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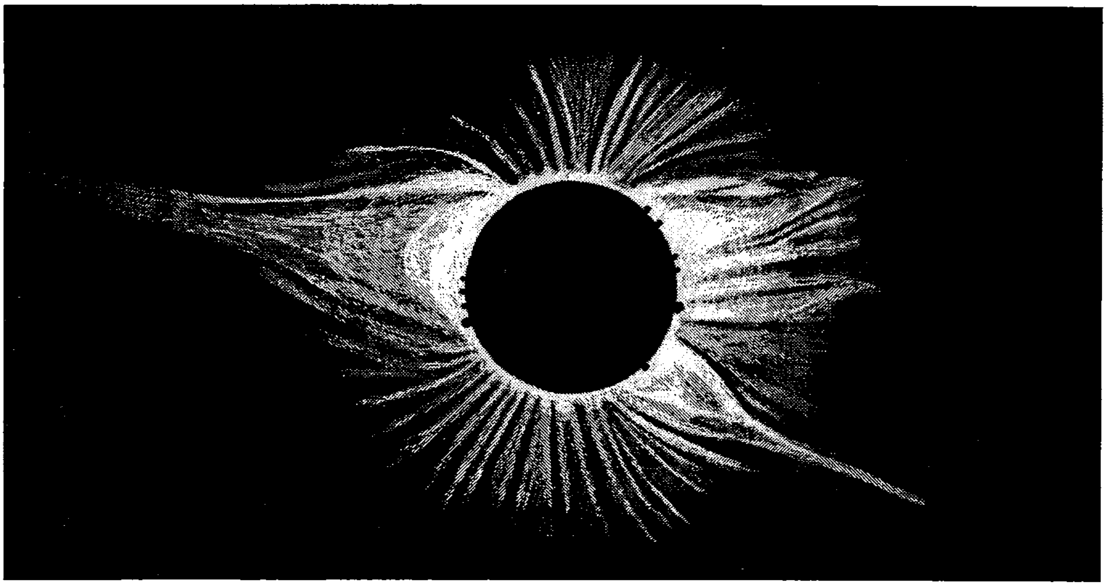

The 1995 Nov. 03 total solar eclipse as seen from the Bolivian *Altiplano.* This is a drawing by Randy Tatum based on four photographs taken by him with a 9-cm f/11 Maksutov telescope. Note the prominences on the limb and the extended coronal streamers. North at top. For other views of this event see page 79 of this issue.

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OBSERVATIONAL PROSPECTS FOR THE 1995-96 APPARITION OF SATURN AND THE EDGEWISE PRESENTATION OF THE RINGS

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

ABSTRACT

As the Rings of Saturn change their inclination to our line of sight over many years, there are times when the plane of the Rings passes through our line of sight. This will occur three times during the 1995-96 Apparition, presenting rare observational opportunities which can help increase our knowledge about Saturn as a planet. Interesting interactions of the Ring System with several of the brighter satellites of Saturn will take place at or near edgewise presentation. Methods and techniques for conducting systematic observations of the Rings during the 1995-96 Apparition are summarized, including a table of dates of specific events as the plane of the Rings passes through the Earth and Sun. Observers are urged to conduct observations of the edgewise presentation as an integral part of the A.L.P.O. Saturn observing program.

THE 1995-96 EDGEWISE APPARITION

Throughout Saturn's sidereal revolution period of 29.4 years, the plane of the Ring System intersects the Earth at intervals of 13.75 and 15.75 terrestrial years; the inequality of the two periods is due to the ellipticity of Saturn's orbit. Thus these events are rare and particularly noteworthy. During the 13.75-year period, the south face of the Rings and the Southern Hemisphere of the Globe of the planet are inclined toward Earth, and Saturn passes through perihelion during this time. In the longer 15.75-year interval, Saturn passes through the aphelion point of its orbit; and the north face of the Rings and Northern Hemisphere of the Globe are exposed to us.

The last apparition in which the Rings of Saturn were turned edgewise to Earth was 1979-80, and since then Saturn's northern regions have been tilted toward us. The value of *B*, the Saturnicentric latitude of the Earth referred to the plane of the Ring System, positive (+) when north, varied from 0° in 1979-80 to a maximum of +26°.0936 on 1988 SEP 26. Since the 1987-88 apparition, the Rings have been progressively closing, returning to 0° during the 1995-96 observing season. Saturn passed through aphelion on 1988 SEP 11.

During the 1995-96 Apparition of Saturn, the Earth will pass through the Ring System three times. The first passage will occur on 1995 MAY 21 at 22.8h (all times in this article are given in Universal Time), with the Earth going southward. The northern face of the Rings will remain illuminated by the Sun; but the Earth, having now passed through the Ring Plane southward, will be on the opposite darkened south side of the Ring Plane. In theory, the Rings should be invisible from 1995 MAY 21 until the time when the Earth and Sun are again on the same side of the Rings. During this invisibility period, the value of B will reach a maximum southerly value of -0°.616 on 1995 JUL 01. The general sequence of events is graphed in *Figure 1* (p. 52).

The second Ring passage by the Earth, which then will move to the north side of the Ring Plane, occurs on 1995 AUG 11, 03.6h; only a month before Saturn, then in the constellation of Aquarius, reaches opposition to the Sun on 1995 SEP 14, 15h. The Earth and Sun will, therefore, again be on the same side of the Ring Plane; and the illuminated north face of Rings should become visible to observers. The maximum northerly value of B during this period is +2°.670 on 1995 NOV 19.

The Sun will pass southward through the plane of the Rings on 1995 NOV 18, 23.8h, with the Earth remaining on the opposite north side of the Ring Plane. This means that the northern face of the Rings will no longer be illuminated by the Sun, and the Rings will be theoretically invisible from Earth after 1995 NOV 18 until 1996 FEB 11, when both the Earth and Sun are south of the Ring Plane.

The third Ring passage by the Earth, now headed southward for the last time this apparition, will take place on 1996 FEB 11, 20.4h. The Earth then will join the Sun to the south of the Ring Plane, and the illuminated south face of the Rings will become visible to us. This final passage of the Earth through the plane of the Ring System will be the most troublesome to observe because Saturn will be only a little more than a month away from conjunction with the Sun and very near the horizon when skies are dark.

Therefore, the intervals when the Rings of Saturn should be theoretically invisible to observers on Earth are:

1995 MAY 21 22.8h—1995 AUG 11 03.6h
1995 NOV 18 23.8h—1996 FEB 11 20.4h

Following 1996 FEB 11, the Earth and the Sun will remain south of the plane of Saturn's Rings until the next edgewise presentation beginning on 2009 AUG 10, 13h, so that astronomers will be able to study the southern face of the Rings for about 13 years.

Table 1 (p. 50) lists the geocentric phenomena for Saturn throughout the 1995-96 apparition, together with their Universal Times.

Table 1. Geocentric Phenomena for the 1995-96 Edgewise Apparition of Saturn (all times are in Universal Time).

Conjunction with Sun	1995 MAR 06 02h
Stationary in R.A.	1995 JUL 07 11h
Opposition to Sun	1995 SEP 14 15h
Stationary in R.A.	1995 NOV 22 14h
Conjunction with Sun	1996 MAR 17 15h

Data for Opposition Date: 1996 SEP 14, 15h

Constellation	Aquarius
Stellar Magnitude	+0.67
Equatorial Diameter	19".24
Polar Diameter	17". 16
Major Axis of Ring System	43".62
Minor Axis of Ring System	00".90
B	+1°.187
B'	+0°.974

(B is the planetocentric latitude of the Earth referred to the plane of the Rings,; B' is the planetocentric latitude of the Sun referred to the Ring Plane. Both are positive (+) when north.)

The apparent disappearance of the Ring System, which occurs several times during a short interval, is due to one or more of the following geometric circumstances:

1. The Earth may be in the plane of the Rings so that only their edge is presented to viewers; and since the Rings are quite thin, they may be temporarily invisible in even the largest apertures.
2. The Sun may be in the plane of the Rings so that only their edge is illuminated.
3. The Sun and Earth may be on opposite sides of the Ring Plane, so that what observers see on Earth are regions that are illuminated only by light passing through the Rings (*forward scattering*).

OBSERVATIONAL PROGRAMS

As was the case in 1979-80, it will be of great interest in the 1995-96 Apparition to determine the limits of visibility of Saturn's unilluminated Ring surface. Ascertaining just how close to the theoretical dates of edge-on orientation that the Rings can be detected will be worthwhile to observe. Larger instruments, at least 30cm (12in) - 41cm (16in) in aperture, have in the past permitted observations of the sunlit side of the Ring System up to within a few days or even hours of the dates and times of theoretical edgewise orientation. With regard to the dark side, the invisibility of the Rings may persist for several days or perhaps a few weeks prior to and following the edgewise presentations. There appears to be an asymmetry to the critical dates with respect to the extent, appearance, and brightness of the Rings of Saturn. Especially near the time of the precise edgewise orientation of the Rings, non-uniformity in brightness may take the form of one or more condensations of light along the otherwise dark Ring surface.

It will be important to measure the surface brightness of the unilluminated and sunlit Ring surfaces throughout the apparition at various distances from the Globe of Saturn, using the Globe as the reference point for visual numerical relative intensity estimates (using the standard A.L.P.O. Visual Numerical Relative Intensity Scale, where 0.0 denotes black shadows and 10.0 refers to the most brilliant objects of all, with intermediate values given to features as they apply). The outer third of Ring B, which is the standard of reference for estimating intensities of Saturnian features at an assigned numerical intensity of 8.0, is a suitable reference when the value of B is greater than about 5°. When the Rings are nearly edgewise, however, this reference point cannot be effectively used; and the observer must refer to another feature on Saturn that can be easily seen. For the purpose of the 1995-96 Apparition, the most logical candidate is the Equatorial Zone (EZ) of Saturn's Globe. Although this region has shown some brightness variations in recent years, it is usually the most stable of the zones in overall intensity. For 1995-96, we shall assign a numerical intensity of 7.0 to the EZ, based on an average over several recent apparitions.

Observers have discussed for many years the perceived relationship between the intensity of the Ring System at different inclinations to the Earth and its particle density. If a relationship exists, it is likely that the light passing through a Ring component from the illuminated surface is complementary; the intensity of the dark side would be the opposite of that of the sunlit side. For example, the outer third of Ring B (normally the brightest component on the sunlit face of the Rings) would appear as the darkest area, Ring A would be somewhat brighter than B, and Ring C would be the brightest component of all! [The components of Saturn's Rings that are visible from the Earth are: A, the outermost and second brightest; B, inside A and brightest; and C, the innermost and relatively faint. Ed.] Light reflected onto the Rings from Saturn's Globe would affect the brightness of the "dark" side of the Rings, but corrections could be made for this illumination. [Voyager images of the unilluminated side of the Rings showed that, indeed, the ring brightness was complementary as suggested above; reflected light from Saturn was relatively faint. Ed.)

The very elusive, but vast, dusky component outside Ring A, denoted as Ring E, has elicited some mixed impressions during past edgewise orientations, times when it would presumably be easier to see from Earth. The question of the existence of Ring E, of course, was answered by the Voyager missions; but its visibility in Earth-based telescopes remains controversial.

Anytime the dark side of the Rings is presented to Earth, bright star-like points of light may be detected along the extent of the Ring. This phenomenon is typically seen when the Rings are nearly edgewise, but one must take extreme care to ascertain whether or not any known satellites of Saturn may be contributing to the visibility of these points of light. If present, satellites will also look like beads of light along the plane of the Rings. Points of light will often appear to twinkle because of poor seeing conditions, resulting in a beautiful spectacle, sometimes colorful because of dispersion. In cases when no known satellite contributes to the existence of these points of light, observers should exercise even greater care in denoting the position of such phenomena on drawings, together with the precise time they are seen and their relative brightness (intensity).

If extra-planar Ring particles truly exist, as suggested in the past by Earth-based observations and more recently by the Voyager spacecraft, the best time to detect them would be when the Rings are edgewise to our line of sight. Any such particles would probably appear as a "haze" above or below the Ring Plane, but one must be extremely careful not to be fooled by the imposing glare of Saturn's Globe, especially in less-than-perfect seeing.

In terms of satellite phenomena, when the plane of the Ring System passes very close to the Earth and the Sun, the best opportunity arises for observing transits, occultations, shadow transits, and eclipses of those satellites of Saturn which orbit near the equatorial plane. These observations involve precise timing of the events to the nearest second. According to the predictions computed by Brian Loader of New Zealand, the brighter satellites will be eclipsed during the following periods:

Mimas (S1)	1992 Jul 04-1999 Mar 09
Enceladus (S2)	1993 Apr 29-1998 Apr 29
Tethys (S3)	1993 Oct 02-1997 Oct 15
Dione (S4)	1994 May 06-1997 May 16
Rhea (S5)	1994 Oct 15-1996 Nov 25
Titan (S6)	1995 May 26-1996 Apr 25
Iapetus (S8	1993 May 01-1993 Jul 21

Thus, most of these satellites are already being eclipsed; Iapetus, with an orbital inclination of 15° to the Ring Plane, was eclipsed in 1993. Small apertures are usually insufficient to view such phenomena, with the possible exception of events involving Titan; and the largest instruments available should be used. Even with moderate to large telescopes, controversy still persists as to the visibility of shadow transits of the Saturnian satellites other than Titan. It is theoretically established that nearly all of the inner satellites of Saturn are far too small to cast umbral shadows onto the Globe of the planet. Nonetheless, trained observers with sufficiently large apertures have reported possible shadow transits of Tethys in past years. [It is also possible that a purely *penumbral* shadow can be seen. Ed.]

Visual magnitude estimates of Saturn's satellites should be made by observers at edgewise Ring orientations, mainly because the brightness correction for scattered light that must be applied is then only a function of the satellite's apparent distance from the Globe of the planet. [Providing that one's telescope does not suffer from diffraction from secondary supports. Ed.] Under other Ring inclinations, difficulties arise because the glare from the Globe and the Rings conspires to complicate matters when one makes magnitude estimates.

Aside from the observational opportunities outlined above, which are specific to edgewise presentations of Saturn's Rings, routine systematic studies of the planet should continue as usual in order to insure consistent, comprehensive observational coverage throughout the apparition. A full description of the nature, aims, and methods of observing Saturn can be found in *The Saturn Handbook*, published by the A.L.P.O. Saturn Section; but an outline of the basic ingredients of the A.L.P.O. Saturn Section observing program may be useful as an organizational and planning aid. Thus, observations of Saturn, its Ring System, and satellites, as far as visual studies are concerned, are usually organized into the following categories:

1. Full-disc and sectional drawings of the planet and accompanying Ring System.

2. Visual photometry (visual numerical relative intensity estimates) of the belts, zones, and Ring components, to include broad and localized variations in brightness.

3. Visual colorimetry using color filters for a comparative investigation of the reflectivity of various regions of the Globe and Rings at different wavelengths of light.

4. Determination of latitudes of global features.

5. Central-meridian (CM) transit timings of discrete detail in belts and zones of the Globe, with accompanying sectional sketches to show morphology of the feature(s).

6. Visual photometric and colorimetric studies of the bicolored aspect of the Ring ansae.

7. Visual magnitude estimates of the satellites of Saturn using appropriate reference standards.

8. Absolute color estimates of global and Ring features using an accepted color reference standard.

9. Simultaneous observations of all Saturnian phenomena by several observers (i.e., working independently from more than a single geographic location, viewing Saturn at the same date and time using similar methods and equipment).

Photographic programs are also important, especially in conjunction with visual research efforts, simultaneously if possible; and we strongly encourage observers to supplement visual studies with good photographs at various wavelengths of light. [This will also be the first edgewise Ring presentation when many amateurs will have CCD cameras. These devices are characterized by their great dynamic range, high sensitivity to light in the visual and near-infrared wavelengths, and the objective and quantitative nature of their data. Thus they should be invaluable in studying the brightness of the Rings near their edgewise orientation. Ed.]

Because of the length of Saturn's seasons, the forthcoming events of the 1995-96 apparition are rare occurrences, and observers should immediately begin making plans with the assistance of the A.L.P.O. Saturn Section. Numerous books and observing guides are available, and the author would be pleased to provide suggestions and guidance for developing an effective observing program. The A.L.P.O. Saturn Section will provide suitable standardized forms, drawing blanks, and other convenient items to assist individuals in recording data at the telescope. Persons interested in joining us for what should prove to be an exciting observational experience need only contact the author (address on inside back cover) for further information.

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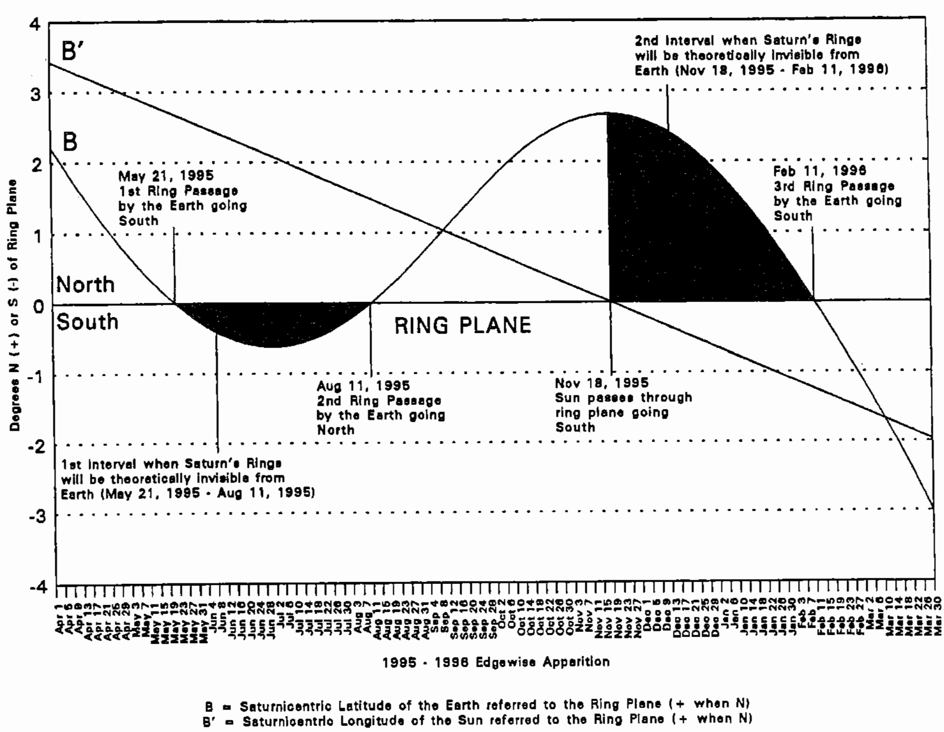

Figure 1. Passages of the Earth and Sun through Saturn's Ring Plane in 1995-1996.

Selected Events of Saturn's Satellites: April - May, 1995

With Saturn pulling away from the Sun in the morning sky, and the Earth and the Sun approaching its Ring Plane, Saturn's satellite events are beginning in earnest. This table gives the predicted dates and times (UT) of occultations, transits, and shadow transits of Rhea and Titan with the Globe of Saturn, as well as mutual (two-satellite) events involving Tethys, Dione, Rhea, and Titan. These predictions are selected from those given in: J.E. Arlot, T. Derouazi, C. Ruatti, and W. Thuillot, *Satellites de Saturne I á VIII. Configurations pour 1995.* Paris, Bureau des Longitudes, 1994. Satellites are coded by number (mean opposition magnitudes in parentheses): 1 = Mimas (+12.9), 2 = Enceladus (+11.7), 3 = Tethys (+10.2), 4 = Dione (+10.4), 5 = Rhea (+9.7), and 6 = Titan (+8.3). Letters indicate: E = eclipse, O = occultation, S = shadow transit, T = transit, b = begins, and e = ends. The times are those predicted for *mid-events*; due to the finite size of the satellites, events will typically take several minutes. For mutual events, the estimated brightness decrease in percent is given; for the eclipsed satellite in a mutual eclipse and for the two satellites combined in the case of a mutual occultation.

Seeing satellites or their shadows in transit across Saturn's globe is a challenge, and we have included only those events for the two largest satellites, Rhea and Titan. Rhea's visual albedo of 0.67 is higher than Saturn's (0.47), so it may be visible in transit as a bright spot. Titan, with an albedo of 0.21, should appear as a dark spot. At mean opposition distance, Rhea's apparent diameter is 0".25, while that of Titan is 0".83. At mean opposition and solar distance, the apparent penumbral/umbral diameters of the shadows of Rhea and Titan on Saturn's noon meridian should be: Rhea, 0".32/0".17; and Titan, 1".01/0".65.

Where on the Globe satellites will transit can be found from the formulae: y(Rhea) = 9.7 tan B, y(Titan) = 22.5 tan B, where y is the satellite's apparent position north or south of the Globe center in Saturn polar radii and B is the saturnicentric latitude of the Earth. For shadow transits, substitute B', the saturnicentric latitude of the Sun. If B or B' is north, the satellite or shadow will be *south* of the Globe center; and will be north of center when B or B' is south. Values of B and B' for each day of the year are listed in the *A.L.P.O. Solar System Ephemeris: 1995* (for information on ordering this publication see page 95).

Date	UT	Event
1995		
Apr 01	01:03	6Te
02	14:12	5Sb
	14:35	5Tb
	17:27	5Se
	18:18	5Te
05	00:33	5Oe
07	02:38	5Sb
	03:07	5Tb
	05:55	5Se
	06:52	5Te
08	19:02	6Ob
	23:35	6Oe
09	13:08	5Oe
11	15:05	5Sb
	15:38	5Tb
	18:23	5Se
	19:27	5Te
12	22:50	3O2 00
14	01:42	5Oe
16	03:31	5Sb
	04:10	5Tb
	06:51	5Se
	08:01	5Te
	21:08	6Tb
17	02:28	6Te
	16:25	2O3 12
18	14:16	5Oe
20	15:58	5Sb
	16:42	5Tb
	19:19	5Se
	20:34	5Te
21	04:36	5O3 01
22	05:45	3O4 47
23	02:49	5Oe
Apr 24	18:46	6Ob
25	00:17	6Oe
	04:24	5Sb
	05:13	5Tb
	07:47	5Se
	09:07	5Te
27	15:22	5Oe
	23:06	3O5 13
29	16:50	5Sb
	17:44	5Tb
	20:15	5Se
	21:40	5Te
30	01:55	3O1 12
May 01	23:13	3O1 01
02	03:54	5Oe
	21:03	6Tb
03	03:05	6Te
	22:56	4O1 02
04	05:17	5Sb
	05:28	4O1 11
	06:15	5Tb
	08:43	5Se
	10:12	5Te
	16:11	5O3 32
05	07:55	1O4 02
06	08:22	1O5 06
	11:20	1O5 01
	16:26	5Oe
	16:59	2O3 06
08	17:43	5Sb
	18:46	5Tb
	21:11	5Se
	22:43	5Te
09	19:45	5O6 08
May 09	19:48	4O3 07
10	18:36	6Ob
11	00:27	6Oe
	04:57	5Oe
	07:46	3O6 02
	08:50	3O5 01
	11:17	3O2 18
	16:46	4O5 33
13	04:30	3E2 100
	06:09	5Sb
	07:17	5Tb
	09:34	5E2 01
	09:39	5Se
	11:15	5Te
	13:34	5O2 10
	16:44	5O2 10
15	17:28	5Oe
	22:36	2O5 10
16	05:29	2O3 05
17	14:56	5O4 04
	18:36	5Sb
	19:47	5Tb
	22:06	5Se
	23:44	5Tr
18	02:27	5O2 10
	11:16	6O3 01
	12:24	6O2 01
18	20:39	6O1 01
	21:00	6Tb
19	03:10	6Te
	03:42	6O4 04
	04:06	3O4 02
	05:13	6O3 04
	09:51	6O2 01
May 19	16:43	6O5 01
20	05:48	2O5 10
	05:58	5Oe
	09:41	4O5 20
	19:25	4O2 17
21	19:17	2O4 17
22	04:26	5O4 25
	07:02	5Sb
	08:17	5Tb
	09:11	5O2 10
	10:34	5Se
	12:14	5Te
23	13:10	4O2 11
24	12:28	2O5 04
	13:02	2O4 02
	18:28	5Oe
26	16:11	5O2 03
	18:20	6Ob
	19:28	5Sb
	20:47	5Tb
	23:02	5Se
27	00:11	6Oe
	00:44	5Te
28	20:51	2O5 09
29	06:57	5Oe
30	21:27	5O4 33
31	07:55	5Sb
	09:16	5Tb
	11:29	5Se
	13:13	5Te
	14:49	5O1 06

ECLIPSES OF TETHYS, DIONE, RHEA, AND TITAN BY SATURN, 1995 APRIL-MAY

The predictions below were computed by Brian Loader. **x** and **y** are apparent distances from the Globe center in units of Saturn's equatorial radius; **x** is positive to the celestial east and **y** is positive to the north. "Limb" is the apparent distance from Saturn's limb in the same units; if negative, the event is invisible from Earth. Italicized times refer to the next UT day.

Eclipses of Tethys, 1995, April-May

	Beginning				End		
	UT	x	y	limb	UT	x	limb
APR							
02	18:34	-1.14	+0.14	+0.15	21:23	+0.78	-0.20
04	15:53	-1.15	+0.13	+0.16	18:42	+0.77	-0.22
06	13:12	-1.16	+0.13	+0.17	16:01	+0.76	-0.23
08	10:30	-1.17	+0.12	+0.18	13:20	+0.75	-0.24
10	07:49	-1.19	+0.11	+0.19	10:39	+0.74	-0.25
12	05:08	-1.20	+0.10	+0.20	07:57	+0.73	-0.26
14	02:26	-1.21	+0.10	+0.21	05:16	+0.72	-0.28
15	23:45	-1.22	+0.09	+0.22	*02:35*	+0.70	-0.29
17	21:04	-1.23	+0.08	+0.24	23:54	+0.69	-0.30
19	18:22	-1.24	+0.08	+0.25	21:12	+0.68	-0.31
21	15:41	-1.25	+0.07	+0.26	18:31	+0.68	-0.32
23	13:00	-1.26	+0.06	+0.27	15:50	+0.66	-0.33
25	10:18	-1.28	+0.06	+0.28	13:08	+0.66	-0.34
27	07:37	-1.28	+0.05	+0.28	10:27	+0.65	-0.35
29	04:55	-1.29	+0.04	+0.29	07:46	+0.64	-0.36
MAY							
01	02:14	-1.30	+0.04	+0.30	05:05	+0.63	-0.37
02	23:33	-1.31	+0.03	+0.31	*02:23*	+0.62	-0.38
04	20:51	-1.32	+0.02	+0.32	23:42	+0.61	-0.39
06	18:10	-1.33	+0.02	+0.33	21:01	+0.61	-0.39
08	15:28	-1.34	+0.01	+0.34	18:19	+0.60	-0.40
10	12:47	-1.35	+0.01	+0.35	15:38	+0.59	-0.41
12	10:06	-1.36	+0.00	+0.36	12:57	+0.58	-0.42
14	07:24	-1.36	-0.00	+0.36	10:15	+0.58	-0.42
16	04:43	-1.37	-0.01	+0.37	07:34	+0.57	-0.43
18	02:01	-1.38	-0.01	+0.38	04:53	+0.56	-0.44
19	23:20	-1.38	-0.02	+0.38	*02:11*	+0.56	-0.44
21	20:38	-1.39	-0.02	+0.39	23:30	+0.55	-0.44
23	17:57	-1.40	-0.02	+0.40	20:50	+0.55	-0.45
25	15:16	-1.40	-0.03	+0.40	18:07	+0.54	-0.46
27	12:34	-1.40	-0.03	+0.41	15:26	+0.54	-0.46
29	09:53	-1.41	-0.04	+0.41	12:45	+0.54	-0.46
31	07:11	-1.42	-0.04	+0.42	10:03	+0.53	-0.46

Eclipses of Dione, 1995, April-May

	Beginning				End		
	UT	x	y	limb	UT	x	limb
APR							
02	14:25	-1.13	+0.23	+0.16	17:26	+0.68	-0.27
05	08:06	-1.16	+0.22	+0.18	11:08	+0.66	-0.29
08	01:48	-1.18	+0.20	+0.20	04:50	+0.64	-0.32
10	19:30	-1.21	+0.19	+0.22	22:32	+0.62	-0.34
13	13:11	-1.23	+0.17	+0.24	16:14	+0.60	-0.36
16	06:53	1.25	+0.16	+0.26	09:56	+0.58	-0.39
19	00:35	-1.27	+0.14	+0.28	03:38	+0.57	-0.41

Eclipses of Dione—Continued.

