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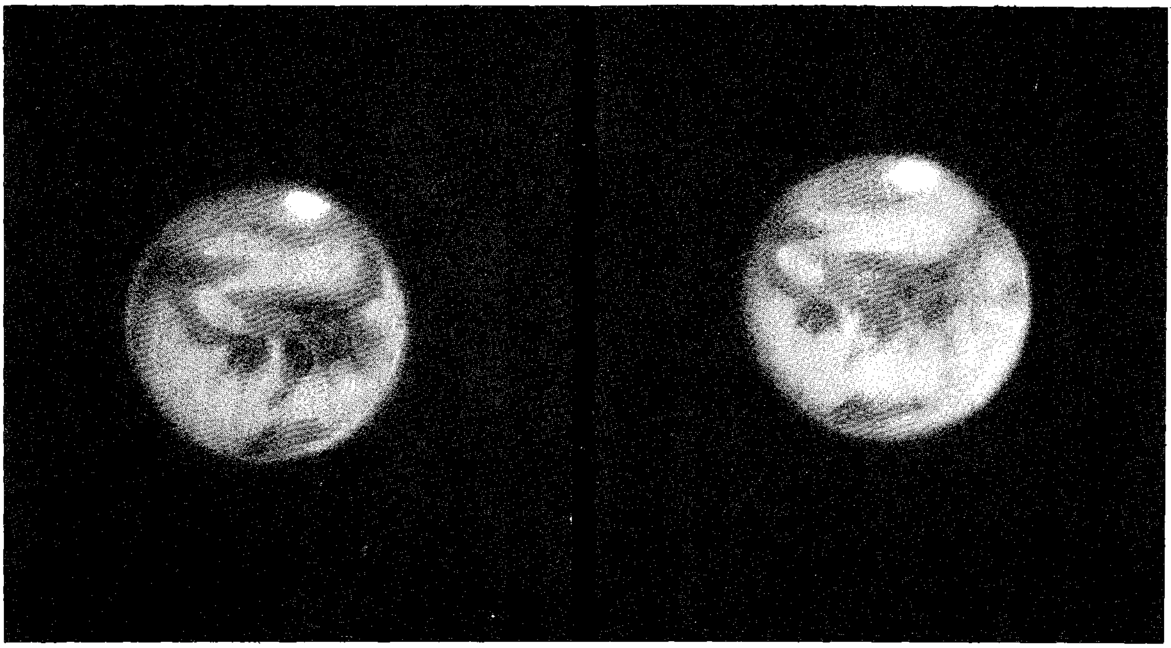

Photo-visual drawings of Mars by Klaus R. Brasch, with a 35.6-cm Schmidt Cassegrain telescope (see pp. 19-21 of this issue). Both views are on 1988 SEP 20, two days before closest approach to the Earth; with the areocentric longitude of the Sun 275°, the disk diameter 23.8 arcseconds, the proportion of disk sunlit 0.995, and the areocentric latitude of the Earth -25°. The left drawing was made at 04h 15m Universal Time at central meridian 001°, showing Syrtis Major near the left limb. The right view was at 05h 40m U.T. and C.M. 022°, with Mare Erythraeum right of center and Solis Lacus near the right limb. Celestial south at top.

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IN THIS ISSUE

THE 1985-86 APPARITION OF JUPITER: ROTATION PERIODS

By: Phillip W. Budine, A.L.P.O. Jupiter Recorder

ABSTRACT

This report summarizes the results of 1451 visual central meridian timings of Jupiter's features during its 1985-86 Apparition, submitted by 29 observers. Tables and graphs of drift rates are given for major features and currents, along with a table of latitude measurements. The discussion includes the outbreaks of two South Equatorial Belt Bright-Streak Disturbances, a STrZ Streak, a STrZ Disturbance, and a bright rift in the NEB; and observations of SEBs retrograding dark spots and Olivarez Blue Features.

GENERAL

This report describes the 1985-86 Apparition of Jupiter, falling between the solar conjunctions of 1985 JAN 14 and 1986 FEB 18. Data for the date of opposition are:

Date of Opposition..... 1985 AUG 04, 12^h
Geocentric Declination.................. -18°.0
Apparent Equatorial Diameter..... 48".4
Apparent Stellar Magnitude............ -2.8
Zenocentric Solar Declination........ -0°.3
Zenocentric Declination of Earth... -0°.1

The highlights of this apparition were: the brightening and increased visibility of Oval FA; the outbreaks of two South Equatorial Belt (SEB) Disturbances, both of a new type-SEB Bright-Streak Disturbances (Nos. 1 and 2); detection of a new South Tropical Zone (STrZ) Streak; the development of a new STrZ Dis-turbance; observations of SEBs retrograding dark spots, associated with SEB Disturbance No. 1, but not with SEB Disturbance No. 2; the detection of a bright rift in the North Equatorial Belt (NEB); and observations of the long-lived Olivarez Blue Features in the NEBs-Equatorial Zone North (EZn).

Figure 1 (p. 2) gives the standard jovian nomenclature for the features described here.

This report is based on 1512 visual central meridian transit timings and photographs submitted by the 29 A.L.P.O. observers who are listed in *Table 1* below. When graphed, 1394 transits formed usable drift-lines for 76 jovian features distributed in ten different atmospheric currents. Sixty-five selected drift-lines are plotted in *Figures 2-4* (pp. 8-9), while some of the features discussed are illustrated in *Figures 5-10* (pp.9-13).

