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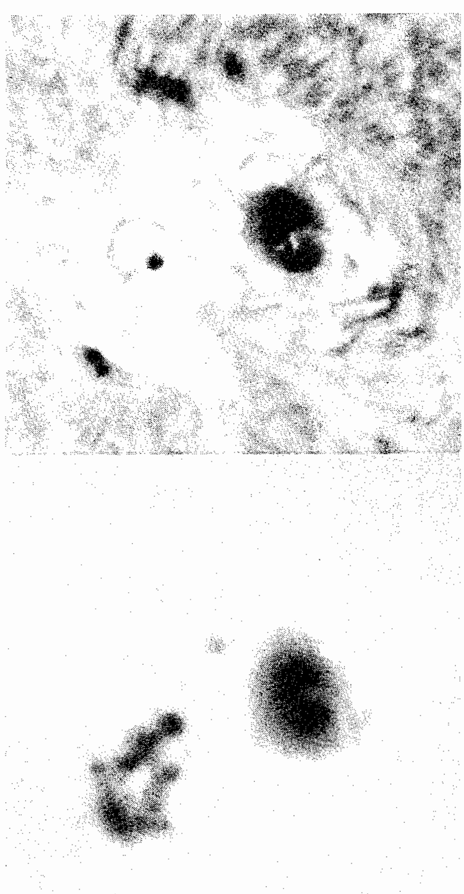

Two nearly-simultaneous photographs of the Sun at different wavelengths taken by Frank J. Melillo on 1922 Aug. 20 with a 20-cm (8-in) Schmidt-Cassegrain telescope, using 1/4-second exposures on Kodak TP 2415 Film. Both show the sunspot Region 7260 with north at the top. The upper view was taken at 22h30m UT in H-α light with a 0.6 Å Daystar Filter, and the aperture stopped to 6 cm (2.5 in) The lower view was taken in integrated light (no filter) at 22h40m UT, using a 7.5-cm (3 in) aperture stop. See Mr. Melillo's article on solar photography on pages 44-45 of this issue.

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In This Issue

THE 1991-92 APPARITION OF SATURN: VISUAL AND PHOTOGRAPHIC OBSERVATIONS

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

ABSTRACT

Members of the A.L.P.O. Saturn Section made visual and photographic studies of the planet Saturn and its Rings between 1991 MAY 04 and DEC 10 with telescopes from 7.5 to 40.0 cm in aperture. Some observers suspected continued white-spot activity in the Equatorial Zone (EZ) of Saturn during 1991, possibly supported by a few photographs from Japan. However, any sightings of white spots were unconfirmed. A few individuals made central-meridian (CM) transit timings of atmospheric detail, but these did not permit useful rotation rates to be derived. There was a limited number of photoelectric photometric observations of Saturn and its brighter satellites in 1991. The inclination of the Rings to our line of sight, **B**, reached a maximum of +21°.383 during 1991-92, exposing the Northern Hemisphere of the Globe and the north face of the Rings to our view, with hints of detail in the Southern Hemisphere. This report is accompanied by references, drawings, photographs, graphs, and tables.

INTRODUCTION

Good observer participation during the period 1991 MAY 04-DEC 10 resulted in a fine collection of visual and photographic observations of the planet Saturn and its Rings. These data form the basis of this analytical report. Selected drawings and photographs accompany this report in order to enhance the reader's understanding and appreciation of the material. [Note that all dates and times in this report are in Universal Time, or "UT."]

Table 1, below, gives pertinent geocentric data for the 1991-92 Apparition of Saturn. The saturnicentric latitude of the Earth, **B**, referred to the ring plane and positive when north, varied from +18°.911 on 1991 MAY 04 to +18°.880 on 1991 MAY 14 to +21°.383 on 1991 OCT 05 and to +20°.261 on 1991 DEC 10, while the saturnicentric latitude of the Sun, **B**', decreased from +20°.926 on 1991 MAY 04 to +18°.819 on 1991 DEC 10. [7]

Table 1. Geocentric Phenomena for Saturn in the 1991-92 Apparition. [7]

Conjunction	1991 JAN 18, 08^h
Opposition (in Capricornus)	1991 JUL 27, 00
Conjunction	1992 JAN 29, 22

Opposition Data:

Visual Magnitude	+0.1
B	+20°.197
B'	+20°.154
Declination of Saturn	-19°.84
Globe Diameter: Equatorial	18".49
Polar	16".74
Rings: Major Axis	42".16
Minor Axis	14".56

Table 2 (to right and on p. 2) lists the 24 persons who submitted a total of 208 observations to the A.L.P.O. Saturn Section for the 1991-92 Apparition, together with their observing sites, number of dates of observations, and descriptions of their telescopes.

Table 2. Contributing Observers, 1991-92 Apparition of Saturn.

Observer & Location	No. of Dates	Telescope Data*
Julius L. Benton, Jr. Wilmington Island, GA	5	15.2-cm (6.0-in) R
Mark Bosselaers	20	22.5-cm (8.9-in) N
Berchem, Belgium	1	25.4-cm (10.0-in) N
Daniel Boyar Boynton Beach, FL	1	7.5-cm (3.0-in) R
J.R. Brunkella Thousand Oaks, CA	2	25.4-cm (10.0-in) N
Frank Daerden	22	11.5-cm (4.5-in) N
Bilzen, Belgium	1	14.5-cm (5.7-in) N
	1	20.0-cm (7.9-in) R
Donald H. DeKarske Colorado Springs, CO	2	10.2-cm (4.0-in) R
Marc A. Gelinas N.D. Ile Perrot, Quebec, Canada	4	15.2-cm (6.0-in) R
David L. Graham	5	15.2-cm (6.0-in) R
Brompton-on-Swale, North Yorkshire, UK	4	40.0-cm (15.8-in) N
Walter H. Haas	3	20.3-cm (8.0-in) N
Las Cruces, NM	13	31.8-cm (12.5-in) N
Alan W. Heath Nottingham, UK	19	30.5-cm (12.0-in) N
Frank J. Melillo North Valley Stream, NY	1	20.3-cm (8.0-in) S
Isao Miyazaki Okinawa, Japan	8	40.0-cm (15.8-in) N
Gary T. Nowak Essex Junction, VT	12	25.4-cm (10.0-in) SS
San Gersolé Planetary Group, Florence, Italy	1	30.0-cm (11.8-in) C
Richard W. Schmude, Jr. Los Alamos, NM	17	25.4-cm (10.0-in) N
Kenneth Schneller Euclid, OH	2	20.3-cm (8.0-in) N

— *Table 2 continued on p. 2* —

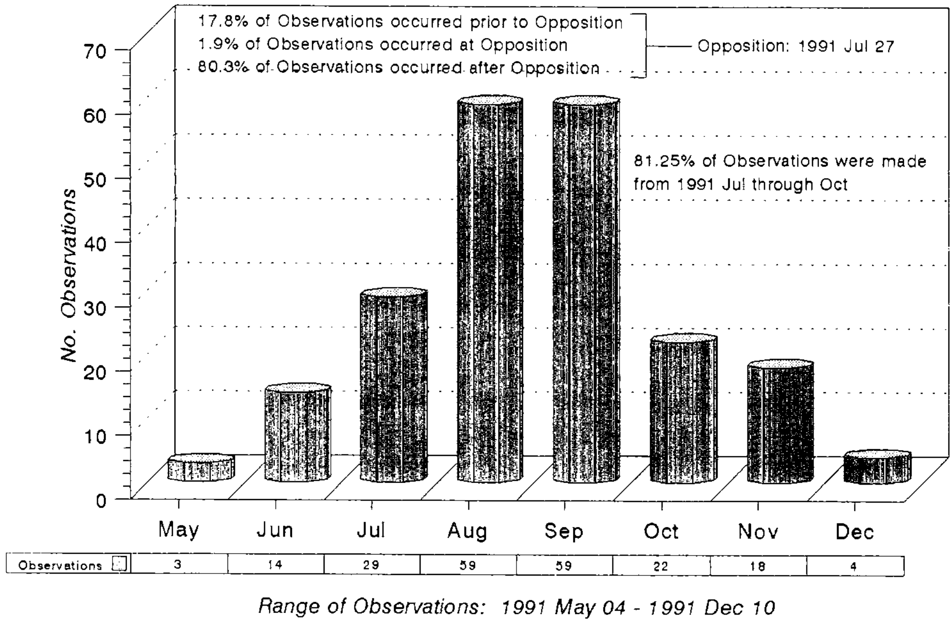


Figure 1. Distribution of observations of Saturn by month during the 1991-92 Apparition .

Table 2—Continued.

Observer & Location	No. of Dates	Telescope Data*
Michael E. Sweetman Tucson, AZ	3	15.2-cm (6.0-in) R
Bert Timmers	6	11.0-cm (4.3-in) R
Tucson, AZ	1	20.3-cm (8.0-in) R
Hendrik Vandenbruaene Beernem, Belgium	10	20.0-cm (7.9-in) N
Erwin Verwichte	2	15.2-cm (6.0-in) N
Genk, Belgium	3	20.0-cm (7.9-in) R
Myron E. Wasiuta	16	25.4-cm (10.0-in) N
Dale City, VA	9	30.5-cm (12.0-in) R
John E. Westfall	2	10.2-cm (4.0-in) R
San Francisco, CA	2	35.6-cm (14.0-in) S
Samuel R. Whitby Hopewell, VA	4	15.2-cm (6.0-in) N
Matthew Will Herrin, IL	6	20.3-cm (8.0-in) N
Total Observations	*208*	
Total Observers	*24*	

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

Figure 1 (above) gives the distribution of observations by month in 1991, showing that 81.25 percent of the observations were for the months of July through October, 1991. Also, only 17.8 percent of the observations were made before opposition, 1.9 percent on the date of opposition (1991 JUL 27), and 80.3 percent after that date It is usual that the maximum observational coverage of Saturn falls near, or slightly after, opposition. This of course creates observational bias; and we encourage all observers to try to maintain a consistent surveillance of Saturn, starting as early in each apparition as possible, and continuing until Saturn nears the time of conjunction with the Sun.

Figure 2 (p. 3) shows our 24 observers and 208 observations by nation of observation; usually also that of residence. Almost one-half of the observations (48.6 percent) and three-eighths of the observers (37.5 percent) were located outside the United States; in Europe, Canada, and Japan, continuing to demonstrate in 1991 the international scope of the A.L.P.O. Saturn Section programs.

Finally, *Figure 3* (p. 3) graphs the number of observations by the type of instrument. Telescopes of classical design predominated the scene again in 1991, with 92.7 percent of the observations; due chiefly to their overall proven performance, soundness of design, and consistent favorable image contrast and resolution; all desirable for planetary work. Also, 83.6 percent of the observations were made with instruments of 15.2 cm (6.0 in) aperture or greater.

During the 1991-92 Apparition, seeing conditions averaged about 5.9 on the A.L.P.O. Seeing Scale, which ranges from 0.0 for the worst possible seeing to 10.0 for perfect conditions. Atmospheric transparency, expressed as the magnitude of the faintest star visible to the unaided dark-adapted eye near the object being observed, averaged about +3.8 during the same period.

The writer expresses his sincere gratitude to all the dedicated colleagues mentioned in *Table 2*, who carried out their observations as part of the A.L.P.O. Saturn Section. We encourage observers in this country and abroad

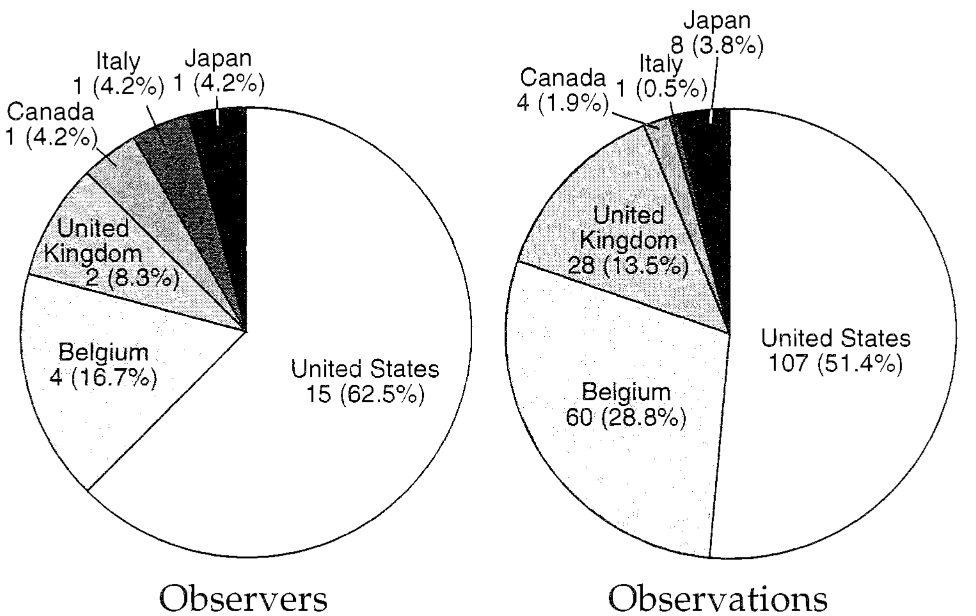


Figure 2. National distribution of Saturn observers and observations for the 1991-92 Apparition.

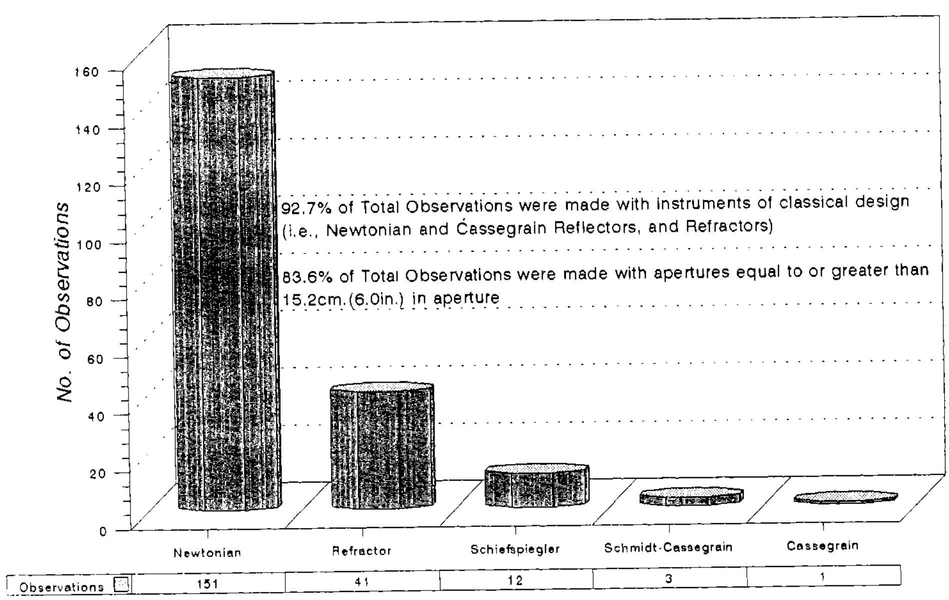


Figure 3. Distribution of observations of Saturn by type of instrument for the 1991-92 Apparition.

to continue working with us in coming apparitions. Efforts are continuing to stimulate intensified and more comprehensive international coverage of Saturn throughout the coming observing seasons. We invite interested observers, regardless of experience, to join us in our work.

THE GLOBE OF SATURN

The discussion that follows has been derived from an analysis of the 208 reports contributed to the A.L.P.O. Saturn Section throughout the 1991-92 Apparition. For the purpose of brevity, except when the identity of an individual is pertinent to the discussion, the names of observers are not given in the text. Numerical tables, graphs, drawings, and photographs accompany the text, and readers should refer to them while reading this report. Features on the Globe are discussed in north-to-south order and can be identified by the nomenclature diagram in *Figure 4* (p. 4).

Northern Portions of the Globe.

Saturn did not exhibit the extraordinary outbursts in white-spot activity that took place in 1990-91, but observers were successful in recording some variations in the appearance, brightness, or both of the belts and zones of the Northern Hemisphere of Saturn in 1991-

92. As is well known, the atmospheric features on the planet are characteristically ill-defined and usually transient, so that it takes a great deal of persistence and meticulous visual monitoring to recognize any subtle variations.

Stephen O'Meara of *Sky & Telescope* advised the A.L.P.O. Saturn Section that astronomers at Pic du Midi Observatory in France had detected a pair of white ovals in the EZ (Equatorial Zone) of Saturn on 1992 FEB 24, 06h44m UT, near CM(I) 252° [i.e., longitude 252° was on the central meridian of Saturn, referred to the System I rotational rate of 844°.3 per day]. However, there were no reports confirming this alert received by the A.L.P.O. Therefore, based on the observations received by the A.L.P.O. Saturn Section during 1991-92, covering the period 1991 MAY 04-DEC 10, there was only limited bright-spot activity. This is in contrast with the spectacular emergence of the Great White Spot in the EZ during the 1990-91 Apparition. Miyazaki in Japan successfully photographed what appeared to be tiny, whitish spots in the EZ on 1991 JUL 20, AUG 03, AUG 30, and SEP 05, but there were no confirming observations by other observers. These and other suspected bright spots, as well as discrete dusky features in specific belts and zones, did not persist for a sufficient length of time for satisfactory CM transit timings.

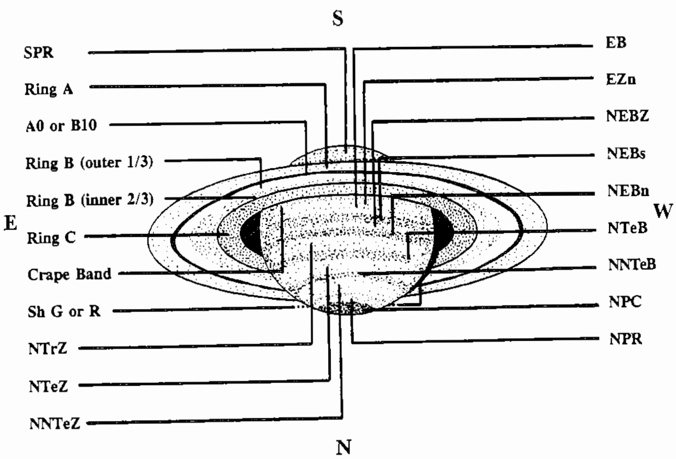


Figure 4. The general appearance of Saturn slightly after opposition (1991 JUL 27), with nomenclature of the major Globe and Ring features that were easily detected with moderate apertures in good seeing. South is at the top; and global features move across the planet from right to left in this normal inverted view (i.e., as seen in an astronomical telescope near culmination in the Earth's Northern Hemisphere without a diagonal or other device that would reverse the image). East (E) and West (W) are shown in the International Astronomical Union (IAU) convention; in the celestial convention, East would be to the right. The numerical value of **B** is +20°. 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; 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*. **[1, 2]**

Table 3 (p. 5) summarizes the relative visual numerical intensities of the atmospheric features of Saturn's Northern Hemisphere during 1991-92, and estimates their change since the 1990-91 Apparition. Intensities are given in the A.L.P.O. Standard Numerical Relative Intensity Scale, where 0.0 is completely black and 10.0 is the brightest possible condition. This scale is normalized by setting the outer third of Ring B to a standard intensity of 8.0. This table should help the reader to appreciate the subtle but recognizable variations that may be underway, both seasonally and longer-term. A similar analysis of Southern-Hemisphere features will soon be possible as more and more of that region comes into view.

It is often held that the varying tilt of Saturn's rotational axis with respect to the Sun and the Earth plays a rather significant role in any changes in the reported belt and zone intensities. The numerical sign of an intensity change is found by subtracting a feature's 1990-91 intensity **[4]** from its 1991-92 intensity. Note, however, that a change of only ±0.1 mean intensity points is considered to be of no significance; indeed, a change is not likely to be significant unless it is greater than about 3 times the intensity's standard deviation.

The latitudes of features in the Northern Hemisphere of Saturn's Globe are given in *Table 4* (p. 6). These were estimated by observers using the visual method developed by Haas many years ago. In this, one estimates the fraction of the polar semidiameter of the planet's disk that is subtended on the central meridian (CM) between the northern or southern limb and the feature whose latitude is sought. This method is easy to use, and its results compare well with similar values obtained using filar micrometers. It must be remembered, however, that it is often risky to place too much confidence on results derived from only a few observers. Yet, Haas particularly has been using this technique for a number of years with consistent results. His method is slowly catching on among other observers, who are encouraged to employ this simple procedure whenever possible, even if a filar micrometer is also available. Comparative data from both visual estimates and micrometer measurements would be particularly useful. A full discussion of this visual technique can be found in the *Saturn Handbook*. **[2]** In

Table 3. Visual Numerical Intensity Estimates and Colors: Saturn, 1991-92.

Globe/Ring Feature	Relative Intensity (1991-92): Number of Estimates	Mean and Standard Deviation	Change Since 1990-91	"Mean" Derived Hue (1991-92)
ZONES AND OTHER BRIGHT AREAS:				
NPC	10	5.2 ± 0.17	+0.1	Dusky Yellowish-Grey
NPR	60	5.0 ± 0.81	+0.3	Yellowish-Grey
NTeZ	15	6.7 ± 0.43	+0.6	Yellowish-White
NTrZ	24	6.1 ± 0.96	+0.5	Dull Yellowish-White
NEB Z	9	5.0 ± 0.69	+0.3	Yellowish-Grey
EZn	51	6.9 ± 0.50	-0.2	Pale Yellowish-White
Globe North of NEB (entire)	22	5.3 ± 0.50	0.0	Dusky Yellowish-Grey
Globe South of Rings (entire)	14	5.0 ± 0.09	---	Dusky Yellowish-Grey
SPR	7	5.1 ± 0.42	---	Yellowish-Grey
BELTS:				
NPB	17	4.0 ± 0.60	+0.2	Greyish
NTeB	8	4.2 ± 1.71	+0.3	Greyish
NEB (entire)	55	4.0 ± 0.58	+0.5	Greyish-Brown
NEBn	10	3.2 ± 0.16	-0.4	Dark Greyish-Brown
NEBs	10	3.1 ± 0.32	-0.2	Dark Greyish-Brown
EB	1	4.2 ---	-0.1	Greyish
SEBn	1	4.5 ---	---	Greyish
RINGS:				
Ring A (entire)	54	6.6 ± 0.83	+0.8	Dusky White
Ring A (outer half)	3	7.0 ± 1.20	+0.5	Dusky White
Encke's Division (A5; ansae)	7	2.9 ± 1.86	-1.0	Dark Grey
Ring A (inner half)	3	6.7 ± 0.09	+0.4	Dusky White
Cassini's Division (A0 /B10; ansae)	29	0.7 ± 0.64	-0.4	Greyish-Black
Ring B				
Ring B (outer third)	208	8.0 **[Standard]**		White
Ring B (inner two-thirds)	26	7.2 ± 0.53	-0.1	Yellowish-White
Intensity Minimum (B1; ansae)	3	1.9 ± 1.35	-0.9	Dark Grey
Ring C (ansae)	26	1.1 ± 0.80	+0.2	Greyish-Black
Crape Band	26	3.4 ± 1.18	+0.6	Dark Grey
Shadow Globe on Ring	32	0.2 ± 0.19	-0.3	Dark Greyish-Black
Shadow Ring on Globe	17	0.2 ± 0.38	---	Dark Greyish-Black
TWS	21	7.9 ± 0.56	+0.3	White

Notes: For nomenclature see text and *Figure 4* (p.4). 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 1990-91" is in the sense of the 1990-91 value subtracted from the 1991-92 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.

the discussions of individual features that follow, latitude data are noted when appropriate.