	Beginning				End		
	UT	x	y	limb	UT	x	limb
APR							
21	18:16	-1.30	+0.13	+0.30	21:20	+0.55	-0.43
24	11:58	-1.32	+0.11	+0.32	15:02	+0.53	-0.45
27	05:39	-1.34	+0.10	+0.34	08:44	+0.52	-0.47
29	23:21	-1.36	+0.09	+0.36	*02:26*	+0.50	-0.49
MAY							
02	17:02	-1.37	+0.07	+0.38	20:08	+0.49	-0.50
05	10:44	-1.39	+0.06	+0.39	13:50	+0.48	-0.52
08	04:25	-1.41	+0.05	+0.41	07:32	+0.46	-0.53
10	22:07	-1.42	+0.04	+0.42	*01:14*	+0.45	-0.55
13	15:48	-1.44	+0.03	+0.44	18:55	+0.44	-0.56
16	09:30	-1.45	+0.02	+0.45	12:37	+0.43	-0.57
19	03:11	-1.47	+0.01	+0.47	06:19	+0.42	-0.58
21	20:53	-1.48	+0.00	+0.48	*00:01*	+0.41	-0.59
24	14:34	-1.49	-0.01	+0.49	17:43	+0.40	-0.60
27	08:16	-1.50	-0.02	+0.50	11:25	+0.39	-0.61
30	01:57	-1.51	-0.02	+0.51	05:07	+0.39	-0.61

Eclipses of Rhea, 1995, April-May

	Beginning				End		
	UT	x	y	limb	UT	x	limb
APR							
04	20:20	-1.17	+0.29	+0.21	23:36	+0.48	-0.40
09	08:46	-1.23	+0.26	+0.26	12:04	+0.44	-0.46
13	21:12	-1.28	+0.22	+0.30	*00:32*	+0.40	-0.51
18	09:39	-1.33	+0.19	+0.35	13:00	+0.36	-0.56
22	22:05	-1.38	+0.16	+0.40	*01:28*	+0.33	-0.62
27	10:31	-1.43	+0.12	+0.44	13:56	+0.29	-0.66
MAY							
01	22:58	-1.48	+0.10	+0.48	*02:24*	+0.26	-0.71
06	11:24	-1.52	+0.07	+0.52	14:52	+0.23	-0.75
10	23:50	-1.56	+0.04	+0.56	*03:20*	+0.20	-0.79
15	12:17	-1.60	+0.02	+0.60	15:48	+0.18	-0.82
20	00:43	-1.63	-0.01	+0.63	04:15	+0.16	-0.84
24	13:09	-1.66	-0.03	+0.66	16:43	+0.14	-0.85
29	01:36	-1.68	-0.04	+0.68	05:11	+0.13	-0.85

Eclipses of Titan, 1995, April-May

	Beginning				End		
	UT	x	y	limb	UT	x	limb
MAY							
26	15:23	-1.98	-0.08	+0.98	16:51	-1.49	+0.49

A.L.P.O. SOLAR SECTION OBSERVATIONS FOR ROTATIONS 1850-1855 (1991 DEC 09 TO 1992 MAY 20)

By: Randy Tatum, A.L.P.O. Assistant Solar Recorder

ABSTRACT

This report summarizes A.L.P.O. Solar Section observations for Rotations 1850-1855 in terms of the morphology and development of sunspot groups. Ten observers from four countries contributed visual drawings and photographs in integrated and Hydrogen-α light.

INTRODUCTION

The mean International Sunspot Number, **RI**, for this six-rotation period was 125.7, with a high mean of 157.7 for Rotation 1852 and a low mean of 85.9 for Rotation 1855. The mean American Sunspot Number, **RA**, for this period was 121.6 with a high mean of 154.7 for Rotation 1852 and a low of 81.1 for Rotation 1855. The highest daily **RI** was 238 on FEB 01. The highest daily **RA** was 233 on JAN 31. This report period can be divided into two parts. The first three rotations had moderate-to-high activity. During the last three rotations activity dropped to low-to-moderate levels. Between Rotations 1852 and 1853 sunspot numbers dropped by 32 percent. By Rotation 1855 sunspot numbers had reached the lowest level since May, 1988.

Of the 30 regions that produced groups of at least class E [lengths over 10°; see *Solar Classification Key* on p. 60], 22 were in the Southern Hemisphere. The sunspot group classifications in this report are for the date of maximum observed development, not necessarily the central-meridian passage date.

The times used in this report are all Universal Time (UT). Cardinal directions are abbreviated (e.g., N, SW) and are heliographic as are angular dimensions. "Preceding" (p) means celestial west and "Following"(f) celestial east. "Groups" are white-light collections of sunspots. "Regions" are entire magnetically associated areas around sunspots in all wavelengths. Active regions are enumerated in this report with the prefix AR, and are designated as such by the Space Environment Services Center (SESC) of NOAA in Boulder, Colorado. AR positions are given in the form (latitude, longitude).

The terms and abbreviations used in this report are explained in the book, *The New Observe and Understand The Sun*, which is avail-

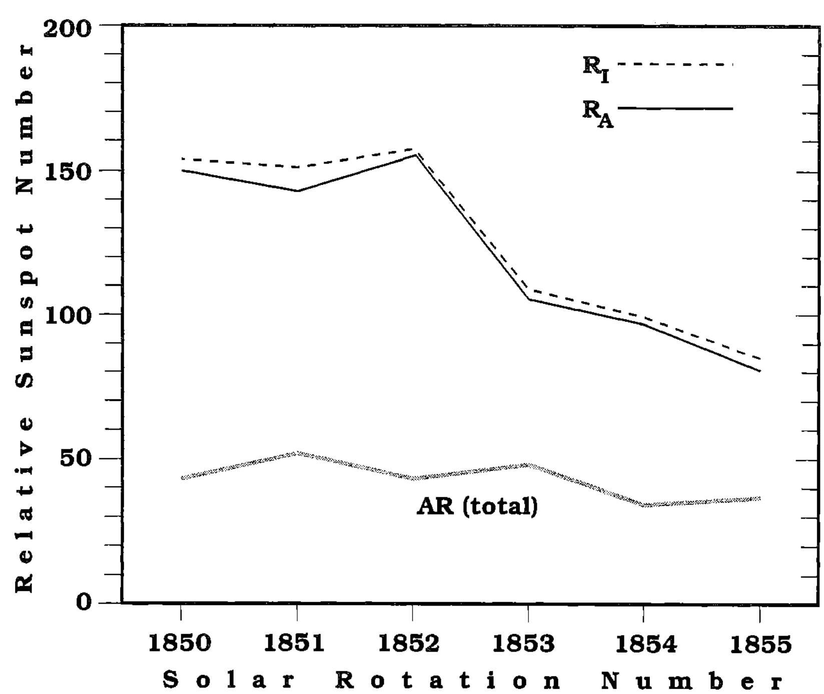

Figure 1. Graph of rotational means of RI (Relative International Sunspot Number) and RA (Relative American Sunspot Number), with total number of Active Regions (AR), for Rotations 1850-1855.

Table 1. Observers Contributing to the A.L.P.O. Solar Section Report, Rotations 1850-1855 (1991 DEC 09 - 1992 May 20).

Observer	Telescope Aper.	Stop	f/	Type	Location
Clement, D.	15	6	12	Refr.	Louisiana, USA
Dragesco, J.	18	-	-	Refr.	France
	35.6	10	11	S.-C	
Garcia, G.	12	-	8.4	Refr.	Illinois, USA
Maxson, P.	25.4	15	10	New.	Arizona, USA
Melillo, F.	20.3	6.3	11	S.-C.	New York, USA
Rousom, J.	10.2	-	15	Refr.	Ontario, Canada
Tao, Fan-Lin	25.4	-	15	Refr.	Rep. of China
Tatum, R..	18	9	15	Refr.	Virginia, USA
Timerson, B.	15.2	-	8.3	New.	New York, USA
Tramazzo, V.	8.9	6.3	17	Mak.	New York, USA

Notes: Aper. = telescope aperture, followed by the aperture of the *stop* if any; both in cm. *f/* = focal ratio; *Mak.* = Maksutov; *New.* = Newtonian; *Refr.* = refractor; and *S.-C* .= Schmidt-Cassegrain.

able for $US 5.75 from the Astronomical League Sales, 1901 South Tenth St., Burlington, IA 52601). A.L.P.O. Solar Section observing forms are available from Recorder Paul Maxson (address on inside back cover).

Ten observers from four countries contributed to this report. This represents a drop of six observers from the previous report! This is surprising considering the level of activity. It is possible that some data were on loan to researchers, thus depleting the data available for this report.

ROTATION 1850 (1991 DEC 08.84 to 1992 JAN 05.17; 43 Active Regions)

Quantity	Mean	Maximum (Dates)	Minimum (Dates)
RI	152.7	212 (DEC 10)	80 (DEC 22)
RA	149.9	217 (DEC 09)	103 (DEC 21)

This rotation was active, with four regions drawing the attention of Solar Section observers. Compared to the previous rotation, 1850 had a 30-percent increase in both **RI** and **RA**.

AR 6961 (N09°, 306°) was an EKI, βγ group with prominent p- and f-spots. As is typical of bipolar groups, the p-spot had a regular umbra with a circular penumbra. The f-spot was more irregular and was broken into two to three spots. Accurate white-light drawings were made by Tao and Rousom. The central-meridian passage date was DEC 13. In a Maxson white-light photograph AR 6961 was a complex chain of 11 umbrae, 15° long on DEC 14. By DEC 16 the interior umbrae had disappeared, leaving a dominant p-spot and f-spot.

With the disappearance of AR 6961 over the W limb on DEC 18 the Northern Hemisphere became devoid of sunspots. However, the Southern Hemisphere was becoming active with three notable regions. The first to appear was **AR 6982** (S14°, 144°). Classed DKI, βγδ, it was a small group of 5-7 medium-size umbrae. It was associated with a wide, simple bipolar group **AR 6978**, a few degrees to the S. In an off-band H-α photograph by Clement taken on DEC 22, the p-spots of both groups were connected by a faint flare filament. A high-resolution white-light photograph, also by Clement on the same day, had a larger f-penumbra containing three umbrae and presumably a δ magnetic configuration. Before **AR 6982** reached the central meridian, two larger groups came into view that formed a stream of spots nearly 40° long. On Christmas day **AR 6985** (S17°, 100°) and **AR 6988** (S14°, 077°) were both classed EKI and βγ by NOAA/SESC. Both consisted of several scattered umbrae with the most prominent being the f-spots. Photographs by Maxson and Garcia and drawings by Rousom showed the gradual disintegration of both ARs by central-meridian passage on DEC 29, leaving the following spot of AR 6988 as the only prominent spot.

ROTATION 1851 (1992 JAN 05.17 to FEB 01.51; 52 Active Regions)

Quantity	Mean	Maximum (Dates)	Minimum (Dates)
RI	150.3	238 (FEB 01)	71 (JAN 18)
RA	142.1	233 (JAN 31)	64 (JAN 17)

Moderate activity continued in the Southern Hemisphere with the appearance of **AR 6993** (S09°, 346°) and **AR 6994** (S16°, 343°). They formed two parallel chains of spots about 5° apart. Dragesco captured them in fine detail in matching white-light and H-α photographs on JAN 04 and JAN 06, when there were three principal umbrae of equal size in AR 6993. Between those dates the middle spot had decreased in size and had moved toward the f-spot in contrast to the p-spot which had grown. AR 6994 overall had more small umbrae and penumbrae than did AR 6993. Although in white-light the two regions were well separated, in H-α both groups were embedded in one large complex of plage.

Solar activity now resumed in the Northern Hemisphere and was nearly equal to that in the Southern Hemisphere for the rest of the rotation. Sunspot activity tended to increase during the later half of the rotation, reaching maximum on JAN 31-FEB 01. A Dragesco white-light whole-disk photograph for FEB 01, reproduced here as *Figure 2* (p. 57), showed 12 sunspot groups, with the solar equator delineated between the zones of sunspots. There was a large variation of 20° of latitude within the sunspot zone. It is curious that the two

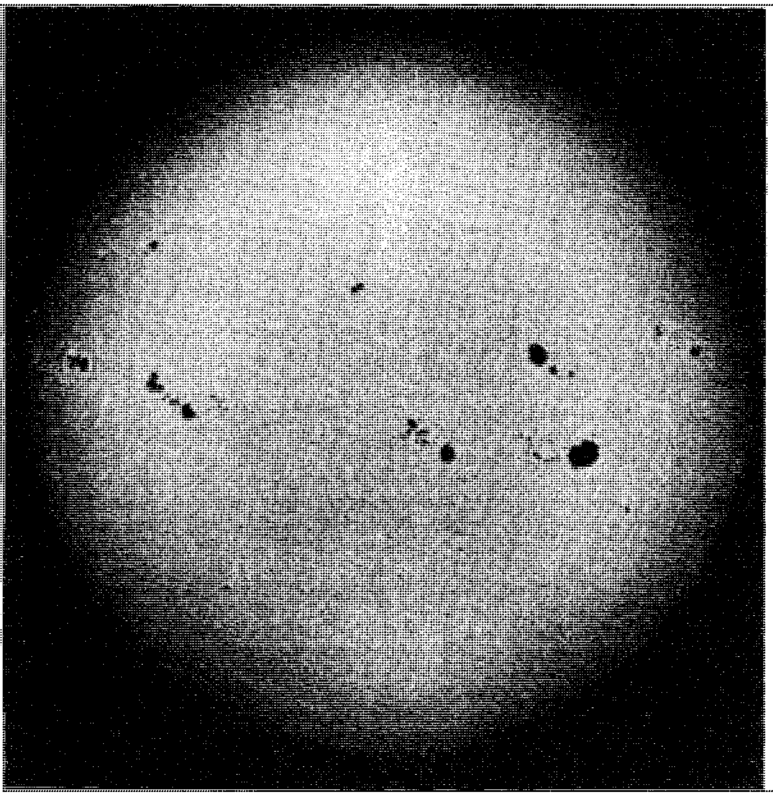

Figure 2. White-light solar photograph by Jean Dragesco, taken on 1992 FEB 01, 10h40m UT, at the end of Rotation 1851. Twelve sunspot groups are visible. AR 7042 is the group nearest the east (left) limb, while AR 7031 is to the right of and below center, containing a large elongated spot. North at top.

largest sunspots in opposite hemispheres were at low latitudes and near the same longitude.

ROTATION 1852 (1992 FEB 01.51 to FEB 28.85; 43 Active Regions)

Quantity	Mean	Maximum (Date)	Minimum (Dates)
RI	157.7	196 (FEB 26)	99 (FEB 18)
RA	154.7	194 (FEB 26)	101 (FEB 19)

This rotation's first observation was a high-resolution H-α filtergram by Dragesco of a class-1 flare on FEB 02; see *Figure 3* (below). It was associated with **AR 7031** (S05°, 026°) which crossed the central meridian on JAN 30. AR 7031 developed a large, crescent-shaped p-spot, but not much else. At 15h37m UT on FEB 02, the flare was a two-ribbon type following the p-spot with a kinked magnetic inversion line between them.

Southern-Hemisphere activity continued unabated when **AR 7042** (S11°, 301°) came over the E-limb at the end of Rotation 1851. Clement photographed a bright sub-flare near

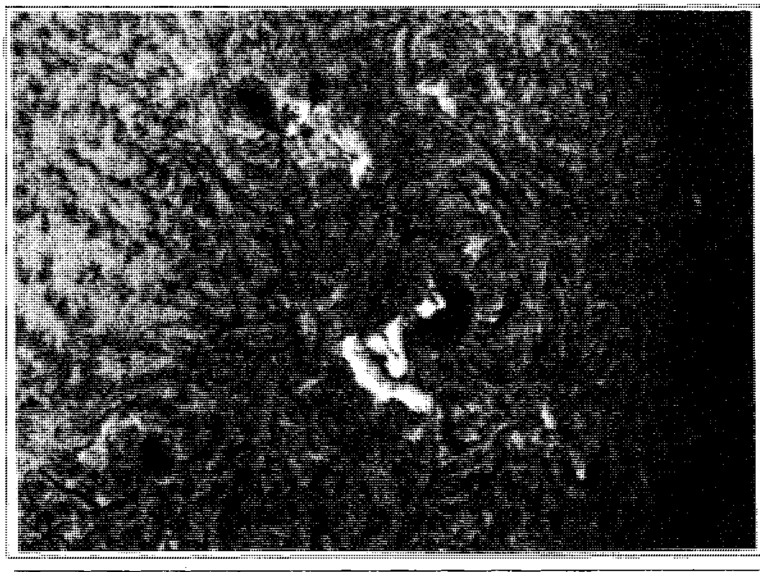

Figure 3. Photograph by Jean Dragesco in Hydrogen-α light on 1992 FEB 02, 15h37m UT, at the beginning of Rotation 1852. A class 1-b flare appears below center, associated with AR 7031. (Compare with Figure 1, above, taken in white light on the previous day.) North at top.

the p-spot at 20h50m UT on FEB 01. On FEB 02 Garcia obtained a high-contrast whole-disk H-α photograph. AR 7042 then had two prominent p-spots in separate penumbrae, with bright trailing plage and small f-spots. It was classed FKI, βγδ by professional observers.

AR 7056 (S12°, 183°) was similar in size and appearance to AR 7042. From FEB 17 to FEB 19 Clement photographed AR 7056 approaching the W-limb. There was a dark filament in a bright ring of plage in his FEB 17 photograph. His FEB 18 photograph, taken under fine seeing conditions, showed a small, bright hook-shaped flare on the NE limb. This was the first indication of a new surge in activity in the Northern Hemisphere. On FEB 23 a filament that crossed the solar equator in the FEB 18 photograph had disappeared. Its demise may have been triggered by a growing region on its southern end.

AR 7067 (N05°, 049°), the source of the limb flare on FEB 18, was then approaching the central meridian and was the leader of a wave of five ARs. Its structure was similar to that of AR 7031; a large p-spot, bright plage, and a few small f-spots. Another interesting region was **AR 7070** (N07°, 024°). Tatum videotaped AR 7067 and AR 7070 in white light and H-α on FEB 22, when there were four medium-to-small umbrae clustered in one penumbra. The H-α view showed a dark filament entering one side of the penumbra and exiting from the other. In white-light the position of the magnetic inversion line was marked by a dark streak between umbrae. This is the most likely location for rare white-light flares; observers should become adept at recognizing them. For most of its disk passage AR 7070 was classed as δ. By FEB 27 it was decaying rapidly.

ROTATION 1853 (1992 FEB 28.85 to MAR 27.16; 48 Active Regions)

Quantity	Mean	Maximum (Date)	Minimum (Dates)
RI	108.4	176 (FEB 29)	65 (MAR 05)
RA	105.5	158 (FEB 29)	69 (MAR 18)

The beginning of Rotation 1853 saw a large decrease in the complexity of sunspot groups. This was reflected in the lower number of individual umbrae, in contrast to the number of groups, which was slightly higher. However, the largest flare event observed by Section observers occurred during this rotation. Clement made whole disk H-α photographs on MAR 08, recording a class-2 flare, shown here as *Figure 4* (below). The region responsible for the flare was **AR 7091** (S09°, 197°). At 16h42m UT on MAR 08 no flare emission was visible. By 17h45m UT two bright, parallel ribbons 113,000 km long had formed. At 19h22m UT there was a small patch of emission at the location of one ribbon (probably a subsequent flare). AR 7091 was classed DAO and was not especially large or complex. Regions with small sunspots can produce large flares, but not very intensive ones. This flare produced an M4.9-level event in X-rays. The X-ray level of a flare recorded from artificial

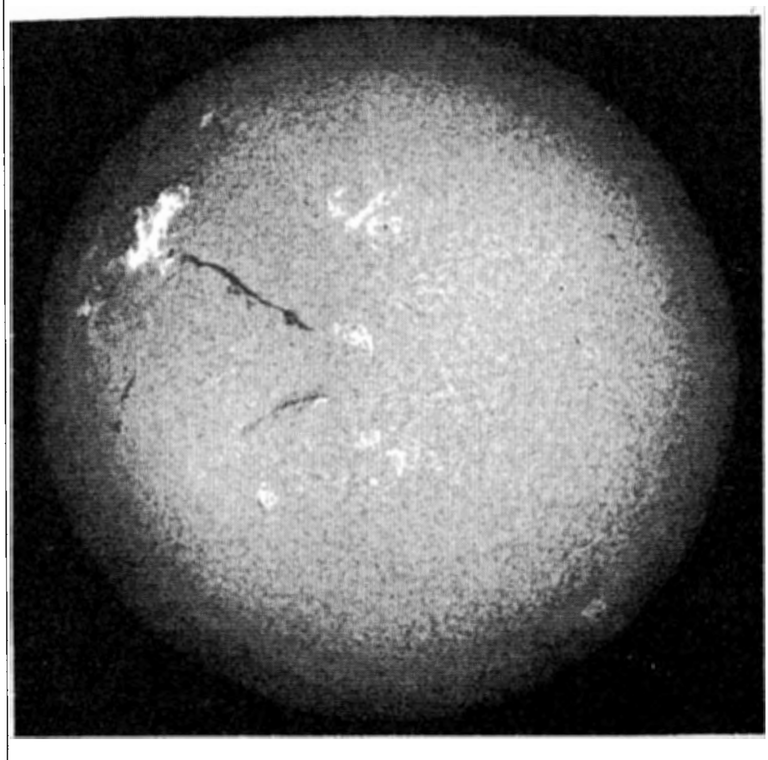

Figure 4. Whole-disk Hydrogen-α photograph by Donald Clement; 1992 MAR 08, 17h45m UT, during Rotation 1853. 6-in (15-cm) refractor, stopped to 2.5-in (6.35-cm) aperture, 72-in (183-cm) focal length. 1/250-second exposure on Kodak TP 2415. A major class-2 flare is near the east (left) limb, associated with AR 7091. North at top.

satellites is a better indicator of the energy output than its area in H-α.

ROTATION 1854 (1992 MAR 27.16 to APR 23.43; 34 Active Regions)

Quantity	Mean	Maximum (Date)	Minimum (Dates)
RI	99.5	185 (APR 21)	54 (APR 10)
RA	96.1	176 (APR 21)	52 (APR 09)

Although Regions **AR 7117** (N07°, 334°) and **AR 7116** (S09°, 337°) were well on the solar disk when Rotation 1853 ended, all data available were collected after central-meridian passage on MAR 29. AR 7117 temporarily ended the lull in activity and was classed FKI, βγ. Its maximum length was 16°. It was first recorded in a white-light photograph by Timerson and a drawing by Rousom, both on MAR 29. The p-spot was a prominent, regular spot. Within the f-penumbra were two to three more irregularly shaped f-umbrae. Several small umbrae and rudimentary penumbrae were between the primary spots, which later faded. The Northern Hemisphere also became active near the same longitude as AR 7117. AR 7116 peaked in size two days before central-meridian passage and was classed as D in the Zurich System. On APR 01 at 1'7h23m UT, Clement photographed a class-1b flare in the f-plage of AR 7116. **AR 7120** (S17°, 316°) was born on the solar disk on APR 27 and developed rapidly. Both AR 7120 and AR 7116 had similar structures, a dominant stable p-spot.

The next region of interest was **AR 7123** (S06°, 202°). A high-resolution H-α photograph by Garcia on APR 05, reproduced below as *Figure 5*, showed the chromospheric fine structures well. In H-α AR 7123 had a prominent, regular p-spot; a bright, filamentary f-plage; and three small f-spots. The plage was divided by a twisted magnetic inversion line that turned, darkened, and flowed into the p-spot. AR 7123 was classed ESI at central-meridian passage on APR 08.

ROTATION 1855 (1992 APR 23.43 to MAY 20.67; 37 Active Regions)

Quantity	Mean	Maximum (Dates)	Minimum (Dates)
RI	85.9	172 (APR 25)	45 (MAY 16/17)
RA	81.1	155 (APR 23)	38 (MAY 17)

This rotation had the lowest sunspot numbers for the report period, although with 37 active regions the Sun was by no means devoid of activity. Fewer groups developed into E- or F-class. Data for this rotation were mostly incomplete. For H-α observers this rotation ended with a beautiful, curved filament in the

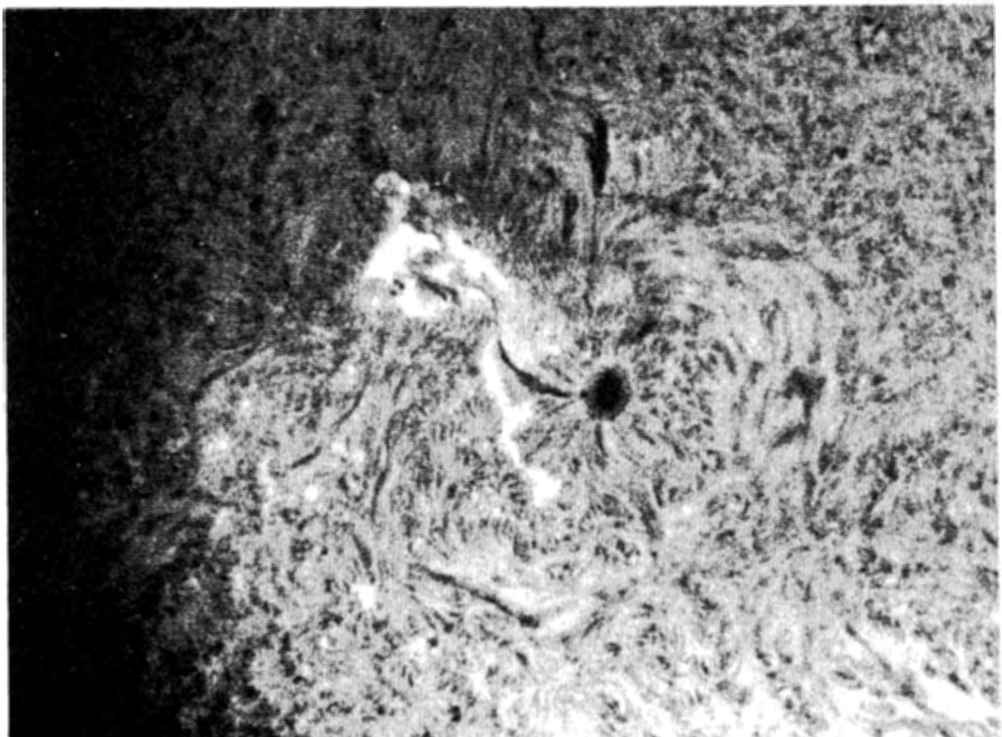

Figure 5. Hydrogen-α photograph by Gordon Garcia; 1992 APR 05, 18h24m UT, during Rotation 1854, showing AR 7123. 12.0-cm refractor used at f/25 with a Daystar 0.56-Å filter at the Hydrogen-α centerline; 1/60-second exposure on Kodak TP 2415. North at top. Also see text.

Northern Hemisphere, as photographed by Melillo on MAY 20, whose photograph appears here as *Figure 6* (p. 60).

