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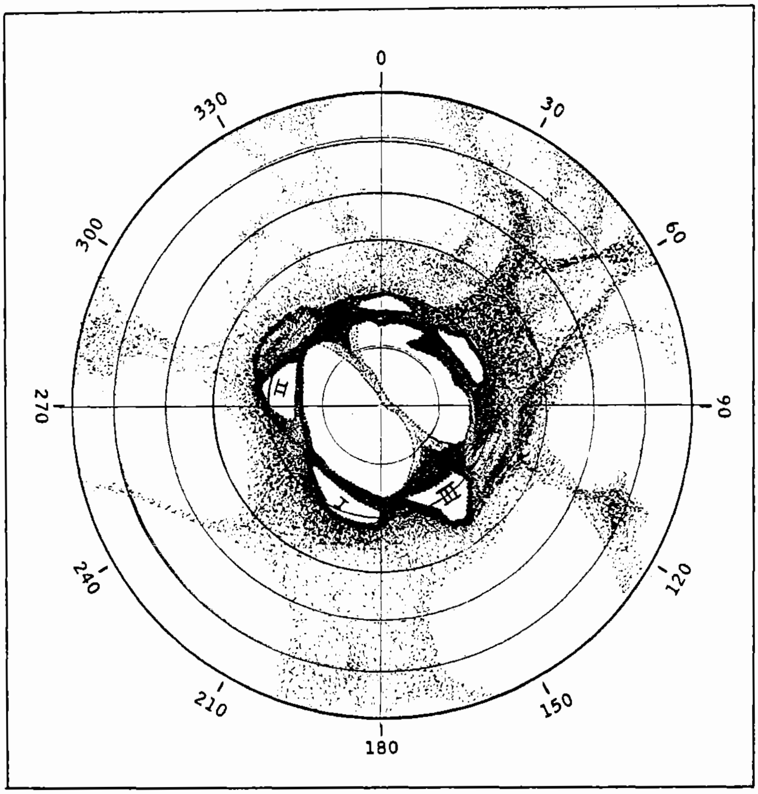

The Martian North Polar Region as observed in 1984 between areocentric solar longitudes 098° and 118° (Summer in the Martian Northern Hemisphere). Bright North Polar Cap remnants and the Rima Tenuis (grey band crossing the Cap from the lower right to the upper left) are shown, together with two small ice remnants that are surrounded by the dark circumpolar collar. The three large ice remnants that are numbered are: (I) Lemuria, (II) Cecropia, and (III) Ierne. The outer circle represents 60° north latitude, and the latitude interval is 5°. Drawn by Mars Recorder Jeff D. Beish from 50 A.L.P.O. visual observations. Also see the article on pages 185-197 of this issue.

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Founded In 1947

IN THIS ISSUE

THE 1983-85 APHELIC APPARITION OF MARS--REPORT I

By: Jeff D. Beish and Donald C. Parker, A.L.P.O. Mars Recorders

Abstract. --This report discusses the A.L.P.O. Mars Section's International Mars Patrol (IMP) observational program. Report I presents the A.L.P.O. observational summary and the Martian North Polar Region's seasonal aspect for the 1983-85 Aphelic Apparition of Mars. It includes drawings, graphs, a map, and tables for the evaluation of the meteorology of Mars during 1983-85.

I. Introduction

The astronomers of the A.L.P.O. Mars Section made a record number of quality visual and photographic observations during the 1983-85 Apparition of Mars. This effort was the result of the close cooperation among observers of the International Mars Patrol (IMP), organized by the senior A.L.P.O. Mars Recorder, the late Charles F. (Chick) Capen. The IMP is supported by observers in 14 countries or other regions of the world: Africa, Australia, Belgium, Canada, England, France, Hungary, Japan, Mexico, New Guinea, Spain, the Soviet Union, the United States, and Venezuela. Thus, these observers obtained good longitudinal coverage of Mars' surface and meteorology through most of a Martian year from the Northern Hemisphere Spring through its late Winter. [1]

The A.L.P.O. Mars Section Recorders are happy to announce that not only has the quantity of the Section's observations increased but the quality has improved as well. The systematic use of color filters has increased over the last three apparitions [1979-81, 1981-83, and 1983-85. Ed.], a fact which may be responsible for the renewed interest in observing Mars. This trend has greatly increased the number of observations of Mars' atmospheric conditions and has substantially enhanced our knowledge of the Red Planet's seasonal meteorological behavior. This interest in Mars is most gratifying, and we hope that this trend will continue.

The need for more quality color-filter observations was stressed by Chick Capen and is still a top priority with the A.L.P.O. Mars Recorders today. Blue- or violet-light photographs are essential in the ongoing meteorological survey of Mars. A well-planned systematic color filter surveillance of Mars will benefit observers and will enhance their enjoyment in observing other planets as well. [2]

Blue- or violet-light photographs with a Wratten W80A or W47 Filter can be made either at the telescope or can be reproduced from color slides in the darkroom by use of the same filters. Remember, using these low-transmission filters at the telescope requires increased exposure times, increasing the risk of sudden changes in the seeing conditions. For example, using a W47 Filter will require a twenty-fold increase in exposure time as compared to using no filter at all.

A good basic set of photo-visual filters for scientific research is available from most camera stores. The Mars Recorders use Eastman Kodak Wratten Filters, which come in 3X3-inch thin gelatin sheets. We encourage the planetary observer to obtain the following Wratten Filters for use in a well-rounded systematic program of observing: yellow (W12 or W15), green (W58), magenta (W30), blue (W38A), blue-green (W64), red (W23A or W25), and violet (W47). [Note that the W30 and W64 filters have been discontinued; but the W32 and W44 Filters respectively may be substituted. Ed.] These filters can be cut into one quarter-inch by one-inch strips and mounted into plastic slide holders. These can then be used at the telescope between the observer's eye and his ocular. Observers who use other types of filters are urged to advise the Mars Recorders of the exact filter types. High-quality glass filters are preferable for use in photographing the planets. Advanced information on the use and fabrication of filter holders is available from: A.L.P.O. Mars Recorders, Box 97-0469, Miami, FL 33197-0469.

Mars exhibited many interesting seasonal phenomena during the 1983-85 Apparition, including five dust storms; one of them occurred in January, 1984, and assumed major proportions. Yellow dust clouds were seen in the Martian northern Spring, Summer, and early Autumn. Observers were fortunate to have witnessed several changes on the Martian surface caused in part by an unusually high number of local or transient dust storms. These changes, as well as the meteorology of Mars, will be described in later reports. Some observers were able to see first-hand several dust storms from beginning to end--a rare event indeed!

The now-familiar Rima Tenuis was again observed in the Martian North Polar Cap. [8] Many of the A.L.P.O. Mars astronomers reported this feature, and a thorough study of this rift is in progress.

The bright polar cap remnants observed during the 1983-85 Apparition were not so numerous as in 1981-83. However, several observers submitted visual as well as photographic observations of these classical projections.

II. 1983-85 Observational Summary

In terms of actual observations, the 1983-85 Apparition of Mars began on 1983 AUG 11 with the first observation of the Red Planet being a visual one by Donald C. Parker of Coral Gables, Florida, when the Sun's planetocentric longitude as seen from Mars (L_s) was 021° and Mars' apparent disk diameter was only 3.70 arcseconds.* This apparition's observing ended on 1985 MAR 20 with an observation by David Moore of Traer, Iowa, at L_s 331°, with a disk diameter of 4.25 arcseconds. During this apparition, 61 percent (218° L_s) of the Martian year was observed. Also, substantial parts of every season were covered; amounting to 61 percent (55° L_s) of the Martian Northern Spring, all (90° L_s) of the Northern Summer, 64 percent (58° L_s) of the Northern Autumn, and 17 percent (15° L_s) of the Northern Winter. [These statistics are based on counts of whether each degree of L was covered. Ed.] The period of coverage is diagrammed in Figure 1, below.

The 1983-85 Apparition was considered an aphelic one even though opposition occurred 76° L_s after aphelion (070° L_s). Actually, the 1983-85 Apparition fell somewhere between an aphelic and a perihelic apparition. Mars reached opposition on 1984 MAY 11 (146° L_s) and was closest to Earth on 1984 MAY 19 (150° L_s), with a distance of 49,402,000 miles (79,505,000 km) and an apparent disk diameter of 17.61 arcseconds. [1] **

A total of 1610 observational reports was received by the A.L.P.O. Mars Section. At the time of the completion of this report on the 1983-85 Mars Apparition [June, 1987], 57 observers had contributed 1267 visual and 194 multi-colored photographic observations of Mars, as well as 149 filar micrometer measurements of the Martian North Polar Cap (NPC). Unfortunately, several

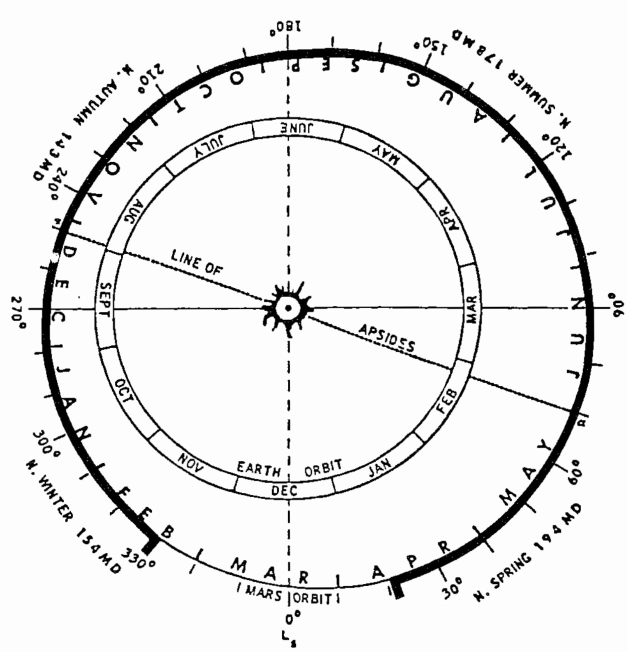

Figure 1. Seasonal observational coverage of Mars during its 1983-85 Apparition by A.L.P.O. observers. The orbit of Mars is graduated in degrees L_s. See also text.

* The quantity L_s is used to define Mars' seasons. In terms of the planet's Northern Hemisphere, the L_s-range of 0 to 90 degrees defines Spring; 90-180, Summer; 180-270, Autumn; and 270-360 degrees defines Winter. Ed.

** Mars' North Pole was tilted towards Earth for most of the 1983-85 Apparition (i.e., preceding 1984 OCT 01), favoring coverage of that hemisphere. Ed.

observers (about 5 percent) forgot to include their names and addresses on their observational reports and thus were not counted in the total and are not listed in Table 1, below.

More than 100 telescopes were used by A.L.P.O. Mars observers in this apparition, ranging from 3-inch (8 cm.) refractors to a 74-inch (188 cm.) reflector. The mean aperture of 9.4 inches (24 cm.) per telescope, or 11 inches (28 cm.) as the largest instrument per observer, indicates that more and more large-aperture telescopes are being used each year for observing the Red Planet. [Text continued on. p. 189.]

Table 1. A.L.P.O. Mars Observers, 1983-85 Apparition.

Note: Under Number of Observations "v" indicates visual, "p" photographs, and "m" micrometers measures. Telescope types are "CASS" for Cassegrains, "CAT" for catadioptrics, "NEW" for Newtonians, and "RR" for refractors.

Observer	Location	Number of Observations			Telescope Aperture and Type (in.)
M. Adachi	Ohtsu-City, Japan	11v			(-- not known --)
L. Aerts	Heist op den berg, Belgium	50v	2p		6.0 (15 cm.) RR
					6.0 (15 cm.) NEW
J. Barnett	Richmond, VA	2v			7.1 (18 cm.) RR
D. Barbany	Barcelona, Spain	5v			3.0 (8 cm.) RR
					8.0 (20 cm.) NEW
J. Beish	Miami, FL	136v	3p	44m	12.5 (32 cm.) NEW
					12.5 (32 cm.) CASS
C. Capen	Cuba, MO	3v			3.0 (8 cm.) RR
					5.5 (14 cm.) NEW
B. Copeland	Surrency, GA	4v			6.0 (15 cm.) NEW
J. Corder	Ashville, NC	3v			3.5 (9 cm.) NEW
					8.0 (20 cm.) NEW
					10.0 (25 cm.) NEW
M. Daniels	Wichita, KS	6v			8.0 (20 cm.) NEW
D. DeKarske	Colorado Springs, CO	1v			4.0 (10 cm.) RR
R. De Terwangne	Antwerp, Belgium	53v			8.0 (20 cm.) NEW
T. Dobbins	Lyndhurst, OH	3v			6.5 (16.5cm.)RR
J. Dragesco	Rwanda, Africa	74v	21p		14.0 (36 cm.) CAT
C. Evans	Hampton, VA	46v			6.0 (15 cm.) NEW
					6.0 (15 cm.) RR
					10.0 (25 cm.) CASS
B. Ezard	Papua, New Guinea	1v			6.0 (15 cm.) NEW
R. Fabré	Aiea, HI	93v			13.0 (33 cm.) NEW
					17.5 (44 cm.) NEW
M. Gelinas	St-Hubert, Quebec	13v			8.0 (20 cm.) NEW
R. Gordon	Nazareth, PA	3v			3.0 (8 cm.) RR
					6.0 (15 cm.) RR
W. Haas	Las Cruces, NM	27v			12.5 (32 cm.) NEW
A. Heath	Nottingham, England	16v			12.0 (30 cm.) NEW
C. Hernandez	Miami, FL	17v			8.0 (20 cm.) CAT
					12.5 (32 cm.) NEW
A. Herring	Anaheim, CA	9v	3p		10.0 (25 cm.) NEW
					12.5 (32 cm.) NEW
R. Hill	Tucson, AZ	3v			8.0 (20 cm.) CAT
M. Legrand	Janze, France	1v			8.3 (21 cm.) NEW
D. Louderback	South Bend, WA	7v			8.0 (20 cm.) CAT
M. Maksyrowicz	Roisson, France	16v	5p		4.3 (11 cm.) NEW
					6.0 (15 cm.) NEW
M. Mattei	Harvard, MA	16v			12.5 (32 cm.) NEW
P. Maxson	Phoenix, AZ	4v	4p		8.0 (20 cm.) NEW
					8.0 (20 cm.) CAT
					11.0 (28 cm.) CAT
R. McKim	Peterborough, England	2v			8.0 (20 cm.) RR

[Table 1 continued on p. 188]

[Table 1--Continued.]

Observer	Location	Number of Observations	Telescope Aperture and Type (in.)
J. Melka	Chesterfield, MO	3v 10p	8.0 (20 cm.) NEW
			14.0 (36 cm.) CAT
D. Moore	Traer, IA	40v	10.0 (25 cm.) NEW
M. Morrow	Ewa Beach, HI	18v	16.0 (41 cm.) NEW
P. Mozel	Oakville, Ontario	10v 2p	8.0 (20 cm.) CAT
			74.0 (188 cm.) CASS
M. Nakajima	Yokohama, Japan	30v	8.0 (20 cm.) NEW
G. Nowak	South Burlington, VT	12v	8.0 (20 cm.) CAT
			9.0 (23 cm.) RR
J. Olivarez	Wichita, KS	10v	10.0 (25 cm.) NEW
			12.5 (32 cm.) NEW
J. Papp	Budapest, Hungary	2v	6.0 (15 cm.) NEW
D. Parker	Coral Gables, FL	130v 141p 100m	12.5 (32 cm.) NEW
			12.5 (32 cm.) CASS
K. Rhea	Paragould, AR	73v 3p	4.0 (10 cm.) RR
			6.0 (15 cm.) NEW
			8.0 (20 cm.) NEW
R. Robotham	Springfield, Ontario	24v	6.0 (15 cm.) NEW
			8.3 (21 cm.) RR
G. Rosenbaum	Tucson, AZ	24v	8.0 (20 cm.) NEW
			10.0 (25 cm.) NEW
			11.0 (28 cm.) CAT
			12.0 (30 cm.) NEW
C. Schambeck	Munich, West Germany	16v	4.7 (12 cm.) RR
			4.7 (12 cm.) NEW
			6.0 (15 cm.) RR
			7.1 (18 cm.) RR
			8.0 (20 cm.) CAT
K. Schneller	Euclid, OH	10v 5m	6.5 (16.5cm.)RR
			8.0 (20 cm.) NEW
P. Silveira	Caracas, Venezuela	2v	8.0 (20 cm.) CAT
M. Sweetman	Tucson, AZ	8v	4.0 (10 cm.) RR
			10.0 (25 cm.) CASS
B. Talaga	Tucson, AZ	10v	14.0 (36 cm.) CAT
R. Tatum	Richmond, VA	7v	6.0 (15 cm.) RR
			9.0 (23 cm.) RR
			10.0 (25 cm.) NEW
G. Teichert	Hattstatt, France	2v	11.0 (28 cm.) CAT
D. Troiani	Chicago, IL	91v	6.0 (15 cm.) RR
			8.0 (20 cm.) NEW
			10.0 (25 cm.) NEW
			12.5 (32 cm.) NEW
			14.0 (36 cm.) NEW
			16.0 (41 cm.) NEW
			18.5 (47 cm.) RR
J. Truax	Rockford, MI	6v	6.0 (15 cm.) NEW
			12.5 (32 cm.) NEW
A. van der Jeugt	Gent, Belgium	9v	5.0 (13 cm.) RR
			6.0 (15 cm.) NEW
F. Van Loo	Heist op den berg, Belgium	49v	10.0 (25 cm.) NEW
G. Waffen	Broadview Heights, OH	8v	5.0 (13 cm.) RR
R. Wessling	Milford, OH	9v	12.5 (32 cm.) NEW
J. Westfall	San Francisco, CA	2v	10.0 (25 cm.) CASS
M. Will	Herrin, IL	32v	6.0 (15 cm.) NEW
A. Wilson	Lakeside, AZ	5v	8.0 (20 cm.) CAT
57 Observers		1267v 194p 149m	Mean 9.4 in. (24 cm.) (11.0 in. {28 cm.} by observer)

[Text continued from p. 187.]

III. The Martian North Polar Region

The Martian North Polar Cap (NPC) Spring and Summer regression curve for 1983-85 is presented in Figure 2 (below), and the latitude measurements of its south edge are tabulated in Table 2 (below). [Throughout this section, it is assumed that the NPC is centered on Mars' North Pole. Ed.] Regression curves for the 1963, 1965, 1967, 1969, 1980, and 1982 apparitions are shown in Figure 3 (p.190) at the same scale as Figure 2 in order to aid comparisons. Comparative regression rates are given in Table 3 (p. 190). The areographic latitudes of the NPC's south edge are given by the vertical scale of each graph, and the areographic longitudes of the Sun (L_s) by the horizontal scale for the indicated seasonal periods observed. [4,6] [Text continued on p. 190.]

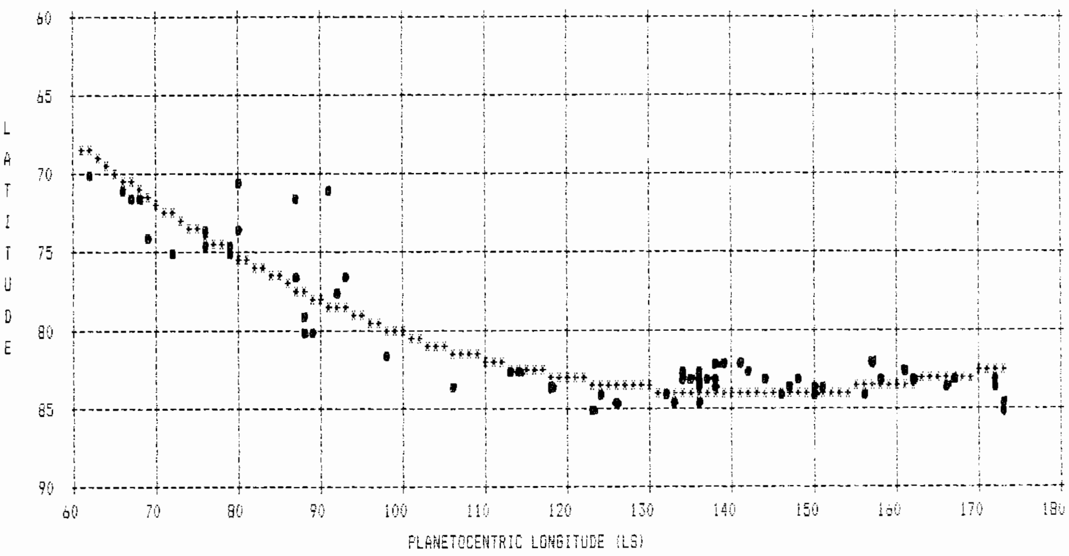

Figure 2. Martian North Polar Cap regression curve for 1983-85, based on micrometer measures of the apparent diameter of the shrinking NPC during the Martian Northern Hemisphere Spring and Summer. The latitude of the south edge of the NPC is plotted against L_s , both measured in degrees. The micrometer measures were made by A.L.P.O. observers Donald C. Parker, Jeff D. Beish, and Ken Schneller. Uncorrected observed latitudes are shown by black squares while a parabolic least-squares fit is shown by asterisks.

Table 2. Martian North Polar Cap (NPC) Micrometer Measurements, 1983-85.

