with three cemented elements and only two air/glass surfaces. This combination reduces the total number of elements and eliminates six additional air/glass surfaces. Now the entire system has but six air/glass surfaces. The improvement in detail and contrast is most dramatic!

It would be wrong to think, however, that the substitution of *any* three- or four-element eyepiece with just four air/glass surfaces will automatically give optimal performance. There is a wide variation of optical quality, even when the prices may be similar. We know of one recent "Plössl" on the market which tests show gives better than 97-percent light transmission, being fully multicoated, yet fails to reveal faint contrasts and details that are seen with another ocular of similar focal length that transmits less light. The problem here is that the aberration residuals in this "Plössl" are greater than expected; the extended image has a "soft" appearance that is characteristic of spherical aberration that is not fully corrected. Nor do the claims of multicoating impart any magical property to an eyepiece, despite various advertising ploys to the contrary. If the eyepiece is not fully corrected and has an inferior design or poor workmanship, multicoating does not help and may, in fact, make these problems more visible.

In another case, an Astronomical League official took a Bausch and Lomb 25-mm focal length Hasting triplet magnifier, with just two air/glass surfaces, converted it into an eyepiece and compared it to his 26-mm name-brand multicoated Plössl. His letter is on file, stating that lunar detail had at least 30-percent more contrast in the Hastings than in the Plössl. This was a surprise to him, but is hardly unexpected! The elimination of just two elements and two additional air/glass surfaces lead to a dramatic difference.

We can understand this fact if we consider the production of unwanted reflections and "ghost images," a ghost image being a reflection that is in focus. Unfocused reflections contribute to background light scatter.

We can calculate the number of unwanted reflections of both types (R) by use of the equation, $R = N(N-1)/2$, where N is the number of air/glass surfaces in the system. If the system uses exotic glasses of highly different refractive indices, then the *cemented* surfaces will have to be counted also. We obtain the following results for the following eyepieces:

- Monocentric, Hastings, etc.—3 elements, 2 air/glass surfaces: $R = 2(2-1)/2 = 1$.
- Orthoscopic, Plössl, etc.—4 elements, 4 air/glass surfaces: $R = 4(4-1)/2 = 6$.
- Erfle and similar—6 elements, 6 air/glass surfaces: $R = 6(6-1)/2 = 15$.
- Nagler and similar—7 elements, 8 air/glass surfaces: $R = 8(8-1)/2 = 28$.
- Nagler or Meade and similar—8 elements, 10 air/glass surfaces: $R = 10(10-1)/2 = 45$.
- Modern Binoculars (all surfaces)—16 air/glass surfaces: $R = 16(16-1)/2 = 120$. !

A slight increase in the number of elements leads to an enormous increase in unwanted reflections. Thus, optics need the best coatings or multicoatings for the best results, and even then are not always successful.

All eyepieces have unwanted reflections and ghosts. The goal is to keep them as unobtrusive as possible. A good design keeps unwanted reflections from being focused into ghost images. Older optical designers, not having coatings to work with, were acutely aware of this. Today some designers seemingly ignore ghosts and hope that coatings or multicoating will alleviate them—often a forlorn wish!

Secondary reflections and ghosts can form in the eyepiece or even in the observer's eye. With certain eyepieces, the addition of a diagonal prism or a Barlow-type lens, or even the eyeglasses one wears, can introduce ghosts where none were present before. Some ghosts will be stationary in the field of view, while others may move in the opposite direction from which the object under scrutiny is drifting. Also, some eyepieces, particularly certain Kellners, have a bevy of ghosts that is most distracting.

Eyepiece flaws of any type are best seen when observing bright subjects. Venus is an especially notorious test for an eyepiece, as is a mercury-vapor light. The Moon near full is also a good test, and also in the crescent phase when Earthlight is visible on the dark portion. An eyepiece should "snap" into focus, just like a good objective or mirror. Eyepieces do not lend themselves well to ordinary bench tests as they are most commonly tested with other other optics in a *system* form. Thus if you are planning to purchase eyepieces, compare several brands in the same telescope or different telescopes. If you are testing, be sure the eyepieces are clean, have good coatings or multicoating, and have similar or nearly-similar focal lengths. A 5×-7× loupe is excellent for inspecting the internal surfaces of an eyepiece and a 10×-20× stereo microscope can be used for internal inspection without taking the eyepiece apart. If an eyepiece shows a color fringe or border to a bright object as it nears the edge of the field of view, it has some uncorrected *lateral* color, a well-known aberration of simple Ramsdens, but which is often evident in some cheaper Plössls and Orthoscopics. Eyepiece astigmatism also shows up as one nears the edge of the field.

The apparent field of view of an eyepiece is determined by only two factors, its design and the diameter of the field stop, which in some cases is the ID (inside diameter) of the barrel. Conservative manufacturers limit the field stop to where the off-axis aberrations just start to affect image quality. Other manufacturers open up the field stop to gain a few extra degrees as an advertising ploy to capture the attention of the uninitiated.

The use of multicoatings can be misleading. Often only one surface is multicoated, usually the exterior surface of the eyelens. Some multicoatings actually scatter more light in certain regions of the spectrum than do standard single-layer coatings (about 1.5 percent) or even a rare glass surface (averaging 4 percent). So-called "V" coatings, often only two layers, scatter 6 percent or more in these regions. There are many types of multicoatings and compounds to choose from. Good-to-excellent multicoating has at least three layers; better, four to seven layers. Most manufacturers do not supply this information, however. If you are buying new oculars, go for the best based on your priorities but experiment before spending your dollars.

Do not pass up older uncoated oculars. There are excellent uncoated, and coated, oculars available in the classifieds such as the *Starry Messenger*. Some of the author's best oculars date back to the 1930's before the advent of coatings. These include Tolles, Zeiss Orthoscopics, and Monocentrics, all of which give excellent results. The Zeiss Monocentric is in fact capable of taking the measure of any current ocular in terms of delicate contrasts. The author's experiments with three modern 12-mm oculars from one manufacturer showed little difference in performance; one ocular had a seven-layer multicoating, the second a standard single layer of MgF_2 [Magnesium Fluoride], and the third had the coating removed from the exterior lens surface. The same experiment was performed with three 32-mm focal length oculars from the same manufacturer, and gave similar results; a negligible difference in performance. In all cases, there were four elements and four air/glass surfaces. One prominent American lens manufacturer recommends multicoating only with systems having at least six elements and six air/glass surfaces. My experiments agree with their conclusion; there is little benefit in multicoating oculars with few elements. Neither Carl Zeiss Jena's Abbé Orthoscopics nor Vernonscope's Brandon "Orthoscopics" use anything more than a single-layer of MgF_2.

One can fabricate one's own eyepiece by purchasing lenses from various manufacturers. Rolyn Optics of Covina, California, sells Steinheil and Hastings Triplet lenses at fairly reasonable prices. Edmund Scientific sells an unmounted 12.5-mm Hasting Triplet lens for less than $40 and Melles Grist Optics Co. of Irvine, California, sells 7.5-, 10-, and 12.5-mm monocentric-form Steinheil triplets, although these last are fairly expensive. Texereau's book, *How to Make a Telescope*, diagrams how to mount a "solid" lens as an eyepiece. The lens should be blackened around the edges and the internal barrel sprayed with flat black paint and allowed to dry for several days. Keep the field stop in these "solid" eyepieces at 30° at most; the penalty one must endure to obtain top-notch performance.

Brands to look for if you are "bargain hunting" are Zeiss, Brandon, Cave Orthostar, Clavé Plössl, University Professional Series, Gailand, Telescopics, J.W. Fecker, Meade Research Grade, Hensoldt, Wild, Busch, and Bausch and Lomb. All these can be found second-hand with diligent searching. Many "new" oculars can also be purchased second-hand from classifieds at a substantial saving. Elderly amateurs, who frequently are long-term members of local astronomical societies, are often excellent sources of older oculars. Ask questions; many older amateurs have many contacts. I paid $100 for my 9-mm Zeiss Monocentric from an elderly gentleman, but only a total of $60 to another fellow for a 10-mm and a 4-mm solid Coddington, a 7-mm Zeiss Orthoscopic, and a 3-mm Solid Tolles by Horace Sall. These are all excellent oculars than would cost a fortune to duplicate today.

When obtaining manufacturer's literature on eyepieces do not expect much more than a list of specifications; hardly enough information to make a decision. Since all the manufacturers claim their products to be the "best," ask what they mean by that. Call or write them and ask questions; if writing, include a stamped, self-addressed envelope. If they can't give satisfactory answers, go elsewhere. They may attempt to "hype" their product, telling you that so-and-so uses their eyepieces and likes them. However, if so-and-so is a deep-sky observer, his recommendation for lunar and planetary work is about as useful as pouring gasoline on a fire! Most suppliers give a "satisfaction guarantee" for a limited time. If the eyepieces you purchase are unsatisfactory, don't hesitate to take advantage of it.

Unsubstantiated claims are worthless. Testimonials from reputable observers are usually reliable if the individual has expertise in the area you are interested in. But beware! Some "name" individuals give product endorsements through an arrangement whereby they get to keep the goods in return for a favorable testimonial.

Astronomical periodicals allow manufacturers to use a certain amount of "puffery" in their advertising. Basically, this means that they get to inflate their claims! Some of this may just be overenthusiastic bragging about the product, but some may also be a deliberate attempt to expand the "truth." Also, remember that if it sounds too good to be true, it probably is. Be aware of current jargon. Terms like "Plössl," "multicoating," or "apochromatic" are bandied about today in the same manner as the words "user friendly" is tossed around in the computer field. If, for example, I were to take every manufacturer to task for using the word "apochromatic" to describe his low-color residual optics, few of those instruments now being described as apochromats would qualify to be called that. Under the strict guidelines set forth by Ernst Abbé when he defined that term, very few apochromats of today have a crossover of wavelengths at three widely spaced points of the visible spectrum!

Discussions of the effects of secondary color on detail in extended images or the effects of central obstructions on the resolution of faint detail are helpful and of definite use in choosing a telescope for lunar or planetary observing. In the same vein, it is also very desirable to pay attention to eyepieces to complement the image quality produced by a fine instrument. The laws of physics and optics have not been superseded by gross misrepresentations and exaggerated unsubstantiated claims. There is no "free lunch" in optics anymore than in any other science. A bit of time spent searching and evaluating before making a purchase can prevent a sense of disillusionment and a lighter wallet later on. The days are long gone when one could say, "an eyepiece is an eyepiece is an eyepiece."

THE 1992 APPARITION OF URANUS

By: Richard W. Schmude, Jr., A.L.P.O. Remote Planets Recorder

ABSTRACT

Four people submitted a total of 79 photometric measurements of Uranus in 1992, resulting in these normalized magnitudes: U(1,0) = -6.39±0.06, B(1,0) = -6.57±0.02, V(1,0) = -7.17±0.02, R(1,0) = -6.98±0.02 and I(1,0) = -6.07±0.09. Twenty-seven V(1,0) measurements, uncorrected for phase angle, were plotted against the solar phase angle and the solar phase angle coefficient (m_v) was found to equal 0.004 magnitude/degree which is close to the literature value. The brightness of Uranus was estimated visually with four different comparison stars and small discrepancies were found (~0.1 mag) which are attributed to differences in the star colors. Visual observations suggest that Uranus had a greenish color in mid-1992 and that there were faint albedo variations on the disk.

INTRODUCTION

Uranus reached opposition on 1992 JUL 07, with a declination of 22.9°S and an angular diameter of 3.8 arc-seconds [1]. Throughout 1992, the sub-Earth latitude on Uranus was 62°S, which meant that the center of Uranus' disc, as seen from the Earth, had a latitude of 62°S. Visual observations and photometric measurements of Uranus are summarized in this report. The people submitting observations and measurements in 1992 are listed in *Table 1* (below).

Table 1. Participating observers, 1992 apparition of Uranus.

Observer and Location	Type of Observation*	Type of Telescope†
Danny Brutan, TX	PP	36-cm SC
John Harper, TX	PP	36-cm SC
Gus Johnson, MD	C	11- & 15-cm New
Frank Melillo, NY	PP, V, C	20-cm SC
Gary Nowak, VT	C, V	25-cm Sch
	VP	9X63 & 11X80 Bi
Richard Schmude, Jr., NM	PP	25-cm New
NM	VP	7X50 Bi
CA	V, C	76-cm New

* C = color, PP = photoelectric photometry, V = visual, VP = visual photometry
† Bi = binoculars, New = Newtonian, SC = Schmidt-Cassegrain, Sch = Tri-Schiefspiegler

PHOTOELECTRIC PHOTOMETRY

A preliminary report on the 1992 photometric measurements of Uranus was given at the COSMOCON 92 conference in San Jose, California, and was published in the proceedings [2]. A more detailed report is given here. The SSP-3 solid-state photometer and the Johnson UBVRI filter scheme were used in measuring the brightness of Uranus; this instrument and the associated filters are described elsewhere [3,4].

The brightness of Uranus is measured using a comparison star of known brightness. After the measurement, corrections due to differential atmospheric extinction are made. The magnitude is normalized by computing it for the hypothetical situation where Uranus is 1.0 astronomical unit (AU; 149.6 million km or 93.0 million mi) from both the Earth and Sun. The normalized magnitudes for the standard filters are given the symbols U(1,0), B(1,0, V(1,0), R(1,0) and I(1,0). The advantage of computing normalized magnitudes is that magnitude comparisons from different years can be made. The normalized visual magnitude is computed as follows:

$$V(1,0) = V_{meas} - 5\log(r\Delta) + 2.5\log(k) - (m_v\alpha)$$

where V_{meas} is the measured magnitude, r is the Uranus-Sun distance in AU, Δ is the Uranus-Earth distance in AU, k is the fraction of Uranus' disc which is illuminated as seen from the Earth; m_v is the solar phase angle coefficient, which is near 0.0028 magnitude/degree; and α is the solar phase angle in degrees. Later in this report, a new m_v value is reported. A factor of 12.71 must be added to the normalized magnitudes to obtain the magnitude at mean opposition [5]. The normalized magnitudes for the other four filters (U, B, R and I) are computed in the same way as V(1,0) except that the appropriate value of the solar phase angle coefficient should be used. For Uranus, the 2.5 log (k) term is negligible and is excluded here. Values for m in the U, B, R and I filters are either poorly known or unknown and so for the sake of consistency, the $m_v\alpha$ term is excluded for all normalized magnitudes. The $m_v\alpha$ term is expected to be no more than 0.01 magnitude and so V(1,α) is taken to equal V(1,0).

The comparison stars used in the photometric measurements are summarized in *Table 2* (p. 117). The magnitudes of ν_2 Sgr, o Sgr and ξ_2 Sgr come from [6] while those for the remaining five come from [7].

Table 3 (p. 117) lists all photometric measurements made of Uranus in 1992. Two forms of magnitude are listed in this table; the

Table 2. Comparison stars used for Uranus photometry in 1992.

	1992 Coord.		Form of Magnitude				
Star Desig.	R.A.	Decl.	U	B	V	R	I
	h m	° '	+	+	+	+	+
v2 Sgr	18 55.1	-22 40	7.80	6.30	4.98	4.04	3.38
ξ2 Sgr	18 55.3	-21 10	5.82	4.67	3.49	2.69	2.11
SAO 187634	19 04.3	-21 32	-	7.70	7.18	-	-
o Sgr	19 04.7	-21 44	5.63	4.77	3.77	3.05	2.52
SAO 187882	19 15.5	-25 15	-	5.41	4.85	-	-
SAO 187883	19 15.6	-24 11	-	6.79	6.25	-	-
SAO 187992	19 20.6	-22 24	-	6.5	5.5	-	-
50 Sgr	19 26.3	-21 47	-	6.81	5.59	-	-

agreement with the magnitudes in *Table 2*.

Mean, normalized magnitudes for Uranus are summarized in *Table 4* (p. 118). All ultraviolet measurements in 1992 were made at an elevation of 2800 m (9200 ft) in the Jemez Mountains near Los Alamos, New Mexico. The 1992 value for V(1,0) (-7.17) is slightly dimmer than its value for 1991 (-7.20) and the value selected by Harris [8] (-7.19) but is quite similar to the 1989 magnitude (-7.16) [9]. The 1992 B(1,0) value is 0.03 magnitudes dimmer than the 14-year average (1953-1966) of B(1,0) = -6.601 measured by Lockwood [10].

first one is the measured value while the second is the normalized value; both have been corrected for atmospheric extinction. The last column, "Diff. in Air Mass", is the air mass of Uranus minus the air mass of the comparison star. This value was used in correcting for extinction. Extinction coefficients of 0.44, 0.20, 0.13, 0.12 and 0.11 magnitudes per air mass (at an elevation of 2200 and 2800 m [7200 and 9200 ft]) were used for the U, B, V, R and I filter measurements respectively; these values are based on measurements made by the author at an elevation of 2200 m (B, V, R and I) and at 2800 m (U). Respective extinction coefficients of 0.40, 0.26 and 0.22 were used for the 11 B, V and I measurements made near sea level.

SAO 187634 was used as a check star. Magnitudes of V = +7.15±0.02 and B = +7.69 ±0.02 were measured for this star which are in

The V(1,0) values measured by the author are plotted as a function of the solar phase angle in *Figure 1* (p. 119); the uncertainties in the star magnitude (±0.018 mag.) are not relevant since it is only the relative values that are of importance. All measurements in *Figure 1* were made at elevations of either 2200 m (7200 ft) or 2800 m (9200 ft) from the same telescope and photometer and by the same observer. The results are consistent with a solar phase coefficient of m_v = 0.004 magnitude/degree, which is close to m_v = 0.0028 magnitude/degree, the value selected by Harris [8].

VISUAL PHOTOMETRY

Gary Nowak used 9×63 and 11×80 binoculars in estimating the brightness of

Table 3. Photoelectric Measurements of Uranus Made in 1992.

Data are in the following order: UT date, filter, measured magnitude (all positive), normalized magnitude (all negative), comparison star, and difference in air mass.