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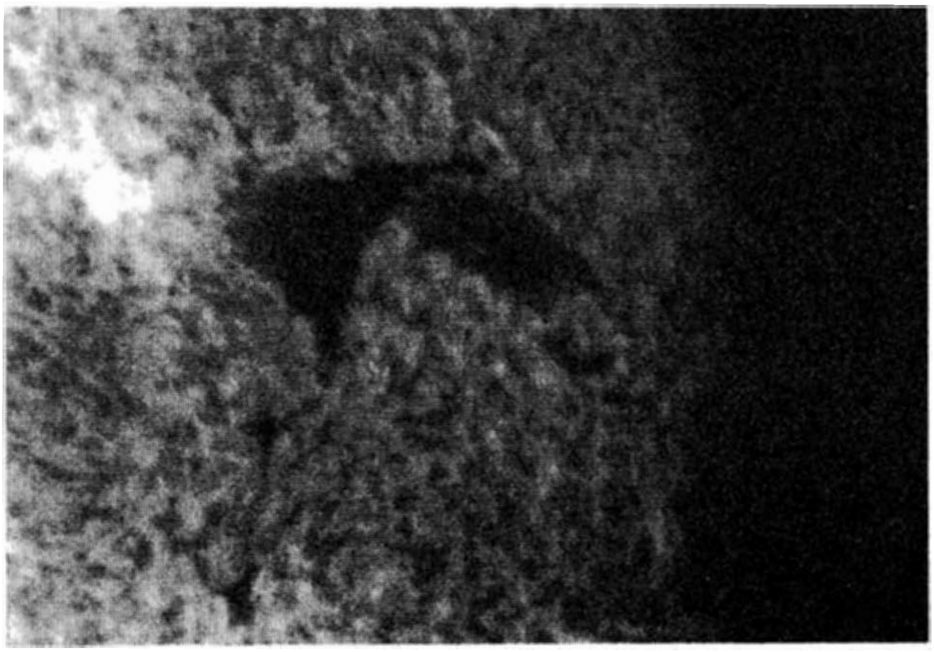

Figure 6. Frank Melillo obtained this Hydrogen-α photograph on 1992 MAY 20, 22h31m UT, near the end of Rotation 1855. 20-cm (8-in) Schmidt-Cassegrain, stopped to 2.5-in (6.35-cm) aperture, 200-cm (80-in) focal length; 0.6-Å bandpass filter; 1/4-second exposure on Kodak TP 2415. A large filament is shown, near the west limb.

SOLAR CLASSIFICATION KEY:

Groups (Modified Zurich System)

First Letter—**A** = Single pore or non-polar group of pores. **B** = Bipolar; without penumbrae. **C** = Bipolar; penumbra on one end. D = Bipolar; penumbrae at both ends; length <10°. **E** = Bipolar; penumbrae at both ends; length 10°-15°. **F** = Bipolar; spots at both ends; length >15°. **H** = Unipolar; penumbra; diameter >2°.5.

Second Letter (Penumbra of Largest Spot)—**X** = No penumbra. **R** = Rudimentary penumbra partly surrounds largest spot. **S** = Small, symmetric penumbra, elliptical or circular; single umbra or compact cluster of umbrae; <2°.5 N-S. **A** = Small, asymmetric penumbra; irregular; <2°.5 N-S. **H** = Large symmetric penumbra; >2°.5 N-S. **K** = Large asymmetric penumbra; >2°.5 N-S.

Third Letter (Spot Distribution)—**X** = (Unipolar). **O** = Open; few or no spots between leader and follower. **I** = Intermediate; numerous spots between leader and follower. **C** = Compact; many large spots between leader and follower.

Magnetic Characteristics

α = Unipolar. β = Bipolar. γ = Complex polarity. δ = Opposite polarity.

Flares

Class (values are areas in millionths of solar disk)—**S** = Subflare; <100. **1** = 100-250. **2** = 250-600. **3** = 600-1200. **4** = >1200.

Brilliance—**f** = Faint. **n** = Normal. **b** = Bright.

X-Ray Importance (Peak Flux in watts/sq. meter; followed by numerical multiplier)

B = 10^{-6}. **C** = 10^{-5}. **M** = 10^{-4}. **X** = 10^{-3}.

ANALYSIS OF THE AUGUST 17, 1989 TOTAL LUNAR ECLIPSE

By: Francis G. Graham, A.L.P.O. Lunar Eclipse Recorder, and Barton P. Levenson

INTRODUCTION

The 1989 AUG 17 Total Lunar Eclipse, with totality predicted for the period 02h 20m-03h 56m UT, was widely observed in the United States, Canada, and Europe [**1,2,3,4**]. Poems were written about it [**5**]. A total of 97 observers submitted data on it to the Association of Lunar and Planetary Observers, either directly or though affiliated organizations. These observations included timings, photographs, drawings, magnitude estimates, and other forms of data. The observers and the data submitted are listed in *Table 1* (pp. 62-63). Many observations came from Europe where they were marshaled through the kind efforts of Sandor Szabo (Hungary), Peter Foley (United Kingdom, British Astronomical Association), W. Nijenhuis (Netherlands), and Jiri Dusek (Czechoslovakia).

The large amount of data received delayed analysis; what follows is a preliminary survey of the results of this widely observed eclipse. A total of 512 crater and limb contact timings for this event was received as of this writing. It is hoped that readers will continue to submit to the Eclipse Recorder observations of this and any other eclipses.

UMBRAL SIZE

The size of the umbra was computed using the method of Mädler [**7**; for explanation see also Ref. **8**] on 48 immersion-emersion crater timings. The code was written in C and compiled for an IBM-compatible personal computer. Interested parties may request the program from this Recorder (address on inside back cover) by supplying a blank floppy and one dollar; a Basic version is also available, and a more detailed explanation will also be supplied. *Table 2* (pp.63-64) shows the pairs of timings that were used. Crater positions are from Kosik [**9**]; certain elements of the eclipse were from Espenak [**10**].

Pairs of timings were preferentially chosen when the same observer observed both immersion and emersion; 13 pairs represent mixed immersion/emersion observers. Thus, eastern and northern European and western American observers are under-represented. The results of applying Mädler's method give a mean umbral enlargement of 1.74 percent. However, there are two outliers which result surely from timepiece error or crater misidentification; when they are removed the mean is 2.01±0.26 [standard error]. This is consistent with the value in Nyren and Sinnott [**11**], which, using a different reduction method and usually more experienced observers, obtained a value of 1.75±0.03 from immersions, 1.68±0.05 from emersions, and 1.86±0.12 from limb contact timings. Neither of our values is consistent with those of Nijenhuis [**12**], who gives 1.01 polar and 1.02 equatorial, but it does appear consistent with Nijenhuis' elucidation of the variation in shadow size with lunar distance, first discussed in [**13**].

DANJON LUMINOSITY

Thirty observers supplied separate numerical Danjon Luminosity estimates. Where a range was specified, the midrange was used. The mean was 1.45±0.19 [standard error], and the standard deviation ±1.06. Hence, the eclipse was a rather dark one, as commented upon by many observers who provided general descriptions. [The Danjon Luminosity, L, is measured on a 0-to-5 scale, where 1 = "Dark eclipse, gray or brownish coloration; details distinguishable only with difficulty," and 2 = "Deep red or rust-colored eclipse, with a very dark central umbra and the outer edge of the umbra relatively bright."]

OCCULTATIONS

Andrew Elliot and Malcolm Gough performed timings of the grazing occultation of the star 44 Capricorni during this rather dark eclipse. These timings were sent to the International Occultation Timing Association and to the International Lunar Occultation Center, Tokyo. Additional total occultations were reported and are shown in *Table 3* (p. 64). Occultation predictions were given in [**14**].

TRANSIENT LUNAR PHENOMENA

A number of observers deliberately checked areas on the Moon for signs of anomalous brightening or unusual appearances. The most important detection, of a brightening of Aristarchus, was recorded by Kolovos and colleagues in Thessalonika, Greece. They used an IP21 photomultiplier aimed at Aristarchus through a 10.2-cm. f/10 refractor, and recorded a 20-percent signal increase for a few seconds at 01h 10m 44s UT, while Aristarchus was still in the penumbra. This was verified by a CCD video by Tony Cook, which we have not seen.

Visually, David Darling, David Weier and others at Brooklyn, Wisconsin reported that Aristarchus appeared unusually bright from 01h 40m onward. It appeared to go up and down in brightness in cycles of 15 minutes during the entire eclipse. David Weier reported a flash phenomenon in the Aristarchus area at 03h 45m 12s which remains unconfirmed. Also, a dark streak appeared across Aristarchus according to observers Darling, Weier, Davis, and others at the Brooklyn station.

nis Fryback of Madison, WI, and Jeffry Peronto of DeForest, WI reported the dark streak, although Davis considered it a normal shadow [During a lunar eclipse? Ed.] and reported no brightening after 03h 56m when he began to observe.

These brightenings are all accounted for by possible lunar luminescence and the dark streak may well be a normal observational effect caused by viewing the Moon as lit by an extended dim circular red light source 2° in diameter, rather than a bright light source 0°.5 in diameter. In fact, one would expect the appearance of lunar features to be changed by this circumstance. However, these phenomena deserve extensive further study.

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Table 1. Contributing Observers.

Observer	Location*	Data†
Edwin Faughn	Paragould, AR	P
Larry Mitchell	Brazos Bend, TX	PEP
Walter Haas	Las Cruces, NM	DL, GD, T, CT
John Westfall	Sierra Brooks, CA	VID, CT, T, GD, P
Stephen Simmons	Callahan, FL	DL, GD, T, CT
Brian Simmons	Callahan, FL	T, CT
Karl Simmons	Callahan, FL	T,DL, CT
Wanda Simmons	Callahan, FL	T, DL
Mike Smith	Calcutta, OH	P (Ref. 6)
H.R. Hatfield	Sevenoaks, UK	GD
Norman Kiernan	Pulborough, UK	DL, GD
John Fairweather	Woking, UK	GD
Carol Bethan	Athens, GR	DL, GD
Lawrence Paynter	Radcliffe, UK	T, GD, CT
T. Moseley	Gegengormley, UK	GD, VP
Andrew Elliot	Naughton, UK	GD
Malcolm Gough	Naughton, UK	GD
Jeremy Chapple	Bristol, UK	TLP, P, GD
George Kolovos,	Thessalonika, GR	PEP, TLP
Mary Kolovou ,	" "	" "
Laura Pylarinou	" "	" "
Tony Cook	Frimley, UK	CCD, PEP
Richard McKim	Oundle, UK	P, CT, GD
Gerald North	Boxhall, UK	GD,P **[a]**
Jim Ashton	Weeping Cross, UK	GD, P
Gordon Ward	Castlefork, UK	GD, DL
Nick James	Chemsford , UK	P, GD
H.J.P. Arnold	Havant, UK	P
Colin Henshaw	Maunatlala, BOT	DL
Roy Holtschke	Shrewsbury, VT	T **[b]**
Sandor Szabo,	Boly, HUN	CT,GD,T
Laszlo Decsi,	" "	" " "
Jozsef Fulop,	" "	" " "
Gabor Guth,	Boly, HUN	CT, GD, T
Laszlo Kaesz	" "	" " "
Krisztian Toth-Dunakeszi	Berlin, GER	GD, CT
Rob Robotham	Scarborough, ONT	CT, T, DL, GD
Antal Kocsis,	Balatonkenese, HUN	CT, GD, DL, T,VP
Laszlo Vimlati,	"	" " "
Tamas Kertesz	"	" " "
Zoltan Jurek	Debrecen, HUN	DL
Gabor Halmi	Pecs, HUN	CT, DL
Istvan Tepliczky	Tata, HUN	CT, GD, DL, T
Sandor Keszthelyi	Pecs, HUN	GD,CT
Viktor Zsohar	Szekesfehervar, HUN	DL, T, CT, GD
Robert Szabo	Ajka, HUN	CT, DL
Lajos Reti	Gyor, HUN	CT, P, GD
Tibor Horvath	Hegyhatsal, HUN	T, GD, DL, CT
Vince Tuboly	Hegyhatsal, HUN	T, GD , DL, CT
Janos Fekete	Felsoezsolca, HUN	GD, CT, DL
Endre Szoboszley	Debrecen, HUN	CT, T
Zoltan Nagy	Budapest, HUN	GD
Endre Barnak	Budapest, HUN	GD
Attila Szoelloesi	Kecskemet, HUN	DL, CT, T
Peter Kecskemeti	Kecskemet, HUN	DL, CT, T
Levente Szarka	Kecskemet, HUN	DL, CT, T
Jozsef Biro	Czikszereda, ROM	P
Ayostron Javorka	Bos, CZECH	P

(continued)

Table 1—*Continued.*

Observer	Location*	Data†
Gregory Kieltyka	Krosno, POL	T, CT, GD, OCC
Mark A. Gelinas	Ile Perrot, QUE	T, GD, DL, CT, P
Gary Nowak,	Georgia, VT	P, GD, DL,
Russell Chmela	" "	CT, VP, T
Robert Hays	Apple State Park, IL	GD, CT, OCC, T
Barbara Wilson	Brazos Bend, TX	GD, DL
William Davis,	New Orleans, LA	GD, TLP
C. Gregory Seab	" " "	" "
David Darling	Brooklyn, WI	GD, TLP, T
David Weier,	Brooklyn, WI	GD, TLP, T,
J. Sullivan,	" "	DL, IR
J. Weier	" "	" "
Gus Johnson	Swanton, MD	GD,TLP
Jose Aguirre	Grenada, SP	T,CT
Kermit Rhea	Paragould AR	P, GD, CT, DL
Alan Heath	Newquay, UK	GD, DL, P
Frank Boinck	NETH	T [c]
Jan Vandenbruaene	NETH	T [c]
Henk Feijth	NETH	T [c]
Adri Gerritsen	NETH	T [c] , CT
Geert Vansdenbulcke	NETH	T [c]
Bart Vandenbussche	BEL	T [c]
Ivo Van de Maagdenberg	NETH	T [c]
Carlo Jenniskens	NETH	T [c]
Jurrian Zijl	NETH	T [c]
Henk Bulder	Zoetermeer, NETH	T
D. Rodriguez,	Madrid, SP	T, CT
J. Ripero	" "	" "

Table 1—*Continued.*

Observer	Location*	Data†
W. Vollman	Vienna, AUSTRIA	T
Maria Morva,	Csicso, CZECH	T
Peter Perjessy,	" "	"
Tibor Szlanicska,	" "	"
Gyorgy Darnay	" "	"
Jiri Dusek	Vyskov, CZECH	T
Vojtech Simon	Hranicena Morave, CZECH	T, CT
James Jones	Houston, TX	DL, GD
Thomas Mohney,	East Liverpool, OH	GD
P. Richard Sine	" " "	"
Francis Graham	East Liverpool, OH	VID, T, GD, CT

** Country Codes:*

Besides the standard USPS two-letter state codes, the following country codes are used: UK = United Kingdom; NETH = Netherlands; CZECH = Czechoslovakia; GER = Germany; SP = Spain; ONT = Ontario, Canada; QUE = Quebec, Canada; BEL = Belgium; HUN = Hungary; ROM = Romania; POL = Poland; GR = Greece; BOT = Botswana.

†Observation Type:

CCD = charge-coupled device imaging; CT = crater contact timings; DL = Danjon Luminosity; GD = general description; IR = near-infrared photography; OCC = occultation timings; P = photograph; PEP = photoelectric photometry; T =limb timings; TLP = transient lunar phenomena search; VID = video; VP = visual photometry

Notes:

a. Royal Greenwich Observatory
b. Copy of data lost in the mail
c. City not specified

Table 2. Observing Pairs Used for Analysis of Umbra Size by Mädler's Method.

Pair No.	Selen. Coord.* Xo	Yo	UT (1989 Aug 17) Immersion	Emersion	Crater	Observer Immersion	Emersion	Umbral Enlargement
1	-.0387	-.1874	01:58:08	04:20.8	Tycho	S. Simmons	Haas	1.75 %
2	-.0348	.2019	02:00:20	04:25.5	Plato	K.Simmons	Haas	-6.80
3	-.1841	.1094	02:06:00	04:08.0	Aristarchus	Paynter	Haas	-21.9
4	-.1841	.1094	01:26:00	04:07.9	Aristarchus	Robotham	Haas	3.63
5	-.0918	.0453	01:39.0	04:18.8	Copernicus	Robotham	Robotham	3.03
6	-.0387	-.1874	01:56.5	04:19.7	Tycho	Robotham	Robotham	2.03
7	-.1841	.1094	01:28:56	04:08.0	Aristarchus	Hays	Westfall	1.81
8	-.2518	-.0260	01:25:40	03:59.6	Grimaldi	Kieltyka	Robotham	0.43
9	-.0918	.0453	01:40:52	04:19:04	Copernicus	Hays	Hays	2.02
10	-.0387	-.1874	01:56:48	04:19:30	Tycho	Hays	Hays	1.74
11	.0418	.0979	01:53:40	04:33:25	Manilius	Hays	Hays	2.90
12	.0720	.0762	01:57:05	04:36:20	Menelaus	Hays	Hays	2.52
13	.1914	.0753	02:08:52	04:48:12	Proclus	Hays	Hays	2.82
14	.1951	.0285	02:10:58	04:49:10	Taruntius	Zsohar	Hays	3.12
15	.2350	-.0421	02:16:00	04:52:42	Langrenus	B.Simmons	Hays	4.62
16	-.1841	.1094	01:25:53	04:08:00	Aristarchus	Tepliczky	Davis	5.05
17	-.1841	.1094	01:28:32	04:07:38	Aristarchus	Aguirre	Agulrre	1.84
18	-.2518	-.0260	01:24:57	03:58:43	Grimaldi	Agulrre	Agulrre	0.32
19	-.1660	.0383	01:32:15	04:10:13	Kepler	Agulrre	Agulrre	1.83
20	-.1667	-.0822	01:36:45	04:07:02	Gassendi	Aguirre	Aguirre	0.31
21	-.0897	.0955	01:38:51	04:18:38	Pytheas	Agulrre	Agulrre	2.42

(Continued)

Table 2—*Continued.*

Pair No.	Selen. Coord.* Xo	Yo	UT (1989 Aug 17) Immersion	Emersion	Crater	Observer Immersion	Emersion	Umbral Enlargement
22	-.0918	.0453	01:39:41	04:17:32	Copernicus	Agulrre	Agulrre	1.79 %
23	-.0550	.1220	01:41:45	04:21:56	Timocharis	Agulrre	Agulrre	2.54
24	-.0271	.2129	01:43:15	04:23:14	Plato	Agulrre	Agulrre	2.76
25	-.0387	-.1874	01:55:58	04:18:14	Tycho	Aguirre	Aguirre	1.69
26	.0720	.0762	01:56:30	04:36:02	Menelaus	Agulrre	Agulrre	2.70
27	.1051	.0718	01:59:44	04:39:34	Plinius	Aguirre	Aguirre	3.01
28	.1914	.0753	02:10:19	04:47:55	Proclus	Aguirre	Aguirre	1.71
29	-.2518	-.0260	01:25:45	03:59:50	Grimaldi	Ripero	Ripero	0.52
30	-.2518	-.0260	01:25:22	03:59:50	Grimaldi	Rodriguez	Rodriguez	0.76
31	-.1841	.1094	01:28:44	04:07:49	Aristarchus	Rodriguez	Rodriguez	1.83
32	-.1660	.0383	01:32:57	04:10:11	Kepler	Rodriguez	Rodriguez	1.37
33	-.1667	-.0822	01:37:02	04:04:38	Gassendi	Rodriguez	Rodriguez	-1.3
34	-.0897	.0955	01:39:12	04:20:45	Pytheas	Rodriguez	Rodriguez	3.54
35	-.0918	.0453	01:39:37	04:17:47	Copernicus	Rodriguez	Rodriguez	1.99
36	-.0550	.1220	01:41:54	04:23:26	Timocharis	Rodriguez	Rodriguez	3.41
37	-.0271	.2129	01:43:26	04:24:16	Plato	Rodriguez	Rodriguez	3.31
38	.0521	.2090	01:51:35	04:30:54	Aristoteles	Rodriguez	Rodriguez	2.19
39	.0551	.1903	01:52:12	04:32:38	Eudoxus	Rodriguez	Rodriguez	2.76
40	-.0387	-.1874	01:55:32	04:36:59	Tycho	Rodriguez	Rodriguez	12.6
41	.0418	.0679	01:53:05	04:33:25	Manilius	Rodriguez	Rodriguez	3.27
42	.0720	.0762	01:56:17	04:35:42	Menelaus	Rodriguez	Rodriguez	2.62
43	.1051	.0718	01:59:41	04:40:11	Plinius	Rodriguez	Rodriguez	3.44
44	.1951	.0285	02:09:55	04:47:33	Taruntius	Rodriguez	Rodriguez	2.77
45	.1914	.0753	02:08:08	04:45:22	Proclus	Rodriguez	Rodriguez	1.47
46	-.1841	.1094	01:30:45	04:06.0	Aristarchus	Simon	Graham	-0.64
47	-.0387	-.1874	01:56:56	04:23.0	Tycho	Simon	Graham	3.68
48	-.1660	.0383	01:33:01	04:11.5	Kepler	Gerritsen	Graham	2.16

* Expressed in units of 1.0000 terrestrial equatorial radius.

Table 3. Total Occultations Reported During the 1989 Aug 17 Total Lunar Eclipse.

Obser.	Phenom.	Star	UT (corr.)
Kieltyka	Disap.	ω Cap	02:08:12.9
Hays	Disap.	SAO 164667	02:40:52.4
Hays	Reap.	SAO 164647	02:42:52.2
Hays	Disap.	BD -14° 6129	02:46:31.3
Hays	Disap.	BD -14° 6135	03:05:42.7
Hays	Disap.	BD -14° 6134	03:07:52.8
Hays	Reap.	BD -14° 6071	03:22:49.5
Hays	Reap.	SAO 164667	03:33:32.6
Hays	Reap.	BD -14° 6129	03:44:28.8

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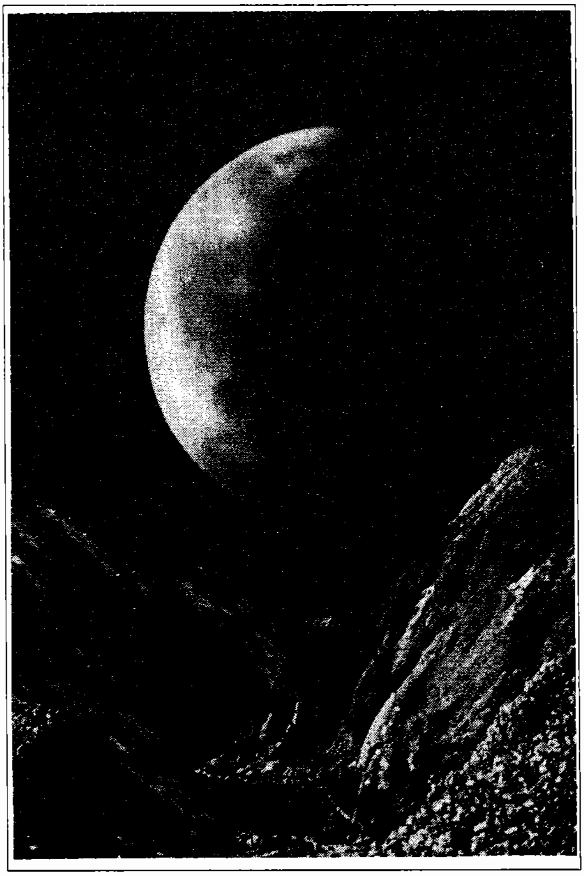

Figure 1. (To right) Photograph of eclipsed Moon, taken by Kermit Rhea; artistically placed with foreground added by Edwin Faughn. North at top. ©1989 Edwin Faughn.

METEORS SECTION NEWS

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

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

1994 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+*N* = Limiting Magnitude)
MAY 13	Robert Hays, IN	07:50-09:20	2 ACA, 1 NOP, 13 SPO	+6.1
JUN 07	Robert Hays, IN	04:50-06:50	4 THE, 15 SPO	+6.0
JUL 02	John Gallagher, NJ	05:25-07:32	3 SPO	+6.4; 5% cloudy
	James Riggs, CA	06:00-07:00	3 SPO	+6.0
03	George Zay, CA	05:00-12:38	1 LSA, 1 CAP, 38 SPO	+5.6
04	George Zay, CA	05:00-12:40	1 TOP, 2 CAP, 1 LSA, 52 SPO	+5.7
	Michael Morrow, HI	07:30-08:45	*None Seen*	+6.3; 35% cloudy
	Tom Giguere, HI	07:32-08:45	1 SPO	+5 8; 35% cloudy
05	James Riggs, CA	04:00-09:00	3 PER, 2 ACY, 9 SPO	+6.0
	Robert Lunsford, CA	09:00-12:00	1 CAP, 1 RSA, 1 ACY, 55 SPO	+6.5
06	Michael Morrow, HI	07:30-08:30	3 SPO	+7.0
	Robert Lunsford, CA	09:00-12:00	1 TOP, 1 JPE, 44 SPO	+6.8
07	James Riggs, CA	07:00-11:30	1 PER, 2 JPE, 5 CAP, 21 SPO	+6.0
08	David Holman, CA	05:19-11:05	4 JPE, 1 CAP, 33 SPO	+6.4
	James Riggs, CA	09:50-10:50	4 PER, 1 CAP, 1 JPE, 1 SPO	+6.0
09	John Gallagher, NJ	04:15-06:24	1 ALY, 1 DCP, 1 PER, 6 SPO	+7.3
	David Holman, CA	05:04-11:30	6 JPE, 1 CAP, 2 SDA, 60 SPO	+6.3
10	James Riggs, CA	07:00-11:30	7 CAP, 3 SDA, 4 ACY, 4 JPE, 1 ODR, 21 SPO	+6.5
11	John Gallagher, CA	04:50-07:02	1 DCP, 1 ACY, 1 ODR, 3 PER, 3 SPO	+7.4
	Robert Lunsford, CA	07:45-11:45	3 JPE, 55 SPO	+6.9
	James Riggs, CA	08:00-11:30	5 ODR, 3 CAP, 1 ACY, 4 PER, 3 SDA, 3 JPE, 21 SPO	+6.8
	Michael Morrow, HI	08:15-10:05	2 NDA, 1 CAP, 11 SPO	+6.3
12	John Gallagher, NJ	05:20-07:31	1 DCP, 1 TCA, 1 UPG, 2 PER, 3 SPO	+7.5
	Robert Lunsford, CA	07:30-11:30	56 SPO	+6.8
	Michael Morrow, CA	08:00-09:00	1 CAP, 6 SPO	+6.5
13	John Gallagher, NJ	05:05-07:48	2 ACY, 1 TCA, 1 JPE, 5 PER, 3 SPO	+7.4
	James Riggs, CA	07:00-11:00	1 ACY, 2 ODR, 9 SDA, 2 JPE, 3 PER, 1 TOP, 23 SPO	+6.5
15	George Zay, CA	05:14-12:43	1 TOP, 2 LSA, 3 CAP, 1 SIA, 3 NDA, 2 PER, 35 SPO	+5.8
16	George Zay, CA	05:18-12:43	1 LSA, 2 PAU, 2 CAP, 2 SIA, 1 NDA, 4 PER, 56 SPO	+5.7
17	John Gallagher, NJ	05:10-07:14	1 PAU, 2 PER, 1 SPO	+7.3
21	John Gallagher, NJ	04:35-07:00	1 PER, 2 SPO	+6.1
29	George Zay, CA	03:52-09:01	4 PER, 22 SPO	+5.4
	James Riggs, CA	04:00-07:00	10 ODR, 1 PER, 1 ACY, 3 TOP, 5 SDA, 1 CAP, 4 SPO	+5.8
	David Holman, CA	05:19-07:04	2 SDA, 1 SIA, 13 SPO	+6.3
30	James Riggs, CA	07:00-08:00	1 SDA, 2 ACY, 1 UPG, 3 SPO	+6.0
31	James Riggs, CA	04:30-08:30	10 SDA, 5 ACY, 1 ODR, 1 TOP, 4 BAQ, 10 SPO	+6.8
AUG 01	James Riggs, CA	04:45-09:15	4 ACY, 10 PER, 3 ODR, 3 CAP, 3 BAQ, 11 SDA, 15 SPO	+6.8
02	James Riggs, CA	04:30-09:15	2 TOP, 2 AUM, 6 CAP, 5 BAQ, 6 ACY, 2 ODR, 6 SDA, 22 SPO	+6.9

Table 1 continued on pp. 66-69 with notes on p. 69.