L_s	Latitude	L_s	Latitude	L_s	Latitude	L_s	Latitude	L_s	Latitude	L_s	Latitude
o	o	o	o	o	o	o	o	o	o	o	o
060.7	+65.7	079.0	+74.6	113.3	+82.7	135.9	+82.9	142.9	+82.6	158.0	+83.0
062.4	70.0	079.5	75.2	114.2	82.7	136.0	82.5	144.9	83.2	161.0	82.7
066.4	70.9	080.8	73.5	118.3	83.7	136.1	83.4	146.4	83.9	162.0	82.9
067.7	71.7	087.4	79.8	123.0	84.9	136.4	82.8	147.0	83.7	166.0	83.7
068.1	71.5	088.2	78.9	124.0	83.9	136.5	84.4	148.5	83.0	167.0	83.2
069.8	73.9	089.6	80.1	126.3	84.7	137.0	82.9	150.5	83.7	172.0	83.5
072.5	75.0	092.2	77.4	132.6	84.0	138.5	81.8	150.9	83.9	172.5	82.9
072.9	74.8	093.1	76.4	133.2	84.3	138.8	83.3	151.0	83.7	173.0	84.6
076.0	73.5	098.0	81.3	134.4	82.7	139.9	82.2	156.0	84.1	173.5	84.8
076.8	74.6	106.9	83.5	134.9	82.9	141.4	82.1	157.0	82.2	198.0	85.9

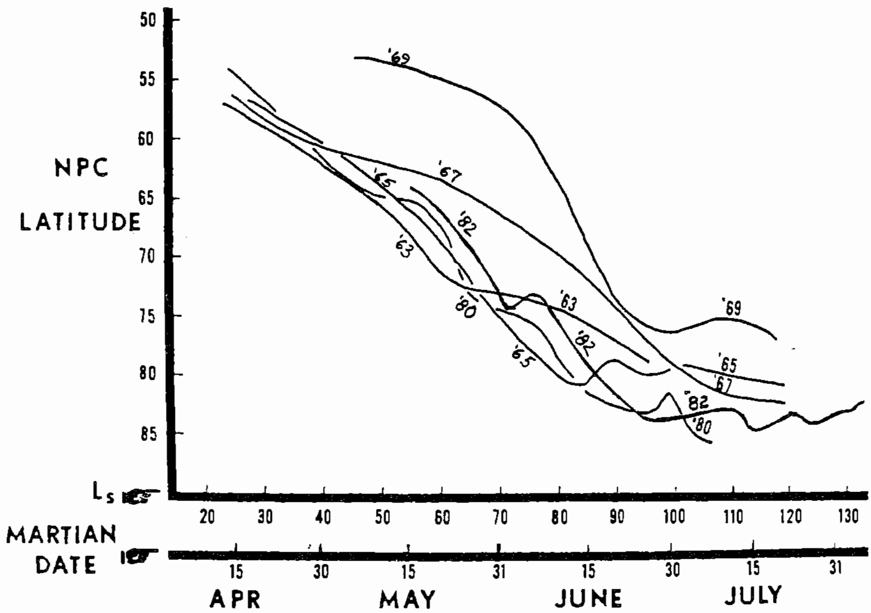

Figure 3. Martian North Polar Cap (NPC) regression curves for the apparitions of 1963 through 1969, 1980, and 1982, which can be compared with the curve for 1984 in Figure 2 (p. 189); also see Figure 4 (p. 191). Comparison curves for 1963 through 1969 by C.F. Capen; 1980 by D.C. Parker, and 1982 by D.C. Parker and Jeff D. Beish. See also text.

Table 3. North Polar Cap (NPC) Regression Rates.

Note: Units are in terms of Martian days ("sols") per degree of regression in latitude.

	Apparition						
Season	1962-63	1964-65	1966-67	1968-69	1979-81	1981-83	1983-85
Early Spring	10 sols	23 sols	15 sols	20 sols	---sols	---sols	---sols
Maximum Rate	3	3	4	2	2	2	3
Early Summer	8	6	10	7	5	20	4
Mid-Summer	-------	30	30	20	30	32	30

[Text continued from p. 189.]

Many interesting and provocative conclusions can be reached regarding the regression curves. It appears that similar seasonal behavior is exhibited by all seven regressions that are graphed in Figures 2-4. Each indicates a slowly retreating ice cap during Martian early northern Spring and then a maximum rate of thawing commencing during middle- to late-Spring. However, one notable feature shown in Figure 3 is that the 1967 and 1969 NPC appeared, on the average, larger than that for 1980, 1982, and 1984, especially during the northern Summer. The 1963 NPC thaw rate decreased after 070° L_s and maintained a relatively slow rate of thaw for some time. Even more dramatic was the 1965 NPC, which appeared to shrink rapidly at first, but then increased in size during the early Martian northern Summer!

A temporary halt in the thawing occurs at about 070° L_s (late northern Spring) and, after a short period, a rapid regression resumes just prior to Martian northern Summer. An almost-static remnant is all the is left of the NPC by late northern Summer. Slight oscillations in the size of the cap are observed during the Martian northern Summer and Autumn. We believe that the oscillations are the result of the intermittent reforming of Arctic hazes and the separating of remnant parts of the outer NPC from the main body. [4]

The temporary halt in the retreat of the NPC occurs when Arctic hazes form over the North Polar Region during the period of maximum regression rate just prior to the northern Summer Solstice (070° -090° L_s). The nature of this interesting phenomenon has been long discussed by planetary astronomers. Dr. Clyde Tombaugh, the discover of the planet Pluto and an expert Mars observer, has observed this phenomenon for many years and describes it as a temporary reforming of Arctic hazes, similar in its characteristics to a polar hood, and has called it the "aphelic chill." [6] Many astronomers, including the present authors, have seen these temporary summer hazes over the NPC. Some have even reported the NPC to increase in size slightly. We have regularly observed this phenomenon during the 1979-81, 1981-83, and 1983-85 Apparitions. [4,9]

A study of the history of the Martian NPC from measurements made from 1882 through 1901 [5], 1962 through 1969 [6], and 1980 through 1985 reveals that the NPC appears to have been larger than average during the 1960's and then slightly smaller than average during the early 1980's.

The 1983-85 NPC exhibited some unusual characteristics during Martian northern late Spring. From 075° through 100° Ls, cap regression slowed dramatically with a few periods of significant recondensation. This was in marked contrast to the behavior in 1982, as is shown in Figure 4, below. A possible explanation for this phenomenon is that the previously noted yellow cloud activity during northern late Spring produced enough dust in the planet's atmosphere to alter the delicate energy balance of the Martian Arctic. Viking Spacecraft data confirm that such atmospheric aerosols absorb heat and retard NPC retreat.

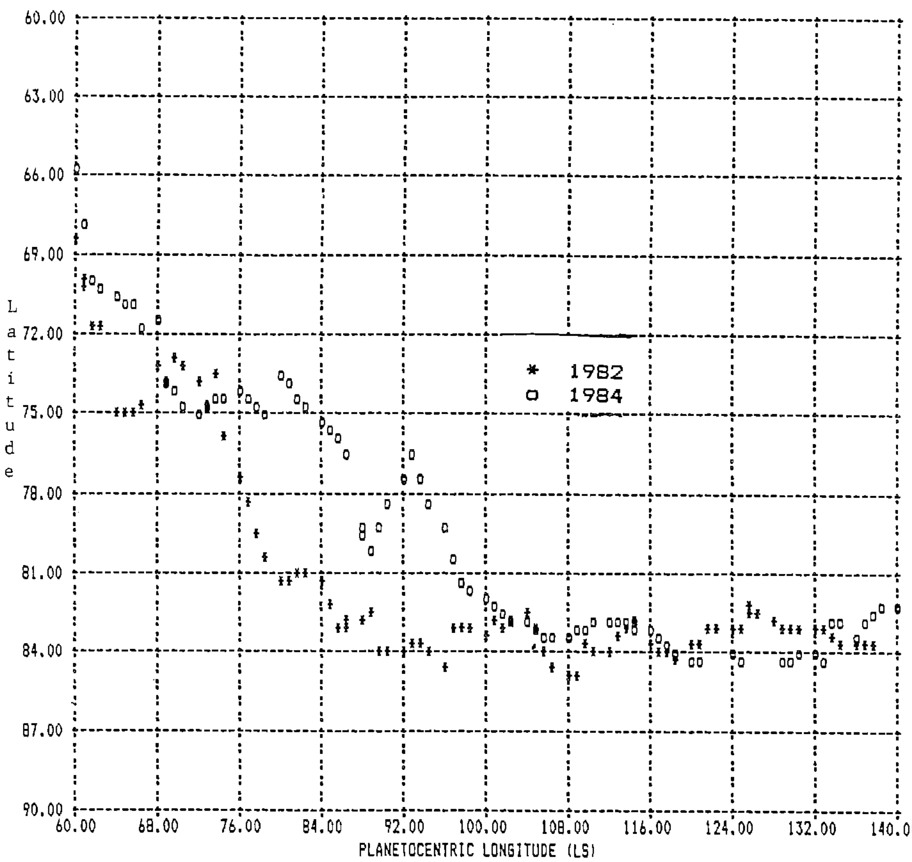

Figure 4. Martian North Polar Cap (NPC) regressions compared for the 1981-83 and the 1983-85 apparitions during the period from 060° to 140° L_s. Latitudes for 1981-83 are shown by asterisks, and those for 1983-85 by open squares. See also text.

The delay in NPC regression lasted approximately one Martian "month" (30° L_s), after which the cap exhibited rapid thawing and shrank to a very small size. This NPC remnant was significantly smaller than the "average" and approximated the dimensions of the 1979-81 and 1981-83 NPC remnants. Thus the cap remnants of the 1980's remain smaller than those of the 1960's. By the Martian northern late Summer (156° Ls), however, the NPC nearly disappeared, leaving only a few traces of Arctic ice.

Observers have long noted that Mars' meteorology follows the behavior of the NPC. As the summer cap shrinks, there is an increase in cloud activity, especially in the orographic water-ice clouds which form over the volcanoes during the Martian northern Summer afternoons. Viking data have verified water vapor movement from the North Pole to the planet's equator during this season. In 1984, however, the appearance of these clouds was delayed by nearly one Martian "month," corresponding to the delay in NPC regression. This lag will be discussed in depth in Part II of this report.

IV. The Periphery of the NPC

Upon emergence from beneath the Polar Hood, the NPC appears to have a rather smooth and uniform border. Later, during the rapid-thaw period, the edge of the cap will appear uneven. C.F. Capen, using the 82-inch reflector of the McDonald Observatory in Texas, wrote that "...observing with the large telescope with high resolution revealed a polar cap with an uneven and jagged edge with numerous small, white, circular detachments along the dark peripheral band as the cap radidly retreated poleward during Martian spring." By Martian summer, the NPC retreat slows; and three observable bright projections appear on the edge of the cap. These areas detach from the NPC as it retreats above 80° N latitude and remain throughout the northern Summer and Autumn. The white remnants are named after the areas on Mars that they occupy. Their averaged center-of-area areographic longitudes, as plotted on G. de Mottini's 1941-52 International Astronomical Union Mars Map are: Ierne, 137° W; Lemuria (Olympia), 200° W; and Cecropia, 297°W. Table 4, below, compares the areographic longitudes of these areas as observed by various Mars observers from 1879 to 1985. These three bright polar projections are shown on the Martian North Polar Region map which appears on the front cover of this issue. [6]

Two other white patches were observed that have not been named previously as classical NPC remnants. One was noted at the areographic location of 81° N, 003°W; the other was at 82°N, 059°W.

Observing these remnants can be most challenging, even when using large telescopes. With high magnifications and apertures of 10 inches or more, these features usually become apparent soon after the Martian northern Summer Solstice (090° Ls). The present authors regularly employ magnifications of 450X to 1000X for studying the Martian Arctic.

Table 4. Longitudes of North Polar Cap Residuals (Bright Projections).

Observer(s)	Years	Areographic West Longitude Ierne °	 Lemuria °	 Cecropia °
Schiaparelli	1879-88	121	208	310
Lowell	1901-05	122	206	311
Antoniadi	1903-29	122	208	309
Maggini	1918-35	136	213	278
de Mottoni	1941-52	137	200	297
Dollfus	1946-52	142	227	292
Capen	1962-68	140	196	290
Beish, Parker, Capen, & Dragesco	1981-83	132	205	280
Beish, Parker, Hernandez, & Dragesco	1983-85	142	205	282
	Mean	133°	208°	294°

V. The Rima Tenuis

While using a 9-inch refractor in 1888, G. Schiaparelli noted that the North Polar Cap of Mars was divided into two parts by a dark rift or fissure. This observation was soon confirmed by Terby and Perrotin. This rift, called Rima Tenuis, was observed many times from 1901 through 1918. Records from the British Astronomical Association (B.A.A.) indicate that the Rima Tenuis has been observed during 1933 and again in 1950.

A search for the Rima Tenuis was carried out by C.F. Capen during the 1960's. Even though he used telescopes of 16, 30, and 82 inches aperture, the search was unsuccessful. It was not until late 1979 that the Rima Tenuis appeared again. The first evidence of its return was observed by D. Troiani of Chicago, Illinois, who observed a dark notch at the south edge of the NPC near 335° W areographic longitude on 1979 DEC 14. R. Robotham, J. Dragesco, J. Beish, and D. Parker observed the Rima Tenuis within days of this first recent observation of this notch. Later, on 1980 FEB 22, P. Moore and C.F. Capen observed the complete Rima Tenuis while using the Lowell Observatory's 24-inch refractor. This rift became a regularly observed feature during the 1979-81 Apparition and again in 1981-83.

On 1983 NOV 04 (060° L_s), Carlos Hernandez of Miami, Florida, observed a slight notch at the edge of the Martian North Polar Cap near 335° W areographic longitude. The Rima Tenuis was sighted by Beish and was confirmed by Parker on 1983 NOV 14 (064° L_s).[6,8] Leo Aerts, F.R. Van Loo, and D. Troiani later confirmed its existence. Later, on 1983 NOV 22 (067° L_s), observers reported that the NPC appeared to be "peanut-shaped," which was similar to the NPC descriptions made during 1979-81 and again in 1981-83 just prior to the first sightings of the Rima Tenuis. [7] Beginning with the next day, 1983 NOV 23 (068° L_s), a dark notch appeared at the edge of the NPC near 135° W longitude. Since its rediscovery in 1979 by A.L.P.O. observers, the Rima Tenuis has been seen intermittently from 064° through 150° L_s in the Martian North Polar Cap. This feature has been observed to cross the cap from longitude 131° W to 331° W, and is shown on the front cover illustration of this issue and on Figures 5 and 6 (pp. 195-196. The dates when it has first become visible are given in Table 5, below. [7,8]

Photographs of the Rima Tenuis have been taken by A.L.P.O. astronomers MacFarlane, Aerts, and Parker. However, due to the extremely low effective contrast and small size of this feature, we do not as yet have a photograph good enough to publish.

Table 5. Initial Observations of the Rima Tenuis.

(* Indicates month and day unknown.)

Observer(s)	Date	L_s °	Areographic Longitudes ° °
G. Schiaparelli	1888 MAY 07	129	134 - 330
A. Douglass	1901 *	---	--- ---
P. Lowell	1903 *	---	--- ---
M. Maggini	1918 *	---	--- ---
B. Burrell	1933 *	---	--- ---
F. Holborn	1933 MAR 24	086	--- ---
T. Phillipa	1933 *	---	--- ---
W. Steavenson	1933 *	---	--- ---
C. du Martheray	1950 FEB 19	083	--- ---
D. Troiani	1979 DEC 14	039	(notch only)
C. Capen & P. Moore	1980 FEB 22	070	130 - 330
J. Beish & D. Parker	1981 DEC 27	064	123 - 332
C. Capen	1981 *	---	129 - 333
C. Hernandez	1983 NOV 04	060	(notch only)
J. Beish & D. Parker	1983 NOV 23	068	141 - 330
		Mean	131 - 331

Figures 5 and 6 (pp. 195-196; captions on pp. 194 and 196) contain selected drawings of Mars made by A.L.P.O. observers during the 1983-85 Apparition.

Captions to Figure 5 (facing page); the arrangement of the captions matches the individual drawings. Dates and times are in Universal Time (U.T.). All longitudes are areographic, expressed in degrees. "CM" indicates central meridian, and DE the areocentric declination of the Earth, both given in degrees. Abbreviations of telescope types are as used in Table 1 (pp. 187-188). South is at the top in all drawings, which are simply inverted views.

1983 NOV 03 10h05m CM 320, DE +25 20-cm. f/10 CAT C. Hernandez First observation of the Rima Tenuis notch at the south edge of the NPC at 335 W longitude.	1983 NOV 24 10h20m CM 119, DE +25 32-cm. f/30 CASS J. Beish Rima Tenuis notch and rift at 145 W longitude.	1983 NOV 24 11h30m CM 136, DE +24 32-cm. f/6.5 NEW D. Parker Rima Tenuis notch and partial rift at 142 W longitude.	1983 NOV 24 11h30m CM 136, DE +24 32-cm. f/30 CASS J. Beish Rima Tenuis across NPC at 140 W Long.
1983 DEC 03 04h30m CM 306, DE +24 15-cm. f/15 RR Leo Aerts Rima Tenuis notch at 305 W Long.	1983 DEC 03 05h40m CM 323, DE +24 25-cm. NEW F.R. Van Loo Notch at 313 W longitude.	1983 DEC 07 11h39m CM 012, DE +23 24-cm. f/6 NEW D. Troiani Notch of Rima Tenuis at 312 W longitude.	1983 DEC 13 10h00m CM 290, DE +23 32-cm. f/30 CASS J. Beish Complete crossing of the NPC by the Rima Tenuis.
1984 FEB 17 05h10m CM 306, DE +14 36-cm. f/11 CAT J. Dragesco "Peanut-shaped" NPC with slight notch at 306 W longitude.	1983 AUG 20 10h30m CM 338, DE +16 32-cm. F/6.5 NEW D. Parker North Polar Hood early in the apparition.	1983 NOV 05 10h45m CM 310, DE +25 32-cm. f/6.5 NEW D. Parker Formation of dark collar near edge of NPC.	1983 DEC 05 10h00m CM 007, DE +23 32-cm. f/30 CASS J. Beish NPC white projections between 270 and 060 W Long.
1983 DEC 19 10h20m CM 236, DE +22 32-cm. f/30 CASS J. Beish Bright NPC projection Cecropia near CM.	1984 JAN 17 09h50m CM 310, DE +19 32-cm. f/6.5 NEW D. Parker NPC projection Cecropia near 270 W longitude.	1984 MAR 22 04h30m CM 338, DE +10 36-cm. f/11 CAT J. Dragesco Bright NPC projection Cecropia near 314 W longitude.	1984 APR 19 09h20m CM 153, DE +11 32-cm. f/6.5 NEW D. Parker Bright NPC projection Lemuria near 210 W longitude.
1984 MAY 05 03h10m CM 281, DE +13 15-cm. f/15 RR C. Evans Uneven NPC border.	1984 JUN 13 01h40m CM 274, DE +19 32-cm. F/30 CASS J. Beish NPC remnants; Cecropia (290 W) & Lemuria (210 W).	1984 JUN 13 02h00m CM 279, DE +19 32-cm. NEW J. Truax Bright NPC remnant Cecropia.	1984 JUN 18 02h25m CM 240, DE +19 32-cm. f/6.5 NEW D. Parker Bright NPC remnant Lemuria.

VI. Conclusion to Report I

This report has attempted to show that the 1983-85 Aphelic Apparition of Mars was an eventful one indeed. A very large number of observations was received and the A.L.P.O. Mars Section astronomers are commended for their efforts. The Martian NPC was shown to have behaved much as it did during the 1979-81 and 1981-83 Apparitions. A study of the Martian North Polar Cap (NPC) regressions shows that the 1979-85 NPC was smaller than that of the 1960's.

The Rima Tenuis was again observed for long periods of time and three classical NPC remnants were also observed. The present authors feel that the return of the Rima Tenuis and the reduced size of the NPC may well be signs that Mars was warmer in the early 1980's than in previous years.

In the next Report, observed meteorological phenomena will be discussed that will add more evidence to this hypothesis. We will also present general meteorological statistics for Mars and a detailed discussion of the five yellow dust storms which were sighted in 1983-85. [References follow on p. 197.]

