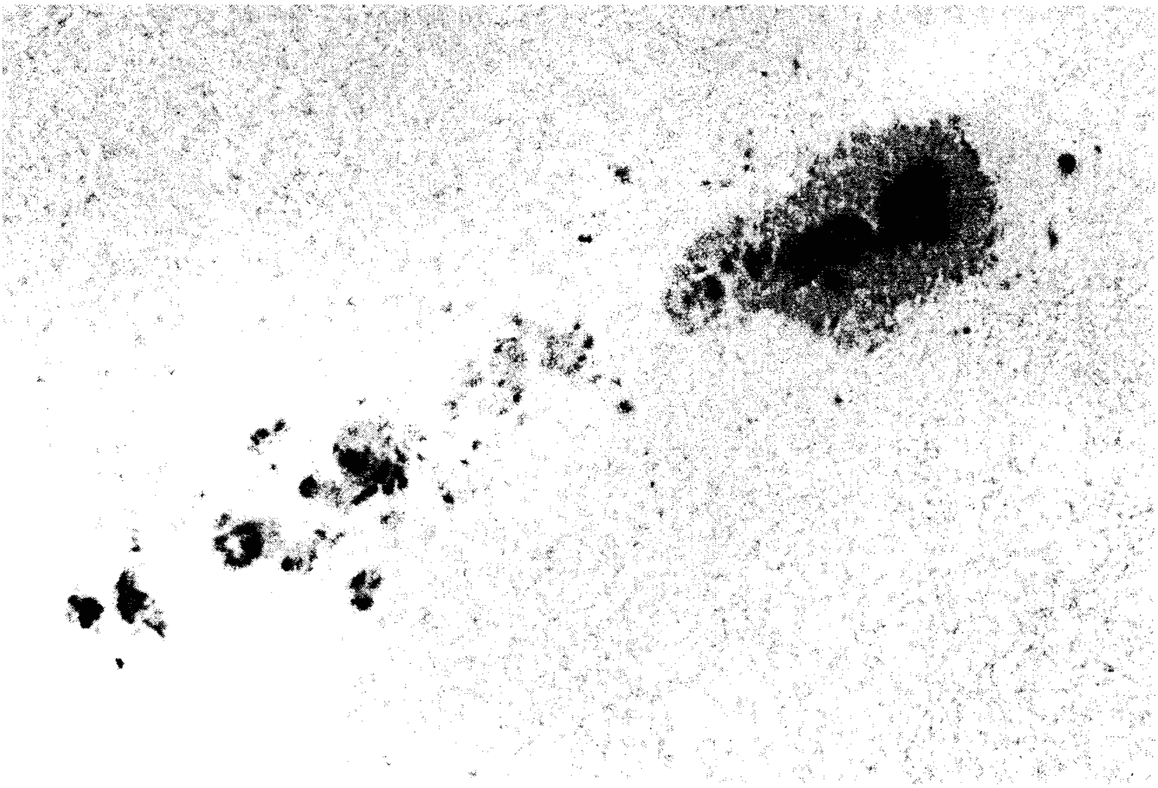
ISSN 0039-2502

# The Journal Of The Association Of Lunar And Planetary Observers

## *The Strolling Astronomer*

Volume 40, Number 4 Published October, 1998



Solar Activity Region 7590, photographed by Gordon Garcia on 1993 Oct. 02, 16h38m UT. Mr. Garcia used a 130-mm refractor telescope with eyepiece projection at f/74, exposing Kodak Technical Pan 2415 Film at 1/1000 second through Tuthill Solar Skreen Mylar and Wratten 58 (green) Filters. North at top. See also page 148 of text.

THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

Editor, John E. Westfall

A.L.P.O. Web Page:
http://www.lpl.arizona.edu./alpo/

Harry D. Jamieson
Membership Secretary
P.O. Box 171302
Memphis, TN 38187-1302

ASSOCIATION OF LUNAR & PLANETARY OBSERVERS ALPO Founded in 1947

# In This Issue




The Strolling Astronomer. Journal of the A.L.P.O.
Volume 40 Number 4. October, 1998

# A.L.P.O. SOLAR SECTION OBSERVATIONS FOR ROTATIONS 1873-1886 (1993 AUG 27.12 TO 1994 SEP 12.96)

By: Richard E. Hill, A.L.P.O. Solar Coordinator
(rhill@lpl.arizona.edu)

Solar activity was low to moderate for this period. A total of 210 numbered active regions were on the Sun during this time, with a mean International Sunspot Number, *R(I)*, of 35 and a mean American Sunspot Number, *R(A)*, of 36. There were a number of days with no spots at all, concentrated in rotations 1880-1883. R(A) was slightly higher than R(I) in terms of means, lows and highs for most of this period. The highest daily numbers were just over 100 for both R(I) and R(A). *Figure 1* (below) is a graph of the rotational means for this reporting period. In general, it shows that activity decreased about 20 percent over the year covered here.

Thirteen individuals contributed observations for this period and are listed, with their locations and instruments, in *Table 1* (p. 146). We extend our appreciation to them.

Most terms and abbreviations used in this report are defined in the old *Section Handbook*, now being rewritten by Assistant Coordinator, Jeffery Sandel. They are also explained in the Astronomical League book *Observe and Understand the Sun*, available from Astronomical League Sales, P.O.Box 572, West Burlington, Iowa 52655 for $5.75. References to sunspot classifications are explained in this latter publication, in "A Three-Dimensional Sunspot Classification System" (*J.A.L.P.O.*, *33*, Nos. 1-3, Jan., 1989, pp. 10-13; see also p. 155 here) and on our webpage for the White Light Flare (WoLF) Patrol at:

http://www.lpl.arizona.edu/~rhill/solar.html

All times used in this report are Universal Time (UT) and celestial directions are abbreviated (e.g., N, E, SW). Angular dimensions however, are heliographic. The term *group* refers to white-light collections of sunspots, while *region* refers to whole areas of activity in all wavelengths. Preceding and follower spots in a group are abbreviated *p-spot* and *f-*

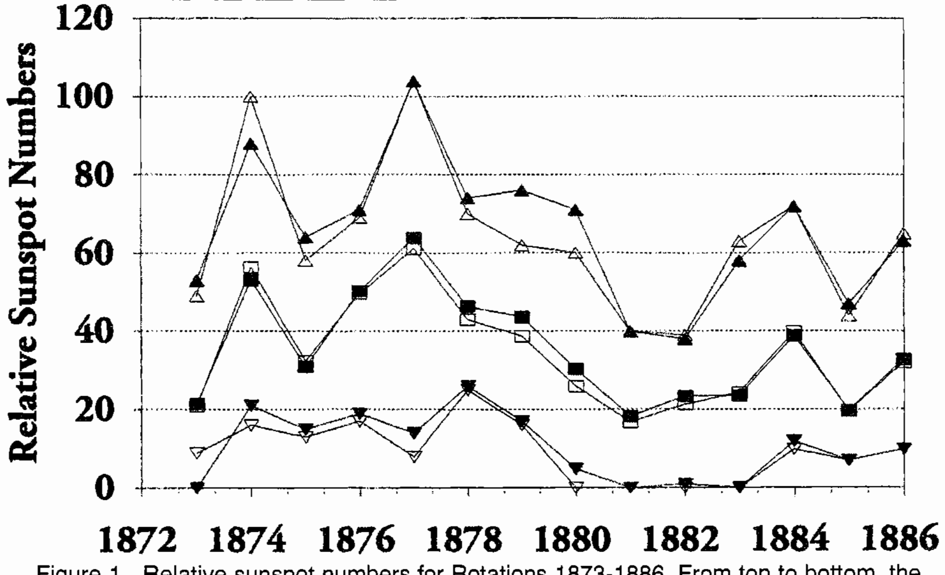



Figure 1. Relative sunspot numbers for Rotations 1873-1886. From top to bottom, the three groups of lines show rotational highs, means, and lows. Solid symbols are American Sunspot Numbers [R(A)]; open symbols are International Sunspot Numbers [R(I)].

**Table 1. A.L.P.O. Solar Section observers, Rotations 1873-1886.**

| Name | Telescope Aperture (cm) | F.L. (cm) | Type* | Stop (cm.) | Location |
|---|---|---|---|---|---|
| Robert Birket | 25 | 152 | rfl | n/a | Mesa, AZ |
| Dave Branchett | 20 | 200 | s-c | n/a | Deltona, FL |
| Mathew Damien | 60 | ? | rfr | n/a | Dickinson, ND |
| Jean Dragesco | 13 | ? | rfr | n/a | France |
| Gordon Garcia | 13 | 102 | rfr | n/a | Hoffman Estates, IL |
| Jan Janssens | 6 | 70 | rfr | n/a | Kapelle, Belgium |
| Paul Maxson | 25 | 152 | rfl | 15 | Phoenix, AZ |
| Frank J. Melillo | 20 | 200 | s-c | 6.4 | Holtsville, NY |
| Larry Scott | 20 | 122 | rfl | 10.2 | Tyler, TX |
| Fan-Lin Tao | 25 | 375 | rfr | n/a | Taipei, R.O.C. |
| Ronald C. Tanguay | 9 | 130 | mak | 4 | Saugus, MA |
| Brad Timerson | 11.4 | 127 | rfl | n/a | Newark, NY |
| Vince Tramazzo | 8.9 | 152 | mak | 6.4 | DeRuyter, NY |

*mak = Maksutov, rfl = Newtonian reflector, rfr = refractor, s-c = Schmidt-Cassegrain.

*spot*. Active Regions are designated by the prefix *AR* and are enumerated by the Space Environment Center (SEC) of the National Oceanic and Atmospheric Administration (NOAA) in Boulder, Colorado.

## Solar Cycle 23. Rotation 1873. 1993 Aug 27.12-1993 Sep 23.38

Relative Sunspot Numbers

| Type | Mean | Maximum Value | Maximum Date(s) | Minimum Value | Minimum Date(s) |
|---|---|---|---|---|---|
| R(I) | 20.9 | 49 | Aug 27 & 29 | 9 | Sep 10 & 12 |
| R(A) | 21.4 | 53 | Aug 28 | 0 | Sep 11 & 12 |

This report opens with a relatively inactive rotation. The American Sunspot Number shows two days of no spots at all. The best-observed group and the largest of this rotation was **AR 7576**. It was first observed by Fan-Lin Tao, already at what would be its maximum development as observed by ALPOSS (A.L.P.O. Solar Section) observers with a McIntosh Class of Cao and a standard area of 100-120 millionths of the hemisphere. True maximum development occurred several days earlier but we received no observations for that day. On Sep 04 Garcia got a good image of the group at 14h38m UT, showing it to be a Cro class with penumbra only well developed on the N side containing about a dozen umbrae. A curious radial line of darker granules was shown off to the NE. This was accompanied to the S by a scattering of pores and umbral spots. There was no clear f-spot. Drawings by Birket on Sep 05 showed some of the umbrae to be merging within the penumbra of the p-spot. The spots to the S remained largely unchanged but the area of the group had decreased by 10-20 percent. As the region reached the central meridian on Sep 06 a Maxson photograph showed that it had completely vanished. This was confirmed by Birket the next day with a total sunspot count of zero. This was the same longitude for AR 7561 on the previous rotation and that region also died on the disk near the central meridian.

## Solar Cycle 23. Rotation 1874. 1993 Sep 23.38-1993 Oct 20.66

Relative Sunspot Numbers

| Type | Mean | Maximum Value | Maximum Date | Minimum Value | Minimum Date |
|---|---|---|---|---|---|
| R(I) | 56.4 | 100 | Oct 04 | 16 | Sep 23 |
| R(A) | 53.1 | 88 | Oct 04 | 21 | Sep 23 |

This rotation was the second most active of this reporting period. There were no days of 0 spots as can be seen above. The largest, and best developed group of the rotation was **AR 7590**, at the same longitude as AR 7576 and AR 7561 of previous rotations, which came into view as a Dhi-class group on Sep 27, developed into an Fkc flare-producing group, and left the disk still a D class on Oct 09.

AR 7590 was first seen in a whole-disk photograph by Maxson on Sep 27, appearing then as a large spot with penumbra followed by a collection of smaller spots within a single penumbra. Several solar observers listed it initially as an Eki group but its morphology was more consistent with a Dhi or Dki classification. No observations were reported on Sep 28, but for Sep 29 Melillo submitted a pair of photographs that well documented this active region, shown as *Figure 2* and *Figure 3* on p. 147. The entire group was visible to the naked eye now and classed as Fki of 1100 millionths of the visible hemisphere in area

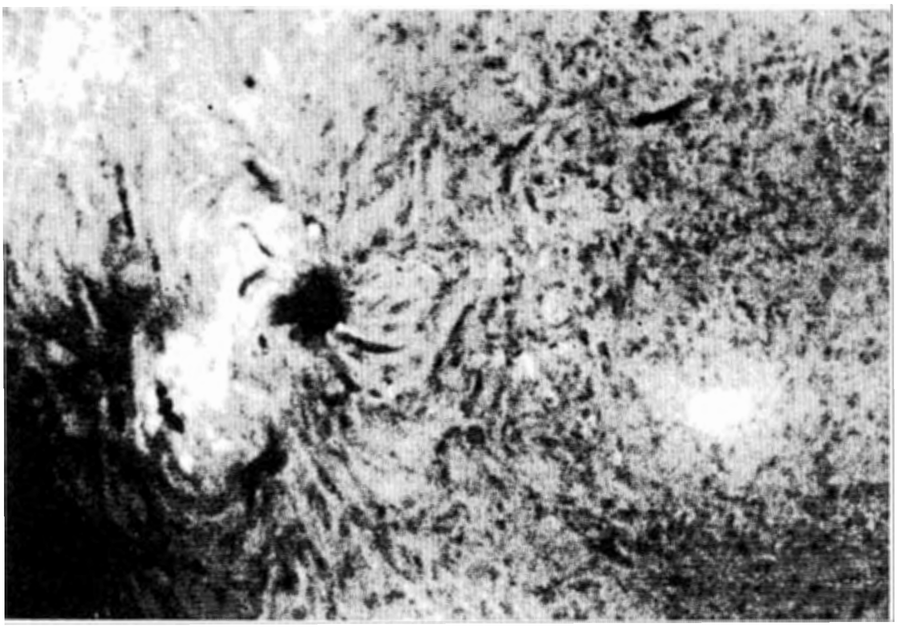


Figure 2. H-α photograph of AR 7590/91 by Frank J. Melillo, 1994 SEP 29, 21h00m UT. 8-in (20-cm) Schmidt-Cassegrain with 2.5-in off-axis stop at f/30. 0.25 sec on Kodak TP 2415 Film with a 0.6-Å bandpass filter. North to upper left. Compare with Figure 3 below.

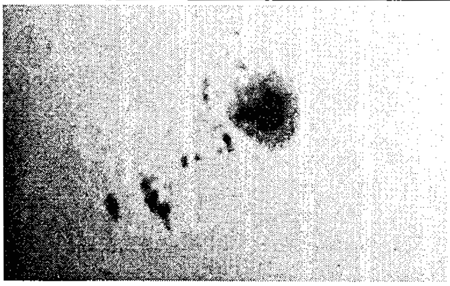


Figure 3. White-light photograph of AR 7590/91 by Frank J. Melillo, 1994 SEP 29, 21h05m UT. Scale and telescopic and photographic data as for Figure 2. North to upper left.

(the standard unit of area measurement of sunspots). The white-light image of the region showed a large E-W oriented, teardrop-shaped spot consisting of massive umbrae in a tight but well-organized penumbra. This feature was followed by spots and pores, many with rudimentary penumbrae, extending about half the distance back to the f-spots. The f-spots were grouped in four tight clusters. Three of the clusters were closely aligned N-S with rudimentary penumbrae on the f-side and a wreath of faculae surrounding. The fourth spot followed this grouping by about 3° or 4° of longitude, and consisted of several umbrae with rudimentary penumbra on the following side and surrounded by faculae.

Melillo's H-α image, taken five minutes earlier than the white-light one, showed a bright neutral line of magnetic polarity running from just N of the l-spot to a plage surrounding the grouping of three f-spots. The fourth f-spot appeared almost completely cut off from the rest of the group. Clearly, the area just preceding the f-spots was a good site for flares.

The next observations reported to the Solar Section were on OCT 01. In a Maxson whole-disk photo at 16h37m UT the l-spot was then seen as more elongated and no longer teardrop-shaped. The area of the group now exceeded 1000 millionths of the visible hemisphere. There were many smaller spots surrounding this l-spot and a umbral projection across the penumbra connecting with one of these small spots to the S. The l-spot was merging on the following side, with some of the small spots, which were already incorporated into the penumbra of the l-spot. The alignment of f-spots had rotated and was nearly E-W now but the fourth spot was still isolated as before. A Melillo H-α photograph at 21h00m UT showed a more quiescent configuration than on SEP 29. A large plage preceded the f-spots and the neutral line could still be seen snaking from N of the l-spot down between the l-spot and f-spots to just S of the f-spots.

By Oct 02, dramatic changes had taken place in the group. The whole group now spanned over 25° of longitude. A spectacular Garcia photograph showed that all umbrae in the group, both l-spot and f-spots umbrae, had aligned E-W. The l-spot was now quite large and a naked-eye spot. The l-spot penumbra enclosed no less than 12 separate umbrae and was over 5° longitude in length. This was followed by fragmentary penumbrae and then the f-spots. These were now umbrae, apparently compressed from the S, with rudimentary penumbra to the north. Following this feature was more fragmentary penumbral material with some umbral dots and pores. The former fourth spot was now two small collections of umbral spots in fragmentary penumbrae. The group was still Fki class and definitely a potential flare-producing group, though none were reported. This region crossed the central meridian on Oct 03, was then even longer and the l-spot more massive. The general appearance of the disk at that time is shown in *Figure 4*, below, while AR 7590 is shown enlarged on the front cover. The l-spot umbra, at a lower magnification or in a whole-disk image, appeared as a single long zig-zag, jagged hole in the Sun. It was quite dramatic, as if someone had spilled ink across the Sun's central meridian. A well-organized penumbra surrounded the umbra. On the S side of this penumbra in the middle of the spot was a disturbance or penumbral projection; a high-resolution image would have helped to clear up this ambiguity. The spots following this spot were largely unchanged from the day before.

The area of AR 7590 decreased substantially from over 1000 millionths of the visible hemisphere on Oct 03 to less than 300 millionths by Oct 04. The penumbra

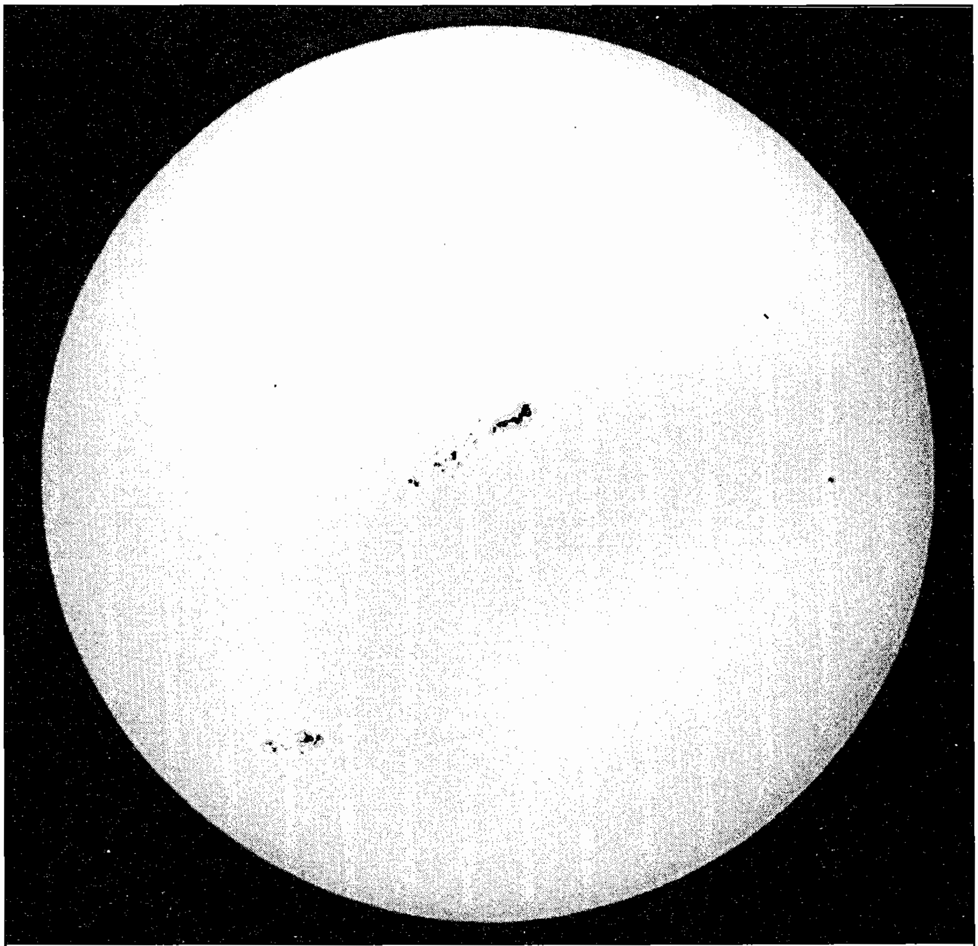


Figure 4. Whole-disk solar image in yellow-orange light by Gordon Garcia. 1993 Oct 03, 16h33m UT. 130-mm refractor with Barlow lens at f/17.7. 1/500 sec. on Kodak TP 2415 Film. North at top. AR 7590 is near the central meridian. See also front cover.

was breaking up to some degree around the l-spot. The penumbrae and umbral spots in the middle of the group had coalesced into a tight cluster. The f-spots now remained as only one or two umbrae in a small rudimentary penumbra. The last f-spot was about the same in area as the day before, consisting of several umbrae in a rudimentary penumbra, as seen by Garcia, Maxson and Melillo. In a Melillo H-α image the middle of the group was seen involved in a large plage and the last remaining umbra of the l-spot was cut off by a bright light bridge. This was a good site for flares as it was also close to the neutral line. The last f-spot still appeared cut off from the rest of the group.

On OCT 05 a Maxson whole-disk photograph showed that the l-spot was being broken up by light bridges and the f-spots were dissolving. A high-resolution image on OCT 06 by Melillo showed the process of dissolution continuing. The l-spot was by then in three large pieces with smaller fragments surrounding them. There was little left of the f-spots but the very last f-spot was still relatively disconnected from the rest of the group. The group was now classed Eki and had an area less than 300 millionths of the visible hemisphere. This situation continued with the smaller spots dissolving and the larger l-spot pieces decreasing in area until it was last seen passing over the limb in a Maxson whole-disk image at 16h50m UT on OCT 09.

## Solar Cycle 23. Rotation 1875. 1993 OCT 20.66-1993 NOV 16.97

Relative Sunspot Numbers

| | | Maximum | | Minimum | |
|---|---|---|---|---|---|
| Type | Mean | Value | Date(s) | Value | Date(s) |
| R(I) | 32.3 | 58 | OCT 23 | 13 | NOV 01 |
| R(A) | 31.0 | 64 | OCT 21 | 15 | NOV 12 |

Activity decreased in this rotation but there were no days of 0 spot counts; thus almost all of the decrease can be attributed to a reduction in the days of highest counts. This rotation also experienced a decrease in observational coverage. A total of 22 observations were submitted for the entire rotation; 15 were from Fan-Lin Tao of the Taipei Observatory and were whole-disk maps for sunspot-counting purposes and hence had little or no detail. The best-developed regions of this rotation, **AR 7613** and **AR 7618**, were not covered at all.

Observations by Birket, Maxson and Tao best covered the meridian passages of **AR 7602**, **AR 7603** and **AR 7605**; three groups that were never achieved as much as 200 millionths in area and did not develop past class Dso.

## Solar Cycle 23. Rotation 1876. 1993 NOV 1697-1993 DEC 14.28

Relative Sunspot Numbers

| | | Maximum | | Minimum | |
|---|---|---|---|---|---|
| Type | Mean | Value | Date(s) | Value | Date |
| R(I) | 49.7 | 69 | NOV 30 | 17 | DEC 13 |
| R(A) | 50.3 | 71 | NOV 30 & DEC 04 | 19 | DEC 13 |

Sunspot activity was slightly increased for this rotation as compared with the previous one. However, Section observational coverage was extremely poor. Again Fan-Lin Tao submitted a fair number of spot maps (14) but only one other observation was submitted, a good H-α drawing of limb prominences and sunspots on NOV 25 by Tramazzo. This set of observations was insufficient data for any analysis of any activity.

## Solar Cycle 23. Rotation 1877. 1993 DEC 14.28 - 1994 JAN 10.61

Relative Sunspot Numbers

| | | Maximum | | Minimum | |
|---|---|---|---|---|---|
| Type | Mean | Value | Date | Value | Date |
| R(I) | 61.1 | 104 | JAN 05 | 8 | DEC 15 |
| R(A) | 53.1 | 104 | JAN 05 | 14 | DEC 15 |

Activity increased during this rotation to the highest levels of the reporting period. Observations from Section members doubled to two! Tao contributed seven spot maps but no observations submitted for the period were detailed enough to do any activity analysis.