MAR					
13.55	V	+5.75	-7.20	o Sgr	+0.07
20.47	V	5.81	7.13	o Sgr	+0.12
25.51	V	5.80	7.13	o Sgr	+0.11
APR					
09.51	V	5.72	7.18	o Sgr	+0.07
10.51	V	5.69	7.21	o Sgr	+0.06
10.52	V	5.74	7.16	o Sgr	+0.06
10.53	V	5.74	7.16	o Sgr	+0.05
12.45	V	5.78	7.11	o Sgr	+0.04
12.45	B	6.30	6.59	o Sgr	+0.05
12.46	V	5.75	7.14	o Sgr	+0.06
21.47	V	5.69	7.19	o Sgr	+0.05
21.48	B	6.31	6.57	o Sgr	+0.04
24.46	V	5.68	7.19	o Sgr	+0.05
24.46	B	6.27	6.60	o Sgr	+0.05
24.47	B	6.32	6.55	o Sgr	+0.04
26.44	V	5.67	7.20	o Sgr	+0.04
26.44	B	6.29	6.58	o Sgr	+0.05
26.46	B	6.30	6.57	o Sgr	+0.05
26.46	B	6.29	6.58	o Sgr	+0.04
MAY					
12.42	B	6.25	6.59	o Sgr	+0.04
12.44	V	5.67	7.17	o Sgr	+0.04
12.45	B	6.30	6.54	o Sgr	+0.03
12.46	B	6.27	6.57	o Sgr	+0.01
17.38	V	5.65	7.18	o Sgr	+0.05
17.38	B	6.24	6.59	o Sgr	+0.05
JUN					
06.35	V	5.63	7.18	o Sgr	+0.10
06.35	B	6.24	6.56	o Sgr	+0.06
06.38	V	5.61	7.20	o Sgr	+0.06
06.38	B	6.19	6.62	o Sgr	+0.07
06.42	V	5.65	7.16	o Sgr	+0.08
22.26	V	5.59	7.21	o Sgr	+0.06
27.25	V	5.61	7.19	o Sgr	+0.05
27.25	B	6.18	6.62	o Sgr	+0.05
27.27	U	6.46	6.34	ξ2 Sgr	+0.10
27.30	U	6.24	6.56	o Sgr	+0.06
27.30	U	6.32	6.48	o Sgr	+0.06
29.22	V	5.62	7.17	o Sgr	+0.06
29.23	B	6.22	6.57	o Sgr	+0.07
29.24	V	5.61	7.18	o Sgr	+0.06
29.25	B	6.22	6.57	o Sgr	+0.06
JUL					
03.17	V	5.64	7.15	o Sgr	+0.09
03.18	B	6.30	6.49	o Sgr	+0.09
03.20	I	6.55	6.24	o Sgr	+0.09
03.24	V	5.60	7.19	o Sgr	+0.06
03.24	B	6.21	6.58	o Sgr	+0.06
03.25	V	5.64	7.15	o Sgr	+0.06
03.27	B	6.20	6.59	o Sgr	+0.06
03.28	V	5.63	7.16	o Sgr	+0.06
03.29	B	6.25	6.54	o Sgr	+0.06
11.22	V	5.64	7.15	o Sgr	+0.06
26.17	V	5.64	7.16	o Sgr	+0.09
26.17	B	6.23	6.57	o Sgr	+0.09
26.18	I	6.71	6.09	o Sgr	+0.09
29.17	V	5.64	7.16	o Sgr	+0.09
29.17	B	6.25	6.55	o Sgr	+0.09
29.18	I	6.65	6.15	o Sgr	+0.09
AUG					
03.19	V	5.60	7.21	o Sgr	+0.07
03.19	B	6.30	6.51	o Sgr	+0.07
22.21	R	5.81	7.02	v2 Sgr	+0.12
26.13	R	5.88	6.95	v2 Sgr	0.00
26.13	R	5.85	6.98	v2 Sgr	-0.01
26.15	R	5.82	7.01	v2 Sgr	-0.03
26.15	I	7.02	5.81	v2 Sgr	-0.05
27.12	V	5.67	7.16	o Sgr	+0.07
27.12	U	6.23	6.60	o Sgr	+0.07
27.14	U	6.44	6.39	o Sgr	+0.11
27.14	U	6.51	6.32	o Sgr	+0.12
27.16	U	6.39	6.44	o Sgr	+0.11
27.17	U	6.40	6.43	o Sgr	+0.13
27.18	U	6.62	6.21	o Sgr	+0.06
27.19	U	6.71	6.11	o Sgr	+0.17
28.10	R	5.85	6.99	v2 Sgr	--0.02
28.10	R	5.87	6.97	v2 Sgr	--0.07
28.10	R	5.87	6.97	v2 Sgr	--0.02
28.15	R	5.86	6.98	v2 Sgr	--0.11
28.15	R	5.84	7.00	v2 Sgr	--0.03
28.15	R	5.87	6.97	v2 Sgr	--0.17
OCT					
18.04	V	5.77	7.16	o Sgr	+0.01
28.11	V	5.78	7.17	o Sgr	+0.10

Table 4. Mean UBVRI magnitudes of Uranus in 1992.

Filter	Normalized Magnitude*	σ (Mag.)	No. of Meas.	Source [1]	Source [8]
U	-6.39 ±0.06	0.15	10	-6.35	-6.35
B	-6.57 ±0.02	0.03	23	-6.63	-6.63
V	-7.17 ±0.02	0.02	32	-7.19	-7.19
R	-6.98 ±0.02	0.02	10	-	-7.04
I	-6.07 ±0.09	0.19	4	-	-6.24
U-B	+0.18 ±0.06	-	-	+0.28	+0.28
B-V	+0.60 ±0.03	-	-	+0.56	+0.56
V-R	-0.19 ±0.03	-	-	-	-0.15
R-I	-0.91 ±0.09	-	-	-	-0.80

* Uncertainties are based on the root mean square of the measurements along with uncertainties in the absolute star magnitude.

Uranus. He used a technique similar to that used by the author. An average value of Vvis(1,0) = -7.13 is calculated from Nowak's six magnitude estimates.

The writer made 60 estimates of the magnitude of Uranus visually using four different comparison stars. The results are summarized in *Table 5* (upper right). A method similar to that described elsewhere [11] was used. An overall average magnitude of Vvis(1,0) = -7.20 was computed from the 60 estimates, with a standard deviation of ±0.15 magnitude. The difference between the three average magnitudes in *Table 5* may be due to differences in the star colors. More studies, however, are needed before a reliable uncertainty in visual estimates can be determined for differences in comparison star color.

TELESCOPIC STUDIES OF URANUS

Faint albedo irregularities have been observed from time to time on Uranus [12-14]; and in at least one case, a rotational period for that planet was determined [15] by monitoring albedo irregularities. Frank Melillo used a 20-cm (8-in) Schmidt-Cassegrain telescope to study Uranus. He was unable to detect any definite albedo irregularities but suspected that Uranus had a greenish hue. The author studied Uranus on 1992 JUL 19 (07:00 UT) with the 76-cm (30-in) "Challenger" telescope near Gilroy, California, at magnifications of 230× and 370×. Some limb darkening was evident and Uranus had a washed-out blue-green hue. Besides limb darkening, however, there were no other definite irregularities on Uranus. I also studied Uranus on 1992 OCT 15 (03:18-03:25 UT) with a 36-cm (14-in) Schmidt-Cassegrain telescope at Texas A&M University Observatory at a magnification of 527×. Uranus possessed a greenish hue. There were no definite albedo irregularities, but at times I suspected faint variations. There were no bright limb spots. A slight greenish hue was observed in August through the 1-m telescope at Pic du Midi [16]; this is consistent with the A.L.P.O. results.

Table 5. Magnitudes of Uranus (based on visual photometric estimates) for three different sets of comparison stars.

Star Combination	V(1,0)±1σ*	No. Ests.
50 Sgr & SAO 187883	-7.23 ±0.17	16
SAO187992 & SAO187883	-7.22 ±0.15	23
SAO187882 & SAO187883	-7.15 ±0.14	21

* No correction for the solar phase angle was taken and so V(1,α) is taken to equal V(1,0); the correction is totally negligible for visual estimates.

Gary Nowak carried out a series of observations of Uranus between 1992 JUL 02 and OCT 06 with the 25-cm (10-in) Tri-Schiefspiegler telescope at Williston, Vermont. Limb darkening was the most common albedo irregularity, followed by the bright central spot. On four occasions (JUL 21, AUG 07, SEP 19 and OCT 06), a bright spot on the southern limb of Uranus was reported at magnifications of 31I× and 317×. Nowak reported that Uranus had a greenish hue.

CONCLUSIONS

The U, B, V, R and I magnitudes of Uranus were measured by four different people during the 1992 Apparition and the results are summarized in *Tables 3* and *4* (p. 118). A total of 27 V-filter measurements are plotted on *Figure 1* (p. 119) with respect to the phase angle, and from this a value for the solar phase angle coefficient of Uranus was determined as m_v = 0.004 magnitude/ degree. This is close to the value (m_v = 0.0028 magnitude/degree) selected by Harris [8]. Visual photometry was also carried out by the author with an overall average of Vvis(1,0) = -7.20 based on 60 estimates. Nowak also made visual magnitude estimates of Uranus with a resulting value of Vvis(10) = -7.13. Uranus had a greenish hue in 1992.

ACKNOWLEDGEMENTS

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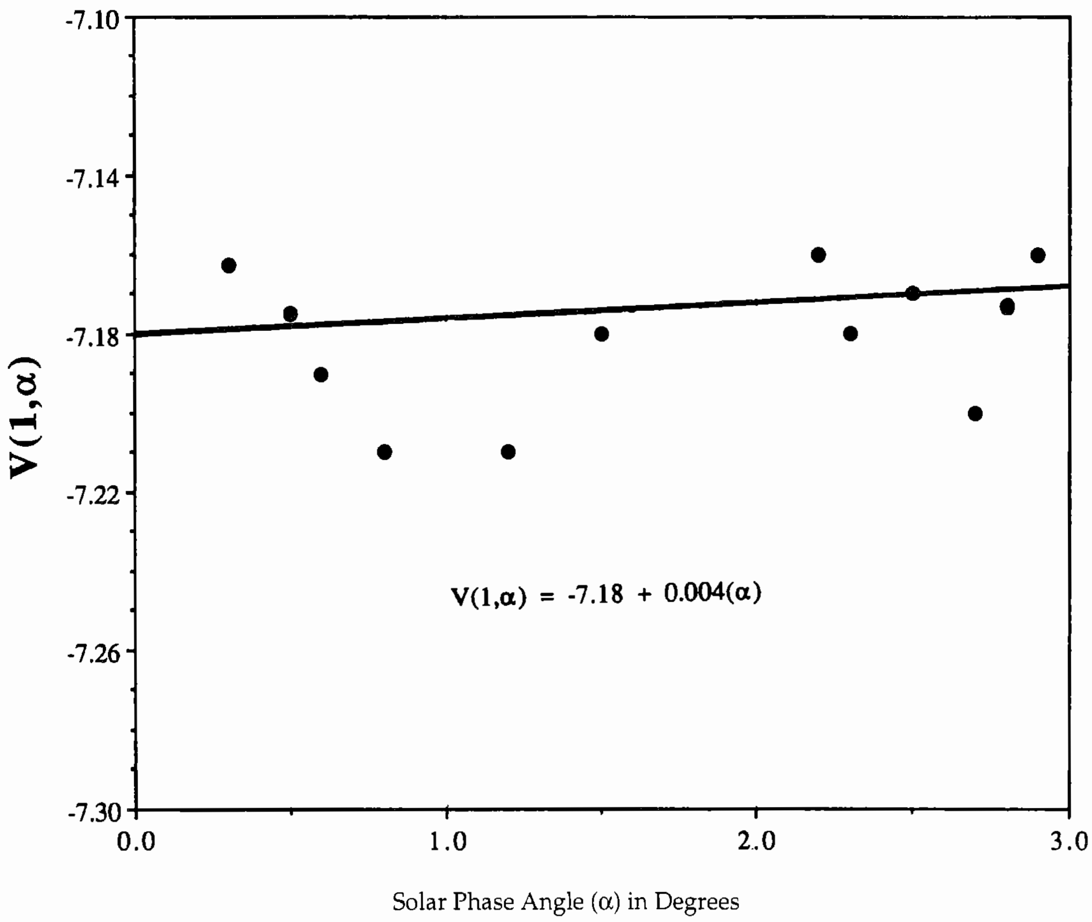


Figure 1. Graph of normalized visual magnitude, V(1,α), of Uranus in 1992 as a function of solar phase angle, α.

THE 1993 PERSEID DISPLAY

By: Robert D. Lunsford, A.L.P.O. Meteors Recorder

The 1993 Perseid meteor shower was by far the most publicized meteor shower ever. Early stories carried a cautious tone indicating a storm was possible but unlikely. Once the media picked up the story it then became a sure bet that the sky would be filled with celestial fireworks. Like many other astronomical events this one turned out to be a dud in the eyes of the public. One or two meteors a minute would delight the experienced meteor observer, but to the average person it was just a small trickle, not enough to get excited about.

So what really happened? First of all a strong display with a Z.H.R. [Zenithal Hourly Rate; the calculated hourly number of meteors an experienced observer would see at the zenith under dark skies] of approximately 300 was seen from Western Europe and the Atlantic area. This occurred well after midnight in the most populated areas of this region. All but the most diehard meteor observers were in bed by then. By the time Perseus rose high in North American skies rates were down to one per minute. At the exact time of maximum activity (3:30 UT) the radiant was situated low in the northeastern sky as seen from most of North America. A great majority of the meteor activity was obscured by the horizon. A meteor shower must produce thousands of meteors per hour in order to produce an impressive display at this altitude. *Figure 1* (below) summarizes the calculated Z.H.R.'s reported to the Meteors Section, in terms of individual and mean values at 15-minute intervals. The Meteors Section report that follows this summary article (see pp. 122-126) gives detailed statistics of the many individual reports of this shower that we have received.

It is painfully apparent that the majority of dust and debris that causes meteors lies outside the orbit of Comet Swift-Tuttle. In 1993 we passed through the inner regions of Swift-Tuttle's orbit. The same circumstance is true concerning Comet Temple-Tuttle, the parent object of the Leonid meteor shower. Luckily the earth encounters that orbit in the outside regions where the greatest concentrations of dust exist. Thus the probability of meteor storms from the Leonids is much greater than for the Perseids.

What can we expect in 1994 and beyond? The first maximum, which is produced by particles recently released from the comet, is predicted to occur near 10:00 U.T. on August 12, 1994. All of North America would be well situated for this display. We could expect a maximum Z.H.R. of 200-300, with many

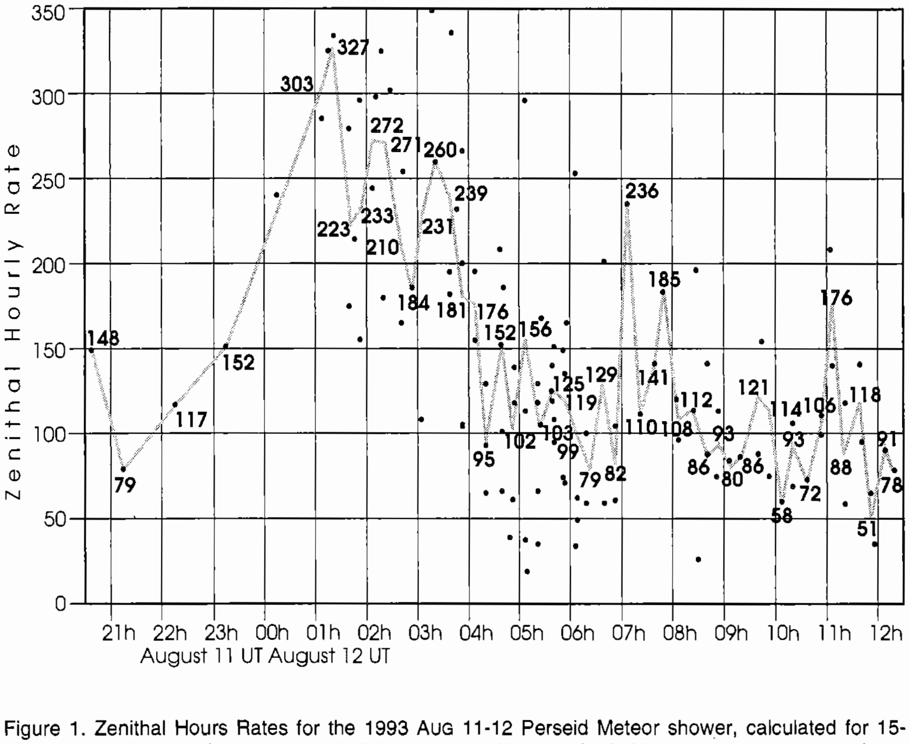


Figure 1. Zenithal Hours Rates for the 1993 AUG 11-12 Perseid Meteor shower, calculated for 15-minute intervals. The dots represent individual rates, while the shaded line represents mean values, which are indicated by the graph.

fireballs. An added bonus is the absence of moonlight, which hampered both the 1992 and 1993 displays. The secondary maximum, which is the annual shower produced by much older debris, would occur over eastern Asia with a Z.H.R. of 60. The double maximum was first noticed in 1988 and it will probably last through 1996, although it will become weaker as time progresses. Strong displays of the secondary maximum have occurred since the mid-seventies. There is no reason to expect any change in this pattern for the next 20 years.

I wish to thank the many observers who sent their Perseid observations to the A.L.P.O. Meteors Section *Figures 2* and *3* (below and to the right) are samples of some of the excellent photographs and video images we have received for this event. I hope your skies are much better in 1994 and I look forward to your next report on this fasinating shower.

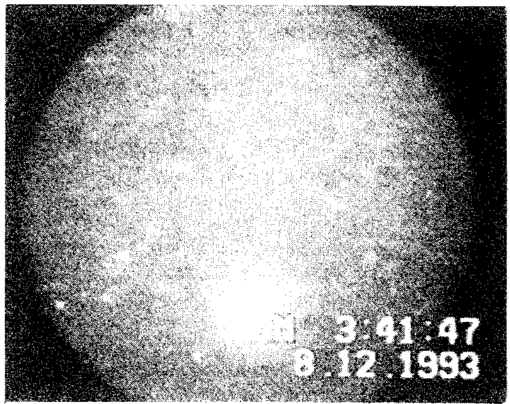
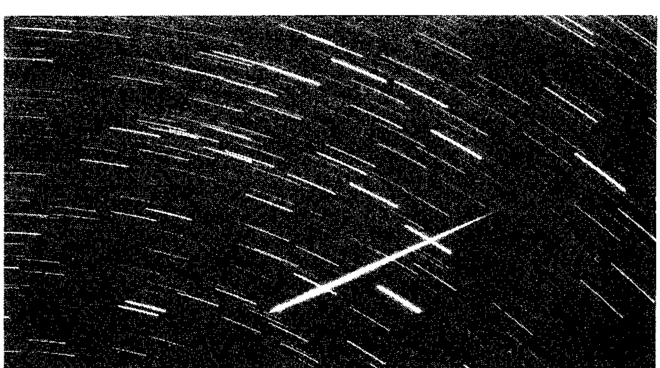


Figure 2. Sample frame from a videotape obtained by R.B. Minton of Colorado, using a video camera in conjunction with an image intensifier. A Perseid fireball is located below center. The time in the lower right is MDT; add 6 hours to obtain UT.

Figure 3. Two photographs of the 1993 Perseid shower, each of which show a fireball, taken on 1993 Aug 11-12 UT by Daniel Fischer of Königswinter, Germany. From a location in southern France, Mr. Fischer used a 50-mm f/1.4 lens with Ilford HP5+ film.