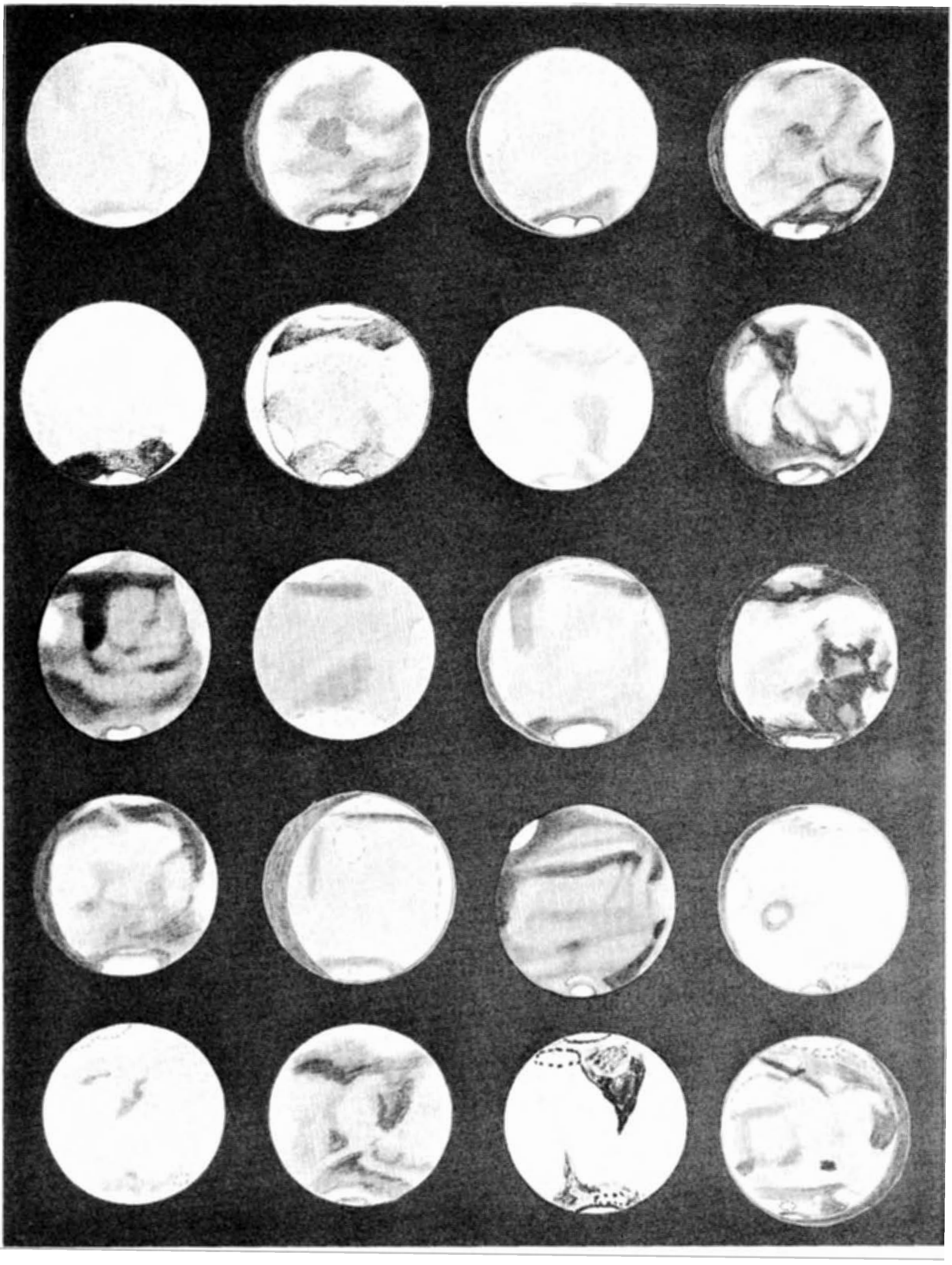

Figure 5. For captions see facing page

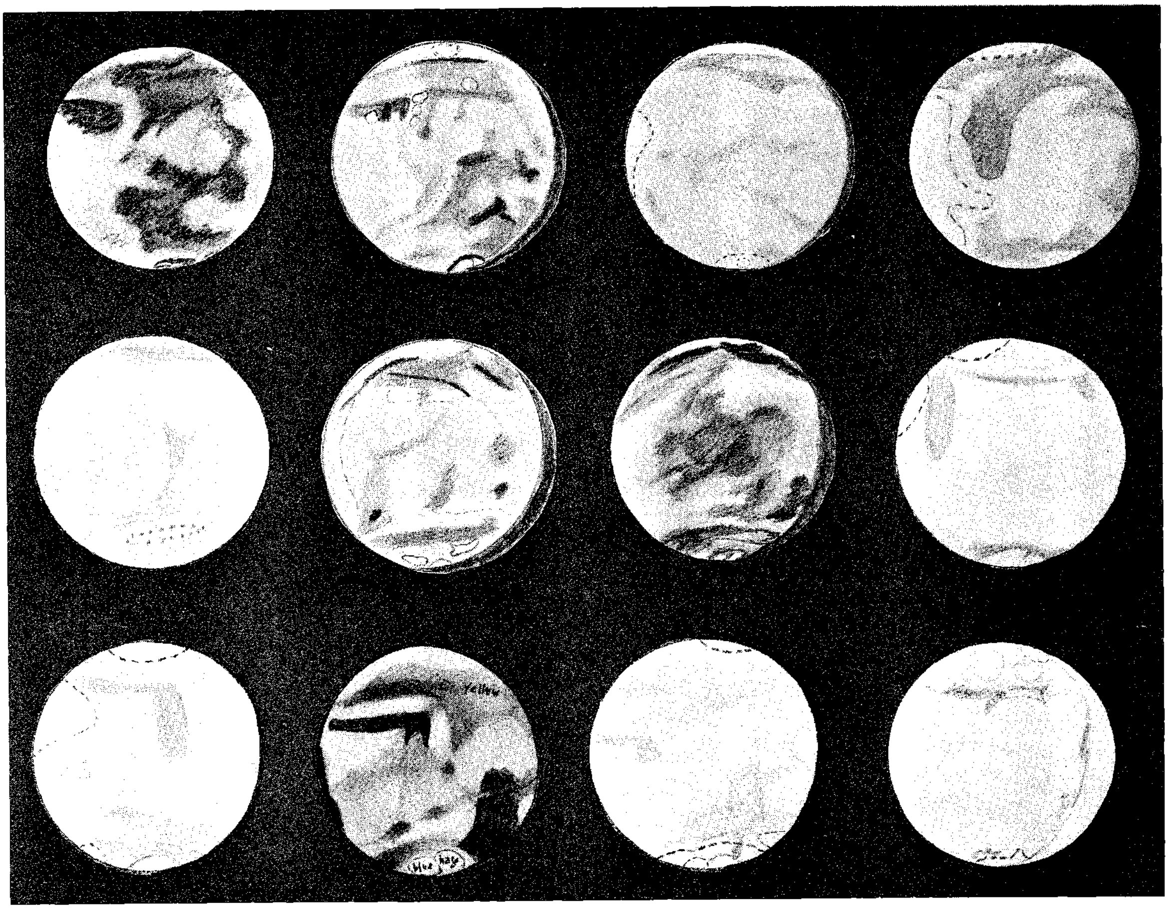

Figure 6. Abbreviations and conventions are as with Figure 5 (p. 195).

1984 JUN 01 02h00m CM 026, DE +17 32-cm. f/30 CASS J. Beish Rima Tenuis crossing NPC from east to west.	1984 JUN 05 04h00m CM 020, DE +18 32-cm. f/6.5 NEW D. Parker Bright ice projection on following edge of NPC.	1984 JUN 06 13h40m CM 153, DE +18 20-cm. NEW M. Nakajima Bright spot in hazy NPC.	1984 JUN 14 05h50m CM 326, DE +19 44-cm. NEW R. Fabré Bright NPC projection Cecropia.
1984 JUN 23 03h25m CM 209, DE +19 20-cm. NEW J. Melka Bright NPC projection Lemuria.	1984 JUN 24 05h10m CM 225, DE +19 32-cm. f/6.5 NEW D. Parker Bright NPC projections Cecropia (left) and Lemuria (right).	1984 JUN 30 02h45m CM 134, DE +19 32-cm. f/30 CASS J. Beish Rima Tenuis near 140 W longitude.	1984 JUL 19 03h10m CM 323, DE +17 25-cm. f/6 NEW D. Troiani NPC with Rima Tenuis.
1984 JUL 22 03h08m CM 294, DE +17 25-cm. f/6 NEW D. Troiani NPC remnant Cecropia.	1984 JUL 03 20h15m CM 002, DE +19 36-cm. f/11 CAT J. Dragesco Note blue haze in North Polar Region and yellow haze on southwest limb. Yellow dust storm?	1984 JUL 12 03h21m CM 031, DE +18 36-cm. f/6 NEW D. Troiani North Polar Region clouds.	1984 JUL 23 00h30m CM 246, DE +17 15-cm. f/15 RR C. Evans NPC cloud.

References

1. Capen, C.F.; Parker, D.C.; & Beish, J.D. "Observing Mars XI--The 1984 Aphelic Apparition." J.A.L.P.O. , 30 , Nos. 5-6 (Jan., 1984), pp. 125-130. [See also: Meeus, J. Astronomical Tables of the Sun, Moon, and Planets. Richmond, VA: Willmann-Bell, Inc., 1983, pp. 1-12.]
2. Capen, C.F. "A Guide to Observing Mars--I." J.A.L.P.O. , 30 , Nos. 7-8 (Apr., 1984), pp. 172-176; and Nos. 9-10 (Aug., 1984), pp. 186-190..
3. Beish, J.D.; Parker, D.C.; & Capen, C.F. "A Major Martian Dust Storm in 1984." J.A.L.P.O. , 30 , Nos. 9-10 (Aug., 1984), pp. 211-217.
4. Capen, C.F. & Cave, T.R. "Mars 1969--The North Polar Region--A.L.P.O. Report II." J.A.L.P.O. , 23 , Nos. 3-4 (Aug., 1971), pp. 67-75; and Nos. 5-6 (Nov., 1971), pp. 79-85.
5. C. Flammarion. La Planete Mars et ses Conditions d'Habitabilite. Paris: Gauthier-Villars et Fils, Vol. I, 1892.
6. Capen, C.F. & Capen, V.W. "Martian North Polar Cap, 1962-68." Icarus , 13 , No. 1 (July, 1970), pp. 100-108.
7. Capen, C.F. & Parker, D.C. "What is New on Mars--Martian 1979-1980 Apparition Report II." J.A.L.P.O. , 29 , Nos. 1-2 (July, 1981), pp. 38-41; and Nos. 3-4 (Dec., 1981), pp. 51-60.
8. Capen, C.F. "Return of the Martian Rima Tenuis." Bull. Am. Astro. Soc. , 12 , No. 13 (1980), pp. 726-727 (abstract).
9. Parker, D.C.; Capen, C.F.; & Beish, J.D. "Exploring the Martian Arctic." Sky & Telescope , 65 , No. 3 (March, 1983), pp. 218-220.

THE 1985-86 APPARITION OF SATURN: VISUAL AND PHOTOGRAPHIC OBSERVATIONS

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

Abstract. --Visual and photographic studies of the planet Saturn and its Ring System were carried out between 1986 JAN 25 and 1986 OCT 05 with instruments ranging in aperture from 6.0 cm. (2.4 in.) to 100.0 cm. (39.4 in.). Saturn showed slightly enhanced activity as compared with the 1984-85 Apparition. A few observers attempted central meridian transit timings of discrete atmospheric details of Saturn, although the features so timed were largely unconfirmed and did not persist long enough to yield reliable rotation rates for the latitudes of the features. The inclination of the ring plane to our line of sight increased to about +26° , and the Northern Hemisphere of the Globe and the north face of the Rings were more favorably presented in 1985-86 than in the previous apparition. References are cited at the end of this report; and the text is accompanied by tables, graphs, drawings, and a photograph.

Introduction

An excellent collection of quality visual and photographic observations of the planet Saturn, made throughout the 1985-86 Apparition, was received by the A.L.P.O. Saturn Section. These observations, made between 1986 JAN 25 and 1986 OCT 05, form the basis for this analysis. Selected drawings and a photograph for this apparition are shown in Figures 9 - 17 (pp. 205-207).

Table 1 (p. 198) gives pertinent geocentric data for the 1985-86 Saturn Apparition, to be referred to when reading the text. [Note that "U.T." indicates Universal Time.] During the observing season, the value of B, the planetocentric latitude of the Earth as referred to the ring plane (positive when north as in 1985-86), varied between a minimum of +25°.019 (1986 JUL 21) and a maximum of +25°.715 (1986 MAR 03). The quantity B', the Saturni- centric solar latitude, ranged from +24°.533 (1985 NOV 23) to +26°.195 (1986 DEC 04).

Table 2 (p. 198) lists the individuals who submitted observations to the A.L.P.O. Saturn Section for 1985-86, together with their observing sites, instruments, and number of observations. This table shows that 160 observations made by 13 persons were submitted for this apparition.

Figure 7 (p. 198), a histogram, gives the distribution of observations by month, showing that most of the observed data were for the months of 1986 May through August (84.4 percent), with a perceptible decline in the number of observations on either side of this peak. Note that 20.6 percent of the observations were made before opposition (1986 MAY 28), 1.3 percent on that date, and 78.1 percent after opposition. Usually, the maximum coverage of Saturn is near [or slightly after] opposition, as in 1985-86. Thus, we encourage all individuals to try to maintain a regular surveillance of Saturn, starting early in the apparition and continuing consistently until as close to the date of conjunction with the Sun as possible. [Text continued on p. 199.]

Table 1. Geocentric Phenomena for the 1985-86 Apparition of Saturn.

Conjunction . . .	1985 NOV 23, 02h U.T.	Stationary. . .	1986 AUG 07, 16h U.T.
Stationary. . . .	1986 MAR 19, 14	Conjunction . .	DEC 04, 16
Opposition. . . .	MAY 28, 01		

Opposition Data: Visual Magnitude. . +0.0, Declination. . $-19^\circ.4$, B. . $+25^\circ.288$

Globe--Equatorial Diameter . .	18".43	Rings--Major Axis . .	41".80
Polar Diameter.	16".81	Minor Axis . .	17".86

Table 2. Contributing Observers, 1985-86 Saturn Apparition.

Observer and Location	No. of Observations	Telescope Aperture and Type*
Julius L. Benton, Jr., Savannah, GA	19	15.2 cm. (6.0 in.) RR
Jean Bourgeois, Conneux, Belgium	1	100.0 cm. (39.4 in.) C
Donald H. DeKarske, Colorado Springs, CO	22	10.2 cm. (4.0 in.) RR
Marc A. Gelinas, St. Hubert, Quebec	2	20.3 cm. (8.0 in.) SC
David L. Graham, Brompton-on-Swale, U.K.	14	15.2 cm. (6.0 in.) RR
Walter H. Haas, Las Cruces, NM	22	20.3 cm. (8.0 in.) N 31.8 cm. (12.5 in.) N
Charles B. Haun, Morristown, TN	24	25.4 cm. (10.0 in.) N
Alan W. Heath, Nottingham, U.K.	11	30.5 cm. (12.0 in.) N
Frank J. Melillo, N. Valley Stream, NY	10	20.3 cm. (8.0 in.) SC
Edward A. Mitton, Colorado Springs, CO	3	6.0 cm. (2.4 in.) RR
Gary T. Nowak, Essex Junction, VT	10	22.9 cm. (9.0 in.) RR
Michael E. Sweetman, Tucson, AZ	16	15.2 cm. (6.0 in.) N 26.2 cm. (10.3 in.) C
John E. Westfall, San Francisco, CA	6	25.4 cm. (10.0 in.) C 35.6 cm. (14.0 in.) SC
Total Number of Observations	160 (13 observers)	

* C = Cassegrain; N = Newtonian; RR = Refractor; SC = Schmidt-Cassegrain.

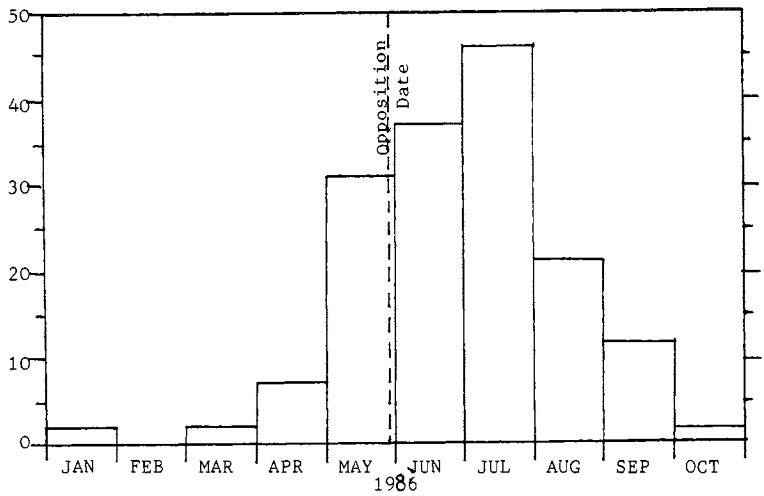

Figure 7. Distribution of observations by month, 1985-86 Saturn Apparition.

[Text continued from p. 197.]

This writer expresses his warmest gratitude to all the dedicated colleagues mentioned in this report who carried out their observations as part of the programs of the A.L.P.O. Saturn Section. We invite individuals in this nation and abroad to continue working with us in the coming observing seasons.

Table 3 (below) lists the number of observations by instrument aperture used throughout the 1985-86 Apparition. From this table, it can be seen that almost four-fifths of the observations were made with instruments ranging in aperture from 6.0 cm. (2.4 in.) to 25.4 cm. (10.0 in.). Note that over four-fifths of the observations were made with refractors and Newtonian reflectors, and about one-ninth with catadioptrics (Schmidt-Cassegrain designs exclusively). More and more Saturn Section participants are using quality instruments of classical designs, chiefly because of the consistent excellent performance of these optical systems in regard to overall resolution, image brightness and contrast, and image orientation. Several people remarked, incidentally, that they were observing without using prismatic image inverters or star diagonals. These accessories normally afford comfortable views of Saturn (particularly with refractors); but they reduce transmission and seriously affect the orientation of the image, leading to inaccuracy and confusion when making drawings at the eyepiece.

Table 3. Telescope Apertures and Types Used in 1985-86 Saturn Apparition.

Aperture	Number of Observations	Aperture	Number of Observations
6.0 cm. (2.4 in.). .	3	26.2 cm. (10.3 in.). .	10
10.2 cm. (4.0 in.). .	22	30.5 cm. (12.0 in.). .	11
15.2 cm. (6.0 in.). .	39	31.8 cm. (12.5 in.). .	9
20.3 cm. (8.0 in.). .	25	35.6 cm. (14.0 in.). .	2
22.9 cm. (9.0 in.). .	10	100.0 cm. (39.4 in.). .	1
25.4 cm. (10.0 in.). .	28		
Subtotal	127 (79.4 %)	Subtotal	33 (20.6 %)
Type: Refractors.	42.5 %	Cassegrain Reflectors.	6.9 %
Newtonian Reflectors. .	39.4 %	Schmidt-Cassegrain Reflectors. .	11.3 %

The Globe of Saturn

This description has been derived from an analysis of the reports contributed to the A.L.P.O. Saturn Section throughout the 1985-86 Apparition. Except when the identity of an individual is pertinent to the discussion, the names of observers are not given in the text in the interest of brevity. Numerical tables, drawings, and a photograph accompany the text and we encourage readers to refer to them as they read this report. Features on the Globe are discussed in north-to-south order and can be identified in the nomenclature diagram in Figure 8 (p. 200). Southern-Hemisphere features are not described because most of that hemisphere was blocked from view by the Rings in 1985-86.

Northern Portions of the Globe. --The Northern Hemisphere of Saturn was characterized by intermittent activity during the 1985-86 Apparition, and it is evident that there was a slightly increased frequency of recurrent local phenomena as compared with the preceding observing season (1984-85). The detail recorded in the Northern Hemisphere of Saturn was frequently ill-defined and quite elusive in 1985-86, but there were a few cases when discrete detail could be seen without any real difficulty in areas such as the North Tropical Zone (NTrZ), North Equatorial Belt (NEB), North Equatorial Belt Zone (NEB Z), and Equatorial Zone (EZ).

The following summary of Northern Hemisphere features compares data between apparitions, as in prior Saturn apparition reports, in order to help the reader to appreciate the subtle but recognizable changes that may be underway, both seasonally and longer-term. It is often held that the changing tilt of Saturn's axis with respect to the Sun and the Earth plays a significant role in any recorded variations in belt and zone intensities, which are given in Table 4 (p. 202).

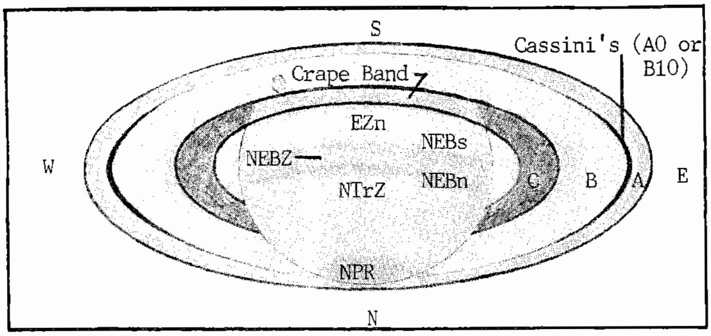

Figure 8. The general appearance of Saturn near opposition in 1985-86, with nomenclature of the principal Globe and Ring features that were easily detected with moderate apertures in good seeing. South is at the top, and global features move across the Globe of Saturn from right to left in this normal inverted view (i.e., as seen in an astronomical telescope in Earth's Northern Hemisphere, without a prismatic diagonal or other device that would reverse the image). East (E) and west (W) are shown in their celestial sense; in the IAU (International Astronomical Union) convention, east is to the left. The value of B is about +25°5. See the text for a discussion of the Globe and Ring features shown here. Some minor features which are not shown above are the: North Polar Cap (NPC), located near the North Pole; North Polar Belt (NPB), encircling the NPR; North Temperate Belt (NTeB), to the north of the NTrZ; Shadow of the Globe on the Rings (Sh G on R), seen at times other than opposition on the Rings to the East or West of the Globe; Shadow of the Rings on the Globe (Sh R on G), when visible currently seen projected on the Crape Band; Terby White Spot (TWS), when visible, on the Rings adjacent to the Sh G on R; Encke's Division (A5), when detected, midway between Cassini's Division and the outer edge of Ring A. The Crape Band shown in this drawing is Ring C projected on the Globe of Saturn. The easternmost and westernmost ends of the Rings are called the Ansae. Several other features, such as intensity minima and other phenomena in the Rings or on the Globe are discussed in the text in reference to specific features which are shown in the above diagram.

North Polar Region (NPR). --The brightness of the dusky yellowish-grey NPR was fairly stable overall between 1984-85 and 1985-86, with an apparent intensity decrease of only -0.1 on the A.L.P.O. intensity scale [which ranges from 0.0 for total black to 10.0 for the brightest possible white]. The intensity of the NPR was uniform except for a few isolated sightings of a lighter, dusky-yellow North Polar Cap (NPC) in the extreme north. Unlike 1984-85, but similar to 1983-84, the NPC was +0.3 intensity units lighter than the surrounding NPR in 1985-86. Encircling the NPR in 1985-86 was the North Polar Belt (NPB), a somewhat linear feature, seen on rare occasions as a dark greyish line running from limb to limb. The NPB had darkened by -1.1 mean intensity units since 1984-85. No abnormal activity was detected in association with any of the aforementioned polar features in 1985-86.

North North Temperate Zone (NNTeZ). --Throughout the 1985-86 Apparition, no reports were submitted which called attention to the NNTeZ.

North North Temperate Belt (NNTeB). --The NNTeB was not recorded by any of the individuals who submitted reports for 1985-86.

North Temperate Zone (NTeZ). --Although gradations in intensity could be seen as one proceeded from the polar regions through the temperate areas of Saturn's Globe, the NTeZ was not described by observers in 1985-86 as a distinctly recognizable feature.

North Temperate Belt (NTeB). --On several occasions, observers recorded a narrow, usually uniform, dusky yellowish-grey NTeB extending from one limb to the other across the Globe of Saturn. A vague whitish spot was reported by Nowak on 1986 MAY 09 (04h 00m - 04h 19m U.T.), but the NTeB was otherwise devoid of activity in 1985-86. This belt had the same mean intensity in 1985-86 as it had in 1983-84, although it had not been seen at all in 1984-85.