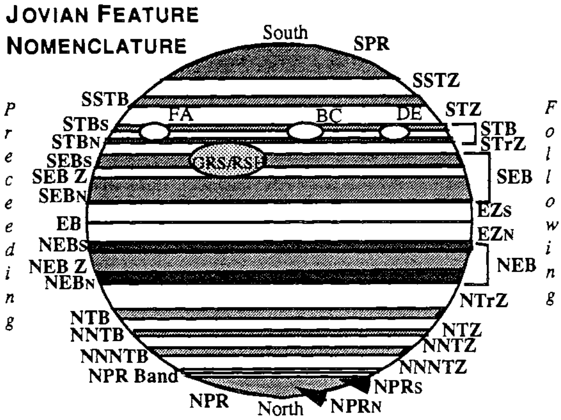
The monthly distribution of transit timings during the 1985-86 observing season was: 1985 APR–13, MAY–48, JUN–196, JUL–276, AUG–380, SEP–392, OCT–176, NOV–27, DEC–1, AND 1986 JAN–3. [Note the normal, if unfortunate, tendency for observers to concentrate on the period near and immediately following opposition. *Ed.*

Table 1. Participating A.L.P.O. Observers, 1985-86 Apparition of Jupiter

Observer	Observing Site	Telescope(s) *	Observation Type**
Akutsu, T.	Okinawa, Japan	20-cm RL	124T, Photographs
Asada, T.	Okinawa, Japan	12.5-cm RR	SS
Barbany, Domenec	Barcelona, Spain	20-cm RR	192T, SS
Beish, Jeff	Miami, Florida	25-cm RL	SS
Benninghoven, Claus	Burlington, Iowa	20-cm RL	174T, SS
Bourke, Tyler	Victoria, Australia	13- & 33-cm RL's	26T, SS
Broadbank, T.	Dorset, England	25-cm RL	59T, SS
Budine, Phillip W.	Walton, New York	9-cm CAT	195T, SS
Daniels, Mark S.	Wichita, Kansas	20-cm RL	24T
Graham, David L.	N. Yorks., England	15-cm RR	24T, SS
Heath, Alan W.	Nottingham, England	32-cm RL	24T, SS
Hirabayashi, J.	Okinawa, Japan	20-cm RL	SS
Lerner, Eric J.	Lawrenceville, New Jersey	15-cm RL	22T, SS
MacDougal, Craig	Tampa, Florida	15-cm RL	9T
Melillo, Frank J.	N. Valley Stream, New York	20-cm RL	3T
Miyazaki, Isao	Okinawa, Japan	20-cm RL	158T, SS
Nakagami, T.	Okinawa, Japan	29-cm RL	Photograph
Olivarez, José	Wichita, Kansas	32-cm RL	29T, SS
Park, Jim	Glen Waverley, Australia	20-cm RL	52T, SS
Parker, Donald C.	Coral Gables, Florida	32-cm RL	Photographs
Pedersen, Steen	Hinnerup, Denmark	6.5-cm RR	54T
Phillips, James	Charleston, South Carolina	20-cm RR	106T, SS
Robotham, Rob	Ontario, Canada	15-cm RL	29T
Rogers, John	Cambridge, England	20-cm RR & 25-cm RL	SS
Ross, Terence	Milwaukee, Wisconsin	32-cm RL	48T, SS
Scott, Pete	Indiana, Pennsylvania	20-cm CAT	43T, SS
Tatum, Randy	Richmond, Virginia	15- & 25-cm RL's; 18 & 66-cm RR's	72T, SS
Troiani, Daniel M.	Chicago, Illinois	25- & 41-cm RL's	27T, SS
Yandrick, Richard M.	Willow Grove, Pennsylvania	20-cm CAT	18T, SS

* CAT = Catadioptric Reflector; RL = Reflector (Undiff.); RR = Refractor. ** SS = Strip Sketches; T = Transits (with No.).

JOVIAN FEATURE NOMENCLATURE



Abbreviation Key:

S, s = South	B = Belt
N, N = North	Z = Zone
E = Equatorial	R = Region
P = Polar	RS = Great Red Spot (Long. Var.)
T = Temperate	RSH = Red Spot Hollow
Tr = Tropical	(FA, BC, and DE are long-term white spots whose longitudes vary)

Figure 1. Standard jovian nomenclature used in this report.

South Temperate Current (S. edge STB, STZ).—The three long-term white ovals (**BC**, **DE**, and **FA**) of the STZ Current continued to be followed by A.L.P.O. Jupiter Section observers. Located in the center of the STB, in decreasing order of conspicuousness these ovals were FA, DE, and BC. Their lengths in longitude were: Oval BC, 6°; Oval DE, 10°; and Oval FA, 7°. Oval BC had decreased 2° in length since the 1983-85 Apparition, while Oval DE remained the same and Oval FA decreased 1°. Oval BC was in conjunction with the center of the RS on 1985 JUL 08 at longitude 023°II. Its appearance near that date is shown in *Figure 5* (p. 9).

Table 2 (p. 3) gives drift-rate information for these three Ovals, along with the separate features **4** and **5**. Note that features **1**, **2**, and **3** refer to the centers of Oval BC, Oval DE, and Oval FA, respectively.

LONGITUDE MOTIONS OF JOVIAN FEATURES

Explanation.—The longitudes, 30-day drift rates, and rotation periods that were derived from our transit timings are given in *Tables 2-10* (pp. 3-7)

In each table except 3, column one gives an identifying number or letter for each object. Column two indicates whether the object was dark (D) or bright (W); and whether the preceding end (p), center (c), or following end (f) was observed. The third column gives the first and last dates of transit observations; and the fourth column gives the appropriate longitudes on those dates. Column five gives the longitude at opposition (1985 AUG 04) if the feature existed at that time. The sixth column gives the number of transits observed. Column seven indicates the mean number of degrees in longitude that each marking drifted in 30 days, negative when the longitude decreased. The eighth and last column shows the corresponding rotation period in hours, minutes, and seconds. All longitudes are given in degrees. [They are given in "System I" or "System II" as appropriate. These two Systems are used as an approximate fit for the longitudes of most jovian atmospheric features. System I applies to the EZ, south edge of the NEB, north edge of the SEB, and the south edge of the NTB; its rotation period is 9h 50m 30.0s. System II applies to the rest of the disk (except the SEB Z, which is often intermediate between the two Systems). The rotation period of System II is 9h 55m 40.6s. In the text, which System is meant will be given following each longitude; e.g., 023°II. *Ed.*]

The Great Red Spot (RS; in the STrZ).—The RS had a mean longitudinal length of 19° for the 1985-86 Apparition, the same as it had in 1983-85. Its appearance in the 1985-86 Apparition is shown on *Figures 5* (p. 9), *6* (p. 9), and *7* (p. 10). *Table 3* (p. 3) provides rotation data for the RS.

