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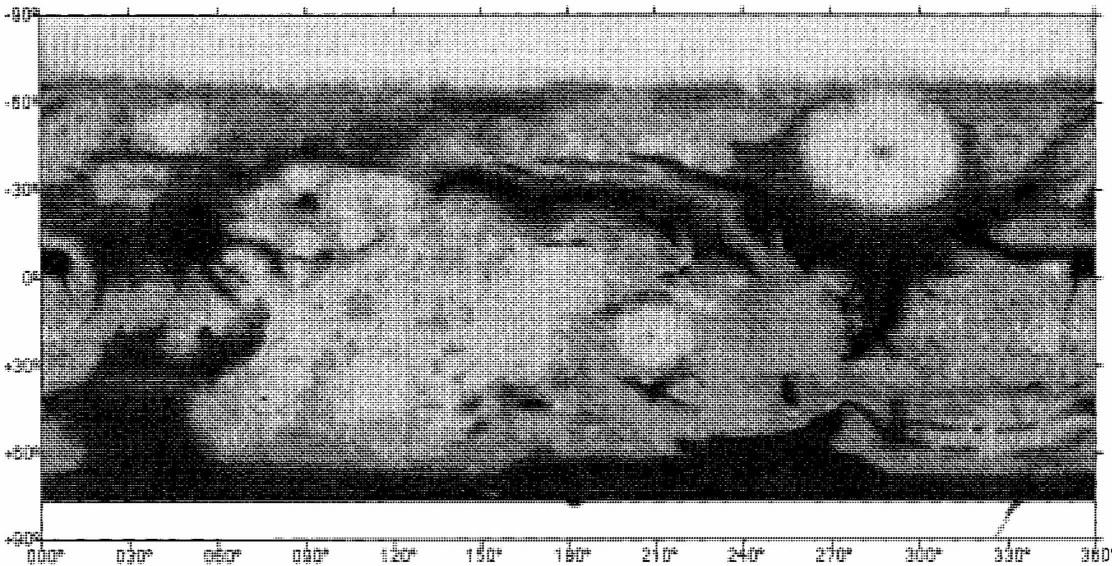

Cylindrical Equidistant Projection map of Mars' albedo features in 1992-1993. Prepared by Daniel M. Troiani, Jim Carroll, Daniel Joyce, and associates using video images and photographs. South is at the top and Martian west is to the right; the left and right margins are at longitude 000°. See report on pp.97-113.

THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS
c/o Dr. John E. Westfall, Director / Editor

Membership Secretary, Harry D. Jamieson
P.O. Box 16882
Memphis, TN 38186-0882

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IN THIS ISSUE

THE 1992-1993 APHELIC APPARITION OF MARS

By: Daniel M. Troiani, Jeffrey D. Beish, Donald C. Parker,
and Carlos E. Hernandez

ABSTRACT

Mars was favorably placed for observers in the Northern Hemisphere from mid-July, 1992 through mid-June, 1993. The Association of Lunar and Planetary Observers' International Mars Patrol (IMP) observational programs for that apparition are discussed, along with the characteristics of the apparition. Included is a description of the Martian North Polar Region's seasonal aspects. The Rima Tenuis was seen very early in the Martian northern spring. This report also presents the environmental conditions that favored the development and the movements of one minor dust storm observed during October, 1992.

INTRODUCTION

One hundred years ago Camille Flammarion published *The Planet Mars*, an extraordinary book that summarized mankind's knowledge of the Red Planet. After 380 years of classical visual observations of Mars, hundreds of dedicated amateur observers still carry on this great tradition. For the past 29 years 1,033 amateur and professional astronomers have participated in this classical astronomical research by contributing nearly 25,000 Mars observations to the A.L.P.O.'s International Mars Patrol. Using modern knowledge gained from the Mariner and Viking Spacecraft missions to Mars, ground-based observers relentlessly record Mars from Earth each apparition, year after year.

Established in the 1960's by Charles F. ("Chick") Capen, the International Mars Patrol (I.M.P.) is a cooperative program conducted by planetary observers located around the Earth, making possible a 24-hour surveillance of all Martian longitudes. Contained within the archives of the A.L.P.O. Mars Section library are the records of fourteen apparitions of Mars covering a span of 29 years (1964-1993). The I.M.P. was supported by observers in eleven countries during 1992-1993: Australia, Belgium, Canada, Denmark, England, Finland, France, Germany, Japan, Sweden, and the United States.

1992-1993 OBSERVATIONAL SUMMARY

The 1992-1993 Apparition of Mars is over and there is much to report. Mars was high in the sky for observers in the Northern Hemisphere, at declination 26° north at opposition. However, poor weather conditions around the world prevented many from participating in a regular Mars patrol. Many observers complained of "less than perfect seeing" and "endless days of clouds."

Unfortunately many participants experienced unusually cloudy weather along with reduced atmospheric transparency caused by the volcanic eruptions in the Far East over the past two years. Even though the number of reports was undoubtedly reduced by the poor conditions, we received thousands of high-quality drawings, photographs, and CCD images.

Interesting meteorological features were seen and the South Polar Region (SPR) was tilted toward the Earth during the early part of the apparition. Later, in Fall 1992, for the first time since 1984, the North Polar Region (NPR) could be studied by terrestrial observers. Mars reached opposition on 1993 JAN 07 (Planetocentric solar longitude [Ls] 022°) and was closest to Earth on 1993 JAN 03 (020° Ls) at a distance of 58,199,514 miles (93,662,226 km) and with an apparent disk diameter of 14".95 (" = arc-seconds). The 1992-93 Apparition is considered aphelic because opposition occurred only 48° from aphelion (Mars' farthest distance from the Sun, at Ls 070°). [Directions here are in the I.A.U. System. Ed.]

The observing season began on 1992 APR 24 (Ls 236°) with the first visual observation by Jeff Beish of Miami, Florida with a disk diameter of only 4".8. Our observing season was ended on 1993 NOV 14 (Ls 166°) by Ted Stryk, a 14 year-old from Bristol, Virginia, with a disk diameter of 3".8! During the apparition, 42 percent (Ls 152°) of the Martian year was observed. Parts of four Martian seasons were covered; 5 percent (4° Ls) of the Martian southern spring (northern autumn); 64 percent (55° Ls) of the Martian northern winter; 90 percent (81° Ls) of the northern spring; and 10 percent (9° Ls) of the northern summer.

Seventy-four A.L.P.O./I.M.P. Mars observers contributed a total of 1491 reports including 916 visual and 330 photographic multi-colored observations of Mars, 77 measurements of the Martian North Polar Cap (NPC), and 168 CCD images. The 106 telescopes used during this apparition ranged from a 2.4-inch (6-cm) refractor to a 200-inch (5-m) reflector. The optical types used were: Newtonians, 52; refractors, 32; catadioptrics, 16; Cassegrains, 5, and one Trischiefspiegler. The mean aperture was 12.4 in (31.5 cm). *Table 1* (p. 101) lists the participating observers for the 1992-1993 Mars Apparition. A selection of their drawings and photographs is shown in *Figures 1-133* (pp. 107-113).

Meteorological Observations

Martian meteorological activities began to increase in early July, 1992 (Ls 279°). By the first weeks of August (Ls 300°), morning limb clouds and hazes, discrete clouds and the southern limb haze increased. From November, 1992 (Ls 349°) the North Polar Hood (NPH) started to slowly break up. The first observation of this was Troiani's view of Mars in late November when he saw numerous thin white clouds visible in violet light (using a W47, or Wratten 47, dark-blue filter) in Mars' northern hemisphere and near the NPH. Thus began a period of moderate white-cloud activity with frequent bright morning and evening limb haze. There was considerable bright haze, on both the evening and morning limbs, observed during this period. Some clouds appeared bright even in red light because of some fine dust in the cirrus white clouds.

Orographic clouds were observed near large volcanoes like Olympus Mons and others in the Tharsis region. These clouds appeared a full month earlier than predicted. This was an indication that the North Polar Cap (NPC) was in rapid retreat. These discrete white orographic clouds are seen in Martian local spring and summer, forming on the upper slopes of the large volcanoes. The Mariner and Viking Spacecraft identified them as water clouds.

There was also some evidence of equatorial cloud bands (ECB), visible across the Tharsis region extending into Amazonis. CCD images by D. Parker on 1993 MAR 11 show extensive cloud bands over the Tharsis region. ECB are faint veils of wispy white clouds with a variety of shapes and degrees of transparency that extend across the Martian equatorial region. These ECB are best detected in violet light, reside at a chilly high altitude, and are probably composed of CO_2 ice crystals.

Near opposition in early January, 1993, the Chryse-Xanthe region was very bright, covered by a haze as seen in blue light. Bright clouds were seen near Tempe in early January. Alan Heath (B.A.A. [British Astronomical Association]) reported a cloud over Olympus Mons. A very bright small circular cloud was seen over the Libya basin and a dense haze was seen in the Hellas basin. Richard McKim (England) saw a bright white cloud over Argyre I. Both the evening and morning limb occasionally had bright clouds adjacent to them. There was a white haze visible along the southern limb that started in January and continued for months. This bright area could be related to the SPC that was not visible itself. This cloud mass was very variable in intensity and not seen on all nights.

Mars was cloudy during February, 1993 as Richard McKim reported Hellas very bright, with patches of clouds in northwest Hellas and to the northeast in Libya. Heath saw the Libya cloud cross over the Syrtis Major region. Several observers reported bright clouds in the Noachis-Serpentis Mare region, Hellas, Libya, hints of the South Polar Hood (SPH), Zephyria, Electris and a very large and bright white cloud over Eridania extending into Ausonia. This cloud activity was reported by Robinson, Melillo, Rhea, McKim. Fabian, Heath, Warell, and Troiani. An ECB was seen by Rhea. A white cloud in the vicinity of Arabia also was reported. It was also noted in February that the NPC was shrinking rapidly.

By March, 1993, several clouds were visible in both Memnonia and Electris. There was a cloud over Ganges and again Libya was very bright. Bright equatorial clouds were seen by Rhea, as well as cloud activity around Argyre I. These ECB's were seen by Johnson (B.A.A), extending 63° in Martian longitude. There also was some cloud activity in the Lunae Lacus vicinity.

In early May, 1993, there was a bright cloud covering parts of Syrtis Major. A bright spot was seen in Iapygia and the SPR was very bright white. Clouds were seen in the Ausonia-Australis region and a bright spot appeared to be in Libya. Hellas was bright with fog.

As Mars continued to recede from Earth in June, 1993, the number of observations grew smaller. We did have a few good observations showing bright clouds in the Amazonis and Tritonis Sinus regions. Propontis I was seen as a small dark rod. There were several observations of clouds that were again visible over the Tharsis region as well as over the great volcano Olympus Mons! A brief list of Martian meteorological, surface white area, and NPC rift activity from early January through August, 1993, is given in *Table 2* (p. 102). The frequency of occurrence of different types of meteorological activity in 1992-1993 is summarized in *Table 3* (p. 102).

Dust Storms

The atmosphere of Mars was relatively clear during the late northern winter and early spring. There is some evidence of dust-cloud activity in Ophir on 1992 JUL 04 (Parker CCD images) and in Hellas and Hadriacum Mare on 1992 JUL 25, 26, and 30 (Parker CCD images); however, no other observations substantiate this.

The *Communication of the Oriental Astronomical Association* (O.A.A.) first reported that H. Ishadoh (Japan) observed two minor dust streaks near Aurorae Sinus on 1992 OCT 03 (Ls 334°). There was a temporary darkening of Ganges and a slight fading of Nilokeras. Y. Higa (Japan) was able to get videos of Mars showing the darkening of Ganges and the fading of the southern part of Nilokeras on 1992 OCT 02 (Ls 334°). By 1992 OCT 06 an Ishadoh drawing showed that Lunae Lacus had returned to normal and that Ganges was slightly darker. Thus it appears that the Japanese observers saw the beginning of several dust storms around the Chryse region throughout most of October, 1992.

While observing Mars in red light on 1992 OCT 15, Jeff Beish (Miami, FL) observed a bright spot west of Solis Lacus. Dust streaks in Chryse were shown on CCD images taken by Parker, Joyce, Troiani, and Carroll during 1992 OCT 16-25. On 1992 OCT 19 (La 342°) A.L.P.O. observers K. Rhea (ARK) and J. Beish both observed a bright spot in Aurorae Sinus and Ophir. Bright dust clouds appeared over Solis Lacus on 1992 OCT 20-23 (Ls 343°-344°) while Chicago, Illinois A.L.P.O. members D. Joyce, D. Troiani, and J. Carroll observed Mars with 17- and 20-in (43- and 51-cm) telescopes and recorded the clouds both visually and with a CCD camera. They also observed a dusty haze extending into Erythraeum Mare over Solis Lacus, Xanthe, and into eastern Memnonia. S. Whitby also reported a bright diffuse area within Chryse on 1992 OCT 20. Aurorae Sinus appeared to have faded into a slightly shaded area and to have been affected by this dust cloud. Sirenum Sinus and Solis Lacus appeared normal for this time of year. Note that Martian dust clouds are best detected with a deep red filter such as a W25 or W29.

The apparent dust-cloud activity subsided by 1992 OCT 23 when K. Rhea and S. Whitby observed only a bright morning limb arc (haze) in red light. Visual reports by Whitby and Rhea and CCD images by D. Parker indicated that Chryse remained bright through 1992 OCT 26 (Ls 344°-346°). CCD images by. D. Parker showed that Chryse was bright in red light even on 1992 OCT 30 (Ls 348°).

In early November, 1992, all this dust activity ended, with the atmosphere returning to its normal clarity. Then, in December 1992, an increase in white clouds was noticed. No other Martian dust clouds or storms were visible during the period from November, 1992, until April, 1993. We did receive a report from Kermit Rhea of a small disturbance or dust cloud moving over Sabaeus Sinus and Meridiani Sinus in early May, 1993.

The October, 1992, observations were similar to the dust-cloud activity in 1990, but on a smaller scale. Mars has shown us that very minor dust storms may be more common than we once thought. The 1990 (Ls 310°-312°) and the 1992 (Ls 335°-346°) storm events appeared without warning! They were very localized without any major changes in the Martian albedo features.

Major dust storms are rather rare events on Mars. Planet-wide dust storms are the rarest, and there have been only five reported in the entire history of Mars observations!

NORTH POLAR REGION

The Martian North Polar Cap (NPC) appeared to retreat towards the pole rather slowly during the early northern spring and began its usual rapid thaw after mid-spring.

Micrometer measurements and CCD and video images revealed a more rapid regression of the Martian North Polar Cap during late 1992 and early 1993. This gives rise to the theory that if the NPC retreats more rapidly than "normal", then more atmospheric clouds and hazes will be seen on Mars.

Also, in apparitions when the Rima Tenuis is observed, the NPC appears to have retreated to a smaller than "normal" size. This appears to be true for this recent apparition, because of early developments of orographic clouds, bright limb hazes, and the fact that the breakup of the NPH was earlier than predicted. Also we had many observations of the reappearance of the Rima Tenuis starting in January, 1993—three months earlier than expected [see below].

Based on the results of the O.A.A. Mars Section, work done by Richard Schmude, and micrometer measurements and CCD and video images, we now know the NPC was about the same size this apparition as it was in 1979-80 (the rediscovery year for the Rima Tenuis). However, micrometer and image measurements indicate that the NPC actually did not begin to retreat until later than expected.

This apparition, the NPC shrank at an average rate of around 7 kilometers per day. Also the NPC dark collar was distinct through at least early May, 1993 (Ls 075°). *Table 4* (p. 103) lists the latitude of the NPC's south edge as a function of Ls during this apparition.

WAS THE RIMA TENUIS SEEN?

G. Schiaparelli, while using a 9-in (23-cm) refractor in 1880, first noted that the NPC was divided into two parts by a dark rift. This observation was soon confirmed by Terby and Perrotin. This rift, called the *Rima Tenuis*, was observed many times from 1901 through 1918. Records from the B.A.A. showed that the Rima Tenuis had been observed during 1933 and again in 1950. A search for it was carried out by C. Capen during the 1960's; even though he used large telescopes of 16-, 30- and 82-in (41-, 76-, and 208-cm) aperture, the search was unsuccessful. It was not until late 1979 that the Rima Tenuis appeared again. It became a regular feature during the 1980, 1982, and 1984 Apparitions.

The Rima Tenuis was expected to appear on about 1993 APR 12 (Ls 065°), as was reported for this Martian seasonal date in 1980, 1982 and 1984. It must be noted that the Rima Tenuis was observed as a notch and partial streak in the NPC when recovered in December, 1979.

T. Iwasaki of Japan was the first to see the NPC split into two parts by a rift on 1992 NOV 30 (Ls 004°), as published in the *Communication of Mars Observations #138* of the Oriental Astronomical Association (O.A.A). There, two drawings showed what appears to be the Rima Tenuis crossing the NPC at 140°W Areographic longitude. This sighting is the earliest Martian date at which the Rima Tenuis has ever been seen.

In January, 1993, observers got a good view of the Rima Tenuis, the best since 1984. Rudolf Hillebrecht of Germany imaged it with a 6-in (15-cm) telescope and a CCD camera. C. Hernandez saw the NPC as "peanut" shaped on 1993 JAN 11 (Ls 024°), and by JAN 18 (Ls 027°) Troiani saw a notch in the NPC.

Troiani again saw a notch and a rift in the NPC on JAN 30. Likewise, on JAN 22 (029° Ls) Schmude observed a small bright spot on the NPC and a notch within it. Jeff Beish, Carlos Hernandez and Dan Troiani all saw the feature visually, making some interesting drawings of it. The notch was again seen by Schmude in the NPC on 1993 FEB 03 (Ls 035°). Gerard Teichert of France had reported a split in the NPC on 1992 DEC 31; however, this was determined not to be the Rima Tenuis because the Areographic longitude did not correspond with historical records.

ARCTIC METEOROLOGY

The North Polar Hood (NPH) was bright and large for most of this apparition until late November, 1992. At this time we started to see the NPH slowly break up. When the NPC appeared it was brilliant and for the most part clearly visible afterward with a very dark collar around it. The NPC appeared at times to be shaped like a "peanut"with notches in the collar. As the NPH started to thin out in December, 1992, we got views of some of Mars' far northern dark markings.

The NPC appeared bright and whitish with an occasional local small cloud over it from January on. The South Polar Region was also of interest because a bright area near the southern limb was frequently visible. Could this have been the SPH (if it exists) or the beginnings of the development of the SPC?

In early December, 1992, the NPH started to thin out. Don Parker on DEC 05 showed the NPH thinning with some rifts in it. On the next day, albedo features were seen through the NPH. In addition, the Hellas region was bright with fog in early December. By DEC 20 white clouds were over the NPC, and in violet light there were high clouds near the NPC as seen by Troiani. The very next day Parker obtained CCD images of orographic clouds over the Tharsis volcanoes and around Olympus Mons. These were confirmed by Rhea, Melillo and Troiani.

SURFACE FEATURES

The crater Newton was shown as a black dot just south of Atlantis I in Electris in a Parker CCD image. A very dark notch was seen in the NPC, with a bright cloud over it, on 1992 DEC 25 by Rhea. Johann Warell of Sweden observed a white area near Syrtis Major with fog again in Hellas. Through most of later December, 1992, and through all of January, 1993, very bright evening and morning limb haze was reported. Hernandez (DEC 22) saw the NPC with an indentation north of Propontis I (at 170° W) corresponding to Deucalidonius Lacus. The last important observation of 1992 was by Gerard Teichert, who saw the NPC as split into two patches by a rift. Mare Acidalium was partly obscured by a haze as reported by Murakami of the O.A.A. Incurva Insula was obscured by a semicircular bright patch.

THE FUTURE!

The 1992-1993 Apparition of Mars has proven to have been a very exciting observing season with always something of interest on the Red Planet. This apparition shows that you don't need a very close approach of Mars to see interesting features. The next three apparitions (1993-1996, 1996-1998, and 1998-2000) will very likely have as much interesting meteorological activity as we had in 1992-93.

Future apparitions of Mars will be exciting times for the amateur observer, due inadvertently to the massive Federal funding cuts for planetary and space research. Since the loss of the Mars Observer Mission, many research programs are in danger of being cut off completely and it will be the role of dedicated amateurs to fill the gap, and perhaps to increase interest in Mars among our country's decision-makers.

The International Mars Patrol (I.M.P.), an observing program of the Association of Lunar and Planetary Observers (A.L.P.O.), began a new Mars patrol CCD-imaging program early in the summer of 1994. We are recruiting as many advanced CCD users as possible around the globe for a Mars patrol using systematic tricolor filter techniques. We hope that the gratifying cooperation of the past will continue and the observing program will speed ahead. At the outset, we guarantee only hard work and only self-fulfilling rewards. For nearly 30 years this is all that the 1,033 I.M.P. observers around the Earth have received. In spite of this, some have even made a career of Mars studies.

The increased popularity of digital CCD technology has decreased the prices of CCD cameras and supporting software so that every interested amateur can produce quality images of Mars if he or she desires. In addition, he or she can regularly match or better many photographs with a simple analog-CCD video camera. Yes, a video camera with a VCR can be used to record images of planets; drawings can be made later—in the comfort of your own living room. Often published in popular magazines, many photographs have ascetic appeal, but lack scientific merit. Even those who have never taken a photograph with a telescope can produce striking and scientifically valuable CCD images.

The personal computer is a tool making it possible for amateurs to join the world of planetary research. A low-cost personal computer can keep observing records, calculate positions of celestial objects and control telescope tracking and a CCD camera. Combining the three technologies of photography, CCD imaging, and computers is a promising approach. Recently Dan Troiani, Jim Carroll, Dan Joyce and their associates of Chicago produced a very good map of Mars using video images and photographs. Using framegrabber techniques and their own special software, they constructed a complete Mercator-projection map of Mars for 1992-93 in a personal computer and printed it out. This map is reproduced on the front cover of this issue.

One of the most rewarding and interesting uses for a well-equipped high-quality telescope is a systematic patrol of the Solar System. High-resolution photography of the Moon and planets can be a torturous experience and is complicated by the need for the highest-quality equipment and almost superhuman tolerance. Now, with the CCD imaging techniques being developed, and information about them becoming more available, the task of capturing useful images is within easy reach of most amateur astronomers. Of great interest to the professional scientific community is the systematic use of modern technology and work by a number of amateurs who are producing high-quality CCD tri-color images of the planets. Now, we can capture and record planetary images far below the lower limit of disk diameter for useful photographic resolution (10".0), producing useful images of Mars even as small as 5".0!

A "THANKS" FROM DAN TROIANI

I wish to express my appreciation to all Mars observers who submitted observations this apparition. Were it not for all your dedicated work and long hours at the telescope or computer, there wouldn't be a A.L.P.O. Mars Section. [Note, Dan Troiani took over the A.L.P.O. Mars Section for Carlos Hernandez, Don Parker, and Jeff Beish who were recovering from the effects of hurricane Andrew that occurred on August 24th, 1992. The entire A.L.P.O. owes Dan gratitude for his great work.]

Table 1. Members of the A.L.P.O. International Mars Patrol for the 1992-1993 Mars Apparition.

The type of observations is: V for visual drawings, P for photographs, C for CCD image-recording sessions, and M for micrometer measurements. The type of telescope is: CAS for Cassegrain, CAT for Catadioptric, NEW for Newtonian, RR for Refractor, and TRI for Trischiefspiegler. All telescopes apertures are given in inches.