North Polar Region (NPR).—The brightness of the yellowish-grey NPR increased very slightly (+0.3 mean intensity points) from 1990-91 to 1991-92. The intensity of the NPR remained mostly uniform throughout the apparition. The dusky yellowish-grey NPC (North Polar Cap) was seen in the extreme north during most of 1991-92, and since 1990-91 showed no real brightness change (only +0.1 in mean intensity value). The greyish NPB (North Polar Belt) was de-

Table 4. Latitudes of the Northern-Hemisphere Belts of Saturn in the 1991-92 Apparition.

Saturnian Belt	Planetocentric ° °	(Change from 1990-91) °	Eccentric ° °	(Change from 1990-91) °	Planetographic ° °	(Change from 1990-91) °
Center EB	+3.2 ±1.5	(+7.3)	+3.6 ±1.7	(+8.2)	+4.0 ±0.9	(+9.2)
South edge NEB	+20.8 ±1.3	(+1.8)	+23.1 ±1.5	(+2.0)	+25.5 ±1.6	(+2.2)
North edge NEB	+27.2 ±2.8	(+1.3)	+29.9 ±3.0	(+1.4)	+32.7 ±3.2	(+1.4)
Center NTeB	+31.9 ---	(- 1.2)	+34.9 ---	(- 1.2)	+38.0 ---	(- 1.1)
South edge NPB	+75.2 ±3.7	(- 2.4)	+76.7 ±3.4	(- 2.2)	+78.1 ±3.0	(- 1.9)

Type of Latitude (Change from 1990-91 in parentheses)

Notes: For nomenclature see *Figure 4* (p. 4). Latitudes are calculated using the appropriate geocentric tilt, **B**, for each date of observation. Planetocentric latitude is the angle between the equator and the feature as seen from the center of the planet. Planetographic latitude is the angle between the surface normal and the equatorial plane. Eccentric, or "Mean," latitude is the 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 1990-91 latitude value **[4]** from the 1991-92 latitude value.

scribed in 1991-92 as a continuous greyish linear feature encircling the NPR, not quite so dark as in 1990-91 (with a small intensity increase of +0.2).

North North Temperate Zone (NNTeZ).– This feature was not referred to in any observational reports submitted for 1991-92.

North North Temperate Belt (NNTeB).— This feature was not referred to in any observational reports submitted for 1991-92.

North Temperate Zone (NTeZ).—When seen in 1991-92, the yellowish-white NTeZ showed slight intensity changes, but these were always very subtle and poorly defined. Other than the EZ, the NTeZ was the brightest of Saturn's zones during 1991-92, and it showed an increase in overall brightness of +0.6 mean intensity points since 1990-91.

North Temperate Belt (NTeB).—This belt was infrequently reported. When it was visible, it was always a narrow, usually uniform feature, greyish in hue, and extending across the Globe from limb to limb. The NTeB was slightly lighter in 1991-92 than in 1990-91 (by +0.3 mean intensity points).

North Tropical Zone (NTrZ).—The NTrZ showed a slight increase in brightness (by +0.5 mean intensity points) from 1990-91 to 1991-92. Observers assigned it a dull yellowish-white color in 1991-92, and it was usually constant in intensity from limb to limb throughout the observing season.

North Equatorial Belt (NEB).—The greyish-brown NEB, by far the most conspicuous belt on the Ball, was sometimes seen in 1991-92 as differentiated into the NEBn and NEBs, where **n** refers to the North Component and **s** to the South Component, separated by the NEB Z (North Equatorial Belt Zone). This aspect was only occasionally seen in 1991-92; most often the NEB was recorded as a single feature during the apparition. As a whole, the NEB showed a slight brightness increase since 1990-91 (by +0.5 mean intensity points), and tied with the NPB as the darkest belt on the Globe during the 1990-91 Apparition.

The greyish-brown NEBn became slightly darker from 1990-91 to 1991-92 (decreasing by -0.4 mean intensity points). Observers suspected some poorly defined features within the NEBn, but none lasted long enough for usable CM transit timings.

The greyish-brown NEBs was the darkest atmospheric feature on the Globe of Saturn in 1991-92, even darker than the NEB as a whole, which had been the case for several other recent apparitions prior to that of 1991-92. The NEBs had darkened only slightly since 1990-91 (-0.2 mean intensity points). Occasional dark condensations were suspected in the NEBs, but CM transit timings were hampered by the transient and ill-defined nature of these features.

The yellowish-grey NEB Z was only occasionally seen during 1991-92, exhibiting a minor brightness increase of +0.3 mean intensity points since 1990-91. As in the last three apparitions, the NEB Z was one of the darkest zones on Saturn in 1991-92. While it might appear that the NEB Z was hard to see in contrast with its surroundings, the location between the darker NEBn and NEBs made it possible to distinguish this zone. The NEB Z showed no activity during the 1991-92 Apparition, and it remained uniform in intensity throughout the observing season.

Equatorial Zone (EZ).—This discussion concentrates chiefly on the EZn, or northern portion of the EZ. This pale yellowish-white feature showed a small darkening (of -0.2 mean intensity points) from 1990-91 to 1991-92. The EZn was the brightest zone on Saturn in 1991-92, with an intensity closely matching the inner two-thirds of Ring B.

Within the EZ there were a few interesting, but unconfirmed, reports of sporadic small white spots during the apparition. As noted above, these apparently short-lived features were suggested on photographs taken in July-September by Miyazaki in Japan. Short-lived wispy festoons, projecting from the NEBs, were also suspected periodically during the apparition. Overall, however, there was little other activity in the EZn during 1991-92.

The Equatorial Band (EB) was seen infrequently during the 1991-92 Apparition; as a yellowish-grey feature, very narrow and discontinuous. Compared with 1990-91, its intensity was essentially unchanged (by -0.1 mean intensity points).

Shadow of the Rings on the Globe (Sh R on G).—This feature was sometimes visible as a dark greyish-black feature both before and after opposition. The deviation from true black (0.0 intensity) was due to poor seeing and scattered light.

Southern Portions of the Globe.

As the Rings of Saturn continue to decrease in their inclination, **B**, to our line of sight, more and more of the Southern-Hemisphere features of the planet are tilted into our view and as the Rings obstruct less of them. Naturally, this also means that the northern latitudes are becoming less visible.

South Polar Region (SPR).—The SPR appeared yellowish-grey during the 1991-1992 Apparition, and essentially at the same mean intensity as the NPR (the SPR being only +0.1 mean intensity points brighter).

South Equatorial Belt (SEB).—There was only one isolated report that even suspected the greyish SEBn in 1991-92.

THE RINGS OF SATURN

This section covers the analysis of the observations of Saturn's Ring System that were submitted throughout the 1991-92 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 1991-92 observing season

Ring A.—Taken as a whole, Ring A was dull white throughout the 1991-92 Apparition, showing a small increase in brightness since 1990-91 (by +0.8 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, and there were no other intensity minima recorded in Ring A in 1991-92.

On rare occasions, Ring A was described as having distinct outer and inner halves in terms of intensity. In 1991-92, the outer half of Ring A was dusky white and was +0.3 mean intensity points lighter than the dusky white inner half. Compared with the 1990-91 Apparition, the outer and inner halves of Ring A were slightly brighter in 1991-92 (by a mean intensity factor of +0.5 for the outer half and +0.4 for the inner half); and both areas remained stable in overall intensity throughout 1991-92.

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 1991-92, this portion of Ring B appeared white, stable in intensity, and easily the brightest feature on either Saturn's Globe or its Rings.

The inner two-thirds of Ring B, chiefly yellowish-white in hue, was of about the same mean intensity in 1991-92 as it had been in the immediately preceding apparition (the apparent -0.1 mean intensity change is not significant). It was also mostly uniform in intensity throughout 1991-92, although observers intermittently sighted an intensity minimum at **B1** (i.e., at 0.1 of the distance from the inner to the outer edge of Ring B). B1 was described as dark grey in hue and was visible only at the ansae. Such intensity minima are not permanent features, as was shown by the Voyager Missions.

Cassini's Division (A0 or B10).—This feature was usually visible at the ansae in 1991-92, seen as extending all the way around the Rings in good seeing. It had a grayish-black appearance in 1991-92, slightly darker (by -0.4 mean intensity points) in intensity when compared with its 1990-91 appearance. As with the Sh G on R, the deviation from a true black appearance is due to scattered light. Observers with even the smallest apertures had little difficulty in finding this feature during the observing season.

Ring C.—In 1991-92, observers reported Ring C as fairly easy to see at the ansae, grayish-black in color, and perhaps a little lighter (by +0.2 mean intensity points) than in 1990-91. Note that faint or narrow Ring features are usually easier to perceive, and thus misleadingly appear darker, the greater the Ring inclination.

The Crape Band, or Ring C as projected onto the Globe, was +0.6 mean intensity points lighter in 1991-92 than in the immediately preceding apparition. In the 1991-92 Apparition, observers described this feature as uniform in intensity and very dark grey in color. During the past several apparitions, the Saturnicentric latitudes of the Sun and Earth have caused at least a portion of the Crape Band to be superimposed on the Shadow of Ring C on the Globe.

Ring Components Other than A, B, or C.—Neither Ring D (inside Ring C) nor Ring E (outside Ring A) was reported in 1991-92. Of course, these Ring components are exceedingly difficult to observe except under the best conditions and with large apertures.

Shadow of the Globe on the Rings (Sh G on R).—This feature was always seen as dark greyish-black and regular in form during 1991-92. As with the Sh R on G, any deviation from true black (0.0) intensity must be due to scattered light.

Terby White Spot (TWS).—The TWS is an occasionally-reported brightening of the Rings adjacent to the Sh G on R. Several observers during 1991-92 recorded a bright, whitish TWS, continuing to be 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 this apparition except for the outer third of Ring B.

Table 5. Observations of the Bicolored Aspect of Saturn's Rings in 1991-92.

Notes: Telescope types are as in *Table 2* (pp. 1-2). Seeing is on the 0-10 A.L.P.O. scale (see p. 2). Transparency is the limiting visual magnitude in the vicinity of Saturn. Under "Filter," **B** refers to the blue W47 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.

Observer	1991 UT Date and Time (entire observing period)		Telescope Type and Aperture	Magnification	Seeing	Transparancy	Filter B	Filter IL	Filter R
Haas	MAY 17	10:57-11:47	N 31.8 cm (12.5 in)	366X	3.5	+3.5	E	=	=
Haas	MAY 27	10:33-11:22	N 31.8 cm (12.5 in)	366X	3.5	+3.5	E	=	=
Haas	JUN 08	11:25-11:53	N 31.8 cm (12.5 in)	321X	3.5	+4.0	E	=	=
Haas	JUN 25	08:40-09:13	N 31.8 cm (12.5 in)	366X	2.5	+3.5	E	=	E
Haas	JUL 05	08:00-09:18	N 31.8 cm (12.5 in)	366X	3.0	+3.0	E	=	=
Will	JUL 14	06:45-07:05	N 20.3 cm (8.0 in)	270X	7.0	+5.0	W	W	=
Schmude	AUG 08	03:30-05:11	N 25.4 cm (10.0 in)	191X	8.5	+6.0	E	=	=
Will	AUG 11	06:05-06:15	N 20.3 cm (8.0 in)	270X	7.0	+4.0	=	E	=
Schmude	AUG 13	03:25-04:16	N 25.4 cm (10.0 in)	191X	6.5	+4.5	E	=	=
Haas	SEP 23	01:46-03:04	N 20.3 cm (8.0 in)	231X	4.0	+3.5	E	=	=
Haas	SEP 25	01:34-03:21	N 20.3 cm (8.0 in)	231X	4.0	+3.5	E	=	=
Haas	OCT 01	02:27-03:08	N 31.8 cm (12.5 in)	366X	3.5	+3.0	E	=	=
Haas	OCT 07	01:29-02:51	N 31.8 cm (12.5 in)	366X	4.5	+3.0	E	=	=
Haas	OCT 18	01:43-02:35	N 31.8 cm (12.5 in)	366X	3.5	+3.5	E	=	=
Haas	NOV 08	02:17-03:15	N 31.8 cm (12.5 in)	366X	3.0	+3.0	E	=	=
Haas	NOV 23	00:47-01:07	N 20.3 cm (8.0 in)	231X	2.5	+3.0	E	=	E
Haas	NOV 26	00:48-01:26	N 31.8 cm (12.5 in)	321X	4.5	+3.0	E	=	=

The TWS is probably a contrast phenomenon and is not usually considered to be an important, or intrinsic, Saturnian feature. Even so, it would be interesting to investigate any correlation that may exist between the brilliance of the TWS and varying Ring tilt, as well as its prominence or appearance in colored filters.

Bicolored Aspect of the Rings.—This phrase refers to reported differences in color between the two ansae of the Rings. Several persons attempted to observe this phenomenon in 1991-92, and variations were seen in the brightness of the east and west ansae (IAU system) when compared with W47 (Wratten 47) or W80A blue filters and W25 or W23A red filters. *Table 5* (above) lists the circumstances of these observations. Note that the directions in *Table 5* refer to Saturnian or IAU directions, where west is to the right in a normally-inverted telescopic image which has south at the top; also see *Figure 4* (p. 4) for the proper orientation.

There is a continuing need for observers to participate in a simultaneous observing program which stresses, among other projects when viewing Saturn, a meaningful study of the bicolored aspect of the Ring ansae. Observer participation in this program during 1991-92 was modest, and yielded no simultaneous sightings of the bicolored aspect of the Rings. The greater the number of persons taking part in this effort, making systematic visual and photographic filter intensity estimates, the better are the chances of shedding some new light on this intriguing and poorly-understood phenomenon.

PHOTOELECTRIC PHOTOMETRY OF SATURN

Schumde and Westfall conducted photoelectric photometry of Saturn during 1991-92, and their similar results suggested that the planet was dimmer by 0.13±.02 visual magnitudes than the ephemeris predictions. A substantial number of observations of this kind is needed to justify revisions to the photometric model used for publications such as the *A.L.P.O. Solar System Ephemeris*. We encourage observers who have access to photoelectric photometers, or who may be considering purchasing these devices, to contact the A.L.P.O. Saturn Section for guidance and specific information.

SATURN'S SATELLITES

A very small number of our observers submitted visual studies of Saturn's satellites for 1991-92. During that apparition, we had a rare opportunity from 1991 AUG 08-12 to conduct visual estimates of the satellites' magnitudes as Saturn passed through a field of stars of accurately-known magnitudes [**3**]. These reference stars were listed in *The Guide Star Photometric Catalog I* (GSPC), which was developed to provide pointing accuracy for the Hubble Space Telescope. The GSPC contains **B** and **V** photometric sequences for 1477 regions of the sky. A typical sequence includes at least six stars ranging in visual magnitude from +9.0 to +15.0, each with a precision of +0.05 magnitudes. A number of Saturn's satellites fall within this range of magnitude.

From 1991 JUL 30-AUG 15, Schmude conducted visual photometry of the satellites Titan, Rhea, Dione, and Iapetus. He concluded that the estimated magnitudes for Titan, Dione, and Iapetus were near the predicted values, but Rhea was about +0.3 magnitudes fainter than expected. As interesting as these results are, it is clear that many more confirming data are required if revisions are to be made to the satellite photometric models used for publications such as the *A.L.P.O. Solar System Ephemeris.*

We encourage observers to pursue visual and photometric studies of Saturn's satellites, as outlined in the *Saturn Handbook* [2].

SIMULTANEOUS OBSERVATIONS

There were only a few simultaneous observations made during 1991-92, defined as when participants independently observed at the same date and time. If more individuals regularly carried out throughout a given apparition the routine programs discussed in this report, there would be a much greater opportunity for observers to make drawings, intensity estimates, or central-meridian (CM) transits on the same night, and possibly even at the same time.

The few simultaneous observations that were received during 1991-92 provided reasonable verification of the appearance of Saturn. These supporting observations strengthen our confidence in our analysis. We strongly encourage our readers to inquire about how to maximize the number of simultaneous observations in coming observing seasons.

CONCLUSIONS

As always, the continuing pursuits of A.L.P.O. Saturn Section members proved successful in 1991-92, making available for analysis a good database of observations. We are sincerely grateful for the enthusiasm, cooperation, and dedication of all of the individuals who helped make this report possible. Anyone who wishes to join our team commitment to further worthwhile scientific research and to increase our knowledge about the planet Saturn should write the A.L.P.O. Saturn Section at the address on the inside back cover for further details.

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.) ________. "A Photometric Opportunity for Saturn's Satellites." *J.A.L.P.O., 35,* No. 2 (June, 1991), p. 77.

4.) ________. "The 1990-91 Apparition of Saturn: Visual and Photographic Observations." *J.A.L.P.O., 36,* No. 2 (July, 1992), pp. 49-62.

5.) ________. "Monitoring Atmospheric Features on Saturn in 1991." *J.A.L.P.O., 35,* No. 1 (March, 1991), pp. 24-25.

6.) ________. "Observing Saturn in 1991." *Sky & Telescope, 81,* No. 4 (April, 1991), pp. 404-406.

7.) United States Naval Observatory. *The Astronomical Almanac.* (Annual publication; the 1991 and 1992 editions were used for this report, which were published in 1990 and 1991, respectively.)

SELECTED DRAWINGS AND PHOTOGRAPHS, 1991-92 APPARITION OF SATURN

NOTE: For the drawings and photographs in *Figures 5-24* (below and pp. 10-13), 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.

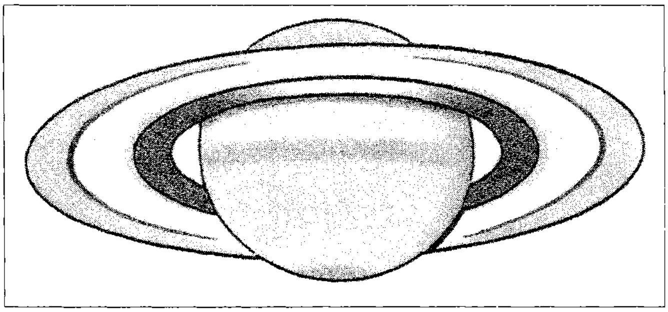


Figure 5. Drawing by Michael E. Sweetman. 1991 JUN 16, 09h07m-09h33m UT. 15-cm (6-in) refractor, 254X. W25A (red), W58 (green), and W80A (blue) Filters. Seeing 4-5, Transparency +5.0. CM(I) = 221-236°; CM(II) = 113-127°. B = +19°.2; B' = +20°.5. Reversed image; with celestial east to the left.

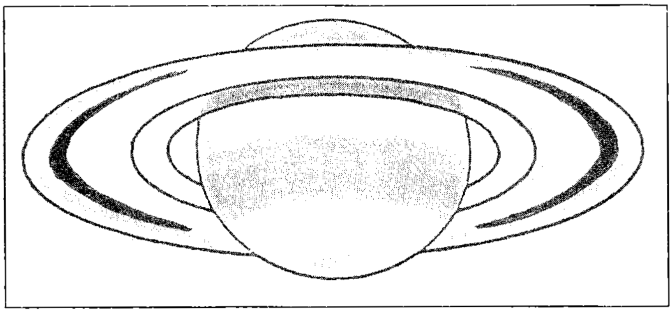


Figure 6. Drawing by Samuel R. Whitby. 1991 JUL 17, 06h30m-06h50m UT. 15.2-cm (6-in) Newtonian, 155X and 310X. No filters. Seeing 4, Transparency +2. CM(I) = 025-037°; CM(II) = 359-010°. B = +19°.9; B' = +20°.2.

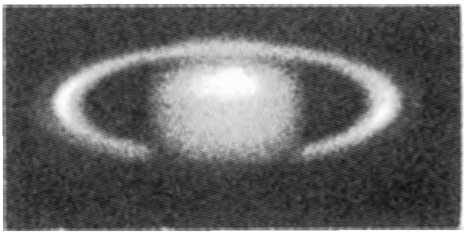


Figure 7. Photograph by Isao Miyazaki. 1991 JUL 20, 13h32m UT. 40-cm (16-in) Newtonian, f/100, no filters. 17 sec on Kodak Technical Pan 2415, developed in Rodinal 1:50 for 11m at 20°C. CM(I) = 286°; CM(II) = 153°. B = +20°.0; B' = +20°.2. Note white spot in EZ.

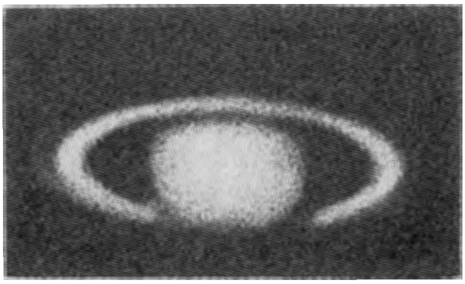


Figure 8. CCD image by J.R. Brunkella. 1991 JUL 27, 05h11m UT. 25.4-cm (10-in) Newtonian, 0.9 sec exposure. CM(I) = 143°; CM(II) = 155°. B = +20°.2; B' = +20°.1. Image taken just 5 hours after opposition.

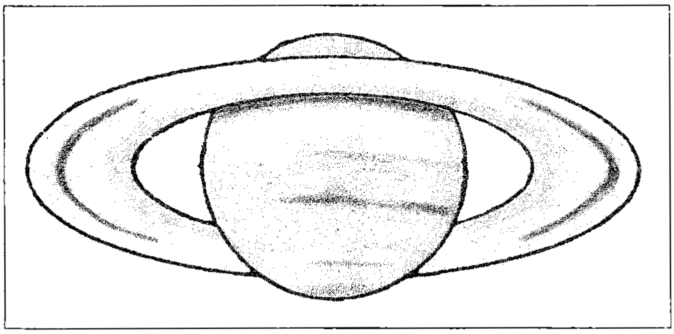


Figure 9. Drawing by Richard W. Schmude, Jr. 1991 JUL 30, 07h42m-08h01m UT. 25.4-cm (10-in) Newtonian, 301X. No filters. Seeing 7, Transparency +4. CM(I) = 244-256°; CM(II) = 157-167°. B = +20°.3; B' = +20°.1. Note dark condensation on S edge of Belt below center.