North Tropical Zone (NTrZ). --The NTrZ was second in brightness only to the North Component of the Equatorial Zone (EZn) during 1985-86, although it was -1.3 mean intensity units darker than it had been in 1984-85. In the 1985-86 Appariton, observers assigned a grayish yellow-white color to the NTrZ. Aside from elusive festoons sighted by Sweetman on 1986 JUN 27 (05h 45m - 06h 10m U.T.) and an ill-defined and somewhat diffuse whitish spot seen by Nowak on 1986 AUG 04 (02h 00m - 02h 20m U.T.), the region was uniform in intensity from limb to limb throughout the entire apparition.

North Equatorial Belt (NEB). --The greyish-brown NEB was observed as differentiated into two components, the NEBs and the NEBn, with the intermediate NEB Z (North Equatorial Belt Zone), on quite a number of occasions in 1985-86. However, the NEB was seen as a single feature about as frequently as in its multiple aspect. As a whole, the NEB was slightly lighter (+0.4 mean intensity units) than it had been in 1984-85, very close to its mean intensity in 1983-84.

The very dark greyish-brown NEBs was the darkest belt on the Globe of Saturn in 1985-86, as has been true for several recent apparitions. The NEBs had about the same mean intensity in 1985-86 as it had in 1984-85 (with an apparent decrease of only -0.1 intensity units). This belt component was slightly diffuse at its edges and showed a mainly uniform intensity across the Globe for most of the time during the 1985-86 Apparition. On 1986 JUN 05 (07h 05m - 07h 29m U.T.) Sweetman reported a darkish area in the NEBs, while Westfall sighted dark spots and projections associated with the NEBs on 1986 JUN 16 (05h 25m - 05h 40m U.T.), JUN 18 (06h 02m - 06h 15m U.T.), JUN 29 (04h 37m - 04h 53m U.T.), and JUN 30 (06h 14m - 07h 12m U.T.). The NEBs dark spot seen on JUN 16 and recovered on JUN 30 showed a longitude drift of $+0.^{\circ}213$/day (System I rotation [which is applied to the NEBs, EZ, and SEBn and is assumed to be 10h 14m 00.0s]), giving a sidereal rotation period of 10h 13m 51s.

The dark greyish-brown NEBn had about the same mean intensity and appearance in 1985-86 as it had in 1984-85. Although features did not persist long enough for central meridian transits, observers could see limited detail in the NEBn in 1985-86. For example, Sweetman reported a light spot at the north edge of the NEBn on 1986 JUN 07 (07h 15m - 07h 43m U.T.), while Nowak sighted projections at the north edge of the NEBn on 1986 JUL 17 (01h 30m - 01h 50m U.T.) and on JUL 21 (01h 55m - 02h 15m U.T.). On 1986 AUG 13 (00h 30m - 00h 45m U.T.) the same observer described a diffuse whitish spot at the north edge of the NEBn. Aside from the above features, the NEBn was usually uniform in intensity along its extent from limb to limb throughout the apparition.

The NEB Z was lighter in intensity during 1985-86 by +1.2 mean intensity units, as compared with 1984-85. It was characterized by observers as being yellowish to yellowish grey in hue, usually the same in intensity across the Globe throughout the region between the NEBs and the NEBn. Exceptions to the uniform intensity of the NEB Z were the dark spots between the NEBn and the NEBs which were first seen on 1986 MAY 27 (06h 30m - 07h 00m U.T.), as reported by Sweetman, who also noted festoons across the NEB Z near the central meridian on 1986 JUL 31 (05h 50m - 06h 11m U.T.).

Equatorial Zone (Chiefly EZn). --The EZn was not so bright in 1986-86 as it had been in 1984-85, although the darkening amounted to only -0.4 mean intensity units. Nonetheless, the pale yellow-white EZn remained easily the brightest zone on the Globe of Saturn in 1985-86. A whitish oval was detected by Benton on 1986 MAY 02 (08h 55m U.T.; see Figure 11, p. 206), and Sweetman reported festoons in the EZn on 1986 JUL 13 (06h 50m - 07h 10m U.T.). He also saw diffuse shaded elongated features in the EZn just south of the NEB on 1986 JUL 24 (06h 15m - 06h 35m U.T.). Throughout 1985-86, no other details could be seen in the EZn, which remained uniform in overall intensity. On occasion, an Equatorial Belt (EB) was seen, and described as a very narrow, linear feature, continuous across the Globe from limb to limb and dark yellowish-grey in hue. Because the EB was not seen in either 1983-84 or 1984-85, no mean intensity time comparisons are possible.

Shadow of the Rings on the Globe (Sh R on G). --The shadow of the Ring System on the Globe was reported by obervers during 1985-86 as a rather uniform greyish-black to black feature, of regular geometric form, and seen to advantage when the seeing was very good. It is known that poor seeing, inadequate aperture, or any other factors that reduce contrast or resolution, all conspire to render this shadow as something other than black.

Shadow of the Globe on the Rings (Sh G on R). --The shadow of the Globe of Saturn on the Ring System was seen in 1985-86 as a very dark greyish-black feature of regular form. Any deviation from the true black condition could be attributed to poor seeing.

Table 4. Visual Numerical Relative Intensity Estimates and Colors, 1985-86.

Globe or Ring Feature	Relative Intensity, 1985-86: Number of Estimates	Mean and Standard Deviation	Change Since 1984-85	"Mean" Derived Hue (1985-86)
Zones:				
NPC	4	4.7 ± 0.98	----	Dusky Yellow
NPR	28	4.4 ± 0.76	-0.1	Yellowish-Grey
NTrZ	11	5.3 ± 0.25	-1.3	Greyish Yellow-White
NEB Z	7	4.8 ± 0.06	+1.2	Light Yellow-Grey
EZn	30	6.6 ± 0.62	-0.4	Pale Yellow-White
Globe North of Rings	24	5.1 ± 0.13	----	Very Dusky Yellow-Grey
Belts:				
NPB	3	3.3 ± 0.40	-1.1	Very Dark Grey
NTeB	14	4.7 ± 0.82	----	Dusky Yellow-Grey
NEBn	13	3.3 ± 0.13	0.0	Dark Greyish-Brown
NEBs	15	2.9 ± 0.16	-0.1	Very Dark Greyish-Brown
NEB (whole)	19	3.8 ± 0.56	+0.4	Greyish-Brown
EB	2	4.4 ± 0.10	----	Dark Yellowish-Grey
Rings:				
Ring A (outer half)	5	6.1 ± 0.04	----	Dusky White
Ring A (inner half)	5	6.3 ± 0.05	----	Pale Dusky White
Ring A (whole)	21	5.9 ± 0.77	+0.8	Dusky White
Cassini's Division (A0/B10)	24	0.6 ± 0.38	+0.3	Greyish-Black
Ring B (outer third)	--	[STANDARD AT	8.00]	White
Ring B (inner 2/3)	21	6.6 ± 0.14	-0.3	Yellow-White
Ring C (ansae)	22	0.6 ± 0.29	-0.9	Greyish-Black
Crape Band	21	3.0 ± 0.82	+0.6	Very Dark Grey
Shadow Globe on Rings	21	0.5 ± 0.41	-0.2	Greyish-Black
Shadow Rings on Globe	4	1.3 ± 0.56	+0.5	Greyish-Black
Terby White Spot	16	7.1 ± 0.26	----	Pale Yellow-White
B2 "intensity minimum"	3	2.8 ± 0.24	----	Very Dark Grey
B1 "intensity minimum"	1	2.8 ± ----	----	Very Dark Grey
Encke's Division (A5)	3	3.8 ± 0.12	----	Greyish

Notes: 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 employs 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 the Rings are systematically estimated using this scale, described in the Saturn Handbook issued by the Saturn Section (see References, p. 205). The "Change Since 1984-85" is in the sense of the 1984-85 value subtracted from the 1985-86 value; thus, "+" indicates an increase (a brightening) and "-" a decrease (a darkening). [When the apparent change is less than about three times the standard deviation, it is probably not statistically significant. Ed.]

Latitudes of Saturn's Belts. --Haas was the only observer to submit usable visual latitude estimates for features on the Globe of Saturn during 1985-86. Employing a technique that he developed many years ago, Haas estimated the fraction of the polar semidiameter of the planet's disk subtended on the central meridian between the north or south limb and the belt whose latitude he sought. This method is easy to use, and the results compare well with values obtained by filar micrometer measurements. Mathematical reduction of the observed distance ratios to latitudes has been carried out, and the results appear in Table 5, below. It must be pointed out, however, that it is often risky to derive too much from data submitted by a single observer; but Haas has been using this method for many years with good, usually reliable results. Other observers are strongly encouraged to begin to use this procedure; even if they have a filar micrometer available, data from both methods would be useful for comparison. A full description of this technique is presented in the Saturn Handbook (pp. 52-55).

Table 5. Latitudes of Saturn's Belts During 1985-86.

	Latitude		
Saturnian Belt	Planetocentric	Eccentric ("Mean")	Planetographic
	°	°	°
North edge NPB	+86.5	+86.9	+87.2
South edge NPB	+79.6	+80.7	+81.7
South edge NPR	+78.6	+79.8	+80.8
Center NTeB	+36.0	+39.1	+42.3
North edge NEB	+23.9	+26.4	+29.1
South edge NEB	+17.6	+19.5	+21.7
Center EB	- 4.7	- 5.7	- 5.2

Notes: Planetocentric latitude is the angle between the equator and the feature seen from the center of the planet. Planetographic latitude is the angle between the surface normal and the equatorial plane. The two differ significantly because of Saturn's high ellipticity. Eccentric latitude is the arctangent of the geometric mean of the tangents of the other two latitudes. Ed.

The Ring System

This section discusses the analysis of the observations of Saturn's Rings that were submitted throughout the 1985-86 Apparition, together with a continuing comparative study of mean intensity data as has been done for previous apparitions. As remarked in the Introduction, the northern face of the Ring System was very accessible to our view during 1985-86.

Ring A. --Taken as a whole, Ring A was dusky white during 1985-86. There were occasional sightings of Encke's Division (A5) at the ansae in good seeing. The mean intensity of Ring A, as a whole, was lighter by +0.8 intensity units in 1985-86 than in 1984-85. Except for Encke's Division, intensity variations or minima in Ring A were not noticed by most observers in 1985-86.

On fairly infrequent occasions, Ring A was described as having a distinct inner and outer half in terms of intensity. The inner half of Ring A was pale dusky white and +0.2 intensity units brighter than the dusky-white outer half in 1985-86, similar to what was reported for 1984-85.

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 constant value of 8.0. Throughout 1985-86, the outer third of Ring B appeared white, stable in intensity, and the brightest feature on either Saturn's Globe or Rings.

The inner two-thirds of Ring B, chiefly yellow-white in hue, was -0.3 intensity units darker in 1985-86 than in 1984-85; and it was uniform in intensity throughout 1985-86 except for rare sightings of intensity minima at B1 and B2 [i.e., about 0.1 and 0.2 of the way between the inner and the outer edges of Ring B. Ed.]. These very dark grey intensity minima were seen at the ansae only and are characteristically non-permanent as was shown by the Voyager missions.

Cassini's Division (A0 or B10) was usually easily visible at the ansae, and was frequently seen all the way around the Ring System in optimum seeing. It had a dark greyish-black appearance in 1985-86, but appeared lighter by +0.3 intensity units than it had in 1984-85.

Ring C. --Observers in 1985-86 described Ring C as fairly easy to detect at the ansae, greyish-black in color, and darker in appearance (by -0.9 intensity units) than in 1984-85. It is worth mentioning that faint or narrow Ring features are easier to detect and are darker in appearance when the Rings are open to the extent that they were in 1985-86.

The Crape Band, or Ring C in front of the Globe, was +0.6 mean intensity units lighter in 1985-86 than in the previous apparition, and individuals described this feature as uniform in intensity and very dark grey in hue.

Ring Components Other Than A, B, or C. --No indications of Ring D (inside Ring C) or Ring E (outside Ring A) were reported in 1985-86. These Ring components are exceedingly difficult to see except under optimum conditions with large apertures.

Terby White Spot (TWS). --Several observers saw a fairly bright TWS during 1985-86, but this feature in no way showed the traditional bright intensity that it had in past apparitions. Even so, it was the brightest object in Saturn's System except for the outer third of Ring B. The TWS is probably a contrast phenomenon and is not usually thought to be an important Saturnian feature.

Bicolored Aspect of the Rings. --Several individuals attempted to observe the bicolored aspect of the Rings of Saturn, but only Haas was able to notice any variation in the relative brightness of the East and West Ansa [celestial directions] during 1985-86 when he used blue (Wratten 47) and red (Wratten 25) Filters alternately in addition to no filter (integrated light). Observing on 12 nights, Haas saw the two ansae as equal in intensity in integrated light and with a red filter, but the West Ansa as brighter than the East one when he used the blue filter. This condition was seen on 11 of the 12 nights; the exception was on 1986 SEP 23, when observing conditions were mediocre and when slight and inconsistent differences were suspected when using the blue filter. Table 6 (below) lists the circumstancess of his observations.

Table 6. Observations of the Bicolored Aspect of Saturn's Rings, 1985-86.

Note: All observations are by Walter H. Haas at Las Cruces, NM, using Newtonian telescopes. "Mag." indicates magnification. Seeing is on the A.L.P.O. Scale, ranging from 0 for impossible to 10 for perfect. "Trans." is the transparency given as the limiting naked-eye stellar magnitude in the direction of Saturn.

1986	Telescope		Atmosphere	
Universal Date and Time	Aperture	Mag.	Seeing	Trans.
MAY 19, 05h 58m - 06h 03m	20.3 cm. (8.0 in.)	256X	4	4.5
JUN 21, 05h 03m - 05h 07m	20.3 cm. (8.0 in.)	256X	4-5	5
JUN 28, 03h 48m - 03h 53m	20.3 cm. (8.0 in.)	256X	5	4.5
JUL 12, 03h 32m - 03h 36m	20.3 cm. (8.0 in.)	256X	4-5	5
JUL 25, 04h 49m	20.3 cm. (8.0 in.)	256X	4	4.5
JUL 27, 03h 27m - 03h 37m	31.8 cm. (12.5 in.)	321X	4-5	4.5
JUL 30, 03h 26m - 03h 34m	31.8 cm. (12.5 in.)	321X	4-5	4.5
AUG 02, 04h 41m - 04h 49m	20.3 cm. (8.0 in.)	256X	5	3
AUG 05, 03h 08m - 03h 11m	31.8 cm. (12.5 in.)	321X	4	4
SEP 08, 02h 37m - 02h 41m	20.3 cm. (8.0 in.)	256X	4-5	4.5
SEP 17, 02h 01m - 02h 04m	31.8 cm. (12.5 in.)	321X	4	4.5
SEP 23, 01h 56m - 02h 01m	31.8 cm. (12.5 in.)	321X	3	3.5

One ideal goal for a simultaneous observing program would be a careful investigation of the bicolored aspect of Saturn's Rings. Systematic filter observations, both visual and photographic, should help shed light on this curious phenomenon.

Saturn's Satellites

Numerous descriptive observations of Saturn's satellites were submitted; but no systematic program of magnitude estimates, or any other study, was forthcoming in 1985-86. We encourage observers in future apparitions to carry out studies of the satellites using filter techniques and magnitude estimates. Details on such programs are given in the Saturn Handbook (pp. 71-73).

Conclusion

Saturn was followed reasonably well by members of the A.L.P.O. Saturn Section in 1985-86, as compared with 1984-85 and several preceding apparitions. Enhanced activity on the Globe was apparent; and most observers remarked that, despite the southerly declination of Saturn in recent years (thus making it low in the sky for Northern-Hemisphere observers), the planet still presented a wealth of interesting phenomena for the systematic, persistent observer.

Areas needing more attention during future observing seasons include latitude estimates, studies of the bicolored aspect of the Rings through simultaneous observations, and studies of the satellites. We want to diligently continue our numerical relative intensity estimates, drawings of Saturn, and careful scrutiny of the Globe for opportunities to make central meridian transits. Our goal is to introduce a higher frequency of simultaneous observations in all areas of Saturn research.

This writer wishes to express once again his gratitude to all those individuals mentioned in this report for their continued interest and participation in our verious programs. New observers of Saturn are welcome to join with us in our work in the coming apparitions.

References

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

Benton, Julius L., Jr. Visual Observations of the Planet Saturn: Theory and Methods. (The Saturn Handbook). Savannah: Review Publishing Co., Inc., 1985 (4th revised edition).

________. "The 1984-85 Apparition of Saturn: Visual and Photographic Observations." J.A.L.P.O. , 32 , Nos. 1-2 (March, 1987), pp. 1-10.

United States Naval Observatory. The Astronomical Almanac. Washington: U.S. Government Printing Office. (Annual publication; the 1985 and 1986 editions were used, published in 1984 and 1985 respectively.)

SELECTED DRAWING, 1985-86 APPARITION OF SATURN

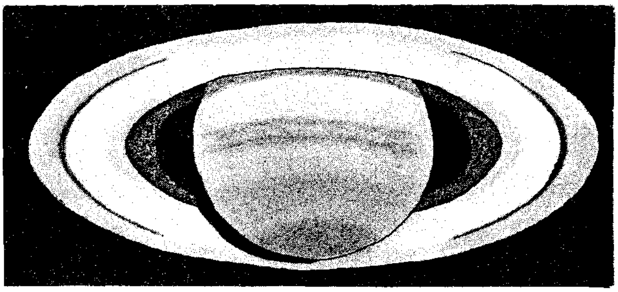

Figure 9. Drawing of Saturn by David L. Graham. 1986 JAN 26, 06h 25m - 06h 50m U.T. 15.2-cm. (6.0-in.) refractor, 222X. Seeing III-II on the Antoniadi Scale (Good-Moderate). CM(I) = 125-140°; CM(II) = 195-209°. B = +25°.6; B' = +24°.9.

Note: For the drawings and photograph, unless otherwise stated, Seeing is on the 0-10 A.L.P.O. Scale with 10 best, and Transparency is in terms of limiting naked-eye visual magnitude in the vicinity of Saturn. South is uniformly at the top of these simply inverted images.

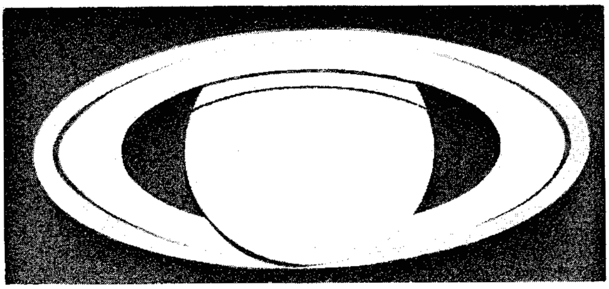

Figure 10. Drawing of Saturn by Donald H. DeKarske. 1986 APR 05, 10h 42m - 10h 53m U.T. 10.2-cm. (4.0-in.) refractor, 120X. Seeing 3; Transparency +5.0. CM(I) = 216-223°; CM(II) = 211-217°. B = +25°.6; B' = +25°.2.

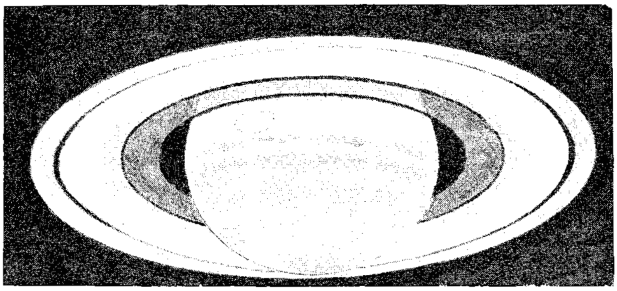

Figure 11. Drawing of Saturn by Julius L. Benton, Jr. 1986 MAY 02, 08h 55m U.T. 15.2-cm. (6.0-in.) refractor, 314X. Seeing 6; Transparency +5.5. CM(I) = 272°; CM(II) = 117°. B = +25°.5; B' = +25°.4.

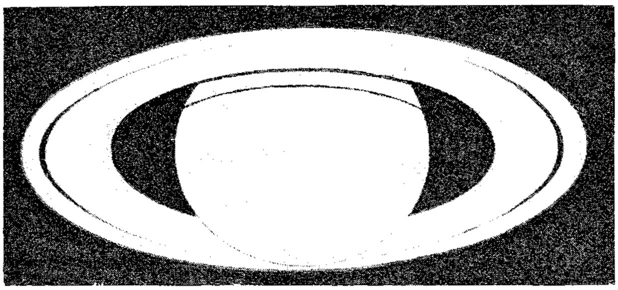

Figure 12. Drawing of Saturn by Donald H. DeKarske. 1986 MAY 06, 10h 21m - 10h 34m U.T. 10.2-cm. (4.0-in.) refractor, 120X & 167X. Seeing 3; Transparency +3.9. CM(I) = 100-107°; CM(II) = 174-181°. B = +25°.5; B' = +25°.4.

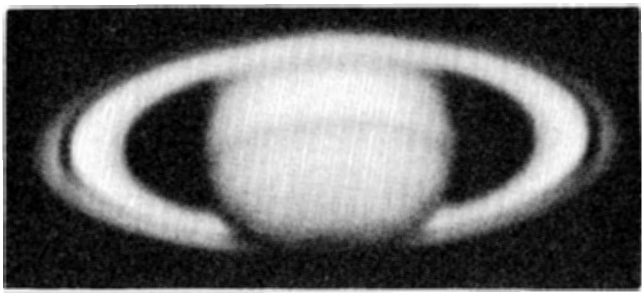

Figure 13. Photograph of Saturn by Jean Bourgeois. 1986 MAY 27, 23h 30m U.T. 100.0-cm. (39.4 in.) reflector of the Pic du Midi Observatory. 4-sec. exposure on Kodak TP2415 Film with orange filter. CM(I) = 295°; CM(II) = 033°. B = +25°.3; B' = +25°.5

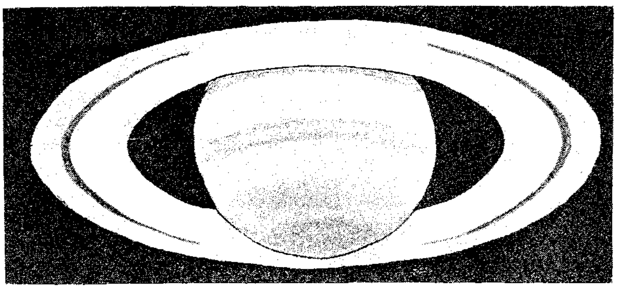

Figure 14. Drawing of Saturn by David L. Graham. 1986 MAY 29, 00h 00m - 00h 17m U.T. 15.2-cm. (6.0-in.) refractor, 222X. Seeing III on the Antoniadi Scale (Moderate).
CM(I) = 077-087°;
CM(II) = 142-151°.
B = +25°.3; B' = +25°.5.