Observer; Location	No. Obser. V	P	C	M	Telescope
M. Adachi; Japan	20	-	-	-	12.0 NEW, 24.0 CAS
P. Albert; Bristol, CT	7	-	-	-	6.0 NEW
W. Baldwin; Jacksonville, FL	-	43	2	-	8.0 NEW
J. Beish; Miami, FL	27	-	-	51	6.0 RR, 11.0 CAT; 16.0, 18.0, 20.0, & 36.0 NEW's
M. Bosselaers; Belgium	23	-	-	-	10.0 NEW
K. Brasch; Highland, CA	5	4	-	-	14.0 CAT
P. Budine; Walton, NY	4	-	-	-	6.0 RR
L. Carlino; Lockport, NY	8	-	-	-	5.1 & 6.0 RR's
J. Carrol; Chicago, IL	-	-	3	-	18.0 NEW
T. Cave; Long Beach, CA	23	-	-	-	12.5 NEW
W. Cuppens; Belgium	1	-	-	-	8.0 RR
F. Daerden; Belgium	36	-	-	-	10.0 NEW
D. Darling; Sun Prairie, WI	1	-	-	-	11.0 CAT
F. Dement; Kennewick, WA	1	-	-	-	5.0 RR
A. Diefvens; Belgium	10	-	-	-	6.0 RR
J. Dijon; France	9	-	9	-	24.0 CAS
C. Evans; Hampton, VA	11	-	-	-	6.0 RR
K. Fabian; Hickory Hills, IL	6	-	-	2	8.0 CAT
N. Falsarella, Brazil	38	-	-	-	7.9 NEW
B. Fimmens; Belgium	3	-	-	-	8.0 RR
D. Finch; Birmingham, AL	-	2	-	-	8.0 NEW
R. Francois, Belgium	31	-	-	-	7.9 RR
M. Gelinas; Canada	3	-	-	-	6.0 RR, 8.0 CAT
W. Haas; Las Cruces, NM	9	-	-	-	6.0, 8.0, & 12.5 NEW's
A. Heath; England	16	-	-	-	12.0 NEW
C. Hernandez; Miami, FL	12	-	-	-	8.0 CAT, 8.0 NEW
R. Hill; Tucson, AZ	14	-	-	-	5.0 & 14.0 CAT's, 14.0 NEW
A. Johnson; England	40	-	-	9	8.3 NEW
D. Joyce; Chicago, IL	5	-	3	-	20.0 NEW
D. Louderback; S. Bend, WA	1	-	-	-	8.0 NEW
C. Lower; Bel Air, MD	2	-	-	-	16.0 CAS
C. MacDougal; Tampa, FL	5	-	-	-	6.0 NEW
V. Makela; Finland	5	-	-	-	5.3 RR
R. McKim; England	11	-	-	-	8.5 RR, 12.0 NEW
F. Melillo; Holtsville, NY	29	-	-	-	8.0 CAT
J. Melka; Chesterfield, MO	10	-	-	-	8.0 NEW
M. Minami; Japan	-	3	-	-	10.0 NEW
I. Miyazaki; Okinawa	-	95	-	-	16.0 NEW
M. Moerpsa; Sweden	1	-	-	-	10.0 NEW
J. Moersch; Ithaca, NY	-	-	36	-	200.0 CAS
Y. Morim; Japan	-	5	-	-	10.0 NEW
M. Morrow; Ewa Beach, HI	11	-	-	-	16.0 NEW
D. Niechoy; Germany	17	-	-	-	4.0 RR, 8.0 CAT
G. Nowak; Essex Jct, VT	14	-	-	-	10.0 TRI
T. Nyberg; Finland	10	-	-	-	5.3 RR
J. Olivarez; Wichita, KS	1	-	-	-	8.0 NEW
D. Parker; Coral Gables, FL	52	-	113	15	6.0 RR; 16.0, 18.0, 20.0, & 36.0 NEW's
A. Plancre; Belgium	2	-	-	-	4.0 RR
Z. Pujic; Australia	1	-	-	-	16.0 NEW
D. Raden; Ft. Meade, FL	1	-	-	-	8.0 RR
K. Rhea; Paragould, AR	85	-	-	-	4.0 RR; 6.0, 8.0, & 10.0 NEW's
R. Robinson; Morgantown, WV	16	-	-	-	10.0 NEW
T. Rolne; Finland	3	-	-	-	5.3 RR
M. Schmidt; Racine, WI	-	104	-	-	6.0 RR, 14.0 CAT
R. Schmude; College Stn., TX	18	7	-	-	10.0 NEW, 14.0 CAT
E. Siegel; Denmark	38	-	-	-	8.0 CAT
T. Stryk; Bristol, VA	22	4	-	-	4.5, 10.0, & 17.5 NEW's
G. Teichert; France	32	-	-	-	11.0 CAT
C. Tobias; Racine, WI	-	63	-	-	6.0 RR, 14.0 CAT
D. Troiani; Shaumburg, IL	36	-	1	-	10.0, 12.5, 16.0, 17.5, 18.0, & 20.0 NEW's
H. Vandenbruaene; Belgium	8	-	-	-	10.0 RR
F.R. Van Loo; Belgium	20	-	-	-	8.0 RR, 10.0 NEW
J. Vantomme; Belgium	7	-	-	-	6.0 RR
R. Verheyen; Belgium	3	-	-	-	2.4 RR
E. Verwichte Belgium	10	-	-	-	8.0 RR
J. Warell; Sweden	36	-	-	-	6.0, 6.3 NEW's
J. Westfall; San Francisco, CA	-	1	-	-	11.0 CAT
S. Whitby; Hopewell, VA	27	-	-	-	7.0 RR, 6.0 & 8.0 NEW's
L. Wicholm; Finland	1	-	-	-	5.3 RR
M. Will; Springfield, IL	3	-	-	-	8.0 NEW
A. Winberg; Denmark	5	-	-	-	4.0 RR
P.C. Wirtanen; Sweden	1	-	-	-	5.1 RR
N. Wouter ; Belgium	1	-	-	-	8.0 RR
R. Young; Harrisburg, PA	8	-	-	-	17.0 CAS

Table 2. Martian meteorological activity, surface white areas, and North Polar Region dark rifts; January —August, 1993. (Observers' names in parentheses.)

JAN	08	Bright area in Nilosyrtis region (Bosselaers). Memnonia very bright (Rogers).
	14	Very bright spot in Libya (Hernandez).
	17	Hellas and evening limb bright (Louderback).
	21	Small cloud visible in Nilosyrtis (Hill).
	31	White cloud in Aeria (Rogers).
FEB	09	Bright cloud in Chryse (Dijon).
	10	Elysium bright (Morita).
	12	Bright cloud in Aeria; white area in Eridania (Dijon). Very bright cloud in Libya; Rima Tenuis notch seen in NPC (Rogers).
	13	White cloud in Elysium and Aeria; small cloud in Hellespontus (Dijon). Bright white evening clouds; cloud in Aeria close to Syrtis Major (Rogers).
	14	Large bright area on evening limb (Dijon).
	21	Eastern end of Memnonia bright (Johnson).
	22	Bright area over Zephyria and part of Amenthes (Johnson).
MAR	13	Hellas bright (Johnson).
	18	Cloud over Elysium and Nodus Alcyonius (Johnson).
	19	Hellas and evening limb bright; southern limb hazy (Teichert).
	20	Argyre-I bright (Melillo).
	23	Bright area near morning limb (Nowak).
	26	Very bright morning limb (Nowak).
APR	09	Electris and Eridania bright with clouds (Melillo).
	10	Bright area on south limb (Schmude).
	11	Bright spots in Memnonia, Electris and Eridania (Rhea).
	12	Bright spot in Phaethontis and Zephyria-Aeolis area (Rhea).
	19	Irregularities in NPC, with dark rift near 030° Areographic longitude (Schmude).
	20	Bright area on evening limb (Troiani).
	22	Bright area in Ganges-Lunae Lacus (Rhea).
	23	Bright white area on evening limb in red and green light (Schmude). Bright evening limb clouds (Troiani).
	27	Very bright cloud over Thaumasia-Solis Lacus (Rhea).
MAY	06	Dark notch in NPC; collar around NPC; possible Rima Tenuis (Schmude).
	09	Bright spot southwest of Syrtis Major (Rhea).
	10	Large cloud in violet light over Southern Hemisphere (Troiani).
	13	Clouds in Libya, SPH seen (Troiani).
	16	Bright region around SPR; very bright evening limb (Rhea).
	21	Very bright southern limb (Schmude).
	27	Very bright region on evening limb (Rhea).
JUN	01	Bright spot in Chryse and Aurorae Sinus; Solis Lacus appeared darkened (Rhea).
	02	Large bright area over Tharsis connected with Lunae Lacus (Rhea).
	06	Bright area in SPR (Rhea).
	22	Many bright clouds southwest of NPC (Rhea).
	23	Bright area connecting Amazonis to Tritonis Sinus (Rhea).
	27	Three large bright clouds on or near evening limb (Rhea).
	30	Bright region near Olympus Mons and on southern limb (Rhea).
JUL	06	Long cloud streak from Chryse into Tharsis; equatorial band cloud (ECB 7). (Rhea).
	09	Bright spot on south limb; possible ECB (Rhea).
AUG	24	Bright area on preceding limb in red and green light, possible dust cloud (Schmude).

Table 3. Meteorology of Mars, 1992-93; type reported as percentages of observed degrees Ls.

	Northern Hemisphere Season with Ls-range				
Type of Phenomenon	Spring 000-089°	Summer 090-179°	Autumn 180-269°	Winter 270-359°	Total 000-359°
Evening Clouds (EC)	80	56	25	28	57
Morning Clouds (MC)	60	22	0	45	51
Discrete Clouds(DC)	41	33	25	14	0
Dust Clouds (YC)	0	0	0	28	11
Cloud Bands (CB)	9	11	0	2	6
White Areas (WA)	0	0	0	0	0
Evening Haze (EH)	16	0	0	0	9
Morning Haze (MH)	31	11	0	48	36
Arctic (NPC)	21	0	0	43	28
Antarctic (SPC)	51	33	0	19	36
Ls Observed	81°	9°	4°	58°	152°

Table 4. North Latitude of South Edge of Martian North Polar Cap as a Function of Ls .
(Measures from video or CCD images except * = micrometer measures.)

Ls	Latitude	Ls	Latitude	Ls	Latitude	Ls	Latitude	Ls	Latitude
°	°	°	°	°	°	°	°	°	°
006.5	64.7	012.8	63.9	025.5	65.0	038.3	67.5	048.6	70.7
006.8	65.2	013.0*	68.7	025.5	67.6	038.3	68.1	048.6	71.0
007.0	62.8	013.1	66.2	025.6*	66.6	038.4*	70.2	048.6	70.9
007.1 *	65.9	013.3	65.4	027.5*	66.7	040.1	67.9	049.0	70.4
008.0	61.9	013.4*	67.4	027.8	66.4	041.0	68.9	050.8	71.6
008.1	66.9	014.3	66.6	027.8	68.9	041.1*	74.9	051.3*	72.3
008.3	65.7	014.3	66.5	029.6	70.4	042.5*	67.7	057.5*	72.4
008.3	65.9	014.3	67.3	029.6	67.1	043.2	70.2	057.9*	73.3
008.3	65.2	021.8	66.9	029.8*	69.1	043.2	70.2	058.8*	72.8
008.3	66.0	021.8	67.9	032.5*	67.0	046.3	72.6	061.0*	72.7
009.5	64.6	021.9*	67.9	032.8	70.9	046.9*	74.8	062.5*	72.0
010.4	68.7	022.2	66.4	033.0*	70.1	047.5*	69.1	067.5*	73.6
010.7	64.3	022.2	69.3	034.2	68.7	048.1	72.2	072.5*	75.4
010.7	65.4	022.2	67.1	035.1	66.4	048.1	70.9		
010.7	63.2	022.4*	67.8	036.5	68.2	048.1	68.1		
011.9	62.4	024.1	64.7	037.5*	65.0	048.2*	71.0		

Captions for Figures 1-25. (See pp. 107-108)

1) 1992 Apr 24,11:05 UT. CM: 046°, Ls: 236°. 11-in (28-cm) CAT. Filter: None. Jeff Beish.
2) 1992 May 04, 10:25:34 UT. CM: 296°, Ls 243°. 16-in (41-cm) f/6 NEW. Filter: W25. Donald C. Parker. Mars appears normal for season.
3) 1992 Jul 04, 10:05:30 UT. CM: 049°.1, Ls: 281°. 16-in (41-cm) f/6 NEW. Filter: W25. Don Parker. CCD. SPC small, morning hazes, no evidence of dust.
4) 1992 Jul I I, 10:20:58 UT. CM: 344°.3, Ls: 286°. 16-in (41-cm) f/6 NEW. Filter: W25. Don Parker. CCD. Eden bright Oxus and Oxia Palus conspicuous, Pandorae Fretum dark.
5) 1992 Jul 30, 10:24:12 UT. CM: 160°.0, Ls: 297°. 16-in (41-cm) f/6 NEW. Filter: W38A. Don Parker. Bright NPH, Limb haze northwest morning.
6) 1992 Aug 01, 09:10 UT. CM:122°, Ls: 298°. 16-in (41-cm) f/6 NEW. Filter: None. Don Parker . Daedalia-Claritas dusky, Phoenicis Lacus small and dark.
7) 1992 Aug 07, 09:30 UT. CM: 069°,Ls: 302°. 8-in (20-cm) f/8 NEW. Filter: W25. Kermit Rhea. Bright cloud on CM.
8) 1992 Aug 16, 10:37:04 UT. CM: 358°.1, Ls: 307°. 16-in (41-cm) f/6 NEW. Filter: W58. Don Parker. Chryse bright on limb, NPH also very bright in green light.
9) 1992 Aug 16, 10:17:26 UT. CM: 353°.3, Ls: 307°. 16-in (41-cm) f/6 NEW. Filter: W25. Don Parker. Chryse bright in red, SPC tiny.
10) 1992 Aug 24, 08:25 UT. CM: 249°, Ls: 312°. 8-in (20.3-cm) NEW. Filter: W21. Samuel R. Whitby. Bright morning limb.
11) 1992 Sep 13, 09:36 UT. CM: 073°, Ls: 323°. 10-in (25-cm) NEW. Filter: W21. Kermit Rhea. Bright cloud in Solis Lacus.
12) 1992 Sep 18, 08:25 UT. CM: 008°, Ls: 326°. 8-in (20.3-cm) f/6 NEW. Filter: W23A. Samuel R. Whitby. Chryse was bright, NPH visible?
13) 1992 Sep 19, 09:00 UT. CM: 007°, Ls: 327°. 11-in (28-cm) CAT. Filter: None. David Darling. Cloud on limb.
14) 1992 Sep 22, 12:15:00 UT. CM: 025°.3, Ls: 328°. 5-in (13-cm) RR. Filter:None. Frank Dement. NPH visible.
15) 1992 Sep 28, 07:45 UT. CM: 262°, Ls: 332°. 16-in (41-cm) f/4.4 NEW. Filter: None. Daniel M. Troiani. Syrtis Major visible.
16) 1992 Oct 01, 08:17 UT. CM: 241°, Ls: 333°. 17.5-in (44-cm) f/4.5 NEW. Filter: Red. Daniel M. Troiani. Cloud in Hellas.
17) 1992 Oct 16, 09:52:38 UT. CM: 121°.6, Ls: 341.° 16-in (41-cm) f/6 NEW. Filter: W25 . Don Parker. Streak across Sirenum-Daedalia is prominent again, NPC not seen.
18) 1992 Oct 17, 10:18:38 UT. CM: 118°.4, Ls: 342°. 16-in (41-cm) f/6 NEW. Filter: W47. Don Parker. NPH brilliant, Electris bright on SW limb.
19) 1992 Oct 19, 10:00:00 UT. CM: 095°.0, Ls: 343°. 4-in (10-cm) RR. Filter: Blue. Kermit Rhea. Evening clouds.
20) 1992 Oct 19, 07:05:00 UT. CM: 052°.3, Ls: 343°. 20-in (51-cm) f/4.5 NEW. Filter: None. Daniel P. Joyce. NPH visible.
21) 1992 Oct 20, 09:55 UT. CM: 084°, Ls: 343°. 6-in (15.2 cm) NEW. Filter: W80A. Samuel R. Whitby. NPC clouds.
22) 1992 Oct 22, 10:01 UT. CM: 067°, Ls: 345°. 17.5-in (44-cm) f/4.5 NEW. Filter: W25. Daniel M. Troiani. Dust in Chryse, dark collar around NPC.
23) 1992 Oct 22, 09:00 UT. CM: 052°, Ls: 344°. 20-in (51-cm) f/4.5 NEW. Filter: W25. Jim Carrol & Dan Joyce. Video of dust in Chryse.
24) 1992 Oct 23, 06:07 UT. CM: 000°, Ls: 345°. 4-in (10-cm) RR. Filter: W80A. Kermit Rhea. Cloud on evening limb.
25) 1992 Oct 23, 08:25 UT. CM: 034°, Ls: 345°. 6-in (15.2-cm) NEW. Filter: None. Samuel R Whitby. Chryse was bright.

Captions for Figures 26-62. (See pp. 108-110)

26) 1992 OCT 25, 08:11 UT. CM: 012°, Ls: 346°. 16-in (41-cm) f/6 NEW. Filter: W58. Don Parker. Bright morning limb, NPH bright, Oxia Palus large and dark.

27) 1992 OCT 26, 05:25 UT. CM: 322°, Ls: 347°. 4-in (10-cm) RR. Filter: None. Kermit Rhea. NPR bright.

28) 1992 NOV 07, 07:17 UT. CM: 236°, Ls: 353°. 16-in (41-cm) f/6 NEW. Filter: W25. Don Parker. Hyblaeus extension dark near terminator. Elysium not so bright.

29) 1992 NOV 08, 03:15 UT. CM: 168°, Ls: 353°. 5-in (13-cm) APO RR. Filter: W23A. Lawrence M. Carllno. Limb clouds.

30) 1992 NOV 13, 07:57 UT. CM: 190°, Ls: 356°. 16-in (41-cm) f/6 NEW. Filter: W25. Don Parker. NPC breaking through hood. NP collar dark. Possible Chasma Borealis at limb

31) 1992 NOV 14, 10:25 UT. CM: 217°, Ls: 356°. 6-in (15-cm) APO f/9 RR. Filters: W23, W38A. Phillip W. Budine. Morning limb cloud.

32) 1992 NOV 15, 07:30 UT. CM: 165°, Ls: 357°. 12.5-in (32-cm) NEW. Filters:W25,W80A. Thomas Cave. Bright limb clouds, NPH.

33) 1992 NOV 16, 1 05:35 UT. CM: 128°, Ls: 357°. 8-cm (20-cm) CAT. Filters: W21, W47 Frank Melillo. White haze along morning limb.

34) 1992 NOV 28, 10:46 UT. CM: 093°, Ls: 003°. 17.5-in (44-cm) f/4.4 NEW. Filter: W47. Daniel M. Troiani. NPH breaking up with NPC visible, High clouds in Northern Hemisphere.

35) 1992 NOV 23, 21:00 UT. CM: 288°, Ls: 001°. 12-in (31-cm) NEW. Filter: None. Makoto Adachi.Bright evening limb.

36) 1992 NOV 29, 06:30 UT. CM: 022°, Ls: 004°. 10-in (25-cm) NEW. Filter: None. Richard Schmude, Jr. Bright equatorial clouds.

37) 1992 NOV 29, 22:59 UT. CM: 263°, Ls: 004°. 11-in (28-cm) CAT. Filter: W80A. Gerard Teicher. Hellas bright and cloud in Libya.

38) 1992 DEC 02, 22:55 UT. CM: 234°, Ls: 006°. 8.5-in (21.6-cm) RR. Filter: None. Richard McKim. Hellas and NPH bright, cloud in Libya

39) 1992 DEC 03, 23:30 UT. CM: 234°, Ls 006°. 12-in (30-cm) RR. Filter: None. Alan W Heath.

40) 1992 DEC 05, 06:05 UT. CM: 321°, Ls: 007°. 16-in (41-cm) f/6 NEW. Filter: W58. Don Parker. Rift in NPH/NPC, Noachis-Argyre bright.

41) 1992 DEC 05, 13:40 UT. CM: 072°, Ls: 007°. 12-in (31-cm) NEW. Filter: None. Makoto Adachi. Nilokeras was very dark. Idaeus Fons was darkest.

42) 1992 DEC 06, 04:00 UT. CM: 282°, Ls: 007°. 16-in (41-cm) f/6.9 NEW. Filters: W25, W38A . Jeff Beish. Cloud in Libya.

43) 1992 DEC 06, 07:09 UT. CM: 328°, Ls: 007°. 16-in (41-cm) f/6 NEW. Filter: W58. Don Parker. Albedo features seen through NPH.

44) 1992 DEC 06, 03:30 UT. CM: 274°, Ls: 007°. 12.5-in (32-cm) f/6 NEW. Filters: W25, W80A . Daniel Troiani. Cloud in Hellas and bright cloud next to NPH.

45) 1992 DEC 08, 05:00 UT. CM: 278°, Ls: 008°. 8-in (20-cm) CAT. Filter: W21. Frank Melillo. Cloud in Hellas.

46) 1992 DEC 09, 03:30 UT. CM: 247°, Ls: 009°. 16-in (41-cm) f/6.9 NEW. Filters: All. Jeff Beish. Bright spot in NPH.

47) 1992 DEC 10, 05:30 UT. CM: 268°, Ls: 009°. 12.5-in (31-cm) f/6 NEW. Filter: W25. Tom Cave.

48) 1992 DEC 12, 22:05 UT. CM: 132°, Ls: 010°. 8-in (20.3-cm) f/10 CAT. Filters: W25, W80A. Elisabeth Siegel.

49) 1992 DEC 15, 04:20 UT. CM: 206°, Ls: 011°. 10-in (25-cm) f/7.8 NEW. Filters: W25, W80A. Robert Robinson. Preceding perimeter of NPH had a very dark line by it.

50) 1992 DEC 16, 05:15 UT. CM: 210°, Ls: 012°. 8-in (20-cm) CAT. Filters: W25, W38A, W47. Carlos E. Hernandez. Trivium Charontis-Cerberus I was very prominent.

51) 1992 DEC 16, 03:15 UT. CM: 181°, Ls: 012°. 10-in (25-cm) NEW. Filters: W25, W80A. Kermit Rhea. Dark aspect protruding into NPR.

52) 1992 DEC 16, 03:20 UT. CM: 182°, Ls: 012°. 16-in (41-cm) f/6.9 NEW. Filters: W25, W80A. Jeff Beish. Bright streak just south of NPC

53) 1992 DEC 18, 05:29 UT. CM: 196°, Ls: 013°. 16-in (41-cm) f/6 NEW. Filter: W58. Don Parker. Clouds on terminator, near Olympus Mons and south of NPC.

54) 1992 DEC 20, 04:26 UT. CM: 163°, Ls: 014°. 17.5-in (44-cm) f/4.5 NEW. Filter: W47. Daniel M. Troiani. Clouds in and around the NPC.

55) 1992 DEC 21, 03:49 UT. CM: 145°, Ls: 014°. 4-in (10-cm) RR. Filter: None. Kermit Rhea. Clouds in Northern Hemisphere.

56) 1992 DEC 21, 05:07 UT. CM: 164°, Ls: 014°. 16-in (41-cm) f/6 NEW. Filter: W47. Don Parker. Orographic clouds over Eridania, Crater Newton noted as black dot south of Atlantis I in Electris.

57) 1992 DEC 22, 05:00 UT. CM: 153°, Ls: 015°. 8-in (20-cm) CAT. Filters: W23A, W58. Carlos E. Hernandez. Dark indentation in NPC-Deucalidonius Lacus.

58) 1992 DEC 23, 02:30 UT. CM: 108°, Ls: 015°. 16-in (41-cm) f/6.9 NEW. Filters: W25, W58. Jeff Beish. Equatorial band clouds?

59) 1992 DEC 25, 03:34 UT. CM: 106°, Ls: 016°. 4-in (10-cm) RR. Filter: None. Kermit Rhea. Bright region in Chryse and dark notch in NPC.

60) 1992 DEC 26, 04:55 UT. CM: 117°, Ls: 017°. 8-in (20-cm) CAT. Filters: W23A, W58. Carlos E. Hernandez. Very bright cloud over Tractus Albus and bright morning limb haze visible.

61) 1992 DEC 27, 04:30 UT. CM: 102°. Ls: 017°. 12.5-in (32-cm) f/6 NEW. Thomas R. Cave. Dark notch in NPC.

62) 1992 DEC 28, 21:38 UT. CM: 344°, Ls: 018°. 11-in (28-cm) CAT. Filters: W58, W23. Gerard Teichert. NPC dark collar, evening clouds.

Captions for Figures 63-99. (See pp. 110-111)

63) 1992 DEC 29, 19:10 UT. CM: 299°, Ls: 018°. 6-in (15-cm) f/8 NEW. Filters: W25, W58, W80A. Johan Warell. Bright cloud in Hellas and Libya.

64) 1992 DEC 31, 22:35 UT. CM: 332°, Ls: 019°. 12-in (30-cm) NEW. Filter: None. Richard McKim. Hellas was very bright.

65) 1993 JAN 01, 21:40 UT. CM: 309°, Ls: 020°. 8-in (20-cm) f/8 NEW. Filter: None. Roger Francois.

66) 1993 JAN 02, 21:39 UT. CM: 301°, Ls: 020°. 11-in (28-cm) f/10 CAT. Filters: W58, W25. Gerard Teichert. Hellas was bright and isolated white spot west of Syrtis Major.

67) 1993 JAN 02, 00:55 UT. CM: 357°, Ls: 020°. 6-in (15-cm) f/8 NEW. Filters: W25, W58. Johan Warell. Bright region in Chryse.

68) 1993 JAN 03, 04:10 UT. CM: 036°, Ls: 020°. 12.5-in (32-cm) f/6 NEW. Filters: W25, W58. Thomas R. Cave. Small cloud in Edom and large cloud over Thaumasia.

69) 1993 JAN 03, 02:00 UT. CM: 004°, Ls: 020° 6-in (15-cm) f/9 APO RR. Filter: W23A. Lawrence Carlino. Bright haze over Chryse.

70) 1993 JAN 04, 13:37 UT. CM: 165°', Ls: 021°. 16-in (41-cm) f/6 NEW. Filter: W58. Isao Miyazaki. Clouds over Nix Olympica.

71) 1993 JAN 06, 03:00 UT. CM: 353°, Ls: 022°. 8-in (20-cm) CAT. Filters: W23, W38A, W58. Carlos E. Hernandez. Margaritifer Sinus obscured by haze and Chryse-Xanthe region very bright.

72) 1993 JAN 07, 23:30 UT. CM: 284°, Ls: 023°. 12-in (30-cm) NEW. Filter: None. Alan W. Heath . Cloud crossing over Syrtis Major.

73) 1993 JAN 07, 01:13 UT. CM: 318°, Ls: 022°. 4-in (10-cm) RR. Filter: W23A. Kermit Rhea. Clouds by evening limb.

74) 1993 JAN 11, 01:20 UT. CM: 284°, Ls: 024°. 16-in (41-cm) f/7 NEW. Filters: All. Jeff Beish. NPC hazy, no hood. South limb very hazy with bright cloud over Hellas. Rift in NPC.

75) 1993 JAN 12, 07:10 UT. CM: 001°, Ls: 025°. 12.5-in (32-cm) NEW. Filter:W25. Thomas Cave. Clouds in Edom and near the southern portions of Syrtis Major.

76) 1993 JAN 12, 01:35 UT. CM: 279°, Ls: 025°. 16-in (41-cm) f/7 NEW. Filter: W25. Jeff Beish. South limb hazy and rift in NPC.

77) 1993 JAN 14, 02:54 UT. CM: 281°, Ls: 026°. 10-in (25-cm) NEW. Filter: W'23A . Kermit Rhea. Cloud visible in western Mare Hadriacum.

78) 1993 JAN 15, 02:40 UT. CM: 269°, Ls: 026°. 12.5-in (32-cm) f/6 NEW. Filters: W25, W80A. Thomas R. Cave. Sizable white cloud on CM.

79) 1993 JAN 18, 05:30 UT. CM: 284°, Ls: 027°. 8-in (20-cm) CAT. Filters: W23A, W25, W58. Carlos E. Hernandez. Rift in NPC-Rima Tenuis. Cloud visible in Libya.

80) 1993 JAN 18, 02:40 UT. CM: 243°, Ls: 027°. 17.5-in (44-cm) f/4.5 NEW. Filter: W25. Daniel M. Troiani. Notch in NPC. Southern limb hazy.

81) 1993 JAN 18, 04:49 UT. CM: 274°, Ls: 027°. 17.5-in (44-cm) f/4.5 NEW. Filter: W47. Daniel M. Troiani. Fairly good "Blue Clearing".