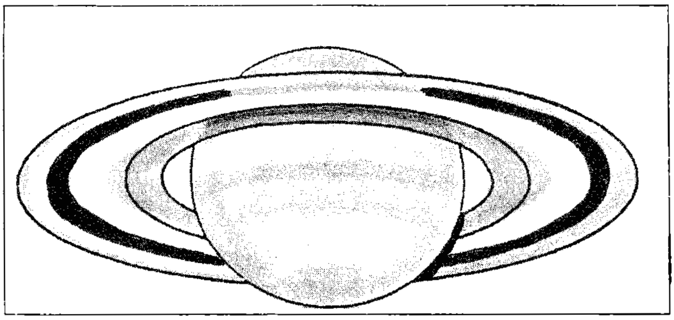


Figure 10. Drawing by Samuel R. Whitby. 1991 AUG 11, 02h30m-03h00m UT. 15.2-cm (6-in) Newtonian, 155X. and 310X. No filters. Seeing 4-6, Transparency +3. CM(I) = 114-131°; CM(II) = 005-022°. B = +20°.6; B' = +20°.0. Note double NEB. The inner portion of the Ring A ansa was noted and drawn as brighter than the outer portion.

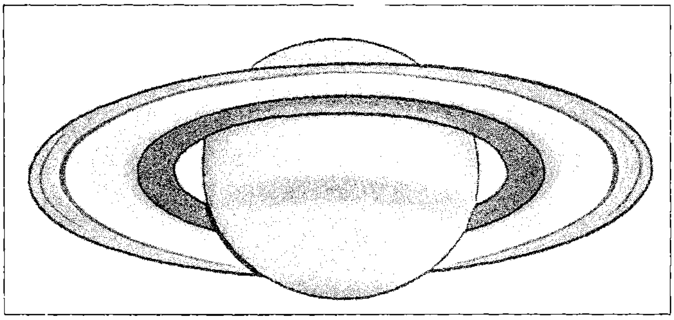


Figure 11. Drawing by Michael E. Sweetman. 1991 AUG 13, 05h27m-06h04m UT. 15-cm (6-in) refractor, 382X. No filters. Seeing 6-7, Transparency +5.0. CM(I) = 106-128°; CM(II) = 289-310°. B = +20°.6; B' = +20°.0. Reversed image; with celestial east to the left.

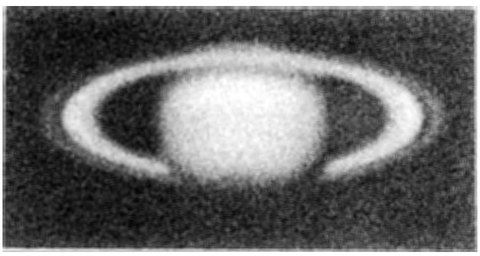


Figure 12. Photograph by Isao Miyazaki. 1991 AUG 13, 14h16m UT. 40-cm (16-in) Newtonian, f/100, no filters. 15 sec on Kodak Technical Pan 2415, developed in Rodinal 1:50 for 11m at 20°C. CM(I) = 056°; CM(II) = 227°. B = +20°.7; B' = +20°.0.

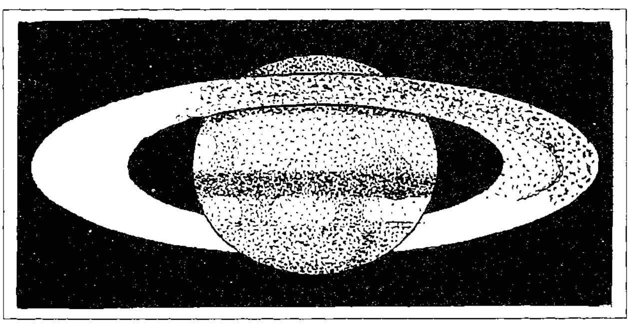


Figure 13. Drawing by Mark Bosselaers. 1991 AUG 16, 23h03m-23h15m UT. 22.5-cm (8.9-in) Newtonian, 150X and 222X. No filters. Seeing 1-3, Transparency 1-2; both on a scale of 1-5. CM(I) = 018-025°; CM(II) = 081-088°. B = +20°.7; B' = +19°.9.

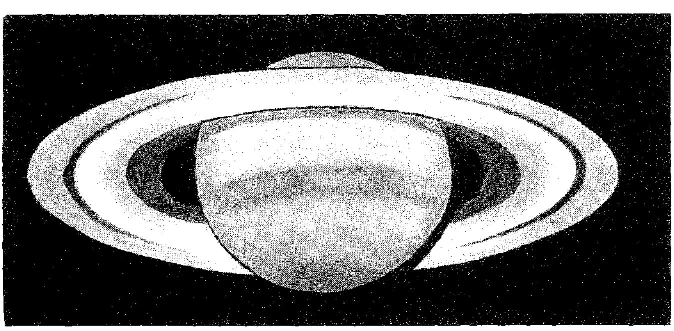


Figure 14. Drawing by David L. Graham. 1991 AUG 26, 22h00m-22h30m UT. 15-cm (6-in) refractor, 222X. No filters. Seeing III (Antoniadi Scale of I-V, with III = moderate seeing). CM(I) = 145-162°; CM(II) = 246-262°. B = +21°.0; B' = +19°.9. Note condensations in the NEB.

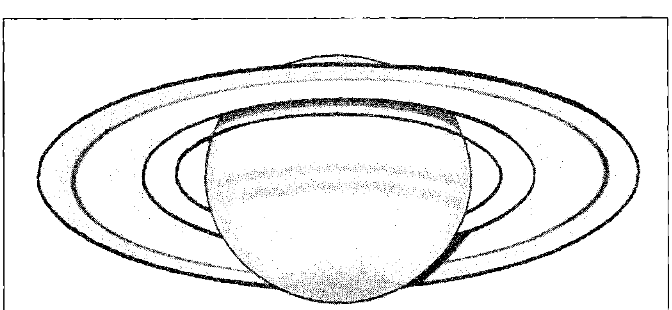


Figure 15. Drawing by Donald H. DeKarske. 1991 AUG 30, 03h25m-03h57m UT. 10.2-cm (4-in) refractor, 150X and 227X. No filters. Seeing 4-7, Transparency +4.0. CM(I) = 348-007°; CM(II) = 345-003°. B = +21°.0; B' = +19°.8.

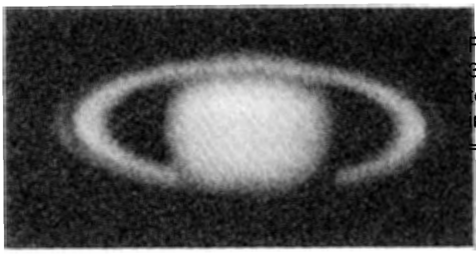


Figure 16. Photograph by Isao Miyazaki. 1991 AUG 30, 14h02m UT. 40-cm (16-in) Newtonian, f/100, no filters. 17 sec on Kodak Technical Pan 2415, developed in Rodinal 1:50 for 11m at 20°C. CM(I) = 002°; CM(II) = 344°. B = +21°.0; B' = +19°.8. Note white spot in EZ.

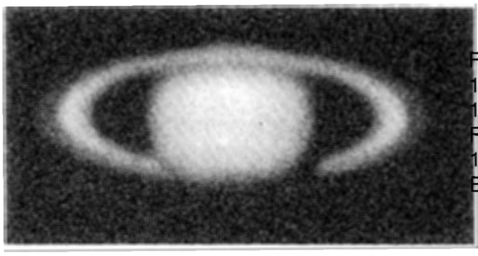


Figure 17. Photograph by Isao Miyazaki. 1991 SEP 05, 13h02m UT. 40-cm (16-in) Newtonian, f/100, no filters. 15 sec on Kodak Technical Pan 2415, developed in Rodinal 1:50 for 11m at 20°C. CM(I) = 352°; CM(II) = 142°. B = +21°.1; B' = +19°.7. Note white spot in the EZ.

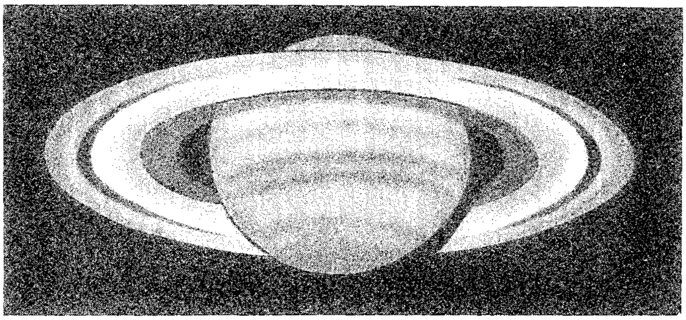


Figure 18. Drawing by David L. Graham. 1991 SEP 07, 20h15m-20h35m UT. 40-cm (16-in) Newtonian, 222X. No filters. Seeing III-II (Antoniadi Scale of I-V, with III-II = moderate-good seeing). CM(I) = 135-146°; CM(II) = 210-222°. B = +21°.2; B' = +19°.7. Note EB and double NEB.

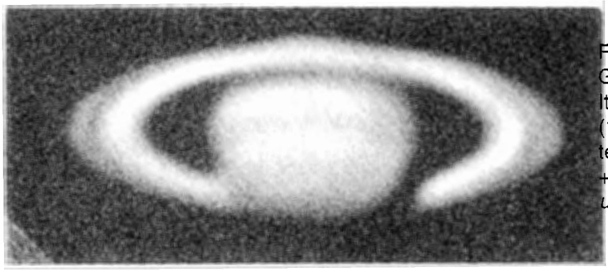


Figure 19. Photograph by the San Gersolé Planetary Group in Florence, Italy. 1991 SEP 09, 21h42m UT. 30-cm (12-in) Cassegrain, f/24, W25 (red) Filter. CM(I) = 074°; CM(II) = 083°. B = +21°.2; B' = +19°.7. Compare with *Figure 20* below.

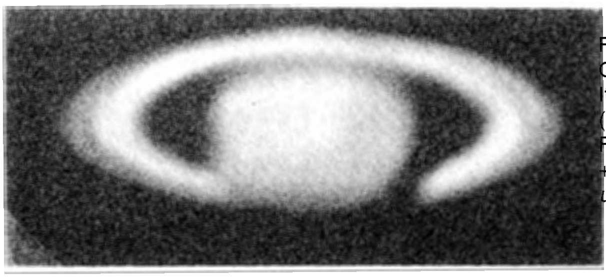


Figure 20. Photograph by the San Gersolé Planetary Group in Florence, Italy. 1991 SEP 09, 21h56m UT. 30-cm (12-in) Cassegrain, f/24, W57 (green) Filter. CM(I) = 082°; CM(II) = 091°. B = +21°.2; B' = +19°.7. Compare with *Figure 19* above.

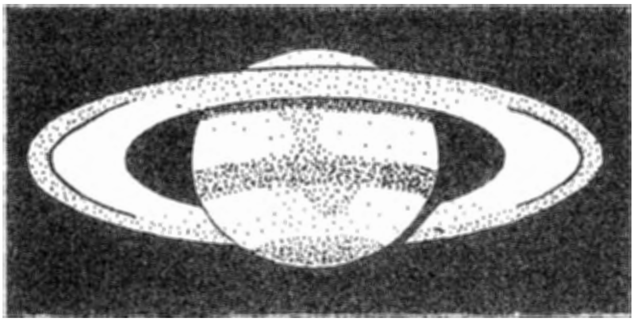


Figure 21. Drawing by Hendrik Vandenbruaene. 1991 SEP 12, 21h02m-21h23m UT. 20-cm (8-in) Newtonian, 135X. KB12 (blue) Filter. Seeing 5, Transparency 1; both on a 1 (good)-5 (poor) scale. CM(I) = 064-076°; CM(II) = 337-349°. B = +21°.2; B' = +19°.7. Note festoon in EZ and dark spot in the NTeZ.

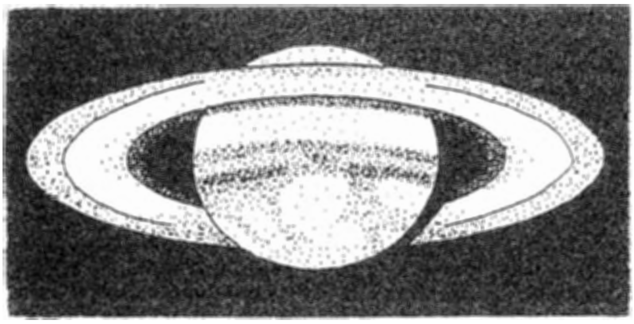


Figure 22. Drawing by Hendrik Vandenbruaene. 1991 SEP 30, 20h03m-20h17m UT. 20-cm (8-in) Newtonian, 240X. Yellow filter. Seeing 3-4, Transparency 1-2; both on a 1 (good)-5 (poor) scale. CM(I) = 106-114°; CM(II) = 159-167°. B = +21°.4; B' = +19°.5. Note dark spot in NEB and light spot in the NTeZ.

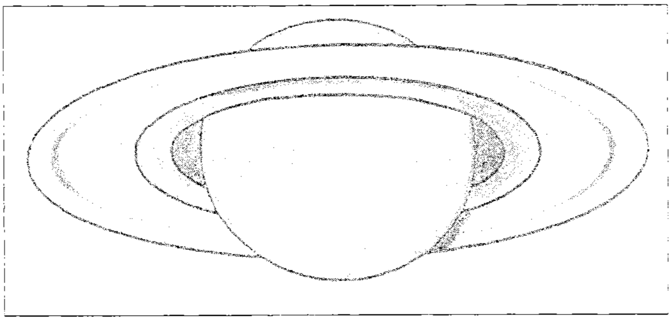


Figure 23. Drawing by Myron Wasiuta. 1991 OCT 25, 23h30m-OCT 26, 00h45m UT. 30-cm (12-in) refractor of the U.S. Naval Observatory , 351X. No filters. Seeing 7, Transparency +4.0. CM(I) = 093-136°; CM(II) = 053-096°. B = +21°.3; B' = +19°.3. See *Figure 24* below.

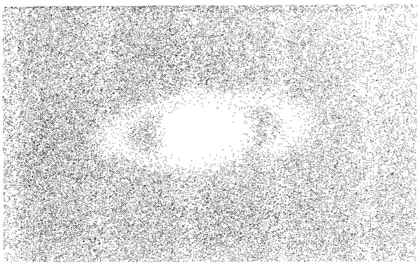


Figure 24. Photograph by Myron Wasiuta. 1991 OCT 25, (no UT given). 30-cm (12-in) refractor of the U.S. Naval Observatory, f/15, no filters. 8 sec on Kodak Technical Pan 2415. Compare with *Figure 23* above.

THE LUNAR DOME SURVEY: FALL, 1992 PROGRESS REPORT

By: Harry D. Jamieson, A.L.P.O. Lunar Recorder

The A.L.P.O. Lunar Dome Survey was begun in 1962 in order to discover, characterize, and catalog as many as possible of these low swellings as could be found with amateur equipment. Some earlier observations, chiefly by Alika K. Herring, and a preexisting catalog by Kenneth J. Schneller were used as a base; and the observational methods pioneered by Herring and Joseph Ashbrook were adopted. In 1964, John Westfall formulated the dome classification system still used by the Survey. Although the leadership of the program changed hands several times, progress continued to be made, resulting in our recently published catalog **[1]**. A special thanks is due to ex-Recorders Kenneth J. Delano, Marvin Huddleston, James H. Phillips, and Charles L. Ricker, as well as to all the observers listed with the catalog. Without these persons' efforts we would not be where we are today.

At present, we are entering all of the Survey's dome observations into a computer data base. When the Survey was founded, personal computers were a distant dream, and little serious thought was given as to how best to record the observations so that they would be easy to analyze later. This oversight was entirely my fault, and I apologize for it. However, we are now making progress in this area and I hope to have the task completed soon. The computer data base will allow us to bring all of the observations for a particular dome together in one place for the first time, making the task of weeding spurious domes out of the catalog much easier, and at the same time solidifying our knowledge of the real ones. We especially thank Craig MacDougal for his help with this project, as well as for his contribution of some 350 personal observations.

In the meantime, we still welcome your observations. The minimum aperture instrument you should use is a 6-in (15-cm) Newtonian, 8-in (20-cm) Schmidt-Cassegrain, or 4-in (10-cm) refractor, although smaller telescopes can be used to observe the larger domes. You also need a good lunar atlas. The *Atlas of the Moon* by Antonin Rükl is probably the best now in print, although its north-at-top orientation and lack of chart overlap make it sometimes difficult to use. Older charts like the *Time Lunar Atlas*, the *Orthographic Lunar Atlas*, and the USAF *Lunar Astronautic Charts (LAC's)* are better, but hard to obtain. The *Lunar Quadrant Charts*, published by the University of Arizona Press and available from Sky Publishing Corp., may also be used, but they lack a detailed coordinate grid.

Another reference is the computer program "Lunar Observer's Tool Kit," provided by the Lunar Dome Survey. You do not need a computer to contribute dome observations; but if you have an IBM PC or compatible, this program can make it much easier to schedule and document your observations. The kit includes documentation and a dome database which it can use to tell you, before you go out to observe, which domes are near the terminator. This program is available from the writer (address on inside back cover) for $15.00 to cover expenses. Please specify whether you prefer 5-1/4 or 3-1/2 inch diskettes. If you are interested in other aspects of lunar observation, you may still wish a kit. The ephemeris-generation portion of the program is based on the latest algorithms from Jean Meeus' *Astronomical Algorithms*. Other general lunar options compute solar altitude and relative elevations, convert coordinates, and provide a physical ephemeris for any date and time between 4000 BC and AD 9999. The program can compute the dates and times when the solar altitude over a given lunar feature will be a certain value, as well as what the solar altitude was for some date in the past. This last option is particularly valuable because it allows you to reproduce the lighting conditions prevailing during a past observation. Finally, the kit will also generate a yearly ephemeris in the format used by the *A.L.P.O. Solar System Ephemeris*, in the form of printout or an ASCII text file, with Dome Survey Observing Report Forms containing all ephemeris information pre-computed. I thank John Westfall for his help during the writing of this program.

The observations presented here are examples of those submitted during the past 30 years. The two that show domes near Linné [*Figure 1*, below] and Milichius [*Figure 2*, p. 15] are especially interesting because they illustrate domes that are one-quarter covered by black shadows. At such times, it is possible to determine a dome's height simply by multiplying the dome's semidiameter by the tangent of the Sun's current altitude over the dome's horizon. For example, the height of

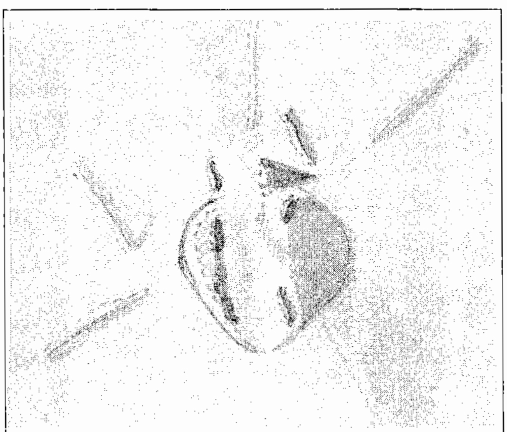


Figure 1. The "Valentine Dome" near Linné in Mare Serenitatis, drawn by Charles L. Ricker. 1965 Aug 04, 03h02m UT, 10-in (25-cm) reflector, 294X. Seeing = 4 on the A.L.P.O. 0 (worst) - 10 (perfect) scale; transparency = +5 (limiting naked-eye stellar magnitude). Dome diameter = 22 km. Colong. = 351°.1. South at top.

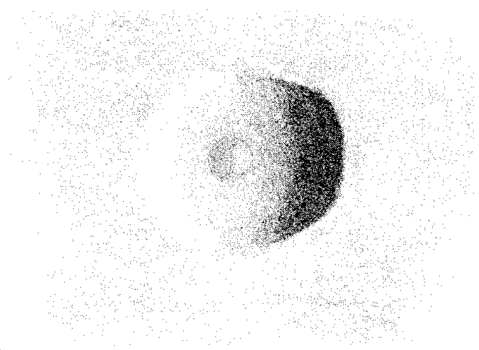


Figure 2. Lunar dome west of the crater Milichius (lunar coordinates ξ = -.510, η = +.175), as drawn by Donald Watts on 1966 JUL 28, 03h55m UT. 10-in (25-cm) refractor, 150X and 300X. Seeing = 4 on the 0-10 scale, transparency = +5 (limiting magnitude). Colong. = 035°.5. Dome diameter = 9 km. South at top. Note summit crater.

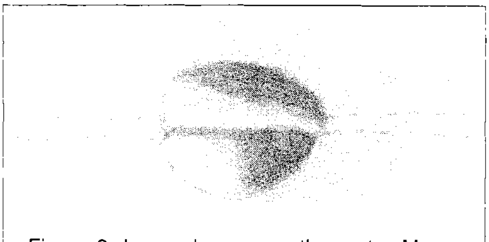


Figure 3. Lunar dome near the crater Menelaus (lunar coordinates ξ = +.269, η = +.300), drawn by Donald Watts on 1967 APR 16, 02h40m UT. 6-in (15-cm) reflector, 160X. Seeing = 3 on the 0-10 scale, transparency = +6 (limiting magnitude). Colong. = 346°.3. South at top. Note transverse cleft.

the dome in *Figure 1* was computed as 360 meters, while that in *Figure 2* was 720 meters. The other observation [*Figure 3*, upper right] illustrates a dome cut in two by a cleft, which is a rather rare occurrence. *Figures 4* and *5* (below and on p. 16) are examples of the excellent photographs of domes that have been submitted in recent years. *Figure 6* (p. 16) is an example of a recent dome sketch. Finally, *Figures 7* and *8* (p. 17) are of CCD images of lunar domes. We also receive many observations without drawings or photographs, but with very useful written descriptions.

Our immediate goal is to place our catalog on the computer in order to remove unconfirmed domes and to organize our information about the domes that remain. During this period, we continue to encourage observers to search for new domes. In the end, we hope to have a catalog that lists every visible dome down to 3 km in diameter, with information on its position, diameter, height, and classification. We encourage those observers who are interested in participating in this program to write to the author for further information.

Reference:

[1] Jamieson, Harry D. and Phillips, James H. (1992). "Lunar Dome Catalog [April 30, 1992 Edition]." *J.A.L.P.O.*, *36*, No. 3 (Sept.), 123-129.