## Solar Cycle 23. Rotation 1878. 1994 JAN 10.61-1994 FEB 06.96

Relative Sunspot Numbers

| | | Maximum | | Minimum | |
|---|---|---|---|---|---|
| Type | Mean | Value | Date(s) | Value | Date |
| R(I) | 43.0 | 70 | JAN 24 | 25 | JAN 17 |
| R(A) | 46.4 | 74 | JAN 24 & 25 | 26 | JAN 17 |

Sunspot activity decreased from the previous rotation by about 30 percent in this rotation. Ten spot maps were submitted

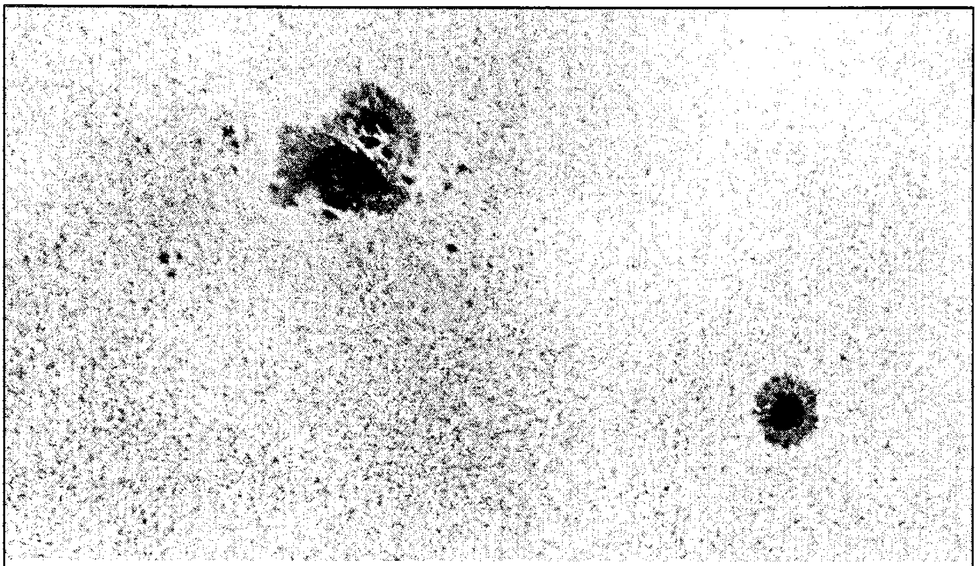


Figure 5. AR 7652 (right) and 7654 (left), photographed on 1994 JAN 22, 17h38m UT, by Gordon Garcia. 130-mm refractor with eyepiece projection at f/74. 1/1000 sec on Kodak TP 2415 Film. Solar Skreen and W 58 (green) Filters. North at top.

by Tao and five additional observations by Section members.

On JAN 22, Garcïa obtained two good high-resolution images of **AR 7654** as a well-developed Dkc group when it was on the central meridian. This had been an active, flare-producing region for several days, covering 650 millionths of the visible disk on JAN 22. Garcia's first image, at 17h38m UT, appears in *Figure 5*, above, and showed the l-spot to be composed of about a dozen umbrae, including one large one (that may actually have been several that were just underexposed as umbrae often are) in a very complex penumbra. To the E the penumbra was disorganized and fragmented, to the W it was completely fragmented on the N side, while it was fairly well organized to the S. Between the two largest collections of umbrae in the spot were some bright regions, possibly light bridges, only a little wider than granules but a few arc seconds long, that appeared to be covering over some of the spots in the smaller collection of umbrae. These were probably good sites for flaring. This l-spot was followed at some distance, almost 10°, by a solitary spot that was a single umbra in a well-organized penumbra. The changes were very rapid in this region as shown in Garcia's second image at 18h11m UT. By this time, only half an hour later, the thin bright areas in the l-spot had been replaced by a less elongated bright spot and the penumbra to the W was better organized. Also, the spots in the smaller umbral collection were much darker and better defined than in the earlier image.

## Solar Cycle 23. Rotation 1879. 1994 FEB 06.96-1994 MAR 06.29

### Relative Sunspot Numbers

| | | Maximum | | Minimum | |
|---|---|---|---|---|---|
| Type | Mean | Value | Date | Value | Date(s) |
| R(I) | 38.7 | 62 | MAR 03 | 16 | FEB 20 |
| R(A) | 43.6 | 76 | MAR 03 | 17 | FEB 21 |

Solar activity continued in a moderate decline during this rotation. Very low numbers of observations were reported. Jean Dragesco submitted eight H-α images, Tramazzo sent in one H-α drawing, including limb prominences, while nine spot maps were submitted by Tao.

A series of images **of AR 7668** on FEB 09 and 10 gives us a snapshot of this region. At 10h45m UT on JAN 09 this Dao region appeared in H-α as a large l-spot with an almost equal-sized f-spot, all covering just under 300 millionths of the disk. Between the two were some smaller spots and a bright plage. This plage connected with the l-spot on the SW side, forming a trident shape on that side of the spot. The S arm of the trident was a separate plume emanating from the umbral/penumbral border. This was probably a site for the several short sub-flares from this group that day.

In the FEB 10, 13h50m UT, image the plage and "trident" were gone. However, on the N-side of the l-spot were two small, bright plumes in a line with the center of the umbra. There were no other observations for those two days, but on FEB 12 Tramazzo recorded a prominence, possibly a loop, where this group was on the limb.

We get another glimpse of an interesting active region on FEB 17 and 19. The region was **AR 7671**, the largest sunspot group of this rotation, attaining an area of just over 400 millionths late on FEB 17. The H-α image for that day shows a l-spot only, which was the bulk of the group. This spot consisted of two massive umbrae (possibly consisting of a number of smaller umbrae but unresolved in the photographs) that were nearly touching. The larger of the two was fairly round and the other was teardrop-shaped. These were enclosed in a single penumbra. A large filament arced in a semicircle around the group. This may have been part of a larger filament structure that passed through **AR 7670** to the W. By FEB 19 the arc was larger, covering more than 180° of the spot's circumference, as shown by Jean Drasgesco's photograph of that date, given in *Figure 6*, below. The umbrae were merged and a weaker filament structure that started at the following end of the spot (the end with the larger umbral mass) snaked across the Sun to the W for some 20°. Further coverage of this region would have been interesting.

## Solar Cycle 23. Rotation 1880. 1994 MAR 06.29-APR 02.60

Relative Sunspot Numbers

| | | Maximum | | Minimum | |
|---|---|---|---|---|---|
| Type | Mean | Value | Date | Value | Date |
| R(I) | 26.0 | 60 | MAR 06 | 0 | APR 02 |
| R(A) | 30.4 | 71 | MAR 06 | 5 | APR 02 |

Activity continued its decline during Rotation 1880. A total of four photographs, two each from Timerson and Garcia, were submitted, along with 12 sunspot maps by Tao. This dataset was insufficient for any analysis of what little solar activity there was.

## Solar Cycle 23. Rotation 1881. 1994 APR 02.60-1994 APR 29.86

Relative Sunspot Numbers

| | | Maximum | | Minimum | |
|---|---|---|---|---|---|
| Type | Mean | Value | Date(s) | Value | Date(s) |
| R(I) | 16.8 | 40 | MAR 24 | 0 | (4 days) |
| R(A) | 18.3 | 40 | MAR 22 & 24 | 0 | APR 03 & 07 |

A further decrease in sunspots throughout this rotation led to the lowest level of this reporting period. Days of 0 counts appeared again. The contributions of observations also remained at a low level for this rotation. Still, one observation

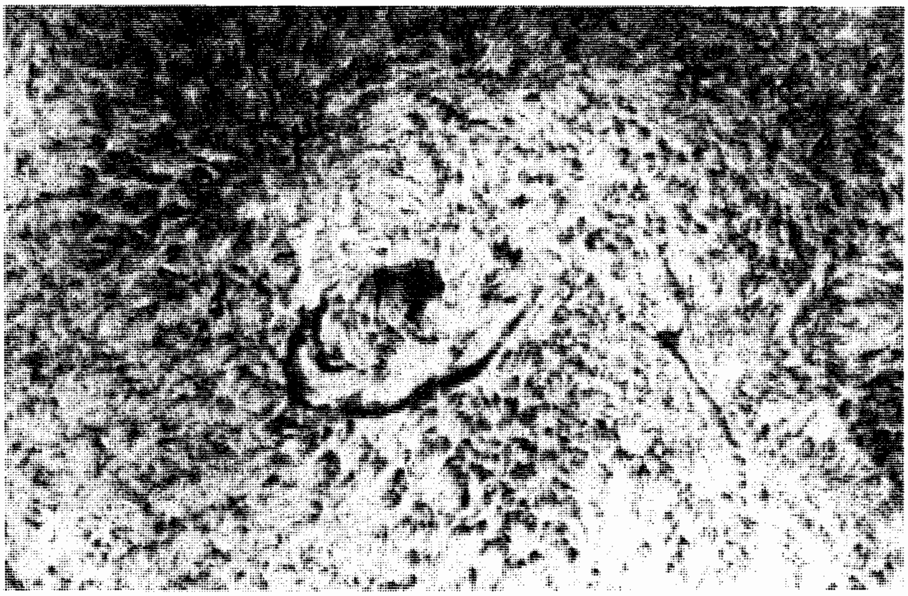


Figure 6. H-α photograph by Jean Dragesco, showing AR 7671. 1994 FEB 19, 10h39m UT. North at top.

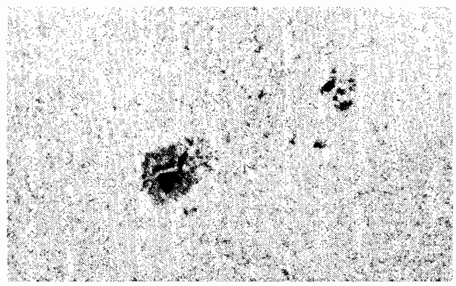


Figure 7. AR 7705 in white light, photographed by Gordon Garcia on 1994 APR 23, 16h59m UT. 130-mm refractor with eyepiece projection at f/48. 1/1000 sec on Kodak TP 2415. North at top.

was of particular note. An arc-second quality image of the Dao group **AR 7705** by Garcia on APR 23, given above as *Figure 7*, showed a curious light bridge dividing the l-spot in two. The spot consisted of a triangular umbral mass surrounded by a fairly symmetrical penumbra except for the E (following) end where it was fragmented. From the front center of the spot, cutting across it in a zig-zag manner, was a light bridge of uniform width that cut off the upper point of the triangular umbral mass. An H-α image of this spot would undoubtedly have been very useful. Following this was a collection of pores and umbral spots, all in a rudimentary penumbra.

## Solar Cycle 23. Rotation 1882. 1994 APR 29.86-1994 MAY 27.08

Relative Sunspot Numbers

| | | Maximum | | Minimum | |
|---|---|---|---|---|---|
| Type | Mean | Value | Date | Value | Date |
| R(I) | 21.3 | 39 | MAY 17 | 0 | MAY 26 |
| R(A) | 23.4 | 38 | MAY 17 | 1 | MAY 26 |

The pace of solar activity remained very low during this rotation. While the number of contributions by observers was very low, it was higher than in many other Rotations in this period. Still it was only enough to give us a brief glimpse of some of the activity that did occur.

**AR 7722** was covered for two days by Timerson and Garcia. On MAY 14 at 13h12m UT, a Timerson photo showed this group (at a relative heliographic position of N08°/E45°) to consist of a large l-spot that was completely bisected by a light bridge so that it appeared to be two spots aligned E-W. This region was classified as Dao with an area just over 300 millionths. A smaller spot to the S led these two by a few degrees. This spot was followed by a large facular patch some 10° long. A week later, on MAY 21, white-light (15h43m UT) and H-α (16h34m UT) images by Garcia showed this group (then at N09°/W48° or the exact other side of the CM) to be not only quiescent, but remarkably unchanged. It was then a Cko group with about the same area as before. This comparison demonstrates how poor coverage can lead to false impressions. One might conclude from this that nothing of any note happened, but data from NOAA show that this region developed rapidly, attaining a maximum area and complexity on MAY 17-18 as a Dko group, and then decayed back to the configuration seen by Garcia.

## Solar Cycle 23. Rotation 1883. 1994 MAY 27.08-1994 JUN 23.28

Relative Sunspot Numbers

| | | Maximum | | Minimum | |
|---|---|---|---|---|---|
| Type | Mean | Value | Date(s) | Value | Date(s) |
| R(I) | 24.4 | 63 | JUN 11 | 0 | (10 days) |
| R(A) | 23.6 | 58 | JUN 14 | 0 | (many days) |

While overall activity rose during this rotation, the number of days with no spots was the most for the reporting period. The rise in activity can be attributed to an over 30-percent increase in the peak number from the previous rotation and more days with numbers near that peak. The rotation opened with low counts, almost all of the activity occurring in the latter half of the rotation.

Only three photographs were submitted, along with 16 sunspot maps by Tao. The photographs are excellent examples of the quiescent Sun near sunspot minimum. None of the major groups responsible for increased activity in the latter half of this rotation were covered by Section observers.

## Solar Cycle 23. Rotation 1884. 1994 JUN 23.28-1994 JUL 20.48

Relative Sunspot Numbers

| | | Maximum | | Minimum | |
|---|---|---|---|---|---|
| Type | Mean | Value | Date | Value | Date |
| R(I) | 39.9 | 72 | JUL 11 | 10 | JUN 27 |
| R(A) | 38.9 | 72 | JUL 11 | 12 | JUN 27 |

Solar activity rose slightly during this rotation and it did so in all three statistical categories of relative sunspot numbers—Mean, Maximum and Minimum. Data submitted by Section observers more than doubled from the previous rotation, but only covered the latter half of the rotation. Three groups attained areas of 200 millionths, less than half the area needed to reach naked-eye visibility. None attained a classification more developed than Dao.

On a whole-disk image by Timerson taken on JUL 04 at 17h17m UT the two largest sunspot groups of the rotation can be seen: **AR 7742** in the SW quadrant and **AR 7746** in the NE. AR 7742 was a large spot that had been bisected by a light bridge and hence only had penumbra on the outboard sides of the two remaining spots. AR 7746 was seen as a large umbra, consisting of a number of smaller umbrae, in a single penumbra. During the next week this region grew in size and complexity. In the next Timerson photo, on JUL 12, AR 7746 was only a couple of small spots with penumbrae. A series of photographs by Timerson and Garcia and drawings by Scott showed the beginning of the passage of AR 7757. This unremarkable and probably decaying group came on the disk as Dao with one larger l-spot followed by some umbrae and decayed into a Cso group by the time it reached the central meridian.

## Solar Cycle 23. Rotation 1885. 1994 JUL 20.48-1994 AUG 16.71

### Relative Sunspot Numbers

| | | Maximum | | Minimum | |
|---|---|---|---|---|---|
| Type | Mean | Value | Date(s) | Value | Date |
| R(I) | 19.7 | 44 | AUG 14 | 7 | JUL 29 |
| R(A) | 19.8 | 47 | AUG 13 | 7 | JUL 29 |

Activity decreased in this rotation to the second lowest level in the reporting period. Though there were no days of 0 sunspots, the overall numbers were lower throughout as compared to the previous rotation. Unlike the sunspot numbers, the numbers of observations from Section members increased dramatically.

At the same position as the developing region AR 7735 in rotation 1884, **AR 7765** was the best-developed and largest group seen on the Sun in several rotations. Its passage across the disk was covered by Branchett, Garcia, Scott and Tao. It was first seen by Tao and Scott on AUG 12 as a Cao group (but listed as Dai by most observatories). It's a pity that no one caught it on AUG 11 as it developed into the Cao class in a matter of hours. There was some confusion by observers as this group formed between ARs 7762 and 7764, interrupting the numerical sequence of regions across the disk. It more than doubled its area from just under 100 millionths to over 200 on AUG 13 and had developed into a Dai group as seen by Branchett. The l-spot was a few umbral spots in a rudimentary penumbra followed by umbral spots. The f-spot comprised several collections of umbral spots in a rudimentary penumbra followed by a few umbral spots. Further development had occurred by AUG 14 and the region was listed as an Eac, although a Branchett drawing shows it more like an Ekc. The l-spot was several collections of umbral spots with penumbrae followed by a large collection of umbral spots divided into two groups in a complex penumbra. The leading portion of this large spot was about half a dozen umbrae followed by a line of a half-dozen such spots aligned NW-SE, all in the same penumbra. This feature was followed by a few umbral spots in a rudimentary penumbra. A day later, on AUG 15, many of the umbral spots in the l-spot appeared to have coalesced into three main spots, each with a penumbra. The foremost l-spot was fairly circular, with radial penumbra followed by a line of four umbrae in rudimentary penumbra. To the NE of this was another line of four umbrae in fragmentary penumbra. The f-spot was composed of three spots. The first of these was a V-shaped collection of umbrae in rudimentary penumbra followed by at least a half-dozen umbrae in a NW-SE line surrounded by a well-organized penumbra. These umbrae were followed by a few umbral spots in rudimentary penumbra as seen in a Garcia photograph. In an H-$\alpha$ photograph by the same observer, clear polarity could be seen by the arrangement of the fibrils but no clear neutral line was apparent. All in all AR 7765 was rather quiescent for an Ekc group.

The decay of this group was obvious by AUG 16, when a Branchett drawing showed only three spots with penumbrae. The l-spot consisted of 4-6 umbrae in a single penumbra. The middle spots were largely unchanged while the f-spot consisted of 4-6 umbrae in a rudimentary penumbra. On AUG 17 Tao and Branchett recorded faculae around the region, which was little changed from the day before but was somewhat reduced in area from about 200 to approximately 150 millionths. As it neared the limb on AUG 18, there were still three main spots to the group, as shown in a drawing by Branchett and a drawing and photograph by Scott . The last observation of this active region was on AUG 19 by Branchett, when only the middle and f-spots could be seen in the faculae. They appeared smaller but otherwise relatively unchanged.

## Solar Cycle 23. Rotation 1886. 1994 AUG 16.71-1994 SEP 12.96

### Relative Sunspot Numbers

| | | Maximum | | Minimum | |
|---|---|---|---|---|---|
| Type | Mean | Value | Date | Value | Date |
| R(I) | 32.0 | 65 | SEP 05 | 10 | SEP 12 |
| R(A) | 32.0 | 63 | SEP 05 | 10 | SEP 12 |

In this rotation, activity increased and the submissions of data from observers soared. The largest and best-developed region of the rotation was **AR 7773**. It attained a maximum area of nearly 600 millionths of the Sun's disk only two days after coming into view, making it the first naked-eye sunspot in several rotations. There was no visible sunspot group at its longitude during the previous rotation.

The first observations of AR 7773 were on AUG 30, by Branchett and Scott. The region was then on the limb with all observations showing a large l-spot with penumbra followed by much smaller umbral spots. A Scott photograph at 14h38m UT was the earliest observation of the region. It shows a small bright facular complex to the N of the visible group and, most amazingly, a clear but very small protuberance beyond a clean limb. He was using a Solar Skreen Filter with a Wratten 47 Filter for a very blue image so it is likely that this was high facular material. Branchett, observing about five hours later, did not show this protuberance. On AUG 31 the l-spot was quite large, about 5° in heliocentric diameter, classed as Ekc, with a well-developed radial penumbra followed by umbral spots. Bright faculae surrounded the group, and in excellent detailed drawings by Branchett, fingers of faculae are shown to be reaching back from the l-spot to the followers. Branchett's drawings for AUG 30 and 31 are shown in *Figure 8*, to the upper right.

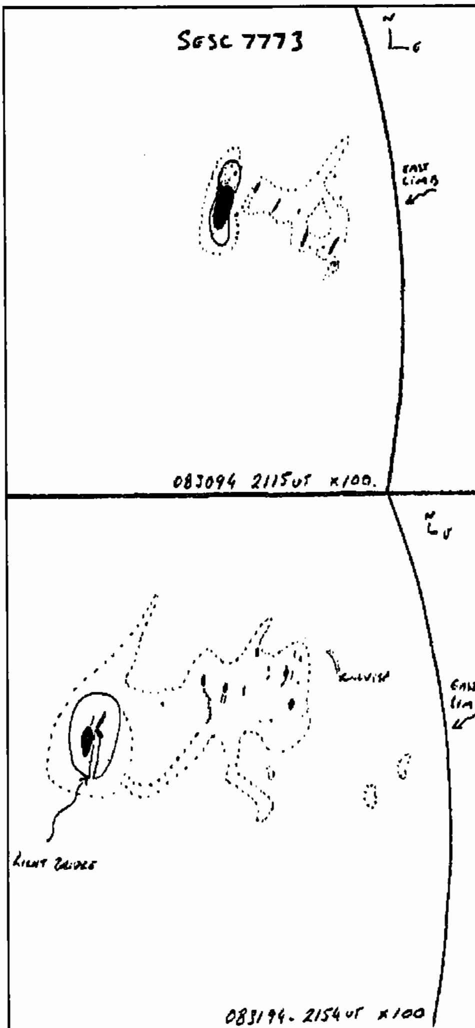


Figure 8. Two drawings by David Branchett. showing AR 7773 on 1994 AUG 30, 21h15m UT (top) and AUG 31, 21h54m UT (bottom). North at top.

For SEP 01, the day of maximum development, we received no observations; but on SEP 02 AR 7773 was an Eki-class group, occupying some 500 millionths of the disk, making it visible to the filtered naked eye. The l-spot was by then a collection of umbrae aligned E-W in a well-developed penumbra followed by two groupings of tiny umbral spots in rudimentary penumbra. The f-spot contained several large umbrae in a penumbra with two smaller detached spots with penumbrae to the N. It was still Eki class on SEP 03 when Branchett observed the f-spot umbrae to be arranged in a u-shape, open to the SE. By the next day, still classed as Eki, this mass of umbrae was breaking up and the penumbra was less symmetrical. Many small umbral spots in rudimentary penumbra made up the f-spot and there were many tiny umbral spots between leader and follower.

On SEP 05, the day of its central-meridian crossing, AR 7773 was much the same, although the l-spot was becoming more elongated E-W. One day later, the l-spot had broken into two pieces with penumbrae on both. On the leading edge of the leading l-spot was a S-pointing hook of penumbra. The rest of the group was largely unchanged. This leading l-spot had rotated nearly 90° by the next day, SEP 07, and the penumbral "hook" was now pointing to the ESE. The piece that had detached the following l-spot was shrinking and now contained only tiny umbral spots. The f-spot was also dissipating and consisted only of umbral spots without penumbra, with the total area of just under 400 millionths. The next observations, on SEP 10, show the spot near the limb and a solitary large spot with penumbra, classed Hhx. Faculae were seen around this spot on SEP 11, the last day it was observed. It was then so close to the limb that Branchett recorded it as just a slender line.

## CONCLUSION

We hope that this report shows the need to document solar activity and also solar inactivity. The Solar Section is now accepting solar observations in a wide variety of formats; including drawings, photographs, CCD images, video and even verbal descriptions of unusual activity. If you are interested in contributing, even if just on weekends, you are strongly encouraged to contact Assistant Coordinator Gordon Garcia or the author, or you can go to our website at:

http://www.lpl.arizona.edu/alpo

and find there the guidelines to observing with our Section.

It is with much sadness that we note the passing of one of the A.L.P.O.'s, and specifically the Solar Section's, greatest supporters, Donald Trombino. His efforts at promoting the work of our observers was ceaseless and just a few weeks before his recent death he represented the Solar Section admirably at a NOAA meeting in Boulder, Colorado. We will miss his support, and his wonderful sense of humor. His death is a great loss to us all.

## REFERENCES

*Solar-Geophysical Data (Prompt Reports)*, Part I, No.590, October 1993.
________, No.591, November 1993.
________, No.592, December 1993.
________, No.593, January 1994.
________, No.594, February 1994.
________, No.595, March 1994.
________, No.596, April 1994.
________, No.597, May 1994.
________, No.598, June 1994.
________, No.599, July 1994.
________, No.600, August 1994.
________, No.601, September 1994.
________, No.602, October 1994.
________, No.603, November 1994.

### 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°-1°°. **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**

$\alpha$ = Unipolar. $\beta$ = Bipolar. $\gamma$ = Complex polarity. $\delta$ = Opposite polarity umbrae in a single penumbra.

**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** = $10^{-3}$.

# THE 1998-1999 APHELIC APPARITION OF MARS

## By: Jeffrey D. Beish; with Donald C. Parker, Daniel Troiani, and Daniel Joyce; A.L.P.O. Mars Section

## INTRODUCTION

Recent spacecraft missions have sparked renewed public interest in planetary sciences. The Mars Global Surveyor mission will bring the first close-up surveillance of the Red Planet Mars since the Viking-1 and -2 visits during the mid-1970s and early 1980s. While the past accomplishments of United States space missions have yielded volumes of scientific information we still ponder many questions about the Earth-like planet Mars.

Some questions remain unanswered: Are the polar climates static or are they changing over long periods of time? Can surface wind directions be inferred from cloud formations and movements? Are equatorial water-ice crystal clouds seasonal? If so, can their appearance and locations be predicted? What causes the secular (long-term) changes in dark albedo features? Are their locations topographically controlled or do they result from unseasonable winds? These are just a few of the important questions remaining.

Still an intriguing world, Mars offers both the casual and serious observer many challenges and delights. This planet offers astronomers a free laboratory for the study another planet's atmosphere: the behavior of condensates and effects on its atmosphere. Mars is similar to Earth in that it has four seasons, exhibits global climates, changing weather patterns, annual thawing of polar caps, storm clouds of water ice, howling dusty winds, and a variety of surface features which predictably change in color and size and move about the surface over long periods of time.

## THE A.L.P.O. AND THE I.M.P.

The International Mars Patrol (I.M.P.) is an international cooperative effort among individual observers and members of observing groups located around the world. Established in the late 1960s by Charles F. Capen, the I.M.P. has contributed more than 30 thousand observations of Mars. Contained within the archives of the A.L.P.O. Mars Section library are the records of 15 apparitions of Mars covering a span of 35 terrestrial years.

Since the late 1960s, interested amateur and professional astronomers in 47 foreign countries and American territories have cooperated in a continuous watch of the Red Planet Mars. Additional support is provided by the British Astronomical Association (B.A.A.), the Arbeitskreis Planetenbeobachter (Germany), as well as Japan's Oriental Astronomical Association (O.A.A.).