82) 1993 JAN 19, 05:20 UT. CM: 273°, Ls: 028°. 8-in (20-cm) f/7.5 NEW. Filter: W23A. Carlos E. Hernandez. Cloud over Libya extending into Syrtis Major.

83) 1993 JAN 20, 03:15 UT. CM: 233°, Ls: 028°. 12.5-in (32-cm) NEW. Filters: W25, W80A. Thomas R. Cave. White cloud on evening limb.

84) 1993 JAN 20, 03:27 UT. CM: 236°, Ls: 028°. 8-in (20-cm) NEW. Filter: None. Walter H. Haas. Bright cloud over NPC.

85) 1993 JAN 21, 17:45 UT. CM: 077°, Ls: 029°. 6.3-in (16-cm) f/12.5 NEW. Filters: W25, W21, W58. Johan Warell. Chryse was bright!

86) 1993 JAN 21, 05:21 UT. CM: 255°, Ls: 029°. 14-in (36-cm) f/5 NEW. Filter: W80A. Richard E. Hill. Clouds by morning limb.

87) 1993 JAN 23, 06:30 UT. CM: 254°, Ls: 030°. 14-in (36-cm) CAT. Filter: W80A. Klaus Brasch. South Polar Hood?

88) 1993 JAN 26, 21:50 UT. CM: 092°, Ls: 031°. 8-in (21-cm) f/7.5 NEW. Filter: None. Alan Johnson. Argyre I was very bright.

89) 1993 JAN 26, 02:03 UT. CM: 163°, Ls: 031°. 17.5-in (44-cm) f/4.5 NEW. Filter: W47. Daniel M. Troiani. Good "blue clearing", bright cloud on NPC.

90) 1993 JAN 27, 02:10 UT. CM:156°, Ls: 032°. 6-in (15-cm) APO f/9 RR. Filters: W23A, W12. Phillip W. Budine. Large cloud in south polar region.

91) 1993 JAN 27, 22:10 UT. CM: 088°, Ls: 032°. 6.3-in (16-cm) f/12.5 RR. Filter.: W25, W80A, W58. Johan Warell. Little notch in NPC. Chryse was bright in blue light.

92) 1993 JAN 30, 02:30 UT. CM: 134°, Ls: 033°. 17.5-in (44-cm) f/4.5 NEW. Filter: None. Daniel M. Troiani. Rift visible in the NPC!

93) 1993 JAN 31, 19:06 UT. CM: 008°, Ls: 034°. 10-in (25-cm) f/8 NEW. Filter: Green. Roger Francois. Clouds in Chryse and by Sinus Meridiani.

94) 1993 FEB 02, 01:05 UT. CM: 086°, Ls: 034°. 7-in (17.8-cm) f/15 RR. Filter: W23A. Samuel R. Whitby. Cloud in Chryse.

95) 1993 FEB 03, 01:30 UT. CM: 083°, Ls: 035°. 17.5-in (44-cm) f/4.5 NEW. Filter: None. Daniel M. Troiani. Notch visible in NPC, Chryse was clear.

96) 1993 FEB 03, 05:29 UT. CM: 142°, Ls: 035°. 12.5-in (32-cm) NEW. Filter: None. Walter H. Haas. SPR was bright.

97) 1993 FEB 04, 19:10 UT. CM: 333°, Ls: 035°. 6.3-in (16-cm) f/12.5 RR. Filters: W25, W80A . Johan Warell. Hellas was very bright. Cloud in Libya.

98) 1993 FEB 04, 13:07 UT. CM: 244°, Ls: 035°. 16-in (41-cm) f/6 NEW. Filter: W25. Isao Miyazaki.

99) 1993 FEB 05, 02:20 UT. CM: 078°, Ls: 036°. 12.5-in (32-cm) f/6 NEW. Filters: W25, W80A. Thomas Cave. Very dark collar around NPC. Ganges was prominent and wide.

Captions for Figures 100-133. (See pp. 111-113)

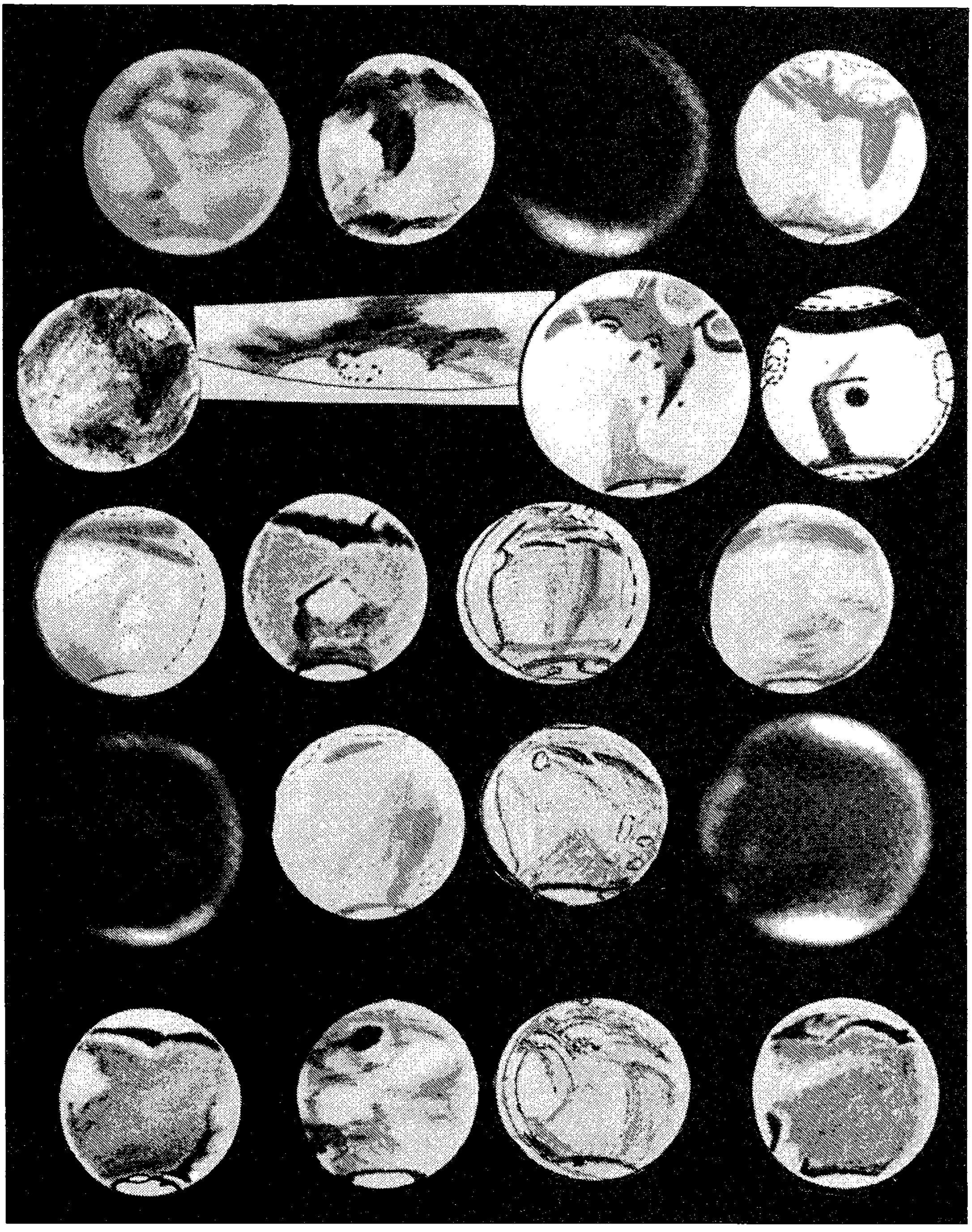
100) 1993 FEB 06, 00:30 UT. CM: 042°, Ls: 036°. 10-in (25-cm) f/9.8 NEW. Filters:W21, W25. Robert L. Robinson. Chryse appeared slightly bright.
101) 1993 FEB 07, 01:30 UT. CM: 047°, Ls: 037°. 12.5-in (32-cm) NEW. Filters: W25, W80A. Thomas R. Cave. Oxia Palus was very triangular and dark. Large cloud on northern evening limb.
102) 1993 FEB 07, 00:41 UT. CM: 036°, Ls: 037°. 6-in (15-cm) NEW. Filter: W38. Kermit Rhea. Chryse appeared bright with yellow-orange hues.
103) 1993 FEB 09, 01:59 UT. CM: 036°, Ls: 037°. 14-in (35-cm) CAT. Filter: None. Richard Schumde, Jr. NPC had a unusual dark bulge in it.
104) 1993 FEB 10, 02:15 UT. CM: 031°, Ls: 038°. 12.5-in (32-cm) f/6 NEW. Filter: W25. Thomas R. Cave. Very dark marking to the south of Aurorae S. and small cloud in Sinus Sabaeus.
105) 1993 FEB 10, 00:00 UT. CM: 358°, Ls: 038°. 7-in (17.8-cm) f/15 RR. Filter: W23A. Samuel R. Whitby. Oxia Palus was visible.
106) 1993 FEB 11, 23:45 UT. CM: 337°, Ls: 039°. 16-in (41-cm) f/6.9 NEW. Filters: W25, W80A. Jeff Beish. Rima Tenuis was very visible!
107) 1993 FEB 12, 21:30 UT. CM: 295°, Ls: 039°. 8-in (20-cm) f/8 RR. Filter: None. Roger Francois. Rima Tenuis notch visible in the NPC! Bright cloud in Libya.
108) 1993 FEB 14, 02:00 UT. CM: 351°, Ls: 040°. 12.5-in (32-cm) f/6 NEW. Filters: W25, W80A. Thomas R. Cave Two bright clouds north of Sinus Meridiani.
109) 1993 FEB 14, 00:32 UT. CM: 330°, Ls: 040°. 10-in (25-cm) NEW. Filter: W23A. Kermit Rhea. Bright limb cloud in Noachis. Elongated cloud north of Sinus Meridiani.
110) 1993 FEB 16, 21:50 UT. CM: 263°, Ls: 041°. 8-in (21-cm) f/7.5 NEW. Filter: None. A. Johnson. Small cloud in Libya and Eridania.
111) 1993 FEB 19, 00:34 UT. CM: 285°, Ls: 042°. 6-in (15-cm)NEW. Filter: W80A. Kermit Rhea. Cloud right over Syrtis Major.
112) 1993 FEB 20, 01:30 UT. CM: 289°, Ls: 042°. 18-in (46-cm) f/6 NEW. Filter: None. Daniel M. Troiani. White cloud seen in Libya.
113) 1993 FEB 21, 05:00 UT. CM: 331°, Ls: 043°. 18-in (46-cm) f/6 NEW. Filter: None. Jim Carrol. Black-and-white CCD video camera image showing notch in NPC-Rima Tenuis!
114) 1993 FEB 23, 01:12 UT. CM: 257°, Ls: 044°. 8'-in (20-cm) NEW. Filters: W56, W8. Kermit Rhea. Bright cloud in Electris-Eridania.
115) 1993 FEB 26 07:57 UT. CM: 328°, Ls: 045°. 16-in (41-cm) f/6 NEW. Filter: W30M. Michael J. Morrow. Cloud in Libya, southern polar region bright.
116) 1993 FEB 27, 04:10 UT. CM: 264°, Ls: 046°. 10-in (25-cm) f/8 NEW. Filters: W25, W80A. Daniel M. Troiani. Bright white cloud in Eridania extending into Ausonia.
117) 1993 FEB 28, 03:15 UT. CM: 241°, Ls: 046°. 8-in (20-cm) f/7.5 NEW. Filters: W23A, W38A, W57. Carlos E. Hernandez. Hyblaeus Extension very prominent. Hesperia visible as narrow bright band.
118) 1993 MAR 05, 02:30 UT. CM: 184° , Ls: 043°.12.5-in (32-cm) f/6 NEW. Filters: W25, W80A. Thomas R. Cave. Rift and notch was visible in the NPC.
119) 1993 MAR 11, 20:15 UT. CM: 027°, Ls: 051°. 11-in (28-cm) f/10 CAT. Filter: RA 61 (Red). Gerard Teichert.
120) 1993 MAR 12, 04:00 UT. CM: 141°, Ls: 051°. 8-in (20-cm) CAT. Filters: W21, W80A . Frank J. Melillo. High clouds over Candor and Tharsis.
121) 1993 MAR 18, 23:45 UT. CM: 013°, Ls: 054°. 6-in (15-cm) APO RR. Filter: W23A. Lawrence Carino. Bright area next to NPC.
122) 1993 MAR 21, 21:50 UT. CM: 317° , Ls: 056°. 8-in (20-cm) f/6.5 NEW. Filter: W80A. Nelson Falsarella. Bright area in south polar region.
123) 1993 MAR 25, 20:50 UT. CM: 264°, Ls: 057°. 8-in (21-cm) f/7.5 NEW. Filter: None. Andrew Johnson. Cloud again in Libya and evening haze.
124) 1993 MAR 26, 01:30 UT. CM: 333°, Ls: 057°. 8-in (20-cm) f/12 NEW. Jose Olivarez. White cloud in Libya.
125) 1993 MAR 27, 00:40 UT. CM: 311°, Ls: 058°. 6-in (15-cm) APO RR. Filter: W23A. Lawrence Carlino. Libya was bright and Hellas was bright and hazy.
126) 1993 MAR 29, 02:20 UT. CM: 316°, Ls: 059°.17.5-in (44-cm) f/4.5 NEW. Filter: W25. Daniel M. Troiani. South polar region bright and cloud in Libya.
127) 1993 APR 04, 20:00 UT. CM: 158°, Ls: 062°. 8-in (21-cm) f/7.5 NEW. Filter: None. A. Johnson. Chryse-Xanthe region was very bright and Argyre I was bright.
128) 1993 APR 23, 02:25 UT. CM: 080°, Ls: 070°. 17.5-in (44-cm) f/4.5 NEW. Filter: W25. Daniel M. Troiani. Very bright cloud visible by evening limb.
129) 1993 MAY 05, 02:56 UT. CM: 3330°, Ls: 075°. 10-in (25-cm) NEW. Filter: W23A. Kermit Rhea. Still bright in Libya, Protonilus detected, area over Sabaeus Sinus very bright.
130) 1993 MAY 07, 03:05 UT. CM: 316°, Ls: 076°. 10-in (25-cm) NEW. Filter: Blue-green. Kermit Rhea. Clouds over Syrtis Major.
131) 1993 MAY 09, 03:16 UT. CM: 299°, Ls: 077°. 10-in (25-cm) NEW. Filter: W58. Kermit Rhea . Cloud in Iapygia-Deltoton Sinus region.
132) 1993 JUN 23, 02:38 UT. CM: 214°, Ls: 096°. 4-in (10-cm) RR. Filter: Gramcolor #385 orange. Kermit Rhea. Bright clouds involved with Tritonis Sinus and bright region in Amazonis.
133) 1993 AUG 20, 01:29 UT. CM: 350°, Ls: 123°. 17.5-in (44-cm) NEW. Filter: None. Ted Stryk.

Description of Wratten Filters: W8, Yellow; W12, Deep Yellow; W21, Orange; W23A, Light Red; W25, Red Tricolor; W30M, Light Magenta; W38, Light Blue; W38A, Blue; W47, Blue Tricolor; W56, Light Green; W57, Green; W58, Green Tricolor; W80A, Blue Color Conversion.

Figures 1-20: Top Row—Figures 1-4; Second Row—Figures 5-8; Third Row—Figures 9-12; Fourth Row—Figures 13-16; Bottom Row—Figures 17-20. This page of figures covers the period 1992 APR 24-1992 OCT 19, during which: Ls increased from 238° to 343°; the disk diameter increased from 4".8 to 9".2; and the areocentric latitude of the Earth increased from -25°.0 to +10°.2. For individual figure captions see p. 103.

Figures 21-40: Top Row—Figures 21-24; Second Row—Figures 25-28; Third Row—Figures 29-32; Fourth Row—Figures 33-36; Bottom Row—Figures 37-40. This page of figures covers the period 1992 OCT 20-1992 DEC 05, during which: Ls increased from 343° to 007°; the disk diameter increased from 9".3 to 13".2; and the areocentric latitude of the Earth increased from +10°.4 to +12°.6 on 1992 Nov 20, and then decreased to +12°.1 on 1992 DEC 05. For individual figure captions see pp. 103-104.

Figures 41-60: Top Row—Figures 41-44; Second Row—Figures 45-48; Third Row—Figures 49-52; Fourth Row—Figures 53-56; Bottom Row—Figures 57-60. This page of figures covers the period 1992 DEC 05-1992 DEC 26, during which: Ls increased from 007° to 017°; the disk diameter increased from 13".2 to 14".8; and the areocentric latitude of the Earth decreased from +12°.1 to +9°.4 . For individual figure captions see p. 104.



Figures 61-80: Top Row—Figures 61-64; Second Row—Figures 65-68; Third Row—Figures 69-72; Fourth Row—Figures 73-76; Bottom Row—Figures 77-80. This page of figures covers the period 1992 DEC 27-1993 JAN 18, during which: Ls increased from 017° to 027°; the disk diameter increased from 14".8 to 14".9 on 1993 JAN 03, and then decreased to 14".4 on 1993 JAN 18; and the areocentric latitude of the Earth decreased from +9°.2 to +5°.4 . For individual figure captions see pp. 104-105.

Figures 81-100: Top Row—Figures 81-84; Second Row—Figures 85-88; Third Row—Figures 89-92; Fourth Row—Figures 93-96; Bottom Row—Figures 97-100. This page of figures covers the period 1993 JAN 18-1993 FEB 06, during which: Ls increased from 027° to 036°; the disk diameter decreased from 14".4 to 12".6; and the areocentric latitude of the Earth decreased from +5°.4 to +3°.7 . For individual figure captions see pp. 105-106.

Figures 101-120: Top Row—Figures 101-104; Second Row—Figures 105-108; Third Row—Figures 109-112; Fourth Row—Figures 113-116; Bottom Row—Figures 117-120. This page of figures covers the period 1993 FEB 07-1993 MAR 12, during which: Ls increased from 037° to 051°; the disk diameter decreased from 12".5 to 9".2; and the areocentric latitude of the Earth increased from +3°.6 to +5°.6 . For individual figure captions see p. 106.

Figures 121-133: Top Row—Figures 121-124; Second Row—Figures 125-128; Third Row—Figures 129-132; Bottom Row—Figure 133. This page of figures covers the period 1993 MAR 18-1993 AUG 20, during which: Ls increased from 054° to 123°; the disk diameter decreased from 8".7 to 4".1; and the areocentric latitude of the Earth increased from +6°.5 to +25°.6 on 1993 AUG 04, and then decreased to +25°.1 on 1993 AUG 20. For individual figure captions see p. 106.

THE 1993-94 APPARITION OF SATURN: VISUAL AND OTHER OBSERVATIONS

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

ABSTRACT

Visual, photographic, CCD, and photoelectric studies of the planet Saturn and its Ring System were done by A.L.P.O. Saturn Section participants, in what continues to be a successful international observational program. Observations were received for the period 1993 MAY 05-1994 JAN 04, using telescopes ranging in aperture from 10.2 cm. (4.0 in.) to 101.6 cm. (40.0 in.). A few observers described recurring, but subtle, white-spot activity on Saturn, mainly situated in the Equatorial Zone (EZ) of the planet during 1993-94; and there were sporadic sightings of transient festoons and other dark features among the belts and zones of the planet, prompting attempts to make central-meridian (CM) transit timings. The number of CM timings, unfortunately, proved insufficient to derive rotation rates. There were a few photoelectric photometric observations of Saturn during 1993-94. During the apparition, the inclination of the rings to our line of sight, B, reached a maximum value of +13°.174 on 1993 OCT 26. The Northern Hemisphere of Saturn's Globe and the north face of the Rings were visible during 1993-94, with the gradually diminishing inclination of the system to our line of sight affecting the appearance of features near Saturn's north limb. Regions of the Southern Hemisphere of the planet were becoming more visible to observers in 1993-94. Accompanying this report are references, drawings, photographs, graphs, and tables.

INTRODUCTION

Excellent observer participation occurred during the 1993-94 Apparition. Slightly over twice as many observers as in the immediately preceding observing season submitted a valuable collection of visual and other observations of the planet Saturn and its Ring System. This analytical summary, accompanied by drawings and photographs, is based upon these data, which were obtained for the period 1993 May 05-1994 Jan 04. All dates and times in this report are in Universal Time (UT).

Table 1 (below) gives geocentric data in Universal Time (UT) for the 1993-94 Apparition of Saturn. Throughout the observing season the numerical value of **B**, the saturnicentric latitude of the Earth referred to the ring plane (positive when north), ranged between the values +10°.421 (1993 MAY 05) to +13°.174 (1993 OCT 27) to + 11°.492 (1993 JAN 04). The values of **B'**, the saturnicentric latitude of the Sun, decreased from + 12°.960 (1993 MAY 05) to +9°.783 (1993 JAN 04). [6]

Table 1. Geocentric Phenomena for Saturn in the 1993-94 Apparition. [6]

Conjunction	1993 FEB 09, 16^h
Opposition	1993 AUG 19, 23
(Capricornus-Aquarius boundary)	
Conjunction	1994 FEB 21, 17

Opposition Data:

Visual Magnitude	+0.3
B	+11°.723
B'	+11°.597
Declination of Saturn	-13°.96
Globe Diameter: Equatorial	18".80
Polar	16".86
Rings: Major Axis	42".86
Minor Axis	8".74

Table 2 (below) lists the 31 individuals who contributed a total of 165 observations to the A.L.P.O. Saturn Section for the 1993-94 Apparition, together with their observing sites, number of dates of observations, and descriptions of their telescopes.

Table 2. Contributing Observers, 1993-94 Apparition of Saturn.

Observer & Location	No. of Dates	Telescope Data*
Julius L. Benton, Jr.	15	15.2-cm (6.0-in) R
Wilmington Island, GA		
Mark Bosselaers	2	25.4-cm (10.0-in) N
Berchem, Belgium	10	40.6-cm (16.0-in) N
Phillip W. Budine,	6	15.2-cm (6.0-in) R
Walton, NY		
Donald H. DeKarske	2	10.2-cm (4.0-in) R
Colorado Springs, CO		
Vitale Francesco	3	10.2-cm (4.0-in) R
Saline, Italy		
Calcagni Gianluca	1	12.5-cm (4.9-in) N
Mestre, Italy		
David L. Graham	6	15.0-cm (5.9-in) R
North Yorkshire, UK	3	40.0-cm (15.7-in) N
Walter H. Haas	1	20.3-cm (8.0-in) N
Las Cruces, NM	7	31.8-cm (12.5-in) N
Alan W. Heath	12	30.5-cm (12.0-in) N
Nottingham, UK		
Richard Hill, Tucson, AZ	1	12.5--cm (4.9-in) S
Gossens Koen	2	11.4-cm (4.5-in) N
Büllingen, Belgium	1	20.3-cm (8.0-in) S
Daniel Louderback	1	20.3-cm (8.0-in) N
South Bend, WA		
Cicognani Massimo	3	10.2-cm (4.0-in) R
Grisignano, Italy		
Detlev Niechoy	12	20.3-cm (8.0-in) S
Göttingen, Germany		
Gary T. Nowak	3	25.4-cm (10.0-in) SS
Essex Junction, VT		

— Table 2 continued on p. 115 —

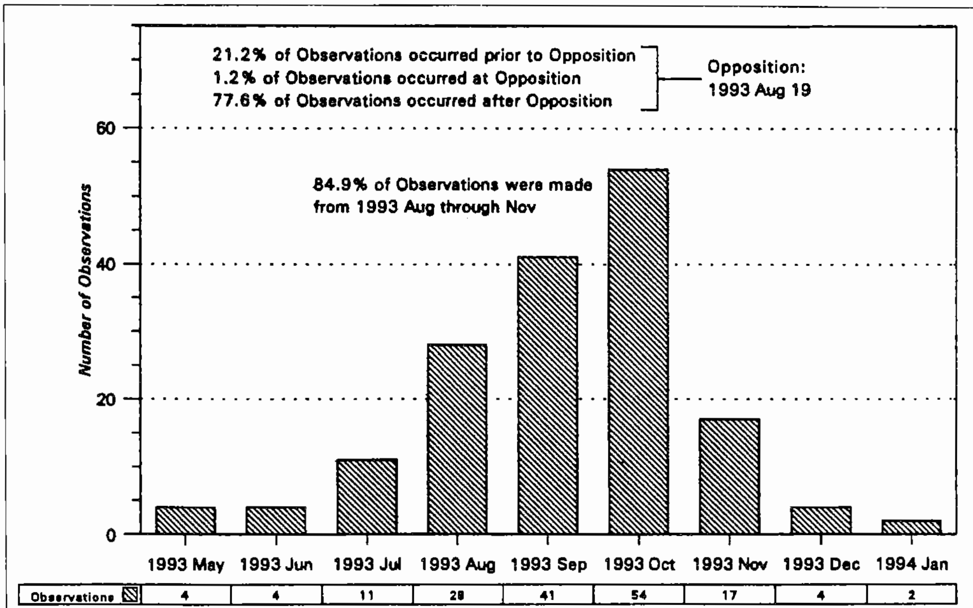


Figure 1. Distribution by month of the 165 observations submitted of the 1993-4 Apparition of Saturn.

Table 2—Continued.

