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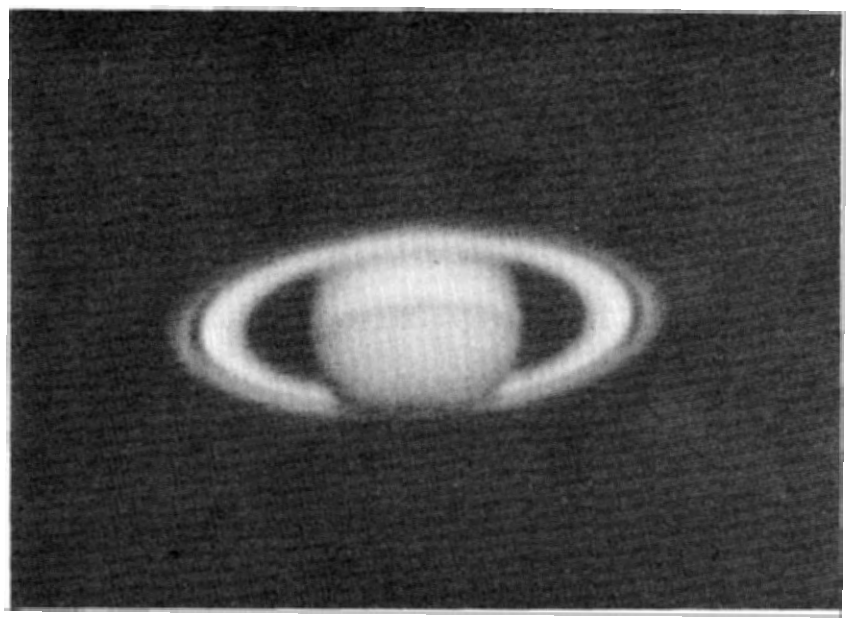

The planet Saturn photographed on 1985 May 01 by Jean Bourgeois with the 1-Meter reflector of the Pic du Midi Observatory in France. Taken with Kodak 2415 Film, exposed for 1 second at f/16. Saturn's Ring System was tilted 23.3 degrees with respect to the Earth on that date. South at top.

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IN THIS ISSUE

THE 1984-85 APPARITION OF SATURN: VISUAL AND PHOTOGRAPHIC OBSERVATIONS

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

Introduction

A number of very fine visual and photographic observations of the planet Saturn were submitted to the A.L.P.O. Saturn Section during the 1984-85 Apparition. Observational data that were received covered the period from 1984 DEC 26 through 1985 SEP 13, and these contributions constitute the basis for the present analytical report.

Extremely limited portions of the Southern Hemisphere of Saturn could barely be seen; but the Northern Hemisphere of the planet and the north face of the Rings could be seen to advantage throughout the observing season. The numerical value of B , the Saturnicentric latitude of the Earth referred to the plane of the Rings (positive when north), varied between +22°.476 (1985 JUL 14) and +23°.828 (1985 FEB 24), the dates during the observing period of minimum and maximum inclination respectively.

Table 1 (below) gives some geocentric data for the 1984-85 period, which should be useful as a reference while one is studying the text of the present report. Table 2 (p. 2) is a listing of those individuals who participated in the observational programs of the A.L.P.O. Saturn Section and who faithfully submitted reports in 1984-85. This table shows that a total of 78 observations were contributed by 12 individuals in 1984-85. The distribution of the observations by month is shown as a histogram in Figure 1 (p. 2).

Table 1. Geocentric Phenomena in Universal Time for the 1984-85 Apparition.

Conjunction . .	1984 NOV 11, 07 hr.	Stationary . .	1985 JUL 26, 12 hr.
Stationary. . .	1985 MAR 07, 23	Conjunction. .	NOV 23, 02
Opposition. . .	MAY 15, 18		

Opposition Data:

Visual Magnitude . . .	+ 0.0	B . . .	+23°.049
Globe: Equatorial Diameter . .	18".54	Polar Diameter . . .	16".85
Rings: Major Axis.	42".06	Minor Axis	16".46

As shown in the histogram in Figure 1, the greatest number of reports were received for the months of 1985 May through July (71.8 percent). There was an obvious decline in the number of observations on either side of this peak. Only 29.5 percent of the observations were made before the opposition date, and 70.5 percent came after (none were made exactly on the date of opposition). As a usual rule, the maximum scrutiny of Saturn takes place near opposition in any given apparition, which was clearly the case in 1984-85. All observers are encouraged to monitor Saturn throughout each apparition, starting early in the observing season and following through until almost the time of conjunction.

The writer extends his most sincere gratitude for their observational support of our programs to all the colleagues and friends who are mentioned in this report. Such systematic, consistent work on the part of such dedicated individuals in this nation and abroad, novice or experienced, is cordially invited.

Table 3 (p. 3) gives a breakdown of the instrumentation used during the 1984-85 Apparition. This table shows that three-fourths of the observations were made with instruments ranging in aperture from 8.9 cm. (3.5 in.) to 25.4 cm. (10.0 in.). It is interesting to note that 90 percent of the observations were about equally distributed between refractors and Newtonian reflectors. Many observers remarked that when the seeing was mediocre the highest resolution could be attained with smaller instruments if of good optical quality, although larger telecopes gave the best results when seeing conditions permitted. It appears from recent analytical studies that more and more Saturn Section participants are using instruments of classical design, chiefly because of the consistent good performance these designs give when optimum resolution, image contrast, and image brightness are sought.

Table 2. Contributing Observers, 1984-85 Saturn Apparition.

Observer and Location	Number of Observations	Instrument(s) Used
Julius L. Benton, Jr., New Hope, PA	14	15.2-cm. (6.0-in.) RR.
Jean Bourgeois, Brussels, Belgium	1	100.0-cm. (39.4-in.) C.
Phillip W. Budine, Tucson, AZ	1	8.9-cm. (3.5-in.) M.
Donald H. DeKarske, Colorado Springs, CO	2	10.2-cm. (4.0-in.) RR.
Marc A. Gélinas, St. Hubert, Quebec	6	20.3-cm. (8.0-in.) S-C.
David L. Graham, Brompton-on-Swale, England	17	10.2-cm. (4.0-in.) RR.; 44.6-cm. (17.6-in.) N., 15.2-cm. (6.0-in.) RR.
Francis Graham, East Pittsburgh, PA	1	33.0-cm. (13.0-in.) RR.
Alan W. Heath, Nottingham, England	14	30.5-cm. (12.0-in.) N.
Gary T. Nowak, Essex Junction, VT	2	22.9-cm. (9.0-in.) RR.
Robert Robotham, Willowdale, Ontario	10	15.2-cm. (6.0-in.) N.
Daniel M. Troiani, Chicago, IL	9	25.4-cm. (10.0-in.) N.; 36.2-cm. (14.3-in.) N.
Chris Walker, Catterick Garrison, England	1	10.2-cm. (4.0-in.) RR.
Total Number of Observations	78	
Total Number of Observers.	12	

Note: C = Cassegrain reflector, M = Maksutov reflector, N = Newtonian Reflector, RR = refractor, and S-C = Schmidt-Cassegrain reflector.

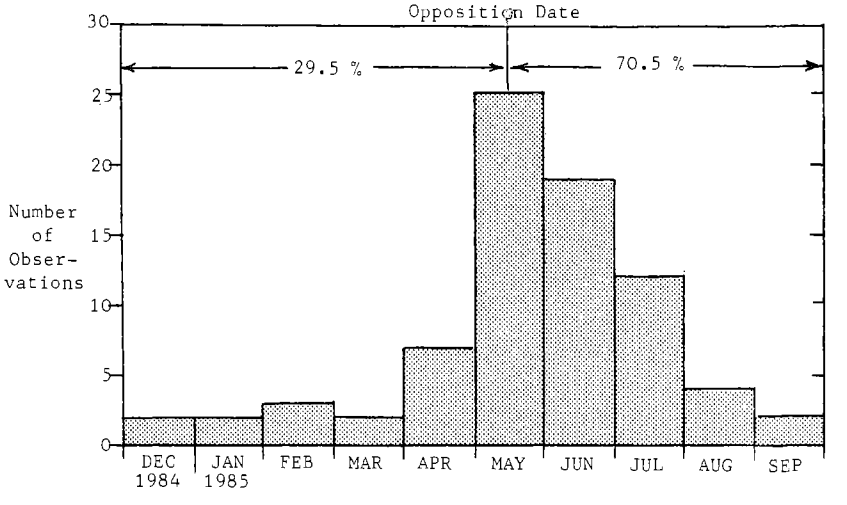

Figure 1. Number of contributed observations of Saturn by month, 1984-85.

The Globe of Saturn

The descriptive treatment below has been derived from an analytical reduction of the collective reports contributed to the A.L.P.O. Saturn Section throughout the 1984-85 Apparition. Except where the identity of an individual is pertinent to the discussion, the names of observers have been omitted from the text in the interest of brevity.

Table 3. Instrumentation Used, 1984-85 Saturn Apparition.

Aperture versus Number of Observations		Type
8.9-cm.(3.5-in.). . 1	30.5-cm.(12.0-in.). . 14	Refractors. . . . 46.2 %
10.2-cm.(4.0-in.). . 14	33.0-cm.(13.0-in.). . 1	
15.2-cm.(6.0-in.). . 29	36.2-cm.(14.3-in.). . 2	Reflectors. . . . 53.8 %
20.3-cm.(8.0-in.). . 6	44.6-cm.(17.6-in.). . 1	Newtonian . . 43.6 %
22.9-cm.(9.0-in.). . 2	100.0-cm.(39.4-in.). . 1	Cassegrain. . 1.3 %
25.4-cm.(10.0-in.). . 7		Schmidt-Cassegrain. . 7.6 %
		Maksutov. . . 1.3 %
Total . . . . . 59 (75.6 %)	Total . . . . . 19 (24.4 %)	

Numerical tables, graphs, and illustrations accompany this report,and the reader is urged to refer to them often for a clearer understanding of the text discussion. Figure 2 (p. 4) depicts and names the more obvious features of the Globe and Rings, while Figures 3-5 (p. 8) are representative visual drawings made during the 1984-85 Apparition. In addition, a photograph of Saturn during that apparition is shown on the front cover.

Northern Portions of the Globe. --A generally low level of activity characterized the Northern Hemisphere of Saturn during 1984-85, a situation similar to several immediately preceding apparitions. The detail recorded in the Northern Hemisphere was essentially elusive and ill-defined, and was chiefly associated with regions such as the Equatorial Zone, North Component (EZn), the North Equatorial Belt (NEB), the North Tropical Zone (NTrZ), and the North Temperate Zone (NTeZ).

The following discussion of Northern Hemisphere features contains data of a comparative nature from apparition to apparition, as in previous Saturn apparition reports. The reader should carefully study the text in order to appreciate the suspected subtle changes that may be underway seasonally and longer-term. It is often held that the changing tilt of the axis of Saturn relative to the Earth and the Sun plays a major role in any recorded variations in belt and zone intensities. These comparative intensity data are given in Tables 4 and 5 (pp. 5-6).

North Polar Region (NPR). --Compared with the immediately preceding apparition, the dusky yellowish-grey NPR in 1984-85 exhibited a fairly significant decrease in overall brightness (by a mean intensity factor of -0.9). This region was largely uniform in intensity throughout 1984-85, with one isolated sighting of a very slightly darker North Polar Cap (NPC) in the extreme north. It is interesting to note that, despite the single observation of the dusky yellow to yellowish-grey NPC in 1984-85, the NPC was darker than the surrounding portions of the NPR during most of the 1984-85 Apparition, which was not the case in 1983- 84. Encircling the NPR, the North Polar Belt (NPB) was seen on rare occasions in 1984-85 as a dark greyish-yellow, somewhat linear belt continuous from limb to limb, not nearly so dark and conspicuous as it had been in 1983-84 (having brightened by a mean intensity factor of +0.6).

North North Temperate Zone (NNTeZ). --No reports were forthcoming of the NNTeZ in the 1984-85 Apparition.

North North Temperate Belt (NNTeB). --The dark greyish-yellow NNTeB was sighted on a very limited number of dates in 1984-85. This belt showed a fine linear structure and was not nearly so diffuse as it has been in 1983-84. The NNTeB was definitely darker in the 1984-85 Apparition than in 1983-84 (by a mean intensity factor of -1.5). The NNTeB was only very slightly darker than the NPB in 1984-85 (by a mean intensity factor of -0.1).

North Temperate Zone (NTeZ). --Compared with 1983-84, the NTeZ was practically unchanged in intensity in 1984-85 (darker by a rather insignificant mean intensity factor of -0.1). The NTeZ was quite uniform in intensity from limb to limb, devoid of detail of any kind, and yellowish-white in color throughout the apparition. The NTeZ was darker (by a mean intensity factor of -0.3) than the NTrZ in 1984-85.

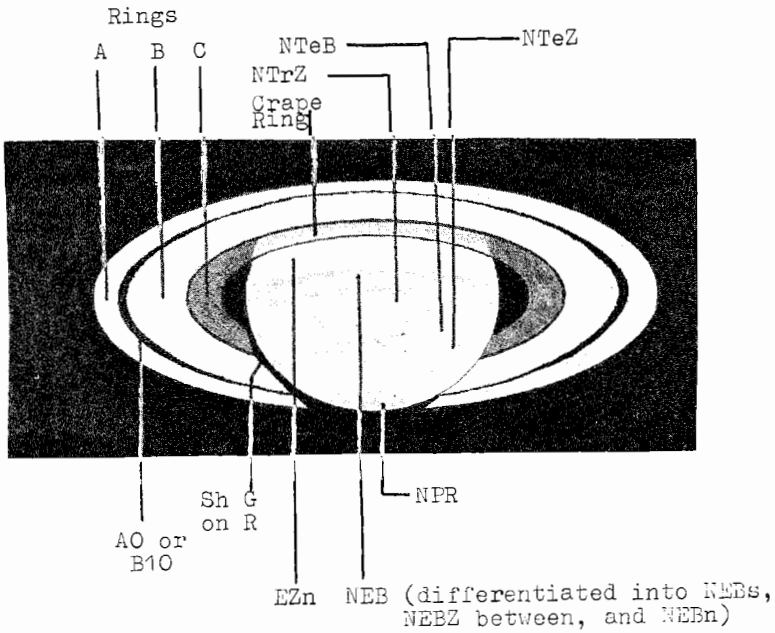

Figure 2. Diagram showing the general appearance of Saturn during the 1984-85 Apparition with the accepted nomenclature of the more obvious belts, zones, and Ring components. South is at the top, and global features appear to move across the Globe from right to left in this normal inverted view. Following the IAU convention, the planet's east is to the left. The value of B is about +24°.0, and the shadow of the Globe on the Rings is to the east of the planet, as occurs before opposition. See the text for a discussion of the Globe and Ring features shown above. Some minor features that are not shown in the diagram are the: North Polar Cap (NPC; near the North Pole); North Polar Belt (NPB; encircling the NPR); North North Temperate Belt (NNTeB; immediately north of the NTeZ); North North Temperate Zone (NNTeZ; immediately north of the NNTeB); Shadow of the Rings on the Globe (Sh R on G; when visible, either projected on the Crape Band or else just south of the projected Ring A); Terby White Spot (TWS; when visible, on Rings adjacent to the Sh G on R); Encke's Division (A5; midway between Cassini's Division and the outer edge of Ring A). Note also: "Sh G on R" is an abbreviation for the "Shadow of the Globe on the Rings"; the Crape Ring (Ring C), when projected on the Globe, is named the "Crape Band"; the portions of the Rings apparently farthest from the Globe are called the "Ansae"; "AO or B1O" is better known as "Cassini's Division."

North Temperate Belt (NTeB). --There were no sightings of the NTeB during the 1984-85 Apparition.

North Tropical Zone (NTrZ). --The NTrZ was second in brightness only to the Equatorial Zone, North Component (EZn) throughout 1984-85. Comparing this region with its appearance in 1983-84, the NTrZ was a little brighter and more conspicuous in 1984-85 (by a mean intensity factor of +0.3). The color assigned to the NTrZ in the 1984-85 Apparition was yellowish-white, and it was uniform in intensity from limb to limb during the entire apparition. No hint of activity in the NTrZ could be detected by observers during 1984-85. [Text continued on p. 6.]

Table 4. Visual Numerical Relative Intensity Estimates of Major Globe and Ring Features of Saturn During the 1984-85 Apparition With Absolute Color Estimates.

Globe or Ring Feature	Relative Intensity: Number of Estimates	Relative Intensity: Mean and Standard Deviation	Derived Absolute Color
Globe--Zones:			
NPC	1	4.40 ----	Dusky-Yellow to Yellowish-Grey
NPR	15	4.49 ± 1.11	Dusky Yellowish-Grey
NTeZ	12	6.28 ± 0.42	Yellowish-White
NTrZ	15	6.59 ± 0.42	Yellowish-White
NEB Z	11	3.61 ± 0.43	Dark Yellow-Grey
EZn	15	7.04 ± 0.57	Pale Yellow-White
Globe North of Rings (Whole)	2	6.25 ± 1.25	Dusky Yellow-Grey
Globe--Belts:			
NPB	2	4.40 ± 0.00	Dark Yellowish-Grey
NNTeB	2	4.25 ± 0.05	Dark Yellowish-Grey
NEBn	13	3.30 ± 0.13	Dark Greyish-Brown
NEBs	11	3.01 ± 0.09	Dark Greyish-Brown
NEB (Whole; Incl. NEB Z)	6	3.43 ± 0.59	Greyish-Brown
Rings (North Face):			
Ring A (Outer 1/2)	2	5.85 ± 0.05	Dusky-White
Ring A (Inner 1/2)	2	6.30 ± 0.00	Pale Dusky-White
Ring A (Whole)	13	5.13 ± 0.65	Greyish Yellow-White
Cassini's Division (A0 or B10)	2	0.30 ± 0.20	Very Dark Greyish-Black
Ring B (Outer 1/3) Standard of Intensity Scale = 8.00			White
Ring B (Inner 2/3)	4	6.93 ± 0.58	Yellow-White
Ring C (Ansae)	2	1.50 ± 0.00	Very Dark Grey
Crape Band	11	2.36 ± 0.20	Dark Grey
Shadow of Globe on Rings	8	0.66 ± 0.36	Greyish-Black
Shadow of Rings on Globe	2	0.75 ± 0.25	Greyish-Black
Terby White Spot	1	9.00 ----	Brilliant White

NOTE: Visual numerical relative intensity estimates (visual surface photometry) use the A.L.P.O. Intensity Scale where 0.0 denotes complete black (shadow) and 10.0 is the most brilliant condition for 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 be stable in overall intensity over time at most Ring inclinations. All other Globe and Ring features are systematically estimated relative to this reference standard. The procedure for conducting such visual estimates is given in the literature issued by the A.L.P.O. Saturn Section.

Table 5. Comparative Mean Intensities for Saturn's Globe and Ring Features.

Globe or Ring Feature	Mean Intensity 1983-84	Mean Intensity 1984-85	Mean Intensity Change* 1983-84 to 1984-85
Globe--Zones:			
NPR	5.4	4.5	-0.9
NTeZ	6.2	6.3	+0.1
NTrZ	6.3	6.6	+0.3
NEB Z	3.7	3.6	-0.1
EZn	6.9	7.0	+0.1
Globe--Belts:			
NNTeB	5.7	4.2	-1.5
NTeB	4.7	---	----
NEBn	3.5	3.3	-0.2
NEBs	3.2	3.0	-0.2
NEB (Whole; Incl. NEB Z)	3.9	3.4	-0.5
Rings (North Face):			
Ring A (Whole)	6.1	5.1	-1.0
Cassini's Division (A0 or B10)	1.1	0.3	-0.8
Ring B (Outer 1/3)	Standard of Intensity Scale = 8.00		
Ring B (Inner 2/3)	7.1	6.9	-0.2
Ring C (Ansae)	1.1	1.5	+0.4
Crape Band	2.6	2.4	-0.2
Shadow of Globe on Rings	0.7	0.7	0.0
Shadow of Rings on Globe	0.7	0.8	+0.1

* Positive for intensity increases, negative for decreases, and 0.0 if stable.

[Text continued from p. 4.]

North Equatorial Belt (NEB). --In 1984-85, the dark greyish-brown NEB was seen as differentiated into three components (the NEBs, NEBn, and the intermediate NEB Z) more often than it was reported as a single feature. The multiple nature of the NEB was more pronounced in 1984-85 than in 1983-84. When taken as a whole, the NEB was moderately darker (by a mean intensity factor of -0.5) in 1984-85 than in 1983-84.

