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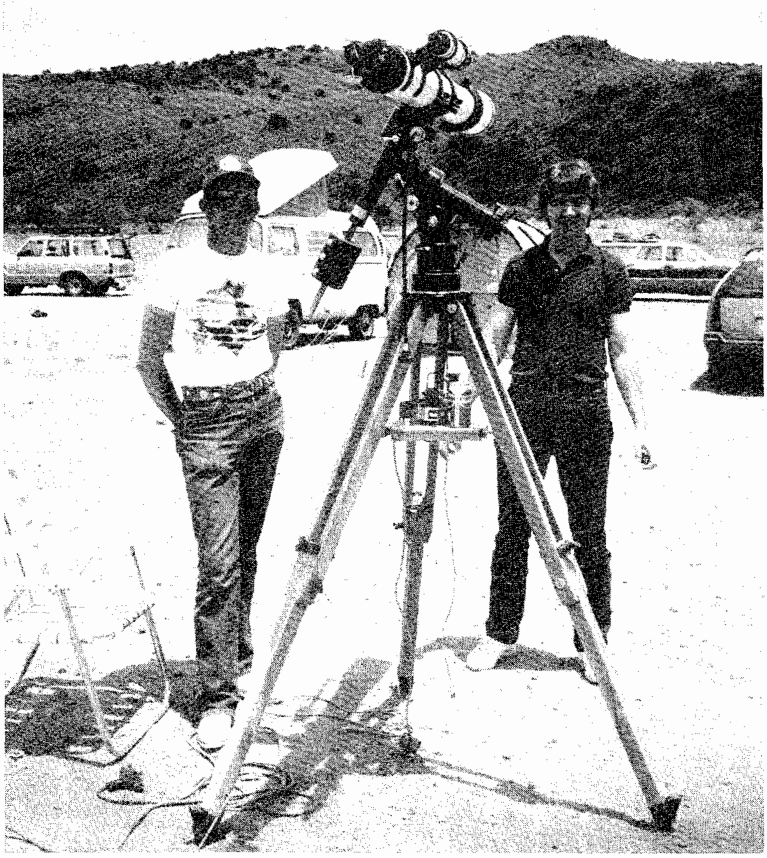

Retiring Assistant Solar Coordinator Randy Tatum is on the right, and solar observer Robert Morris on the left, at the 1987 Texas Star Party. Robert's fine H-alpha filtergrams are remarkable in that they were made with the 4-inch Unitron refractor shown here, stopped to 2 inches. Photo by J.P. Prideaux.

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In This Issue

THE CHALLENGE OF OBSERVING MERCURY: FRUSTRATIONS AND REWARDS

By: Oscar Cole Arnal, Acting A.L.P.O. Mercury Section Coordinator

ABSTRACT

Observing Mercury, with binoculars and telescope, is a continuing challenge for amateur astronomers, offering a combination of hazards and rewards. The following is a detailed description of the observing journey of one particular Mercury lover, a combination of personal experiences with detailed advice on monitoring this elusive planet. We hope it will inspire others to join the Mercury Section members taking up this observational challenge.

Since my early adolescence I have had a love affair with the planet Mercury. In part, I was captivated by the notion that I might glimpse what the great Copernicus supposedly never saw. This fueled my naked-eye search at age thirteen in a small steel town in western Pennsylvania. I organized a handful of youngsters into a local club committed largely to planetary observing. My assignment was the inner planets. My first goal was to spot Mercury, the only naked-eye planet I had never seen. *Sky & Telescope* informed me of a favorable apparition in Spring 1955. So off I trudged to my school, climbed its fire escape to get a better horizon and began to scan the western dusk. After a half hour of frustration, I was ready to give up, but decided to make a final attempt. There it was, a yellow star-like object—Mercury. After the initial thrill I ascertained that there was no other bright celestial body in that sector of the sky. It was indeed Mercury. What a thrill! I had seen what Copernicus, with his hazy skies, had never discerned. [1] For me it was the moment of a lifetime. I had undertaken the challenge to observe Mercury, and had succeeded.

Today, four decades afterward, observing Mercury remains a challenge for me and any amateur prepared to accept the challenge. Recently I experienced setbacks common to Mercury observers. November and December, 1993, marked Mercury's best morning apparition of that year. At the same time, November and December are habitually the worst months for observers who, like me, live near the Great Lakes. Consequently I expected difficulties, but I was convinced that I could observe the planet telescopically at least three times. How wrong I was! On seven different occasions the weather report promised clear morning skies, while other meteorological predictions suggested partly cloudy. Each time, I set my alarm in anticipation of observing. For four of these mornings I rose to find total cloud cover, and one other time I watched partly cloudy skies get worse as the dawn came. One common frustration of observing Mercury is the necessity of having low and flat horizons. In my case this means loading a telescope and accessories into a car, transporting them to the appropriate location and then hauling them back home once the Mercurian moment is over. One morning it was clear; so I took my telescope to a choice site and left my equipment in the car while I watched the clouds take over. Two other times I assembled my telescope beneath the beauty of clear skies only to watch the fog roll in at the last minute. Later at work, colleagues, who lived in the city, told me how beautiful Jupiter, Venus and Mercury appeared those same mornings. There was the one instance that I saw all three with my naked eye and binoculars. Unfortunately I was unable to use my telescope. I had a meeting at my university and had promised also to transport my stepdaughters to early piano lessons. This marvelous apparition of Mercury had passed me by in spite of carefully laid plans. These are an example of the frustrations that Mercury chasers encounter.

From my own experiences, spanning almost four decades, one can see that observing Mercury is quite a challenge, with its rewards and its frustrations. The appeal is that you can also take up this challenge; for yourself or in conjunction with the Mercury Section of the Association of Lunar and Planetary Observers (A.L.P.O.). As encouragement I have provided some of my own observations during 1990-1993 and suggestions that may help you embark on this observational adventure. Those three years saw a resurrection of this childhood hobby. I am an amateur with a minimum of sophistication, a maximum of enthusiasm, and the firm conviction that we all can make useful contributions in planetary astronomy.

I. OBSERVING MERCURY WITH THE NAKED EYE AND BINOCULARS

On Monday morning, September 17, 1990, I scanned the eastern horizon at 09h30m UT using 7×50 binoculars in my first effort to spot Mercury in 35 years. It was a lovely morning with excellent visibility to the horizon. As the first hints of dawn appeared I noted the beauty of Leo's sickle and the rising waning crescent Moon. At 10h00m UT, about 1° above the horizon, I caught a yellowish star-like object in my binoculars. I was convinced it was Mercury for several reasons. Its location was identical with that of my star charts, and by 10h10m UT I noted the much brighter Venus rising slightly to its northeast. This was the beginning of a serious effort to monitor my favorite planet. I observed Mercury nine times during this particularly favorable morning appearance, and plotted its motion against the background stars of Leo using binoculars and naked eye. Since then I have employed this combination of instruments to spot and plot Mercury during a number of subsequent favorable apparitions. It is a good way to begin observations of this planet.

Beyond finding and plotting Mercury's course along the ecliptic there is little else that can be done with naked eye and binoculars. Nonetheless, this beginning involves little cost. Initially the biggest expense is a decent pair of binoculars with as large an aperture as possible while retaining the light weight necessary for steady holding. Binoculars meeting such specifications are the standard 7×50 models, although I use the Celestron 8×56 binoculars, designed especially for astronomical work. These are more expensive and not markedly superior to the 7×50 variety. [2]

It is necessary to have a good set of star charts. For a wide range of observing the best buy is a laminated set of Wil Tirion's *Sky Atlas 2000* which indicates stars to the 8th magnitude. Donald H. Menzel's and Jay M. Pasachoff's *A Field Guide to the Stars and Planets* (in the Peterson series) has similar but smaller charts. For Mercury observing alone a simpler atlas like *Norton's 2000* is sufficient. Above all, it is important to be able to identify the constellations of the ecliptic and to know them well. Of course this is best accomplished under dark skies. One of the chronic frustrations of observing Mercury is that it always appears close to the Sun, thus making even its best appearances in twilight skies. Consequently only the brightest stars near Mercury can be seen even with binoculars. Hence it is exceedingly more difficult to plot Mercury among the stars than the other naked-eye planets. Mars, Jupiter and Saturn spend most of their apparitions in dark skies, and Venus reaches greater elongations from the sun than Mercury and thus can shine in dark skies.

Plotting Mercury uses only the brighter stars which can be seen with the eye and binoculars in twilight skies. Thus, for example, I had to use only Regulus and Algeiba (γ Leonis) as my background stars in 1990, causing considerable inaccuracy. Though these charting efforts have no scientific value, they are fun and good practice in observing precision.

Observers can also estimate Mercury's brightness. Because all inner planets exhibit a complete range of phases, its apparent brightness varies greatly. At inferior conjunction it dips to fifth magnitude, and at its brightest, near superior conjunction, it exceeds the magnitude of Sirius ($m_v = -1.5$). However, the usual range of brightness during visibility for the amateur is very roughly from $m_v = +2.5$ (crescent phase) to $m_v = -1.5$ (gibbous phase). Unfortunately such magnitude estimates are made difficult due to the planet's proximity to the Sun. The bright skies of dusk and dawn serve to apparently dim the stars and planets in twilight. Hence Mercury appears dimmer than stars found higher in the sky where the background is darker. Reasonably accurate estimates are possible only when the planet is visible with first-magnitude stars; for example, Capella in Auriga or Castor and Pollux in Gemini during a late Spring western apparition. Though this effort has no immediate scientific value, it provides yet another opportunity to develop observing skills. Such work might lead an observer to take up variable star monitoring with the American Association of Variable Star Observers (AAVSO). [3]

Of course one cannot chart Mercury or estimate its brightness without first finding it in the sky. Despite the myth of Copernicus' inability to spot the object, Mercury is easy to locate as long as one knows where to look. Since the planet lies between the Earth and the Sun, the best period for its observation is near to or shortly before greatest eastern elongation or near to or shortly after greatest western elongation. This occurs about seven or eight times per year. However, only about four of these events are favorable for viewers, whether in the Northern or Southern Hemispheres. For those north of the Equator these ideal instances are late winter to mid-summer during evening apparitions and late summer to late fall for morning apparitions. The remaining apparitions, while unfavorable to northerners, are the best ones for Mercury lovers south of the Equator. The issue is one of viewing angle: Mercury is best seen when it appears to be as directly above the point of sunset or sunrise as possible. The more nearly perpendicular to the horizon Mercury and the Sun are aligned, the better the observing conditions, as shown in *Figure 1* (below). Another factor contributing to the difficulty in monitoring Mercury is the eccentricity of its orbit. This produces a marked variation in its angular distance from the Sun at greatest elongations. The planet is never more than 28° east or west of the Sun. Often it is less, and frequently that optimum distance coincides with an unfavorable elongation.

Despite these difficulties—proximity to the Sun, only four decent elongations yearly, bright skies, and varying magnitude of the planet itself—Mercury is fairly easy to spot. The two periodicals, *Sky & Telescope* and *Astronomy,* cover the best apparitions with advice for observers, including maps, times and bright objects nearby to help find the planet.

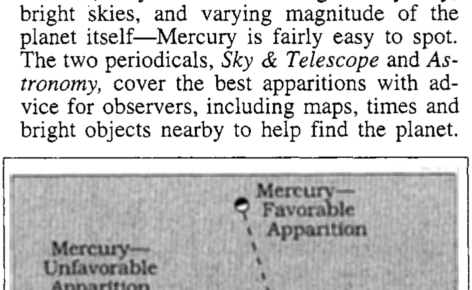


Figure 1. Favorable and unfavorable evening apparitions of Mercury (seen from the Northern Hemisphere mid-latitudes).

[4] During Mercury's best observing windows, one has about a three-week period both to locate the planet and then chart its motion against the stellar background. To spot it, for the first time and thereafter, use a combination of naked eye and binoculars to make the task easier. Once found, Mercury is relatively simple to find again during any favorable apparitions. For an interesting challenge, search for Mercury during an unfavorable apparition.

II. Observing Mercury with a Telescope

The challenge of observing Mercury is even greater when a telescope is used. The difficulties here are greater than those provided by any other naked-eye planet, save perhaps Venus. Many leading amateurs are exceedingly pessimistic about such telescopic work. Patrick Moore had this to say about the matter: "My own conclusion is that although it is probable that a few real albedo features were glimpsed occasionally, the errors in observation were so unavoidably large that, without the spacecraft, we would never have learned anything definite about Mercury's features." [5] Moore's assessment is underscored by the fact that excellent planetary astronomers, such as E.M. Antoniadi, determined a Mercurian rotation period that was proved wrong by subsequent radar observations. In light of this Gerald North leaves us with this conclusion: "I would certainly stop short of trying to dissuade anyone from observing Mercury. We can never be absolutely sure that the planet won't ever throw us some unusual appearance, as remote as that possibility might be." [6]

Other observers are more cautiously optimistic. The A.L.P.O. observing guide, *Introduction to Observing and Photographing the Solar System*, states that "dusky markings and diffuse bright patches on Mercury can be seen with only four inches of aperture." However, after describing what can be seen and how to see it, the writers add this caution: "Be warned, however, that it is often quite a challenge to discern any features at all on Mercury's tiny, rosy disc unless the atmosphere is very tranquil." [7] Terence Dickinson affirms that "under the best conditions of daytime or early-twilight viewing, Mercury will be a sharply defined disc with hints of dark and light splotches just at the threshold of vision." [8] Not surprisingly Richard Baum of England, the former Mercury A.L.P.O. Recorder, is enthusiastic about the potential of telescopic observations of the planet: "Most times it will show a blank disk, but in good moments a pattern will be made out, and as experience grows this will become more obvious." [9]

Even these encouraging Mercury aficionados recognize the difficulties and frustrations of observing this planet, which are denied by no one. Mercury's proximity to the Sun creates most of the problems. Seeing is never good. The air is almost always hazy and turbulent whether one examines the planet when the Sun is in the sky or not. At dusk or dawn, one observes Mercury through a thicker layer of air that is even more turbulent due to temperature changes resulting from either sunset or the coming sunrise. Even if one waits until after sunrise the problems remain. As the Sun warms the air it becomes less stable, and the Sun's glare reduces the contrast of details on the planet as well. Eliminating one difficulty opens the door to another. Consequently, Mercury observers are divided as to the best time to observe. Some are convinced that the most favorable period occurs when the Sun is not in the sky, while others suggest that one or two hours after sunrise is the best period for telescopic work. The best advice is to experiment until one finds his or her own best viewing method. However, no matter what choice is made, it is virtually impossible to observe Mercury without its appearing as a shimmering blob floating in a sea of air.

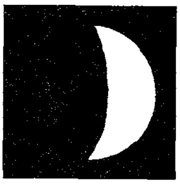
Finally, Mercury's small angular diameter makes it a most difficult telescopic object. Its diameter ranges between roughly 5" to 12" (arc seconds), hardly ideal for noting surface detail. Further, Mercury appears closer to the 5" size when it is at a phase that displays more of its surface. Thus a telescopic observer needs a magnification of 150-350× to make Mercury as large in the eyepiece as the Moon is to the unaided eye, but the useful magnification is limited by the habitual poor seeing conditions so common to Mercurian observations.

After having read this litany of woes, the reader might believe that there are no rewards to be found in observing Mercury. This is not the case at all, but I must add that every reward for work on Mercury is contained within the challenge of observing itself. The following reflections both report on my own observations and give advice to those who might consider taking up a similar challenge:

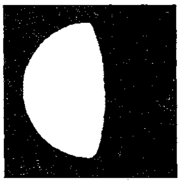
1. The nature of one's optics is of the essence. For my observations I have used my childhood 2.4-in Unitron refractor, my Meade 10-in Schmidt-Cassegrain and my Meade 5-in apochromatic refractor. Without qualification this last telescope has proven to be the best, but it is also the most expensive. [10]

2. Even the standard 2.4-3.0-in refractor can detect the phases of Mercury. This is an excellent initial task for the telescope user, who might attempt to see how close his or her observations come to Mercury's predicted phases. It is a real treat to see the planet as a crescent, in half-phase (*dichotomy*), and in gibbous mode. An observer could try to discern the planet's apparent color, which appears to vary subtly over the period of any given apparition. From September 18, 1990 through August 31, 1991 I concentrated on observing and drawing the full range of Mercury's phases (see *Figure 2*, p. 52) [All the drawings in this article have been converted to normal orientations, as seen in simply inverting telescopes in the Northern Hemisphere; i.e., with celestial south at top and celestial east to the right. Black backgrounds have also been added in *Figure 2*. Dr. Cole Arnal is the

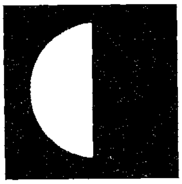
Morning Apparition.
1990 Sep 18, 10h15m-10h 30m UT. 6-cm Refr., 100X. Seeing = 4-1/2. D = 8".4, k = 0.23. Walton, Ontario



Evening Apparition.
1991 Jul 24, 01h40m-01h45m UT. 25.4-cm Sch.-Cass., 153X. Seeing = 5. D = 6".6, k = 0.60. Walton, Ontario.



Evening Apparition.
1991 Jul 15, 01h28m-01h31m UT. 25.4-cm Sch.-Cass., 153X. Seeing = 5. D = 7".7, k = 0.47. Walton, Ontario.



Morning Apparition.
1991 Aug 31, 10h10m-10h15m UT. 25.4-cm Sch.-Cass., 153X. Seeing = 5-1/2. D = 9".0, k = 0.17. Belwood, Ontario.

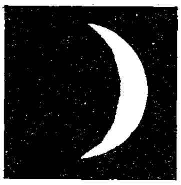


Figure 2. Drawings of Mercury's phases.

observer unless otherwise indicated. The Editor has added the following quantities: D = angular diameter, k = proportion sunlit {phase}, and CM = central meridian *Ed.*]. The first sketch was made with the Unitron refractor, the latter three with the Schmidt-Cassegrain. No filters were used, and in every view, the image was shimmering and distorted.On 1991 Jul 24 my sister Judy Zeman made a similar drawing, confirming what I had seen.

3. I began serious sketching of the planet in the September 1991 Morning Apparition. For the first time I was able to see subtle markings on the surface (see *Figure 3*, to the right). Until that moment my Schmidt-Cassegrain had shown only severely distorted images of Mercury, but this time I was determined to use my clock drive to follow Mercury up in the sky. This can be done relatively easily during morning apparitions and is one of the most effective means to see Mercury at its best. Near sunrise itself I made this drawing without a filter. This success inspired me to begin a program of observing and drawing Mercury at each of its favorable apparitions.

4. From September 17, 1991 until December 14, 1992 I observed Mercury as often as time, weather and favorable apparitions permitted. In that period I accumulated five drawings from five different apparitions. On December 23, 1992 I sent them to the previous Mercury Recorder Richard Baum, who sent back a cordial, encouraging and informative reply. In every instance I used my 10-in Schmidt-Cassegrain, and in the last four sketches I used 250X magnification and a W21 orange filter. Without that filter it would have been impossible to detect anything but the phase, partly because I was unable in any of these instances to observe the planet higher in the sky. Even with the filter there was noticeable shimmering, rendering my drawings more subjective than they might have been with steadier air. I used the method of quick glimpses and drawing during the rare seconds of relatively good seeing and confirmed what I saw by several trips to the eyepiece. In short, I was learning by my experience.

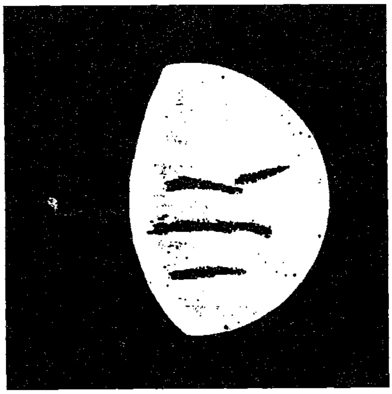


Figure 3. Mercury during a morning apparition: 1991 Sep 17, 10h27m-10h55m UT. 25.4-cm Sch.-Cass., 190X. No filter. Seeing = 4-1/2. D = 5".7, k = 0.83, CM = 131°. Belwood, Ontario.

5. What can one expect to see? On the positive side, Mercury is one of only two planets whose surfaces can be viewed by Earth-bound telescopes; the other is Mars. However, in both cases, few if any actual relief markings can be observed. Earlier optimism that topographical details could be mapped on Mars were dashed soundly by the discoveries of space probes. Virtually everything we see with our amateur telescopes are contrast (albedo) features and not actual surface topography, and then only the grossest albedo features. This is demonstrated by the experimental drawings of a highway sign found in *Figure 4* (p. 53). In these roadside sketches by my step-daughter Sarah Lamble, the first at 0.2 km from the target and the second at 0.1 km, the details of the second drawing are barely hinted at in the more distant first drawing. The 0.2-km sketch is akin to what we amateurs observe and draw on Mercury. In spite of this, monitoring the planet is worthwhile as something significant might emerge. [11]

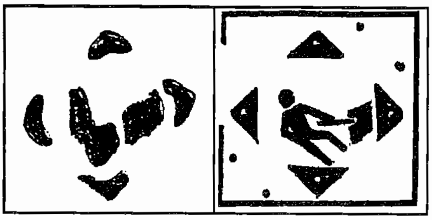


Figure 4. Drawings of road sign showing role of distance in seeing detail of albedo features. Done by Sarah Lamble on September 4, 1993. *Left:* 15h10m-15h14m UT, distance 0.2 km. *Right:* 15h15m-15h20m UT, distance 0.1 km.

6. To date the highpoint of my Mercurian journey has been my work with the 5-in apochromatic refractor; both at the favorable evening apparition of June, 1993 and during the fine morning appearance of August, 1993. For me, these observations have been most rewarding, so much so that I recommend the use of apochromatic refractors for Mercury work whenever the observer can afford such a telescope. The following drawings, reflections and advice are based on these two periods.

The June, 1993 Evening Apparition.-During this apparition I made five drawings, shown in *Figure 5* (to right). The phase ranged from almost half to a slender crescent, and the size of the disc from 7".4-9".3. In each case I used a 4.7-mm eyepiece (243X) and the W21 orange filter. Seeing ranged from 4 to 6 on the standard A.L.P.O. Scale (0 for worst to 10 for perfect). The biggest problem with this apparition was that it was an evening one. Thus polar alignment, done in daylight, was rough and did not permit finding Mercury until after sunset. I set my telescope up before the Sun set and then began my binocular search. Upon finding Mercury I turned my telescope on it and centered it with my lowest-power eyepiece. The last step before drawing the disc was replacing the wide-field eyepiece with my 243X ocular, orange filter attached. Compared to my Schmidt-Cassegrain the apochromatic refractor showed a sharp disk with definite, though still diffuse markings (see drawings). On the evening of June 13 (June 14 UT) I was joined by my friend Tom Michaels. We both made drawings on that occasion (see *Figure 6*, p. 54). Drawings by different observers at nearly the same time are a valuable means of comparison to check for accuracy of perception. Also, it is fun to observe with friends.

The August, 1993 Morning Apparition.-This particular appearance of Mercury gave me an excellent opportunity to further experiment with my observing technique. I drew the planet on four different mornings, but on each occasion I sketched the planet several times: August 5, 4 drawings; August 9, 3 drawings; August 12, 4 drawings; and August 15, 4 drawings—a total of 15 sketches. On every morning I employed 243X magnification (4.7-mm eyepiece) and the orange (W21) filter. My purpose was to draw Mercury several times as it rose higher in the sky. The computerized drive on my telescope made this relatively easy. My last drawing, on each of these days, was done in white light (without a filter). As expected, seeing conditions improved as Mercury rose higher. In one instance the seeing was estimated at 7. In *Figure 7* (p. 54) I have provided a series of drawings from one particular morning, August 12. From these one can see how Mercurian detail emerges with the improvement in seeing conditions.

Figure 5. Five Mercury drawings, 1993 June Evening Apparition.

1993 JUN 13, 01h40m-01h52m UT. 12.7-cm apochromat refractor, 243X. W21 (orange) Filter. Seeing = 6. D = 7".4, k = 0.47, CM = 121°. Belwood, Ontario.

1993 JUN 14, 01h28m-01h35m UT. 12.7-cm apochromat refractor, 243X. W21 (orange) Filter. Seeing = 6. D = 7".6, k = 0.45, CM = 126°. Belwood, Ontario.

1993 JUN 16, 01h32m-01h39m UT. 12.7-cm apochromat refractor, 243X. W21 (orange) Filter. Seeing = 5-1/2. D = 7".9, k = 0.42, CM = 136°. Belwood, Ontario.

1993 JUN 23, 02h08m-02h13m UT. 12.7-cm apochromat refractor, 243X. W21 (orange) Filter. Seeing = 4. D = 9".1, k = 0.29, CM = 173°. Belwood, Ontario.

1993 JUN 24, 01h49m-01h58m UT. 12.7-cm apochromat refractor, 243X. W21 (orange) Filter. Seeing = 5. D = 9".3, k = 0.27, CM = 179°. Belwood, Ontario.

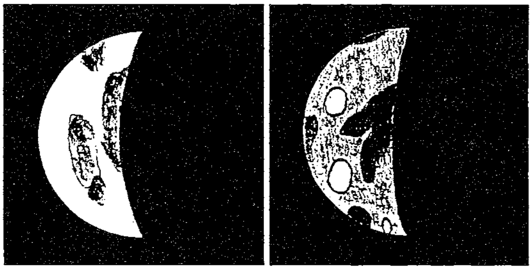


Figure 6. Near-simultaneous comparison drawings (for both: 1993 JUN 14, 12.7-cm apochromat refractor, 243X. W21 [orange] Filter. Seeing = 6. D = 7".6, k = 0.45, CM = 126°, Belwood Ontario). *Left:* Tom Michaels, 01h36m-01h40m UT. *Right:* Oscar Cole Arnal, 01h28m-01h35m UT.