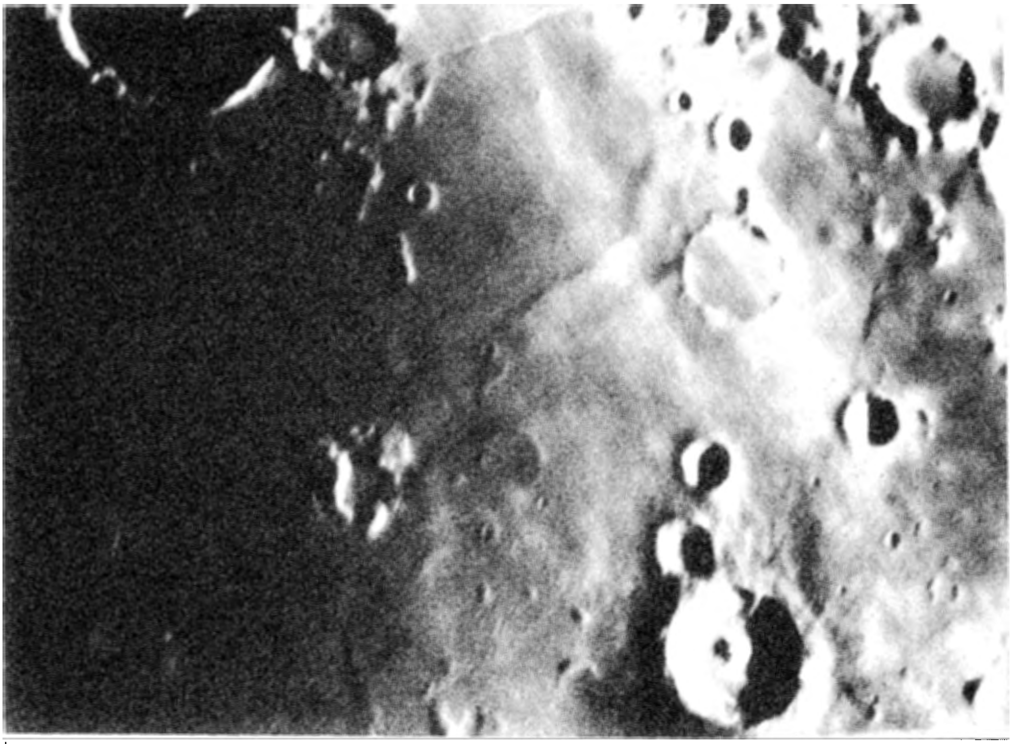


Figure 4. Photograph of southwest Mare Nubium (IAU directions) , showing the prominent dome west of the flooded crater Kies (upper right), with a small crater on its summit. Other less obvious domes may also be seen. Taken by F. Courbin on 1990 JUL 16, 02h54m UT, using the 60-cm (24-in) reflector of Pic du Midi Observatory, France. Colongitude = 192°.2. South at top.

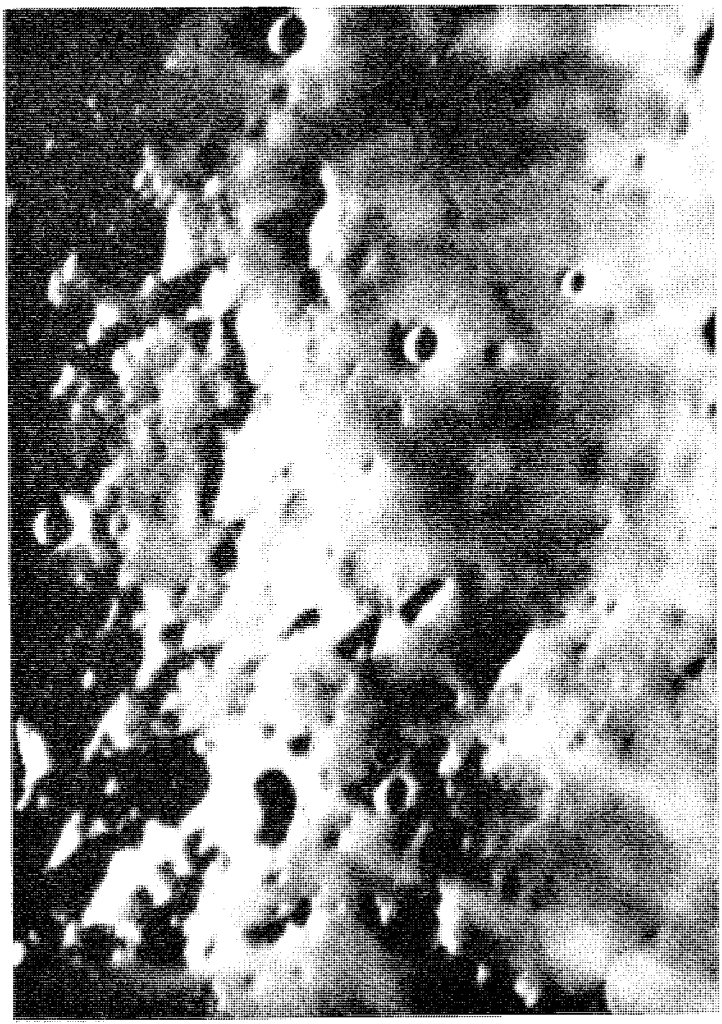
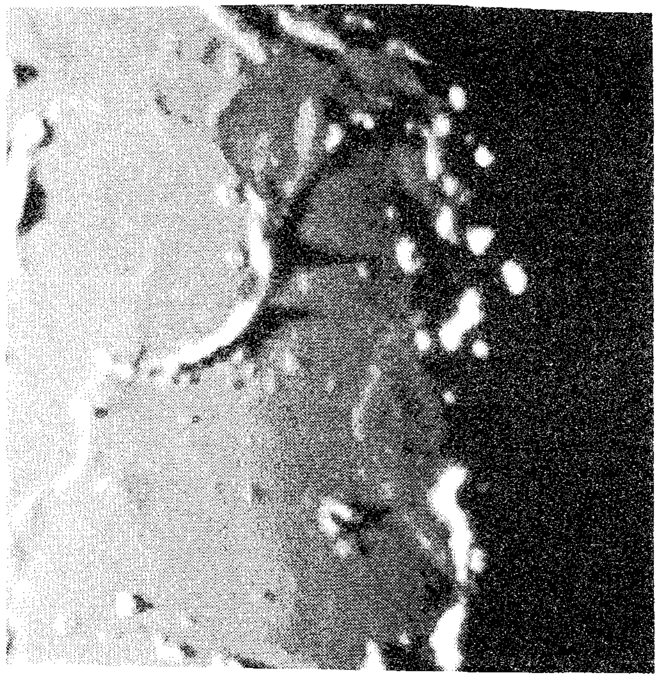


Figure 5. How many domes can you see in this photograph of the Tobias Mayer-Milichius-Hortensius dome field? Taken by F. Courbin on 1990 JUL 17, 03h19m UT. 60-cm (24-in) reflector, Pic du Midi Observatory. Colongitude = 204°.7. South at top.

Figure 6. Drawing by Michael Mattei of the dome west (IAU) of the crater Gutenberg (lunar coordinates $\xi = +.618$, $\eta = -.167$). 1992 MAY 07, 01h09m-01h29m UT. 6-in (15-cm) Schupmann Medial telescope, 244×. Seeing = 5 (0-10 scale). Colongitude = 327°.8. South at top.

Figure 7 (upper right). Domes in southern Oceanus Procellarum. CCD image by John Westfall on 1993 MAR 04, 03h12m UT. 28-cm Schmidt-Cassegrain, f/21, 0.50-sec exposure. Colongitude = 038°.2. One small dome is located about midway between the center and the lower left corner. Also, a large dome is on the terminator below center, and contains the 11-km crater Wichmann. South at top, sunlight from the left.



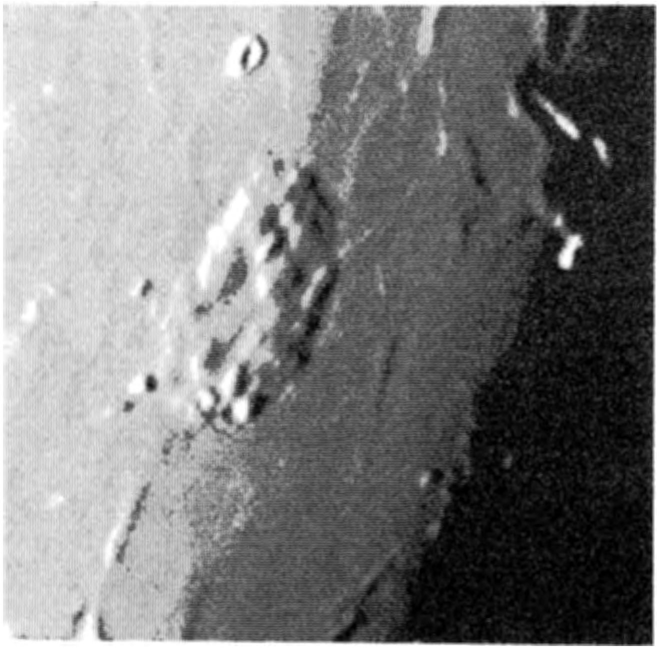


Figure 8 (lower right). The dome complex Rümker in the northern Oceanus Procellarum. CCD image by John Westfall on 1993 MAR 06, 03h43m UT. 28-cm Schmidt-Cassegrain, f/21, 0.20-sec exposure. Colongitude = 062°.7. Rümker is about 55 km in diameter. South at top, sunlight from the left.

CCD images have considerable potential for dome studies because these devices have a wide and linear brightness range; 4096:1 in the case of the LynxxMC unit used for these images. This means that usable images are possible for areas near the terminator, where domes are best seen.

GETTING STARTED: THE ART OF MAKING DRAWINGS OF THE MOON

By: Andrew Johnson

ABSTRACT

This article addresses the problems usually encountered by the beginning visual lunar observer. It discusses drawing equipment, paper selection, telescopic observation, drawing techniques, and producing finished drawings. The article is intended to encourage beginning lunar observers who wish to record what they see in the form of drawings, and to gain a deeper understanding of an increasingly neglected field of observational astronomy.

INTRODUCTION

The Moon is the first telescopic target for most amateur astronomers. Undoubtedly few of them were unimpressed by what they saw. However, it is increasingly often that these first impressions fail to develop into a long-term interest in the Moon. Why is this? One of the most often-cited reasons is that since the Apollo Missions there is nothing more to be learned from earthbased observation, at least by amateurs. In this respect, the current low level of interest in the Moon parallels that during the period after Beer and Mädler's publication of *Der Mond* in 1837.

This article does not attempt to address the question of the *general* decline in interest in lunar studies; the work of the A.L.P.O. Lunar Section in the study of lunar domes **[1]**, Selected Areas **[2]**, Lunar Transient Phenomena, and lunar eclipses are doing this. The question to be addressed here is why fewer people are *drawing* features on the Moon.

WHY MAKE DRAWINGS OF THE MOON?

Drawing the Moon introduces the observer to, and familiarizes him with, this stark world, ever changing in appearance, as no other method can. You never fully develop this one-to-one relationship with the Moon through the study of books or photographs. Seeing this wonderful landscape for yourself is as close as is possible to first-hand experience of our subject.

However, in this age of CCD's some observers wonder why others still bother making drawings. The answer is simple: We observe as we do because we enjoy it! This reason is often overlooked or forgotten. Rather than to try to assign scientific merit to my chosen method of making drawings, I justify this approach on the basis of history, heritage, and individuality.

It is only natural that observers wish to use the best equipment and the latest technology in pursing their interest. However, in our headlong dash toward technology, are we not in danger of ignoring the real objective? I consider this last to be to develop a full understanding and enjoyment of astronomy. Were we all to adopt tunnel vision, or more topically CCD vision, then we could lose sight of all the other aspects of our study which are highlighted by other methods of observation.

Also, what are we to make of the work of our predecessors? You cannot interpret the observations of Schröter, Beer and Mädler, or Elger, in terms of the CCD images of today. If you try, all you will conclude is that they often made inaccurate observations. To understand their work, one needs to be a contemporary observer who is still practicing the old methods.

Technology is progressing at a quickening pace. Visual observers were at the cutting edge of observational astronomy for some three hundred years. Photography held that position for a century. It is my guess that CCD's will last considerably less than that. However, when CCD's are finally classified as obsolete, I hope that not everyone will abandon them. If with every new technological advance we abandon all that has gone before, then we lose touch with our past, and hence with our history and the heritage of our predecessors' work. The result would be that our common interest is much poorer. Also, we must not forget individuality. It is astronomers, and their interpretations of what they find, that add flesh to the science. On its own the pure science of astronomy is cold, and less captivating than some of us might suppose.

TELESCOPIC EQUIPMENT

There has been much discussion of this subject in recent issues of this Journal **[3,4]**, so I will not dwell long on this subject. My overriding concern is to encourage more observers to draw the Moon. Thus the only appropriate suggestion about telescopes is: "Whatever you have, use it!" The ideal situation would be for all of us to have the telescopes of our dreams. However, in reality most of us have to compromise on the basis of portability, storage space, ease of use; or, more likely, cost. More often than not, those promoting the virtues of a particular form of telescope are defending the telescope that they already have, by which they hope to reassure themselves that they made the right choice when they parted with their hard-earned money.

Many people with small telescopes think

that they cannot contribute useful work in observing programs unless they own some computerized all-resolving monster of a light bucket! This is simply not the case the majority of the time, especially where the Moon is concerned; and it is well to remember the small telescopes successfully used by the early selenographers. What those pioneers might have given to have one of those telescopes that now lie idle on clear moonlit nights! Remember, more often than not it is the skill, determination, and enthusiasm of the observer that determine how useful a given set of observations is, rather than the equipment used.

PREPARATION

Before going to the telescope to make a drawing of a lunar region, spend some time in preparation, so as to get the most out of the time spent at the eyepiece. First, you should know in advance what you are going to observe. If you participate in any of the A.L.P.O. Lunar Section programs mentioned above, then this task is made all the easier for you. There is nothing worse than trying when at the telescope to decide what feature to draw. This is time-consuming and wasteful of your concentration, energy, and enthusiasm, and of those all-too-rare observing opportunities.

Once you have set an observing goal, the next step is to prepare for making a drawing at the telescope. For this you will need certain items: a clipboard and clips, a source of illumination; drawing supplies, such as good-quality copier paper and pencils. Although they are not strictly necessary for making the drawing, it will help to have a copy of the Elger Intensity Scale (described below) and a fairly detailed outline map of the Moon.

Most of us have our own preferred ways of equipping ourselves, so we will discuss this topic only briefly. The nature of the source of illumination is not so critical as it is for deep-sky observation. You can use something more substantial than a tiny red LED because you are not too concerned about ruining your dark adaptation when you are observing the Moon! A small flashlight attached to your clipboard will do. As for the paper, we now simply note that it will have to be thick enough so that, when the humidity is high, it will not wrinkle due to moisture while the drawing is being made. Pencils of various grades can be used, such as HB and B. The harder grades are less suitable because the marks that they make will be hard to see under dim lighting conditions.

The Elger Intensity Scale is a method of gauging the intensity of light and shade on the lunar surface. This numerical intensity scale was actually introduced by Schröter and was later elaborated by Elger. In many ways it parallels the intensity scale used by planetary observers. The Elger Scale runs from 0 through 10, with 0 being black shadows and 10 the brightest feature normally seen on the Moon, usually taken as the sunlit central peak of Aristarchus. This scale can be calibrated by reference to well-known lunar features. It has recently been published in this Journal **[5]**, and the A.L.P.O. Lunar Recorders can also provide information about it.

If you are unfamiliar with the locations of the standard features used for Elger's Scale, it will help to have a simple outline map of the Moon, with the relevant features prominently marked on it. You can paste both the verbal description of the scale and the reference map to each side of a piece of cardboard, covering them in clear plastic for use at the telescope.

The simple outline map just described should be adequate for identifying features. I would not take anything more detailed to the telescope so as to ensure that my observations are objective and unbiased. In any case, I find that, the more I observe, the more I realize how inaccurate some charts are, even post-Apollo ones. Thus it is best not to rely on them too much.

MAKING THE OBSERVATION

Upon commencing an observation, it is best not to start drawing right away. It will pay dividends later if you spend some time studying your subject through the eyepiece, familiarizing yourself with some of its details.

One important consideration is the scale you will use for your drawing. In my very first drawing of the Moon, I represented the crater Clavius, 225 km in diameter, by an oval only 50 mm across! Needless to say, it was not a great observation. The question of scale has as much to do with convenience as with anything else. It is hard on a small drawing to fit in all the details visible. Drawings that are too large, however, are daunting and difficult to place detail upon. There are no set rules, so experiment to determine the drawing scale that is best for you. If you find that the details on your drawing are cramped, of if you are having problems with proportions, then the first thing to check is what scale you are using. However, as you can see from the foreshortening evident in the figures, any scale you adopt can only be approximate.

When you are finally prepared to make your drawing, the question is where to start. Before drawing, study the shape of the crater or other formation you intend to draw. A common mistake of beginners is to assume that all craters are circular, at least as seen from directly above. This is definitely wrong; you will be hard pressed to find a circular crater larger than 30 km in diameter anywhere on the Moon. Most larger craters are actually polygonal, so study their sides: How many are there, are they of the same length, are they straight or are they curved? [Many observers prefer to prepare the outlines of the major features to be drawn before they go to the telescope, often by tracing a photograph taken at librations and lighting similar to those for the time of observation. Participants in A.L.P.O. Lunar Section programs can often receive outline drawing forms from the appropriate Recorder. Ed.]

Also remember the effects of foreshortening. The classic example of this is Mare Crisium, which is actually elongated east-west. However, as seen from Earth, it appears elon-

Figure 1. The first stage of making a lunar drawing; preparing the outlines of major features and shadow areas.

concept that crater walls need not be circular, or even curved. At this stage, draw the outlines of the crater walls and shadow areas slightly heavier than any other lines. Once the main shadow outline has been delineated, it is important not to alter it because shadows are the visible features that are most likely to change during the observation. Subtle changes in the tones of other areas will occur as the solar angle changes, but these changes are nothing like so important as the changes in the shadow outlines. These last can occur in less than a half hour, especially when near the terminator. No really useful observation is likely to be completed in less time than this, so the early fixing of shadow outlines is necessary.

As the next step, start filling in the major details as shown in *Figure 2* (below). Such details include inner-wall terraces, large craterlets, and similar features. The best way to determine these objects' positions and proportions is to establish their sizes and positions in terms of fractions of the dimensions of the main crater. You can do this mentally by dividing up the crater into fractions; such as quarters, sixths, eighths, or whatever proportions suit you. You can also follow this procedure for minor details, using the sizes of features to determine their positions in terms of their own diameters. Follow this procedure for all the features that you can definitely see, working from the largest to the smallest, constantly checking that you are maintaining correct positions and proportions. Your drawing should be almost com-

gated north-south. Most of the features you observe will be elongated. In drawing them, decide what ratio best describes the proportion of their apparent major and minor axes; for example, is it 2:3 or 3:4? This proportional way of considering a feature to be drawn is quite useful, especially in the placement of minor details.

Very frequently, the observer will draw a crater, such as is illustrated in the figures with this article. For this reason we will now concentrate on drawing craters.

Once the shape and outline of the crater have been considered, we can turn to its details. Again, two separate aspects have to be considered; the actual features on the Moon, and the appearance of these features due to the effects of light and shade. The study of minor detail can become very absorbing, so be careful not to study one little area too long. The purpose of the initial scrutiny is simply to prepare yourself for making the drawing. Ask yourself what details are visible; whether there are craterlets, hills, scarps, or rilles. Then look at the shadows and bright areas. Consider how the shapes of these tonal areas are affected by the actual relief, and what is the nature of the relief that can produce such a pattern. Build up your initial study along these lines, and only then start to think in terms of putting this information down on paper.

Figure 1 (above) shows the creation of the main outline and the major shadows. Some construction lines are shown to reinforce the

Figure 2. Stage 2—adding major details to the drawing.

plete by now as far as linework is concerned.

You should not attempt shading at the eyepiece, but you can add it later instead if you make annotations on the drawing concerning the levels of light and shade. This is best done using the Elger Scale. However, if as a beginner you are not confident about its use, then just jot down some notes about which areas were darkest and which were lightest. As your experience grows, you will find a need for refinements such as the Elger Scale. *Figure 3* (to right) shows the nearly completed drawing with tonal areas outlined and the Elger Scale value drawn within them or indicated with arrows. In addition, you should have added backgound documentation: name of formation, UT date, UT beginning and finishing times, seeing and transparency [both on the A.L.P.O. standard scales; seeing ranges from 0 for horrible to 10 for perfect, transparency is in terms of the limiting naked-eye stellar magnitude. Ed.], telescope, magnification, and your name and address. You should also add the current solar colongitude and latitude; see John Westfall's recent description of these quantities **[6]**. Finally, it is helpful to have some notes regarding the observation itself, with the approximate scale.

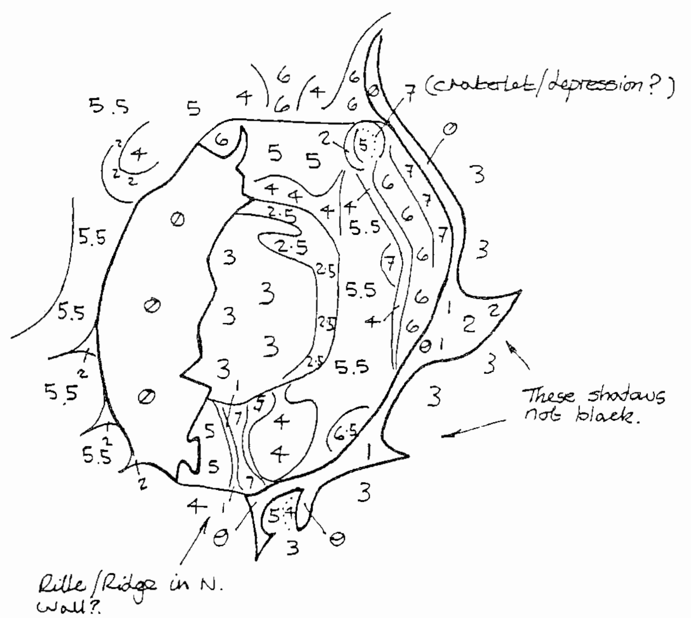


Figure 3. Areas of different brightness and darkness have been outlined with their tones indicated using the 0-10 Elger Scale.

By now the observation itself is nearly complete. If you still have sufficient energy, you can start the finished drawing when you return indoors. The initial stages of finishing the drawing are shown in *Figure 4* (to right). However, you need not finish the drawing immediately if the observation was completed carefully in the first place. The finishing of the drawing depends on which drawing technique you wish to use. *Figure 5* (p. 22) is an example of a finished drawing made from the observation described above, using the stippling technique.

Figure 4. A partially completed final drawing.

FINISHED DRAWING METHODS

Line Diagrams.—There are two basic approaches to making finished drawings from lunar observations; line diagrams (outlines) or tonal drawings. There are three methods of making tonal drawings, described later.

It is simple to finish an observation in terms of a line drawing. One needs to add background information to make the observation useful to others, and perhaps to tidy up the drawing, taking care not to alter any actual details in the process.