South Tropical Current (STrZ).—In *Table 4* (p. 3), which describes the features in this current, Feature **1** was the preceding end of a narrow dark STrZ Streak which was first seen, by Claus Benninghoven, on 1985 APR 14 at 336°II. Feature **5** was the preceding end of a darker section in the same STrZ Streak.

Feature **4** was a large bright oval which developed near the preceding end of the RS and was first seen on 1985 SEP 05 by Terry Broadbank at 007°II. His drawing of it on that date is shown in *Figure* 6 (p. 9). By SEP 07 this oval was slightly larger and brighter. It then decelerated in drift (increasing longitude) during the period SEP 19-30. James Phillips had an excellent series of observations of this feature during that period. I believe that the bright Oval **4** was the "forerunner" of a STrZ event which soon followed; the development of a new STrZ Disturbance which took form near the preceding end of the RS. This Disturbance, with a concave preceding end, was first seen on 1985 SEP 12, at 008°II, by James Phillips and Phillip Budine. During its short period of visibility, it was also seen by José Olivarez, whose drawings of it appear in *Figure 7* (p. 10), and was photographed by Donald Parker. Isao Miyazaki first saw, and sketched, this Disturbance on 1985 OCT 11, at 358°II. It was last seen, on OCT 13, by

Table 2. South Temperate Current (S. edge STB, STZ), System II. 1985-86 Apparition.
(Selected Features graphed in *Figure 2*, p. 8.)

Ident.	Mark	Limiting Dates (1985)	Limiting Longitude	Opposition Longitude	No. of Transits	30-day Drift Rate	Period
B	Wp	MAY 11-OCT 01	049-342°	008°	9	-14.0°	$09^h\ 55^m\ 21^s$
1	Wc	MAY 11-OCT 01	052-345	011	26	-14.0	09 55 21
C	Wf	MAY 11-OCT 01	055-348	014	8	-14.0	09 55 21
D	Wp	JUN 07-NOV 23	119-036°	138°	11	-14.8°	$09^h\ 55^m\ 20^s$
2	Wc	JUN 07-NOV 23	124-041	143	39	-14.8	09 55 20
E	Wf	JUN 07-NOV 23	129-046	148	15	-14.8	09 55 20
F	Wp	APR 28-NOV 22	244-160°	199°	13	-12.2°	$09^h\ 55^m\ 24^s$
3	Wc	APR 28-NOV 22	248-164	203	49	-12.2	09 55 24
A	Wf	APR 28-NOV 22	251-167	206	16	-12.2	09 55 24
4	Wc	JUN 18-JUL 27	255-232°	----	5	-17.7°	$09^h\ 55^m\ 16^s$
5	Dp	MAY 25-AUG 13	302-253	258°	7	-18.2	09 55 16

Mean Rotation Period: $09^h\ 55^m\ 21^s$

Table 3. Great Red Spot (RS; in STrZ), System II. 1985-86 Apparition.
(Center graphed in *Figure 2*, p.8; ends graphed in *Figure 3*, p. 8.)

Mark	Limiting Dates (1985)	Limiting Longitude	Opposition Longitude	No. of Transits	30-day Drift Rate	Period
RSp	APR 24-NOV 19	014-013°	013°	65	-0.14°	$09^h\ 55^m\ 40^s$
RSc	APR 24-NOV 19	024-023	023	94	-0.14	09 55 40
RSf	APR 24-NOV 19	033-032	033	70	-0.14	09 55 40

Mean Rotation Period: $09^h\ 55^m\ 40^s$

Table 4. South Tropical Current (STrZ), System II. 1985-86 Apparition.
(Selected Features graphed in *Figure 3*, p. 8.)

Ident.	Mark	Limiting Dates (1985)	Limiting Longitude	Opposition Longitude	No. of Transits	30-day Drift Rate	Period
1	Dp	APR 14-SEP 11	336-270°	287°	12	-13.2°	$09^h\ 55^m\ 23^s$
2	Dc	JUN 08-JUL 29	281-276	----	7	-2.9	09 55 37
3	Wc	JUN 08-JUN 25	286-282	----	3	-6.7	09 55 31
4	Wc	SEP 05-OCT 01	007-351	----	9	-17.7	09 55 16
5	Dp	SEP 03-SEP 26	347-342	----	5	-6.3	09 55 32
6	Dp	SEP 12-OCT 13	008-358	----	7	-10.0	09 55 27
7	Wc	AUG 19-SEP 07	057-039	----	5	-30.0	09 55 00

Mean Rotation Period: $09^h\ 55^m\ 24^s$

Olivarez (see *Figure 7*, p. 10). The preceding end of this Disturbance had an effect on Oval **4**, causing it to increase its System II longitude 5° in the period 1985 SEP 19-30.

Oval **7** approached the following end of the RS during the period 1985 AUG 19-SEP 07. It reached the following shoulder of the RS on SEP 07 at 039°II. On the same date, Oval **4** was seen on the preceding shoulder of the RS. Broadbank made strip sketches on 1985 SEP 05 and 07 that depicted these two features, which are shown here as *Figure 6* (p. 9). Oval **4** was last seen on 1985 OCT 01, at 351°II. Did Oval **7** survive a passage across the RS? If it did, that oval would be following Oval **4**, and would have been able to transit the STrZ Disturbance, which had developed on 1985 SEP 12. This is very unlikely. A second oval, somewhat smaller, was seen following Oval **4** during the period 1985 SEP 24-30, as seen in good views by Phillips. However, the drift-line of Oval **7** is considerably different from that of the Oval of SEP 24-30 above. Therefore, Oval **7** probably dissolved near the dark material at the following shoulder of the RS area. These ovals are discussed further in the SEBS section (p. 5).