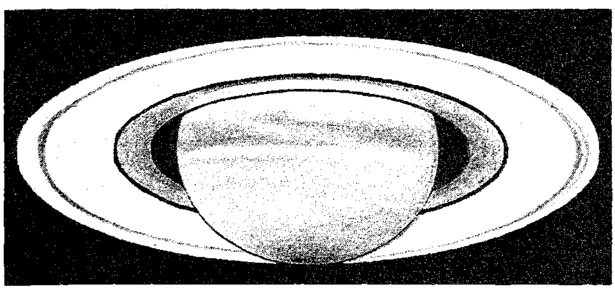

Figure 15. Drawing of Saturn by Michael E. Sweetman. 1986 JUN 11, 06h 50m - 07h 15m U.T. 15.2-cm. (6.0-in.) reflector, 218X & 281X. Yellow filter. Seeing 6-7; Transparency +5.
CM(I) = 134-149°;
CM(II) = 130-144°.
B = +25°.2; B' = +25°.6.

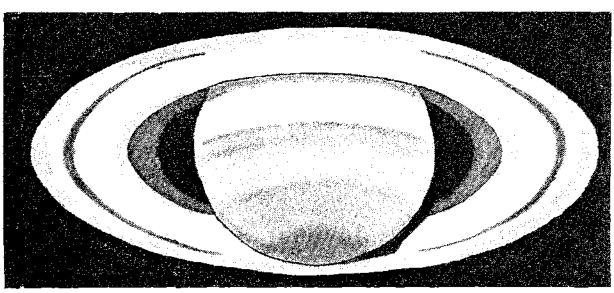

Figure 16. Drawing of Saturn by David L. Graham. 1986 JUN 28, 22h 12m - 22h 34m U.T. 15.2-cm. (6.0-in.) refractor, 222X & 333X. Seeing II-I on the Antoniadi Scale (Good - Perfect).
CM(I) = 268-281°;
CM(II) = 054-067°.
B = +25°.1; B' = +25°.6.

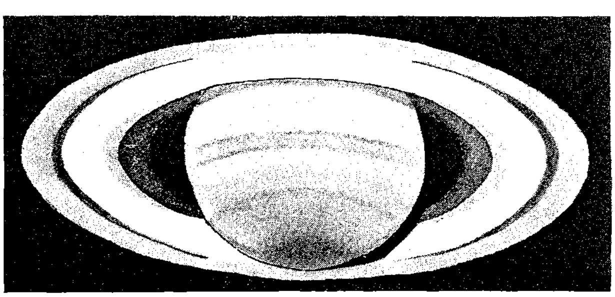

Figure 17. Drawing of Saturn by David L. Graham. 1986 JUL 08, 21h 25m - 21h 45m U.T. 15.2-cm. (6.0-in.) refractor, 222X. Seeing II-III on the Antoniadi Scale (Good - Moderate).
CM(I) = 044-056°;
CM(II) = 228-239°.
B = +25°.0; B' = +25°.7.

[The preceding report describes the observations submitted to the A.L.P.O. Saturn Section for that planet's 1985-86 Apparition. Gianluigi Adamoli has also sent to us a report of the Saturn observations of the Unione Astrofili Italiani (U.A.I.) for the same apparition. It is very useful to have two independent reports for the same planet and for the same apparition, and hence we are publishing them together as we did for the 1983-84 and 1984-85 Saturn Apparitions. The U.A.I. report follows below and should be compared with the above A.L.P.O. report. Note that the intensity scale used by the U.A.I. is the reverse of that used by the A.L.P.O., as the U.A.I.rates black as 10 and white as 0. Otherwise, the terms and nomenclature are the same in the two reports. Ed.]

VISUAL OBSERVATIONS OF SATURN IN 1986

By: Gianluigi Adamoli, Saturn Section, Unione Astrofili Italiani

Abstract. --This report summarizes the results of 101 Saturn observations made by 21 observers in 1986. All the zones of the planet were darker than usual. The NEBs was more prominent than the NEBn although atmospheric activity was low for both. The NNTB and the NPC in the NPR were observed as well.

General Remarks

A total of 101 visual observations was received from the following 21 observers: G. Adamoli (Padua), P. Alvino (Salerno), P. Aucelli (Naples), S. Baroni (Milan), G. Borgonovo (Milan), F. Caizzi (Modena), M. Corbisiero (Naples), L. Da Palto (Naples), W. De Gregorio (Naples), G. De Simone (Naples), A. Ferlito (Naples), E. Filippone (Naples), M. Frasca (Naples), M. Giuntoli (Pistoia), A. Guatteri (Reggio E.), A.W. Heath (Long Eaton, U.K.), C. Modesti (Rome), E. Palumbo (Salerno), P. Russo (Naples), M. Sabioneta (Reggio E.), and D. Sarocchi (Florence). These observers used both reflecting and refracting telescopes, ranging from 10 to 36 cm. aperture. A sample drawing by A. Guatteri is shown as Figure 18 (p. 209).

In more detail, the visual observations comprised some 977 intensity estimates, 509 color estimates, and 329 latitude measurements made from drawings (of which 215 are represented in Table 1 on p. 209). The intensities here are weighted means (observers' estimates are weighted 1, 2, or 3 depending upon whether they made 1-2, 3-6, or 7 or more estimates respectively). Latitudes are saturnicentric and are simple unweighted means.

Opposition was on 1986 MAY 28. Saturn's North Pole was then tilted 25°3 toward the Earth. This value changed little during the observing period of 1986 MAR 16-AUG 30, and latitudes south of the EZ were occulted by the Rings. Due to the planet's southerly declination (19°4 S at opposition) Saturn always was at a low altitude for our observers and the seeing was often unfavorable.

The Rings

Ring colors and intensities were similar to the last apparition, but the intensity difference between the inner and outer components of Ring B was a value more usual than the 1.6 intensity-unit difference recorded in 1985. [1, 2,3,4] Two observers saw the outer portion of Ring A as darker than the inner. Sabioneta and Sarocchi claimed to see the Encke Division at the Ansae.

From Table 1 Ring C appears to be of uniform intensity, but this is uncertain because the Ansae of Ring C are difficult to see and estimate. Only seven observers saw the Ring C Ansae, and some of them recorded only the brighter outer part. Also, several intensity estimates of the sky background gave a mean value of 8.1 (six observers), which illustrates light pollution [as well as scattered light from Saturn; Ed.]. Thus, although Cassini's Division and the Globe Shadow on the Rings were both estimated as darker than 8, they were in reality totally obscure.

The Globe

The EZ was somewhat dull, confirming a gradual darkening in recent years. [1,2,3,4] The other zones of the planet were rather dark as well.

The major belts that were visible were the NEBs, NEBn, and the NTB, which were similar in appearance to the 1985 Apparition with the NEBs the most prominent of the three. These belts were rather close to each other in latitude compared with the 1985 Apparition, and had moved south toward the Equator as well, a reversal of the trend for 1980-85. [1,2,3,4]

No atmospheric activity was apparent in 1986 except that two observers claimed to see additional faint belts and zones at high northerly latitudes, and the NNTB was confirmed by five observations in May and June 1986. The NPR was well-presented and showed some structure, consisting of an extensive darkening with indistinct borders containing a small NPC that was more sharply-defined than the NPR itself and was centered on the North Pole. The intensity of the NPR as a whole appears in recent years to have become darker, but this trend may be due at least in part to its better presentation as the North Pole is tilted increasingly earthward.

Table 1. Intensities, Colors, and Latitudes of Saturnian Features in 1986.

Note: In parentheses are given the number of observers for intensities and colors and the number of measures for latitudes.

Feature	Intensity	Color	Saturnicentric Latitude
Ring A	2.8 (19)	White-Yellow (17)	-----
Cassini's Division	8.5 (19)	-----	-----
Ring B (outer)	1.1 (19)	White (15)	-----
Ring B (inner)	1.9 (7)	White-Yellow (4)	-----
Ring C (Ansae)	7.1 (7)	-----	-----
Rings A & B across Globe	1.5 (7)	White-Yellow (5)	-----
Ring C across Globe	7.2 (18)	Grey-Black (11)	-----
Globe Shadow	8.9 (15)	-----	-----
EZ	1.9 (19)	Yellow-White (14)	-----
EB	4.4? (2)	-----	+ 4°? (3)
NEBs	4.2 (20)	Brown-Grey (15)	+ 9° to +18° (90)
NEB Z	2.8 (7)	Yellow (5)	-----
NEBn	4.0 (12)	Brown-Grey (7)	+20° to +25° (24)
NTrZ	2.7 (16)	Yellow (11)	-----
NTB	3.9 (11)	Brown-Grey (5)	+41° (25)
NTZ	2.8 (10)	Yellow (5)	-----
NPR	4.7 (20)	Grey (15)	edge +72° (73)
NPC	5.7? (3)	-----	-----

For the identification of features see the previous article, p. 200. As expected, there is a strong negative relationship between the U.A.I. and the A.L.P.O. intensity estimates (R = -0.918), where: (A.L.P.O. Intensity) = (7.9 ± 0.5) - (0.81 ± 0.10)*(U.A.I. Intensity), with a standard error of ± 0.86. These results are very similar to those for 1985. Note also that the two latitudes quoted for the NEBs and for the NEBn refer to the southern and northern edges of those features. Ed.

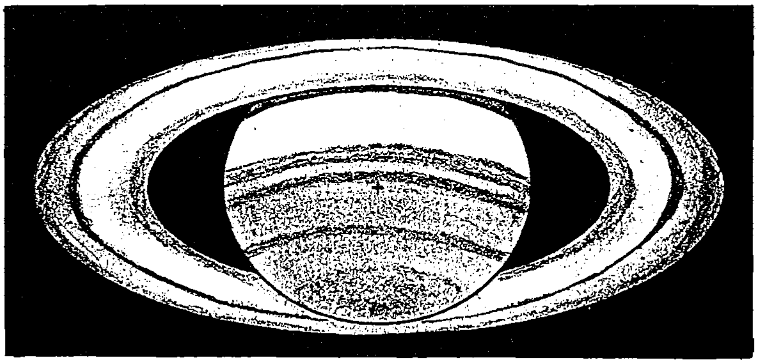

Figure 18. Saturn as drawn by A. Guatteri of the Unione Astrofili Italiani on 1986 MAY 11, 01h 40m U.T. 15.7-cm. refractor at 225X. Seeing II (Antoniadi Scale; i.e., good). CM(I) = 056°; CM(II) = 340°. B = +25°.4; B' = +25°.4.

References

1. G. Adamoli (1985). Astronomia , No. 3, p. 13.
2. ________ (1986). Astronomia , No. 1, p. 10.
3. ________ (1986). "Visual Observations of Saturn in 1984." J.A.L.P.O., 31 , Nos. 7-8 (April), pp. 164-167.
4. ________ (1987). "Visual Observations of Saturn in 1985." J.A.L.P.O., 32 , Nos. 1-2 (March), pp. 10-12.

COMET NOTES: XIII. THE 1988 COMET HANDBOOK

By: David H. Levy, A.L.P.O. Comets Recorder

Among the more important publications of the comet community is the Comet Handbook of the International Comet Quarterly (ICQ). This 56-page soft-covered book containing predictions for comets that are to remain visible, or are expected to return, in 1988 is a gold mine of information for observers of comets, and is a credit to its Editor, Daniel Green.

With perseverance, a good telescope, and some degree of luck, observers can use this ephemeris to observe as many as 54 comets during 1988. Obviously, some of the comets included will be too faint for visual observations; but if you are really interested in knowing where even the faint departing comets are, this book is an invaluable resource.

The ICQ Handbook closely follows the style of its parent, Nakano's annual Handbook published by the Oriental Astronomical Association, and, in fact, this is only the second year that a version has been published outside of Japan. Each comet is listed on a separate page, with Epoch 1950.0 and current positions given at 10-day intervals, along with Sun and Earth distances, total and nuclear magnitude predictions, and other information useful in identifying the object. For long-period and recently-recovered short-period comets, the daily motion is listed; however, for yet-to-be-recovered short-period comets, a column for "variation for T=+1 day" is included instead as a guide to recovery in case the time of perihelion passage is somewhat off. Thus, observers can use the material in this book to look for unrecovered periodic comets; a returning comet may be hidden in the Sun's glare until it is bright enough to be recovered visually.

Obviously this book should be used in conjunction with the IAU Circulars, which give announcements of new comet discoveries, updated positions for recovered comets, and visual magnitude estimates of observed comets. The combination of Circulars and the ICQ Handbook will give an observer a very complete understanding of 1988's comet picture. The Handbook is available for $10.00 from: Daniel Green, Smithsonian Astrophysical Observatory, 60 Garden Street, Cambridge, MA 02138, U.S.A.

OBSERVING METEORS: XIII. SUMMER SHOWER SHENANIGANS

By: David H. Levy, A.L.P.O. Meteors Recorder

If you are a member of an astronomy club, the chances are that you have heard about a possible August shower called the Upsilon Pegasids. In recent years this shower has received considerable press attention. I read many club newsletters; articles about the importance of observing the Upsilon Pegasids, both visually and photographically, somehow appear frequently in their pages. In 1987, articles in the Astronomical League's Reflector and in the Observer's Digest encouraged amateur astronomers to spend their good observing time on this shower.

All this publicity has been terribly unfortunate because it takes advantage of new and inexperienced observers who are advised simply to count any meteor originating in the Square of Pegasus as belonging to an Upsilon Pegasid radiant. No! The result is a lot of careless observations that do not prove either way whether a new shower exists or not, and moreover cast doubt on the idea that meteor observing is good for beginners.

To show that meteor observing is an excellent activity for beginners is a central aim of the A.L.P.O. Meteors Section. We want groups of people to go outside and enjoy the vast and varied activity of the summer meteor streams. The Section has even organized groups of young children to observe meteors.

The results were not accurate enough to place in a professional journal; but they were gratifying in the sense that, with the proper encouragement and training, these enthusiastic young people could go on to become accurate and careful observers.

On that level, having beginners throughout the country, or beyond, observing meteors is fine; and the A.L.P.O. Meteors Section encourages observers to watch as many showers as possible, including the confirmation of new or borderline showers. However, this definitely does not mean that the clear nights of these observers should be employed to chase after marginal radiants. We feel that it is a mistake to give any single stream or possible stream an inordinate buildup, especially for beginning observers.

The "Upsilon Pegasid" meteors occur during the busiest time of the meteor shower year. The maxima of the Perseids (August 11), Southern Delta Aquarids (July 28), Northern Delta Aquarids (August 11), Alpha Capricornids (July 29), Southern Iota Aquarids (August 3), Northern Iota Aquarids (August 20), and Kappa Cygnids (August 18) all occur within the time period advertised. The Perseids and Delta Aquarids are big, important showers; the Perseids especially because there is still a chance that their parent comet, P/Swift-Tuttle, may return in the next few years. In view of all this activity, some experienced observers advise beginners to forget the summer showers. No again! Concentrate on the major showers, the Delta Aquarids and the Perseids, and be very careful before assigning a meteor to any other radiant.

Checking for meteors that may belong to a new and unknown radiant is work that can go a long way toward increasing our understanding of meteoroid and comet activity across the Earth's orbit. The work should not be casual. When too much fuss is made over any one possible radiant, observers may subconsciously try to "force" meteors into that stream. It is important not to read too much into what you think is a new radiant. Those of us who are frequently under the stars see groups of meteors that seem to come from previously unknown radiants. It is always possible that a new "radiant" is just a coincidence. Also, it is possible that our planet encounters many swarms of meteoroids, but whose radiants are active just once.

Separating out the busy summer meteor activity is a job for conscientious and experienced observers who are interested in all the meteor streams. With activity so rich and exciting, it is absurd to concentrate on one small possible stream. We recommend that you watch all the showers; and let the meteors, by their paths, speeds, and colors, tell you to which stream they belong.

A.L.P.O. SOLAR SECTION OBSERVATIONS FOR ROTATIONS 1787 - 1792 (1987 MAR 26 TO 1987 SEP 06)

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

During the period covered by this report, solar activity reached the highest levels in the past three years! Only about 10 percent of the days were without spots as compared with 30 percent for the last reporting period. 1987 JUL 23 was the first day when the International Sunspot Number exceeded 100 since May, 1984. [1-8] A graph by rotation number of sunspot numbers for the present reporting period is given in Figure 19 (p. 212).

All times and dates in this report are in Universal Time (U.T.). Directions are heliographic and are abbreviated (N, E, NW, etc.). The term "group" refers to white-light features only, but "region" designates features evident in all wavelengths. Region numbers are assigned by the Space Environmental Services Center (SESC) of NOAA in Boulder, Colorado. All other terms and abbreviations used here are defined in The Handbook for the White Light Observation of Solar Phenomena, available from this Recorder for $US 6.00.

The observers who contributed to this report are:

Observer	Telescope Aperture (cm.)	f-ratio	Type	Stop (cm.)	Location
Garcia, G.	20	f/10	Schmidt-Cassegrain	6.3	Illinois, U.S.A.
Hill, R.	6	f/12	Refractor	----	Arizona, U.S.A.
Maxson, P.	28	f/10	Schmidt-Cassegrain	14	Arizona, U.S.A.
" "	15	f/13.3	Refractor	----	" "
Melillo, F.	20	f/10	Schmidt-Cassegrain	7.5	New York, U.S.A.
Rousom, J.	8	f/6.3	Refractor	----	Ontario, Canada
Tatum, R.	18	f/15	Refractor	9	Virginia, U.S.A.
Timerson, B.	32	f/4	Newtonian	11.4	New York, U.S.A.

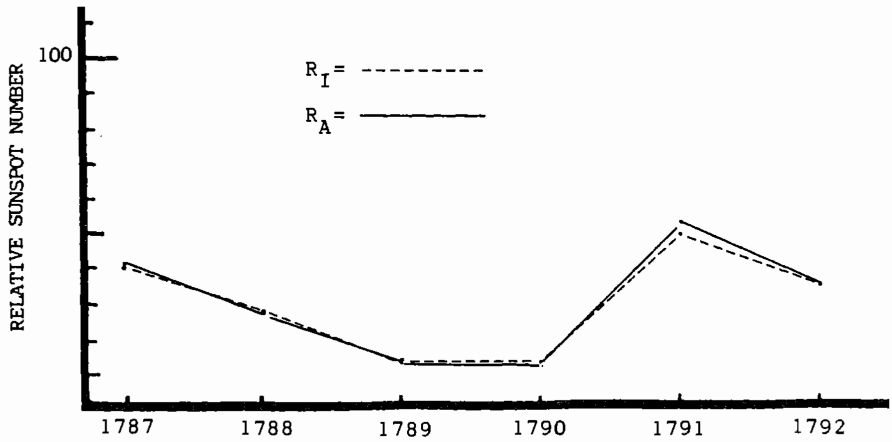

Figure 19. Graph of rotational means of R_I (the International Sunspot Number) and R_A (the American Sunspot Number) for Solar Rotations 1787 - 1792.

Rotation 1787 (1987 03 26.72 to 1987 04 23.00)

Sunspot Number [1,2]	Mean	Maximum (date)	Minimum (dates)
R_I	39.9	80 (04/11)	10 (04/03)
R_A	40.1	86 (04/11)	11 (4 days)

This report opens with a good active rotation, which will probably not compare with those a few years from now but was better than a year before! At least there were no days of 0 sunspot count.

The first major activity region began a day before this rotation started. SESC 4783 was first observed by Hill on 03/25 and was followed fairly comprehensively across the disk by Garcia, Hill, and Maxson. This was a quiescent group consisting of one main, round spot with a symmetrical penumbra surrounded at times by a few umbral spots. This group never attained an area greater than 200 millionths of the disk (200 mil.) and never less than 100 mil., attesting to its inactivity.

SESC 4786 also was a rather inactive region. It was not observed by Section members until 04/10, by which time it was past its peak development and consisted of a round symmetrical spot with a penumbra amd a few following umbral spots. In two days it lost the umbral spots and became a lone diminishing spot.

First observed on 04/10, after they had been on the disk for several days, SESC 4787 amd 4790 were seen at once as being quite complex. SESC 4790 consisted of a large spot to the N with a fairly symmetrical penumbra, except to its S where a projection pointed to the W. This region had separated from SESC 4787 just after they came around the limb, and consequently there was considerable interaction between the two regions. Involved in and around the penumbral projection were over a dozen umbral spots, many in the process of forming rudimentary penumbrae. These spots were the remnants of SESC 4787. They lacked penumbral material on the side of their umbrae toward SESC 4790. By 04/13 the projection was more massive, and several of the spots in SESC 4787 had merged into one rudimentary penumbra. Most of the spots in SESC 4787 were showing more symmetry in their penumbrae by this time. There was a break in Section coverage until 04/17; but as the regions were leaving the disk on that date, SESC 4787 appeared to be one main spot consisting of several umbrae in one penumbra, while SESC 4790 was several umbrae in one large penumbra that appeared to be in the process of being broken up by light bridges. [2,3]

Rotation 1788 (1987 04 23.00 to 1987 05 20.23)

Sunspot Number [2,3]	Mean	Maximum (date)	Minimum (date)
R_I	29.7	64 (05/17)	11 (04/27)
R_A	29.3	68 (05/17)	11 (04/27)

While overall activity decreased somewhat during this rotation, there were several regions which demonstrated remarkable activity.