This type of finished observation is suitable for scientifically-oriented programs such as the Selected Areas Program, Lunar Dome Survey, and Lunar Transient Phenomena. However, it is natural for observers to want their finished drawings to appear as lifelike as

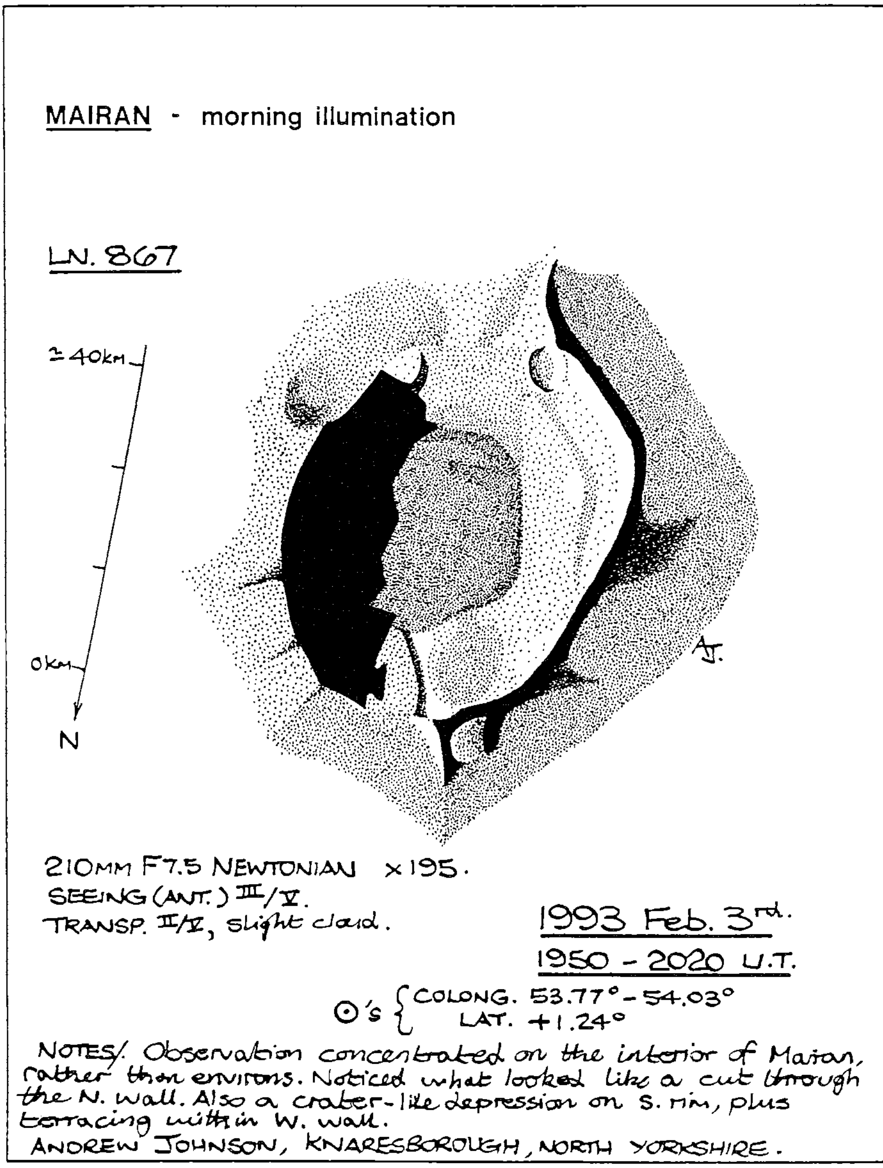


Figure 5. Lunar tonal drawing finished by using the stippling method. [The *Astronomical Almanac* values for the colongitude range are 53°.69-53°.95, and for the solar latitude is +1°.217. Ed.]

possible, and thus to seek other, more "artistic" methods of representation.

Tonal Drawings: Pencil Shading.—Most observers will use use pencils to make their first lunar shaded drawings. This is because pencils can be easily controlled and thus used effectively by beginners. With sufficient practice, pencils can be used to make beautiful and realistic drawings.

My best advice as to which grade of pencil to use is to experiment and see what suits you. Remember that too soft a grade will smudge easily, while too hard a grade can damage the paper surface and also be harder to remove entirely if mistakes are made. You can buy sets of pencils which provide a good selection of grades from art shops, which may be able to provide you with good advice.

The grade of paper will have to be robust enough to be used outdoors without too much wrinkling due to moisture. Paper is graded by its weight, and I prefer 130 gsm [grams per square meter; this reflects the system used in Britain. An American equivalent might be 30-35-pound paper. Ed.]

Besides weight, paper is available in different textures. Paper texture has been discussed recently in the B.A.A. Lunar Section [7]. One line of thought is to use the paper texture deliberately to produce a desired effect. This approach is advanced largely in order to improve reproduction. One drawback here is that, as texture size increases, so too does the danger of the texture's being interpreted as actual observed detail. Thus a compromise has to be reached between smooth and rough texture; again the keyword is *experimentation.*

You can achieve good pencil-shading effects through numerous layers of cross hatching and slight softening by rubbing with a cotton ball. Alternatively, you can lay down a less-precise layer of cross hatching and use harder rubbing with a cotton ball. Then the lighter areas can be picked out with an eraser, and the darker areas filled in. One refinement is to use black ink for shadows, remembering that not all lunar shadows are totally black. White paint can be used to bring out exceptionally bright areas. This last method has the disadvantage that, if you subsequently use a cotton ball to smooth shading, the recesses in the paint will be shaded as well.

The best advice for photocopying pencil drawings is to make your drawing with shading as dark as you can accept, and then to turn up the copying machine's contrast by a notch or two. These copies will probably suffice for sending observations to program Recorders and other colleagues. If later on the drawing needs to be published, you should send the original by registered mail. [Or you can have the original photographed and then submit a photographic print, rather than the original. Ed.]

Tonal Drawings: Stippling.—This method, along with hatching, is best exemplified by the work of Harold Hill [**8**]. It is likely that these methods originated in response to the problems of reproducing continous-tone drawings. We are all familiar with stippling as used for reproducing pictures in newspapers and magazines. This process, called "half tones," builds up a picture using many small black dots, which blur together into a grey sensation when viewed from a distance. Manual stippling works on a similar principle; and since the picture is made up of discrete black ink dots, simple photocopying machines have no trouble in copying them, with the copy virtually as good as the original.

In making a stipple drawing, skill is needed in order to make the dots unobtrusive for anyone viewing the drawing. The factors that are involved in this method are dot density, size, spacing, and the time spent in producing the drawing.

The greater the dot density, the greater the apparent darkness of any area, so this density should be matched with the intensity noted in the original observation. The second consideration is that the smaller the dots, the less distracting they will be. [Sadly, the smaller the dots, the more numerous they must be. Ed.]

The size of the dots is governed by the size of the pen point; I usually use 0.25 mm, 0.3 mm, and 0.35 mm; more rarely I use 0.5 mm. My favorite size is 0.3 mm because 0.35 mm is, I think, a bit too "coarse," while stippling can take too much time with 0.25 mm dots. You can use larger pen sizes if you reduce your drawing in copying; reducing a 0.5-mm dot drawing to about 70 percent of original size gives good results. You can also enlarge drawings for displays.

The choice of type of pen is vast, ranging from professional drafting pens to felt-tips. You need to compromise between durability and cost. Professional pens are more expensive, but will last almost indefinitely if treated carefully; this is just as well given the cost of replacement nibs! Felt-tips are cheaper, but will blunt rapidly as you constantly tap them on the paper surface.

The keywords here are practice and patience. Also make sure to create the right conditions for completing the drawing. Use good lighting to reduce eyestrain. If possible, use a magnifying glass. Some form of support for the magnifier is helpful, although I use a hand-held 75-mm diameter glass myself.

Remember that stippling is time-consuming; in my experience a drawing takes 1-1/2 to 2 hours or more to complete. Thus do not be concerned if a stockpile of drawings builds up, each awaiting its turn to be stippled. This is not a major problem if the original observations were made carefully, with all the relevant information included.Then, if you alter none of the original when you make the final version, the finished drawing will not be far removed from what you observed.

Tonal Drawings: Hatching.—This method of drawing was very popular in the past, and is illustrated in *Figure 6* (p. 24). Such drawings are also easy to copy. The lunar drawings of Schröter come to mind when one thinks of this method. I tried this method of drawing in order to compare it with stippling, to see whether the former was any quicker. The conclusion was: "No, not really." The hatching method has problems all its own, one of which is how to portray the finer details. All that I can suggest is that you experiment yourself; the only true way of coming to a conclusion in such cases.

Tonal Drawings: Ink Washes.—This last method consists of extremes. It is arguably the most realistic method to portray the lunar surface if it is executed beautifully; again, see the work of Harold Hill. It is also perhaps the hardest method to master, and definitely the worst method for photocopying!

Constant practice is the key to this method, and I am still not skillful enough to risk using it on an actual observation. Thus, any or all of the previous methods should be practiced first, rather than risk ruining an observation.

To achieve the various tones needed, you must apply various solutions of drawing ink, diluted to different darkness levels. You then apply this ink with soft hop hair brushes. Paper weight is important, and I would not recommend using cartridge paper of weight less than 150 gsm [perhaps 40-pound paper. Ed.] with this method.

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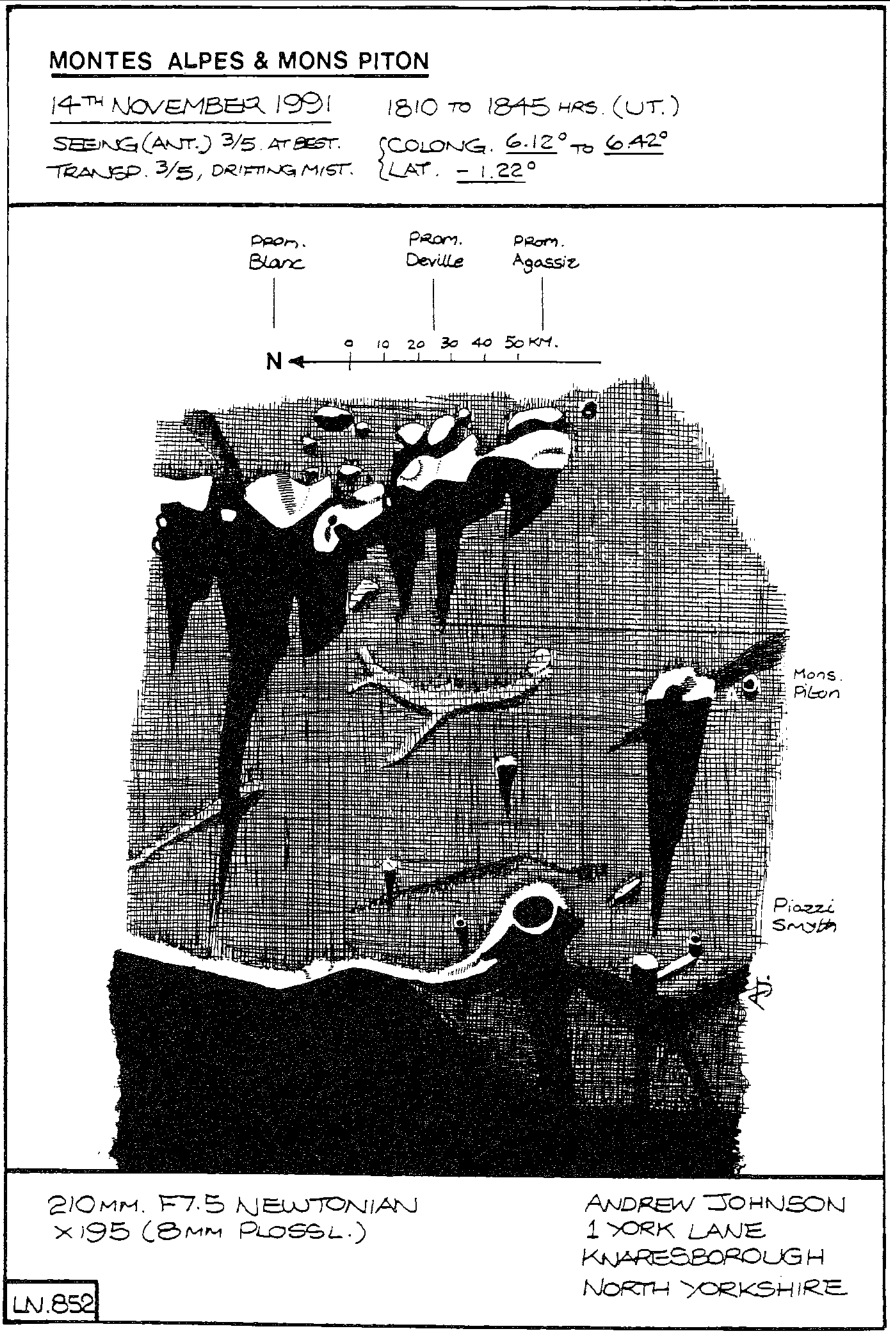

Figure 6. Example of a lunar drawing using the hatching technique of shading. [The *Astronomical Almanac* values for the colongitude range are 6°.06-6°.36, and for the solar latitude is -1°.21. Ed.]

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METEORS SECTION NEWS

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

Now that Comet Swift-Tuttle has come and gone, what behavior can we expect from the Perseid meteor shower of August, 1993? When Swift-Tuttle last visited the inner Solar System in 1862, Perseid displays were enhanced for the next ten years, with 1863 providing the strongest rates. In 1993, circumstances are again favorable for an exceptional display of celestial fireworks. The Earth will intersect the orbit of Comet Swift-Tuttle near 0h Universal Time (UT) on August 12. Unfortunately for North American observers, this corresponds to late afternoon for the West Coast and near sunset for eastern observers on Wednesday, August 11, local time.

The ideal location to observe this year's Perseid shower would be the Middle East, near longitude 60°E. European observers are also well-situated, but the radiant will not have risen as high in their sky as in the Middle East. There are also arguments over the best latitudes from which to observe this shower. The latitude range of 20°-40°N will enjoy a longer night, but the radiant does not rise as high in the sky as in the latitude range of 40°-60°N. The more northerly latitudes enjoy a higher radiant altitude, but at the cost of a shorter night.

From North America, the New England states and extreme eastern Canada (the Island of Newfoundland and Nova Scotia) would be the best locations for seeing any enhanced activity. For those situated farther west, the best display will occur during the last dark hour before morning twilight on August 12 (local time), when perhaps a meteor a minute may be seen. Unlike last year when observers were hampered by the Full Moon, this year the Moon will be a waning crescent and will not cause any major interference for visual observers or photographers of the Perseid Shower. *Figure 1* (below) is an example of an amateur photograph of the Perseids.

Figure 1. Two bright Perseid meteors, in the upper- right and lower-left corners. Photograph taken by Robert M. Hays, Jr., on 1992 AUG 11, 08h55m-09h07m UT. 35-mm f/2.8, Tri-X Film.

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

1992 UT Date	Observer and Location	Universal Time	Number and Type of Meteors Seen*	Comments (+*N* = Limiting Magnitude)
MAY 14	Carl Hergenrother, AZ	10:15-11:15	2 ETA, 1 SPO	+5.0
AUG 09	Robert Young, PA	03:34-04:45	2 PER, 7 SPO	+5.0
	" " "	05:15-06:15	5 PER, 7 SPO	+5.0
OCT 01	John Gallagher, NJ	05:45-07:28	1 DAU, 1 ORI, 2 AND, 6 SPO	+6.0
02	" " "	06:00-07:40	1 OEC, 3 AND, 9 SPO	+6.9
	George Zay, CA	06:51-12:25	3 SOR, 3 ORI, 1 STA, 3 NTA, 28 SPO	+5.7
	Robert Hays, WY	09:06-11:06	1 SPI, 3 NPI, 29 SPO	+6.8
03	John Gallagher, NJ	06:15-09:06	1 DAU, 5 AND, 4 ORI, 2 EGE, 9 SPO	+7.0
	Richard Taibi, MD	07:17-08:28	1 ORI, 1 TAU, 2 SPO	+5.7
04	John Gallagher, NJ	05:40-07:49	1 DAU, 1 AND, 2 NPI, 1 DER, 5 SPO	+6.7
05	Robert Hays, WY	09:06-11:06	6 NPI, 34 SPO	+6.8
06	George Zay, CA	06:35-11:41	2 SPI, 2 SOR, 1 ORI, 2 STA, 33 SPO	+5.7
	Robert Lunsford, CA	08:00-12:00	1 SPI, 1 OEC, 1 ORI, 40 SPO	+6.7
07	John Gallagher, NJ	04:30-07:14	1 AND, 2 ORI, 1 OEC, 1 NTA, 1 KAQ, 1 SOR, 4 SPO	+6.5

------------------------------- *Table 1 continued on pp.32-33 with note on p.33* -------------------------------

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

1992 UT Date	Observer and Location	Universal Time	Number and Type of Meteors Seen*	Comments (+N = Limiting Magnitude)
OCT 14	John Gallagher, NJ	04:35-06:37	1 ORI	+5.2; 20% obstruction
17	George Zay, CA	04:16-06:36	1 SOR, 1 ORI, 1 STA, 1 NTA, 13 SPO	+5.6
20	John Gallagher, NJ	04:50-08:11	2 DAU, 8 ORI, 1 OEC, 1 OAR, 2 STA, 10 SPO	+6.8
	Ronald Rosenwald, TX	08:45-10:16	15 ORI, 2 SPO	+4.9
	Daniel Rhone, NJ	09:00-10:15	7 ORI, 3 SPO	+4.5
	Michael Morrow, HI	09:00-10:45	3 ORI, 1 STA, 5 SPO	+4.5; 50% cloudy
21	Ronald Rosenwald, TX	08:40-10:25	14 ORI, 6 SPO	+5.8
	Earl Mead, CO	09:00-10:00	15 ORI, 6 SPO	+4.4
	Michael Morrow, HI	09:30-11:30	6 ORI, 1 TAU, 5 SPO	+5.0; 40% cloudy
22	John Gallagher, NJ	04:50-08:13	5 ORI, 2 OEC, 1 OAR, 1 EGE, 2 NTA, 3 STA, 11 SPO	+6.8
	Richard Taibi, MD	05:54-08:08	2 STA, 1 EGE, 1 NTA, 5 SPO	+5.4
	Ronald Rosenwald, TX	08:38-10:45	8 ORI, 3 SPO	+4.0
	George Gliba, MD	09:01-10:01	5 ORI, 6 SPO	+5.0
	Michael Morrow, HI	09:40-11:30	5 ORI, 4 SPO	+5.0; 20% cloudy
	Phyllis Eide, HI	09:40-11:45	10 ORI, 5 SPO	+5.0; 10% cloudy
23	John Gallagher, NJ	05:10-07:25	5 ORI, 1 STA, 9 SPO	+7.1
	Richard Taibi, MD	06:37-08:34	11 ORI, 1 STA, 2 EGE, 5 SPO	+5.7
	Phyllis Eide, HI	09:15-11:15	1 ORI, 2 SPO	+5.0; 10% cloudy
	Michael Morrow, HI	09:15-11:15	3 ORI, 4 SPO	+4.9; 25 % cloudy
24	George Gliba, MD	08:45-09:45	6 ORI, 1 STA, 4 SPO	+5.5; 30% cloudy
	John Gallagher, NJ	08:50-09:09	7 ORI, 1 OAR, 3 LMI, 1 PEG, 1 TAU, 7 SPO	+7.2
25	Michael Morrow, HI	08:00-10:45	4 ORI, 1 TAU, 1 STA, 8 SPO	+5.5; 50% cloudy
	Phyllis Eide, HI	08:00-11:05	1 ORI, 4 SPO	+3.5; 50% cloudy
26	John Gallagher, NJ	05:15-07:16	5 SPO	+7.0
28	" " "	05:40-07:50	5 ORI, 3 OAR, 1 NTA, 1 STA, 2 SPO	+7.1
29	" " "	05:30-07:38	2 OAR, 1 STA, 2 SPO	+7.1
30	George Zay, CA	06:34-08:26	1 STA, 4 NTA, 14 SPO	+5.7
Nov 01	" " "	06:50-13:05	6 ORI, 3 NTA, 45 SPO	+5.7
	Robert Lunsford, CA	10:00-13:15	3 ORI, 2 STA, 38 SPO	+6.3
02	" " "	09:00-13:00	4 ORI, 2 STA, 2 NTA, 26 SPO	+5.6
06	" " "	10:00-12:30	12 SPO	+5.3
09	John Gallagher, NJ	05:15-08:50	1 STA, 6 SPO	+6.4
14	" " "	05:45-07:50	1 DER, 6 SPO	+6.6
16	" " "	05:10-07:18	8 SPO	+7.0
	Richard Taibi, MD	08:16-10:29	4 LEO, 1 TAU, 2 SPO	+4.6
	Daniel Rhone, NJ	09:45-10:30	*None Seen*	+4.5
17	George Zay, CA	04:00-12:19	1 STA, 2 NTA, 3 LEO, 13 SPO	+5.3; 10% cloudy
	Robert Lunsford, CA	10:00-13:00	1 STA, 1 NTA, 8 LEO, 1 AMO, 3 SPO	+6.2; 20% cloudy
18	George Zay, CA	03:00-13:22	1 ORN, 2 NTA, 1 LEO, 1 AMO, 25 SPO	+5.4
	Robert Lunsford, CA	10:00-13:00	1 COL, 1 NTA, 14 LEO, 14 SPO	+6.1
20	John Gallagher, NJ	05:30-07:34	1 NTA, 4 SPO	+7.1
	George Zay, CA	05:56-13:25	3 STA, 9 LEO, 1 AMO, 51 SPO	+5.6
21	John Gallagher, NJ	04:45-09:06	1 LEO, 14 SPO	+7.1
24	George Zay, CA	03:06-13:25	3 STA, 1 NTA, 3 AMO, 1 ORN, 28 SPO	+5.7
	Robert Lunsford, CA	10:30-13:30	2 LEO, 2 NTA, 1 AMO, 1 ORN, 18 SPO	+6.4
29	John Gallagher, NJ	06:20-08:29	6 SPO	+7.0
DEC 01	Robert Lunsford, CA	10:00-11:30	8 SPO	+5.1; 60% cloudy
08	John Gallagher, NJ	06:35-08:39	1 GEM, 2 SPO	+7.0

------------------------------ *Table 1 continued on p. 33 with note* ------------------------------