South Equatorial Belt Bright-Streak Disturbance No. 1 (S. Edge SEBN, SEB Z).—Usually, prior to an eruption of an SEB Disturbance, the SEB has one of the following aspects: (1) invisible, (2) one of the components is invisible (usually the SEBS), or (3) both components are very faint. (However, in

Table 5. South Equatorial Belt Bright-Streak Disturbance No. 1 (S. edge SEBN, SEB Z), System II. 1985-86 Apparition.
(Features graphed in *Figure 3*, p. 8.)

Ident.	Mark	Limiting Dates (1985)	Limiting Longitude	Opposition Longitude	No. of Transits	30-day Drift Rate	Period
1	Wc	JUL 09-AUG 02	143-099°	----	14	-55.0°	09h 54m 25s
2	Dc	JUL 22-AUG 31	124-059	103°	10	-50.0	09 54 32
3	Dc	JUL 22-AUG 05	135-119	120	6	-32.0	09 54 57
4	Wc	JUL 19-AUG 09	145-117	124	12	-40.0	09 54 46
5	Wc	JUL 22-JUL 31	147-136	----	7	-37.0	09 54 50
6	Dc	AUG 12-AUG 25	120-101	----	8	-47.5	09 54 36
7	Wc	AUG 05-OCT 16	146-052	----	21	-39.2	09 54 47
8	Dc	AUG 12-OCT 16	140-078°	----	16	-28.2°	09h 55m 02s
9	Wc	AUG 17-SEP 07	145-135	----	6	-16.7	09 55 18
10	Dc	SEP 10-OCT 06	132-116	----	6	-17.8	09 55 16
11	Wc	SEP 01-NOV 19	145-091	----	18	-20.8	09 55 12
12	Dc	SEP 15-SEP 20	143-138	----	6	-25.0	09 55 06
13	Wf	OCT 08-OCT 24	139-118°	----	5	-42.0°	09h 54m 43s
				Mean Rotation Period:	*Features 1-7, 13*		09h 54m 42s
					Features 8-12		09 55 11

early July, 1985, the SEB was dark and prominent. No one suspected that there would be an eruption of the SEB of an entirely new type, and least of all not one, but two eruptions!)

On 1985 JUL 09, Isao Miyazaki of Japan discovered the first of the new type of SEB Disturbances; his drawing is shown on *Figure 5* (p. 9). The A.L.P.O. Jupiter Section has named this new type of eruption as "South Equatorial Belt Bright-Streak Disturbances." Miyazaki saw the Disturbance's initial eruption as a bright spot at 143°II. He also observed this feature on JUL 12 and JUL 14 in its early stages of development. On 1985 JUL 12, it was also observed by Tyler Bourke of Australia at 132°II. Its first American observers were José Olivarez, Jeff Beish, and Donald Parker (who photographed it); all on 1989 JUL 14 near 124°II.

Feature **1** in *Table 5* above is the advancing preceding bright streak of the SEBN-SEB Z current. This bright spot is the preceding end of the SEB Bright-Streak Disturbance. Feature **2** is the preceding dark spot following the preceding bright streak.

Besides the events which occurred when the SEB was very dark and prominent, which itself is highly unusual, another peculiar fact about this Disturbance is that it erupted four times from approximately the same source longitude! Most classical Disturbances erupt from one source longitude, and the advancing bright and dark spots all meet at one source longitude when they are projected backward in time. Also, classical Disturbances have triggered outbreaks in other longitudes, such as was the case with the 1971 Triple SEB Disturbance.

After the first eruption on 1985 JUL 09 at 143°II, the second was first observed on JUL 19 at 145°II by Isao Miyazaki, J. Park, and Pete Scott. Its appearance then is shown in *Figure 8* (p. 11). Its early stages were also observed by Phillip Budine on JUL 21 and by J. Park on JUL 22. Feature **4** in the above table represents this second Disturbance.

The third eruption was first recorded by Claus Benninghoven on 1985 AUG 05 at 146°II; his strip sketch is shown in *Figure 9* (p. 13). It was also observed on AUG 07 by Miyazaki. This eruption is Feature **7** in *Table 5* above. It, along with Feature **2**, approached within 15-20° of the following end of the RS.

The fourth eruption was observed first by Terry Broadbank on 1985 SEP 01 at 145°II, followed by Pete Scott on SEP 05. This eruption is given as Feature **11** in *Table 5*.

Isao Miyazaki and T. Asada made an excellent series of strip sketches of the development of this 1985 SEB Bright-Streak Disturbance for the period of 1985 JUL 09-AUG 09,. Their series, which shows the first three eruptions of this feature, is reproduced here as *Figure 8* (pp. 11-12).

Randy Tatum made a very significant observation of the possible last stages of the STrZ Disturbance remnant, which he observed on 1985 JUN 15 at 163°II. SEB Disturbances usually erupt very near the longitude of the disappearance, or last observation, of an STrZ Disturbance. This first SEB Bright-Streak Distur-bance erupted first at 143°II; within 20° of the last observation of the STrZ Disturbance remnant!

As a final note about this phenomenon: When I extrapolated their drift-lines back to the intersection point of the preceding end of the Disturbance, and for the first SEBS retrograding spot, they met at 160°II on 1985 JUN 29. This STrZ Disturbance was at 163°II when last seen!

South Equatorial Belt Bright-Streak Disturbance No. 1 (SEBS).—Information on the features in the SEBS associated with this Disturbance is given in *Table 6* (p. 5). Feature **1** in that table is the first SEBS retrograding

Table 6. South Equatorial Belt Bright-Streak Disturbance No. 1 (SEBs), System II. 1985-86 Apparition.
(Features graphed in *Figure 3*, p. 8.)