Table 1—Continued.

1994 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+*N* = Limiting Magnitude)
AUG 02	Robert Lunsford, CA	08:00-12:00	7 CAP, 21 SDA, 15 PER, 3 PAU, 4 SIA, 3 NDA, 1 UPG, 35 SPO	+6.5
03	Lucy Deming, TX	02:00-06:00	1 PER, 4 SPO	+6.0
	James Riggs, CA	06:15-11:15	11 ACY, 21 PER, 10 SDA, 1 PAU, 5 CAP, 4 BAQ, 24 SPO	+7.0
	Robert Lunsford, CA	08:00-12:00	18 PER, 16 SDA, 7 SIA, 2 NDA, 11 CAP, 1 PAU, 1 UPG, 30 SPO	+6.6
04	John Gallagher, NJ	04:35-06:13	1 PER, 1 SPO	+5.0
	James Riggs, CA	07:15-12:00	6 BAQ, 13 SDA, 8 UPG, 26 PER, 6 ACY, 5 CAP, 24 SPO	+7.0
	Robert Lunsford, CA	08:00-12:00	16 SDA, 3 CAP, 35 PER, 8 NDA, 5 SIA, 2 PAU, 4 UPG, 35 SPO	+6.9
05	John Gallagher, NJ	04:45-06:22	5 PER, 1 CAP, 3 SPO	+7.0
	James Riggs, CA	07:55-11:55	7 AUM, 13 SDA, 28 PER, 10 ACY, 19 SPO	+6.7
06	John Gallagher, NJ	05:35-07:58	5 PER, 1 BAQ, 1 ERI, 5 SPO	+7.2
	George Gliba, VT	05:58-07:58	27 PER, 7 NDA, 5 SIA, 3 SDA, 3 UPG, 1 CAP, 7 XPR, 1 ACY, 15 SPO	+6.3
	James Riggs, CA	08:00-12:00	12 ACY, 31 PER, 5 AUM, 2 CAP, 17 SDA, 23 SPO	+6.9
07	Vince Giovannone, NY	01:15-04:00	1 SPO	-----
	John Gallagher, NJ	04:55-07:11	12 PER, 1 CAP, 1 PAU, 1 SIA, 1 UPG, 2 SPO	+7.4
	Richard Taibi, MD	05:17-08:23	21 PER, 34 SPO	+6.1
	George Gliba, VT	05:59-06:59	10 PER, 5 NDA, 2 SIA, 1 CAP, 9 SPO	+6.3
	James Riggs, CA	07:00-10:30	8 AUM, 25 PER, 1 CAP, 7 BAQ, 11 ACY, 10 SDA, 11 SPO	+7.0
	Michael Morrow, HI	08:00-11:00	3 UPG, 2 NIA, 2 SIA, 2 PER, 1 CAP, 14 SPO	+5.8; 10% cloudy
	Tom Giguere, HI	08:00-10:00	3 PER, 15 SPO	+6.0; 10% cloudy
	Betty Yee, HI	08:30-10:30	5 NDA, 1 UPG, 10 SPO	+5.0; 10% cloudy
08	Vince Giovannone, NY	02:11-02:52	1 PER, 1 SPO	-----
	George Zay, CA	04:06-12:07	15 PER, 1 KCG, 21 SPO	+5.4
	David Holman, CA	04:33-11:55	50 PER, 7 NDA, 4 CAP, 55 SPO	+6.3
	John Gallagher, NJ	05:15-07:27	9 PER, 1 CAP, 1 BAQ, 2 SPO	+7.3
	Richard Taibi, MD	06:01-08:52	25 PER, 14 SPO	+6.2
	James Riggs, CA	07:30-12:00	38 PER, 11 ACY, 6 CAP, 2 AUM, 14 NDA, 3 UPG, 3 BAQ, 4 SDA, 34 SPO	+7.0
09	James Riggs, CA	04:00-12:00	45 PER, 7 AER, 18 ACY, 6 CAP, 12 AUM, 21 NDA, 3 SDA, 1 BAQ, 1 PAU, 1 UPG, 28 SPO	+7.0
	Vince Giovannone, NY	04:30-05:30	*None Seen*	-----
	David Holman, CA	04:33-11:51	66 PER, 7 NDA, 4 CAP, 59 SPO	+6.5
	Robert Hays, IN	06:50-08:34	24 PER, 1 NDA, 11 SPO	+6.2; 15% cloudy
	Vince Giovannone, NY	07:43-08:20	2 PER	+4.0
	Richard Taibi, MD	05:09-08:09	18 PER, 22 SPO	+6.1
	Robert Lunsford, CA	06:00-12:00	1 KCG, 5 ACY, 64 PER, 2 CAP, 4 UPG, 66 SPO	+6.7
10	James Riggs, CA	04:00-11:15	12 PER, 5 AUM, 9 NDA, 2 BAQ, 3 CAP, 5 ACY, 1 KCG, 7 SPO	+6.2
	Daniel Simmons, FL	04:10-05:15	5 PER, 9 SPO	+6.0
	Brian Simmons, FL	04:10-05:24	9 PER, 10 SPO	+6.0
	Wendy Simmons, FL	04:15-05:16	3 PER, 3 SPO	+6.0
	Wanda Simmons, FL	04:20-05:25	5 PER, 3 SPO	+6.0
	David Holman, CA	04:20-11:55	97 PER, 8 NDA, 14 CAP, 119 SPO	+6.4
	Stephen Simmons, FL	04:22-05:20	1 PER, 5 SPO	+6.0
	Karl Simmons, FL	04:24-05:22	4 PER, 5 SPO	+6.0
	Ron Rosenwald, TX	07:45-09:20	12 PER, 11 SPO	+5.0
	Vince Giovannone, NY	07:54-08:32	4 PER, 1 SPO	+5.0

Table 1 continued on pp. 67-69 with notes on p. 69.

Table 1—Continued.

1994 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+N = Limiting Magnitude)
AUG 11	George Zay, CA	03:30-13:06	90 PER, 66 SPO	+5.6
	James Riggs, CA	04:00-10:30	43 PER, 5 AUM, 15 ACY, 8 NDA, 8 CAP, 9 SPO	+6.2
	John Gallagher, NJ	04:35-08:25	22 PER, 1 AER, 1 NDA, 7 SPO	+7.4
	David Holman, NV	04:50-05:58	7 PER, 1 NDA, 19 SPO	+6.1; 20% cloudy
	Nathan Kirkwood, FL	05:25-05:40	3 PER	+6.0; 70% cloudy
	Richard Kirkwood, FL	05:25-05:40	2 PER	+6.0; 70% cloudy
	Becky Kirkwood, FL	05:25-05:40	5 PER	+6.0; 70% cloudy
	Jeffery Sandel, SC	06:00-09:30	64 PER, 16 SPO	+5.2; 5% cloudy
	Robert Lunsford, CA	06:00-12:00	1 ACY, 1 NDA, 2 CAP, 1 SDA, 78 PER, 3 UPG, 49 SPO	+6.4
	Tom Giguere, HI	06:30-09:30	3 PER, 1 NIA, 6 SPO	+4.3; 15% cloudy
	Michael Morrow, HI	06:30-09:30	1 PER, 1 NDA, 8 SPO	+4.5; 15% cloudy
	Vince Giovannone, NY	07:15-08:15	1 PER	-----; 50% cloudy
	Ron Rosenwald, TX	07:45-08:35	5 PER, 1 SPO	+4.5
	David Holman, NV	10:04-11:45	43 PER, 32 SPO	+6.5; 10% cloudy
12	Bob McAlister, TX	02:00-05:00	12 PER	-----
	Sara Eyler, FL	02:00-05:00	19 PER, 1 SPO	+5 9
	Mike Rossi, FL	02:00-05:00	18 PER, 2 SPO	+5 9
	Lindsay Gray, FL	02:00-06:06	41 PER, 7 SPO	+5 9
	Thayne Saunders, FL	02:00-07:06	47 PER, 5 SPO	+5 9
	Bill Eyler, FL	02:00-07:06	52 PER, 17 SPO	+5 9
	Dona Crelia, FL	02:00-09:06	91 PER, 1 SDA, 8 SPO	+5 9
	Roger Curry, FL	02:00-09:06	96 PER, 12 SPO	+5 9
	Stephen Meeks, FL	02:00-09:06	223 PER, 9 SDA, 5 UPG, 31 SPO	+5 9
	Lori Wilimon, FL	02:00-09:06	167 PER, 1 SDA, 45 SPO	+5.9
	Mike Rossett, FL	02:00-09:06	45 PER, 5 SPO	+5.9
	Allan Kimble, FL	02:00-09:06	220 PER, 2 SDA, 36 SPO	+5.9
	David Crum, FL	02:00-09:06	114 PER, 5 SDA, 1 UPG, 18 SPO	+5.9
	Gregory Zents, FL	02:00-09:06	213 PER, 3 SDA, 2 UPG, 36 SPO	+5.9
	Glen Williams, FL	02:00-09:06	133 PER, 2 SDA, 14 SPO	+5.9
	Harold Carney, FL	02:00-09:06	82 PER, 3 SDA, 13 SPO	+5.9
	Kathy Machin, CO	02:45-08:15	76 PER, 13 SPO	+5.5; 5% cloudy
	Carroll Iorg, CO	02:45-08:15	77 PER, 13 SPO	+5.5; 10% cloudy
	Randy Thompson, CO	02:45-07:50	98 PER, 10 SPO	+5.4; 10% cloudy
	John Walker, OK	03:00-05:30	18 PER, 3 SPO	-----
	George Zay, CA	03:00-12:00	43 PER, 5 SPO	+5.5; 90% cloudy
	Richard Kirkwood, FL	03:20-05:05	18 PER, 3 SPO	+6.5
	Vic Winter, CO	03:28-10:34	227 PER, 18 SPO	+6.3; 15% cloudy
	David Kirkwood, FL	03:30-07:00	77 PER, 32 SPO	+6.5
	Jeffery Sandel, SC	03:30-09:30	250 PER, 23 SPO	+5.4
	Brian Simmons, FL	03:40-07:00	79 PER, 44 SPO	+6.5
	Stephen Simmons, FL	03:40-07:00	70 PER, 18 SPO	+6.5
	Daniel Simmons, FL	03:40-04:30	2 PER, 4 SPO	+6.5
	Nathan Kirkwood, FL	03:40-07:00	46 PER, 21 SPO	+6.5
	William Smith, TX	03:45-09:45	66 PER, 5 SPO	-----
	Becky Kirkwood, FL	03:48-05:38	14 PER, 6 SPO	+6.5
	Wendy Simmons, FL	03:48-05:01	9 PER, 8 SPO	+6.5
	Dennis Hands, NC	04:00-05:00	3 PER, 5 SPO	-----
	Deborah Carroll, NC	04:00-05:00	3 PER, 3 SPO	-----
	Barbara Hands, NC	04:00-05:00	3 PER, 5 SPO	-----
	Rex Carroll, NC	04:00-05:00	8 PER, 5 SPO	-----
	Robert Lunsford, CA	04:00-12:00	68 PER, 19 SPO	+6.1; 90% cloudy
	Wanda Simmons, FL	04:05-06:05	24 PER, 8 SPO	+6.5
	Karl Simmons, FL	04:05-06:35	38 PER, 11 SPO	+6.5
	James Riggs, CA	04:15-12:00	150 PER, 1 AUM, 8 ACY, 4 CAP, 4 NDA, 16 SPO	+7.0
	David Holman, CA	04:26-11:55	379 PER, 8 NDA, 113 SPO	+6.1
	Rett Alonzi, KS	04:53-10:10	89 PER, 10 SPO	+4.6; 15% cloudy
	Doug Eakins, CA	06:00-07:00	18 PER, 4 SPO	+5.5
	Debby Eakins, CA	06:00-07:00	15 PER, 8 SPO	+5.5
	J.F. Viens, QUEBEC	06:00-07:40	55 PER, 4 NDA, 3 KCG, 1 NIA	+6.0
	J.K. Eakins, CA	06:00-08:00	30 PER, 9 SPO	+5.5
	Doug Smith, TN	06:00-10:00	44 PER, 3 SPO	+4.0; 20% cloudy

Table 1 continued on pp. 68-69 with notes on p. 69.

Table 1—Continued.

1994 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+N = Limiting Magnitude)
AUG 12	James Salmond, HI	07:00-13:00	33 PER, 9 SPO	+5.0; 30% cloudy
	Michael Morrow, HI	07:00-13:00	27 PER, 1 UPG, 1 NDA, 15 SPO	+5.0; 30% cloudy
	Richard Taibi, MD	07:08-09:08	25 PER, 10 SPO	+4.3; 25% cloudy
	Tom Giguere, HI	07:15-13:00	44 PER, 7 SPO	+4.8; 10% cloudy
	Mark Davis, SC	07:20-09:20	110 PER, 22 SPO	+5.2
	Ron Rosenwald, TX	07:45-10:30	53 PER, 13 SPO	+4.0; 5% cloudy
	Bob McAlister, TX	08:00-10:00	10 PER	-----
	J.K. Eakins, CA	08:30-11:30	159 PER, 7 SPO	+5.6
	Phyllis Eide, CA	08:45-09:15	6 SPO	+5.0; 65% cloudy
13	Lucy Deming, TX	01:00-04:00	5 PER	+4.9
	W. Robinson, KS	02:00-03:30	11 PER, 5 SPO	+5.5
	Bob McAlister, TX	02:00-05:30	19 PER	-----
	John Walker, OK	03:00-07:00	25 PER, 5 SPO	-----
	David Holman, CA	04:29-11:55	362 PER, 4 NDA, 2 CAP, 193 SPO	+6.1
	George Gliba, WV	04:51-05:51	18 PER, 1 KCG, 1 NIA, 1 SDA, 4 SPO	+5.5; 20% cloudy
	Richard Taibi, MD	05:44-07:00	15 PER, 3 SPO	+5.3
	William Smith, TX	06:00-09:00	15 PER	-----
	George Gliba, WV	06:35-07:35	21 PER, 4 SPO	+4.5; 35% cloudy
	John Gallagher, NJ	07:15-09:15	14 PER, 2 SPO	+5.7; 40% cloudy
	Ron Rosenwald, TX	07:40-09:30	33 PER, 9 SPO	+5.0
	Phyllis Eide, HI	09:20-11:00	18 PER, 12 SPO	+5.8; 5% cloudy
	Bob McAlister, TX	09:30-10:30	1 PER, 2 SPO	-----
14	George Zay, CA	04:07-12:09	104 PER, 53 SPO	+5.6
	John Gallagher, NJ	05:40-09:05	28 PER, 1 NIA, 1 SPO	+6.5
	Robert Hays, IL	06:00-08:00	49 PER, 3 KCG, 1 NDA, 19 SPO	+6.5
	Richard Taibi, MD	06:50-09:00	32 PER, 17 SPO	+6.0
	James Riggs, CA	09:30-12:00	36 PER, 3 NDA, 3 AER, 1 UPG, 5 ACY, 2 ERI, 3 SPO	+6.5
15	George Zay, CA	03:50-12:08	43 PER, 52 SPO	+5.7
	Vince Giovannone, NY	04:00-05:00	1 PER	+5.0
	Robert Hays, IL	06:00-08:00	21 PER, 7 KCG, 1 NDA, 16 SPO	+6.5
	James Riggs, CA	09:15-10:45	5 PER, 3 ACY, 4 NDA, 1 ERI, 9 SPO	+6.5
16	John Gallagher, NJ	05:25-08:47	10 PER, 1 SIA, 1 UPG, 1 NIA, 1 KCG, 11 SPO	+7.5
24	John Gallagher, NJ	04:50-06:55	1 UPG, 1 NIA, 1 KCG, 2 SPO	+6.4
25	John Gallagher, NJ	04:15-06:22	2 SPO	+6.2
28	John Gallagher, NJ	04:35-06:38	1 KCG, 2 SPO	+7.1
29	James Riggs, CA	04:51-05:51	5 SPO	+5.5
30	John Gallagher, CA	04:40-06:49	1 PER, 1 UPG, 1 AER, 1 NDA, 3 SPO	+7.5
	Robert Lunsford, CA	09:00-12:30	2 AUR, 35 SPO	+6.4
31	Robert Lunsford, CA	09:00-12:30	2 AUR, 24 SPO	+6.5
SEP 01	George Zay, CA	03:12-12:24	20 AUR, 8 NIA, 5 KCG, 4 ERI, 4 SPI, 44 SPO	+5.2
	James Riggs, CA	05:00-06:00	1 ACY, 4 SPO	+5.0
	Robert Lunsford, CA	06:30-12:30	17 AUR, 62 SPO	+6.7
02	George Zay, CA	03:10-12:21	7 AUR, 5 SPI, 2 ERI, 2 NIA, 1 KCG, 49 SPO	+5.3
	John Gallagher, NJ	04:10-06:21	1 AUR, 1 DAS, 1 SEC, 9 SPO	+7.4; 30% cloudy
	James Riggs, CA	04:30-09:00	6 GAQ, 3 EDR, 2 ERI, 3 CAP, 1 SEC, 40 SPO	+6.3
03	George Zay, CA	03:10-12:23	5 AUR, 5 ERI, 3 NIA, 1 SPI, 1 KCG, 57 SPO	+5.4
	John Gallagher, NJ	05:10-07:19	1 TRI, 1 GAQ, 6SPO	+7.3
04	John Gallagher, NJ	04:25-05:41	3 SPO	+7.4; 25% cloudy
	James Riggs, CA	06:00-11:00	10 EDR, 6 NIA, 2 PER, 2 ERI, 6 AUR, 2 GAQ, 2 NEC, 39 SPO	+6.4
05	John Gallagher, NJ	04:45-06:54	1 AUR, 1 GPI, 1 ERI, 8 SPO	+7.1

Table 1 continued on p. 69 with notes.

Table 1—Continued.

1994 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+N = Limiting Magnitude)
SEP 06	James Riggs, CA	04:15-10:00	16 EDR, 7 AUR, 5 KCG, 10 GAQ, 1 DAS, 3 NEC, 5 EER, 68 SPO	+6.9
	John Gallagher, NJ	05:05-08:19	2 AUR, 1 NIA, 11 SPO	+7.5
	Robert Lunsford, CA	10:00-12:30	1 GAQ, 5 SPO	+5.8
07	John Gallagher, NJ	05:00-06:05	2 TRI, 2 SPO	+6.9
	James Riggs, CA	07:30-12:00	8 AUR, 13 GAQ, 4 EER, 3 EDR, 4 NEC, 99 SPO	+7.0
	Robert Lunsford, CA	08:00-12:00	1 SEC, 1 EER, 18 SPO	+6.1
08	John Gallagher, NJ	05:00-07:41	1 AUR, 3 DAS, 1 SEC, 1 SAR, 1 SPO	+7.4
	James Riggs, CA	07:00-12:00	20 GAQ, 5 EDR, 4 CAP, 3 EER, 16 TRI, 10 DAS, 5 NEC, 3 STA, 55 SPO	+6.5
	Robert Lunsford, CA	09:45-12:30	1 SEC, 3 SPI, 3 EER, 1 NIA, 2 SAR, 30 SPO	+6.6
09	John Gallagher, NJ	04:40-06:50	1 AUR, 1 DAS, 1 TRI, 1 SAR, 1 NEC, 1 SPO	+7.1
10	John Gallagher, NJ	05:20-07:26	4 TRI, 1 SAR, 1 SPI	+6.7
11	John Gallagher, NJ	04:25-07:36	1 DAS, 2 NIA, 4 TRI, 2 SAR, 4 SPO	+7.4
	George Gliba, WV	08:07-09:07	4 TRI, 1 SPI, 6 SPO	+6.0; 20% cloudy
12	George Gliba, WV	04:17-08:17	18 TRI, 6 SPI, 10 DAS, 3 GAQ, 47 SPO	+6.4
	John Gallagher, NJ	04:20-07:30	5 TRI, 1 GPI, 1 KAQ, 7 SPO	+7.1
	Robert Lunsford, CA	07:00-12:30	5 SOR, 2 SPI, 3 SAR, 6 TRI, 76 SPO	+6.7
	James Riggs, CA	10:20-11:20	3 STA, 2 ZPR, 2 SPO	+7.0
13	John Gallagher, NJ	05:10-07:22	2 AUR, 2 TRI, 2 SAR, 1 NEC, 1 SPI, 4 SPO	+7.0
	George Zay, CA	06:00-07:22	1 NIA, 1 SPI, 1 SOR, 2 SPO	+5.5
	Robert Lunsford, CA	09:30-10:30	2 SAR, 3 TRI, 4 SPO	+6.7
14	George Zay, CA	03:00-12:31	4 DAS, 3 NIA, 3 NTA, 2 SOR, 1 SPI, 42 SPO	+5.5
	Robert Lunsford, CA	08:00-12:30	1 SPI, 1 DAS, 7 SAR, 5 TRI, 50 SPO	+6.7
15	George Zay, CA	06:43-12:31	6 DAS, 3 SOR, 2 NTA, 1 SPI, 22 SPO	+5.6
19	John Gallagher, NJ	05:45-06:47	1 DAS	+6.3; 10% cloudy
26	George Zay, CA	02:38-06:51	1 SPI, 6 SPO	+5.5
28	John Gallagher, NJ	05:05-07:11	1 GPI, 1 OAR, 1 EGE, 1 SPO	+6.6
	Robert Lunsford, CA	09:00-11:00	2 SPI, 1 DAO, 6 SPO	+6.1; 25% cloudy
30	John Gallagher, NJ	05:20-07:37	1 DAS, 1 SPI, 1 KAQ, 1 NPI, 2 EGE, 1 AND, 3 SPO	+7.4

* Key to Abbreviations

ACA	May Capricornids	GAQ	Gamma Aquarids	RSA	Rho Sagittarids
ACY	Alpha Cygnids	GPI	Gamma Piscids	SAR	September Arietids
AER	August Eridanids	JPE	July Pegasids	SDA	South Delta Aquarids
ALY	Alpha Lyrids	KAQ	Kappa Aquarids	SEC	South Eta Cetids
AND	Annual Andromedids	KCG	Kappa Cygnids	SIA	South Iota Aquarids
AUM	August Ursa Majorids	LSA	Lambda Sagittarids	SOR	Sigma Orionids
AUR	Aurigids	NDA	North Delta Aquarids	SPI	Southern Piscids
BAQ	Beta Aquarids	NEC	North Eta Cetids	SPO	Sporadic
CAP	Alpha Capricornids	NIA	North Iota Aquarids	STA	Southern Taurids
DAO	October Delta Aurigids	NOP	Northern Ophiuchids	TCA	Tau Cetids
DAS	September Delta Aurigids	NPI	Northern Piscids	THE	Tau Herculids
DCP	Delta Cepheids	NTA	Northern Taurids	TOP	Theta Ophiuchids
EDR	Eta Draconids	OAR	October Arietids	TRI	Triangulids
EER	Epsilon Eridanids	ODR	Omicron Draconids	UPG	Upsilon Pegasids
EGE	Epsilon Geminids	PAU	Pisces Austrinids	XPR	Chi Perseids
ERI	Pi Eridanids	PER	Perseids	ZPR	Zeta Perseids

THE 1994 ALPHA AURIGID OUTBURST

By: Robert D. Lunsford, A.L.P.O. Meteors Recorder and George Zay, International Meteor Organization

ABSTRACT

On the night of August 31/September 1, 1994, two experienced observers in California witnessed an outburst of meteors from the Alpha Aurigid radiant.

On the night of August 29/30, 1994, PDT, a meteor observing session was initiated by Robert Lunsford to cover pre-maximum and maximum dates of the Alpha Aurigid meteor shower. The first two sessions began at 2 AM PDT and ended at 5:30 AM PDT. The sky was completely clear on both pre-maximum mornings. A last-quarter Moon was present, but Lunsford faced due north so as not to stare directly toward the bright moonlight. The sky was very transparent both mornings, providing average limiting magnitudes of +6.42 and +6.38, respectively, in the northern sky. Two Alpha Aurigids were seen on each morning during the 3-1/2 hour watches. This was normal activity for these pre-maximum dates. *Table 1* (below) summarizes Lunsford's pre-maximum observations. Notice that time was lost during each hour while Lunsford was plotting the meteors he had seen. This time loss is an important factor when calculating the zenithal hourly rate [i.e., the rate a hypothetical observer would report under dark-sky conditions and uninterrupted observing with the meteor radiant in the zenith].

Table 1. 1994 AUG 30/31 UT, Meteor Counts by R. Lunsford.

Date AUG	UT	Effective Duration	Meteor Counts Aurigids	Meteor Counts Sporadic	Limiting Magnitude
30	09:00-10:00	0.92 hr	0	13	+6.74
30	10:00-11:00	0.90	1	12	+6.70
30	11:00-12:00	0.94	0	9	+6.46
30	12:00-12:30	0.49	1	1	+5.76
31	09:00-10:00	0.96	0	6	+6.77
31	10:00-11:00	0.94	1	8	+6.56
31	11:00-12:00	0.93	1	10	+6.40
31	12:00-12:30	0.50	0	0	+5.81

For the night of maximum activity Lunsford joined George Zay at the latter's observatory site near Descanso, California. This was only a few hundred feet from where Lunsford observed the first two mornings. Zay arrived first and commenced observations at 8:12 PM PDT. Lunsford arrived some 3 hours later and began observing at 11:30 PM PDT. The Moon was absent when both observers started meteor counting. Once again the sky was perfectly clear and transparent. Zay was facing due north while Lunsford faced northeast, toward the rising radiant. During the first hour they were together the radiant was actually hidden by a low hill toward the northeast. Activity was low, as one would expect with the radiant so low in the sky. At 12:22 AM PDT Zay spotted the first Alpha Aurigid of the night. It was an average meteor of third magnitude, moving fairly slowly across the sky despite a geocentric velocity of 66 km/sec; this is very fast when compared to most other showers. Five minutes later they both witnessed a beautiful first-magnitude Alpha Aurigid darting upwards from the radiant and crossing nearly half the sky before extinguishing itself. It had an impressive blue hue to Lunsford and appeared greenish to Zay. A train of two seconds duration was also seen. At 12:36 another bright Aurigid identical to the one seen at 12:27 was seen by both observers. They both remarked how these meteors appeared similar to the Perseids seen just after sunset on August 12, 1993. They were long, bright, and colorful. Zay spotted another bright Aurigid at 12:40 in the western sky, out of Lunsford's field of view. Two minutes later a zero-magnitude Aurigid was seen by both observers in Perseus, leaving a train that lasted 3 seconds. At 12:44 both observers witnessed a first-magnitude Aurigid tracing a path over one-half the sky and leaving another persistent train. Seven minutes passed before another Aurigid appeared. The next interval was five minutes.

The peak rates occurred just after 1:00 AM PDT. Zay witnessed an Aurigid occurring at 1:02, two at 1:03, and others at 1:09 and 1:11. Lunsford observed Aurigids at 1:03, 1:09, 1:11, 1:13, and 1:17. Zay mis- sed one shower member that skimmed the eastern horizon and another while plotting a previous meteor. Lunsford was also plotting previous meteors and missed the event that occurred at 1:02 and one at 1:03. During the one-hour period 12:22-1:22 Zay recorded 13 Aurigids and Lunsford 11. The remainder of the morning (4 hours) produced only 7 Aurigids for Zay and 6 for Lunsford. *Table 2* (p. 71) illustrates activity for the night of maximum activity: August 31/September 1, 1994, PDT.