The dark greyish-brown NEBs was the darkest belt on the Globe of Saturn in 1984-85, as was the case in 1983-84; and this feature was darker in the more recent apparition (by a mean intensity factor of -0.2). The NEBs was not so diffuse as it had been in recent years, and showed a general uniformity in intensity across the Globe and only a hint of activity during the course of the 1984-85 Apparition.

The NEBn, with a greyish-brown to dark greyish-brown hue, was slightly lighter in intensity in 1984-85 than the NEBs. The NEBn also showed a more linear and less diffuse appearance than in previous years. This component was also darker than it had been in 1983-84 (by a mean intensity factor of -0.2). In 1984-85, the NEBn very closely matched the average intensity of the NEB as a whole (the mean difference amounting to 0.1). No detail could be detected in the NEBn by observers in 1984-85, or at least no features which persisted long enough for even rudimentary central meridian transits to be attempted. This belt component was uniform from limb to limb.

The NEB Z was about the same overall intensity in 1984-85 as it had been in 1983-84 (having darkened by a mean intensity factor of only -0.1). Because both NEB components were darker by larger amounts in 1984-85 than in 1983-84, the NEB Z was thus more obvious as a feature separating the two belt components. The color assigned to the NEB Z was dark yellow-grey during 1984-85, and this feature showed little or no detail throughout the apparition.

Equatorial Zone (EZn chiefly). --Although exhibiting only a very minor increase in intensity since 1983-84 (by a +0.1 mean intensity factor), the pale yellow-white EZn was the brightest zone on Saturn's Globe in 1984-85. Very minor detail was detected in the EZn, chiefly in the form of suspected vague whitish spots or features and diffuse festoon activity. The Equatorial Band (EB) was not reported during 1984-85.

Shadow of the Rings on the Globe. --The projected shadow of the Ring System on the Globe was reported by observers in 1984-85 as a rather uniform greyish-black to black feature, of regular geometric form, and was seen best when seeing conditions were good. It is known that poor seeing, inadequate aperture, and other factors all conspire to give the shadow an appearance other than true black.

Shadow of the Globe on the Rings. --The shadow of the Globe of Saturn upon the Rings was seen in 1984-85 as a very dark greyish-black feature of regular form. Any deviation from a true black appearance can be ascribed to the factors noted in the previous paragraph.

Southern Portions of the Globe. --Because of the Ring inclination of approximately +23°, the likelihood of detecting southern features of the Globe was small. Some participants in our program remarked that they could see regions of the Equatorial Zone (EZ) within the Southern Hemisphere, such as the EZs, while some observers reported the SEBn. Such reports were the exception rather than the rule, and from geometrical considerations it appears likely that the SEBn would have been obscured by the Crape Band.

Latitudes of Saturn's Belts and Zones. --No latitude measurements or estimates were received during the 1984-85 Apparition.

Saturn's Ring System

The following discussion concerns the analytical reduction of observations of Saturn's Rings submitted throughout the 1984-85 Apparition, together with a comparative study of mean intensity data as has been done in previous apparition reports. The northern face of the Ring System was increasingly accessible to our view during 1984-85, with the latitude of the Earth varying from +22.°476 to +23.°828.

Ring A. --Considered as a whole, Ring A was greyish yellow-white in color during the 1984-85 Apparition, with practically no reports of any intensity differentiation. Observers noted only fleeting glimpses of Encke's Division (A5) or any other "intensity minima." Compared with 1983-84, Ring A was fairly dim in 1984-85 (with a decrease of -1.0 mean intensity factor).

On rare occasions, observers reported that the outer half of Ring A was darker than its inner half (with an intensity difference of 0.4). In 1983-84, the same relative brightness difference had been seen between the inner and outer halves of Ring A. In 1984-85, the outer half of Ring A was dusky white on most occasions, while the inner half was pale dusky white. [Text continued on p. 9.]

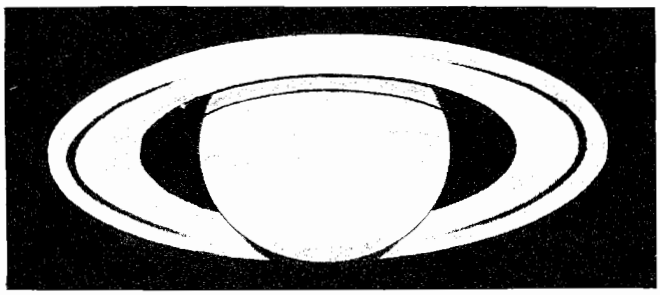

Figure 3. Drawing of Saturn by Donald H. DeKarske, on 1985 APR 16, 08:44-08:53 U.T., with a 10-cm. (4.0-in.) refractor at 120X, 167X, and 214X. Seeing 4-7 (scale of 10, ranging from 0 for worst to 10 for perfect), transparency 4.0 (limiting magnitude). CM(I) = 079- 085°; CM(II) = 351-356°. B = +23.°48; B' = +23.°07. "CM" refers to the longitude of the central meridian; "System(I)", with a rotation rate of 844°.3/day, is used for the NEBs, EZ, and SEBn; "System(II)", rotating at a rate of 812.°0/day, is used for the remainder of the Globe. B and B' are the Saturnicentric latitudes of the Earth and the Sun, respectively. South is to the top in Figures 3-5. Note that all three drawings were made with relatively small apertures.

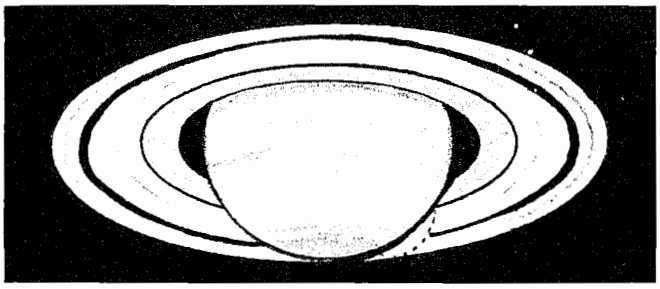

Figure 4. Drawing of Saturn by Phillip W. Budine, made on 1985 MAY 22, 02:55-03:10 U.T., using an 8.9-cm. (3.5-in.) Maksutov reflector at 130X and 160X. Seeing 8-9 (scale of 10), transparency 5 (scale of 5). CM(I) = 033-042°; CM(II) = 228-238°. B = +22.°95; B' = +23.°33. Note the Terby White Spot (TWS) on the Rings to the lower right of the Globe.

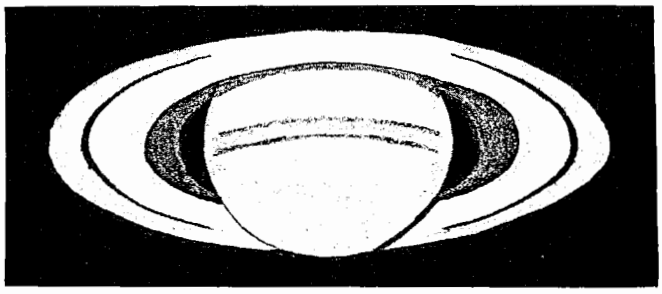

Figure 5. Saturn as drawn by David L. Graham on 1985 JUN 15, 22:25-22:40 U.T. with a 15.2-cm. (6.0-in.) refractor at 222X. CM(I) = 103-112°; CM(II) = 218-227°. B = +22.°63; B' = +23.°50.

[Text continued from p. 7.]

Ring B. --The outer third of Ring B is the adopted standard of reference for the A.L.P.O. Visual Numerical Relative Intensity Scale for Saturn, with an assigned constant intensity value of 8.0. Throughout 1984-85, this region was stable in intensity with no suspected variations, having a white appearance, and was the brightest Saturnian feature (both for Globe and Rings).

The inner two-thirds of Ring B, chiefly yellow-white in color, was just slightly darker in 1984-85 than it was in 1983-84 (by a mean intensity factor of -0.2). The inner portion of Ring B exhibited a uniform intensity throughout with no definite "intensity minima" visible during the apparition anywhere on Ring B..

Cassini's Division (A0 or B10) was usually visible completely around the visible north face of the Ring System, and it exhibited a very dark greyish-black coloration throughout 1984-85. When clearly detected in good seeing, the intensity assigned to Cassini's Division was much darker than in 1983-84 (by a mean intensity factor of -0.8).

Ring C. --Observers in 1984-85 noted that Ring C at its ansae was rather difficult to see, but that it was somewhat more obvious than in 1983-84. Ring C showed an overall brightness increase since 1983-84 (by a +0.4 mean intensity factor), and the color given to it at its ansae was very dark grey. Ring C was uniform in intensity throughout.

The Crape Band (Ring C projected in front of the Globe) was nearly the same in appearance and intensity in 1984-85 as it had been in 1983- 84. The mean intensity of the Crape Band showed only a minor change since the previous apparition, darkening by an intensity factor of -0.2. The color of the Crape Band was dark grey in 1984-85. [The varying visibilities of the shadows of Ring B and Ring C may affect the apparent darkness of the Crape Band. Ed.]

Other Ring Components. --No indications of Ring D (internal to Ring C) or Ring E (external to Ring A) were received during 1984-85. The past experience of A.L.P.O. observers has shown that these Ring components are, at the very best, exceedingly difficult to detect.

Terby White Spot. --The Terby White Spot (TWS) was only infrequently reported during 1984-85. [Figure 4 (p. 8) shows one drawing that depicts this feature. Ed.]

Bicolored Aspect of the Rings. --Although several observers applied systematic filter techniques to the ansae of Saturn's Rings, looking for the curious bicolored aspect whereby one ansa would appear "enhanced" or brighter in one filter while not so in another, there were no instances during 1984-85 in which any intensity differences could be noted. When such reports were submitted, both ansae were of equal brightness in blue (Wratten Filter 47), red (Wratten Filter 25), and integrated light (no filter). Regular and systematic observations in search of this puzzling intensity phenomenon are sought from observers throughout each apparition. Simultaneous reports by different observers are very important here.

The Satellites of Saturn

Although many observers indicated that they detected several of Saturn's brighter satellites, no useful magnitude estimates were submitted during 1984-85. Observers are encouraged to undertake systematic visual magnitude work on the brighter satellites of Saturn. Procedures for doing so can be found in the appropriate literature supplied by the A.L.P.O. Saturn Section.

Conclusions

As can be seen from the foregoing report, our team of observers took part fairly actively in the more general programs of observation in 1984-85. These endeavors mainly included visual numerical relative intensity estimates, full-disk drawings of Saturn, studies of Saturn's Globe and Ring morphology, and limited efforts to detect the bicolored aspect of the Rings. Subjects needing more intense observation include satellite magnitude estimates, latitude measures and estimates, colorimetric work with filters of known transmission, and central meridian transits when detail permits. It is important to point out that observers are particularly urged to follow Saturn throughout each apparition from shortly after a solar conjunction to shortly before the next one.

In coming apparitions, Saturn will even better exhibit the Northern Hemisphere of the Globe and the north face of the Rings. With the Rings opening to their maximum extent, Northern-Hemisphere Globe and Ring features will be seen to their greatest advantage, and close surveillance with telescopes of all apertures should generate valuable data. Individuals are heartily welcomed to participate in our programs, and the writer is always delighted to assist the novice as well as the experienced observer as he or she embarks on a systematic program of study. Readers are urged to write the author about their interests and observational preferences.

In closing, the author would like to thank the group of dedicated observers who made this report for 1984-85 possible. The continued voluntary efforts of these friends and colleagues is vital to our programs. Our work is becoming more and more international in scope and this is certainly a desirable trend in view of the completeness of coverage that we seek.

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[The above report describes the observations submitted to the A.L.P.O. Saturn Section for that planet's 1984-85 Apparition. We have also received a summary of the observations conducted by the Saturn Section of the Unione Astrofili Italiani (U.A.I.) for the same apparition. It is very useful to have two independent reports on the same planet for the same time period, as we also had for the 1983-84 Apparition of Saturn. The U.A.I. report is presented below and should be compared with the A.L.P.O. report above. 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. Ed.]

VISUAL OBSERVATIONS OF SATURN IN 1985

By: Gianluigi Adamoli, Saturn Section, Unione Astrofili Italiani

Abstract. --This paper describes 126 observations by 17 observers of the planet Saturn in 1985. In June and July, activity was reported in the NEB; its South Component was decidedly the darkest, widest, and most active NEB component. Despite unfavorable seeing, the EB and NTB [NTeB] were also seen.

General Remarks

A total of 126 visual observations were contributed by the following 17 observers: G. Adamoli (Padova), P. Aucelli (Naples), S. Baroni (Milan), M. Barretta (Naples), G. Borgonovo (Milan), S. Calì (Palermo), F. Carro (Naples), L. D'Allio (Milan), G. De Simone (Naples), E. Di Giovanni (Pescara), A. Ferlito (Naples), M. Frasca (Naples), S. Gargano (Milan), M. Giuntoli (Pistoia), A.W. Heath (Great Britain), A. Manna (Switzerland), and E. Palumbo (Salerno). These observers used both reflecting and refracting telescopes, typically 20 cm. in aperture.

Opposition was on 1985 MAY 15, when B equaled $+23^{\circ}$, a value that remained virtually constant throughout the observing period (1985 MAR 31-SEP 13), thus making the Globe essentially invisible south of the EZ. Due to Saturn's southerly declination (-17° at opposition), the planet was low in the sky for our observers; and unfavorable seeing often prevented them from using their instruments to full advantage. Table 1 (p. 12) summarizes data for the major features of Saturn's System based upon 1325 intensity estimates (on the B.A.A. scale), 651 color estimates, and 441 latitude measurements made upon drawings. The table's intensity values are means, weighted by the observer depending on whether he contributed 1-2, 3-6, or 7 or more estimates. The latitude values are Saturnicentric and are simple means of all the measures. These latitudes are graphed on Figure 6 (p. 11) with those for the previous four apparitions.

The Rings

Visual intensity estimates gave the largest brightness difference in recent years between the two components of Ring B [1, 2, 3, 4]. They also indicate that Ring C was brightest at its ansae and darkest when projected on the Globe. Intensity estimates of the sky background near Saturn, on the same scale as for the Globe and Ring features, gave a mean value of 7.6 (5 observers), which is a measure of the light pollution suffered at most observing sites. [And also of the scattered light due to the instrument and the Earth's atmosphere. Ed.] Accordingly, referring to Table 1, Cassini's Division (8.3) and the Globe Shadow (8.4) were actually completely black.

The general hue of the Rings, widely confirmed in recent years, is yellow, which degrades to greyish in the darkest regions (inner Ring B, Ring C on the Globe) [1, 2, 3, 4]. Intensity estimates through red (Wratten 25) and blue (Wratten 47) filters by Heath confirm that Ring A is brighter in red light than in blue.

The Globe

Due to unfavorable seeing, we had only a few indications of atmospheric activity in the equatorial region. In all likelihood, there was actually considerable activity, according to observations by De Simone, Di Giovanni, and Giuntoli in June - July. For example, the NEBs had irregular condensations on June 3 (Di Giovanni), confirmed in the same longitudes on June 21 (Di Giovanni and Giuntoli, independently of each other). The NEBn was duller, much less wide, and comparatively less active, with only one observation of irregularities on its north edge. Sometimes the NTB [NTeB] formed with the NEB the appearance of a triple belt with one component (the NEBs) markedly the widest and darkest component, and with the other two almost equal.

The EZ was somewhat duller than previously, and certainly darker than the outer Ring B. Three observers saw the EB almost exactly centered on the Equator. The NPR was darker than in recent years and remarkably smaller. However, one must remember that its degree of visibility varies considerably with the Saturnicentric declination of the Earth.

The general hue of the Globe and the Rings was uniformly warm (e.g., yellow zones and brownish belts). This is also confirmed by Heath's filter intensity estimates, mentioned above, in which the EZ, NEB, and NPR were all darker through the blue filter (the EZ very remarkably so).

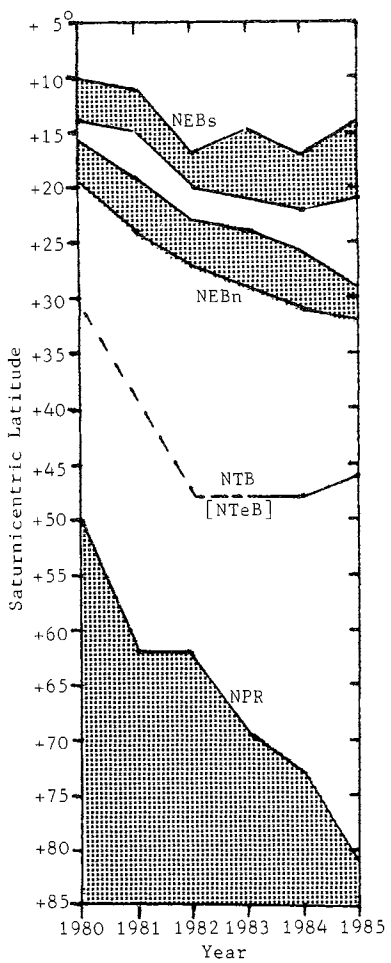

Figure 6. Graph of Saturnicentric latitudes of Northern Hemisphere features as measured by members of the Unione Astrofili Italiani for the 1980-85 Apparitions.
[Note the large latitude variations for the "NTB", which may have been identified with both the NTeB and the NNTeB, and of the NPR, which may have been influenced by the varying visibility of the NPB and the NPC. The overall northerly trend for features may be real or may reflect a biasing due to changes in B . Ed.]

Table 1. Intensities, Colors, and Latitudes of Saturnian Features in 1985.

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	3.0 (17)	Yellow-Grey (16)	---
Cassini's Division	8.3 (17)	---	---
Ring B1 [B; outer]	1.1 (17)	Yellow-White (16)	---
Ring B2 [B; inner]	2.7 (8)	Grey (7)	---
Ring C [ansae]	6.5 (7)	---	---
Rings A and B across Globe	1.4 (8)	Yellow (6)	---
Ring C across Globe	7.3 (14)	Grey (10)	---
Globe Shadow on Rings	8.4 (16)	---	---
EZ	1.6 (16)	Yellow-White (11)	---
EB	4.7 (3)	---	$+1^{\circ}$ (7)
NEBs	4.4 (17)	Grey-Brownish (16)	$+14^{\circ}$ (109) to $+21^{\circ}$ (59)
NEB Interior Zone [NEB Z]	2.1 (8)	Yellow (5)	---
NEBn	3.8 (17)	Grey-Brownish (16)	$+29^{\circ}$ (59) to $+32^{\circ}$ (109)
NTrZ	2.3 (16)	Yellow (11)	---
NTB [NTeB]	3.6 (8)	Grey-Brownish (5)	$+46^{\circ}$ (17)
NTZ [NTeZ]	2.3 (8)	Yellow-Grey (4)	---
NPR	4.5 (15)	Grey (14)	edge $+81^{\circ}$ (81)

For the identifications of features see the previous article, p. 4. There is a strong negative relationship between the U.A.I. and the A.L.P.O. intensity estimates ($R = -0.879$), where: (A.L.P.O. Intensity) = $(7.9 \pm 0.7) - (0.89 \pm 0.14)$(U.A.I. Intensity), with a standard error of $\pm$ 1.21. These results are not significantly different from the same relationship for the 1983-84 Apparition. [Ed.]

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THE METEOROLOGY OF MARS--PART II

By: J.D. Beish, C.F. Capen, and D.C. Parker, A.L.P.O. Mars Recorders; Institute for Planetary Research Observatories

Abstract. --This paper is the second of a series of A.L.P.O. Mars reports, and presents the results of a computerized analysis of the meteorology of Mars over a 20-year period. Seasonal percentage tables covering ten Martian years from 1963-65 through 1983-85 are listed for evening clouds (EC), morning clouds (MC), discrete clouds (DC), yellow clouds (YC), cloud bands (CB), and white areas (WA).

The long and laborious task of evaluating, measuring, and cataloging more than 6,000 reports is finished, and the computerization of the meteorology data is completed. The Martian Meteorological Survey indicates future weather trends for the Red Planet.

Mars observations and information for this project were contributed by A.L.P.O. planetary astronomers. The Mars Section Recorders wish to thank all of the International Mars Patrol (IMP) observers around the world for their time at the telescope and for their effort in supplying the massive amount of quality material that was used for this survey.