METEORS SECTION NEWS

By: Robert D. Lunsford, A.L.P.O. Meteors Recorder

Table 1. Recent A.L.P.O. Meteor Observations.

1993 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+N = Limiting Magnitude)
AUG 11	Felix Martinez, Italy	20:30-20:45	1 PER, 1 NDA, 2 SPO	+6.7; 20% cloudy
	Paul Roggemans, France	20:37-21:42	21 PER, 1 KCG, 13 SPO	+6.4
	Felix Martinez, Italy	20:45-21:45	23 PER, 2 CAP, 4 NDA, 3 SPO	+6.6; 20% cloudy
	Paul Roggemans, France	21:42-22:25	27 PER, 3 NDA, 1 KCG, 7 SPO	+6.3
	Felix Martinez, Italy	21:45-22:45	36 PER, 2 NDA, 2 CAP, 5 SPO	+6.4; 20% cloudy
	Paul Roggemans, France	22:25-22:55	39 PER, 1 NDA, 2 SPO	+6.3
	Felix Martinez, Italy	22:45-23:45	38 PER, 1 NDA, 2 SPO	+6.1; 30% cloudy
	Paul Roggemans, France	22:55-23:10	20 PER, 1 KCG	+6.3
	" " "	23:10-23:20	11 PER, 3 SPO	+6.3
	" " "	23:20-23:30	13 PER, 1 NDA , 3 SPO	+6.3
	" " "	23:33-23:45	12 PER, 3 SPO	+6.3
	" " "	23:45-23:55	13 PER	+6.3
	Felix Martinez, Italy	23:45-00:45	59 PER, 2 NDA 1 SPO	+5.9; 30% cloudy
	Paul Roggemans, France	23:55-00:05	16 PER, 1 SPO	+6.3
AUG 12	Paul Roggemans, France	00:05-00:15	19 PER, 2 SPO	+6.3
	" " "	00:15-00:25	8 PER, 3 SPO	+6.2
	" " "	00:25-00:35	16 PER, 2 SPO	+6.2
	" " "	00:35-00:45	18 PER, 4 SPO	+6.2
	John Gallagher, NJ	00:38-02:26	1 PER	+5.8; 75% cloudy
	Paul Roggemans, France	00:45-00:55	13 PER, 1 SPO	+6.2
	Felix Martinez, Italy	00:45-01:45	92 PER, 1 CAP, 1 NDA, 5 SPO	+5.9; 30% cloudy
	Frank Melillo, NY	00:45-03:00	4 PER	+4.0
	Paul Roggemans, France	00:55-01:05	14 PER, 2 SPO	+6.2
	Mark Davis, SC	01:00-01:15	2 PER, 1 SPO	+4.6
	Paul Roggemans, France	01:05-01:15	30 PER, 2 SPO	+6.2
	Richard Taibi, ME	01:14-02:13	18 PER, 1 NDA	+5.0
	Paul Roggemans, France	01:15-01:25	20 PER, 1 SPO	+6.2
	Wanda Simmons, FL	01:16-01:32	1 PER	+6.0; 30% cloudy
	Karl Simmons, FL	01:16-01:45	4 PER, 1 SPO	+6.0; 30% cloudy
	Tom Webb, GA	01:20-01:30	1 PER	+3.7
	Roger Venable, GA	01:20-02:50	20 PER, 1 SPO	+5.5
	Tom Giguere, TN	01:24-05:25	45 PER, 4 SPO	+4.3; 5% cloudy
	Paul Roggemans, France	01:25-01:35	19 PER, 1 NDA , 2 SPO	+6.1
	Mark Davis, SC	01:30-01:45	3 PER, 5 SPO	+4.8
	Tom Webb, GA	01:30-01:45	2 PER	+4.8
	Mike Deming, TX	01:30-06:00	50 PER	+5.0; 5% cloudy
	Dave Deming, TX	01:30-06:00	32 PER, 5 SPO	+5.0; 5% cloudy
	Lucy Deming , TX	01:30-06:00	45 PER, 4 SPO	+5.0; 5% cloudy
	Paul Roggemans, France	01:35-01:45	25 PER	+6.0
	" " "	01:45-01:55	22 PER, 1 NDA , 3 SPO	+6.0
	Tom Webb, GA	01:45-02:00	5 PER, 1 SPO	+5.2
	Mark Davis, SC	01:45-02:00	2 PER, 3 SPO	+4.9
	Felix Martinez, Italy	01:45-02:50	98 PER, 1 ACY, 2 SPO	+5.9; 40% cloudy
	Paul Roggemans, France	01:55-02:00	22 PER, 2 SPO	+6.0
	" " "	02:00-02:12	25 PER, 5 SPO	+6.0
	Tom Webb, GA	02:00-02:15	5 PER, 2 SPO	+5.2
	Daniel Rhone, NJ	02:00-02:45	8 PER, 1 SPO	+5.0; 65% cloudy
	Mark Davis, SC	02:05-02:20	5 PER, 4 SPO	+5.0
	Kathy Machin, KS	02:10-03:55	12 PER, 3 SPO	+3.1; 33% cloudy
	Paul Roggemans, France	02:12-02:20	28 PER, 1 SPO	+6.0
	Richard Taibi, ME	02:14-03:13	1 PER	+5.0
	Tom Webb, GA	02:15-02:30	5 PER, 2 SPO	+5.2
	Paul Roggemans, France	02:20-02:30	30 PER, 2 SPO	+6.0
	Mark Davis, SC	02:20-02:35	6 PER, 2 SPO	+5.1
	Karl Simmons, FL	02:22-03:03	4 PER, 3 SPO	+6.0
	Tom Webb, GA	02:30-02:45	4 PER	+5.2
	Paul Roggemans, France	02:30-02:35	10 PER	+5.9
	" " "	02:35-02:40	15 PER	+5.9

------------------------------ *Table 1 continued on pp. 123-126 with notes on p. 126* ----------------------------------

Table 1. Recent A.L.P.O. Meteor Observations—*Continued.*

1993 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+*N* = Limiting Magnitude)
AUG 12	Mark Davis, SC	02:35-02:50	6 PER, 5 SPO	+5.2
	Kermit Rhea, AR	02:36-03:04	1 PER	+5.0
	Paul Roggemans, France	02:40-02:45	11 PER, 1 SPO	+5.9
	Wanda Simmons, FL	02:41-03:00	2 PER	+6.0
	Amy Gilstrap, FL	02:41-03:05	2 PER, 1 SPO	+6.0
	Becky Kirkwood, FL	02:41-03:41	8 PER, 2 SPO	+6.0
	Carroll Iorg, KS	02:42-07:45	41 PER, 6 SPO	+6.0; 10% cloudy
	Tom Webb, GA	02:45-03:00	5 PER	+5.2
	Stephen Simmons, FL	02:49-03:17	5 PER, 1 SPO	+6.0
	David Kirkwood, FL	02:49-03:17	5 PER, 3 SPO	+6.0
	Paul Roggemans, France	02:45-02:50	25 PER, 1 KCG	+6.0
	" " "	02:50-02:55	7 PER, 1 SPO	+6.0
	Mark Davis, GA	02:50-03:05	3 PER, 3 SPO	+5.3
	Brian Simmons, FL	02:50-03:18	7 PER, 2 SPO	+6.0
	Paul Roggemans, France	02:55-03:00	19 PER	+6.0
	Tom Webb, GA	03:00-03:15	10 PER	+5.2
	Robert Lunsford, CA	03:00-03:15	1 PER	+2.8
	George Zay, CA	03:00-03:15	1 PER	+2.5
	Frank Melillo, NY	03:00-04:00	7 PER	+4.1
	Paul Roggemans, France	03:00-03:05	16 PER, 1 NDA	+6.0
	" " "	03:05-03:10	14 PER, 1 SPO	+5.9
	Kermit Rhea, AR	03:04-04:04	8 PER	+5.0
	Daniel Simmons, FL	03:07-03:53	3 PER	+6.0
	Paul Roggemans, France	03:10-03:15	24 PER, 1 SPO	+5.5
	Richard Taibi, ME	03:14-04:13	28 PER, 2 NDA, 1 UPG	------
	Tom Webb, GA	03:15-03:30	8 PER, 2 SPO	+5.2
	Robert Lunsford, CA	03:15-03:30	1 PER	+4.3
	George Zay, CA	03:15-03:30	1 PER	+4.0
	Damien Mathew, ND	03:15-04:15	8 PER	------
	Paul Roggemans, France	03:15-03:20	17 PER	+5.2
	" " "	03:20-03:25	18 PER	+5.0
	Wendy Simmons, FL	03:20-04:20	4 PER, 1 SPO	+6.0
	Paul Roggemans, France	03:25-03:30	3 PER	+4.5
	James Fox, MN	03:30-03:45	1 PER, 1 SPO	+5.0
	Ronald Rosenwald, TX	03:30-03:45	6 PER, 2 SPO	+4.0
	Mark Davis, SC	03:30-03:45	6 PER, 4 SPO	+5.3; 5% cloudy
	Tom Webb, GA	03:30-03:45	11 PER, 4 SPO	+5.2
	Robert Lunsford, CA	03:30-03:45	5 PER	+5.3
	George Zay, CA	03:30-03:45	3 PER	+5.0
	David Kirkwood, FL	03:35-04:35	26 PER, 6 SPO	+6.0
	Stephen Simmons, FL	03:35-04:35	17 PER, 4 SPO	+6.0
	Becky Kirkwood, FL	03:41-04:41	12 PER, 4 SPO	+6.0
	Brian Simmons, FL	03:42-04:42	26 PER,11 SPO	+6.0
	Vic Winter, CO	03:45-04:00	12 PER, 2 SPO	+7.0
	James Fox, MN	03:45-04:00	3 PER	+5.0
	Ronald Rosenwald, TX	03:45-04:00	3 PER	+4.0
	Mark Davis, SC	03:45-04:00	8 PER, 2 SPO	+5.3; 10% cloudy
	Robert Lunsford, CA	03:45-04:00	2 PER, 1 SPO	+5.8
	George Zay, CA	03:45-04:00	3 PER, 1 SPO	+5.5
	John Kirkwood, FL	03:54-04:54	21 PER, 1 SPO	+6.0
	Amy Gilstrap , FL	03:54-04:56	19 PER, 3 SPO	+6.0
	Wanda Simmons, FL	03:56-04:56	16 PER, 2 SPO	+6.0
	Daniel Simmons, FL	03:58-04:18	1 PER	+6.0
	Frank Melillo, NY	04:00-05:00	8 PER, 1 KCG	+4.2
	Vic Winter, CO	04:00-04:15	3 PER	+7.0
	Karl Simmons , FL	04:00-05:00	23 PER, 3 SPO	+6.0
	James Fox, MN	04:00-04:15	1 SPO	+5.0
	Ronald Rosenwald TX	04:00-04:15	4 PER, 1 SPO	+4.5
	Mark Davis, SC	04:00-04:15	6 PER	+5.3; 15% cloudy
	Robert Lunsford, CA	04:00-04:15	3 PER, 6 SPO	+6.5
	George Zay, CA	04:00-04:15	1 PER, 2 SPO	+5.5
	Richard Taibi, ME	04:14-05:13	17 PER, 1 SPO	+5.0
	Vic Winter, CO	04:15-04:30	12 PER	+7.0
	James Fox, MN	04:15-04:30	2 PER	+5.0

------------------------------ *Table 1 continued on pp. 124-126 with notes on p. 126* ----------------------------------

Table 1. Recent A.L.P.O. Meteor Observations—*Continued.*

1993 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+*N* = Limiting Magnitude)
AUG 12	Ronald Rosenwald, TX	04:15-04:30	2 PER	+4.5
	Mark Davis, SC	04:15-04:30	4 PER	+5.3; 20% cloudy
	Robert Lunsford, CA	04:15-04:30	5 SPO	+6.6
	George Zay, CA	04:15-04:30	1 PER, 4 SPO	+5.5
	Wendy Simmons, FL	04:20-05:21	6 PER	+6.0
	Daniel Simmons, FL	04:30-05:05	8 PER, 1 SPO	+6.0
	Vic Winter, CO	04:30-04:45	9 PER, 1 SPO	+7.0
	James Fox, MN	04:30-04:45	1 PER, 1 SPO	+5.0
	Ronald Rosenwald, TX	04:30-04:45	5 PER, 3 SPO	+5.0
	Robert Lunsford, CA	04:30-04:45	3 PER, 8 SPO	+6.7
	George Zay, CA	04:30-04:45	2 PER, 5 SPO	+5.5
	Peter Wlasuk, FL	04:35-05:35	68 PER, 3 KCG, 8 SPO	+5.9; 10% cloudy
	David Kirkwood, FL	04:35-05:35	32 PER,12 SPO	+6.0
	Stephen Simmons, FL	04:35-05:35	34 PER, 4 SPO	+6.0
	James Riggs, CA	04:40-05:00	1 PER, 1 SPO	+2.0
	Becky Kirkwood, FL	04:41-05:41	19 PER, 5 SPO	+6.0
	Brian Simmons, FL	04:42-05:46	33 PER,12 SPO	+6.0
	Vic Winter, CO	04:45-05:00	9 PER	+7.0
	James Fox, MN	04:45-05:00	4 PER	+5.0
	Ronald Rosenwald, TX	04:45-05:00	1 PER, 3 SPO	+5.0
	Robert Lunsford, CA	04:45-05:00	5 PER, 2 SPO	+6.8
	George Zay, CA	04:45-05:00	2 PER, 1 SPO	+5.6
	John Kirkwood, FL	04:54-05:54	18 PER, 7 SPO	+6.0
	Wanda Simmons, FL	04:56-05:56	22 PER, 7 SPO	+6.0
	Frank Melillo, NY	05:00-06:00	9 PER, 1 KCG	+4.3
	Karl Simmons, FL	05:00-06:00	21 PER, 7 SPO	+6.0
	Vic Winter, CO	05:00-05:15	3 PER	+7.0
	James Fox, MN	05:00-05:15	1 NDA	+5.0
	Ronald Rosenwald, TX	05:00-05:15	1 PER	+5.0
	Mark Davis, SC	05:00-05:15	3 PER	+5.0; 25% cloudy
	James Riggs, CA	05:00-05:15	*None Seen*	+3.5
	Robert Lunsford, CA	05:00-05:15	12 PER, 3 SPO	+6.8
	George Zay, CA	05:00-05:15	7 PER, 3 SPO	+5.6
	Richard Taibi, ME	05:14-06:04	13 PER, 1 SPO	+5.0
	Vic Winter, CO	05:15-05:30	6 PER	+7.0
	James Fox, MN	05:15-05:30	4 PER, 1 SPO	+5.0
	Ronald Rosenwald, TX	05:15-05:30	2 PER	+5.0
	Mark Davis, SC	05:15-05:30	4 PER	+4.9; 30% cloudy
	James Riggs, CA	05:15-05:30	4 PER	+5.5
	Robert Lunsford, CA	05:15-05:30	6 PER, 4 SPO	+6.8
	George Zay, CA	05:15-05:30	4 PER, 4 SPO	+5.7
	Amy Gilstrap, FL	05:29-06:23	12 PER, 4 SPO	+6.0
	Vic Winter, CO	05:30-05:45	19 PER	+7.0
	James Fox, MN	05:30-05:45	6 PER, 1 SPO	+5.0
	Ronald Rosenwaid, TX	05:30-05:45	4 PER, 1 SPO	+5.0
	Mark Davis, SC	05:30-05:45	3 PER	+4.9; 30% cloudy
	James Riggs, CA	05:30-05:45	2 PER, 1 CAP, 1 SPO	+6.5
	Robert Lunsford, CA	05:30-05:45	7 PER, 4 SPO	+6.8
	George Zay, CA	05:30-05:45	4 PER, 3 SPO	+5.7
	Bob Birket, AZ	05:30-10:00	133 PER, 23 SPO	+5.0; 20% cloudy
	Stephen Simmons, FL	05:35-06:35	22 PER, 9 SPO	+6.0
	David Kirkwood, FL	05:35-06:35	20 PER, 15 SPO	+6.0
	Becky Kirkwood, FL	05:41-06:42	20 PER, 6 SPO	+6.0
	Vic Winter, CO	05:45-06:00	13 PER	+7.0
	James Fox, MN	05:45-06:00	3 PER	+5.0
	Ronald Rosenwald, TX	05:45-06:00	5 PER	+5.0
	Mark Davis, SC	05:45-06:00	3 PER	+4.8; 35% cloudy
	James Riggs, CA	05:45-06:00	4 PER	+7.0
	Robert Lunsford, CA	05:45-06:00	1 PER	+6.8
	George Zay, CA	05:45-06:00	4 PER	+5.7
	Jim Cadieux , GA	05:50-06:50	29 PER, 3 SPO	+5.5
	Jerry Barton, GA	05:50-06:50	44 PER, 5 SPO	+4.0
	Roger Venable, GA	05:50-06:50	54 PER, 5 SPO	+5.0
	John Gallagher NJ	05:51-08:17	16 PER, 1 KCG, 1 SPO	+5.7; 45% cloudy

------------------------------ *Table 1 continued on pp. 125-126 with notes on p. 126* ------------------------------