7. I have constructed a partial map of the planet's surface from the drawings I made from 1991 Sep 17 - 1993 AUG 15. To test its accuracy I have placed it with the standard map employed by the A.L.P.O. (see *Figure 8*, p. 55). There is little resemblance between the two, but I am not discouraged. It is only a beginning, one step in the exciting challenge of observing this most elusive planet. [12]

III. IN THE INTERIM

Three or four times a year is scant fare for eager Mercury observers. In the interim, the heavens offer many other opportunities—from work with other planets to deep-sky activities. However, even when Mercury is not directly observable it is available through the printed page. When I cannot observe the planet I read about it— in science fiction, in popular nonfiction or in technical publications. Both *Astronomy* and *Sky & Telescope* occasionally highlight Mercury, including the startling reports that it may have polar ice. There are thorough texts as well, notably the Vilas, Chapman and Matthews collection and Robert G. Strom's *Mercury, the Elusive Planet.* At a simpler level is the Mercury section in the colorful and popular Time-Life series book *The Near Planets.* Texts on the Solar system abound, and most have fine sections on Mercury. [13] So in the interim I wait, read, and eagerly look forward to the next apparition when I can hone my skills in the endless challenge of observing the planet Mercury.

ENDNOTES

1. The belief that Copernicus never saw Mercury is almost certainly a myth.

2. For thorough coverage of binoculars (specifications, costs, pros and cons), see "Binoculars for the Beginner and the Serious Observer," Cpt. 2, pp. 24-28, 33-35, 38-39 in Terence Dickinson and Alan Dyer, *The Backyard Astronomer's Guide* (Camden, Ontario: Camden House, 1991). Also, Dickinson's excellent introductory book, *Nightwatch*, Camden (1989), has useful advice for buying binoculars.

3. For further information, contact: AAVSO; 25 Birch St.; Cambridge, MA 02138; U.S.A.

4. For daily ephemerides an excellent buy is the annual *A.L.P.O. Solar System Ephemeris.* Also useful is the Royal Astronomical Society of Canada's annual *Observers' Handbook.*

5. Faith Vilas, Clark R. Chapman and Mildred Shapley Matthews, editors, *Mercury.* Tucson: University of Arizona Press, 1988. p. 5.

6. Gerald North, *Advanced Amateur Astronomy.* Edinburgh University Press, 1991. p. 141.

7. Thomas A. Dobbins, Donald C. Parker and Charles F. Capen. *Introduction to Observing and Photographing the Solar System.* Richmond, Va.: Willmann-Bell, Inc., 1988. p. 31.

8. Dickinson and Dyer, p. 146. I chatted with Dickinson at a star party in August, 1993, when he affirmed my good experience of Mercury observing for that month's apparition.

9. Letter to the author, November 14, 1991. I cannot emphasize enough the my gratitude to Richard Baum. His enthusiasm and expert advice have served me well.

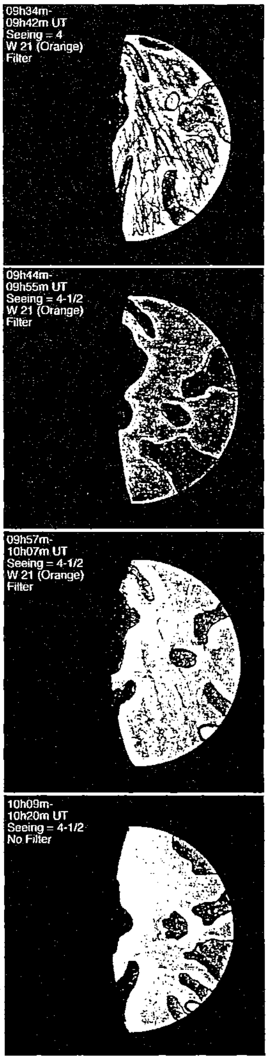


Figure 7. Four morning-apparition drawings of Mercury, on 1993 AUG 12. 12.7-cm apochromat refractor, 243X, Belwood, Ontario, D = 6".1, k = 0.70, CM = 114° in all cases.

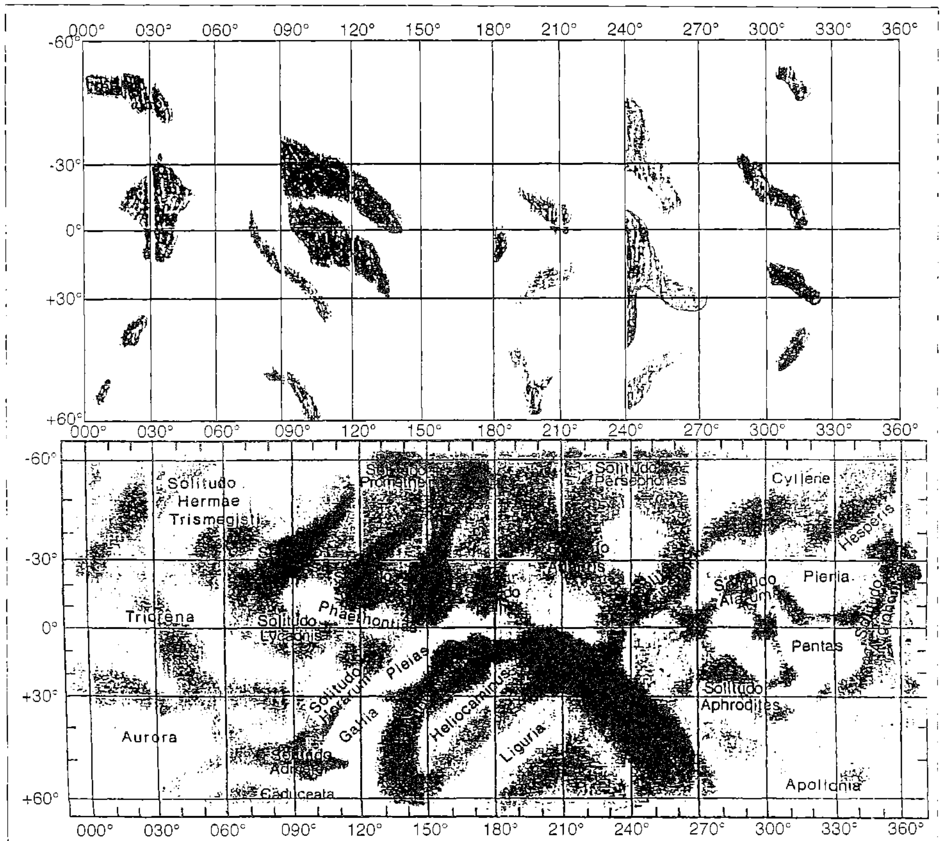


Figure 8. Comparison maps of Mercury, both approximately on the Mercator Projection with south up. *Top:* Partial map by Oscar Cole Arnal. *Bottom:* Standard map used by the A.L.P.O. Mercury Section.

10. Dickinson's and Dyer's book offers extensive advice to the telescope buyer, especially Cpt. 3 ("Telescopes for Recreational Astronomy"), pp. 40-65 and Cpt. 4 ("Eyepieces and Filters"), pp. 66-81. Serious Mercury observing demands high-quality optics and filters.

11. This is the opinion of Richard Baum (correspondence with the author: January 10 and July 2, 1993) and David L. Graham, the Mercury Recorder for the British Astronomical Association (see "An Observer's Guide to Mercury," *Sky & Telescope*, Dec., 1990, pp. 665-666). In his excellent *Seeing the Solar System* (New York: John Wiley & Sons, Inc., 1991, p. 149), Fred Schaaf says: "Above all else, there is no doubt that real features can be glimpsed on Mercury—and, with the fine optics available to today's amateur astronomers, even fairly small telescopes can reveal them. There seems little doubt that some bright patches on Mercury seen by skilled observers really do correspond to the bright areas of rayed craters on the very Moonlike Mercurian surface." Baum's correspondence echoes this.

12. I have cited a few sources of great assistance to potential Mercury observers. Three of them are especially useful: *Introduction to Observing and Photographing the Solar System*; Graham's "An Observer's Guide to Mercury;" and above all, Schaaf's *Seeing the Solar System*, especially pp. 143-151.

13. Mercury is not a favorite subject of science fiction writers, but I remain hopeful. The Vilas, *et al.* text has been cited earlier, and the Strom book was published in Washington, D.C. by the Smithsonian Institution Press (1987). The most recent edition of *The Near Planets* appeared in 1992. Three examples of informative articles on Mercury are: Robert G. Strom, "Mercury: The Forgotten Planet," *Sky & Telescope*, Sept., 1990, pp. 256-260; Clark R. Chapman, "Mercury's Heart of Iron," *Astronomy*, Nov., 1988, pp. 22-35; and Clark R. Chapman, "A Clean, Well-Lighted Place," *Planetary Report*, Sept.- Oct., 1991, pp. 8-11. One text on planetary science, which has an easy-to-understand chapter on Mercury, is *Exploring the Planets* by W. Kenneth Hamblin and Eric H. Christiansen (New York: Macmillan, 1990), pp. 94-117. For the story on a possible polar ice cap on Mercury, see J. Kelly Beatty, "Mercury's Cool Surprise," *Sky & Telescope*, Jan., 1992, pp. 35-36 and "Does Mercury Have Polar Ice Deposits?" *Astronomy*, Feb., 1992, pp. 20, 22.

A.L.P.O. OBSERVATIONS OF VENUS DURING THE 1993-94 WESTERN (MORNING) APPARITION

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

ABSTRACT

This synoptic report is based on visual and photographic data received from eleven A.L.P.O. Venus Section observers in the United States, Belgium, Germany, and Italy during the 1993-94 Western (Morning) Apparition, including instrumentation and data sources used in compiling those observations. Comparative studies deal with observers, instruments, and 190 visual and photographic observations. The report includes: illustrations; a statistical analysis of the categories of features in the atmosphere of Venus, including cusps, cusp-caps, and cusp-bands, seen or suspected at visual wavelengths, both in integrated light and with color filters; terminator irregularities; the apparent phase; and results from the continuing monitoring of the dark hemisphere of Venus for the Ashen Light.

INTRODUCTION

A valuable collection of 190 visual and photographic observations of Venus during the 1993-94 Western (Morning) Apparition was contributed by A.L.P.O. observers. The geocentric parameters for the apparition are given in *Table 1* (right). *Figure 1* (below) shows the distribution of observations for each month during the observing season.

The number of reports contributed was satisfactory. Individuals started their programs fairly early in the apparition and followed through until Venus was about two months from inferior conjunction. The "observing season" was 1993 APR 11-NOV 21, with the maximum emphasis during the months of 1993 May-August (73.2 percent of the total observations). As in many previous apparitions, observational activity in 1993-94 increased during the period when Venus was at its greatest brilliancy and maximum elongation from the Sun.

Table 1. Geocentric Data in Universal Time (UT) for the 1993-94 Western (Morning) Apparition of Venus. ***[A.L.P.O.; 1992, 1993]***

			d	h
Inferior Conjunction......................	1993	APR	01	13
Initial Observation (Elong. 16°W).		APR	11	09
Greatest Brilliancy (-4.5)..............		MAY	07	04
Greatest Elongation West (46°)...		JUN	10	13
Dichotomy (predicted)..................		JUN	11	08
Final Observation (Elong. 14°W).		NOV	21	13
Superior Conjunction...................	1994	JAN	17	02

Apparent Diameter (observed range):
56".18 (1993 APR 11) - 10".16 (1993 NOV 21)

Phase Coefficient (*k*, observed range):
0.040 (1993 APR 11) - 0.973 (1993 NOV 21)

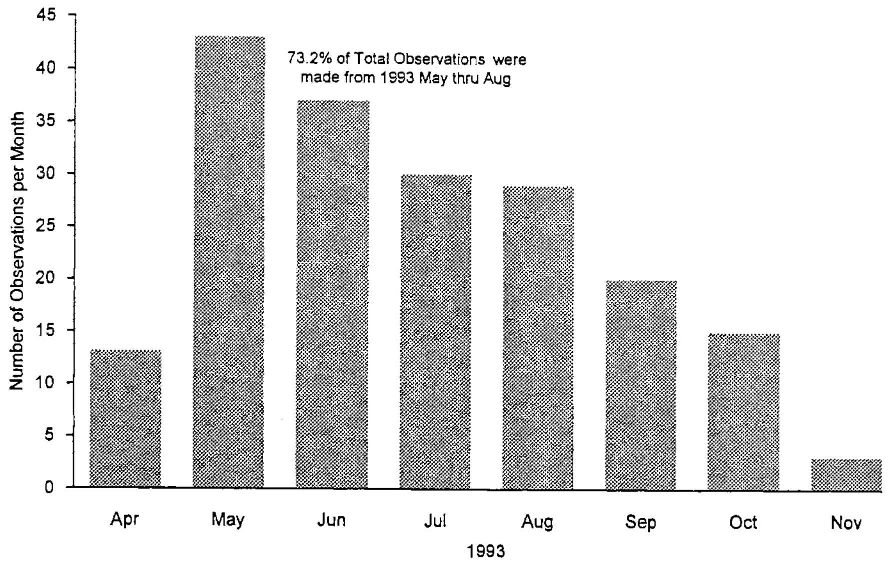


Figure 1. Venus Western (Morning) Apparition, 1993-94: Number of Observations Contributed by Month. (Total Number of Observations = 190)

Table 2. Participants in the A.L.P.O. Venus Observing Program During the 1993-94 Western (Morning) Apparition.

Observer	Observing Site	Number of Observations	Telescope(s) Used
Benton, Julius L.	Wilmington Island, GA	21	15.2-cm (6.0-in) Refractor
Bosselaers, Mark	Berchem, Belgium	2	25.4-cm (10.0-in) Newtonian
Giuntoli, Massimo	Montecatini, Italy	8	8.0-cm (3.1-in) Refractor
		2	10.2-cm (4.0-in) Refractor
Graham, Francis G.	East Pittsburgh, PA	2	16.0-cm (6.3-in) Refractor
Lupoli, A.	Bari, Italy	1	6.0-cm (2.4-in) Refractor
Marizani, T.	Abbiate, Italy	15	10.2-cm (4.0-in) Refractor
Niechoy, Detlev	Göttingen, Germany	3	7.9-cm (3.1-in) Refractor
		96	20.3-cm (8.0-in) Schmidt-Cass.
		9	30.5-cm (12.0-in) Newtonian
Schmude, Richard W.	College Station, TX	2	35.6-cm (14.0-in) Schmidt-Cass.
Stryk, Ted	Bristol, VA	1	5.0-cm (2.0-in) Refractor
Tanguay, Ronald C.	Saugus, MA	1	8.9-cm (3.5-in) Maksutov
Testa, Luigi	Parma, Italy	1	8.0-cm (3.2-cm) Refractor
		24	20.3-cm (8.0-in) Newtonian
		2	40.6-cm (16.0-in) Newtonian

Total Number of Observers..................... 11
Total Number of Observations.. 190

The eleven individuals who submitted visual and photographic observations of Venus during the 1993-94 Apparition are listed in *Table 2* (above) with their observing sites, number of observations, and instruments used.

Figure 2 (below) shows the distribution of observers and observations by nation of origin for this 'apparition. Nearly half of the participating observers were located in the United States, but those individuals only accounted for 14.2 percent of the total observations received. Thus our programs continue to be international in scope.

The frequency of use of different types of telescope, by number of observations, were: Schmidt-Cassegrain, 51.6 percent; refractor, 28.4 percent; Newtonian, 19.5 percent; and Maksutov-Cassegrain, 0.5 percent. The number of observations were almost evenly distributed between instruments of catadioptric and classical design. Most (83.2 percent) of the observations were made with telescopes of 15.2 cm (6.0 in) aperture or above.

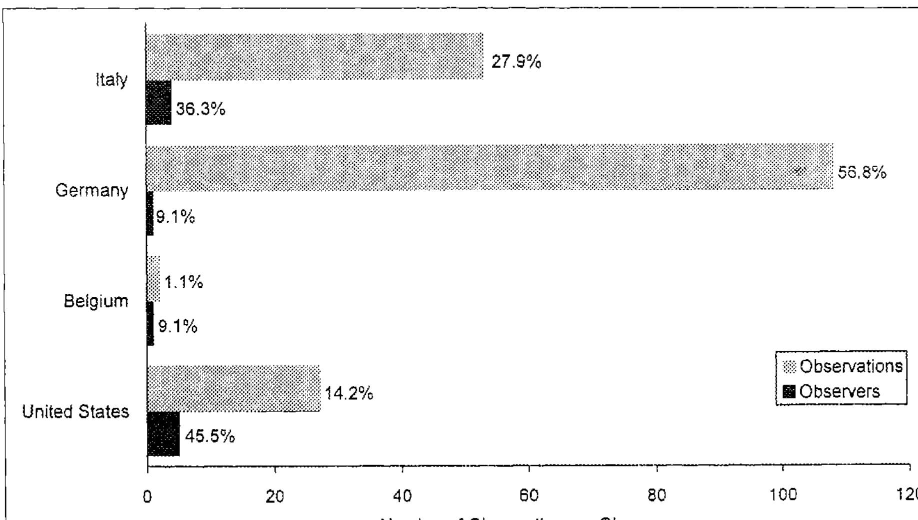


Figure 2. Venus Western (Morning) Apparition, 1993-94: Number and Percentage of Observations and Observers by Nation of Origin. (Total Number of Observations = 190)

In terms of atmospheric conditions, the mean Seeing was 3.5, or "fair," on the standard A.L.P.O. Seeing Scale that ranges from 0.0 (worst) to 10.0 (perfect). The mean Transparency, expressed as the limiting stellar magnitude in the vicinity of Venus, was about +4.0. However, during 1993-94, most observations (86.1 percent) were made against a light or twilight sky where the limiting magnitude is difficult to judge.

International participation in our programs is very gratifying, as shown by the valuable work contributed by the eleven individuals mentioned in this report, and this Coordinator extends his sincerest thanks to those observers for their support during 1993-94. We encourage anyone interested in the planet Venus to join us in our observational endeavors in coming apparitions.

OBSERVATIONS OF VENUSIAN ATMOSPHERIC DETAILS

As mentioned in previous Venus reports that have appeared in this Journal, the methods and techniques for conducting visual studies of the vague, characteristically elusive "markings" in the atmosphere of Venus have been outlined in the *Venus Handbook* and other A.L.P.O. Venus Section publications [Benton, 1973, 1987, 1992, 1994]. We highly recommend that new observers study these sources as well as previous apparition reports.

All of the observations used for this report were made at visual wavelengths, and several samples of these observations in the form of drawings and photographs appear here in order to aid the reader in interpreting the phenomena reported or suspected on Venus in 1993-94 (see *Figures 5-19*, p. 62).

The visual and photographic data for the 1993-94 observing period represented virtually all of the categories of dusky and bright markings on Venus, as covered in the literature cited above. *Figure 3* (below) graphs the frequency by which the specific forms of markings were reported. Because many observations showed more than one type of marking or feature, totals of over 100 percent are possible. As always, there is a subjective element in the reporting of the elusive, vague markings of Venus that affect the values in *Figure 3*, but even so, our conclusions derived from these data appear reasonable.

Dusky markings in the atmosphere of Venus are nearly always difficult to see for the novice and experienced visual observer alike. It is widely held that ultraviolet (UV) photographs of Venus are preferred to visual-wavelength observations in order to reveal these subtle shadings. The A.L.P.O. Venus Section is always actively seeking good UV photographs, because the morphology of features at these short wavelengths is considerably different from those seen in the visual region of the spectrum, particularly in the case of radial dusky patterns. *Figure 3* shows that 33.3 percent of the drawings and other visual observations of Venus during the 1993-94 observing season represented the planet as devoid of shadings or markings of any kind, which compares fairly well with the 1990 Western (Morning) Apparition, but represented a slightly lower frequency of the totally blank aspect of Venus than the immediately preceding Western (Morning) Apparition of 1991-92. In the photographs taken at visual wavelengths, there were no markings detected. So, on photographs submitted to the A.L.P.O. Venus Section, the planet displayed a completely blank disc, despite the fact that visual

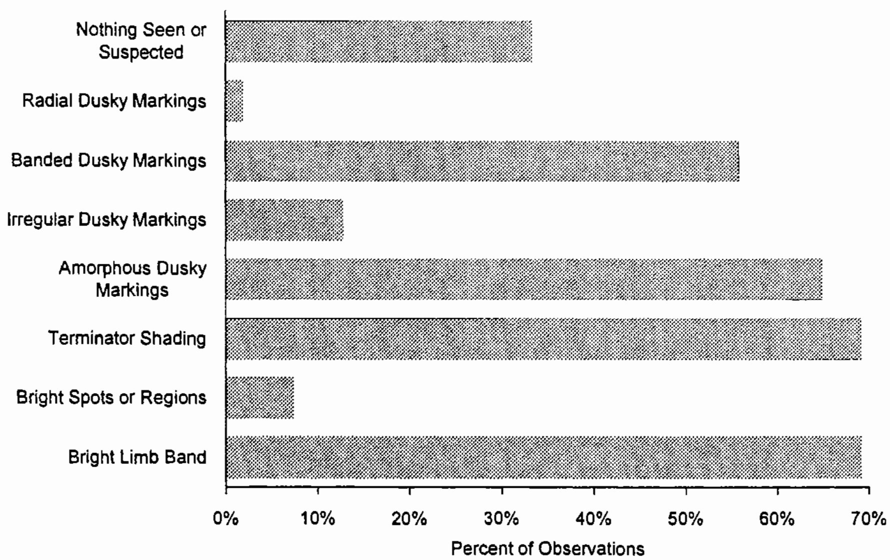


Figure 3. Venus Western (Morning) Apparition, 1993-94: Relative Frequency of Reporting of Types of Atmospheric Markings and Other Features.

observers recorded banded, radial, irregular, and amorphous dusky markings with fairly high confidence levels. One important factor here is that observers have been utilizing more standard, systematic techniques with polarizing and color filters during the 1990s than previously.

Figure 3 shows that nearly two-thirds of the dusky features that were reported fell in the category of "Amorphous Dusky Markings," indicated in 64.9 percent of the total observations. Other dusky shadings were distributed among the categories of "Banded Dusky Markings" (55.8 percent) and "Irregular Dusky Markings" (12.7 percent), while only 1.8 percent of the observations reported "Radial Dusky Markings" in 1993-94.

Terminator shading was visible in 69.1 percent of the 1993-94 observations, as shown in *Figure 3*. There was the usual tendency for the terminator shading to lighten (i.e., assume a higher intensity value) as one progressed from the terminator region toward the sunlit limb of the planet. This gradation in brightness often culminated in the Bright Limb Band. Also, this terminator shading usually extended from one cusp region to the other. Unlike most of the drawings received during 1993-94, photographs did not show any hint of terminator shading.

The mean relative intensity for all of the dusky features on Venus in 1993-94 was 7.8 on the standard A.L.P.O. Brightness Scale, which ranges from 0.0 for black to 10.0 for the brightest possible condition.

The standard A.L.P.O. Conspicuousness Scale, ranging from 0.0 for "definitely not seen" up to 10.0 for "certainly seen," was also used routinely during the 1993-94 observing season. The dusky markings in *Figure 3* were assigned a mean conspicuousness of 5.0 during the apparition, meaning that all of these features were judged to lie somewhere between vague suspicions and strong indications of actual presence on Venus.

Figure 3 also shows that "Bright Spots or Regions," exclusive of the cusp areas, were evident in only 7.3 percent of the submitted observations (averaging about 9.5 in mean relative intensity). At visual wavelengths, only a small number of drawings showed these bright spots or mottlings, and no photographs revealed any indication of these features.

Color-filter techniques were systematically used during the 1993-94 Western (Morning) Apparition. These methods gave useful results, and when compared with studies in integrated light, the usage of Wratten and Schott color filters, and variable-density polarizers helped improve the visibility of elusive atmospheric phenomena on Venus.

THE BRIGHT LIMB BAND

Figure 3 shows that 69.1 percent of the 1993-94 observations called attention to the "Bright Limb Band" on the sunlit hemisphere of Venus. When this dazzling band was reported, the feature extended uninterrupted from cusp to cusp 82.5 percent of the time, and broken or partially visible in the remaining 17.5 percent of the positive reports. The mean numerical intensity of the Bright Cusp Band was 9.7, and its visibility was markedly improved when color filters and variable-density polarizers were utilized.

TERMINATOR IRREGULARITIES

The terminator is the geometric curve that separates the sunlit and dark hemispheres of Venus. Almost half (47.9 percent) of the observations in 1993-94 referred to an irregular or asymmetric terminator; amorphous, irregular, and banded dusky markings; and to a lesser extent radial dusky shadings, which merged with the terminator shading and appeared to contribute to the reported deformities. As with other features observed during the 1993-94 Western (Morning) Apparition, filter techniques helped enhance the visibility of terminator irregularities and associated dusky atmospheric features. Note that irradiation may cause brilliant features adjacent to the terminator to become apparent bulges, and dark features may appear as dusky hollows.

CUSPS, CUSP-CAPS, AND CUSP-BANDS

The most contrasting and conspicuous features periodically seen in the atmosphere of Venus are found at or near the planet's cusps, most often when the phase coefficient, *k*, lies between 0.1 and 0.8 (the phase coefficient is the fraction of the disc that is sunlit). These cusp-caps are sometimes bounded by dark, often diffuse, peripheral cusp-bands. *Figure 4* (p. 60) depicts the visibility statistics for Venusian cusp features in 1993-94.

It can be seen in *Figure 4* that, when the northern and southern cusp-caps were recorded, the majority of the time they were equal in size and brightness. There were a few instances, however, when the either the northern or southern cusp-cap was the larger, the brighter, or both. In a little more than one-quarter (28.5 percent) of the observations, neither cusp-cap could be detected. The mean relative intensity of the cusp-caps was about 9.6 during the 1993-94 Apparition.