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

1992 UT Date	Observer and Location	Universal Time	Number and Type of Meteors Seen*	Comments (+N = Limiting Magnitude)
Dec 10	John Gallagher, NJ	00:20-01:23	1 SPO	+6.8
	" " "	05:20-06:06	2 SPO	+6.3
13	Robert Lunsford, CA	07:00-08:00	14 GEM, 3 SPO	+5.1
	Phyllis Eide, HI	07:25-09:45	4 GEM, 6 SPO	+5.0; 10% cloudy
	Robert Lunsford, CA	08:00-09:00	23 GEM, 3 SPO	+5.3
	" " "	09:00-10:00	22 GEM, 4 SPO	+5.1
	" " "	10:00-11:00	18 GEM, 3 SPO	+4.9
	" " "	11:00-12:00	19 GEM, 3 SPO	+4.9
	" " "	12:00-13:00	22 GEM, 3 SPO	+5.1
14	George Zay, CA	02:44-03:48	6 GEM, 2 SPO	+5.7
	Robert Lunsford, CA	02:47-03:47	9 GEM, 1 SPO	+6.9
	George Zay, CA	03:48-04:58	20 GEM, 1 SPO	+5.7
	Robert Lunsford, CA	03:47-04:47	15 GEM, 3 SPO	+6.6
	George Gliba, MD	04:45-05:45	35 GEM, 1 DAR, 1 ORN, 2 SPO	+5.2
	Robert Lunsford, CA	04:47-05:47	25 GEM	+6.4
	George Zay, CA	04:58-06:06	14 GEM, 1 SPO	+5.4
	Robert Lunsford, CA	05:47-06:47	22 GEM, 1 SPO	+5.9
	Phyllis Eide, HI	06:00-09:00	8 GEM, 17 SPO	+5.5; 5% cloudy
	George Zay, CA	06:06-07:16	21 GEM	+5.1
	Richard Taibi, MD	06:21-07:22	16 GEM, 2 SPO	+4.7
	Robert Lunsford, CA	06:47-07:47	20 GEM	+5.6
	Michael Morrow, HI	06:55-07:55	1 GEM	+5.0; 90% cloudy
	George Zay, CA	07:16-08:40	16 GEM, 2 SPO	+5.1
	Richard Taibi, MD	07:26-08:43	21 GEM, 4 SPO	+4.7; 5% cloudy
	George Zay, CA	08:40-09:43	7 GEM	+5.1
	" " "	09:43-11:02	17 GEM	+5.1
	Robert Lunsford, CA	10:00-11:00	9 GEM	+5.6
	" " "	11:00-12:00	8 GEM, 2 SPO	+5.7
	George Zay, CA	11:02-12:09	10 GEM, 1 MON, 1 SPO	+5.1
	Robert Lunsford, CA	12:00-13:00	8 GEM, 2 SPO	+5.8
	" " "	13:00-14:00	7 GEM, 3 SPO	+5.5
15	George Zay, CA	03:45-05:04	2 SPO	+5.4; 5% cloudy
	John Gallagher, NJ	05:30-07:41	2 GEM, 1 URS, 6 SPO	+6.7
	Tom Giguere, HI	06:55-07:55	1 GEM, 1 SPO	+5.0; 90% Cloudy
18	John Gallagher, NJ	05:55-08:03	1 GEM, 1 MON, 1 HYD, 1 COM, 6 SPO	+7.5
19	" " "	06:30-08:41	3 GEM, 1 *11C*, 9 SPO	+7.4; 10% cloudy
	George Zay, CA	09:14-13:44	2 GEM, 1 COM, 1 URS, 33 SPO	+5.5
21	Richard Taibi, MD	09:03-10:36	2 COM, 6 SPO	+5.5
	Robert Lunsford, CA	11:00-14:00	1 URS, 7 SPO	+5.6
22	Carl Hergenrother, AZ	06:22-06:57	2 URS, 1 SPO	+4.7
	Tim Spahr, AZ	06:22-06:57	1 URS, 2 SPO	+4.7
	George Zay, CA	08:17-13:46	8 URS, 2 GEM, 2 COM, 54 SPO	+5.7
	Robert Hays, IN	09:50-10:50	4 URS, 3 COM, 4 SPO	+6.0
	Robert Lunsford, CA	10:00-11:00	5 URS, 11 SPO	+6.9
	Richard Taibi, MD	10:00-11:27	2 URS, 3 SPO	+5.0
	Robert Hays, IN	10:50-11:50	5 URS, 2 COM, 5 SPO	+5.8; 10% cloudy
	Robert Lunsford, CA	11:00-12:00	7 URS, 8 SPO	+7.0
	" " "	12:00-13:00	1 URS, 1 COM, 11 SPO	+6.8
	" " "	13:00-14:00	5 URS, 7 SPO	+6.6
23	Robert Lunsford, CA	10:00-14:00	1 URS, 1 COM, 20 SPO	+5.8

Key to Abbreviations:

AMO	Alpha Monocerotid
AND	Annual Andromedid
COL	Columbid
COM	Coma Berenicid
DAR	Delta Arietid
DAU	Delta Aurigid
DER	Delta Eridanid
EGE	Epsilon Geminid
ETA	Eta Aquarid
GEM	Geminid
HYD	Sigma Hydrid
KAQ	Kappa Aquarid
LEO	Leonid
LMI	Leo Minorid
MON	Monocerotid
NPI	North Piscid
NTA	North Taurid
OAR	October Arietid
OEC	October Cetid
ORI	Orionid
ORN	North Chi Orionid
PEG	Pegasid
PER	Perseid
SOR	Sigma Orionid
SPI	South Piscid
SPO	Sporadic
STA	South Taurid
TAU	Taurid
URS	Ursid
11C	11 Canis Minorid

COMET CORNER

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

PRESENT COMET ACTIVITY

No bright comets are expected during the second half of 1993. However, you never know when a new bright comet will be found. Also, you may wish to observe the following comets. If so, please send your observations to this Recorder (address on inside back cover).

Periodic Comet Schwassmann-Wachmann 1.—This comet remains nearly 5 AU [1 Astronomical Unit equals the mean distance of the Earth from the Sun; 149,597,870 km] from the Sun in a near-circular orbit. It is normally quite faint, but will occasionally outburst to magnitude +11 or +12, as it has during the past year. Thus, you may wish to monitor this comet. (See *Table 1,* to the right.)

Periodic Comet Schwassmann-Wachmann 2.—Not to be confused with the previous comet, this object will brighten to 11th magnitude in early 1994. Its orbital period is 6.4 years, and it stays outside the orbit of Mars. (See *Table 2*, to the lower right.)

Periodic Comet Shoemaker-Levy 9 (1993e).—Discovered in late March, 1993, this comet remains nearly 5 AU distant from the Sun in a near-circular orbit. A close approach to Jupiter last year apparently tore this comet apart. Early observations thereafter showed many nuclei and multiple tails—a most unusual object. This comet will remain faint; but those of you with large telescopes, photographic or CCD equipment, or both may wish to observe it. [The magnitude forecasts given are for the combined magnitude of all this comet's fragments and are thus highly uncertain. As we go to press, there are forecasts that this comet will have another close encounter with Jupiter, in late July, 1993, with an impact on Jupiter possible. We will keep you informed when more refined predictions become available. Ed.] (See *Table 3*, p. 35.)

Comet Mueller (1993a).— This comet comes to perihelion (closest to the Sun) in early 1994, one year after its discovery. When found, it appeared rather bright for its distance. Whether it will brighten up as expected is not yet known, but it is well-placed for Northern-Hemisphere observers. (See *Table 4* and *Figure 1*, p. 35.)

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. Following our ephemerides are given orbital elements for those who wish to compute their own ephemerides.

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

1993 UT Date (0h UT)	2000.0 Coörd. R.A. h m	Decl. ° '	Elongation from Sun °		Total Mag.
(Too close to the Sun for observation)					
Aug 16	07 12.6	+26 55	037	M	+18.0
21	07 16.3	+26 48	041	M	+18.0
26	07 19.9	+26 42	045	M	+18.0
31	07 23.3	+26 35	049	M	+18.0
Sep 05	07 26.6	+26 29	053	M	+17.9
10	07 29.7	+26 22	057	M	+17.9
15	07 32.7	+26 16	062	M	+17.9
20	07 35.5	+26 11	066	M	+17.9
25	07 38.0	+26 06	070	M	+17.8
30	07 40.4	+26 00	075	M	+17.8
Oct 05	07 42.5	+25 57	079	M	+17.8
10	07 44.3	+25 53	083	M	+17.8
15	07 45.9	+25 50	088	M	+17.7
20	07 47.3	+25 48	093	M	+17.7
25	07 48.3	+25 46	097	M	+17.7
30	07 49.1	+25 45	102	M	+17.7
Nov 04	07 49.5	+25 44	107	M	+17.6
09	07 49.7	+25 45	112	M	+17.6
14	07 49.5	+25 45	117	M	+17.6
19	07 49.1	+25 47	122	M	+17.6
24	07 48.3	+25 49	127	M	+17.5
29	07 47.3	+25 52	133	M	+17.5

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

1993 UT Date (0h UT)	2000.0 Coörd. R.A. h m	Decl. ° '	Elongation from Sun °		Total Mag.
Sep 10	06 38.8	+20 25	068	M	+13.2
15	06 48.1	+20 15	071	M	+13.1
20	06 57.2	+20 04	074	M	+13.0
25	07 06.2	+19 51	077	M	+12.9
30	07 14.9	+19 37	079	M	+12.8
Oct 05	07 23.5	+19 21	082	M	+12.7
10	07 31.8	+19 04	085	M	+12.6
15	07 39.9	+18 47	088	M	+12.5
20	07 47.7	+18 29	091	M	+12.4
25	07 55.1	+18 10	094	M	+12.3
30	08 02.1	+17 52	098	M	+12.2
Nov 04	08 08.8	+17 35	101	M	+12.1
09	08 15.0	+17 18	105	M	+12.0
14	08 20.7	+17 03	108	M	+11.9
19	08 25.8	+16 49	112	M	+11.8
24	08 30.4	+16 37	116	M	+11.7
29	08 34.3	+16 28	120	M	+11.6

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

1993 UT Date (0h UT)	2000.0 Coörd. R.A. h m	Decl. ° '	Elongation from Sun °		Total Mag.
Aug 01	12 27.5	-04 08	059	E	+13.6
06	12 30.6	-04 28	055	E	+13.6
11	12 33.8	-04 48	051	E	+13.6
16	12 37.2	-05 10	047	E	+13.6
21	12 40.7	-05 32	043	E	+13.7
26	12 44.3	-05 55	040	E	+13.7
31	12 48.0	-06 18	036	E	+13.7
Sep 05	12 51.9	-06 42	032	E	+13.7

(Too close to the Sun for observation.)

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

1993 UT Date (0h UT)	2000.0 Coörd. R.A. h m	Decl. ° '	Elongation from Sun °		Total Mag.
Aug 01	07 44.2	+58 31	042	M	+12.1
06	07 50.4	+59 14	045	M	+12.0
11	07 57.0	+60 02	047	M	+11.8
16	08 03.9	+60 56	050	M	+11.7
21	08 11.3	+61 57	054	M	+11.6
26	08 19.3	+63 06	057	M	+11.4
31	08 27.9	+64 23	060	M	+11.3
Sep 05	08 37.4	+65 49	064	M	+11.2
10	08 48.0	+67 26	067	M	+11.0
15	09 00.4	+69 14	071	M	+10.9
20	09 15.2	+71 14	074	M	+10.7
25	09 33.8	+73 26	078	M	+10.6
30	09 58.8	+75 50	081	M	+10.4

(Continued on top of right column)

Ephemeris of Comet Mueller—Continued.

1993 UT Date (0h UT)	2000.0 Coörd. R.A. h m	Decl. ° '	Elongation from Sun °		Total Mag.
Oct 05	10 35.3	+78 21	085	M	+10.2
10	11 34.1	+80 47	088	M	+10.1
15	13 13.2	+82 31	091	M	+9.9
20	15 27.8	+82 28	094	E	+9.8
25	17 18.0	+80 09	096	E	+9.7
30	18 24.6	+76 22	097	E	+9.6
Nov 04	19 05.1	+71 48	098	E	+9.5
09	19 32.2	+66 49	098	E	+9.4
14	19 52.0	+61 38	096	E	+9.3
19	20 07.5	+56 26	094	E	+9.3
24	20 20.3	+51 19	092	E	+9.3
29	20 31.3	+46 26	088	E	+9.3

Those wishing to compute their own ephemerides for these four comets may use these orbital elements. [In order, they are: The UT date of perihelion passage, the perihelion distance, the argument of the perihelion, the longitude of the ascending node, the orbital inclination, and the orbital eccentricity.]

Value	Comet P/ S-W-1	Comet P/ S-W 2	Comet P/ Shoemaker-Levy 9	Comet Mueller
T	1989 Oct 26.7	1994 Jan 23.9	1996 Jun 24.6	1994 Jan 13.3
q (AU)	5.7718	2.0703	5.00194	1.937118
ϖ	049°.897	358°.142	313°.316	130°.728
☊	312°.123	125°.624	336°.390	144°.711
i	009°.367	003°.757	001°.765	124°.867
e	0.04466	0.39875	0.04611	1.00000

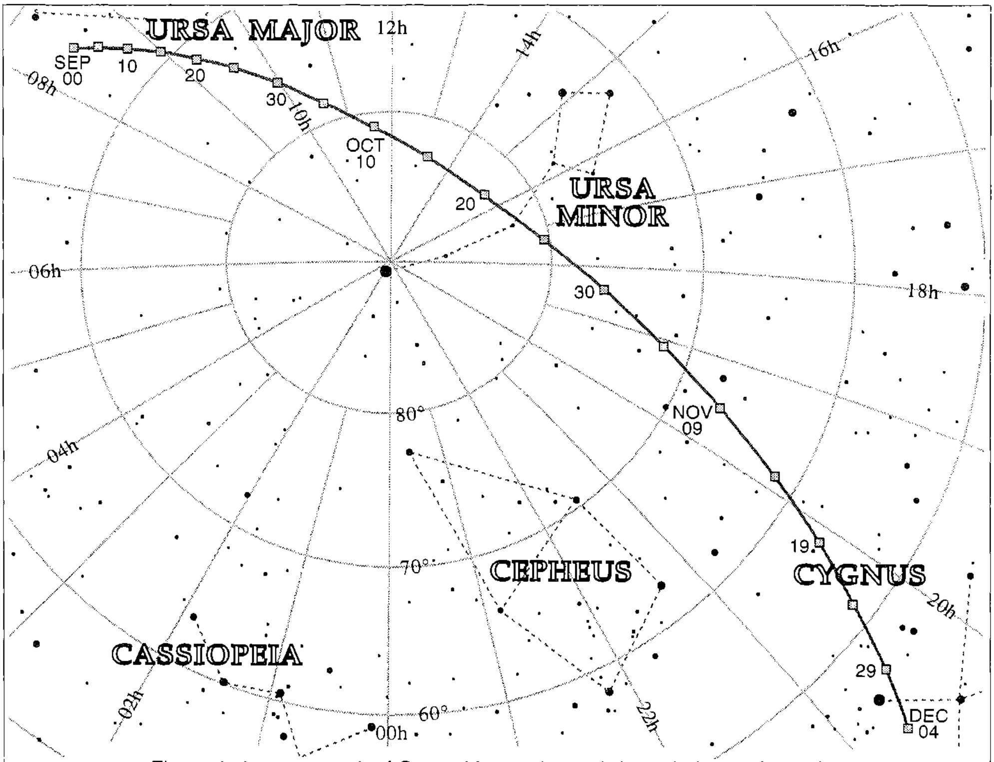

Figure 1. Apparent path of Comet Mueller (1993a) through the northern sky 1993 Sep 00-DEC 04, 0h UT. Stars shown to magnitude +5.6, 1993 coordinates.

COMING SOLAR-SYSTEM EVENTS: AUGUST - OCTOBER, 1993

WHAT TO LOOK FOR

Although this three-month period includes no spectacular eclipses or conjunctions, it is a good time to view several planets conveniently. There are also eleven predicted occultations of stars by minor planets, rare events involving Saturn's satellites Iapetus and Tethys, and a possible spectacular meteor shower.

This column is intended to alert our readers about upcoming 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 1993 edition of the *A.L.P.O. Solar System Ephemeris*. (See p. 48 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!

PLANETS: MAINLY SATURN IN THE PM, VENUS IN THE AM

To put it briefly, the evening observer is largely restricted to viewing Saturn and the Remote Planets during the period, while the morning observer's chief attraction is Venus.

Both **Mars** and **Jupiter** are in Virgo, low in the SW sky after sunset and setting in the evening. Mars' magnitude brightens from +1.6 to +1.5 as its apparent diameter shrinks from 4".3 to 3".8 (" = arc-seconds), comparable to that of Uranus! Jupiter, being brighter, is much easier to spot; its magnitude drops from -1.8 to -1.6. The giant planet's disk will still present some detail as its equatorial diameter drops from 34" to 31". However, give up on Jupiter for October as it is in conjunction with the Sun on OCT 18.

In September, Mars, Jupiter, Mercury, and the star Spica are all close to one another, with the Moon entering the picture on SEP 17-18. You may need a pair of binoculars to see them all together, as is shown in *Figure 1* (below). Related events are: (1) Mars passes 0°.9 S of Jupiter on SEP 07, 00h (32°E of the Sun, with respective magnitudes +1.6 and -1.6); (2) Mars passes 2° N of Spica on SEP 16, 10h (29°E, +1.6/+1.0); (3) Mercury passes 2°S of Jupiter on SEP 24, 12h (19°E, -0.2 /-1.6); (4) Mercury passes 1°.1 N of Spica on SEP 26, 08h (20°E, -0.2/+1.0); (5) Mercury passes 2°S of Mars on OCT 06, 17h (24°E, -0.1/+1.6); and (6) another passage of Mercury 2°S of Mars, on OCT 28, 06h (17°E, +1.1/ +1.5).

Mercury, as always, is intermittently visible. Two apparitions of **Mercury** occur in these three months. The first is a morning one, favorable for observers in the Northern Hemisphere. It is centered on AUG 04, the date of Greatest Western Elongation (19°.3); the planet will be at least 15° from the Sun between JUL 26-AUG 14, with *dichotomy* (half-phase) *predicted* for AUG 07, 00h. Mercury's second apparition is a evening one, favorable for Southern-Hemisphere observers. Greatest Eastern Elongation is on OCT 14, with the planet then 25°.0 from the Sun, and at elongation 15° or greater from SEP 17-OCT 29; and

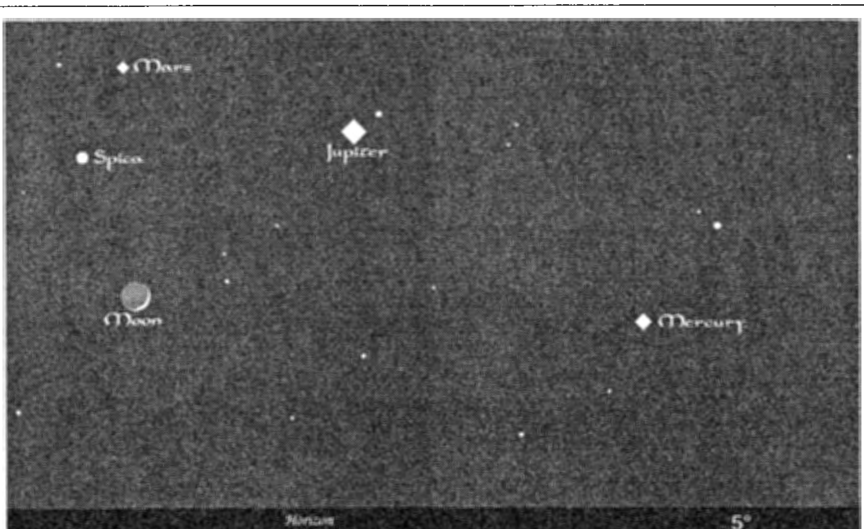

Figure 1. The southwestern sky 10 minutes after sunset on September 17, 1993, local time, as seen from the central United States (*ca.* 40°N/90°W). The Moon is only 2.0 days old at the time; the visual magnitudes of the other objects are: Spica, +1.0; Mars, +1.6; Jupiter, -1.6; and Mercury, -0.4.

dichotomy is forecast for OCT 19, 12h. Terminating this last apparition will be Mercury's rare *transit* across the Sun on 1993 NOV 06, to be featured in our next issue.

Saturn is the most obvious planet in the evening sky. At opposition on AUG 19, 23h, in Aquarius, it is visible essentially all night. Northern-Hemisphere observers will also be happy to hear that Saturn is now definitely moving north, and will be at declination -14° at opposition. At the time of opposition, Saturn will be at visual magnitude +0.4, with a disk measuring 19" by 17". Its Rings, now tilted only 12°to our line of sight, will then span 43" EW and just 9" NS.

The Earth and Sun continue to lie near the plane of Saturn's "two-faced" satellite **Iapetus**. On AUG 28, this moon *transits* (passes in front of) Saturn's Globe. This is a rare event; but unfortunately the tiny 11th-magnitude satellite, with a 0".22 diameter disk, will be hard to spot. It is predicted to *ingress* at Saturn's NE limb at 15h 20m; and to *egress* at the WNW limb at 23h 32m, then at the outer NW Ring edge. The next Iapetus event is an *occultation* that is to begin with disappearance on the W limb on OCT 07, at 18h 25m; and to end with reappearance on the ENE limb on OCT 08, at 04h 08m.

Saturn's innermost "classical" satellite, Mimas, began undergoing eclipses in July, 1992, while the next satellite out, Enceladus, began being eclipsed in April, 1993. However, these faint, close satellites are hard to spot. Fortunately, the next satellite farther out from Saturn, **Tethys**, is at 10th magnitude, and begins its series of eclipses in October. The UT of disappearance and reappearance for eclipses of Tethys that are forecast for October are given below:

OCT 02	06:37-06:44	OCT 17	08:54-09:32
04	03:52-04:07	19	06:11-06:53
06	01:08-01:29	21	03:30-04:13
07	22:25-22:50	23	00:48-01:33
09	19:43-20:11	24	22:06-22:53
11	17:00-17:31	26	19:24-20:13
13	14:18-14:52	28	16:42-17:33
15	11:36-12:12	30	14:00-14:53

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

Uranus and **Neptune** are both in Sagittarius and visible in the SE in the evening. They are the closest to each other that we have ever seen them, as shown in *Figure 2* (below), and can be compared in a binocular or low-power telescope field. They were both in opposition on JUL 12; now Uranus' magnitude is dropping from +5.6 to +5.8, still visible to the naked eye from a dark site. Neptune requires binoculars, at magnitude +7.8 - +7.9.

Pluto, near the Serpens-Libra border, is well-placed for observation in the evening in August but not later. At 14th magnitude, its elongation from the Sun decreases from 104°E on AUG 01 to only 20°E on NOV 01.

Venus remains the brightest "star" in the morning sky, but is gradually moving towards the Sun; the planet's elongation decreases from 40°W on AUG 01 to 19°W on NOV 01. During the same period, Venus' phase increases from 72 to 95 percent while its angular diameter drops from 15" to 11". The planet's magnitude hangs between -4.0 and -3.9. Venus passes only 0°.4 N of the +1.4-magnitude star Regulus on SEP 21, 06h, Venus appearing about 130 times brighter than the star.

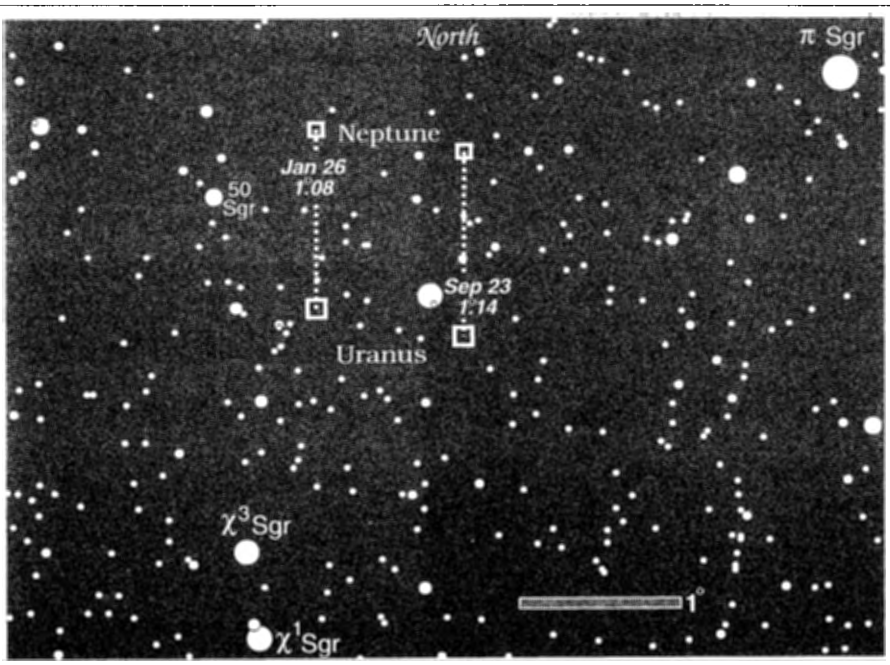

Figure 2. The two conjunctions of Uranus and Neptune in 1993. This chart appeared on the front cover of the *A.L.P.O. Solar System Ephemeris: 1993* and has a limiting magnitude of +9.