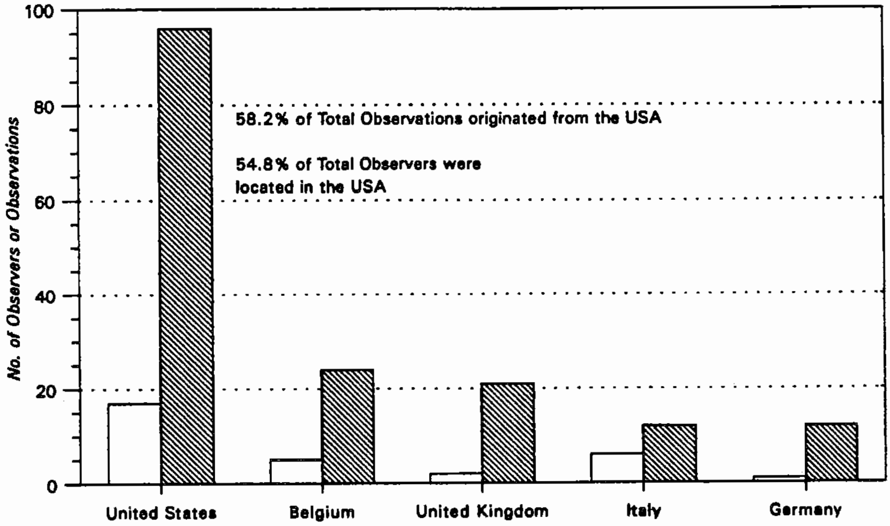
Observer & Location	No. of Dates	Telescope Data*
Spaggiari Patrizio	1	40.0-cm (15.7-in) N
Firenze, Italy		
James E. Pearsall	2	20.3-cm (8.0-in) N
McMinnville, TN		
Phil Plante	1	15.2-cm (6.0-in) R
Poland, OH	7	20.3-cm (8.0-in) N
Giuseppe C. Rigato	1	12.6-cm (5.0-in) N
Caltana, Italy		
Filip Rooms	1	10.2-cm (4.0-in) R
Berchem, Belgium		
Richard W. Schmude	11	35.6-cm (14.0-in) S
College Station, TX		
Ted Stryk	1	11.4-cm (4.5-in) N
Bristol, VA	5	25.4-cm (10.0-in) N
Michael E. Sweetman	7	10.2-cm (4.0-in) R
Tucson, AZ		
Luigi Testa	1	20.3-cm (8.0-in) N
Parma, Italy	2	40.0-cm (15.7-in) N
Hendrik Vandenbruaene	3	25.4-cm (10.0-in) N
Berchem, Belgium		
Roger Venable	9	40.0-cm (15.7-in) N
Augusta, GA		
Erwin Verwichte	3	15.2-cm (6.0-in) N
Genk, Belgium	2	20.3-cm (8.0-in) R
John E. Westfall	3	27.9-cm (11.0-in) S
San Francisco, CA		
Samuel R. Whitby	7	15.2-cm (6.0-in) N
Hopewell, VA	1	17.8-cm (7.0-in) R
Matthew Will	1	15.2-cm (6.0-in) N
Springfield, IL	4	20.3-cm (8.0-in) N
Peter T. Wlasuk	1	101.6-cm (40.0-in) R
Madison, WI		(Yerkes Obser.)
Total Observations	*165*	
Total Observers	*31*	

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

Figure 1 (above), a histogram, gives the distribution of observations by month, showing that 84.9 percent of the data were obtained during the months of 1993 August-November, with a decline in the number of observations on either side of this peak. Only 21.2 percent of the observations were made before opposition (1993 AUG 19), 1.2 percent actually on that date, and 77.6 percent were made after opposition, a pattern that has been common in recent observing seasons. Thus, maximum observational coverage of Saturn routinely clusters around the months nearest to, and including, the date of opposition. To insure relatively uninterrupted coverage of the planet during any given apparition, observers are encouraged to start monitoring the planet as soon as it becomes visible in the eastern sky before sunrise, continuing until Saturn approaches conjunction with the Sun.

Figure 2 (p. 116) depicts the international distribution of the 31 observers and 165 observations of the A.L.P.O. Saturn Section for 1993-94. The United States was responsible for slightly more than half of the submitted observers (58.2 percent) and observations (54.8 percent) during the 1993-94 Apparition. An increasing percentage of individuals and observational reports are from abroad, and this welcome trend continues to demonstrate that our endeavors are international in scope.

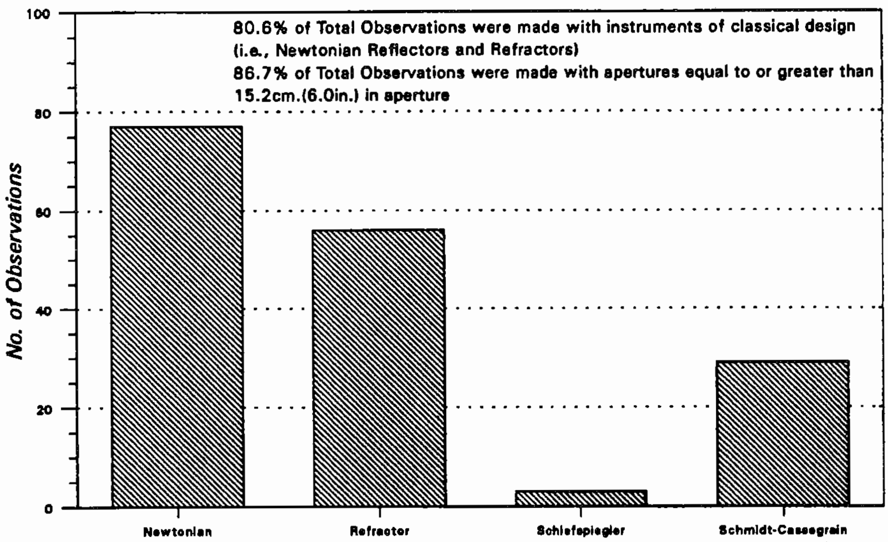
The final graph, *Figure 3* (p. 116), shows the number of observations by instrument type. As in the immediately preceding observing season, telescopes of classical design, Newtonian reflectors and refractors, dominated the scene in 1993-94; 80.6 percent of all observations were made with them, mainly due to their overall proven performance and soundness of design, and consistent favorable image contrast and resolution for detailed planetary work. Also, 86.7 percent of the total



	United States	Belgium	United Kingdom	Italy	Germany
Observers □	17	5	2	6	1
Observations ▧	96	24	21	12	12

Nation of Origin

Figure 2. Number of Observers and Observations by Nation of Origin, 1993-1994 Saturn Apparition.



	Newtonian	Refractor	Schiefspiegler	Schmidt-Cassegrain
Observations ▧	77	56	3	29

Instrument Type

Figure 3. Number of Observations by Type of Instrument, 1993-1994 Saturn Apparition.

of 165 observations was made with instruments equal to or greater than 15.2 cm (6.0 in) in aperture.

For the first time in the history of Saturn observations submitted to this writer, a few individuals almost apologetically have started employing premium-quality Dobsonian Newtonian reflectors of fairly large aperture! These observers contend that, given the proper choice of focal ratio, eyepieces, and high-quality diffraction-limited optics, success can be achieved with Dobsonians when observing the Moon and planets. Furthermore, users of these telescopes remind us that access to reasonably large but moderately inexpensive telescopes is a plus, and they also submit that the altazimuth mountings present no real burden to their visual observing. So, while tradition tempts many of us to question the notion of using such instruments for planetary work, the results received from our Saturn observers this apparition support the fact that something useful has been accomplished with these simple designs. Whether a trend is occurring here is uncertain. This writer offers no opinion, but remains open-minded, simply stating that participation by all who wish to use Dobsonians (or any type of instrument, for that matter) for observing Saturn, as long as the optics are truly high-quality, is always welcome.

Seeing conditions during the 1993-94 Apparition averaged 5.2 on the A.L.P.O. Seeing Scale (where 0.0 is the worst possible seeing and 10.0 denotes perfect seeing). Atmospheric transparency, defined as the magnitude of the faintest star visible to the unaided, dark adapted eye near the object being observed, averaged about +3.9 during the 1993-94 observing season.

The writer is sincerely grateful to all the dedicated A.L.P.O. colleagues mentioned in *Table 2* who conducted routine and specialized observations of Saturn. We encourage observers in this country and abroad to continue working with us in future apparitions. Individuals everywhere have expressed significant interest in the 1995-96 edgewise presentation of Saturn's Rings. [4] Of course, our main goal in any observing season is to maintain comprehensive international coverage of Saturn, and interested persons, regardless of experience, are invited to join us in our endeavors.

The Globe of Saturn

The discussion which follows is based upon the 165 observational reports contributed to the A.L.P.O. Saturn Section throughout the 1993-94 apparition. In the interest of brevity, except when the identity of a specific person is pertinent, the names of observers are omitted in the text. Tables, graphs, drawings, and photographs accompany this report, and we urge readers to refer to them as well as the text. Features on the globe of Saturn are described in north-to-south order and can be identified by the nomenclature diagram in *Figure 4* (below).

Northern Portions of the Globe

A significant number of individuals recorded sporadic whitish ovals, diffuse light patches, transient dark, wispy festoon activity, and subtle dusky mottlings in the Equatorial Zone (EZ) during the 1993-94 Apparition, and numerous attempts were made to obtain recurring central-meridian (CM) transit timings of them. Observers also detected slight variations in the appearance and/or brightness of the belts and zones in the Northern Hemisphere of Saturn during 1993-94. Many of our readers know that the atmospheric features on Saturn are typically poorly-defined, and any bright or dark spots and/or disturbances are usually short-lived. A reasonable amount of patience and continuous, consistent visual monitoring is necessary to perceive any delicate variations in features.

The following summary of the Northern-Hemisphere atmospheric features compares data between apparitions, as in prior Saturn observing reports, in order to help the reader to appreciate the delicate yet recognizable

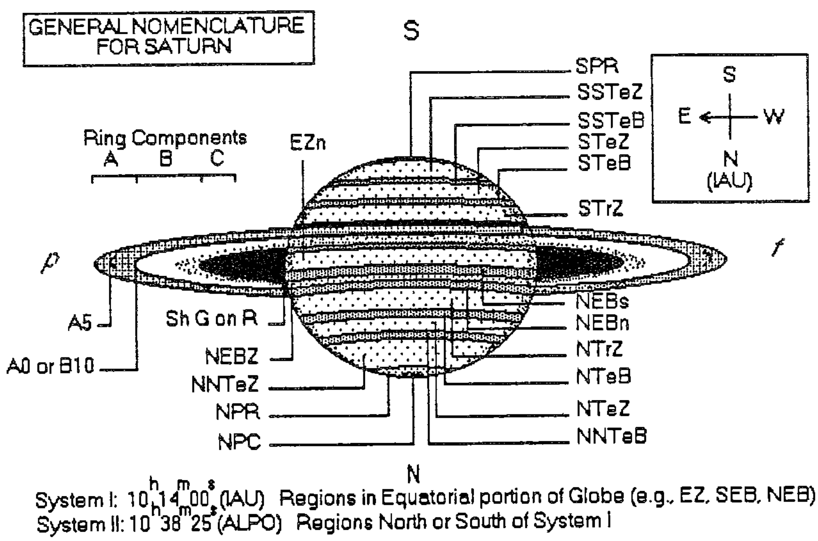


Figure 4. Nomenclature of the Globe and Rings of Saturn. The view is for near opposition on 1993 Aug 19, with **B** equal to about +10°, and shows the major features that are usually easily detected with moderate apertures in good seeing. South is at the top, and global features move across the planet's disk from right to left in the normal view seen with an inverting telescope in the Earth's Northern Hemisphere near culmination and with an even number of reflections. The text describes the Globe and Ring features shown here; not shown in the diagram are the: *North Polar Belt* (NPB) encircling the NPR; *North North North Temperate Belt* (NNNTeB) immediately north of the NNTeZ; *Shadow of the Rings on the Globe* (Sh R on G); *Terby White Spot* (TWS), adjacent to the S*hadow of the Globe on the Rings* (Sh G on R); and any intensity minima in several Ring components. Also, the easternmost and westernmost extensions of the Rings are called the *ansae*.

variations that may be occurring both seasonally and over a much longer time. Similar comparisons are now becoming possible for Southern-Hemisphere features as more and more of that region comes into our view.

There appears to be reliable evidence which suggests that the varying inclination of Saturn's rotational axis with respect to the Sun and Earth plays an important role in any recorded changes in belt and zone intensities, which are given in *Table 3* (below). Also, photoelectric photometry of Saturn in recent years points to the possibility that Saturn's brightness may vary by over 0.10 visual magnitude even after changes in viewing and lighting geometry are considered. **[5]** It has been suggested that the formation of transient atmospheric features in the belts and zones of the planet may contribute to such brightness variations. Obviously, long-term photoelectric

Table 3. Visual Numerical Intensity Estimates and Colors: Saturn, 1993-94.

	Relative Intensity (1993-94)			
Globe/Ring Feature	Number of Estimates	Mean and Standard Deviation	Change Since 1992-93	"Mean" Derived Hue (1993-94)
ZONES AND OTHER BRIGHT AREAS:				
NPC	4	4.7 ± 0.60	-0.4	Dusky Yellowish-Grey
NPR	25	4.8 ± 0.99	-0.0	Yellowish-Grey
NTeZ	11	5.8 ± 0.81	-0.2	Dull Yellowish-White
NTrZ	11	5.8 ± 0.91	+0.5	Dull Yellowish-White
NEB Z	3	5.2 ± 0.24	+0.5	Yellowish-Grey
EZn	37	7.6 ± 0.90	+0.7	Pale Yellowish-White
Globe North of NEB (entire)	19	5.4 ± 0.70	+0.5	Dusky Yellowish-Grey
Globe South of Rings (entire)	18	5.6 ± 0.59	+0.6	Dusky Yellowish-Grey
STrZ	8	6.7 ± 0.25	---	Yellowish-White
STeZ	7	6.2 ± 0.40	---	Yellowish-White
SPR	30	5.4 ± 0.97	+0.1	Yellowish-Grey
BELTS:				
NPB	4	4.5 ± 0.83	+0.4	Greyish
NTeB	3	5.5 ± 0.47	+1.1	Light Grey
NEB (entire)	28	3.7 ± 0.74	-0.1	Greyish-Brown
NEBn	7	3.8 ± 0.87	+0.4	Dark Greyish-Brown
NEBs	8	3.4 ± 0.94	+0.2	Dark Greyish-Brown
EB	1	6.0 ----	+1.8	Light Grey
SEB (entire)	1	3.9 ----	---	Greyish-Brown
STeB	6	4.8 ±1.10	---	Greyish
RINGS:				
Ring A (entire)	30	6.2 ± 1.16	-0.2	Dusky White
Ring A (outer half)	3	6.9 ± 0.05	0.0	Dusky White
Encke's Division (A5; ansae)	1	4.2 ----	+1.1	Dark Grey
Ring A (inner half)	3	6.6 ± 0.00	-0.1	Dusky White
Cassini's Division (A0 /B10; ansae)	15	1.2 ± 1.01	-0.2	Greyish-Black
Ring B				
Ring B (outer third)	-	8.0 **[Standard]**		White.
Ring B (inner two-thirds)	26	7.4 ± 0.34	+0.2	Yellowish-White
Ring C (ansae)	18	1.1 ± 0.80	+0.5	Dark Greyish-Black
Crape Band	20	3.0 ± 1.15	+0.1	Dark Grey
Sh G on R	18	0.3 ± 0.56	0.0	Dark Greyish-Black
Sh R on G	3	0.2 ± 0.24	-0.9	Dark Greyish Black
Terby White Sport (TWS)	8	7.8 ± 0.46	-0.1	White

Notes: For nomenclature see text and *Figure 4* (p.117). A letter with a digit (e.g., A5) refers to a location on the Ring specified in terms of units of tenths of the distance from the inner edge to the outer edge. Visual numerical relative intensity estimates (visual surface photometry) are based upon the A.L.P.O. Intensity Scale, where 0.0 denotes complete black (shadow) and 10.0 refers to the most brilliant condition (very brightest Solar System objects). The adopted scale for Saturn uses a reference standard of 8.0 for the outer third of Ring B, which appears to remain stable in intensity for most Ring inclinations. All other features on the Globe or in the Rings are compared systematically using this scale, described in the *Saturn Handbook*, which is issued by the A.L.P.O. Saturn Section. **[2]** The "Change Since 1992-93" is in the sense of the 1992-93 value subtracted from the 1993-94 value, "+" denoting an increase in brightness and "-" indicating a decrease (darkening). When the apparent change is less than about 3 times the standard deviation, it is probably not statistically significant.

photometry is needed in conjunction with visual intensity estimates to help further understand such variations.

The intensity scale used here is the A.L.P.O. Standard Numerical Relative Intensity Scale, where 0.0 is total black and 10.0 is the brightest possible condition. This scale is normalized by setting the outer third of Ring B at a standard brightness of 8.0. The arithmetic sign of an intensity change is found by subtracting a feature's 1992-93 intensity from its 1993-94 intensity. A change of only ±0.1 mean intensity points is considered to be of no real significance, nor is a variation truly noteworthy unless it exceeds about three times its standard deviation.

With respect to latitudes of features in the Northern Hemisphere of Saturn's globe, observers used the visual method developed and introduced by Haas during the 1960's. Employing this method, one estimates the fraction of the polar semidiameter of the planet's disk that is subtended on the central meridian (CM) between the limb and the feature whose latitude is sought. This procedure is extremely easy to use, and with care in its execution, the results from this method compare very favorably with similar values derived with a bifilar micrometer. After mathematical reduction, the resulting latitudes of selected features appear in *Table 4* (below). It must be remembered, however, that it is often risky to place extreme confidence in data from only a few observers. However, Haas has been using this technique for many years with excellent and reliable results. Use of this method continues to grow among our observers, and it is strongly recommended that individuals use this very simple procedure whenever possible, even if a bifilar micrometer is available. This advice is given because data from both methods would be useful for comparison. A full discussion of this visual technique can be found in the *Saturn Handbook*. [2]

North Polar Region (NPR).—The yellowish-grey NPR was uniform in appearance and displayed no detectable variation in brightness from 1992-93 to 1993-94. The dusky yellowish-grey **North Polar Cap** (NPC) was only occasionally seen in the extreme north during 1993-94; and since 1992-93, the NPC has displayed a very slight decrease in brightness (a mean intensity change of -0.4). The greyish **North Polar Belt** (NPB) was described during the 1993-94 observing season in good seeing as a continuous linear greyish feature that encircled the NPR, showing a small increase in brightness since 1992-93 (a change of +0.4 mean intensity points).

North North Temperate Zone (NNTeZ).—This feature was not referred to in observational reports submitted during 1993-94.

North North Temperate Belt (NNTeB).—Observers did not submit reports of this feature during the 1993-94 Apparition.

North Temperate Zone (NTeZ).— In 1993-94 the dull yellowish-white NTeZ showed little change in intensity since 1992-93 (the change in mean intensity amounted to only -0.2). Observers were largely unconvinced of the reality of activity in this region, much of which was at the threshold of vision, even in larger instruments. The NTeZ and NTrZ were of about the same intensity during the 1993-94 Apparition.

North Temperate Belt (NTeB).—This light-greyish belt was far more diffuse during 1993-94 than in 1992-93, and it was barely distinguished from its environs most of the time during the more recent apparition. When seen, it appeared to extend uniformly across the Globe from limb to limb. Contributing to the poor contrast of the NTeB with adjacent zones on Saturn was the increased brightness of the belt in 1993-94 (it was lighter by + 1.1 mean intensity points than in 1992-93).

North Tropical Zone (NTrZ).—Almost of the same intensity as the NTeZ in 1993-94, the NTrZ showed a subtle increase in brightness compared with the 1992-93 period (+0.5 mean intensity points). Observers assigned a dull yellowish-white color to this zone in 1993-94, and it was mostly stable in overall intensity as it extended across the planet from limb to limb throughout the observing season.

Table 4. Latitudes of the Equatorial and Northern-Hemisphere Belts of Saturn in the 1993-94 Apparition.

	Type of Latitude (Change from 1992-93 in parentheses)					
Saturnian Belt	Planetocentric		Eccentric		Planetographic	
	° °	°	° °	°	° °	°
South edge NPB	+60.9 ---	(-12.2)	+63.6 ---	(- 11.2)	+66.1 ---	(- 10.2)
Center NEB	+20.6 ---	--------	+22.9 ---	--------	+25.3 ---	--------
North edge NEB	+20.6 ±2.0	(- 3.2)	+22.9 ±2.2	(- 3.4)	+25.3 ±2.3	(- 3.7)
South edge NEB	+15.2 ±1.2	(- 3.2)	+16.9 ±1.3	(- 3.6)	+18.9 ±1.4	(- 3.9)
Center STeB	-40.3 ±5.4	--------	-43.5 ±5.5	--------	-46.7 ±5.5	--------

Notes: For nomenclature see *Figure 4* (p. 117). Latitudes are calculated using the appropriate geocentric tilt, B, for each date of observation. Planetocentric latitude is the angle between the equator and the feature as seen from the center of the planet. Planetographic latitude is the angle between the surface normal and the equatorial plane. Eccentric, or "Mean," latitude is the arc-tangent of the geometric mean of the tangents of the other two latitudes. The change shown in parentheses is the result of subtracting the 1992-93 latitude value [3] from the 1993-94 latitude value.

North Equatorial Belt (NEB).—The greyish-brown NEB was sometimes seen differentiated into the **NEBn** and **NEBs**, where **n** refers to the North Component and **s** to the South Component, separated by the **NEBZ** (North Equatorial Belt Zone). However, the more common aspect in 1993-94 was the NEB appearing as a single feature. No indisputable brightness changes in the NEB were revealed when intensity estimates of 1993-94 were compared with those of 1992-93 (apparently darker by only -0.1 mean intensity points does not imply a real reduction in brightness).

The greyish-brown NEBn was slightly brighter in 1993-94 than in 1992-93 (+0.4 mean intensity points). Observers were able to perceive ill-defined and transient dark projections and condensations within the NEBn, but no features persisted long enough to enable good CM transit timings.

The greyish-brown NEBs was the darkest belt on the Globe of Saturn in 1993-94 (as a component, darker than the NEB as a whole), which had been the case in 1992-93 and several previous observing seasons. Compared with 1992-93, the NEBs in 1993-94 exhibited only a minor increase in brightness (difference of +0.2 mean intensity points). Occasional dark mottlings and dusky spots were suspected in the NEBs, but CM transit timings were hampered by the short-lived and poorly-defined nature of these features.

The yellowish-grey NEBZ was rarely observed during 1993-94. Exercising caution in the interpretation of results based on only a few sightings, there was an impression that a mean intensity increase of +0.5 had occurred since 1992-93. Even so, as in several past apparitions, the NEBZ remained as one of the darker zones on Saturn in 1993-94. While it might be expected that the NEBZ was troublesome to see in contrast with its surroundings, the location of this zone between the darker NEBn and NEBs made distinguishing this feature considerably easier. No activity was seen associated with the otherwise uniform NEBZ during the 1993-94 Apparition.

Equatorial Zone (EZ).—The pale yellowish-white EZ (chiefly the **EZn** in this report) was brighter by +0.7 mean intensity points in 1993-94 when compared with the 1992-93 Apparition. The EZn was always the most brilliant zone on Saturn during the 1993-94 Apparition, closely approaching the intensity of the outer third of Ring B. This increase in brightness during the observing season appeared to be associated with recurring sightings of bright, diffuse areas and sporadic white-spot activity from early July through October, 1993; and some observers remarked that the EZ stayed consistently brighter after opposition. This impression was also noted in 1992-93. Sightings of wispy festoons, projecting from the NEBs, also occurred during the 1993-94 Apparition, but capturing CM transits of any of the vague bright and dark features in the EZn proved fruitless.

The **Equatorial Band** (EB) was seen only once during the 1993-94 Apparition, as a light-grey, hardly perceptible linear feature across Saturn's Globe. Although a single intensity estimate suggested an increase in brightness of +1.8 intensity points since 1992-93, this conclusion is very uncertain with only one estimate.

Shadow of the Rings on the Globe (Sh R on G).—This feature was sometimes visible as a dark greyish-black feature on either side of opposition during 1993-94, and the deviation from the actual black (0.0) intensity was obviously due to bad seeing and scattered light. Visibility of this feature was obviously affected by changes in the values of **B** and **B'**.

Shadow of the Globe on the Rings (Sh G on R).—This features was always seen as dark greyish-black during 1993-94 and regular in form, although any deviation from the true black (0.0) intensity occurs for the same reasons as noted for the Sh R on G.

SOUTHERN REGIONS OF THE GLOBE

As the Rings of Saturn continue to decrease their tilt to our line of sight (i.e., as the value of **B** becomes smaller), increasing portions of the Southern Hemisphere of the planet come into our view; and, of course, correspondingly less of the Northern Hemisphere is visible. During 1993-94, observers were able to start recording intensity estimates, as well as to represent on drawings, some of the more prominent belts and zones in the Southern Hemisphere. As a whole, the Globe of Saturn south of the plane of the rings was slightly brighter than the portion of the Globe north of the ring plane in 1993-94.

South Equatorial Belt (SEB).—There was only one sighting of this feature during 1993-94, and it was described as a single, greyish-brown feature with an intensity similar to that of the NEBs. No differentiation of the SEB into components analogous to the NEBn and NEBs was apparent. On the basis of this single observation, one may cautiously assume that the SEB was the darkest and most conspicuous belt visible in the Southern Hemisphere of Saturn in 1993-94.

South Tropical Zone (STrZ).—Other than the EZn, the yellowish-white STrZ was the brightest zone on the Globe of Saturn during 1993-94. It was stable throughout the entire apparition in overall intensity as it spanned the planet from limb to limb, and no activity was reported in this region in 1993-94.

South Temperate Belt (STeB).—This greyish feature was seen periodically during the 1993-94 Apparition extending from one limb to the other. The STeB was somewhat darker than its counterpart in the Northern Hemisphere (by -0.7 intensity points). No activity was visible in the STeB in 1993-94.

South Temperate Zone (STeZ).—The yellowish-white STeZ was the third brightest zone on Saturn in 1993-94, and was uniform in intensity throughout the apparition, with no perceptible activity. The STeZ was +0.4 intensity points brighter than the NTeZ during 1993-94.

South Polar Region (**SPR**).—The SPR appeared yellowish-grey during the 1993-94 Apparition, and unchanged in intensity since 1992-93. No reports of the **South Polar Cap** (SPC) or **South Polar Belt** (SPB) were received during the apparition.

THE RINGS OF SATURN

This section addresses observations of Saturn's Ring System that were submitted during the 1993-94 apparition, along with a continuing comparative study of the mean intensity data as has been traditional for previous apparitions. The northern face of the Rings was presented less favorably to our view in 1993-94 than in previous years because of the diminishing tilt of the Ring System.