The cusp-caps were devoid of bordering dusky cusp-bands in slightly more than one-third (37.6 percent) of the submitted observations, with a mean relative intensity of about 7.5 (see *Figure 4*).

CUSP EXTENSIONS

As illustrated in *Figure 4*, in 95.2 percent of the observations there were no reported cusp extensions beyond the 180° expected from simple geometry, both in integrated light and with color and polarizing filters.

When Venus was in a crescent phase early in the apparition, however, a few reports of cusp extensions were received, the extension ranging from about 2° to no more than 25°. Unlike several recent apparitions, there were,

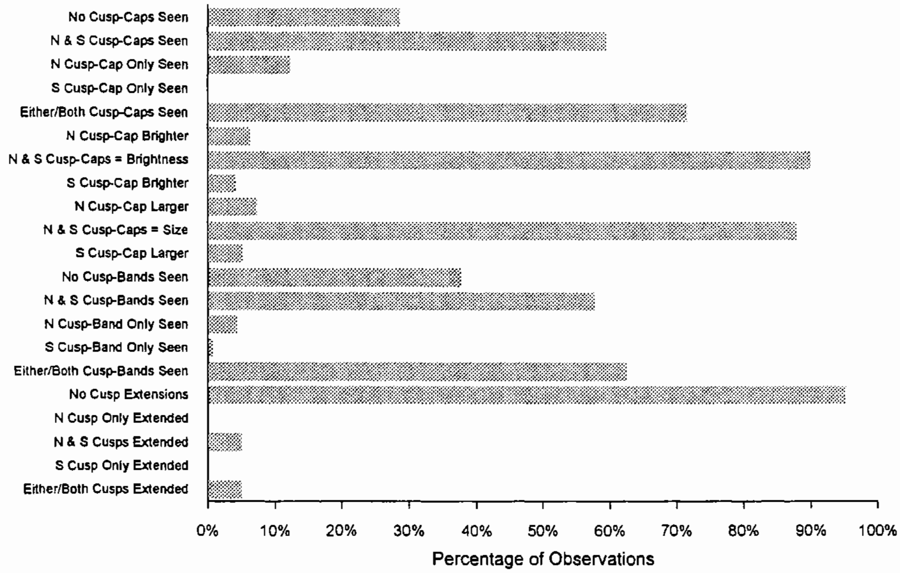


Figure 4. Venus Western (Morning) Apparition, 1993-94: Relative Frequency of Reports of Cusp-Caps, Cusp-Bands, and Cusp-Extensions.

surprisingly, no reports in the 1993-94 Western (Morning) apparition of both cusps joining, forming a beautiful halo encircling the entire dark hemisphere of Venus. Any cusp extensions that were seen during the observing season were depicted on drawings, enhanced by color filters and polarizers, but were not visible on any photographs that were submitted. Cusp extensions are exceedingly troublesome to capture on film, since they are significantly fainter than the sunlit regions of the disc of Venus. Observers with CCDs might try their hand at capturing cusp extensions in future apparitions.

ESTIMATES OF DICHOTOMY

The "Schroeter Effect" on Venus, a discrepancy between the predicted and the observed dates of dichotomy (half phase), was reported in 1993-94. The predicted half-phase occurs when $k = 0.500$, and the phase angle, i, between the Sun and the Earth as seen from Venus, equals 90°. The observed-minus predicted discrepancies for 1993-94 are given in *Table 3* (below).

Table 3. Observed versus Predicted Dichotomy of Venus: 1993-94 Western (Morning) Apparition.

Quantity		Observer: J. Benton	Observer: D. Niechoy
Date (1993 JUN):	Observed (O)	14.45 d	21.14 d
	Predicted (P)	11.30	11.30
	Difference (O - P)	+3.15	+9.84
Phase Coefficient:	Observed (O)	0.500	0.500
	Predicted (P)	0.514	0.550
	Difference (O - P)	-0.014	-0.050

DARK-HEMISPHERE PHENOMENA AND ASHEN-LIGHT OBSERVATIONS

The Ashen Light, first reported by G. Riccioli in 1643, is an extremely elusive, faint illumination of the dark hemisphere of Venus. It resembles, but cannot have the same origin, as Earthshine on the dark portion of the Moon. It is often argued that Venus must be viewed against a dark sky in order to perceive the Ashen Light, but the planet is very low in the sky at those times and suffers significantly from poor seeing and glare in contrast with the dark sky background.

During 1993-94 there were very few unconfirmed reports of what amounted to little more than vague suspicions of the Ashen Light on Venus. This contrasts with several recent apparitions, when a number of observers had rather strong impressions that the phenomenon was definitely present in integrated light and with color filters. There were one or two instances when observers felt that the dark hemisphere of Venus looked actually darker than the background sky, but this phenomenon is almost certainly a contrast effect.

CONCLUSIONS

Interpretations of the observations of Venus submitted during the 1993-94 Western (Morning) Apparition suggest that the level of atmospheric activity was moderate. It is useful to compare these results with those of previous morning observing seasons, as well as with evening apparitions of the planet.

Our studies of the Ashen Light, peaked during the Pioneer Venus Orbiter Project, but are continuing each apparition. Constant monitoring of the planet for the presence of this phenomenon by a large number of observers is important in order to improve our chances for simultaneous observations of dark-hemisphere events. The international cooperation of individuals and organizations in making continuous, systematic, and simultaneous observations of Venus remains our primary objective. All interested readers are welcome to join us in our efforts.

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SELECTED DRAWINGS: 1993-94 WESTERN (MORNING) APPARITION OF VENUS

Notes: Figures 5-19 are oriented with celestial south at the top and celestial west to the left (simple inverted views). Unless otherwise stated, Seeing (S) is on the standard A.L.P.O. Scale (ranging from 0 for worst to 10 for perfect) and Transparency (T) is the limiting naked-eye stellar magnitude in the vicinity of Venus. *k* is the computed phase coefficient, *d* is the angular disk diameter, Mak = Maksutov, New = Newtonian, Rr = refractor, and SC = Schmidt-Cassegrain.

Captions to Figures 5-19 on p. 62.

Figure 5. 1993 APR 16, 11h37m UT. D. Niechoy. 20.3-cm (8.0-in) S-C, 51×, no filter. S = average, k = 0.077, d = 53".0.

Figure 6. 1993 APR 16, 11h39m UT. D. Niechoy. 20.3-cm (8.0-in) S-C, 112×, no filter. S = average, k = 0.077, d = 53".0.

Figure 7. 1993 APR 30, 05h12m UT. D. Niechoy. 20.3-cm (8.0-in) S-C, 225×, W15 (yellow) Filter. S = average, k = 0.199, d = 42".9.

Figure 8. 1993 APR 30, 05h18m UT. D. Niechoy. 20.3-cm (8.0-in) S-C, 225×, W47 (blue) Filter. S = average, k = 0.199, d = 42".9.

Figure 9. 1993 MAY 30, 08h07m UT. D. Niechoy. 7.9-cm (3.1-in) Rr, 150×, RG610 Filter. S = above average, k = 0.430, d = 27".3.

Figure 10. 1993 JUN 22, 06h36m UT. D. Niechoy. 20.3-cm (8.0-in) S-C, 225×, W15 (yellow) Filter. S = very poor, daylight observation, k = 0.556, d = 21".0.

Figure 11. 1993 JUN 22, 06h46m UT. D. Niechoy. 20.3-cm (8.0-in) S-C, 225×, W25 (red) Filter. S = average-poor, daylight observation, k = 0.556, d = 21".0.

Figure 12. 1993 AUG 02, 04h05m UT. D. Niechoy. 20.3-cm (8.0-in) S-C, 225×, W15 (yellow) Filter. S = average, clouds during observation, k = 0.724, d = 15".1.

Figure 13. 1993 AUG 02, 04h11m UT. D. Niechoy. 20.3-cm (8.0-in) S-C, 225×, W25 (red) Filter. S = average, clouds during observation, k = 0.724, d = 15".1.

Figure 14. 1993 AUG 14, 10h15m-11h00m UT. F.G. Graham. 16-cm (6.3-in) Rr, 666×, W47 (blue) Filter. T = +5.5, k = 0.766, d = 14".0.

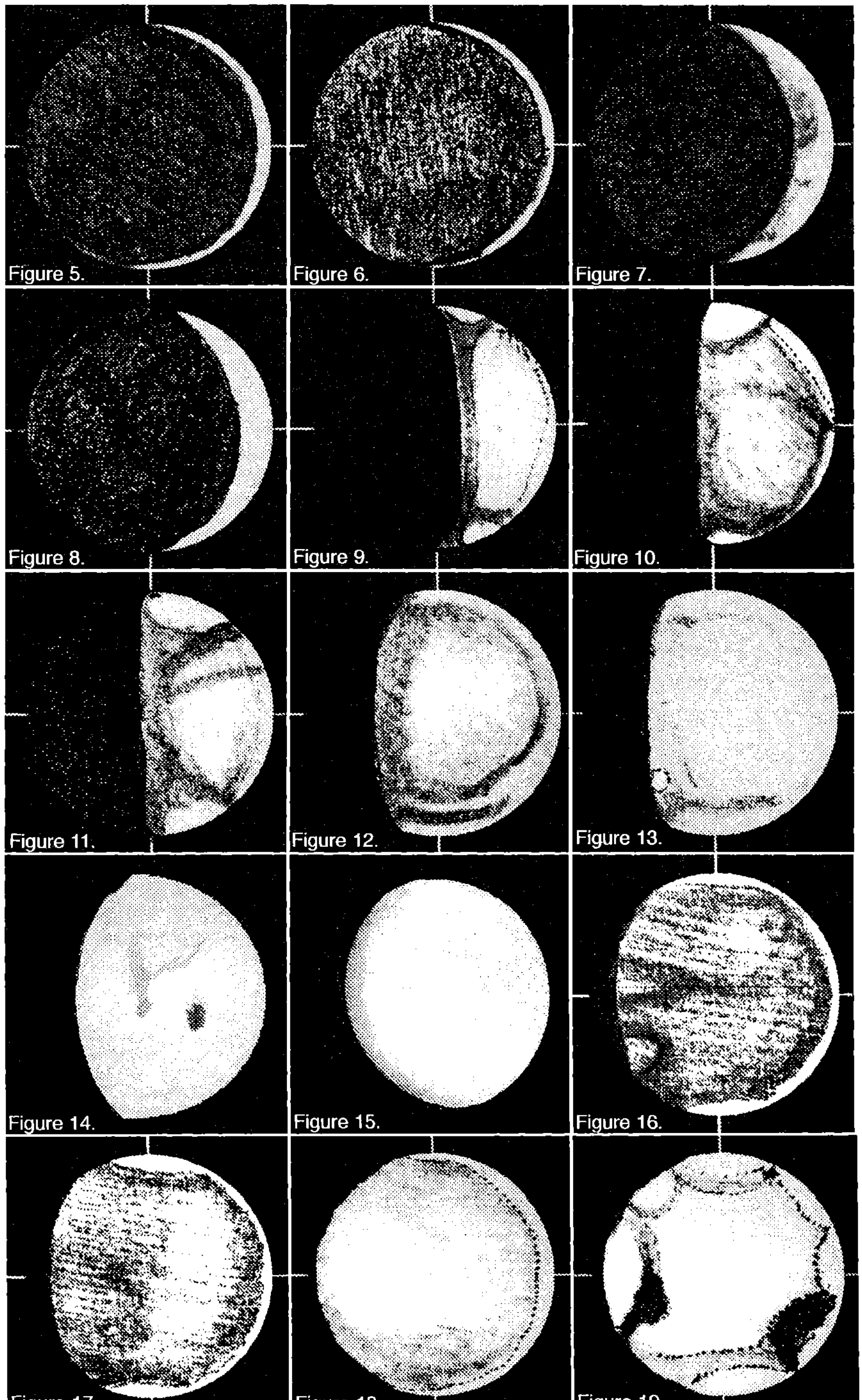
Figure 15. 1993 SEP 19, 16h05m-16h20m UT. R.C. Tanguay. 8.9-cm (3.5-in) Mak, 160× and 250×, W47 (blue) Filter. S = 3-4, daylight observation, k = 0.867, d = 11".9.

Figure 16. 1993 SEP 28, 05h10m UT. D. Niechoy. 20.3-cm (8.0-in) S-C, 270×, no filter. S = excellent, twilight/daylight observation, k = 0.887, d = 11".5.

Figure 17. 1993 SEP 28, 05h16m UT. D. Niechoy. 20.3-cm (8.0-in) S-C, 333×, no filter. S = excellent-average, daylight observation, k = 0.887, d = 11".5.

Figure 18. 1993 NOV 04, 06h08m UT. D. Niechoy. 20.3-cm (8.0-in) S-C, 51×, no filter. S = average-poor, daylight observation, k = 0.953, d = 10".5.

Figure 19. 1993 NOV 04, 06h12m UT. D. Niechoy. 20.3-cm (8.0-in) S-C, 112×, no filter. S = average-poor, daylight observation, k = 0.953, d = 10".5.



Figures 5-19. (Captions on p. 61)

URANUS AND NEPTUNE IN 1993

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

ABSTRACT

Based on 207 UBVRI photometric measurements of Uranus and Neptune made in 1993 at Texas A&M University Observatory, selected normalized magnitudes for Uranus are: U(1,0) = -6.28±0.03; B(1,0) = -6.57±0.02; V(1,0) = -7.17±0.02; R(1,0) = -7.03±0.02 and I(1,0) = -5.81±0.03. The corresponding selected values for Neptune are: B(1,0) = -6.49±0.02; V(1,0) = -6.93±0.02; R(1,0) = -6.61±0.03 and I(1,0) = -5.50±0.03. The solar phase angle coefficients (in mag./degree) in the B and V filters, respectively, were measured as 0.007±0.004 and 0.0015±0.001 for Uranus and 0.007±0.004 and 0.005±0.003 for Neptune. Drawings and a photograph revealed a possible bright limb spot on Uranus; this spot was used in determining a rotational period of 17.0±0.1 hours.

INTRODUCTION

A preliminary account of observations and measurements of Uranus and Neptune was given at the 1993 annual meeting of the Association of Lunar and Planetary Observers in Las Cruces, NM [1]. A total of 86 photometric measurements of Uranus and 79 of Neptune were summarized there. An additional 30 photometric measurements of Uranus and 12 measurements of Neptune were subsequently made and are reported here, bringing the photometric total to 207. Furthermore, several photographs and CCD images of Uranus were made between August and October, 1993 and are also discussed. Finally, photometric measurements of the comparison stars used in 1991, 1992 and 1993 were made and are given here. Nine individuals contributed observations and measurements of the remote planets in 1993 and are listed in *Table 1* (below).

Table 1. Participating Observers: 1993 Apparitions of Uranus and Neptune .

Observer and Location	Type of Observation*	Type of Telescope†
Danny Bruton (College Stn., TX)	C, PP	36-cm SC
Paul Comba (Prescott, AZ)	P	28-cm SC
Walter Haas (Las Cruces, NM)	V	32-cm NEW
Richard Hill (Tucson, AZ	C, CCD, PP	13-cm SC 152-cm CASS
Gus Johnson (Swanton, MD	VP	20-cm SC
Mike Mattei (Littleton, MA)	VP	20X80 BI
Gary Nowak (Essex Jct., VT)	C, V, VP	25-cm TS 11X80 BI
John Sanford (Costa Mesa, CA)	CCD	36-cm SC
Richard Schmude, Jr (College Stn., TX)	C,P, PP, V, VP	36-cm SC, 7X35 BI 7X50 BI, 7X50 FI

* Type of Observation: C = color, CCD = CCD image, P = photograph, PP = photoelectric photometry, V = visual or drawing, VP = visual photometry.

† Type of Telescope: BI = binoculars, CASS = Cassegrain, FI = finder, NEW = Newtonian, SC = Schmidt-Cassegrain, TS = Tri-Schiefspiegler.

PHOTOMETRY OF URANUS AND NEPTUNE

The magnitudes of ν^2 Sgr and 50 Sgr used in the reduction of all our photometric measurements are given in Table 1 of Schmude [1]. The U magnitude of o Sgr was taken as +5.63.

Measured magnitudes of ν^2 Sgr, ν^1 Sgr, o Sgr and SAO 187634 are listed in *Table 2* (p. 64), the first of which was taken as the standard in these measurements, the purpose of which was to check the consistency of the star magnitudes in Iriartre *et al.* [2]. Preliminary results suggest small inconsistencies. The author plans to carry out further measurements on the stars in *Table 2* in the upcoming years and invites others to carry out similar measurements. Photometric measurements of Uranus and Neptune made since August, 1993 are summarized in *Tables 3* and *4* (pp. 65-66); the integration times are the same as in the earlier 1993 measurements [1]. The selected magnitudes for 1993 are summarized in *Table 5* (p. 66). One objective during the 1993 Apparition was to measure the solar phase coefficients of Uranus and Neptune [i.e., α, the magnitude change of the planet due to phase angle, assuming a linear relationship; Ed.]. Essentially, the $X(I,\alpha)$ values were plotted against α and the slope, equal to the solar phase coefficient, was determined. The same evaluation was done for Uranus during the 1992 Apparition [4]. The respective solar phase coefficients (in mag./degrees) for the

Table 2. Measured magnitudes of comparison stars used for photometry of Uranus and Neptune, 1991-1993.

(The number of measurements is given in brackets. v^2 Sgr is used as a standard)

Star	B	V	R	I
v^2 Sgr	+6.30	+4.98	+4.04	+3.38
v^1 Sgr	+6.23 [1]	+4.81 [2]	----------	----------
o Sgr	+4.74 [1]	+3.74 [1]	+2.99 [1]	+2.50 [1]
SAO 187634	+7.67 [2]	+7.12 [2]	----------	----------
50 Sgr	+6.75 [3]	+5.55 [4]	+4.65 [7]	+4.03 [7]
SAO 187992	----------	+5.61 [1]	----------	----------

B and V filters for Uranus are 0.007±0.004 and 0.0015±0.001; the values for Neptune are 0.007±0.004 and 0.005±0.003.

The solar phase angle B- and V-coefficients for Neptune and V-coefficient for Uranus are consistent with previous measurements [5-10]. However, the B-coefficient for Uranus (0.007+0.004 mag./degree) is larger than the literature values [5-9].

The solar phase angle coefficients in the Johnson R and I filters should be lower than the B- and V-coefficients because there are large methane absorption bands in the R and I filters and Lockwood and Thompson [10] have found that the solar phase coefficients of Uranus are much smaller in the two methane bands of 6190 and 7261 Å than at other wavelengths. Consequently, any corrections due to the solar phase angle are expected to be below 0.001 magnitudes for Uranus with the R and I filters.

Any variation in brightness of Neptune with respect to rotation is expected to be small in the B and V filters [11]. Lockwood *et al.* [11] concluded that any brightness variations of Neptune at λ = 5510 Å. in 1989 was less than 0.01 magnitudes. In the case where there is a significant rotational brightness (such as in the methane absorption bands) the rotational effects could be subtracted out in a similar way as was done for Mars by Schmude and Bruton [12].

VISUAL PHOTOMETRY

Four individuals estimated the magnitudes of Uranus and Neptune visually; the means are: Vvis(1,0) = 7.20±0.15 for Uranus and Vvis(1,0) = -6.7±0.2 for Neptune (the uncertainties are ±1 standard deviation). A total of 31 estimates were made for Uranus and 15 estimates for Neptune.

DRAWINGS AND PHOTOGRAPHS

Several individuals submitted photographs of Uranus. A photograph of Uranus and two of its satellites is shown in *Figure 1* (right). The author succeeded in taking a color photograph of Uranus on 1993 OCT 15 at 01h40m UT, using Ektar 1000 color print film at f/106; with a 10-second exposure. This photograph shows a north-south (celestial directions) asymmetry with the southern portion being whiter and brighter than the northern half.

Walter Haas, Gary Nowak and the author made drawings of Uranus between 1993 AUG 24-SEP 16. Walter Haas suspected a bright limb area on Uranus. A rotational period of 17.0±0.1 hours was determined for Uranus by assuming that the bright spots suspected by Haas are real; this rotational period also suggests that the brightening photographed on 1993 OCT 15 is the same area suspected by Haas 4-7 weeks earlier. It must be emphasized, however, that all of the disc irregularities reported by Haas were "suspected." We hope that CCD images of Uranus can be obtained in 1994.

One dark area on Uranus was imaged in the infrared by a team at Kitt Peak Observatory [13]. The author and Haas suspected a large dark feature on Uranus several times between May-September, 1993; in all cases however, the dark feature suspected visually was about three times larger than the feature imaged in the infrared. Finally, Gary Nowak suspected limb darkening on Uranus in late September.

CONCLUSION

An extensive photometric study of Uranus and Neptune was carried out in 1993, giving normalized V-filter magnitudes, V(1,0) for Uranus of -7.17±0.02 and for Neptune of -6.93±0.02, which are close to the values found in 1989, 1991 and 1992. The U-B, B-V, V-R and R-I values for Uranus are: +0.29, +0.60, -0.14 and -1.22 respectively. The corresponding B-V, V-R and R-I values of Neptune are: +0.44, -0.32 and -1.11. The solar phase angle coefficients for Uranus and Neptune were measured in 1993 and the results are consistent with the literature values to within experimental uncertainty. Drawings and photographs of Uranus reveal a possible bright limb area, which was used to determine a tentative rotational period of 17.0±0.1 hours.

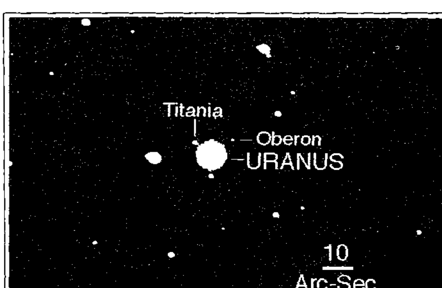


Figure 1. Photograph of Uranus by Paul Comba on 1993 AUG 18 at 04h54m UT, using an 11-inch (28-cm) Schmidt Cassegrain telescope and Kodak TMZ 3200 Film with a 5-minute exposure. Celestial north at top

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Table 3. Photometric measurements of Uranus made in late 1993.

UT Date	Filter	Comparison Star	Differential Air Mass	Measured Magnitude	Reduced Magnitude X(l,α)*	Solar Phase Angle (deg.)
1993 Sep						
02.128	B	50 Sgr	+0.029	+6.288	-6.571	2.3
02.130	V	50 Sgr	+0.028	+5.683	-7.176	2.3
02.133	R	50 Sgr	+0.028	+5.792	-7.062	2.3
02.135	I	50 Sgr	+0.028	+7.075	-5.78	2.3
02.158	B	50 Sgr	+0.018	+6.300	-6.559	2.3
02.156	V	50 Sgr	+0.018	+5.676	-7.183	2.3
02.160	R	50 Sgr	+0.020	+5.823	-7.021	2.3
02.162	I	50 Sgr	+0.020	+7.05	-5.80	2.3
17.086	U	o Sgr	+0.030	+6.60	-6.29	2.6
17.089	U	o Sgr	+0.018	+6.62	-6.27	2.6
17.098	U	o Sgr	+0.023	+6.58	-6.31	2.6
17.103	U	o Sgr	-0.003	+6.61	-6.28	2.6
17.114	U	o Sgr	+0.013	+6.55	-6.34	2.6
17.128	U	o Sgr	-0.038	+6.63	-6.26	2.6
17.138	U	o Sgr	-0.006	+6.63	-6.26	2.6
17.144	U	o Sgr	-0.068	+6.61	-6.28	2.6
17.156	U	o Sgr	-0.015	+6.64	-6.25	2.6
17.158	U	o Sgr	-0.103	+6.67	-6.22	2.6
Oct						
18.048	B	50 Sgr	+0.017	+6.356	-6.589	2.9
18.050	V	50 Sgr	+0.019	+5.775	-7.170	2.9
18.052	R	50 Sgr	+0.018	+5.894	-7.045	2.9
18.053	I	50 Sgr	+0.009	+7.18	-5.76	2.9
18.078	B	50 Sgr	-0.087	+6.398	-6.547	2.9
18.081	V	50 Sgr	-0.088	+5.798	-7.147	2.9
18.083	R	50 Sgr	-0.092	+5.907	-7.032	2.9
18.084	I	50 Sgr	-0.101	+7.19	-5.75	2.9
18.105	B	50 Sgr	-0.175	+6.370	-6.575	2.9
18.107	V	50 Sgr	-0.191	+5.762	-7.183	2.9
18.108	R	50 Sgr	-0.198	+5.895	-7.044	2.9
18.110	I	50 Sgr	-0.193	+7.18	-5.76	2.9

* Magnitudes have not been corrected for the solar phase angle coefficient; this correction is expected to be less than 0.01 magnitude for all filters.

Table 4. Photometric measurements of Neptune made in late 1993.

UT Date	Filter	Comparison Star	Differential Air Mass	Measured Magnitude	Reduced Magnitude X(l,α)*	Solar Phase Angle (deg.)
1993 Oct						
18.068	B	50 Sgr	+0.096	+8.293	-6.524	1.9
18.071	V	50 Sgr	+0.110	+7.873	-6.944	1.9
18.073	R	50 Sgr	+0.110	+8.175	-6.633	1.9
18.074	I	50 Sgr	+0.104	+9.33	-5.47	1.9
18.086	B	50 Sgr	-0.070	+8.368	-6.449	1.9
18.089	V	50 Sgr	-0.065	+7.899	-6.918	1.9
18.091	R	50 Sgr	-0.058	+8.179	-6.629	1.9
18.093	I	50 Sgr	-0.056	+9.20	-5.60	1.9
18.114	B	50 Sgr	-0.099	+8.320	-6.497	1.9
18.116	V	50 Sgr	-0.100	+8.165	-6.643	1.9
18.119	I	50 Sgr	-0.095	+9.41	-5.39	1.9

* Magnitudes have not been corrected for the solar phase angle coefficient; this correction is expected to be no more than 0.01 magnitude for all filters.