## THE A.L.P.O./I.M.P. OBSERVING PROGRAM FOR MARS

The I.M.P. coordinates and instructs the cooperating observers in using similar visual, photographic, photometric, and micrometric techniques; employing color filters; as well as standard methods for reporting their observations, which result in homogeneous sets of observing data that have good analytic value.

Each Mars apparition the A.L.P.O. Mars Section receives thousands of individual observations consisting of visual disk drawings made with the aid of color filters, black-and-white and color photographs and CCD and video images, intensity estimates of light and dark albedo features, color contrast estimates, and micrometer measurements of polar caps, cloud boundaries, and variable surface features during the 10-12 month observing period. The chronological filing of this large quantity of data requires that observation information obtained for each Universal Date be recorded on one or two standard observing report forms!

It is in this regard that the A.L.P.O. Mars Coordinators have prepared a simple, efficient and standard Mars observing Report Form. This Standard Form, or its format, can be used for reporting all types of observations such as micrometry, transit timings, intensity estimates, and so forth. Photographs may also be attached to the top or back of the form and the relevant information blanks be filled in at the telescope. Planetary aspects blanks can be filled in at other times than while observing [Capen *et al.*, 1981].

Observational data consist of color-filter photography, visual disk drawings, visual photometry (intensity estimates on the standard A.L.P.O. Scale, where: 10 = polar brightness, 8 = desert mean brightness, 0 = night sky), micrometry, and CCD and video imaging. Very important are high-quality photographs in red, blue, and violet light, full-disk drawings using standard color filters, polar-cap micrometer measurements, as well as modern observing techniques such as full-disk photometry and CCD imaging.

We recommended strongly that all observers, visual, photographic, video and CCD, use at least a basic set of tricolor filters chosen from the following: red or orange (W25 or W23A), green (W58), blue-green (W64), blue (W38A or W80A), and deep blue (W47). Observers with telescopes under 8-in (20-cm) aperture may find a yellow (W15) filter useful in providing better performance than the deep-red filter (see *Table 1*, below). Those employing instruments over 8-in aperture will find the deep-red and deep-blue filters most useful for fine surface details or atmospheric cloud detection [Capen *et al.* 1984].

## The Mars Watch Observing Program

The Marswatch Program was initiated in electronic form in 1996 through the collaboration of astronomers at Cornell University, the JPL Mars Pathfinder Project, and the Mars Section of the A.L.P.O. as a means by which Mars astronomers worldwide can upload their observations to a WWW home page and archive site at JPL.

MarsNet is the WWW arm of the International Mars Watch, a group founded by professional astronomers interested in Mars to facilitate better communication between the amateur and professional Mars observing communities. At these Internet sites, you will find images of Mars contributed by amateurs and professionals, tools to aid you in planning your own Mars observations, current and past issues of the International Mars Watch Electronic Newsletter, and links to other Mars-related sites on the Internet. The primary purpose of this project is frequent CCD imaging of Mars using B, V, R or other standard filters, visual drawings, and photographs in order to monitor the planet's atmospheric dust and cloud activity.

Secondary Mars Watch goals include imaging or spectroscopy of the surface color and mineralogy, characterization of the growth and retreat of the polar caps, and analysis of atmospheric water vapor content. Because Mars rotates at nearly the same rate as Earth and the former also has a dynamic atmosphere that exhibits hourly, daily, and seasonal changes, frequent observations from sites spanning the widest possible range of terrestrial longitudes are desired.

The upcoming 1998-1999 Apparition is particularly important because the United States Mars Global Surveyor

**Table 1. Eastman Kodak Wratten Filters Used by A.L.P.O. Observers.**

| Color | Wratten Number(s) | Characteristics for Mars Observation |
|---|---|---|
| Yellow | W12, W15 | Brightens desert regions, darkens bluish and brownish features. |
| Orange | W21, W23A | Further increases contrast between light and dark features, penetrates hazes and most clouds, and limited detection of dust clouds. |
| Red or Deep-Red | W25 W29 | Gives maximum contrast of surface features, enhances fine surface details, dust-cloud and polar-cap boundaries. |
| Green | W57 | Darkens red and blue features, enhances frost patches, surface fogs, and polar projections. |
| Blue-Green | W64 | Helps detect ice-fogs and polar hazes. |
| Blue or Deep-Blue | W80A, W38, W38A W46, W47 | Shows atmospheric clouds, discrete white clouds and limb hazes, equatorial cloud bands, polar cloud hoods, and darkens reddish features. The W47 is the standard filter for detection and evaluation of the mysterious blue clearing. |
| Magenta | W30, W32 | Enhances red and blue features and darkens green ones. Improves polar region features, some Martian clouds, and surface features. |

Orbiter will then start regular imaging. In addition, the orbiter will be in a low sun-synchronous polar orbit, so it will only view the surface of Mars around 2 a.m. and 2 p.m. local time (the rest of the planet will be over the horizon), so high-quality Earth-based observations are needed in order to place these single-time-of-day orbiter views of the planet, as well as the single-location lander data, in a global context.

The project will maintain a WWW home page and archive site in association with the Mars Pathfinder Mission. The goal will be to have participants submit one or more of their images (or entire data sets if they like) to this site for dissemination to NASA Project personnel, professional astronomers, amateur astronomers, news and print media, educators and students, and the general public. Another general project goal is to post at least one new CCD image of Mars on the Web every day between December, 1998 and December, 1999. Even better would be one "daily global view" per day, composed of two-three Mars images taken on the same night but from sites widely separated in terrestrial longitude. To make this a reality will require a dedicated and geographically-diverse network of observers.

The current web site address for Mars Watch is:

http://mpfwww.jpl.nasa.gov/mpf/marswatch.html

Images from the 1995 and 1997 Apparitions may be viewed here. When it becomes available, the address for 1999 will be announced in the *Martian Chronicle* and on the A.L.P.O. Home Page.

## Mars in 1998-1999

Mars has a mean 15.8-year seasonal opposition cycle, consisting of three-four Aphelic oppositions and three consecutive Perihelic oppositions. The 1998-99 Apparition is termed an Aphelic apparition because opposition occurs only 58° after aphelion (070°Ls, where *Ls* is the areocentric [Mars-centered] longitude of the Sun, measured eastward in Mars' orbital plane from its Northern Vernal Equinox). Mars will reach opposition on 1999 Apr 24 (129° Ls) at declination 11°.6 South and will be closest to Earth on 1999 May 01 (132° Ls) with an apparent diameter of 16.2 arc-seconds. Mars will then be 0.57846 Astronomical Units (86.54 million km) from us.

For observers located in Earth's Northern Hemisphere, Mars will not be positioned as favorably during the upcoming apparition as it was in 1997, since it will be placed south of the celestial equator throughout the entire apparition.

Mars' North Pole will be tilted earthward throughout the 1998-1999 Apparition, permitting study of its Northern Hemisphere during Martian late Spring, Summer, and Autumn in that hemisphere. Thus astronomers can again investigate the regression of the NPC (North Polar Cap) and follow Martian arctic meteorology. This apparition should also allow careful scrutiny of the summer NPC remnant.

## Days and Seasons on Mars

The Martian solar day, also called a "sol" by planetary scientists, is about 40 minutes longer than a day on Earth. Thus Mars rotates through only 350° of longitude in 24 terrestrial hours. An astronomer on Earth who observes a particular surface feature on Mars sees the same feature 10° farther to its west (closer to the morning limb) each successive night.

Mars and Earth have four comparable seasons because their axes of rotation are each tilted at about the same angle to their respective orbital planes; Mars' axial tilt is 25.°2 as compared to 23.°4 for that of the Earth. Mars' seasons are expressed in terms of the value of Ls. The Martian year is 687 Earth days, nearly twice as long as ours, so that the Martian seasons are similarly longer. While Earth's are nearly equal in duration, the length of a Martian season can vary by as much as 52 days because of the greater eccentricity of its orbit.

The axis of Mars does not aim at our North Star, but is displaced about 40° towards α Cygni. Because of this celestial displacement the Martian southern-hemisphere seasons are 85° out of phase with the terrestrial seasons, or about one season in advance of our northern-hemisphere seasons. Consequently, when you observe Mars next Spring and Summer you will be seeing Summer and Autumn, respectively, in the Martian Southern Hemisphere.

## Making Observations of Mars

The ancient art of visual observation at the telescope is still a most useful tool to the modern astronomer, and is the forte of the amateur astronomer. The authors, attending various professional meetings over the past few years, were pleasantly surprised to find that carefully made amateur drawings were considered by Mars professional to be useful sources of data.

Mars is challenging to observe at best. The disk is tiny and its markings are blurred by our atmosphere. A telescope for planetary work should provide sharp images with the highest possible contrast. A long-focus refractor is usually considered the best, followed by a long-focus Newtonian or Cassegrain reflector. Telescopes with large central obstructions do less well.

Observers of Mars will find it rewarding to make a sketch of whatever they see, both to make a permanent record and to help train the eye in detecting elusive detail. Start with a circle 1-3/4 inches (42 mm) in diameter. Draw the phase defect, if any, and the bright polar caps or cloud hoods. Next, shade in the largest dark markings, carefully placing them in exactly the right locations on the disk. At this stage, record the time to the nearest minute. Now add the finer details, using various color filters, starting at the sunset limb. Finally, note the date, your name, the instrument(s) used, and any other relevant information.

The Martian Central Meridian (CM) is an imaginary line passing through the planetary poles of rotation, bisecting the planetary disk, and is used to define the range of areographic longitude visible on the disk during an observing session. It is independent of any phase which may be present—if Mars presents a gibbous phase the CM will appear to be off center. The CM value is the areographic longitude that is on the central meridian of the disk as seen from Earth at a given Universal Time (UT). It can be calculated by adding 0°.24/min., or 14°.6 /hr., to the daily CM value for 0h UT as listed in *The Astronomical Almanac*.

The terminator (phase defect) is the line where daylight ends and night begins on Mars. The defect of illumination, is given in arc-seconds on the apparent disk. The ratio $k$ describes the proportion of the geometrical Martian disk that is illuminated. The sunset terminator appears on the east side, or evening limb, before opposition; after opposition the terminator becomes the sunrise line on the morning limb on the west side. At opposition there is no perceptible phase defect.

The declination of the planet Earth (*De*) as seen from Mars defines the axial tilt of Mars relative to Earth. De is also equal to the areocentric latitude of the apparent center of the Martian disk, which is known as the *subearth point*. The latitude is positive if the North Pole is tilted toward Earth and negative if the South Pole is tilted toward Earth. This quantity is an important factor when drawing Mars or when trying to identify features.

## Surface Features of Mars

The dark surface markings of Mars were once thought by some astronomers to be great lakes, oceans, or vegetation, but space probes in the 1970s revealed the markings to be vast expanses of rock and dust. Windstorms sometimes move the dust, resulting in both seasonal and long-term tonal changes.

Among the areas where yearly variations have been recorded are Trivium-Elysium, Solis Lacus, Syrtis Major, and Sabaeus-Meridiani. Syrtis Major is the planet's most prominent dark area. Classical observations have revealed seasonal variations in the breadth of this feature: maximum width occurring in Northern Mid-Summer (145° Ls), and minimum during early Northern Winter, just after perihelion (290° Ls) [Antoniadi, 1930; Capen, 1976]. However, recent observations by A.L.P.O. astronomers and by the Hubble Space Telescope (HST) suggest that no such variations have occurred since 1990 [Lee *et al.*, 1995; Troiani *et al.*, 1997].

The marking Solis Lacus, the "Eye of Mars", is notorious for undergoing major changes. Also, in 1977 amateur observers discovered a new dark feature in the Aetheria desert at longitude 240° west, latitude 25° north, between Nubis Lacus and Elysium. This feature was subsequently found on Viking Orbiter photographs taken in 1975, apparently undetected by Viking scientists. This discovery is an example of the importance of ground-based observations of the Solar System.

Another feature that is of great interest to professional Mars researchers is the Trivium-Cerberus, on the southern rim of the Elysium shield. A classically dark feature 1300 × 400 km in size, it has all but disappeared during the 1990s [Moersch *et al.*, 1997; Troiani *et al.*, 1997].

## MARTIAN METEOROLOGY

**Clouds and Hazes.—**The Martian atmosphere is ever-changing. White water-ice clouds, yellowish dust clouds, bluish limb hazes, and bright surface frosts have been studied with increasing interest in the past two decades. Clouds appear to be related to the seasonal sublimation and condensation of polar-cap material. An intensive study of Martian meteorology has been conducted by the A.L.P.O. Mars Section using visual data and photographs from professionals and amateurs around the world. The first report, published in 1990, analyzed 9,650 IMP observations submitted over eight Martian apparitions between 1969 and 1984 [Beish and Parker, 1990]. This study has now been expanded to include 24,130 observations between 1965 and 1993. Statistical analysis indicates that discrete water-ice crystal cloud activity and near-surface fog occurrence is significantly higher in the Spring and Summer of the Martian Northern Hemisphere than for the same seasons for the Southern Hemisphere.

For their observations to be included in this unique study, A.L.P.O. astronomers must employ blue filters when making visual, photographic, or CCD observations.

**Discrete Clouds.—**These have been observed on Mars for over a century. In 1954, a remarkable W-shaped cloud formation was found to be recurring each late-spring afternoon in the Tharsis-Amazonis region. A decade later, C.F. Capen proposed that the W-clouds are orographic; caused by winds passing over high mountains. Indeed, in 1971 the Mariner 9 spacecraft probe showed them to be water clouds near the large volcanoes Olympus Mons (longitude 133° west, latitude 18° north), Ascraeus Mons (104° W, 11° N), Pavonis Mons (112° W, 0° N), and Arsia Mons (120° W, 9° S). The W-clouds should be active during the 1999 Apparition at least until opposition (129° Ls) and, perhaps, late in the apparition, during Southern Spring. Although often observed without filters, these clouds are best seen in blue or violet light when they are high in altitude and in yellow or green light at very low altitudes. Other orographic clouds are observed over the Elysium Shield.

In addition to the dramatic orographic clouds, Mars exhibits many localized discrete clouds. These rotate with the planet and are most often found in northern Spring-Summer in Libya, Chryse, and Hellas. One remarkable example of a discrete topographic cloud is the "Syrtis Blue Cloud", which circulates around the Libya basin and across Syrtis Major, changing the color of this dark albedo feature to an intense blue. Originally named the "Blue Scorpion" by Angelo Secchi in 1858, this cloud usually makes its appearance during the late Spring and early Summer of Mars' Northern Hemisphere. It has been prominent during the 1995 and 1997 Apparitions and is best seen when the Syrtis is near the limb. Viewing this cloud through a yellow filter causes the Syrtis to appear a vivid green (yellow + blue = green).

**Limb Brightening.—**Also called "limb arcs", these features are caused by scattered light from dust and dry-ice particles high in the Martian atmosphere. They should be present on both limbs often throughout the apparition and are also best seen in blue-green, blue or violet light. When dust is present, these arcs are often conspicuous in orange light.

**Morning Clouds.—**Morning clouds are bright, isolated patches of surface fog or frosty ground near the morning limb (Mars' western edge as seen on Earth's sky). The fogs usually dissipate by mid-morning, while the frosts may persist most of the Martian day, depending on the season. These bright features are viewed best with a blue-green, blue, or violet filter. Occasionally, very low morning clouds can be seen in green or yellow light.

**Evening Clouds.—**These have the same appearance as morning clouds but are usually larger and more numerous. Best seen in blue or violet light, they appear as isolated bright patches over light desert regions in the late Martian afternoon and grow in size as they rotate into the late evening

The size and frequency of limb clouds appear to be related to the regression of the Northern, rather than the Southern, Polar Cap. Both limb arcs and limb clouds are prominent after aphelion (070° Ls), but limb clouds tend to rapidly decrease in frequency after early Summer, while limb hazes become more numerous and conspicuous throughout the Northern Summer.

**Equatorial Cloud Bands (ECBs).—** These features appear as broad, diffuse hazy bands along Mars' equatorial zone and are difficult to observe with ground-based telescopes. The Hubble Space Telescope has revealed that these clouds may be more common than we have suspected in the past. Their prevalence during the 1997 Apparition led some conferees at the Mars Telescopic Observations Workshop-II (MTO-II) to postulate that many limb clouds are simply the limb portions of ECBs. A.L.P.O. astronomers are encouraged to watch for these elusive features during the 1998-1999 Apparition. Are they really more common, or are our improved technologies merely allowing us to detect them more easily?

ECBs are best detected visually through a deep-blue (W47 and W47B) Wratten filters and may be photographed or imaged in blue or ultraviolet light.

New technologies, such as CCD cameras, sophisticated computer hardware and software, and large-aperture planetary telescopes, have given rise to an explosion in advanced techniques of studying our Solar System. Never before have we been able to readily detect the delicate wispy Martian Equatorial Cloud Bands so well as we do now with CCD imaging.

**Dust Storms.**—Recent surveys, including our Martian meteorology study, have shown that dust events can occur during virtually any season [Martin and Zurek, 1993; Beish and Parker, 1990]. The main peak (285° Ls) occurs just after Southern Summer Solstice, but a secondary peak has been observed in early Northern Summer, around 105° Ls. Historically, the storms occurring during Southern Summer are larger and more dramatic than those in Northern Summer; they can even grow rapidly to enshroud the whole planet. Remember, however, that these global dust storms are quite rare; only five have been reported since 1873, all since 1956. Much more common is the "localized" dust event, often starting in desert regions near Serpentis- Noachis, Solis Lacus, Chryse, or Hellas. During the 1997 apparition, CCD and HST observations revealed localized dust clouds over the North Polar Cap early in Northern Spring.

Identifying the places where dust storms begin and then following their subsequent spread are most important to future Mars exploration missions. The following criteria apply in the diagnosis of Martian dust clouds:

1. The *sine qua non* for Martian dust clouds is movement with obscuration of previously well-defined albedo features. Absence of this criterion in the present study disqualified a candidate from inclusion as a dust cloud.

2. They must be bright in red light. In the past, astronomers have identified Martian dust clouds, obscurations, or both as "yellow clouds". It is incorrect to describe the color of Martian dust clouds as "yellow". While they may appear yellowish when observed without the aid of color filters, they are in fact brighter in red and orange light than they are in yellow light. Dust clouds brighten faintly in yellow filters and display well-defined boundaries through orange and red filters. During the initial stages of formation, they often appear very bright in violet and ultraviolet light, suggesting the presence of ice crystals.

We vigorously discourage the use of the term "yellow clouds" to describe dust. If a suspect cloud is not bright in red light, it is not to be considered a dust cloud.

3. There are numerous reports of anomalous transient albedo features appearing near dust clouds, especially when the solar phase angle was reasonably large. When these clouds reach heights of several kilometers, they may cast shadows that are observable from Earth.

Richard McKim of the B.A.A. has written an excellent review of Martian dust storms [McKim, 1996].

**Blue Clearing?**—Normally the surface albedo features of Mars appear vague through light-blue filters, such as the Wratten 80A. With a dark-blue (W47) or violet (380-420 nm) filter, the disk usually appears featureless except for clouds, hazes, and the polar regions. When a little-understood phenomenon known as the "Blue Clearing" occurs, however, Martian surface features can be seen and photographed in blue and violet light for periods of several days. The clearing can be limited to only one hemisphere and can vary in intensity from 0 (no surface features detected) to 3 (surface features can be seen as well as in white light). The Wratten 47 Filter or equivalent is the standard for analyzing Blue Clearing.

Recently there has been renewed professional interest in Blue Clearing. We encourage A.L.P.O. Mars observers to watch for this phenomenon during the 1998-1999 Apparition.

## Calendar of Events, Mars, 1998-1999

*Table 2* (below) lists the predictable, probable, and possible events associated with the upcoming Mars apparition.

## References


Antoniadi, E.M. (1930) *The Planet Mars.* Chatham: W. & J. Mackay, Ltd.

Beish, J.D. and Parker, D.C. (1990) "Meteorological Survey of Mars, 1968-1985." *J. Geophs. Res.* Vol. 95, B9, pp. 14567-14675 (August 20).

Capen, C.F. (1984) "A Guide to Observing Mars—I." *J.A.L.P.O.* Vol. 30, Nos. 7-8 (April), pp. 172-176; and Nos. 9-10 (August), pp. 186-190.

Capen, C.F. and Parker, D.C. (1981) "What is New on Mars—Martian 1979-1980 Apparition Report II." *J.A.L.P.O.* Vol. 29, Nos. 1-2 (July), pp. 38-41; and Nos. 3-4 (Dec.), pp. 51-61.

Capen, C.F.; Parker, D.C. and Beish, J.D. (1984) "Observing Mars XI—The 1984 Aphelic Apparition." *J.A.L.P.O.* Vol. 30, Nos. 5-6 (Jan.), pp. 125-130.

Lee, S.W.; Wolf, M.J.; James, P.B.; Martin, L.J.; Clancy, R.T. and Bell, J.F. III. (1995). "HST Observations of Time-Variable Albedo Features on Mars." *Workshop on Mars Telescopic Observations.* LPI Technical Report Number 95-04. p. 19.

Martin, L.J. and Zirek, R.W. (1993) "An Analysis of the History of Dust Activity on Mars." J. *Geophys. Res.* Vol. 98, E2, pp. 3221-3246.

McKim, R. (1996) "The Dust Storms on Mars." *J.B.A.A.* Vol. 106, No. 4, pp. 185-200.

Moersch, J.; Bell, J. III; Carter, L.; Hayward, T.; Nicholson, P.; Squyres, S. and Van Cleve, J. (1997) "What Happened to Cerberus? Telescopically Observed Thermophysical Properties of the Martian Surface." *Mars Telescopic Observations Workshop II.* LPI Technical Report Number 97-03. pp. 25-26.

Troiani, D.M.; Joyce, D.P.; Parker, D.C.; Hernandez, C.E. and Beish, J.D. (1997) "Telescopic Observations of Mars. 1996-1997: Results of the Marswatch Program I: Surface and Dust." *Mars Telescopic Observations Workshop II.* LPI Technical Report Number 97-03. pp. 32-33.


**Table 2. Calendar of Martian Events, 1998-1999 Apparition.**

| UT Date | Ls ° | Points of Interest |
|---|---|---|
| *1998* | | |
| Dec 16 | 070 | Aphelion. Mars at 5".7 apparent diameter. Views of surface details well defined. NPC Rima Tenuis may appear. Northern Hemisphere mid-spring. NPC beginning rapid retreat? Are limb arcs present? NPR clouds increasing in frequency, intensity. Use filters! Antarctic hazes, hood? Cloud activity increases. Watch for "Aphelic Chill" in NPR (usually between 060° and 070° Ls). |
| Dec 25 | 075 | Mars at 6" apparent diameter. Apparition begins for observers using 4- to 8-in (10-20 cm) aperture telescopes and up. Begin low-resolution CCD imaging. Blue Syrtis Cloud? Is Hellas brightening? |
| *1999* | | |
| Jan 29 | 090 | Northern Summer /Southern Winter Solstice. Mars at 7".8' apparent diameter. Orographic clouds over the Tharsis volcanoes; W-Cloud? Look for orographic clouds (violet filter and blue-green filter). |
| Feb 02 | 092 | Mars at 8" apparent diameter. High-quality micrometer measurements of NPC possible. |
| Feb 26 | 102 | Mars at 10" apparent diameter. Continue NPC measurements. Is North Cap fairly static or entering rapid retreat phase? South polar regions becoming difficult to observe. Any signs of SPH? Some photography now possible. Begin high-resolution CCD imaging. |
| Mar 16 | 110 | Mars at 12" apparent diameter. Begin high-resolution visual observations and high-quality photography. Hellas bright? Watch for limb clouds. Blue Syrtis Cloud. |
| Apr 24 | 129 | Opposition. Mars at 16".03 apparent diameter. Declination -11°.7. Distance 0.58435 AU (87.41 million km). |
| May 01 | 132 | Closest approach to Earth; Mars at 16".19 apparent diameter. Declination -11°.0, Distance 0.57846 AU (86.54 million km). Polar clouds. NPC remnant. Is Syrtis Major broad? |
| Jun 25 | 160 | Mars drops below 12" apparent diameter. Is north polar hood forming? Look for NPC remnant in red light. |
| Jul 20 | 173 | Mars drops below 10" apparent diameter. Are both polar hoods visible? Decrease in discrete clouds. |
| Jul 31 | 180 | Northern Autumn/Southern Spring. Watch for increase in dust clouds. Is South Polar Cap visible free of its hood? |
| Aug 28 | 195 | Mars drops below 8" apparent diameter. Early Southern Spring. Possible W-clouds reforming. Is Syrtis Major narrowing? |
| Nov 08 | 240 | Mars drops below 6" apparent diameter. Mars near perihelion. Watch for dust. De = -9°. Late Spring South Polar Cap visible. |

# INTERIM REPORT: THE 1998-1999 APPARITION OF JUPITER

By: David J. Lehman, Acting Jupiter Coordinator, and John W. McAnally, Acting Assistant Jupiter Coordinator

## GENERAL

Jupiter has not disappointed observers this apparition. Many Jovian events are rewarding those following the 1998-1999 Apparition, and consequently many observations have been submitted. In addition, the Section is having closer communication with the professional community than in the recent past. This circumstance has allowed current Jupiter Section data to be used by professional astronomers with access to the Hubble Space Telescope, the Galileo Orbiter spacecraft, and Earth-based professional facilities. Observers in Australia, Canada, France, Germany, Great Britain, Japan, Portugal, and the United States have contributed to the Jupiter Section during this apparition. On page 166, *Figures 1-4* provide examples of drawings and a CCD image that have been received by the Section.