Introduction

In 1979, the A.L.P.O. Mars Recorders began to evaluate, measure, and catalog the clouds and bright patches recorded in the many volumes of Mars observations in order to determine the meteorological conditions on the planet for the 20-year period from 1963-65 through 1983-85. [1,2] During the past six years, we have measured and cataloged the meteorological information contained in the A.L.P.O. Mars Section Library's many thousands of visual and photographic observations of Mars.

We are finally at the end of this tedious task and have completed handwritten histograms of event frequencies. Using Digital PDP-11/55 and Osborne-1 computers, the authors have started a statistical analysis of these data in order to develop a scientific model for the observed Martian weather. [3,4,5]

Regularly in the A.L.P.O. Mars Reports, we have strongly appealed to observers to use color filters when observing Mars. This is very important for our study of Mars' weather and greatly increases the quality of information in planetary observing. We again urge observers to use the modern observing techniques developed over the years by the authors and other astronomers all over the world. [6,7,8]

It may be of interest to our readers that the reliability of the observational reports has steadily improved over the past few years. The proportion of reports that have been reliable has increased from 80 percent to an estimated 95 percent. With more reliable data, we are able to identify systematic errors to a high degree, and thus to present more accurate results in our reporting on Mars' meteorology.

The use of color filters is just one way by which we have increased our ability to observe Mars and to produce reports with fewer errors. The worldwide network of Mars observers, through its consistent round-the-clock surveillance, provides substantial data about the weather conditions on Mars. It is time that A.L.P.O. observers shared in the fruits of their labors by being able to see at least the summary results of our analysis thus far.

The tables in this report present simple percentages of the frequency with which we observe the various types of meteorological phenomena on Mars. These results are arranged by season. Because their axial tilts are similar, Mars' seasons are analogous to those of the Earth. From the Earth, we see both the Northern and the Southern Hemispheres of Mars, so we must specify which Hemisphere's seasons we are talking about. As is customary, we use the northern seasons in our tables.

Due to the greater eccentricity of the Martian orbit, the seasons on Mars are not so symmetrical as Earth's. The Martian northern spring or summer are longer than autumn or winter (this difference is reversed for the Southern Hemisphere). For our statistical analyses, these percentages are usually based on the number of events observed during seasonal periods in relation to the actual time spent observing Mars during that particular season. The Martian year of four seasons starts with its Vernal Equinox at 0° planetocentric longitude of the Sun (L_S), and the Sun moves eastward in the Martian sky as the year progresses. The Martian Northern Hemisphere seasons are defined in degrees as follows (in parentheses are their lengths in terrestrial days):

Spring, L = 000°- 090° (199 days);
Summer, L = 090°- 180° (183 days);
Autumn, L = 180°- 270° (147 days);
Winter, L = 270°- 360° (158 days).

Each season is subdivided into 30-degree L_S periods ("subseasons"), and in our final analysis degree-by-degree averages are taken. Time-series evaluations with tables and curves for the event-frequency distributions are in the making and are expected to be included in the next Part of "The Meteorology of Mars."

Statistical Evaluation

Figure 7 (p. 14) is a histogram of the observational periods for the ten Mars apparitions from 1963-65 through 1983-85, and is separated into four sections to indicate the four Martian Northern Hemisphere seasons. The percentages above the dashed lines indicate the proportion of L_S degrees that were observed each season in each apparition. At the bottom, ten-apparition average observing percentages are given for each season. At the top, ticks demarcate 30-degree L_S intervals in order to designate each subseason.

L_s	000° 030° 060°	090° 120° 150°	180° 210° 240°	270° 300° 330° 360°
YEAR				
1963-65	------64%-----	------48%-----	2%	
1966-68	------51%-----	------94%-----	------72%-----	22%
1968-69	6%	------51%-----	------61%-----	10%
1970-72		13%	------93%-----	46%
1972-73	28%	6 %	------46%-----	------87%-----
1974-76	------77%-----	6%	----23%-----	------61%-----
1977-78	------91%-----	21%		---40%-----
1979-81	------98%-----	------66%-----	1%	17%
1981-83	------72%-----	------96%-----	------41%---	5%
1983-85	-----68%-----	-----100%-----	------50%-----	17%
SEASON	SPRING	SUMMER	AUTUMN	WINTER
MEAN	62%	50%	43%	34%

NOTE: Percentages above give the proportion of actual L_s degrees observed.

Figure 7. Apparition observation history, showing the degrees of L_s observed during the Martian apparitions from 1963-65 through 1983-85.

In order to demonstrate how the visual observations are evaluated, /Figure 8/ (p. 15) illustrates our standard meteorological designations for the various phenomena reported. Each type of phenomenon is classified, cross-checked with the observation's notes, and then measured with a transparent overlay grid to determine its Martian latitude and longitude.

Percentage frequencies for each cloud type have been calculated on the basis of the ratio of the number of observed activities to the degrees of L_s observed. In other words, if someone is observing Mars during a particular L_s degree and sees a cloud, it will be recorded as a "hit" for that period. It should be noted that Mars is not observed throughout its entire orbit, despite our attempted constant surveillance, because Mars is unobservable when near conjunction with the Sun. However, for our statistical analysis, we are interested only in the actual time spent observing Mars and not merely the 90-degree L_s period for each season.

We have found by using simple graphs a linear relationship between the number of clouds reported and the frequency of L_s degrees observed. The relationship of "active" versus "clear" degrees L_s appears to be independent of the amount of time during which Mars is actually observed.

Percentage Tables

Table 1 (p. 16) is a summary of the results of our statistical analysis for each cloud type by season. White areas are included in the meteorological survey, although not all white areas observed on Mars are atmospheric; some are surface frosts. Average frequencies are given for each subdivision and for the entire apparition. Tables 2-6 (pp. 17-21) provide a more detailed breakdown for each cloud type by season for each apparition and also differentiate between Northern Hemisphere and Southern Hemisphere activity. Also included in these tables are limb and polar hazes. Observational errors may appear in these statistics as well, due to confusion between clouds and hazes, which can occur if the proper color filters were not used.

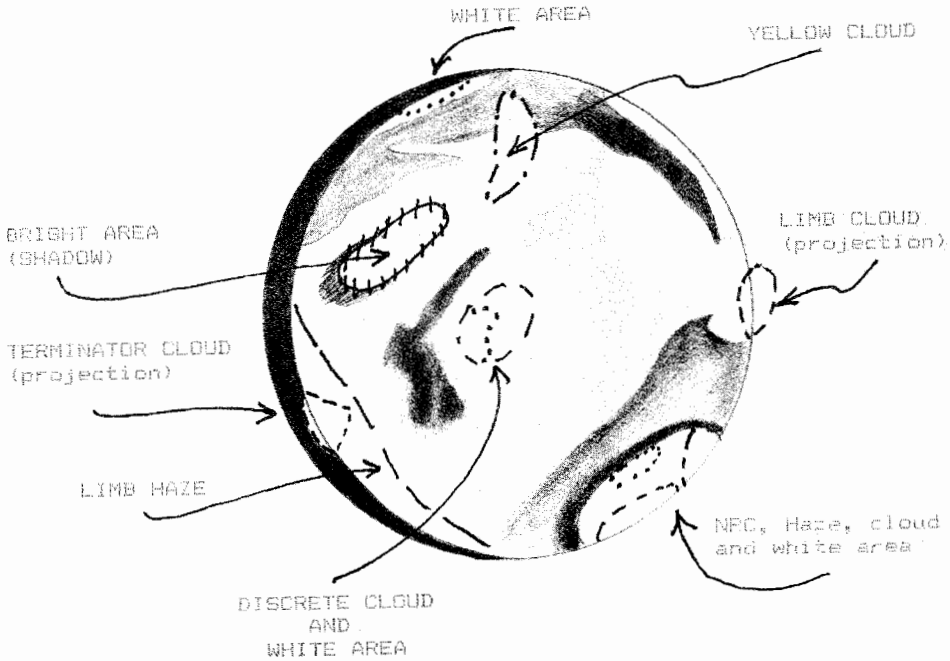

Figure 8. Illustration of hypothetical Mars observation report, showing all combinations of cloud types. The dark lines on the drawing represent the following types of boundaries:

Shadow or Unknown	//////////
Yellow Clouds	-·-·-·-
Clouds and Hazes	- - - - -
White Areas	·····
Polar Cap Boundary	———

In each table, the percentages reflect the number of activities versus the number of degrees L_s observed for each period. These values thus represent the negative as well as the positive inference for clear periods versus cloudy periods.

"Blue Clearing is included in our study, although its true nature remains unknown. However, we have found to our surprise that, when comparing periods of strong blue clearing with periods during Martian dust storms, a high percentage of observational reports indicates strong blue clearing in areas near the dust clouds. This inference is, of course, not conclusive, but is worth further study.

Conclusion

Trend and regression curves are being prepared for each classification of meteorological phenomena and we hope to develop a "meteorological standard model of Mars." While some conclusions may be drawn from the data presented, an overall systematic error-free analysis has yet to be published. [There may well be a biasing of results due to the varying apparent size, phase, and axial orientation of Mars during and between apparitions. Ed.] The next part of this series will contain a more detailed analysis of our survey. Systematic errors for observing conditions, observers, and equipment will be presented, along with detailed statistics of average cloud and white area activities for each season. Well-known classical weather areas of Mars have shown at least some predictability in terms of Mars' climate and in our study. We have tried to make a small step toward a better understanding, not only of Mars' climate, but of our own planet. [Text continued on p. 17.]

Table 1. Martian Meteorological Survey for the 1964 - 1984 Apparitions.

APPARITIONS	1963 - 65	1966 - 68	1968 - 69	1970 - 72	1972 - 73	1974 - 76	1977 - 78	1979 - 81	1981 - 83	1983 - 85	MEAN*
SPRING. L_s Observed	58°	46°	0°	0°	25°	69°	82°	88°	65°	55°	49°
Evening Clouds (EC)	64%	48%	0%	0%	84%	81%	88%	59%	78%	76%	72%
Morning Clouds (MC)	29	43	0	0	84	55	80	65	85	60	62
Discrete Clouds (DC)	28	37	0	0	28	25	72	52	58	29	41
Yellow Clouds (YC)	0	0	0	0	0	9	5	2	3	36	6
Cloud Bands (CB)	0	20	0	0	0	0	1	1	5	0	3
White Areas (WA)**	66	76	0	0	0	16	29	22	49	42	37
Evening Limb Haze (EH)	14	46	0	0	28	22	15	6	40	40	26
Morning Limb Haze (MH)	72	43	0	0	20	10	41	35	62	38	40
Blue Clearing***	29	20	0	0	0	0	4	20	43	45	20
Arctic Clouds/Haze	16	30	0	0	92	51	57	18	45	69	47
Antarctic Clouds/Haze	59	30	0	0	100	62	50	40	49	18	51
SUMMER. L_s Observed	43°	85°	46°	12°	0°	0°	19°	59°	86°	90°	44°
Evening Clouds (EC)	72%	58%	76%	17%	0%	0%	79%	86%	97%	94%	72%
Morning Clouds (MC)	26	39	63	0	0	0	84	81	95	92	60
Discrete Clouds (DC)	2	35	43	0	0	0	42	53	79	86	45
Yellow Clouds (YC)	0	0	11	42	0	0	0	3	13	37	13
Cloud Bands (CB)	0	29	0	0	0	0	0	5	22	2	7
White Areas (WA)**	63	82	33	17	0	0	0	29	53	60	42
Evening Limb Haze (EH)	44	2	37	17	0	0	21	42	50	26	29
Morning Limb Haze (MH)	33	8	41	58	0	0	11	39	29	50	33
Blue Clearing***	26	53	30	0	0	0	5	49	28	62	31
Arctic Clouds/Haze	40	79	26	50	0	0	68	53	83	82	60
Antarctic Clouds/Haze	16	72	87	75	0	0	68	42	88	77	65
AUTUMN. L_s Observed	0°	65°	55°	84°	41°	21°	0°	0°	37°	58°	36°
Evening Clouds (EC)	0%	74%	35%	67%	37%	5%	0%	0%	95%	41%	52%
Morning Clouds (MC)	0	18	36	58	56	29	0	0	80	31	46
Discrete Clouds (DC)	0	17	38	63	20	19	0	0	30	16	31
Yellow Clouds (YC)	0	0	0	23	37	5	0	0	0	0	10
Cloud Bands (CB)	0	2	0	0	0	0	0	0	0	0	0
White Areas (WA)**	0	46	40	37	12	0	0	0	19	7	25
Evening Limb Haze (EH)	0	17	36	69	20	10	0	0	46	21	33
Morning Limb Haze (MH)	0	20	20	85	63	0	0	0	38	2	37
Blue Clearing***	0	20	2	15	0	0	0	0	0	22	6
Arctic Clouds/Haze	0	100	60	39	63	0	0	0	57	53	53
Antarctic Clouds/Haze	0	14	69	45	15	14	0	0	49	52	27
WINTER. L_s Observed	0°	20°	0°	41°	78°	55°	36°	15°	0°	15°	26°
Evening Clouds (EC)	0%	70%	0%	12%	62%	45%	81%	60%	0%	93%	55%
Morning Clouds (MC)	0	35	0	7	63	62	42	67	0	27	46
Discrete Clouds (DC)	0	0	0	10	67	38	44	7	0	0	27
Yellow Clouds (YC)	0	0	0	100	43	9	0	0	0	0	25
Cloud Bands (CB)	0	0	0	0	0	0	0	0	0	0	0
White Areas (WA)**	0	30	0	10	13	31	11	0	0	0	15
Evening Limb Haze (EH)	0	25	0	68	18	22	6	0	0	27	23
Morning Limb Haze (MH)	0	0	0	22	46	85	81	47	0	0	46
Blue Clearing***	0	65	0	0	0	9	0	0	0	0	12
Arctic Clouds/Haze	0	100	0	83	50	76	94	67	0	27	78
Antarctic Clouds/Haze	0	0	0	73	26	55	72	53	0	27	46
Total L_s Observed	101°	216°	101°	137°	144°	145°	137°	162°	188°	218°	154°

* Means based on observed periods only. *** Nature of Blue Clearing unknown.
** White areas may be either surface or atmospheric.

Table 2. Martian Meteorological Survey, 1963-65 and 1966-68.

TYPE	1963-65 Spr.	Sum.	Aut.	Win.	Appar.	1966-68 Spr.	Sum.	Aut.	Win.	Appar.
	%	%	%	%	%	%	%	%	%	%
Evening Clouds (EC)	64	72	0	0	66	48	58	74	70	62
EC--North	62	67	0	0	63	35	33	58	45	42
EC--South	28	19	0	0	23	15	25	15	25	20
Morning Clouds (MC)	29	26	0	0	27	43	39	18	35	33
MC--North	28	26	0	0	26	30	22	15	25	22
MC--South	5	14	0	0	9	13	16	6	10	12
Discrete Clouds (DC)	28	2	0	0	17	37	55	17	0	35
DC--North	28	2	0	0	17	26	32	14	0	22
DC--South	14	0	0	0	8	11	24	5	0	13
Yellow Clouds (YC)	0	0	0	0	0	0	0	0	0	0
YC--North	0	0	0	0	0	0	0	0	0	0
YC--South	0	0	0	0	0	0	0	0	0	0
Cloud Bands (CB)	0	0	0	0	0	20	29	2	0	16
CB--North	0	0	0	0	0	13	20	2	0	11
CB--South	0	0	0	0	0	7	13	2	0	7
White Areas (WA)	66	63	0	0	63	76	82	46	30	65
WA--North	52	42	0	0	47	76	80	11	15	52
WA--South	38	44	0	0	40	67	71	46	20	58
Evening Haze (EH)	14	44	0	0	26	46	2	17	25	18
EH--North	10	44	0	0	24	33	2	12	15	13
EH--South	14	42	0	0	5	13	1	5	10	6
Morning Haze (MH)	72	33	0	0	54	43	8	20	0	19
MH--North	72	9	0	0	45	33	8	15	0	15
MH--South	55	21	0	0	40	43	8	20	0	19
Blue Clearing (BC)	29	26	0	0	27	20	53	20	65	37
BC--North	29	19	0	0	24	20	49	12	45	31
BC--South	5	12	0	0	8	7	49	20	65	33
Arctic (NPC)	16	40	0	0	25	30	79	100	100	77
Antarctic (SPC)	59	16	0	0	41	30	72	14	0	39
Degrees L_s Observed	58	43	0	0	101	46	85	65	20	216

NOTES: Percentages are based on the number of active degrees L_s versus the number of degrees L_s observed during the period.
Abbreviations of column headings are: Spr. = Spring; Sum. = Summer; Aut. = Autumn.; Win. = Winter; and Appar. = Apparition (whole).
Martian Northern Hemisphere seasons are used.

[Text continued from p. 15.]

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[Continued on p. 18.]

Table 3. Martian Meteorological Survey, 1968-69 and 1970-72.

TYPE	1968-69 Spr.	Sum.	Aut.	Win.	Appar.	1970-72 Spr.	Sum.	Aut.	Win.	Appar.
	%	%	%	%	%	%	%	%	%	%
Evening Clouds (EC)	0	76	35	0	53	0	17	67	12	46
EC--North	0	63	29	0	45	0	17	48	12	34
EC--South	0	43	31	0	37	0	0	57	12	39
Morning Clouds (MC)	0	63	36	0	49	0	0	58	7	38
MC--North	0	61	33	0	46	0	0	36	0	22
MC--South	0	43	13	0	27	0	0	52	7	34
Discrete Clouds (DC)	0	43	38	0	41	0	0	63	10	42
DC--North	0	39	31	0	35	0	0	27	0	17
DC--South	0	24	20	0	22	0	0	60	10	39
Yellow Clouds (YC)	0	11	0	0	5	0	42	23	100	47
YC--North	0	4	0	0	2	0	17	10	100	37
YC--South	0	11	0	0	5	0	42	23	100	47
Cloud Bands (CB)	0	0	0	0	0	0	0	0	0	0
CB--North	0	0	0	0	0	0	0	0	0	0
CB--South	0	0	0	0	0	0	0	0	0	0
White Areas (WA)	0	33	40	0	37	0	17	37	10	27
WA--North	0	9	7	0	8	0	8	5	0	4
WA--South	0	30	33	0	32	0	17	37	10	27
Evening Haze (EH)	0	37	36	0	37	0	17	69	68	64
EH--North	0	28	31	0	30	0	17	61	66	58
EH--South	0	28	35	0	32	0	17	58	66	57
Morning Haze (MH)	0	41	20	0	30	0	58	85	22	64
MH--North	0	39	16	0	27	0	50	77	20	58
MH--South	0	30	13	0	21	0	50	79	15	57
Blue Clearing (BC)	0	30	2	0	15	0	0	15	0	9
BC--North	0	20	2	0	10	0	0	12	0	7
BC--South	0	30	0	0	14	0	0	13	0	8
Arctic (NPC)	0	26	60	0	45	0	50	39	83	53
Antarctic (SPC)	0	87	69	0	77	0	75	45	73	56
Degrees L_s Observed	0	46	55	0	101	0	12	84	41	137

NOTES: Percentages are based on the number of active degrees L_s versus the number of degrees L_s observed during the period.
Abbreviations of column headings are: Spr. = Spring; Sum. = Summer; Aut. = Autumn.; Win. = Winter; and Appar. = Apparition (whole).
Martian Northern Hemisphere seasons are used.

[Continued from p. 17.]

5.) Capen, C.F. and Parker, D.C. (1981). "What is New on Mars--Martian 1979-80 Apparition Report II." J.A.L.P.O. , 29 , 1-2 (July), 38-41.
6.) Capen, C.F.; Beish, J.D.; and Parker, D.C. (1982). "Observing Mars IX--The 1981-82 Aphelic Apparition." J.A.L.P.O. , 29 , 5-6 (Apr.), 110-117, 119.
7.) Capen, C.F.; Parker, D.C.; and Beish, J.D. (1984). "Observing Mars XI--The 1984 Aphelic Apparition." J.A.L.P.O. 30 , 5-6 (Jan.), 125-130.
8.) Capen, C.F. (1984). "A Guide to Observing Mars." J.A.L.P.O. 30 ; 7-8 (Apr.), 172-176; 9-10 (Aug.), 186-190.

Table 4. Martian Meteorological Survey, 1972-73 and 1974-76.