Table 5. Selected normalized magnitudes of Uranus and Neptune based on all 1993 measurements, corrected for the solar phase angle.

	Uranus		Neptune	
Quantity	X(1,0)	No. Meas.	X(1,0)	No. Meas.
U(1,0)	-6.28±0.03	10	-------------	--
B(1,0)	-6.57±0.02	34	-6.49±0.02	27
V(1,0)	-7.17±0.02	34	-6.93±0.02	29
R1,0)	-7.03±0.02	19	-6.61±0.03	18
I(1,0)	-5.81±0.03	19	-5.50±0.03	17
U-B	+0.29±0.04	--	-------------	--
B-V	+0.60±0.03	--	+0.44±0.03	--
V-R	-0.14±0.03	--	-0.32±0.03	--
R-I	-1.22±0.04	--	-1.11±0.04	--

A.L.P.O. Dues Payment Policy

The following dues payment policy was adopted by vote of the A.L.P.O. Board of Directors on September 14, 1996:

A.L.P.O. dues may be collected only by persons authorized to have access to the Membership Secretary's bank account. At the present time, these persons are: Walter H. Haas, A.L.P.O. Founder; Harry D. Jamieson, A.L.P.O. Membership Secretary/Director; John E. Westfall, A.L.P.O. Treasurer.

Unauthorized persons must adhere to the following policies when approached by someone wanting to pay their A.L.P.O. dues:

1. Give interested people the name and address of the Membership Secretary. Upon request, the Membership Secretary will provide a supply of stamped envelopes addressed to him which members may distribute to people interested in joining.

2. A.L.P.O. Members receiving dues money in the mail must remit this money to the Membership Secretary within 30 days, along with the payer's name and address.

3. Under no circumstances should any member solicit dues money from anyone, nor should he ever accept dues money in a situation where it is possible to refuse it.

The Board of Directors wishes to encourage our members to seek out new members, but the appropriate way to do this is to direct them to the Membership Secretary. Failure to adhere to the above policies could result in disciplinary action by the Board.

THE 1996-98 APHELIC APPARITION OF MARS: A PREVIEW

By: Daniel M. Troiani, Mars Coordinator; Daniel P. Joyce, Acting Assistant Mars Coordinator; and Jeff Beish, A.L.P.O. Mars Section

INTRODUCTION

Modern amateur astronomers can contribute much to our knowledge of long-term weather and surface conditions on Mars. With a set of color filters and a high-quality telescope at least 6 inches in aperture, the amateur can produce professional-level work in planetary research. Several cooperative international Mars observing programs are underway this year, to assist professional and amateur astronomers alike. These programs include the International Mars Patrol (I.M.P.), coordinated by the Association of Lunar and Planetary Observers (A.L.P.O.), the Terrestrial Planets Section of the British Astronomical Association (B.A.A.), the Mars Section of the Oriental Astronomical Association (O.A.A.); and the International MarsWatch project. High-quality amateur drawings, photographs, micrometer measurements, videos and CCD images are all welcomed by each of these organizations.

THE INTERNATIONAL MARS PATROL

The observing program of the A.L.P.O. Mars Section is a cooperative, international effort between individuals and members of observing groups around the world. Established in the late 1960s by Charles F. Capen, the I.M.P. has compiled more than 27,000 observations of Mars and the archives of the A.L.P.O. Mars Section record 14 successive apparitions covering 28 terrestrial years.

The I.M.P. contributes to professional activities by providing observers for the Lowell Observatory International Planetary Patrol, and by furnishing good photographs and CCD images of Mars to the United States Geological Survey, to assist them in creating maps of the Red Planet's albedo features. Since the late 1960s, amateur and professional astronomers located in 47 different countries and American territories have participated in 24-hour MarsWatch patrols. Additional support is also provided by the O.A.A., the B.A.A., the Arbeitskreis Planetenbeobachter (Germany), and the Groupement International d'Observateurs des Surfaces Planetaires (France). I.M.P. participants are located in Arabia, Argentina, Australia, Austria, Belgium, Bolivia, Brazil, Canada, Chile, China, Columbia, Czech Republic, Denmark, England, Faroe Islands, Finland, France, Germany, Greece, Hungary, India, Israel, Italy, Japan, Korea, Mexico, New Guinea, New Zealand, Norway, Okinawa, Oman, Philippines, Puerto Rico, Romania, Rwanda, Samoa, Scotland, Slovakia, Spain, South Africa, Sweden, Tahiti, Taiwan, the United States and Venezuela.

The Coordinators of the A.L.P.O. Mars Section instruct participants in the use of standardized methodology for reporting all types of observations, to insure that data are recorded in a uniform manner and thus can be used for analysis. The Mars Section receives thousands of individual observations each apparition, including disk drawings made with the aid of color filters, photographs, video and CCD images, intensity estimates of albedo features, micrometer measurements of polar caps and cloud boundaries, all secured during a 10- to 12-month observing period. In order to record such large quantities of information accurately and in chronological sequence, the A.L.P.O. Mars Coordinators have prepared an efficient, easy-to-use, standard Mars report form. This form, or a copy in its format, can be used to report all types of observations, including disk drawings, transit timings, micrometry, and so forth. Photographs or hard-copy computer images may also be attached to the top or back of the forms, and all relevant information can be filled in at the telescope. Planetary aspect blanks can be filled in at times other than while observing. In observing Mars, great emphasis must always be placed on quality and accuracy in recording data. In addition to the various types of observations mentioned above, photometry and intensity estimates of Martian features are also very useful. These can take the form of full-disk photometry, CCD- and video-image photometry; and visual intensity estimates using the standard A.L.P.O. scale, where: 10 = polar region brightness, 8 = mean brightness of desert regions, and 0 = the brightness of the background night sky.

THE MARS WATCH PROJECT

Although an extensive program of Mars exploration by spacecraft is planned for the coming decade, and should help answer many fundamental questions about the planet, specific areas will continue to require coverage with Earth-based telescopes. In particular, long-term coverage of planet-wide meteorological and albedo changes are required, information that cannot be obtained from orbiters and landers, but which will augment and support the spacecraft data. It is the goal of the international MarsWatch program to facilitate this through co-operative efforts between professional and amateur astronomers worldwide. Amateur contributions will be featured via the Internet on the MarsWatch home page and provide an opportunity for skilled observers to participate in a global program to monitor the Red Planet.

SOME FUNDAMENTALS ABOUT THE RED PLANET

The Martian solar day, or "sol," is about 40 minutes longer than a day on Earth, causing Mars to rotate through only 350° of longitude in 24 terrestrial hours. Consequently, an Earth-based astronomer observing a given Martian feature one night, will see the same feature displaced 10° further west, or closer to the planet's morning limb, the following night at the same local time.

Since their axes of rotation are tilted at about the same angle with respect to their orbital planes, 25°.0 and 23°.4 respectively, Mars and Earth have comparable seasons. In describing Martian seasons, the term "Ls" is used, which stands for areocentric longitude of the Sun along the planet's ecliptic [Ls equals 000° at Mars' Northern-Hemisphere Winter Solstice; 090°at the Northern Spring Equinox, 180° at Northern Summer Solstice, and 270° at Northern Autumn Equinox. "Areo" is the prefix employed when referring to "Ares," the Greek name for the Roman god "Mars." *Ed.*]. Because Mars is further from the Sun than Earth, its year lasts about 687 Earth days, nearly twice as long as ours, with correspondingly longer seasons. Moreover, due to the greater orbital eccentricity of Mars, its seasons can differ in length by as much as 52 days, in contrast to the Earth's nearly equal-length seasons.

The axis of Mars does not point toward our North Star, but is displaced about 40° towards Deneb (α Cygni). Because of this, the Martian seasons are 85° out of phase with terrestrial seasons, or about one season in advance of ours. Consequently, when you observe Mars this Northern-Hemisphere autumn, you will be seeing winter in Mars' Northern Hemisphere, or summer in its southern.

CHARACTERISTICS OF THE 1996-98 APPARITION

Mars has a mean 15.8-year seasonal opposition cycle, which includes a series of 3 or 4 aphelic, and 3 consecutive perihelic oppositions. The Earth and Mars have their closest approaches during perihelic oppositions. However, the 1996-98 Apparition is considered aphelic, because opposition occurs only 22° after aphelion (070° Ls). Mars will be closest to Earth at 16h54m UT on 20 MAR 1997 (092°.9 Ls) and will reach opposition at 07h48m UT on 17 MAR 1997 (091°.6 Ls), with an apparent diameter of 14.2 arc-seconds. [Note that the term "apparition" refers to the time span from conjunction to conjunction; in the case of this apparition, in theory from 1996 MAR 04 - 1998 MAY 12. The actual "observing window," during which the planet can be studied, is of course a shorter period. The term "opposition" refers to the date the planet is opposite the Sun in our sky, which is always near the time of closest approach. *Ed.*]

Mars will be relatively favorably placed in the sky for observers in both hemispheres, being slightly north of the celestial equator for most of the 1996-98 apparition, and will be at declination 5° north at opposition. It began to rise above the horizon about one hour before the Sun early in June 1996, at which time its apparent diameter was less than 4 arc-seconds, too small to be usefully observed.

Useful telescopic observing can begin when the apparent diameter of Mars exceeds 6 arc-seconds, although telescopes with apertures over 12 inches can extend this to about 4 arc-seconds under good seeing conditions. However, since Mars is at the extremes of the apparition and low in the sky when its diameter is this small, excessive turbulence (seeing) in our atmosphere is usually then a problem as well. This makes visual detection of all but the major surface features then very difficult. Despite these problems, A.L.P.O. members should make observations even at such times. A red filter, such as the Wratten 25 or equivalent, can lessen the effects of poor seeing and improve image contrast. Even under poor conditions, any sudden changes in the contrast or intensity of major Martian features, such as Syrtis Major, could indicate the development of a dust storm or other obscuration on the planet to an observer familiar with them.

During most of the 1996-98 Apparition, the North Pole of Mars will be tilted earthward, a time corresponding to late spring and summer in that hemisphere. This will provide a good opportunity to study the regression of the North Polar Cap (NPC) and to follow the arctic meteorology (and, to a lesser extent, antarctic meteorology) of Mars. This apparition will also permit careful scrutiny of the NPC remnant during Martian summer, since the planet's apparent diameter will exceed 14 arc-seconds during its Northern Autumn Equinox. In many ways the viewing geometry for this apparition resembles that of 1981-1982.

Observers should always pay close attention to the polar regions of Mars for possible formation of rift-like features and other developments. During the last apparition, a rift called Rima Tenuis was observed in the NPC, a feature that does not always appear on a regular basis. There are many questions regarding this and other transient aspects of Mars, aspects that may be related to the planet's meteorology and long-term surface changes. For example, when and under what conditions do Rima Tenuis and other NPC rifts become visible? When does the north polar hood or haze (NPH) disappear to reveal the underlying NPC? Are there any signs of a hood or haze over the south polar region (SPH)? Is there any evidence of "W-cloud" formation over the Tharsis volcanoes? Wili there be seasonal developments of discrete clouds and equatorial-type clouds this apparition?

To help answer questions like these and to keep professional astronomers updated on current conditions on Mars, we need the assistance of serious amateur observers. With the coming NASA PathFinder missions to Mars, there is much need for high-quality earth-based observations to support and complement the spacecraft findings. This was quite evident during the August,1995 Mars Telescopic Observations (MTO) Workshop at Cornell University, sponsored by the Lunar and Planetary Institute, where professional astronomers were most impressed with the high quality work of amateur observers. There is much cooperative work for the serious amateur to do in support of professional efforts. So go out and enjoy Mars and help support scientific research directly!

VISUAL OBSERVATIONS OF MARS

The ancient art of visual observation at the telescope is still a most useful tool in modern astronomy, and is certainly the forte of the amateur. Even at its best, however, Mars is a challenging object to observe. Its disk appears small even in large telescopes and its surface markings are usually blurred by our atmosphere. A telescope for planetary work should provide sharp images with the highest possible contrast. A long-focal length, highly color-corrected refractor is usually considered best, followed by long-focal length Newtonian and Cassegrain reflectors. Telescopes with relatively large central obstructions tend to do less well. Information about other types of optical systems is available through the A.L.P.O. Equipment Section. Also, a good mounting is essential.

Anyone observing Mars will find it rewarding to make a sketch of whatever is seen, both to create a permanent record and to help train the eye in detecting elusive detail. Start with a circle 42 mm (1.6 in) in diameter, which corresponds to a scale of roughly 1 mm: 100 miles on Mars. Draw the phase defect, if any, and the bright polar caps or cloud hoods next, which will help orient Martian north-south directions. Next, shade in the largest dark markings, being careful to place them as precisely as possible on the disk. At this point, record the Universal Time (UT) to the nearest minute. Now, add finer details while viewing through various color filters. Last, note the UT date; the observer's name; instrument type, aperture, and magnification and filters used; seeing (on the A.L.P.O. Scale ranging from 0 for worst to 10 for perfect) and transparency (limiting naked-eye magnitude in the vicinity of Mars) and any other relevant information.

In addition to the polar markings discussed above, some of the main types of Martian features visible in a good telescope include the following:

Albedo Features.—These include both the relatively dark albedo features and their surrounding lighter areas. Once thought to represent lakes, oceans or even vegetation, the dark features, historically often termed "maria" or "seas," are surrounded by the lighter areas, frequently described as "deserts." Space probes in the 1970s finally revealed the true nature of these markings as vast expanses of rocks, solidified lava flows, and sand, with differing colors and reflectivity. Windstorms sometimes move the dust, resulting in both seasonal and longer-term changes in the boundaries and contrast of the features.

Among the areas where yearly variations have been observed are Trivium-Elysium, Solis Lacus, Syrtis Major, and Sabaeus Meridiani. Syrtis Major is the most prominent dark feature on Mars. Its eastern side becomes streaked and shrinks during Martian spring, and then widens again in the autumn. This area should be monitored closely this apparition to see if it narrows again on schedule. Similarly, Solis Lacus, the "Eye of Mars," should be watched closely, since it is notorious for undergoing major changes in appearance. Other areas of interest include the Aetheria desert at longitude/latitude 240°/ 25°N, between Nubis Lacus and Elysium. In 1977 amateur observers discovered a new dark feature in this region, a feature subsequently found on Viking Orbiter photographs taken earlier in 1976, and that had apparently been missed by the NASA scientists. This is an excellent example of how ground-based observations of a planet continue to make important contributions to science.

Clouds and Haze.—The Martian atmosphere is ever-changing. Discrete water clouds, dust clouds, limb haze and bright surface frost have been studied with increasing interest during the past two decades. The A.L.P.O. is currently undertaking an intensive study of Martian weather patterns, using visual and photographic data from both amateur and professional observers. Analysis so far indicates that cloud activity appears related to the seasonal evaporation and condensation of polar-cap material. In addition, blue and white cloud activity and the formation of near-surface fogs, are greater in the Northern Spring and Summer on Mars than during the same seasons in its Southern Hemisphere.

Discrete Clouds.—These features are also called "localized clouds," and have been observed on Mars for over a century. In 1954, a remarkable W-shaped cloud formation was observed to form over the Tharsis-Amazonis region each afternoon during late spring. A decade later, C.F. Capen proposed that this cloud formation was orographic (mountain-generated), and was caused by wind passing over high peaks. In 1971, the Mariner 9 spacecraft confirmed that these were indeed water clouds, near the large volcanoes Olympus Mons (133°/18°N), Ascraeus Mons (104°/ 11°N), Pavonis Mons (112°/0°N), and Arsia Mons (120°/9°S). The "W-cloud" should be active from March though August, 1997 (090°-170°Ls). Although often seen without filters, clouds like these are best observed with the aid of blue or violet filters, when they are at relatively high altitudes, and with yellow or green filters when at lower elevations.

Limb Brightening.—This phenomenon is caused by scattered light from dust and dry ice particles high in the Martian atmosphere. It should be present on whichever limb is sunlit, often throughout the apparition, and is best observed in blue-green, blue or violet light.

Morning Clouds.—These are bright, isolated patches of surface fog or frosty ground, near the morning (Martian west) limb of the planet. Fog will usually dissipate by mid-morning, but frosts may persist most of the Martian day, depending on the season. These bright features are also best viewed with blue-green, blue or violet filters, although occasionally very low morning clouds can seen in green or yellow light.

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

Dust Storms.—These very dramatic events, which occur each Martian year, usually begin near Summer Solstice in the Southern Hemisphere of Mars. During this apparition, the dust-storm season should have started in July-September, 1996. Watch for small clouds that appear bright in red light, and arise overnight in the Serpentis-Noachis, Solis Lacus and Chryse regions; areas where dust-storms have frequently formed before. They can evolve rapidly into global obscurations that persist for months. When such a storm reaches maturity, the disk of Mars can appear a nearly uniform, orange color. The identification of sites where dust storms originate is clearly important for future exploratory missions to Mars and amateur observations can be most useful in this regard.

CALENDAR OF EVENTS FOR MARS IN 1996-98

By the time that you receive this article, Mars will be well up in the predawn sky, approaching 6 arc-seconds in apparent diameter, when amateur telescopes will start to reveal useful detail. The calendar of events in *Table 1* (below) gives a general indication of what to watch for on Mars in this ongoing apparition. We invite you to participate in the Mars Section's programs; in order to do so, you should contact the appropriate Mars Coordinator, as listed on p. 95 of this issue.

Table 1. Calendar of Events During the 1996-98 Mars Apparition.

UT Date	Ls	Data* and Possible Events
1996 MAR 04		(CONJUNCTION WITH THE SUN; APPARITION OFFICIALLY BEGINS)
NOV 18	039°	Dia. = 6".0, Dec. = +10°, De = +24°, El. = 076°W. Apparition begins for observers using telescopes of aperture 4 inches and larger.
1997 JAN 01	059°	Dia. = 8".1, Dec. = +3°, De = +24°, El. = 101°W. High-quality micrometer measurements of NPC possible; clear views of surface details; Rima Tenuis may appear in NPC.
JAN 25	069°	Dia. = 10".0, Dec. = +1°, De = +23°, El. = 120°W. Northern-Hemisphere Spring. Continue NPC measurements; is NPC fairly static or entering a rapid-retreat phase? South Polar Region difficult to observe; any sign of SPH? Some photography now possible. Begin high-resolution CCD imaging.
JAN 27	070°	Dia. = 10".1, Dec. = +1°, De = +23°, El. = 122°W. Mars at aphelion. Northern-Hemisphere mid-spring. Is NPC beginning rapid retreat? Are bright limb arcs increasing in frequency and intensity? Use filters! Are there Antarctic hazes or Hood? Cloud activity increases. Watch for "aphelic chill" in NPR.
FEB 15	078°	Dia. = 12".0, Dec. = +1°, De = +22°, El. = 141°W. Begin high-resolution visual observations and high-quality photography.
MAR 14	090°	Dia. = 14".1, Dec. = +4°, De = +23°, El. = 174°W. Northern Summer/Southern Winter Solstice. Orographic clouds over the Tharsis volcanoes; is "W-cloud" present? Use blue or violet filter to look for orographic clouds.
MAR 17	092°	Dia. = 14".2, Dec. = +5°, De = +23°, El. = 176°. Opposition to the Sun at 07h48m UT.
MAR 20	093°	Dia. = 14".2, Dec. = +5°, De = +23°, El. = 174°E. Closest approach to Earth at 16h54m UT (98,640,000 km).
APR 26	109°	Dia. = 12".0, Dec. = +7°, De = +24°, El. = 131°E.
MAY 19	120°	Dia. = 10".0, Dec. = +5°, De = +25°, El. = 111°E.
JUN 20	135°	Dia. = 8".0, Dec. = +0°, De = +26°, El. = 092°E.
AUG 15	164°	Dia. = 6".0, Dec. = -12°, De = +22°, El. = 068°E.1998
MAY 12		(CONJUNCTION WITH THE SUN; APPARITION OFFICIALLY ENDS. THE SUN OCCULTS MARS!)

* Dia. = angular diameter in arc-seconds; Dec. = geocentric declination of Mars; De = areocentric declination of the Earth; El. = geocentric angle between Mars and the Sun.

THE APPARITION OF COMET OKAZAKI-LEVY-RUDENKO (1989r = 1989 XIX)

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

ABSTRACT

This report summarizes observations by A.L.P.O. observers of the 1989 Apparition of Comet Okazaki-Levy-Rudenko, including 282 observations that were used to determine the comet's light curve. This long-period comet was discovered in August, 1989 and observed through the end of that year.

DISCOVERY

Comet Okazaki-Levy-Rudenko was discovered by Kiyomi Okazaki on film he exposed through a 10-in (25-cm) Schmidt telescope on 1989 AUG 24.502 [1]. This was his first named comet discover; although he had also visually discovered Comet 1975X in October 1975, he was the fourth person to find it and did not get his name on it.

David Levy of Arizona found this comet independently the next night, using his 16-in (41-cm) reflector, 350 search hours and 17 months since his last previous find. Finally, Michael Rudenko of Massachusetts discovered this object on August 26, using a 6-in (15-cm) refractor at 30×, equipped with a light-pollution filter. For Levy this was his fifth named comet, and the third for Rudenko.

The American discoveries were announced first, so initially the comet was known as Comet Levy-Rudenko [2]. Two days later Okazaki's report reached the Smithsonian Astrophysical Observatory, so his name was added to that of the comet [3].

Okazaki reported the photographic magnitude of the comet as +13 [4]. However, photographic magnitude estimates are often fainter than visual ones, and Levy's visual estimate of +10.6 appears closer to the mark. Estimates of the coma diameter ranged from 2 to 5 arc-minutes. When Okazaki photographed it, Comet 1989r was at 15h 28.7m, +34° 22' (1950 coordinates) [5], moving west-southwest at 0°.4/day. It was then near the border of the constellations Boötes and Corona Borealis in the evening sky, 75° from the Sun.

ORBIT

The following orbital elements were calculated by Daniel Green of the Central Bureau for Astronomical Telegrams and published in IAU Circular 4918 and MPC 15520 (1950.0 coordinates) [6]:

Time of perihelion:	1989 Nov 11.91653
Distance of Perihelion:	0.6423668 AU*
Argument of Perihelion:	150°.57406
Ascending Node:	274°.81232
Inclination:	090°.15044
Eccentricity:	1.0002973

* AU = mean Earth-Sun distance; 149,597,870 km.

SKY POSITION OF COMET OKAZAKI-LEVY-RUDENKO

With an orbit almost exactly perpendicular to the Earth's, the comet showed great changes in declination. Discovered at a declination of +34°, the comet moved slowly southwestward, reaching +25° by Nov. 1. It then picked up speed reaching the Equator by Nov. 21 and -85° by Christmas. Elongation, or the distance from the sun as seen from the Earth, always remained greater than 39°, while the comet switched from the evening to the morning sky in late October. On Nov. 24 it was less than a degree away from the crescent moon.

These conditions permitted uninterrupted observation by A.L.P.O. comet watchers. Knowing this in advance, I published an announcement of the new comet which appeared in the October, 1989 issue of the *J.A.L.P.O.* The result was that this was one of our most observed comets. I received reports from both north and south of the Equator.

The comet was closest to the Earth on Nov. 30 at 0.515 AU, not quite three weeks after perihelion. Distance from the comet to the Earth and the Sun varied greatly, as shown in *Table 1* (below).

Table 1. Distances of Comet Okazaki-Levy-Rudenko from Earth and the Sun near Perihelion Date.

UT Date	Distance in AU: Earth	Sun	Solar Elong.
1989			
AUG 27	1.57	1.59	073°
SEP 06	1.57	1.44	064
16	1.55	1.29	056
26	1.51	1.14	048
OCT 06	1.43	0.99	044
16	1.31	0.85	041
26	1.15	0.74	039
NOV 05	0.94	0.66	040
15	0.72	0.65	041
25	0.55	0.70	044
DEC 05	0.53	0.81	055
15	0.67	0.94	066
25	0.88	1.08	071
1990			
JAN 04	1.11	1.23	072
14	1.34	1.39	072

Table 2. Participating A.L.P.O. Observers: Comet Okazaki-Levy-Rudenko.

Observer	Observing Site	Instrument(s)
Aguiar, Jose de	Campinas, BRAZIL	20X50 binoculars
Camilleri, Paul	Victoria, AUSTRALIA	20X80 binoculars, 20-cm reflector
Chen, Dong hua	Gulomgyu, Xiamen, CHINA	20X80 binoculars, 7X50 binoculars
Clark, Michael	Armadale, W. AUSTRALIA	25-cm reflector, 3-cm refractor
Garradd, Gordon	Tamworth, NSW, AUSTRALIA	10X50 binoculars, 20-cm reflector
Jahn, Jost	Rodenteich, WEST GERMANY	20-cm reflector, 5-cm refractor
Kronk, Gary	Troy, IL, USA	33-cm reflector, 20X80 binoculars
Modic, Robert	Richmond Heights, OH, USA	20-cm reflector
Nowak, Gary	Essex Jct., VT, USA	20-cm reflector
Pearce, Andrew	Scarborough. W. AUSTRALIA	20-cm reflector, 20X80 binoculars
Pearce, Don	Bellaire, TX, USA	45-cm reflector
Pryal, Jim	Kirkland, WA, USA	20-cm Schmidt-Cass., 20X80 binoculars
Rhea, Kermit	Paragould, AR, USA	10-cm refractor, 7X50 binoculars
Robinson, Paul	Morgantown, WV, USA	10X50 binoculars
Sabia, John	Clarks Summit, PA, USA	24-cm refractor
Seargent, David	The Entrance, NSW, AUSTRALIA	15-cm reflector, 15X80binoculars
Simmons, Karl	Callahan, FL, USA	14Xl00 binoculars, 7X50 binoculars
Simmons, Wanda	Callahan, FL, USA	14Xl00 binoculars
Tao, Yiang Hong	Tianjin, P.R. CHINA	8-cm refractor
Viens, Jean	Charlesbourg, Quebec, CANADA	10X50 binoculars
Williams, Peter	Heathcote, NSW, AUSTRALIA	25-cm reflector, 11-cm reflector

Some 21 A.L.P.O. observers from six countries contributed observations for this report, and are listed in *Table 2* (above).