## THE NORTH POLAR REGION

Many recent CCD images show dark veils and mottling of the North Polar Region (NPR). CCD chips are sensitive to the near infrared, and these features probably are most evident at these wavelengths. It has been difficult to find consistency among these observations and more study needs to be done.

Most observers report the NPR as darker than the SPR.

## THE NORTH NORTH TEMPERATE REGION

Several observers, supported by CCD images, have reported the North North Temperate Belt (NNTB) to be distinct. Observers also note some segments are darker than others. The preceding end of one dark segment was located at 150°(II) [i.e., System II longitude, assuming a rotation period of 9h 50m 55.4s; usually applied to areas north of the south edge of the NEB and south of the north edge of the SEB, except for the SEB Z and the south edge of the NTB] on a CCD image by Donald Parker on 1998 OCT 02, shown in *Figure 4* (p. 166). This feature was also observed visually by two other observers, one using a Wratten 8 (yellow) Filter. The North North North Temperate Belt (NNNTB) has been reported by only one observer this apparition thus far, and then during exceptionally good seeing.

## THE NORTH TEMPERATE REGION

The North Temperate Belt (NTB) has been dark and conspicuous. Most observers report it to be the second darkest belt, after the NEB. A few observers have reported the NTB as double, although images do not confirm this. A CCD image by Donald Parker on 1998 SEP 29 shows a section of the NTB as displaced north from 340°(II)-355°(II), or possibly double. Harry Pulley observed a "dip and braiding" northward of the NTB starting at 300°(II). Drawings by some observers indicate intermittent widening of the NTB. A few report seeing dark, low projections or spots on the southern edge of the NTB. This suggests that a few Rapidly Moving Spots (RMS) survived through solar conjunction [which occurred on 1998 FEB 23]. However, of the nine RMSs that were tracked last apparition, none remain to date or can be identified.

The North Temperate Zone (NTZ) is light gray in color and has exhibited shaded and bright segments. It is much wider than the NTB. Some have reported seeing bright ovals, veils and shadings. However, these features have not been observed frequently enough to permit drift rate calculations.

## THE NORTH TROPICAL REGION AND EQUATORIAL ZONE

The North Tropical Zone (NTrZ) has been reported by many as the brightest zone this apparition. Some bright ovals have been observed in this zone.

The North Equatorial Belt (NEB) continues to be very active and dark again in this apparition, although it is narrower than last apparition. Its color has usually been described as reddish-brown.

Dark condensations, including barges, and bright ovals can be seen on the north edge of the NEB. These features were more dramatic last apparition. Fourteen dark condensations are currently being monitored along the north edge of the NEB. These include seven barges recovered from the 1997-1998 Apparition. Some of the barges are quite large, three being 10-13° in length, and arguably do not fit the definition of a barge. These features do not appear to be as dark this year, and probably are fading. They exhibit a small prograding drift.

At least eleven blue or blue-gray features of the NEBs/EZn (North Equatorial Belt south component/Equatorial Zone north) are being monitored. Many A.L.P.O. observers refer to these as "Olivarez Blue Features" (OL). These are usually the bases of festoons that project into the EZ. Bright areas follow many OLs, and are often referred to as "plumes". Most of these features are prograding. For example, one such feature is prograding at -10°/30 days in System I longitude [System I uses a rotation period of 9h 50m 30.0s and is applied to the EZ, south edge of the NEB, north edge of the SEB, and the south edge of the NTB].

The EZ appears to be slightly darker this apparition. Some observers report bright areas, however, most observers are reporting veils or shadings in the zone. The Equatorial Band (EB) is prominent and often observed.

## The South Tropical Region

The South Equatorial Belt (SEB) experienced a dramatic increase in activity early this apparition. After solar conjunction, early observations showed an SEB disturbed with white ovals expanding longitudinally from a source near 240° (II). The outbreak possibly started during solar conjunction. Bright spots and white ovals in the northern half of the SEB characterize the disturbance. The disturbance trails southward at its following end. Observers have compared the appearance to the turbulence following the GRS. Following the disturbance is a region that looks like a typical split SEB. On 1998 May 06 the preceding and following ends of the SEB disturbance were reported at 220°(II) and 347°(II), respectively. By 1998 Oct 04, the preceding and following ends of the disturbance were located at 095°(II) and 300°(II), respectively. As of early October, the preceding end of the disturbance ends in the northern half of the SEB just preceding the following end of the turbulence following the GRS. Separating these two disturbances is a dark section of the SEB that runs diagonally from north-preceding to south-following in the SEB. The expansion of this disturbance is of great interest. Jose Olivarez points out that this is not a typical SEB Disturbance, but rather similar to the disturbance of the 1985 Apparition.

The south component of the SEB is darker than the north component. The color of the SEB is described as light reddish-brown, except for the bright, turbulent areas, which are grayish to white. The SEB is the widest belt on the disk.

White patches have been observed in the South Tropical Zone (STrZ) along with a few observations of a STrZ Band.

## The Great Red Spot

The Great Red Spot (GRS) is in its Red Spot Hollow (RSH) form, which most observers report as an ellipse of light gray to creme color with a grayish border on its southern rim. The GRS proper is a much smaller feature, occupying the southern third of the RSH, and is pale orange to orange-salmon in color. Transit timings indicate that the GRS was at 066°(II) in September and was 10° in length while the RSH was 25° in length. The GRS/RSH is preceded by bright markings in the SEB north and south and separated by a very dark middle section of the SEB. The GRS/RSH is followed by the characteristic area of bright turbulence. This turbulence begins with two large diagonal ovals.

## The South Temperate Region

The South Temperate Belt (STB) is thin and faint. Its color is gray to reddish-brown, the hue depending on longitude. The belt is broken and streaked preceding the GRS. It fades near the GRS, then following the GRS the STB is thin and faint and becomes diffused following Dark Spot–2 (see below). The STB becomes darker following oval FA.

The most notable features in this region this apparition have been the Dark Spots (DS) on the southern edge of the STB. We are currently monitoring four such spots and two possible others. One spot, DS–1, is exceptionally dark, almost black, and condensed. Harry Pulley first visually observed it on 1998 Jun 20 at 199°(II). By Oct 04 this spot was located at 150°(II). Its System-II drift rate is thus about -15°/30 days, which places it in the South Temperate Current (STC). STB DS–2 was located at 185°(II) on 1998 Oct 04. We are referring to this as a "feature" and not a spot because it is extended in longitude about 10° and is not nearly as condensed as DS–1. STB DS–3 was at 103°(II) on 1998 Oct 04 and is rather faint. A fourth spot has been identified and was located at 002°(II) on 1998 Sep 24. All of these features exhibit a rate of drift similar to STB DS–1, placing them in the STC.

During solar conjunction long-lived South Temperate Ovals (STO) BC and DE interacted and probably merged, forming an oval that John Rogers of the British Astronomical Association has named "BE". Oval BE is of low contrast and difficult to observe visually. On 1998 Sep 24 the oval was located at 248°(II). STO FA is much brighter than BE and was at 278°(II) on 1998 Oct 12. Both ovals are drifting with the STC.

## The South South Temperate Region and the South Polar Region

The South South Temperate Belt (SSTB) is broad and gray. Four bright ovals, in two pairs, have been observed in the SSTB, although few transit timings have been reported. One pair is between 030°(II) and 075°(II), near the GRS. The other pair is centered south of DS–1. In mid-October, Sam Whitby placed this pair at 122°(II) and 154°(II).

The South Polar Region (SPR) is light gray in color and lighter than the NPR. The SPR has been unremarkable at all longitudes throughout its latitude range.

## Latitudes and Intensities

*Table 1* (below) presents the results of belt and zone zenographic latitude measurements during this Apparition. [A feature's *zenographic latitude* is the angle, at Jupiter's center, between the equator and the feature.] Likewise, *Table 2* (bottom) summarizes Walter Haas' estimates of the intensities of belts and zones. The intensities are on the Standard A.L.P.O. Scale, ranging from 0 for a black shadow to 10 for a 100-percent reflective white feature.

**Table 1. 1998 Jupiter Apparition, Zenographic Latitudes of Belts and Zones [1].**

| Edge | Latitude ° | S.E.[2] ° | No. [3] | Historical [4] ° |
|---|---|---|---|---|
| SPR | -41.25 | ±0.45 | 2 | -41.9 (SSTBs) |
| SSTBn | -37.28 | ±0.03 | 2 | -36.3 |
| STBs | -33.14 | ±1.44 | 5 | -33.3 |
| STBn | -28.89 | ±1.36 | 5 | -26.8 |
| SEBs | -21.93 | ±0.96 | 6 | -20.7 |
| SEBn | -7.87 | ±0.62 | 6 | -7.0 |
| NEBs | +8.06 | ±0.57 | 6 | +7.5 |
| NEBn | +15.03 | ±0.83 | 6 | +18.1 |
| NTBs | +24.16 | ±0.47 | 6 | +23.9 |
| NTBn | +27.88 | ±0.80 | 6 | +31.0 |
| NNTBs | +34.64 | ±0.73 | 5 | +35.8 |
| NNTBn | +38.09 | ±0.87 | 5 | +39.1 |
| NPR | +47.29 | ±1.60 | 4 | +47.0 (NNNTBn) |

*Notes:*

[1] Latitudes measured from images by G. McKinzie and M. Valimberti, F. Melillo, A. Nikilai, D. Parker, D. Peach, and T. Platt.
[2] Standard error (standard deviation of mean).
[3] Number of observations.
[4] 1950-1979 means: John H. Rogers, *The Giant Planet Jupiter*, page 44.

**Table 2. 1998 Jupiter Apparition, Belt and Zone Intensity Estimates (Observations by Walter Haas)**

| Belt/Zone | Limiting Dates | Range | Mean [1] | No.[2] |
|---|---|---|---|---|
| SEBs[3] | 5-19 to 6-18 | 1.5-2.0 | 1.67±0.24 | 3 |
| NEB | 5-19 to 8-15 | 1.7-2.5 | 2.10±0.29 | 7 |
| SEBs[3] | 7-18 to 8-15 | 2.5-3.1 | 2.78±0.28 | 4 |
| NTB | 5-19 to 8-15 | 2.5-3.2 | 2.89±0.28 | 7 |
| SEBn | 5-19 to 6-18 | 2.5-3.3 | 2.93±0.33 | 3 |
| STB | 5-19 to 8-15 | 2.8-3.2 | 2.95±0.14 | 6 |
| SEBn | 7-18 to 8-15 | 3.0-3.5 | 3.18±0.20 | 4 |
| NNTB | 6-18 to 8-8 | 3.7-4.2 | 3.93±0.19 | 4 |
| NPR | 6-1 to 8-15 | 3.5-4.6 | 4.03±0.40 | 6 |
| EB | 6-1 to 8-8 | 3.8-4.3 | 4.10±0.19 | 4 |
| SPR | 6-1 to 8-15 | 3.7-4.7 | 4.25±0.33 | 6 |
| EZ | 5-19 to 8-15 | 4.8-5.0 | 4.96±0.07 | 7 |
| STZ | 7-18 to 8-15 | 4.9-5.5 | 5.13±0.26 | 3 |
| NTZ | 6-1 to 8-15 | 4.8-6.2 | 5.17±0.46 | 6 |
| STrZ | 5-19 to 8-15 | 5.5-6.0 | 5.67±0.22 | 7 |
| NTpZ | 5-19 to 8-15 | 5.7-6.5 | 6.24±0.31 | 7 |

Notes:
[1] Mean of observations; standard error (standard deviation of mean).
[2] Number of observations.
[3] The SEBs lightened in late June.

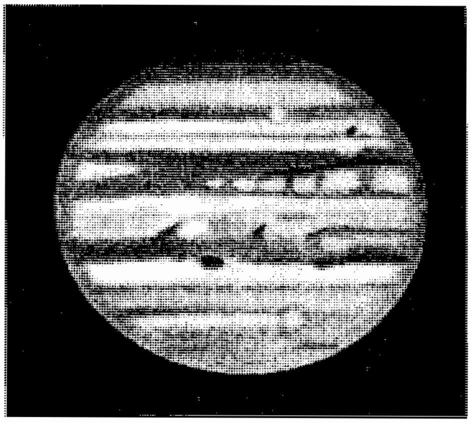


Figure 1. Drawing of Jupiter by Sam Whitby on 1998 AUG 07, 07h29m UT. 6-in (15-cm) f/8 Newtonian. CM(I) 217°, CM(II) 141°. South at top.

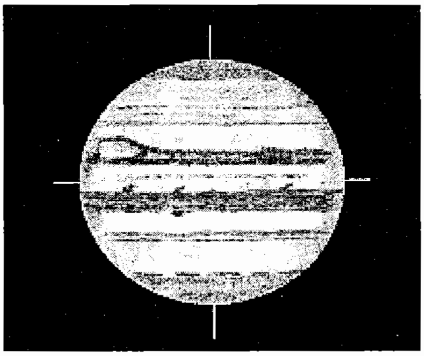


Figure 2. Drawing of Jupiter by Daniel Rollin on 1998 SEP 18, 00h50m UT. 15-in (38-cm) refractor, 175X. Seeing = 3-5 (A.L.P.O. 0-10 scale), transparency = +2 (limiting magnitude). CM(I) 131°, CM(II) 097°. South at top.

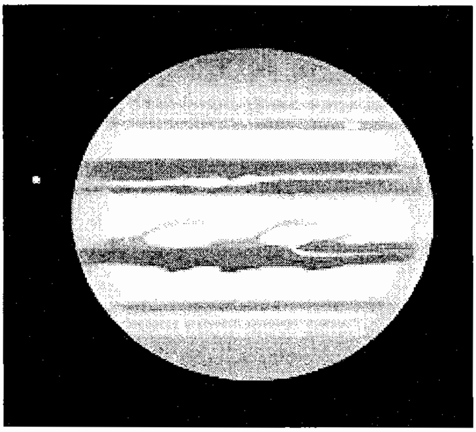


Figure 3. Drawing of Jupiter by Carlos Hernandez on 1998 AUG 16, 03h35m UT. 8-in (20-cm) Schmidt-Cassegrain, 222X, no filter. CM(I) 057°, CM(II) 274°. South at top. Satellite Io to left of disk.

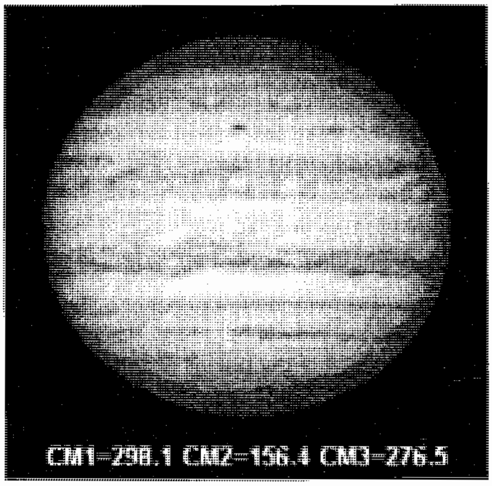



Figure 4. CCD image by Don Parker on 1998 OCT 02, 03h59m UT. 16-in (41-cm) f/5 Newtonian. CM(I) 298°, CM(II) 156°. Grey-scale version of tricolor image. South at top.

# Observations of the Remote Planets in 1997

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

## Abstract

Seven individuals submitted 114 photoelectric magnitude measurements, 185 visual magnitude measurements, one drawing and five photographs of the Remote Planets during 1997 and these data are summarized. The selected normalized magnitudes for Uranus based on photoelectric measurements are: $V(1,0) = -7.15\pm0.01$ and $I(1,0) = -5.93\pm0.01$, while the corresponding values for Neptune are: $B(1,0) = -6.68\pm0.03$ and $V(1,0) = -6.96\pm0.02$. The selected normalized magnitudes based on naked-eye brightness estimates are: $V_{vis}(1,0) = -7.2\pm0.03$ for Uranus and $V_{vis}(1,0) = -7.0\pm0.03$ for Neptune. Pluto may have been 0.6±0.4 magnitudes dimmer than predicted in early June 1997.

## Introduction

There were several discoveries made during 1997 that are related to the Remote Planets. Two new moons orbiting Uranus were discovered in September, 1997 [Sky & Telescope, 1998a, 19; Sky &Telescope, 1998b, 22]. Reports of a 0.8-magnitude drop in Pluto's brightness were published in October, 1997 [di Cicco, 1997, 102]. Finally, a near-infrared image of Uranus taken with the Hubble Space Telescope on 1997 Jul 28 reveals a large amount of cloud detail [Astronomy, 1998, 28]. These developments have been a motivating factor for the continuation of the gathering of photoelectric magnitude measurements of the Remote Planets.

*Table 1* (below) lists the characteristics of the 1997 apparitions of Uranus, Neptune and Pluto. Seven individuals submitted observations, measurements, or both, of the Remote Planets during 1997; their names, locations and forms of observation are summarized in *Table 2* (p. 168).

## Photoelectric Photometry

Three observers (Eugene Lopata, Frank J. Melillo and the author) made photoelectric magnitude measurements of Uranus and Neptune during 1997. All three used SSP-3 solid-state photometers along with Johnson B, V, and I filters. Eugene Lopata and Frank Melillo used 20-cm (8-in) Schmidt-Cassegrain telescopes while the author used the 51-cm (20-in) Newtonian telescope at the Charles Barber Observatory (located at 84°.935 W, 33°.791 N at an elevation of 323 meters). The SSP-3 photometer is described elsewhere [Optec, 1988; Schmude, 1992, 20].

The coordinates, magnitudes and spectral classifications for all comparison stars used in photoelectric measurements are summarized in *Table 3* (p. 168). No corrections due to transformation were made to the V-filter measurements; however, a correction was made for the B-filter measurements of Lopata. No correction was made for the I-filter measurements by

**Table 1: Characteristics of the 1997 Apparitions of Uranus, Neptune and Pluto.**
(All dates are for Universal Time.)

| Date or Parameter | Uranus | Neptune | Pluto |
|---|---|---|---|
| First conjunction date[a,b] | 1997 Jan 24 | 1997 Jan 17 | 1996 Nov 25 |
| Opposition date[b] | 1997 Jul 29 | 1997 Jul 21 | 1997 May 25 |
| Angular diameter (opposition)[c] | 3.7 arc-sec | 2.3 arc-sec | 0.1 arc-sec |
| Right ascension (opposition)[b,c] | 20h 37m | 20h 02m | 16h 17m |
| Declination (opposition)[b,c] | -19°.2 | -20°.0 | -8°.5 |
| Second conjunction date[b,d] | 1998 Jan 28 | 1998 Jan 19 | 1997 Nov 27 |

[a] Bishop, 1995.
[b] Bishop, 1996.
[c] *Astronomical Almanac for the year 1997.*
[d] Bishop, 1997.

**Table 2: Contributors of Remote Planet Observations in 1997.**

| Observer and Location (United States) | Type of Observation[a] |
|---|---|
| Norman J. Boisclair; South Glens Falls, NY | V |
| Rik Hill; Tucson, AZ | VP, PP |
| Gus Johnson; Swanton, MD | VP |
| Gene Lopata; Digger Pines, CA | PP |
| Frank J. Melillo; Holtsville, NY | PP, P |
| Gary T. Nowak; Essex Junction, VT | VP |
| Richard W. Schmude, Jr.; Villa Rica and Barnesville, GA | VP, PP, V |

[a]Type of Observation: P = photograph, PP = photoelectric photometry, V = visual description or drawing, VP = Visual (naked-eye) magnitude estimate.

**Table 3. Comparison Stars Used for Uranus and Neptune Photometry in 1997.**

[Magnitudes and other characteristics are from Hirshfeld, Sinnott and Ochsenbein (1991).]

| | Coordinates (2000) | | Magnitude | | Spectral |
|---|---|---|---|---|---|
| Star Name | R.A. | Dec. | B | V | Type |
| ρ Cap | 20h28.9m | -17°49' | +5.16 | +4.78 | F2 |
| 56 Sgr | 19h46.4m | -19°46' | +5.79 | +4.86 | KI |
| HD 196078 | 20h35.5m | -16°32' | +6.39 | +6.19 | A7 |

**Table 4: Photoelectric Magnitude Measurements of Neptune in 1997.**

| UT Date | | Magnitude | | Comparison | Δ |
|---|---|---|---|---|---|
| 1997 | Filter | Meas. | Normal. | Star | Air Mass |
| Jun | | + | - | | |
| 14.415 | B | 8.05 | 6.68 | 56 Sgr | 0.03 |
| 14.448 | V | 7.74. | 6.99 | 56 Sgr | 0.00 |
| Jul | | | | | |
| 11.219 | V | 7.73 | 6.99 | HD 196078 | 0.03 |
| 11.222 | V | 7.76 | 6.96 | HD 196078 | 0.02 |
| 11.243 | V | 7.76 | 6.96 | HD 196078 | 0.07 |
| 11.245 | V | 7.77 | 6.95 | HD 196078 | 0.06 |
| 11.263 | V | 7.74 | 6.98 | HD 196078 | 0.10 |
| 11.266 | V | 7.76 | 6.96 | HD 196078 | 0.10 |
| 11.282 | V | 7.85 | 6.87 | HD 196078 | 0.13 |
| 11.284 | V | 7.78 | 6.94 | HD 19607 | 0.13 |
| 11.301 | V | 7.85 | 6.87 | HD 196078 | 0.17 |
| 11.303 | V | 7.84 | 6.88 | HD 196078 | 0.17 |
| 11.344 | V | 7.71 | 7.01 | HD 196078 | 0.28 |
| 11.347 | V | 7.74 | 6.98 | HD 196078 | 0.30 |
| 11.370 | V | 7.80 | 6.92 | HD 196078 | 0.41 |
| 11.372 | V | 7.72 | 7.00 | HD 196078 | 0.45 |
| 11.393 | V | 7.73 | 6.99 | HD 196078 | 0.64 |
| 11.395 | V | 7.72 | 7.00 | HD 196078 | 0.71 |
| 12.367 | B | 8.08 | 6.64 | 56 Sgr | 0.01 |
| 12.399 | V | 7.76 | 6.96 | 56 Sgr | -0.03 |
| Aug | | | | | |
| 09.301 | B | 8.01 | 6.70 | 56 Sgr | 0.01 |
| 09.333 | V | 7.74 | 6.98 | 56 Sgr | -0.02 |
| Sep | | | | | |
| 06.255 | B | 8.04 | 6.70 | 56 Sgr | 0.00 |
| 06.287 | V | 7.76 | 6.98 | 56 Sgr | -0.03 |

Melillo, since his comparison star has a B-V value similar to Uranus; however, transformation coefficients for Melillo's instrument have not been measured. The final photometric results for Neptune are listed in *Table 4* (lower left). (The complete list of Uranus measurements is too long to be published here, but a table of results can be sent to those interested by request to the author.) In Table 4, the first column lists the date and time as a fractional day, all in Universal Time (UT). The filter, measured, and normalized magnitude are listed in the next three columns, respectively. The final two columns list the comparison star and the difference in air mass (air mass of the planet - air mass of the comparison star).

The normalized magnitude is the brightness an object would have were it 1.0 A.U. from both the Earth and Sun. (One AU, or Astronomical Unit, is the mean distance between the Earth and Sun, which is 149.6 million kilometers or 93.0 million miles.) The advantage of reporting a normalized magnitude is that brightness changes due to changing object-Earth and object-Sun distances have already been accounted for; therefore any changes in the normalized magnitude would be due to activity on the planet or Sun. The equation for reporting normalized magnitude is summarized in our 1996 report [Schmude, 1998].

The V-filter magnitudes of Uranus and Neptune were plotted

**Table 5. Mean Photoelectric Magnitudes of Uranus and Neptune in 1997.**

(Two additional photoelectric measurements made in 1996 were submitted in 1997 but are not included in the values below.)

| Filter | Normalized Magnitude Uranus | Normalized Magnitude Neptune | Number of Measurements Uranus | Number of Measurements Neptune |
|---|---|---|---|---|
| B | --- | -6.68±0.03 | — | 4 |
| V | -7.15±0.01 | -6.96±0.02 | 57 | 20 |
| I | -5.93±0.01 | ----- | 31 | -- |

against time and the results indicate that, if the brightness of Uranus changes as that planet rotates on its axis, the change is less than 0.1 magnitude between maximum and minimum. Infrared (I) filter magnitudes of Uranus were also plotted on Jul 12, 30 and 31; the data indicate that a minimum in I magnitude may have occurred on 1997 Jul 31.19 UT. Any change in the I-magnitude of Uranus as a result of rotation is less than 0.2 magnitudes between maximum and minimum brightness.

*Table 5* (above) summarizes the mean normalized magnitudes for Uranus and Neptune. Overall normalized magnitudes of V(1,0) = -7.15±0.01 and I(1,0) = -5.93 ±0.01 are selected for Uranus while the corresponding selected values for Neptune are: B(1,0) = -6.68±0.03 and V(1,0) = -6.96 ±0.02. The V-filter magnitudes are similar to the 1996 values; however, Uranus was apparently brighter in the infrared than it was in 1993-1996.

Rik Hill contributed 1996 photoelectric magnitude measurements for Uranus and Neptune after the 1996 Remote Planets report had been submitted for publication. His data were collected on 1996 Aug 13 and are consistent with V-filter magnitudes of +5.63 for Uranus and +7.83 for Neptune. These magnitudes are consistent with the selected magnitudes in the previously published 1996 report.

## Visual Photometry

The Remote Planets Section received 109 and 76 naked-eye magnitude estimates for Uranus and Neptune respectively from Rik Hill, Gus Johnson, Gary Nowak and the author. The mean normalized naked-eye magnitude for Uranus based on 1997 estimates is Vvis(1,0) = -7.2±0.03, while the corresponding value for Neptune is Vvis(1,0) = -7.0±0.03. The uncertainties include only random errors and do not include possible systematic errors arising from differences in comparison-star and planet color.