Table 1. Recent A.L.P.O. Meteor Observations—*Continued.*

1993 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+*N* = Limiting Magnitude)
AUG 12	John Kirkwood, FL	05:54-07:05	30 PER, 2 SPO	+6.0
	Wanda Simmons, FL	05:56-07:05	34 PER, 4 SPO	+6.0
	Peter Wlasuk , FL	06:00-07:00	149 PER, 5 KCG, 8 SPO	+5.6; 5% cloudy
	Frank Melillo, NY	06:00-07:00	12 PER, 1 UPG, 1 NDA, 1 KCG, 2 SPO	+4.3
	Karl Simmons , FL	06:00-07:00	35 PER, 6 SPO	+6.0
	Vic Winter, CO	06:00-06:15	12 PER	+7.0
	Ronald Rosenwald, TX	06:00-06:15	9 PER, 2 SPO	+5.0
	James Riggs, CA	06:00-06:15	1 PER	+7.0
	Robert Lunsford, CA	06:00-06:15	2 PER, 3 SPO	+6.7
	George Zay, CA	06:00-06:15	3 PER	+5.7
	Vic Winter, CO	06:15-06:30	10 PER, 1 SPO	+7.0
	James Riggs, CA	06:15-06:30	2 PER	+7.0
	Robert Lunsford, CA	06:15-06:30	4 PER, 6 SPO	+6.7
	George Zay, CA	06:15-06:30	3 PER, 2 SPO	+5.7
	Vic Winter, CO	06:30-06:45	8 PER, 1 SPO	+6.5
	James Riggs, CA	06:30-06:45	*None Seen*	+7.0
	Robert Lunsford , CA	06:30-06:45	15 PER, 4 SPO	+6.7
	George Zay, CA	06:30-06:45	7 PER, 4 SPO	+5.7
	Stephen Simmons, FL	06:35-07:07	19 PER, 5 SPO	+6.0
	David Kirkwood, FL	06:35-07:05	21 PER, 9 SPO	+6.0
	Becky Kirkwood, FL	06:42-07:05	14 PER, 5 SPO	+6.0
	Vic Winter, CO	06:45-07:00	15 PER, 1 SPO	+6.5
	James Riggs, CA	06:45-07:00	2 PER	+7.0
	Robert Lunsford, CA	06:45-07:00	5 PER, 1 SPO	+6.7
	George Zay, CA	06:45-07:00	5 PER	+5.7
	Frank Melillo, NY	07:00-07:38	7 PER	+4.3
	Jim Cadieux, GA	07:00-09:07	36 PER, 6 SPO	+4.5
	Roger Venable, GA	07:00-08:00	43 PER, 12 SPO	+5.1
	Jerry Barton, GA	07:00-08:00	35 PER, 9 SPO	+4.0
	Vic Winter, CO	07:00-08:30	29 PER	+6.5
	James Riggs, CA	07:00-07:15	3 PER	+7.0
	Robert Lunsford, CA	07:00-07:15	22 PER	+6.7
	George Zay, CA	07:00-07:15	13 PER	+5.7
	Phyllis Eide, HA	07:00-11:15	21 PER, 31 SPO	+4.3; 25% cloudy
	James Riggs, CA	07:15-07:30	3 PER	+7.0
	Robert Lunsford, CA	07:15-07:30	11 PER, 1 SPO	+6.7
	George Zay, CA	07:15-07:30	7 PER, 1 SPO	+5.7
	James Riggs, CA	07:30-07:45	5 PER, 1 ACY	+7.0
	Robert Lunsford, CA	07:30-07:45	15 PER, 5 SPO	+6.7
	George Zay CA	07:30-07:45	6 PER, 2 SPO	+5.7
	Peter Wlasuk, FL	07:40-08:40	176 PER, 3 KCG, 7 SPO	+5.1
	James Riggs, CA	07:45-08:00	6 PER, 1 UPG,1 SPO	+7.0
	Robert Lunsford, CA	07:45-08:00	21 PER, 1 SPO	+6.7
	George Zay, CA	07:45-08:00	12 PER, 2 SPO	+5.7
	John Swatek, HA	07:45-12:00	38 PER, 32 SPO	+5.0; 30% cloudy
	J. Kenneth Eakins, HA	08:00-09:00	3 PER	+5.2
	James Riggs, CA	08:00-08:15	7 PER	+7.0
	Robert Lunsford, CA	08:00-08:15	12 PER, 3 SPO	+6.7
	George Zay, CA	08:00-08:15	10 PER	+5.7
	Betty Yee, HA	08:00-12:15	24 PER, 15 SPO	+5.0; 45% cloudy
	Michael Morrow, HA	08:00-12:15	24 PER, 1 NDA , 1 KCG,11 SPO	+4.7; 45% cloudy
	Roger Venable, GA	08:07-09:07	43 PER, 5 SPO	+4.1
	James Riggs, CA	08:15-08:30	5 PER, 1 SPO	+7.0
	Robert Lunsford, CA	08:15-08:30	15 PER, 4 SPO	+6.7
	George Zay, CA	08:15-08:30	7 PER, 3 SPO	+5.7
	Norman McLeod, FL	08:15-08:45	9 PER	+6.0
	James Riggs, CA	08:30-08:45	3 PER, 1 CAP	+7.0
	Robert Lunsford, CA	08:30-08:45	20 PER, 3 SPO	+6.7
	George Zay, CA	08:30-08:45	11 PER	+5.7
	JoAnn Homsany, HA	08:30-12:15	15 PER, 9 SPO	+5.0; 35% cloudy
	Vic Winter, CO	08:45-09:00	22 PER	+6.5
	James Riggs, CA	08:45-09:00	6 PER, 1 CAP	+7.0
	Robert Lunsford, CA	08:45-09:00	11 PER, 2 SPO	+6.7
	George Zay, CA	08:45-09:00	9 PER, 4 SPO	+5.7

Table 1 continued on p. 126 with notes

Table 1. Recent A.L.P.O. Meteor Observations—*Continued.*

1993 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+N = Limiting Magnitude)
AUG 12	Waida Patterson, CA	08:45-09:45	83 PER	+6.5
	Walter Haas, NM	08:53-09:54	3 PER, 3 SPO	+3.0; 20% cloudy
	J. Kenneth Eakins, HA	09:00-10:00	2 PER, 2 SPO	+5.5
	James Riggs, CA	09:00-09:15	5 PER	+7.0
	Robert Lunsford, CA	09:00-09:15	12 PER, 2 SPO	+6.6
	George Zay, CA	09:00-09:15	6 PER, 1 SPO	+5.7
	James Riggs, CA	09:15-09:30	2 PER	+7.0
	Robert Lunsford, CA	09:15-09:30	13 PER, 1 SPO	+6.6
	George Zay , CA	09:15-09:30	10 PER, 1 SPO	+5.7
	James Riggs, CA	09:30-09:45	7 PER	+7.0
	Robert Lunsford, CA	09:30-09:45	14 PER, 4 SPO	+6.6
	George Zay, CA	09:30-09:45	12 PER, 3 SPO	+5.7
	James Riggs, CA	09:45-10:00	4 PER, 1 UPG	+7.0
	Robert Lunsford, CA	09:45-10:00	12 PER, 5 SPO	+6.6
	George Zay, CA	09:45-10:00	12 PER, 2 SPO	+5.7
	James Riggs, CA	10:00-10:15	3 PER, 1 UPG, 3 SPO	+7.0
	Robert Lunsford, CA	10:00-10:15	9 PER, 5 SPO	+6.5
	George Zay , CA	10:00-10:15	7 PER, 2 SPO	+5.7
	J. Kenneth Eakins, HA	10:05-10:15	2 PER	+5.5
	" " " "	10:15-10:30	5 PER, 1 SPO	+5.5
	James Riggs, CA	10:15-10:30	3 PER	+7.0
	Robert Lunsford, CA	10:15-10:30	11 PER, 1 SPO	+6.5
	George Zay, CA	10:15-10:30	13 PER, 5 SPO	+5.7
	James Riggs, CA	10:30-10:40	3 PER, 1 SPO	+7.0
	J. Kenneth Eakins, HA	10:30-10:45	1 PER	+5.5
	Robert Lunsford, CA	10:30-10:45	12 PER, 2 SPO	+6.5
	George Zay, CA	10:30-10:45	9 PER, 2 SPO	+5.6
	J. Kenneth Eakins, HA	10:45-11:00	6 PER	+5.5
	Robert Lunsford, CA	10:45-11:00	17 PER, 3 SPO	+6.5
	George Zay, CA	10:45-11:00	11 PER, 1 SPO	+5.5
	J. Kenneth Eakins, HA	11:00-11:15	8 PER, 1 SPO	+5.5
	Robert Lunsford, CA	11:00-11:15	19 PER	+6.5
	George Zay, CA	11:00-11:15	13 PER	+5.4
	J. Kenneth Eakins, HA	11:15-11:30	7 PER, 1 SPO	+5.5
	Robert Lunsford, CA	11:15-11:30	11 PER, 6 SPO	+6.5
	George Zay, CA	11:15-11:30	11 PER, 3 SPO	+5.3
	J. Kenneth Eakins, HA	11:30-11:45	6 PER	+5.5
	James Riggs, CA	11:30-11:45	3 PER	+5.5
	Robert Lunsford, CA	11:30-11:45	27 PER, 2 SPO	+6.5
	George Zay, CA	11:30-11:45	16 PER, 2 SPO	+5.0
	James Riggs, CA	11:45-12:00	5 PER, 1 SPO	+5.0
	Robert Lunsford, CA	11:45-12:00	12 PER, 4 SPO	+6.5
	George Zay, CA	11:45-12:00	11 PER, 3 SPO	+4.1
	J. Kenneth Eakins, HA	11:45-12:05	5 PER	+5.5
	Robert Lunsford, CA	12:00-12:15	10 PER, 4 SPO	+5.8
	George Zay, CA	12:00-12:16	13 PER, 3 SPO	+3.0
	James Riggs, CA	12:00-12:21	6 PER, 1 UPG	+3.5
	Robert Lunsford, CA	12:15-12:30	4 PER	+4.8

**** Key to Abbreviations:***

ACY	Alpha Cygnid	NDA	North Delta Aquarid	UPG	Upsilon Pegasid
CAP	Alpha Capricornid	PER	Perseid		
KCG	Kappa Cygnid	SPO	Sporadic		

COMET CORNER

By: Don E. Machholz, A.L.P.O. Comets Recorder

PRESENT COMET ACTIVITY

Several comets should be visible to us as we enter 1994, and the numbers hardly decrease in Spring, 1994. You may wish to observe the following comets. Please send observations to the A.L.P.O. Comets Recorder (address on inside back cover).

Periodic Comet Schwassmann-Wachmann 1.— Observers may wish to monitor this comet. Although it stays about 5 AU (1 Astronomical Unit equals the mean distance of the Sun from the Earth; 149,597,870 km] from the Sun, and generally remains faint, it occasionally outbursts and brightens to magnitude 9-12. (See *Table 1* to right.)

Periodic Comet Schwassmann-Wachmann 2.—Not to be confused with the previous comet, this object remains high in the northern sky as it slowly dims. (See *Table 2*, to lower right and p. 128.)

Periodic Comet Shoemaker-Levy 9 (1993e).—Observers may wish to observe this comet soon, because in late July, 1994 it is expected to collide with Jupiter and disappear. It has several nuclei and multiple tails. (See *Table 3*, p. 128.) [For an update on preparations for this "encounter," see p. 142.]

Comet Mueller (1993a).—After spending the last few months in the northern circumpolar region, this comet heads south and behind the Sun. It emerges into the southern evening sky where it should remain visible through Summer, 1994. (See *Table 4*, p. 128.)

Periodic Comet Encke.—The comet with the shortest orbital period of them all, 3.3 years, appears in our evening winter sky. We lose it as it goes behind the sun in early February, 1994. It then enters the southern evening sky where it dims over the next few months. (See *Table 5*, p. 128 and *Figure 1*, p. 129.)

Comet Mueller (1993p).—This comet is closest to the Sun in March at 0.96 AU, and has a high inclination. It should be visible in the southern evening sky before finally heading northward in May, 1994. (See *Table 6*, p. 128.)

Periodic Comet Tempel 1 (1993c).—This comet has an orbital period of 5.50 years. While near opposition it brightens until within reach of amateur scopes, and by mid-Summer, 1994, it should become a binocular object. (See *Table 7*, pp. 128-129.)

Periodic Comet Tempel 2.—This comet orbits the sun every 5.48 years. It will be hard to see as it slowly emerges from behind the Sun and into the southern morning sky. Southern-Hemisphere observers will be favored for this visit of Comet Tempel 2. (See *Table 8*, p. 129.)

EPHEMERIDES

Notes: In the "Elongation from Sun" column, **E** refers to visibility in the evening sky, and **M** to morning visibility. "Total Mag." values are forecasts of visual total magnitudes and are subject to considerable uncertainty. Orbital elements follow our ephemerides for those who wish to compute their own ephemerides.

Table 1. Ephemeris of Periodic Comet Schwassmann-Wachmann 1.

1994 UT Date	2000.0 Coörd. R.A.		Decl.		Elongation from Sun		Total Mag.
(0h UT)	h	m	°	'	°		
FEB 02	07	17.7	+26	20	154	E	+17.5
07	07	15.5	+26	19	149	E	+17.5
12	07	13.6	+26	16	143	E	+17.5
17	07	12.0	+26	14	138	E	+17.5
22	07	10.6	+26	10	133	E	+17.5
27	07	09.5	+26	06	127	E	+17.6
MAR 04	07	08.7	+26	01	122	E	+17.6
09	07	08.2	+25	56	117	E	+17.6
14	07	08.0	+25	51	112	E	+17.7
19	07	08.1	+25	45	107	E	+17.7
24	07	08.5	+25	38	102	E	+17.7
29	07	09.2	+25	32	097	E	+17.7
APR 03	07	10.2	+25	24	093	E	+17.8
08	07	11.5	+25	17	088	E	+17.8
13	07	13.0	+25	09	084	E	+17.8
18	07	14.8	+25	01	079	E	+17.9
23	07	16.8	+24	53	075	E	+17.9
28	07	19.1	+24	44	070	E	+17.9
MAY 03	07	21.5	+24	34	066	E	+17.9
08	07	24.2	+24	25	062	E	+18.0
13	07	27.0	+24	15	058	E	+18.0
18	07	29.9	+24	04	054	E	+18.0
23	07	33.1	+23	54	050	E	+18.0
28	07	36.3	+23	43	046	E	+18.1

Table 2. Ephemeris of Periodic Comet Schwassmann-Wachmann 2.

1994 UT Date	2000.0 Coörd. R.A.		Decl.		Elongation from Sun		Total Mag.
(0h UT)	h	m	°	'	°		
FEB 02	08	23.5	+19	35	171	E	+11.0
07	08	20.5	+20	00	165	E	+11.0
12	08	18.0	+20	22	159	E	+11.0
17	08	16.0	+20	42	153	E	+11.0
22	08	14.7	+20	58	148	E	+11.1
27	08	14.2	+21	11	143	E	+11.2
MAR 04	08	14.4	+21	21	138	E	+11.3
09	08	15.5	+21	27	133	E	+11.4
14	08	17.4	+21	29	128	E	+11.5
19	08	20.1	+21	28	124	E	+11.5
24	08	23.5	+21	24	120	E	+11.6

(Continued on p. 128)

Ephemeris of Periodic Comet Schwassmann-Wachmann 2—Continued.

1994 UT Date	2000.0 Coörd. R.A.		2000.0 Coörd. Decl.		Elongation from Sun		Total Mag.
(0h UT)	h	m	°	'	°		
MAR 29	08	27.6	+21	16	116	E	+11.7
APR 03	08	32.3	+21	05	112	E	+11.8
08	08	37.6	+20	50	108	E	+11.9
13	08	43.3	+20	33	105	E	+12.0

Table 3. Ephemeris of Periodic Comet Shoemaker-Levy 9 (1993e).

1994 UT Date	2000.0 Coörd. R.A.		2000.0 Coörd. Decl.		Elongation from Sun		Total Mag.
(0h UT)	h	m	°	'	°		
FEB 02	14	36.7	-16	07	091	M	+13.9
07	14	38.2	-16	14	096	M	+13.9
12	14	39.3	-16	18	101	M	+13.9
17	14	40.2	-16	22	105	M	+13.8
22	14	40.8	-16	23	110	M	+13.8
27	14	41.1	-16	24	115	M	+13.8
MAR 04	14	41.1	-16	22	120	M	+13.7
09	14	40.8	-16	20	125	M	+13.7
14	14	40.2	-16	15	131	M	+13.7
19	14	39.3	-16	10	136	M	+13.6
24	14	38.l	-16	02	141	M	+13.6
29	14	36.7	-15	54	146	M	+13.6
APR 03	14	35.0	-15	44	152	M	+13.6
08	14	33.2	-15	33	157	M	+13.5
13	14	31.2	-15	21	162	M	+13.5
18	14	29.1	-15	08	168	M	+13.5
23	14	26.9	-14	54	174	M	+13.5
28	14	24.6	-14	40	179	M	+13.5
MAY 03	14	22.4	-14	26	176	E	+13.5
08	14	20.2	-14	12	170	E	+13.5
13	14	18.1	-13	57	165	E	+13.5
18	14	16.1	-13	44	160	E	+13.5
23	14	14.3	-13	31	154	E	+13.6
28	14	12.7	-13	19	149	E	+13.6

Table 4. Ephemeris of Comet Mueller (1993a).

1994 UT Date	2000.0 Coörd. R.A.		2000.0 Coörd. Decl.		Elongation from Sun		Total Mag.
(0h UT)	h	m	°	'	°		
(Too close to the Sun for observation.)							
MAR 24	22	44.4	+01	25	022	M	+10.2
29	22	48.0	+00	37	026	M	+10.2
APR 03	22	51.4	-00	12	030	M	+10.2
08	22	54.7	-01	03	034	M	+10.3
13	22	57.7	-01	55	038	M	+10.3
18	23	00.5	-02	51	043	M	+10.3
23	23	03.0	-03	49	047	M	+10.4
28	23	05.2	-04	52	052	M	+10.4
MAY 03	23	07.1	-05	59	057	M	+10.4
08	23	08.6	-07	12	062	M	+10.4
13	23	09.8	-08	31	067	M	+10.4
18	23	10.5	-09	57	072	M	+10.5
23	23	10.7	-11	31	078	M	+10.5
28	23	10.3	-13	14	083	M	+10.5

Table 5. Ephemeris of Periodic Comet Encke.

1994 UT Date	2000.0 Coörd. R.A.		2000.0 Coörd. Decl.		Elongation from Sun		Total Mag.
(0h UT)	h	m	°	'	°		
(Too close to the Sun for observation)							
FEB 17	20	36.3	-23	03	023	M	+6.4
22	20	40.9	-23	56	027	M	+7.3
27	20	50.6	-23	55	030	M	+8.1
MAR 04	21	01.8	-23	31	033	M	+8.8
09	21	13.1	-22	54	035	M	+9.4
14	21	24.0	-22	12	037	M	+9.9
19	21	34.2	-21	29	040	M	+10.3
24	21	43.7	-20	45	042	M	+10.7
29	21	52.5	-20	03	045	M	+11.0
APR 03	22	00.6	-19	22	048	M	+11.3
08	22	08.0	-18	44	051	M	+11.5
13	22	14.7	-18	09	054	M	+11.7
18	22	20.8	-17	37	058	M	+11.9
23	22	26.2	-17	08	061	M	+12.1

Table 6. Ephemeris of Comet Mueller (1993p).

1994 UT Date	2000.0 Coörd. R.A.		2000.0 Coörd. Decl.		Elongation from Sun		Total Mag.
(0h UT)	h	m	°	'	°		
FEB 02	23	21.4	-17	09	033	E	+9.2
07	23	26.8	-18	42	030	E	+9.0
12	23	32.7	-20	15	027	E	+8.8
17	23	39.0	-21	49	025	E	+8.6
22	23	45.7	-23	26	024	E	+8.4
27	23	53.0	-25	06	024	E	+8.2
MAR 04	00	01. 0	-26	50	025	E	+8.0
09	00	09.8	-28	40	027	E	+7.8
14	00	19.6	-30	36	030	E	+7.6
19	00	30.7	-32	38	033	E	+7.5
24	00	43.5	-34	49	037	E	+7.3
29	00	58.7	-37	08	041	E	+7.2
APR 03	01	17.l	-39	35	045	E	+7.1
08	01	39.8	-42	09	050	E	+7.0
13	02	08.3	-44	45	055	E	+6.9
18	02	44.8	-47	10	060	E	+6.9
23	03	31.0	-49	01	065	E	+6.9
28	04	27.0	-49	42	070	E	+6.9
MAY 03	05	29.4	-48	33	074	E	+7.0
08	06	30.7	-45	17	079	E	+7.1
13	07	24.5	-40	19	082	E	+7.3
18	08	08.4	-34	32	084	E	+7.6
23	08	43.2	-28	46	085	E	+7.9
28	09	10.8	-23	31	084	E	+8.3

Table 7. Ephemeris of Periodic Comet Tempel 1 (1993c).