MINOR PLANETS

No less than seven of the brighter **minor planets** reach opposition during 1993 AUG-OCT and will be visible in binoculars. Their 10-day ephemerides are given in the 1993 edition of the *A.L.P.O. Solar System Ephemeris*, and their opposition data are given below:

Minor Planet	1993 Date	Stellar Magnitude	Declination& Constellation	
	Opposition Data			
2 Pallas	AUG 18.7	+9.1	9°N	Peg
4 Vesta	AUG 31.4	+5.9	19°S	Aqr
9 Metis	SEP 27.2	+9.0	8°S	Cet
27 Euterpe	OCT 01.5	+9.4	0°N	Cet
11 Parthenope	OCT 10.3	+9.3	2°S	Cet
79 Eurynome	OCT 21.1	+9.5	10°N	Psc
1 Ceres	OCT 26.6	+7.4	1°S	Cet

The above objects include three of the "Big Four" minor planets; **1 Ceres**, **2 Pallas**, and **4 Vesta**. Vesta will be visible to the naked eye from a dark-sky site during AUG-SEP. To help you to find Vesta, *Figure 3* (below), charts its path during those months.

THE MOON

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

New Moon	First Quarter	Full Moon	Last Quarter
JUL 19.5	JUL 26.1	AUG 02.5	AUG 10.6
AUG 17.8	AUG 24.4	SEP 01.1	SEP 09.3
SEP 16.1	SEP 22.8	SEP 30.8	OCT 08.8
OCT 15.5	OCT 22.4	OCT 30.5	NOV 07.3

The four lunations listed above constitute Numbers 873-876 in Brown's series. Note also that, for those using local time, there will be two Full Moons in AUG for the Americas; likewise, there will be two SEP Full Moons for locations in Europe, and two in OCT in central and east Asia. (The second Full Moon in a calendar month is often called a "Blue Moon.")

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
JUL 17	JUL 23	JUL 30	AUG 05
AUG 14	AUG 19	AUG 26	SEP 01
SEP 11	SEP 15	SEP 23	SEP 28
OCT 09	OCT 12	OCT 21	OCT 25

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 librations are well-synchronized with the phases; the lunar limb will be tilted toward us when there is favorable lighting. First, the S limb can be seen well on AUG 02-08, AUG 29-SEP 04, SEP 25-OCT 01, and OCT 22-28; the Sun's southerly lunar declination (1°.57S on SEP 02) also helps. The W limb will be well-presented on AUG 11-15, SEP 09-13, and OCT 09-12. Finally, the E limb can be well seen on AUG 23-24, SEP 20-23, and OCT 18-22. Note that libration tables give *geocentric librations*, and can differ by up to 1° from the *topocentric librations* that one sees from a particular observing location. Thus, if the Moon is N of your zenith, you will see even more of the S polar region.

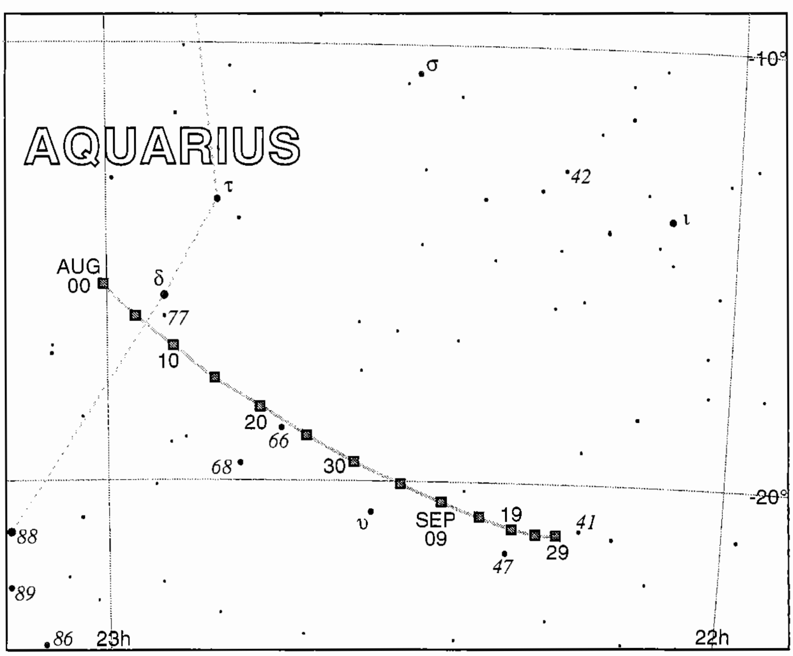

Figure 3. The path of Vesta in the constellation of Aquarius during August and September, 1993. Positions are marked for every 5 days at 0h UT. Stars are shown to 7th magnitude (fainter than Vesta), with Bayer numbers or Greek letters given for the brighter stars. 1993 coordinates.

Lots of Occultations

Eleven minor planets will occult stars. *Table 1* (below) lists the date, occulting object, visual magnitude of planet followed by that of the star, and *possible* zone of visibility for each occultation. The SEP 28 occultation of the star BD +43°0511 by **89 Julia** is particularly promising because it can be viewed with binoculars from an area that contains many of our members. A finding chart for this star is shown in *Figure 4* (to the right).

(No occultations of stars by a major planet, or of bright stars or planets by the Moon, are predicted for this period.)

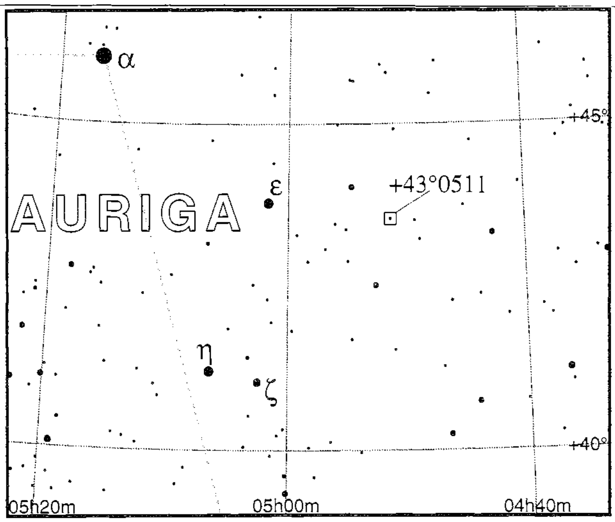

Figure 4. Finding chart for the star BD+43°0511 (SAO 39807), to be occulted by the minor planet 89 Julia on 1993 SEP 28.18. Limiting magnitude +8.0, Epoch 2000.0 coordinates.

Comets

The column by Don E. Machholz, "Comet Corner," on pp. 34-35, and the *A.L.P.O. Solar System Ephemeris: 1993* list a total of thirteen known comets that will be visible during at least part of this period. Of these, **Comet Mueller** may be as bright as 9-10th magnitude and thus should be visible in binoculars under dark skies.

The above is a conservative statement of comet visibility as 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, with Orionid notes by the Editor. Local times are used.)

The **South Delta Leonids** are best seen near July 28th and often produce up to 20 meteors per hour near this date. The Moon will set shortly after midnight, allowing an unhampered view of this shower and of the many other minor showers active this time of year.

The **Perseids** are predicted to reach their maximum strength on Wednesday evening, August 11th. Since their parent comet, P/Swift-Tuttle, has just passed perihelion, a strong display may occur. For more details, see p. 31 of this issue.

The peak date of the **Orionids** is on October 21-22, with the best viewing after the First Quarter Moon sets about midnight. The normal peak rate near maximum is about 20 Orionids per hour, but this shower has a long duration; from October 5-November 3.

Table 1. Occultations of Stars by Planets, 1993 AUG-OCT.

(For further information, consult the A.L.P.O. Solar System Ephemeris: 1993 or the 1993 Asteroidal Occultation Supplement to Occultation Newsletter, Vol 5, No. 9.)

1993 UT Date	Occulting Object	Visual Mag. Object	Visual Mag. Star	Predicted Visibility Zone
AUG 02.22	**70 Panopaea**	12.4	8.7	South America
17.87	**304 Olga**	12.1	8.4	W Russia, Iran
18.13	**19 Fortuna**	10.4	8.5	Central America, Caribbean
SEP 06.56	**13 Egeria**	12.2	9.1	Indonesia
11.38	**709 Fringilla**	13.2	8.9	N Canada
19.82	**52 Europa**	11.9	9.3	Indonesia
28.18	**89 Julia**	11.6	7.5	N & Central Canada, E United States, Caribbean
OCT 03.66	**566 Stereoskopia**	13.8	8.5	Australia
04.17	**107 Camilla**	13.3	9.0	Africa
09.29	**27 Euterpe**	9.6	8.7	NW Mexico, S & E United States
15.06	**30 Urania**	12.2	9.1	N Scandinavia

(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 John:

I should have gone into this in the last letter I sent you, and I think it important enough to share with the readers. Earlier this year [1992], a friend of mine, who is well-respected in the amateur and optical community, wrote to one of the major periodicals, complaining of a misleading and inaccurate Ad. by a major manufacturer (no, it was not related to Schmidt-Cassegrains!). He got a reply from the periodical stating that he should also write to the company and complain (which he had already done). However, the periodical stated that they allowed advertisers to use "puffery" in their Ads., but did not allow *direct* attacks by one advertiser on another. So I looked up the word "puffery", but it is not listed in my 1992 copy of *New Roget's Thesaurus and Webster's Dictionary*. The word "puff", however, is listed, and it is both amusing and informative as to its meanings. Here are some of them: "a short blast of wind" (how appropriate!), "to inflate", "to praise extravagantly", and perhaps the best of all—"a consciously exaggerated commendation." I later confirmed in a 'phone call to a staff member of the periodical that indeed some "puffery" is allowed. I can only assume from this that inflated and exaggerated claims are allowed to be made in the Ads. I have not queried another major periodical about this, but since the same Ad. appeared in its pages too, I can only assume that they also permit "puffery."

Now I realize that the major periodicals cannot police every Ad. Meeting magazine deadlines every month is a tough, tough job. But some claims are blatant and go beyond mere "puffery", and where is the guideline on this drawn? So the question is "why is 'puffery' allowed in the first place?" When "puffery" is allowed, we can be sure that manufacturers and dealers will take advantage of it, so perhaps a good deal of the fault lies with the periodicals when their policy allows inflated claims to be made! Perhaps a change of policy is in order.

Every manufacturer probably has made an inflated or exaggerated claim from time to time. But is there a pattern of abuse? We can "forgive" one or two transgressions over a reasonable time period, but not dozens.

Now those of us who are fairly advanced in the hobby and possess some optical knowledge can usually see through an inflated or exaggerated claim. There are many amateurs, perhaps most, who do not have the expertise to question the claim. Manufacturers rely on advertising to bring them inquiries for eventual continued sales; and if the Ad. is misleading, can we expect less from the manufacturer's mail-out literature? I think not.

On page 707 of the December [1992] *Sky & Telescope*, a Japanese exporter made a claim of being able to supply 1/100-wave mirrors. The question is: What does this accuracy relate to and by what system is it measured? If it is on the RMS [Root-Mean Square] system, then such accuracy is not out of the question because a mirror measured by this system appears *on the average* to be some 5 or 6 times better than if measured on the *peak to valley* [P-V] system, such a mirror being perhaps about 1/16-1/20 λ—well within the range of what is considered a very good amateur mirror. If, on the other hand, the 1/100-wave claim refers to the P-V system, the claim is absurd. I spoke with a professional optical worker who has stated to me that a claimed accuracy of 1/100 λ on the P-V system for Pyrex or similar-type glass is fiction. The material itself is incapable of supporting such an accuracy over any reasonable time frame. Are we seeing a return to the 1950's and 60's when some firms claimed accuracies for their optics far in excess of what the material is capable of holding? At the very least, the advertiser in this case should have been required to identify the measurement system his 1/100 λ claim refers to.

Back in the 1960's, a certain manufacturer in his mail-out literature referenced an earlier article in a major periodical to state that this article proved that their telescope gave superior performance. This went on for *several years* until the writer of the original article stated in a letter that this particular telescope's performance bore no relationship to the performance parameters described in the article. Shortly thereafter, the manufacturer's literature was changed to reflect this change. I have copies of their original literature, the later corrected copy, and a copy of the letter written by the author of the article. I approached a member of our local astronomical society, who also happens to be a lawyer, with the possibility that a class-action lawsuit be filed on behalf of all the owners of this telescope who thought that they were buying this telescope on the premise that it conformed to the performance parameters of the article. The lawyer told me that I had a very good case; but the manufacturer had the resources to tie such a case up in court for years, whereas I did not have the funds to pursue such an action. I can assure you, however, that had I such resources I would have pursued it to the limit!

One thing I do want to make clear—when it comes to false, misleading, exaggerated, or inflated Ad. claims, I make no distinction between manufacturers. I've called into question Ads, and mail-out literature claims, at one time or another over the years from most of the manufacturers, even those that I've at times been particularly friendly with. If some manufacturers have felt the sting of my pen more often than others, it's because they produce more of the misleading and inaccurate statements than perhaps others do. Of course, this attitude on my part sometimes isn't appreciated, and there is always the attitude in some quarters that it's "the messenger's fault" and not the message's.

We can complain about misleading and inflated Ad. claims all we want; but in my opinion, as long as the major periodicals permit "puffery" as described earlier, it will continue. The "guidelines" for advertisers (if such exist) are perhaps too lenient or are not spelled out in enough detail, which again may lead to a wider latitude of interpretation than is desirable.

Mr. Harry Jamieson has stated to me that the A.L.P.O. has lost members, especially newer members, because as newcomers they trusted the Ads. and literature, bought the product, and then were disillusioned and disappointed when the equipment failed to do as advertised. An organization like the A.L.P.O. needs constant new blood if it is to continue its work. I Note in *J.A.L.P.O.*, Vol. 36, No. 3 [p. 112] that the A.L.P.O. has lost almost 100 members from the 700 it had two years ago. It would be informative to know how many were lost due to the reasons given above by Mr. Jamieson.

I do not like to take up valuable A.L.P.O. Journal space; but while some manufacturers have made strides in improving their products, *much* remains to be done. The hobby of amateur astronomy is in trouble as a whole in terms of not attracting new younger members; and if misleading or inaccurate Ads. drive just *one* beginner away from the hobby, we are all the worse for it.

Rodger W. Gordon

637 Jacobsburg Road
Nazareth, PA 18064

November 14, 1992

To Whom It May Concern:

The "Getting Started: Telescope Selection" section of *The Strolling Astronomer* has been needed for some time, and it's once again nice to see friendly debate concerning the telescope. Good move.

I will not elaborate on my choice of instruments or what is the best telescope—those who know of me could not mistake which Newtonian telescope I like. For better or worse, for me the best all-around instrument for observing our Solar System is a Standard- Newtonian (f7-f8) reflecting telescope made by myself, or at least put together by me. However, living in a house in Florida not far away from the steady atmosphere above the Gulf Stream and being able to design and construct most anything I want to, gives me certain advantages over many others. It would not surprise anyone that I have certain opinions about astronomical instruments. Most of you do the best you can; and to those who strive for excellence, with whatever telescope they have, we in the A.L.P.O. Mars Section sincerely appreciate your efforts. If given the opportunity I would write each observer a long letter thanking him; however, we have had 541 observers in the past three apparitions!

It may surprise some of you to hear that the largest professional optical observatory south of Gainesville, Florida is the U.S. Naval Observatory (USNO) in Miami. Prior to installing my old 12.5-inch f/7 Newtonian on the station grounds the largest optical instrument we had was a C11. During the 1990-91 apparition of Mars I would occasionally stop observing the Red Planet from my observatory and go three miles to the USNO station and continue observing with the C11. The difference in image contrast quality was immediately seen. Although the Mars image in the C11 had sharp and steady limb definition the contrast of dark features was surely lacking as compared to my Newtonian. This is of course due to the large central obstruction—with the f/7 Newtonian having 12% and the C11 with 35%, giving contrast factors (CF) of 4.25:1 and 1.91:1, respectively. These values vary a little depending on whose equations you use. However, it is easily seen that the 4.25 CF is closer to the unobstructed system's 5.25:1 ratio than is a mere 1.91.

Of course one might ask why I don't have a refractor! Well, the importance of aperture cannot be talked about too much here. When the seeing permits, you need all you can get—so a 16-inch refractor, to replace my 16-inch Newtonian, would not only be a problem to house, and hide from Andrew storms; it would necessitate selling my house to purchase such an instrument and selling that white powder, found most abundantly here, in order to buy the dome! No thank you, I can live without the lovely chromatic aberration (purple haze) around every bright image.

So, no matter what you use, do your best and even if you have to squint to see those Martian features, report them to us.......astronomy is fun!

Jeff Beish

A.L.P.O. Mars Recorder

January 31, 1993

Dear Dr. Westfall:

I am writing in response to Rodger Gordon's second letter in the February, 1993, issue of the *Strolling Astronomer.*

Anyway, I will make this as brief as I can since I have discussed the Mars canal controversy with Mr. Gordon before, and it is plain that we are on two different sides of that controversy. I understand that Mr. Gordon was supposed to have written an article about his views on the Martian canals in an issue of *Sky & Telescope* not too many years ago [probably "Martian Canals: Is Lowell Vindicated?" April, 1988, p. 348].

Because I switched from *Sky & Telescope* to *Astronomy* about 13 years ago, I did not read that particular article so I can't make a judgment on what he said in that, only that I heard that he wrote it. But, judging from what he wrote me at the time we discussed the subject, I would venture to say his views were probably anti-canal and anti-Lowell. While I have attacked some views of his about canals, I have since withdrawn some of that criticism because of the mounting evidence for Mars craters from the space probes that went to Mars after Mariner 4, whose first pictures were pretty crude. But I also that these same Mars probes did not completely wipe out the controversy concerning the "canals" either.

First off, I posed this question once before to Mr. Gordon when we had our discussion, but did not feel that he answered it very satisfactorily.

I had a copy of E.C. Slipher's book, *A Photographic Study of the Brighter Planets*, and in this book were some photographic plates of Mars from the Lowell Observatory files that were taken by Slipher himself and some by a photographer who worked for Percival Lowell by the name of Lampland. On these plates many Martian canals appeared that had a very straight, fine linear structure, just as Lowell showed them on his drawings.

Okay—so it is easy to see how the human eye can be confused by markings forming an illusion, which Rodger Gordon thinks the canals are, but how about the *camera*; how do you fool it? Also, several of these canal markings show up on one of the Mars photographs by Donald Parker that were on the front cover of the most recent issue of the *Strolling Astronomer* [February, 1993], made with his CCD camera on a 16-inch reflecting telescope.

Many scientists who examined the Mariner and Viking spacecraft photographs tried to say that the canals were simply chance alignments of craters and valleys on the planet's surface. If this is so, why do they appear and disappear with the seasons on the planet, while some are not seen again for most of a century? I know what Mr. Gordon will say to that, but I don't think that "windblown dust" can totally explain all these changes.

Also, when the Mariner 6 and 7 spacecraft flew past the planet in 1969, some of the canals did show up on the far-encounter views of Mars, and at that time *Sky & Telescope* mentioned this and said that "the real cause of these features is still unknown." And I think I should mention for Mr. Gordon's sake that these were post-Mariner 4 observations!

I also have an 8-by-10 Viking Orbiter photograph that was issued by N.A.S.A. and shows a fine linear canal-like marking on it, slightly curved, and it is connected to a triangular oasis-like marking just like the ones Percival Lowell drew. The caption under the photograph, which showed two-thirds of the planet's disk, probably taken by the Orbiter's wide-angle camera, claimed that the marking was the "shock wave of an explosion," without elaborating what could cause such an explosion on Mars! Was it an asteroid impact? A volcanic explosion? The caption did not speculate. So, whatever that was, it would be an interesting phenomenon in itself.

Okay, I will leave Mr. Gordon with this thought: If the celebrated "Face on Mars" structure turns out to be just that, a carved face made by some ancient civilization on Mars, when it is rephotographed by the Mars Observer spacecraft now on its way to Mars, then nobody can prove Percival Lowell completely wrong in all his ideas about Mars; much to the chagrin of all present-day space scientists and astronomers who want to believe otherwise. I'll bet "old Lowell" will be "spinning in his grave" with glee then! And it won't take the "canals" to prove that point either. If there is found *any* evidence for a past civilization on Mars, Lowell will be vindicated!

Daniel Louderback

Box 702
South Bend, WA 98596

April 2, 1993

Dear Dr. Westfall

In the July, 1992, issue of the *Strolling Astronomer*, Rodger Gordon quotes a contrast comparison test among various 8- and 9-inch Schmidt-Cassegrains and a 4-inch refractor, in which he states that the refractor "trashed" all of the Schmidt-Cassegrains in the test. If this contrast test was the only criterion used to determine the performance of a planetary telescope, then a 2.4-inch refractor should be able to "trash" a 5-inch Celestron Schmidt-Cassegrain, based on the aperture ratios involved in the test! I think most of us will agree that even a superb 2.4-inch refractor is no match for a good 5-inch Schmidt-Cassegrain.

Regarding the contrast test, was it conducted at identical effective focal lengths or at prime focus? If they were conducted at prime focus, which I suspect, any good refractor, *regardless of aperture*, would win the test!

It is my opinion that only a very poor 8-inch Schmidt-Cassegrain would be outperformed by a 4-inch refractor as a planetary telescope. As evidence supporting my opinion, see the June, 1991, issue of *Astronomy*. In that issue, Alan Dyer conducted a field test of a Meade 4-inch SCT [Schmidt-Cassegrain Telescope] and ran a side-by-side comparison with a 94-mm Brandon APO [apochromatic refractor] and a 76-mm Takahashi fluorite [refractor], using Jupiter and Saturn as test targets. The results were surprising. In Dyer's own words, "...the more affordable Meade stood up to the APO refractors very well, providing views that showed everything the more expensive refractors showed, but with slightly less snap..." The results of this test are especially surprising when one considers that the 4-inch Meade has a larger than usual 1.8-inch central obstruction, fully 45 percent of the aperture! (Most larger SCT's have 30 to 35 percent obstructions). This test is good evidence that a telescope with a sizable central obstruction can perform well, provided the optics are good. I share the opinion expressed by Klaus Brasch that most of the contrast problems associated with the Schmidt-Cassegrain can be traced to poor quality control during the pre-Halley's Comet production rush. We hope that the Meade tested by *Astronomy* is representative of the optics being produced today.