TYPE	1972-73 Spr.	Sum.	Aut.	Win.	Appar.	1974-76 Spr.	Sum.	Aut.	Win.	Appar.
	%	%	%	%	%	%	%	%	%	%
Evening Clouds (EC)	84	0	37	62	58	81	0	5	45	57
EC--North	80	0	22	37	40	77	0	5	31	49
EC--South	68	0	32	58	52	78	0	5	44	54
Morning Clouds (MC)	84	0	56	63	65	55	0	29	62	54
MC--North	68	0	39	29	39	46	0	29	42	42
MC--South	48	0	44	56	51	38	0	29	55	43
Discrete Clouds (DC)	28	0	20	67	47	25	0	19	38	29
DC--North	16	0	2	23	16	20	0	14	24	21
DC--South	28	0	17	62	43	25	0	14	27	24
Yellow Clouds (YC)	0	0	37	43	34	9	0	5	9	8
YC--North	0	0	7	21	13	6	0	5	2	4
YC--South	0	0	37	43	34	4	0	5	9	6
Cloud Bands (CB)	0	0	0	0	0	0	0	0	0	0
CB--North	0	0	0	0	0	0	0	0	0	0
CB--South	0	0	0	0	0	0	0	0	0	0
White Areas (WA)	0	0	12	13	10	16	0	0	31	19
WA--North	0	0	0	1	1	6	0	0	7	6
WA--South	0	0	12	12	10	14	0	0	29	18
Evening Haze (EH)	28	0	20	18	20	22	0	10	22	20
EH--North	28	0	7	17	16	19	0	5	18	17
EH--South	20	0	15	14	15	20	0	10	20	19
Morning Haze (MH)	20	0	63	46	47	10	0	0	85	37
MH--North	20	0	63	45	46	10	0	0	85	37
MH--South	0	0	59	40	38	7	0	0	84	35
Blue Clearing (BC)	0	0	0	0	0	0	0	0	9	3
BC--North	0	0	0	0	0	0	0	0	9	3
BC--South	0	0	0	0	0	0	0	0	9	3
Arctic (NPC)	92	0	63	50	61	51	0	0	76	53
Antarctic (SPC)	100	0	15	26	35	62	0	14	55	52
Degrees L_s Observed	25	0	41	78	144	69	0	21	55	145

NOTES: Percentages are based on the number of active degrees L_s versus the number of degrees L_s observed during the period.
Abbreviations of column headings are: Spr. = Spring; Sum. = Summer; Aut. = Autumn.; Win. = Winter; and Appar. = Apparition (whole).
Martian Northern Hemisphere seasons are used.

Table 5. Martian Meteorological Survey, 1977-78 and 1979-81.

TYPE	1977-78 Spr.	Sum.	Aut.	Win.	Appar.	1979-81 Spr.	Sum.	Aut.	Win.	Appar.
	%	%	%	%	%	%	%	%	%	%
Evening Clouds (EC)	88	79	0	81	85	59	86	0	60	69
EC--North	85	79	0	58	77	58	81	0	47	65
EC--South	85	68	0	75	80	56	80	0	53	64
Morning Clouds (MC)	80	84	0	42	71	65	81	0	67	71
MC--North	78	79	0	36	67	64	81	0	67	70
MC--South	74	84	0	31	64	57	73	0	60	63
Discrete Clouds (DC)	72	42	0	44	61	52	53	0	7	48
DC--North	61	32	0	36	50	49	46	0	7	44
DC--South	65	37	0	33	53	42	20	0	7	31
Yellow Clouds (YC)	5	0	0	0	3	2	3	0	0	2
YC--North	5	0	0	0	3	1	2	0	0	1
YC--South	2	0	0	0	1	2	3	0	0	2
Cloud Bands (CB)	1	0	0	0	1	1	5	0	0	2
CB--North	1	0	0	0	1	1	5	0	0	2
CB--South	1	0	0	0	1	1	5	0	0	2
White Areas (WA)	29	0	0	11	20	22	29	0	0	22
WA--North	13	0	0	0	8	15	12	0	0	12
WA--South	21	0	0	11	15	16	24	0	0	17
Evening Haze (EH)	15	21	0	6	13	6	42	0	0	19
EH--North	15	21	0	0	12	3	42	0	0	17
EH--South	12	16	0	6	11	6	34	0	0	15
Morning Haze (MH)	41	11	0	81	47	35	39	0	47	37
MH--North	40	5	0	75	45	35	29	0	40	33
MH--South	37	11	0	81	45	34	36	0	47	36
Blue Clearing (BC)	4	5	0	0	3	20	49	0	0	29
BC--North	4	5	0	0	3	20	49	0	0	29
BC--South	4	5	0	0	3	20	49	0	0	29
Arctic (NPC)	57	68	0	94	69	18	53	0	67	35
Antarctic (SPC)	50	68	0	72	58	40	42	0	53	42
Degrees L_s Observed	82	19	0	36	137	88	59	0	15	162

NOTES: Percentages are based on the number of active degrees L_s versus the number of degrees L_s observed during the period.
Abbreviations of column headings are: Spr. = Spring; Sum. = Summer; Aut. = Autumn.; Win. = Winter; and Appar. = Apparition (whole).
Martian Northern Hemisphere seasons are used.

Table 6. Martian Meteorological Survey, 1981-83 and 1983-85.

TYPE	1981-83 Spr.	Sum.	Aut.	Win.	Appar.	1983-85 Spr.	Sum.	Aut.	Win.	Appar.
	%	%	%	%	%	%	%	%	%	%
Evening Clouds (EC)	78	97	95	0	90	76	94	41	93	76
EC--North	69	97	62	0	80	71	94	40	60	72
EC--South	75	97	81	0	86	76	89	22	53	66
Morning Clouds (MC)	85	95	80	0	89	60	92	31	27	63
MC--North	78	91	81	0	80	60	91	17	27	59
MC--South	78	92	59	0	81	53	83	17	27	54
Discrete Clouds (DC)	58	79	30	0	62	29	86	16	0	47
DC--North	57	73	22	0	57	24	83	10	0	43
DC--South	32	62	19	0	43	25	78	14	0	42
Yellow Clouds (YC)	3	13	0	0	7	36	37	0	0	24
YC--North	2	13	0	0	6	35	32	0	0	22
YC--South	3	12	0	0	6	35	32	0	0	24
Cloud Bands (CB)	5	22	0	0	12	0	2	0	0	1
CB--North	5	22	0	0	12	0	2	0	0	1
CB--South	5	20	0	0	11	0	2	0	0	1
White Areas (WA)	49	53	19	0	45	42	60	7	0	37
WA--North	31	45	16	0	35	33	50	2	0	29
WA--South	40	33	8	0	30	25	37	5	0	23
Evening Haze (EH)	40	50	46	0	46	40	26	21	27	28
EH--North	32	48	46	0	42	33	22	21	27	25
EH--South	35	37	38	0	37	36	20	16	27	23
Morning Haze (MH)	62	29	38	0	42	38	50	2	0	31
MH--North	62	28	38	0	41	38	43	2	0	29
MH--South	60	10	24	0	30	35	49	2	0	29
Blue Clearing (BC)	43	28	0	0	28	45	62	22	0	43
BC--North	40	26	0	0	26	45	62	21	0	43
BC--South	34	26	0	0	23	45	62	22	0	43
Arctic (NPC)	45	83	57	0	64	69	82	53	27	67
Antarctic (SPC)	49	88	49	0	67	18	77	52	27	52
Degrees L_s Observed	65	86	37	0	188	55	90	58	15	218

NOTES: Percentages are based on the number of active degrees Ls versus the number of degrees L_s observed during the period.
Abbreviations of column headings are: Spr. = Spring; Sum. = Summer; Aut. = Autumn.; Win. = Winter; and Appar. = Apparition (whole).
Martian Northern Hemisphere seasons are used.

COMET REVIEW: 1985

By: J.V. Scotti, Assistant Recorder, A.L.P.O. Comets Section

The year 1985 was busy for comet research. It included the first glimpse of Comet Halley by amateurs in the current apparition and the first encounter by a spacecraft with a comet. Among the observable comets, seventeen were either discovered or recovered in 1985, and one was bright enough to see with the naked eye.

Previous Comets with Continued Observation in 1985

P/Halley (1982i). --At the beginning of the year Comet Halley was just becoming visible to moderate-sized professional telescopes, with a magnitude of 19.5 reported by T. Seki in late January.

With the exception of the visual detection of Comet Halley by Stephen J. O'Meara from Hawaii in January, the first visual observations of the celebrated comet were made at the end of July, when Charles S. Morris and Stephen J. Edberg estimated the comet's magnitude as 15.0 on July 27 and 28. The comet increased its activity throughout the remaining months of 1985; brightening to magnitude 12-13 in September, to about 9-10 in late October, and to magnitude 6-7 by the middle of November. The first known naked-eye detection of Comet Halley was made by Morris and Edberg during November. By the time the Moon began to intefere in mid-December, the comet had brightened to 5th magnitude and was putting on a display of jets and an ion tail. By the end of 1985, Halley's was by far the brightest comet in the sky and also the brightest of the year.

P/Giacobini-Zinner (1984e). --Comet Giacobini-Zinner began its spectacular performance in 1985 by receiving increasing publicity in preparation for the ICE Spacecraft encounter in September. Requests were made for astrometric observations of this comet in order to improve its computed orbit prior to the encounter. The first visual observations of this comet were made on April 13 when it was observed at visual magnitude 15.5 by Charles Morris and Stephen Edberg. It brightened to visual magnitude 7 or 8 in late August, and then faded. The 1985 apparition of Comet Giacobini-Zinner was one of the brightest recorded since its discovery in 1900. A CCD (charge-coupled-device) image of this comet is shown below in Figure 9 .

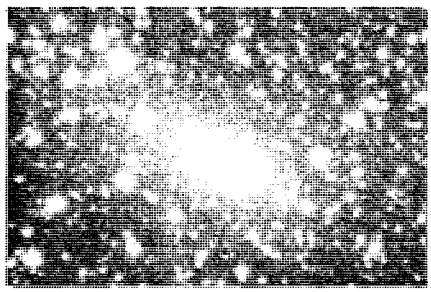

Figure 9. Image of Comet Giacobini-Zinner (1984e) made on 1985 JUN 25.364 Universal Time (U.T.) with the 91-cm. Spacewatch Camera CCD and an integration time of 66 seconds. The image scale is 1.73 arc seconds per pixel and the field shown here measures about 11 by 8 arc minutes. South is at the top and East is to the right.

Shoemaker (1984f). --Comet Shoemaker was observed visually by Charles Morris on January 18 and 20; he estimated its visual magnitude as 13.0. It was observed throughout March by Andrew Pearce and David Seargent when it was seen to brighten from about visual magnitude 12.0 to 11.7. This comet was observed by Jerry Jordan to be at about visual magnitude 10.9 on April 26. Chris Schur noted a fan-shaped tail on April 13, which was even more apparent in May when noted by Morris. Seargent and Pearce observed this comet again in June, reporting it as near visual magnitude 11. Pearce noted a 9 arc-minute tail on June 18. M.L. Clark observed this comet to be about visual magnitude 11 in November.

P/Arend-Rigaux (1984k). --Observations of this comet continued from late 1984 into early 1985. C.S. Morris reported it as being near visual magnitude 12 throughout the month of January. This comet was seen to have a tail some 8-10 arc minutes long in January in CCD images made with the 91-centimeter Spacewatch Camera. W. Wisniewski and T. Fay reported photometric observations of the nuclear region that showed 0.6-magnitude variations with a best-fitting period of 27 hours, 12 minutes during January and February (International Astronomical Union Circular ["IAUC"] 4041).

P/Schaumasse (1984m). --Periodic Comet Schaumasse was observed by C.S. Morris in January to be near visual magnitude 10, and later by J. Shanklin to be fainter, between visual magnitudes 11.2 and 11.7.

P/Tsuchinshan 1 (1984p). --Periodic Comet Tsuchinshan 1 was observed by Alan Hale and Charles Morris in January to be near visual magnitude 11. In February, J. DeYoung and J. Bortle reported it between visual magnitude 11.1 and 11.7. In March, Morris reported this comet's visual magnitude as near 11.6.

Shoemaker (1985s) .--Charles Morris observed Comet Shoemaker (1984s) to have a tail 3 arc-minutes in length on January 16. This comet was last observed visually on March 24 by Morris, who reported it as magnitude 12.0 (IAUC 4049). It was last observed by the Spacewatch Camera CCD on May 22 as a very faint and uncertain image near magnitude 19.5.

Levy-Rudenko (1984t). --Comet Levy-Rudenko was well observed throughout January and February, being reported by Charles Morris on January 3 as at visual magnitude 7.8 and by John Bortle at magnitude 8.8 on February 20. This comet was last seen visually by Bortle on March 10, who then estimated its total magnitude as 10.4 (IAUC 4057). It was last observed on May 24 by T. Gehrels and J.V. Scotti, who used the 91-centimeter Spacewatch Camera CCD. It was then quite diffuse and appeared to have faded quite rapidly as it moved westward into the Sun's glare. Figure 10 , below, shows this comet on March 22. (Personal note: It is interesting that this comet's co-discoverer was our A.L.P.O. Comets Section Recorder, David Levy, and the last to see it was our Comets Section Assistant Recorder and author of this report.)

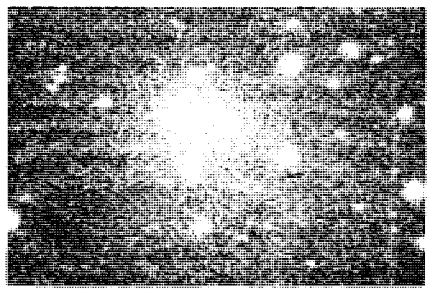

Figure 10. Comet Levy-Rudenko (1984t) on 1985 MAR 22.186 U.T., imaged with the 91-cm. Spacewatch Camera CCD and an integration time of 68 seconds. The comet appears to have a faint tail-like structure extending to the North-East. South is at the top and East is to the right. The field size in this figure is about 5.0 by 3.3 arc minutes.

Comet Discoveries and Recoveries in 1985

Seventeen comets were discovered or recovered during 1985. Table 1 (below) gives their designations, names, date and distance of perihelion, and orbital periods.

Table 1. Comets Discovered or Recovered in 1985.

Comet	Name	T/ET*	q**	P***
1985a	P/Ashbrook-Jackson	1986 JAN 24.374	2.307	7.47
1985b	P/Russell 1	1985 JUL 05.224	1.612	6.10
1985c	P/Honda-Mrkos-Pajdušáková	1985 MAY 23.890	0.542	5.30
1985d	P/Tsuchinshan 2	1985 JUL 21.189	1.794	6.85
1985e	Machholz	1985 JUN 28.740	0.106	----
1985f	P/Hartley	1985 JUN 11.608	1.540	5.61
1985g	P/Giclas	1985 OCT 01.236	1.838	6.93
1985h	P/Whipple	1986 JUN 25.023	3.077	8.49
1985i	P/Shajn-Schaldach	1986 MAY 27.332	2.331	7.46
1985j	P/Daniel	1985 AUG 04.332	1.651	7.07
1985k	P/Maury	1985 JUN 08.146	2.011	8.84
1985l	Hartley-Good	1985 DEC 09.113	0.695	----
1985m	Thiele	1985 DEC 19.188	0.984	----
1985n	P/Boethin	1986 JAN 16.452	0.778	11.2
1985o	P/Kojima	1986 APR 04.728	2.414	7.89
1985p	P/Ciffréo	1985 OCT 29.782	1.703	7.27
1985q	P/Wirtanen	1986 MAR 19.359	1.084	5.50

* Date and time of perihelion passage, given in Ephemeris Time.
** Perihelion distance in astronomical units (AU).
*** Orbital period in years ("----" indicates a parabolic orbit).

P/Ashbrook-Jackson (1985a). --The first comet recovery of 1985 was that of P/Ashbrook-Jackson by A.C. Gilmore and P.M. Kilmartin on March 20, which was then reported to be at magnitude 18 (IAUC 4048). This comet brightened throughout the first portion of the year, peaking in August and September at about magnitude 12-13 as it approached perihelion on 1986 JAN 24.

P/Russell 1 (1985b). --Periodic Comet Russell 1 was found on April 9 and 10 by J. Gibson at the Palomar Observatory with a CCD attached to the 1.5-meter reflector. He reported it to have a nuclear magnitude of 19.5, a coma 8-10 arc seconds in diameter, and a tail about 20 arc seconds long (IAUC 4053). This intrinsically faint comet did not get brighter than magnitude 18-19 throughout its observing season.

P/Honda-Mrkos-Pajdušáková (1985c) .--M.L. Clark, A. Pearce and Athanasoa reported the visual recovery of Comet P/Honda-Mrkos-Pajdušáková on April 18 and 20, giving only approximate positions (IAUC 4055). This comet remained too near the Sun to be easily observed. Indeed, it is quite remarkable that it was even observed at all, given that it was a mere 26 degrees from the Sun at the time of recovery!

P/Tsuchinshan 2 (1985d) .--Comet P/Tsuchinshan 2 was recovered with a CCD camera by J. Gibson at Palomar, being observed on April 10 at magnitude 22 and on May 8 at magnitude 21.5 (IAUC 4063). This apparition was quite unfavorable because the comet passed perihelion on July 21 while in conjunction with the Sun.

Machholz (1985e). --The first comet discovery of 1985 was made by Don Machholz on May 27 during the Riverside Telescope Makers Conference; he reported it at visual magnitude 9.5 (IAUC 4067). It eventually reached visual magnitude 6 before disappearing into the Sun's glare. The expectations for this comet's reappearance were great, with predictions of peak brightness near perihelion of about magnitude 0 or brighter. However, it appears that this comet may have disintegrated as it passed within 0.1063 AU of the Sun on June 28. The only reported earthbased sighting after perihelion was by T. Seki, who made simultaneous visual and photographic observations on July 8. His report was of a possible object of visual magnitude 10.0-10.5, as seen through clouds (IAUC 4083). The comet was not seen on subsequent nights by other observers, to a limiting visual magnitude of about 11. This comet was observed after perihelion, however, by the Solar Max satellite.

P Hartley (1985f). --Malcom Hartley discovered this comet with the 1.2-meter U.K. Schmidt telescope at Siding Spring on June 13 (IAUC 4077). It was reported at magnitude 16 and was found to be a periodic comet with a perihelion distance of 1.54 AU and an orbital period of 5.61 years.

P/Giclas (1985g). --Periodic Comet Giclas was recovered by J. Briggs and E. Everhart at the Chamberlin Observatory field station on June 22, and by G. Schwartz and C.-Y. Shao at Oak Ridge on July 18 and 21. It was reported at magnitude 20 in June and at magntiude 18 in July (IAUC 4086). It was independently recovered at magnitude 18.5 by T. Seki at Geisei on July 22 (IAUC 4089). Near mid-October, Alan Hale and Charles Morris made visual observations of this comet, both giving magnitude estimates of 13.3 and 13.4. It was observed at magnitude 14.0 by J.-C. Merlin in December.

P/Whipple (1985h). --Periodic Comet Whipple was recovered by J. Gibson on July 10 as a magnitude 20 object, and on July 25 by T. Gehrels and J.V. Scotti when it was reported to be closer to magnitude 19 (IAUC 4088). Later observations by Gehrels and Scotti reported a 10-arc second coma. When last viewed during this apparition, this comet was reported at magnitude 18.7. With a perihelion distance of 3.077 AU, it probably did not get brighter than about magnitude 18 during its 1986 perihelion passage. Figure 11 , below, shows the comet on 1985 AUG 14.

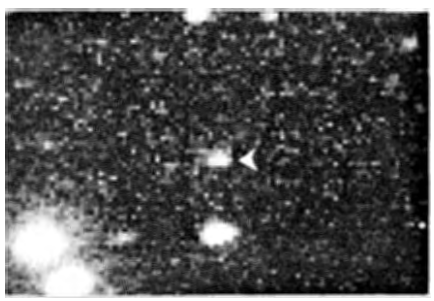

Figure 11. Comet P/Whipple (1985h) is shown by an arrowhead, imaged on 1985 AUG 14.318 U.T., about one month after it was recovered by Jim Gibson and two weeks after its position was confirmed by T. Gehrels and J.V. Scotti. Taken with the 91-cm. Spacewatch Camera CCD and a 59-second integration time. Note a tail extending about 20 arc seconds to the South-West (South at top, East to right). The field of view here is about 2.6 by 1.7 arc minutes.