Finally, Zay was able to observe on the two nights following maximum activity. His results are summarized in *Table 3* (p. 71). *Table 4* (p. 71) summarizes the magnitude distributions of the meteors the two observers recorded.

Conclusions

An outburst of bright Alpha Aurigid meteors occurred between 7:22 and 8:22 UT on 1994 Sep 01. As seen from Descanso, California, the radiant was only 13° above the northeastern horizon at the midpoint of this display. George Zay counted 13 and Robert Lunsford counted 11 shower members in this period. Considering Zay's limiting magnitude of +5.70, the corresponding zenithal hourly rate would equal 55. Lunsford's limiting magnitude for the same period was +6.87, and his corresponding zenithal hourly rate would equal 37. A great majority of the shower members seen during this period were of the first magnitude or brighter and possessed persistent trains lasting several seconds. Zay commented that a majority of the shower members were green, while Lunsford saw them as blue.

A possible repetition of this event could occur near 14:00 UT, 1995 Sep 01. This circumstance would favor Hawaii and the Eastern Pacific area. All interested meteor observers are encouraged to participate in the 1995 Alpha Aurigid meteor watch, no matter where they are situated. Send your results to the Meteors Recorder (address on inside back cover) as soon as possible after the event.

Table 2. Meteor Activity, 1994 Sep 01 UT.

UT	Observer	Eff. Duration	Limiting Mag.	Meteor Count Aurigid	Meteor Count Sporadic	Magnitude Aur.	Magnitude Spor.
		hr	+			+	+
03:12-04:18	Zay	1.01	5.56	0	7	----	2.57
04:19-05:19	Zay	0.93	5.70	0	6	----	2.50
05:20-06:20	Zay	0.90	5.70	0	8	----	2.25
06:21-07:21	Zay	0.92	5.70	0	7	----	2.43
06:21-07:21	Lunsford	0.78	6.85	0	12	----	2.08
07:22-08:22	Zay	0.90	5.70	13	7	1.00	2.71
07:22-08:22	Lunsford	0.91	6.87	11	9	1.27	3.00
08:23-09:23	Zay	0.91	5.70	2	10	3.50	1.90
08:23-09:23	Lunsford	0.95	6.86	3	8	2.33	2.00
09:24-10:24	Zay	0.96	5.70	0	10	----	2.50
09:24-10:24	Lunsford	0.95	6.80	0	13	----	2.54
10:25-11:25	Zay	0.93	5.56	3	4	3.66	2.66
10:25-11:25	Lunsford	0.92	6.58	2	7	1.50	2.69
11:26-12:26	Zay	0.91	5.34	2	4	2.00	2.00
11:26-12:26	Lunsford	0.95	6.04	2	7	1.50	2.71
Total or *Mean**		13.83	*6.04*	38	119	*1.63*	*2.42*

* Weighted by number of meteors observed.

Table 3. Meteor Counts by Zay, 1994 Sep 02-03 UT.

1994 Sep	UT	Effective Duration	Meteor Counts Aurigids	Meteor Counts Sporadic	Limiting Magnitude
		hr			+
02	03:10-05:16	2.00	0	6	5.59
02	05:17-07:31	2.01	2	17	5.70
02	07:32-09:45	2.00	1	21	5.87
02	09:46-11:55	2.00	4	11	5.68
03	03:10-05:17	2.00	0	8	5.59
03	05:18-07:30	2.02	0	14	5.77
03	07:31-09:50	2.01	0	22	5.90
03	09:51-12:07	1.98	4	20	5.79

Table 4. Magnitude Distribution of Aurigid and Sporadic Meteors, 1994 Aug 30 - Sep 03 UT.

Date	Observer	Shower	Number of Meteors	-3	-2	-1	0	+1	+2	+3	+4	+5	Mean
				Visual Magnitude Category									
Aug 30	Lunsford	Aurigid	2	-	-	-	-	1	-	1	-	-	2.00
	Lunsford	Sporadic	35	1	-	-	3	7	10	7	4	3	2.17
Aug 31	Lunsford	Aurigid	2	-	-	-	1	1	-	-	-	-	0.50
	Lunsford	Sporadic	24	-	-	-	1	4	8	5	6	-	2.46
Sep 01	Lunsford	Aurigid	18	-	1	-	1	8	6	2	-	-	1.33
	Lunsford	Sporadic	62	1	1	-	3	3	18	24	10	2	2.52
	Zay	Aurigid	20	-	1	-	1	9	3	3	2	1	1.75
	Zay	Sporadic	65	1	-	2	6	5	16	21	8	6	2.42
Sep 02	Zay	Aurigid	7	-	-	-	-	1	4	-	2	-	2.43
	Zay	Sporadic	57	-	-	-	3	9	17	11	13	4	2.60
Sep 03	Zay	Aurigid	5	-	-	-	-	2	-	1	1	1	2.80
	Zay	Sporadic	66	-	1	-	2	10	23	18	9	3	2.41
	Total:	Aurigid	54	0	2	0	3	22	13	7	5	2	1.76
		Sporadic	309	3	2	2	18	38	92	86	50	18	2.44
		All	363	3	4	2	21	60	105	93	55	20	2.34

COMET CORNER

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

THE NEW METHOD OF NAMING COMETS

Beginning this year, the Smithsonian Astrophysical Observatory's Central Bureau for Astronomical Telegrams made some changes in the way that comets are named. The preliminary designation now consists of the year of discovery followed by an uppercase letter for the half-month of the year, and ending with a numeral for the order of discovery in that half-month. All this is preceded by a "C/" for a non-periodic comet and a "P/" for a periodic comet (one that orbits the Sun in under 200 years). For example, if the first comet of 1995 is found on JAN 10, and it is non-periodic, it is known as C/1995 A1. If one is found on FEB 10, it is C/1995 C1. If the next comet, a new periodic one, is found the next day, it is known as P/1995 C2. Recoveries of returning comets will not receive further designations.

As for the "proper" name of comets, there will be a few minor changes. Comet Smith will still be Comet Smith. However, observatory teams are asked to limit the number of names on a new comet to one. In the past, such a comet could contain the names of (1) the person who finds it on the plate, (2) the person who exposed the plate, and(3) the person guiding or operating the telescope during the exposure. Also, attempts will be made to limit the number of names on any comet to two. Finally, it may take several days before any such naming becomes official.

Older and established periodic comets will be preceded by a number. Here are some of the more popular comets:

1P/Halley: Probably the most famous comet of all; 76-year period, 30 appearances.

2P/Encke: Shortest orbital period, 3.3 years; 56 appearances.

6P/d'Arrest: 6.4 years, due back this summer.

8P/Tuttle: 13.5 years, responsible for the Ursid meteor shower on DEC 22.

9P/Tempel 1: 5.50 years.

10P/Tempel 2: 5.48 years.

19P/Borrelly: Visible in our skies now.

26P/Grigg-Skjellerup: 5.10 years.

29P/Schwassmann-Wachmann 1: Occasionally has outbursts of several magnitudes.

45P/Honda-Mrkos-Pajdusakova: Visits us every 5.30 years.

55P/Tempel-Tuttle: 33 years; responsible for the Leonid meteor shower.

95P/Chiron: A very large distant comet, once thought to be an asteroid.

96P/Machholz 1: 5.24 years; shortest periodic comet perihelion distance 0.126 AU.

107P/Wilson-Harrington: 4.3 years. Occasionally observed as an asteroid.

109P/Swift-Tuttle: Responsible for the Perseid meteor shower.

NEW COMETARY CATALOG

The tenth edition of the *Catalogue of Cometary Orbits (1995)* is now available from the Smithsonian Astrophysical Observatory, 60 Garden St., Cambridge, Massachusetts 02138. This is a 108-page summary of all comets for which orbits have been computed. The orbital elements are given for each comet, along with the new and old comet designations. The price is $20.00, or $30.00 for airmail delivery outside North America.

From this catalog we learn that 878 comets have been observed accurately enough for their orbits to be calculated. A growing percentage of them are periodic; that is, they orbit the Sun in under 200 years. Presently, 21 percent (184 comets) are periodic; some have visited us many times. Therefore, the total number of cometary apparitions is 1444.

COMETS DISCOVERED OR RECOVERED DURING THE SECOND HALF OF 1994

The year 1994 will be best remembered for the collision of Periodic Comet Shoemaker-Levy 9 with Jupiter, and the effects that event had on the planet. Otherwise, the year saw twelve returning comets recovered, five new comets found by professional astronomers, and six new comets found by amateurs. Of those six amateur finds, two were solely photographic finds (Kushida and Takamizawa) and one was found both photographically and visually (Takamizawa-Levy). The remaining three were found solely visually.

Periodic Comet Borrelly (1994L).–Two teams, one in New Zealand and one in Australia, recovered this comet in mid-June at magnitude +17. It has a period of 6.9 years, and reached magnitude +7 by the end of 1994.

Comet Nakamura-Nishimura-Machholz (1994m).–This comet was discovered on JUL 05 by M. Nakamura and H. Nishimura of Japan and by myself on JUL 06. They used 25×150 binoculars, while I used my homemade 27×120 binoculars from my comet-hunting observatory in Colfax, California. For me, this find took 575 hours and 337 sessions since my last previous find fully two years before. Then at magnitude +10 in the polar morning sky, the comet slipped slowly southward and brightened to magnitude +7.5 by September. It has an orbit that is essentially parabolic and will never return.

Periodic Comet McNaught-Hartley (1994n).–Robert McNaught of Siding Spring, Australia found this comet on plates exposed by Malcolm Hartley on JUL 05. Then at magnitude +16, the comet did not brighten much as its 18.0-year orbit kept it at least 2.6 AU from the Sun. [1 AU is the mean distance of the Earth from the Sun: 149,597,870 km.]

Periodic Comet Machholz 2 (1994o).–I discovered this comet on the morning of AUG 13 from Colfax. I was using my 10-in (25-cm) reflector at 36X when I found this +10-magnitude fast-moving object near the open cluster NGC 1502. This find came 46 search hours and 21 sessions after my previous find five weeks earlier.

This comet is now dimming in our morning sky. A refined orbit indicates that it orbits the Sun every 5.23 years. Since this is my second periodic comet, it bears the suffix "2", while my 1986 periodic comet (5.24-year orbit) gains the suffix "1". This comet surprised us several times. In late August it had an outburst, increasing its brightness by two full magnitudes. Then, in early September, several small comets were found nearby; they are companions of the main body and acquired the designations *B*, *C*, *D*, and *E*. One theory suggests that the main body broke once about 10 years (two orbits) ago, while during the last orbit both the fragment and the main comet broke again. Next came reports that it may someday hit the earth. These reports were carried in the media (including Paul Harvey) for a few days, but now appear to be false. Finally, in early October component *D* brightened while *A* dimmed, producing a "double comet" effect for about two weeks.

Periodic Comet Reinmuth 1 (1994p).–A. Nakamura of Japan and Jim Scotti of Kitt Peak recovered this comet in early September at magnitude +20. It orbits the Sun every 7.3 years; this time around it was not well-placed and will remain faint.

Periodic Comet Longmore (1994q).–Jim Scotti of Kitt Peak recovered this comet on SEP 27 at magnitude +21. Perihelion will occur in October 1995, but the comet will then be behind the Sun and will remain faint.

Comet Machholz (1994r).–I visually discovered this, my ninth comet, on the morning of October 8 local time with my 10-in f/3.8 reflector at 36X. This find came 55.25 search hours and 34 comet hunting sessions after my previous find eight weeks earlier. Since I began comet hunting on January 1, 1975, I've accumulated 5589 hours so my average number of hours per comet discovery is now 621. This compares to an average of 423 hours per find for the 60 visual comet discoveries by all observers during the years 1975-1990. Although 35 percent of my time is spent sweeping the evening sky, all of my finds have been in the morning sky.

Periodic Comet Kopff (1994s).–S. Larson used the 1.5-m reflector at Catalina Station and a CCD to record images of this comet on NOV 30. The object was stellar and faint at magnitude +22.8. It orbits the Sun in 6.45 years and will again be closest to the Sun (1.57 AU) in early 1996.

Periodic Comet Clark (1994t).–This comet was recovered on DEC 05 by A. Nakamura of Japan. He used a 0.6-m telescope with a CCD. Then at magnitude +17.5, the comet, which takes 5.5 years to orbit the Sun, will brighten to perhaps magnitude +12 by mid-1995.

Periodic Comet McNaught-Russell (1994u).– Robert McNaught of Siding Spring, Australia found this image on plates exposed by Kenneth Russell. It was magnitude +17 when found on DEC 12. We now know that it orbits the Sun every 15.3 years, and was last closest to the Sun on SEP 06 at 1.28 AU.

Periodic Comet Wild 4 (1994v).–Jim Scotti recovered this comet from Kitt Peak on NOV 09, with follow-up confirmation a month later. At that time the comet appeared stellar and at magnitude +21; it was over 4.0 AU from the Earth. When it reaches perihelion in early 1996 (!) it will be 2.0 AU from the Sun and visible in moderate-sized telescopes. It orbits the Sun in 6.2 years.

Periodic Comet Schwassmann-Wachmann 3 (1994w).–Recovered on DEC 28, this comet has a rather short orbital period of 5.34 years. It will be closest to the Sun on 1995 SEP 22, but on the far side of the Sun and difficult to observe.

COMETS PRESENTLY VISIBLE

During the summer of 1995 we can expect to see only a few returning comets. They are as follows.

Periodic Comet Schwassmann-Wachmann 1 1989 XV (29P/Schwassmann-Wachmann 1).–In a nearly circular orbit, the comet occasionally undergoes outbursts which brighten it to the magnitude +12-13 range. Amateurs are asked to monitor it for outbursts and to report both positive and negative observations to the Comets Recorder (address on inside back cover). (See *Table 1*, p. 74.)

Periodic Comet d'Arrest (6P/d'Arrest).– This apparition is very favorable, with the comet reaching magnitude +7 by the middle of summer, 1995. Perihelion is in late July while opposition occurs in late August. After that the comet travels south as it dims in our evening sky. (See *Table 2*, p. 74.)

Periodic Comet Jackson-Neujmin (58P/Jackson-Neujmin).–This comet is also making a favorable return, reaching magnitude +11 in the southern sky in September. (See *Table 3*, p. 74.)

EPHEMERIDES

Notes: In the "Elongation from Sun" column, **E** refers to visibility in the evening sky, and **M** to morning visibility. "Total Mag." values are forecasts of visual total magnitudes and are subject to considerable uncertainty. Orbital elements follow our ephemerides (*Table 4*, p. 74) for those who wish to compute their own ephemerides.

Table 1. Ephemeris of Periodic Comet Schwassmann-Wachmann 1 1989 XV (29P/Schwassmann-Wachmann 1).

1995 UT Date	2000.0 Coörd. R.A.	Decl.	Elongation from Sun	Total Mag.
(0h UT)	h m	° '	°	
Apr 03	08 47.9	+16 54	117 E	+17.7
08	08 47.7	+16 52	112 E	+17.8
13	08 47.8	+16 49	107 E	+17.8
18	08 48.2	+16 45	102 E	+17.8
23	08 48.8	+16 40	098 E	+17.8
28	08 49.6	+16 35	093 E	+17.9
May 03	08 50.8	+16 28	088 E	+17.9
08	08 52.1	+16 20	084 E	+17.9
13	08 53.7	+16 12	080 E	+18.0
18	08 55.5	+16 02	075 E	+18.0
23	08 57.5	+15 52	071 E	+18.0
28	08 59.6	+15 41	067 E	+18.0
Jun 02	09 02.0	+15 29	062 E	+18.1
07	09 04.5	+15 16	058 E	+18.1
12	09 07.1	+15 02	054 E	+18.1
17	09 09.9	+14 48	050 E	+18.1
22	09 12.8	+14 33	046 E	+18.2
27	09 15.9	+14 17	042 E	+18.2
Jul 02	09 19.0	+14 01	038 E	+18.2
07	09 22.2	+13 44	034 E	+18.2

(Too Close to the Sun for Observation)

Table 2. Ephemeris of Periodic Comet d'Arrest (6P/d'Arrest).

1995 UT Date	2000.0 Coörd. R.A.	Decl.	Elongation from Sun	Total Mag.
(0h UT)	h m	° '	°	
May 03	19 37.5	+05 00	103 M	+10.1
08	19 48.6	+05 49	105 M	+10.0
13	19 59.9	+06 36	106 M	+ 9.8
18	20 11.3	+07 21	108 M	+ 9.6
23	20 23.0	+08 02	109 M	+ 9.4
28	20 34.8	+08 39	110 M	+ 9.2
Jun 02	20 47.0	+09 09	112 M	+ 9.1
07	20 59.4	+09 31	113 M	+ 8.9
12	21 12.2	+09 44	114 M	+ 8.7
17	21 25.3	+09 45	116 M	+ 8.5
22	21 38.8	+09 31	117 M	+ 8.4
27	21 52.7	+09 01	119 M	+ 8.2
Jul 02	22 06.8	+08 12	121 M	+ 8.1

(continued)

Ephemeris of Periodic Comet d'Arrest—Continued.

1995 UT Date	2000.0 Coörd. R.A.	Decl.	Elongation from Sun	Total Mag.
(0h UT)	h m	° '	°	
Jul 07	22 21.3	+07 01	123 M	+ 7.9
12	22 35.9	+05 26	126 M	+ 7.8
17	22 50.6	+03 27	128 M	+ 7.7
22	23 05.3	+01 02	131 M	+ 7.6
27	23 19.7	- 01 47	134 M	+ 7.6
Aug 01	23 33.5	- 04 57	136 M	+ 7.4
06	23 46.6	- 08 23	139 M	+ 7.4
11	23 58.8	- 11 58	142 M	+ 7.4
16	00 09.8	- 15 35	144 M	+ 7.4
21	00 19.5	- 19 06	146 M	+ 7.5
26	00 27.7	- 22 24	147 M	+ 7.6
31	00 34.4	- 25 24	147 M	+ 7.7

Table 3. Ephemeris of Periodic Comet Jackson-Neujmin (58P/Jackson-Neujmin).

1995 UT Date	2000.0 Coörd. R.A.	Decl.	Elongation from Sun	Total Mag.
(0h UT)	h m	° '	°	
Jul 02	21 10.9	+02 58	136 M	+14.5
07	21 14.3	+03 15	139 M	+14.2
12	21 17.4	+03 23	142 M	+13.9
17	21 20.2	+03 21	146 M	+13.6
22	21 22.8	+03 06	150 M	+13.4
27	21 25.0	+02 39	153 M	+13.2
Aug 01	21 26.7	+02 06	157 M	+12.9
06	21 28.7	+01 09	161 M	+12.7
11	21 30.7	- 00 05	165 M	+12.4
16	21 32.8	- 01 38	168 E	+12.2
21	21 35.2	- 03 28	169 E	+12.0
26	21 38.2	- 05 34	169 E	+11.9
31	21 41.8	- 07 53	167 E	+11.7
Sep 05	21 46.3	- 10 20	163 E	+11.6
10	21 51.7	- 12 51	159 E	+11.4
15	21 58.2	- 15 20	154 E	+11.4
20	22 05.9	- 17 41	150 E	+11.3
25	22 14.6	- 19 48	146 E	+11.4
30	22 24.4	- 13 23	142 E	+11.4

Table 4. Orbital Elements of Current Comets.

Comet Designation	Perihelion Passage (T)	Dist. (q; AU)	Argument (ϖ)	Longitude of Asc. Node (Ω)	Inclination (i)	Eccentricity (e)
29P/Sch.-Wach. 1*	1989 Oct 26.72	5.771773	049°.870	312°.848	009°.372	0.04466
6P/d'Arrest†	1995 Jul 27.36	1.345869	178°.050	138°.987	019°.523	0.61404
58P/Jackson-Neujmin**	1995 Oct 06.62	1.381125	200°.347	160°.718	013°.478	0.66143

* Epoch 1989 Nov 10.0. Period 14.85y. From 1056 observations 1902-1994. [*MPC 23105*]

† Epoch 1995 Jul 22.0. Period 6.51y. From 250 observations 1963-1988. [*MPC 20122*]

**Epoch 1995 Oct 10.0. Period 8.24y. From 27 observations 1970-1987. [*MPC 20123*]

THE 1989 APPARITION OF PERIODIC COMET BRORSEN-METCALF (1989O = 1989 X)

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

ABSTRACT

The report studies the 1989 Apparition of Periodic Comet Brorsen-Metcalf. With a 70-year orbital period, it has been observed only twice before. Ninety-five observations from A.L.P.O. archives help us to determine its brightness parameters and changes in appearance.

RECOVERY

The history of the comet prior to 1989 was discussed in these pages previously. **[1]** Briefly, the comet was first found by Danish astronomer Theodor Brorsen on 1847 JUL 20. It was observed for less than two months and an orbit was computed suggesting a return in 75 years, in 1922.

The scene now shifted to Burlington, Vermont, where on 1919 AUG 21, the Reverend Joel Metcalf discovered his fourth comet. The newly calculated orbit showed it identical to Brorsen's comet, but returning three years early. Metcalf's name was added to the comet, and the orbital period was determined to be just under 70 years.

This event set the stage for one of the more interesting comet return searches in history. Due to non-gravitational forces—jetting and out-gassing by the comet's nucleus—the comet may be early or late in returning by several weeks. Were the comet barely affected by these forces, then it would be close to its predicted position and large observatory telescopes would pick it up while it is still far away and faint. However, if it is more than a few degrees off course, the narrow-field observatory telescopes might miss it completely, and it would be left for amateurs to find.

Throughout the Spring of 1989, large professional instruments searched for faint telltale images along the predicted path of the comet's return. By early April it was not detected to magnitude +18. It had not been picked up in May or June. By then amateur astronomers were searching the morning sky, slightly off the path down to 11th magnitude.

Finally the comet was found. On JUL 04, E. Helin recorded it on plates exposed through the 0.46-m Schmidt on Palomar Mountain. It was estimated to be magnitude +15, returning 15.6 days earlier than expected. The recovery position was at right ascension 00h24.2m, declination +11°11'; 20° from its predicted position. It was given the designation 1989o. **[2]**

ORBIT

The following orbital elements were calculated by Brian Marsden of the Central Bureau for Astronomical Telegrams and were published on July 7. **[3]**

Time of perihelion:	1989 SEP 11.9395
Distance of Perihelion:	0.47875 AU
Argument of Perihelion:	129°.626
Ascending Node:	310°.876
Inclination:	019°.3310
Eccentricity:	0.971970
Orbital Period:	70.586 years
Distance of Aphelion:	17.0797 AU

[Note: 1 AU (Astronomical Unit) is the mean distance of the Earth from the Sun, 149,597,870 km.]

POSITION OF PERIODIC COMET BRORSEN-METCALF

When recovered, the comet was in the morning sky, appearing 92° from the Sun, 1.10 AU from the Earth and 1.52 AU from the Sun. Its elongation decreased, slowly at first, as the comet moved northeast, reaching a maximum declination of 42° north in mid-August. The comet then moved southward, entering the morning twilight by SEP 25, shortly after perihelion. After this point there were no more A.L.P.O. observations of the comet. When it emerged into the southern morning sky in mid-November it had dimmed too much to be easily visible.

The comet was closest to the Earth on AUG 07 at 0.624 AU. The comet-Earth distance then increased, reaching 1.44 AU by SEP 25. The comet-Sun distance decreased to 0.479 AU at perihelion (SEP 11), then increased again.

MAGNITUDE

Nearly 100 visual magnitude estimates from around the world were sent to the A.L.P.O. archives. These are plotted in *Figure 1* (p. 77). They covered the time period JUL 07-SEP 25. During that time the comet reached perihelion and moved slightly away from the Sun in our sky, while the comet-Earth distance decreased, then increased. The comet was seen by observers in both North and South Hemispheres, and with a variety of instruments. Therefore a large body of data was received and was available for study.

Gary Kronk evaluated the magnitude and coma size data compiled from the A.L.P.O. observations. He also went back and analyzed the limited data (two months of observations) from the 1919 passage of the comet.

In the comet magnitude formula, the *apparent magnitude* is the brightness of the comet as it appears through the telescope. This is usually corrected for aperture size, because larger telescopes tend to make the comet appear fainter, in relation to the stars, than do small telescopes. The *absolute magnitude*, a calculated value, is the brightness of the comet at a standard distance of 1.0 AU from both the Earth and the Sun. As the comet is almost never at these distances, we use this formula to calculate the absolute magnitude:

$$m = Ho + 5 \log D + 2.5N \log R,$$ where:

- m = Apparent magnitude.
- Ho = Absolute magnitude.
- D = Comet-Earth distance in AU
- R = Comet-Sun distance in AU.
- N = A constant representing the rate of brightness changes as the comet-Sun distance changes. A high number indicates rapid change. The mean for all comets is 3.3.

The initial brightness determination for 1989, corrected for aperture size, showed a mean absolute magnitude of +8.05 and an *N* of +3.2. After eliminating a few estimates which departed greatly from the trend, and those interfered with by moonlight, the remaining 81 observations produced a mean absolute magnitude of +7.92 and *N* equal to +3.0. These estimates, reduced to absolute magnitudes, are plotted in *Figure 2* (p. 77).

A similar study of 69 observations of Periodic Comet Brorsen-Metcalf in 1919 are plotted in *Figure 3* (p. 77). Uncorrected for aperture, these gave a much fainter absolute magnitude (+9.66) and a higher "rate of change" (*N*) of +6.0. The absolute magnitudes reduced for 1919 are shown in *Figure 4* (p. 77).

COMPARING THE 1919 AND 1989 VISITS OF THE COMET

It would appear that the absolute magnitude of the comet was 1.8 magnitudes fainter in 1919 than in 1989. However, a close look at the magnitude graphs (*Figures 1-4* on p. 77) shows much more scatter among the 1919 data than in the 1989 data. Kronk proposes three reasons for this:

1) The refinement of magnitude determination procedures between 1919 and 1989 made the latter magnitudes more consistent. Standardized methods, star magnitudes, and reporting forms were not popular in 1919.

2) Aperture corrections were applied in 1989, but not in 1919. They were not applied in 1919 is because little is known of the sizes and types of instruments used at that time.

3) Finally, the comet approached to within 0.20 AU of the Earth on 1919 SEP 05, but never closer than 0.62 AU in 1989. This can account for the "Delta" effect, the underestimating of the size and magnitude of the comet as it comes close to the Earth. A look at the coma diameter sizes (*Figures 5* and *6* on p. 77) shows that, considering its distance from the Earth, the comet appeared smaller in 1919. The earlier observers were probably not seeing the full size of the coma, therefore choosing fainter stars to throw out of focus to compare to the comet.

Indeed, the scatter of magnitudes for 1919 is so large that, when superimposed upon each other, the 1989 absolute magnitude plot easily falls within the 1919 data. Kronk also points out that this means that the comet's *N*-value, in 1919, could have also been +3.0, not +6.0 as the scattered 1919 data indicate. **[4]**

No unusual brightness changes were noted during either visit. During the periods when observed visually, the comet appeared consistent and well-behaved.

However, regarding the 70-year gap in observation prior to recovery on 1989 JUL 04, did Periodic Comet Brorsen-Metcalf "turn on" near the time of recovery? The "photographic" magnitude at recovery was +15.0 on JUL 04.4. Alan Hale of Las Cruces, New Mexico, visually estimated it at +11.5 just three days later. At that same time a photographic magnitude of +14 was estimated by S. Bus at Lowell Observatory. This shows again that the photographic magnitude can be and often is much fainter than the visual magnitude.