## Drawing, Photographs and Visual Descriptions

Two photographs of Pluto taken by Frank Melillo in June 1997 are shown in *Figure 1* (p. 171). After close inspection of the photographs, it appears that Pluto was slightly brighter on Jun 05 than on Jun 09; the brightness difference is estimated to be about 20 percent, or 0.2 magnitudes. Both photographs were analyzed with a 10X microscope. There is a possibility that Charon is the small smudge just north of Pluto on the Jun 09 photograph; Charon was at greatest elongation when the Jun 09 photograph was taken. However, the smudge extends 0.4 mm north of Pluto, which corresponds to 3.7 arc-seconds; this is larger than the 1.0 arc-second elongation distance of Charon.

Frank Melillo also submitted three photographs of Uranus, Titania and Oberon. He used hypered Kodak Technical Pan 2415 film with a 20-cm (8-in) Schmidt-Cassegrain telescope. The three photographs were taken on 1985 Jun 15 and 1997 Jul 30 and Jul 31. In all three photographs, Titania was distinctly brighter than Oberon by about 20-40 percent. Titania was about 0.2 magnitudes brighter than Oberon in the 1985 photograph but may have been 0.3-0.4 magnitudes brighter than Oberon in the 1997 photograph. Titania is reported to be about 0.2 magnitudes brighter than Oberon according to V-filter photoelectric measurements [Veverka *et al.*, 1991, 532] and so the photographs are consistent with previously reported magnitudes. However, there is a possibility that the brightness difference between Titania and Oberon increased between 1985 and 1997.

*Table 6* (p. 170) lists estimated magnitudes for Titania and Pluto assuming a magnitude of +14.0 for Oberon on 1997 Jul 30/31. Exposure times and extinction have been taken into account in determining the estimated magnitude. The mean magnitude for Pluto in early June is +14.3 which is dimmer than the predicted magnitude of +13.7. Uncertainties due to sky conditions along with interpreting and processing the photographs are estimated to be ±0.4 magnitude. The photographs suggest

**Table 6. Summary of an Analysis of Photographs of Uranus' Satellites and Pluto.**

| UT Date (1997) | JUN 05.15 | JUN 09.175 | JUL 30.2 | JUL 31.2 |
|---|---|---|---|---|
| Object | Pluto | Pluto | Titania | Titania |
| Exposure time | 19 m | 19 m | 15 m | 15 m |
| Altitude of Object | 41° | 41° | 29° | 29° |
| Phase Angle of Object | 0°.5 | 0°.6 | 0°.1 | 0°.1 |
| Raw Magnitude[a] | +13.9 | +14.1 | +13.6 | +13.8 |
| Estimated Magnitude[b] | +14.2 | +14.4 | +13.6 | +13.8 |
| V(0°)[c] | -0.6 | -0.4 | +0.7 | +0.9 |

[a]Oberon is assumed to have been at magnitude +14.0 on July 30/31, 1997.
[b]Approximate corrections of 0.2 and 0.1 magnitudes have been added to Pluto's magnitude due to exposure time and atmospheric extinction respectively.
[c]V(0°) is defined as the normalized magnitude with the true opposition surge; see Veverka *et al.*, 1991,532.

that Pluto was dimmer than expected in June, 1997; however, there are too many uncertainties to make a definite conclusion.

Norman Boisclair and the author both used 51-cm (20-in) Newtonian telescopes to study the Remote Planets in 1997. Boisclair reports that at 1016X Uranus had a sharp limb with little limb darkening and no albedo irregularities on 1997 AUG 12 (03h30m-04h00m UT); this is in contrast to descriptions made in 1965 [Cross, 1969, 152] and 1969 [Hodgson, 1969, 168], that Uranus has a strong limb darkening. There is the possibility that the limb darkening may be more pronounced near the poles. The high measurements of ellipticity for Uranus from 1842 to 1969, usually between 0.04 and 0.10 [Shartle, 1969, 199], compared to the actual value of 0.0229 [Beatty and Chaikin, 1990, 289], may be due to a more pronounced limb darkening at the poles. Members of the A.L.P.O. Remote Planets Section are encouraged to look for any asymmetry in the limb darkening of Uranus in upcoming years.

Boisclair reports that Neptune had strong limb darkening at 840X on 1997 AUG 12. As with Uranus, no albedo irregularities were observed on Neptune. The author studied Uranus at 380X on 1997 AUG 03 (06h09m-06h24m UT) and suspected both a bright and dark spot. The bright spot was near the center of the disc while the dark spot was just south of the dark spot. The bright spot was more distinct through a yellow filter than in integrated light but was not distinct through a red filter. The dark spot was more distinct in the red filter than in the yellow filter.

Boisclair also reports that Uranus had a combination of a "yellow and washed-out green" color. Neptune was reported to have an indigo color. A magnification of 508X with a Wratten #8 (yellow) Filter was used by Boisclair in making the color estimates.

## CONCLUSIONS

An intense photoelectric and visual study was made of the Remote Planets in 1997. The selected normalized magnitudes for Uranus are V(1,0) = -7.15±0.01 and I(1,0) = -5.93±0.01, while the corresponding values for Neptune are: B(1,0) = -6.68 ±0.03 and V(1,0) = -6.96±0.02. The selected normalized magnitudes based on naked-eye magnitude estimates are $V_{vis}(1,0)$ = -7.2±0.03 for Uranus and $V_{vis}(1,0)$ = -7.0 ±0.03 for Neptune. The maximum rotational change in brightness for Uranus is estimated to be less than 0.1 magnitude in the V filter and 0.2 magnitude in the I filter. Photographs made in 1985 and 1997 reveal that the brightness difference between Titania and Oberon may have increased from 0.2 magnitudes to 0.3 magnitudes. Photographs suggest that Pluto was 0.6±0.4 magnitude dimmer in early June, 1997 than expected.

## REFERENCES


*Astronomical Almanac for the Year 1997.* Washington, DC: U.S. Government. Printing Office.

Astronomy (1998). "Hubble Space Telescope." *Astronomy,* Vol. 26, No. 3 (March), p. 28.

Beatty, J.K. and Chaikin, A., eds. (1990) *The New Solar System.* Cambridge, MA: Sky Publishing Corp., p. 289.

Bishop, R.L., ed. (1995) *Observer's Handbook 1996.* Toronto: Univ. of Toronto Press Inc.

________., ed. (1996) *Observer's Handbook 1997*. Toronto: Univ. of Toronto Press Inc.

________., ed. (1997) *Observer's Handbook 1998*. Toronto: Univ. of Toronto Press Inc.

Cross, E.W., Jr. (1969) "Some Visual Observations of Markings on Uranus," *J.A.L.P.O.*, Vol. 21, Nos. 9-10 (July) pp. 152-153.

di Cicco, D. (1997) "Fading Pluto and Other Planetary Highlights." *Sky & Telescope*, Vol. 94, No. 4, (October) p. 102.

Hirshfeld, A;, Sinnott, R.W. and Ochsenbem, F., eds. (1991) *Sky Catalogue 2000.0. Volume 1: Stars to Magnitude 8.0.* 2nd Ed. Cambridge, MA: Sky Publishing Corp.

Hodgson, R.G. (1969) "Uranus in Early 1969." *J.A.L.P.O.* Vol. 21, Nos. 9-10 (July), pp. 167-170.

Optec Inc. (1988) *Model SSP-3 Solid State Stellar Photometer Technical Manual for Theory of Operation and Operating Procedures.* Lowell, MI: Optec Inc.

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

________. (1998) "The 1996 Apparitions of Uranus and Neptune." *J.A.L.P.O.* Vol. 40, No. 3 (July), pp.121-125

Shartle, S.M. (1968) "The Ellipticity of Uranus." *J.A.L.P.O.* Vol. 20, Nos. 11-12 (March), pp. 197-200.

Sky & Telescope (1998a) "Two New Moons for Uranus ." *Sky & Telescope.* Vol. 95, No. 1 (January), p. 19.

________. (1998b) "Second New Uranian Satellite Confirmed." *Sky & Telescope.* Vol. 95, No. 4 (April), p. 22.

Veverka, J;, Brown, R.H.; and Bell, J.F. (1991) "Uranus Satellites: Surface Properties" in *Uranus* (Bergstralh, J.T.; Miner, E.D.; and Matthews, M.S., eds.) Tucson AZ: The Univ. of Arizona Press, pp. 528-560.

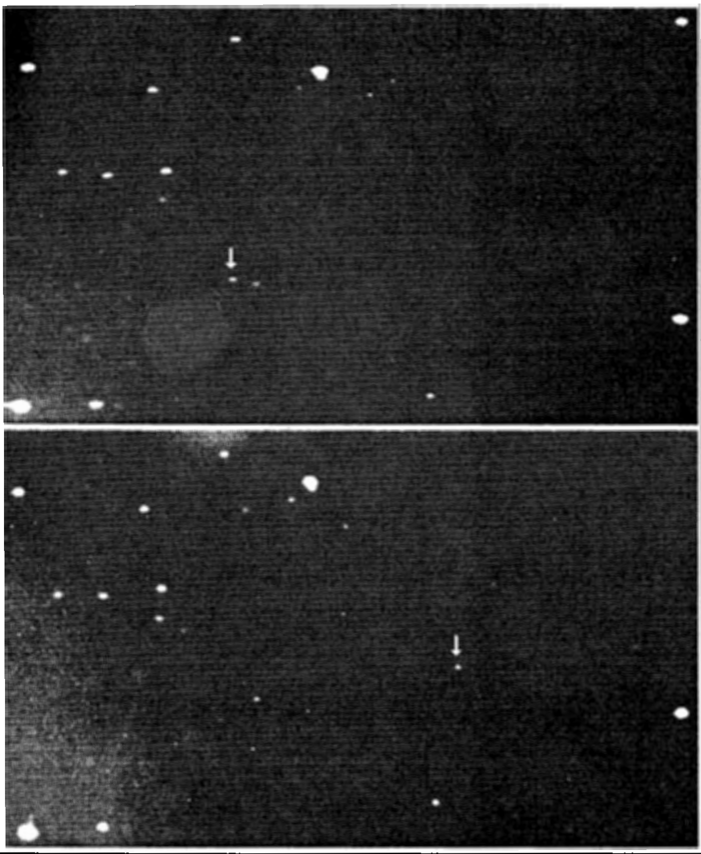


Figure 1: Two photographs taken of Pluto on 1997 Jun 05, 03h 30m UT (top) and 1997 Jun 09, 03h30m UT (bottom). Both photographs were taken by Frank Melillo at the prime focus (f/10) of an 8-in (20-cm) Schmidt-Cassegrain telescope using hypered Kodak Technical Pan 2415 Film. The exposure time was 19 minutes in both cases. Pluto is shown by white arrows, and moved 6.2 arc-minutes westward between the two dates. Celestial north is at the top; the field of view is approximately 19 arc-minutes east-west by 11 arc-minutes north-south. The bright star near the right margin is SAO 141071 (visual magnitude +8.98). See also text (p. 169).

# METEORS SECTION NEWS

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

### SUMMARY

The short but strong Quadrantid shower was well seen in early January. The remainder of the first half of January was dominated by weak activity from the Delta Cancrids and the Coma Berenicids. The Alpha Centaurids made their first appearance late in January. As seen from lower latitudes the Alpha Centaurids were the dominant shower during the first half of February. From mid-northern latitudes the February Leonids (Virginids) and a possible new shower, the Xi Böotids, were most active. Meteor observations were not undertaken between February 18 and 28.

For observers in the Southern Hemisphere the Virginids and Gamma Normids were most active during March. Northern observers were reporting activity from the Delta Leonids and Virginids. Rates were low, averaging less than one shower member per hour.

The first half of April remained slow with the only active shower being the Virginids. Activity picked up in the second half of the month as the Lyrids became active. Unfortunately a full moon was present during the peak of the Lyrids and counts were low. Showers reported during the second half of April included the Pi Puppids, Librids, Omicron Capricornids, and the Eta Aquarids.

The Eta Aquarids were the major event of May. The Moon was favorable and good counts were obtained especially from observers in the Southern Hemisphere. Many observers made special efforts to watch this shower, which is only active during the late morning hours before dawn.

June produced very low activity. The most active shower was the Sagittarids which were active the entire month. The new Xi Draconids made another reappearance in midmonth reaffirming the possibility that this shower is related to and may have replaced the June Lyrids. The June Lyrids have been nearly nonexistent the last several years.

**Table 1. Recent A.L.P.O. Meteor Observations; January - June, 1997.**

| 1997 UT Date | Observer and Location | Universal Time | Number and Type*of Meteors Seen | Comments (+N = Limiting Magnitude) |
|---|---|---|---|---|
| JAN 01 | Graham Wolf, N. Zealand | 1000-1500 | 1 DCA, 20 SPO | +5.6 |
| JAN 02 | Graham Wolf, N. Zealand | 1000-1500 | 1 DCA, 22 SPO | +5.6 |
| JAN 2/3 | J. Rendtel, Germany | 2311-0545 | 4 COM, 7 DCA, 104 QUA, 31 SPO | +6.0 |
| | Norman McLeod, FL | 2330-0044 | 2 SPO | +5.0 |
| JAN 03 | Doug Kniffen, MO | 0515-0625 | 12 QUA, 9 SPO | +6.0 |
| | Richard Schmude, GA | 0556-0656 | 6 QUA, 3 SPO | +5.7; 5% cloudy |
| | Norman McLeod, FL | 0624-1120 | 142 QUA, 28 SPO | +6.2 |
| | Roger Venable, GA | 0637-0955 | 95 QUA, 24 SPO | +5.8 |
| | Mark Davis, SC | 0815-0915 | 1 COM, 15 QUA, 3 SPO | +5.1; 50% cloudy |
| | Michael Morrow, HI | 1110-1210 | 7 QUA, 7 SPO | +5.2 |
| JAN 07 | Kevin Kilkenny, NJ | 0230-0430 | 1 DCA, 4 SPO | +5.3 |
| | Robert Lunsford, CA | 0930-1330 | 1 COM, 1 DCA, 10 SPO | +5.8 |
| JAN 08 | Robert Lunsford, CA | 0945-1345 | 1 COM, 13 SPO | +5.7 |
| | Graham Wolf, N. Zealand | 1000-1400 | 2 DCA, 13 SPO | +5.5 |
| JAN 09 | Robert Lunsford, CA | 0900-1200 | 7 SPO | +5.3 |
| JAN 10 | Graham Wolf, N. Zealand | 1000-1400 | 3 DCA, 17 SPO | +6.4 |
| JAN 11 | Graham Wolf, N. Zealand | 1000-1500 | 7 DCA, 46 SPO | +6.4 |
| JAN 12 | Graham Wolf, N. Zealand | 1000-1500 | 5 DCA, 21 SPO | +6.6 |
| JAN 13 | Graham Wolf, N. Zealand | 1000-1400 | 3 DCA, 13 SPO | +5.5 |
| JAN 14 | Graham Wolf, N. Zealand | 1000-1400 | 4 DCA, 17 SPO | +5.3 |
| JAN 15 | Wayne Hally, NJ | 0932-1038 | 6 SPO | +5.3 |
| JAN 15 | Graham Wolf, N. Zealand | 1000-1400 | 4 DCA, 13 SPO | +5.4 |
| JAN 16 | Graham Wolf, N. Zealand | 1000-1400 | 4 DCA, 11 SPO | +5.2 |
| JAN 28 | Graham Wolf, N. Zealand | 0900-1600 | 2 ACE, 25 SPO | +5.4 |

*Table 1 Continued on pp. *173-175 with notes on p. 175.*

***Table 1—Continued.***

| 1997 UT Date | Observer and Location | Universal Time | Number and Type* of Meteors Seen | Comments (+N = Limiting Magnitude) |
|---|---|---|---|---|
| JAN 29 | Wayne Hally, NJ | 0120-0340 | 1 DCA, 2 SPO | +5.5 |
| | Kevin Kilkenny, NJ | 0430-0540 | 2 DCA, 2 SPO | +5.5 |
| | Graham Wolf, N. Zealand | 0900-1600 | 4 ACE, 30 SPO | +5.5 |
| JAN 30 | Graham Wolf, N. Zealand | 0900-1600 | 8 ACE, 30 SPO | +5.4 |
| JAN 31 | Graham Wolf, N. Zealand | 0900-1600 | 9 ACE, 36 SPO | +5.6 |
| FEB 01 | Graham Wolf, N. Zealand | 0900-1600 | 10 ACE, 35 SPO | +5.6 |
| FEB 02 | Graham Wolf, N. Zealand | 0900-1600 | 11 ACE, 32 SPO | +5.4 |
| FEB 03 | Robert Lunsford, CA | 0815-1300 | 4 FLE, 44 SPO | +6.6 |
| FEB 06 | George Gliba, FL | 0723-0823 | 1 ACE, 7 XBO, 9 SPO | +6.2; 15% cloudy |
| | Graham Wolf, N. Zealand | 0900-1600 | 31 ACE, 24 SPO | +5.6 |
| | George Gliba, FL | 0910-1010 | 3 FLE, 5 XBO, 12 SPO | +6.2; 20% cloudy |
| | Robert Lunsford, CA | 1100-1400 | 14 SPO | +6.1 |
| FEB 6/7 | Tim Cooper, S. Africa | 2335-0250 | 1 ACE, 24 SPO | +5.4 |
| FEB 07 | George Gliba, FL | 0836-1036 | 1 ACE, 3 FLE, 6 XBO, 16 SPO | +5.9; 30% cloudy |
| | Graham Wolf, N. Zealand | 1200-1600 | 23 ACE, 17 SPO | +5.5 |
| FEB 08 | Cathy Hall, Ontario | 0430-0645 | 11 SPO | +5.8 |
| | George Gliba, FL | 0837-1037 | 2 ACE, 3 FLE, 4 XBO, 21 SPO | +6.3 |
| | Graham Wolf, N. Zealand | 1000-1500 | 18 ACE, 20 SPO | +5.4 |
| FEB 09 | George Gliba, FL | 0825-0925 | 1 ACE, 2 FLE, 2 XBO, 4 SPO | +5.8; 35% cloudy |
| FEB 10 | Wayne Hally, NJ | 0800-0950 | 2 FLE, 4 SPO | +5.4 |
| | Robert Lunsford, CA | 1000-1300 | 1 FLE, 9 SPO | +5.6 |
| FEB 12 | Robert Lunsford, CA | 0830-1230 | 4 FLE, 1 TCE, 20 SPO | +6.3 |
| FEB 13 | Robert Lunsford, CA | 0800-1300 | 1 FLE, 12 SPO | +5.9 |
| | Michael Morrow, HI | 1320-1520 | 14 SPO | +6.5 |
| FEB 15 | Graham Wolf, N. Zealand | 0900-1600 | 2 ACE, 2 DLE, 4 FLE, 28 SPO | +5.3 |
| FEB 16 | Graham Wolf, N. Zealand | 0900-1600 | 2 ACE, 2 DLE, 3 FLE, 22 SPO | +5.2 |
| | Michael Morrow, HI | 1345-1530 | 11 SPO | +6.2 |
| FEB 17 | Michael Morrow, HI | 1330-1530 | 23 SPO | +6.5 |
| MAR 01 | Wayne Hally, NJ | 0102-0322 | 1 DLE, 6 SPO | +5.1 |
| MAR 03 | Robert Lunsford, CA | 0600-1100 | 14 SPO | +5.5 |
| MAR 04 | Robert Lunsford, CA | 0900-1200 | 9 SPO | +5.3 |
| MAR 05 | Robert Lunsford, CA | 0900-1300 | 2 VIR, 13 SPO | +5.5 |
| MAR 06 | Robert Lunsford, CA | 0900-1200 | 9 SPO | +5.3 |
| MAR 09 | Graham Wolf, N. Zealand | 0800-1300 | 1 DLE, 4 GNO, 1 VIR, 25 SPO | +5.4 |
| MAR 10 | Robert Lunsford, CA | 0800-1200 | 2 VIR, 13 SPO | +5.5 |
| | Graham Wolf, N. Zealand | 0800-1300 | 1 DLE, 5 GNO, 2 VIR, 32 SPO | +5.5 |
| MAR 11 | Robert Lunsford, CA | 0800-1200 | 3 VIR, 12 SPO | +5.6 |
| | Graham Wolf, N. Zealand | 1000-1600 | 11 GNO, 1 VIR, 35 SPO | +5.5 |
| MAR 12 | Graham Wolf, N. Zealand | 0800-1600 | 9 GNO, 33 SPO | +5.3 |
| MAR 13 | Graham Wolf, N. Zealand | 0800-1600 | 11 GNO, 3 VIR, 45 SPO | +5.5 |
| | Michael Morrow, HI | 1300-1500 | 7 SPO | +6.2 |
| MAR 14 | Graham Wolf, N. Zealand | 1000-1600 | 19 GNO, 3 VIR, 42 SPO | +5.4 |
| | Michael Morrow, HI | 1300-1500 | 15 SPO | +6.0 |
| MAR 15 | Graham Wolf, N. Zealand | 0800-1600 | 9 GNO, 4 VIR, 44 SPO | +5.2 |
| | Michael Morrow, HI | 1300-1500 | 13 SPO | +6.0 |
| MAR 16 | Graham Wolf, N. Zealand | 0800-1600 | 7 GNO, 4 VIR, 36 SPO | +5.4 |
| MAR 17 | Graham Wolf, N. Zealand | 1200-1400 | 2 GNO, 7 SPO | +5.3 |
| MAR 18 | Robert Lunsford, CA | 1000-1200 | 15 SPO | +6.5 |
| | Graham Wolf, N. Zealand | 1200-1700 | 5 GNO, 22 SPO | +5.3 |
| MAR 19 | Robert Lunsford, CA | 0830-1130 | 1 VIR, 10 SPO | +5.2 |
| | Graham Wolf, N. Zealand | 1200-1700 | 3 GNO, 20 SPO | +5.2 |
| MAR 20 | Robert Lunsford, CA | 0900-1200 | 1 VIR, 12 SPO | +5.5 |
| MAR 25 | Graham Wolf, N. Zealand | 0700-0800 | 2 VIR, 3 SPO | +5.0 |
| MAR 27 | Graham Wolf, N. Zealand | 0800-0900 | 1 VIR, 3 SPO | +5.0 |
| MAR 28 | Graham Wolf, N. Zealand | 0800-1200 | 3 VIR, 10 SPO | +4.9 |
| MAR 29 | Graham Wolf, N. Zealand | 0800-1000 | 2 VIR, 6 SPO | +5.1 |
| MAR 30 | Graham Wolf, N. Zealand | 0800-1200 | 4 VIR, 12 SPO | +5.3 |
| MAR 31 | Graham Wolf, N. Zealand | 0800-1500 | 5 VIR, 29 SPO | +5.3 |
| APR 01 | Robert Lunsford, CA | 0900-1200 | 7 SPO | +5.2 |
| APR 02 | Graham Wolf, N. Zealand | 0800-1500 | 5 VIR, 27 SPO | +5.4 |