Ident.	Mark	Limiting Dates (1985)	Limiting Longitude	Opposition Longitude	No. of Transits	30-day Drift Rate	Period
1	Dc	JUL 12-SEP 12	199-039°	271°	14	+95.2°	09^h 57^m 51^s
2	Dc	JUL 29-SEP 17	232-045	255	11	+101.8	09 58 00
3	Dc	AUG 13-SEP 12	245-002	----	13	+117.0	09 58 21
4	Dc	AUG 03-SEP 15	198-003	201	12	+117.9	09 58 22
5	Dc	JUL 29-SEP 19	169-357°	189°	14	+110.6°	09^h 58^m 12^s
6	Dc	AUG 12-SEP 19	198-344	----	9	+112.3	09 58 14
7	Dc	AUG 12-SEP 19	191-335	----	10	+110.8	09 58 12
8	Wc	AUG 12-SEP 01	187-255	----	6	+97.1	09 57 54
9	Dc	AUG 08-OCT 01	168-350°	----	15	+101.1°	09^h 57^m 59^s
10	Wc	AUG 12-SEP 16	171-275	----	8	+86.7	09 57 39
11	Dc	AUG 12-SEP 21	160-284	----	12	+95.4	09 57 51

Mean Rotation Period: 09^h 58^m 03^s

spot observed moving rapidly in a direction of increasing longitude (positive drift). After 50 days, it had reached the preceding end of the RS on 1985 AUG 31 near 010°II. Observers were watching eagerly to see if the SEBS spots would move north into the channel or bay of the RS and then around it to the following end of the RS. Feature **1** did get through the channel on SEP 03 at 017°II, according to observations by Randy Tatum and Phillip Budine. By SEP 12 the spot was near the following shoulder of the RS at 039°II, according to observations by Budine. Dark Spot **2** was also watched closely as it approached the RS area. On SEP 05, Terry Broadbank observed the bright STrZ spot which appeared to be stopping the spots from entering the RS channel to the north. On SEP 06, a dark spot was observed at 012°II within the channel. On SEP 07, Broadbank recorded dark material entering the preceding channel of the RS area. Then, on SEP 12, Budine drew a strip sketch that showed Spot **1** at 039°II and Spot **2** at 025°II. Feature **2** was last seen on SEP 17 at 045°II.

Also on 1985 SEP 12, Budine discovered the new STrZ Disturbance near the preceding end of the RS at 008°II. It is significant that after this date none of the other SEBS spots—Features **3-7** and **9**—survived long enough to reach the preceding end of the RS or to go into the associated channel. Spots **8**, **10**, and **11** were observed moving north of the STrZ oval and were last seen near the preceding end of the STrZ Disturbance.

Near the period SEP 10-12, the RS decelerated in the direction of increasing its longitude by 2°II. The effect may have been caused by the STrZ Oval, the retrograding SEBs spots; or, most likely, the STrZ Disturbance.

South Equatorial Belt Bright-Streak Disturbance No. 2 (S. Edge SEBN, SEB Z).—SEB Bright-Streak Disturbance Number 2 was discovered by Isao Miyazaki of Japan and John Rogers of England on 1985 NOV 03 near 193°II. It was first seen in the United States by José Olivarez on NOV 05, as shown in his drawing of that date in *Figure 10* (p. 13). Its early stages were also observed by James Phillips on 1985 NOV 09. This Disturbance was exceptional as was the SEB Disturbance No. 1; but it was also very unusual in that it had only one eruption source longitude, and it was *unaccompanied* by retrograding SEBS dark spots!

In *Table 7*, below, Feature **1** is the preceding end of the bright streak, which constituted the advancing front of the Disturbance. Feature **2** is the second bright streak, which erupted from the same source. Feature **3** is the bright streak that was the following end of Feature **2** and moved slightly in increasing longitude. The Disturbance was rather short-lived with most of its features being observed for 12-16 days. José Olivarez made two excellent strip sketches of the Disturbance, on 1985

Table 7. South Equatorial Belt Bright-Streak Disturbance No. 2 (S. Edge SEBN, SEB Z), System II. 1985-86 Apparition.
(Features graphed in *Figure 3*, p. 8.)

Ident.	Mark	Limiting Dates (1985)	Limiting Longitude	Opposition Longitude	No. of Transits	30-day Drift Rate	Period
1	Wp	NOV 03-NOV 19	193-129°	----	7	-128.0°	09^h 52^m 45^s
2	Wp	NOV 05-NOV 17	190-166	----	6	-60.0	09 54 18
3	Wf	NOV 07-NOV 22	189-190	----	5	+2.0	09 55 43

Mean Rotation Period: 09^h 54^m 15^s

Table 8. North Equatorial Current (S. Edge NEB, EZN), System I. Olivarez Long-Lived Blue Features 1985-86 Apparition.
(Features listed here by increasing longitude, and graphed in *Figure 4*, p. 9.)

Ident. OL-	Mark	Limiting Dates (1985)	Limiting Longitude	Opposition Longitude	No. of Transits	30-day Drift Rate	Period		
1-85	Dc	MAY 29-NOV 09	025-027°	025°	47	+0.4°	09^h	50^m	31^s
7-83	Dc	APR 14-SEP 09	050-055	052	29	+1.0	09	50	31
1-83	Dc	APR 13-NOV 17	080-079	080	39	-0.1	09	50	30
2-83	Dc	MAY 05-SEP 16	095-093	093	28	-0.4	09	50	29
3-85	Dc	JUN 25-NOV 22	115-118	115	31	+0.6	09	50	31
4-85	Dc	JUN 06-OCT 12	142-143°	142°	34	+0.2°	09^h	50^m	30^s
3-83	Dc	JUN 09-OCT 25	165-161	161	33	-0.9	09	50	29
4-83	Dc	JUN 07-NOV 18	185-184	185	24	-0.2	09	50	30
2-84	Dc	JUN 07-OCT 12	228-229	220	42	+0.3	09	50	30
3-84	Dc	JUN 10-OCT 12	242-242	242	33	0.0	09	50	30
2-85	Dc	JUN 03-SEP 29	274-276°	275°	31	+0.5°	09^h	50^m	31^s
5-83	Dc	APR 14-OCT 02	306-306	306	53	0.0	09	50	30
6-83	Dc	APR 13-OCT 01	323-325	323	16	+0.4	09	50	31
4-84	Dc	MAY 25-OCT 15	350-351	351	37	+0.2	09	50	30

Mean Rotation Period: 09^h 50^m 30^s

NOV 05 and 17, which are shown here in *Figure 10* (p. 13). Some residual material was being observed in this area as late as 1985 DEC 15, when Claus Benninghoven made a strip sketch which showed a bright streak, dark material, and a bright oval in the SEB longitudes occupied by the Disturbance; from 163°-185°II.