Since we have no photographic magnitudes before JUL 03 (a prediscovery image was later found), and visual magnitude estimates began on JUL 07.4, we don't know what happened earlier. If the comet was behaving normally, it would have been brightening at a rate of 0.1 magnitude a day. A flood of observations made during the first week after recovery indicates a rate of three times that. I believe that the best that we can say is that the comet, quite diffuse during that time, was turning on, but probably not having outbursts.

COMA AND TAIL SIZE AND APPEARANCE

Observers estimated the size of the coma, or head of the comet. The apparent size can vary depending upon sky conditions, the observer's eyes and instrument. *Figure 6* (p. 77) shows the apparent size in 1989.

By knowing the comet's distance from the Earth, we can determine the actual size of the comet. The coma spanned roughly 120,000 mi (197,000 km) near the time of recovery. It increased to 200,000 mi (328,000 km) by mid-August, then decreased again during September.

The degree of condensation is shown in *Figure 7* (p. 77). A degree of "0" indicates a diffuse object, while a "9" indicates a well-condensed comet, with a sharp, bright center. As with most comets, Periodic Comet Brorsen-Metcalf condensed as it neared the Sun.

A short tail was reported by some observers beginning in early August, and continuing though September. By early September the tail reached a maximum length of about 2.7 million mi (4.4 million km).

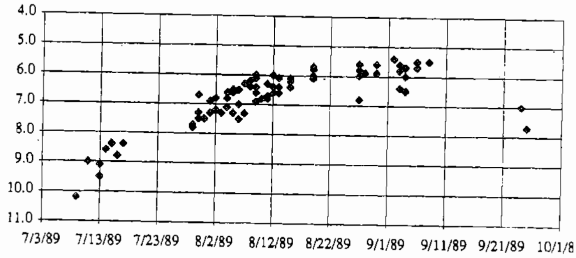

Figure 1. Uncorrected visual magnitude estimates of Comet P/Brorsen-Metcalf (1989o) in 1989.

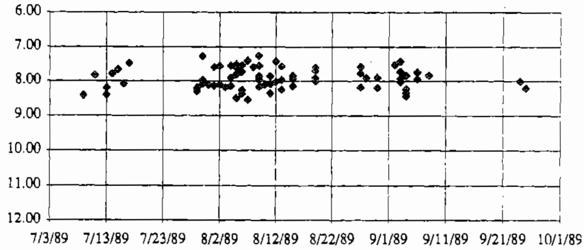

Figure 2. Absolute visual magnitudes derived from moonless observations of Comet P/Brorsen-Metcalf (1989o) in 1989.

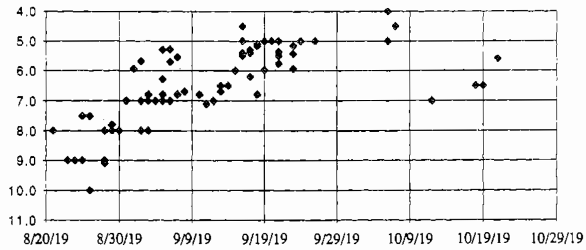

Figure 3. Uncorrected visual magnitude estimates of Comet P/Brorsen-Metcalf (1919 III) in 1919.

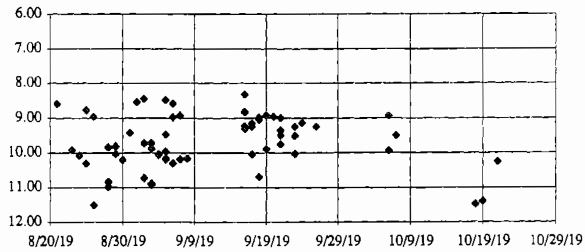

Figure 4. Absolute visual magnitudes derived from moonless observations of Comet P/Brorsen-Metcalf (1919 III) in 1919.

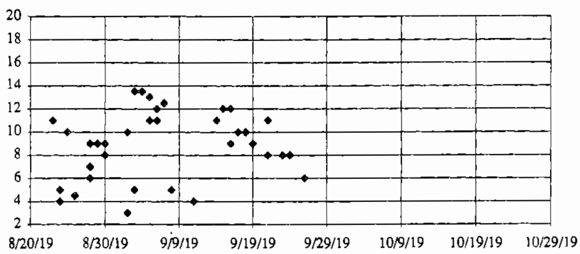

Figure 5. Coma diameter in arc-minutes of Comet P/Brorsen-Metcalf (1919 III) in 1919.

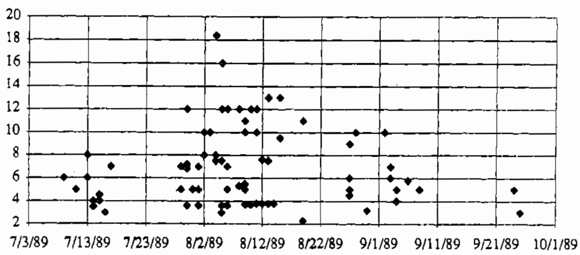

Figure 6. Coma diameter in arc-minutes of Comet P/Brorsen-Metcalf (1989o) in 1989.

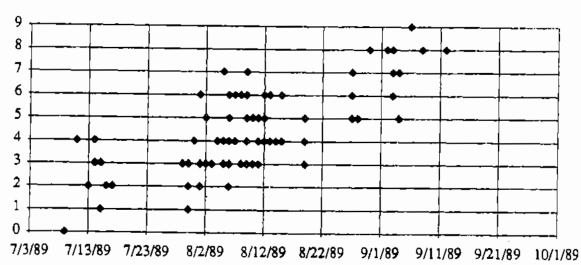

Figure 7. Degree of Condensation (0-9 scale) of Comet P/Brorsen-Metcalf (1989o) in 1989.

Observers' Comments

Here are some comments by A.L.P.O. observers, as gleaned from their observation reports.

Paul Robinson wrote that between JUL 15 and AUG 09 the coma was brighter on the sunward side. He added that the "central condensation 'grew denser' but was never starlike. It was more like a disk". He also reported that the tail was "not symmetrical about its center line...it was noticeably brighter north of center line."

Robert Modic wrote that in late August the tail width was 5-7 arc-minutes. Paul Robinson added that the tail was "not fanned". Gary Nowak commented that on SEP 04 the tail was "..thin, faint, with streamers coming from nucleus", and "..tail had a mist appearance to it"; his drawing for that date is shown in *Figure 9* (lower right). In mid-August Jim Pryal reported an elongated coma, a feature also noticed by Kermit Rhea and Don Pearce. Robert Modic reported that on AUG 27 the coma had a "strong blue color." A drawing by Don Pearce on that date appears in *Figure 8* (to right).

Table 1. A.L.P.O. Observers of Comet P/Brorsen-Metcalf.

Observer	Observing Site	Instruments)
Aguiar, Jose de	Campinas, Brazil	20X50 B
Camilleri, Paul	Victoria, Australia	8X20 B
Garradd, Gordon	Tamworth, NSW, Australia	10X15 B
Hua, Chen Dong	Gulomgyu, Xiamen, China	20X100 B
Jahn, Jost	Rodenteich, (W) Germany	5-cm Rr
Kronk, Gary	Troy, IL, USA	33-cm Rl
Modic, Robert	Richmond Heights, OH, USA	20-cm Rl
Neto, Vinente de	Sao Francisco, Brazil	10X70 B
Nowak, Gary	Essex Junction., VT, USA	20X100 B, 9X63 B
Pearce, Andrew	Scarborough. WA, Australia	41-cm Rl, 20X80 B
Pearce, Don	Bellaire, TX, USA	44-cm Rl
Pryal, Jim	Kirkland, WA, USA	11X80 B
Rhea, Kermit	Paragould, AR, USA	8-cm Rr
Robinson, Paul	Norman, OK, USA	25-cm Rl, 11X80 B
Sabia, John	Clarks Summit, PA, USA	24-cm Rr
Seargent, David	The Entrance, NSW, Australia	15-cm Rl, 8X15 B

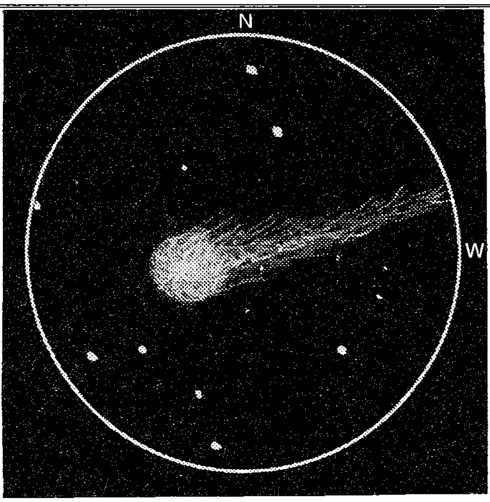

Figure 8. Comet P/Brorsen-Metcalf drawn by Don C. Pearce on 1989 AUG 27, 10h15m UT using a 44-cm (17.5-in) reflector at 62X, giving a 1° field. Seeing 9 (0-10 scale, with 10 best), transparency 4.5 (0-5 scale, with 5 best). Original drawing converted from negative to positive and reoriented to place north at top.

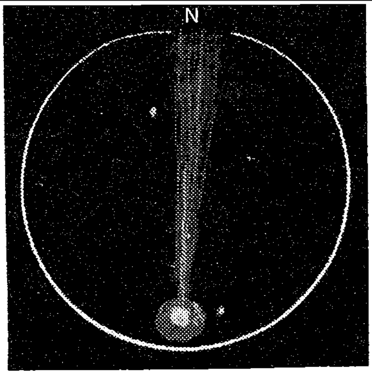

Figure 9. Drawing of Comet P/Brorsen-Metcalf by Gary T. Nowak on 1989 SEP 04, 08h45m UT with a 41-cm (16-in) reflector at 56X. Seeing 6.0 (0-10 A.L.P.O. Scale); Transparency +6.0 (limiting magnitude). The drawing is not to scale, as the 1°.5 tail extended out of the 0°.75 field of view. Original drawing converted from negative to positive and reoriented to place north at top.

Participating Observers

The participating observers are listed in *Table 1* (upper right), where "B" = binoculars, "Rl" = reflector", and "Rr" = refractor.

References

1. Machholz, Don E. "The Present Apparition of Comet Brorsen-Metcalf." *J.A.L.P.O.*, *33*, Nos. 7-9 (July, 1989), pp 118-121.
2. Central Bureau for Astronomical Telegrams. *International Astronomical Union Circular No. 4804*, issued July 7, 1989 by Daniel W. E. Green.
3. Central Bureau for Astronomical Telegrams. *International Astronomical Union Circular No. 4805*, issued July 7, 1989 by Daniel W. E. Green.
4. Private communication.

SOLAR ECLIPSE SNAPSHOTS: 1994 NOV 03

On November 3, 1994, a total solar eclipse swept across South America from Peru to Brazil, with clear skies along most of the track. Assistant Solar Recorder Randy Tatum was able to photograph this event from the Bolivian *Altiplano*, and our **front cover** is a composite drawing of the solar coronal structure gleaned from several photographs of different exposures through a C90 (9-cm f/11 Maksutov). Below are photographs of this event furnished by two other A.L.P.O. members.

Figure 1 (left). Nelson Falsarella of São José do Rio Preto, Brazil, traveled to Chapecó in Santa Catarina State, Brazil where he and his wife, Fatima Carnical, joined a group of other members of the "Rede de Astronomia Observacional" (REDE) group. In this view, REDE members are preparing their instruments prior to the eclipse, which in Brazil occurred in mid-morning, local time. Group observing teams engaged in photography, videography, sky photometry, contact timing, and studied magnetism and atmospheric transparency, shadow bands, and meteorology. Note the cloud-free sky.

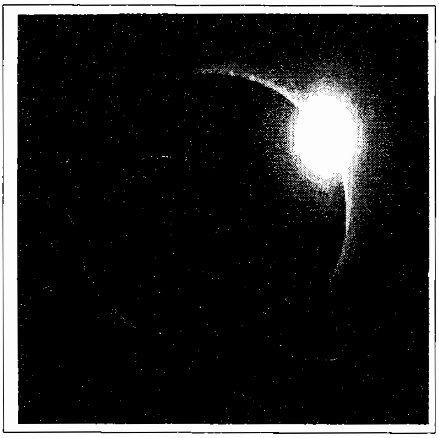

Figure 2 (right), The "Diamond Ring" at the end of totality (Third Contact), photographed by Mr. Falsarella with a 20-cm (8-in) Newtonian reflector at f/6.5 on Kodak Velvia Film at 1/1000 second exposure. Taken 1995 Nov 03, at 12h 54m 45s UT. North is approximately at top.

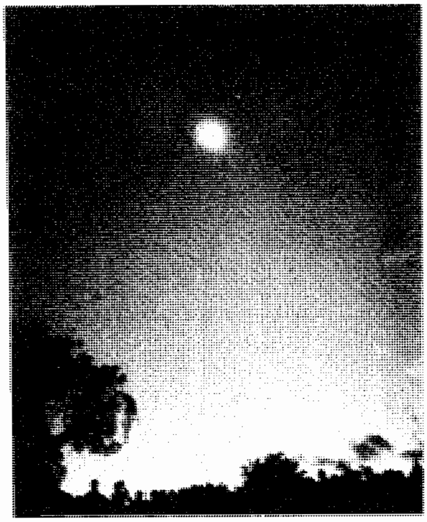

Figure 3 (left). John and Elizabeth Westfall traveled to Iguassu Falls on the Brazilian-Argentine border. Although there were scattered clouds during the initial partial phases, the sky was almost completely clear during totality as this view shows. Slightly above and right of the overexposed corona is the planet Venus; somewhat farther to the lower right of the corona is the fainter image of Jupiter. Taken hand-held with a 24-mm f/2.5 lens, ca. 2 seconds exposure on Kodak Ektachrome 400 Film.

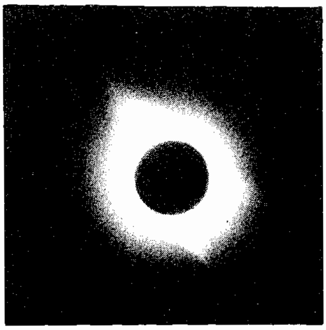

Figure 4 (right). Photograph of outer corona during totality by John Westfall. 400-mm f/6.3 lens; 1/4 second exposure on Kodak Velvia Film. North approximately at top. Note the three elongated coronal streamers.

COMING SOLAR-SYSTEM EVENTS: APRIL - JUNE, 1995

WHAT TO LOOK FOR

In this period, besides the bright planets, there is an opportunity to view an annular solar eclipse, a partial lunar eclipse, occultations of Venus and Mercury by the Moon, and several comets and minor planets predicted to be bright enough to spot in small telescopes.

This column is intended to alert our readers to coming events in the Solar System; giving visibility conditions for major and minor planets, the Moon, comets, and meteors. You can find more detailed information in the 1995 edition of the *A.L.P.O. Solar System Ephemeris*. (See p. 94 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

Mercury, because of its rapid motion, belongs to both the evening and morning sky. Two apparitions of Mercury occur in this period. The first is an evening one, favorable from the N Hemisphere, centered on MAY 12, the date of Greatest E Elongation (21°.6); the planet will be at least 15° from the Sun between APR 29-MAY 25 with *dichotomy* (half-phase) *predicted* for MAY 07, 09h. Mercury's second apparition is a morning one that is favorable for observers in both hemispheres. Greatest W Elongation is on JUN 29, with the planet then 22°.0 from the Sun, and at elongation 15° or greater from JUN 16-JUL 14. Dichotomy is forecast for JUL 04, 21h.

Venus is a morning object gradually approaching the Sun. During APR-JUN its elongation decreases from 36° to 14°W of the Sun, its diameter decreases from 13".6 (" = arc-seconds) to 10".0, and its phase (fraction illuminated) increases from 79 to 97 percent.

Mars is conveniently visible in the evening sky and transits the meridian at a high altitude for Northern-Hemisphere viewers. Unfortunately its disk is small and growing smaller, dropping from 10".4 to 5".7 during this period. Nonetheless, its North Polar Cap remains tilted toward us and should be readily visible. The planet is also moving Sunward in Leo, closing from 123°E to 70°E of the Sun. No longer spectacular, its magnitude dims from -0.2 to +1.1.

Jupiter, in Scorpius, is becoming more readily visible in the morning, and then in the late evening, allowing the continued scrutiny of the Comet Shoemaker-Levy 9 impact spots. The Giant Planet reaches opposition to the Sun on JUN 01, when its disk will span 45".5 in equatorial diameter, at magnitude -2.6. Jupiter's declination will then be 21°S, favoring observers in our Southern Hemisphere.

Saturn, in Aquarius, is now becoming visible in the morning sky, moving from 23°W to 104°W of the Sun during our period. At the same time, the equatorial diameter of its disk increases from 15".7 to 17".7, while the major axis of the Ring System grows from 45".5 to 40".1. The Rings are now rapidly closing to our line of sight as the Earth moves S in Saturn's sky. We will cross the Ring Plane on MAY 22 and the Rings will probably be invisible for days or even 1-2 weeks near then. Following MAY 22, we will be viewing the unilluminated Ring face until AUG 11, and the Rings will be visible, not by direct sunlight, but by sunlight scattered through the Rings or reflected from Saturn itself.

The eclipses and other phenomena of Saturn's satellites are continuing, and events involving the brighter satellites are predicted on pages 53-54 of this issue.

Uranus and **Neptune** both remain in Sagittarius and can be seen in the morning and late-evening sky. Uranus' magnitude is +5.7 - +5.9, while Neptune's is +7.9 - +8.0. Both reach opposition in July..

Pluto, in Libra, is in opposition to the Sun on MAY 20, so this is a good period to look for this 14th-magnitude star-like object (a finding chart is given in our *Solar System Ephemeris* for 1995, p. J-3).

MINOR PLANETS

Two **minor planets** reach opposition and are brighter than 10th magnitude in Spring, 1995. Their 10-day ephemerides are given in the 1995 edition of the *A.L.P.O. Solar System Ephemeris*, their opposition data are given here:

	Opposition Data		
Minor Planet	1995 Date	Stellar Magnitude	Declination& Constellation
27 Euterpe	APR 09.2	+9.9	05°S Vir
63 Ausonia	MAY 24.4	+9.7	32°N Lup

Although not currently at opposition, five additional minor planets, **1 Ceres**, **2 Pallas**, **4 Vesta**, **9 Metis**, and **10 Hygiea**, will fall in the 8th-10th magnitude range during the April-June period.

THE MOON

For this period the schedule for the Moon's **phases** is:

New Moon	First Quarter	Full Moon	Last Quarter
MAR 31.1	APR 08.2	**APR 15.5**	APR 22.1
APR 29.7	MAY 07.9	MAY 14.9	MAY 21.5
MAY 29.4	JUN 06.4	JUN 13.2	JUN 19.9
JUN 28.0	JUL 05.8	JUL 12.5	JUL 19.5

The lunations listed are Numbers 894-897 in Brown's series. The dates in bold face indicate a partial eclipse of the Sun and an annular solar eclipse, both described below.

Another 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 (with 1995 in italics):

North	West	South	East
MAR 13	MAR 14	MAR 26	MAR 29
APR 10	APR 11	APR 22	APR 24
MAY 07	MAY 10	MAY 20	MAY 22
JUN 03	JUN 07	JUN 16	JUN 19
JUN 30	JUL 05	JUL 13	JUL 17

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

During this period the latitude and longitude librations are not well-synchronized with the phases. Nonetheless, the N limb can be seen well on APR 07-12, MAY 04-10, MAY 31-JUN 06, and JUN 27-JUL 03. The S limb is well exposed on APR 20-25, MAY 17-22, and JUN 14-18.

Visibility of the Moon is also affected by its altitude in the sky; better seeing being associated with higher altitudes. The dates and phases when the Moon will be at its highest for observers in each hemisphere will be:

Date	Age	Declination	Hemisphere
APR 06	06d	19°N	Northern
APR 19	*19d*	*19°S*	*Southern*
MAY 03	03d	19°N	Northern
MAY 17	*17d*	*19°S*	*Southern*
MAY 31	02d	19°N	Northern
JUN 13	*15d*	*19°S*	*Southern*
JUN 27	29d	19°N	Northern

ECLIPSES

Partial Lunar Eclipse, 1995 APR 15.—The Earth's umbral shadow grazes the N limb of the Moon for this event, which has an umbral magnitude of 0.117. The predicted schedule of events is:

First Penumbral Contact	10h08.0m
First Umbral Contact	11 40.7
Middle of the Eclipse	12 18.0
Fourth Umbral Contact	12 55.5
Fourth Penumbral Contact	14 28.1

The entire eclipse will be visible from most of the Pacific Basin. The beginning will be visible from most of the Americas, and the end from Central, S and E Asia.

During the partial phase, try to note the brightness and color of the lunar limb within the umbra. You can also make timings of the two umbra-limb contacts. Unfortunately, the umbra will miss most of the craters normally used for limb contact timings, although Plato may be grazed. However, the bright ray crater Anaxagoras will definitely be crossed by the umbra and thus can be timed

Before and after the partial phase, the Earth's penumbral shadow will produce obvious shading on the lunar N limb. Note that Lunar Transient Phenomena have been reported within the penumbral shadow for some eclipses. This will also be an opportunity, just before or after the eclipse, to observe the Moon at an unusually small phase angle. Because there will be minimal shadow interference from lunar features, this is a good time to study the actual albedo of the Moon's surface.

Note that North American observers can see an occultation of the bright star Spica just before, or during the early phases, of this eclipse. The predicted occultation times for selected locations are (D = disappearance; R = reappearance):

Vancouver, B.C.	09h 25m D	10h 34m R
Edmonton	09h 31m D	10h 38m R
N Calif. (122°W/38°N)	09h 44m D	10h 46m R
Winnipeg	09h 52m D	-------------
Los Angeles	09h 57m D	10h 54m R
Denver	10h 02m D	11h 03m R
NM-AZ (109°W/34°N)	10h 09m D	11h 05m R
Chicago	10h 13m D	-------------
Kansas City	10h 14m D	-------------
Austin	10h 32m D	11h 13m R

Annular Solar Eclipse, 1995 APR 29.—South America enjoys a solar eclipse for the second time in six months as the track of annularity crosses parts of the countries of Peru, Ecuador, Colombia, and Brazil, including the large city of Belem near the mouth of the Amazon. A partial solar eclipse will be visible from central Mexico and Florida south almost to the tip of South America, along with the westernmost portion of Africa. *Figure 1* (p. 82) shows the annular track and partial zone for this solar eclipse.

The maximum duration of the annular phase, 6m 37s, occurs at 17h 32m UT near the Peru-Ecuador border. The Moon's diameter will be 95.0 percent of the Sun's (90.2 percent of the Sun's area). In the vicinity of the eclipsed Sun, observers may see the planets Mercury (016°E, Mag. -0.9) and Venus (030°W, -3.9).

OCCULTATIONS

The Moon will occult **Venus** and **Mercury** during the period of interest. On MAY 27, near 07h, the Moon will occult **Venus** as seen from Greenland, most of Europe (except the SE), and northern Asia. Venus will then be 23°W of the Sun, at magnitude -3.9.

Mercury is occulted on JUN 26, near 02h, as seen from easternmost Europe; SW, central, and NE Asia; and Alaska. Mercury will be 22°W of the Sun, at magnitude +0.9.

The bright star **Spica** (magnitude +1.0) will be occulted three times by the Moon: APR 15, 09h from most of North America (see above under the lunar eclipse); MAY 12, 20h, from most of Europe, the Middle East, and central Russia; and JUN 09, 06h, from easternmost Russia, and northern North America except the east coast.

COMETS

The column by Don E. Machholz, "Comet Corner," on pp. 72-74 and the *A.L.P.O. Solar System Ephemeris: 1995* list two known comets that are predicted to be 12th magnitude or brighter during at least part of this period. Of these, **Comet 6P/d'Arrest** should brighten from 10th to 8th magnitude in May and June. This will be one of its most favorable apparitions and the comet should be readily visible in small telescopes, or even in binoculars from dark sites.

Somewhat fainter is **Comet Clark (1994t)**, which is forecast to brighten from magnitude +13.1 to +12.4 in May and June.

METEOR SHOWERS

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

The **Lyrids** reach their maximum activity on the morning of April 22, when the last-quarter Moon will hamper observations, obscuring the fainter shower members. Face away from the bright moonlight to catch the most meteors. When the radiant is high in the sky shower members can appear in any part of the sky. Face high enough in the sky that no horizon appears in your line of sight; 45°-65° altitude is ideal.

Both the **Eta Aquarids** and the **Alpha Scorpids** peak during the first week in May. The Moon reaches its first-quarter phase on MAY 07 and thus does not hamper the viewing of either shower.

The Eta Aquarids are much the stronger of the pair, producing up to one meteor per minute as seen from our Southern Hemisphere. In the Northern Hemisphere, the best rates seen are near 25 per hour close to 30°N and 15 per hour near 40° N. This shower is visible only during the last 2 hours before dawn. Face high in the sky to get the best view of the Eta Aquarids, whose shower members radiate from near the "Water Jar" in Aquarius. These meteors are very swift and most of them leave persistent trains.

The Alpha Scorpids are visible most of the night. They radiate from near Antares and are much slower than the Aquarids. A notable feature of this shower is the many brightly colored fireballs that it produces. Unfortunately, this shower is best seen from the Southern Hemisphere; rates are usually 5 or less per hour as seen from the Northern Hemisphere.

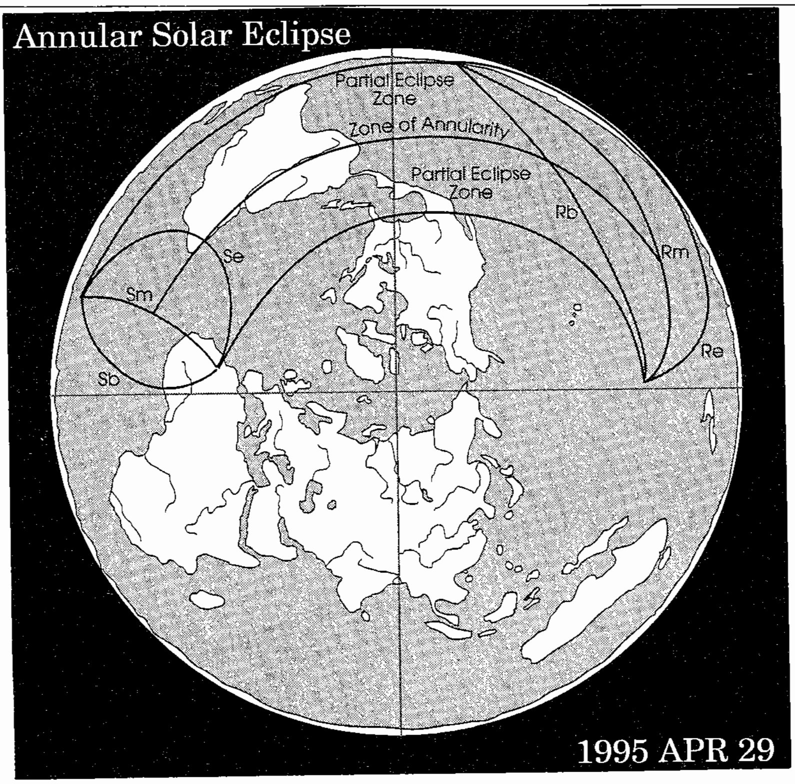

Figure 1. Visibility zones of annular solar eclipse on 1995 APR 29. Abbreviations are as follows: Rb = Sunrise at beginning of eclipse; Rm = Sunrise at middle of eclipse; Re = Sunrise at end of eclipse; Sb = Sunset at beginning of eclipse; Sm = Sunrise at middle of eclipse; Se = Sunrise at end of eclipse.