*Table 1 Continued on pp. 174-175 with notes on p. 175.*

***Table 1—Continued.***

| 1997 UT Date | Observer and Location | Universal Time | Number and Type*of Meteors Seen | Comments (+N = Limiting Magnitude) |
|---|---|---|---|---|
| Apr 03 | Graham Wolf, N. Zealand | 0800-1500 | 6 VIR, 34 SPO | +5.3 |
| Apr 04 | Graham Wolf, N. Zealand | 0800-1500 | 4 VIR, 31 SPO | +5.3 |
| Apr 05 | Graham Wolf, N. Zealand | 0800-1400 | 3 VIR, 24 SPO | +5.4 |
| Apr 06 | Graham Wolf, N. Zealand | 0800-1500 | 5 VIR, 35 SPO | +5.3 |
| Apr 08 | Robert Lunsford, CA | 0800-1100 | 2 VIR, 14 SPO | +5.2 |
| Apr 09 | Graham Wolf, N. Zealand | 0800-1500 | 3 VIR, 27 SPO | +5.5 |
| | Robert Lunsford, CA | 0830-1130 | 1 VIR, 9 SPO | +5.0 |
| Apr 10 | Graham Wolf, N. Zealand | 0800-1500 | 6 VIR, 32 SPO | +5.3 |
| Apr 11 | Graham Wolf, N. Zealand | 0800-1500 | 3 VIR, 26 SPO | +5.3 |
| Apr 12 | Graham Wolf, N. Zealand | 0800-1500 | 3 VIR, 31 SPO | +5.5 |
| Apr 14 | Graham Wolf, N. Zealand | 0800-1500 | 4 VIR, 34 SPO | +5.5 |
| Apr 15 | Robert Lunsford, CA | 0845-1215 | 24 SPO | +6.2 |
| | Graham Wolf, N. Zealand | 1000-1700 | 26 SPO | +5.4 |
| Apr 16 | Lewis Gramer, MA | 0715-0825 | 1 LYR, 1 VIR, 4 SPO | +5.5; 10% cloudy |
| | Graham Wolf, N. Zealand | 1000-1700 | 2 LIB, 1 PPU, 34 SPO | +5.3 |
| Apr 17 | Graham Wolf, N. Zealand | 0800-1600 | 2 LIB, 1 PPU, 35 SPO | +5.3 |
| Apr 18 | Graham Wolf, N. Zealand | 0800-1400 | 1 LIB, 1 PPU, 21 SPO | +5.3 |
| Apr 22 | Robert Lunsford, CA | 0800-1100 | 7 LYR, 2 SPO | +4.7 |
| Apr 27 | Tim Cooper, S. Africa | 0140-0330 | 4 ETA, 3 WCA, 11 SPO | +5.3 |
| | Graham Wolf, N. Zealand | 0800-1700 | 10 ETA, 2 LIB, 6 PPU, 21 SPO | +4.1 |
| Apr 28 | Tim Cooper, S. Africa | 0135-0335 | 2 ETA, 1 WCA, 14 SPO | +5.4 |
| | Graham Wolf, N. Zealand | 1000-1400 | 1 LIB, 10 SPO | +4.7 |
| | Graham Wolf, N. Zealand | 1500-1700 | 10 ETA, 4 SPO | +3.9 |
| Apr 29 | Tim Cooper, S. Africa | 0132-0335 | 7 ETA, 2 LIB, 4 WCA, 10 SPO | +5.3 |
| | Graham Wolf, N. Zealand | 0800-1200 | 4 LIB, 15 SPO | +5.2 |
| | Graham Wolf, N. Zealand | 1500-1700 | 11 ETA, 6 SPO | +4.2 |
| Apr 30 | Tim Cooper, S. Africa | 0133-0333 | 5 ETA, 3 LIB, 2 WCA, 12 SPO | +5.0 |
| May 01 | Tim Cooper, S. Africa | 0134-0334 | 6 ETA, 11 SPO | +5.4 |
| | Adam Marsh, Australia | 1345-1445 | 4 SPO | +5.3 |
| May 02 | Tim Cooper, S. Africa | 0134-0334 | 8 ETA, 8 WCA, 14 SPO | +5.6 |
| May 03 | Tim Cooper, S. Africa | 0136-0336 | 13 ETA, 5 WCA, 19 SPO | +5.6 |
| May 04 | Tim Cooper, S. Africa | 0100-0300 | 30 ETA, 8 WCA, 23 SPO | +5.7 |
| | Richard Schmude, GA | 0915-0942 | 4 ETA, 1 SPO | +5.3 |
| May 05 | Tim Cooper, S. Africa | 0130-0330 | 53 ETA, 4 WCA, 28 SPO | +5.6 |
| | Dana Beasley, GA | 0137-0207 | 2 SPO | +5.0 |
| | Stacey Dunn, GA | 0137-0207 | 1 SPO | +5.0 |
| | Christine Pagnard, GA | 0137-0207 | *None Seen* | +5.0 |
| | Kim Rolen, GA | 0137-0207 | *None Seen* | +5.0 |
| | Richard Schmude, GA | 0137-0207 | 1 SPO | +5.0 |
| | Pierre Martin, Ontario | 0244-0446 | 2 ASC, 1 ETA | +5.6 |
| | Peter Gural, VA | 0630-0830 | 5 ETA, 15 SPO | +5.4 |
| | Norman McLeod, FL | 0726-0939 | 2 ASC, 36 ETA, 2 MV, 16 SPO | +7.2 |
| | Pierre Martin, Ontario | 0759-0841 | 3 ETA, 1 GCA, 2 SPO | +5.5 |
| | Cathy Hall, Ontario | 0800-0900 | 1 LYR, 4 ETA, 2 SPO | +5.1 |
| | Robert Lunsford, CA | 0800-1200 | 5 ASC, 20 ETA, 1 MVI, 1 NOP, 2WCA, 18 SPO | +6.6 |
| | Adam Marsh, Australia | 1445-1755 | 5 ASC, 21 ETA, 2 WCA, 18 SPO | +5.7 |
| May 06 | Peter Gural, VA | 0630-0830 | 5 ETA, 15 SPO | +5.7 |
| | Norman McLeod, FL | 0726-0938 | 2 ASC, 26 ETA, 1 MVI, 14 SPO | +7.3 |
| | Robert Lunsford, CA | 0800-1200 | 17 ETA, 2 MVI, 1 NOP, 1 WCA, 25 SPO | +6.5 |
| | Joseph Assmus, CA | 0905-1130 | 14 ETA, 12 SPO | +6.3 |
| May 07 | Robert Hays, IN | 0648-0928 | 3 ASC, 11 ETA, 28 SPO | +6.6 |
| | Richard Taibi, MD | 0711-0848 | 1 ETA, 1 SPO | +5.7 |
| | Norman McLeod, FL | 0725-0939 | 1 ASC, 26 ETA, 3 MVI, 9 SPO | +7.2 |
| | Pierre Martin, Ontario | 0742-0842 | 2 ETA, 1 GCA, 6 SPO | +5.6 |
| | Robert Lunsford, CA | 0800-1200 | 4 ASC, 30 ETA, 1 MVI, 1 WCA, 16 SPO | +6.4 |
| May 08 | Norman McLeod, FL | 0626-0942 | 1 ASC, 10 ETA, 3 MVI, 21 SPO | +7.3 |
| | Robert Lunsford, CA | 0800-1200 | 3 ASC, 16 ETA, 5 MVI, 1 WCA, 19 SPO | +6.4 |
| | Adam Marsh, Australia | 1425-1635 | 1 ASC, 2 ETA, 18 SPO | +5.8 |
| May 09 | Norman McLeod, FL | 0726-0926 | 3 ASC, 8 ETA, 9 SPO | +7.2 |
| May 10 | Tim Cooper, S. Africa | 0133-0335 | 32 ETA, 4 WCA, 22 SPO | +5.6 |
| May 11 | Tim Cooper, S. Africa | 0135-0337 | 1 ASC, 33 ETA, 5 WCA | +5.7 |

*Table 1 Continued on p. 175 with notes.*

*Table 1—Continued.*

| 1997 UT Date | Observer and Location | Universal Time | Number and Type*of Meteors Seen | Comments (+N = Limiting Magnitude) |
|---|---|---|---|---|
| MAY 12 | Tim Cooper, S. Africa | 0129-0329 | 20 ETA, 6 WCA, 28 SPO | +6.0 |
| MAY 13 | Tim Cooper, S. Africa | 0135-0337 | 17 ETA, 3 WCA, 23 SPO | +5.8 |
| | Robert Lunsford, CA | 0745-1145 | 3 ASC, 10 ETA, 2 KSC, 1 NOP, 30 SPO | +6.4 |
| MAY 15 | Robert Lunsford, CA | 0800-1200 | 1 ASC, 3 ETA, 25 SPO | +6.6 |
| MAY 16 | Tim Cooper, S. Africa | 0129-0333 | 8 ETA, 6 WCA, 22 SPO | +5.9 |
| MAY 18 | Tim Cooper, S. Africa | 0130-0333 | 5 ETA, 4 WCA, 21 SPO | +5.6 |
| JUN 01 | Doug Kniffen, MO | 0510-0612 | 7 SPO | +4.5 |
| JUN 06 | Pierre Martin, Ontario | 0607-0708 | 1 SAG, 1 SPO | +5.6; 5% cloudy |
| JUN 07 | Doug Kniffen, MO | 0505-0610 | 17 SPO | +5.0 |
| | Wayne Hally, NJ | 0536-0817 | 3 SAG, 9 SPO | +5.3 |
| JUN 10 | Pierre Martin, Ontario | 0400-0527 | 3 SAG, 4 SPO | +5.7 |
| | Wayne Hally, NJ | 0535-0815 | 2 SAG, 8 SPO | +5.4 |
| JUN 11 | Wayne Hally, NJ | 0507-0808 | 9 SPO | +5.2 |
| | Robert Lunsford, CA | 0730-1130 | 6 SAG, 30 SPO | +6.3 |
| JUN 12 | Robert Lunsford, CA | 0730-1130 | 7 SAG, 1 TOP, 9 XDR, 28 SPO | +6.5 |
| JUN 15 | Pierre Martin, Ontario | 0500-0800 | 4 JLY, 4 THE, 1 SAG, 13 SPO | +5.7; 15% cloudy |
| | Cathy Hall, Ontario | 0500-0757 | 2 SAG, 14 SPO | +5.4; 15% cloudy |
| | Wayne Hally, NJ | 0703-0818 | 1 SAG, 3 SPO | +5.4; 15% cloudy |
| JUN 16 | Robert Lunsford, CA | 0515-1115 | 1 ARI, 2 SAG, 4 XDR, 20 SPO | +5.9 |
| | Pierre Martin, Ontario | 0638-0745 | 1 JLY, 3 SAG, 2 SPO | +5.6; 10% cloudy |
| | Wayne Hally, NJ | 0657-0812 | 1 SAG, 7 SPO | +5.3 |
| JUN 27 | Pierre Martin, Ontario | 0347-0500 | 1 SAG, 1 THE, 9 SPO | +5.8 |
| JUN 28 | Wayne Hally, NJ | 0258-0600 | 3 SAG, 14 SPO | +5.6 |
| | Pierre Martin, Ontario | 0309-0540 | 3 SAG, 10 SPO | +5.8 |
| JUN 29 | Wayne Hally, NJ | 0515-0732 | 13 SPO | +5.4 |
| JUN 30 | Adam Marsh, Australia | 1425-1625 | 15 SPO | +5.9 |

***Meteor Shower Abbreviations**

| | | | | | |
|---|---|---|---|---|---|
| ACE | Alpha Centaurids | GNO | Gamma Normids | SAG | Sagittarids |
| ARI | Daylight Arietids | JLY | June Lyrids | SPO | Sporadic |
| ASC | Alpha Scorpids | KSC | Kappa Scorpids | TCE | Theta Centaurids |
| COM | Coma Berenicids | LIB | Librids | THE | Tau Herculids |
| DCA | Delta Cancrids | LYR | Lyrids | TOP | Theta Orphiuchids |
| DLE | Delta Leonids | MVI | Mu Virginids | VIR | Virginids |
| ETA | Eta Aquarids | NOP | Northern Orphiuchids | WCA | Omega Capricornids |
| FLE | February Leonids | PPU | Pi Puppids | XBO | Xi Böotids |
| GCA | Gamma Capricornids | QUA | Quadrantids | XDR | Xi Draconids |

*Fifty Years AGo: A Seclection from The Strolling Astronomer, October 1, 1948 (Vol. 2, No. 10), "Some Recent Observations," p. 5.*

Venus has been receiving much attention from E. Pfannenschmidt and his colleagues at several German observatories during its present very favorable morning apparition. Perhaps the most interesting and surprising result of their observations comes from the Treptow Observatory in Berlin. On July 18 at 2h 15m Messrs. Bomm and Pocher, both experienced observers, saw the dark hemisphere "illuminated in a purple-brownish color with a clearly lighter (less dim) part eccentrically located" in the north central part of the disc regarded as a complete circle. They were using a 6-inch reflector with good seeing and transparency. To the best of the editor's knowledge, no one else has ever perceived differences in the brightness of the "ashy light" in its different portions. "The same effect", this same curious lighting on the non-sunlit regions, was observed by Bomm with a 2-inch refractor on July 19 , by Pocher with a 6-inch reflector and a 4-inch refractor on July 21, by Pflug (also at Berlin) with a 4-inch reflector on July 21, and finally by both Bomm and Pocher with a 6-inch reflector on July 29. It is interesting that the July 18 observation, if not the others as well, was made with Venus still brilliant in a dawn sky. On that date the sun rose at Treptow at 3h 4m, U.T., 49 minutes after the observation. Many of the past records of the "ashy light" have been made with Venus viewed against a daylight sky.

# A.L.P.O. YOUTH PAGE

(Coordinated by R.W. Schmude, Jr.)

# OBSERVATIONS OF MINOR PLANET 174 PHAEDRA, JUPITER AND THE LUNAR CRATER PETAVIUS

## By: Jens Rummler

## MINOR PLANET POSITION: 174 PHAEDRA

Listed below in *Table 1* are two position estimates for the minor planet 174 Phaedra made during April and May of 1997. They were made using an 8-inch Newtonian reflector on a Dobsonian mount. The way in which these observations were made was by plotting the position of the planet, as observed, onto copies of the *Minor Planet Observer* chart for it. After these positions are plotted I carefully, using the measurements of the relative position of the stars on the MPO chart, translate the planet's position onto the pertinent page of *Uranometria 2000.0*. At this point I can use the formulae provided in the sheet I received from the Minor Planets Section to calculate the positions as they will be written on the report form. The Epoch for the positions below is 2000.0. A magnification of 102X was used.

**Table 1. Position Measurements of Minor Planet 174 Phaedra**

| | | |
|---|---|---|
| UT Date (1997) | APR 30 | MAY 01 |
| UT | 04h07m | 05h06m |
| Right Ascension | 14h52.4m | 14h51.5m |
| Declination | -37°00' | -37°01' |
| Seeing | 7.7 | 7.0 |
| Transparency | +4.7 | +4.7 |

Note: Seeing is on the standard A.L.P.O. Scale (0 = worst, 10 = perfect) and Transparency is the limiting visual magnitude.

## DISC DRAWING AND INTENSITY ESTIMATES OF JUPITER

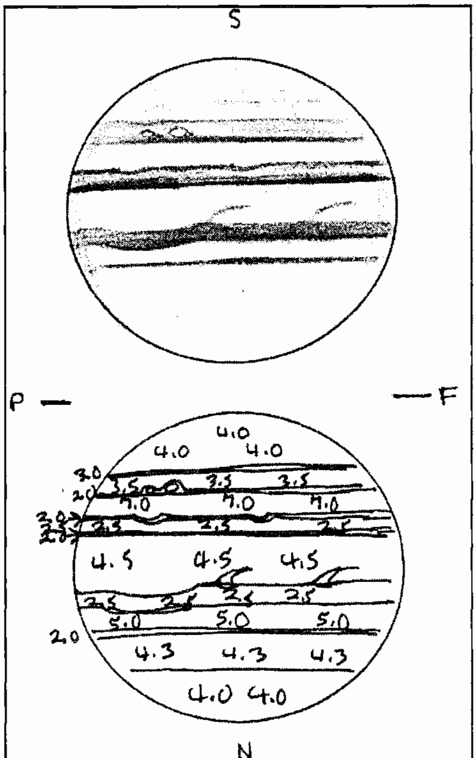



Figure 1. Drawing (top) and visual intensity estimates (bottom) by Jens Rummler. 1996 JUL 19, 11h16m-11h38m UT. 8-in (20-cm) Newtonian, 102X. Seeing = 7-8 on the A.L.P.O. Scale, Transparency = +5.0 (limiting visual magnitude). Central Meridian: 348°.2 System I, 228°.5 System II. South at top. The intensities are on the Standard A.L.P.O. Scale, ranging from 0.0 for black shadow to 10.0 for the brightest possible feature. Also see text below.

The disk drawing and intensity estimates of Jupiter shown in *Figure 1* (upper right)were made on 1996 JUL 19 UT. During the observing session, an 8-in Newtonian telescope was used at a magnification of 102X; the seeing was between 7 and 8 on the A.L.P.O. scale and the transparency was +5.0. The central meridians were 348°.23 for System I, and 228°.49 for System II, The following are the notes I took during this observation.:

"I believe I am for once able to make out the SSTB as well as the STB. Also I am able to make out two white spots (nodules) [the brighter of these 'spots' turned out to be the 'long-enduring white oval' BC] on the S. edge of the STB. I can also separate the SEB into two belts (a north and south one) separated by a relatively dark zone. The EZ appeared darker than the other zones. I saw two festoons with a possible third one on the extreme p. limb on the s. side of NEB. I also saw a 'bay' in the s. side of the NEB. In the area corresponding to this 'bay' on the n. side of the NEB there was a bulge into the NTrZ. The belt below the NEB seemed to widen towards the f. side. I would say the nodules were about a 7.0 on the intensity scale. The darkness of the festoons was exaggerated in the drawing. On the intensity scale they were about a 4.0. Intensities are fairly approximate."

### Observation of the Lunar Crater Petavius

I drew the lunar crater Petavius using my 8-in Newtonian on the night of 1997 Jul 22, 05h55m UT; this drawing is shown in *Figure 2* (to right). The seeing was a 7.0 on the A.L.P.O. scale and the transparency was +3.2 to +3.5. To identify the crater, I used a lunar map based on the original drawing by Karel Andel published in 1926 as *Mappa Selenographica*. Petavius is located southeast of Mare Fecunditatis and is 13,800 feet deep. According to Cherrington's *Exploring the Moon through Binoculars and Small Telescopes*, it measures 99 by 110 miles, with a central uplift that rises 8,200 feet above the crater floor. A small portion of the crater Hase can also be seen in the area just above Petavius in my drawing.


Figure 2. Drawing of the lunar crater Petavius by Jens Rummler. 1997 Jul 22, 05h55m UT. 8-in (20-cm) Newtonian. Seeing = 7.0, Transparency = +3.2 to + 3.5. South at top. Also see text.

# A.L.P.O. Instruments Section—A Call from Retirement

**By: R. B. Minton, Acting Coordinator, Instruments Section.**
**568 North First Street, Raton, NM 87740**

Hello to all 600 worldwide members of A.L.P.O. I recently rejoined this wonderful organization after a 40-year hiatus. My first issue announced the closure of the Instruments Section, and contained a letter from the Founder; both had a common theme—lack of reader participation. I see this closure as an opportunity for me to share my enthusiasm with the readers, and, I hope, increase participation along the way.

After corresponding and brainstorming with some of our Staff, they decided to reopen the Instruments Section. I also suggested that we conduct a simple survey among members as to what type of astronomical instrumentation interests them the most. Buying what is needed is better than doing without, but one misses the immense satisfaction and intimate knowledge that comes from building it yourself.

Let me know what you currently like to do, what you use to do it with (even if it's only your eyes); and what you might want to buy or build in the near future. I will tally and publish the results, and select the most popular topics for treatment. I also confess that I will solicit help from readers who have experience in areas where I have none. I envision my role as more of a coordinator, conductor, and cheer-leader rather than author. (Biographicaly, I am a 58 year-old retired, married, male telescope nut who has a few striped threads.)

Please send me a short letter or postcard with your comments, wishes, or even questions. A stamped self-addressed envelope will help if you have a question, and I will try to answer any and all questions. Sorry, but I do not have Internet access. Your name and address will be kept confidential if so expressed.

# Observing the Moon: Rilles

## By: Bill Dembowski, Coordinator, Lunar Topographical Studies

The topographical study of the Moon, selenography, is an old and noble pursuit. Although of limited scientific value, there is no better way to sharpen your observing skills than to sketch what you see at the eyepiece. Also, there is no greater challenge to the high-resolution astro-imager than to record the details of the lunar surface. There has been a renewed interest in general lunar observing in recent years, perhaps fired by the availability of affordable CCD equipment, which helped focus attention back to our only natural satellite. In this series of articles we hope to further that renewed interest by featuring informative and enjoyable explorations of the Moon and provide a showcase for the work of those who engage in topographical studies of the Moon.

Rilles, or "clefts" as they are sometimes called in older lunar writings, are channels or grooves in the Moon's surface. Rilles are most often divided into three classes: *straight*, *arcuate*, and *sinuous*. As with many other lunar features these classifications are based on appearance rather than on origin. Their "official" latinized designation is *rimae* (singular, *rima*).

Straight rilles can be found on virtually all mare surfaces and on the floors of many large craters. Their origins are due largely to faulting, although some volcanic action is also often evident. Perhaps the most readily observable straight rille is the portion of the Rimae Petavius which runs for about 80 km across the floor of the crater Petavius. The most prominent section of this rille runs from the central peak of Petavius to its southeast wall. Easily seen in even a small telescope, it is an ideal target for beginning lunar observers.

Another easily seen rille is Rima Cauchy in Mare Tranquillitatis. Of particular interest, it runs for 210 km in a relatively straight line northeast of Cauchy. To its southwest is Rupes Cauchy, a scarp that parallels the rille, which hints at a similar origin. Both features may appear similar under a low sun but their differences become evident under a high sun when the rille virtually disappears and the scarp appears as a bright line. *Figure 1* (to the right), shows a drawing of these features.

For sheer frequency and complexity it is difficult to match the rilles near the very center of the lunar disk. Those surrounding the craters Triesnecker, Hyginus, and Ariadaeus form a virtual spiderweb of cracks in the lunar surface. The Rimae Triesnecker , in Sinus Medii, are approximately 1.5 to 2 km wide, between 500 and 750 meters deep, and have V-shaped profiles. The Rimae Triesnecker appear in *Figure 2* (p. 179).

The Rima Hyginus, in contrast to the Rimae Triesnecker, has a flat floor and may be a graben. Grabens are areas that have subsided between two parallel faults. Under high magnification, and with good seeing, the northern section of Rima Hyginus can be seen to be composed of a chain of craterpits. Their perfect alignment, interconnection, and lack of rims reveal that they are not impact craters but are tectonic in nature.

Arcuate rilles are similar in origin to straight rilles in that they are subsidence features. As their name implies, however, they form sweeping arcs rather than straight or branching lines. Arcuate rilles are grabens as well and cross both mare and highland terrains near the periphery of circular maria. Irregular maria, such as Mare Frigoris, are regions of relatively shallow flooding and do not contain arcu-

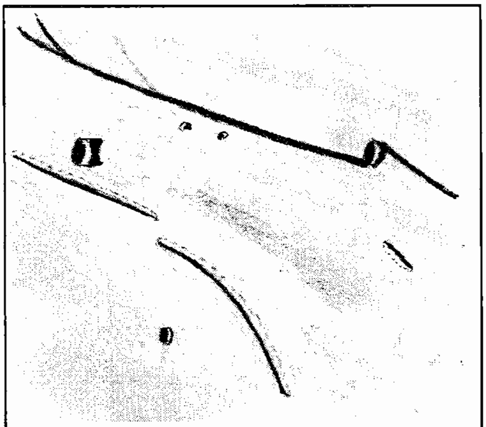


Figure 1. Rima Cauchy (lower left). Sketch by Robert H. Hays, Jr., of Worth, IL. 1998 Jun 29, 02h26m-02h42m UT. 15-cm Newtonian, 170X. Seeing 4-6 on the A.L.P.O. 0-10 scale. Colongitude 325°.8-326°.0. Crater Cauchy on left. South at top.

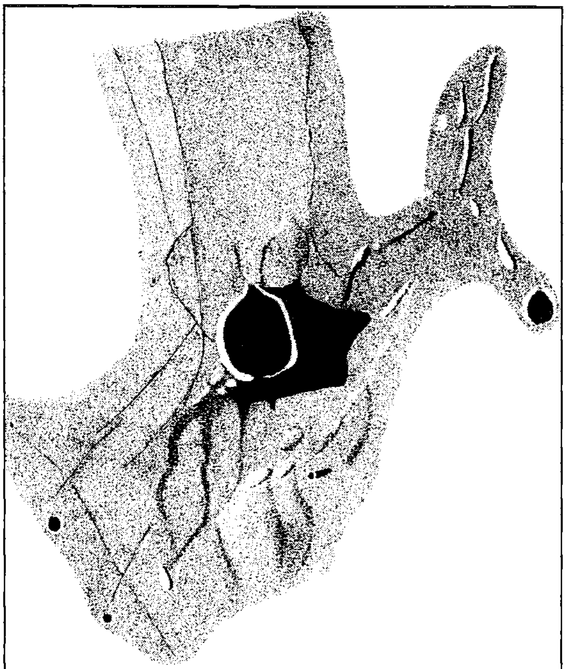


Figure 2. The 26-km crater Triesnecker with the Rimae Triesnecker to its left (south at top). Drawing by Colin Ebdon, of London, England. 1998 May 03, 21h20m-21h40m UT. 25-cm Newtonian, 183-262X. Seeing II-III on the Antoniadi Scale. Colongitude 359°.15-359°.30.

ate rilles, which are the result of gradual downwarping of the Moon's crust. A fine example of arcuate rilles can be found on the eastern shore of Mare Humorum, Rimae Hippalus, which is a series of concentric rilles that are easily seen in a small telescope. One of the wide rilles passes directly through the walls and across the floor of the partially submerged crater Hippalus. The total length of Rimae Hippalus is about 240 km.

Another series of arcuate rilles, Rimae Sosigenes, skirts the western shore of Mare Tranquillitatis. Running for approximately 150 km, one rille is interrupted by a small young crater, Sosigenes A. For a more challenging view, observers should turn their telescopes to Rimae Riccioli, a 390-km rille system that is actually associated with Mare Orientale. Being on the extreme western limb of the Moon, it is best studied under conditions of favorable libration.

The third class of rilles, sinuous rilles, may be the most interesting. Sinuous rilles typically begin at a crater or craterlike depression and end by fading into the mare surface or into a chain of elongated pits. Although they can be found anywhere on a mare, and even in a few highland locations, they are most likely to be found along the margins of mare-filled basins. They differ from straight and arcuate rilles in that they are not the result of subsidence but of erosion. One result of this is that sinuous rilles go around obstructions rather than through them as do straight and arcuate rilles.

In pre-Apollo years there were three principal theories as to the origins of sinuous rilles. In one theory the head crater was the source of water in the form of ice which was released by an impacting body. The rille itself was the dry river bed that resulted after the flooding waters boiled off into space. A second theory postulated erosion by pyroclastic flows of hot gasses and volcanic ash. The third has the source crater as a vent from which free-flowing lava originated. The rilles themselves were seen as collapsed lava tubes like those found in Craters of the Moon National Park in Idaho. It is almost certain now that the rilles are the result of basaltic lava flows but the exact details of their formation are still uncertain. Even with the lower gravity of the Moon, and the low viscosity of the mare lava (about the consistency of motor oil), it is difficult to explain the great width of the rilles (up to 3 km) and their tremendous length (some extend over 250 km).

The first sinuous rille was discovered in Oceanus Procellarum by Johannes Schroeter in 1787 and it still bears his name, Vallis Schröteri. Shown in *Figure 3* (p. 180), it is easily seen in a small telescope. Its source crater is near Herodotus and is about 6 km in diameter. The rille widens to a 10 km-diameter depression known informally as the "Cobra Head", and then narrows and fades into the mare surface 160 km later. Interesting in its own right, Vallis Schröteri is also the site of frequent reports of lunar transient phenomena and is well worth a close look.