Ring A.—Considered as a whole, Ring A was dull white throughout the 1993-94 Apparition, showing no substantial change in brightness since 1992-93 (darker by only -0.2 mean intensity points). There were few reports of Encke's Division (A5) at the Ring ansae during the apparition, and there were no other intensity minima recognized in Ring A in 1993-94. On rare occasions, Ring A was noted to have distinct outer and inner halves in terms of intensity. In 1993-94, the perceived outer and inner halves of Ring A were dusky white and exhibited virtually the same intensity as in 1992-93 (a difference in both cases of no more than -0.1 mean intensity points).

Ring B.—The outer third of Ring B is the adopted standard of reference for the A.L.P.O. Saturn Intensity Scale, with an assigned value of 8.0. For all of 1993-94, this region of Ring B appeared white, stable in intensity, and unmistakably the brightest feature on both Saturn's Globe and Rings. On some occasions, however, the brightness of the EZn closely approached that of the outer third of Ring B. In 1993-94, the inner two-thirds of Ring B, which was yellowish-white in color, showed only a minute increase in brightness since the immediately preceding observing season (a brightness increase of +0.2). It was uniform in intensity throughout 1993-94, with no confirmed sightings of wispy "spoke" features as had been suspected in 1992-93.

Cassini's Division (**A0 or B10**).—Cassini's Division was usually visible at the ansae in 1993-94, and this feature extended all the way around the Rings in favorable seeing with larger apertures. It was described as greyish-black during the 1993-94 Apparition and it appeared to have a slightly darker intensity when compared with 1992-93 (a difference of -0.2 mean intensity points), certainly attributable to better seeing and/or atmospheric transparency. Readers are reminded that, as with the Sh G on R described earlier, any deviation from a true black appearance for this feature is due chiefly to scattered light and poor seeing.

Ring C.—Ring C, most often visible at the ansae, was of a lighter intensity (+0.5 mean intensity points) during 1993-94 when compared with 1992-93, and its greyish-black appearance was quite obvious most of the apparition. Usually, faint or narrow Ring features are easier to see, and they typically appear darker, at greater ring inclinations.

The **Crape Band** (Ring C as projected onto the Globe) had about the same mean intensity in 1993-94 as in 1992-93 (a non-significant difference of +0.1). Observers agreed that this feature was uniform in intensity and very dark grey in hue. Except when they are near the plane of the Rings, the Saturnicentric latitudes of the Sun and Earth conspire to bring about the partial coincidence of the Crape Band with the Shadow of Ring C on the Globe.

Ring Components Other Than A, B, or C.—Neither **Ring D** (inside Ring C) nor **Ring E** (outside Ring A) was reported in 1993-94. Normally, investigations of these Ring components are beyond the scope of most visual work because they are difficult to detect, requiring the best possible seeing conditions and significant aperture. CCD images may prove useful in showing them, however.

Terby White Spot (**TWS**).—The TWS is an occasionally-seen brightening of the Rings immediately adjacent to the Sh G on R. A few observers in 1993-94 saw a brilliant white TWS, and as in 1992-93 and other recent apparitions, this feature appeared not nearly so conspicuous as it had been in the early to mid-1980's. However, it was still the brightest object on Saturn's Globe or in the Rings this apparition, except for the outer third of Ring B. The TWS as a feature is virtually of no importance, since it is most probably a spurious contrast phenomenon and not an intrinsic Saturnian feature. It is of interest, however, to try to ascertain whether there is any correlation between the observed brightness of the TWS and the varying tilt of the Ring, as well as to record its appearance and prominence in different color filters and polarizers.

Bicolored Aspect of the Rings.—This term refers to a reported difference in color between the two ansae of the Rings. A handful of people routinely attempted to see if they could observe the bicolored aspect in 1993-94, and their efforts resulted in the detection of variations in the brightness of the East and West ansae (IAU direction system) when compared with W47 (Wratten 47; blue) or W80A (blue) and W25 or W23A (red) Filters. *Table 5* (p. 122) lists the circumstances of these observations. It can be seen that there were two instances of simultaneous observations of the bicolored aspect. On one occasion when three observers were viewing Saturn at the same time, two reported a difference in color but the third observer did not see any difference. To get a better understanding of the bicolored aspect of the Rings, there remains a great need for observers to strive to conduct simultaneous observing programs which stress, among other projects, a system-

Table 5. Observations of the Bicolored Aspect of Saturn's Rings in 1993-94.

Notes: Telescope types are as in *Table 2* (pp. 114-115). Seeing is on the 0-10 A.L.P.O. Scale. Transparency is the limiting visual magnitude in the vicinity of Saturn. Under "Filter," **B** refers to the blue W47 or W80A filters, **IL** to integrated light (no filter), and **R** to the red W25 or W23A Filters. **E** means that the east ansa was brighter than the W, **W** that the west ansa was brighter, and = means that the two ansae were equally bright. East and West directions are as noted in the text. A letter in the right-hand column indicates a particular group of simultaneous observations. **n.a.** indicates "not available."

Observer	UT Date and Time (entire observing period)			Telescope Type and Aperture		Magnification	Seeing	Transparancy	Filter B	IL	R	
	1993											
Whitby	JUN	10	09:05-09:23	N	15.2 cm (6.0 in)	214×	4.0	+4.0	E	=	=	
Whitby		11	08:55-09:10	N	15.2 cm (6.0 in)	205×	5.0	+3.0	E	=	=	
Haas	AUG	21	04:48-05:04	N	31.8 cm (12.5 in)	303×	3.0	+2.5	W	=	=	
Schmude		31	04:00-04:35	S	36.0 cm (14.0 in)	325×	8.0	+4.5	=	=	E	
Will	SEP	05	03:10-03:30	N	15.2 cm (6.0 in)	230×	6.0	+2.5	=	E	E	
Will		06	03:30-03:50	N	20.3 cm (8.0 in	270×	4.0	+3.0	E	E	E	
Venable		10	02:40-03:00	N	40.0 cm (15.7 in)	146×	2.5	+3.5	E	E	=	
Venable		11	02:55-03:20	N	40.0 cm (15.7 in)	375×	1.0	+6.0	E	=	=	
Haas		13	04:34-04:50	N	31.8 cm (12.5 in)	303×	3.5	+3.5	E	=	=	
Venable		19	02:41-03:08	N	40.0 cm (15.7 in)	375×	2.0	+3.5	=	=	=	a
Benton		19	02:30-03:15	R	15.2 cm (6.0 in)	222×	4.0	+5.0	E	=	=	a
Haas		19	02:39-05:06	N	31.8 cm (12.5 in)	321×	4.0	+3.5	E	=	=	a
Venable		25	02:49-03:00	N	40.0 cm (15.7 in)	146×	3.0	+3.0	E	=	=	
Haas		26	02:52-03:45	N	20.3 cm (8.0 in)	231×	3.0	+ 4.0	E	=	=	
Haas		28	04:08-04:50	N	31.8 cm (12.5 in)	321×	4.0	+3.5	E	=	=	
Venable	OCT	02	02:48-03:05	N	40.0 cm (15.7 in)	146×	n.a.	+3.0	E	=	=	
Venable		09	02:45-03:07	N	40.0 cm (15.7 in)	375×	n.a.	+4.0	E	=	=	
Haas		24	02:17-03:41	N	31.8 cm (12.5 in)	366×	3.5	+3.5	E	=	=	
Venable	NOV	07	00:41-01:30	N	40.0 cm (15.7 in)	375×	n.a.	+1.5	E	E	E	
Benton		10	00:35-03:16	R	15.2 cm (6.0 in)	266×	3.0	+5.0	E	=	=	b
Haas		10	02:14-03:31	N	31.8 cm (12.5 in)	202×	3.5	+2.5	E	=	=	b

atic study of this phenomenon. The greater the number of persons taking part in this effort, making independent, systematic visual estimates with color filters and doing CCD work and photography in the corresponding wavelengths, all at the same time, the better will be the chances of shedding some new light on this intriguing and poorly-understood phenomenon.

SATURN'S SATELLITES

No observers in 1993-94 contributed systematic visual estimates of Saturn's satellites using the methods outlined in *The Saturn Handbook*. Photoelectric photometry and systematic visual magnitude estimates of Saturn's satellites are encouraged for future apparitions.

As the Ring System approaches edge-on orientation to our line of sight, interesting events involving the satellites of Saturn occur. For example, when the plane of the Ring System passes near the Sun, the best opportunity arises for observing transits, occultations, shadow transits, and eclipses of the satellites of Saturn which are near the equatorial plane. These observations involve precise timing of the events to the nearest whole second. In observing seasons leading up to and following the 1995-96 edgewise apparition, as well as during 1995-96, the satellites Mimas (S1), Enceladus (S2), Tethys (S3), Dione (S4), Rhea (S5), and Titan (S6) will participate in these events. Small apertures are usually insufficient to view such phenomena, with the possible exception of events involving Titan, and the largest instruments available should be used for such observations. Even with moderate to large telescopes, controversy still persists as to the visibility of shadow transits of the Saturnian satellites other than Titan. Nearly all of the inner satellites of Saturn are far too small in diameter to cast umbral shadows onto the globe of the planet. Nonetheless, trained observers with sufficiently large apertures have reported possible shadow transits of Tethys in the past.

SIMULTANEOUS OBSERVATIONS

There were a few simultaneous, or near-simultaneous, observations of Saturn during 1993-94, where "simultaneous observations" are defined as those when individuals work independently but observe at the same time and on the same date. As in the immediately preceding apparition, this outcome was purely coincidental, and the Saturn Section needs more persons who will regularly participate in *scheduled* simultaneous observation programs, carrying out their routine activities (i.e., making drawings, intensity estimates, satellite magnitude measurements, and central-meridian [CM] transit timings), all on the selected date and time. Such simultaneous observations can provide better verification of subtle, variable phenomena on Saturn. These supporting observations greatly strengthen confidence in our analysis, and readers are urged to inquire about how to undertake simultaneous observations in future observing seasons. The Saturn Section is developing a simultaneous observing schedule for the current and future apparitions, particularly for the noteworthy edgewise presentation of the Rings in 1995-96. The schedule will be published in this Journal as a means to facilitate simultaneous visual and photographic programs.

CONCLUSIONS

As in many past apparitions, the dedicated, continuing efforts of A.L.P.O. Saturn Section members provided an excellent compendium of observations for study and analysis during 1993-94, and the writer very much appreciates the enthusiasm and participation of all of the individuals mentioned in this report. Any readers who desire to start regularly contributing to our programs are cordially invited to inquire about our observational objectives for the coming years. Some interesting evenings at the telescope lie ahead as Saturn nears the somewhat rare edgewise apparition of 1995-96, and more information will appear in this Journal about that observing season in coming issues.

REFERENCES

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

[2] Benton, J.L. ,Jr. *Visual Observations of the Planet Saturn: Theory and Methods (The Saturn Handbook).* Savannah, GA: Review Publishing Company, 1994 (6th Revised Edition).

[3] ________. "The 1992-93 Apparition of Saturn: Visual and Photographic Observations," *J.A.L.P.O.*, *37*, No. 3 (February, 1994), pp.97-107.

[4] ________. "Observational Prospects for the 1995-96 Apparition of Saturn and the Edgewise Presentation of the Rings." *J.A.L.P.O.*, *38*, No. 2 (March, 1995), pp.49-52.

[5] Schmude, R.W., Jr., "Wideband Photometry of Mercury, Venus, Jupiter, Callisto, and Saturn," *Journal of the Royal Astronomical Society of Canada*, *87*, No. 3 (June, 1993), pp. 133-139.

[6] United States Naval Observatory. *The Astronomical Almanac.* Washington: U.S. Government Printing Office. (Annual Publication; the 1993 and 1994 editions were used for this report, which were published in 1992 and 1993, respectively.)

Figures 5-16. For the illustrations below and on pp. 124-125, unless otherwise stated, **Seeing** is given on the 0-10 A.L.P.O. Scale, and **Transparency** is the limiting naked-eye visual magnitude in the vicinity of Saturn. South is at the top in these views, and celestial east to the right. **CM(I)** is the central-meridian longitude in rotational System I; **CM(II)** is the same in System II. (System I applies to the NEBs, EZ, and SEBn, with a rate of 844°.3 per day; System II to the rest of the Globe, at 812°.0 per day.) **B** is the Saturnicentric latitude of the Earth, and **B'** that of the Sun. Contrasts have been exaggerated for reproduction.

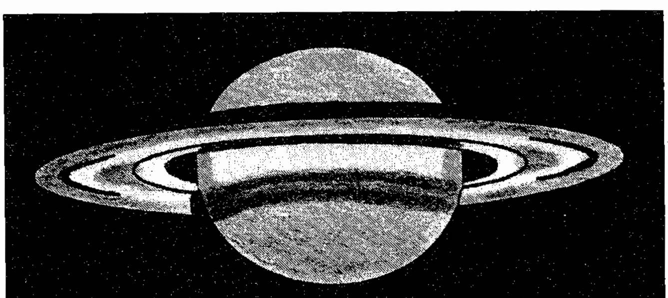


Figure 5. Drawing by Samuel R. Whitby. 1993 MAY 08, 09:00-09:15 UT. 15.2-cm (6.0-in) Newtonian, 205X. No filter. Seeing 5; Transparency +3. CM(I) = 166-175°; CM(II) = 027-036°. B = +10°.3; B' = +12°.9.

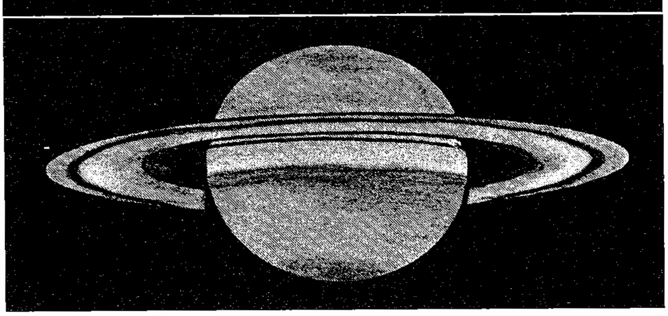


Figure 6. Drawing by Phil Plante. 1993 JUL 22, 05:30-05:49 UT. 20.3-cm (8.0-in) refractor, 176X, 428X. No filter. Seeing 4-5; Transparency +4.5. CM(I) = 011-022°; CM(II) = 334-345°. B = +10°.8; B' = +12°.0.

Figures 7-16 continued on pp. 124-125.

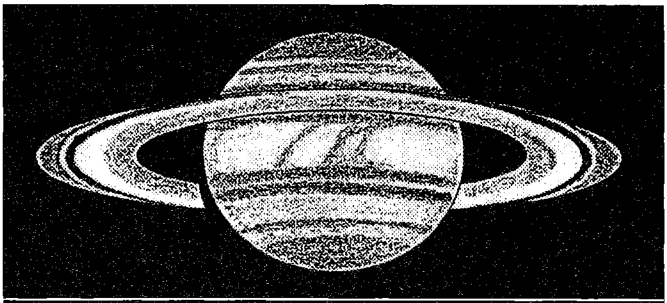


Figure 7. Drawing by Massimo Cicognani. 1993 AUG 02, 23:25 UT. 10.2-cm (4.0-in) refractor, 266X. No filter. Seeing 1.5 (Antoniadi Scale; very good); Transparency +2. CM(I) = 209°; CM(II) = 153°. B = +11°.1; B' = +11°.8.

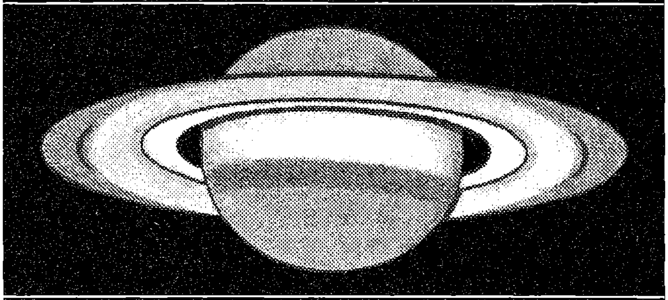


Figure 8. Drawing by Michael E. Sweetman. 1993 AUG 15, 06:30-06:44 UT. 10.3-cm (4.0-in) refractor, 250X. No filter. Seeing 6; Transparency +5.0. CM(I) = 151-160°; CM(II) = 058-066°. B = +11°.6; B' = +11°.7.

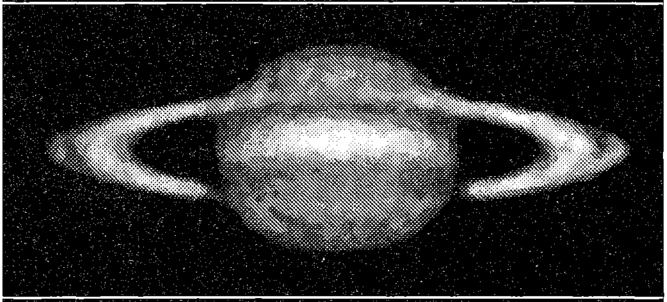


Figure 9. Photograph by Richard W. Schmude, Jr. 1993 AUG 17, 04:58 UT. 35.6-cm (14.0-in) Schmidt-Cassegrain, f/106, 10 seconds on Kodak 100HC Slide Film. CM(I) = 346°; CM(II) = 190°. B = +11°.6; B' = +11°.6.

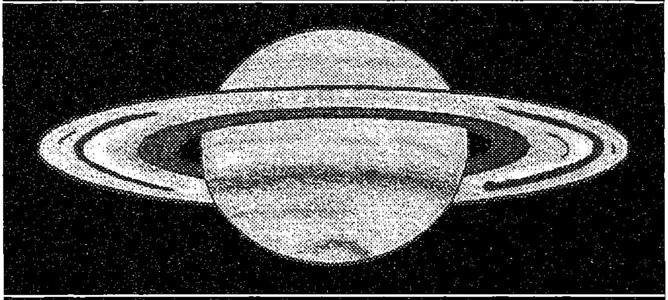


Figure 10. Drawing by Richard W. Schmude, Jr. 1993 AUG 17, 05:26-05:51 UT. 35.6-cm (14.0-in) Schmidt-Cassegrain, 325X, 530X. No filter. Seeing 7; Transparency +5. CM(I) = 003-017°; CM(II) = 206-220°. B = +11°.6; B' = +11°.6.

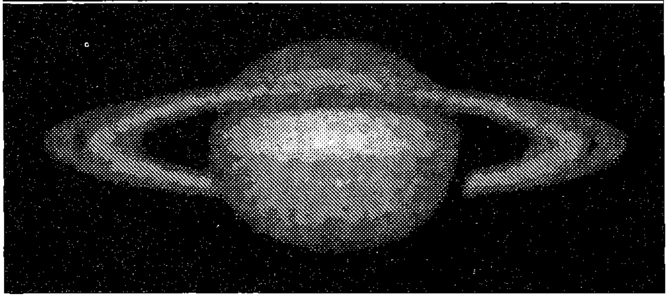


Figure 11. CCD image by James E. Pearsall. 1993 SEP 07, 03:20 UT. 20.3-cm (8.0-in) Newtonian, f/58, 1 second. No filter. Lynxx PC Camera, processed with Richard Berry's Quik Pix software. Seeing 6-7; Transparency +4. CM(I) = 020°; CM(II) = 268°. B = +12°.3; B' = +11°.4.

Figures 12 - 16 continued on p. 125.

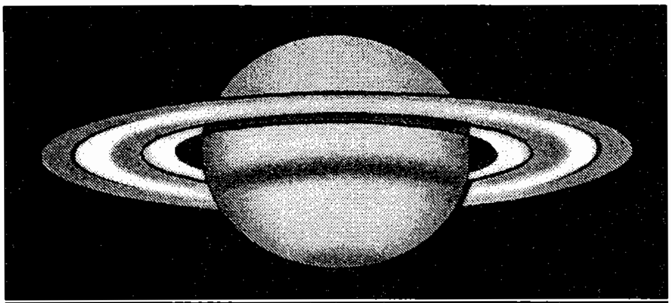


Figure 12 Drawing by Donald H. DeKarske. 1993 Sep 09, 04:07-04:35 UT. 10.2-cm (4.0-in) refractor, 167X. No filter. Seeing 6-7; Transparency +4.0. CM(I) = 296-313°; CM(II) = 119-134°. B = +12°.4; B' = +11°.3.

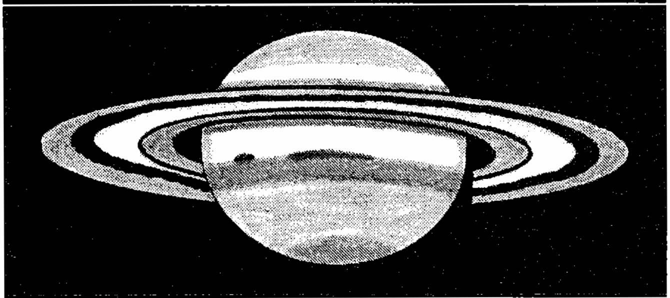


Figure 13. Drawing by Phillip W. Budine. 1993 Sep 23, 01:15 UT. 15.2-cm (6.0-in) refractor, 205X, 285X. No filter. Seeing 7-8; Transparency +4 - +3. CM(I) = 136°; CM(II) = 230°. B = +12°.6; B' = +11°.1.

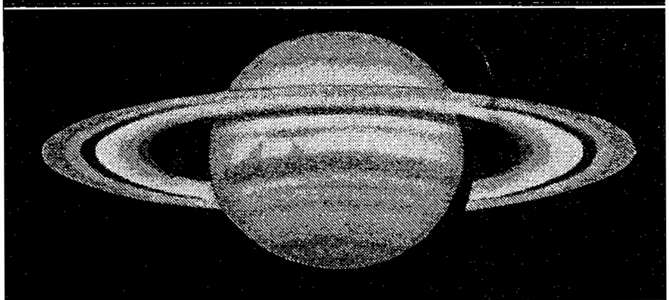


Figure 14. Drawing by David L. Graham. 1993 Oct 17, 20:15 UT. 15.0-cm (5.9-in) refractor, 286X. CM(I) = 187°; CM(II) = 200°. B = +13°.1; B' = +10°.8.

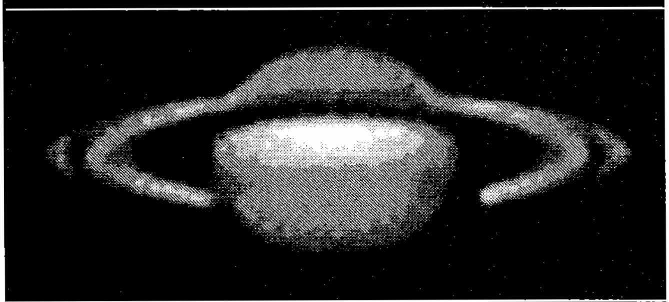


Figure 15. Composite of four CCD images by John E. Westfall. 1993 Oct 18, 03:24-03:29 UT. 27.9-cm (14.0-in) Schmidt-Cassegrain, f/21, 0.75 sec. No filter. Lynxx MC Camera, processed with Adobe PhotoShop. CM(I) = 079-082°; CM(II) = 082-085°. B = +13°.1; B' = +10°.8.

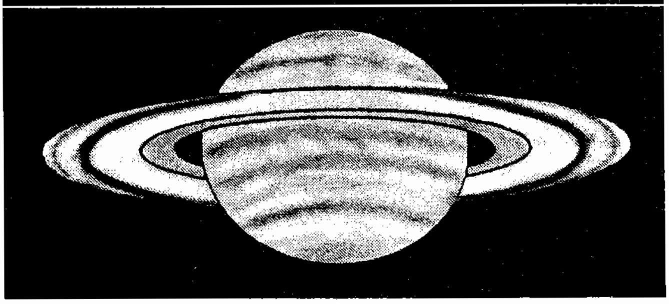


Figure 16. Drawing by Peter T Wlasuk. 1993 Oct 24, 00:02-00:22 UT. 101.6-cm (40.0-in) refractor (Yerkes Observatory), 344X. Seeing 4-7; Transparency +5. CM(I) = 346-357°; CM(II) = 160-171°. B = +13°.2; B' = +10°.7.

COMET CORNER

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

The first part of 1995 saw little comet activity, the only new comet discovery being a faint photographic find. This summer and autumn should see a few returning comets.

MILLIONS OF COMETS?

You recently might have heard about the *Kuiper Belt*, a band of material in orbit around our Sun near the orbit of Neptune. A couple of dozen such objects have already been discovered from Earth; they are at about magnitude +22. This translates to a diameter of about 100 km. While many consider them to be comets rather than minor planets, their orbits seem to be rather circular and it appears unlikely that they will approach close to the Sun and develop cometary features. A question arises: How many objects are there in the Kuiper Belt?

According to *IAU Circular 6163*, the Hubble Space Telescope conducted a limited search for objects in the Kuiper Belt. The test covered a small section of sky, four square arc-minutes in size. The limiting magnitude was +28, about the brightness of the nucleus of Halley's Comet at that distance. Thirty-four images were recorded over two days in August, 1994, which were "stacked" (summed) after the galaxies and stars were removed. Of the many objects remaining, statistical studies were done to determine which "spots" exhibited the motion of objects in a typical Kuiper-Belt orbit. Some 244 objects were found in such paths, compared to only 185 in a "control" group. The result: "If our 59 excess candidates are indeed real members of the Kuiper Belt, there must be about 60,000 such objects per square degree, or at least a total of 100 million comets brighter than our limiting magnitude in the restricted range of orbits similar to the ones studied here."

COMETS PRESENTLY VISIBLE

During the summer we can expect to see only four returning comets. They are as follows.

Periodic Comet Schwassmann-Wachmann 1 = 29P/Schwassmann-Wachmann 1.—In a nearly circular orbit, the comet occasionally experiences outbursts which brighten it to the range of magnitude +12-13. We ask amateurs to monitor it for outbursts and to report both positive and negative observations to the Comets Recorder (address on inside back cover). This comet passes behind the Sun during the summer, emerging into the morning sky in September. (See *Table 1* to the right.)