1994 UT Date	2000.0 Coörd. R.A.		2000.0 Coörd. Decl.		Elongation from Sun		Total Mag.
(0h UT)	h	m	°	'	°		
MAR 04	13	33.2	+10	16	141	M	+12.0
09	13	33.9	+10	42	146	M	+11.7
14	13	33.9	+11	08	149	M	+11.5
19	13	33.0	+11	35	153	M	+11.2

(Continued on p. 129)

Ephemeris of Periodic Comet Tempel 1—Continued.

1994 UT Date (0h UT)	2000.0 Coörd. R.A. h m	Decl. ° '	Elongation from Sun °		Total Mag.
MAR 24	13 31.2	+12 00	156	M	+11.0
29	13 28.7	+12 21	159	M	+10.7
APR 03	13 25.5	+12 37	160	M	+10.5
08	13 21.8	+12 45	160	E	+10.3
13	13 17.6	+12 44	158	E	+10.1
18	13 13.4	+12 33	156	E	+9.9
23	13 09.2	+12 10	152	E	+9.7
28	13 05.3	+11 34	148	E	+9.5
MAY 03	13 02.0	+10 46	144	E	+9.4
08	12 59.5	+09 45	140	E	+9.3
13	12 57.8	+08 33	136	E	+9.2
18	12 57.2	+07 11	132	E	+9.1
23	12 57.6	+05 40	128	E	+9.0
28	12 59.1	+04 00	125	E	+8.9

Table 8. Ephemeris of Periodic Comet Tempel 2.

1994 UT Date (0h UT)	2000.0 Coörd. R.A. h m	Decl. ° '	Elongation from Sun °		Total Mag.
MAR 24	22 33.8	-11 51	028	M	+11.1
29	22 49.4	-10 47	029	M	+11.1
APR 03	23 04.7	-09 41	030	M	+11.1
08	23 19.8	-08 34	031	M	+11.2
13	23 34.6	-07 27	032	M	+11.2
18	23 49.2	-06 20	033	M	+11.3
23	00 03.6	-05 13	034	M	+11.4
28	00 17.7	-04 06	036	M	+11.5
MAY 03	00 31.6	-03 02	037	M	+11.6
08	00 45.2	-01 58	038	M	+11.7
13	00 58.5	-00 57	040	M	+11.8
18	01 11.6	+00 02	041	M	+11.9
23	01 24.4	+00 58	042	M	+12.0
28	01 37.0	+01 52	044	M	+12.2

Table 9. Orbital Elements of Current Comets.

Comet Designation	Perihelion Passage (T)	Perihelion Dist. (q; AU)	Perihelion Argument (ϖ)	Longitude of Asc. Node (Ω)	Inclination (i)	Eccentricity (e)
Schwass.-Wach. 1	1989 OCT 26.7	5.7718	049°.897	312°.848	009°.372	0.04466
Schwass.-Wach. 2	1994 JAN 23.9	2.0703	358°.218	126°.247	003°.753	0.39875
Shoemaker-Levy 9	1994 APR 17.8	5.38247	356°.296	221°.254	005°.056	0.17370
Mueller (1993a)	1994 JAN 13.3	1.937118	130°.669	144°.722	124°.878	1.00000
Encke	1994 FEB 09.5	0.33091	186°.270	334°.729	011°.941	0.85021
Mueller (1993p)	1994 MAR 26.4	0.967240	261°.056	193°.791	105°.032	1.00000
Tempel 1	1994 JUL 03.3	1.49415	178°.902	068°.985	010°.552	0.52025
Tempel 2	1994 MAR 16.6	1.48354	194°.883	118°.249	011°.975	0.52245

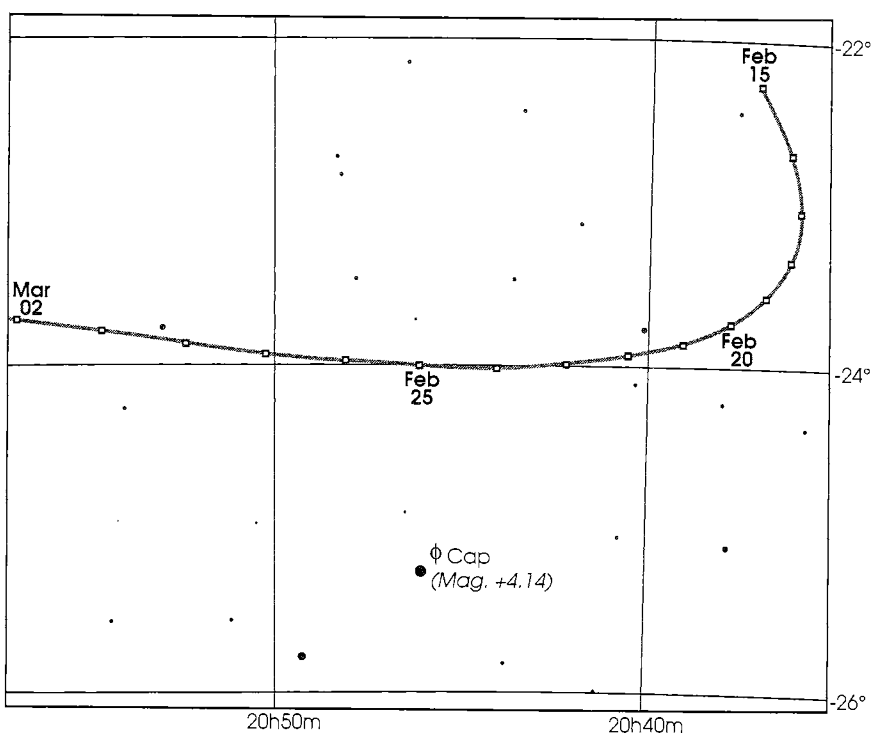


Figure 1. Path of Comet Encke in late February, 1994. 00h UT. Limiting magnitude +8.

OUR READERS SPEAK

(As always, these letters have been slightly edited for style; but not for content; this means that the letter writers are responsible for their opinions, not the A.L.P.O.)

Dear Dr. Westfall,

Re: Craters on Mars and Spots on Neptune

There has been a good deal of discussion in these pages concerning telescope performance, in the course of which the question of possible Martian crater sightings by E.E. Barnard and J.E. Mellish has been raised again. Although we do not wish to prolong such discussions unduly, it seems to us that several points have been completely overlooked.

First, we should point out that all of Barnard's Mars observations are intact. One of us (William Sheehan) actually located and examined all of Barnard's Mars drawings and other notebooks and papers in the archives of Vanderbilt University, Lick Observatory and Yerkes Observatory. His discovery of Barnard's Mars drawings from 1892 and 1894 was first described five years ago in his *Planets and Perception* (University of Arizona Press, 1988, pp. 147-149), and later in *Sky & Telescope* (Vol. 84 [1]. pp. 23-25, July 1992). The drawings are numbered in sequence and there are no missing ones.

As the author pointed out, although they show features which can be correlated with the known topography of the planet, and the circular smudges with dark kernels showing what we now know to be the Tharsis region volcanoes are suggestive, none (of the drawings) show craters in any recognizable form. We regard Barnard highly as an observer and delineator of planetary features, but the resolution of his renderings has been considerably surpassed by later workers, such as Antoniadi, Focas, Dollfus and others. Barnard's Mars drawings were made on a large scale (5 inches/12.5 cm diameter), and the recollection of Mellish that Barnard followed features for hours on end at the eyepiece, and made his drawings on a generous scale is, therefore, essentially correct. (For more details on Barnard's career, see Sheehan's forthcoming biography to be published by Cambridge University Press in the United Kingdom.)

In his intriguing article in the *1983 Yearbook of Astronomy* (edited by Patrick Moore and published by Sidgwick & Jackson), Rodger W. Gordon reproduces a series of drawings by Mellish made between 1915 October 26 and 1916 March 10. While almost all of these drawings were made with the 12-inch refractor at Yerkes, one drawing was made with the Yerkes 40-inch refractor [Also see other writings by Mr. Gordon in previous issues of this Journal: 25(9-10), pp. 196-200 (1975); 36(4), pp. 174-175 (1993).]

As director of the British Astronomy Association (B.A.A.) Mars Section, I, Richard McKim, examined firsthand the work of every famous Mars observer, as well as that of hundreds of others, preserved in the archives of the B.A.A. and elsewhere. There is no question in my mind that Mellish was then at best a fair draftsman, as Gordon's reproductions demonstrate very well. Indeed, some of the drawings could only be interpreted after the writers had worked out the longitude of the Central Meridian! Furthermore, Mellish drew the planet in a very Lowellian style, despite what Gordon says in this Journal (36(4), pp. 174-175 (1993)).

According to Gordon, Mellish made his crater sightings on the gibbous Martian disk in November 1915. This now seems to us extremely unlikely (as Joel Goodman also considered (see this Journal, 36(3), p. 135 (1992)), for the seeing at Yerkes throughout that winter had been consistently awful, as the entries in Barnard's log demonstrate. The following extracts are representative:

> November 6. Mars. Image jumping badly. The detail was too poorly seen to make anything of it.
>
> November 9. Jupiter. Seeing so bad can make nothing of it.
>
> November 12. Examined Mars with 12-in. at 5h 25m. Image jumping badly...Could see N. cap, but could not make out any definite details on the disk.

There is another good reason to doubt Mellish's claim. To cite a parallel case, it will be recalled that E.M. Antoniadi's early work from the Observatoire Flammarion at Juvisy showed many of the "canals" in a rather linear form. After his "revelation" at the eyepiece of the great Meudon refractor (1909 September 20), Antoniadi never drew another canal on the planet, and devoted much of the rest of his life to demolishing Lowell's theories (see *Planets and Perception*; W.G. Hoyt, *Lowell and Mars*, University of Arizona Press, 1976; R.J. McKim, "The Life and Times of E.M. Antoniadi," *B.A.A. Journal*, 103(5), in press, (1993)).

Suppose that Mellish had experienced such a revelation (miracle?) at the eyepiece in November 1915. Would he really have ever again drawn linear features across the disk? Not a chance! And yet, what do we find on his sketch of 1916 January 7 with the 40-inch refractor, (supposedly made two months after this event)? The Elysium region central and the rest of the disk criss-crossed by long, dark, straight streaks defying the laws of perspective. Although Gordon says the Mellish "canals" are irregular and have the appearance of natural features, this published drawing alone almost seems to discredit any verbal or written evidence in favor of Mellish's earlier crater sightings.

In passing, Gordon alludes several times to possible crater sightings by H.P. Wilkins at Yerkes. Sadly, Wilkins was neither an accurate nor artistic draftsman, and his 1954 Mars drawing and map in "Mysteries of Space and Time" (Frederick Muller Ltd., 1955) show just that. He was also an admirer of Lowell, and drew the planet in the Lowellian style. This is clear from many other unpublished Wilkins sketches in the B.A.A. archives.

Later observers have singularly failed to spot craters from the Earth, even where equipped with the best instruments and blessed with the best conditions (and even when they knew that craters existed!). A conspicuous dark spot with lighter surround was seen in the Iapigia region throughout the last decade or so; this turns out to be the Huygens crater on the planet, but no one could have recognized it to be a crater from Earth-based observations. Other cases could also be cited (See Sheehan and S.J. O'Meara, "Exotic Worlds," *Sky & Telescope*, 85(1), pp. 20-24 (1993), and McKim's Mars Section note in the *B.A.A. Journal*, 97(4), pp. 191-192 (1987)).

On the other hand, Mellish's claim to have seen bright-rimmed, circular features along the Martian terminator is harder to dismiss. It is a question of faith, perhaps, but until some observer can repeat such an observation, we shall continue to remain skeptical! Mellish now has his place in history (and on Mars -- the IAU working committee has recently approved the naming of a crater for him). But let us not overly romanticize the past.

In a similar vein, we wish to call into question the claim on the part of Francis Graham in this *Journal* (35(2), p. 69, (1991)) that some Earth-based observers may have seen the Great Dark Spot on Neptune visually with moderate- or large-aperture telescopes. Graham reproduces a drawing by C.F. Capen. This view is also featured (for a different reason) in Richard Baum's book *The Planets: Some Myths and Realities* (David & Charles Ltd., 1973), which dates it to 1950 April 20, 0400 UT. The telescope was a 12.5-inch Newtonian at Lowell Observatory, the magnification was 432x, and the seeing was described as "fair." South is uppermost and the disk was described as being mottled.

In later years, Capen was to make many high-resolution observations of the planets with large telescopes, but in 1950, he was a much younger and less experienced observer. It is more likely that the features drawn represent the outcome more of youthful enthusiasm than objective reality, as so often happens in reports of complex markings on Venus, spots on Saturn and LTPs (lunar transient phenomena) on the Moon!

Concerning the sketch by T.J.J. See, we have examined an earlier, perhaps clearer, reproduction in W.L. Web's *Brief Biography and Popular Account of the Unparalleled Discoveries of T.J.J. See* (Thos. P. Nichols & Son Co., 1913) in the plates between pp. 74 and 75. In this book of extremely dubious authority, we find the same drawing by See used as a comparison with a view of the Uranian belts by the Henry brothers; this is certainly the intention of the text (p. 72). It seems to us that the drawing is rather coarsely shaded, and See may have smudged the upper equatorial belt in one place in attempting to create the conventional "soft" appearance.

Regardless, the drawing is certainly not an earlier representation of the Great Dark Spot! We note that Jeff Beish in *Sky & Telescope* (85(4), pp. 6-7, (1993)) used the same illustrations and reached the same (erroneous) conclusions—we assume independently—of Graham.

We would also point out that in the case of such vague drawings, the comments of Camille Flammarion need to be borne in mind: "It is essential to consult the original drawing, because all too often, strange metamorphoses creep, gradually and unobtrusively, from copy to copy" (*La Planete Mars*, Paris: Gauthier-Villars et Fils, 1892, vol. 1, p. 45).

Thank you for allowing us the space to comment.

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August 9, 1993

Dear John,

I see in the latest issue of the *Strolling Astronomer* (Volume 37, No. 2, October, 1993) Rodger Gordon's rebuttal to my letter of a few months earlier when I challenged some of his present views on the Mars canals controversy.

I had written him back several times over the last few months; in our letters, we argued about this subject. After our last exchange of letters, I told him I would not discuss the "canals" with anyone again. But in his new letter of rebuttal in the *Strolling Astronomer*, he has raised new questions about the whole thing all over again. So he has forced me to express some more of my views all over again.

I think I will title my answering article "Whipping a Dead Horse that Does Not Know it is Dead and Refuses to Roll Over and Die." Now that is what Rodger accused me of doing about the Martian "canals," but it is also what he is doing about John Mellish (claiming Mellish to be the first astronomer to see craters on Mars). Rodger seems to place great importance on this, but I say "who cares?" It is now a moot question after all the Mars probe photos that show craters on Mars, so the matter no longer needs to be proven. I would say that the question of whether or not Mellish saw craters on Mars comes under the heading of trivia, and there are a lot more real mysteries about Mars that remain to be solved.

For instance, the recent Phobos probe that the Russians sent to Mars in 1988— which met a mysterious and untimely demise—recorded two quite mysterious anomalies on the planet before contact was lost with the satellite. One anomaly was a strange shadow moving across the planet's surface (not a shadow of either of Mars' moons)! The other anomaly was a strange grid-like pattern at one location on the Martian surface; it was photographed with an infrared camera on Phobos 2, the first such instrument carried on a spacecraft sent to Mars.

The Russians said this pattern was caused by something giving off heat from under the ground, and they did not rule out the possibility that this might even be some kind of underground city!

All of this was reported on television news shows in Europe and Canada, but American radio and TV news was strangely silent about it. I think *Astronomy* magazine mentioned something about this pattern on Mars in its report on the Phobos 2 mission, but did not comment on it beyond that.

Okay, now back to the "canals." I have some more questions to ask about Rodger Gordon's ideas about them in his rebuttal to my letter. He seemed to be contradicting himself over what he wrote about the canals in his *Sky & Telescope* magazine article, when he said in the article that "chance alignment of surface features cannot solely account for them."

But in this recent article, he said that the canals were due to chance alignment of surface features and also weather patterns. I would like to know how transitory weather patterns could create them when they (the canals) are always seen in the same locations on Mars, locations that have not changed over at least a century?

I think the greatest mystery about them is why do they manifest themselves as geometric patterns? There are lines caused by surface markings on the planet Mercury and Jupiter's largest moon, Ganymede, but these do not manifest themselves as geometric patterns. Only on Mars do they do that! If it is an illusion that tricks the human eye, you would expect to see geometric "canals" on those other bodies, too!

Also, I have come up with a piece of interesting evidence myself. I mentioned that during the 1969 flybys of Mars by the twin Mariner 6 and 7 spacecraft that *Sky & Telescope* magazine said that some Martian canals did show up on far encounter pictures of the planet taken by the spacecraft. I mentioned that fact in my first article that criticized Rodger's views on them. I have one of those photos; during the Mariner flybys, I used Polaroid type 107 film to photograph some of the Mariner 7 photos from my television screen when they were being broadcast at that time. One photo very clearly shows a straight, line-like Lowellian-type "canal" joining a dark area with the north polar cap.

As far as seeing them in a telescope like Rodger did with his 8-inch reflector, and where he says he saw the whole network of them, I have not had that exciting experience, but I have seen a few of them. I also own an 8-inch reflector (since being in high school in 1961, the same year I first joined the A.L.P.O.), but poor seeing conditions at my location most of the time have always prevented me from seeing the canal network even during the most favorable apparitions.

In 1965 and 1969, I did see the two double "canals" coming off the tip of Syrtis Major and extending northward, but thought they were broad and diffuse and did not appear very Lowellian.

My interest in this controversy goes back to about 1952 when *Popular Science* magazine printed an article called "Does Anybody Live on Mars?" This article also appeared in Readers Digest at a later date. It was the first time I read about Prof. Lowell and his ideas about the "canals," and at that time, considered it very fascinating. I would have to say Lowell was one of my first heroes in astronomy, because he was also the first real champion of life on Mars.

Well, Rodger was quite right in one thing he said about the"canals"-- they are seasonal. That is, they only show during certain seasons on the planet. The first good picture the Hubble Space Telescope took of Mars in January 1989 had superb resolution (31 miles), but did not show a single "canal", very probably because the season on the planet was wrong.