MAGNITUDE

Comet Okazaki-Levy-Rudenko was widely observed; 282 apparent visual magnitude estimates from around the world were sent to the A.L.P.O. archives. These were corrected for aperture and sent to A.L.P.O. comet observer and author Gary Kronk. He generated *Figures 1-5* and offers his comments on the behavior of the comet.

The apparent magnitude estimates are plotted in *Figure 1* (below), covering the period 1989 AUG 27 through 1990 JAN 05.

Next, to correct for the comet's varying distance from the Sun and Earth, we calculate the *absolute magnitude*. This expresses the brightness of the comet at a standard distance of 1.0 AU from both the Earth and the Sun. Since a comet is almost never at such a distance, we use this formula to calculate it:

$$m = Ho + 5 \log D + 2.5 N \log R, \text{ where}$$

m = apparent magnitude
Ho = absolute magnitude
D = Comet-Earth distance in AU
R = Comet-Sun distance in AU
N = A constant representing how the rate of brightness changes as the comet-Sun distance changes. A high number indicates much change; the average for all comets is 3.3.

Figure 2 (p. 73) shows the comet's absolute magnitude, which Kronk calculates to average +7.58, with an N-value of 2.2. Such a small value for N suggests that the comet did not brighten much as it neared the Sun, nor dim much as it receded.

A close look at *Figures 1* and *2* shows that the comet behaved differently after perihelion (1989 NOV 11) than it did before. *Figure 3* (p. 73) shows the pre-perihelion portion of the light curve in detail. The absolute magnitude was then brighter, at +7.14 with N = 2.5. Likewise, *Figure 4* (p. 73) shows the post-

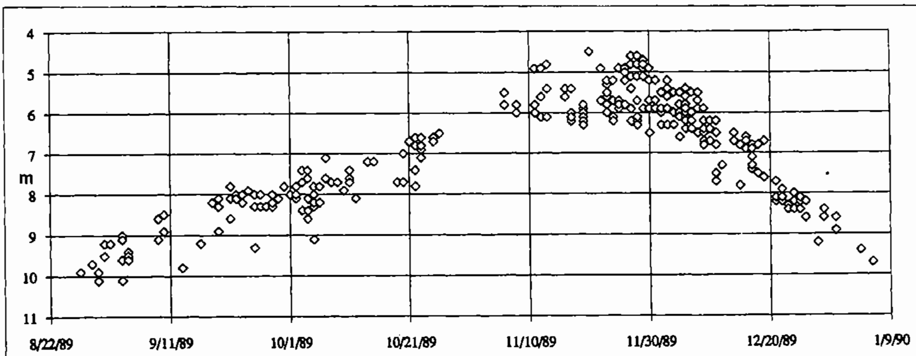

Figure 1. Estimates of the Apparent Visual Magnitude (m) of Comet Okazaki-Levy-Rudenko, Corrected for Aperture.

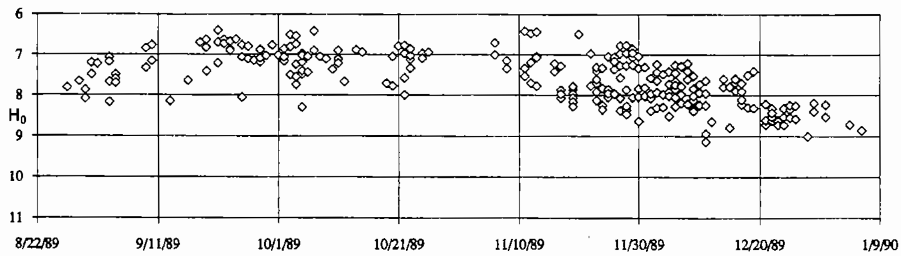

Figure 2. Absolute Visual Magnitude (Ho) of Comet Okazaki-Levy-Rudenko, Entire Observing Period.

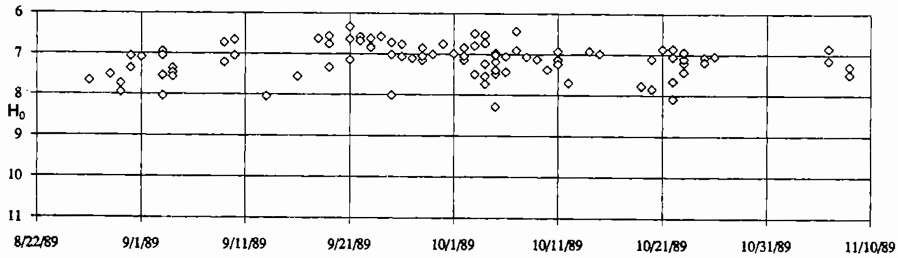

Figure 3. Absolute Visual Magnitude (Ho) of Comet Okazaki-Levy-Rudenko, Pre-Perihelion Period.

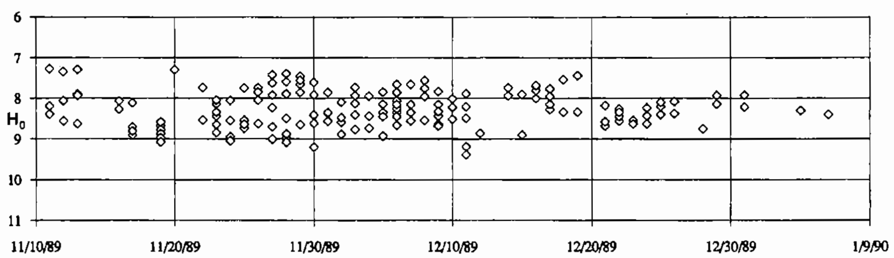

Figure 4. Absolute Visual Magnitude (Ho) of Comet Okazaki-Levy-Rudenko, Post-Perihelion Period.

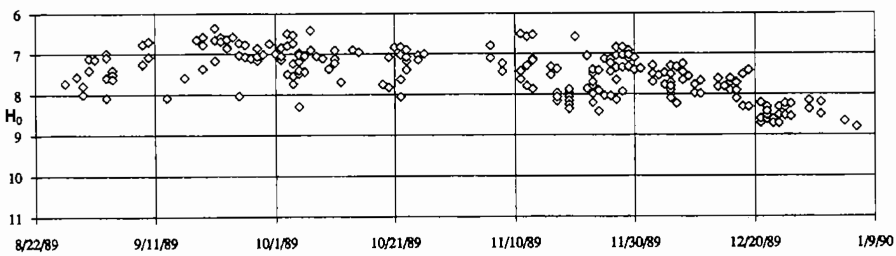

Figure 5. Absolute Visual Magnitude (Ho) of Comet Okazaki-Levy-Rudenko, Entire Observing Period, Observations Near Perigee Deleted.

perihelion behavior, the absolute magnitude then averaging +8.22, with N = 4.0. Therefore, not only was the comet fainter after perihelion, but it dimmed more rapidly after perihelion than it brightened before perihelion.

Gary Kronk believes an interesting observing effect influenced the values of the magnitude coefficients Ho and N; the wide variance of magnitude estimates in the period of late November-early December, 1989 when the comet was closest to the Earth, largest in size, and its magnitude most difficult to estimate. When he eliminated nearly 50 observations made during that period, giving the distribution of absolute magnitudes shown in *Figure 5* (above), the absolute magnitude for the entire remainder of the period brightened to +7.47 with N = 2.4.

Finally, the comet was not observed after 1990 JAN 05, even though attempts were made for three more weeks. It appears that the comet faded very rapidly during January, a trend that Kronk suggests had began around 1989 DEC 20.

SIZE AND APPEARANCE OF THE COMA AND TAIL

The apparent size of the coma, or head of the comet, as estimated by observers, can vary depending upon sky conditions and the observer's eyes and instrument. From knowing its distance from the Earth, the actual size of the coma can be determined. The coma size estimates varied from 240,000 km near the time of discovery to nearly double that at the beginning of December.

Most observers did not report a tail until the last week of November, and such reports lasted for only about three weeks. The maximum length, reported by several observers, was one degree, translating to about 1.6 million km (1.02 million miles) in length.

As for appearance, the comet appeared diffuse upon discovery. It condensed as it neared perihelion, and retained a condensed appearance for the remaining observations. A photograph by Jim Pryal on 1989 OCT 03 is shown in *Figure 6* (to right).

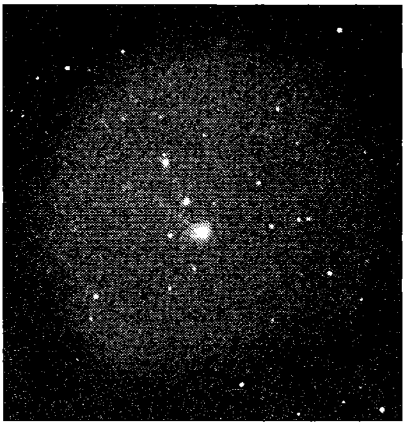

Figure 6. Photograph of Comet Okazaki-Levy-Rudenko (1989r) by Jim Pryal. Taken on 1989 OCT 03.165 (03h54m30s-03h59m) UT, with an 8-in (20-cm) f/5 Schmidt telescope, using Konica 3200 Print Film for a 4.5-minute exposure. The illuminated circle is about 0°.7 in diameter and celestial north is at the top. The relatively bright star immediately above and to the left of the comet is SAO 64262, at visual magnitude +7.5; Mr. Pryal estimated the limiting visual magnitude through the telescope as +12.9 magnitude or fainter. Note the comet's tail extending to the northeast (upper left) of the coma.

SELECTED COMMENTS BY OBSERVERS

- Naked-eye visibility was reported as early as 1989 NOV 25 (Jost Jahn) and lasted until 1989 DEC 05 (Michael Clark).
- Many observers, especially Jahn, mentioned that the coma appeared elliptical, rather than circular.
- On 1989 NOV 29, David Seargent reported an elongated coma that was perpendicular to the tail. The next morning's observation suggested that this aspect could be due to a dust feature north of the ion tail. Two days later, further observation indicated that the ion tail had faded and the elongated appearance of the coma was probably caused by a broad dust feature.
- Jost Jahn and Paul Camilleri reported both a gas and a dust tail. Occasionally Jahn saw a third, short tail.
- Camilleri reported the dust tail to be "slightly curved" on 1989 DEC 02.
- Gordon Garradd photographed a 4° tail on 1989 NOV 27.
- Gary Nowak wrote that the comet had a "slightly blue color" on 1989 SEP 04.
- Only one observer mentioned the 1989 NOV 24 conjunction of the Moon and the comet 1° apart. That observer commented that "glare from moon spoiled view."

FOOTNOTES

1) Central Bureau for Astronomical Telegrams, *International Astronomical Union Circular No. 4841*, issued August 28, 1989 by Daniel W.E. Green.

2) *IAU Circular 4840*, issued August 26, 1989 by Brian G. Marsden.

3) *Ibid.* 4) *Ibid.* 5) *Ibid.*

6) *IAU Circular 4918*, issued December 6, 1989 by Daniel W. E. Green.

TWO NEW A.L.P.O. MONOGRAPHS: 1995 PROCEEDINGS AND MARS

Two new A.L.P.O. monographs are now available; to order, see pages 95-96.

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.

A.L.P.O. SOLAR SECTION OBSERVATIONS FOR ROTATIONS 1862-1872 (1992 OCT 31 TO 1993 AUG 27)

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

ABSTRACT

This report summarizes A.L.P.O. observations for Rotations 1862-1872 in terms of the morphology and development of sunspot groups. Eleven observers from four countries contributed visual drawings and photographs in integrated and Hydrogen-α light.

INTRODUCTION

The mean International Sunspot Number, **RI**, for the eleven-rotation period was 67.0, with a high mean of 91.0 for Rotation 1862 and a low mean of 42.3 for Rotation 1872. The mean American Sunspot Number, **RA**, for the period was 66.8 with a high mean of 88.4 for Rotation 1862 and a low mean of 42.1 for Rotation 1872. The highest daily **RI** was 134 on 1993 FEB 08, and the highest daily **RA** was 128 on 1992 DEC 13. *Figure 1* (below) graphs the rotational mean Sunspot Numbers and the number of Active Regions for this period.

Activity recovered from a brief post-maximum slump during Rotation 1861 and thereafter continued its prevailing decline during the reporting period. Superimposed on the smooth decline of the 11-year cycle was a minor cycle lasting between 2 to 4 rotations. Minor peaks in the sunspot numbers occurred during Rotations 1858 (during the previous reporting period), 1862, 1866, 1869, and 1871.

The times used in this report are all Universal Time (UT). Cardinal directions are abbreviated (e.g., N, SW) and are heliographic as are angular dimensions. "Preceding" (p) means celestial west and "Following" (f) celestial east. "Groups" are white-light collections of sunspots. "Regions" are entire magnetically associated areas around sunspots in all wavelengths. Active regions are enumerated in this report with the prefix AR, and are designated as such by the Space Environment Services Center (SESC) of NOAA in Boulder, Colorado. AR positions are given in the form (latitude, longitude). Sunspot classifications follow the *Solar Classification Key* on p. 80.

Table 1 (p. 76) lists the observers who submitted data for this reporting period. The

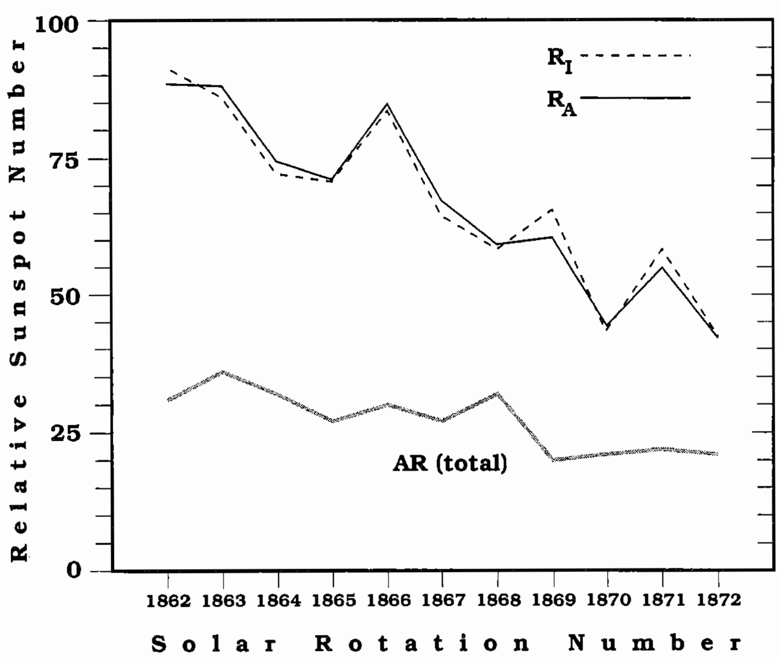

Figure 1. Graph of rotational means of RI (Relative International Sunspot Number), RA (Relative American Sunspot Number), and total number of Active Regions (AR), for Rotations 1862-1872.

Table 1. Observers Contributing to the A.L.P.O. Solar Section Report, Rotations 1862-1872 (1992 OCT 31 - 1993 AUG 27).

Observer	Telescope Aper. cm	Stop	f/	Type	Location
Birket, B.	25.4	-	6	New.	Arizona, USA
Garcia, G.	13	6.3	8	Refr.	Illinois, USA
Jausseus, J.	6	-	12	Refr.	Belgium
Mathew, D.	6	-	15	Refr.	N. Dakota, USA
Maxson, P.	25.4	15	10	New.	Arizona, USA
Melillo, F.	20.3	6.3	11	S.-C.	New York, USA
Radhakrishnan, R.	12	-	8.4	Refr.	Illinois, USA
Rousom, J.	10.2	-	15	Refr.	Ontario, Canada
Tao, Fan-Lin	25.4	-	15	Refr.	Rep. of China
Tatum, R.	18	-	15	Refr.	Virginia, USA
Timerson, B.	8.9	6.3	17	Mak.	New York, USA

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

terms and abbreviations used in this report are explained in the book, *The New Observe and Understand The Sun*, which is available for $US 5.75 from: Astronomical League Sales, P.O. Box 572, West Burlington, IA 52655).

ROTATION 1862 (1992 OCT 31.09 to NOV 27.40; 31 Active Regions)

Quantity	Mean	Maximum (Dates)	Minimum (Dates)
RI	91.0	125 (Nov 25)	62 (Nov 13)
RA	88.4	114 (Nov 26)	65 (Nov 03)

Tao recorded on whole-disk drawings the passage of two Class-E, βγ groups in the S Hemisphere. Of these, **AR 7330** (S08°, 265°) had prominent p- and f-spots, the p-spot being the largest. Several small spots, lacking penumbra, were subsequently observed between the primary spots near its CM (central-meridian) passage on 1992 NOV 02. The other, **AR 7335** (S17°, 206°) had a similar appearance, except that the f-spot was larger than the p-spot. The larger f-penumbra included several smaller umbrae between the p- and f-spots on NOV 10. Following its CM passage on 1992 NOV 12, a Maxson photograph showed only the p- and f-spots.

S-Hemisphere activity continued with a complex of three regions. The dominant region, **AR 7346** (S07°, 052°), had three well-separated medium-size spots. This Class-F group was 19° long and had prominent f-spots separated by 10° in latitude. S of AR 7346 was **AR 7345** (S23°, 062°), a Class-E, β group with four medium- to small-size umbrae. This region decayed rapidly after its CM passage. Finally, **AR 7347** (S06°, 071°) formed preceding AR 7346 on the CM and grew to Class D before foreshortening began to affect its appearance. All three regions had "open" structures. Tao made whole-disk drawings of these three groups from 1992 NOV 21 to 25, while Maxson photographed it from NOV 21 to 26.

Meanwhile, N-Hemisphere activity increased on 1992 NOV 22 with the appearance of two regions on the NE limb. Since they both transited the CM on NOV 28, they will be discussed under the next rotation.

ROTATION 1863 (1992 NOV 27.40 to DEC 24.72; 36 Active Regions)

Quantity	Mean	Maximum (Dates)	Minimum (Date)
RI	86.0	116 (NOV 27, DEC 11)	34 (DEC 07)
RA	88.1	128 (DEC 13)	31 (DEC 07)

One of the regions from the previous rotation, **AR 7348** (N12°, 342°) was classed DKO, βγ, with a large p-spot. Tao drew four umbrae divided by light bridges on 1992 NOV 25, and three umbrae on 1992 NOV 30. To this region's N was **AR 7352** (N20°, 340°). Only a few small umbrae were observed in it until 1992 NOV 27, when the p- and f-spots became prominent. By 1992 NOV 29, Garcia and Maxson photographed a stream of six umbrae within AR 7352.

Following the disappearance of AR 7348 and AR 7352 the solar disk was inactive and on 1992 DEC 06 only one region was reported. This inactivity was brief, however, ending with the appearance of **AR 7362** (S05°, 177°) in the SE quadrant on 1992 DEC 08. It developed into the classic bipolar configuration with a larger, regular p-spot with smaller, irregular f-spots. AR 7362 was Class EKI when it transited the CM, maintaining its complexity until it passed over the W limb. Traveling in tandem with AR 7362 was **AR 7360** (S17°, 164°), another bipolar group that had an open configuration. Its f-spots were few and small.

ROTATION 1864 (1992 DEC 24.72 to 1993 JAN 21.06; 32 Active Regions)

Quantity	Mean	Maximum (Dates)	Minimum (Dates)
RI	72.0	100 (JAN 10)	38 (JAN 03)
RA	74.1	105 (JAN 12)	50 (JAN 02, 03)

For this rotation, no regions developed into Class F, although 10 regions did become Class D. The p-spots of **AR 7362** and **AR 7360** survived to transit the solar disk once more. **AR 7386** (S05°, 184°) was the remnant of AR 7362 and was Class CKO. **AR 7387** (S22°, 181°), the remnant of AR 7360, was Class DAO. Both regions were drawn by Tao.

ROTATION 1865 (1993 JAN 21.06 to FEB 17.40; 27 Active Regions)

Quantity	Mean	Maximum (Date)	Minimum (Date)
RI	70.7	134 (FEB 08)	22 (FEB 01)
RA	71.0	127 (FEB 08)	25 (FEB 01)

The first half of this rotation was relatively quiet; but, by 1993 JAN 31, two bright clouds appeared over the W limb in the lower corona and were imaged by the new Yohkoh soft X-ray satellite. The clouds were much brighter the next day. The sunspot groups associated with the coronal emission did not appear until 1993 FEB 02. Tao drew the impressive p-spot of **AR 7417** (N17°, 117°), showing several smaller spots trailing around the E limb. On the next day, he drew 3 or 4 smaller f-spots, with separate penumbrae. By then, a light bridge divided the p-spot into 2 or 3 umbrae. The f-spots of this EKI group were dissolving by the region's CM passage on 1993 FEB 08.

Not to be outdone, the S Hemisphere produced an EKI group larger than 1000 millionths of a solar hemisphere in area. This group, **AR 7420** (S07°, 086°), was a source of coronal emission like AR 7417. AR 7420 was a βγ group by 1993 JAN 31, but had a larger and more complex F-penumbra and spots.

Three observers contributed data for these regions: Melillo, Maxson, and Tao.

ROTATION 1866 (1993 FEB 17.40 to MAR 16.73; 30 Active Regions)

Quantity	Mean	Maximum (Date)	Minimum (Dates)
RI	83.6	105 (MAR 05)	56 (MAR 14, 16)
RA	84.9	114 (MAR 05)	54 (MAR 14)

The detection of soft X-ray emission by the Yohkoh satellite on 1993 MAR 01 should have alerted professional observers that AR 7420 had survived as a strong region. However, the region that had produced AR 7417 was a ghost of its former self; for earthbound observers, only some faculae and plages remained.

The highlight of this rotation was **AR 7440** (S06°, 103°), the remnant of AR 7420. Sunspot activity increased during this rotation due to the complex of activity near solar longitude 100°. At first sight, AR 7440 appeared to be a bipolar group with a large f-spot. Professional magnetograms showed the f-spot to have positive polarity, which is unusual for for f-spots in the S Hemisphere. The medium-size p-spot also exhibited positive polarity, which was expected. So, where were the negative polarity f-spots? A high-resolution white-light photograph by Garcia, shown below as *Figure* 2, taken on 1993 MAR 06, showed a medium-size umbra between the p- and f-spots, almost in contact with the large f-spot. Although it is difficult to see in the magnetogram, it is likely that the negative-polarity f-spot that had formed with the p-spot of AR 7420 had dissolved. Apparently, an emerging flux region erupted just W of the old p-spot of AR 7420, forming a new bipolar group. The old f-spot of AR 7420 disappeared and the large p-spot pushed into the new negative-polarity f-spot. An H-α photograph by Melillo on 1993 MAR 07 confirms this scenario. In it, he captured the bright footprints of a subflare between the large positive-polarity spot and the smaller negative spot. The appearance of the disk on 1993 MAR 12 is shown on a photograph by Maxson in *Figure 3* (p. 78).

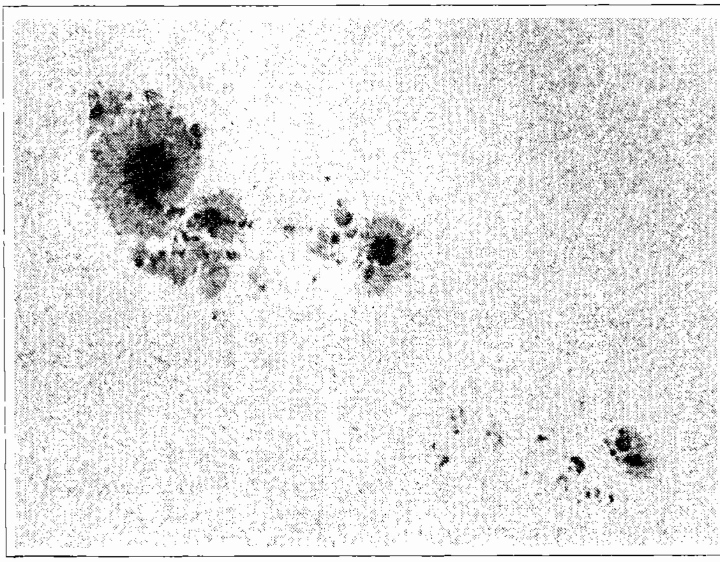

Figure 2. Photograph of AR 7440 by Gordon Garcia. 1993 MAR 06, 17h21m UT. 130-mm (5.1-in) refractor, f/74; 1/1000 sec on 2415 Technical Pan Film; Tuthill Solar Skreen and W58 (green) Filters. North at top; CM 131°.9. Seeing 3 arc-seconds.