P/Shajn-Schaldach (1985i). --Periodic Comet Shajn-Schaldach was recovered on July 25 and 26 by T. Gehrels and J.V. Scotti near magntiude 19 (IAUC 4089). This comet also has a relatively large perihelion distance of 2.33 AU. It was last observed by Gehrels and Scotti on August 14 with a possible 5-10 arc second coma.

P/Daniel (1985j). --J. Gibson at Palomar recovered Periodic Comet Daniel on July 27, 28, and 29, reporting a nuclear magnitude of 20 and, on July 28, 5-arc second streamers (IAUC 4092). Observations of this comet continued into 1986, although it never became brighter than about magnitude 18.

P/Maury (1985k). --Alain Maury discovered Comet 1985k while examining Schmidt plates from the Second Palomar Sky Survey that had been taken on August 16, reporting its magnitude as 16 (IAUC 4102). Later measurements during August and September indicated total brightnesses in the magnitude range of 16-17. The comet was found to have a periodic orbit with a perihelion distance of 2.011 AU and a period of 8.84 years. This comet was spotted visually by David Levy with a 1.54-meter telescope in September, 1985. It was last observed in 1985 sinking into the west during December, by J.V. Scotti using the Spacewatch Camera CCD. Magnitude estimates with this instrument showed it fading from about magnitude 17 in October to near magnitude 19 in December and at about magnitude 19.5 early in January, 1986.

Hartley-Good (19851). --On September 13, M. Hartley reported that he and A. Good had discovered a comet using the 1.2-meter Schmidt telescope at Siding Spring on a single objective-prism plate taken on September 11, and reported an obvious tail on this 12th-magnitude object (IAUC 4107). Perihelion occurred on December 9 as the comet's brightness peaked at visual magnitude 6-7. This comet was well-observed, being brighter than visual magnitude 8 from early October through conjunction with the Sun and into 1986.

Thiele (1985m). --U. Thiele discovered this comet on a 10-minute exposure with the Hamburg Schmidt on October 9 and 10 while photographing Comet Halley. Comet Thiele was reported at magnitude 13, with a 25-arc second coma surrounding a star-like core (IAUC 4119). Shortly after discovery, visual observers estimated it as at about magnitude 10. The comet brightened to magnitude 8 in November before beginning to fade as it approached perihelion on December 19.

P/Boethin (1985n). --A.C. Gilmore and P.M. Kilmartin recovered Comet P/Boethin on October 11 using the 25-centimeter astrograph at the Mount John University Observatory, reporting the comet at magnitude 15, located about -3.5 days from the location predicted (IAUC 4121). Visual estimates by D. Seargent in early November were near magnitude 10, with observations in December near magnitude 9. This object put on a better performance than had been predicted, as based on its discovery apparition.

P/Kojima (1985o). --Periodic Comet Kojima was recovered by T.Gehrels and J.V. Scotti on October 19 with the Spacewatch Camera CCD. It was reported as near magnitude 20 and was star-like to the limits of observability (IAUC 4126). It was observed by the Spacewatch Camera during November and December, and was found to be at about magnitude 18.5, with a hint of a coma in December.

Comets SOLWIND 4 and SOLWIND 5. --N.R. Neely, Jr., of the Naval Research Laboratory reported the observations of two additional probable sungrazing comets by the satellite P78-1 SOLWIND. The observations were made prior to the deliberate destruction of the satellite on September 13; SOLWIND 4 was observed on 1981 NOV 03 and 04, and SOLWIND 5 was observed on 1984 JUL 28. Computations by B.G. Marsden indicate that SOLWIND 5 (but not SOLWIND 4) is a probable member of the Kreutz Family of sungrazing comets (IAUC 4129).

P/Ciffréo (1985p). --J.-L. Heudier reported that Jacqueline Ciffréo discovered a diffuse moving object of magnitude 10 on November 8 (IAUC 4135). This comet was the second found near P/Halley in 1985. During December, it was noted that this comet had a strong curved jet extending approximately sunward 6-12 arc seconds from the nucleus. The unusual appearance of this comet included a tail about 1-2 arc minutes in length. Visual estimates in late November and December put this comet between magnitudes 10.9 and 12.5.

P/Wirtanen (1985q). --The last comet of 1985, P/Wirtanen, was recovered by A.C. Gilmore and P.M. Kilmartin on images taken on November 13 (IAUC 4139). They reported it as diffuse with a central condensation, at magnitude 19. The correction to the ephemeris predictions was -0.26 days.

COMET NOTES: IX. THE NAMING OF COMETS

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

[Note: After this paper was submitted to the A.L.P.O., a version of it also appeared in the December, 1986 National Newsletter of the Royal Astronomical Society of Canada. Nonetheless, we are publishing it here because few of our readers will have access to the above publication. Ed.]

Our modern procedures for naming comets arise from tradition and science. A newly discovered comet is assigned the name of its discoverer. Although early rules allowed but one discoverer per comet, during the nineteenth century the current rules evolved, which permit a maximum of three discoverer names. Thanks to the efforts of some persistent comet discoverers, these comet names are not always unique; in fact, there are four Comets Meier. Because a particular name is needed, at discovery each comet is assigned a letter designation based on the order of discovery or recovery in that year. Thus, Comet 1982i was the ninth comet to be located in 1982. These designations are provisional but important because they are used during the period when most of the active observations of the comet are being made. After some time has elapsed, comets are assigned new Roman Numeral designations based on the order of perihelion passage in a particular year. For example, the designation 1984 XXIII was given to the 23rd comet to pass its perihelion point during 1984.

I felt that there must be some poetic way to describe this colorful nomenclature, and found one in T.S. Eliot's book of light verse called Old Possum's Book of Practical Cats, in which one of the poems describes the three types of names for each cat. Here is a somewhat revised version:

The naming of comets is a difficult matter,
  It isn't just one of your holiday games;
You may think at first I'm mad as a hatter
When I tell you, a comet has THREE DIFFERENT NAMES.
First of all, there's the name that the family use daily,
  Such as Whipple, Wilk-Peltier, Wirtanen or Wolf,
Such as Hubble or Humason, Honda, P/Halley--
  All of them sensible everyday names.
There are fancier names if you think they sound sweeter,
  Some for the gentlemen, some for the dames:
Such as Grigg-Skjellerup, de Kock-Paraskevopoulos,
  Schwassmann-Wachmann, Herschel-Rigollet, Tsuchinshan 1,
  Churyumov-Solodovnikov, Bappu-Bok-Newkirk--
But all of them sensible everyday names.
But I tell you, a comet needs a name that's particular,
  A name that's peculiar, and more dignified,
Else how can he keep up his tail antisolar,
  Or spread out emissions, or cherish his pride?
Of names of this kind, I can give you a score.
  1910a, '84u, '86b and such,
Or '65f, '66b, '83d--there's more--
  Names that never belong to more than one comet.
But above and beyond there's still one name left over,
  And that is the name that at first you can't guess;
The name that no human research can discover--
  Until long after the comet's come and it's gone,
Like Nineteen hundred fifty-nine X--
  But the COMET HIMSELF KNOWS, and won't now confess.
When you notice a comet in profound meditation,
  The reason, I tell you, is always the same:
His mind is engaged in rapt contemplation
  Of the thought, of the thought, of the thought of his name:
    His rotational, orbital
    Coma-morphological
Deep and inscrutable singular name.

OBSERVING METEORS: IX

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

"Generations come, and generations go," the writer of Ecclesiastes intones, "but the Earth endures forever." Perhaps a most gentle but unappreciated way to understand that is to observe a meteor shower. Even to skeptics, meteor showers prove that the Earth is moving through space. Try observing on the night of a substantial shower of more than, say, 15 meteors per hour, and you can trace them back to a point or radiant. You are actually watching the Earth pick up meteors that happen to cross its path through space. This is really a natural, everynight occurrence, although most casual observers do not grasp its meaning.

Unfortunately, the Earth does not encounter significant meteor streams every week, and really major ones occur only a few times each year. The Quadrantids offer superb displays if their maximum comes at the right time and the right phase of the Moon. A reasonably careful observer of the Quadrantids can count over 60 meteors per hour, but only for the hour or two around maximum. Most Northern Hemisphere observers ignore this shower because of the inconvenience involved in observing on a clear and frigid January morning. It is unfortunate that this shower is little watched because there is little else for meteor observers until late April when the Lyrids come. In the early 1980's, Norman McLeod observed a major Lyrid display, much stronger than usual. It pays to watch every shower because occasionally the Earth encounters a dense part of a stream.

Our next chance comes with the Eta Aquarids in early May, whose 20-meteor per hour average can provide a welcome Spring experience; but then we must wait until July and August for the major showers of the Delta Aquarids and the Perseids. Fall offers two moderate showers, the Orionids of October and the Leonids of November, and one weak one, the Taurids in early November. Then we need to wait until December when the Geminids, the strongest shower of the year, makes its Christmastime presence felt.

These are the major predictable showers, but that does not mean that you should ignore the possibilities of other nights. Minor showers from confirmed radiants often fill the long gaps between the major showers, especially the Ursids of December, which can produce some bright fireballs, the Tau Herculids of June, and the Sigma Leonids of April. These minor showers often represent old streams whose members have spread out so that their presence, although light, is observable for several weeks. Watch also for the unexpected, the new shower that may manifest itself once and never again as the Earth passes through the dust trail of some unexpected comet. If you see more than 5 or 6 meteors that are traceable back to a common point, you can suspect a shower. I think that such tiny showers may be very common, so common that we needn't make a fuss over them unless we can confirm them from at least two sites. If more of these suspected radiants could be proven, and then related to comet orbits, these observations would be scientifically useful.

Even known showers can show wide variations in strength. In recent years the Perseids have been riding some celestial roller coaster, first increasing in strength in the early 1980's, then sharply declining to a low in 1985. The predicted return of their parent comet, Swift-Tuttle, at the height of the Perseids' increased strength, gave this shower much attention; but the comet, which was conspicuous in 1862, was not detected. Perhaps it will return in the early 1990's and another increase in Perseid activity near that time will certainly heighten interest in that comet's possible return. Although showers can offer a clue as to the nearness of return of the parent comet, they are not particularly reliable. Both the Eta Aquarids and the Orionids are "children" of Comet Halley; but although the Eta Aquarids showed some good activity, neither shower exhibited a dramatic increase in 1986. Often, meteoroids are irregularly clumped in their streams, and predicting when the Earth will encounter such a dense region is not possible with most showers.

In the first part of 1987 watch for these minor showers:

Delta Cancrids, January 13-21; peaking on January 16.
Virginids, February 3 - April 15; very weak, no definite peak.
Delta Leonids, February 5 - March 19; peaking on February 26.
Camelopardalids, March 14 - April 7; no definite peak.
Sigma Leonids, March 21 - May 13; peaking on April 17.
Delta Draconids, March 28 - April 17; no definite peak.
Kappa Serpentids, April 1-7; no definite peak.
Mu Virginids, April 1 - May 12; peaking on April 25.

TWO LUNAR ECLIPSES: 1983 JUN 25 AND 1986 APR 24

By: Francis G. Graham, A.L.P.O. Lunar Recorder, Eclipses and Photometry

Below are observational reports on two lunar eclipses. All times are given in Universal Time (U.T.). When lunar directions are given, they follow the IAU convention (Mare Crisium to the east and Oceanus Procellarum to the west). Observations are arranged by location.

The Partial Lunar Eclipse of June 25, 1983

Numerous contributions from A.L.P.O. members highlighted the partial lunar eclipse of June 25, 1983, which had a predicted umbral magnitude of 0.339.

Sierra Brooks, California. --John Westfall observed the eclipse photoelectrically at an altitude of 1604 meters, with a 35.6-cm. catadioptric telescope, processing data directly into an Apple-II computer. The results of this program will be published in a future issue. He also took a series of 19 photographs, one of which is reproduced to the left as Figure 12.

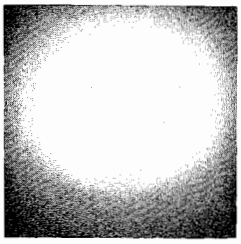

Figure 12. The partial lunar eclipse of 1983 JUN 25, photographed at 07:59.8 U.T. with a 750-mm. f/6.3 lens. 1-sec. exposure on Ektachrome 400 Film. The penumbral part of the shadow was overexposed in order to show the umbral portion, which appears at the bottom (north).

Las Cruces, New Mexico. --Walter Haas observed this event with a 32-cm. Newtonian reflector. His observations are summarized below:

08:11-08:15	Edge of umbra moderately well defined.
08:26	Border of umbra a slate-blue band 20 arc-seconds wide.
08:30.7	Aristarchus emersion from umbra.
08:35	Lack of detail inside umbra.
08:35.5	Pytheas emersion.
08:43	Diffuse slate-blue band at umbral edge.
08:48 (?)	Timocharis emersion.
09:11.1	Plato emersion.
09:16.1	Eudoxus emersion.
09:19.6	Aristoteles emersion.
09:28.3 ± 1.0	Last umbral contact with limb [Predicted at 09:30.1. Ed.].
09:32	Penumbra plain to eye.
09:36	Penumbra invisible to eye.
09:42	Shading seen on northeast limb in telescope.
09:46	Penumbra faintly visible in telescope.

East Pittsburgh, Pennsylvania. --Francis and Charmaine Graham and Theresa Palmer observed the eclipse with a Mazur 15-cm. f/12 Newtonian. Their planned photometry program failed, but they took 24 photographs of the eclipse, although it was crisscrossed by intermittent clouds. Their results have been published elsewhere [2]. Their photographs showed a greenish color during the penumbral phase.

Paragould, Arkansas. --Kermit Rhea observed from this location, recording penumbral phenomena with a 7X50 monocular. In particular, he confirmed penumbral color, although he described it as yellow.

Springfield, Ontario. --Rob Robotham observed through occasional cirrus with a 15-cm. Newtonian and binoculars. The penumbra was distinct and obvious to him although he did not see color. The umbral edge was diffuse with an orange-yellow fringe and he confirmed the dark appearance of the umbra as did all the other observers.

Summary. --All observers agreed that the umbra was dark with a diffuse edge , as was also shown by Westfall's photoelectric measures. Two observers reported large-scale color changes in the portion of the Moon outside the penumbra, although they disagreed in detail. The number of crater timings was not enough to plot accurately the apparent umbra.

References. --

1.) di Cicco, Dennis (1983). "Observer's Page. June's Partial Lunar Eclipse." Sky & Telescope , 66 (Sep.), 274.
2.) Graham, Francis G. (1984). "June 25 1983 Eclipse Photographed with Clouds." Selenology , 3 , No. 1 (Winter), 15.
3.) Westfall, John E. (1983). "The Lunar Eclipses of 1983: June 24/25 and December 19/20." J.A.L.P.O. , 29 , Nos. 11-12 (Mar.), 249-250.

The Total Lunar Eclipse of April 24, 1986

The total lunar eclipse of April 24, 1986, with a predicted umbral magnitude of 1.208, was observed by several A.L.P.O. members. All the reports received were from North America, although the end of the eclipse could not be seen from that continent.

San Francisco, California. --John Westfall observed with binoculars and 9-cm. catadioptric and 25.4-cm. Cassegrain reflectors, timing phenomena and the umbral contacts of selected craters. He also took 36 photographs of the event, one of which is reproduced below as Figure 13. His Danjon luminosity estimate was 2*; the crater timings will be published separately.

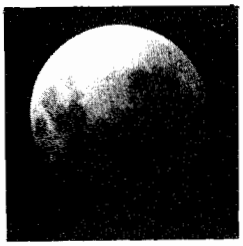

Figure 13. The total lunar eclipse of April 24, 1986, photographed at 12:26.8-29.0 U.T. with a 9-cm. f/11 catadioptric reflector, exposing 128 sec. on Ektachrome 200 Film. The view is during totality, about 15 minutes before mid-eclipse. South is at the top. Note that the southern and eastern portions of the disk are much brighter than the remainder.

Las Cruces, New Mexico. --Walter Haas observed with a 20-cm. reflector, and fought clouds during his crater timings. He did not estimate the Danjon luminosity, but did note that the eclipse was bright. Some of the timings that he made for crater-umbra contacts and other phenomena are:

10:16	Slight penumbral dimming on west lunar limb.
10:32	Dimming slight but definite.
10:34	Dimming in lunar Western Hemisphere slight but distinct.
10:43	Pronounced dimming near west limb; also seen with naked eye.
10:51	Dimming definite to the naked eye.
10:58	Beginning of Astronomical Twilight at Las Cruces.
11:04	Clouds interfered with observation of first umbral contact; definitely past by this time. [Predicted at 11:02.8. Ed.]
11:15	No detail visible inside umbra except near umbral edge.
11:16	Edge of umbra diffuse, with a slate-grey border 30 arc seconds wide.
11:18.7	Gassendi immersion.
11:23.6	Timocharis immersion.
11:25.6	Plato immersion.
11:28	Limb in umbra faintly visible.
11:34.1 (?)	Birt immersion.
11:37	Portion of Moon in umbra faintly visible.
11:51	Portion of Moon in umbra faintly visible and reddish.
12:27	Sunrise at Las Cruces.

Seeing averaged only 4 on the A.L.P.O. 0 (worst) - 10 (perfect) scale, with the transparency limiting magnitude +4.

Seattle, Washington. --Kenneth D. Luedeke observed this eclipse from the Gas Works with a 20-cm. catadioptric reflector. He made an impressive series of 17 Ektachrome photographs despite a light fog (36° F temperature) which prevented optimum conditions. He estimated the Danjon luminosity to be 1.5 at 12:15. [Totality was predicted to begin at 12:10.3. Ed.]

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* A Danjon luminosity estimate (L) describes the visual brightness of the Moon near mid-totality during a total eclipse. Danjon values are on a numerical scale ranging from L = 0 for a very dark eclipse to L = 4 for a very bright eclipse. [Ed.]

Paragould, Arkansas. --Kermit Rhea observed with a 20X50 monocular from this town, which was the easternmost observing site, causing the eclipsed Moon to be near his horizon. He estimated a Danjon luminosity of 4, and also fought clouds, which obscured the Moon at 11:02. Mr. Rhea's observations are particularly worthwhile for their information on the penumbra.

Summary. --We note that Rhea made his Danjon estimate either before the onset of totality or shortly thereafter because he reported clouds at 11:02 and totality was predicted to begin at 11:02.8. As he did not time craters, we assume that his watch was slow. If that is the case, this eclipse clearly had a Danjon luminosity of about 2. However, it could be the case that this conclusion from all the combined observations may be biased by a Danjon estimate made before totality, which would indicate that a darker eclipse probably occurred (Westfall estimating 2.0, Luedeke 1.5). The crater timings by Haas and Westfall are numerous enough to put an upper limit of 1.012 to the ratio of the diameter of the apparent umbra that of the geometric umbra. We thank all observers for their prompt submissions.

References. --

1.) di Cicco, Dennis (1986). "Observer's Page. April Eclipses." Sky & Telescope , 72 (Sep.), 313.
2.) Westfall, John E. (1986). "Lunar Eclipses Return: April 24, 1986." J.A.L.P.O. , 31 , Nos. 7-8 (Apr.), 146-149.

A.L.P.O. SOLAR SECTION OBSERVATIONS FOR ROTATIONS 1754 - 1760 (1984 OCT 07 TO 1985 APR 17)

By: Richard E. Hill and Paul Maxson, A.L.P.O. Solar Section Recorders

Introduction

This reporting period was characterized by very low activity, and there were no days wheN the sunspot number (roughly equal to ten times the number of sunspot groups plus the number of spots) exceeded 63. This contrasts with one year earlier, when the average monthly count was about 100, and five years earlier, when the average monthly number was approximately 200 or higher.

Those groups or regions that were observed were relatively inactive. (A "group" refers only to white light sunspot features, while "region" means the entire feature in all wavelengths, bounded only by the local magnetic field.) Those that did display some activity tended to be short lived. In only one case did we find a group to have a lifetime longer than one rotation, although many regions lasted longer than that.

As with all A.L.P.O. Solar Section reports, the times here are in Universal Time (U.T.), and all directions are heliographic unless otherwise noted and are abbreviated (e.g., N, SE, etc.). Regions and groups will be referred to by the designations given to them by the Space Environmental Services Center (SESC) in Boulder, Colorado. Other terms and information in this report are defined in The Handbook for the White Light Observation of Solar Phenomena , available from this Recorder for $US 4.00.