SESC 4806 came onto the disk on 05/04, when it was known as RAMEY 038, being designated as SESC 4806 on the following day. This region was observed by Maxson and Rousom as consisting of a round leader spot with good penumbral development followed by an E-W elongated follower spot and a sprinkling of umbral spots. As it crossed the disk, first the umbral spots and then the follower spot shrank and then dissipated until by 05/13 the group was reduced to a lone round spot with a radially symmetrical penumbra.

SESC 4811 was first observed on 05/15 and was seen by Maxson, Melillo, and Rousom as a complex group of spots with a large leader surrounded by a complex penumbra. There were only a few faculae involved with the group or preceding it onto the disk, which gave no hint of what was to come. A good close-up photograph by Maxson on 05/16 (shown to the left as Figure 20) showed the penumbra of the leader spot as extended toward the numerous following spots; some of which had no penumbrae, some had rudimentary penumbrae, and some had only detached penumbral islands. It is possible that this aspect showed the latter stages of a large spot which was being broken up by light bridges.

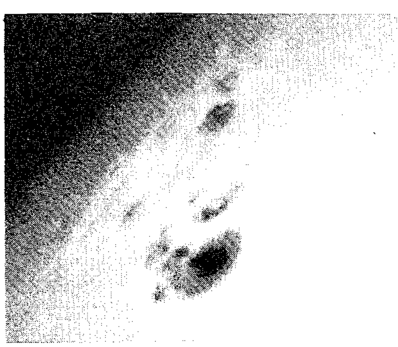

Figure 20. Photograph of SESC 4811 by Paul Maxson on 1987 05 16 at 18h 30m U.T. 28-cm. Schmidt-Cassegrain at effective f/25. Exposure 1/60 second on Kodak 2415 Film. North is at the top. See also text.

Hydrogen-alpha observations by Garcia showed no unusual features though a group of this type of configuration (called a "delta configuration") is often a flare producer. By 05/17 many following spots were gone and the penumbra of the leading spot was reduced. A large Hydrogen-alpha filament now extended well to the N from a plage which had doubled in area during the previous 24 hours. A break now occurred in Section coverage, the next observations being on 05/21. By then the follower spots that remained were around the leader spot, which had become quite round and had a fairly symmetrical penumbra. The small spots to the NW had penumbrae on their far sides only, while the spot to the NE had an extension of penumbra reaching SW toward the main spot. There was little change in this situation for two days. Then on 05/23 the activity around the small spots had become quite chaotic although the main spot was still round. The spots to the E were immersed in a penumbral filgree. Two days later as the group was nearing the limb all spots were coalescing into one penumbra which extended well to the N, broken only by a narrow light bridge. As the group rounded the limb on 05/27, extensive faculae could be seen; in sharp contrast to 05/15 when it had come into view. Many limb prominences were seen on 05/27 and 05/28. [3,4]

Rotation 1789 (1987 05 20.23 to 1987 06 16.43)

Sunspot Number [3,4]	Mean	Maximum (dates)	Minimum (dates)
R_I	15.4	41 (05/21)	0 (7 days)
R_A	15.7	35 (05/21, 05/25)	0 (6 days)

For the first few days of this rotation SESC 4811 dominated the disk. Other than this region there was very little activity except for SESC 4812, which formed a leader spot that was always fairly round with a symmetrical penumbra. A follower spot formed for one day, on 05/27. Then the group declined until it died on the disk near the limb on 06/01. [4,5]

Rotation 1790 (1987 06 16.43 to 1987 07 13.63)

Sunspot Number [4,5]	Mean	Maximum (dates)	Minimum (dates)
R_I	16.8	41 (06/26, 06/28)	0 (9 days)
R_A	16.9	40 (06/22, 06/27)	0 (8 days)

Activity remained quite low in Rotation 1790. Only one region, SESC 4819, showed any appreciable activity, going from a few umbral spots on 06/20 to a group with both a leader and a follower spot with penumbrae in only 24 hours. As observed by Maxson on 06/21, both leader and follower spots had rudminentary penumbrae with a collection of small umbral spots between them. In a drawing on 06/24, Rousom showed that the leader spot was becoming more nearly round while the penumbra of the follower was dissolving. By 06/26 the leader spot was a lone round spot with a radially symmetrical penumbra and only a few umbral spots in attendance. Even those few umbral spots were gone on the next day; and the spot went around the limb two days later on 06/29 as a typical Class H spot [i.e., a large spot surrounded by a penumbra with small random spots nearby; larger than 2°.5]. [5,6]

Rotation 1791 (1987 07 13.63 to 1987 08 09.85)

Sunspot Number [5,6]	Mean	Maximum (date)	Minimum (date)
R_I	50.4	102 (07/23)	11 (07/15)
R_A	52.4	102 (07/23)	7 (07/15)

The first four days of this rotation were its most quiet period. Activity picked up quite rapidly, peaking with the first daily counts over 100 in a long time. Two regions achieved areas over 300 mils, thus being the largest since SESC 4811.

Although SESC 4826 was born on the disk on 07/19, there was no good coverage of it until 07/24. On the latter date, the group consisted of a leader spot with a penumbra in a large facular region. Figure 21 (p. 215) shows a full-disk photograph taken on 07/24. There was also a following spot with a penumbra. Between the two spots was a collection of umbral spots within one penumbra. This middle spot was moving rapidly to the E, heading for the following spot. By 07/26 the middle spot had moved farther E, passing S of the follower spot, moving some 40,000 km. in two days! It is a pity that there was not more comprehensive, close-up coverage of this near miss. Unfortunately the group left the disk on 07/27 and no further observations were possible.

On 08/01 RAMEY 065 was born on the disk and was caught in a photograph by Maxson. On 08/02 it was designated SESC 4835. By 08/05 Hill observed it to have developed into leader and follower spots, each with a penumbra. Great activity truly began the next day when there were three spots with penumbrae and a dozen or more umbral spots. Two of the main spots were close together, following the other large spot. On 08/07 the structure of the group was much more complex with many umbral spots involved in four main islands of penumbral material. The two largest islands had extensions 10,000 km. to the S. This pattern had radically changed by 08/09, when the group reached its maximum area of about 450 mil. The group now consisted of a large leader spot composed of at least a half dozen umbral spots in one E-W elongated penumbra. The follower was a collection of umbral spots in the form of an equilateral triangle surrounded by a very strange penumbra. While being reasonably symmetric, with only one gap to the SE, the penumbra appeared detached from the umbrae on all sides! Photographs by Maxson showed a penumbra with dark fibrils, of nearly umbral darkness, with a clear or nearly clear space between the inner edge of the penumbra and the outer edge of the umbral spots. This view was the last close-up photograph of the group; a whole-disk photograph by Timerson on 08/10 (in Rotation 1792) showed little apparent change as this region left the disk. [6,7]

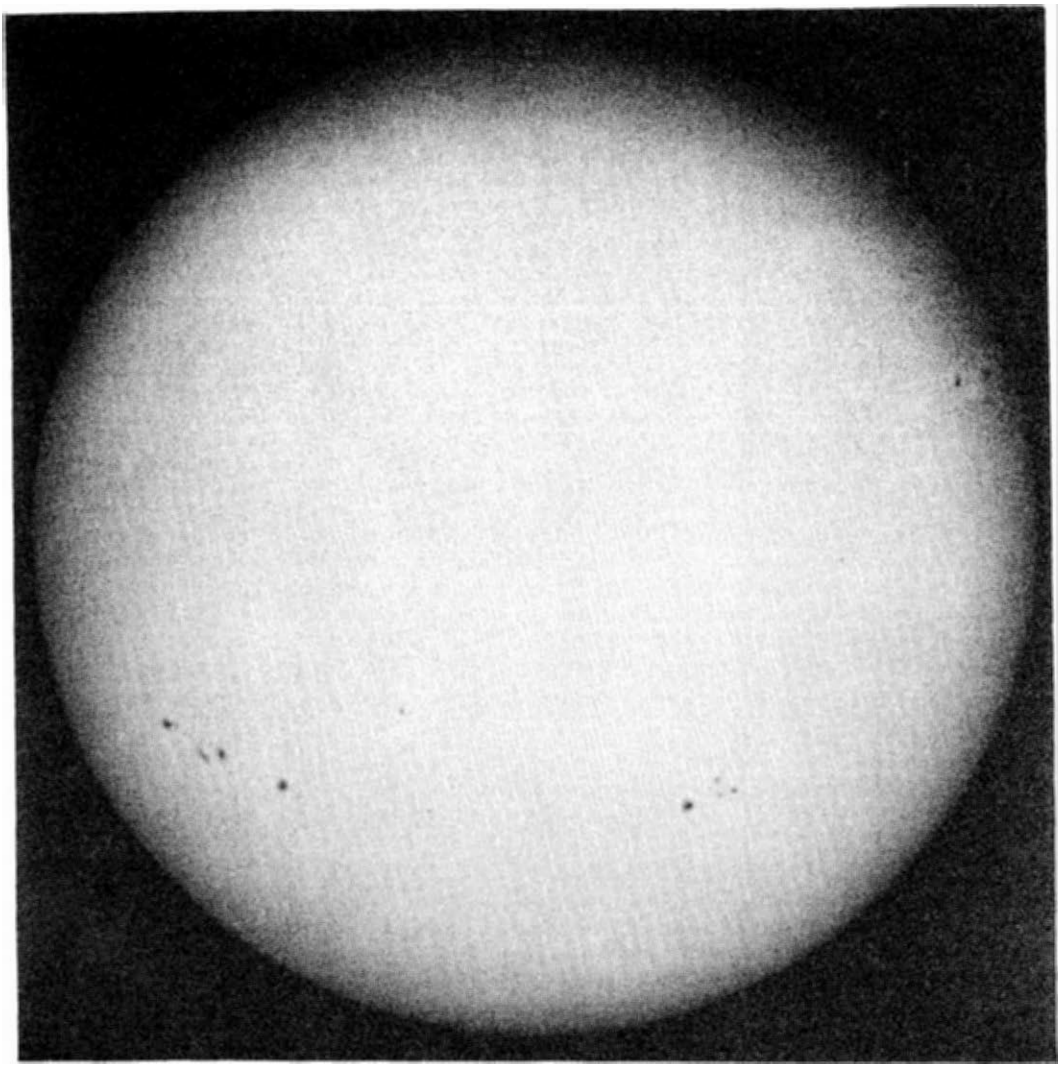

Figure 21. Five sunspot groups at once. Whole-disk solar photograph by Paul Maxson on 1987 07 24 at 19h 15m U.T. 15-cm. refractor at f/13.3. Exposure 1/250 second on Kodak 2415 Film. The three groups in the lower left are, from left to right, SESC 4826, SESC 4824, and SESC 4829. To the lower right is SESC 4827, while SESC 4831 is near the right limb. North is at the top. See also text.

Rotation 1792 (1987 08 09.85 to 1987 09 06.09)

Sunspot Number [6,7]	Mean	Maximum (date)	Minimum (date)
R_I	38.2	56 (09/11)	10 (09/30)
R_A	38.3	52 (09/11)	10 (09/29)

Activity decreased significantly in this rotation. Only one activity center, consisting of two regions, was worthy of note.

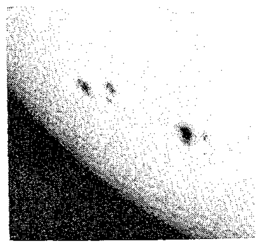

Figure 22. Photograph by Brad Timerson on 1987 08 14 at 14h 22m 15s U.T. with a 32-cm. Newtonian stopped to 11.4 cm. 127-cm. focal length. Exposed 1/500 second on Kodak 2415 Film. SESC 4841 is to the right, and SESC 4842 is to the left. North at top. See also text.

SESC 4841 was first observed by Hill as two large spots on the limb with penumbrae on 08/12. On the next day Hill and Maxson observed this feature as two regions. SESC 4841 appeared to be a large spot with penumbrae and an appendage to the S, while SESC 4842 was a complex region of at least three spots with penumbrae. On 08/14 SESC 4841 was surrounded by a bright filigree of faculae and its largest spot held no less than five umbrae within one radially symmetric penumbra. The appendage then had four small umbral spots in it and appeared to be detaching and moving W. SESC 4842 was then quiescent. These two groups on 08/14 are shown to the left in Figure 22. On 08/15 SESC 4841 showed penumbral activity as two small penumbral appendages formed to the E. Rousom noted a few other changes on 08/16; SESC 4842 had formed some small umbral spots to its S and between the two main spots. However, from this point on SESC 4842 went into rapid decline until it left the disk as only a few umbral spots. By 08/19 the appendage on SESC 4841 had dissipated, but on 08/20 a portion of penumbra either separated or new umbral spots with penumbrae formed to the S; the observations allow either interpretation. The new spot strengthened on 08/21 and the situation remained unchanged when SESC 4841 left the disk on 08/22. [7,8]

Conclusion

It is glaringly apparent from this report that we badly need observations from members in the Eastern Hemisphere! We are regularly mailing to this area but we need observations. Several very interesting events could not be followed with any certainty due to this longitude gap. We also need to get more observations from our observing friends in South America. This is especially true during their summer when the Sun is conveniently high for them but low for us northerners! Solar activity is rapidly rising, more rapidly than predicted in our last report. I hope that we can soon fill these gaps.

In closing I must apologize for the paucity of monochromatic (Hydrogen-alpha) data. This lack is due to a problem with the transport of the data, and should be cleared up in the next report. All such data were from the United States and are not related to the longitude gap described above. The fault was this Recorder's and not that of our Co-Recorder Randy Tatum. All monochromatic observers were credited in this Report even though only about 10 percent of their data were available.

References

1.) Solar-Geophysical Data (prompt reports), Part I, No. 512, Apr., 1987.
2.) ________, No. 513, May, 1987.
3.) ________, No. 514, June, 1987.
4.) ________, No. 515, July, 1987.
5.) ________, No. 516, Aug., 1987.
6.) ________, No. 517, Sept., 1987.
7.) ________, No. 518, Oct., 1987.
8.) ________, No. 519, November, 1987.

PHOTOELECTRIC PHOTOMETRY OF THE 1983 JUN 25 PARTIAL LUNAR ECLIPSE

By: John E. Westfall, A.L.P.O. Lunar Recorder

Introduction

The lunar eclipse of 1983 JUN 25 was "only" partial, but this event was of interest because it allowed photometry of the southernmost portion of the umbral shadow. [2, p. 28] This area was not observable during the unusually dark total lunar eclipses of 1982 JUL 6 and DEC 30, when similar photoelectric photometry was done. [4,5] The umbral magnitude of the 1983 event was 0.339, meaning that the umbral shadow was predicted to extend 0.339 lunar radii into the Moon's disk. Note also that the forthcoming 1988 AUG 27 partial lunar eclipse will be very like the one reported here, with a predicted umbral magnitude of 0.297, again involving the northern portion of the Moon and the southern portion of the Earth's umbral shadow.

Instruments and Methods

The observing site was at Sierra Brooks, California, east of the Sierra Nevada crest at an elevation of 1604 meters. A 35.6-cm. f/11 catadioptric telescope was used, stopped down to f/28 off-axis during the brighter portions of the eclipse (before 07h 40m and after 09h 20m U.T.). The photometer was an Optec SSP with a 0.5-mm aperture, subtending 26".1 with this telescope, used with three filters: Red ("R"; 80 percent transmission at its 6500-Angstrom peak), Visual ("V"; 75 percent transmission at its 5550-Angstrom peak), and Blue ("B": 62 percent transmission at its 4500-Angstrom peak). The major difference from the photometry of the two previous eclipses was that the photometer output was now read into an Apple-II computer via an 8-bit (256 levels) analog-to-digital card, matched with time readings from a calendar/clock card to 1- second accuracy. The computer interface allowed each record to consist of the mean of a series of photometer signals (in this case numbering 29-90).

The five bright craters Anaxagoras, Aristarchus, Copernicus, Eudoxus, and Kepler were measured frequently using the V filter with 13, 11, 11, 10, and 6 readings respectively. Additional R and B readings were made of Aristarchus, Copernicus, and Kepler when they were in the penumbra because these features have been suspected of having occasional color changes in the penumbral phases of past eclipses. These craters received 4, 6, and 3 sets of three-band readings respectively. The comparison stars measured were Alpha Sco (4 readings), Lambda Sgr (4 readings), and SAO 186629 (1 reading). The total observing period was from 05h 17m 47s to 10h 37m 44s U.T., covering the entire eclipse except for the last 24 minutes of the penumbral egress.

Sources of Error

As with the photometry of the two previous eclipses, in 1982 [4,5], the stellar readings showed considerable scatter, and the writer chose to calibrate the crater readings by using readings of the same craters when outside, or in the outermost portions of, the penumbra. There were apparent discrepancies ranging from 8 to 22 percent (0.08-0.22 stellar magnitude) between the craters' pre- and post- eclipse readings, which gives an indication of the accumulative errors arising from all sources.

One problem was that the low altitude of the Moon during this eclipse resulted in undesirably high extinction corrections. Fortunately the altitude of the Moon did not vary much during the observing period, ranging from 17°.2 to 25°.4 (air mass 3.350 to 2.322). An approximate visual extinction coefficient of 0.20 mag. per air mass was used, as determined previously for the observing site. A red coefficient of 0.13 mag./air mass, and a blue coefficient of 0.31 mag./air mass were used, derived from atmospheric transmission tables [1, pp. 126-127], and a lunar (B - V) value of 0.94 mag. was used for the blue extinction [3, p. 331]. Given the air mass range, extinction uncertainties of 0.03- 0.04 mag. appear likely.

Another source of error was in the removal of skylight from the readings. This is a particularly serious problem for umbral measures in a partial lunar eclipse, where there is considerable scattered light from the bright penumbral portions of the Moon, due both to the instrument and to the atmosphere. For this reason, during the eclipse 17 sky brightness readings (13 in V, 2 in R, and 2 in B) were taken of the sky adjacent to the portion of the Moon's limb nearest to the crater being measured. However, the amount of skylight varied considerably both with position and with time, so its attempted removal doubtless introduced some further error.

Inconsistent placement of the photometer aperture upon particular craters probably introduced additional errors. The scatter among readings made of the same crater at approximately the same time suggests that such errors may have averaged about ± 0.06 mag. Using a smaller photometer aperture, or extending the telescope's effective focal length, would have helped to reduce this misplacement error, but probably would have given too little light for the umbral readings.

Finally, some uncertainty is attributable to sampling error in the averaging of readings. At least this factor was measurable and, for the V readings, gave a standard error of ± 0.41 percent (± 0.004 mag.) in the outer portions of the penumbra and ± 3.58 percent (± 0.038 mag.) in the umbra and the innermost penumbra. This uncertainty averaged ± 0.44 percent (± 0.005 mag.) for R readings and ± 0.78 percent (± 0.008 mag.) for B readings.

In conclusion, errors of ± 0.05-0.10 mag. appear probable outside the umbra, rising to perhaps ± 0.2 mag. within it.

Visual Filter Results

In order to allow comparisons between this lunar eclipse and the two previous to it, the majority of the measures were made with a visual (V) filter; and their results are summarized in two diagrams that are similar to those given in the published reports of the earlier eclipses.

Figure 23 (p. 219) maps the V-photometry results in units of visual magnitudes of light reduction relative to full sunlight, with positions given in arc-minutes north-south and east-west of the shadow center. The fading within the penumbra appears regular and geometrical in cause, although it is possible that lunar luminescence may have contributed some light (see next section). The maximum recorded dimming in the umbra, about 30 arc-minutes from its center, was slightly under 10 magnitudes (1/10,000 the illumination of full sunlight). In the 1982 JUL 06 eclipse, the dimming in the central zone of the umbra was observed to be about 11 magnitudes. [4] In the northern umbra, observed in the 1982 DEC 30 event, the dimming reached about 14 magnitudes. [5] We can conclude that the southern portion of the umbra, seen in the eclipse reported here, was relatively bright and that the atmospheric obscuration caused by the volcanic eruption of El Chichon on 1982 APR 04 was weaker in the Earth's Southern Hemisphere, as compared with the Northern Hemisphere.

Visual observations through the same telescope, even when somewhat hindered by viewing through the photometer's V filter, showed lunar features within the umbra to be considerably more easily visible in this eclipse than in the two previous ones. Likewise, photographs taken during this eclipse recorded the umbra with only about 1/4-1/2 the effective exposure required for the previous two eclipses. [2, p. 28] These photographs also showed an orange hue within the umbra.

Figure 24 (p. 220) graphs the Earth's shadow's light reduction against distance from the shadow center. As with the two 1982 eclipses, a dimming of about 6 mag. (0.004 of full sunlight) occurred at the edge of the geometric umbra. The dimming gradient in this region of the shadow appears to be less steep than in the two earlier eclipses, with a dimming of about 5 mag. (0.01 of full sunlight) at the apparent edge of the umbra. This implies a gradient of about 1.3 mag./arc-minute. Inside the umbra, the dimming curve is still rising in the innermost zone observed, and hence it is likely that the unobserved inner umbra was considerably darker than the portion that was visible.

Red/Visual/Blue-Filter Results

When they were both inside and outside the penumbra, the three craters Aristarchus, Copernicus, and Kepler were measured in three colors. This was done because color enhancements have been observed for these features, particularly when within the penumbra during lunar eclipses. [3, pp. 391-397]

Table 1 (p. 221) gives the ratios between readings for different colors. The values in the table have been corrected for atmospheric extinction and skylight, and for shadow-center distance variations between readings of different colors in each set of three readings. These results, however, have not been corrected for differential filter transmission and photocell response; and thus the results, although comparable with each other, are not on an absolute scale, such as (B - V).

The uncertainty limits given in this table refer to statistical errors only, and systematic errors are probably larger. Some of the apparent differences betweem the color ratios for the same feature can be attributed to aperture misplacement. In three cases, however, the changes in color ratios are sufficiently large that real lunar luminescence phenomena are likely:

09h 32.91m U.T. Aristarchus--B and V enhanced relative to R.
10h 22.06m U.T. Aristarchus--V enhanced relative to B.
10h 28.59m U.T. Copernicus--R and B enhanced relative to V.