North Equatorial Current (S. edge NEB, EZN) Olivarez Long-Lived Blue Features.—In *Table 8*, above, the markings are identified by **OL-** for (José) Olivarez, who first recognized that these objects are long-lived blue features of the NEBS-EZN, along with an identifying number, and the year in which the object was first observed. OL-2-84 was a spectacular feature with a long festoon. It moved rapidly in increasing longitude during the period 1985 JUL 19-27, when it drifted +14°, then moved back to its original longitude by 1985 AUG 07. The mean rotational period of the long-lived blue features, 09h 50m 30s, was unchanged from the 1983-85 to the 1985-86 Apparitions.

North Equatorial Current (S. edge NEB, EZN).—*Table 9* (p. 7) gives the dark and bright features of the North Equatorial Current other than the Olivarez Blue Features. The mean period for the dark markings (Features **1**, **5**, and **9**) was 09h 50m 29s. Features **8**, **11**, and **12** were bright spots, or the "plumes" of three long-lived blue features; **OL-2-84**, **OL-5-83**, and **OL-4-84**, respectively. Therefore some of the blue-feature plumes are long-lived as well.

North Equatorial Belt (NEB Z).—The first feature listed in *Table 10* (p. 7) was a very bright rift in the NEB. It was first observed by Randy Tatum on 1985 JUN 22 at 159°II. Isao Miyazaki's drawing of 1985 JUL 09, given here in *Figure 5* (p.9), shows it approaching the central meridian; near 093°II. Claus Benninghoven also observed it in early July. It was last observed by James Phillips on 1985 JUL 17 at 062°II. This feature moved extremely rapidly in decreasing System II longitude.

North Temperate Current (NTB, NTZ).—The second marking listed in *Table 10* (p. 7) is a dark section of the NTB; the following end of the section is the feature in the table. It was observed best by Isao Miyazaki and Claus Benninghoven.

BELT LATITUDES

T. Akutsu of Japan was kind enough to forward the results of his program of measurements from his own photographs of the zenographic latitudes of Jupiter's belts in 1985, which are summarized in *Table 11* (p. 7). [The zenographic latitude of a feature is equal to the angle between its surface normal and Jupiter's equatorial plane. *Ed.*]

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Table 9. North Equatorial Current (S. Edge NEB, EZN), System I. Other Features. 1985-86 Apparition.

(Features listed here by increasing longitude, and graphed in *Figure 4*, p. 9.)

Ident.	Mark	Limiting Dates (1985)	Limiting Longitude	Opposition Longitude	No. of Transits	30-day Drift Rate	Period
1	Dc	MAY 25-AUG 26	010-004°	004°	16	-1.9°	$09^h\ 50^m\ 27^s$
2	Wc	JUN 22-SEP 16	037-042	039	15	+1.7	09 50 32
3	Wc	JUN 06-SEP 02	063-061	061	14	-0.7	09 50 29
4	Wc	SEP 12-OCT 25	112-115	----	12	+2.1	09 50 33
5	Dc	AUG 17-OCT 21	130-131	----	11	+0.5	09 50 31
6	Wc	AUG 06-OCT 12	135-141	----	17	+2.7	09 50 34
7	Wc	JUN 23-SEP 24	205-204	204	12	-0.3	09 50 30
8	Wc	JUL 23-SEP 24	229-223	225	14	-2.9	09 50 26
9	Dc	AUG 26-SEP 17	235-234	----	11	-1.4	09 50 28
10	Wc	JUL 22-SEP 08	253-250	250	9	-1.2	09 50 28
11	Wc	JUL 13-SEP 05	316-316	316	8	0.0	09 50 30
12	Wc	JUL 09-SEP 20	356-356	356	12	0.0	09 50 30

Mean Rotation Period: $09^h\ 50^m\ 30^s$

Table 10. North Equatorial Belt (NEB Z; "NEB-1") and North Temperate Current (NTB, NTZ; "NTC-1"), System II. 1985-86 Apparition.

Ident.	Mark	Limiting Dates (1985)	Limiting Longitude	Opposition Longitude	No. of Transits	30-day Drift Rate	Period
NEB-1	Wc	JUN 22-JUL 17	159-062°	----	9	-121.3°	$09^h\ 52^m\ 55^s$
NTC-1	Df	JUL 31-AUG 07	106-114	112°	5	+34.3	09 56 28

Table 11. Zenographic Latitudes Measured by T. Akutsu, 1985-86 Apparition.