The observers who contributed to this report are:

Observer	Telescope Aperture (cm.)	f-ratio	Type	Stop (cm.)	Location
DeKarske, D.	10	f/15	Refractor	--	Colorado, U.S.A.
Garcia, G.	20	f/10	Schmidt-Cass.	--	Illinois, U.S.A.
Hill, R.	20	f/10	Schmidt-Cass.	10	Arizona, U.S.A.
" "	6	f/12	Refractor	--	" "
Hoferer, K.	7.6	f/10	Newtonian	--	(Not known)
Janh, J.	20	f/ 6	Newtonian	10.2	West Germany
	5	f/10	Refractor	--	" "
Maxson, P.	20	f/ 6	Newtonian	10.2	Arizona, U.S.A.
" "	20	f/ 6	Newtonian	17.8	" "
" "	28	f/10	Schmidt-Cass.	10.2	" "
" "	40.6	f/ 4.5	Newtonian	15.2	" "
Nicolini, J.	13.5	f/15	Refractor	--	Brazil
Timerson, B.	30	f/ 4	Newtonian	10	New York, U.S.A.
Young, S.	20	f/10	Schmidt-Cass.	7.5	California, U.S.A.

Rotation 1754 (1984 10 07.35 to 1984 11 03.65)

Sunspot Number [1, 2, 15]*	Mean	Maximum (date)	Minimum (date)
R_I	14.1	25 (10/11, 10/18, 10/19)	0 (10/07, 10/28)
R_A	11.2	24 (10/18, 10/19)	0 (10/13, 10/27, 10/28)

As the above values suggest, this rotation opened on a quiet note until 10/15, when a photograph by Timerson showed a region (SESC 4586) coming around the E limb. There was no hint of it on a photograph by Maxson taken the day before. Although the number of spots in this region increased, its area nonetheless decreased during nearly its whole passage. On 10/19 Maxson showed the leader spot split by a light bridge. This was a clear sign of the end for this group, which by 10/22 was reduced to a single spot. At that time, the umbra of this spot consisted of a collection of umbral spots that decreased in size towards the E within a single penumbra. That was the last Section record for this region, and the remainder of the rotation was quiet.

Rotation 1755 (1984 11 03.65 to 1984 11 30.96)

Sunspot Number [2, 16]	Mean	Maximum (date)	Minimum (date)
R_I	23.8	59 (11/25)	0 (11/06, 11/07)
R_A	20.3	46 (11/25)	0 (11/06, 11/07)

There were three major regions during this rotation, all of which were covered by Section observers. For this reporting period, this rotation had the highest mean activity level, although not the highest maximum count.

On 11/08, the region SESC 4592 was born on the disk. The first Section observations were on 11/09 and showed two condensations, oriented NE-SW, with a few small umbral spots surrounding. The group reached its maximum area and complexity on the following day with three condensations with separate penumbrae that were oriented E-W. The group probably rotated counter-clockwise during the intervening time. By 11/11, only one major spot with a penumbra and a few small spots to its W were left as this area decayed. This decrease continued over the next few days until the group was gone by 11/14.

The next region, SESC 4597, rapidly evolved at first after being born on the disk on 11/20. By 11/21 it consisted of a W spot followed by a collection of smaller spots. It remained much the same until it left the disk on 11/24, as shown by drawings by Hoferer and Garcia and by photographs by Maxson and Timerson.

In contrast to the previous two regions, SESC 4598 came onto the disk on 11/20 already fairly well developed, as was shown in a photograph by Timerson. It then consisted of two large spots with penumbrae and some faculae. By 11/24, drawings by Hoferer and Garcia showed it to have increased in complexity; and it was now followed to the E by a new bipolar region, SESC 4600. On 11/25, the following or E spot in SESC 4598 was split E-W by a thin light bridge. The umbra on either side formed a row of umbral spots along the light bridge. Each of these rows of spots had a fan-shaped penumbra that pointed away from the light bridge, which gave the entire spot the appearance of a Rorschach Diagram. This is an example of how sunspot groups, and even individual spots, can take on some very unusual appearances when invaded by light bridges. Thus, they should be watched closely by observers when such an invasion is taking place; the changes can often happen very quickly. The last photographs of SESC 4598, as it approached the limb, showed it to be decreasing in both area and complexity. Its companion, SESC 4600, was quite short-lived, reaching its maximum area on 11/25, and being nearly gone by 11/29 with only faint faculae marking its position.

* R_I designates the International Sunspot Number; RA, the American Sunspot Number. [Ed.]

Rotation 1756 (1984 11 30.96 to 1984 12 28.28)

Sunspot Number [2, 7, 16, 17]	Mean	Maximum (date)	Minimum (date)
R_I	18.7	30 (12/16)	9 (12/20)
R_A	17.5	31 (12/12)	2 (12/23)

It is interesting to note that there was less difference between the maximum and minimum sunspot numbers than in the previous rotations, with no zero count days, although the mean was lower. This rotation's sunspot groups tended to be small and few in number. Section coverage was scanty, although Garcia made an excellent whole-disk drawing on 12/16 (the date of maximum R_I) that showed SESC 4607 and SESC 4608 very nicely. Drawings by Young showed facular areas well into the disk, and detailed drawings showed large areas of "open" and "dense" granulation around SESC 4610.

Rotation 1757 (1984 12 28.28 to 1985 01 24.62)

Sunspot Number [7, 9, 17, 18]	Mean	Maximum (date)	Minimum (date)
R_I	18.6	63 (01/20)	0 (9 days)
R_A	14.3	46 (01/20)	0 (8 days)

Activity decreased markedly for this rotation, although the mean and maximum numbers may appear to dispute this. Activity was longitudinally confined to small areas of the disk, and nearly one-third of the days had counts of 0!

The best-observed feature was SESC 4616, with almost all the data consisting of drawings by Young and Hill. These showed SESC 4616 to be a complex and compact group. Only four consecutive days of data were submitted. While this is enough to give some indication of the evolution of this region, it is not comprehensive enough coverage for a detailed commentary.

On 12/29, Young noted rapid changes in SESC 4611. He recorded changes in the shapes and areas of "bright areas" that were large compared to the spot (several arc minutes in extent). Any similar or corroborating observations of such phenomena would be appreciated.

Rotation 1758 (1985 01 24.62 to 1985 02 20.96)

Sunspot Number [9, 12, 18, 19]	Mean	Maximum (date)	Minimum (date)
R_I	14.4	27 (02/20, 02/21)	0 (01/26, 01/28, 01/30)
R_A	14.4	29 (02/01, 02/20)	0 (4 days)

Activity decreased still further for this rotation, and most reports of observations were just blank forms showing no activity! What coverage of features there was, was very sporadic and was not adequate for detailed comments.

Rotation 1759 (1985 02 20.96 to 1985 03 20.28)

Sunspot Number [19, 20]	Mean	Maximum (date)	Minimum (date)
R_I	9.8	25 (02/22)	0 (5 days)
R_A	10.5	25 (02/22)	0 (5 days)

By Rotation 1759, solar activity had decreased to yet lower levels, and only one region was deemed worthy of study by Section members. This was SESC 4633, which literally popped into existence overnight for us in the Western Hemisphere. On 03/16, neither Timerson's nor Maxson's photographs showed anything at the position where DeKarske drew and Maxson photographed a spot group the next day, showing a main spot with the penumbra surrounded by small umbral spots. However, this group declined from this time on and was totally gone by 03/19.

Rotation 1760 (1985 03 20.28 to 1985 04 16.57)

Sunspot Number [20, 21]	Mean	Maximum (date)	Minimum (date)
R_I	6.2	36 (03/24)	0 (6 days)
R_A	6.1	27 (03/24)	0 (7 days)

This reporting period closed with the lowest mean counts for any rotation covered. Even so, there was one region, SESC 4637, which members covered well. It was first observed by Maxson on 03/22 as a large spot invaded by a broad light bridge with a few trailing smaller spots, one with a small penumbra of its own. As this region crossed the disk, it continually decreased in area and complexity. By 03/27, the light bridge had completely bisected the spot and penumbra. The pieces continued decaying. By the time this region reached the W limb it was just one large symmetrical spot with a radial penumbra and a smaller attendant spot, which was the piece cut off earlier. Both spots were now less than 20 percent the area they had possessed on 03/22. As the statistics above suggest, there was very little additional activty. Members, especially Young, made detailed observations of faculae, as possible precursors of future activity.

Conclusion

This reporting period's activity was quite low and activity is still low in early 1987. Nevertheless, observers should now be hard at work perfecting their methods and procedures. Photographers should occasionally attempt to do intensive work on a region. Photographing a given region once an hour in order to record changes during the entire time that the region can be observed can prepare a person for similar work when there are, say, ten groups on the disk at one time. Those who make drawings should try to show internal motions and changes for spots. Details in the penumbrae as well as the umbrae can also be shown best by this medium. Observers with micrometers should draw spot groups, noting separations and position angles in relation to celestial north.

All these projects should be worked on now, during minimum activity. If one waits until there are spot counts of 200 or more, the task of establishing the necessary observing techniques and of accurately recording all the features will be insurmountable.

Obsevers are strongly urged to draw umbrae as solid black and then to sketch only the outer boundary of the penumbrae unless they make an effort to show fibrils and bright grains. These guidelines are made for the purpose of subsequent reproduction. Often the electrostatically photocopied drawings of penumbrae that have been shaded in merge with the umbrae or break up, giving the appearance of small spots. Also, such shadings, especially if photocopied, do not bear up well when being halftoned for publication.

However, the most important factor to keep in mind is that we now are at sunspot minimum; a perfect time for initiating a regular program of solar observing. Join in with us!

References

1.) "Sunspot Numbers," Sky & Telescope , 69 , No. 1 (January, 1985), 87.
2.) "Sunspot Numbers," Sky & Telescope , 69 , No. 2 (February, 1985), 182.
3.) Prelim. Report and Forecast of Solar-Geophys. Data , Oct. 16, 1984, 3.
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7.) "Sunspot Numbers," Sky & Telescope , 69 , No. 3 (March, 1985), 284.
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9.) "Sunspot Numbers," Sky & Telescope , 69 , No. 4 (April, 1985), 375.
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16.) _____, No. 484, Pt. I, Dec., 1984.
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18.) _____, No. 486, Pt. I, Feb., 1985.
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20.) _____, No. 488, Pt. I, Apr., 1985.
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LUNA INCOGNITA: 1985-86 PROGRESS REPORT

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

A report in our previous issue briefly described the A.L.P.O. Lunar Section's "Luna Incognita Project," and gave an observing schedule for the year 1987 [Westfall, 1986b]. Because work on the final map is now under way, we plan to end the observational phase of this project at the end of 1987. Those wishing to join our project may obtain observing kits from the writer (address on front cover) for $ 1.50 in stamps. Here, we would like to let readers know about the progress made since the last such report [Westfall, 1986a].

Observations

The lunar librations (orientation of the Moon in respect to the Earth) were favorable for viewing Luna Incognita in 1985 and 1986 and our participants responded gratifyingly with 524 drawings and photographs submitted by 19 observers. Those observations submitted since the last report, but by the end of 1986, were:

Observer(s)	Instrument(s)*	Number of Observations Contributed: Drawings	Photographs
Abbott, Patrick	32 RL	1	-
Aloy, Jordi	20 RL, 31 RL	6	-
Caruso, Joseph	51 RR	7	16
Cruz Conejo, Manuel	20 RL	3	-
Genebriera, Joan	36 RL	-	15
Graham, Francis	6, 18, 25 & 102 RR; 15, 20, 76, & 209 RL	33	229
--- & Palmer, T.	18 RR	2	-
--- & Potemra, J.D.	15 & 20 RL	4	13
---; Palmer, T. & Onder, E.	15 RL	2	7
---; Palmer, T. & Potemra, J.D.	18 RR	1	-
Libert, Claude	12 RR	-	1
Mazzanti, Ferran	35 & 41 RL	2	-
Oehlert, Ronald	15 RL	20	20
Parizek, Dr. A.K.	29 RL	-	50
Pola, Salvador	40 RL	1	-
Rhea, Kermit	20 RL	-	51
Sabia, John	24 RR	-	2
Soldevilla, Josep	16, 26, 30 & 35 RL	6	1
Tobal, Cristofol	10 RR, 16 RL	10	-
Westfall, John	25 RL	5	24
	1985/86 Total	103	429
	Project Total	356	1121

* Apertures are given in centimeters; RL = Reflector and RR = Refractor.

About one-third of the observations made during the 15-year history of this project were made in 1985/86! It is clear that the above observers were particularly busy during this period, and we wish to thank all those who participated. Francis Graham should be singled out, both for his many personal observations and for his continued efforts to recruit other participants. He, and several other observers, are also noteworthy for being able to employ telescopes larger than those usually used by our members. One of Mr. Graham's large-aperture photographs is reproduced in Figure 14 on the following page.

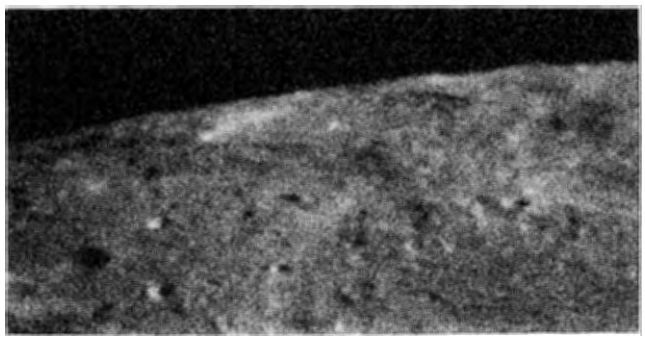

Figure 14. A portion of Luna Incognita, as photographed by F.G. Graham on 1985 NOV 05 ca. 9 hr. U.T., using the 76-cm. reflector of McDonald Observatory. Colong. 182°. Lunar south is to the left. The crater with a central peak is Hausen, and part of the large crater Bailly lies to the left.

Other Developments

The process of measuring Lunar Orbiter and Soviet Zond-8 photographs has been completed and the results cataloged, comprising the positions of 769 points, the diameters of 318 craters, and 831 relative elevations found from shadow measurments. Computer files have been prepared of the position and diameter measurements, which have been used to plot base maps of the four sheets of the final Luna Incognita map. Feature outlines have been traced from rectified Orbiter and Zond-8 photographs onto these base maps.

Our mapping project has a new participant, Don Davis, an astrogeologist and space artist. Figure 15 , below, is a reproduction of a rendering he has painted of the southern portion of Luna Incognita. He has also been very helpful in bringing the writer's attention to two valuable references. The first is a catalog of positions [NASA, 1975], while the second is an earthbased radar-image atlas of the Moon, which extends into portions of Luna Incognita [Zisk, 1970?]. The radar atlas, which has a latitude/longitude grid overprinted on each plate, has been copied onto the base maps mentioned above. Both of these references have been very helpful in providing improved detail and positions for our final map.

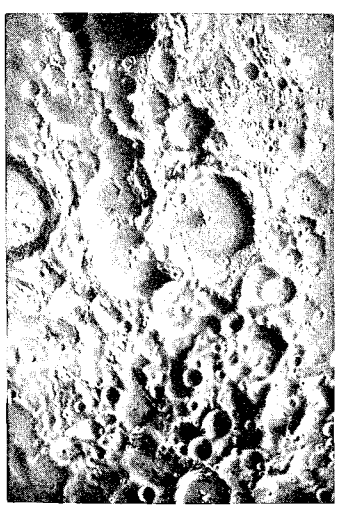

Figure 15. To the left is an artistic rendering of the southern half of Luna Incognita done by Don Davis. The Earthside Hemisphere is to the right and the lunar South Pole is near the bottom. The large crater Zeeman is on the left margin, while Drygalski is slightly above and to the right of center. Copyright 1986 by Don Davis.

References

U.S. NASA. (1975). Catalog of Lunar Positions Based on the Lunar Positional Reference System (1974). St. Louis: Defense Mapping Agency, 1975.

Westfall, John E. (1986a). "Luna Incognita: 1984/85 Report and 1986 Observing Schedule." J.A.L.P.O. , 31 , Nos. 5-6 (Jan.), 119 - 123.

_____. (1986b). "Observing Luna Incognita in 1987." J.A.L.P.O. , 31 , Nos. 11-12 (Nov.), 258-260.

Zisk, S.H. (1970?). Radar Atlas of the Moon. Westford, MA: Haystack Observatory.

COMING SOLAR SYSTEM EVENTS: MARCH - AUGUST, 1987

As space and time allow, we hope occasionally to publish brief notices about upcoming astronomical events. These are intended chiefly as reminders; and serious observers should also consult more detailed sources such as the A.L.P.O. Solar System Ephemeris , the Astronomical Almanac , Sky & Telescope magazine, the Observer's Handbook of the Royal Astronomical Society of Canada, and the Handbook of the British Astronomical Association. All dates and times given here are in Universal Time (U.T.).

Planetary Visibility. --Mercury will be visible low in the eastern pre-dawn sky in late March-early April and in late July-early August and low in the western sky after sunset in late May-early June. Its Greatest Western Elongations are on March 26 (28°) and July 25 (20°), and its Greatest Eastern Elongation occurs on June 07 (24°). Venus can be seen in gibbous phase before dawn during March and April (it is in conjunction with the Sun on August 23). The Red Planet, Mars, with a small disk, can be seen in the west after sunset during March - June. Jupiter is in conjunction on March 27 and will be visible in the east before dawn beginning in June. Saturn is thus the most consistently observable planet during this period, being chiefly a morning object until opposition on June 9, after which it can be observed in the evening.

Eclipses. --An annular-total eclipse of the Sun occurs on March 29, with a track extending from southern Argentina across the Atlantic through central Africa. It will be total over the South Atlantic Ocean and annular over land, although a partial eclipse will be visible from the southern half of South America, Africa (except the northwesternmost portion), and southwest Asia.

A penumbral lunar eclipse, with penumbral magnitude 0.802, takes place on April 14, between 00:19.6 and 04:18.2. Its beginning will be visible from eastern North America, South America, Europe, Africa, and western Asia, while the end can be seen from all the Americas (except Alaska) and western Europe and Africa. Shading of the northern portion of the Moon should definitely be visible, and a useful photoelectric project would be to make readings in several spectral bands of the craters Aristarchus, Kepler, and Copernicus, all suspected of fluorescence when within the penumbral shadow. During the first portion of the eclipse, the 1st-magnitude star Spica will be within 0.5 degrees of the Moon's limb for viewers in the American Midwest and Eastern Seaboard. For much of Europe, Spica will be occulted during this eclipse; at Greenwich, Spica should disappear at 02:08 and reappear at 03:16 (mid-eclipse is at 02:18.8).

Lunar Occultations. --Besides the Spica event described above, a large number of stellar occultations will happen during the March-August period; for more information, contact the International Occultation Timing Association (IOTA), 6 N 106 White Oak Lane, St. Charles, IL 60174. Note that Venus will be occulted on April 25 at about 12 hr. when 31° west of the Sun. This event can be seen from Central America, eastern North America, Greenland, Iceland, northern Scandinavia, and the Arctic.

The Moon will also pass through the Pleiades star cluster on several dates: APR 02, 13 hr. (Moon 16-percent sunlit, visible from southeast Asia); APR 29, 22 hr. (Moon 3-percent sunlit, visible from northeast South America); JUN 23, 08 hr. (Moon 7-percent sunlit, visible from Brazil); JUL 20, 14 hr. (Moon 10-percent sunlit, visible from Pacific islands such as Tahiti and Hawaii); and AUG 16, 21 hr. (Moon 44-percent sunlit; visible from south and east Asia and Japan).

Planetary Conjunctions and Appulses. --Although of no scientific value, seeing two planets in the same telescopic field of view can be an impressive sight. Two such events happen during our period. On May 04, at about 22 hr., Venus passes 0°.6 south of Jupiter, both being 29° west of the Sun, with respective visual magnitudes of -3.9 and -2.1. Then, on June 11, near 0 hr., Mars will lie 0°.6 east of Mercury (and 23° east of the Sun), Mars being at visual magnitude +2.0 and Mercury at +0.9. This is an interesting opportunity to compare the diameters, and surface brightnesses and markings of these two planets.