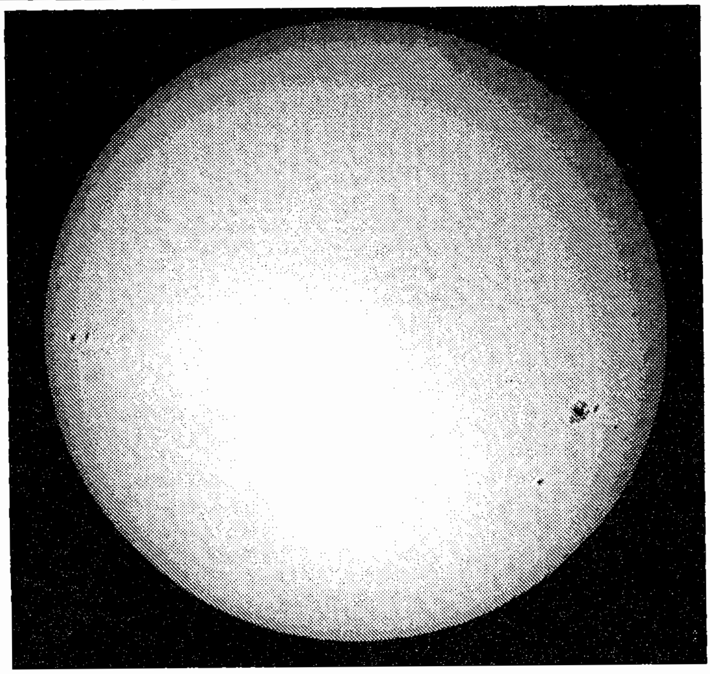

Figure 3. Whole-disk photograph by Paul Maxson. 1993 MAR 12, 20h01m UT. 10-in reflector, stopped to 6-in at f/74; 1/500 sec on 2415 Technical Pan Film; W47 (blue) Filter. North at top; CM 051°.3. Seeing 1-3 arc-seconds. AR 7440 is near the right (W) limb.

ROTATION 1867 (1993 MAR 16.73 to APR 13.02; 27 Active Regions)

Quantity	Mean	Maximum (Date)	Minimum (Date)
RI	64.7	89 (APR 06)	37 (APR 12)
RA	67.3	92 (APR 06)	36 (APR 12)

Activity during this rotation tended to decline, although the main spot of AR 7420 and AR 7440 did make a third disk passage. **AR 7465** (S06°, 107°; previous AR 7440) was by now a medium-size spot with a few small trailing umbrae. Some growth of the f-spot took place after CM passage on 1993 APR 05; this group was again Class E, but without a δ. Garcia made an off-band H-α filtergram on 1993 APR 03 that showed a long filament to the SE of AR 7465. This is useful for the identification of AR 7465 with AR 7440 because the earlier region also had a similar filament to the SE.

Following on the heels of AR 7465 were two regions that emerged on the disk. The first was **AR 7469** (S10°, 078°), which first appeared on 1993 APR 03 near the E limb. It quickly developed from a simple β to a βγ group, and consisted of a loose collection of small- to medium-size umbrae. The second, **AR 7472** (N05°, 074°), appeared on 1993 APR 08 near the same longitude as AR 7469, but in the opposite hemisphere. It was a simple β group when it passed over the limb.

During this rotation, Radhakrihnan and Garcia contributed the first CCD image of the Sun to the Solar Section. Made with a camera using a TC 211 chip, it showed AR 7465 and AR 7569 nearing the W limb on 1993 APR 10. In addition, Tramazzo made whole-disk drawings of sunspot umbrae, filaments, and prominences from 1993 APR 07 to 09.

ROTATION 1868 (1993 APR 13.02 to MAY 10.27; 32 ACTIVE Regions)

Quantity	Mean	Maximum (Dates)	Minimum (Dates)
RI	58.4	98 (APR 21)	13 (APR 15, 16)
RA	59.1	106 (APR 24)	14 (APR 15)

This rotation began with a solar disk that was nearly blank in white light, and Tao drew just one region on 1993 APR 15.

The largest and most complex regions observed during Rotation 1868 were in the N Hemisphere. **AR 7496** (N15°, 007°) was Class D, βγ, with two medium-size spots with regular penumbrae and several small spots and penumbral patches near it. **AR 7500** (N17°, 350°), Class D, βγδ, was the larger of the two groups and had two medium-size spots with regular penumbrae. Between the two principal spots were complex, irregular penumbra and small spots. Garcia photographed the two groups in white light and H-α on 1993 MAY 09 when both were near the CM, shown in *Figures 4* and *5* (p. 79).

ROTATION 1869 (1993 MAY 10.27 to JUN 06.48; 20 Active Regions)

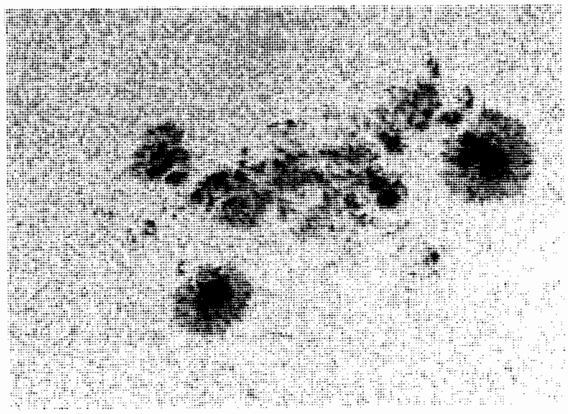

Figure 4. Photograph of AR 7500 by Gordon Garcia. 1993 MAY 09, 16h37m UT. 130-mm (5.1-in) refractor, f/89; 1/1000 sec on 2415 Technical Pan Film; Tuthill Solar Skreen and W58 (green) Filters. North at top; CM 007°.6. Seeing 1-2 arc-seconds. Compare with *Figure 5* below.

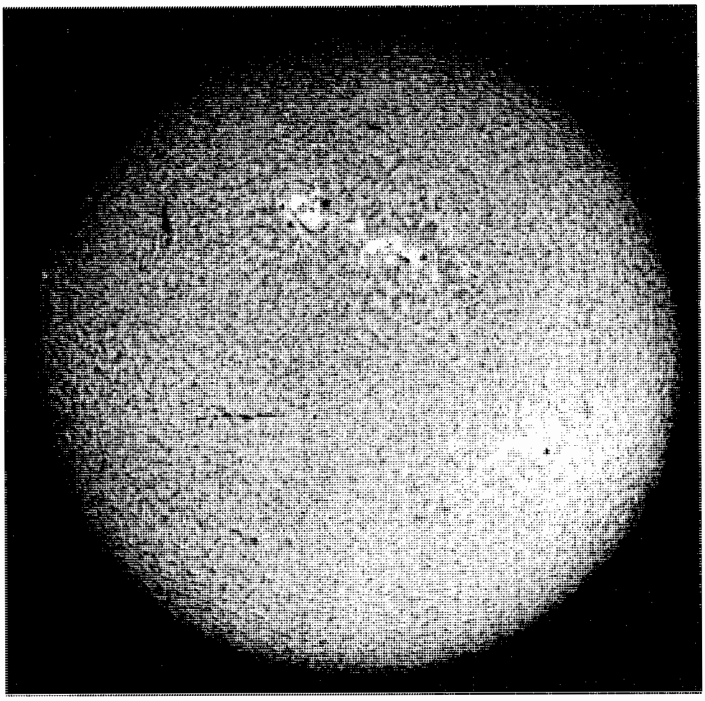

Figure 5. Whole-disk H-α photograph by Gordon Garcia. 1993 MAY 09, 18h18m UT. 130-mm (5.1-in) refractor, stopped to 63 mm, f/32; 1/60 sec on 2415 Technical Pan Film; Daystar University 0.56-Å H-α Filter tuned to centerline. North at top; CM 006°.6. Seeing 3 arc-seconds. AR 7500 is above and slightly left of center.

Quantity	Mean	Maximum (Date)	Minimum (Dates)
RI	66.5	125 (MAY 11)	14 (MAY 19)
RA	60.4	106 (MAY 11)	12 (MAY 22)

During this rotation, a Maxson white-light photograph showed **AR 7515** (N14°, 077°) as a 15°-long train of several small- to medium-size spots. The small spot at the p end of the group grew while to the E of the CM. Only 2°-3° N of this spot was a medium-size Class-H p-spot belonging to **AR 7514** (N17°, 084°). The growth of AR 7515 pushed this p-spot closer to AR 7514, giving AR 7515 the appearance of a double p-spot. Finally, AR 7514 dissolved prior to crossing the W limb.

ROTATION 1870 (1993 JUN 06.48 to JUL 03.67; 21 Active Regions)

Quantity	Mean	Maximum (Date)	Minimum (Dates)
RI	43.3	83 (JUN 06)	10 (JUN 13, 14, 15)
RA	44.2	84 (JUN 06)	10 (JUN 14, 15)

On 1993 JUN 19, observers at Boulder, Colorado, recorded no sunspots on the solar disk. On the same date, no spots were visible on a white-light whole-disk photograph by Maxson. RI and RA were not 0, but were less than 10, which is possible because they are averaged from many observers with different correction factors. Indeed, the last day when both RI and RA were zero was 1987 JUL 14.

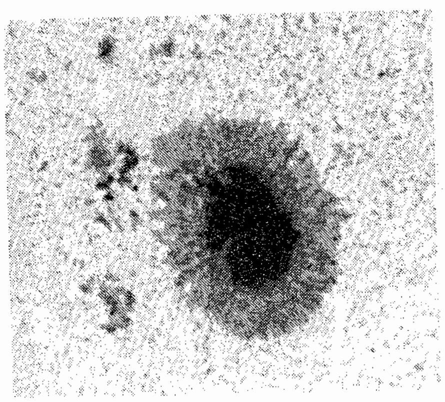

Figure 6. Photograph of AR 7529 by Gordon Garcia. 1993 JUN 26, 15h20m UT. 130-mm (5.1-in) refractor, f/89; 1/1000 sec on 2415 Technical Pan Film; Tuthill Solar Skreen and W58 (green) Filters. North at top; CM 093°.1. Seeing 1-2 arc-seconds.

Garcia photographed **AR 7529** (S12°, 062°) in high resolution on 1993 JUN 26, showing a medium-size, regular p-spot with a few small umbrae following it; see *Figure 6*, above.

ROTATION 1871 (1993 JUL 03.67 to JUL 30.88; 22 Active Regions)

Quantity	Mean	Maximum (Date)	Minimum (Dates)
RI	58.2	82 (JUL 18)	31 (JUL 10)
RA	55.0	82 (JUL 18)	33 (JUL 10)

The data available for this rotation were scanty, consisting mostly of whole-disk drawings by Tao. No activity regions developed beyond a simple β magnetic configuration.

ROTATION 1872 (1993 JUL 30.88 to AUG 27.12; 21 Active Regions)

Quantity	Mean	Maximum (Date)	Minimum (Dates)
RI	42.3	73 (AUG 11)	22 (AUG 16)
RA	42.1	66 (AUG 11)	23 (AUG 16, 20)

AR 7558 (N12°, 242°), the most noteworthy group of this rotation, was a 16°-long Class E, β group with an open structure. There were only a few spots with this group, the largest being a medium-sized p-spot. On 1993 AUG 08 Garcia photographed this region in H-α when on the CM, showing a bright plage between the p- and f-spots, bisected by a filament. There were no spotless days during this rotation, but no activity region developed beyond a simple β magnetic configuration.

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1.) *Solar-Geophysical Data* (Prompt Report). Part 1, No. 581, January, 1993.
2.) ________. No. 582, February, 1993.
3.) ________. No. 583, March, 1993.
4.) ________. No. 584, April, 1993.
5.) ________. No. 585, May, 1993.
6.) ________. No. 586, June, 1993.
7.) ________. No. 587, July, 1993.
8.) ________. No. 588, August, 1993.
9.) ________. No. 589, September, 1993.
10.) ________. No. 590, October, 1993.

SOLAR CLASSIFICATION KEY:

Groups (Modified Zurich System)

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

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

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

Magnetic Characteristics

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

Meteors Section News

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

Table 1. Recent A.L.P.O. Meteor Observations; July - September, 1995.

1995 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+N = Limiting Magnitude)
Jul 01	Graham Wolf, New Zealand	08:00-14:00	4 LSA, 27 TOP, 17 SPO	+5.5
02	Graham Wolf, New Zealand	08:00-16:00	1 LSA, 4 TOP, 25 SPO	+4.3
03	George Zay, CA	05:47-11:31	3 TOP, 2 LSA, 1 CAP,48 SPO	+5.9
	Graham Wolf, New Zealand	06:00-14:00	3 TOP, 24 SPO	+4.5
	James Riggs, CA	06:15-10:00	3 CAP, 45 SPO	+6.1
	Robert Lunsford, CA	07:30-11:30	2 GSA, 51 SPO	+6.4
04	Michael Morrow, HI	06:00-07:45	5 SPO	+5.0
	Graham Wolf, New Zealand	06:00-08:00	5 SPO	+4.3
	Robert Lunsford, CA	08:00-11:30	2 GSA, 41 SPO	+6.6
05	Mark Davis, SC	04:20-05:20	13 SPO	+5.1
	George Zay, CA	06:38-11:30	2 CAP, 29 SPO	+6.0
	Robert Lunsford, CA	07:25-11:30	58 SPO	+6.5
	Michael Morrow, HI	11:15-12:15	9 SPO	+5.0
06	Robert Lunsford, CA	08:00-11:30	1 GSA, 55 SPO	+6.6
07	John Gallagher, NJ	04:30-06:36	1 ACY, 1 PER	+7.3; 5% cloudy
	Pierre Martin, Ont., Canada	05:22-05:55	*None Seen*	+5.3; 25% cloudy
	George Zay, CA	07:36-11:31	38 SPO	+5.9
09	John Gallagher, NJ	04:55-05:27	1 SPO	+6.5
	Mark Davis, SC	06:00-08:03	1 CAP, 23 SPO	+5.2
	John Gallagher, NJ	06:10-07:02	1 JSC, 2 SPO	+6.9
	Richard Taibi, MD	07:05-08:21	8 SPO	+5.2
	George Zay, CA	09:16-11:33	21 SPO	+5.7
10	John Gallagher, NJ	04:15-05:02	1 ACY, 1 SPO	+6.6
15	John Gallagher, NJ	04:40-06:45	2 SPO	+5.2
19	John Gallagher, NJ	04:25-06:30	3 SPO	+7.4
	Robert Lunsford, CA	07:30-11:30	25 SPO	+5.8
20	John Gallagher, NJ	03:50-05:56	3 SPO	+7.5
	James Riggs, CA	04:00-07:00	2 CAP, 16 SPO	+5.5
21	Michael Morrow, HI	06:20-07:20	2 SPO	+6.5
22	George Zay, CA	04:00-11:36	2 CAP, 2 LSA, 1 PAU, 4 PER, 24 SPO	+6.0
	Pierre Martin, Ont., Canada	04:48-05:25	1 NDA, 2 CAP, 1 ACY,1 PER	+5.4; 10% cloudy
	James Riggs, CA	08:19-12:00	2 CAP, 2 NDA, 17 SDA, 4 PER, 45 SPO	+6.0
23	Norman McLeod, FL	04:17-06:40	1 CAP, 1 NDA, 3 SDA , 1 SIA, 1 PAU 4 PER, 9 SPO	+6.7; 10% cloudy
24	John Gallagher, NJ	03:55-06:08	1 JSC 1 UPG, 2 PER, 8 SPO	+7.5
	Pierre Martin, Ont., Canada	04:57-05:25	2 SDA, 1 PER	+5.8; 10% cloudy
	Norman McLeod, FL	06:13-08:58	2 CAP, 1 NDA, 6 PER, 4 SDA, 3 SIA, 16 SPO	+6.9
	Richard Taibi, MD	06:25-08:07	2 SDA, 1 CAP, 5 SPO	+5.3
	Michael Morrow, HI	07:00-09:00	1 CAP, 2 NDA, 1 PER, 13 SPO	+6.5
	James Riggs, CA	08:30-12:00	1 CAP, 1 NDA, 1 PAU, 5 PER, 10 SDA, 41 SPO	+5.8
25	Pierre Martin, Ont., Canada	03:51-07:22	10 SDA, 1 NDA, 5 CAP, 1 PAU 3 ACY, 6 PER, 16 SPO	+5.8
	Michael Morrow, HI	06:30-12:30	2 NDA, 1 PAU, 1 PER, 5 SDA, 23 SPO	+7.0
	Graham Wolf, New Zealand	09:00-16:00	12 CAP, 5 NDA, 22 SDA, 18 SPO	+4.5
26	John Gallagher, NJ	04:30-06:35	1 CAP, 1 PER, 2 SPO	+6.4
	James Riggs, CA	05:13-09:45	2 CAP, 9 PER, 3 SDA, 28 SPO	+6.1
	Michael Morrow, HI	06:00-09:00	3 CAP, 10 SPO	+5.8

Table 1 continued on pp. 82-86 with notes on p. 86.

Table 1—Continued.

1995 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+N = Limiting Magnitude)
JUL 27	James Riggs, CA	05:40-11:30	7 CAP, 9 PER, 3 SDA, 57 SPO	+6.0
	Mark Davis, SC	05:45-06:45	2 SDA, 1 CAP, 8 SPO	+5.4
	David Holman, CA	06:15-11:18	1 SDA, 7 CAP, 7 PER, 55 SPO	+6.2
	Robert Lunsford, CA	08:00-11:45	19 SDA, 4 CAP, 6 PER, 2 SIA, 1 UPG, 35 SPO	+6.5
	Ron Rosenwald, TX	08:30-09:30	1 CAP, 1 PER, 2 SIA, 1 NDA, 7 SPO	+5.4
	Graham Wolf, New Zealand	09:00-16:00	13 CAP, 6 NDA, 26 SDA, 20 SPO	+4.3
28	Robert Togni, AR	04:00-07:00	10 SDA, 2 CAP, 5 PER, 2 SPO	+5.0; 10% cloudy
	Pierre Martin, Ont., Canada	04:24-08:32	23 SDA, 4 NDA, 1 SIA, 4 CAP, 1 UPG, 9 PER, 3 ACY, 23 SPO	+5.9
	David Swann, OK	04:30-09:45	13 SDA, 4 CAP, 4 UPG, 3 PER, 43 SPO	+6.0
	David Holman, CA	07:37-11:32	7 SDA, 9 NDA, 2 SIA, 6 CAP, 13 PER, 83 SPO	+6.4
	Ron Rosenwald, TX	08:00-09:31	1 SDA, 1 UPG, 14 SPO	+5.4
	Robert Lunsford, CA	08:30-11:45	18 SDA, 4 NDA, 2 SIA, 4 CAP, 4 PAU, 3 UPG, 6 PER, 31 SPO	+6.6
	Graham Wolf, New Zealand	09:00-16:00	12 CAP, 8 NDA, 39 SDA, 18 SPO	+4.3
29	George Zay, CA	04:16-11:38	14 CAP, 2 PAU, 25 SDA, 14 PER, 50 SPO	+6.0
	Alton Smith, AR	04:40-07:40	40 AQR, 7 PER, 6 SPO	+5.7
	David Holman, CA	04:58-10:10	10 SDA, 4 NDA, 7 SIA, 7 CAP, 21 PER, 76 SPO	+6.3
	Mark Davis, SC	05:40-08:10	13 SDA, 2 NDA, 2 SIA, 3 CAP, 18 SPO	+5.7
	Brian Simmons, FL	05:42-06:55	10 SDA, 4 CAP, 3 PER, 11 SPO	+6.0; 25% cloudy
	Wanda Simmons, FL	05:43-07:03	5 SDA, 5 CAP, 1 PER,1 UPG, 4 SPO	+5.8; 25% cloudy
	Milton Hays, FL	05:43-06:15	4 SDA, 1 CAP, 3 SPO	+6.1; 25% cloudy
	Wendy Simmons, FL	05:43-06:15	5 SDA, 2 CAP, 5 SPO	+6.0; 25% cloudy
	Karl Simmons, FL	05:43-07:03	11 SDA, 2 CAP, 1 PER, 7 SPO	+6.2; 25% cloudy
	Jeffery Sandel, SC	05:43-09:15	1 SDA, 14 PER, 4 UPG, 61 SPO	+6.3
29	Robert Lunsford, CA	07:45-11:45	21 SDA, 5 NDA, 3 SIA, 10 CAP, 1 PAU, 1 UPG, 4 PER, 38 SPO	+6.5
	Ron Rosenwald, TX	08:00-09:00	*None Seen*	+5.4; 100% cloudy
	James Riggs, CA	08:40-11:00	2 CAP, 5 PER, 5 SDA, 20 SPO	+6.4
	Graham Wolf, New Zealand	09:00-16:00	14 CAP, 10 NDA, 28 SDA, 15 SPO	+4.5
	Michael Morrow, HI	10:20-12:20	1 CAP, 1 NDA, 1 PAU, 11 SDA, 27 SPO	+6.3; 25% cloudy
30	Yvonne Pover, Jamaica	03:00-05:00	5 CAP, 3 SDA, 3 SPO	+7.1
	Pierre Martin, Ont., Canada	04:04-07:56	21 SDA, 1 NDA, 3 SIA, 6 CAP, 1 ACY, 7 PER, 18 SPO	+5.8
	George Zay, CA	04:32-11:50	7 CAP, 8 NDA, 2 PAU, 11 PER, 2 SIA, 46 SDA, 61 SPO	+5.8
	Alton Smith, AR	04:35-05:35	6 AQR, 5 PER, 6 SPO	+5.5
	Richard Taibi, MD	04:53-08:32	7 SDA, 3 SIA, 3 CAP, 3 NDA, 2 UPG, 6 PER, 11 SPO	+5.2
	John Gallagher, NJ	04:55-05:48	1 SPO	+7.1
	Jeffery Sandel, SC	05:00-09:00	10 CAP, 6 PER, 45 SPO	+6.4
	Brian Simmons, FL	05:13-05:48	5 SDA, 1 CAP, 3 PER	+5.7; 75% cloudy
	Daniel Simmons, FL	05:13-05:44	2 SDA, 1 CAP, 1 PER	+6.0; 75% cloudy
	Wanda Simmons, FL	05:13-05:45	1 PER, 1 UPG, 9 SPO	+5.5; 75% cloudy
	Karl Simmons, FL	05:13-05:45	1 SDA, 1 CAP, 1 PER, 5 SPO	+5.8; 75% cloudy
	George Gliba, WV	05:15-08:15	12 SDA, 4 NDA, 7 SIA, 6 CAP, 3 PAU, 1 UPG, 21 PER, 33 SPO	+6.4
	Robert Hays, IN	06:50-08:50	13 SDA, 2 NDA, 4 PER, 1 CAP, 18 SPO	+6.3
	David Holman, CA	07:28-11:30	10 SDA, 8 NDA, 9 CAP, 34 PER, 81 SPO	+6.3
	James Riggs, CA	07:50-11:53	14 CAP, 1 NDA, 35 PER, 13 SDA, 77 SPO	+6.1
	Robert Lunsford, CA	08:00-12:00	51 SDA, 6 NDA, 4 SIA, 2 CAP, 3 PAU, 13 PER, 59 SPO	+6.5
	Michael Morrow, HI	08:30-09:30	2 CAP, 6 SPO	+6.0; 50% cloudy
	Graham Wolf, New Zealand	09:00-16:00	7 CAP, 4 NDA, 15 SDA, 10 SPO	+4.3

Table 1 continued on pp. 83-86 with notes on p. 86.

Table 1—Continued.