[Text continued on p. 221.]

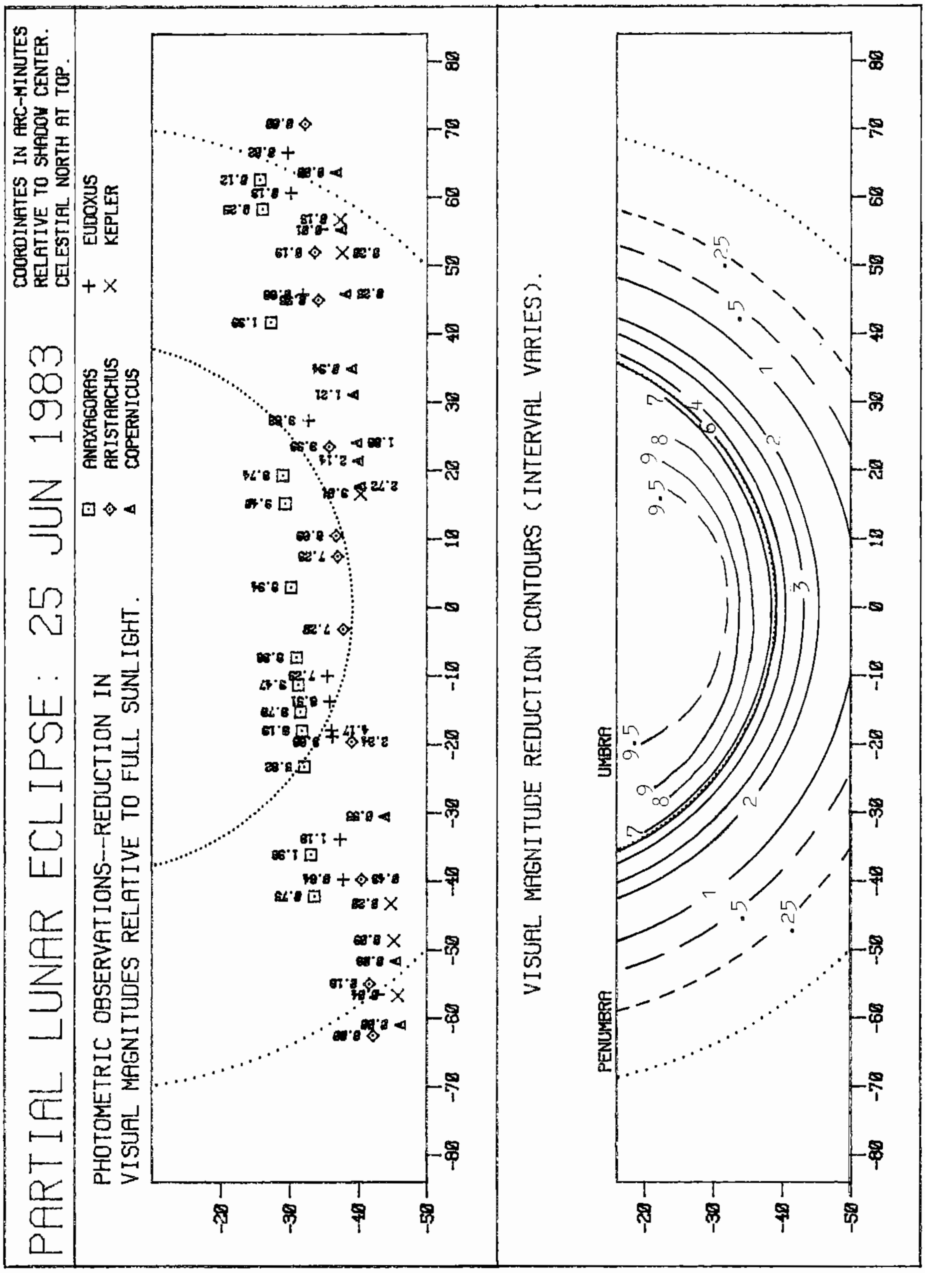

Figure 23 (Oriented sideways). Maps of the dimming of sunlight within the umbra and penumbra of the Earth's shadow during the partial lunar eclipse of 1983 JUN 25. The upper map (when the page is reoriented) shows the locations of individual photometric readings in reference to the shadow center, while the bottom map shows contours for selected amounts of dimming. The dimming is expressed in units of visual stellar magnitudes. Coordinates are in units of arc-minutes. See also text on p. 218. Diagram by the writer.

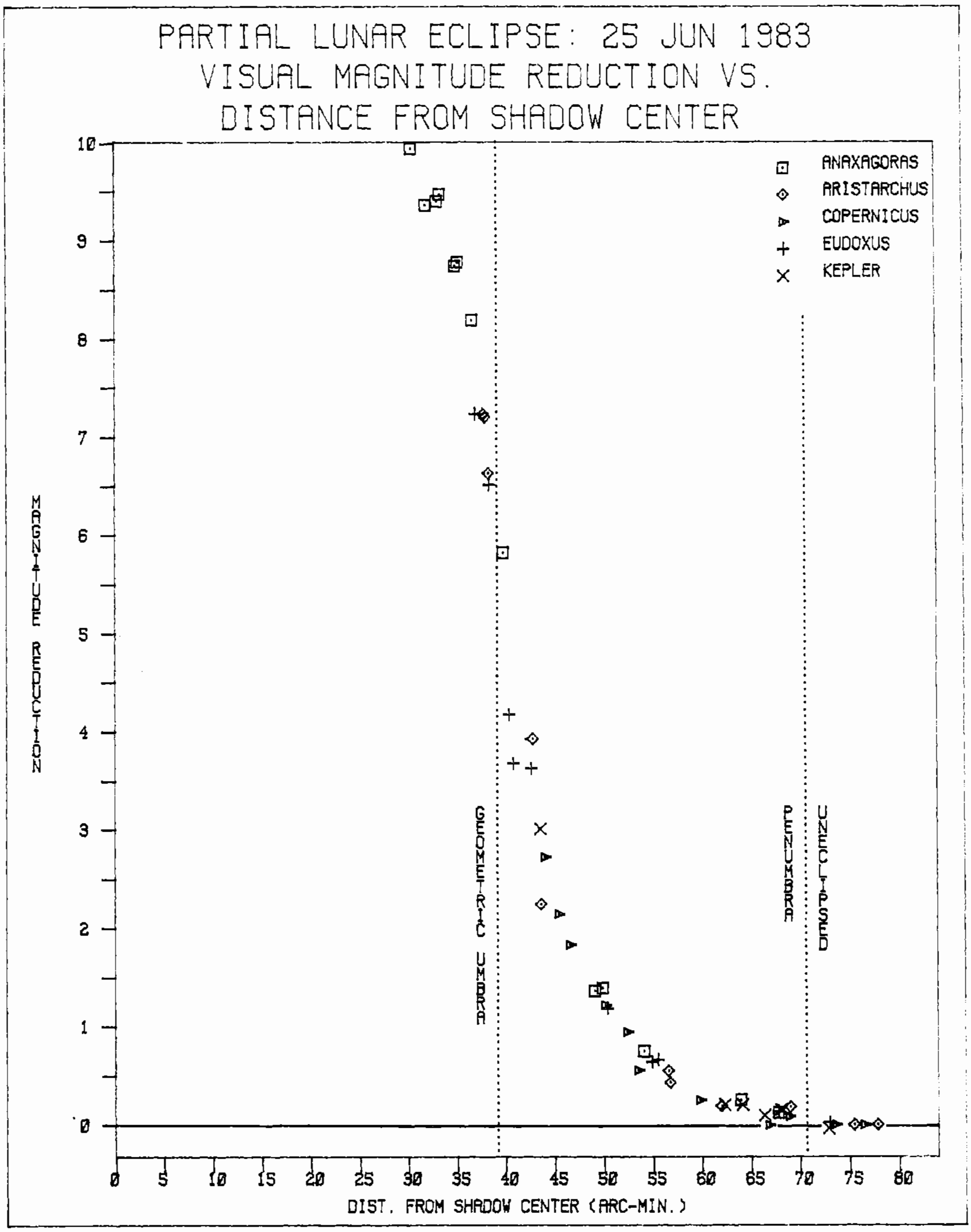

Figure 24. Graph showing dimming in visual stellar magnitudes, measured photoelectrically during the 1983 JUN 25 partial lunar eclipse, plotted in relation to distance in arc-minutes from the center of the shadow. See also text on p. 218. Diagram by the writer.

[Text continued from p. 218.]

The predicted eclipse schedule was as follows: First Penumbral Contact at 05h 43.0m; First Umbral Contact at 07h 14.4m; Last Umbral Contact at 09h 30.1m; and Last Penumbral Contact at 11h 01.6m. Hence, all three suspected events took place during penumbral egress, or after the respective craters had been deepest within the Earth's shadow.

Thus, the likelihood that a single observer detected three lunar luminescence events in a space of less than one hour suggests that these phenomena may be fairly common during lunar eclipses. A.L.P.O. observers with photoelectric photometers and RVB filters are urged to conduct similar photometry during the upcoming 1988 AUG 27 partial lunar eclipse, when the same three craters--Aristarchus, Copernicus, and Kepler--will be reasonably "deep" in the penumbra.

Table 1. R/V/B Color Ratios, 1983 JUN 25 Partial Lunar Eclipse.

Feature	U.T. (V)	Distance from Shadow Center (V)*	Color Ratio		
			R/B	R/V	V/B
	h m	'			
Aristarchus	05 35.21	77.8	4.54 ± .03	1.54 ± .01	2.96 ± .02
"	06 30.79	56.5	4.58 ± .06	1.68 ± .01	2.72 ± .03
"	09 32.91	56.7	2.91 ± .04	1.21 ± .01	2.41 ± .04
"	10 22.06	75.4	5.98 ± .11	1.43 ± .01	4.18 ± .07
Mean			4.50 ± .63	1.46 ± .10	3.07 ± .39
	h m	'			
Copernicus	06 00.23	73.6	4.64 ± .02	1.82 ± .005	2.56 ± .01
"	06 38,47	59.7	4.14 ± .03	1.67 ± .01	2.48 ± .01
"	07 10.38	50.1	4.92 ± .04	2.02 ± .007	2.44 ± .02
"	07 39.18	44.0	3.98 ± .03	1.96 ± .02	2.03 ± .02
"	09 23.11	53.5	4.05 ± .04	1.73 ± .01	2.34 ± .02
"	10 28.59	76.5	3.77 ± .03	2.21 ± .01	1.71 ± .01
Mean			4.25 ± .18	1.90 ± .08	2.26 ± .13
	h m	'			
Kepler	06 06.69	67.9	3.88 ± .01	1.72 ± .005	2.26 ± .01
"	09 42.02	62.2	3.47 ± .04	1.52 ± .01	2.29 ± .02
"	10 10.86	72.8	3.56 ± .03	1.52 ± .008	2.35 ± .02
Mean			3.64 ± .12	1.58 ± .07	2.30 ± .02
Overall Mean			4.13 ± .26	1.65 ± .13	2.54 ± .26

* Note that the geometric umbral radius was 39'.1 and that of the penumbra was 70'.6.

References

1. Allen, Claton Walter. Astrophysical Quantities. 3rd. Ed. London: The Athlone Press, 1973.
2. Graham, Francis G. "Two Lunar Eclipses: 1983 JUN 25 and 1986 APR 24." J.A.L.P.O., 32, Nos. 1-2 (March, 1987), pp. 28-30.
3. Kopal, Zdeněk. An Introduction to the Study of the Moon. New York: Gordon and Breach, 1966.
4. Westfall, John E. "Photoelectric Photometry of the July 6, 1982 Total Lunar Eclipse." J.A.L.P.O., 29, Nos. 7-8 (Aug., 1982), pp. 168-171.
5. ________. "Photoelectric Photometry of the December 30, 1982 Total Lunar Eclipse." J.A.L.P.O., 30, Nos. 1-2 (June, 1983), pp. 6-9.

MINUTES OF THE 1987 A.L.P.O. BUSINESS MEETING

By: Jeff D. Beish, Recording Secretary

The 1987 A.L.P.O. Business Meeting was held as part of "Universe'87," where we held our 37th Convention, meeting with the Astronomical League, Western Amateur Astronomers, Astronomical Society of the Pacific, International Amateur-Professional Photoelectric Photometry group, International Occultation Timing Association, and the Planetary Society. Our meeting place was on the campus of Pomona College, in Claremont, California. The Business Meeting was called to order at 6:15 P.M. PDT on July 13, 1987, by John Westfall, A.L.P.O. Director, with approximately 15 A.L.P.O. members attending. Updates by the Director to Mr. Beish's notes are given in brackets.

I. A.L.P.O. Status Reports.

A. Financial; reported on by John E. Westfall and Walter H. Haas, as of July 7, 1987.

San Francisco Bank Account . . .	$ 1722.85
Las Cruces Bank Account.	1144.00
Undeposited Checks	37.00
Subtotal	2903.85
Owed to Director	- 446.07
Total.	2457.78

B. Membership; reported on by John E. Westfall, as of July 7, 1987.

Issue Number	Mailing Date	Number of Subscribers/Members	Change Since Previous Issue
31, 9-10	July 16, 1986	671	---
31, 11-12	Oct. 24, 1986	664	- 7 (- 1.0 %)
32, 1-2	Mar. 19, 1987	678	+14 (+ 2.1 %)
32, 3-4	July 07, 1987	671	- 7 (- 1.0 %)
Total Change in 1 Year			0 (0.0 %)

The above includes 8 gift subscriptions. The regional distribution of all members was: United States, 77 percent; Canada and Mexico, 4 percent; all other countries, 19 percent.

C. Journal; reported on by John E. Westfall.

Issue Number	Number of Pages	Interval Since Previous Issue
31, 9-10	44	4 months
31, 11-12	48*	3 "
32, 1-2	48*	5 "
32, 3-4	44	4 "
Mean	46	4 months

*Note: 4 additional pages paid for by 2 full-page advertisements.

II. Staff Changes; reported on by John E. Westfall.

Dr. Jim Phillips has been appointed as a Lunar Recorder, conducting the Lunar Dome Survey. At the time of the meeting, his ongoing project had over 80 participants.

III. Hubble Space Telescope Proposals; reported on by Walter H. Haas.

Thirty-eight proposals had been received as of the initial June 30, 1987 deadline. [The deadline was subsequently extended to the next Space Shuttle launch; and eleven more proposals have been received as of June 16, 1988.]

IV. 1988 A.L.P.O. Meeting Site and Time.

The Director moved to accept the Astronomical LEague's invitation to meet with them at their next Convention. Passed. [Later set as July 27-30, 1988, at Iowa Western Community College near Council Bluffs, Iowa.]

V. Appointment of a Membership Secretary.

A. The Director moved that Harry D. Jamieson be appointed as A.L.P.O. Membership Secretary. Passed.
B. Discussion about computerizing membership records. [This was already the case.]
C. Discussion about giving a microcomputer to Membership Secretary for A.L.P.O. business. Undecided.
D. Discussion on how to transmit data between the A.L.P.O. Director and the Membership Secretary. [The Membership Secretary has entered all A.L.P.O. membership expiration dates, names, and addresses on a database program for his C64 computer.]

VI. Annual Survey of Observing Sections.

Moved by the Director that he annually survey the A.L.P.O. Sections as to their projects, personnel, and publications, in order to produce a booklet for new members and persons who inquire about the A.L.P.O. Passed. [This booklet is now available from the Director for a stamped self-addressed envelope.]

VII. Reproduction of Back Issues of the Journal A.L.P.O. Reported on by John E. Westfall.

Discussion. The Director recommended microfiche as the only economical format. He will make inquiries as to the costs of reproduction and of microfiche viewers and printers. [He estimates that a complete set of the Journal would cost $125-150. Responding to an announcement in the October, 1987 issue, only five members indicated any interest.]

VIII. A.L.P.O. Solar System Ephemeris; reported on by John E. Westfall.

1987: Fifty-six issues (at $5.00 each) had been sold as of July 7, 1987. Fifteen had been distributed free to contributors and reviewers, making 71 copies total. [The final number sold was 60, with 17 free, making the total 77.]

1988: The format will be reduced from 8.5X11 to 5.5X8.5 inches in order to lower costs, although the number of pages will be slightly increased. The new price will be $6.00 for the United States, Canada and Mexico; and $7.00 for other countries. [As of June 20, 1988, 86 copies had been sold and 13 distributed free, making 99 copies in all.]

IX. Foreign Members Fund.

The Director moved that a special fund be established for contributions to pay for A.L.P.O. memberships for deserving persons living in nations where dollars are unobtainable. The Director would decide who is deserving. Passed. [As of June 20, 1988, $64 had been contributed.]

The 1987 A.L.P.O. Business Meeting was adjourned at 7:15 P.M. PDT.

COMING SOLAR SYSTEM EVENTS: JULY - OCTOBER, 1988

The notes below are intended as brief reminders of upcoming astronomical events. For more information, consult more detailed sources such as the 1988 edition of the A.L.P.O. Solar System Ephemeris. All dates and times here are given in Universal Time (U.T.); found by adding 9 hours to Alaska-Hawaii Daylight Time, 7 hr. to PDT, 6 hr. to MDT, 5 hr. to CDT, and 4 hr. to EDT.

Planetary Visibility.--The most obvious planet in the evening sky for most of this period will be Saturn. The Ringed Planet was in opposition to the Sun on JUN 20; hence it will be best seen in the late evening in July and

August and in the early evening sky in the Fall. Saturn will be at +0.1–+0.5 stellar magnitude in Sagittarius, with its Rings tilted 27° to our line of sight--the maximum possible. On AUG 01, the Rings will span 40 by 18 arc-seconds, while the disk will measure 18 by 16 arc-seconds. Saturn is also of interest because the two planets just outwards from it will be in its vicinity. Uranus, at magnitude +5.9, will be only 1°07 south of Saturn on OCT 18. Neptune will be about 10° east of Uranus at magnitude +7.7.

Mars' rising will move from the morning to the evening sky, although it will be best observed when it transits--in local standard time (for someone on their standard meridian) at 3:54 AM on AUG 01, 2:08 AM on SEP 01, and 11:38 PM on OCT 01. The Red Planet will be in opposition on SEP 28 at magnitude -2.8, but will be closest to Earth on SEP 22, with an 23".85-diameter disk. Because Mars will then be in Cetus, near the Celestial Equator, this will be one of the best Mars apparitions in this century for observers in the Northern Hemisphere. Note that Mars' Southern Hemisphere will be well-presented to Earth.

Venus will be the "star" of the morning sky, 27° west of the Sun on JUL 01, reaching greatest brilliancy (magnitude -4.5) on JUL 19, Greatest Elongation West (46°) on AUG 22 (also the date of "dichotomy;" the predicted half-phase), and still 37° west of the Sun at the end of October. This apparition of Venus is quite favorable for Northern-Hemisphere observers. Jupiter, however, will be a close second to Venus, and will be well up in the southeast by dawn during the Summer and in the late evening skies by the Fall. The Giant Planet will be well north of the Celestial Equator in the constellation Taurus between the Pleiades and the Hyades. During this period, Jupiter's brightness will increase from magnitude -2.1 to -2.8, while its equatorial disk diameter grows from 35 to 48 arc-seconds. The remaining "bright" planet, Mercury, will have a morning apparition in early July, and an evening one in mid-September; both unfavorable for Northern-Hemisphere observers, but favorable for those south of the Equator; however, the late-October morning apparition of Mercury will be favorable for the Northern Hemisphere.

The Moon. --The most spectacular lunar event will be a partial eclipse of magnitude 0.297 (maximum umbral coverage of the Moon) that takes place on AUG 27 according to the following schedule: First Penumbral Contact, 08h 51.6m; First Umbral Contact, 10h 07.5m (position angle 354°); Mid-Eclipse, 11h 04.5m; Last Umbral Contact, 12h 01.7m (position angle 300°); and Last Penumbral Contact, 13h 17.5m. The schedule shows that the umbral phases will be visible from most of the Americas and East Asia, while the entire eclipse can be seen from western North America and the Pacific Basin. One of the more valuable projects to do during this event will be to time the umbral contacts with the lunar limb and with selected lunar features. We particularly recommend timing the following features, indicated by letter on the map on Figure 25 (p. 225): A. Plato; B. Aristoteles; C. Eudoxus; D. Timocharis; E. Pico; F. Posidonius A; and G. Proclus. Enthusiasts may also wish to time: h. Sharp B; i. Sharp A; j. Foucault; k. Bouguer; l. Condamine A; m. Maupertuis A; n. Archimedes A; o. Pico Beta; p. Epigenes A; q. Cassini C; r. Cassini A; s. Egede A; t. W.C. Bond B; u. Eudoxus A; v. Hercules G; w. Maury; x. Cepheus A; y. Macrobius A; z. Macrobius B; aa. Tralles A; and bb. Picard. Note that some of these features may fall outside the umbra, depending on its degree of enlargement.

The Moon also causes an annular eclipse of the Sun; on SEP 11, with the annular phase beginning at 02h 58.5m at 44°46 E/0°86 N and ending at 06h 28.2m at 165°28 E/56°68 S. The Annular Track barely touches the coast of Somalia and then crosses the southern Indian Ocean without touching land again. However, a partial eclipse will be visible from East Africa, South Asia and Indonesia, and from most of Australia.

Our Moon occults bright planets four times during this period--Mercury on AUG 13 12h when 11° E of the Sun (seen from easternmost Brazil and western and southern Africa); Mercury again on SEP 13 15h, 26° E of the Sun (seen from most of South America); Venus on OCT 07 03h, 41° W of the Sun (visible from Siberia, China, the Philippines, and Japan); and Mercury for a third time, on OCT 10, but only 3° E of the Sun and thus unobservable. Note also that the Moon will pass through the Pleiades on: JUL 09 18h, 17-percent sunlit, seen from East Asia and Japan; AUG 06 00h, 36-percent sunlit, seen from Europe; SEP 02 06h, 59-percent illuminated, visible from the United States and Canada; SEP 29 15h, 80-percent sunlit, seen from Asia and Japan; and OCT 27 02h, 95-percent sunlit, seen from eastern North America and Europe. Finally the Moon will occult the bright stars Regulus (JUL 17 01h, SEP 09 13h, and OCT 06 20h) and Antares (JUL 25 05h, AUG 21 14h, SEP 17 21h, and OCT 15 02h).