	Date of Measurement (1985)									Mean, Std.
Feature	AUG 09	AUG 04	AUG 09	AUG 04	AUG 05	JUL 26	JUL 26	AUG 08	AUG 08	Deviation
Long.I	262°	322°	297°	287°	323°	263°	322°	090°	164°	---
Long.II	036	038	071	099	128	144	202	238	306	---
SPRN	-50.6°	-51.5°	-52.8°	-50.9°	-46.3°	-47.6°	-46.8°	-51.5°	-47.7°	-49.5±2.1°
STZS	---	---	---	-40.5	---	---	---	---	-40.4	-40.5 ---
STZN	---	---	---	---	---	---	---	---	-34.8	-34.8 ---
STBS	-36.9	-34.7°	-37.9°	---	-37.2°	-36.6°	-36.7°	-39.7°	---	-37.1±1.4°
Width	*6.0*	*2.7*	*6.1*	---	*7.7*	*9.6*	*9.4*	*8.7*	---	*7.2±2.3*
STBN	-30.9	-32.0	-31.8	-27.9°	-29.5	-27.0	-27.3	-31.0	---	-29.7±1.9
STrZ B	---	---	-28.3°	---	---	---	---	---	-24.5°	-26.4° ---
RS	-22.7°	-22.0°	---	---	---	---	---	---	---	-22.4 ---
SEBS	---	---	-21.0°	-19.7°	-19.9°	-18.8°	-19.3°	-18.6°	---	-19.6±0.6°
Width	---	---	*13.5*	*12.8*	*11.2*	*13.7*	*13.5*	*14.0*	---	*13.1±0.9*
SEBN	-5.8	-6.2	-7.5	-6.9	-8.7	-5.1	-5.8	-4.6	-7.8	-6.5±1.6
EB	+0.2	---	+0.4	-0.7	-2.6	-0.3	-1.4	---	-0.1	-0.6±0.9°
NEBS	+9.0°	+11.0°	+9.1°	+9.0°	+7.6°	+9.1°	+9.1°	+7.2°	+7.4°	+8.7±1.1°
Width	*6.7*	*4.6*	*6.4*	*8.4*	*6.3*	*7.6*	*6.4*	*8.2*	*6.8*	*6.8±1.1*
NEBN	+15.7	+15.6	+15.5	+17.4	+13.9	+16.7	+15.5	+15.3	+14.2	+15.5±1.0
NTrZ B	+20.7°	---	+19.4°	+21.2°	+16.2°	+19.9°	+19.6°	+18.9°	+19.1°	+19.0±1.4°
NTBS	+24.2°	+23.6°	+23.8°	+23.7°	+21.0°	+24.7°	+23.6°	+25.2°	+23.1°	+23.7±1.1°
Width	*6.9*	*6.9*	*4.8*	*6.3*	*6.5*	*5.7*	*7.6*	*6.4*	*6.2*	*6.4±1.0*
NTBN	+31.1	+30.5	+28.6	+30.0	+27.5	+30.4	+31.2	+31.6	+29.3	+30.0±1.3
NNTB	---	---	+34.5°	---	---	---	+36.4°	---	---	+35.5 ° ---
NPRS	+45.1°	+44.3°	+43.5	+44.6°	---	+41.8°	+45.7	+42.6	+41.8	+43.7±1.4°

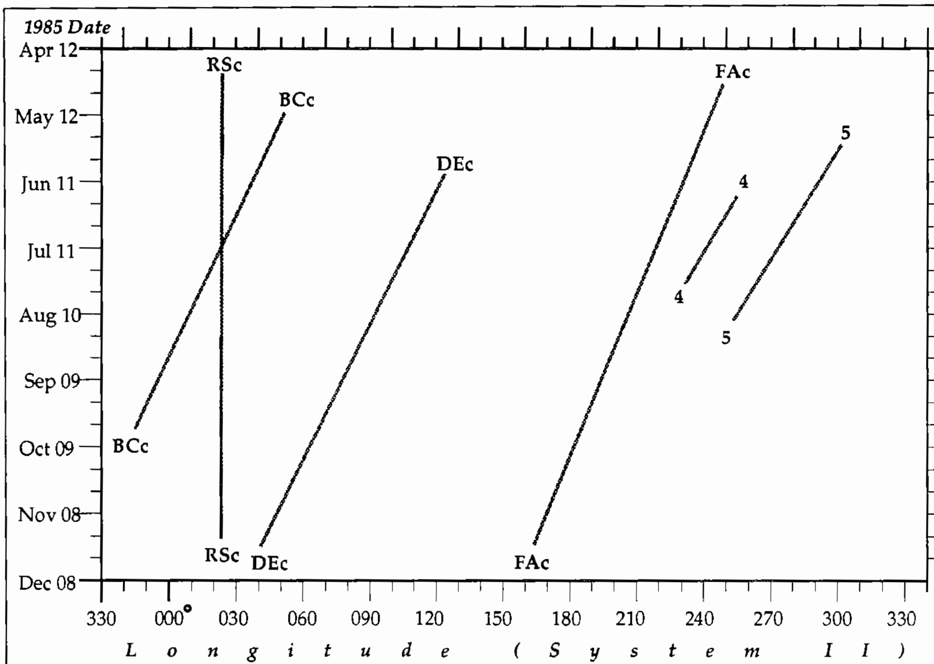


Figure 2. Drift chart, plotting System II longitude versus date, of important features in Jupiter's STZ, STB, and STrZ during the 1985-86 Apparition. See also *Tables 2* and *3* in the text (p. 3). On *Figures 2-4*, the initial and final longitudes of features are connected with straight lines, even though many features showed non-linear drifts between the two dates.

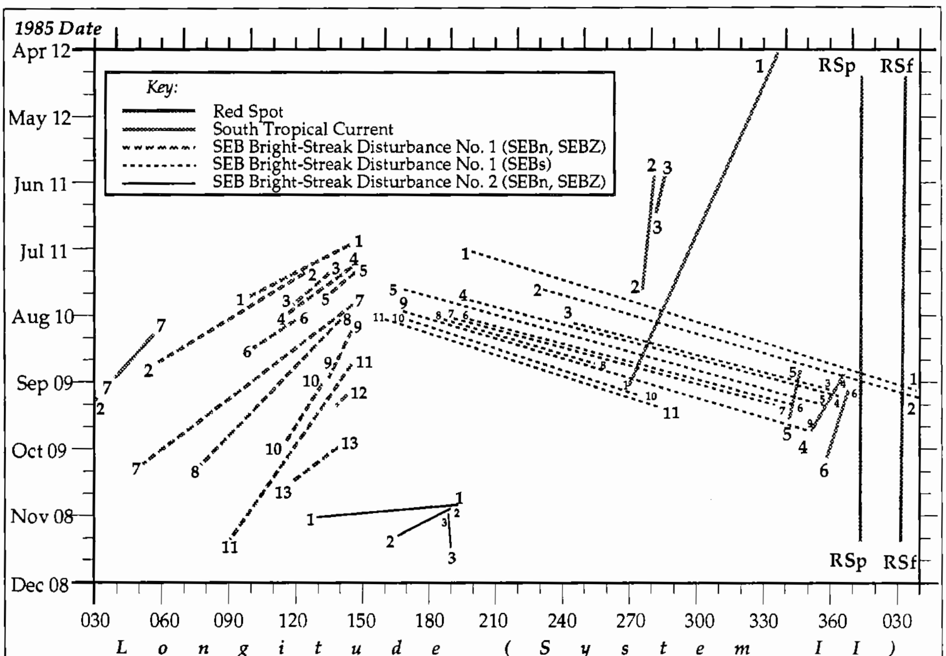


Figure 3. Drift chart, plotting System II longitude versus date,of Jupiter's RS and important features in the South Tropical Current and SEB Bright-Streak Disturbances Nos. 1 and 2 during the 1985-86 Apparition. See also *Tables 3 -7* in the text (pp. 3-5).