About 200 km south of Vallis Schröteri is another classic sinuous rille, Rima Marius. Rima Marius is approximately 2 km wide and meanders across Oceanus Procellarum for 250 km before fading from view. For a real challenge in rille observing, however, there is the well-known but elusive rille that traverses the

Figure 3. Vallis Schröteri (upper right of center). Photograph by David Lehman, Fresno, CA. 1996 Oct 24, 05h30m UT. Colongitude 056°.40. 25-cm Newtonian, f/41. TP2415 Film, 0.5 s. South at top.

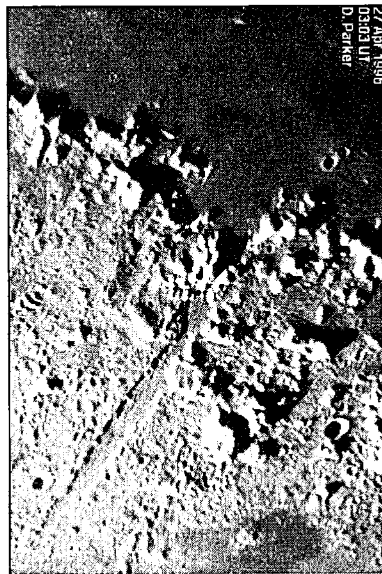



Figure 4. Vallis Alpes and rille. CCD image by Donald Parker. Coral Gables, FL. 1996 Apr 27, 03h03m UT. Colongitude 017°.37. 40-cm Newtonian, f/19, Integration time = 0.072 s. South at top.

floor of the Vallis Alpes. The rille has the characteristics both of a tension fracture and a feature originating by erosion from lava flows; it is, therefore, difficult to classify. It is also difficult to observe. Excellent optics and excellent seeing are essential to catching a glimpse of the rille and seldom is its entire length of 180 km visible at the same time. *Figure 4* (upper right) shows the Vallis Alpes and its central rille.

The *Gazetteer of Planetary Nomenclature 1994* lists 52 named rilles (rima) and 63 named networks or systems of rilles (rimae). Fortunately for us, all but four of them lie on the earthside hemisphere of the Moon, so there are plenty to give observers hours of pleasure and firsthand knowledge of the lunar surface. Your observations, sketches, and images of these fascinating features are welcomed by the Coordinator of Lunar Topographical Studies. So, too, are those of lunar rays, which will be the subject of the next installment of "Observing the Moon".

## References

Batson, Raymond M. and Russell, Joel F., eds. (1995) *Gazetteer of Planetary Nomenclature 1994*. U.S. Geological Survey Bulletin 2129. Washington: U.S. Government Printing Office.

Heiken, Grant.H.; Vaniman, David T. and French, Bevan, M. (1991) *Lunar Sourcebook*. Cambridge, UK: Cambridge University Press.

Kitt, Michael T. (1991) *The Moon. An Observing Guide for Backyard Telescopes*. Waukesha, WI: Kalmbach Books.

Rükl, Antonin. (1991) *Atlas of the Moon*. London: Paul Hamlyn Publishing.

Schultz, Peter H. (1976) *Moon Morphology: Interpretations Based on Lunar Orbiter Photography*. Austin: University of Texas Press.

# A.L.P.O. Lunar Dark-Haloed Crater Catalog: Updated, Corrected, and Amended

By: Robert A. Garfinkle, F.R.A.S.


## Abstract

In the early 1970s, the Lunar Section of the A.L.P.O. conducted a search for lunar dark-haloed craters (DHCs) and in 1976 published a list of them. The 1976 list was incomplete, contained many errors, and was missing the coordinates for several DHCs. In this article, the author has revised, corrected, and amended the original A.L.P.O. DHC catalogue.


I am in the process of writing a lunar observers' handbook and wanted to include the A.L.P.O. catalogue of lunar dark-haloed craters (DHCs). I discovered that the catalogue, as published in this Journal in 1976 by the then Lunar Recorder, Kenneth J. Delano, was incomplete and contained several errors [Delano, 1976]. I set about to verify the 1976 catalogue and recalculate the orthographic and selenographic positions of the DHCs that were missing this information or had incorrect coordinates. I added those positions that were missing in the original catalogue. For DHCs that are named features, I consulted the Andersson and Whitaker *NASA Catalogue of Lunar Nomenclature* [Andersson and Whitaker, 1982] to check their listed coordinates. In my effort to derive the correct positions for all of the DHCs, I verified the location of each one visually at the telescope. I also consulted numerous lunar atlases, a set of LACs [Lunar Astronautic Charts; a series of 1:1,000,000-scale maps that covered most of the lunar Earthside in the 1960s. ed.], and photographs to pinpoint questionable or missing coordinates.

*Table 1* (pp. 182-184) and *Table 2* (p. 189) are my revised and amended catalogue of dark-haloed craters. As originally published in 1976, the catalogue contained data on 83 features and was compiled by the A.L.P.O. in 1975-76. In 1996 and 1997, John Westfall and I revised, corrected, and amended this catalogue. John submitted 20 new DHCs to add to the original list. After visual verification of the orthographic coordinates for the DHCs, all coordinates were converted to the selenographic system using Harry Jamieson's revised (November 1997) *Lunar Observers' Tool Kit*, using the orthographic coordinates of the 103 features as the baseline.

*Table 2* shows the DHCs that are either in pairs or groups. The approximate distances between members of a pair or group are also given. The "Remarks" column gives the approximate location of the pair or group of DHCs.

In the tables, lunar orthographic coordinate xi ($\xi$) is given first, followed by the eta ($\eta$) coordinate. A minus sign (-) indicates that xi is west of the central meridian (toward Grimaldi), as measured at mean libration. For eta, a minus sign means that the feature is south of the lunar equator. A plus (+) indicates that xi is east of the central meridian (toward Mare Crisium) or that eta is north of the lunar equator. In the selenographic coordinates column, plus and minus signs are applied similarly to longitude and latitude. Since the original A.L.P.O. catalogue listed the DHCs to three-decimal-place precision, I have retained that format here and converted the orthographic coordinates to two-decimal-place selenographic coordinates.

Other indications in Table 1 are as follows:

Location:

- C = DHC is located within a dark-floored crater
- CW = DHC is on the wall of a larger crater
- E = DHC is located in the Copernicus ejecta blanket
- H = DHC is located in a highlands area

G = DHC is a member of a group of dark-haloed craters
M= DHC is located in a mare
P = DHC is one of a pair of dark-haloed craters.

(I added the new categories of "CW" and "E.")

Diameter of crater:

An asterisk (*) in this column indicates the crater is not centered in the halo.

Shape of halo:

C = circular halo
E = an elliptical halo
I = an irregular-shaped feature

Near rille:

Yes = DHC is within 15 km distance of a rille.

The following A.L.P.O. members contributed observations of DHCs for the original catalogue: Kenneth Delano (Fall River, MA), Frank Des Lauriers (Plaistow, NH), Bruce Frank (East Pepperell, MA), Eddie Harris (Lake Charles, LA), Marvin Huddleston (Mesquite, TX), William Keel, (Nashville, TN), Chet Patton (Buchanan, MI), Alain Porter (Narragansett, RI), Chris Vaucher (Portland, OR), John E. Ventre (Cincinnati, OH), and John Westfall (San Francisco, CA).

## References


Andersson, Leif E. and Whitaker, Ewen A. (1982) *NASA Catalogue of Lunar Nomenclature*. NASA Reference Publication 1097. Washington, DC: NASA Scientific and Technical Information Branch.

Delano, Kenneth J. (1976) "Dark-Haloed Craters: A Concluding Report." *J.A.L.P.O.*, Vol. 26, Nos. 3-4 (August), pp. 75-80.


**Table 1. Catalogue of Lunar Dark-Haloed Craters.**

| Coordinates: Orthographic xi (ξ) | Coordinates: Orthographic eta (η) | Coordinates: Selenographic Long. ° | Coordinates: Selenographic Lat. ° | Location | Diameter: Crater km | Diameter: Halo km | Shape of Halo | Near Rille | Named Feature or General Location (Previous Name) |
|---|---|---|---|---|---|---|---|---|---|
| +863 | -098 | +60.13 | -05.62 | H, P | 13 | 73 | I | Yes | Acosta (Langrenus C) |
| +844 | -115 | +58.17 | -06.60 | H | 7 | 48 | I | | Langrenus KA |
| +838 | -355 | +60.69 | -20.79 | H | 8 | 15 | C | | East of Holden R |
| +821 | -122 | +55.81 | -07.01 | M | 2 | 6×8 | E | | SW of Bilharz (Lan. F) |
| +789 | +251 | +54.60 | +14.54 | M, P | 25 | 37 | C | Yes | Picard |
| +774 | +384 | +56.96 | +22.58 | M | 12 | 50 | C | | Cleomedes F |
| +761 | +313 | +53.25 | +18.24 | M, P | *18 | 32×60 | I | | Peirce |
| +757 | +331 | +53.34 | +19.33 | M, P | 10 | 15×20 | E | | Swift (Peirce B) |
| +744 | +227 | +49.81 | +13.12 | M, P | *14 | 27×32 | E | | Greaves (Lick D) |
| +690 | -029 | +43.65 | -01.66 | M, P | 1.5 | 14 | C | | South of Secchi X |
| +671 | -053 | +42.22 | -03.04 | M, P | 4 | 11 | C | | Northeast of Lubbock |
| +607 | -055 | +37.44 | -03.15 | H | 13 | 24 | C | | Leakey (Censorinus F) |
| +559 | -074 | +34.09 | -04.24 | H | 15 | 39 | E | | Isidorus D |
| +556 | -317 | +35.89 | -18.48 | M | 5 | 10 | C | | Southeast of Rosse |
| +500 | -196 | +30.66 | -11.30 | M | 2 | 6 | C | | East of Mädler |
| +490 | +717 | +44.66 | +45.81 | C, P | 5.5×4 | 15 | C | Yes | Inside Atlas |
| +490 | -239 | +30.31 | -13.83 | M, G | *1 | 4 | C | | Southeast of Mädler |
| +487 | -045 | +29.18 | -02.58 | M | 7 | 14 | C | | Torricelli B |
| +485 | -249 | +30.05 | -14.42 | M, G | *5 | 15 | I | | Beaumont L |
| +484 | +034 | +28.97 | +01.95 | M | *5 | 20 | I | | Maskelyne B |
| +481 | -237 | +29.68 | -13.71 | M, G | 2 | 8 | C | | South of Mädler |
| +480 | +814 | +55.73 | +54.49 | C, G | 1 | 4 | C | | Inside Endymion |
| +476 | +815 | +55.23 | +54.59 | C, G | 1.5×2.5 | 5 | C | | Inside Endymion |
| +476 | +735 | +44.59 | +47.31 | C, P | 1.5×3 | 15 | C | Yes | Inside Atlas |
| +473 | +816 | +54.91 | +54.69 | C, G | 1.5×3.5 | 5 | C | | Inside Endymion |
| +473 | +670 | +39.58 | +42.07 | H | 4 | 12 | C | | East of Williams |
| +412 | +709 | +35.75 | +45.15 | M, G | *4 | 10 | E | | Southwest of Hercules |
| +407 | +708 | +35.19 | +45.07 | M, G | *2 | 10 | E | | Southwest of Hercules |
| +392 | +707 | +33.66 | +45.00 | M, G | 4 | 15 | I | Yes | East of Bürg |
| +353 | +017 | +20.67 | +00.97 | M | 3 | 10 | C | | Southeast of Hypathia C |

*Table 1 continued on pp. 183-184.*

***Table 1—Continued.***

| Coordinates: Orthographic xi (ξ) | Orthographic eta (η) | Selenographic Long. ° | Selenographic Lat. ° | Location | Diameter Crater km | Diameter Halo km | Shape of Halo | Near Rille | Named Feature or General Location (Previous Name) |
|---|---|---|---|---|---|---|---|---|---|
| +271 | +301 | +16.51 | +17.52 | M, P | *3 | 5×8 | E | Yes | Dome north of Menelaus |
| +256 | +306 | +15.60 | +17.82 | M, P | *2 | 7 | C | Yes | Dome north of Menelaus |
| +234 | -614 | +17.25 | -37.88 | H | 8 | 34 | I | | Buch B |
| +222 | +294 | +13.43 | +17.10 | M | 7 | 20 | C | | Menelaus A |
| +178 | -668 | +14.22 | -43.48 | H | 15 | 25 | I | | Maurolycus A |
| +172 | +229 | +10.18 | +13.24 | M | 2 | 7 | C | | Southeast of Manilius |
| +134 | +787 | +12.54 | +51.91 | M | 4 | 5 | C | | Egede F |
| +127 | +248 | +07.53 | +14.36 | M, P | 1.5 | 6 | C | | West of Manilius |
| +125 | +259 | +07.44 | +15.01 | M, P | 2 | 2 | C | | Northwest of Manilius |
| +107 | +500 | +07.10 | +30.00 | M, G | 2 | 5 | C | | NE of Prom. Fresnel |
| +087 | +513 | +05.82 | +30.86 | M, G | 3 | 12 | C | | NE of Autolycus |
| +081 | +517 | +05.43 | +31.13 | M, G | 3 | 8×12 | E | Yes | Autolycus K |
| +073 | +510 | +04.87 | +30.66 | M, G | 4 | 14 | C | Yes | North of Prom. Fresnel |
| +066 | +553 | +04.54 | +33.57 | M | 5 | 11 | C | | Aristillus A |
| +050 | +071 | +02.87 | +04.07 | M, G | 1 | 7 | C | | West of Triesnecker |
| +041 | +069 | +02.36 | +03.96 | M, G | 0.5 | 3.5 | C | | West of Triesnecker |
| +037 | +073 | +02.13 | +04.19 | M, G | 0.5 | 4 | C | | Northwest of Triesnecker |
| +037 | +078 | +02.13 | +04.47 | M, G | 0.5 | 2 | C | | West of Triesnecker |
| +034 | +082 | +01.96 | +04.70 | M, G | 2 | 3 | C | | Northeast of Chladni |
| +033 | +076 | +01.90 | +04.36 | M, G | 2 | 4 | C | | Northeast of Chladni |
| +002 | +077 | +00.11 | +04.42 | M | 3 | 4 | C | | Murchison T |
| -013 | +565 | -00.90 | +34.40 | M | 3 | 12 | C | | Northwest of Aristillus |
| -025 | -235 | -01.47 | -13.59 | C, G | 1 | 8 | C | Yes | Inside Alphonsus |
| -027 | -223 | -01.59 | -12.89 | CW, G | 3 | 10 | C | Yes | Alphonsus KC |
| -028 | -217 | -01.64 | -12.53 | C, G | 2 | 7 | C | Yes | Inside Alphonsus |
| -028 | -248 | -01.66 | -14.36 | C, G | 3.5 | 11 | C | Yes | Alphonsus R |
| -033 | -216 | -01.94 | -12.47 | C, G | 2 | 7 | C | Yes | Alphonsus MD |
| -057 | -238 | -03.36 | -13.77 | C, G | 1 | 5 | C | Yes | Inside Alphonsus |
| -069 | -235 | -04.07 | -13.59 | C, G | 2 | 8 | C | Yes | Inside Alphonsus |
| -070 | -234 | -04.13 | -13.53 | C, G | 1 | 6 | C | Yes | Inside Alphonsus |
| -071 | -237 | -04.19 | -13.71 | C, G | 2 | 8 | C | Yes | Inside Alphonsus |
| -112 | -538 | -07.64 | -32.55 | C | *2 | 6.5×5.5 | C | | Inside Hell |
| -127 | +192 | -07.44 | +11.07 | M | 2 | 6 | C | | Southeast of Eratosthenes |
| -132 | -267 | -07.87 | -15.49 | M | 23 | 50 | E | | Lassell |
| -137 | +314 | -08.30 | +18.30 | M, G | 7 | 16 | C | | Eratosthenes A |
| -142 | -684 | -11.22 | -43.16 | H | 85 | 210 | I | | Tycho |
| -143 | +320 | -08.68 | +18.66 | M, G | 6 | 16 | C | | Eratosthenes B |
| -150 | +335 | -09.16 | +19.57 | M, G | 1.5 | 3 | C | Yes | Southwest of Wallace |
| -156 | -353 | -09.60 | -20.67 | M | 4 | 15 | C | Yes | Birt E |
| -166 | +306 | -10.04 | +17.82 | M, G | 0.5 | 1.5 | C | | West of Eratosthenes F |
| -179 | +308 | -10.84 | +17.94 | M, G | 4 | 8 | C | Yes | Eratosthenes E |
| -180 | +299 | -10.87 | +17.40 | M, G | 4 | 7 | C | Yes | Eratosthenes D |
| -186 | +146 | -10.84 | +08.40 | M | 2.5 | 7 | C | | South of Eratosthenes |
| -205 | +290 | -12.37 | +16.86 | M, G | 6 | 9 | C | Yes | Eratosthenes C |
| -231 | +142 | -13.50 | +08.16 | M | 2 | 6 | C | | South of Stadius |
| -231 | +199 | -13.63 | +11.48 | C, P | 1.5 | 6 | C | | Inside Stadius |
| -237 | +199 | -14.00 | +11.48 | C, P | 2.5 | 7×11 | E | | Inside Stadius |
| -240 | +420 | -15.33 | +24.83 | M | 7 | 14 | C | | Heinrich (Timocharis A) |
| -253 | +859 | -29.61 | +59.20 | M | 6 | 15 | C | | La Condamine T |
| -261 | +421 | -16.72 | +24.90 | M | 2 | 4.5 | C | | Southwest of Timocharis |
| -264 | +311 | -16.13 | +18.12 | M | 1.5 | 6 | C | Yes | Southeast of Pytheas |
| -265 | +140 | -15.52 | +08.05 | M | 1.5 | 2×5 | C | Yes | Southwest of Stadius |
| -293 | +219 | -17.47 | +12.65 | E | *1 | 6 | C | Yes | Northeast of Copernicus |
| -312 | +120 | -18.32 | +06.89 | E | 5 | 15 | C | Yes | Copernicus H |
| -320 | +167 | -18.94 | +09.61 | CW | 3 | 6 | C | | Copernicus A |
| -348 | +233 | -20.97 | +13.47 | E | 4 | 15 | C | | Southwest of Gay-Lussac A |

*Table 1 continued on p. 184*

***Table 1—Continued.***

| Coordinates | | | | | Diameter | | Shape | | Named Feature |
|---|---|---|---|---|---|---|---|---|---|
| Orthographic | | Selenographic | | | | | of | Near | or General Location |
| xi (ξ) | eta (η) | Long. ° | Lat. ° | Location | Crater km | Halo km | Halo | Rille | (Previous Name) |
| -350 | +220 | -21.03 | +12.71 | E | 2.5 | 10×5 | E | | Gay-Lussac N |
| -350 | +293 | -21.47 | +17.04 | M, P | 8 | 23 | E | Yes | Draper C |
| -353 | +302 | -21.73 | +17.58 | M, P | 9 | 15 | E | Yes | Draper |
| -390 | +130 | -23.16 | +07.47 | M | 3.5 | 13 | E | | Copernicus BB |
| -398 | +083 | -23.54 | +04.76 | M | 1 | 4.5 | C | | Northwest of Reinhold |
| -409 | +052 | -24.18 | +02.98 | M | *2 | 10 | E | | West of Reinhold |
| -418 | +257 | -25.63 | +14.89 | H | 5.5 | 12 | I | | Tobias Mayer M |
| -435 | +298 | -27.11 | +17.34 | M | 7 | 18 | C | | Tobias Mayer G |
| -447 | +103 | -26.70 | +05.91 | M | 7 | 16 | I | | Hortensius C |
| -457 | +078 | -27.28 | +04.47 | M | 2.5 | 7 | C | | Southwest of Hortensius EB |
| -466 | +124 | -28.01 | +07.12 | M | 1.5 | 9 | C | | North of Hortensius |
| -488 | -744 | -46.92 | -48.07 | H | 9 | 21 | I | | Nöggerath F |
| -500 | -726 | -46.64 | -46.55 | M | 3.5 | 7 | C | | Northwest of Nöggerath |
| -575 | -695 | -53.10 | -44.03 | C, P | 4 | 11 | I | | Inside Schickard |
| -578 | -696 | -53.61 | -44.11 | C, P | 5 | 11 | I | | Schickard R |
| -660 | -700 | -67.55 | -44.43 | H | 6 | 14 | C | | Inghirami W |
| -786 | -499 | -65.09 | -29.39 | H | 32 | 65 | I | | Lagrange C |

**Table 2. Separations of Groups of Lunar Dark-Haloed Craters.**

| Number of DHCs in Group | Dark-Haloed Craters | Distance Between Members km | Remarks |
|---|---|---|---|
| 2 | +789+251, +774+227 | 45 | Craters Picard and Greaves |
| 2 | +761+313, +757+331 | 35 | Craters Peirce and Swift |
| 2 | +690 -029, +671 053 | 35 | In Mare Fecunditatis |
| 2 | +490+717, +476+735 | 30 | In Atlas |
| 3 | +490 -239, +485 -249, +481 -237 | 10 & 20 | In Mare Nectaris |
| 3 | +480+814, +476+815, +473+816 | 7 & 7 | In Endymion |
| 3 | +412+709, +407+708, +392+707 | 12 & 40 | In Lacus Mortis |
| 2 | +271+301, +256+306 | 36 | In Mare Serenitatis |
| 2 | +127+248, +125+259 | 20 | In Mare Vaporum |
| 4 | +107+500, +087+513, +081+517, +073+510 | 10,15, & 25 | In Mare Serenitatis |
| 6 | +050+071, +041+069, +037+073, +037+078, +034+082, +033+076 | 7 to 15 | In Sinus Medii |
| 9 | -025 -235, -027 -223, -028 -217, -028 -248, -033 -216, -057 -238, -069 -235, -070 -234, -071 -237 | 10 to 50 | In Alphonsus |
| 7 | -137+314, -143+320, -150+335, -166+306, -179+308, -180+299, -205+290 | 15 to 50 | In Mare Imbrium; N. of Montes Apenninus and Eratosthenes |
| 2 | -231+199, -237+199 | 8 | In Stadius |
| 2 | -353+302, -350+293 | Merged Haloes | Craters Draper and Draper C |
| 2 | -575 -695, -578 -696 | 10 | In Schickard |

# STATE OF THE A.L.P.O. MESSAGE

## By: Harry D. Jamieson, A.L.P.O. Executive Director, 1996-1998

*Note: The following report is the text of a paper delivered at the A.L.P.O. Convention in Atlanta, GA, on July 9, 1998*

In the thirteen months since we last met to celebrate our 50th Anniversary in Las Cruces, we have continued to make progress on many of the long- and short-term problems that face us today. I would like to bring you up to date on some of these things now, and then invite questions and remarks during the Business Meeting to follow. 1997 was a much less volatile year than was 1996, but we nevertheless made considerable progress on several important fronts.

Before beginning my Section-by-Section report, I must thank all of the people who together made this year's meeting in Atlanta both possible and flawless. The entire A.L.P.O. owes a debt of gratitude to Elizabeth Westfall and to Ken Poshedly, Leonard Abbey, and others in the Atlanta Astronomical Society for their behind-the-scenes work on the arrangements for this year's convention. It can be very difficult to make all of the arrangements for an A.L.P.O. convention, and even more difficult to do so in such a way that everything comes off as well as it has during this meeting. Thank you all very much.

In the Solar Section, we lost Tony Portoni to personal problems, but Rik Hill has managed to completely reorganize the Section and add three people to it—Gordon Garcia, Jeffery Medkeff, and Jeffery Sandel. In additional to overall coordination, Rik now handles the web site, SolNet, the Rotation Report, and the writing of the new Handbook. Gordon now handles correspondence and new observers. Jeff Medkeff generally assists Rik and will be responsible for the computerized archiving of the Section's observational files. And Jeff Sandel will handle the Section's publications. SolNet, the Section's e-mail news service, continues to come out several times a day as observers and staff members have newsworthy things to report. Future goals continue to be the reactivation of the White-Light Flare Patrol and, down the road, a bit, 24-hour coverage in white light.

In the Mercury Section, we have lost Oscar Cole-Arnal, who has been given additional teaching responsibilities. However, we have acted upon his recommendation and replaced him with Harry Pulley, a friend of Oscar's who lives nearby. Harry and Oscar have been observing Mercury together for several years, and Oscar says that he will continue to work together with Harry and help him with the Mercury Section. Harry has a strong mathematics and computer science background, and one of his first tasks will be to start on the job of creating a computerized archive for the Section's observations. Oscar will be missed, but as he wants to continue on as a "silent partner" in the Section with Harry, I have high hopes that the Section will continue to advance as it has during the past two years.

The Lunar Section continues its revival. Bill Dembowski's really excellent newsletter, "The Lunar Observer", continues to come out regularly every month and is always enjoyable reading. Newsletters are difficult to maintain without material coming in from contributors, but Bill has been receiving regular observations from quite a few people—Robert H. Hays' work stands out in my mind—which have made the newsletter well worth subscribing to. Bill has branched out into vertical studies, and would like to start a formal Lunar Section program to compile and catalog the heights and depths of as many lunar features as possible. He and a few others on the A.L.P.O. staff have also been making their presence known in the Shallow Sky organization, which is a group of amateurs like ourselves with a less formal approach to lunar and planetary observing.

In another part of the Lunar Section, Julius Benton's revival of the old Bright and Banded Craters and Dark-Haloed

Craters Programs into the Selected Areas Program is going well. These earlier programs studied craters with bright and dark bands within them as well as craters (such as several within Alphonsus) that are surrounded by very dark ejecta. These additions to the Selected Areas Program will widen observer interest in it as well as enhance the science produced by it.