But the idea that they are caused by neat drifts of wind-blown dust piled into rows of sand dunes -- I don't buy that either. They could not hold their shape for the long period of time they are visible, and why would this dust pile itself into geometric patterns? It looks like it would be quite haphazard, that it would simply pile wherever the winds blew it.

Now, as to the question Rodger proposed about the photographs of the canals taken in Lowell's time at his observatory in Arizona, Rodger claims they were defects in the film. Has anybody ever taken those photographs out of the Lowell Observatory archives and done a study of the pictures or the original negatives? Until this is done, I would not make a judgment like Rodger has.

I read that most of the canals that appeared in those photos were also located in the same positions that Lowell drew them on his maps and drawings of Mars. And if Rodger thinks those are picture/film defects, he has a new mystery to explain because canals are also showing up on CCD camera photos like the one taken by Donald Parker with a 12.5-inch reflector and shown on the cover of the *Strolling Astronomer* earlier this year. It clearly showed a pentagonal pattern of canals surrounding Elysium. It is almost a certainty that these were not a "picture defect"!

Okay, before I shut down at last (I'm liable to be called the new "James Bartlett", an observer the A.L.P.O. had in the early 1960s who had controversial and unpopular theories based on his own observations of the Moon and Venus), I think that Rodger's vicious attacks on Hoagland, the scientist that is researching the "Face on Mars," were rather uncalled-for.

Even if you label Hoagland a crackpot working alone, you could not apply that term to the many scientists and photographic experts that helped humanize the photos of the "face", and they came to the same conclusion that Hoagland did -- that the face was an artificial construction.

I told Rodger in one of my last letters to him on this subject that the "Face on Mars" won't go away just because he wishes it would. It is there and it demands a reasonable explanation for it. And as far as the associated pyramid structures go, Carl Sagan commented on these on his "Cosmos" television series when he discussed a set of 3-sided pyramids that were photographed on the Elysium Plain of Mars by one of the Viking Orbiters. He said, "When we get a rover vehicle on Mars, we will make our first cautious approaches to these formations, that we don't know for sure whether they are artificial or not." Coming from Sagan, usually an ultra-conservative scientist, that was a real revelation!

Well, back to Hoagland. When the Viking scientists finally came to their own conclusions about the result of the life-seeking experiments aboard the two Viking landing craft on Mars, and announced the anticlimax that they did not find life on Mars despite hopeful early signs, the reaction from the general public was that their interest in the planet that had always captured mankind's imagination had shrunk to zero.

Enter Hoagland and his fantastic revelations about the Mars face, and what he has done that we can at least give him some credit for is that he has at least rekindled some in the planet Mars in our young people -- an interest that was almost dead beforehand.

So Mr. Gordon, you can at least give Hoagland credit for that, whether or not his theories about the face on Mars are right or wrong. It is just too bad that the Mars Observer spacecraft was mysteriously lost. With its camera with 10-foot resolution, it probably would have solved the mystery of the Mars face once and for all. But it just was not to be. So that will have to await some future Mars mission, probably a Russian probe.

Well, in all fairness to Rodger Gordon, I am not just picking on him. As a member of Wini Cameron's Lunar Transient Phenomena (LTP) program that she heads for the A.L.P.O., I feel that I must protest those scientists that continue in disbelief at the reality of these lunar phenomena.

This was even in the face of mounting evidence in the last few decades gathered by several prominent scientists and astronomers like Dinsmore Alter, who photographed in ultra-violet light gaseous emissions in Alphonsus and the crater Aristarchus. There was also the Russian astronomer Kosyrev who obtained spectrograms of an eruptions of gas from the central peak of the crater Alphonsus.

Then there were the two Air Force mappers Greenacre and Barr who were making maps of the Moon for the Apollo Project using the Lowell telescope at Flagstaff when they spotted two or three mysterious glows inside the rim of the crater Aristarchus, and in Schroter's Valley near the Cobra Head.

But it seems that despite of all this mounting evidence by experienced observers and professional astronomers, there are other self-styled "experts" among the scientific elite who continue to scoff in disbelief, even in the face of very good evidence gathered by their fellow scientists! So I decided to put this plug in to support Mrs. Cameron in her quest for truth on LTP.

Now in closing, I would like to commend A.L.P.O. founder and former Director Walter Haas for his excellent article in the most recent issue of the *Strolling Astronomer* about the early history of the organization. Since I did not join the A.L.P.O. until 1961, there was a lot I did not know about its very earliest beginnings. So Walter's writings really filled me in!

Daniel Louderback

P.O. Box 702
South Bend, WA 98586-0702

November 9, 1993

Dear John,

I am writing to let you know of the recent success and publicity the A.L.P.O. Meteors Section has received.

As you are aware, the Section was founded with two main purposes in mind: to encourage observers to begin a program of meteor observing, and to collect and maintain the data obtained from these observations. Meteor astronomy, especially in the United States, had been in a decline for many years. This decline was also experienced by the Meteors Section. I am glad to report that this is no longer the case.

The success of the Section prompted Mr. Paul Roggemans, Secretary-General of the International Meteor Organization (IMO), to state: "A remarkable progress has been made in the USA. Bob Lunsford successfully organized the A.L.PO. Meteor Section and reported hundreds of observations... today, visual observing work in the USA is reaching once again the level of the glorious days of 60 to 70 years ago."

With the appointment of Robert Lunsford as Recorder in 1989, the Section began a slow but steady increase and became much more active. Beginning with the 1990 observing year, an annual observation report has been compiled and distributed, recounting the activity of the year. Additionally, May 1992 saw the rebirth of the quarterly Section newsletter, giving practical advice and highlighting upcoming meteor showers (the A.L.P.O. Meteors Section Newsletter is free of charge by sending the Recorder a SASE).

Although the number of observers contributing observations declined from 37 in 1990 to 26 in 1992, the total time spent observing meteors increased from 380 hours to 947 hours. Likewise, the total number of nights per year in which observations were made increased from 85 to 185 nights, and the total number of meteors observed from 4,291 to 6,506 during this same period.

Finally, the Section now enjoys a cooperative relationship with the IMO. The observations which are submitted to IMO are used in the worldwide analysis of meteor showers to determine such characteristics as magnitude distributions, population indexes and spatial densities. This ensures that we will now receive recognition throughout the world.

The recent success of the Meteors Section could not have occurred without the dedication and enthusiasm of its observers. I hope you will join me in thanking these observers by printing these accomplishments in a future issue of the Journal.

Mark Davis

1700 Whipple Road, Apt. 11-A
Mt. Pleasant, SC 29464

November 15, 1993

We welcome these letters from our readers. At times, though, they are becoming lengthy and take magazine space away from other features. Thus we ask that you try to keep letters for this column to a length no longer than one single-space typewritten letter-size page or two handwritten letter-size pages. Longer submissions might well be more appropriate as separate articles.

The Editor

THE A.L.P.O. SEEKS ITS ROOTS: LAS CRUCES, 1993

The 43rd Convention of the Association of Lunar and Planetary Observers was held in Las Cruces, on Thursday-Saturday, August 5-7, 1993. As *Figure 1* (upper right) shows, Las Cruces made us very welcome. This was an attractive site in at least two ways. First, this city in southern New Mexico had been the headquarters of the A.L.P.O. for many years, its Founder and Director Emeritus, Walter Haas, still lives there, and its *Journal* is printed and mailed from there. Indeed, Las Cruces in general, and New Mexico State University in particular, is a center for planetary research, with local planetary scientists such as Clyde Tombaugh and Reta Beebe, who participated in our meeting. *Figure 2* (p. 135) shows Dr. Tombaugh introducing Dr. Beebe at her Thursday evening audiovisual presentation. Las Cruces was also attractive in the sense that it attracted a record number of members, 61 registrants, to this A.L.P.O.-only meeting.

Figure 1. The A.L.P.O. (and another organization) are officially greeted at Las Cruces' Downtown Mall.

Our planned activities consisted of papers, workshops, a Business Meeting, a banquet, and a field trip. Our appreciation goes to David H. Levy, who organized the program; and Elizabeth Westfall, who coordinated the registration, lodging, banquet, and field trip.

Table 1 (below) lists the papers and workshops that were presented and organized by A.L.P.O. members and invited guests; we plan that most of these will be published in coming issues of this *Journal*. One workshop and several papers dealt with the coming collision between Comet Shoemaker-Levy 9 and the planet Jupiter. Interest in this event was very high, and two guests filled us in on observing plans:

Table 1. Papers Presented at the 1993 A.L.P.O. Convention

Thursday Morning

Walter Haas—*An Outline of the History of the A.L.P.O.: 1947-1993.*
Joseph Zurlinden—*An A.L.P.O. of the Past.*
Richard E. Hill—*Don't Miss a Near Miss!*
Richard W. Schmude, Jr.—*Wideband Photometry of Uranus and Venus in 1993: Preliminary Results.*
Alan Heat and Paul Mackal—*Jovian White-Light Intensity Estimates: 1960-1977.*

Thursday Afternoon

Richard E. Hill—*Using the CCD for Planetary Astronomy.*
John E. Westfall—*Converting Lunar CCD Images into Lunar Maps.*
Donald C. Parker, Jeffrey D. Beish, Daniel C. Troiani, and Carlos E. Hernandez—*The Martian Atmosphere in 1992-93: A New Slant.*
Julius L. Benton, Jr.—*The Element of Fun in What We Do.*
Richard W. Schmude, Jr.—*Getting Children Interested in Astronomy.*
Reta Beebe—*Space Imagery of the Solar System* (audiovisual presentation)
Stephen J. Edberg—*Galileo's Role in the Comet Shoemaker-Levy 9/Jupiter Encounter.*

Friday Morning

Reta Beebe—*Jupiter's Changing Clouds.*
Periodic Comet Shoemaker-Levy 9 Workshop:
David H. Levy—*The Discovery of P/S-L 9.*
Jim Scotti—*CCD Observations of P/Shoemaker-Levy 9 (1993e).*
Richard E. Hill—*Observing the Comet Shoemaker-Levy 9/Jupiter Encounter.*
Stephen J. Edberg—*Ephemerides and Observing Plans for the Comet-Jupiter Encounter*

Friday Afternoon-Evening

José Olivarez—*Recent Observations of Jupiter.*
Phillip W. Budine—*Jupiter's 1993 SEB Disturbance.*
Daniel Joyce and Daniel M. Troiani—*Astro-Video Workshop.*
Harry D. Jamieson—*A Video Record of a Lunar Transient Phenomenon.*
Craig MacDougal—*An Overview of Recent Studies in Visual Perception from a Planetary Astronomer's Viewpoint.*

Friday Evening Banquet: Clyde W. Tombaugh—*Is There a Tenth Planet?*

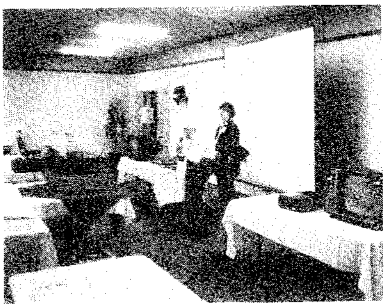

Figure 2. Clyde Tombaugh introduces Reta Beebe for her fascinating planetary audiovisual program on Thursday evening, August 5.

Stephen Edberg of the Jet Propulsion Laboratory and Cindy Jalife of the Planetary Society.

After lunch on Thursday, the A.L.P.O. had its annual Board Meeting, which was open to the attending members as well. The minutes of this meeting are given after this report (pp. 135-136).

About twice as many A.L.P.O. members than we had expected came to this meeting; the one event where this caused congestion was the Friday evening banquet. Still, Clyde Tombaugh's talk on his discovery of Pluto and subsequent work at White Sands was eagerly followed by a packed audience; as was the presentation by Walter H. Haas of the A.L.P.O. Walter H. Haas Observing Award for 1993 to José Olivarez for his many years of observational contributions, particularly of Jupiter (see *Figure 3*, below).

Figure 3. A.L.P.O. Founder Walter Haas (left) presents the Walter H. Haas Observing Award for 1993 to José Olivarez, A.L.P.O. Jupiter Recorder.

The majority of our attending members climbed on a bus for Saturday's all-day field trip. We traveled east past the White Sands Missile Range and then climbed to over 9,000 feet in the Sacramento Mountains, visiting in order the National Solar Observatory at Sacramento Peak (see *Figure 4*, upper right), the new 3.5-meter reflector at nearby Apache Point (see *Figure 5*, right center), and the

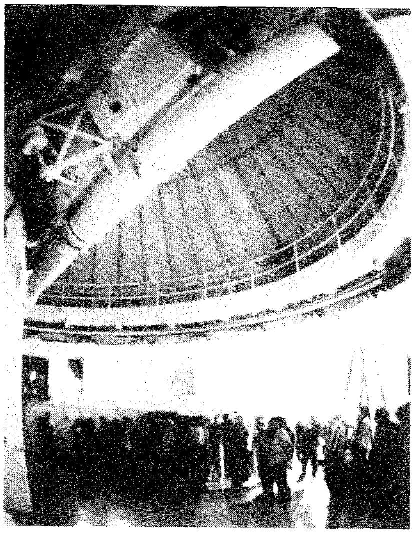

Figure 4. The A.L.P.O. visitors were quite impressed by the Solar Spar telescope at the National Solar Observatory in Sunspot.

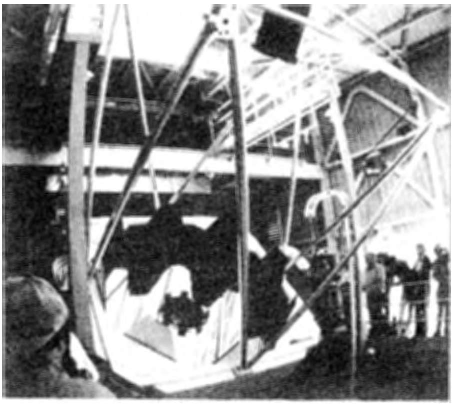

Figure 5. The A.L.P.O. group's next stop was the Apache Point Observatory, a short distance from the National Solar Observatory. Here they view the brand-new 3.5-meter reflector on its altazimuth mount.

Space Center at Alamogordo with its outdoor display of rocketry remnants. The last site visited was the gypsum sand dunes of White Sands National Monument, where evening electrical storm observing was conducted.

And thus we returned after dark to the Mission Inn in Las Cruces, tired but for the wishing that our Convention was not coming to an end. Its success is attributable to those persons already mentioned, together with Scott Murrel and Jack Burns of the Astronomy Department of New Mexico State University, the Astronomical Society of Las Cruces, the staffs of the National Solar and Apache Point Observatories, and the staff of the Best Western Mission Inn of Las Cruces; and to all the A.L.P.O. members, friends, and family who came to Las Cruces in 1993.

MINUTES OF THE 1993 A.L.P.O. BOARD MEETING, LAS CRUCES, NEW MEXICO, AUGUST 5, 1993

Minutes taken by: Elizabeth W. Westfall, A.L.P.O. Board Secretary

The Annual Board Meeting of the Association of Lunar and Planetary Observers for 1993 was called to order on August 5, at 1:15 PM MDT. All seven Board members were present—Phillip Budine, Walter Haas, Harry Jamieson, José Olivarez, Donald Parker, Elizabeth Westfall, and John Westfall. Approximately forty A.L.P.O. members and staff who were not Board members were also present. Such persons attend in a nonvoting capacity, but are always welcome at our meetings for the valuable input that they supply.

OLD BUSINESS

1. Financial Report.—The total balance in the two A.L.P.O. bank checking accounts (Heber Springs, and San Francisco) was \$7763. The amount owed to the Executive Director, chiefly for postage and photocopying expenses, was \$44 (he bills the Association for such costs at the end of each year)

2. Staff Changes.—A provisional Computing Section has been established, with Robert P. Manske and David D. Weier as Acting Co-Recorders.

3. The A.L.P.O. Journal.—There were 600 subscribers for the July, 1993, issue. Since the last Board Meeting, we had published three quarterly issues, each with 48 pages.

4. Solar System Ephemeris.—About 100 copies of the 1992 Edition had been distributed; 20 were complimentary copies and the rest were sold at a price of \$7.00 per issue for North American purchasers and \$9.50 for those in other countries. The 1993 Edition had 132 pages. Mr. Mark Davis is generously handling production and distribution. The new Computing Section will be supplying much of the contents in future.

5. Foreign Membership Fund.—This fund is provided by voluntary contributions and is administered by John Westfall with the intention of providing A.L.P.O. memberships to deserving but needy amateurs. We expect the recipients to participate in A.L.P.O. observing programs. Over the previous year \$20 had been contributed and \$20 expended for one 1-year foreign memberships, leaving a balance of \$20 as of July 30, 1993. [Immediately after our meeting, members Paül Comba, Richard Hill, and John Griesé generously contributed \$20 each to this fund.]

6. International Solar System Observers Fund (ISSOF).—This fund is supported by contributions of money, equipment, and supplies, and is administered by Paul H. Bock, Jr. As of July 30, 1993, there were three new requests from as many countries, one of which had been fulfilled. Six items remain on inventory. Donors of cash or goods were T. Aranda, P.H. Bock, J. Bryan, A. Chalable, and L. Netzler.

7. Membership Trends.—Recent A.L.P.O. membership trends are shown by the table below:

Vol., No.	Issue Date	No. of Subscribers U.S.A.	Abroad	Total
36, 2	1992 July	476	134	610
36, 3	Oct.	459	127	586
36, 4	1993 Mar.	468	126	594
37, 1	July	475	125	600
1-year change		-1	-9	-10

NEW BUSINESS

1. Future Meetings.—At the time of the meeting, we had just one possible site for our 1994 meeting: Meet by ourselves at Roper Mountain Science Center, Greenville, South Carolina (firm invitation; June 16-18 most likely). Passed.

2. Instrument Section.—Make the provisional Instrument Section into a Permanent Section. Passed.

3. Staff Confirmations and Promotions.—(1) Michael Mattei, the Acting Recorder of the Instrument Section was made a permanent Recorder (Passed). (2) Paul Maxson, the Acting Solar Recorder, was made a permanent Recorder (Passed). (3) Daniel Troiani, Assistant Mars Recorder, was made a full Mars Recorder (Passed).

4. Establishment of a provisional Transit Section.—A provisional Mercury/Venus Transit Section was established in order to encourage the observation of these phenomena and the study of past observations of them (Passed). John Westfall was appointed as Acting Recorder (Passed).

5. Status of Lunar and Planetary Training Program.—After some discussion of the future of this program, the two volunteers for Training Coordinator, Tim Robertson and Matthew Will, were asked to develop a plan for the organization and operation of the program. (No vote.)

6. Termination of Program.—Because its goal, the completion of a map of the lunar south polar and southwest limb region, was completed, the Luna Incognita Program was terminated (Passed). Its Recorder, John Westfall, resigned from that post (Accepted).