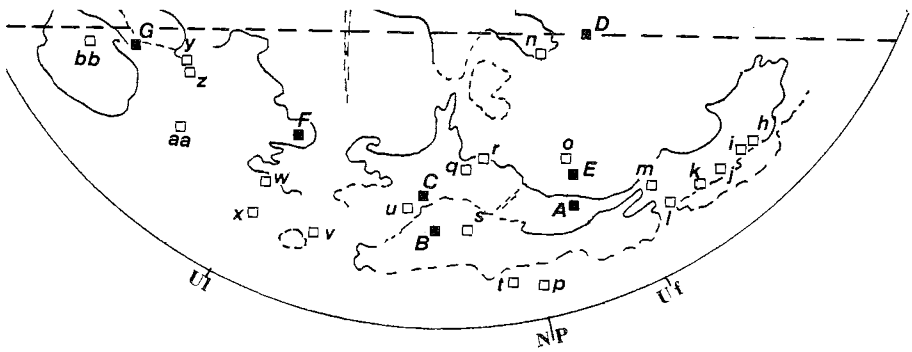

Figure 25. Map of the northern portion of the Moon showing the approximate limits of the umbral shadow during the partial lunar eclipse of 1988 AUG 27. Letters indicate features recommended for umbral contact timings. See also text on p.224. "NP" represents the lunar North Pole; and "Uf" and "Ul" the first and last umbral contacts, respectively. The dashed line at top shows the approximate maximum extent of the Earth's umbral shadow on the Moon.

Meteor Showers. --The late Summer and early Fall are often good timeS for meteor watching, but which particular showers are best seen depends on the Moon's phases. Moonlight will hamper the following showers in 1988, which are given with their dates of maxima in parentheses: South Delta Aquarids (JUL 28), Alpha Capricornids (JUL 29), South Iota Aquarids (AUG 03), South Piscids (SEP 20), Annual Andromedids (OCT 03), and Orionids (OCT 21). On the other hand, the major shower of the Perseids peaks on AUG 11, near New Moon, with zenithal rates of 40-100 meteors per hour and a 4.6-day duration. Other showers during dark skies are the North Delta Aquarids (AUG 11, 2-5 meteors/hour, lasting from JUL 13 to AUG 29), Kappa Cygnids (AUG 18 peak, but running from AUG 9 through OCT 06), North Iota Aquarids (AUG 20, 1-2/hour, from JUL 15 to SEP 20), and Northern Piscids (OCT 12 peak, from SEP 25 to OCT 19).

BOOK REVIEWS

Coordinated by J. Russell Smith

Your Future in Space: The U.S. Space Camp Training Program. Photographs by Flip and Debra Schulke, Text by Penelope and Raymond McPhee. Crown Publishers, Inc., 225 Park Avenue, S., New York, NY 10003. 1986. 143 pages, Illus., Glossary, Appendix. Price $14.95 paper (ISBN 0-517-56418-1).

Reviewed by Randy Tatum

As the title implies, this book is the story of the United States Space Camp in Huntsvile, Alabama. "Space Camp" was the idea of the late Dr. Werner von Braun. Its purpose is to inspire young people and to prepare them for space-related careers, although NASA also offers a program for older persons. The training at Space Camp is nearly identical to the training that Space Shuttle astronauts experience.

In the foreword, astronauts Bruce McCandless and Kathryn SUllivan recount how their past experiences prepared them for careers in the United States space program. The text then describes what trainees must learn and experience in order to become members of flight and ground crews. Designing model rockets teaches Newton's Laws of Motion. Hardware and other systems in the Space Shuttle are studied. Trainees prepare for their mission in several simulators, most of which simulate weightless conditions. Extravehicular activities (EVA) are often the critical part of any space mission; hence, this is an important part of training. Each Space Camp trainee participates in two simulated missions, one as part of the Shuttle crew and the other as part of Mission Control.

Finally, an ambitious program of space exploration is outlined, lasting into the next century. This includes a space station, a network of spaceports, and bases on the Moon and Mars. It appears unlikely that these accomplishments will be possible without cooperation between spacefaring nations.

This book contains few errors. On page 134, the photograph of Mars was taken by the Viking 1 spacecraft, not Mariner 9 as stated. Also, it is now unlikely that the Hubble Space Telescope will be launched before mid-1989, due to the Challenger accident.

Beautiful color photographs on nearly every page show the excitement of Space Camp. The text is written in a clear, easy-to-read manner. The Glossary contains many new terms from the shuttle program, and the Appendix is also a good source of information. Your Future in Space conveys an optimism that NASA surely needs.

The Riddle of Gravitation. By Peter C. Bergmann. Charles Scribner's Sons. 115 Fifth Avenue, New York, NY 10003. Revised and updated Edition. 1987. 233 p., Illus., Glossary, Appendices, Index. Price $18.95 cloth (ISBN 0-684-18460-5).

Reviewed by David D. Meisel

This volume, which appeared one month after the Large Magellanic Cloud supernova, and therefore was not able to include the profound investigations of that object, still gives the intelligent lay reader an overview of modern relativity theory and uses a minimum of mathematical details. Relying on geometrical reasoning and numerous figures, the author provides a Cook's Tour of topics including gravitational radiation and cosmology. The chapters form a series of vignettes that are lucid and authoritative.

However, this is not a book that can be read casually. The chapters cover virtually every aspect of general relativity theory, including some topics that are difficult even for students of the subject to understand. Rereading several times may be required. In some places the narrative jumps over some details which the uninitiated reader may find a bit jarring. For example, I am sure that some readers will find it difficult to understand why the time and position lines for second observers are tilted (pp. 21 and 31), compared with the right angles for the first observer. This concept is difficult enough for college physics students, and hence an appendix explaining this concept in more detail would have been welcome. In addition, I found the list of further readings to be quite superficial, with a strong bias to several older works that have been out of print for some time now.

Continuity problems aside, much of the narrative contains a number of beautiful analogies and concepts that can be used to visualize this difficult subject at a much deeper level than most readers expect. One feels that one is in attendance at one of Professor Bergmann's lectures. Many of the viewpoints are unique to this volume. While it is tempting to compare this book with Robert Geroch's General Relativity from A to B, the two works differ considerably in style and intent. While Geroch described the geometrical properties of space-time in great detail, he had no room in his book to comment on current developments and observations. Bergmann tends to sweep over much wider territory and therefore skimps somewhat on the details of the theoretical background in order to get at the observational considerations and their philosophical ramifications. Both books deserve places on the shelf of the person who wants an adroit introduction to this fascinating subject.

NEW BOOKS RECEIVED

Notes by J. Russell Smith

Thursday's Universe. By Marcia Bartusiak. Times Books, 201 East 50th Street, New York, NY 10022. 1986. 306 pages. Illus., Bibliography, Index. Price $19.95 cloth (ISBN 0-8129-1202-0).

This is "A Report from the Frontier on the Origin, Nature, and Destiny of the Universe." There are eleven chapters, followed by "Acknowledgments," a Bibliography, and an Index. I believe that anyone interested in astronomy would like to have this book.

The Study of Variable Stars Using Small Telescopes. Edited by John R. Percy. Cambridge University Press, 32 East 57th Street, New York, NY 10022. 1986. 265 pages, Illus., Index. Price $34.50 cloth (ISBN 0-521-33300-8).

The sections of this book are "Visual Observations," "Photographic Observations," "Other Techniques," "Coordination and Archiving of Observations," "Period Analysis," and "New Directions," followed by an Index. As a retired astronomer who studied variable stars for many years, I recommend this book.

Mars. Our Future on the Red Planet. By Robert M. Powers. Houghton Mifflin Company, 1 Beacon Street, Boston, MA 02108. 1986. 230 pages, Illus., Index. Price $17.95 cloth (ISBN 0-395-35371-8).

After a "Prologue," one finds the following chapters: "Far Lonelier than Barsoom," "The Rhyme of the Last Mariner," "Gateway to Mars," "We Are The Martians Now," "Build We Must," "The Canterbury Pilgrims," "Give Me a Longer Lever," "It's a Rotten Job but Somebody's Got to Do It," "The Red Earth," and "And So On Ad Infinitum." These are followed by an "Epilog," "Sugested Reading," and the Index.

The Amateur Radio Astronomer's Handbook. By John Potter Shields. Crown Publishers, 225 Park Avenue South, New York, NY 10003. 1986. 104 pages. Illus., Index. Price $19.95 paper (ISBN 0-517-55810-6).

The chapters of this book are: "Introduction," "Comparison of Optical and Radio Astronomy," "Radio Wave Propagation and the Ionosphere," "Extraterrestrial Radio Sources," "Some Optical Astronomy Basics," "Some Basic Electronics," "Basic Radio Astronomy Systems," "The Radio Telescope Antenna," "Radio Telescope Receivers," "And Now Into Practice," "Antenna Design and Construction," "Observing the Sun," "A 400-MHz Interferometer," "Receiving Signals from Jupiter," "Detection of Meteors and Meteor Showers," and "Some Final Words." Those interested in this subject will certainly want this book.

The Galaxy and the Solar System. Edited by Roman Smoluchowski, John N. Bahcall, and Mildred S. Matthews with 34 collaborating authors. The University of Arizona Press, 1230 N. Park Ave., No. 102, Tucson, AZ 85719. 1986. 483 pages, Illus., Glossary, Bibliography, Index. Price $29.95 cloth (ISBN 0-8165-0982-4).

This book is divided into six Parts: "The Solar-Galactic Neighborhood: Galactic Gravitational Fields," "Massive Gravitational Fields," "Other Galactic Features," "The Oort Cloud," "Perturbations of the Solar System," and "Existence and Stability of a Solar Companion Star." These are followed by a "Color Section" of illustrations, a Glossary, a Bibliography, a list of contributors, and an Index.

Backyard Astronomy. By Alan MacRobert. Sky Publishing Corporation, 49 Bay State Road, P.O. Box 9102, Cambridge, MA 02238-9102. No date; probably 1986. 21 pages. Price, paper, $3.95 for a single copy; $0.40 each for 12-280 copies (ISBN 0-933346-44-1).

This booklet is composed of articles from Sky & Telescope magazine, covering the topics: "The Power of the Naked Eye," "Pathfinding in the Sky," "The Art of Using a Telescope," "Mastering Polar Alignment," "Close-Up of an Alien World," "A Guided Tour of the Moon," "Close-Up of a Star," "The Lure of the Variables," "Observing Variable Stars," "Secrets of Deep-Sky Observing," and "Comet Watching Tips." You will be glad that you purchased this booklet.

Practical Astronomy, Lectures on Time, Place and Space. By David H. DeVorkin. Smithsonian Institute Press, Blue Ridge Summit, PA 17294-0900. 1986. 108 pages, Illus., Index. Price $17.50 paper; (ISBN 0-87474-359-1).

I recommend this book to the beginner as well as to the more advanced student of astronomy.

The Invisible Universe Revealed. By Gerrit L. Verschuur. Springer-Verlag New York, Inc., 175 Fifth Avenue, New York, NY 10010. 1987. 262 pages, Illus., Index. Price $19.95 cloth (ISBN 0-387-96280-8).

The chapters are: "The Adventure of Radio Astronomy," "Quasars," "Radio Galaxies," "Cosmic Jets, Black Holes and Cannibalism," "Radio Galaxies and Quasars: An Overall View," "The Galactic Center," "The Milky Way Radio Beacon," "The Galactic Radio Nebulae," "Interstellar Hydrogen," "Interstellar Molecules," "Pulsars," "The Radio Sun and Planets," "The Galactic Superstars," "Beyond the Quasars--Radio Cosmology," "On the Search for Extraterrestrial Intelligence," "Musings on the Evolution of a Science," and "Radio Telescopes --The Present and the Future." Following these are an Appendix, "Further Reading," and the Index. I recommend this book to all those interested in Radio Astronomy.

Astrophoto VII Seminar Proceedings. By Orange County Amateur Astronomers. Orange County Amateur Astronomers, 2215 Martha Avenue, Orange, CA 92667. 1987. 63 pages, Illus., paper. Price $11.00 domestic, $12.00 foreign surface, $14.00 foreign airmail.

The contents of this collection are: "A Survey of Current Color Films for Gas Hypering," "Educational Astrophotography for the Amateur," "Ghostless Filters for Astrophotography," "Is Bigger Better? A Comparison of 12-inch and 24-inch Astrophotographic Systems in Real-Life Performance," "An Amateur Computerized Camera for the Automatic Tracking of Comets," "Beginning Slide Dduupplliiccaattiioonn," "Sharing Astronomy With the News Media," "Reciprocity Failure of Photographic Emulsions Before and After Hypersensitization with Forming Gas," and "Steblicom/Problicom/Veblicom, an International Search for Comets," followed by a set of photographs. The many black-and-white photographs are excellent; and once you see this book, you will be glad that you bought it.

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NOTICE: NEW MEMBERSHIP SECRETARY HARRY D. JAMIESON

At our 1987 Business Meeting, reported on pp. 222-223 of this issue, the members attending unanimously approved the appointment of Harry D. Jamieson as the Membership Secretary of the A.L.P.O. Since Fall, 1987, Mr. Jamieson has been responsible for maintaining our membership/subscription lists and for printing our address labels. Now, beginning imediately all correspondence regarding memberships and Journal, A.L.P.O. subscriptions should be addressed directly to him: Harry D. Jamieson, A.L.P.O. Membership Secretary, P.O. Box 143, Heber Springs, AR 72543. When writing him, please mention your member number, which is given in the upper left corner of your address label.

Mr. Jamieson, a long-term A.L.P.O. member and observer, is a very welcome addition to our staff. His work in handling our considerable membership correspondence and records will mean that the Director/Editor can devote more attention to directing and editing.

!!!

ANNOUNCEMENTS

Last-Minute Convention Reminder. --In the hope that this issue will reach our members before ALCON'88 starts, we remind them that our 38th Convention will be held with the Astronomical League at Iowa Western Community College near Council Bluffs on July 27-30, 1988. There will be a number of excellent invited speakers. A.L.P.O. events are concentrated on Thursday, July 28th, and include a paper session, a workshop, a Business Meeting, and an exhibit. The paper session will include papers by: Julius Benton ("The Role of the A.L.P.O. in the Worldwide PVO Ashen Light Patrol"), Phillip Budine ("Jupiter's Oscillating Spot of 1987"), Francis Graham ("Visual Observations of Venus' Atmosphere with a Violet Filter"), Jose Olivarez ("Highlights of the Recent Observations of Jupiter"), Don Parker ("Martian Meteorology and Climate"), and John Westfall ("How Bright the Sky?"). The Workshop will present observing techniques such as drawing, photography, micrometric measurement, and CCD videotaping. A.L.P.O. members should also try to attend the Business Meeting; one agenda item will be a proposed dues increase. For more information about the Convention, call Robert D. Allen, Convention Chairman, at 712-328-0651.

Comets and Meteors Section Changes. --Due to the press of many additional duties, Comets and Meteors Recorder David H. Levy has decided to resign from the Recorderships of those two Sections. We were very sorry to hear this, but are gratified that he has located two very able replacements who will serve as Acting Recorders pending their confirmation at our Business Meeting. Mr. Levy will continue as an Assistant Meteors Recorder and we are also happy to say that James V. Scotti will continue as Assistant Recorder for both Sections.

The new Acting Comets Recorder is Don E. Machholz, 5234 Camden Avenue, San Jose, CA 95124. An A.L.P.O. member since 1970, Mr. Machholz is the discoverer of three comets.

A new A.L.P.O. member, Mr. John Griese, is the new Acting Recorder of the Meteors Section, and has been an active variable star observer for many years. His address is: 963 Elms Common Drive, Apt. 103, Rocky Hill, CT 06067.

In the next issue, we plan to publish short statements by both new Recorders that will describe their plans for their Sections.

Jupiter Week. --In our previous issue, we announced the "Io Patrol," a project using photoelectric photometry to monitor Io in order to detect new surface deposits resulting from volcanic eruptions. This is part of a larger amateur-professional effort called "The International Jupiter Watch Satellite Discipline." This group has declared the period of September 19-29, 1988, as International Jupiter Watch Week. This more-than-a-week will see concentrated observations of Jupiter and its satellites. Photoelectric monitoring of Io and of eclipses of all four major satellites is especially desirable during this period. Contact Assistant Jupiter Recorder John Westfall (address on inside back cover) for further information.

Ashen Light Survey Continues. --With Venus now aqppearing in the pre-dawn sky, observers are reminded that the Venus Section's monitoring of that planet for the elusive "Ashen Light" phenomenon is continuing. To find out more, contact Venus Recorder Julius L. Benton, Jr., Associates in Astronomy, 305 Surrey Road, Savannah, GA 31410.

Hubble Space Telescope Reminder. --Our November, 1986 issue (Vol. 31, Nos. 11-12) announced that amateur astronomers were invited to submit proposals for observing time on the Hubble Space Telescope (HST). In October, 1987 (Vol. 32, Nos. 5-6) another announcement stated that the submission deadline had been extended to the time of the next Space Shuttle launch. We now remind our readers that this launch date is approaching (currently scheduled for September 4, 1988), so prospective HST amateur observers should write soon to the American Association of Variable Star Observers (25 Birch St., Cambridge, MA 02138) for an application kit.

Mars Observer's Guide Up but Not Out. --We announced in the last issue (Vol. 32, Nos. 7-8) that the Planetary Society was publishing the A.L.P.O. Mars Section's Mars Observer's Handbook, and would make it available at $5.00. They now ask $6.00 in order to cover postage and handling, and California residents should include sales tax on the $5.00 price. As of this writing in early July, this publication is not yet available, but is expected soon to be so. Order it from the Planetary Society, 65 N. Catalina Avenue, Pasadena, CA 91106.

Astronomical Society of the Pacific; Moved but Still Productive. --The Astronomical Society of the Pacific (A.S.P.) has moved to: 390 Ashton Avenue, San Francisco, CA 94112 (telephone number 415-337-1100). They now have four items of interest to our members: (1) "Solar System Portraits," a set of 20 color slides of paintings by the well-known astronomer-artist Dr. William Hartmann ($21; A.S.P. Slides Dept.). (2) "Venus Kit;" consisting of six slides with captions, a 28-page booklet, data table, a set of five activities, and a bibliography ($11.50--add $2.50 if outside the United States; A.S.P. Venus Kit Dept.). (3) "Worlds in Comparison;" a set of 20 slides showing the planets and satellites of the Solar System, and their major features, compared with each other at the same scales (comparisons with the Earth and its features are frequent), including a 20-page guide ($22.50-- add $4.00 if outside the U.S.; A.S.P. "Worlds" Slide Set Dept.). (4) A "Mars Kit," which contains six color slides and captions, a 36-page booklet, a set of eight activities, and a two-page resource list ($11.50--add $2.50 if outside the U.S.; A.S.P. Mars Kit Dept.). Postage and handling are included in all prices. Please pay in U.S. funds and send orders to the appropriate A.S.P. department.

Triton Occultations. --Our October, 1987 issue (Vol. 32, Nos. 5-6) announced a program for observing occultations by Neptune's large satellite Triton, coordinated by John Hewitt (418 Boynton Ave., Berkeley, CA 94707). A 15th-magnitude star may be so occulted on 1988 SEP 02, 5h U.T., visible from Chile, Argentina, and New Zealand. A second such event may be visible from Hawaii, involving a 14th- magnitude star on 1988 OCT 22. Suitably-placed observers with telescopes of 35 cm. aperture or above should watch the International Occultation Timing Association's Occultation Newsletter for updates.

Lunar Dome Survey Maps. --The Lunar Dome Recorder, Dr. Jim Phillips, has recently published a set of 24 letter-size lunar maps, where all currently known or suspected domes are plotted on the well-known University of Arizona Lunar Quadrant Maps. Intended for dome observers, the set is available for $3.00 from Dr. Phillips at his address on the inside back cover.

Keedy Comet Award. --Several years ago the Keedy Award of the British Astronomical Association Comet Section was introduced on an annual basis. Consisting of a small financial gift and a certificate, it is given for outstanding work within the B.A.A. Comet Section in the hope that this will encourage cometary studies. George Alcock of England was the first recipient of the Keedy Award for his discovery of Comet IRAS-Araki-Alcock in 1983, followed by Andrew Pearce of Australia for his numerous comet observations in 1984. The next recipient was Brian Manning of England for his highly accurate astrometric observations of comets in 1985. More recently, Tony Ward of England received this award for his valuable visual and photographic cometary work in 1986. It is indeed a pleasure to see this award flourish, particularly when much greater astronomical awards exist. What is humbling to its founder and presenter, Mr. David R. Keedy, an amateur astronomer from the United Kingdom, is the fact that all the recipients--all skilled observers--have been most grateful to receive the award. Mr. Keedy hopes that astronomers from various countries will join the B.A.A. Comet Section in order to pursue worthy observational work on comets and thus become eligible to receive the Keedy award, thereby giving it a truly international flavor. [Received from D.R. Keedy; note that the award is restricted to members of the B.A.A. Comet Section. Ed.]

Free Publications for Classes. -- Do you teach a course in Astronomy? If so, Sky Publishing would like to help. To support the instruction of astronomy, we are giving our 1988 GUIDE TO THE HEAVENS and WELCOME TO OUR UNIVERSE publication free to students. The GUIDE is an 8-page preview for the Sun, Moon, and planets for the year. It contains a beautiful graphic almanac and a detailed map of the Moon. Its companion publication is a brief introduction to some observing basics. For more information, please write (under your school's letterhead) to William Lawrence, Sky Publishing Corporation, P.O. Box 9111, Belmont, MA 02178-9111. Be sure to include a brief description of the astronomy course(s) that you teach and the number of students in each class.

The Strolling Astronomer

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