1995 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+*N* = Limiting Magnitude)
JUL 31	John Gallagher, NJ	02:45-06:56	4 CAP, 1 NDA, 4 PER, 1 SDA, 12 SPO	+7.5
	Pierre Martin, Ont., Canada	03:14-08:08	30 SDA, 2 NDA, 4 SIA, 6 CAP, 1 UPG, 1 ACY, 22 PER, 28 SPO	+5.9
	Brian Simmons, FL	04:16-05:15	10 SDA, 2 CAP, 2 PER	+6.1
	Daniel Simmons, FL	04:16-05:17	2 SDA, 6 CAP, 9 SPO	+6.1
	Doug Kniffen, MO	04:25-05:35	2 PER, 10 SPO	+5.7
	Wanda Simmons, FL	04:35-06:05	6 SDA, 6 CAP, 2 PER, 12 SPO	+6.2
	Stephen Simmons, FL	04:35-05:17	2 SDA, 4 CAP, 1 PER, 3 SPO	+6.0
	Karl Simmons, FL	04:35-05:37	7 SDA, 4 CAP, 2 PER, 2 SPO	+6.1
	James Riggs, CA	04:43-11:53	16 CAP, 5 NDA, 1 PAU, 21 PER, 11 SDA, 63 SPO	+6.3
	Robert Lunsford, CA	08:45-11:45	28 SDA, 5 NDA, 3 SIA, 3 CAP, 2 PAU, 17 PER, 32 SPO	+6.7
	Graham Wolf, New Zealand	09:00-16:00	4 CAP, 4 NDA, 11 SDA, 11 SPO	+4.3
	Michael Morrow, HI	09:30-11:30	2 NDA, 1 PER, 10 SDA, 24 SPO	+6.3
AUG 01	John Gallagher, NJ	04:15-06:20	2 PER, 1 BAQ, 3 SPO	+7.5
	Pierre Martin, Ont., Canada	04:23-08:30	12 SDA, 2 NDA, 4 CAP, 19 PER, 18 SPO	+5.7
	Patrick Marleau, Ont., Can.	06:24-08:25	1 SDA, 1 CAP, 9 PER, 3 SPO	+5.4
	Vincent Giovannone, NY	07:30-08:30	*None Seen*	+5.0
	Graham Wolf, New Zealand	08:00-17:00	7 CAP, 5 NDA, 12 SDA, 17 SPO	+4.6
	Robert Lunsford, CA	08:45-11:45	16 SDA, 3 NDA, 2 SIA, 2 CAP, 1 PAU, 3 UPG, 11 PER, 1 SPO	+6.5
	Michael Morrow, HI	10:45-12:45	4 NDA, 3 NIA, 1 PAU, 3 PER, 3 SDA, 2 SIA, 53 SPO	+6.0
02	Richard Taibi, MD	04:27-06:54	1 NDA, 1 CAP, 1 UPG, 5 PER, 1 SPO	+5.1
	George Zay, CA	04:49-11:57	11 CAP, 3 NDA, 1 PAU, 27 PER, 9 SIA, 24 SDA, 42 SPO	+6.0
	Vincent Giovannone, NY	06:50-07:30	3 SPO	+3.0
	Robert Lunsford, CA	08:30-11:45	18 SDA, 1 NDA, 2 SIA, 7 CAP, 1 PAU, 3 UPG, 18 PER, 45 SPO	+6.5
	James Riggs, CA	09:00-12:00	7 PER, 6 SDA, 39 SPO	+6.3
03	George Zay, CA	06:02-11:53	9 CAP, 9 NDA, 5 PAU, 20 PER, 3 SIA, 27 SDA, 36 SPO	+6.0
	Robert Lunsford, CA	07:30-12:00	35 SDA, 13 NDA, 2 SIA, 3 CAP, 3 PAU, 28 PER, 39 SPO	+6.4
	Pierre Martin, Ont., Canada	07:38-07:59	1 SDA, 2 PER	+5.5; 30% cloudy
04	Richard Taibi, MD	04:42-08:42	1 SDA, 1 NDA, 1 SIA, 3 CAP, 1 UPG, 27 PER, 25 SPO	+6.1
	Norman McLeod, FL	06:15-09:51	3 NDA, 1 PAU, 12 PER, 14 SDA, 3 SIA, 15 SPO	+6.6
	George Zay, CA	06:44-11:55	2 CAP, 4 NDA, 5 PAU, 35 PER, 2 SIA, 15 SDA, 34 SPO	+6.1
	James Riggs, CA	08:25-11:30	9 CAP, 2 PAU, 3 PER, 5 SDA, 53 SPO	+6.5
05	George Zay, CA	07:22-11:55	2 CAP, 3 KCG, 2 NDA, 32 PER, 3 SIA, 3 SDA, 45 SPO	+5.9
	Michael Morrow, HI	11:00-13:00	1 NDA, 1 NIA, 4 PER, 22 SPO	+6.0
06	George Zay, CA	06:28-11:56	3 CAP, 6 NDA, 8 PAU, 43 PER, 5 SDA, 39 SPO	+5.8
	Robert Hays, IN	06:50-08:50	11 PER, 6 SDA, 2 NDA, 16 SPO	+5.9
	James Riggs, CA	08:33-12:03	1 PAU, 20 PER, 4 SDA, 76 SPO	+6.7
07	Wanda Simmons, FL	05:25-06:25	1 CAP, 3 PER	+4.5
	Nathan Kirkwood, FL	05:25-06:25	1 CAP, 2 PER, 1 SPO	+4.5
	Brian Simmons, FL	05:25-06:25	2 SDA, 2 CAP, 3 SPO	+4.5
	Stephen Simmons, FL	05:25-06:25	1 CAP, 1 PER, 3 SPO	+4.5
	Daniel Simmons, FL	05:25-05:45	*None Seen*	+4.5
	Wendy Simmons, FL	05:25-06:25	1 CAP, 2 PER	+4.7
	Karl Simmons, FL	05:25-06:25	1 CAP, 3 PER, 1 SPO	+4.7
	Pierre Martin, Ont., Canada	05:32-07:05	10 PER, 1 SIA, 1 PAU, 1 UPG, 5 SPO	+5.8

Table 1 continued on pp. 84-86 with notes on p. 86.

Table 1—Continued.

1995 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+*N* = Limiting Magnitude)
AUG 07	George Zay, CA	08:25-11:58	30 PER, 29 SPO	+5.7
	Robert Lunsford, CA	09:00-12:00	27 PER, 4 SDA, 1 NDA, 37 SPO	+5.9
08	John Gallagher, NJ	03:55-05:59	1 AER, 4 SPO	+6.5
	Pierre Martin, Ont., Canada	06:40-08:49	1 KCG, 2 NDA, 18 PER, 1 SDA, 1 SIA, 9 SPO	+5.5
	Vincent Giovannone, NY	07:00-08:00	1 SPO	+5.0
	James Riggs, CA	09:15-12:05	1 CAP, 29 PER, 3 SDA, 30 SPO	+6.5
	George Zay, CA	09:50-11:58	23 PER, 11 SPO	+5.1
	Yvonne Pover, Jamaica	03:00-08:00	5 SDA, 7 CAP, 5 SPO	+7.1; 10% cloudy
	Robert Lunsford, CA	09:47-11:47	20 PER, 2 UPG, 13 SPO	+5.5
09	Vincent Giovannone, NY	06:50-07:50	2 PER, 1 SPO	+5.0
	Pierre Martin, Ont., Canada	07:52-08:44	2 NDA, 4 PER, 4 SPO	+5.4
10	John Gallagher, NJ	06:35-08:42	1 KCG, 2 PER, 4 SPO	+6.6
	Vincent Giovannone, NY	06:40-07:40	3 PER	+4.0
	James Riggs, CA	10:04-11:04	7 PER, 1 SDA, 7 SPO	+3.0
11	Doug Kniffen, MO	05:20-07:55	14 PER, 6 SPO	+4.3
	John Gallagher, NJ	07:55-08:43	1 AER, 1 PER, 1 SPO	+6.6
	George Gliba, MD	08:00-09:00	6 PER, 1 SPO	+5.0
	George Zay, CA	08:47-11:56	18 PER, 5 SPO	+4.3
12	George Zay, CA	03:51-12:00	23 PER, 18 SPO	+4.4
	Doug Kniffen, MO	04:30-05:32	5 PER, 5 SPO	+4.1
	Mark Davis, SC	05:16-08:18	12 PER, 13 SPO	+4.3
	Richard Taibi, MD	05:52-08:19	8 PER, 3 SPO	+4.5
	John Gallagher, NJ	06:35-09:17	1 AER, 4 PER	+5.5; 20% cloudy
	David Swann, OK	07:15-10:15	17 PER, 9 SPO	+4.4
	Ron Rosenwald, TX	08:00-09:30	11 PER, 1 SPO	+3.1
	James Riggs, CA	08:14-11:00	13 PER, 1 SDA, 7 SPO	+3.0
	Robert Lunsford, CA	10:00-12:00	6 PER, 4 SPO	+4.8; 50% cloudy
	Robert Togni, AR	10:10-10:40	7 PER	+2.7
	Michael Morrow, HI	11:45-14:45	10 PER, 14 SPO	+4.0; 40% cloudy
	Linda Wilson, HI	11:45-13:54	16 PER, 5 SPO	+4.5
	Jan Fletcher, GA	01:23-01:53	1 SPO	+4.0
	Suzie Gerard, GA	01:23-01:53	1 PER, 1 SPO	+4.0
	Donna Hendricks, GA	01:23-01:53	1 SPO	+4.0
	Crystal Jones, GA	01:23-01:53	2 PER, 1 SPO	+3.7
	Brad Pritchard, GA	01:23-01:53	2 PER, 1 SPO	+4.0
	Richard Schmude, Jr., GA	01:23-01:53	1 SPO	+3.5
	Kathy Tucker, GA	01:23-01:53	2 PER, 1 SPO	+4.0
	Rachel Wilder, GA	01:23-01:53	2 PER, 1 SPO	+4.0
	John Gallagher, NJ	02:20-04:20	7 PER, 1 SPO	+6.9
	Donna Hendricks, GA	03:25-05:00	2 PER, 1 SPO	+4.0
	Doug Kniffen, MO	03:30-08:05	38 PER, 8 SPO	+4.0
	Richard Schmude, Jr., GA	04:26-05:03	1 PER, 1 SPO	+4.2
	Wanda Simmons, FL	04:30-05:00	1 SPO	+3.0
13	Stephen Simmons, FL	04:30-05:00	*None Seen*	+3.0
	Daniel Simmons, FL	04:30-05:00	*None Seen*	+3.0
	Wendy Simmons, FL	04:30-05:00	1 PER, 1 SPO	+3.0
	Karl Simmons, FL	04:30-05:00	1 PER, 1 SPO	+3.0
	Brian Simmons, FL	04:30-05:00	*None Seen*	+3.0
	Robert Hays, FL	05:51-06:51	11 PER, 4 SPO	+4.5
	John Gallagher, NJ	06:27-09:12	23 PER, 2 SPO	+6.6
	David Swann, OK	06:30-10:00	44 PER, 14 SPO	+5.2
	Robert Lunsford, CA	07:30-11:30	45 PER, 7 SPO	+5.1
	Michael Morrow, HI	10:45-12:45	8 PER, 2 SPO	+3.5; 60% cloudy
	Linda Wilson, HI	11:14-12:45	5 PER, 1 SPO	+4.0; 60% cloudy
14	David Griffen, GA	01:20-01:50	*None Seen*	+4.1
	Richard Schmude, Jr., GA	01:20-01:50	*None Seen*	+4.1
	Bret Wehs, GA	01:20-01:50	2 PER	+4.1
	Vincent Giovannone, NY	04:00-05:20	2 PER, 1 SPO	+4.0
	George Zay, CA	04:23-12:05	54 PER, 27 SPO	+5.0

Table 1 continued on pp. 85-86 with notes on p. 86.

Table 1—Continued.

1995 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+N = Limiting Magnitude)
Aug 14	John Gallagher, NJ	06:00-09:00	18 PER, 5 SPO	+6.9
15	George Zay, CA	04:59-12:07	2 KCG, 35 PER, 25 SPO	+5.3
16	James Riggs, CA	04:06-05:14	1 PER, 4 SPO	+4.0
	John Gallagher, NJ	04:40-06:18	1 KCG, 2 PER, 6 SPO	+6.9
17	James Riggs, CA	03:22-05:22	6 SPO	+5.0
18	John Gallagher, NJ	05:00-06:34	2 PER, 1 SIA, 1 SPO	+6.6
19	Graham Wolf, New Zealand	08:00-17:00	3 CAP, 6 NDA, 7 SDA, 9 SPO	+4.5
20	Richard Taibi, MD	04:10-05:51	2 NIA, 2 SIA, 7 SPO	------
	Doug Kniffen, MO	04:20-05:20	8 SPO	+5.7
	John Gallagher, NJ	04:55-07:18	1 NIA, 3 PER, 5 SPO	+7.4
	Graham Wolf, New Zealand	08:00-13:00	2 CAP, 1 SDA, 5 SPO	+4.3
21	John Gallagher, NJ	03:55-06:11	1 ERI, 3 NIA, 3 PER, 9 SPO	+7.4
	Robert Hays, IL	05:00-06:35	3 KCG, 2 PER, 16 SPO	+6.7
22	Doug Kniffen, MO	03:40-04:43	9 SPO	+5.7
	Graham Wolf, New Zealand	08:00-13:00	1 CAP, 3 NDA, 1 SDA, 10 SPO	+4.3
	Graham Wolf, New Zealand	13:00-17:00	2 ERI, 9 SPO	------
23	Doug Kniffen, MO	03:40-05:00	12 SPO	+5.5
	John Gallagher, NJ	04:05-06:14	4 PER, 6 SPO	+7.3
24	James Houser, PA	03:40-06:15	2 AUR, 3 KCG, 1 NDA, 4 PER, 4 SPI, 2 SPO	------
25	Pierre Martin, Ont., Canada	05:02-07:06	1 AUR, 6 ERI, 1 NDA, 7 NIA, 7 PER, 1 SPI, 5 SPO	+5.8
	Doug Kniffen, MO	05:10-06:41	27 SPO	+5.2
26	John Gallagher, NJ	04:30-06:54	2 KCG, 1 NDA, 1 NIA, 1 PER, 10 SPO	+7.5
27	George Zay, CA	03:45-12:19	4 AUR, 5 ERI, 3 KCG, 4 NIA, 3 SPI, 44 SPO	+6.0
	Michael Morrow, HI	07:00-08:00	7 SPO	+5.0; 50% cloudy
	John Gallagher, NJ	07:58-08:31	1 PER, 1 SPO	+7.2; 10% cloudy
28	George Zay, CA	03:45-12:18	2 AUR, 1 ERI, 3 KCG, 4 NIA, 2 SPI, 30 SPO	+6.0
	Pierre Martin, Ont., Canada	04:11-07:23	1 AUR, 2 ERI, 2 KCG, 1 NDA, 10 NIA, 1 PER, 1 SPI, 11 SPO	+5.9
	James Riggs, CA	04:45-05:45	1 PER, 6 SPO	+6.0
29	Doug Kniffen, MO	03:30-05:05	30 SPO	+5.2
30	John Gallagher, NJ	04:45-06:53	1 NDA, 5 SPO	+6.9
	Michael Morrow, HI	05:45-08:00	7 SPO	+6.5
	Pierre Martin, Ont., Canada	06:39-09:08	7 AUR, 3 NIA, 2 PER, 3 SPI, 1 UPG, 14 SPO	+5.7
	Graham Wolf, New Zealand	13:00-17:00	2 ERI, 9 SPO	+4.6
31	George Zay, CA	03:58-12:20	3 AUR, 2 ERI, 2 MIA, 4 SPI, 41 SPO	+5.9
	Robert Lunsford, CA	09:00-12:00	1 AUR, 3 SPO	+5.1
Sep 01	George Zay, CA	04:37-12:16	8 AUR, 7 NIA, 1 SPI, 41 SPO	+5.8
	Pierre Martin, Ont., Canada	06:12-08:57	7 AUR, 3 ERI, 2 NIA, 1 SPI, 14 SPO	+5.7
	Jeffery Sandel, SC	06:45-09:55	3 AUR, 21 SPO	+6.3
	Robert Lunsford, CA	07:00-12:45	7 AUR, 52 SPO	+6.3
	Mark Davis, SC	07:24-08:42	4 AUR, 16 SPO	+5.7
	John Gallagher, NJ	07:45-09:21	1 AUR, 2 SPO	+6.1
	David Holman, CA	07:52-12:00	4 AUR, 3 DAS, 2 SPI, 55 SPO	+6.6
	James Riggs, CA	08:09-13:09	11 AUR, 1 PER, 53 SPO	+6.3; 50% cloudy
03	Robert Togni, AR	09:57-10:45	1 AUR	+5.0
04	John Gallagher, NJ	04:30-06:39	1 NIA, 1 SAR, 5 SPO	+7.5
	David Holman, CA	08:44-12:15	4 DAS, 6 SPI, 65 SPO	+6.4
	Michael Morrow, HI	11:45-13:30	21 SPO	+6.0; 10% cloudy
	Phyllis Eide, HI	12:00-13:30	13 SPO	+5.3; 10% cloudy

Table 1 continued on pp. 86 with notes.

Table 1—Continued.

1995 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+*N* = Limiting Magnitude)
SEP 05	Pierre Martin, Ont., Canada	07:10-07:59	1 DAS, 1 SPI, 2 SPO	+5.6; 10% cloudy
06	John Gallagher, NJ	04:40-06:42	1 SPO	+6.0
12	James Riggs, CA	03:55-04:55	11 SPO	+6.0
	John Gallagher, NJ	04:40-06:49	1 TRI, 9 SPO	+7.1
	Pierre Martin, Ont., Canada	06:18-07:19	1 DAS, 1 SPI, 2 TRI, 1 SPO	+4.5
15	John Gallagher, NJ	05:10-07:20	1 KAQ, 1 SOR, 6 SPO	+7.5; 5% cloudy
18	John Gallagher, NJ	04:40-06:45	1 SPI, 4 SPO	+7.5
19	Mark Davis, SC	02:50-04:08	1 KAQ, 1 SPI, 5 SPO	+5.5
	Pierre Martin, Ont., Canada	04:22-06:08	3 DAS, 1 KAQ, 4 SPI, 3 SPO	+5.8
	George Zay, CA	04:47-12:37	7 DAS, 5 KAQ, 6 NTA, 4 SOR, 3 SPI, 1 STA, 28 SPO	+5.9
	John Gallagher, NJ	04:50-06:57	1 NPI, 3 SPO	+7.5
	Robert Lunsford, CA	08:00-12:45	6 DAS, 1 KAQ, 3 SPI, 4 STA, 32 SPO	+6.1
20	George Zay, CA	03:58-12:31	4 DAU, 8 NTA, 2 SOR, 1 SPI, 3 STA, 33 SPO	+5.8
	John Gallagher, NJ	04:55-07:04	1 NPI, 3 SPO	+7.5
	Robert Lunsford, CA	07:30-12:30	5 DAS, 1 KAQ, 3 NTA, 12 SPI, 6 STA, 34 SPO	+6.3
21	Robert Lunsford, CA	08:47-11:47	2 DAS, 2 KAQ, 1 NTA, 1 SOR, 3 SPI, 3 STA, 38 SPO	+6.3
23	George Zay, CA	03:50-12:35	3 DAS, 1 KAQ, 3 NTA, 2 SOR, 7 SPI, 2 STA, 33 SPO	+6.0
	Pierre Martin, Ont., Canada	06:08-06:45	2 SPI	+6.0
24	Norman McLeod, FL	05:20-09:34	1 DAS, 5 KAQ, 2 SPI, 26 SPO	+7.3
	Pierre Martin, Ont., Canada	05:46-07:30	1 DAS, 1 KAQ, 1 NTA, 1 SOR, 1 SPI, 4 SPO	+5.8
	John Gallagher, NJ	06:50-08:13	2 SPO	+7.5; 30% cloudy
	Tom Giguere, HI	10:55-11:55	8 SPO	+5.0; 25% cloudy
25	Pierre Martin, Ont., Canada	04:41-04:53	1 DAS, 1 SPO	+5.8; 20% cloudy
	Norman McLeod, FL	07:24-10:12	3 DAS, 1 KAQ, 2 SPI, 29 SPO	+7.4
	Robert Lunsford, CA	09:00-12:30	6 DAS, 4 SPI, 1 STA, 38 SPO	+6.5
26	George Zay, CA	03:47-12:35	4 DAS, 1 NTA, 1 OCC, 1 SOR, 4 SPI, 3 STA, 43 SPO	+5.9
	Norman McLeod, FL	07:08-10:12	4 DAS, 5 KAQ, 1 SPI, 19 SPO	+7.3
	Robert Lunsford, CA	07:35-12:35	1 DAS, 1 NTA, 3 SOR, 8 SPI, 2 STA, 53 SPO	+6.3
27	Robert Lunsford, CA	08:30-12:30	7 DAS, 4 SOR, 1 SPI, 51 SPO	+6.5
	Pierre Martin, Ont., Canada	09:27-10:20	1 NTA, 2 SOR, 4 SPO	+4.9
28	John Gallagher, NJ	04:55-06:55	10 SPO	+7.3
29	John Gallagher, NJ	04:45-06:50	1 EGE, 4 SPO	+7.5
30	Richard Taibi, MD	04:46-05:46	3 SPO	+6.0
	Mark Davis, SC	05:56-09:00	1 DAS, 3 SOR, 1 SPI, 25 SPO	+5.7

* Key to Abbreviations

ACY	Alpha Cygnids	GSA	Gamma Sagittarids	PER	Perseids
AER	Alpha Eridanids	JSC	June Scutids	SAR	September Arietids
AQR	Aquarids	KAQ	Kappa Aquarids	SDA	South Delta Aquarids
AUR	Alpha Aurigids	KCG	Kappa Cygnids	SIA	South Iota Aquarids
BAQ	Beta Aquarids	LSA	Lambda Sagittarids	SPI	South Piscids
CAP	Capricornids	NDA	North Delta Aquarids	SPO	*Sporadics*
DAS	Delta Aurigids (Sept.)	NIA	North Iota Aquarids	STA	South Taurids
DAU	Delta Aurigids	NPI	North Piscids	TOP	Theta Ophiucids
EGE	Epsilon Geminids	OCC	October Capricornids	TRI	Triangulids
ERI	Eridanids	PAU	Piscid Austrinids	UPG	Upsilon Pegasids

BOOK REVIEWS

Edited by Jose Olivarez

The 20-cm Schmidt-Cassegrain Telescope.

By Peter L. Manly.

Cambridge University. Press, 40 West 20th St., N.Y., NY 10011-4211. 1994. 265 pages. Price $29.95 cloth (ISBN 0-521-43360-6).

Reviewed by Richard E. Hill

After reading *Unusual Telescopes* by this same author (and reviewing it here [Vol. 36, No. 3; Sept. 1992, p. 139]), I was eager to dig into this new work and I was delighted with what I found.

Being the former owner of no less than five 20-cm Schmidt-Cassegrains, all of which were excellent telescopes, and being a former optician, I expected an exhaustive optical-mechanical review, and a history and analysis of these telescopes. Instead I was surprised to find a comprehensive guide for the beginning amateur astronomer and first-time owner of such an instrument. The title is too restrictive for this is a good book for the beginner regardless of the telescope owned!

As with his earlier book, this book is liberally punctuated with Manly's delightful wit, making the reading quick and enjoyable. There are informative and entertaining footnotes on about half the pages and the reader is advised to read them all; they are often the best part! The A.L.P.O. is frequently referenced as are many other amateur organizations, with their addresses listed in the first Appendix. The book has a good Index and Table of Contents so the tyro will find this a very convenient reference work.

There are a few minor errors that need correction:

The second line of page 4 tells how Bernhard Schmidt used the vacuum deformation method to grind and polish corrector plates. Manly states that, after pulling the vacuum on the plate, "He ground the warped surface flat on the exposed side...," but actually a shallow spherical curve was ground on the plate.

On page 49, the author states, "When observing Uranus it is best to focus the telescope on one of the nearby moons or field stars which are indeed point sources." If one is even able to see the moons with averted vision in a 20-cm telescope this would be good, but focussing on them would be out of the question.

In the section, "Optimizing the View," Manly warns against "excessive magnification" but does not define it. Today's amateurs have developed a fear of magnification. Rarely do you see an amateur that uses magnification on the Moon, planets, and double stars sufficient to exploit the full potential of the aperture. Frankly, I am weary of seeing the moon in half-meter telescopes at less than 100×! It brings tears to the eye! Also in this section, the author castigates the use and quality of Barlow lenses. His comments are well-meaning and perhaps accurate for the less expensive Barlows, but the multi-element Barlows that are on the market today let the owners of short focal-length, large-aperture telescopes do the high-resolution lunar and planetary observing that was impossible for them only a decade ago. The novice should not fear magnification and Barlows, but only use them wisely.

In the section on the Sun, Manly advises "against so-called 'Herschel Wedges' and filters that slip into or over eyepieces." While I wholeheartedly agree with the latter caution, having experienced the breakage of just such a filter while observing the Sun in my youth, I cannot agree with the former. The Herschel Wedge is perfectly safe. The light from the telescope, in a defocused state, is reflected off the first surface of a small-angle wedge and then through a moderately dense filter (only a few times darker than ophthalmic sunglasses) and into the eyepiece. I have used such a system for years with no ill effects. Should the wedge break, no light gets to the eyepiece at all. It is failsafe. The trouble is, no one makes Herschel Wedges any longer. One of the most detailed views of the sun that I ever had was with a Herschel Wedge on an 11-inch refractor at the Riverside Telescope Makers Conference; they do work and are safe.

Perhaps the most interesting section for me was "Artificial Earth Satellites." Here Manly describes how he had tried to observe satellites with a 20-cm Schmidt-Cassegrain with one observer on the finder and the other on the eyepiece. He had no luck with this method. (In the 1960's a friend and I tried the same with his 8-in f/4.5 Newtonian and were somewhat successful.) He then details how the reader can find geosynchronous satellites, which move much more slowly [indeed not at all with respect to the observer], and observe them at different aspects. This inspired me to give it a try, and it may do the same for you!

While the book was brief with the descriptive material on many Solar-System objects and what can be done on them with the 20-cm Schmidt-Cassegrain, it got very detailed and technical after page 140 when Manly shows his proclivities as "a full-fledged card-carrying Techno-Geek!" (his self-descriptive terms). Here he relates many of his personal experiences, good and bad, with devices and equipment over the years. All readers, regardless of their level of expertise will enjoy this last half of the book and find it inspirational.

So, while there are some minor points where I differ with the author, and some small errors (including typographical ones not mentioned here) still I recommend this book as entertaining and informative reading for amateur astronomers whether or not they own *The 20-cm Schmidt-Cassegrain Telescope*.

Observing Comets, Asteroids, Meteors, and Zodiacal Light.

By Stephen J. Edberg and David H. Levy.

Cambridge University Press, 40 West 20th St., New York, NY 10011-4211. 1994. 259 pages, Price $29.95 cloth (ISBN 0-521-42003-2)

Reviewed by Don Machholz

These four subjects—-Comets, Asteroids, Meteors, and Zodiacal Light—are covered well in this book, which is part of the *Practical Astronomy Handbook* series published by Cambridge University Press.

This comprehensive guide makes easy reading, yet it could find itself on the amateur astronomer's reference shelf for many years to come.

Stephen Edberg comes with years of experience as an observer and writer. He has a way of making the complicated sound easy. This is necessary since Edberg generally covers the sections on photography, spectroscopy, and the analysis of data. David Levy, former A.L.P.O. Comets Recorder and Meteors Recorder, has decades of experience as a comet hunter and discoverer and as a meteor observer. His more recent work with the Shoemakers at Palomar Mountain has refined his knowledge of asteroids. He covers many of the visual observing sections of this book. Both authors freely share their personal experiences with the reader.

Following an introduction is a short chapter on fundamental observing techniques. This makes good reading for even the advanced amateur.

The longest chapter covers comets. As with each subject, this one starts with an historical perspective. Following the discussion of the nature of comets, there is a 13-page section on comet hunting. Levy, who knows the subject well, covers it thoroughly. Anyone wishing to search for comets will find a good primer on these pages. Levy then moves on to the visual observation of comets; this is the heart of what the A.L.P.O. Comets Section is all about. I wish that all of our observers would read this.

Some of us wish historical and background information about asteroids and this book provides it. I was surprised to learn that each day as many as 50 small asteroids (10 meters in diameter or less) pass by us at less than the Moon's distance. Visual observing, photography and electronic imaging of asteroids are also discussed in this chapter.