Comets. --A.L.P.O. Comets Recorder David Levy has set a good example for Section participants; he discovered the first comet of 1987! Logically, it is called Comet 1987a Levy, and was first sighted on 1987 JAN 05. Although now unfortunately growing fainter, it is still observable. Its Epoch-1950 coordinates and predicted magnitudes during March-April are: MAR 26, 13h 27.7m/-21° 58' (+12.5); MAR 31, 12h 57.6m/-23° 03'; APR 05, 12h 29.9m/-23° 36' (+13.0); APR 10, 12h 06m/-23° 44; APR 15, 11h 45.2m/-23° 34' (+13.6); APR 20, 11h 28.4m/-23° 14'; and APR 25, 11h 14.8m/-22° 50' (+14.2).

Note also that Comet 1987c Nishikawa-Takamizawa-Tago should be visible in small telescopes after it pulls away from the Sun in the morning sky; its coordinates and magnitudes for Epoch 1950 are predicted to be: MAR 26d, 23h 02.5m/-8° 45' (+7.0); APR 05d, 22h 53.2m/-11° 09'; APR 15d, 22h 41.8m/-14° 07' (+7.1); APR 25d, 22h 25.2m/-18° 15'; MAY 05d, 21h 55.4m/-24° 48' (+6.9); MAY 15d, 20h 47.5m/-35° 43'; MAY 25d, 18h 00.7m/-45° 46' (+6.7); JUN 04d, 15h 04.8m/-37° 34'; JUN 14d, 13h 53.0m/-26° 54' (+8.6); JUN 24d, 13h 25.0m/-20° 43'; JUL 04d, 13h 13.2m/-17° 17' (+10.4). These ephemerides are summarized from the Comets Section publication, Tails and Trails , No. 11 (Feb., 1987); for information on obtaining this useful newsletter, write Comets Recorder Levy at his address on the inside back cover.

OBSERVER'S LOG

Another occasional item we hope to publish is this "Observer's Log," consisting of brief summaries of recent observations somewhat like the "Observations and Comments" column that our long-time subscribers may recall.

Jovian Blue Cloud Features. --Jupiter Recorder Jose Olivarez continues to observe and time blue cloud features on Jupiter's North Equatorial Belt, South Component and Equatorial Zone, North Component. Below are listed such features that he timed during October through December, 1986:

C.M. Transit UT Date/Time	Feature	Sys. I Long.	C.M. Transit UT Date/Time	Feature	Sys. I Long.
		°			°
OCT 08 02:10	(1) Blue Pr.	310	OCT 27 05:04	(5) Blue lump	177
OCT 15 02:25	(15) Blue Pr.	345	OCT 28 00:44	(5) Blue mass	176
OCT 08 05:05	(2) Blue Pr.	057	NOV 06 01:20	(5) Blue Pr.	179
OCT 15 03:10	(14) Blue Pr.	012.2	OCT 28 03:33	(4) Blue festoon	279
OCT 29 01:54	(14) Bl. festoon	017	NOV 15 00:00	(?) Blue festoon	110.3
OCT 16 01:10	(33) Blue Pr.	097	NOV 15 00:44	(6) Blue festoon	137.1
OCT 27 02:59	(33) Bl. festoon	101	NOV 15 03:18	(7) Large Bl.Pr.	231.0
OCT 29 04:15	(33) Tall Bl.Pr.	102	NOV 18 23:59	(14) Blue festoon	021
NOV 14 23:48	(33) Blue mass	102	DEC 15 01:47	(7?) Blue Pr.	228
OCT 27 04:25	(3) Blue festoon	153	DEC 20 00:30	(?) Large Bl. Pr.	249.5
OCT 30 01:20	(3) Tall Bl. Pr.	154	DEC 27 00:31	(4?) Dark Bl. Spot	274
NOV 15 01:15	(3) Blue festoon	156			

"Sys.I Long." indicates observed longitudes for the center of each feature. "Pr." designates "Projection," and "Bl." stands for "blue." The numbers in parentheses are identifications assigned by Olivarez, except for number 33, assigned by Phillip W. Budine. Olivarez made all the timings except for those of OCT 08, which were by Daniels. We hope that members will attempt to recover these features when Jupiter becomes visible in the morning sky in May or June.

Jupiter-Mars Conjunction. --On 1986 DEC 19 Mars passed 0°5 north of Jupiter, and many of our readers must have observed this spectacular event, when Jupiter was visual magnitude -2.3 and Mars was +0.6. Figure 16 , to the left, shows this conjunction as photographed by Richard Hill.

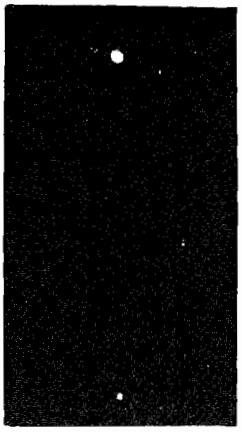

Figure 16. Conjunction of Mars (lower) and Jupiter on 1986 DEC 19, photographed at 04:17 U.T. by A.L.P.O. Solar Recorder Richard Hill with a Celestron-8 20-cm. catadioptric reflector at f/10 (prime focus), using an 8-sec. exposure on Ektachrome 400 Film. Jupiter's four Galilean satellites are also visible. Ganymede is to the right of Jupiter and, of the three satellites to the left, Callisto is the lowest, Io the right, while Europa is the left one. South at the top.

Transit of Mercury. --On 1986 NOV 13, Mercury passed in front of the Sun for the first time in 13 years, although this event was visible only from the Eastern Hemisphere. A new A.L.P.O. member, Dr. Stephen Davis, and his wife Grania were able to watch this event from China, just two days after they had visited the Purple Mountain Observatory in Nanjing. Their observing location was rather unusual, being in the Imperial City in Beijing, and a large number of local people were thus able to view this event, as is shown to the left in Figure 17.

Figure 17. Dr. Stephen Davis observing the 1986 NOV 13 transit of Mercury from the Imperial City in Beijing. China. Dr. Davis, in the lower right, used a filtered 20X60 monocular, shown to his left, for direct viewing. Many Chinese visitors to this tourist site were also able to view the transit through this instrument.

BOOK REVIEWS

Coordinated by J. Russell Smith

The A.L.P.O. Solar System Ephemeris: 1987. Edited by John E. Westfall. Association of Lunar and Planetary Observers , P.O. Box 16131, San Francisco, CA 94116. 1986. 89 pages. Price $ 5.00 ($US 6.00 outside North America) paper (ISSN 0890-216X).

Reviewed by Walter H. Haas

The advent of modern personal computers of considerable power--ones extremely cheap as compared to computers of similar capabilities 10 or 15 years ago--has made it possible for amateurs to produce their own astronomical ephemerides and tables of observational data. One of the best of these books is the A.L.P.O. Solar System Ephemeris: 1987 , the second annual volume of its kind. It was chiefly prepared and was edited by the Director of the Association of Lunar and Planetary Observers, Dr. John Westfall, with contributions from A.L.P.O. staff members Richard Hill, Brad Timerson, Jeff D. Beish, Frederick Pilcher, David H. Levy, and James V. Scotti. The volume is intended to meet the needs of the advanced amateur making regular and systematic observations of Solar System objects. It offers at least three advantages over The Astronomical Almanac , which many such experienced observers have been using for decades, namely:

1. The price is a large saving; The Astronomical Alamanc for 1987 costs $ 18.00.
2. Compared to the A.A. , the much smaller A.L.P.O. Solar System Ephemeris is light and handy to use, an easy companion at the telescope and readily taken along to a distant observing site.
3. The time system for the tables is Universal Time, not the Dynamic Time of the A.A. The difference between the two is about 57 seconds in 1987. The effect on the central meridian of longitude of Jupiter is hence about 0.6 degrees.

The A.L.P.O. System Ephemeris opens with an Introduction, followed by orbital and physical data on planets and satellites. Next comes an ephemeris for physical observations of the Sun, with terms adequately defined as throughout the book, and a summary of 1987 solar eclipses. Data for physical observations of the Moon and for 1987 lunar eclipses come next. We then have a page describing the lunar occultations of bright planets. A section for physical observations of Mercury supplies all that any observer of that planet would be likely to want, and the same is true for the following section on Venus. The observer of Mars will find columns for Martian Date, Mars' right

ascension and declination, heliocentric position, tilt of the axis to the Earth and to the Sun, phase, central meridian, and so forth, and even a very handy table giving the change of the central meridian with time. Observers of Jupiter and Saturn are treated equally well in the next two sections, and even get their own central meridian rate tables. For Uranus, Neptune, and Pluto, right ascension and declination, elongation from the Sun, visual magnitude, and semidiameter are given at 40-day intervals. The section on satellites gives, for 0 hours Universal Time, the daily configurations of the four Galilean satellites of Jupiter, all eclipse disappearances and reappearances of those bodies in 1987, and the positions relative to their primary of the three Saturnian satellites Rhea, Titan, and Iapetus. (Identifying Iapetus from A.A. data can be troublesome.) Next come ephemerides for the 14 brightest Minor Planets to come to opposition in 1987, plus another for Earth-crossing Midas. A three-page description of annual meteor showers is supplemented by a table giving dates, rate, and age of Moon for each expected important shower, and a chart showing their radiants on the celestial sphere. Finally, the book closes with a section on comets, with data for the distant Halley's Comet, Comet Wilson, and for seven other periodic comets which will reach perihelion in 1987.

The question of the exact contents of a book of this kind deserves careful consideration, and Dr. Westfall will welcome the opinions of readers. Obviously, if this book included everything in The Astronomical Almanac , its price would become at least as high as theirs! Each observer will have his own preferences. The reviewer would like to see predicted times not just for the eclipses of the Galilean satellites but also for their occultations, transits across the face of Jupiter, and shadow transits. He also would much prefer to have the continuous-time graphs of the positions of these satellites as given, for example, in The Astronomical Almanac for 1987 on pages F17-F39. Positional data on a few more of the satellites of Saturn would be welcome. Maps of the areas of visibility of solar eclipses would be informative. Tables of the times of sunrise, sunset, and the beginning and ending of twilight would also be useful. It is realized that all such additions would increase the size of the book and hence its price. Perhaps some compensating pages could be saved by eliminating data over intervals when observations of an object would be impossible. Surely, for example, there will be very few Mars observers when its angular diameter is less than 4 arc-seconds from May 11 to December 3. Again, the eclipse disappearances of Jupiter III and Jupiter I on March 28, 1987, will be hard to observe one day after Jupiter's conjunction with the Sun!

Reviewers are expected to find errors, but editor Westfall's care has made the search unrewarding. On pages C-3 to C-9 the data for physical observations of the Sun are presumably for 0 hours Universal Time, but such is nowhere stated. On page G-1 it is the North Hemisphere vernal equinox of Mars which is the origin of L_S. On the same page it is stated that the central meridian of Mars is adjusted for motion during ΔT, which is not defined. On page G-9 the motion of the central meridian of Mars in 9 minutes is curiously omitted. On page H-1 we find the familiar statement that System I of Jovian longitudes applies to the south edge of the NEB, the EZ, and the north edge of the SEB, while System II applies to all the rest of the disc. Yet the south edge of the NTB rotates even more rapidly than System I, and the region between the SEB components is often intermediate between the two Systems. On page I-1 we should be told to what parts of Saturn its System I and II apply. On the Galilean satellite configurations on K-2 there is a code for satellites which are occulted or in transit but not for ones invisible in eclipse. In the chart of meteor radiants on page M-5 it should be explained that meteor radiants move among the stars when showers endure for weeks; what is shown is presumably for the date of maximum.

It has been found that the numbers in the tables of the A.L.P.O. Solar System Ephemeris: 1987 sometimes disagree with other sources in the last decimal digit retained. This difference will seldom be of any consequence to the book's users. The reviewer would suggest using the double-precision mode in a suitable computer language for future volumes. For example, in some versions of FORTRAN IV double-precision computations give us about 17 significant decimal digits on each arithmetic operation.

This book is very heartily recommended to observers planning this year's Solar System observations, to all who want such observations to become more interesting and more meaningful, and to anyone foreseeing a future need to find out what physical quantities had what values in 1987.

Astrophotography for the Amateur. By Michael A. Covington. Cambridge University Press, 32 East 57th St., New York, NY 10022. 1985. 168 pages, 150 photographs. Price $ 24.95 cloth (ISBN 0-521-25391-8).
Astrophotography. By Barry Gordon. Willmann-Bell, Inc., P.O. Box 3125, Richmond, VA 23235. 1985, 2nd edition. 206 pages, 81 photographs. Price $ 18.95 paper (ISBN 0-943396-07-7).
Astrophotography. A Step-by-Step Approach. By Robert T. Little. Macmillan Pub. Co., 866 Third Ave., New York, NY 10022. 1985. 79 pages, 61 photographs. Price $ 19.95 cloth (ISBN 0-02-948980-6).

Reviewed by John Sanford, Orange County Astronomers

In 1985, three new books on astrophotography for the amateur were published. After nearly 25 years since George Keene's and Hank Paul's standard texts were originally written, the amateur now has a choice of three well-produced volumes on skyshooting. I hope that this comparative review will help the reader choose the right book for his or her needs.

These are all attractive books and, after 20 years of nothing, are all worth reading. The Little and Covington books are full of color photographs, and all three made informative and enjoyable reading. All are written on a beginner's level, and I would subjectively rate the completeness of information as: Covington, nearly 100 percent; Gordon, 80 percent; and Little at 60 percent. Only Covington discusses developing, printing, and copying; and it is a definite plus for his book that some effort is made to encourage home darkroom work. Many astrophotographers like myself find that the after-exposure work in the darkroom is very pleasurable, especially after seeing what a disaster commercial processing is with most astrophotographs!

Little's book is on a more basic level than the others, and is much shorter and perhaps suffers somewhat for its brevity. There is no index, and only five sources for further reading are listed in the Introduction. All of its photographs are Bob's--a tribute to his diversity and excellence in the field. The "Step-by-Step Approach" of the subtitle is not one of progression from easy to difficult, but rather is that of a listing of procedural steps for photographing certain subjects, such as the Star Field procedure (12 steps), Piggyback procedure (16 steps), and so on, including the Deep Sky guiding (17 steps) and Deep Sky exposure procedures (18 steps). Although these stepped procedures should be all right for amateur photographers, outright beginners may have unanswered questions about the brief explanations for each subject area. Some subjects receive too much space, notably eight pages on solar eclipse photographs (including Bob's and George Keene's famous cover for Life) and a few pages on the quick-process Polaroid 35-mm. films, demonstrably the world's worst astrophotography films despite their "convenience." (The photographs shown do the demonstrating.) The strengths of the book are in its succinctness for someone who already knows photography and would like to start astrophotography, and in Little's down-to-earth style in giving good advice. Particularly good is "Critical Mechanical and Atmospheric Factors" on page 75, a list with some content which will be unexpected by the beginner, such as "Smog. Good!" The advice to use the fastest films for lunar and planetary photography is suspect, however, because the best amateur work (by Rouse, Dragesco, and Parker) in black and white has been with Kodak Technical Pan 2415 or its predecessors, all slow, ultra-finegrain materials, or on moderate-speed (ISO 100-200) color emulsions.

Barry Gordon, a New York City amateur (as is Little), has rewritten and expanded much of his previous privately published book; and it is now available in its "Second Edition, Revised and Enlarged." Also part of the subtitle is "Featuring the fx system of Exposure Determination." If you like math, Gordon's is the book for you. The mathematics is not difficult, but Gordon does provide mathematical formulae and derivations for many of the optical and photographic topics in his book. I found the constant references to formulae a bit boring after a while, but some would find this wonderful. Appendices deal with a wide variety of subjects and, along with the Index, occupy about 38 pages at the end of the book. Several of these would be useful to the serious astrophotographer, especially Appendix C, which has simple formulae for "Image Size and Related Data," and also includes format-coverage and image-trailing formulae, which are hard to find elsewhere. There is an excellent bibliography that includes 84 articles and book titles published through 1983,

mostly from Sky & Telescope , Astronomy , and Star & Sky magazines. If there is a subject slighted, it would be lunar and planetary photographs, which, although present, are far from the best available. Chapter 9, "Subjects for Long Lenses," is only eight pages long, including several poor photographs of the Moon and planets.

Theory is Gordon's strong point (he is a mathematics teacher so this is natural), and the fx system of exposure determination works quite well once its principle is grasped. Basically, each astronomical subject is assigned a brightness value, and this value and the optical system's f-ratio are plugged into one of two formulae (one for extended sources, the other for point sources), which are then solved for the exposure time. These provide starting points for virtually any optical system and film speed. This system is not new, and credit should have been extended to Gordon N. Patterson of the Royal Astronomical Society of Canada, who published a similar system (using B for brightness in his formulae) in an obscure book published in 1974 and 1981, Handbook of Astrophotography for Amateur Astronomers .

This brings us to Michael Covington's book, which is more like the book that I would have written on the subject than the other two reviewed here. In organization it somewhat resembles the best previous modern book on amateur astrophotography, Le Photographie Astronomique d'Amateur , written by Bourge, Dragesco, and Dargery. Unfortunately, their superb book has not been translated from the French as far as I know. Covington's newer book has excellent chapters on theory and equipment, followed with application and darkroom sections. The photographs are by diverse authors, such as Akira Fujii of Japan, Sherman Schultz, Dale Lightfoot, and Dennis Milon. Covington is no slouch himself, as several fine deep-sky and planetary shots attest. The Appendices total 30 pages and include very useful film data sheets, a good guide for further reading, and an exhaustive exposure recommendation table. Photographs are well used to illustrate various configurations of camera and telescope and to compare techniques on the same star field. If I had to choose one book of the three, it would have to be Covington's excellent and quite complete effort . My only disappointment was that none of the three books even mentions the Astrophotography Seminars, six of which have been held biennially since 1975, each resulting in a 50-60 page book of Proceedings, which are distributed all over the world by the Orange County Astronomers.

The Universe Next Door. By Terry Holt. Charles Scribner's Sons, 115 Fifth Ave., New York, NY 10003. 1985. 408 pages, illustrated. Price $ 24.95 (ISBN 0-684-18358-7).

Reviewed by Walter Scott Houston

The recent invasion by Halley's Comet has brought a flood of popular books on astronomy that are aimed at the general public and at the beginning amateur. Most of these are simply rehashes, intended for sales. The publishers, who really have little marketing experience with astronomy, appear to be unable to locate competent authors and end up depending on degrees and titles. As a result, J. Russell Smith's splendid book Teaching a Unit in Astronomy had to go via the vanity press, which meant no publicity and no promotion, depriving the teachers of America of the only worthwhile guide to lesson planning in astronomy for elementary school teachers. Burnham never did get a publisher and had to pay for his own printing. As a result, it took his books 20 years to get properly known, when by rights they should have swept the amateur world like a forest fire in a fraction of that time.

Because of the above, it was a pleasant surprise to open Terry Holt's new book and find, by some strange alchemy, a book written with a prose style on the same level as Carl Sagan's and with an intimate grass-roots familiarity with the amateur community in the class of a Richard Berry. It gives hope for American publication.

The book's plan is simple. The usual chapters on the Moon, the Sun, Mercury, and the stars are all there, beginning with a lucid description that clarifies what most writers tangle up. This is followed by an account of what observations the average amateur can make. Here is the topic where most books stumble. Holt makes this section as fascinating as the earlier general description. Published in 1985, this book naturally lacks information on the new filters, the AAVSO Atlas, the Nagler eyepiece, and the Revised New General Catalog ; but the mechanics of book production make a 1-2 year time lag inevitable.

The prose has splendid peaks where it reads as colorfully and freely as a good novel. The Mercury chapter just glows. This is the best popular guide book that I have ever encountered in this tricky and usually confusing square dance. Yet Holt is always in control. I ended up surprised and a real fan of Terry Holt. Just as enticing were the one-sentence or one-paragraph gems scattered in the text; little pieces of critical information that no one else had bothered to communicate, but still gems that made a real difference.

Holt points out that the opposition magnitude of Saturn depends heavily upon the amount that the Rings are open. He also won my heart when he said: (1) Buy a telescope, (2) then buy binoculars, and (3) then buy filters. This is modern advice and very different from the 19th-century wisdom that still dominates most of our books. He spends more time on picking an observing site and on learning some meteorology so that you can use the site than any other author I have yet read. He is also unique in that he stresses knowing that most commercial telescopes mirror-image the field, making it virtually impossible for the beginner to do any useful star hopping.