Periodic Comet d'Arrest = 6P/d'Arrest.– This apparition is very favorable with the comet reaching magnitude +9, and even possibly +8 by the middle of the summer. Perihelion is in late July, while opposition occurs in late August. After that ,the comet travels south as it dims in our evening sky. (See *Table 2* , p. 127.)

Periodic Comet Jackson-Neujmin = 58P/Jackson-Neujmin.—This comet is also making a favorable return, reaching magnitude = +11 in the southern sky in September. (See *Table 3*, p. 127.)

Periodic Comet Honda-Mrkos-Pajdusakova = 45P/Honda-Mrkos-Pajdusakova.. This comet has a short orbital period of 5.27 years. This time around, it becomes rather bright, but it then will be near the Sun in the southern sky. (see *Table 4*, p. 127.)

EPHEMERIDES

Notes: In the "Elongation from Sun" column, **E** refers to visibility in the evening sky, and **M** to morning visibility. "Total Mag." values are forecasts of visual total magnitudes and are subject to considerable uncertainty. Orbital elements follow our ephemerides (*Table 5*, p. 127) for those who wish to compute their own ephemerides.

Table 1. Ephemeris of Periodic Comet Schwassmann-Wachmann = 29P/Schwassmann-Wachmann 1.

1995	2000.0 Coörd.		Elongation	Total
UT Date	R.A.	Decl.	from Sun	Mag.
(0h UT)	h m	° '	°	
JUL 02	09 19.0	+14 01	038 E	+18.2
07	09 22.2	+13 44	034 E	+18.2
(Too Close to the Sun for Observation)				
SEP 30	10 20.1	+07 53	033 M	+18.2
OCT 05	10 23.2	+07 31	037 M	+18.2
10	10 26.1	+07 10	041 M	+18.2
15	10 29.0	+06 49	045 M	+18.1
20	10 31.7	+06 29	049 M	+18.1
25	10 34.3	+06 09	053 M	+18.1
30	10 36.7	+05 50	058 M	+18.1
NOV 04	10 39.0	+05 31	062 M	+18.1
09	10 41.1	+05 14	066 M	+18.0
14	10 43.1	+04 57	071 M	+18.0
19	10 44.8	+04 41	075 M	+18.0
24	10 46.4	+04 26	080 M	+18.0
29	10 47.7	+04 12	085 M	+17.9
DEC 04	10 48.8	+03 59	089 M	+17.9
09	10 49.7	+03 48	094 M	+17.9
14	10 50.3	+03 38	099 M	+17.8
19	10 50.7	+03 30	104 M	+17.8
24	10 50.9	+03 22	109 M	+17.8
29	10 50.7	+03 17	114 M	+17.8

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

1995 UT Date	2000.0 Coörd. R.A.	Decl.	Elongation from Sun	Total Mag.
(0h UT)	h m	° '	°	
Jul 02	22 06.8	+08 12	121 M	+9.9
07	22 21.3	+07 01	123 M	+9.7
12	22 35.9	+05 26	126 M	+9.5
17	22 50.6	+03 27	128 M	+9.4
22	23 05.3	+01 02	131 M	+9.3
27	23 19.7	-01 47	134 M	+9.2
Aug 01	23 33.5	-04 57	136 M	+9.1
06	23 46.6	-08 23	139 M	+9.1
11	23 58.8	-11 58	142 M	+9.1
16	00 09.8	-15 35	144 M	+9.2
21	00 19.5	-19 06	146 M	+9.3
26	00 27.7	-22 24	147 M	+9.5
31	00 34.4	-25 24	147 M	+9.7
Sep 05	00 39.6	-28 01	147 M	+9.9
10	00 43.5	-30 13	147 M	+10.2
15	00 46.1	-32 00	146 M	+10.5
20	00 47.8	-33 21	145 M	+10.7
25	00 48.6	-34 18	144 M	+11.0
30	00 49.0	-34 52	142 M	+11.3
Oct 05	00 49.0	-35 06	140 M	+11.6
10	00 49.0	-35 00	139 E	+11.9
15	00 49.1	-34 38	136 E	+12.3
20	00 49.4	-34 02	134 E	+12.6
25	00 50.1	-33 14	132 E	+12.9
30	00 51.1	-32 16	130 E	+13.2
Nov 04	00 52.7	-31 10	128 E	+13.5
09	00 54.7	-29 58	125 E	+13.9
14	00 57.1	-28 40	123 E	+14.2
19	01 00.0	-27 18	120 E	+14.5

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

1995 UT Date	2000.0 Coörd. R.A.	Decl.	Elongation from Sun	Total Mag.
(0h UT)	h m	° '	°	
Aug 01	21 26.7	+02 06	157 M	+12.9
06	21 28.7	+01 09	161 M	+12.7
11	21 30.7	-00 05	165 M	+12.4
16	21 32.8	-01 38	168 E	+12.2
21	21 35.2	-03 28	169 E	+12.0
26	21 38.2	-05 34	169 E	+11.9
31	21 41.8	-07 53	167 E	+11.7
Sep 05	21 46.2	-10 21	163 E	+11.5
10	21 51.7	-12 52	159 E	+11.4
15	21 58.2	-15 20	154 E	+11.4
20	22 05.8	-17 40	150 E	+11.3
25	22 14.6	-19 48	146 E	+11.3
30	22 24.4	-21 37	142 E	+11.4
Oct 05	22 35.1	-23 06	139 E	+11.4
10	22 46.6	-24 13	135 E	+11.5
15	22 58.7	-24 58	132 E	+11.6
20	23 11.1	-25 21	130 E	+11.7
25	23 23.7	-25 24	127 E	+11.8
30	23 36.4	-25 07	125 E	+12.0
Nov 04	23 49.0	-24 34	123 E	+12.2
09	00 01.4	-23 47	121 E	+12.4
14	00 13.5	-22 47	120 E	+12.6
19	00 25.4	-21 37	118 E	+12.8
24	00 37.0	-20 19	116 E	+13.0

Table 4. Ephemeris of Periodic Comet Honda-Mrkos-Pajdusakova = 45P/Honda-Mrkos-Pajdusakova.

1995 UT Date	2000.0 Coörd. R.A.	Decl.	Elongation from Sun	Total Mag.
(0h UT)	h m	° '	°	
Nov 09	18 21.1	-25 50	049 E	+14.7
14	18 33.3	-25 46	046 E	+13.9
19	18 46.3	-25 37	044 E	+13.2
24	19 00.2	-25 23	042 E	+12.4
29	19 14.9	-25 03	041 E	+11.5
Dec 04	19 30.2	-24 35	039 E	+10.6
09	19 45.6	-23 59	038 E	+9.6
14	20 00.5	-23 15	036 E	+8.7
19	20 13.9	-22 24	034 E	+7.9
24	20 24.2	-21 30	032 E	+7.4
29	20 29.5	-20 35	028 E	+6.9

Table 5. Orbital Elements of Current Comets.

Comet Designation	Perihelion Passage (T)	Dist. (q; AU)	Argument (ϖ)	Longitude of Asc. Node (Ω)	Inclination (i)	Eccentricity (e)
29P/Sch.-Wach. 1*	1989 Oct 26.72	5.771773	049°.870	312°.848	009°.372	0.04466
6P/d'Arrest†	1995 Jul 27.36	1.345869	178°.050	138°.987	019°.523	0.61404
58P/Jackson-Neujmin‡	1995 Oct 06.62	1.381125	200°.347	160°.718	013°.478	0.66143
45P/Honda-Mrkos-Pajdusakova¶	1995 Dec 25.93	0.531929	326°.061	089°.167	004°.250	0.82430

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

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

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

¶ Epoch 1995 Dec 29.0. Period 5.27y. From observations 1974-1990. [*MPC 20124*; no. Ob. not given]

COMING SOLAR-SYSTEM EVENTS: AUGUST - OCTOBER, 1995

WHAT TO LOOK FOR

In this period, besides the bright planets, there is an opportunity to view a total solar eclipse, a penumbral lunar eclipse, an occultation of Mars by the Moon, and several comets and minor planets predicted to be bright enough to spot in small telescopes.

This column is intended to alert our readers to coming events in the Solar System; giving visibility conditions for major and minor planets, the Moon, comets, and meteors. You can find more detailed information in the 1995 edition of the *A.L.P.O. Solar System Ephemeris*. (See p. 143 to find out how to obtain this publication.) Celestial directions are abbreviated. All dates and times are in Universal Time (UT). For the time zones in the United States, UT is found by adding 10 hours to HST (Hawaii Standard Time), 9 hours to AST (Alaska Standard Time), 8 hours to PST, 7 hours to MST or PDT, 6 hours to CST or MDT, 5 hours to EST or CDT, and 4 hours to EDT. Note that this addition may well put you into the next UT day!

PLANETS

Mercury, because of its rapid motion, belongs to both the evening and morning sky. Two apparitions of Mercury occur in this period. The first is an evening one, favorable from the S Hemisphere, centered on SEP 04, the date of Greatest E Elongation (27°.0); the planet will be at least 15° from the Sun between AUG 13-SEP 27 with *dichotomy* (half-phase) *predicted* for SEP 12, 15h. Mercury's second apparition is a morning one that is favorable for observers in the N Hemisphere. Greatest W Elongation is on OCT 20, with the planet then 18°.2 from the Sun, and at elongation 15° or greater from OCT 14-29. Dichotomy is forecast for OCT 19, 13h.

Venus is a morning object until Superior Conjunction on AUG 21, after which it is visible in the evening. The planet remains within 10° of the Sun and essentially unobservable until SEP 27, then reaching 19° E of the Sun by the end of October. Throughout this period Venus will show a small, nearly-full disk. Its diameter is near 10" throughout this period, and its phase (fraction illuminated) decreases from 100 to 95 percent.

Mars remains in the evening sky but is slowly approaching the Sun. Unfortunately its disk is tiny, dropping from 5".0 to 4".2 during this period. Nonetheless, its North Polar Cap remains tilted toward us and should be readily visible. The planet is also moving Sunward from Virgo to Libra, Scorpius, and Ophiuchus, closing from 58°E to 30°E of the Sun. No longer spectacular, its magnitude hangs near +1.3 to +1.4.

Jupiter, in Scorpius, is convenient to observe in the evening, allowing the continued scrutiny of the Comet Shoemaker-Levy 9 impact spots. During August-October the Giant Planet's elongation from the Sun drops from 117° E to 39° E. Jupiter's disk will decrease from 41".8 to 32".7 in equatorial diameter, its magnitude dims from -2.3 to -1.8. Jupiter's declination will then be 21°-22°S, favoring observers in our S Hemisphere.

Saturn, in Aquarius, is now visible most of the night. On opposition on SEP 14, the equatorial diameter of its disk is 19".2, while the major axis of the Ring System is 43".6. On AUG 01 the sunlit face of the Rings is turned from us by 0°.27; but this angle rapidly closes and the Earth crosses the Ring plane on AUG 11, 03h. After that date, the Rings should be more readily seen as we will be looking at their sunlit face at an increasing angle, reaching 2°.52 by the end of October. On the other hand, the Sun is shining at an increasingly oblique angle on the Ring face and will cross the Ring plane on NOV 19d, 05h.

Eclipses of Saturn's satellites by Saturn and by themselves are continuing, and events involving the brighter satellites are predicted on pages 131-133 of this issue.

Uranus and **Neptune** remain in Sagittarius and can be seen in the evening sky. Uranus' magnitude is +5.7 to +5.8, while Neptune's is +7.9. Both reached opposition in July.

Pluto, in Libra, is in the evening sky and will move too close to the Sun to observe in October. A finding chart of this 14th-magnitude object is given in our *Solar System Ephemeris* for 1995, page J-3.

MINOR PLANETS

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

	Opposition Data		
Minor Planet	1995 Date	Stellar Magnitude	Declination& Constellation
387 Aquitania	AUG 11.1	+9.6	21°S Cap
18 Melpomene	SEP 18.5	+7.8	11°S Aqr
6 Hebe	OCT 27.9	+7.9	16°S Cet

Although not currently at opposition, no less than eight additional minor planets, **1 Ceres**, **2 Pallas**, **4 Vesta**, **7 Iris**, **9 Metis**, **10 Hygiea**, **70 Interamnia**, and **88 Thisbe** will fall in the 8th-10th magnitude range during the August-October period. Thus eleven minor planets will be easily accessible by binoculars during this three-month time span.

THE MOON

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

New Moon	First Quarter	Full Moon	Last Quarter
JUL 27.6	AUG 04.1	AUG 10.8	AUG 18.1
AUG 26.2	SEP 02.4	SEP 09.2	SEP 16.9
SEP 24.7	OCT 01.6	OCT 08.6	OCT 16.7
OCT 24.2	OCT 30.9	NOV 07.3	NOV 15.5

The lunations listed are Numbers 898-901 in Brown's series. The underlined dates indicate a penumbral eclipse of the Moon and a total solar eclipse, both described below.

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

North	West	South	East
JUL 27	AUG 02	AUG 10	AUG 14
AUG 23	AUG 28	SEP 06	SEP 11
SEP 20	SEP 24	OCT 03	OCT 08
OCT 17	OCT 21	OCT 30	NOV 03

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

Due to favorable librations, the N limb can be seen well on AUG 21-24, SEP 17-22, and OCT 14-20. The S limb is well exposed on AUG 07-12, SEP 03-08, SEP 30-OCT 05, and OCT 28-NOV 02. In August, the southerly selenocentric declination of the Sun aids the visibility of the south polar region. The E limb will be well-exposed just after Full phase on AUG 11-12, SEP 10-11, and OCT 09-10. Finally, a favorable period to view the W limb on a waning crescent is OCT 20-22.

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

Date	Age	Declination	Hemisphere
AUG 21	24d	19°N	Northern
SEP 17	22d	19°N	Northern
OCT 14	19d	19°N	Northern
AUG 07	*10d*	*19°S*	*Southern*
SEP 03	*08d*	*19°S*	*Southern*
OCT 01	*06d*	*19°S*	*Southern*
OCT 28	*04d*	*19°S*	*Southern*

ECLIPSES

Penumbral Lunar Eclipse, 1995 OCT 08.—The Earth's penumbral shadow crosses most of the Moon for this event, which has a penumbral magnitude of 0.851. The predicted schedule of events is:

First Penumbral Contact	13h 58.0m	(PA 118°)
Middle of the Eclipse	16 04.2	
Fourth Penumbral Contact	18 10.2	(PA 208°)

The entire eclipse will be visible from Australia, and Asia except for the SW. Only the beginning will be visible from W North America, and only the end from Europe, SW Asia, and most of Africa.

Near mid-eclipse, observers will see at best a faint shading near the lunar S limb. However, Lunar Transient Phenomena have been reported within the penumbral shadow for some eclipses. This will also be an opportunity, just before or after the eclipse, to observe the Moon at an unusually small phase angle. Because there will be minimal shadow interference from lunar features, this is a good time to study the "normal" albedo of the Moon's surface.

Total Solar Eclipse, 1995 OCT 24.–Asia and the W Pacific experience a total solar eclipse as the path of totality crosses Iran, Afghanistan, Pakistan, India, Bangladesh, Burma, Thailand, Cambodia, Vietnam, and Malaysia. The partial phases will be visible throughout most of Asia, Indonesia, and the northern two-thirds of Australia (i.e., a grazing partial eclipse will be visible from Brisbane and Alice Springs, but not from Perth and Sydney). *Figure 1* (p. 130) shows the annular track and partial eclipse zone for this event.

Although a fairly short eclipse, the path of totality crosses heavily populated areas, and passes close to Agra and Calcutta; and across the ruins of Angkor Wat. Fair weather is most probable in W India, but the eclipse duration there is under one minute.

The maximum duration of the total phase, 2m 10s, occurs at 04h 22m UT in the South China Sea. The Moon's diameter will be 102.14 percent of the Sun's. In the vicinity of the eclipsed Sun, observers may see the planets Mercury (017°W, Mag. -0.8), Venus (017°E, -3.9), Mars (032°E, +1.4) and Jupiter (044°E, -1.9). In addition, the +1.0-magnitude star Spica will lie just 7° to the W of the Sun.

OCCULTATIONS

The Moon will occult **Mars** on AUG 30, near 03h in a strip of Pacific Ocean that includes the Philippines, E Indonesia, New Guinea, and Northernmost Australia. At the time, Mars will be 48°E of the Sun, at magnitude +1.4. The approximate Universal Times of events for some selected locations are listed below, where disappearances are given first, followed by reappearances. In parentheses is given the altitude of the Moon, followed by that of the Sun.

Manila	01:20 (+7°/+61°)	02:10 (+15°/+63°)
Jakarta	01:35 (-3°/+38°)	02:10 (+5°/+46°)
Darwin	01:50 (+25°/+59°)	02:30 (+34°/+65°)
Brisbane	03:00 (+59°/+49°)	03:15 (+62°/+48°)
Auckland	03:50 (+62°/+23°)	04:20 (+60°/+18°)
Tahiti	04:35 (+37°/-11°)	05:30 (+24°/-24°)

The International Occultation Timing Association (IOTA) predicts the occultation of a naked-eye star (ω Ophiuchi, magnitude +4.45, spectral class A7) by Jupiter on SEP 24 at about 23h.9. The unusual event should be visible from the E United States and E Canada.

COMETS

The column by Don E. Machholz, "Comet Corner," on pp. 126-127 of this issue and the *A.L.P.O. Solar System Ephemeris: 1995* list two known comets that are predicted to be 12th magnitude or brighter during at least part of this period.

Comet 6P/d'Arrest should appear its brightest in early August, at somewhere between 7th to 9th magnitude. This comet will be most favorably placed for Southern-Hemisphere observers during our period, dropping from declination -5° at the beginning of August to -35° at the end of September, and then rising to -32° at the end of October. Nonetheless, this will be one of its most favorable apparitions and the comet should be readily visible in small telescopes, or even in binoculars from dark sites.

Somewhat fainter is **Comet 58P/Jackson-Neujmin**, which is forecast to reach 11th magnitude in September.

METEOR SHOWERS

Activity from the **South Delta Aquarids** (JUL 08-AUG 19; peak JUL 29, 15/hour) and **Alpha Capricornids** (JUL 03-AUG 25; peak JUL 30, 5/hour) continue into this period. The Moon will not initially be a problem for viewing them, not reaching First Quarter until AUG 04. Both these showers are best seen from our Southern Hemisphere.

It is unfortunate that the major shower of the season, the **Perseids** (JUL 17-AUG 24), will peak on AUG 12 (60/hour) when the 16-day Moon will light sky all night except for the evening. Nonetheless, the Moon will cause few problems for Perseid-watching before AUG 04 or after AUG 21.

THE **Alpha Aurigids** (AUG 24-SEP 05; peak SEP 01, 5/hour) can be observed with no lunar interference after midnight. Although rates are low, this shower has a broad maximum; its slow, bright meteors are relatively easy to photograph.

The final major shower peaking in our period is the **Orionids** (OCT 02-NOV 07; peak OCT 22, 15/hour). The peak date occurs near New Moon, so conditions are very favorable for viewing this event. Occasionally, the Orionids produce rates up to 40/hour, but most of its members are faint.

Finally, although the period covered here is before their peak dates, the pre-peak portions of the following showers will be observable during our period: **Southern Taurids** (SEP 15-NOV 25; peak NOV 03, 5/hour), **Northern Taurids** (SEP 13-NOV 25; peak NOV 13, 5/hour). Because of their long duration, observers can choose nights with little Moon interference to observe them.

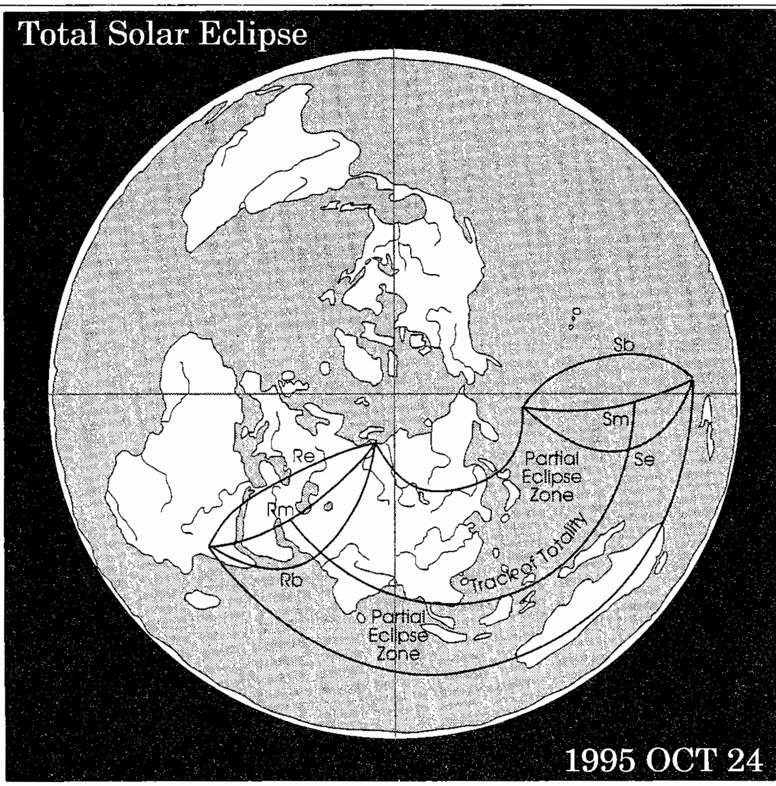


Figure 1. Visibility zones of total solar eclipse on 1995 OCT 24. Abbreviations are as follows: Rb = Sunrise at beginning of eclipse; Rm = Sunrise at middle of eclipse; Re = Sunrise at end of eclipse; Sb = Sunset at beginning of eclipse; Sm = Sunrise at middle of eclipse; Se = Sunrise at end of eclipse.

ECLIPSES OF TETHYS, DIONE, RHEA, AND TITAN BY SATURN, 1995 AUGUST-OCTOBER

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

Eclipses of Tethys, 1995 August-October

	Beginning				End		
	UT	x	y	limb	UT	x	limb
AUG							
01	14 25	-1.32	-0.01	+0.32	17 19	+0.66	-0.34
03	11 44	-1.31	-0.01	+0.31	14 38	+0.67	-0.33
05	09 03	-1.30	-0.00	+0.30	11 57	+0.68	-0.32
07	06 22	-1.29	-0.00	+0.29	09 16	+0.69	-0.31
09	03 40	-1.28	+0.00	+0.28	06 34	+0.70	-0.30
11	00 59	-1.26	+0.01	+0.26	03 53	+0.71	-0.29
12	22 18	-1.25	+0.02	+0.25	*01 12*	+0.73	-0.27
14	19 36	-1.24	+0.02	+0.24	22 30	+0.74	-0.26
16	16 55	-1.22	+0.03	+0.23	19 49	+0.75	-0.25
18	14 14	-1.21	+0.03	+0.21	17 08	+0.76	-0.23
20	11 32	-1.20	+0.04	+0.20	14 27	+0.78	-0.22
22	08 51	-1.19	+0.04	+0.19	11 45	+0.79	-0.20
24	06 10	-1.17	+0.05	+0.17	09 04	+0.81	-0.19
26	03 28	-1.16	+0.06	+0.16	06 23	+0.82	-0.18
28	00 47	-1.14	+0.06	+0.14	03 42	+0.84	-0.16
29	22 06	-1.13	+0.07	+0.13	*01 00*	+0.85	-0.14
31	19 25	-1.11	+0.08	+0.12	22 19	+0.87	-0.13
SEP							
02	16 43	-1.10	+0.08	+0.10	19 38	+0.88	-0.11
04	14 02	-1.08	+0.09	+0.09	16 57	+0.90	-0.10
06	11 21	-1.07	+0.10	+0.07	14 16	+0.92	-0.08
08	08 40	-1.05	+0.10	+0.06	11 35	+0.93	-0.06
10	05 59	-1.04	+0.11	+0.04	08 54	+0.95	-0.04
12	03 17	-1.02	+0.12	+0.03	06 12	+0.96	-0.03
14	00 36	-1.01	+0.12	+0.02	03 31	+0.98	-0.01
15	21 55	-0.99	+0.13	+0.00	*00 50*	+0.99	+0.00
17	19 14	-0.98	+0.14	-0.01	22 09	+1.01	+0.02
19	16 33	-0.96	+0.14	-0.03	19 28	+1.03	+0.04
21	13 52	-0.95	+0.15	-0.04	16 47	+1.04	+0.05
23	11 10	-0.93	+0.16	-0.05	14 06	+1.06	+0.07
25	08 29	-0.91	+0.16	-0.07	11 25	+1.07	+0.09
27	05 48	-0.90	+0.17	-0.08	08 44	+1.09	+0.10
29	03 07	-0.88	+0.18	-0.09	06 02	+1.10	+0.12
OCT							
01	00 26	-0.87	+0.18	-0.11	03 21	+1.12	+0.14
02	21 45	-0.85	+0.19	-0.12	*00 40*	+1.14	+0.15
04	19 04	-0.84	+0.19	-0.13	21 59	+1.15	+0.17
06	16 23	-0.83	+0.20	-0.14	19 18	+1.16	+0.18
08	13 42	-0.81	+0.20	-0.16	16 37	+1.18	+0.20
10	11 01	-0.80	+0.21	-0.17	13 56	+1.19	+0.22
12	08 20	-0.78	+0.21	-0.18	11 15	+1.21	+0.23
14	05 39	-0.77	+0.22	-0.19	08 34	+1.22	+0.24
16	02 58	-0.76	+0.22	-0.20	05 53	+1.24	+0.26
18	00 17	-0.74	+0.23	-0.21	03 12	+1.25	+0.27
19	21 36	-0.73	+0.23	-0.22	*00 31*	+1.26	+0.29
21	18 55	-0.72	+0.24	-0.23	21 50	+1.27	+0.30
23	16 14	-0.71	+0.24	-0.24	19 09	+1.28	+0.31
25	13 33	-0.70	+0.25	-0.25	16 28	+1.30	+0.32
27	10 52	-0.69	+0.25	-0.26	13 47	+1.31	+0.34
29	08 11	-0.68	+0.25	-0.26	11 06	+1.32	+0.35
31	05 30	-0.66	+0.26	-0.27	08 26	+1.33	+0.36