In the Jupiter Section, Wynn Wacker has resigned due to the pressures of family and job. We will miss Wynn, who had a lot of good hopes and aspirations for the Section. I have appointed David Lehman to take his place, while our other two Coordinators will remain with us in their current positions. The remaining Coordinators' commitment to the proper running of the Jupiter Section remains strong, as is their commitment to see the Section expand. I expect to see two or three additional Assistant Coordinators appointed soon to take responsibility for the past unwritten Jupiter apparition reports, a Jupiter Section Handbook, and the revival of Jovian radio astronomy. David has already vastly improved the Section's presence and services on our web site, including a regular newsletter, and is currently seeking professionals and advanced amateurs to serve on a Jupiter Section Science Advisory Team. In addition, David Lehman and Julius Benton are working together to build a joint Jupiter/Saturn Section Science Advisory Team. Our goal is to see the Jupiter Section assume its proper place in the A.L.P.O. and rival the Mars Section in its number of observers, level of activity, and contribution to planetary astronomy.

In the Computing Section, our new Coordinator, Mike McClure, has done an outstanding job with the Section's newsletter, *The Digital Len*s, with the latest issue being over 60 pages long in .pdf format. The newsletter is free and available in Adobe Acrobat 3.0 format or on the internet. I am especially proud of this achievement, though all of the credit for it must go to Mike and the many people who have contributed material to *The Digital Lens*.

The A.L.P.O.'s web page has not stood still during the past twelve months either, thanks to the hard work of our Webmaster Rik Hill! It has nearly doubled in size since October. Our web received The Education Index's Award for Excellence last year, and continues to maintain it. Rik has helped all of the Sections to build attractive and useful "Section pages", which in turn have helped to bring in new observers and members (he considers the Mars Section page to be our best!). His biggest need right now is for more post-ready material from Coordinators. Thank you again, Rik.....We owe you a great deal.

While many positive things are happening in the A.L.P.O. right now, we still face many challenges. One of the foremost of these is the question of how to publish the *Journal* on a regular schedule. After giving the matter much thought, it was decided last summer to enlarge the editorial staff and reorganize how papers enter and flow through the editing process. Julius Benton, who already had much on his shoulders, volunteered to act as our Distribution Editor. All papers should now come to him first so that he can distribute them among our new Assistant Editors. After a paper has been edited by an Assistant Editor it is then returned to Julius for additional checking, after which he may return it to the Assistant, return it to the author for rewriting, make further editorial changes himself, or simply pass it on to Editor John Westfall. While John may make additional changes, this process should at least fix the most obvious problems and result in his getting cleaner material. This in turn should result in him having more time to put the *Journal* together and get it to the printer on schedule. Indeed, I'm proud to say that since we have developed this system, every issue has been on schedule. While additional editorial help has been an important part of the solution, it must be remembered that every equation has two sides. Authors need to take more responsibility for their papers, and follow John Westfall's guidelines for authors published recently in the *Journal*. Papers that don't follow these guidelines or contain excessive mistakes can (and should) be returned to the author by the editorial staff for reworking. Everyone, including authors, must do their part to keep the *Journal* coming out on schedule. We can no longer afford to make the entire membership wait for the *Journal* because an author cannot spell or write a coherent sentence.

On a much more positive note, I wish to take this moment to thank and praise Leonard Abbey for the work that he did as Editor of our new booklet called *Exploring the Solar System with the A.L.P.O.* Aimed at people who write to me asking for information about the A.L.P.O. and how to join it, it gives us for the first time something solid to send to inquirers. Though we've had little pamphlets in the past briefly describing our programs and listing our staff members, this booklet takes a different approach. It more fully describes our programs, but does not list our staff people at all. This does several things, including keeping the booklet from becoming obsolete when a staff member resigns, and encouraging people to join instead of just submitting observations. A cover sheet giving current dues and other membership information is inserted into the booklet before it is sent. I would also like to thank David Graham for allowing us to use one of his fine Saturn drawings on our front cover, as well as the authors who wrote the various chapters within. These include in no particular order Leonard Abbey, Rik Hill, Richard Schmude, Julius Benton, Wynn Wacker, Oscar Cole-Arnal, Matt Will, John Westfall, Dan Joyce, and Bill Dembowski.

The A.L.P.O. still faces one final challenge, and that is the aging of its membership. I said last year that I recalled attending my first convention in Detroit in 1961 and seeing a lot of my peers about the room. I also said that as I look around today I still see a lot of my peers, but now they're all over 50! Unfortunately, little has been done to address this problem in the last year, and as Executive Director I have to assume full responsibility for this. Though some very positive steps have been taken by Rik Hill, Jeffery Medkeff, and Bill Dembowski to generate some interest in what we do among the members of the Shallow Sky Association, this effort has been directed at increasing membership in general and not specifically at bringing in young people. With this in mind, I propose that the A.L.P.O. institute a program where volunteers go into their local high schools and, in cooperation with the school's science teachers, give special astronomy presentations emphasizing the Solar System and the bodies that make it up. This idea is not new, and I will admit without shame that I have stolen it from a very similar program that the A.A.V.S.O. appears to have been conducting for years. What is needed first is someone to volunteer to coordinate such a program and come up with a standardized set of materials to be used during these presentations. The program coordinator would work with the local volunteers, instruct them on presentation methods and materials, and report to the A.L.P.O. Board at set intervals. The local volunteers would be responsible for making contact with their local high schools and making the presentations. While the presentations would stress real Solar-System astronomy, the materials and some of the dialog would "plug" to the A.L.P.O. These presentations could also be done as a part of the school programs that many local astronomy clubs, planetariums, and museums already have in place. Recently, Ken Poshedly has volunteered to coordinate a pilot version of this program in Atlanta, and Richard Schmude has volunteered to design educational and presentation materials. Our sincere thanks go to both of these individuals.

All in all, I feel that the A.L.P.O. is still moving in the right direction. What we need more than anything, though, is for more people to come forward and contribute their time, their skills, and their love (*amateur* is a French word meaning "love"). Like many other organizations, ours is kept going by the work of only about 5 percent of its membership. Think of what we could be if this percentage were just doubled! Ultimately it will be you, the members of this organization, who decide whether or not it will survive far into the next century.

In closing, I want to take this opportunity to personally thank those who have been there for me when I needed them during my two-and-a-half-year term as the A.L.P.O.'s Executive Director. Again in no particular order, these have especially been John and Beth Westfall, Julius Benton, Richard Hill, Mike Mattei, Ken Poshedly, and our Founder Walter Haas. Without their constant support and good advice, I would not have come close to accomplishing anything during my term.

# A.L.P.O. ANNOUNCEMENTS

## SECTION CHANGES

***Instruments Section Reestablished.***—Our Instruments Section was closed down at the beginning of this year, but now has been started up again thanks to R.B. Minton volunteering to serve as Acting Coordinator with an active program for the Section. For details, see Mr. Minton's announcement on page 177 of this issue.

***Lunar Dome Survey Terminated.***—Lunar Dome Survey Coordinator Harry D. Jamieson has decided to close the Lunar Dome Survey due to lack of observer interest. He will now concentrate on correcting and revising the Lunar Dome Catalog, and will be happy to receive further dome observations, now on an informal basis.

***Title Change in Lunar Section.***—William Dembowski has requested a change in the title of his "General Lunar Programs", which has been approved. His new title is **Coordinator, Lunar Topographical Studies**. The new title more accurately describes the observational activities that Mr. Dembowski coordinates.

## E-MAIL ADDRESS CHANGES

The E-Mail addresses of several A.L.P.O. Staff have changed since our last previous issue; the persons affected and their new addresses are:

Donald C. Parker, Executive Director, Assistant Mars Recorder. dparker@netside.net
Harry D. Jamieson, Membership Secretary/Treasurer. hjamieso@bellsouth.net
Lawrence Garrett, Acting Assistant Minor Planets Coordinator.
Lgasteroid@globalnetisp.net

The above changes are already in effect. As our staff experiment with new Internet providers, we have consolidated staff E-mail address at the end of our staff listing (see the inside back cover of this issue).

## OTHER A.L.P.O. NEWS

***Termination of Credit-Card Dues Payments.***—We have cancelled our previous arrangement with the Chabot Observatory and Science Center regarding their accepting credit-card payment for A.L.P.O. dues. While we greatly appreciate the cooperation of COSC and its Director, Mike Reynolds, the volume of use of this service does not justify our continuing it.

***Proceedings for 1998 Convention Available.***—A.L.P.O. Monograph Number 8, the 122-page *Proceedings* of our 1998 Atlanta Convention, compiled by Ken Poshedly, are available from Editor John Westfall (P.O. Box 16131, San Francisco, CA 94116). The price is $17.00 for the United States, Canada, and Mexico, and is $26.00 elsewhere.

***Contacting Frank Smith.***—Mr. Smith was the author of the paper "Some Constraints on Lunar Transient Phenomena", that appeared in our last previous issue. He writes that he welcomes correspondence regarding his article, and can be reached at the E-Mail address: fhasmith@crocker.com .

***Meeting Reminders.***—We remind our readers that the A.L.P.O. is planning two meetings in 1999.

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

***A.L.P.O./Astronomical League Convention for 1999.***—We will hold our annual convention with the Astronomical League, the American Association of Variable Star Observers, the International Dark Sky Association, and the International Occultation Timing Association at Eastern Washington University in Cheney, Washington (about 20 miles southwest of Spokane), on July 13-17, 1999. The event is hosted by the Spokane Astronomical Society; more information is on the ALCON99 webpage: www.spokaneastronomical.org/alcon99.html . Also, the Convention Chairman is Mickey Moreau: Telephone 509-326-5465, E-Mail mickeym@runway.net.

# Forthcoming Amateur and Professional Meetings

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

**December 1-3, 1998: Origin of the Earth and Moon.** At Monterey, California. Sponsored by the Publications and Programs Services Department, Lunar and Planetary Institute, Houston, Texas. [Lunar and Planetary Institute, 3600 Bay Area Blvd., Houston, TX 77058-1113. Telephone: 1-281-486-2158; FAX: 1-281-486-2160; E-mail: simmons@lpi.jsc.nasa.gov ; Web: http://cass.jsc.nasa.gov/meetings/origin98/ ]

**January 31-February 4, 1999: Space Technology and Applications International Forum (STAIF-99).** At Albuquerque, New Mexico. [Institute for Space and Nuclear Power Studies (ISNSPS), University of New Mexico (UNM). Telephone: 1-505-277-0446, Web: http://www.chne.unm.edu/isnps/isnps.htm ]

**February 11-12, 1999: In Situ Resource Utilization (ISRU III) Technical Interchange Meeting.** At Denver, Colorado. Sponsored by NASA, Lunar and Planetary Institute, and Lockheed Martin Astronautics. [David Kaplan, Mail Code EX13, NASA Johnson Space Center, 3600 Bay Area Boulevard, Houston, TX 77058. Telephone: 1-281-483-7667, FAX: 1-281-483-6266, E-mail: david.kaplan@jsc.nasa.gov , Web: http://cass.jsc.nasa.gov.meetings/ISRU-III-99 ]

**March 15-19, 1999: 30th Lunar and Planetary Science Conference.** At Houston, Texas. [30th LPSC, Publications and Program Services Department, Lunar and Planetary Institue, 3600 Bay Area Boulevard, Houston, TX 77058-1113. Telephone: 1-281-486-2158, FAX: 1-281-486-2125, E-mail: simmons@lpi.jsc.nasa.gov , Web: http://cass.jsc.nasa.gov/meetings/thermal99/ ]

**April 28-30, 1999: Workshop on Thermal Emission Spectroscopy and Analysis of Dust, Disks, and Regoliths.** At Houston, Texas. Sponsored by the Lunar and Planetary Institute and NASA. [Thermal99 Workshop, Lunar and Planetary Institue, 3600 Bay Area Boulevard, Houston, TX 77058-1113. Telephone: 1-281-486-2158, FAX: 1-281-486-2125, E-mail: simmons@lpi.jsc.nasa.gov , Web: http://cass.jsc.nasa.gov/meetings/LPSC99/

**July 1-7, 1999: The Astronomical Society of the Pacific, the Royal Astronomical Society of Canada, and the American Association of Variable Star Observers.** At Toronto, Ontario, Canada on the University of Toronto Campus. [John Percy, Erindale College, University of Toronto, Mississauga, Ontario, Canada L5L 1C6. Telephone: 1-905-828-5351, FAX: 1-905-828-5425, E-mail: jpercy@erin.utoronto.ca ]

**July 13-17, 1999: ALCON99, The Astronomical League Convention**. See previous page.

**July 26-30, 1999: Asteroids, Comets, Meteors Conference.** At Cornell University, Ithaca, New York. [Beth E. Clark, ACM Conference, Space Sciences Building, Cornell University, Ithaca, NY 14853-6801; Telephone: 1-607-254-8895; FAX: 1-607-255-9002; E-mail: acm@scorpio.tn.cornell.edu ; Web: http://scorpio.tn.cornell.edu/ACM ]

**August 1-22, 1999: 35th International Astronomical Youth Camp.** In a castle near Vep (near Szombathley), Hungary. Includes observing the 1999 Aug 11 total solar eclipse. [IWA e.V., c/o Gwendolyn Meeus, Parkstraat 91m 3000 Leuven, Belgium. E-mail: info@iayc.org ]

**August 7-13, 1999: Solar Eclipse August 1999 Symposium: Research Amateur Astronomy in the VLT Era.** At Garching (near Munich), Germany. Sponsored by the Vereinigung der Sternfreunde, VdS and the European Southern Observatory. [Klaus Reinsch, E-mail: reinsch@neptun.uni-sw.gwdg.de , Web: http://neptun.uni-sw.gwdg.de/sonne/eclipse99_conference.html ]

## THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

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

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

All payments should be in U.S. funds, drawn on a U.S. bank with a bank routing number, and payable to "A.L.P.O." All cash or check dues payments should be sent directly to: A.L.P.O. Membership Secretary, P.O. Box 171302, Memphis, TN 38187-1302. When writing to our staff, please provide stamped, self-addressed envelopes. Note that the A.L.P.O. maintains a World-Wide Web homepage at: http://www. lpl.arizona.edu/alpo/

*Keeping Your Membership Current.*—The top line of your *J.A.L.P.O.* mailing label gives the volume and issue number when your membership will expire (e.g., "40.4" means Vol. 40, No. 4). We also include a First Renewal Notice in that issue, and a Final Notice in the next one. Please let the Membership Secretary know if your address changes. Dues payments should be made directly to the Membership Secretary.

## A.L.P.O. MONOGRAPH SERIES

A.L.P.O. monographs are publications that we believe will appeal to our members, but which are too lengthy for our Journal. Order them from our Editor (P.O. Box 16131, San Francisco, CA 94116 U.S.A.) for the prices indicated, which include postage; make checks to "A.L.P.O."

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

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

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

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

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

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

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

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

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

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

Order from: A.L.P.O., P.O. Box 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 October, 1998

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

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

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

**Back issues of *The Strolling Astronomer (J.A.L.P.O.)*.** The back issues listed below are still in stock but may not long remain so. In this list, volume numbers are in italics, issue numbers are not, and years are given in parentheses. The price is $4.00 for each back issue; the current issue, the last one published, is $5.00. We are always glad to be able to furnish old issues to interested persons and can arrange discounts on orders of more than $25. Make payment to "Walter H. Haas."

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

**Current Issue [*40*, 4]; $5.00.**

# PUBLICATIONS OF THE SECTIONS OF THE A.L.P.O.

*Order the following directly from the appropriate Section Coordinator; use the address in the staff listing unless another address is given below.*

**Lunar and Planetary Training Program (Robertson):** *The Novice Observers Handbook,* $10.00. An introductory text to the Training Program. Includes directions for recording lunar and planetary observations, useful exercises for determining observational parameters, and observing forms. To order, send a check or money order made out to "Timothy J. Robertson."

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

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

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

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

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

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

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

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

**Jupiter**: (1) "Jupiter Observer's Start-Up Kit" is available for $3.00 from David J. Lehman. (2) *Jupiter,* the newsletter of the Jupiter Section is available on the Internet at the Jupiter Section Web page or by mail: send SASEs to David J. Lehman. (3) To join the Jupiter Section's E-mail network, "J_Net," send an E-mail message to David J. Lehman at DLehman111@aol.com, write "subscribe J_Net" in the subject field. (4) *Timing the Eclipses of Jupiter's Galilean Satellites;* send a SASE with 55 cents in stamps to John Westfall. This is the project "Observing Kit" and includes a report form.

**Saturn (Benton):** (1) *The ALPO Saturn Observing Kit,* $20.00. Includes introductory description of ALPO Saturn observing programs for beginners, a full set of observing forms, and a copy of *The Saturn Handbook.* (2) *Observing Forms Packet,* $10.00. Includes observing forms to replace the quantity provided in the Observing Kit above. Specify the Saturn Forms. (See note for Venus.)

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

**Meteors (Astronomical League Sales, P.O. Box 572, West Burlington, IA 52655):** (1) The pamphlet, *The A.L.P.O. Guide to Watching Meteors* is available for $4.00 (price includes postage). (2) The *Meteors Section Newsletter* is published quarterly (March, June, September, and December) and is available free of charge if you send 32¢ in postage per issue to Coordinator Robert D. Lunsford, 161 Vance Street, Chula Vista, CA 91910.

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

**Computing Section (McClure):** A Computing Section Newsletter, *The Digital Lens,* is available via e-mail. To subscribe or to make contributions, contact the editor, Mike W. McClure, at: MWMCCL1 @ POP.UKY.EDU .

# Association of Lunar and Planetary Observers Personnel

## Association Board of Directors

Julius L. Benton, Jr.
Harry D. Jamieson (Treasurer)
John E. Westfall
Walter H. Haas
Donald C. Parker (Chair)
Matthew Will
Richard Hill
Elizabeth W. Westfall (Secretary)

## Association Staff

**Executive Director:** Donald C. Parker, 12911 Lerida Street, Coral Gables, FL 33156.
**Associate Director:** Julius L. Benton, Jr., Associates in Astronomy, 305 Surrey Road, Savannah, GA 31410.
**Founder/Director Emeritus:** Walter H. Haas, 2225 Thomas Drive, Las Cruces, NM 88001
**Membership Secretary/Treasurer:** Harry D. Jamieson, P.O.Box 171302, Memphis, TN 38187-1302
**Publications Section.—**

**Editor:** John E. Westfall, P.O. Box 16131, San Francisco, CA 94116. FAX 415-731-8242
**Distributing Editor:** Julius L. Benton, Jr., Associates in Astronomy, 305 Surrey Road, Savannah, GA 31410.
**Assistant Editor:** Klaus R. Brasch, Department of Biology, California State University, 5500 University Parkway, San Bernardino, CA 92407-2397.

**Book Review Editor:** Jose Olivarez, Chabot Observatory and Science Center, 10902 Skyline Boulevard, Oakland, CA 94619.
**Publicist:** Ken Poshedly, 1741 Bruckner Court, Snellville, GA 30078-2784.
**Lunar and Planetary Training Program Coordinators:** Timothy L. Robertson, 2010 Hillgate Way #L, Simi Valley, CA 93065. Matthew Will, 2112 Austin Drive, Springfield, IL 62704.

### Solar Section

Richard Hill, *Coordinator—Website, SolNet, Rotation Report, Handbook*; Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721.
Jeff Medkeff, *Acting Assistant Coordinator*; Rockland Observatory, 3602 Trevino Drive, Sierra Vista, AZ 85635-5262.
Gordon W. Garcia, *Acting Assistant Coordinator-Correspondence and New Observers.*; 340 Illinois Boulevard, Hoffman Estates, IL 60194-3319.
Francis G. Graham, *Assistant Coordinator—Eclipses*; P.O. Box 209, East Pittsburgh, PA 15112.
Jeffery Sandel, *Acting Assistant Coordinator—Publications*; 937 Michaelmas Avenue, Cayce, SC 29033.

### Lunar Section

Julius L. Benton, Jr., *Coordinator, Selected Areas Program*; Associates in Astronomy, 305 Surrey Road, Savannah, GA 31410.
David O. Darling, *Coordinator, Lunar Transient Phenomena*; 416 W. Wilson St., Sun Prairie, WI 53590-2114.
William M. Dembowski, *Coordinator, Lunar Topographical Studies,* 219 Old Bedford Pike, Windber, PA 15963.
Francis G. Graham, *Coordinator, Eclipses and Photometry*; P.O. Box 209, East Pittsburgh, PA 15112.

### Mercury Section

Harry Pulley, *Acting Coordinator*;22 Liverpool Street, Guelph, Ontario N1H 2K9, Canada.

### Venus Section

Julius L. Benton, Jr., *Coordinator*;Associates in Astronomy, 305 Surrey Road, Savannah, GA 31410.

### Mars Section

Daniel M. Troiani, *Coordinator; All Observations*; *U.S. Correspondence*; 629 Verona Court, Schaumburg, IL 60193.
Donald C. Parker, *Assistant Coordinator*; *CCD Imaging, "Mars Project"*; 12911 Lerida Street, Coral Gables, FL 33156.t
Daniel Joyce, *Assistant Coordinator*; 6203 N. Keeler Ave., Chicago, IL 60648-5109.
James F. Bell, III, *Assistant Mars Coordinator; Scientific Advisor*; Cornell University, Department of Astronomy, 424 Space Sciences Building, Ithaca, NY 14853-6801

**Minor Planets Section**

Frederick Pilcher, *Coordinator*; Illinois College, Jacksonville, IL 62650.

Lawrence S. Garrett, *Acting Assistant Minor Planets Coordinator*, 206 River Road, Fairfax, VT 05454.

**Jupiter Section**

David J. Lehman, *Acting Coordinator, Internet Communications*; 6734 N. Farris, Fresno, CA 93711.

Sanjay Limaye, *Assistant Coordinator, Scientific Advisor*; University of Wisconsin, Space Science and Engineering Center, Atmospheric Oceanic and Space Science Bld. 1017, 1225 W. Dayton St., Madison, WI 53706.

John McAnally, *Acting Assistant Coordinator, Transit Timings*; 2124 Wooded Acres, Waco, TX 76710.

John E. Westfall, *Assistant Coordinator, Galilean Satellites*; P.O. Box 16131, San Francisco, CA 94116. ;FAX 415-731-8242

**Saturn Section**

Julius L. Benton, Jr., *Coordinator*; Associates in Astronomy, 305 Surrey Road, Savannah, GA 31410.t

**Remote Planets Section**

Richard W. Schmude, Jr., *Coordinator*; Gordon College, Division of Natural Sciences and Nursing, 419 College Drive, Barnesville, GA 30204.

**Comets Section**

Don E. Machholz, *Coordinator*; P.O. Box 1716, Colfax, CA 95713.

James V. Scotti; *Assistant Coordinator*; Lunar and Planetary Lab., University of Arizona, Tucson, AZ 85721

**Meteors Section**

Robert D. Lunsford; *Coordinator*; 161 Vance Street, Chula Vista, CA 91910.

Mark A. Davis, *Assistant Coordinator*; 1054 Anna Knapp Blvd., Apt. 32H, Mt. Pleasant, SC 29464.

**Computing Section**

Mike W. McClure, *Coordinator*; 108 Woodhurst Lane, Russellville, KY 42276-9267.

**Mercury/Venus Transit Section**

John E. Westfall, *Coordinator*; P.O. Box 16131, San Francisco, CA 94116. FAX 415-731-8242

**Historical Section** ***(Provisional)***

Gary L Cameron, *Acting Coordinator*; 4112 Lincoln Swing, Apt. 202, Ames, IA 50010.

**Instruments Section.**

R.B. Minton, *Acting Coordinator*; 568 N. 1st Street, Raton, NM 87740.

## A.L.P.O. Staff Internet Directory

**Bell, J.F.** jimbo@cuspif.tn.cornell.edu
**Benton. J.L.** jlbaina@bellsouth.net
**Brasch, K.R.** kbrasch@wiley.csusb.edu
**Cameron, G.L.** gcameron@iastate.edu
**Darling, D.O.** DOD121252@aol.com
**Davis, M.A.** MeteorObs@charleston.net
**Dembowski, W.M.** dembow@mail.third-wave.com
**Garcia, G.W.** gordg@megsinet.net
**Garrett, L.S.** Lgasteroid@globalnetisp.net
**Graham, F.G.** fgraham@e14.kenteliv.kent.edu
**Haas, W.H.** whaas@psl.nmsu.edu
**Hill, R.** rhill@lpl.arizona.edu
**Jamieson, H.J.** hjamieso@bellsouth.net
**Joyce, D.** djoyce@triton.cc..il.us
**Lehman, D.J.** DLehman11@aol.com
**Limaye, S.** LIMAYE@MACC.WISC.EDU
**Lunsford, R.D.** LUNRO.IMO.USA@PRODIGY.COM
**Machholz, D.E.** donm353259@aol.com
**McAnally, J.** CPAJohnM@aol.com
**McClure, M.W.** MWMCCL1@POP.UKY.EDU
**Medkeff, J.** medkeff@c212.com
**Olivarez, J.** jolivarez@cosc.org
**Parker, D.C.** dparker@netside.net
**Pilcher, F.** pilcher@hilltop.ic.edu
**Poshedly, K.** ken.poshedly@mindspring.com
**Pulley, H.** hpulley@home.com
**Robertson, T.L.** trobert@earthlink.net
**Schmude, R.W.** Schmude@Falcon.gdn.peachnet.edu
**Troiani, D.M.** dtroiani@triton.cc.il.us
**Westfall, J.E.** 73737.1102@compuserve.com
**Will, M.** 76131.1525@compuserve.com