OUR READERS SPEAK

(These letters have been slightly edited for style; but not for content, although the first letter has been shortened. The writers are responsible for their opinions, not the A.L.P.O.)

Dear Mr. Westfall:

I have been an A.L.P.O. member for about one year now, and though I haven't personally contributed to any particular observing program yet, I thought I'd try to add some fuel to the flame regarding the very long but interesting exchanges between Rodger W. Gordon and Daniel Louderback.

First, as a writer myself, I was recently involved in preparing an article on the "First Explorers of Mars," this is, pre-spacecraft telescopic studies of the red plant since the 17th Century. In trying to obtain suitable illustrations for the article, I contacted a source of mine who is perhaps the most efficient and knowledgeable person regarding archival material at the Lick Observatory—her name is Dorothy Schaumberg. While digging up some interesting photographs for me to use in conjunction with my article, Dorothy sent me a drawing that was done by Dr. James E. Keeler, the famed spectroscopist and second Director of the Lick Observatory. Apparently not many of Keeler's drawings of Mars are to be found; in fact Ms. Schaumberg located only two. However, the significance of the drawing dated July 6, 1890, because clear to me—it is the first convincing drawing done that might suggest that craters on Mars were actually visible to astronomers of the period. The drawing clearly shows a large bowl-like depression on the edge of the terminator. Though I'm not an expert at measuring distances on planetary maps, I do get the impression that this feature on the terminator is located on or near Acidalia Planitia. [this drawing is reproduced as *Figure 1* to the upper right.]

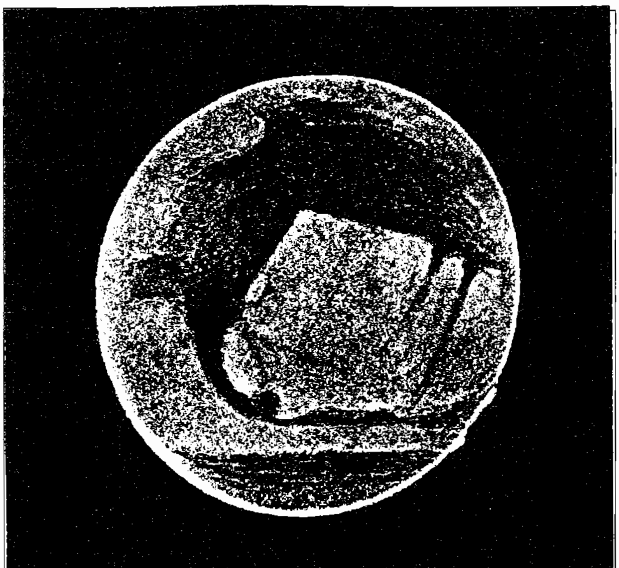

Figure 1. Drawing of Mars by J.E. Keeler with the 36-in (0.91-meter(refractor of Lick Observatory on July 6, 1890, at 09:25 PM P.S.T. The feature referred to in the letter is on the terminator to the lower right. Mars' apparent diameter was 16".6 and its phase coefficient 93 percent. South at top.

I recently spoke with Mars Recorder Jeff Beish regarding this peculiar feature and have since sent a copy of the drawing to him. Mr. Beish is convinced that Martian craters are impossible to see from Earth. I look forward to reviewing the drawings and CCD images that will be taken on November 15, 1994, when the conditions of Mellish's observations of Mars craters are almost exactly duplicated. I have also send Dr. William Sheehan a copy of the Keeler drawing and this letter. I'm hoping that this historic drawing will create a healthy scientific debate!

Barry Elliott DiGregorio

16 North Hartland Street
Middleport, NY 14105

November 18, 1994

To Dr. Westfall

We submit the following letter of reply concerning Rodger Gordon's comments in the October 1994 issue of *J.A.L.P.O.*

Rodger W. Gordon has written a letter and a four-page article in the October 1994 issue of J.A.L.P.O., in which he attempts to defend Mellish's alleged observation of Martian craters in November 1915. While not wishing to prolong the discussion unduly—it is not the most important question in the world!—we do find it necessary to make a few points in response.

Mellish commented that not only he but E.E. Barnard saw the craters—the latter in 1892-93 with the 36-inch (0.91-m) Lick refractor. For a long while Barnard's drawings remained lost, but they have now been rediscovered, and they show only a few circular dark patches. There are no craters as such. Barnard, in describing his observations in the *Monthly Notices of the Royal Astronomical Society* in January 1896, did so in terms of probable analogies between the features in the Martian dark areas and the rugged terrain around Mt. Hamilton, "broken by canyon and slope and ridge." He plausibly inferred the existence of such topography, and so did others—notably, Alfred Russel Wallace, who commented in *Is Mars Habitable?* in 1907: "The assumption of perfect flatness ... gives no account whatever of the numerous and large dark patches, once termed seas, but now found not to be so, and to be full of detailed markings and varied depths of shadow. To assume that these are all the same dead-level as the light-coloured portions are assumed to be, implies that the darkness is one of material and colour only, not of diversified contour, which again is contrary to experience, since difference of material with us always leads to differences in rates of degradation, and hence of diversified contour, as these dark spaces actually show themselves under favourable conditions to independent observers." Despite the plausibility of his conjectures, Barnard did not see. nor did he claim to have seen, any topographical features *directly* as such. He saw them only by what Sir W. Herschel once referred to as "the mental eye," the "eye of reason and experience."

Gordon claims that what was special about Mellish's observations. even relative to Barnard's, was that he saw the craters as actual topographic features, with elevated rims and shadowed interiors. But this alleged observation remains unique. Gordon's willingness to accept *at face value* Mellish's descriptions at different times between 1935 and 1966—and these do not agree very exactly even among themselves—seems naive, given the extent to which the whole history of Martian studies has been one long saga of misinterpretation and illusion. Moreover, what distinguishes science is the ability of others to repeat the results under the same or similar conditions—yet thus far no one has been able to do so. Apart from ourselves—and since we have had the opportunity to use large telescopes rather extensively for planetary observations, and sometimes under conditions of perfect seeing, we are at least entitled to express an opinion—we mention the negative results of Alan Lenham, who used the 40-inch (1m.02) refractor extensively in the 1950s under conditions similar to those when Mellish observed it. Lenham has made the point that observations of objects on the terminator of the Moon using binoculars, which Gordon cites to support his position, are not strictly comparable with telescopic observations of Mars; for the simple reason that Mars, unlike the Moon. has an atmosphere. (see McKim, *JBAA*, *97*, 191 (1987)).

The following observation by E.M. Antoniadi, under conditions as close to those claimed by Mellish as possible, is deserving of careful attention (see "Les Grands Instruments," *Bulletin Societe Astronomique de France*, *41*, 154 [1927]). Antoniadi frequently used the 0.83-m refractor at Meudon on Mars long after opposition, because he was interested in measuring cloud heights along the sunrise terminator. Between February 8 and 12, 1927, Wit:h a disc diameter of 7".8 (compared with Mellish's 7".7), he and a colleague, M. Nechvile, were favored with a "series of perfect images," and used a magnification of 1250X. Antoniadi's drawing, which is reproduced here [*Figure 2,* to the right] and is exquisite as usual, shows considerable detail for the small disc size, but again nothing remotely resembling craters. Antoniadi's (translated) description is as follows: "The image was very still and the left-hand edge of the planet appeared with this ocular as if cut by a knife, but the markings, while showing their irregularities, were very pale."

In passing, we should comment on Gordon's claim that Antoniadi drew canals on the planet even after his highly revealing observations at Meudon in 1909. To this end he reproduces one of Antoniadi's sketches (undated). The drawing was actually made on October 19, 1909, and is specifically 'marked "tremulous seeing" in Antoniadi's original description (*JBAA*, *20*, 78 [1909]). Antoniadi was of the view that canals were apt to appear in flashes under mediocre atmospheric conditions, and this was the point he meant to illustrate here—his sketch was made with the full realisation that it was not representative of the true nature of the underlying topography!

Finally, we must briefly comment on the rather extraordinary letter by Stryk in the same issue of *J.A.L.P.O.*, p. 42. He appears to think we are naive to dismiss (without stronger evidence) Capen's alleged observation of the Great Dark Spot of Neptune with a 12-1/2 inch telescope. Now that the latest HST pictures (*Sky & Telescope*, *89* (2), 20 [1995 February]) have shown that the spot has disappeared, and that it was evidently a transient, we wonder whether he still has the same confidence that Capen's drawing from the early 1950s distinctly shows this particular feature!

In conclusion, there currently exist two schools of thought, but this situation cannot persist much longer, since the definitive observations are likely to be made soon by the HST. At the moment we only note here that the image taken with the planetary camera (*Sky & Telescope*, 1995 February) on October 20, 1994 (disc size 6".5 across) must show Mars incomparably better than Mellish ever saw it; the phase is gibbous, and the atmosphere of Mars is remarkably clear—and yet there are no craters to be seen.

William Sheehan

1212 Oakwood Lane NW, Hutchinson, MN 55350

Richard McKim

5 Ashton Road, Oundle, Peterborough PE8 4BY, Great Britain

January 10, 1995

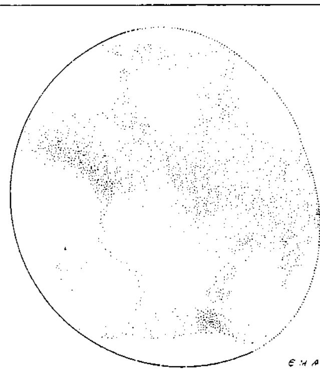

Figure 2. Drawing of Mars by E.M. Antoniadi with the 0.83-m Meudon refractor at 1250X on 1927 FEB 12, 17h45m. The disk diameter is 7".8. South at top.

THE MARTIAN DUST CLOUD OF 1994 JUN 05: APPEARANCE AND IMPLICATIONS

By: Ted Stryk

ABSTRACT

This paper describes a Martian dust cloud detected by the author on 1994 JUN 05, and is almost entirely based on his observations, in the form of day -by-day accounts. A conclusion describes what the author believes caused the dust cloud and how such clouds may be useful in understanding the global distribution of fine-grained dust. The apparent diameter for the Martian disk on all three nights was 4.4 arc-seconds.

1994 JUN 04; CM (Central Meridian) = 159°.—The atmosphere was fairly clear, with the Martian Southern Hemisphere appearing distinctly darker than the Northern, with no sign of the South Polar Cap (SPC). The North Polar Cap (NPC) was prominent, surrounded by a dark collar.

The limb was as clear as the rest of the planet. However, the same could not be said for the terminator. An intense haze covered it, which was fairly conspicuous even in red light, suggesting it had a high dust content. The ice content was not confirmed, as clouds ended the observing session before a blue-filter observation could be obtained. (The term "ice" is used here to describe both carbon dioxide and water ice.)

The only clue to the composition of the haze was that, while still prominent, the limb haze was somewhat subdued in red light as compared to integrated light, so there was definitely some ice mixed in with the dust. No other dust activity had yet appeared.

1994 JUN 05; CM = 147°.—In integrated light, Mars had an appearance almost identical to the day before, with the exception of a small cloud near the terminator just east of Argyre. The surprise came when a red filter was employed, and the cloud appeared to brighten, indicating it was mainly composed of dust; the dust cloud most likely also contained ice particles too. Unfortunately, clouds once again prevented a blue-filter observation, so the ice content could not be confirmed.

1994 JUN 06.—June 6 was cloudy, and no observations could be obtained.

1994 JUN 07; CM = 127°.—June 7 was mostly cloudy, but observations were still obtained. The seeing was a good deal steadier than the previous nights. Solis Lacus was prominent, as well as Mare Acidalium. West of Mare Acidalium was a small cloud, probably associated with a frontal system moving off the NPC.

The dust cloud had vanished, but due to the small size of the Martian disk, Argyre could not be resolved. Although the dust cloud covered a smaller area than that of Argyre, its greater intensity (brightness) had permitted it to be seen. The limb was clear again, but the terminator was covered in a haze identical to the previous nights. However, a blue filter was finally employed, producing observations that indicated the terminator haze was a roughly equal mixture of ice and dust. Due to its prominent red-light appearance, the author suspected less ice. However, the dust cloud, which was even more prominent in red light, probably contained little ice. Clouds then ended the observing session.

The writer's visual intensity estimates and drawings of Mars for the dates of 1994 JUN 04, 05, and 07 are given on p. 86 in *Table 1* and *Figures 1-3*.

CONCLUSION

On JUN 04, intense winds were blowing east from the unlit hemisphere of Mars across the evening terminator, sweeping dust and ice particles off the surface and producing the dusty terminator haze. When Argyre approached the terminator and moved into the windy area, it provided a vast source of dust which was swept east across the terminator and produced the observed cloud. Any frost in Argyre would also have been swept up. When the observations on JUN 07 were made, Argyre was far from the terminator, out of position to provide dust. However, wind speeds were still very high, producing the dusty limb haze. During that period of high winds, a similar cloud probably formed every time Argyre, Hellas, or any other particularly dusty area crossed the terminator, and probably persisted for the one to two hours that a dust source was in the correct position.

This hypothesis successfully explains why the dust cloud formed east of Argyre and not directly over it. However, with no other observations during this time with Hellas or Argyre near the terminator, it cannot be proven. If it is true, then analysis of where such dust clouds occur could help pin down which areas of Mars contain large amounts of fine-grained dust.

Unfortunately, Mars is rarely observed during the early and very late months of the apparition, allowing many dust clouds to slip past observers. This can have serious consequences. For example, without good coverage, we may still believe Mars has a dust-free season [Berry and Parker 1993]. Only with coverage extended throughout most of each Martian apparition will we ever truly understand the frequency of dust clouds.

REFERENCE

Berry, Richard and Parker, Donald. (1993) "Clear skies on Mars." *Astronomy, 21*, No.7 (July), pp. 72 - 77.

Table 1. Intensity Estimates of Martian Features Through Color Filters.

(Note: Intensities are expressed in the standard A.L.P.O. 0-10 scale, where represents black shadow and 10 the brightest possible condition.)

DATE, Feature	Integ. Light	W23A (Red)	W82A (Blue)
JUN 04			
NPC Collar	3	3	-
Southern Features*	4	3	-
NPC	10	9	-
Terminator Haze	7	7	-
JUN 05			
NPC Collar	3	3	-
Southern Features*	4	3	-
NPC	10	9	-
Terminator Haze	7	7	-
Dust Cloud	7	9	-
JUN 07			
NPC Collar	3	3	4
Southern Features*	4	3	4
NPC	10	9	10
Cloud near NPC	6	-	9
Solis Lacus	3	2	4
Mare Erythraeum	4	3	4
Meridiani Sinus†	5	4	5
Terminator Haze	7	7	7
Mare Acidalium	2	3	4
Southern Features¶	5	4	5
Disk Mean	5.0	4.5	5.5

* The dark southern albedo features (i.e. Solis Lacus or Mare Erythraeum) made most of the Southern Hemisphere look darker but could not be resolved into individual features on JUN 04 and 05. On JUN 07 I made an overall estimate of intensity of the dark southern features for comparison purposes.

† Meridiani Sinus was only partially visible and covered in terminator haze, making it fainter than normal.

¶ This is an intensity estimate for the darker regions of the Southern Hemisphere excluding Solis Lacus, Mare Erythraeum, and Meridiani Sinus.

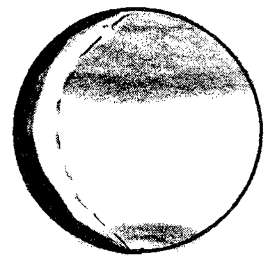

Figure 1. Drawing of Mars by Ted Stryk on 1994 JUN 04 at CM 159°, prior to the appearance of the dust cloud. 10-in (25-cm) f/4.5 Newtonian reflector; W23A (red) Filter and integrated light. North at top.

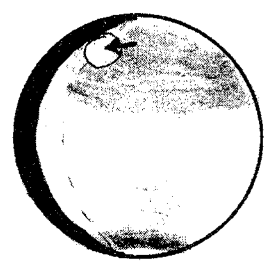

Figure 2. Drawing of Mars by Ted Stryk on 1994 JUN 05 at CM 147°. The dust cloud is marked by an arrow. 10-in (25-cm) f/4.5 Newtonian reflector; W23A Filter and integrated light. North at top.

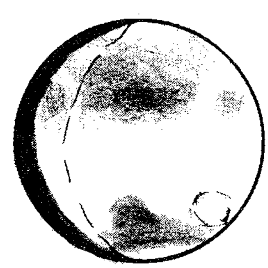

Figure 3. Drawing of Mars by Ted Stryk on 1994 JUN 07 at CM 127°. The dust cloud has disappeared; note the small cloud moving off the North Polar Cap. 10-in (25-cm) f/4.5 Newtonian reflector; W23A and W82A (blue) Filters and integrated light. North at top.

BOOK REVIEWS

Edited by José Olivarez

How the Shaman Stole the Moon—In Search of Ancient Prophet-Scientists from Stonehenge to the Grand Canyon.

By William H. Calvin

Bantam Books, 666 Fifth Avenue, New York, NY 10103. 1991. 223 pages, illustrations, notes, index. Price $21.50 cloth (ISBN 0-553-07740-6).

Reviewed by Phillip W. Budine

Your interest in early historical observatories of the Sun, Moon, planets, and stars will be rekindled by purchasing this enjoyable and readable book by William Calvin. The book is definitely "different" and fills a gap in literature concerning natural monuments and positioning of the celestial bodies. Mr. Calvin has done considerable research and traveling to explore first-hand sites of early observation by ancient scientists.

This book is well-illustrated with numerous sketches and adequate photographs of man's possible early stone observatories. Most of the book concerns the nature and possible uses of Stonehenge and other stone-type observatories and measuring monuments in the Grand Canyon. Mr. Calvin's impressive observations and theories concerning the design and use of these structures will stimulate your thinking on early man and his surroundings.

The book is well organized. I wished for more photographs, but the illustrations used do a good job of defining Mr. Calvin's logic. He takes some liberty in choosing many stone alignments from many locations to be possible positional observatories, However, his theories will stand unless someone wants to retrace his many steps and prove them wrong.

I found most fascinating the information the author details about sunrises, moonrises, sunsets, moonsets, eclipses, and positioning observatories.

I recommend this book, one of a very few on this subject. To complete your library, this fine book concerning the nature and observational use of stone observational monuments will be an excellent addition. Mr. Calvin should be commended for his considerable efforts on a very ancient subject!

CCD ASTRONOMY: Construction and Use of an Astronomical CCD Camera.

By Christian Buil

Willmann-Bell, Inc, P.O. Box 35025, Richmond, VA 23235. 1991. 321 pages, Appendix. Price $24.95 cloth (ISBN 0-943396-29-8).

Reviewed by Richard Hill

More and more amateurs are getting involved in CCD astronomy. As a result, there is a proliferation of books and articles on making and using these devices. But for a clear, highly technical and comprehensive overview on the workings of a CCD, this book is quite good. This is not a book for the sometimes amateurs that want to buy their CCD cameras off-the-shelf, plug them in and make some kind of image right away. Rather this is a book for those with a technical background in mechanics, physics, electronics, or all three.

The book does a fine job of describing the basic principles of the CCD and camera, concentrating on the design used by the author. It suffers from the same malady that any work on this subject would, rapid obsolescence. The author tells, in great detail, how to build a CCD camera with chip sizes of 512×512 or less: "A typical CCD has 512×512 pixels, each about 20μm square..." Few amateurs would build one like this today since such are available ready-made. In fact, most building their own systems are now using chips of 1024×1024 (1K chips) or larger with pixel sizes as small as 9μm! Professional observatories are experimenting with as large as 4K×4K chips; in some cases combined in panes like windows so they are effectively 8K×8K! Lunar and planetary observers can and do use smaller chips. They save money when purchasing hardware, process images faster and store them more easily.

Unfortunately, Buil makes some opinionated statements in the book that should not be taken as fact. A good example occurs in the Foreword when he states:

> "The measurement can either be analog, the image being reconstituted on a video screen (the camcorder principle), or numerical to be visualized later on a computer screen. The latter is the only method used in astronomy because a maximum amount of information can be obtained thanks to mathematical processing software."

Anyone who went to the A.L.P.O. Convention in 1993 saw clearly that the above is just not so. Many lunar and planetary observers are doing spectacular work using video media. Frame grabbing can be used to make and process individual frames of interest providing good calibration footage exists. Mars Recorder Don Parker displayed excellent examples of this kind of work. Dozens of amateur astronomers across the country are using video-CCD to record occultations, as well as for solar, lunar and planetary monitoring.

Perhaps no section of the book needs regular updating more than "Choosing a Computer." Amateurs doing image processing today should be using 486 computers (25MHz+) with at least 50Mb of hard disk memory instead of the 386 (16MHz) with 10Mb. The more powerful machines cost the same as the earlier ones did, and compared to only 5 years ago, memory is cheap today.

While these out-of-date statements are bothersome, all being due to the rapid advances in electronic technology, still they do not seriously mar the solid foundation of the book. The principles are the same, whether a big chip or little chip. I recommend this text to any who want to know, in technical detail, what is going on inside their camera, or those who wish to build one. You will read this book more than once!

Atlas of the Moon.

By Antonin Rükl.

Kalmbach Publishing Company, 21027 Crossroads Circle, P.O. Box 1612, Waukesha, Wisconsin 53187. 1992. 224 pages, glossary. Price $29.95 cloth (ISBN 0-913135-17-8).

Reviewed by Charles A. Kapral

Anyone planning to use a lunar atlas at their telescope should buy two copies of this atlas, one for the telescope and one for the desk. It would be a shame for dew to destroy your only copy of this excellent lunar atlas.

The first 19 pages describe the Moon with its phases, how it appears in the sky, its surface, its origin and history, and lunar cartography, with a host of numerical data. The text is not only written in a clear, concise manner, it's truly enjoyable to read. It also contains an excellent description of the crater diameter-to-depth ratio, not often found in an atlas.

Pages 20-25 illustrate the Moon at First and Last Quarter, and at Full Moon, using photographs accompanied by maps showing the major features. These are especially useful for binocular observers. Page 25 also lists features which are useful for timing the progress of a lunar eclipse.

Pages 26-179 form the meat of the atlas, the surface of the Moon depicted in 76 charts. At first glance I knew I liked this atlas. The charts show selenographic longitude and latitude, not the χ–ξ (Xi and Eta) direction-cosines of most atlases. Although more experienced observers are comfortable with χ–ξ coordinates, longitudes and latitudes allow a novice observer to gain an easier understanding of lunar positions, since the coordinate system is similar to the Earths. Also, the charts are bite-sized portions of the Moon, making it very simple to become familiar with the Moon in easy-to-learn bits. Each chart is accompanied by a description of each named feature, its size, and who it was named after. Lunar landing sites are also indicated.

The charts are plotted on the orthographic projection and show the Moon as it appears to the observer at mean libration. The scale used is 1:2,400,000, or about 38 miles per inch. The surface is drawn under morning illumination, and albedo differences are shown by light or dark shading. The maps use International Astronomical Union nomenclature approved up to the end of 1988, making it the most current atlas available today.

Pages 180 to 189 contain maps of the librational zones of the Moon in conformal projections, but otherwise in the same style as the main charts. This is followed by a small-scale map of the near and far sides of the Moon, and a two-page description of the various flights to the Moon. Mr. Rükl states that the main reason that the flights to the Moon ceased was due to the vast accumulation of data from them and that several decades will be needed to complete the analysis.

Pages 194 to 207 offer views of 50 interesting features, describing each. The "photographs", modified by airbrush, are excellent, with the exception of those of Gassendi, Copernicus, Hesiodus A, and Wargentin, which didn't reproduce well.

Pages 208 to 215 describe lunar observing in a very clear manner. The text on eclipses is done very well, ending with a list of the total and partial lunar eclipses from 1990 to 2011. A glossary and index end the atlas.

A few criticisms are inevitable. More overlap should be shown between charts. The use of old terminology, such as "walled plain" or "ring mountain" should be updated. Mention should have been made of the χ–ξ direction-cosine system. An overlay for each chart would be extremely useful.

The editorial errors described in John Westfall's review of the 1990 edition of the atlas (in *Sky & Telescope*, April 1992, Vol. 83, No. 4, pp. 404-406) have been corrected. New ones have occurred, such as: The photograph caption on page 40 describes "the AREA under high illumination." On page 52, the Caucasus Montes description should state "could view parts of both maria." Esam Mons, described on Page 98, is on Chart 25, not Chart 36. Timocharis Catena is not shown on Chart 21. Catena Abulfeda on Chart 56 is at 15°S, 14°E, not 17°S, 17°E. Finally, Merrill on Page 182 is spelled "Merril" on the Chart.

I strongly recommend this atlas. It will be a lunar observers' standard for some time to come. (I wish the publisher would please publish a laminated set of charts, perhaps with the chart on one side and the description on the other.) There is enough information on the charts to keep a lunar observer busy for years, especially within the libration zones.

Worlds in The Sky: Planetary Discovery From Earliest Times Through Voyager and Magellan.

By William Sheehan.

The University of Arizona Press, 1230 N. Park Avenue, Suite 102. Tucson, Arizona 85719-4140. 1992. 242 pages. Price $17.95 paper (ISBN 0-8165-1308-2).

Reviewed by Joseph R. Kraus

As an avid amateur astronomer, psychiatrist and writer, William Sheehan provides an overview of the discovery and examination of different Solar System objects in *Worlds in the Sky*. He describes three different stages of planetary exploration. The first stage of observation, called "the naked eye era," was the longest in time span and yielded the least results. The next stage was the discovery of planetary details and atmospheres using telescopes. The last stage involves the use of planetary probes to examine Solar System bodies. The first three chapters are each devoted to one of the stages of astronomical discovery. In the following eleven chapters Sheehan uses these three stages to discuss the Moon, Mercury, Venus, Mars, Asteroids, Jupiter, Saturn, Uranus, Neptune, Pluto, and Comets and Meteors. As would be expected, he concentrates most of his attention to the telescopic and space-probe methods of discovery.

This book reads easily enough for a high school student. It may not appeal to someone younger because it has few pictures, and none of them are in color. Sheehan has written this book for an audience who is already interested in planetary exploration. He furnishes items of historical information that are not normally presented in typical discourses of planetary discovery. For example, it may be common knowledge that Clyde Tombaugh had used farm machinery parts for his 9-inch reflector, but I did not know that "its base had been part of a cream separator, while another component was the crankshaft of his father's 1910 Buick." (page 191) This book can be compared to a good movie; every time you see it, you learn something new.

Sheehan occasionally refers to his own observations with a 12.5-inch reflector. In Chapter 10 about Saturn, he said that his telescope rarely shows Mimas because of the glare created by Saturn. I would have liked to have read more of his observations. He also gives many numerical examples to the reader and does not present any formulas. A typical example from the text is:

> "Enceladus completes each orbit in 1 day, 8 hours, and 53 minutes and thus lies at a 2:1 resonance position with Dione, whose orbital period is 2 days, 17 hours, 41 minutes. This means that Enceladus is subject to strong tidal forces from more massive Dione...[The] tidal flexing and bending keeps the interior warm, allowing continuing geological activity." (page 149)

These are just some of the details from the book. Sheehan covers this overview of planetary astronomy concisely. He expounds on much of the history within the context of each planet and subject. The chapters are so interwoven with scientific history and biographical anecdotes that *Worlds in the Sky* is a pleasure to read every time it is picked up.

The Man Who Sold the Milky Way, A Biography Of Bart Bok.

By David Levy

The University of Arizona Press, 1230 N. Park Avenue, Suite 102, Tucson, Arizona 85719-4140. 1993. 228 pages, illustrations, bibliography, index. Price $35.00 cloth (ISBN 0-8165-1149-7)

Reviewed by Tim Hager

In our own minds, when many of us were just starting to kindle an interest in astronomy, there existed a place populated by a race of beings known as The Great Astronomers. These mythical figures were thought to live on remote mountain tops where they used gargantuan telescopes to divine the secrets of the universe. Sometimes, they wrote learned articles in scientific journals to let us mere mortals in on some of the things they had found before they withdrew again to their exclusive world.