7. Free Distribution of *Solar System Ephemeris* to Recorders.—Hitherto, free copies of our Ephemeris have gone largely to its contributors. Beginning with the 1994 edition, a free copy will be supplied to each Section Recorder (Passed).

8. A.L.P.O. Staff Guidelines.—The A.L.P.O. Board accepted the recommended staff guidelines that were developed by Harry Jamieson and presented at our 1992 Meeting (Passed). These guidelines are repeated at the end of these minutes.

9. Use of Credit Cards for A.L.P.O. Dues.—Although efforts to allow A.L.P.O. members to pay their dues with a credit card have been unsuccessful, it was recognized that this would be a major convenience for foreign members. Accordingly, the Executive Director will investigate if we can make use for this purpose of an organization that already accepts credit cards. (Discussion only.)

There being no further business, the Meeting was adjourned at 2:45 PM MDT.

Appendix:

A.L.P.O. STAFF GUIDELINES

By: Harry D. Jamieson

The A.L.P.O. has always suffered from having no clearly defined guidelines and enforced code of ethics and performance for its staff members. Unethical or non-performing staff members have all too often retained their positions for years after any ordinary business concern would have dismissed them. The code being offered below is based upon the contemporary standards of our society (as I see them) and what I hope everyone will agree is enlightened self-interest. It also stresses service to our membership, which is to say, our customer base.

1. Staff members should not advertise for sale, or accept money for, handbooks or other items which do not yet exist.

2. Staff members should take all reasonable care to acknowledge promptly the work of their observers, both personally and (where the work deserves publication) in the pages of the *Journal*. It is also recognized that staff members should expect to receive stamped self-addressed envelopes from persons writing to them.

3. Staff members should submit regular and timely reports covering the work of their Sections at intervals appropriate for them (e.g., within 180 days of the end of an apparition).

4. Staff members should attempt to promote the A.L.P.O. and the work of their Sections wherever possible. This need should be obvious, but I have seen articles in the major magazines by staff members which do not mention the A.L.P.O. at all.

5. Staff members should attempt to write their articles using language which invites rather than intimidates the reader. It should certainly be possible to do this without sacrificing the scientific values of the article. Indeed, the article is more valuable if more people read it.

6. Correspondence should be answered within three weeks of receipt.

7. Recorders should attend A.L.P.O. conventions at least once every three years.

8. Recorders should make every effort to standardize observing methods and reporting forms, along with illustrations submitted for publication.

9. Each Recorder should maintain well-organized files and pass them along to his or her successor upon resigning.

10. All Section publications should maintain proper standards in terms of content, English, and format.

ONE LESS STAR IN OUR SKY: WALTER SCOTT HOUSTON, 1912-1993

"Scotty" Houston's name will be very familiar to most of our readers, in part because he has authored the monthly "Deep-Sky Wonders" column in *Sky & Telescope* since 1946. He also was a familiar, indeed almost legendary, figure at the annual Stellafane and Astronomical League meetings.

"Scotty" passed away of pneumonia on December 23rd at the age of 81. He was then in Cancun, Mexico, with his wife, Miriam and his daughter Margaret; the family often traveled to Mexico in the winter, where Scotty could indulge both his deep-sky and archaeoastronomy interests.

Born in 1912, Scotty's interest in astronomy began in the 6th Grade, when he observed all the Messier objects with a home-built 1-inch refractor. Besides his deep-sky interests, he was a skilled solar observer and was very active in the American Association of Variable Star Observers. He joined that organization in 1931, and eventually contributing about 12,500 magnitude estimates to them.

It is perhaps less well known that Scotty was a charter member of the Association of Lunar and Planetary Observers in 1947, and maintained his membership in our group until his death. The breadth of his interests is shown by a contribution to the October, 1947 issue of the *Strolling Astronomer*, where he recommended systematic observing programs for three specific lunar features.

Again involving the Solar System, Scotty was active in the 1950's in the radio observation of meteors—a project that perhaps we should pay more attention to today.

Scotty will be a permanent presence in the Solar System because Asteroid number 3031 was designated "Houston" in 1986. He will be remembered by all of us, including the thousands who Scotty inspired to go out and *observe* to their fullest.

Coming Solar-System Events: February - April, 1994

What to Look For

Planet-viewing will be limited in this three-month period because several planets will appear close to the Sun. Nonetheless, there are two predicted occultations of stars by minor planets, three close planetary conjunctions, two major meteor showers, and a full half-dozen comets predicted to be bright enough to spot in small telescopes.

This column is intended to alert our readers to coming events in the Solar System; giving visibility conditions for major and minor planets, the Moon, comets, and meteors. You can find more detailed information in the 1994 edition of the *A.L.P.O. Solar System Ephemeris*. (See p. 144 to find out how to obtain this publication.) Celestial directions are abbreviated. All dates and times are in Universal Time (UT). For the time zones in the United States, UT is found by adding 10 hours to HST (Hawaii Standard Time), 9 hours to AST (Alaska Standard Time), 8 hours to PST, 7 hours to MST or PDT, 6 hours to CST or MDT, 5 hours to EST or CDT, and 4 hours to EDT. Note that this addition may well put you into the next UT day!

A Few Planets

Several bright planets remain near the Sun in early 1994. The evening sky is occupied only by Mercury (briefly) and Venus. Meanwhile, Jupiter dominates the morning sky.

Mercury, because of its rapid motion, belongs to both the morning and evening sky. Two apparitions of Mercury occur in these three months. The first is an evening one, favorable from the Northern Hemisphere, centered on FEB 04, the date of Greatest Eastern Elongation (18°.3); the planet will be at least 15° from the Sun between JAN 27-FEB 11 with *dichotomy* (half-phase) *predicted* for FEB 05, 13h. Mercury's second apparition is a morning one that is very favorable for Southern-Hemisphere observers but very unfavorable for those of us in north temperate latitudes. Greatest Eastern Elongation is on MAR 19, with the planet then 27°.7 from the Sun, and at elongation 15° or greater from FEB 28-APR 15! Dichotomy is forecast for MAR 16, 16h.

Venus, now technically in the evening sky, will probably first become visible low in the SW evening twilight in late February. By the end of April, the planet will be 25° E of the Sun, appearing as an 11" (" = arc-second) disk, still fully 90-percent illuminated.

Mars is starting to become visible in the morning as it moves from Capricornus through Aquarius to Pisces, reaching 28° W of the Sun by APR 30. However, even then it is only at magnitude +1.2, and detail will be hard to see on its 4".3 disk.

Jupiter is definitely the planet easiest to observe, although still in the morning sky, in Libra, until its opposition on APR 30, 9h. At that date, the planet's declination will be 13°.4 S, and its -2.4-magnitude disk will measure 44".5 N-S and 41".6 E-W. This entire period is a good time to become familiar with the Giant Planet's "normal" appearance in preparation for any changes caused by its collision with Comet Shoemaker-Levy 9 in late July.

Saturn is too near the Sun for convenient observation until late March. By the end of April, the Ringed Planet is 60°W of the Sun, and visible before dawn in Aquarius as a +1.1-magnitude object. By then, the tilt of the Rings to our line of sight will have decreased to only 5°.7, making their E-W dimension (36".8) a full 10 times their N-S dimension (3".6). The planet's Globe itself will then measure 16".2 E-W by 14".5 N-S.

By April, we should be able to resume observation of eclipses of the 10th-magnitude satellite **Tethys**. The UT's of disappearance and reappearance for eclipses of Tethys for 1994 APR are given in *Table 1* immediately below.

Table 1. Eclipses of Tethys by Saturn, 1994 APR.

(Reappearances occur behind Saturn's limb .)

APR 01	12 02.7-14 04.4	APR 16	14 30.2-16 35.7
APR 03	09 21.2-11 23.3	APR 18	11 48.6-13 54.6
APR 05	06 39.6-08 42.2	APR 20	09 07.1-11 13.4
APR 07	03 58.0-06 01.2	APR 22	06 25.5-08 32.3
APR 09	01 16.5-03 20.1	APR 24	03 43.9-05 51.2
APR 10/11	22 34.9-00 39.0	APR 26	01 02.3-03 10.0
APR 12	19 53.4-21 57.9	APR 27/28	22 20.7-00 28.9
APR 14	17 11.8-19 16.8	APR 29	19 39.1-21 47.7

(We thank Brian Loader for furnishing the predictions above. The other bright satellites–Dione, Rhea, and Titan–will gradually follow suit as the Sun and the Earth approach Saturn's Ring plane, crossing it in 1995.)

Uranus and **Neptune** are now morning objects in Sagittarius. By late April they are more than 90°W of the Sun and thus easily found in the morning sky.

Pluto, near the Serpens-Libra border, rises late in the evening, approaching its opposition on MAY 17.

The proximity of several planets to the Sun means that there will be several planetary conjunctions, some of them close ones and all involving Saturn. Also, the proximity of the Sun will make these events hard to observe. Conjunctions of planets approaching to within 1°.0 or less, with the solar elongation and respective visual magnitudes given in parentheses, are: (1) FEB 14, 03h—Venus 2' (arc-minutes) S of Saturn (7° E; -3.9, +0.9); (2) MAR 14, 10h— Mars 22' N of Saturn (18°W; +1.2, +1.0); and (3) MAR 24 08h—Mercury 15' S of Saturn (27°W; +0.4, +1.0).

MINOR PLANETS

Four of the brighter **minor planets** reach opposition during FEB-APR and will be bright enough to be visible in binoculars. Their 10-day ephemerides are and will be given in the 1994 edition of the *A.L.P.O. Solar System Ephemeris*, and their opposition data are given below:

Minor Planet	Opposition Data: 1994 Date	Stellar Magnitude	Declination& Constellation	
23 Thalia	FEB 06.6	+9.3	35°N	Lyn
41 Daphne	FEB 26.7	+9.9	1°S	Sex
10 Hygiea	APR 04.6	+9.3	12°S	Crv
3 Juno	APR 18.5	+9.9	1°N	Vir

In addition, two other of the "Big Four" minor planets, **1 Ceres** and **4 Vesta,** will be about 9th and 8th magnitude, respectively, during this period and in the evening sky.

THE MOON

During the current period, the schedule for the Moon's **phases** is:

New Moon	First Quarter	Full Moon	Last Quarter
JAN 12.0	JAN 19.9	JAN 27.6	FEB 03.3
FEB 10.6	FEB 18.7	FEB 26.1	MAR 04.7
MAR 12.3	MAR 20.5	MAR 27.5	APR 03.1
APR 11.0	APR 19.1	APR 25.8	MAY 02.6

The four lunations listed above constitute Numbers 879-882 in Brown's series.

The other significant lunar visibility condition is the Moon's **librations**, or E-W and N-S tilts in relation to the Earth. Extreme librations occur on the following dates:

West	North	East	South
JAN 25	JAN 29	FEB 08	FEB 11
FEB 22	FEB 25	MAR 07	MAR 10
MAR 22	MAR 25	APR 04	APR 06
APR 19	APR 21	MAY 02	MAY 04

Our lunar E and W directions follow the convention of the International Astronomical Union, with Mare Crisium near the *east* limb.

During this period the latitude librations are well-synchronized with the phases; the lunar poles will be tilted toward us when there is favorable lighting. The N limb can be seen well on FEB 23-28, MAR 22-27, and APR 18-23. In FEB and MAR the Sun's lunar latitude will be northerly, helping the lighting in the north polar area. The S limb will be displayed favorably on MAR 08-10 and APR 04-09.

OCCULTATIONS

Two minor planets will occult stars in this period.) *Table 2* (right) lists the date, occulting object, visual magnitude of planet followed by that of the star, and *possible* zone of visibility for each occultation.

Table 2. Occultations of Stars by Minor Planets, 1994 FEB-APR.

(For further information, see the A.L.P.O. Solar System Ephemeris: 1994.]

1994 UT Date	Occulting Object	Visual Mag. Object	Star	Predicted Visibility Zone
FEB 16.84	**712 Boliviana**	12.0	9.0	W Australia
APR 15.85	**516 Amherstia**	11.5	8.4	China

The Moon will occult Venus on APR 12 at about 23h, but only in a small zone in Greenland, the Arctic Ocean, and NE Siberia. Venus will then be at magnitude -3.9, 21° E of the Sun.

SOLAR ECLIPSE

No lunar or solar eclipse occurs during this period. However, following this article is a forecast of conditions of the MAY 10 annular solar eclipse that crosses North America.

COMETS

The column by Don E. Machholz, "Comet Corner," on pp. 127-129 and the *A.L.P.O. Solar System Ephemeris: 1994* list six known comets that are predicted to be 12th magnitude or brighter during at least part of this period. Of these, **Comets Encke** and **Mueller (1993p)** may be as bright as 7th magnitude; they should be readily visible in small telescopes, or even in binoculars from dark sites.

The above is a conservative statement of comet visibility since it of course does not take into account any discoveries that may be made after this column is written!

METEOR SHOWERS

(Contributed by Robert D. Lunsford, A.L.P.O. Meteors Recorder. Local times are used unless otherwise stated.)

The **Lyrids** will reach maximum activity on the morning of April 22. Unfortunately, the Full Moon occurs only three days later, creating only a small dark-sky window between moonset and dawn. To see this shower at its best, wait until the Moon is near or below the western horizon. Face eastward, look near the zenith, and watch for possible shower members. Remember that the Lyrids do not radiate from Vega, but rather from an area between Lyra and the "Keystone" of Hercules.

The **Eta Aquarids** will peak near MAY 05, when the Moon will be a waning crescent located near the shower's radiant. Fortunately, the moonlight will not be severe and most shower members will be seen without difficulty. Shower members will be best seem just before dawn, radiating from the "Water Jar" of Aquarius. Face northward with the Moon at your back to see this shower at its best.

THE ANNULAR SOLAR ECLIPSE OF 1994 MAY 10

On 1994 MAY 10, the first solar eclipse sweeps across North America coast-to-coast since 1979. A partial eclipse of the Sun will occur throughout the continent; and indeed northern Siberia, Greenland, North and Northwest Europe, and Northwest Africa.

This will be an *annular* eclipse; the Moon's apparent diameter will be less than that of the Sun. Seen from the path of annularity, during the annular phase, the Moon will be surrounded by a ring of solar photosphere. The solar corona and prominences will not be visible without special equipment, although bright stars and planets may appear if the sky is quite clear. Note that Venus, at magnitude -3.9, will lie 28° E of the Sun. Mercury, at magnitude -1.2, will be harder to see, just 12° E of the Sun.

Figure 1 (below) shows the path of annularity for the eclipse as it crosses northwest Mexico, the central and northeast United States, and parts of eastern Canada. (Not shown is the Atlantic continuation of the path, crossing the Azores, with an eastern termination in Morocco, including the cities of Rabat and Casablanca.) The width of the annular zone decreases from 271 km in Baja California to 236 km in Nova Scotia. At the same time, the duration of annularity on the center line increases from 5m 28s in western Baja California to a maximum of 6m 14s in Lake Erie, and then drops to 5m 58s in Nova Scotia.

The prospects for clear skies vary along the eclipse path. Coastal fog is a danger on the Pacific coast of the Baja California peninsula, but the shores of the Gulf of California and the Mexican State of Sonora are likely (but never certain!) to have clear skies, as do southern New Mexico and western Texas. As one moves to the Great Plains and Middle West, however, the likelihood of clouds increases. New England and Nova Scotia are, statistically, the portion of North America most likely to be cloudy.

In both the partial or annular phases, the way to observe this eclipse is the same as you would do in observing the Sun outside of eclipse—DO NOT LOOK DIRECTLY AT THE SUN. If observing by naked-eye, look through either #14 Welder's Glass, or aluminum-coated mylar (e.g., Solar Skreen) or glass that reduces light of all wavelengths by *at least* 99.999 percent (.00001 transmission or density 5.0). If using binoculars or a telescope, or film or video camera, use such a filter *in front of* the lens or telescope aperture. You can project a solar image through the eyepiece of binoculars or small telescopes , but you should use a simple non-cemented eyepiece and take care that nobody looks through it!

Although an annular eclipse is always a spectacular and photogenic sight, the opportunity for scientific observation is less than in a total solar eclipse. One important observation is the careful timing of the interior contacts of the Moon's limb with that of the Sun. The *First Umbral Contact* occurs when the Moon's limb first touches the Sun's and is notoriously hard to time; it begins the partial phase. The *Fourth Umbral Contact* is the last contact of the lunar and solar limbs and ends the partial phase. If one is within the path of annularity, one can time the *Second Umbral Contact*, when the annular phase begins, and the *Third Umbral Contact*, when the annular phase ends.

Photographs taken during the annular phase are also useful in determining the pro-

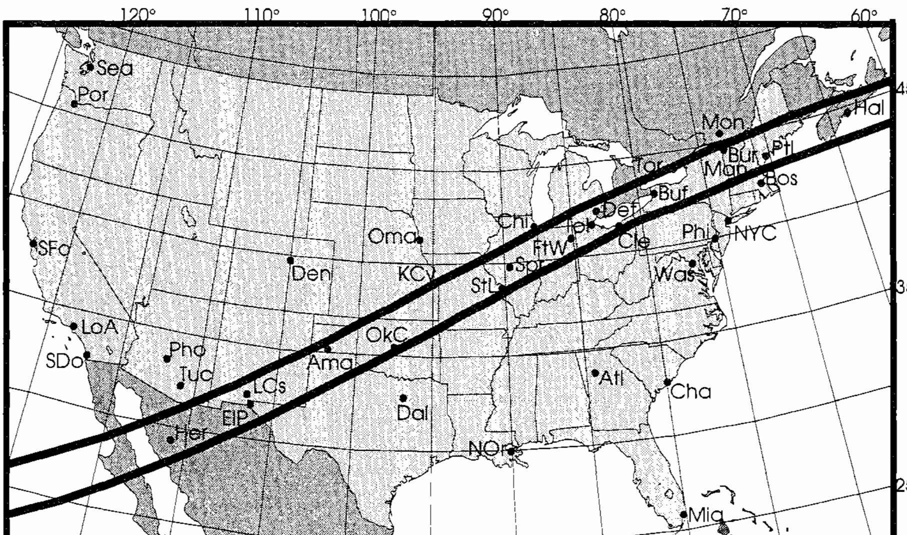

Figure 1. The annular track of the solar eclipse of 1994 MAY 10 across North America. The cities listed in *Table 1* (p. 141) are shown, with their names abbreviated.

Table 1. Circumstances for the 1994 MAY 10 Annular Solar Eclipse: Selected Cities.

Note: "Obscuration" is the percentage of the Sun's disk that is covered by the Moon's disk. The solar altitude is given for the time of maximum eclipse.