Meteor observing is covered throughout the meteor chapter. Anyone wishing to casually observe meteors, observe and report them, or assemble a team of observers to monitor the sky, will find loads of helpful tips here. Photography, electronic imaging and radio methods round out this chapter.

Have you ever seen a significant fraction of an observer's guide devoted to zodiacal light? This one explains what it is, how it was discovered, and how the amateur can make useful observations of it.

A chapter entitled "Advanced Observing Techniques" dives into astrometry, triangulation of a meteor path, spectroscopy, and photoelectric photometry. This is followed by a glossary, report forms, a list of meteor streams, plenty of references, and a comprehensive bibliography.

This is an excellent guide that covers the subjects well. I recommend it to anyone interested in what some authors call the "debris of the solar system."

The Jupiter Observer's Guide and Reference Book.

By Phillip W. Budine (and others).

Published privately by Phillip W. Budine, R. D. 3, Box 145C, Walton, New York 13856. 1994. 333 pages. Price: $24.95 paper.

Reviewed by Claus Benninghoven

In this book veteran observer and A.L.P.O. Assistant Jupiter Coordinator Phillip W. Budine has compiled an extensive record of the chronology of observations of the Giant Planet spanning the 42-year period that ends in 1994. He also provides the reader with details about observing methods and equipment required to participate in one of the more enjoyable and potentially useful observing activities; the systematic monitoring of changes in the colorful cloud-deck of the planet Jupiter.

The author presents a good selection of the observational material that has accumulated during this period which begins in the early 1950s at the conclusion of coverage by B.M. Peek's book, *The Planet Jupiter*. The subject-matter covered in Budine's book is well arranged and offers the reader valuable and easily accessible information for research about the Giant Planet.

Much of the material presented consists of rotation period tables, drift charts, and graphs that make it easy for the reader to follow the development of spots and outbreaks of matter in different currents of the planet's atmosphere. The book is amply illustrated with numerous photographs, disk drawings, and sectional and strip sketches by observers from many parts of the world. Outstanding are the beautifully detailed disk drawings by I. Miyazaki, which should be an inspiration to novice and experienced observers alike.

The first six chapters deal with instrumentation and visual observing techniques. Minimum aperture, F-ratio, magnification and optical systems are mentioned briefly. A more detailed description covers methods of making disk drawings, strip and sectional sketches, and intensity and color estimates. This section includes two very informative articles by Ron Doel. There is also a wealth of information on transit timings and their reduction; and the nomenclature of belts, zones, special features and the abbreviations for them. The author stresses the advantage and importance of strip and sectional sketches, which are much easier to execute than disks, take less time, have the potential to show more small-scale detail, and represent more accurately the relationships between features.

Chapters Seven through Ten are devoted to the aspect of belts, zones, permanent features (the Great Red Spot), and semi-permanent features (the long-enduring South Temperate Ovals). The STrZ Disturbance, STr Dark Streaks and STr Dislocations are discussed in detail.

The lengthy chapter Eleven (pages 159-293) deals with a host of interesting features; for example, the "classical" SEB outbreaks are described and documented (the author's research indicates a three- year cycle). Much less frequent is the SEB Bright Streak Disturbance, also discussed in this chapter. In addition, there is an account of the discovery and observational history of the rare occurrence of the Oscillating Spots, a phenomenon that was first observed in 1940 and then again in 1987. The STB Fade and related events, with highlights of developments on Jupiter during the late 1980s and early 1990s are included in this chapter, as are articles and notes by Budine and Jose Olivarez which had been previously published.

Chapter Twelve describes the Olivarez Blue Features, projections located at the south edge of the NEB which rotate fairly consistently in System I. The author includes a drift-line graph of their 1984 rotation periods and speculates about their true nature. Jose Olivarez was the first observer to detect and identify twelve of these objects in 1983; according to Budine most have survived for at least seven apparitions of the Giant Planet.

Chapter Thirteen first gives an account of the history of events of the North Temperate Current C in the NTBs, also called "Jupiter's Jet Stream," then goes on to examine observations of the outbreak of activity in this region in early 1990.

Although much knowledge about Jupiter has been gathered from the Voyager and Pioneer Missions, it is widely recognized that there is still a need for a continuous patrol to keep track of changes in the Jovian atmosphere. At the end of the book, in Chapter Fourteen, the author makes just this point. In an interview with noted observer Stephen James O'Meara, he also refers to remarks made by the professional astronomer Rita Beebe, who stresses the importance of archiving data collected by amateur Jupiter observers.

Budine has accomplished what he set out to do, to provide the amateur observer with an up-to-date record of observations and a frame of reference for future studies of Jupiter. His thorough knowledge of, and intimate familiarity with, Jovian atmospheric currents are based on a lifetime of observing experience and involvement in the evaluation, analysis and reduction of observational data submitted by many individuals over the past several decades. This book is a must for any student of the Giant Planet who is interested in keeping informed of recent developments and who intends to contribute to the observational record.

An Observer's Guide to Comet Hale-Bopp.

By Don Machholz.

MakeWood Products, P.O. Box 1716, Colfax, CA 95713. 1996. 82 pages. Price $12.00 paper (ISBN 0-9646487-2-5).

Reviewed by Jose Olivarez

As of the Spring of 1996, Comet Hale-Bopp was already expected to put on a good show in March and April, 1997 [and continues to live up to expectations as of Fall, 1996]. With this prospect in mind, Don Machholz, a very experienced observer and discover of comets, and the A.L.P.O. Comets Coordinator, wrote this user-friendly guide to help both the experienced or the novice follow the comet as it glides past star clusters, galaxies, and nebulae from March, 1996 through December, 1998.

This guide's 88 pages are divided into five chapters, beginning with: "A Crash Course on Comets" (Chapter 1). It then details the specifics of the comet (orbit, path, and brightness) in Chapter 2, and ends with suggestions for "Special Projects" in Chapter 5. One of the special projects suggested is viewing the comet during the total solar eclipse of March 9, 1997 when the comet should be visible to the naked eye 45 degrees from the Sun! Other project descriptions discuss photography and CCD imaging of the comet and showing the comet off at public star parties and to the media. The book continues with sections on using "planetarium" computer programs to plot the comet's path, together with the necessary orbital elements. This is followed by a list of Web pages that will provide up-to-date information on Comet Hale-Bopp. The final page describes "Other Things to See With Your Telescope."

But the heart of this well-prepared and well-printed Guide is Chapter 4, "Along the Path of Comet Hale-Bopp". This chapter's 44 pages, half the book, are filled with 54 general maps and detailed finder charts that precisely locate Comet Hale-Bopp's position from March, 1996 through June, 1997. There are also maps of the comet's southern travels for the July -December, 1998 period. The scales and limiting magnitudes of these charts vary, depending on the comet's brightness and its rate of motion. These charts are accompanied by notes on the comet's location with respect to the Earth, Sun, and other pertinent objects.

So, if you are new to astronomy and want to see Comet Hale-Bopp, this Guide provides the maps you need to see the comet from a dark site. And if you are an experienced observer, this detailed Guide charts the progress of Comet Hale-Bopp nightly from March 1, 1996 through December 31, 1998.

I also recommend *An Observer's Guide to Comet Hale-Bopp* for science educators and planetarium directors who will undoubtedly be called upon to show Comet Hale-Bopp to student groups.

A.L.P.O. GUIDELINES FOR AUTHORS

John E. Westfall, A.L.P.O. Editor
(Approved by A.L.P.O. Board on July 24, 1996)

GENERAL

The A.L.P.O. welcomes reports, articles, and letters for publication. In most cases, such materials are considered for the *Journal, A.L.P.O.* ("The Strolling Astronomer"); the Guidelines that follow are intended for that Journal. Special guidelines for A.L.P.O. Monographs and Proceedings are provided at the end.

All submissions, including "letters to the Editor", should be accompanied by a cover letter stating that the material is being submitted for publication. Please give your telephone number, and FAX number and E-mail address if you have them. A single copy of a submission is usually sufficient, although we recommend strongly that the author(s) retain a copy for themselves.

In terms of content, we deal with the objects in the Solar System; the Sun, Moon, major and minor planets, comets, and meteors. Our emphasis is on observations and observing techniques rather than theory or cosmology. Ordinarily, submissions should not exceed a total of 10-12 printed pages *including illustrations*; allow about 1000 words per printed page.

The A.L.P.O. publishes in the English language only. All submissions should be in clear, grammatical English.

We assume that all submissions are original and have neither been published nor currently submitted to any other publication. Once material has been published by the A.L.P.O. it may not be published elsewhere without the permission of both the author(s) and the A.L.P.O. Editor.

Unsolicited revisions of previous submissions will be accepted only in unusual cases, such as when new information invalidates statements in the original.

Text and illustrations are to be submitted on letter-size white paper, unfolded and printed on only one side of the sheet.

Material not conforming to these guidelines may be either rejected outright or returned to the author for correction. In summary, remember that papers need accurate information, should be clearly written, and need to be carefully typed.

Electronic Submissions

We encourage submissions in electronic form, with the following conditions:

• The submission must also include paper copy of **all** text and illustrations.

• The submission text must be in the form of a Plain Text file (ASCII) on a 3-1/2 inch diskette formatted for either a Macintosh or PC-compatible.

• If illustrations are submitted electronically, they also should be on a 3-1/2 inch diskette formatted for either a Macintosh or PC-compatible. The file format should be either EPS if a line drawing; or PICT, TIFF, or GIF, if greyscale (color illustrations cannot be printed in color; if submitted in color, they will be converted to greyscale).

• Do not compress submitted files unless there is no other way to squeeze a file onto a diskette (in which case it will probably be too large to print anyway).

• Label the disk as to the type of computer and the file format(s).

TEXT

General

Handwritten or hand-printed submissions are not acceptable. The text should be either typewritten or computer-printed in clear black type, 1-1/2 or double-space.

The title and author's (authors') name(s) should be centered at the top of the first page. If the author(s) wishes, an affiliation or address may be given.

For articles longer than about 2 printed pages (roughly 2000 words) place a 75-100 word **abstract** just preceding the main text (the *J.A.L.P.O.* is abstracted).

Number all equations in order, beginning with (1). Each equation should be placed on a separate line.

Pay particular attention to:

• Consistency in numerical values between different parts of the text, between tables, and between the text and tables.

• Accuracy and completeness of literature references.

• Consistency between English and Metric units for telescope apertures; metric units are preferred for astronomical dimensions.

Footnotes

Footnotes should be literature citations only, in the form, "(Jones, 1973, 18)", where the last figure is the page referred to. Use, for example, "Smith *et al.*" when there are four or more authors. Note that, where italics are used in these guidelines, authors may use underlining instead.

References

Literature references are to be listed at the end of the text, in alphabetical order by author, formatted as in the following examples:

Moriarty, J. (1885) *Asteroid Dynamics.* Arkham, MA: Miskatonic University Press.

Ward, C.D. (1987) "Watching Four Comet Halley Apparitions." *New England Journal of Astronomy*, Vol. 285, No. 5 (July), pp. 17-31.

If there is more than one reference to the same author in the same year, use, for example, "(1994a)", "(1994b)", in the order of publication. Note that the title should be given for all works, including papers, and that the range of pages should be given for papers, not just the first page.

If the author refers to a "personal communication", a reference "in press", or to a WWW page, they should submit appropriate hardcopy with their paper.

Tables

Tables are treated as text rather than illustrations, and may be submitted either as separate pages or embedded in the main text. Number tables consecutively with Arabic numbers, beginning with "Table 1." No table should exceed the size of one full page (6.5 by 11.0 inches).

ILLUSTRATIONS

General

Illustrations submitted should be clearly drawn, with good contrast. Normally, they will be scanned and placed in the final copy by the Editor. We cannot publish in color, and will have to convert any color originals to greyscale. Illustrations are returned only if requested.

The author should select which illustrations are to be used; rather than, for example, providing the Editor with an envelope full of illustrations and letting him choose.

Number all illustrations on their backs, with Arabic numbers beginning with "Figure 1." For astronomical views (drawings, photographs, electronic images), celestial north must be indicated; if the image is laterally reversed, indicate this as well.

Graphs need to be clearly drawn and labeled, with scales provided on all four margins.

Captions

Provide captions for all figures, indicated by consecutive number, beginning with "Figure 1." For astronomical views, supporting information is essential. At the minimum, this should include: Observer name; date and time in UT; telescope type, aperture (cm preferred), and magnification (if a drawing); filters used, if any; atmospheric conditions (Seeing on the 0-10 A.L.P.O. Scale, Transparency as limiting stellar magnitude in the vicinity of the object); and other data pertinent to the object observed. Object-specific data include, for example, colongitude for the Moon and central meridians for most planets. For photographs or electronic images, the exposure time and effective focal ratio should also be given.

"Camera-Ready Illustrations"

Occasionally, authors wish to submit illustrations that are intended to be published exactly as they appear. Most often, these are groups of small drawings or photographs that are to appear together. Such submissions must: (1) Be in clean reproducible form with good contrast and linework; (2) Not exceed 6.5 by 11.0 inches for the actual illustration(s); (3) Not contain captions or figure numbers (although these may be provided on another sheet); (4) May contain letters to identify separate figures within the illustration. Bear in mind that *Journal, A.L.P.O.* illustrations are reduced to about 70 percent of their original size for publication.

SPECIAL INSTRUCTIONS: SECTION REPORTS

Section Reports present some special problems for their authors:

- A large volume of observations need to be summarized in no more than 10-12 pages of printed text and illustrations.
- Not every observer can be trusted to calculate correct central meridians and other ephemeris quantities; these all need to be checked by the author/Section Coordinator.
- It is important to give credit to observers by name, so every Section Report should include a list of contributing observers, containing at the least their names and location (both spelled correctly). If space allows, observers' telescope types and apertures, and the number of observations contributed by type, should also be given.
- Statistical information about the apparition should be included; with information such as dates of conjunction, opposition or greatest elongation, declination at opposition, angular diameter, length of observing season, and so forth.
- The author/Section Coordinator may need to convert to American or A.L.P.O. standard usage foreign usages, such as the Antoniadi Seeing Scale.

SPECIAL INSTRUCTIONS: MONOGRAPHS

A.L.P.O. Monographs comprise special publications that are too lengthy for *Journal* publication. Unless intended for Convention Proceedings (see below), Monograph submissions follow the same guidelines as for the *Journal*, except for the length restriction.

SPECIAL INSTRUCTIONS: PROCEEDINGS

All material for Convention Proceedings is to be camera-ready, both text and illustrations. All the editor will do before photocopying is to add continuous page numbers. Thus, what the author submits will be reproduced exactly in appearance. Page numbers should be on the *back* of each page. Also, illustrations must be submitted mounted on pages with captions in place.

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These guidelines are intended to help produce a higher-quality Journal.. Obviously, no paper will be perfect, but the Editor is happy to work with authors to improve submissions when the author makes a a good-faith effort to comply. However, repeated disregard of these guidelines will result in a paper being rejected.

THE A.L.P.O. PAGES

THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

Founded by Walter Haas in 1947, the A.L.P.O. now has about 650 members. Our dues include a subscription to the quarterly Journal, *The Strolling Astronomer*, and are $16.00 for one year ($26.00 for two years) for the United States, Canada, and Mexico; and $20.00 for one year ($33.00 for two years) for other countries. One-year Sustaining Memberships are $25.00; Sponsorships are $50.00. 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**. VISA or MasterCard may be used by telephoning the Chabot Observatory and Science Center, 510-530-3480 (ask for "Extension 30" and leave a message) between the hours of 10 AM-noon and 1-4 PM Pacific Time, M-F, or by mail to: Chabot Observatory and Science Center, Starry Nights Gift Shop, 4917 Mountain Boulevard, Oakland, CA 94619 U.S.A; you may also FAX to 1-510-482-0425.

When writing 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/**

A.L.P.O. ANNOUNCEMENTS

New Address for Executive Director/Membership Secretary.—Effective immediately, Harry D. Jamieson, the A.L.P.O. Executive Director and Membership Secretary, has a new postal address: **P.O. Box 171302, Memphis, TN 38187-1302 U.S.A.** All correspondence regarding membership and subscriptions should go to this address.

Recorders are now Coordinators.—By decision of the A.L.P.O. Board, the previous and rather passive title of "Recorder" for Section staff has been replaced by the more active title of "Coordinator."

New Historical Section.—The A.L.P.O. now has a provisional Historical Section, concerned with both the history of Solar-System astronomy and the A.L.P.O. (aren't these pretty much the same?). The Acting Coordinator is: Gary L. Cameron, 4231 Northwest Dr., Des Moines, IA 50310-3308.

New Mercury Recorder.—The vacant post of Mercury Coordinator has now been filled by an Acting Coordinator: Dr. Oscar Cole Arnal, Waterloo Lutheran Seminary, Waterloo, Ontario N2L 3C5, CANADA; e-mail: ocole@mach1.wlu.ca . Please note Dr. Cole Arnal's article on pp. 49-55 of this issue.

Solar Coordinators Resign.—Due to personal reasons, Solar Coordinator Paul Maxson has resigned. Joining the Solar Section staff in 1982, he has directed it since 1992. During his tenure on our staff he has regularly produced the *Solar Rotation Report*, which has been widely referred to by both amateurs and professionals. We are deeply appreciate of Mr. Maxson's long-term contributions to the A.L.P.O. and are searching for a worthy successor to him.

Likewise, Randy Tatum, who has served as an Assistant Solar Coordinator since 1984, has resigned, also for personal reasons. Mr. Tatum has prepared the solar reports published in this Journal since 1993 and one of his reports is on pp. 75-80 of this issue. We also extend our thanks to Mr. Tatum for his years of service to the A.L.P.O.

Computing Section Newsletter.—The A.L.P.O. Computing Section will publish a free bimonthly newsletter, tentatively titled *The Digital Lens*, beginning in January, 1997. The newsletter will be an electronic publication designed to foster the exchange of ideas and information in astronomical computing. It will focus on all areas of computing—hardware, software, analysis, telescope control, and the Internet—and will include informative articles, reviews, and technical tips in all areas of computing directly or indirectly related to Solar-System astronomy. The newsletter's success will depend heavily on contributions of articles, reviews, and comments from its readers. Send all communications via e-mail to: MWMCCL1@HOP-UKY.CAMPUS.MCLNET . The newsletter will be available by subscription and distributed via e-mail. If you would like to subscribe, send your name, postal address, and e-mail address to: Mike W. McClure, the editor, at the e-mail address above. If server space can be allocated, the newsletter will also be posted on the A.L.P.O. Homepage. Dr. McClure looks forward to receiving comments and suggestions for *The Digital Lens.*

A.L.P.O. Homepage.—Persons continue to suggest that the A.L.P.O. have a world-wide web homepage, so perhaps we should repeat the announcement that we *already have one*: Our Assistant Solar Recorder, Richard E. Hill, has generously devoted his time to establishing and maintaining an A.L.P.O. home page on the World-Wide Web; its WWW address is:

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

We also thank the University of Arizona, Lunar and Planetary Institute for proving a host computer for this page. All staff who wish to post Section news for our page should send it to Rik Hill, whose address is in our staff listing.

Thanks to Mark Davis.—Due to the increase in his workload in our Meteors Section, Mark Davis will no longer be in charge of receiving orders, printing, and distributing the *A.L.P.O. Solar System Ephemeris*. These are very valuable services that he had performed for our organization for several years, and we take the opportunity to thank him for doing so. (Watch for announcements about the future availability of the *A.L.P.O. Solar System Ephemeris* in this Journal and in our newsletter, *Through the Telescope*.)

THE UNIVERSE BEYOND THE A.L.P.O.

This section provides news about non-A.L.P.O. organizations, meetings, and individuals concerned with Solar-System topics and thus which should be of interest to our readers.

Twenty-Eighth Lunar and Planetary Science Conference.—One of the chief two such annual professional Solar-System conferences, this meeting is scheduled for March 17-21, 1997, at the NASA Lunar and Planetary Institute in Houston, Texas. For submitting an abstract for a paper or poster, the deadline is January 8, 1997 for hardcopy and January 10, 1997 for electronic submission. For ongoing information see the conference web page (http://cass.jsc.nasa.gov/LPSC97); or telephone 713-486-2166 concerning the program and logistics, or 713-486-2180 about abstract preparation, submission, and publication.

Universe'97.—Now a regular institution hosted by the Astronomical Society of the Pacific and *Astronomy* magazine, Universe'97 will be held at the Hyatt Regency Hotel in downtown Chicago on June 27-29. On the weekend (June 28-29), events will include speakers and organizational and vendor displays oriented toward amateurs, educators, and the interested public. (No further information is available at this time, but you may wish to mark these dates on your calendar.)

Venus Section: Julius L. Benton, Jr. , *Coordinator;* Associates in Astronomy, 305 Surrey Road, Savannah, GA 31410. CompuServe 74007,3446 .

Mars Section: Daniel M. Troiani , *Coordinator; all observations; U.S. correspondence;* 629 Verona Court, Schaumburg, IL 60193.

Carlos E. Hernandez, *Coordinator; all other correspondence,* 9430 SW 29nd Terrace, Miami, FL 33165.

Donald C. Parker, *Assistant Coordinator; CCD imaging, "Mars Project";* 12911 Lerida Street, Coral Gables, FL 33156.

Daniel Joyce, *Acting Assistant Coordinator;* 6203 N. Keeler Ave., Chicago, IL 60648-5109.

Minor Planets Section: Frederick Pilcher, *Coordinator;* Illinois College, Jacksonville, IL 62650.

Jupiter Section: Wynn K. Wacker, *Acting Coordinator;* 7601 Carrington Dr. #D, Madison, WI 53719.

Phillip W. Budine, *Assistant Coordinator, Transit Timings;* R.D. 3, Box 145C, Walton, NY 13856

Carlos E. Hernandez, *Assistant Coordinator;* 9430 SW 29nd Terrace, Miami, FL 33165.

John E. Westfall , *Assistant Coordinator, Galilean Satellites;* P.O. Box 16131, San Francisco, CA 94116. CompuServe 73737,1102; FAX 415-731-8242 .

Sanjay Limaye, *Acting Assistant Coordinator; Scientific Advisor;* Atmospheric Oceanic & Space Sciences Bldg. 1017, 1225 W. Washington Ave., University of Wisconsin, Madison, WI 53806. Internet: LIMAYE@MACC.WISC.EDU .

Saturn Section: Julius L. Benton, Jr., *Coordinator;* Associates in Astronomy, 305 Surrey Road, Savannah, GA 31410. CompuServe 74007,3446 .

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, *Acting Assistant Coordinator;* 7304 Doar Road, Awendaw, SC 29429.

Instrument Section: Michael Mattei , *Coordinator;* 11 Coughlin, Littleton, MA 01460.

Computing Section *(Provisional)*: Bob Manske, *Acting Coordinator;* 404 Prospect Road, Waunakee, WI 53597.

Mercury/Venus Transit Section: John E. Westfall , *Coordinator;* P.O. Box 16131, San Francisco, CA 94116.

Historical Section *(Provisional)*: Gary L. Cameron, *Acting Coordinator,* 4231 Northwest Dr., Des Moines, IA 50310-3308. CompuServe 73737,1102; FAX 415-731-8242 .

A.L.P.O. MONOGRAPH SERIES

The A.L.P.O. monograph series consists of publications that we believe will appeal to our members, but which are too lengthy for our *Journal.* Five monographs are now available, and more will be issued at intervals in the future. They may be ordered from our Editor (P.O. Box 16131, San Francisco, CA 94116 U.S.A.) for the prices indicated in parentheses, 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.

(over)

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.

OTHER PUBLICATIONS OF THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

(All Section Publications must be ordered directly from the appropriate Section Coordinators.)
(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 June, 1996.

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

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

② ***A.L.P.O. Membership Directory.*** $5.00 in North America; $6.00 elsewhere. Continuously updated list of members on MS-DOS diskette; specify 3.5-in or 5.25-in disk and whether DBASE or ASCII format. Make payment to "A.L.P.O." *Provided at the discretion of the Membership Secretary.*

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

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

1 (1947); 6. *8* (1954); 7-8. *11* (1957); 11-12. *21* (1968-69); 3-4 and 7-8.
23 (1971-72); 3-4, 7-8, 9-10, and 11-12. *25* (1974-76); 1-2, 3-4, and 11-12.
26 (1976-77); 3-4, 5-6, and 11-12 [each $1.75]. *27* (1977-79); 3-4, and 7-8 [each $1.75].
31 (1985-86); 5-6 and 9-10 [each $2.50]. *32* (1987-88); 5-6 [each $2.50].
33 (1989); 4-6, 7-9, and 10-12 [each $2.50]. *34* (1990); 2 and 4 [each $2.50].
37 (1993); 1, 2, 3, and 4 [each $2.50]. *38* (1994-96); 1, 2, 3, and 4 [each $2.50]. *39* (1996); 1 ($2.50).

Current Issue [*39*, 2]—$3.00.

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*, $6.00. 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 (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): A "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 ALPO 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 (Westfall): *Timing the Eclipses of Jupiter's Galilean Satellites*; send a SASE with 55 cents in stamps. 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 Recorder for monthly installments of *Comet Comments*, a one-page newsletter reviewing recent comet discoveries and recoveries, and providing ephemerides for bright comets.

Meteors (Astronomical League Sales, P.O. Box 572, West Burlington, IA 52655): The handbook, *Observe Meteors*, by David H. Levy and Stephen J. Edberg, is available for $6.00.

Minor Planets (Derald D. Nye, 10385 East Observatory Drive, 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*, will be available via e-mail beginning January, 1997. To subscribe or to make contributions, contact the editor, Mike W. McClure, at: MCMCCL1@HOP-UKY.CAMPUS.MCI.NET .

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