Now, David Levy leads us into that world and lets us discover the real life and the humanity of one of those Great Astronomers, Bart Bok. In the process he reveals a multifaceted human being who is not only a scientist but also an educator, husband and politician.

Levy begins with the story of how Bok's interest in astronomy began when he was a young boy scout in the Netherlands and was chided by a superior because he did not know his constellations. Throughout his early years he proved himself an exceptional student and during his high school studies Bok began to follow the work of Harlow Shapley who was to have a profound effect on the remainder of Bok's professional life.

The story of his meeting and subsequent devotion to his wife Priscilla is touching. However, his departure from Harvard in the 1950's and the future course of his career is shown to be dictated more by politics than by academic pursuits. Thus, Levy shows us that even Great Astronomers can share the same joys and trials that we can.

Bok's work is portrayed in a style that is not intimidating to the non-technical reader. Levy makes a point of inserting simple explanations of astronomical concepts where they are necessary. Further explanations and definitions can be found in the extensive notes at the end of the book.

I found the book to be very easy to read. The language is clear and simple. The only minor criticism I have is that I felt the author's selection of photos could have been used to better illustrate the text. An example is the description of the unusual housing for the 90-inch telescope of Steward Observatory. A photograph of the building itself would have illustrated the point clearly.

To his credit, Levy points out that this is not a completely unbiased biography of his subject and his admiration of Bok clearly shows through in his writing. I did not find this disturbing because I believe the book is meant to give a flavor of the man and his times and is not intended to be a historical treatise.

I highly recommend this book to anyone, and especially those who have an interest in. the history of astronomy and its human side. Bart Bok's career spanned a time when tremendous changes took place, not only in the science itself, but also in how it is funded and practiced. David Levy has done an admirable job of capturing not just the Great Astronomer Bart Bok but also the man and the astronomical era that he lived in.

Remote Geochemical Analysis: Elemental and Mineralogical Composition.

Edited by Carle M. Pieters and Peter A. Englert

Cambridge University Press, 40 West 20th Street, New York, NY 10011-4211. 1993. 594 pages, index. Price $74.95 cloth (ISBN 0-521-402811-6).

Reviewed by Richard W. Schmude, Jr.

This book is organized into three major sections entitled "Technical and Scientific Background," "Applications and Measurements," and "Active Surface Analysis". There are 27 chapters, 23 color plates, 341 figures, 73 tables and 1732 references in the book. A 1700-item index and a thorough table of contents listing major sections and sub-sections of each chapter are included. Each of the chapters is written by one or more specialists in their field. The book is written at an advanced level which would be suitable to the specialist or advanced amateur astronomer. Several disciplines are integrated in the book with the one goal of obtaining information about the surface composition of various Solar System bodies. Geologists, geographers, chemists, physicists, engineers and planetary scientists will find this book of interest.

The first section contains 11 chapters which serve to give an understanding of the various types of spectra used in the study of planets. Ultraviolet, visible, near infrared, mid-infrared, x-ray, γ-ray, neutron and α-particle spectra are all covered in this section. The reader is also exposed to the techniques used in simulating planetary spectra in the laboratory. After reading this section, one learns how the different types of spectra can be used in extracting geological information.

The second section focuses on how spectra have been used in determining the elemental, chemical, and mineralogical composition of Solar System bodies. Chapters 12 and 13 focus on Landsat images of the Earth, emphasizing the integration of remote sensing results and field work. Chapters 14 and 15 describe both 0.5-2.5 μm and γ-ray spectra of the Moon. Remote sensing spectra are integrated with chemical/spectroscopic analysis of lunar soil samples in giving a geological picture of the Moon. γ-ray spectra of Mars are described in Chapters 17 and 18. Of special interest is a discussion of γ-ray spectra of Mars collected by Phobos 2. Reflectance spectra of asteroids and of the satellites of Jupiter, Saturn, Uranus, Neptune and Pluto are discussed in Chapters 20-21. The reader discovers how chemical compounds are detected on these bodies from visible/near infrared spectra.

The third section contains 6 chapters and centers around obtaining geochemical information from direct study of the soil. The first three chapters describe how x-ray and γ-ray spectra have been used in identifying elemental abundances on the Earth, Moon and Mars. One chapter is devoted to the theory and applications of Mossbauer spectroscopy. Mass spectrometry is the main topic of another chapter, presenting the basic components of a mass spectrometer. Descriptions of the mass spectrometers flown on the Viking, Vega and Giotto spacecraft are also given. The final chapter focuses on an experiment whereby the surface of Phobos is first struck by a laser which both vaporizes and ionizes soil material while a close-approaching spacecraft containing a mass spectrometer analyses the vaporized material. The laser-mass spectrometer on board Phobos 2 is discussed.

I recommend this book to the scientist or engineer who is actively doing planetary research or spacecraft design. The amateur astronomer with a strong science background will also find much of the book interesting. This book is also well suited as a graduate-level textbook. The abundance of reference makes this an ideal reference book in the field of remote sensing of planetary surfaces.

Sub-arcsecond Radio Astronomy.

Edited by R.J. Davis and R.S. Booth.

Cambridge University Press. 40 West 20th Street, New York, NY 10011-4211. 1993. 451 pages. Author, object and subject indices. Price $64.95 cloth (ISBN 0-521-43472-6).

Reviewed by Peter Wlasuk

Sub-arcsecond Radio Astronomy is a technical monograph on radio astronomy intended primarily for professional astronomers, it constitutes the proceedings of a conference held in 1992 at the Nuffield Radio Astronomy Laboratories in Manchester, England. The book is conveniently divided into five principal sections, "Galactic Astronomy," "Extragalactic Astronomy," "Cosmology," "Astrometry," and "Instruments & Techniques." These sections are subdivided, for example, into topics like "Stars", "The Galactic Centre," and so forth. Although most of the book is filled with research papers that are concerned with just one astronomical object, class of objects or a particular radio telescope, there are also many "review articles" which summarize the state of current research in such areas as "Compact radio sources in the Galactic Centre" and "Observations of gravitational lenses."

In my opinion, one of the best review articles in *Sub-arcsecond Radio Astronomy* is the very first one presented, by A.R. Taylor (University of Calgary) on radio interferometry of the continuum radio emission from stars. Taylor's article, like many of the articles in this book, discusses the major advancements made possible by VLBI, or Very-Long Baseline Interferometry, a technique which combines coordinated observations of the same object made by several different radio telescopes spaced around the Earth. VLBI, which was the subject of an episode of the acclaimed PBS-TV series, *The Astronomers*, has enabled radio astronomers to discover jets, shells, and so-called bi-polar structures in the gas-rich regions surrounding stars. Many of these structures are much smaller than 1 arc-second across, and cannot be adequately observed by optical telescopes. Taylor predicts that VLBI, which can already greatly exceed the resolution of our best optical instruments, will be further improved by the perfection of a relatively new observing technique called "phase referencing", making possible resolutions of a few thousandths of an arcsecond!

One of the hottest topics in radio astronomy today is gravitational lenses, and there are no fewer than fifteen separate papers in *Sub-arcsecond Radio Astronomy* on these exotic objects. Since the first gravitationally lensed system was found in 1979, radio-astronomers have become increasingly excited by the possibility that these objects will allow them to determine with unprecedented accuracy the masses of galaxies and perhaps even that "holy grail" of cosmology known as the "deceleration parameter" which will tell us whether the universe is "open" and will expand forever, or whether it is "closed" and will someday reverse its expansion.

However, by far the greatest number of articles in this book concern AGN, or active galactic nuclei—quasars, BL Lacertae objects (commonly called "Blazers") and Seyfert galaxies. Some of the interesting papers in this section discuss parsec-scale radio jets, many of which are referred to as "superluminal" because their great velocities, when added to the cosmological velocity of the host quasar, appear to exceed the speed of light. Unlocking the secrets of AGNs will also require milli-arcsecond (mas) resolution, which will likely remain confined to the domain of radio astronomers for decades to come.

Sub-arcsecond Radio Astronomy is a book that most amateur astronomers would not find to be easy reading, but a basic familiarity with some of the topics discussed in this book gleaned, say, from a popular magazine like *Sky & Telescope*, will enable the amateur to get something of value from at least the review articles. To get more out of a monograph like this, a strong background in graduate-level physics and mathematics is needed. Unfortunately, none of the articles in this book concern Solar System objects, so its appeal to A.L.P.O. members may be limited.

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A Short Review of a New Solar Product: Class A Solar Filter (JMB Inc. 20762 Richard, Trenton, MI 48183)

By: Richard Hill, A.L.P.O. Assistant Solar Recorder

Over many years now, especially since joining the Solar Section staff in 1982, I have looked through hundreds of solar filters. About 20 percent were glass filters. Few were what I would categorize as "good" quality. In almost every case the problem was the glass, not the coating. The wide variation in quality (from fair to awful) made it often necessary for serious solar observers to make their own filters.

JMB Inc. is a company that produces glass solar filters. I obtained one of their filters for my C5 that is used for solar observing. The filter that I got was one of their "Class A" filters. It came well-packed in a double box with styrofoam chips between the boxes. This turned out to be a good idea since the outer box was punctured! The filter came with instructions, an opaque marker to block out any pinholes, and three foam pads. The latter were needed for the filter cell. The C5 filter cell is designed to fit 4.5-inch to 6-inch tube diameters. By placing the foam pads at 120-degree intervals on the inside lip of the cell it will fit snugly on the tube. I used felt pads instead since the Arizona heat makes short work of rubber products.

Looking through just the filter, before putting it on the telescope, the Sun was a nice crisp circle and there were no pinholes! The cell is black plastic, which may not be a good color, especially in the southwestern sun and heat. No problems from this were specifically noted, however. (Heating problems from this would likely cause image degradation at the arc-second level.) At low power (50X) the image was crisp and the sky quite dark just off the limb. Focussing was easy and unambiguous. Many other glass filters I have used showed significant astigmatism at this point. The color was a pleasing yellow-orange. At higher power (150X) the image was still good, though a bit dimmer than I would have liked. This made it a bit more difficult to see the fainter, finer detail, but one thing is sure, this is a safe filter! Given this, it was still possible to see granulation, penumbral grains, fibrils and small light bridges in umbrae. One disadvantage of a neutral-density filter like this is that the faculae are harder to see than in the blue-image Mylar-type filters. So the serious solar observer may want to keep both types of filters handy.

In general, the filter is a good one and I recommend its use. It appears quite safe for solar observing but the user may be limited in magnifications. I would cover the black cell with a white material to exploit the full resolution capabilities of your instrument.

ANNOUNCEMENTS

ASSOCIATION AFFAIRS

NEW ADDRESS FOR MEMBERSHIP SECRETARY.—Harry D. Jamieson, the A.L.P.O. Membership Secretary, has moved. All membership-related correspondence should now be addressed to: A.L.P.O. Membership Secretary, P.O. Box 16882, Memphis, TN 38186-0882.

A.L.P.O. 1995 CONVENTION.—Our 45th convention will be held on August 2-5, 1995, in Wichita, Kansas. Our activities this year will include paper sessions and workshops, displays, a banquet, and an observatory field trip and star party. The meeting site will be the Days Inn East, 8300 E. Kellogg, Wichita, KS 67207. Further details will be provided in a special mailing to our members in the United States and Canada; those in other countries who are interested should contact the A.L.P.O. Director individually for this information.

All members are invited to deliver papers or conduct workshops. If you wish to do so, please submit an abstract (100 words maximum) to Director Westfall by July 1, 1995. With the abstract indicate any audio-visual needs and the presentation time you need (20 minutes is the default time).

Tax Deductions for A.L.P.O. Contributions.—Because the A.L.P.O. is a qualified charitable nonprofit organization, donations of cash, goods, or services to it may qualify for tax deductions, as may expenses incurred in participating in its programs. To make certain of this, donors should consult their own tax consultants. In addition, for donations or expense claims exceeding $250, you should contact the A.L.P.O. Treasurer, Harry D. Jamieson (address on cover) for information and a copy of our donation/expense form.

Carlos Hernandez Joins Jupiter Section.—While continuing as a Mars Recorder, Dr. Hernandez (address on p. 96) has also joined the Jupiter Section as an Acting Assistant Recorder. He has been active in helping the Jupiter Section analyze observations of the Jupiter-Comet Shoemaker-Levy 9 collision and its aftermath; we are planning to publish his report on this event in the near future.

BEYOND THE A.L.P.O.

Twenty-Sixth RTMC.—The Riverside Telescope Makers Conference will be held May 26th-29th, 1995 at Camp Oakes, near Big Bear Lake, California. The theme for this year's conference is "Making and Using Telescopes on the Deep Sky". A "shoot-out" for CCD camera and software manufacturers has also been organized. Make requests for an information and registration package to RTMC, c/o Fox & Stephens, CPA's, 9045 Haven Avenue, Suite 109, Rancho Cucamonga, CA 91730; leave messages at 909-948-2205.

American Astronomical Society.—June 11-15, 1995 are the dates for the 186th Meeting of the American Astronomical Society, at the Pittsburgh Vista Hotel and Lawrence Convention Center in Pittsburgh, Pennsylvania. Highlights will include several invited speakers, special and topical paper sessions, and tours to Allegheny Observatory and the Contraves, Inc. optical facilities. Obtain registration information from: ferbets associates, P.O. Box 1630, 1895 Mt. Lemon Road, Oracle, AZ 85623 (Tel.: 602-896-9316; FAX: 602-896-2639; E-Mail: reg-help@aas.org; and, yes, the company name is all lower-case).

UNIVERSE '95.—This annual "astronomy festival" is sponsored by the Astronomical Society of the Pacific (ASP) and *Astronomy* magazine, and will meet this year on June 24-25 (Saturday and Sunday) at the University of Maryland in College Par, immediately prior to the annual Scientific Meeting of the ASP. These two weekend days are reserved for a general conference for amateurs, vendors, and the interested public; at which time the A.L.P.O. will host an information counter. Find out more by contacting: UNIVERSE '95, ASP, 390 Ashton Avenue, San Francisco, CA 94112 (Tel: 415-337-1100; FAX 415-337-5205).

Astronomical League Meets in San Antonio.—The dates for this meeting, ALCON-95, are July 20-22, only about two weeks before the A.L.P.O. Wichita meeting. We are hoping that enough A.L.P.O. members will come to San Antonio to give papers that a special A.L.P.O session can be arranged. For further information and a registration form, contact: Registrar, ALCON-95, Valerie Kinnamon, P.O. Box 701261, San Antonio, TX 78270-1261 (Tel.: 210-690-9551).

Second Nightfall.—*Nightfall* is a deep-sky observers' conference/star party, scheduled at Borrego Springs, California, in the Anza-Borrego Desert, for the dark-of-the-moon nights bracketed by 22 - 24 September 1995. It will be held at a resort featuring hotel and RV facilities. For registration materials write to NIGHTFALL, c/o Fox & Stephens, CPA's, 9045 Haven Avenue, Suite 109, Rancho Cucamonga, CA 91730. Messages may be left at 909-948-2205.

Hear About and See What Happens When We Are Impacted.—The conference, "Ecological Consequences of Earth Collisions with Small Bodies in the Solar System," in Tomsk, Russia on July 20-23, will be followed by the "Fifth International Tunguska Expedition" to the Tunguska Meteoritic Park on July 24-31. For more information on either or both of these events, contact: Gennadij Andreev, Astronomical Observatory of the Tomsk State University, Box 1106, 634010 Tomsk, Russia (Tel.: 7-3822-909721; FAX: 7-3822-230450; E-Mail address: ok@siberia-ltd.tomsk.su *or* niipmm@urania.tomsk.su).

Kona Conclave.—The 27th Annual Meeting of the Division for Planetary Sciences of the American Astronomical Society will be held in Kona, Hawaii (Big Island), on October 8-13. With the Spring Lunar and Planetary Science Conference in Houston, this is one of the two major professional Solar-System meetings held each year. More information can be obtained from: Karen Meech, University of Hawaii, Institute of Astronomy, 2680 Woodlawn Drive, Honolulu, HI 96822 (her Internet address is: meech@pavo.ifa.hawaii.edu).

Unusual Meteors, Bolides, and Transient Lunar Phenomena.—David J. Robinson of S.H.A.R.P. Research requests literature and observed examples of the above for a research project. His address is: S.H.A.R.P. Research, 115 Berkeley Grange, Carlisle, Cumbria, Great Britain CA2 7PN.

OBITUARIES

Harold J. Stelzer (1909-1994)

Harold J. Stelzer passed away on October 7, 1994 after a long illness. He was a long-term member of the Chicago Astronomical Society, the American Association of Variable Star Observers (AAVSO), International Amateur-Professional Photoelectric Photometry (IAPPP) and the Association of Lunar and Planetary Observers; he was a Sustaining Member of our organization.

Harold had became active in amateur astronomy after his retirement from Sears, Roebuck and Company in 1969. On of his activities was the photoelectric photometry of variable stars, beginning in 1979 and submitted to the AAVSO and IAPPP. In addition, every clear day, Harold would prepare a solar disk drawing and sunspot count, contributing his data to the Solar Division of the AAVSO.

(We thank Gordon Garcia for the information used in the above notice.)

J. U. Gunter (1911-1994)

Dr. J.U. Gunter was one of the founding members of our Minor Planets Section and achieved an international reputation through his publication for over 15 years of *Tonight's Asteroids*, a bimonthly newsletter.

Born in 1911, Dr. "Jay" Gunter received his medical degree in 1938 and served as a pathologist from 1947 until his retirement in 1976. Following his retirement, Dr. Gunter became a leader in the area of amateur observation of minor planets, being honored in 1980 by the naming of Asteroid 2136 as *Jugta* (i.e., J. U. Gunter Tonight's Asteroids). He received the 1983 Amateur Achievement Award from the Astronomical Society of the Pacific and the 1989 Caroline Herschel Award from the Western Amateur Astronomers.

Dr. Gunter died peacefully on November 14, 1994, at the age of 83.

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.

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

Gregory L. Bohemier
RR2 Box 1306
Canton, MO 63435
Instrumentation and Equipment Selection

Bill Dembowski
1355 Virginia Avenue
Johnstown, PA 15906-2435
Lunar Photography

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

Harry D. Jamieson
P.O. Box 16882
Memphis, TN 38186-0882
Lunar; Instrumentation and Equip. Select.; Software—Astron. Programming

Andrew Paul Johnson
1 York Lane, Knaresborough, North Yorkshire
United Kingdom HG5 0AJ
Lunar

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

Robert D. Lunsford
161 Vance Street
Chula Vista, CA 91910
Meteors

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

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

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

Fred Pilcher
Illinois College,
Jacksonville, IL 62650
Minor Planets

Zac Pujic
23 Attungan St.
Kingston 4114
Queensland, Australia
Drawing Skills

Timothy J. Robertson
2010 Hillgate Way, Apt. L
Simi Valley, CA 93065
Lunar; Comets; Jupiter

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

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

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

Matthew Will
2112 Austin Drive
Springfield, IL 62704
Mars; Saturn

PUBLICATIONS OF THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

(All Section Publications on p. 95 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: 1995. $8.00 in the United States, Canada, and Mexico; $10.00 elsewhere (airmail included). Contains 132 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 16882, Memphis, TN 38186-0882, U.S.A:

① ***A.L.P.O. Section Directory--1995.*** *Free*; just send a stamped, self-addressed envelope. An 8-page description of each Observing Section's personnel, projects, and publications.

② ***A.L.P.O. Membership Directory.*** $5.00 in North America; $6.00 elsewhere. Continuously-updated list of members on MS-DOS diskette; specify 3.5-in or 5.25-in disk and whether DBASE or ASCII format. 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, and 11-12.
26 (1976-77); 3-4, 5-6, and 11-12 [each $1.75]. ***27*** (1977-79); 3-4, and 7-8 [each $1.75].
31 (1985-86); 5-6 and 9-10 [each $2.50]. ***32*** (1987-88); 5-6 [each $2.50].
33 (1989); 4-6, 7-9, and 10-12 [each $2.50]. ***34*** (1990); 2 and 4 [each $2.50].
35 (1991); 3 [$2.50]. ***37*** (1993); 1, 2, 3, and 4 [each $2.50]. ***38*** (1994-); 1 [$2.50].

Current Issue [***38***, 2]—$3.00.

KEEPING YOUR MEMBERSHIP CURRENT—

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., "38.1" means Vol. 38, 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, although we do not wish material that has been published or submitted elsewhere. Please submit double-spaced copy, either typewritten or printed; MS-DOS or Macintosh 3.5-inch diskette text (ASCII) files are very helpful as well. 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, exaggerate contrasts on drawings , photographs, and CCD images. Be sure to indicate the direction of celestial north or south, as well as celestial east or west if the image is laterally reversed.

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

Publications of the Sections of the A.L.P.O.

Order the following directly from the appropriate Section and person; use the address on p. 96 unless another address is given below.

Venus (Benton): (1) *The ALPO Venus Observing Kit*, $15.00. Includes introductory description of ALPO Venus observing programs for beginners, a full set of observing forms, and a copy of *The Venus Handbook.* **(2)** *Observing Forms Packet*, $8.50. Includes observing forms to replace the quantity provided in the Observing Kit above. Specify the *Venus Forms. (To order the above, send a check or money order made out to "Julius L. Benton, Jr." All foreign orders should include $4.00 additional for postage and handling; for domestic orders, these are included in the prices above. Shipment will be made in two weeks under normal circumstances.)*

Mars (Troiani): **(1)** *Martian Chronicle*; send 8-10 SASE's; published approximately monthly during each apparition. **(2)** *Observing Forms*; send SASE to obtain one form which you can copy; otherwise send $3.60 to obtain 25 copies (make checks out to "J.D. Beish").
Mars (Astronomical League Sales, 1901 South 10th St., Burlington, IA 52601): *ALPO's Mars Observer Handbook*, $9.00.

Jupiter (Olivarez): *Jupiter Observing Forms.* $4.00 postpaid ($7.00 overseas) for 25 forms; make checks payable to "José Olivarez." These forms are for disk drawings, descriptive reports, and central meridian transits.
Jupiter (Westfall): *Timing the Eclipses of Jupiter's Galilean Satellites*; send a SASE with 58 cents in stamps. This is the project "Observing Kit" and includes a report form. Indicate if you are interested in photoelectric observations, including the "Io Patrol." (Predictions for Galilean Satellite eclipses are given in the *A.L.P.O. Solar System Ephemeris* for each year.)

Saturn (Benton): (1) *The ALPO Saturn Observing Kit*, $17.50. Includes introductory description of ALPO Saturn observing programs for beginners, a full set of observing forms, and a copy of *The Saturn Handbook.* **(2)** *Observing Forms Packet*, $8.50. Includes observing forms to replace the quantity provided in the Observing Kit above. Specify the Saturn Forms. *(See note for Venus.)*

Solar (Maxson): (1) *Solar Rotation Reports*; send SASE's to receive this monthly newsletter. **(2)** *ALPO Solar Section Catalog of Data Vol. II*, $5.00. A list of over 6000 solar observations, observer profiles and Section history in the Solar Section available to aid in professional or amateur research. The first printing was in March, 1991; a second printing is based on demand.
Solar (Hill): *Handbook for the White Light Observation of Solar Phenomena,* $6.00. (A second volume of this Handbook is in preparation, with articles by the observers detailing their techniques and equipment.)
Solar (Graham): (1) *Eclipse of May 30, 1984--Scientific Results*, $5.00 Ppd. paperbound, $15.00 Ppd. hardbound. 40 pages, 10 investigations. **(2)** *Eclipse of October 3, 1986--Observations*, $5.00 Ppd. paperbound, $15.00 Ppd. hardbound. 20 pages, 6 authors, 10 investigations, theoretical contributions, and a commentary. **(3)** *Partial Eclipse of March 7, 1989—Observations*, $3.00 Ppd. paperbound only. (A *Handbook for Solar Eclipses* is under preparation.)

Lunar (Benton): (1) *The ALPO Lunar Section's Selected Areas Program (SAP)*, $12.50. Includes a full set of observing forms for the assigned or chosen lunar area or feature, together with a copy of the *Lunar Selected Areas Program Manual.* **(2)** *Observing Forms Packet*, $8.50. Includes observing forms to replace the quantity provided in the Observing Kit above. Specify the *Lunar* Forms. *(See note for Venus.)*
Lunar (Graham): (1) Forms with explanations (in English or German); send a SASE. **(2)** *Lunar Photometry Handbook*, $5.00 Ppd. paperbound, $15.00 Ppd. hardbound. **(3)** Orders are now being accepted for a *Lunar Eclipse Handbook*, $3.00 paperbound plus $1.00 shipping and handling. **(4)** Observations and studies of previous lunar eclipses are available, including the photometry of the 1987 penumbral eclipse. Please write for a free list, with prices, of available observational reports; include a SASE.
Lunar (Jamieson): A "Lunar Observer's Tool Kit," consisting of a 5-1/4-in. MS/DOS diskette containing an observational-planning program and a lunar dome data base with built-in instructions. Price $20.00.

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

Meteors (Astronomical League Sales, 1901 South 10th St., Burlington, IA 52601): The handbook, *Observe Meteors*, by David H. Levy and Stephen J. Edberg, is available for $6.00.

Minor Planets (Derald D. Nye, 10385 East Observatory Drive, Tucson, AZ 85747): Subscribe to: *The Minor Planet Bulletin*; quarterly, $9.00 per year for United States, Mexico and Canada; or $13.00 for other countries (air mail only).

The Association of Lunar and Planetary Observers

Founded in 1947, the A.L.P.O. now has about 600 members. Our dues include a subscription to the quarterly Journal, *The Strolling Astronomer*, and are $16.00 for one year ($26.00 for two years) for the United States, Canada, and Mexico; and $20.00 for one year ($33.00 for two years) for other countries. One-year Sustaining Memberships are $25.00; Sponsorships are $50.00. Associate Memberships, which do not include a Journal subscription, are $3.00 per year. There is a 20-percent surcharge on all memberships obtained through subscription agencies or which require an invoice.

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

All payments should be in U.S. funds, drawn on a U.S. bank with a bank routing number, and payable to "A.L.P.O." When writing our staff, please provide stamped, self-addressed envelopes.

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• Francis G. Graham •
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East Pittsburgh, PA 15112

—Lunar Section—
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(Recorder, Lunar Transient Phenomena)
416 W. Wilson St.,
Sun Prairie, WI 53590-2114
• Julius L. Benton, Jr. •
(Recorder, Selected Areas Program; Address under Venus Section.)
• Francis G. Graham •
(Recorder, Eclipses and Photometry; Address under Solar Section)
• Harry D. Jamieson •
(Recorder, Lunar Dome Survey; Address under Membership Secretary)

—Mercury Section—
• Richard M. Baum •
(Recorder)
25 Whitchurch Road
Chester CH3 5QA, UK

—Venus Section—
• Julius L. Benton, Jr. •
(Recorder)
Associates in Astronomy
305 Surrey Road
Savannah, GA 31410

—Mars Section—
• Jeff D. Beish •
(Recorder; New observer inquiries)
9460 Toni Drive
Miami, FL 33157-8754
• Donald C. Parker, M.D. •
(Recorder; CCD imaging, "Mars Project")
12911 Lerida Street
Coral Gables, FL 33156
• Daniel M. Troiani •
(Recorder; all observations; U.S. correspondence)
629 Verona Court
Schaumburg, IL 60193
• Carlos E. Hernandez •
(Recorder; all other correspondence)
8691 SW 32nd Terrace
Miami, FL 33155-3237

-Minor Planets Section-
• Frederick Pilcher •
(Recorder)
Illinois College
Jacksonville, IL 62650

—Jupiter Section—
• Phillip W. Budine •
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