Place	Universal Time (UT) Ecl. Begins	Maximum Ecl.	Ecl. Ends	Duration of Annularity	Maximum Obscuration	Solar Altitude
	h m s	h m s	h m s	m s	%	°
Amarillo, TX	14:54:00	16:23:59	18:08:48	4 36	88.7	54
Atlanta, GA	15:16:19	17:00:13	18:53:57	*none*	69.6	72
Boston, MA	15:56:56	17:42:55	19:24:06	*none*	87.6	62
Buffalo, NY	15:41:23	17:25:00	19:09:12	6 11	88.9	65
Burlington, VT	15:54:52	17:38:33	19:18:47	4 26	88.9	61
Charleston, SC	15:25:15	17:11:46	19:04:39	*none*	62.0	75
Chicago, IL	15:24:18	17:03:50	18:49:58	*none*	88.6	64
Cleveland, OH	15:33:44	17:17:09	19:03:40	4 47	89.0	66
Dallas, TX	14:54:38	16:28:41	18:18:49	*none*	82.1	60
Denver, CO	15:01:12	16:27:44	18:06:17	*none*	75.5	51
Detroit, MI	15:32:44	17:14:45	19:00:24	5 19	88.9	65
El Paso, TX	14:44:02	16:09:56	17:51:52	5 40	88.5	49
Fort Wayne, IN	15:26:51	17:08:31	18:55:48	6 09	89.0	66
Halifax, Nova Scotia, Canada	16:15:54	17:58:51	19:33:11	5 53	88.7	55
Hermosillo, Sonora, Mexico	14:36:46	15:58:32	17:36:12	5 17	88.3	43
Kansas City, MO	15:09:21	16:44:55	18:31:47	*none*	88.8	61
Las Cruces, NM	14:44:52	16:10:35	17:52:03	5 16	88.5	49
Los Angeles, CA	14:44:11	16:00:26	17:28:56	*none*	71.9	37
Manchester, NH	15:56:49	17:42:10	19:22:59	2 16	88.9	62
Miami, FL	15:19:17	17:00:18	18:52:50	*none*	40.0	81
Montreal, Quebec, Canada	15:55:32	17:38:04	19:17:18	*none*	87.3	60
New Orleans, LA	15:00:03	16:38:26	18:32:57	*none*	64.7	68
New York City, NY	15:48:43	17:35:34	19:19:51	*none*	83.9	65
Oklahoma City, OK	14:58:46	16:32:26	18:20:32	3 26	88.8	59
Omaha, NE	15:12:28	16:46:04	18:29:47	*none*	82.2	59
Philadelphia, PA	15:45:03	17:32:05	19:17:42	*none*	82.2	66
Phoenix, AZ	14:44:29	16:05:51	17:41:18	*none*	81.6	43
Portland, ME	16:00:09	17:44:55	19:24:24	5 39	88.8	60
Portland, OR	15:09:52	16:19:00	17:35:08	*none*	42.9	35
St. Louis, MO	15:14:14	16:53:22	18:42:33	3 44	88.9	65
San Diego, CA	14:41:44	15:59:02	17:29:21	*none*	76.6	37
San Francisco, CA	14:51:43	16:04:05	17:26:26	*none*	58.6	34
Seattle WA	15:15:11	16:23:22	17:37:46	*none*	39.4	36
Springfield, IL	15:17:22	16:56:33	18:44:40	6 10	88.9	65
Toledo, OH	15:30:38	17:12:52	18:59:25	6 14	89.0	66
Toronto, Ontario, Canada	15:41:34	17:24:19	19:07:48	2 54	88.9	64
Tucson, AZ	14:42:28	16:04:44	17:41:52	*none*	86.1	44
Washington, DC	15:39:24	17:26:28	19:14:01	*none*	79.7	68

file of the Moon. Focal lengths from 500 to 2500 mm will fit the Sun within a 35-mm film frame. The lunar profile can also be accurately studied by observing *Baily's Beads*—sunlight shining through valleys on the Moon's limb; this phenomenon is particularly well seen along the the northern and southern limits of the annular track. This spectacle can be well captured by videotaping the eclipse with one's zoom lens at its maximum focal length, combined with a telextender.

In planning serious eclipse observation, contact our Solar Eclipse Recorder, Francis G. Graham, whose address is given on the inside back cover. For more information on making contact timings and lunar-limb observations observations, you should also contact the International Occultation Timing Association [IOTA], 2760 S.W. Jewell Avenue., Topeka, KS 66611-1614.) For such critical observations, you should use short-wave time signals for your timings (e.g., WWV at 2.5, 5, 10, 15, and 20 MHz; CHU at 3.330, 7.335, and 14.670 MHz), determine your latitude and longitude to 1 arc-second (about 30 meters) and your elevation to 20 meters.

More complete information on this eclipse is given in: Fred Espenak and Jay Anderson, *Annular Solar Eclipse of 10 May 1994* (NASA Reference Publication 1301), April, 1993. To request a copy, write to: Jay Anderson, Prairie Weather Centre, 900-266 Graham Avenue, Winnipeg, MB, CANADA R3C 3V4.

Selected eclipse information for the cities shown in *Figure 1* is given in *Table 1* (above), derived from the aforementioned publication.

ANNOUNCEMENTS

ASSOCIATION NEWS

1994 Convention.—We remind our readers that the 44th A.L.P.O. Convention will be held at the Roper Mountain Science Center, Greenville, SC, on June 16-18, 1994. This conference will include workshops for educators and for observing the Comet Shoemaker-Levy 9/Jupiter impact in July, 1994. Those interested in delivering a paper should send a 1-paragraph abstract to John Westfall (address on inside back cover), who will serve as Program Chairman, *no later than May 15, 1994.* Please indicate your audio-visual needs. The normal paper time will be 20 minutes, including questions, so be sure to specify if your paper will be longer or shorter.

Lunar Transient Phenomena Program Staff Change.—We regret to announce that Mrs. Winifred S. Cameron has resigned as Recorder of our Lunar Transient Phenomena (LTP) Program. Mrs. Cameron began her LTP studies as a NASA professional staff scientist during the Apollo Program, and has served as our LTP Recorder since 1971; her most recent article appeared in the preceding issue, and she will continue informally to help us analyze LTP Reports. Her successor, the Acting LTP Recorder, is Mr. David O. Darling, 416 W. Wilson St., Sun Prairie, WI 53590-2114. Mr. Darling has long been active in organizing LTP observations, particularly for the American Lunar Society.

New A.L.P.O. Training Coordinators.—With this position vacant for over one year, we are happy to announce that *two* persons have volunteered to serve as Acting A.L.P.O. Lunar and Planetary Training Coordinators. They are polling our staff to determine their observers' training needs and one of them, Mr. Will, plans to describe their intended program at our forthcoming convention. The names and address of our two new Coordinators are: Timothy J. Robertson, 2010 Hillgate Way #L, Simi Valley, CA 93065; and Matthew Will, 2112 Austin Drive, Springfield, IL 62704.

A.L.P.O. - NASA Clementine Mission Cooperation.—The Clementine Mission is the first space probe in over two decades that will image the Moon at close range, orbiting it between February 21 and May 3. The A.L.P.O. Lunar Transient Phenomena program has been furnished with the imaging schedule of the mission and is organizing a program of earth-based observations of 33 LTP sites at the times they are imaged by Clementine. To take part, write: David Darling, Madison Astronomical Society, P.O. Box 14747, Madison, WI 53714-0747.

Comet Shoemaker-Levy 9 Collision Preparations.—Jupiter Recorder, Phillip W. Budine is the A.L.P.O. Observing Coordinator for observing this unprecedented event; his address is on the inside back cover. He has begun issuing a monthly *Jupiter Chronicle: A.L.P.O. Jupiter Section Newsletter* dealing with this event, and plans to have a handbook for impact observers ready by March 1.

Now that Comet Shoemaker-Levy 9 has entered the morning sky, new astrometry has improved predictions of when its 21 (at least!) fragments will impact Jupiter; the stated time uncertainties are down to 0.03 days, allowing prospective observers to determine which impacts will occur when Jupiter is visible from their location, and which satellites may reflect the impact flashes. The new ephemerides still place the impact points on the hemisphere of Jupiter turned away from the Earth, but nearer to the limb than previous forecasts. This makes it more likely than previously thought that we may see something of the impact plumes and other related phenomena.

The A.L.P.O. Solar System Ephemeris: 1994.—Our annual ephemeris volume is now available for 1994. This issue contains 144 pages of tables, graphs, and maps describing the positions and appearances of the Sun, Moon, each major planet, the brighter planetary satellites, Minor Planets, meteors, comets, and the coming impact of Comet Shoemaker-Levy 9 with the planet Jupiter. You may order this publication from: Mark A. Davis, 1700 Whipple Road, Apt 11A, Mt. Pleasant, SC 29464, USA Make payment to "A.L.P.O." for $7.00 in the United States, Canada, and Mexico; $9.50 elsewhere (airmail included).

Appeal for Transit of Mercury Observations.— This new Provisional Transit Section desires observations for the 1993 NOV 06 Mercury Transit. Contact timings are particularly useful, as long as you indicate your latitude and longitude to 1 arc-minute accuracy.

Errata.—The article, "Librational Data and Other Correlations from David O. Darling's LTP Network for the A.L.P.O. LTP Observing Program," in our October, 1993 issue, contained two errors. David Weier's name was misspelled ("Weir") on p. 54. Also, a version of *Figure 1* (p. 56) had appeared earlier in the American Lunar Society journal, *Selenology* (Vol. 7, No. 2; Spring, 1988, p. 17).

ELSEWHERE IN THE SOLAR SYSTEM

Amateurs and the Hubble Space Telescope.—The Hubble Space Telescope Amateur Astronomers Working Group, on which the A.L.P.O. is represented, announces that April 30, 1994 is the postmark deadline for the fourth annual cycle of amateur proposals to use the Hubble Space Telescope. Proposers who are American citizens or legal residents may request a proposal package from: HST Package, AAVSO, 25 Birch St., Cambridge, MA 02138. Amateurs outside the United States should contact the European Director of

HST Activities at the European Space Agency. For the purposes of this program, an amateur is defined as anyone who does not have an advanced degree in astronomy or physics and does not work at an observatory.

First Annual Peach State Star Gaze.—This new event will be held at the Future Farmers of America Campground outside Covington, Georgia (50 miles east of Atlanta) on April 7-10, 1994. It will feature nationally-known speakers, astrophotographers, dark skies, swap tables, A-1 accommodations, and more. The event is sponsored by the Atlanta Astronomy Club. To find out more, contact Ken Poshedly, 3440 Everson Bay Court, Snellville, GA 30278-4463, (404) 979-9842.

Twenty-fifth Annual Lunar and Planetary Science Conference.—This is one of the two major Solar-System conferences, having met each year since the Apollo-11 lunar landing. The 1994 meeting will consist of five days of paper and poster sessions. Some of the fields represented will be petrology, geochemistry, geophysics, geology, and astronomy. It will be held (as always) in Houston, Texas, on the dates of March 14-18, 1994. For more information about the program and logistics, contact: 25th LPSC, Publications and Program Services Department, Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston, TX 77058-1113; telephone 713-486-2166.

Astronomical Telescopes & Instrumentation for the 21st Century.—Hosted by the Society of Photo-Optical Instrumentation Engineers (SPIE), this meeting will be held March 13-18, 1994 at the Kona Surf Resort and Country Club in Kona, Hawaii. Tours of the large telescopes on Mauna Kea are planned. This conference will be held March 15-16.The non-SPIE member registration fee is $410; to find out more call SPIE at 206-676-3290.

Riverside Telescope Markers Conference.—The 26th annual RTMC will be held May 27-30, 1994, at Camp Oakes near Big Bear Lake, California. The theme for this year's conference is "Making and Using Planetary Telescopes," with an eye towards the collision of Comet P/Shoemaker-Levy 9 with Jupiter; an instructional session on using CCD cameras will be held. Requests for an information and registration package should be directed to: RTMC, c/o Fox & Stephens, CPA's, 9045 Haven Ave., Suite 109, Rancho Cucamonga, CA 91730. Messages may be left at 909-948-2205.

Astronomical Society of the Pacific 106th Meeting/UNIVERSE '94.—The theme of the 106th scientific meeting of the A.S.P. will be "Completing the Inventory of the Solar System." To further appeal to A.L.P.O. members, the location will be the Northern Arizona University in Flagstaff, Arizona. The dates will be June 25 - July 1, 1994, and will include the centennial celebration of Lowell Observatory. For more information on this scientific symposium, contact: Lowell Observatory, ASP Symposium, 1400 W. Mars Hill Road, Flagstaff, AZ 86001.

At the same time and place, on the weekend of June 25-26, will be UNIVERSE '94. the A.S.P.'s third annual exposition oriented to amateurs and educators.

A.L.P.O. Volunteer Tutors

Below are listed experienced A.L.P.O. members who are available to serve as volunteer tutors to correspond with less-experienced members interested in their specialities. There is no better way to learn than by such one-on-one education. If you want to brush up on any of our observing techniques, write to one of them; be sure to enclose a SASE.

Dr. Julius L. Benton, Jr.
305 Surrey Road
Savannah, GA 31410
Instrumentation and Equipment Selection

Mr. Gregory L. Bohemier
E Berkshire Road,
RR1 Box 193
Berkshire, NY 13736
Instrumentation and Equipment Selection

Mr. Richard E. Hill
Lunar & Planetary Lab.,
University of Arizona,
Tucson, AZ 85721
(Internet: rhill@hindmost.lpl.arizona.edu)
Solar.

Mr. Harry D. Jamieson
P.O. Box 143, Heber Springs, AR 72543
Lunar; Instrumentation and Equipment Selection; Software—Astronomical Programming

Mr. Andrew Paul Johnson
1 York Lane, Knaresborough, North Yorkshire
United Kingdom HG5 0AJ
Lunar; Drawing Skills

Mr. Charles A. Kapral
6601 Hana Road
Edison, NJ 08817
Lunar; Photometry

Mr. Michael Mattei
11 Coughlin Road.
Littleton, MA 01460
Drawing Skills; Telescope Making or Enhancement

Mr. Frank J. Melillo
14 Glen Hollow Dr.,
Apt. E-16
Holtsville, NY 17742
Solar; Photometry

Mr. José Olivarez
1469 North Valleyview Ct., Wichita, KS 67212
Instrumentation and Equipment Selection; General Literature

Mr. Zac Pujic
23 Attungan St.
Kingston 4114
Queensland, Australia
Planetary Observing

Mr. Timothy J. Robertson
2010 Hillgate Way, Apt. L
Simi Valley, CA 93065
Drawing Skills; Comets

Mr. Andrew M. Sorenson
RR 4, Box 4A
Jefferson, IA 50129
Telescope Making or Enhancement

Mr. Brad Timerson
623 Bell Road.
Newark, NY 14513
Instrumentation and Equipment Selection

Mr. Daniel M. Troiani
629 Verona Ct.
Schaumburg, IL 60193
Mars; Video/CCD Imaging

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

◆◆

Order from: Mark A. Davis, 1700 Whipple Road, Apt. 11A, Mt. Pleasant, SC 29464, USA

The A.L.P.O. Solar System Ephemeris: 1994. $7.00 in the United States, Canada, and Mexico; $9.50 elsewhere (airmail included). Contains 144 pages of tables, graphs, and maps describing the positions and appearances of the Sun, Moon, each major planet, the brighter planetary satellites, Minor Planets, meteors, and comets. Make payment to "A.L.P.O."

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

An Introductory Bibliography for Solar System Observers. *Free* for a stamped, self-addressed envelope. A 4-page list of books and magazines about Solar System bodies and how to observe them. The current edition was updated in July, 1993.

◆◆

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Order from: Walter H. Haas, 2225 Thomas Drive, Las Cruces, NM 88001, U.S.A:

Back issues of ***The Strolling Astronomer (J.A.L.P.O.).*** The following are still in stock but may not long remain so. In this list, volume numbers are in ***italics***, issue numbers are not, years are given in parentheses, and prices are $1.50 per issue unless otherwise stated. Discounts can be arranged for purchases over $20. Make payment to "Walter H. Haas."

1 (1947); 6. ***8*** (1954); 7-8. ***11*** (1957); 11-12.
21 (1968-69); 3-4 and 7-8. ***23*** (1971-72); 3-4, 7-8, 9-10, and 11-12.
25 (1974-76); 1-2, 3-4, 7-8, and 11-12.
26 (1976-77); 3-4, 5-6, and 11-12 [each $1.75].
27 (1977-79); 3-4, 5-6, 7-8, 9-10, and 11-12 [each $1.75].
28 (1979-81); 3-4 [each $1.75]. ***31*** (1985-86); 5-6 and 9-10 [each $2.50].
32 (1987-88); 5-6 and 11-12 [each $2.50].
33 (1989); 4-6, 7-9, and 10-12 [each $2.50]. ***34*** (1990); 2 [each $2.50].
35 (1991); 1 and 3 [each $2.50]. ***36*** (1992); 1 and 2 [each $2.50].
37 (1993); 1 and 2 [each $2.50]. ***Current Issue*** [***37***, 3]—$3.00.

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A.L.P.O. memberships include a subscription to the *Strolling Astronomer (J.A.L.P.O.)*; the top line of your mailing label gives the volume and issue number for which your membership will expire (e.g., "37.3" means Vol. 37, No.3). We include a *First Renewal Notice* in that issue, and a ***Final Notice*** in the next one.

Please also let the Membership Secretary know if your address changes.

CONTRIBUTING TO *THE STROLLING ASTRONOMER (J.A.L.P.O.)*—

We welcome reports and observations from our readers and our staff, although we do not wish material that has been published or submitted elsewhere. Please submit typewritten, doubled-spaced copy. For articles longer than two pages, begin with a 75-150 word abstract (our Journal is abstracted). Cite pertinent references in full, including page numbers. Fully document observations with the name and address of the observer; the observing site if different from the observer's address; the date and time in Universal Time; the telescope type, aperture (cm preferred), and magnification; filters used if any; atmospheric conditions (Seeing on the 0-10 A.L.P.O. scale; Transparency as the limiting stellar magnitude in the vicinity of the object); and other data as pertinent to the object observed. Illustrations are welcome but we cannot publish color. For low-contrast objects, contrasts should be exaggerated on drawings and photographs. Also, be sure to indicate the direction of celestial north or south, as well as celestial east or west if the image is laterally reversed.

With all communications with A.L.P.O. staff, please furnish a stamped, self-addressed envelope.

The Association of Lunar and Planetary Observers

Founded in 1947, the A.L.P.O. now has about 600 members. Our dues include a subscription to the quarterly Journal, *The Strolling Astronomer*, and are $16.00 for one year ($26.00 for two years) for the United States, Canada, and Mexico; and $20.00 for one year ($33.00 for two years) for other countries. One-year Sustaining Memberships are $25.00; Sponsorships are $50.00. Associate Memberships, which do not include a Journal subscription, are $3.00 per year. 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 Ad., $50.00 per half-page, and $35.00 per quarter-page. Classified Ads. are $10.00 per column-inch. There is a 10-percent discount for a 3-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." When writing our staff, please furnish stamped, self-addressed envelopes.