Eclipses of Dione, 1995, August-October

	Beginning				End		
	UT	x	y	limb	UT	x	limb
AUG							
01	00 54	-1.41	-0.03	+0.41	04 09	+0.55	-0.45
03	18 36	-1.39	-0.02	+0.39	21 51	+0.57	-0.43
06	12 17	-1.37	-0.01	+0.37	15 33	+0.59	-0.41
09	05 59	-1.35	-0.00	+0.35	09 15	+0.62	-0.38
11	23 41	-1.33	+0.00	+0.33	*02 57*	+0.64	-0.36
14	17 22	-1.31	+0.01	+0.31	20 39	+0.66	-0.34
17	11 04	-1.28	+0.02	+0.28	14 21	+0.69	-0.31
20	04 46	-1.26	+0.03	+0.26	08 03	+0.71	-0.28
22	22 28	-1.23	+0.04	+0.23	*01 45*	+0.74	-0.26
25	16 10	-1.21	+0.05	+0.21	19 27	+0.77	-0.23
28	09 51	-1.18	+0.06	+0.18	13 09	+0.80	-0.20
31	03 33	-1.15	+0.07	+0.16	06 51	+0.82	-0.17
SEP							
02	21 15	-1.13	+0.08	+0.13	*00 33*	+0.85	-0.14
05	14 57	-1.10	+0.10	+0.10	18 15	+0.88	-0.11
0 8	08 39	-1.07	+0.11	+0.08	11 57	+0.91	-0.08
11	02 21	-1.04	+0.12	+0.05	05 39	+0.94	-0.05
13	20 03	-1.01	+0.13	+0.02	23 21	+0.97	-0.02
16	13 45	-0.98	+0.14	-0.00	17 03	+1.00	+0.01
19	07 27	-0.96	+0.15	-0.03	10 45	+1.03	+0.04
22	01 09	-0.93	+0.16	-0.05	04 27	+1.06	+0.08
24	18 51	-0.90	+0.17	-0.08	22 09	+1.09	+0.11
27	12 33	-0.87	+0.18	-0.10	15 52	+1.12	+0.14
30	06 15.	-0.84	+0.19	-0.13	09 34	+1.15	+0.17
OCT							
02	23 57	-0.82	+0.20	-0.15	*03 16*	+1.18	+0.20
05	17 39	-0.79	+0.21	-0.18	20 58	+1.20	+0.23
08	11 21	-0.76	+0.22	-0.20	14 40	+1.23	+0.26
11	05 04	-0.74	+0.23	-0.22	08 22	+1.26	+0.28
13	22 46	-0.71	+0.24	-0.24	*02 05*	+1.28	+0.31
16	16 28	-0.69	+0.25	-0.26	19 47	+1.31	+0.34
19	10 10	-0.66	+0.25	-0.27	13 29	+1.33	+0.36
22	03 52	-0.64	+0.26	-0.29	07 12	+1.36	+0.38
24	21 35	-0.62	+0.27	-0.30	*00 54*	+1.38	+0.41
27	15 17	-0.60	+0.27	-0.32	18 36	+1.40	+0.43
30	08 59	-0.58	+0.28	-0.34	12 19	+1.42	+0.45

Eclipses of Rhea, 1995, August-October

	Beginning				End		
	UT	x	y	limb	UT	x	limb
AUG							
04	20 15	-1.53	-0.04	+0.53	*00 05*	+0.41	-0.59
09	08 42	-1.48	-0.02	+0.48	12 32	+0.46	-0.54
13	21 08	-1.43	-0.00	+0.43	*01 00*	+0.52	-0.48
18	09 35	-1.38	+0.02	+0.38	13 27	+0.58	-0.42
22	22 02	-1.32	+0.04	+0.32	*01 55*	+0.64	-0.36
27	10 30	-1.26	+0.06	+0.26	14 23	+0.70	-0.30
31	22 57	-1.20	+0.09	+0.20	*02 50*	+0.77	-0.23
SEP							
05	11 24	-1.14	+0.11	+0.14	15 18	+0.83	-0.16
09	23 51	-1.07	+0.14	+0.08	*03 46*	+0.90	-0.08
14	12 18	-1.01	+0.16	+0.03	16 13	+0.97	-0.01

(Continued on p. 132)

Eclipses of Rhea, 1995—*Continued.*

	Beginning				End		
	UT	x	y	limb	UT	x	limb
SEP							
19	00 46	-0.94	+0.19	-0.03	04 41	+1.04	+0.06
23	13 13	-0.88	+0.21	-0.09	17 09	+1.11	+0.13
28	01 41	-0.81	+0.24	-0.14	05 37	+1.18	+0.20
OCT							
02	14 09	-0.75	+0.26	-0.19	18 05	+1.24	+0.27
07	02 36	-0.69	+0.28	-0.24	06 33	+1.30	+0.34
11	15 04	-0.63	+0.30	-0.28	19 01	+1.37	+0.40
16	03 32	-0.57	+0.32	-0.32	07 29	+1.42	+0.47
20	16 00	-0.52	+0.34	-0.35	19 57	+1.48	+0.52
25	04 28	-0.47	+0.35	-0.37	08 25	+1.53	+0.58
29	16 56	-0.42	+0.36	-0.39	20 53	+1.58	+0.62

Eclipses of Titan, 1995, August-October

	Beginning				End		
	UT	x	y	limb	UT	x	limb
AUG							
14	09 14	-1.87	+0.00	+0.87	14 21	-0.17	-0.83
30	08 14	-1.44	+0.19	+0.46	13 38	+0.36	-0.56
SEP							
15	07 16	-0.95	+0.39	+0.05	12 55	+0.93	+0.03
OCT							
01	06 22	-0.45	+0.59	-0.18	12 10	+1.48	+0.61
17	05 30	+0.01	+0.75	-0.14	11 24	+1.98	+1.13

TRANSITS, SHADOW TRANSITS, AND OCCULTATIONS OF SATURN'S SATELLITES RHEA AND TITAN: 1995 AUGUST-OCTOBER

With Saturn near opposition, and the Earth and the Sun near its Ring Plane, Saturn's brighter satellites Rhea and Titan are undergoing occultations by Saturn, and the satellites and their shadows are transiting Saturn's disk. This table gives the predicted dates and times (UT) of these events These predictions are taken from those given in: J.E. Arlot, T. Derouazi, C. Ruatti, and W. Thuillot, *Satellites de Saturne I á VIII. Configurations pour 1995.* Paris, Bureau des Longitudes, 1994. Satellites are coded by number (mean opposition magnitudes in parentheses): 5 = Rhea (+9.7), and 6 = Titan (+8.3). Letters indicate: O = occultation, S = shadow transit, T = transit, b = begins, and e = ends. The times are those predicted for *mid-events*; due to the finite size of the satellites, events will typically take several minutes. Times are given in the form hhmm; when two times are given they refer to the beginning and end of an event. Italicized times refer to the next UT day.

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

Where on the Globe satellites will transit can be found from the formulae: y(Rhea) = 9.7 tan B, y(Titan) = 22.5 tan B, where y is the satellite's apparent position north or south of the Globe center in Saturn polar radii and B is the saturnicentric latitude of the Earth. For shadow transits, substitute B', the saturnicentric latitude of the Sun. If B or B' is north, the satellite or shadow will be *south* of the Globe center; and will be north of center when B or B' is south. Values of B and B' for each day of the year are listed in the *A.L.P.O. Solar System Ephemeris: 1995* (for information on ordering this publication see page 143).

Date & UT's	Event
AUG	
02 1407-1756	5S
1511-1908	5T
06 1208-1711	6S
1533-2141	6T
07 0234-0623	5S
0333-0730	5T
11 1501-1851	5S
1554-1951	5T
16 0328-0718	5S
0415-0812	5T
20 1554-1946	5S
1636-2032	5T
22 1108-1633	6S
1320-1927	6T
25 0422-0814	5S
0456-0852	5T
29 1649-2041	5S
AUG	
29 1716-2112	5T
SEP	
03 0516-0909	5S
0536-0932	5T
07 1012-1554	6S
1102-1651	6T
1743-2137	5S
1756-2151	5T
12 0610-1005	5S
0617-1010	5T
16 1837-2229	5T
1838-2232	5S
19 0046	5Ob
21 0658-1048	5T
0705-1100	5S
23 0853-1358	6T
0919-1514	6S
SEP	
23 1306	5Ob
25 1918-2307	5T
1933-2328	5S
28 0127	5Ob
30 0739-1126	5T
0800-1156	5S
OCT	
01 0535	6Ob
02 1348	5Ob
04 2000-2346	5T
2028-*0024*	5S
07 0210	5Ob
09 0703-1058	6T
0822-1206	5T
0829-1432	6S
0856-1252	5S
11 1432	5Ob
OCT	
13 2044-*0026*	5T
2123-*0120*	5S
16 0254	5Ob
17 0354	6Ob
18 0906-1246	5T
0951-1348	5S
20 1516	5Ob
22 2129-*0107*	5T
2219-*0216*	5S
25 0339	5Ob
0540-0758	6T
0740-1348	6S
27 0952-1328	5T
1047-1444	5S
29 1602	5Ob
31 2215-*0151*	5T
2315-*0312*	5S

Selected Mutual Events of Saturn's Satellites: 1995 August-October

This table gives the predicted dates and times (UT) of mutual (two-satellite) events involving Tethys, Dione, Rhea, and Titan as one of the satellites and Mimas, Encledadus, Tethys, Dione, Rhea, or Titan as the other. These predictions are selected from those given in: J.E. Arlot, T. Derouazi, C. Ruatti, and W. Thuillot, *Satellites de Saturne I á VIII. Configurations pour 1995.* Paris, Bureau des Longitudes, 1994. Satellites are coded by number (mean opposition magnitudes in parentheses): 1 = Mimas (+12.9), 2 = Enceladus (+11.7), 3 = Tethys (+10.2), 4 = Dione (+10.4), 5 = Rhea (+9.7), and 6 = Titan (+8.3). Letters indicate: E = eclipse, O = occultation. The times are those predicted for *mid-events*; the duration of an event, in minutes, is given in parentheses following the mid-times. The final entry is the estimated brightness decrease in percent; for the eclipsed satellite in a mutual eclipse and for the two satellites combined in the case of a mutual occultation.

Date & UT	Event
AUG	
02 0947 (2.3)	3E1 68%
1339 (7.6)	5O1 6%
03 1443 (0.6)	2O3 4%
04 0705 (2.3)	3E1 66%
05 0504 (3.6)	1O5 0.8%
06 0423 (2.3)	3E1 60%
1158 (1.0)	3O4 4%
2136 (2.3)	5O4 14%
08 0141 (2.3)	3E1 51%
0526 (0.9)	4O2 2%
09 0527 (1.0)	2O4 9%
0643 (1.7)	2O5 10%
2259 (2.2)	3E1 37%
10 1939 (2.8)	2E3 5%
2309 (1.8)	4O2 17%
11 1035 (1.7)	5O2 4%
2213 (1.8)	5O4 9%
2310 (1.2)	2O4 17%

Date & UT	Event
AUG	
13 1651 (1.4)	4O2 10%
1737 (1.7)	3E1 10%
2218 (7.6)	4O6 4%
14 0602 (97.8)	1O6 0.6%
1444 (5.1)	2O6 0.9%
1946 (3.6)	1O6 0.6%
15 0332 (57.4)	4O6 4%
0810 (39.8)	4O6 4%
16 1154 (2.0)	5O2 10%
20 1040 (1.3)	1O4 11%
2232 (0.5)	5O1 0.4%
21 2010 (0.8)	4O1 3%
22 2342 (27.4)	4O5 26%
23 0550 (1.2)	1O5 3%
1332 (13.0)	4O5 20%
24 0758 (0.4)	1O3 2%
25 0150 (1.4)	3O2 18%

Date & UT	Event
AUG	
25 1622 (7.2)	5E3 21%
2210 (3.3)	2E3 3%
26 0513 (0.9)	1O3 12%
2311 (3.2)	3O1 7%
28 0228 (0.8)	1O3 10%
1842 (0.6)	3O4 0.3%
2031 (4.5)	3O1 12%
30 1750 (3.2)	3O1 5%
SEP	
01 1054 (3.8)	3O5 32%
03 0756 (3.4)	3O4 29%
14 1804 (3.4)	3E2 99%
1804 (2.1)	3O2 6%
21 0316 (6.5)	4O3 27%
24 0118 (5.6)	3E5 46%
OCT	
04 1406 (2.7)	2E3 20%
05 0317 (1.2)	5E1 11%

Date & UT	Event
OCT	
07 1033 (2.7)	1E5 3%
09 0808 (1.4)	3E2 11%
10 0523 (1.8)	4E3 5%
11 0826 (0.8)	1E4 2%
12 1755 (1.4)	4E1 84%
14 0322 (1.5)	1E4 12%
15 1248 (1.3)	4E1 38%
16 2214 (0.7)	1E4 0.3%
20 1910 (1.7)	1E5 5%
22 1231 (2.8)	3E4 46%
23 0248 (1.5)	5E1 35%
24 1022 (1.8)	3E2 29%
25 1919 (4.6)	4E5 19%
1943 (8.6)	6E1 70%
29 0424 (2.0)	2E3 22%
30 0216 (1.7)	2E5 1%
0219 (3.0)	3E5 16%

OBSERVATIONS OF JUPITER: 1995 JUN 13-15

By: José Olivarez, A.L.P.O. Jupiter Recorder

This note reports the appearance of Jovian features on 1995 JUN 13, 14, and 15 UT, with 8-in (20-cm) f/7 and 16-in (41-cm) f/5.5 reflectors. The standard feature abbreviations are: B = Belt; E = Equatorial; GRS = Great Red Spot; N, n = North; S, s = South; Te = Temperate; Tr = Tropical; and Z = Zone. All dates are in Universal Time (UT).

• The colors on Jupiter were striking when seen in the 16-in. The NEB was mainly orange color and its southern edge had a bluish fringe.

• In the 16-in the SEBn and SEBZ were bright orange and the dark SEBs was bluish. On JUN 14, the SEB preceding the GRS was orange, but the color of the SEB following the GRS was overall bluish-gray and much less intense.

• The color of the EZ was *bluish* throughout.

• The GRS was a light-orange color and was not a uniformly intense ellipse (JUN 14). Indeed, the GRS looked more like an inclined streak than an ellipse!

• The STrZ was the brightest zone on the planet. The SEBs looked very dark (bluish!) on JUN 13 and 15; the System II longitudes of the centers of the disc were 303° (JUN 13); and 226° (JUN 15). The SEBs was very dark across Jupiter's disc at these longitudes. The SEBs was less intense following the GRS.

• There was a bright oval that made a shallow bay on the south edge of the SEBs. Its longitude on JUN 12 had been 303°(II).

• There were two ovals in the NEBZ One lay at 190.4° (I).

• There was a round white oval in the STrB at longitude 070°.2 (II). This may have been Oval FA.

• The color of the STrZ was white.

• I was able to time the transits of two very blue "OL" features on the south edge of the NEB, giving 283° (I; JUN 13) and 182° (I; JUN 15). Both projections had festoons extending from them.

• On JUN 15, the belts in decreasing order of intensity were: NEB, SEBs, NTeB, STrB, and SEBn.

OUR READERS SPEAK

(These letters have been slightly edited for style. The writers are responsible for their opinions, not the A.L.P.O. Note that Mr. Gordon's letter below is the last letter we shall publish on the Mellish-Martian crater question until fresh evidence appears.)

John Westfall:
Director, A.L.P.O.

The comments by McKim and Sheehan in *J.A.L.P.O.*, Vol. 38, No. 2 [pp. 83-84] require a response.

As anyone who has read *Astronomy* or *Sky & Telescope* knows, the Hubble Space Telescope pictures of Mars clearly reveal craters, with NASA's Jim Bell stating, "we're resolving Martian volcanoes right down to their calderas [central craters]!" The claimed resolution is 15 mi or 25 km.

I suspect Charles Capen had similar views with the refigured 82-inch MacDonald Observatory telescope in 1969. Capen claimed a resolution of "less than 20 miles" or about 0.1 arc second. Hubble's observations are of a disk 13".8 diameter, whereas Capen's was 19".2.

In *NASA TR-32-1492*, a copy of which Capen sent me, he stated that on the nights of May 29 and 30 [1970?], "The oases appeared to be composed of small triangular and circular objects, the maria of various geometric structures..." This report is dated June 15, 1970.

During the preparation of my article on Mellish and Barnard for Patrick Moore's 1983 *Yearbook of Astronomy*, I contacted Capen and asked if he could give me more information about these observations. I received a phone call from him and asked if he saw craters with the 82-inch. He responded that he did, but couched his language in his previously published statements due to the politics of the time. He explained that in the late 60's, there was a small, but vocal, minority, in both the political and scientific communities, who wished to scrap any future Mars probes. Mariner 4 had revealed a barren crater-pocked world and Mariners 6 and 7 seemed to some just to add to this impression. He said he did not wish to give these negative groups any further ammunition they might use to delete funding for future Mars missions and thus he used "ambiguous" terms. We would say that he made a politically correct decision.

Now to the $64 question—did Capen ever mention this to any of his other colleagues, amateurs or professionals, or hint of it? This question is important to resolve the Mellish matter because it would indicate that large Martian craters can be seen with Earth-based telescopes.

McKim and Sheehan ignore statements by Mellish that elaborate on his 1915 observations. In a November, 1967, letter to Eugene Cross, Mellish said, "..there were mountains in circles that were the crater rings and high peaks were white on top showing they were white with snow, frost, or quartz, lime, or something like those substances."

Commenting on the missing Barnard drawings in the same letter, Mellish stated that Barnard's drawings lacked any sign of the crater rings except as dark round circles. This is clear evidence that Barnard's view was inferior to that of Mellish. Here, Mellish was recalling Barnard's drawings which he had not seen for some 52 years, and when Sheehan recovered the missing Barnard drawings, Mellish's recollection of them lacking craters tallies with Sheehan's results.

In their *J.B.A.A.* article (Vol. 104, 1994) they attempt to discredit Mellish by referring to Barnard's comment in his notebook that November 13, 1915 (the date Mellish stated that his observations were made) was cloudy. It was cloudy at night, when Barnard tried to observe, but Mellish made his observations after sunup. The fact that it was clear is unquestionably shown by a surviving Mellish drawing dated November 12, 1915, done with the Yerkes 12-inch refractor.

McKim and Sheehan cite "inconsistencies" in Mellish's observations, as described in a 1935 letter to Leight and a 1966 letter to *Sky and Telescope*. One such is a date of 1915 given to Leight and a 1916 date in *Sky and Telescope*, an obvious typographical error. Mellish sent a similar letter to Leight in June, 1966, and the 1915 date is given as on all other Mellish correspondence.

The Antoniadi drawing in *J.A.L.P.O.*, Vol. 38, No. 2, while interesting, does not show the same face of Mars that Mellish saw. Therefore its use as "proof" that Mellish could not see craters is not acceptable. The terminator on the Antoniadi drawing is around longitude 280°-290°, near Syrtis Major. But the Westfall-Parker ephemeris shows that the terminator for Mellish would have been 055°-065°; quite a difference!

Regarding the Lenham observations cited, we are told virtually nothing. Were his observations conducted near the same terminator as Mellish's? Was seeing good enough to allow use of 750X or 1100X, as it was in Mellish's case? Until we know more about these observations, they are useless for comparison purposes. Gentlemen, let's compare apples to apples, not apples to oranges!

Thanks to the HST, we now know that aphelic Mars oppositions tend to have very clear Martian skies, free of dust and other material. Thus the Martian atmosphere at such times may not pose serious problems to observing craters on Mars as Sheehan and McKim state.

Mellish's observations may be unique but they are not impossible. Not enough observations have been made of the areas observed by Mellish under similar conditions. It may be that Mellish had an imperfect view of the craters, only partially resolving them, but was clearly able to recognize them as such as his descriptions indicate depth. In fact in 1957 Max B. Miller stated that Mellish called them "volcanic crater pits"; an indication that he saw them with depth.

The question will go unresolved until the requisite observations are made during several apparitions under similar conditions.

Rodger W. Gordon

637 Jacobsburg Road
Nazareth, PA 18064

May 16, 1995

Dear John:

Ted Stryk has given us a very interesting report in his article, "The Martian Dust Cloud of 1994 JUN 05: Appearance and Implications," in *J.A.L.P.O.*, Vol. 38, No. 2 (March, 1995), pp. 85-86. He deserves great praise for the care with which he employed different color filters and for his persistence in examining in detail the small Martian disk; only 4".4 in diameter, just slightly larger than the 3".8 attained by Uranus at its 1994 opposition **[4]** Of course, a direct comparison here can be misleading; surface detail is very different on the two planets, and Mars is illuminated much more brightly by the Sun.

There do appear to be some problems with the orientation of the three drawings on p. 86 and with the use of *east* and *west* on Mars in the text. With a simply-inverted image and with south at the top for observers in middle northern latitudes, the terminator of Mars is on the left side before opposition; eight months before in June, 1994. This interpretation agrees with the presence of the North Polar Cap at the bottom of each of the three disks. Thus the text in the drawing captions should read *not* "North at top" but instead "South at top." [This error is attributable to the Editor and not Mr. Stryk. Ed.] Mr. Stryk's first sentence in his "Conclusion" shows us that he uses Martian *east* to be to the right on his drawings, i.e., following in the sense of the planet's rotation, or at a greater Martian longitude. Therefore, one sentence in his description of the JUN 07 observation should be amended to read "East of Mare Acidalium was a small cloud..", not *west*.

There are some problems with the identifications of Martian features in this article. The stated central meridians are longitude 159° on JUN 04, 147° on JUN 05, and 127° on JUN 07. It is impossible to check these values because the time of each observation is not given. It always should be! It is relevant to interpreting detail drawn that the Martian latitude of the center of the disk was about 17° South. **[3]** Accepting the central meridians as given, we would have to say that the dark albedo features shown agree only very roughly with the standard maps of Mars. **[1]** However, this criticism is not really severe, given a disk only 4".4 in diameter.

The identification of features in the report has some problems. We list these Martian longitudes and latitudes, with longitudes first: Argyre I (035°, -48°), Argyre II (070°, -66°), Solis Lacus (085°, -26°), Mare Erythraeum (030°, -30°), Meridiani Sinus (000°, -05°), and Mare Acidalium (028°, +48°), where minus means south latitude. **[2]** With the phase-defect on the left side of the disk, features at the equator would go into night about 68° preceding the central meridian **[5]**, and much less still if one allows for foreshortening. Accepting the central meridians, and looking at the text, we find that Argyre II would have been present close to the evening terminator on JUN 05 and 07, Solis Lacus would have been close to the terminator on JUN 07, Mare Acidalium could *not possibly* have been on the visible disk on JUN 07, nor could Mare Erythraeum and Meridiani Sinus have been correctly identified at central meridian 127°.

These errors do not affect Mr. Stryk's basic idea that winds form dust clouds to the east of a few special dusty areas such as Argyre.

It appears remarkable that Mr. Stryk could use color filters to determine that Martian clouds can be part dust and part water or carbon dioxide ice. Perhaps those with expertise in filter applications can discuss such techniques.

Finally, I agree most heartily with Mr. Stryk that we need to observe Mars and its clouds over a wide range of seasons. Our frequent failure to do so is shown by the continuing use by many astronomers of the word *opposition* to describe periods when Mars is studied. Opposition is really a momentary geometric configuration of the planet in its orbit. Let us use instead *apparition* to denote the period of observations, ideally extending for many months both before and after opposition—hence, whenever the planet is close enough to allow gathering useful data.

Notwithstanding these few objections, let me congratulate Mr. Stryk on his report. The A.L.P.O. would be stronger if it had more members sharing his enthusiasm and perseverance.

Walter H. Haas

2225 Thomas Drive
Las Cruces, NM 88001

May 30, 1995

References:

[1] *Mars Observer's Handbook*, Jeffrey D. Beish and Charles F. Capen, published by the Planetary Society, Pasadena, CA, 1988; map of Mars on p. 22.

[2] *Ibid*, pp. 23 and 24.

[3] *The A.L.P.O. Solar System Ephemeris: 1994*, edited by John E. Westfall, available from Mark A. Davis, Mt. Pleasant, SC, 1993, p. G-4.

[4] *Ibid.*, p. J-1.

[5] A phase angle was computed from the ephemeris quantity *k* found in reference **[3]**.

(Submitted Observation)

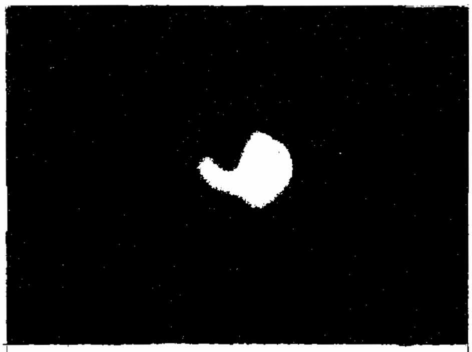


Figure 1. Photograph of Mars by Frank J. Melillo. 1995 FEB 03, 05h45m UT. 20-cm (8-in) Schmidt-Cassegrain, 9-mm eyepiece projection. W21 (orange) filter and Kodak TP2425 Film, 10-second exposure using Adaptive Optics System. Central Meridian 292°, disk diameter 13".7. South at top. Syrtis Major is above and slightly left of center, with Hellas above it. The North Polar Cap lies at the bottom.

BOOK REVIEW

Edited by José Olivarez

A Tapestry of Orbits.

By Desmond King-Hele.

Cambridge University Press, 40 W. 20th Street, New York, NY 10011. 1992. 244 pages, illustrations, index. Price $54.95 cloth (ISBN 0-521-39323-X).

Reviewed by Peter Wlasuk

Many A.L.P.O. members will recognize Desmond King-Hele as the author of the classic guide to observing artificial Earth satellites. In his most recent book, *A Tapestry of Orbits*, the long-time British space scientist has interwoven two stories—his autobiography and a brief history of the Royal Aircraft Establishment (RAE), the venerable nerve center of British satellite design and tracking. The book is based upon King-Hele's research between 1953 and 1990, a period that effectively spans the Space Age.