Planetary observers will side with him when he contends that the Dawes Limit is useful for double stars only and that on extended surfaces the limit of resolution is half again smaller. They will also appreciate Holt's reviving Paul Herget's 1947 work which showed that planets cannot "capture" satellites, and that satellites cannot be kidnapped from a planetary system. He makes a major statement when he remarks that, when he put a good Plossl ocular on his old Newtonian, he "acquired a new respect" for the telescope. Amateurs by and large do not understand how important is the ocular.

With all this excellence, it is sheer depression to look at the production errors of the book (none of which must be attributed to the author). The graphics are full of mistakes, and some are not even labeled. The H-R diagrams on page 305 neglect to tell which is for an old cluster and which is for a new cluster. The Jupiter photograph on page 182 is inverted as compared with the caption underneath. Aitken, the double-star observer, is identified by the code designation "a," when it should be "A." The double-star photograph, apparently of Albireo, is merely called "Cygni." On page 263 is a curve which the caption identifies as a light curve of a Cepheid . Actually, the drawing is one of the velocity curve which is roughly a mirror image of the light curve. This blunder is most misleading, especially for the novice.

The account of the Bayer and Flamsteed numbers obviously got the editor confused, and he edited the text to say that Bayer stars do not have Flamsteed numbers. A glance at any atlas, such as that of Tirion, would have saved him a messy black eye. Oh, yes, in a star table Arcturus is marked as a star too far south for northern observers to see. These are only a few examples, and any reprinting should not only have an extensive error sheet inserted, but also should include the publisher's personal apology to the readers.

All the above, however, does not detract from the overall excellence of this book. It is a marvelous introduction to amateur astronomy, giving both needed theory and practical advice. Amateurs should get this book into their local libraries, both public and school. It belongs in the club library, no matter how small that library may be. Also, A.L.P.O. observers will have a warm reaction to Holt's remark that the Voyager images of Jupiter in many cases did confirm what ground-based observers had reported for years. No other book has said this!

NEW BOOKS RECEIVED

Notes by J. Russell Smith

Universe in the Classroom. A Resource Guide for Teaching Astronomy. By Andrew Fraknoi. W.H. Freeman and Co., 41 Madison Ave., New York, NY 10010. 1985. 269 pages. 6 X 9 in. Price $ 8.95 paper (ISBN 0-7167-1692-5).

If you teach astronomy, you will find that this book contains many useful resources, and may be used without any introductory text. Also, it may be adapted to courses at different levels. As a former teacher of astronomy, I recommend this book.

Mathematics and the Search for Knowledge. By Morris Kline. Oxford University Press, 200 Madison Ave., New York, NY 10016. 1985. 257 pages, index. 9.5 X 6.25 in. Price $ 19.95 cloth (ISBN 0-19-503533-X).

This volume begins with an "Historical Overview: Is There an External World?," followed by thirteen chapters: "The Failings of the Senses and Intuition," "The Rise and Role of Mathematics," "The Astronomical Worlds of the Greeks," "The Heliocentric Theory of Copernicus and Kepler," "Mathematics Dominates Physical Science," "Mathematics and the Mystery of Gravitation," "Mathematics and the Imperceptible Electromagnetic World," "A Prelude to the Theory of Relativity," "The Relativistic World," "The Dissolution of Matter: Quantum Theory," "The Reality of Mathematical Physics," "How Does Mathematics Work?," and "Mathematics and Nature's Behavior," followed by a bibliography.

Saturn. By Seymour Simon. William Morrow & Co., Inc., 105 Madison Ave., New York, NY 10016. 1985. 32 pages, illustrated. Price $ 11.75 cloth (ISBN 0-688-05798-5).

This is an elementary book about our most beautiful planet, with many excellent photographs and large print. Its vocabulary is well suited to the beginner.

Astronomical Objects for Southern Telescopes. With Addendum for Northern Observatories: A Handbook for Amateur Observers. By E.J. Hartung. Cambridge University Press, 32 East 57th St., New York, NY 10022. 1985. 238 pages, illustrated, index. 9 X 8 in. Price $ 17.95 paper (ISBN 0-521-31887-4).

This book covers the following topics: "Radiation," "Stars," "Star Clusters," "Galactic Nebulae," "Extra-Galactic Systems," "Amateur Observing," "General List of Telescopic Objects for Southern Observers," "Description of Constellations and Objects," and "Addendum for Northern Observers," followed by a bibliography.

The Cambridge Atlas of Astronomy. Edited by Jean Audouze and Guy Israel. Cambridge University Press, 32 East 57th St., New York, NY 10022. 1985. 432 pages, illustrated, index. 14.5 X 10.5 in. Price $ 75.00 cloth (ISBN 0-521-26369-7).

The sections of this atlas consist of "Astronomy Today," "The Sun," "The Solar System," "The Stars and the Galaxy," "The Extragalactic Domain" and "The Scientific Perspective." There is also a Sky Map and a Glossary. If you could choose only one book on astronomy, this would be the one.

Accretion Power in Astrophysics. By J. Frank, A.R. King, and D.J. Raine. Cambridge University Press, 32 East 57th St., New York, NY 10022. 1985. 273 pages, not illustrated, index. 9.25 X 6 in. Price $ 59.50 cloth (ISBN 0-521-24530-3).

This book contains a considerable amount of advanced mathematics. Its chapters are titled "Accretion as a Source of Energy," "Gas Dynamics," "Plasma Concepts," "Accretion in Binary Systems," "Accretion Discs," "Accretion onto a Compact Object," "Quasars and Active Nuclei," "Gas Flow and Line Emission in Active Nuclei," "Accretion onto Super-Massive Black Holes," and "Thick Discs." Also included is an Appendix.

Universe. By William J. Kaufmann, III. W.H. Freeman and Co., 41 Madison Ave., New York, NY 10010. 1985. 595 pages, 665 illustrations (210 in color), index. 8 X 10.25 in. Price $ 32.95 cloth (ISBN 0-7167-1673-9).

This book covers its subject in 29 chapters, and may be used for either a one- or two-term course. Each chapter is followed by a summary, review questions, advanced questions, discussion questions, and suggestions for further reading. Answers to the questions and problems are given in the back of the book. There is also a suitable Glossary. As a retired teacher of astronomy in two great universities in Texas, I recommend this book.

Comet! The Story Behind Halley's Comet. By Greg Walz-Chojnacki, edited by Nancy Mack. AstroMedia Corp., P.O. Box 92788, Milwaukee, WI 53202. 1985. 64 pages, illustrated, index. 8.5 X 11.25 in. Price $ 9.75 cloth (ISBN 0-913135-03-8).

This book's chapters are as follows: "Introduction," "An Ancient Puzzle," "What is a Comet?," "Where do Comets Come From?," "Do Comets Affect Earth?," "The Halley Missions," and "The Return of Halley's Comet." There are also three suggested projects; "Build a Comet," "Looking for Meteors" and "The View from Space." These are followed by a Glossary. I recommend this book to anyone interested in this famous comet.

On Civilized Stars. The Search for Intelligent Life in Outer Space. By Joseph F. Baughter. Prentice-Hall, Inc., Route 9 W, Englewood Cliffs, NJ 07632. 1985. 260 pages, illustrated, index. Price $ 21.95 cloth (ISBN 0-13-634429-1), $ 9.95 paper (ISBN 0-13-634411-9).

You will find the following chapters in this book: "Life in the Solar System," "Life Around Other Stars," "Galactic Life and Civilizations," "The Era of the Starship" and "The Search for Intelligent Signals," followed by suitable Appendices and References. This is an excellent book.

Constructing the Universe. By David Layzer. Scientific American Library, distributed by W.H. Freeman and Co., 41 Madison Ave., New York, NY 10010. 1985. 313 pages, 309 illustrations, index. 8.75 X 9.5 in. Price $ 27.95 cloth (ISBN 0-7167-5003-1).

This book contains the following chapters: "Cosmology and Scientific Truth," "Aristarchus, Copernicus, and Kepler," "Archimedes, Galileo and Newton," "Newton's Theory and the Astronomical Universe," "Special Relativity: Einstein's Theory of Unaccelerated Motion," "Einstein's Theory of Gravitation," "Einstein's Theory and the Universe," and "Cosmic Evolution." There is an Appendix and a "Guide to Further Reading." There are mathematical equations throughout, but even non-mathematicians will enjoy this book.

Ice Ages: Solving the Mystery. By John and Katherine Imbrie. Harvard University Press, 79 Garden St., Cambridge, MA 02138. 1986. 224 pages, illustrations, index. 9.25 X 5.75 in. Price $ 16.95 cloth, $ 7.95 paper (ISBN 0-674-44075-7).

If you are interested in this subject, you will want this book, which is a new printing of a book originally published in 1979. Part 1, "Ice Age Discovered," is covered in three sections. Part 2, "Explaining the Ice Ages," occupies 12 sections. Part 3, "Ice Ages of the Future," includes "The Coming Ice Age," "The Last Billion Years of Climate," an Appendix, "Suggested Reading," and a bibliography.

Moon, Mars, and Meteorites. By Peter Adams. Cambridge University Press, 32 East 57th St., New York, NY 10022. 1986. 36 pages, illustrations. 8.25 X 7.75 in. Price $ 2.95 paper (ISBN 0-521-32414-9).

The topics covered are "The Growth of Knowledge" (regarding the Moon), "The Lunar Landscape," "Man on the Moon" (which includes information about the six Apollo landings, 1969-1972), "Geology of the Moon," The Lunar Rocks," The Planet Mars," and "Meteorites." This is a small but informative book.

ANNOUNCEMENTS

1987 A.L.P.O. Convention. --As announced in our last issue, we will take part in the joint AL-WAA-ASP-ALPO-IAPPP-IOTA "UNIVERSE '87" Convention, July 11-16, 1987 at Pomona College in Claremont, southern California. The A.L.P.O. will hold a Business Meeting Sunday evening, July 12, a paper session Monday morning, July 13, and an observing workshop Monday afternoon. Members wishing to deliver a paper and/or lead a discussion on observing techniques can do so at our workshop, while those wishing to speak about observing results can do so at the A.L.P.O. Monday morning session. There will also be an A.L.P.O. Display, and members wishing to exhibit their work can bring their materials with them when they arrive, or mail them well before the Convention to the A.L.P.O. Exhibits Director, John Westfall (use his home address: 2775 - 39th Avenue, San Francisco, CA 94116).

The Banquet, which will include the presentation of the 1987 Walter H. Haas Observing Award, will be held Saturday evening, July 11. There will also be an A.S.P. Banquet Wednesday, July 15, and A.S.P. paper sessions, along with numerous tours. Lodging will be available in dormitories (with on-campus meals) and the nearby Griswald's Inn. For full information, write for a meeting packet and registration form to: A.S.P., Summer Meeting Department, 1290-24th Ave., San Francisco, CA 94122 (include two 22-cent stamps to help defray costs). If you wish to present a paper, write to the ASP soon so as to know of any deadlines before it is too late. Portions of the program will be oriented to the general public and to astronomy educators. We invite A.L.P.O. members to what looks to be one of the best-attended and action-packed Conventions in recent years!

Amateur Proposal Deadline Extended for Hubble Space Telescope. --The proposal deadline for amateur HST projects, announced as March 31 in our last issue, has been extended to June 30, 1987, due to the rescheduling from July to November, 1988 of the Space Shuttle launch that will carry the HST. To obtain application forms and proposal guidelines, amateurs should send $ 1.00 for postage and handling to: Hubble Space Telescope Amateur Astronomers Working Group, c/o American Association of Variable Star Observers, 25 Birch Street, Cambridge, MA 02138.

New Address for A.L.P.O. Jupiter Recorder, Phillip W. Budine. --Effective immediately, Mr. Budine's new address is: P.O. Box 761, Oxford, NY 13830.

International Comet Quarterly (ICQ) Data Available. --Two joint cooperative efforts by the International Comet Quarterly and the A.L.P.O. Comets Section were recently described by Daniel W.E. Green and David H. Levy in Tails and Trails (No. 11, Feb., 1987), our Comets Section Newsletter. The first item is the 1987 issue of the /Comet Handbook/, published for the first time outside of Japan. The author, Syuichi Nakano of the Smithsonian Astrophysical Observatory, is one of the world's top experts in computing the orbits of comets and minor planets. Published for over 10 years in Japanese by the Oriental Astronomical Association, the 1987 edition has been published in English as the January, 1987 issue of the ICQ , whose 56 pages contain recent sets of orbital elements and ephemerides for 53 comets. These data include celestial positions at 10-day intervals (5-day and 1-day interals for some comets with daily motions of over 1°), with geocentric and heliocentric distances, projected magnitudes, and the solar and lunar elongations of the comet. This publication is available for $ 10.00 postpaid from: Daniel W.E. Green, Smithsonian Astrophysical Observatory, 60 Garden St., Cambridge, MA 02138 USA.

Another joint ICQ-ALPO effort, beginning in 1980, is an archive of photometric observations of comets in the ICQ . This archive emphasizes the comprehensive cataloging of all good total visual magnitude (m_1) estimates of comets made by observers worldwide and making these data readily available to interested individuals in the published ICQ . Except for astrometric data, this archive provides the most extensive form of information for comets that goes back to the turn of this century. These carefully-obtained m_1 estimates can be used effectively in studying the overall physical nature of comets. Each m_1 estimate is published in full in the ICQ and is also stored in machine-readable form (each in one 80-byte record) along with the U.T. date, magnitude estimation method, source of comparison stars, instrument information, coma diameter, degree of condensation, tail information and observer. This archive has grown to include nearly 20,000 observations, with several thousand made by A.L.P.O. Comets Section members. A large collection of A.L.P.O. observations from the 1960's and 1970's is currently being added. In addition to the A.L.P.O., organized amateur groups from seven foreign nations also submit large amounts of data. For example, nearly 3700 P/Halley observations have been included so far, which may double when all observations for this comet have been entered! For information on obtaining a 9-track computer-tape version of this archive, contact Daniel W.E. Green at the address above.

Comet Ephemerides Available. --Longer-term but more restricted comet predictions are available in a recent 62-page booklet by Charles Townsend and John Rogers, Predictive Ephemerides for Selected One-Apparition Periodic Comets . This unbound booklet contains 23 sets of AD 1987-2000 predictions of one-apparition comet return positions, magnitudes, distances, elongation angles, and other useful data. The post-paid cost for this publication is $ 6.00 for the United States and Canada and $US 9.00 elsewhere; send either money order or check to Charles Townsend, 3521 San Juan Avenue, Oxnard, CA 93033. [Text continued on p. 48.]

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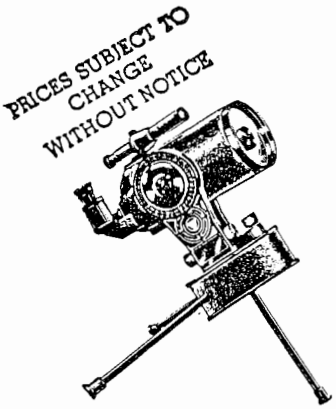

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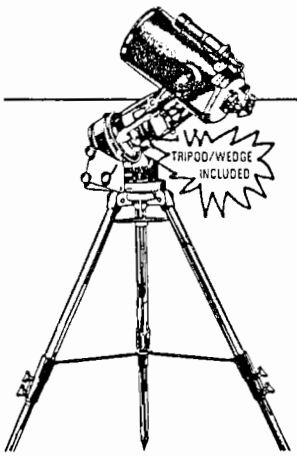

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The Bausch & Lomb 8000 has a visual power range of 40x to 480x, and a photographic power range of 40x (2,110mm) to 800x (40,000mm). The 8000 comes in a 28 pound package measuring 12" x 13" x 24". Focusing down to 25 feet, the Bausch & Lomb 8000 also allows you to take your bird watching seriously.

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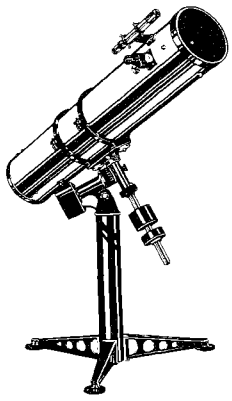

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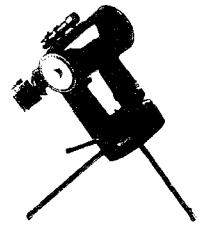

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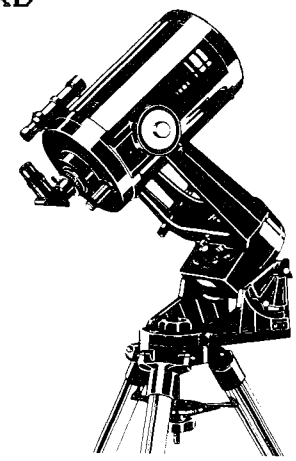

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Prop. Frederick Pauli, Jr. has worked as a consultant for Perkin-Elmer on the Hubble Space Telescope and has been an active amateur observer for over 30 years.

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[Text continued from p .45.]

Goodies from the Astronomical Society of the Pacific. --The A.S.P. has announced the availability of five items that should be of interest to our members: (1) A 17-slide set of views of Halley's Comet during the recent apparition which includes observatory photographs and images by the Very Large Array and by the Giotto, Vega, and Pioneer spacecraft, together with a detailed booklet ($ 16.50; add $US 3.00 if outside the U.S.A.). (2) A 15-slide set of Voyager spacecraft imagery of Uranus including a 20-page booklet ($ 14.95; add $US 3.00 if outside the U.S.A.). (3) A 39-minute videotape interview with Clyde Tombaugh, accompanied by a 12-page booklet, in which he explains in nontechnical language the work that led to his discovery of the planet Pluto (VHS format only; $ 32.95; add $US 4.00 if outside the U.S.A.). (4) A 28-page "Astronomy as a Hobby" packet full of advice on getting started in amateur astronomy. It gives non-technical tips on objects to observe, equipment, groups (of course including the A.L.P.O.), and books and magazines of use to the amateur ($ 3.00). (5) A booklet, "Computer Software for Astronomy," which describes 89 commercially available programs for popular microcomputers and also gives company addresses and reviews of 13 introductory books and articles on the topic ($ 2.00; add $US 1.00 if outside the U.S.A.). To obtain any of the above, write: A.S.P., 1290 - 24th Ave., San Francisco, CA 94122. After "A.S.P." on the address add the following, as appropriate: "Halley Slides Dept.," "Uranus Slides Dept.," "Tombaugh Tape Dept.," "Hobby Packet Dept.," or "Computer List Dept."

Free Publication for Educators. --The Sky Publishing Corporation publication Welcome to Our Universe which was announced in our previous issue continues to be available without cost to educators. This is a brief introduction to some basics of observing. For more information, write (under your school's letterhead) to: William Lawrence, 49 Bay State Road, Cambridge, MA 02238. Be sure to include a brief description of the astronomy course or courses that you teach and the number of students in each class.

A.L.P.O. Membership/Subscription Status. --We wish to remind our readers that they can determine the volume/issue number when their subscription expires by inspecting the top lines of their mailing labels. For example, the code "32.06" means expiration with the issue of Vol. 32, Nos. 5-6. A renewal notice is also included with the issue of expiration. Please also remember that the A.L.P.O. subscription period is by the volume (about 1-1/2 years) rather than by calendar year.

BOOKS ON ASTRONOMY

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THE PLANET SATURN, by A.F.O'D. Alexander, Repr.. $ 8.00
THE TELESCOPE, by L. Bell, reprint . . . . . $ 6.50
THE HISTORY OF THE TELESCOPE, by H.C. King . . . $ 8.95
NORTON'S STAR ATLAS - limited supply only -. . . $ 22.95
ASTRONOMICAL ALMANAC FOR 1986. . . . . $ 25.00
AMATEUR ASTRONOMER'S HANDBOOK, by J.B. Sidgwick,
4th ed. hardcover . $ 24.95; 3rd ed. soft-bd. $ 6.95
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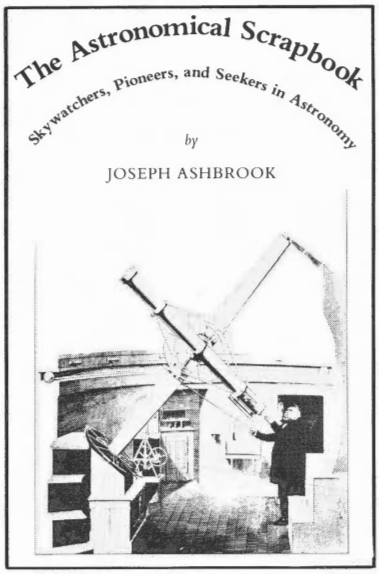

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