At present I do most of my observing with a somewhat rare 8-inch Bausch and Lomb 8001 SCT. It delivers textbook quality intra- and extra-focal images using the "star test", which is probably the most severe test of optical quality. I can assure Mr. Gordon that no 4-inch refractor will "trash" this telescope in any area of performance, including planetary work. There are several reasons why this is true, the main reason being that a 4-inch simply lacks the aperture. Both image brightness and resolution in a 4-inch refractor are a fraction of that of a good 8-inch SCT, not to mention a 9-inch. With only 4 inches to work with, the refractor lacks the aperture effectively to utilize the higher magnification necessary to study faint planetary detail. For example, at 350X an extended planetary image in a 4-inch refractor would be dim, making delicate shades of contrast difficult to distinguish. At nearly 90X per inch the image would also be badly degraded. Needless to say, the contrast would be poor at this magnification with so small an aperture. This brings me back to the "contrast" tests mentioned at the beginning of this letter. Were they conducted at the same EFL's [effective focal lengths] or magnifications?

On the other hand, at 350X an 8-inch SCT would be working at only 44X per inch, giving a much sharper image, with *more* contrast. With an effective light-gathering area of over 44 square inches, the images in a good 8-inch SCT would be up to 3.5 times brighter than in a 4-inch refractor.

Another extremely important consideration, usually not mentioned by proponents of small apertures, is that *at identical magnifications*, the larger aperture will have the larger exit pupil. An 8-inch SCT has an exit pupil two times larger than a 4-inch refractor. This is critical to the planetary observer because small exit pupils magnify irregularities and "floaters" in the observer's eye, in actual practice *lessening* contrast and sharpness. Clearly, other factors besides *central obstruction* enter into the contrast equation!

In my opinion, many of the objections to a large central obstruction are overcome simply by increasing the aperture. While a central obstruction spreads light away from the Airy disk and into the diffraction rings, an increase in aperture shrinks the angular extent of the entire diffraction pattern, increasing resolution, and in many cases contrast. A good analogy would be the difference between a coarse newspaper halftone and a high-resolution glossy photograph. Merely increasing contrast in the halftone is unlikely to reveal delicate shadings and colors visible in the glossy!

E.M. Antoniadi stated the case for aperture well when he said "...a real, dark, planetary line, such as Cassini's Division of Saturn's ring becomes naturally darker and broader with an increase in aperture."

In conclusion, I believe that a Schmidt-Cassegrain can be an effective planetary telescope; it simply needs a bit larger aperture to compete with smaller refractors and long-focus Newtonians. Also, in many cases the larger-aperture SCT will still be more compact and portable!

Karl Fabian

8811 W. 89th Street
Hickory Hills, IL 60457

April 12, 1993

Dear Mr. Westfall:

I read with extreme interest Mr. Beish's article on modified spider leg profiles; I avoid the term "diffraction reduction" purposely. About a year ago, I made such a device and found it totally unsatisfactory for a number of reasons. However, my employment of the device was somewhat different than Mr. Beish's, so I can now add to the confusion of data interpretation. The profile modifiers were made of 20 thousandths [of an inch] styrene plastic affixed to my two spider legs with super glue. My spider legs are 64 thousandths thick and so form a large enough surface for easy gluing without making a machine shop job of the process.

The results were very disturbing. Vega (a blue-white star), the first object viewed, was a wonderful surprise—no spikes. I couldn't believe it. Arcturus (a red star), on the other hand, showed an odd red circle, like a huge artificial diffraction ring, surrounding the star. Obviously, a lot of extra diffraction was being created by the device and smeared around the field. I began to fear that what I was seeing was not real. Other stars showed the false diffraction rings. I got nervous and removed the device. However, I admit I did not carry my experiments as far as Mr. Beish.

I have my own method of handling the diffraction problem and would like to pass it on for the benefit of others. I chose a spider design for my telescope which uses only two legs, instead of three or four, made of 64 thousandths hobby brass one inch wide at an angle of 30°. I suspect that four legs are worse than two for a couple of reasons. First, the two opposing legs in a four-leg spider are never exactly 180 degrees apart—they are invariably off a little, and even a little can make trouble. A single leg will cause a duplicate of its diffraction image to form opposite itself at exactly 180°. In other words, a two-legged spider will show four equal spikes. Now, if you have four legs not exactly opposed, the result is eight spikes. You may not see eight spikes, because in pairs the spikes are very close and unresolved, and appear as a single broad and intensified spike. Second, I suspect that it is the act of bending the light that is more detrimental than how much it is bent. According to my premise, a single leg 64 thousandths thick does not cause as much diffraction as two legs 32 thousandths thick. This is, of course, highly arguable and I shall not attempt a proof; but I feel that my two-legged spiders show less diffraction that the three- or four-legged types. [Mr. Royce was kind enough to furnish a photograph of his two-legged spider, which is shown on p. 44 in *Figure 1*.]

The goal, in my opinion, is to reduce the actual or real diffraction, rather than to create more and smear it around. The problem is similar to deciding if one wants a picture with a dirty but unblemished cover glass, as opposed to a clean glass with a scratch. For astronomical purposes, I'll take the scratch. But there is more that can be done...

Once one has settled on a spider leg pattern, there is one way to reduce the effects of diffraction dramatically; and that is to reduce the amount of incoming light to a minimum for good observing. I see few people who observe with a sense of understanding how the eye works. Also, few people use filters art all, and fewer yet with any regularity or objective purpose. The eye is a delicate instrument and it must be fed with care and understanding; or, like your digestive tract, it will fail to function on a high level. The basic rule that I follow is that, if I can see a diffraction spike, I have too much light in my eye—period. The only time that I accept visible diffraction is for observing a double star with a very bright primary and a faint companion. For all work, except binary stars fainter than 4th magnitude and faint planets, I use a neutral-density filter to reduce light. Color filters for planets, and some binary stars, are used in combination with a neutral-density filter as required. With the Moon, I use a red filter to reduce the light and to keep the image nearly monochromatic in a range of wavelength where the eye has the greatest response to contrast. As magnification is increased, I change to orange and yellow. Try it–I think you will be pleased.

It may come as a surprise to some that the eye is not an achromatic optical system. The achromatization is accomplished in the brain. When white light is fed into the eye, its ability to produce sharp images is strained. Keep the light monochromatic if possible for a better image. The faint-object people are very sensitive to treating the eye with consideration as to its best operation, and so should we for the best results. During the last Martian apparition the surface detail was faint. People kept telling me that they saw little or nothing.

When one such fellow used my telescope, a 10-inch f/25 Gregorian, he saw a lot of detail. He wasn't using neutral dimming filters on his own telescope. A little too much light and the detail vanished. Airy disks on bright stars can be seen more readily with a neutral density or yellow filter. Fainter scattered light due to atmospheric turbulence is reduced to invisibility while the brighter Airy disk core remains. Try it on Castor, Gamma Virginis, or some other bright pair. I see Airy disks all the time.

Robert F. Royce

30 Holly Mar Hill Road
Northford, CT 06472

April 15, 1993

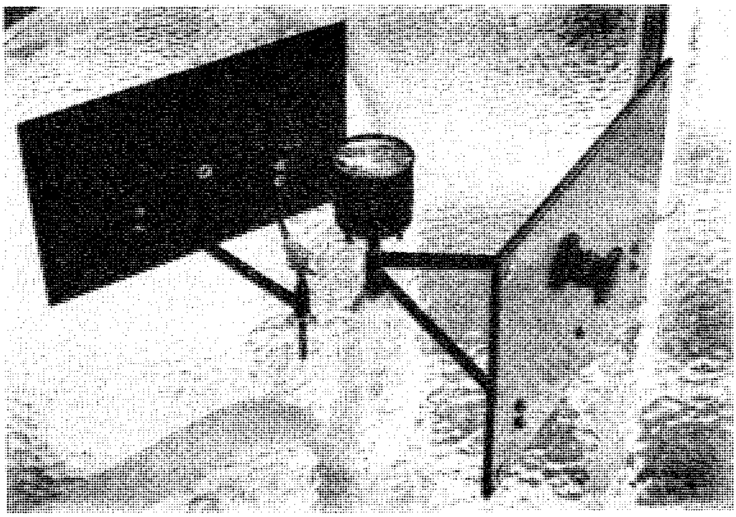

Figure 1. Two-legged spider supports for Gregorian secondary (right) and tertiary (left) mirrors constructed by Robert F. Royce for his 10-inch f/6– Newtonian/f/25–Gregorian telescope.

HIGH-RESOLUTION SUNSPOT PHOTOGRAPHY

By: Frank J. Melillo, 14 Glen-Hollow Drive, Holtsville, NY 11742

ABSTRACT

This paper describes a high-resolution two-hour photographic sequence of a stable sunspot, approximately 20° from the center of the disk. The purpose of this observation is to see how much H-α activity takes place around one isolated sunspot, far away from any active group. It is nearly impossible to detect changes visually; but the photographs can be analyzed easily, and recorded motion over a two-hour period.

INTRODUCTION

Most of my experience in solar observing has concentrated on active sunspot groups. Recently, solar activity has been quite low and there hasn't been any good-looking group to photograph. Instead, I have been trying to make my solar observation more meaningful by looking at some isolated sunspots with very low activity. I wonder if there are any changes within a specified time period; certainly the group may change very slowly, but by how much?

OBSERVATION

On 1992 JUL 28 UT, an isolated sunspot, Region 7238, lay about 20° from the center of the Sun's disk. I had originally intended to seek a sunspot two to three times larger for my study, but an isolated sunspot that large could be rare. After studying Region 7238 and seeing no activity visually, I chose that spot for my observation.

The observations were made with a Celestron 20-cm (8-in) Schmidt-Cassegrain telescope, using a 6-cm (2.5-in) off-axis diaphragm and a Daystar 0.6 Å H-α filter. Three photographs were taken one hour apart; at 20h35m, 21h35m, and 22h35m on 1993 JUL 28 UT. Kodak Technical Pan TP 2415 film was used, with a Barlow lens to double the image scale to permit higher resolution. Unfortunately the seeing was mediocre, slightly under 5 on the standard A.L.P.O. Scale from 0 for worst to 10 for perfect. Nonetheless, all three photographs show adequate detail.

RESULTS

Region 7238 was in a good position for observation, lying close to the center of the disk so that we were looking straight down upon it. All three photographs were analyzed to determine how much activity was present around this uncomplicated spot. Its magnetic field had a simple structure, and showed no hint of activity or a twisted appearance which would indicate a higher amount of activity.

Observing began at 20h35m UT with the first photograph, showing Region 7238 near its center, reproduced here as *Figure 1* (p. 45). There was a very small plage nearby, apparently emitting at a temperature higher than its surroundings. Also, a small inverted arch filament, narrow and rather short, lay near the 7 O'clock position relative to the spot. Around the spot were fibrils spreading out in all directions, appearing like streamers, following the magnetic field lines.

The second photograph was taken one hour later, at 21h35m UT (see *Figure 2*, center right). Visually, the spot and its surroundings looked exactly the same as before. However, a close look at the photographs showed a few minor changes. The inverted-arch filament had become slightly shorter. Also, the fibril at the 10 O'clock position got noticeably darker than before, but became very short.

The third and last photograph was taken an hour later, at 22h35m UT (see *Figure 3*, lower right). If one looks closely, one sees that the inverted arch filament continued to shorten. The fibril at 10 O'clock was still developing slowly and was noticeably longer. The fibrils radiating out in all directions around the spot gave a rosette appearance, especially to the south. The plague, and indeed most of the features shown, remained much the same in all three photographs.

CONCLUSION

It was nearly impossible to detect the above changes visually. Even if one makes sketches, there are too many details around to spot to cover. In an active region movement can be detected within minutes, even visually. However, there are some changes even in a quiet region like Region 7238. Photography is the best way to monitor these slight changes. I hope in the near future to find a much larger sunspot that also has low activity, and then to concentrate my observations on the umbra and penumbra of the spot itself, as well as on the immediate area.

Note by Editor: For two more examples of Mr. Melillo's high-resolution solar photographs, see the front cover of this issue.

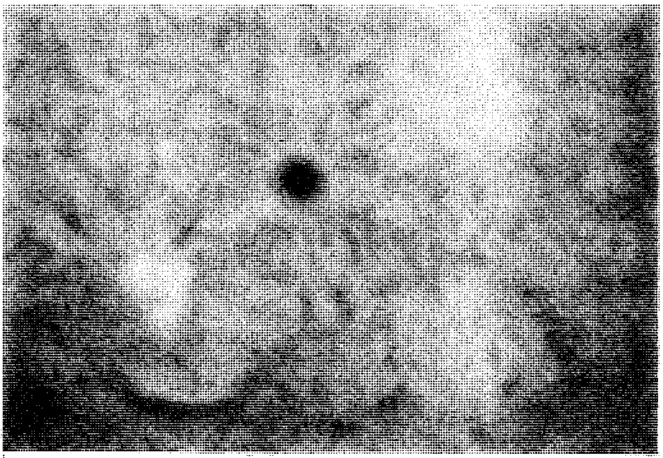

Figure 1. Sunspot Group 7238, photographed by Frank J. Melillo, 1992 JUL 28, 20h35m UT. 20-cm (8-in) Schmidt-Cassegrain stopped to 6-cm (2.5-in) aperture with 0.6Å Daystar H-α filter. 1/4-sec on Kodak TP2415 Film with Barlow lens at effective f/64. North at top.

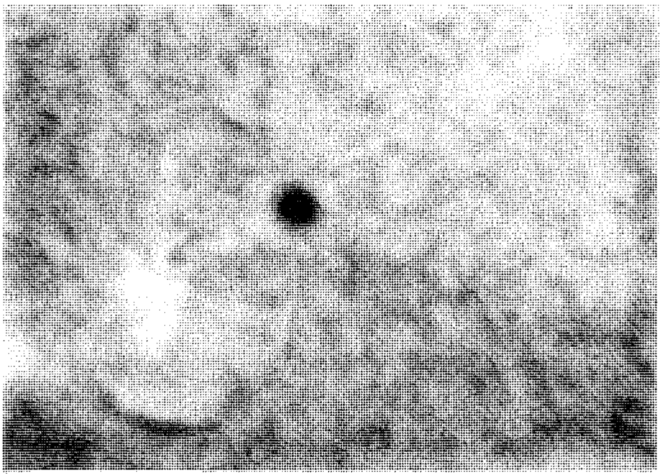

Figure 2. Sunspot Group 7238, photographed by Frank J. Melillo, 1992 JUL 28, 21h35m UT, 1 hour later than Figure 1. Other data as in Figure 1.

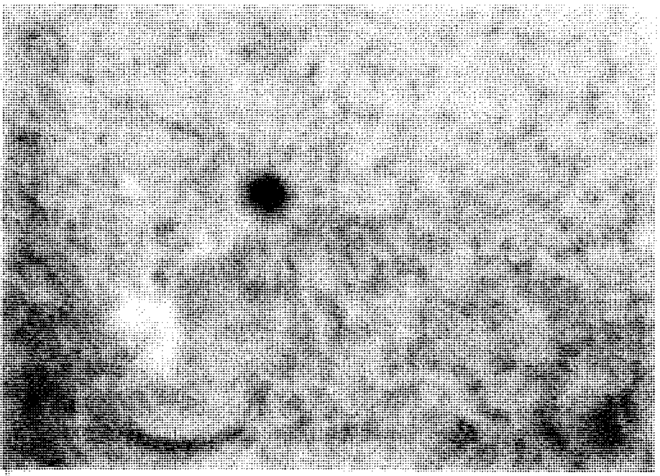

Figure 3. Sunspot Group 7238, photographed by Frank J. Melillo, 1992 JUL 28, 22h35m UT, 1 hour later than Figure 2. Other data as in Figure 1.

New (Provisional) Computing Section.—More and more of our members use personal computers to plan and analyze their observations, and even to make them in the first place. Thus we are glad to announce that the A.L.P.O. now has a Provisional Computing Section. The two new Acting Co-Recorders are: David D. Weier, 205 Cameo Lane, Madison, WI 53714-2514 (Tel. 608-241-1444); and Bob Manske, 404 Prospect Road, Waunakee, WI 53597 (Tel. 608-849-5287). Address correspondence and inquiries to Mr. Weier and please include a SASE with all correspondence. The new Co-recorders wish to state:

> We are currently working on producing planetary ephemerides for the *1994 A.L.P.O. Solar System Ephemeris*. Later on, as time and resources permit, we will publish reviews of books and software which deal with astronomical computing in the *Journal, A.L.P.O.*, and eventually will publish a Section newsletter.
>
> Your comments and suggestions are welcome. Interested parties should send their name, address, telephone number, and platform [type of computer], and identify which software packages and programming languages they are using. Dave Weier will be handling all the Computing Section correspondence, so please address all your inquiries to him. Bob Manske will be handling the programming and may be reached through Dave Weier.

Address Change for Remote Planets Recorder.—Effective immediately, the address of our Remote Planets Recorder has been changed to: Richard M. Schmude, Jr., Department of Chemistry, Texas A&M University, College Station, TX 77843.

Book Reviewers Sought.—Our Book Review Editor, Mr. José Olivarez, writes that he *desperately* needs volunteer reviewers for the astronomy books he receives. We have not published many reviews recently; a lack of reviewers is the reason, even though new and interesting books in our field are continually being published. Besides a certain amount of notoriety, our reviewers retain without charge the books they review. To start a career as an A.L.P.O. book reviewer, write Mr. Olivarez at the address on the inside back cover.

Availability of Past Issues of The Strolling Astronomer.—Our Director Emeritus, Walter H. Haas, asks us to state:

> We often receive requests for back issues of *Journal, A.L.P.O.* which are out of stock. Our only way of filling such requests, other than through costly advertising for back issues, is to make xerox copies from bound volumes. These are not really satisfactory; both as regards copying near left and right page margins, and as regards the quality of many illustrations (e.g., photographs of faint planetary features).
>
> Persons needing access to such missing back issues might like to know that there are at least two complete files of our Journal in public places: the Library of Congress in Washington, D.C.; and the Library of New Mexico State University at Las Cruces, NM. A *small* number of complete files exist in private collections.

Lunar Rays.—Lunar rays are the bright streaks which emanate from some of the fresher lunar craters. The rays show considerable variety, yet have received comparatively little study, particularly in terms of mapping them and recording their brightness changes. Mr. Andrew Johnson, author of our current "Getting Started" column, is interested in conducting an initially informal cooperative study of these features. If you are interested in working with him, contact him at: Andrew Johnson, F.R.A.S., 1 York Lane, Knaresborough, North Yorkshire, England HG5 0AJ.

A.L.P.O. Benefactors.—We are proud to list our members who have generously contributed more than the minimum membership dues. Thanks to them, we are able to maintain our operations and publications. The persons listed below have made contributions since our previous listing in our July, 1992, issue.

A.L.P.O. **Sponsors** contribute at least $50 per year and are: Richard Baum; Julius L. Benton, Jr.; Paul H. Bock, Jr.; Nancy J. Byrd; Darryl J. Davis; Phillip R. Glaser; Virginia Glaser; Michael Mattei; Patrick S. McIntosh; Paul C. Millikan; Brenton R. Ogle; Arthur K. Parizek; Donald C. Parker; Thomas C. Peterson; James Phillips; Takeshi Sato; Richard W Schmude; Berton and Janet Stevens; Richard J. Wessling; Matthew Will; and Thomas P. Williams.

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25th Annual Meeting of the Division of Planetary Sciences of the American Astronomical Society (DPS).—One of the two major annual professional conferences, this will meet in Boulder, Colorado on October 18-22, 1993 (Monday-Friday). The meeting will be hosted by the University of Colorado's Laboratory for Atmospheric and Space Physics (LASP). If a topic has *anything* to do with the Solar System, it should be represented in the *several hundred* oral and poster papers to be presented at this conference. If you register by mail before September 24, the fee is $165 for DPS members, $180 for non-members, and $95 for students; late registration costs $20 more; the banquet charge is $35. To obtain the registration packet, write: DPS Registration, Publications and Program Services Department, Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston, TX 77058.

The conference site will be Clarion Harvest Hotel, with overflow in the Holiday Inn, also in Boulder. Make your hotel reservation by September 15 using the form in the registration packet (see above).

Project ASTRO.— This item is primarily for California A.L.P.O. members. The Project Coordinator, Jessica Richter, writes:

> Project ASTRO, a new California pilot project funded by the National Science Foundation, is seeking 40 enthusiastic amateur and professional astronomers who want to visit classrooms and develop partnerships with teachers in grades 4 through 9 during the 1993-1994 school year. The project was developed by the Astronomical Society of the Pacific, an international scientific and educational organization located in San Francisco.
>
> Astronomers and teachers will work together to plan activities and projects for students in and out of the classroom. Astronomers will visit a local school at least four times to help lead hands-on activities, give talks on astronomy, organize evening "star parties," and serve as role models and mentors for students.
>
> Astronomers and teachers will attend a regional astronomy workshop during a Friday and Saturday in October 1993, and will attend a follow-up meeting in Spring 1994. Participants will receive materials and activities for classroom use, learn strategies for teaching students of different ages about astronomy, and work together to plan activities and projects. Stipends, travel expenses, and materials will be provided.
>
> Amateur and professional astronomers with an interest in education and some experience working with children or teens or presenting astronomy to the public are encouraged to apply for the project. To receive a volunteer form and more information, write or call: Project ASTRO, Astronomer Applications, ASP, 390 Ashton Avenue, San Francisco, CA 94112 (Tel. 415-337-1100).

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
6/64 Warren St.
St. Lucia 4067
Queensland, Australia
Planetary Observing

Mr. Peter Rasmussen
1210 W. Maple, Heber
Springs, AR 72543
Instrumentation and Equipment Selection

Mr. Timothy J. Robertson
38121-25th St. E #h-101
Palmdale, CA 93550-1300
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/CC Imaging

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(All Section Publications must be ordered directly from the appropriate Recorders.)
(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: 1993. $7.00 in the United States, Canada, and Mexico; $9.50 elsewhere (airmail included). Contains 129 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."

◆◆

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.

◆◆

Order from: A.L.P.O. Membership Secretary, P.O. Box 143, Heber Springs, AR 72543, U.S.A:

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② ***A.L.P.O. Membership Directory.*** $5.00 in North America; $6.00 elsewhere. Continuously-updated list of members: alphabetically, and by location and by interest(s). Make payment to "A.L.P.O." *Provided at the discretion of the Membership Secretary.*

◆◆

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

Back issues of ***The Strolling Astronomer (J.A.L.P.O.).*** The 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); 1-3, 4-6, 7-9, and 10-12 [each $2.50]. ***34*** (1990); 2 and 4 [each $2.50].
35 (1991); 1, 2, and 3 [each $2.50]. ***36*** (1992); 1, 2, and 4 [each $2.50]
Current Issue [*37*, 1]—$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., "37.1" means Vol. 37, No. 1). 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. 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 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

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