King-Hele began calculating ballistic missile trajectories in the early 1950's with electromechanical calculators "which took about half a minute to grind out a division." Square roots were found by dividing the number whose root you wanted to know by a guessed value, then halving the difference. Eventually, the calculators got better, and the RAE researchers were able to analyze more sophisticated orbital parameters and perturbations. Curiously, King-Hele himself had no prior experience in celestial mechanics before coming to RAE, nor did many of his collaborators. "This naivety [*sic*] proved to be a great advantage," recalls the author, "because we did not have to hack away a jungle of wrong preconceptions." Of course, this naivete could also cause embarrassment, as when the author thought he was the first person to discover that a satellite's descent path is spiral-shaped, only to find out later that Sir Isaac Newton had long before reached the same conclusion, in his 1687 magnum opus, *Principia*!

King-Hele's precise comparisons of real satellite orbits with hypothetical orbits did much to advance our understanding of the near-Earth environment, not to mention geodesy. For example, King-Hele predicted that a satellite's orbit would decay more quickly in the tenuous upper atmosphere than in a perfect vacuum, but few colleagues could believe his figures, which showed the outer atmosphere to be about eight times denser than previously thought. The first two Sputnik satellites confirmed King-Hele's predictions, each successive orbit coming just a little more quickly than the last. King-Hele showed that satellite orbits could be used to determine the oblateness of the earth itself. The RAE scientists found that a very small deformation in the Earth's surface of, say, 1500 feet, causes a very large oscillation, of three to six miles, in the height of the satellite's perigee, due to the differential gravity. Scrutinizing satellite orbits allowed King-Hele and his cohorts to calculate upper-level wind velocities, and it was soon proven that Earth's upper atmosphere rotates about 1.25 times as quickly as the planet's surface. King-Hele also noticed that solar activity indirectly affects satellites. Specifically, the density of Earth's upper atmosphere varies perceptibly every 28 days, the period of the Sun's rotation, due to varying levels of solar UV-radiation as different regions of the Sun face Earth. These density variations affect the amount of drag a satellite encounters.

Visual observations of earth satellites are frequently discussed in *A Tapestry of Orbits*, though not from the same "how-to" perspective as in King-Hele's popular *Observing Earth Satellites*. The author lauds amateur observers, who, particularly in the early days of Sputnik, Vanguard, and Explorer, helped space scientists to roughly confirm their orbital prognostications. King-Hele notes that data from British amateurs and their American "Moonwatch" counterparts made possible the more accurate photographic work of the British Hewitt cameras and the American Baker-Nunn cameras. The British amateur effort was coordinated by the Royal Astronomical Society, who loaned observers binoculars, stopwatches, and star charts—all the essentials a satellite observer requires. King-Hele, who did much to encourage amateur satellite "spotters" in England, quips that amateurs enjoy the advantage of portable observatories (lawn-chairs).

King-Hele's writing style is simple and lucid. Though *A Tapestry of Orbits* does contain some mathematical formulae, the book can still be read and enjoyed even if these are ignored, though the reviewer found them helpful. The author is to be highly commended for the numerous pictures and diagrams which illustrate this book, for they are an immense help in explaining difficult concepts like the influence of air drag on orbit decay or the "pear-shaped" Earth. Some of the diagrams are simplified, such as the orbital decay diagram on page 36, but the author chose to simplify for clarity's sake. Some readers may be disappointed that *A Tapestry of Orbits* discusses British satellite research almost to the exclusion of American and Russian work in this area, but King-Hele acknowledges that the book is "a hybrid of science and life," by necessity viewed from a British perspective. The only real drawback to this thoroughly-written history is its price, which regretfully may restrict its readership.

THE 1992 APPARITION OF NEPTUNE

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

ABSTRACT

A total of 28 wideband photometric measurements were made of Neptune in 1992. The selected magnitudes are: B(1,0) = -6.48±0.04; V(1,0) = -6.90±0.02 and I(1,0) = -5.64 ±0.12. The V(1,0) magnitude is close to the 1991 value, suggesting that Neptune continued relatively bright in 1992. Neptune did not have a strong greenish color in 1992 as it had in 1991.

INTRODUCTION

Neptune reached opposition on 1992 JUL 09, with a declination of 21°.5 S and an angular diameter of 2".3 (" = arc-seconds). **[1]** Throughout 1992, the sub-Earth latitude on Neptune was 29°S, meaning that its Southern Hemisphere faced the Earth. The relative positions of Uranus, Neptune and the comparison stars in 1992 are plotted in *Figure 1* (p. 138). Both photometric measurements and visual observations of Neptune are summarized in this report. Three persons, Frank Melillo, Gary Nowak, and the author, submitted observations of Neptune in 1992.

PHOTOELECTRIC PHOTOMETRY

A preliminary account of 1992 photometric measurements of Neptune was presented at COSMOCON-92. **[2]** A more detailed report of all 1992 measurements is now given here.

All photometric measurements were carried out with an SSP-3 solid-state photometer and the Johnson BVI filter sequence; a description of this instrument and the filters is given elsewhere. **[3,4]** The positions and magnitudes of the two comparison stars used for the photometric measurements are summarized in *Table 1* (p. 138). The magnitudes of SAO 187634 are from **[5]** and those for o Sgr are from **[6]**. Individual photometric measurements of Neptune are summarized in *Table 2* (p. 139). Two magnitudes are listed; the first one is the measured value and the other is the normalized value; both have been corrected for extinction. (The normalized magnitude is calculated in the same way as it was for Uranus **[4]**; it is the theoretical magnitude of Neptune were it 1.000 Astronomical Units from the Sun and the Earth.) The mα (phase-angle) term for Neptune was neglected for all normalized magnitudes. The Neptune-Earth and Neptune-Sun distances used in calculating the normalized magnitudes are from the *Astronomical Almanac* **[1]**. The fifth column in *Table 2* lists the comparison star and the sixth gives the value of the air mass of the comparison star subtracted from the air mass of Neptune. This difference was used in correcting for atmospheric extinction. Extinction coefficients of 0. 13 and 0.20 magnitude/air mass were used for the V and B measurements, respectively, made at an elevation of 2200 meters (7200 feet)—all measurements in *Table 2* except for those made in July. With the July measurements, values of 0.22, 0.26 and 0.40 mag./air mass were used for the I, V and B measurements, respectively, made at sea level.

Mean normalized magnitudes of Neptune are summarized in *Table 3* (p. 139). The V(1,0) magnitude is -6.90 for 1992 which is close to the 1991 value of -6.91 **[7]** and is 0.03 magnitudes brighter than the value selected by the *Astronomical Almanac* **[1]** and Harris **[8]**. The recent meteorological activity on Neptune **[9]** underscores the need for more photometric measurement of this planet in the future.

VISUAL PHOTOMETRY

Gary Nowak used 9X63 and 11X80 binoculars in estimating the brightness of Neptune. A technique similar to that described elsewhere was used. **[10]** A mean value of V(vis,1,0) = -6.8 was calculated from Nowak's magnitude estimates, which compares well with the V-filter magnitude of V(1,0) = -6.90 selected for 1992.

VISUAL STUDIES

Melillo described Neptune as having a "pale greenish" color on 1992 JUL 08 through a 20-cm (8-in) Schmidt-Cassegrain telescope. The author had the impression that Neptune had a slightly bluish color on 1992 JUL 19 (7:10 UT) but that the color was not strong. The 76-cm (30-in) Challenger Telescope, a Newtonian reflector on Fremont Peak, California, was used in this observation. The limb darkening was more pronounced on Neptune than on Uranus through the Challenger Telescope. Gary Nowak observed Neptune with a 25-cm (10-in) f/20 Buchroeder Tri-Schiefspiegler telescope and had the impression that Neptune had a slightly bluish or grayish hue. Nowak pointed out the effect of the Earth's atmosphere and the possible influence of ash from Mt. Pinatubo on the observed colors of Uranus and Neptune.

CONCLUSION

The selected magnitudes for Neptune in 1992 are B(1,0) = -6.48±0.04; V(1,0) = -6.90 ±0.02 and I(1,0) = -5.64±0.12. The V-filter magnitude is close to the value in 1991 (-6.91) but is 0.03 magnitudes brighter than the value cited in the literature. Neptune did not have a strong greenish color in 1992 as it did in 1991.

REFERENCES

[1]. U.S. Naval Observatory. *Astronomical Almanac for the Year 1992.* Washington DC: U.S. Government Printing Office, 1991.

[2]. Schmude, R.W. Jr. "Photometry of Uranus and Neptune", *Proceedings of the Astronomical League-46th National Convention (COSMOCON-92)*, San Jose, California, (July 14-18, 1992), p. 21.

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

[4]. Schmude, R.W. Jr. "The 1991 Apparition of Uranus", *J.A.L.P.O.*, *36* (March, 1992), p. 20.

[5]. Hirshfeld, A. and Sinnott, R.W., eds. *Sky Catalog 2000.0, Vol. 1, Stars to Magnitude 8.0.* Sky Pub. Corp., Cambridge, MA, 1982.

[6]. *Arizona-Tonantzintla Catalog*, Sky Pub. Corp., Cambridge, MA,1965.

[7]. Schmude, R.W., Jr. "The 1991 Apparition of Neptune", *J.A.L.P.O.*, *36* (July, 1992), p. 91.

[8]. Harris, D.L. "Photometry and Colorimetry of Planets and Satellites", Chapter 8 in: Kuiper, G.P. and Middlehurst, B.M. eds., *Planets and Satellites*, Chicago: University of Chicago Press, 1961.

[9]. Hammel, H.B.; Lawson, S.L.; Harrington, J.; Lockwood, G.W.; Thompson, D.T.; and Swift, C., "An Atmospheric Outburst on Neptune from 1986 through 1989", *Icarus*, 99, (1992), p. 363.

[10]. Porter, A., "The Minor Planets: As Interesting As Ever", *J.A.L.P.O.*, *29* (December, 1981), p. 64.

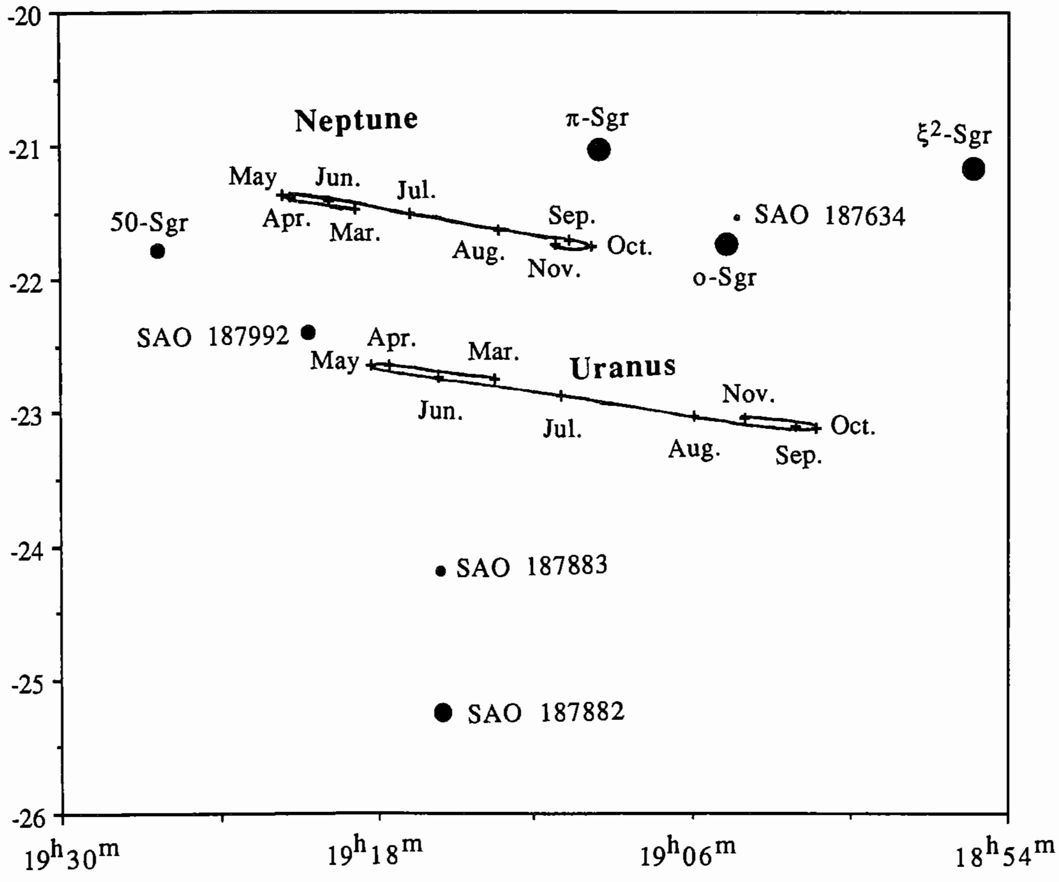


Figure 1. Positions of Uranus, Neptune, and comparison stars in 1992.

Table 1. Magnitudes of the comparison stars used for photometric measurements of Neptune; star coordinates are Epoch 2000.0.

Star Name	Right Ascension	Declination	Magnitude U	B	V	R	I
SAO 187634	19h 04.3m	-21°32'	-------	+7.70	+7.18	-------	--------
o Sgr	19h 04.7m	-21°44'	+5.63	+4.77	+3.77	+3.05	+2.52

Table 2. Photometric measurements of Neptune made in 1992.
(All measurements were made with an SSP-3 solid-state photometer.)

1992 U.T. Date	Filter	Magnitude Measured	Magnitude Normalized	Comparison Star	Difference in Air Mass
		+	-		
May 17.41	V	7.83	6.92	SAO 187634	-0.01
May 17.41	B	8.32	6.43	SAO 187634	-0.01
May 17.44	V	7.81	6.94	SAO 187634	0.00
May 31.38	V	7.88	6.86	SAO 187634	+0.01
May 31.38	V	7.84	6.90	SAO 187634	0.00
May 31.41	V	7.85	6.89	SAO 187634	-0.01
May 31.41	V	7.83	6.91	SAO 187634	-0.01
May 31.41	V	7.94	6.80	SAO 187634	-0.01
Jun 06.40	V	7.83	6.91	SAO 187634	-0.01
Jun 06.40	V	7.79	6.95	SAO 187634	-0.01
Jun 06.42	V	7.78	6.96	SAO 187634	+0.01
Jul 03.19	V	7.88	6.84	o Sgr	-0.02*
Jul 03.19	B	8.50	6.22	o Sgr	-0.03*
Jul 03.20	I	8.84	5.88	o Sgr	-0.04*
Jul 26 19	V	7.76	6.97	o Sgr	-0.09*
Jul 26 19	B	8.29	6.44	o Sgr	-0.11*
Jul 26 20	I	9.16	5.57	o Sgr	-0.13*
Jul 29 19	V	7.81	6.92	o Sgr	-0.11*
Jul 29 19	B	8.37	6.36	o Sgr	-0.13*
Jul 29 20	I	9.25	5.48	o Sgr	-0.15*
Aug 03.23	B	8.22	6.51	SAO 187634	+0.01
Aug 03.23	B	8.25	6.48	SAO 187634	+0.01
Aug 03.25	B	8.13	6.60	SAO 187634	0.00
Aug 03.26	B	8.10	6.63	SAO 187634	0.00
Aug 03.27	B	8.21	6.52	SAO 187634	0.00
Aug 03.28	B	8.21	6.52	SAO 187634	-0.01
Aug 03.29	V	7.87	6.86	SAO 187634	-0.01
Aug 03.30	B	8.20	6.53	SAO 187634	-0.01

*Calculated from the times given; there may be some error in these values.

Table 3. Mean BVI magnitudes of Neptune in 1992.

Filter	Normalized Magnitude	Standard Error (Mag.)	Standard Deviation (Mag.)	Number of Measurements
B	-6.48	±0.04	±0.11	11
V	-6.90	±0.02	±0.05	14
I	-5.64	±0.12	±0.21	3
B-V	+0.42	±0.04	------	------
V-I	+1.26	±0.12	------	------

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ASSOCIATION AFFAIRS

A.L.P.O. 1995 CONVENTION.—All our members in the United States, Canada, and Mexico have been mailed flyers describing our upcoming convention. To summarize: Our 45th convention will be held on August 2-5, 1995, in Wichita, Kansas. Our activities this year will include paper sessions and workshops, displays, a banquet, and a field trip to Lake Afton Public Observatory observatory field trip and star party. A member-Board meeting is also scheduled. Call 415-665-7522 to register by telephone. The meeting will be at the Days Inn East, 8300 E. Kellogg, Wichita, KS 67207. To make a reservation telephone the hotel directly at 316-684-0541; mention you are with the A.L.P.O. to obtain the $40/room rate for 1-4 persons.

A.L.P.O. Staff Honored.—In recent months, two A.L.P.O. Recorders have been honored by awards from other organizations. Don E. Machholz, our Comets Recorder, received *two* awards at the 1995 Riverside Telescope Makers' Conference (RTMC): The Western Amateur Astronomers *G. Bruce Blair Award* and the RTMC *Clifford Holmes Award*. Don Machholz is known to us for his frequent comet discoveries, but not everyone may be aware of his extrasolar activity: organizing Messier Marathons. The second person so honored was Mars Recorder Donald C. Parker, who received the Astronomical Society of the Pacific's (ASP) *Amateur Achievement Award* at the ASP's UNIVERSE'95 conference in College Park, Maryland. The award ceremony acknowledged Donald Parker's long-term reputation for excellence in planetary photography, and now planetary CCD imaging.

BEYOND THE A.L.P.O.

Mars Telescopic Observations Workshop.—Several members of our Mars Section are already planning to attend this observing-oriented meeting, which will be held in Ithaca, New York, on August 14-15, 1995. You can obtain more information from: MTO, Publications and Program Services Department, Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston, TX 77058-1113. (Telephone: 713-486-2166; FAX: 713-486-2160; Internet: cangelosi@lpi.jsc.nasa.gov)

New Organization: The Society for Amateur Scientists.—There is a new organization whose goals complement those of the A.L.P.O. The Society for Amateur Scientists (SAS) is devoted to to encouraging amateur scientific research, often in conjunction with professional scientists. Projects are conducted in various scientific fields, including anthropology, archaeology, astronomy, biology, geography, geology, mathematics, oceanography, and physics. Membership begins at $35 per year; members receive the *Amateur Scientists' Bulletin.* and other privileges. The SAS address is: Society for Amateur Scientists, 4951 D Clairemont Sq. Suite 179, San Diego, CA 92117. The SAS can also be contacted by: (1) E-mail: info@sas.org; (2) the World-Wide Web: http://www.thesphere.com/SAS/; (3) telephone 800-873-8767; or (4) FAX: 619-239-8807.

Dust in Space.—This is the topic of IAU Colloquium 150: Physics, Chemistry & Dynamics of Interplanetary Dust, Gainesville, FL, August 14-18, 1995. Contact: M.S. Hanner, Internet: msh@jplsc8.dnet.nasa.gov.

Dust and Larger.—The 58th Annual Meteoritical Society Meeting will take place in Washington, DC, on September 11-15, 1995. Contact: Glenn MacPherson, Department of Mineral Sciences, MRC-NHB 119, U.S. National Museum of Natural History, Smithsonian Institution, Washington, DC 20560. Telephone 202-357-2260; FAX 202-357-2476; Internet: mnhms044@sivm.si.edu.

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

Prepare for the Martian Landing.—This is the motivation for the Mars Pathfinder Landing Site Workshop II: Characteristics of Ares Vallis Region, held in Spokane, Wa, September 24-30, 1995. The meeting includes field trip to the channeled scablands (Sep. 24-27) and the Missoula Lake breakout area (Sep. 30). Contact: Publications and Program Services Department, LPI, 3600 Bay Area Boulevard, Houston, TX 77058-1113 (telephone 713-486-2158; FAX 713-486-2160; Internet: simmons@lpi.jsc.nasa.gov).

Kona Conclave.—The 27th Annual Meeting of the Division for Planetary Sciences of the American Astronomical Society will be held at the Ritz-Carlton, Mauna-Lani Hotel. 28 miles north of Kona, Hawaii (Big Island), on October 9-13, 1995. With the Spring Lunar and Planetary Science Conference in Houston, this is one of the two major professional Solar-System meetings held each year. There will be two tours of the Mauna Kea Observatories (Oct. 10 and 12) and one of volcanic districts (Oct. 14-15). More information can be obtained from: Karen Meech, University of Hawaii, Institute of Astronomy, 2680 Woodlawn Drive, Honolulu, HI 96822 (her Internet address is: meech@ifa.hawaii.edu). The program and abstracts will be available on or about September 8, 1995 at: World-Wide Web: http://cass.jsc.nasa.gov/lpi.html ; Internet: telnet cass.jsc.nasa.gov, username: cass, password online.

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

Astronomical Opportunity for Young Europeans.—The European Southern Observatory (ESO) has announced a program, "Europe Towards the Stars," to allow about fifty 17-18 year old students and their teachers to observe via a satellite link with two telescopes at ESO La Silla Observatory in Chile. To find out more about this competition, contact your national representative; the countries represented are: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxemburg, The Netherlands, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. To obtain the address of your national representative, contact ESO Information and Photographic Service, Karl-Schwartzschild-Str. 2, D-85748 Garching bei München, Germany for PR 06/95 (alternatively, you may obtain the information via the World-Wide Web URL: http://www.hq.eso.org/ or CompuServe GO SPACE).

Lunar and Planetary Science Conference Number 27.—The 27th LPSC, held near Johnson Spaceflight Center, Houston, is scheduled for March 18-22, 1996. For information about this major annual conference, write: Publications and Program Services Department, LPI, 3600 Bay Area Boulevard, Houston, TX 77058-1113 (telephone 713-486-2166; FAX 713-486-2160; Internet: simmons@lpi.jsc.nasa.gov). January 10, 1996 is the deadline for abstracts; details on abstract preparation are on the LPI World-Wide Web home page (http://cass.jsc.nasa.gov/lpi.html).

American Astronomical Society Prizes and Awards.—If you are a member of, or affiliated with, the American Astronomical Society (AAS), you are entitled to make nominations for any of their six awards: (1) The Henry Norris Russell Lectureship; (2) The Newton Lacy Pierce Prize; (3) The Helen B. Warner Prize; (4) The Dannie Heineman Prize for Astrophysics; (5) The AAS Annenberg Foundation Award; and (6) The Beatrice M. Tinsley Prize. An information sheet describing the awards and giving the nomination requirements and addressess of Committee Chairpersons can be obtained from: American Astronomical Society, Arlo Landolt, Office of the Secretary, Louisiana State University, Department of Physics and Astronomy, Baton Rouge, LA 70803-4001. Nominations are due by October 1, 1995.

A.L.P.O. Volunteer Tutors

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

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305 Surrey Road
Savannah, GA 31410
Instrumentation and Equipment Selection; Mercury; Venus

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

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

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

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

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

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

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

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

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

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Wichita, KS 67212
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Illinois College,
Jacksonville, IL 62650
Minor Planets

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

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

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

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

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Schaumburg, IL 60193
Mars; Video/CCD Imaging

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

PUBLICATIONS OF THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

(All Section Publications on p. 144 must be ordered directly from the appropriate Recorders.)
(Checks must be in U.S. funds, payable to an American bank with bank routing number.)

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

The A.L.P.O. Solar System Ephemeris: 1995. $8.00 in the United States, Canada, and Mexico; $10.00 elsewhere (airmail included). Contains 132 pages of tables, graphs, and maps describing the positions and appearances of the Sun, Moon, each major planet, the brighter planetary satellites, Minor Planets, meteors, and comets. Make payment to "A.L.P.O."

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

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

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Order from: A.L.P.O. Membership Secretary, P.O. Box 16882, Memphis, TN 38186-0882, U.S.A:

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1 (1947); 6. ***7*** (1953); 2, 3, 4, 5, 7, and 8. ***8*** (1954); 3-4, 5-6, and 7-8. ***9*** (1955); 1-2.
10 (1956); 5-6, 9-10, and 11-12. ***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.
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We welcome reports and observations from our readers and our staff, although we do not wish material that has been published or submitted elsewhere. Please submit double-spaced copy, either typewritten or printed; MS-DOS or Macintosh 3.5-inch diskette text (ASCII) files are very helpful as well. Gray-scale graphics may also be sent on disk, but should be uncompressed and in a common format such as TIFF, GIF, or PICT. For articles longer than two pages, begin with a 75-150 word abstract (our Journal is abstracted). Cite pertinent references in full, including page numbers. Fully document observations with the name and address of the observer; the observing site if different from the observer's address; the date and time in Universal Time; the telescope type, aperture (cm preferred), and magnification; filters used if any; atmospheric conditions (Seeing on the 0-10 A.L.P.O. scale; Transparency as the limiting stellar magnitude in the vicinity of the object); and other data as pertinent to the object observed. Illustrations are welcome but we cannot publish color. For low-contrast objects, exaggerate contrasts on drawings , photographs, and CCD images. Be sure to indicate the direction of celestial north or south, as well as celestial east or west if the image is laterally reversed.

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

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

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

Jupiter (Olivarez): *Jupiter Observing Forms.* $4.00 postpaid ($7.00 overseas) for 25 forms; make checks payable to "José Olivarez." These forms are for disk drawings, descriptive reports, and central meridian transits.
Jupiter (Westfall): *Timing the Eclipses of Jupiter's Galilean Satellites*; send a SASE with 55 cents in stamps. This is the project "Observing Kit" and includes a report form. Indicate if you are interested in photoelectric observations, including the "Io Patrol." (Predictions for Galilean Satellite eclipses are given in the *A.L.P.O. Solar System Ephemeris* for each year.)

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Solar (Graham): (1) *Eclipse of May 30, 1984--Scientific Results*, $5.00 Ppd. paperbound, $15.00 Ppd. hardbound. 40 pages, 10 investigations. **(2)** *Eclipse of October 3, 1986--Observations*, $5.00 Ppd. paperbound, $15.00 Ppd. hardbound. 20 pages, 6 authors, 10 investigations, theoretical contributions, and a commentary. **(3)** *Partial Eclipse of March 7, 1989—Observations*, $3.00 Ppd. paperbound only. (A *Handbook for Solar Eclipses* is under preparation.)

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

The Association of Lunar and Planetary Observers

Founded 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.

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