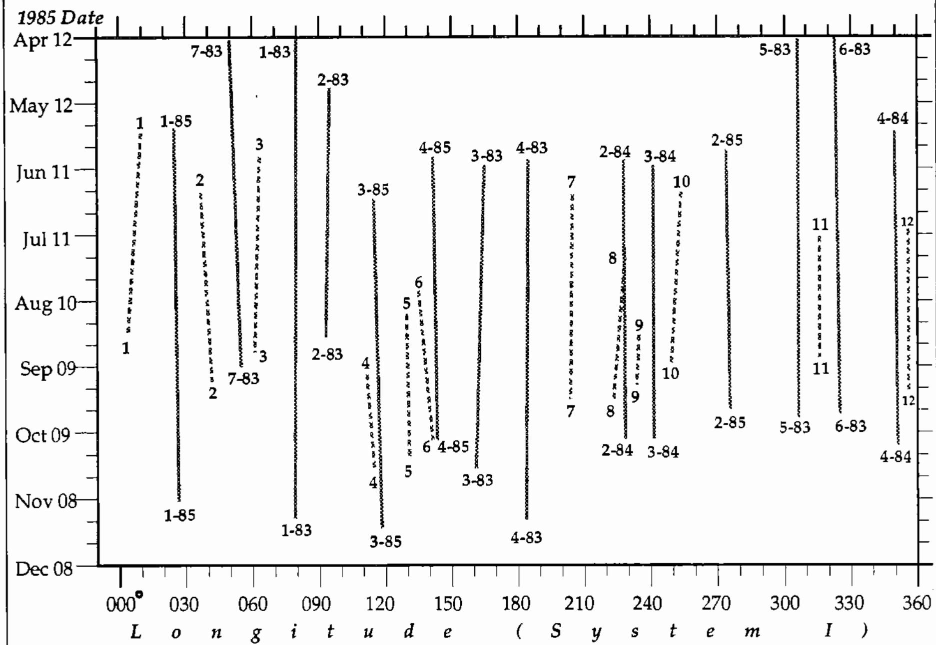


Figure 4. Drift chart, plotting System I longitude versus date, of Jupiter's Olivarez Long-Lived Blue Features and other important features in the North Equatorial Current during the 1985-86 Apparition. See also *Tables 8* and *9* in the text (pp. 6 and 7).

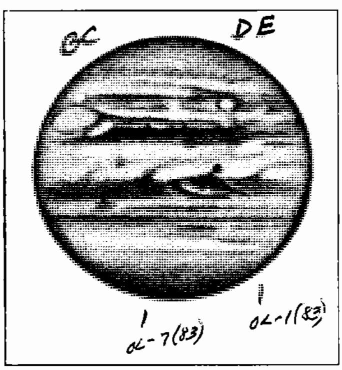
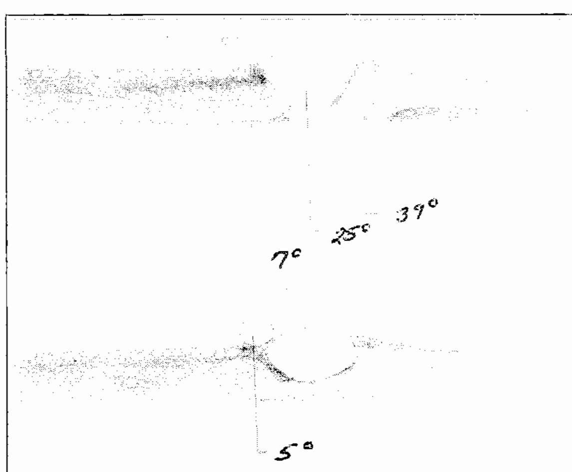


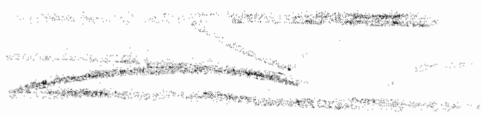
Figure 5 (left). Drawing of Jupiter by Isao Miyazaki on 1985 JUL 09, 14h 26m U.T. 20-cm. reflector at 316×. Seeing = 7 on the A.L.P.O. scale (0 = worst to 10 = best); Transparency = 4 on the A.L.P.O. scale (0 = worst to 5 = best). CMI = 065°.5, CMII = 076°.0, CMIII (radio period) = 350°.9. Note the Ovals BC and DE, the RS, and the Olivarez Long-Lived Blue Features OL-1-83 and OL-7-83. South at top.

Figure 6 (right). Strip-sketches of Jupiter by Terry Broadbank with a 25-cm reflector at 160×. The vicinity of the RS is shown, with System II longitudes indicated. The RS was noted by him as having a light grey margin and a pink interior. The upper sketch was made on 1985 SEP 05, the lower on 1985 SEP 07. South at top.



OBSERVATIONS OF JUPITER's SOUTH TROPICAL ZONE DISTURBANCE
1985

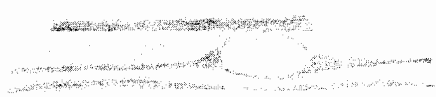
BC



September 26, 1985 U.T. at 2:00 UT

South Tropical Zone Disturbance

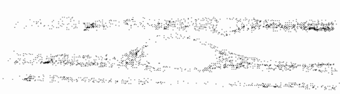
↑
#6 STRZD



↑#6 STRZD

October 13, 1985 U.T. at 1:30 UT

South Tropical Zone Disturbance



November 4, 1985 U.T. at 0:30 UT

STrZ Disturbance not seen

Figure 7. Three strip-sketches of Jupiter by José Olivarez with a 32-cm reflector showing the RS and the STrZ Disturbance. South at top. The System II longitudes of the CM were: top drawing, 343°; middle drawing, 358°; bottom drawing, 025°.

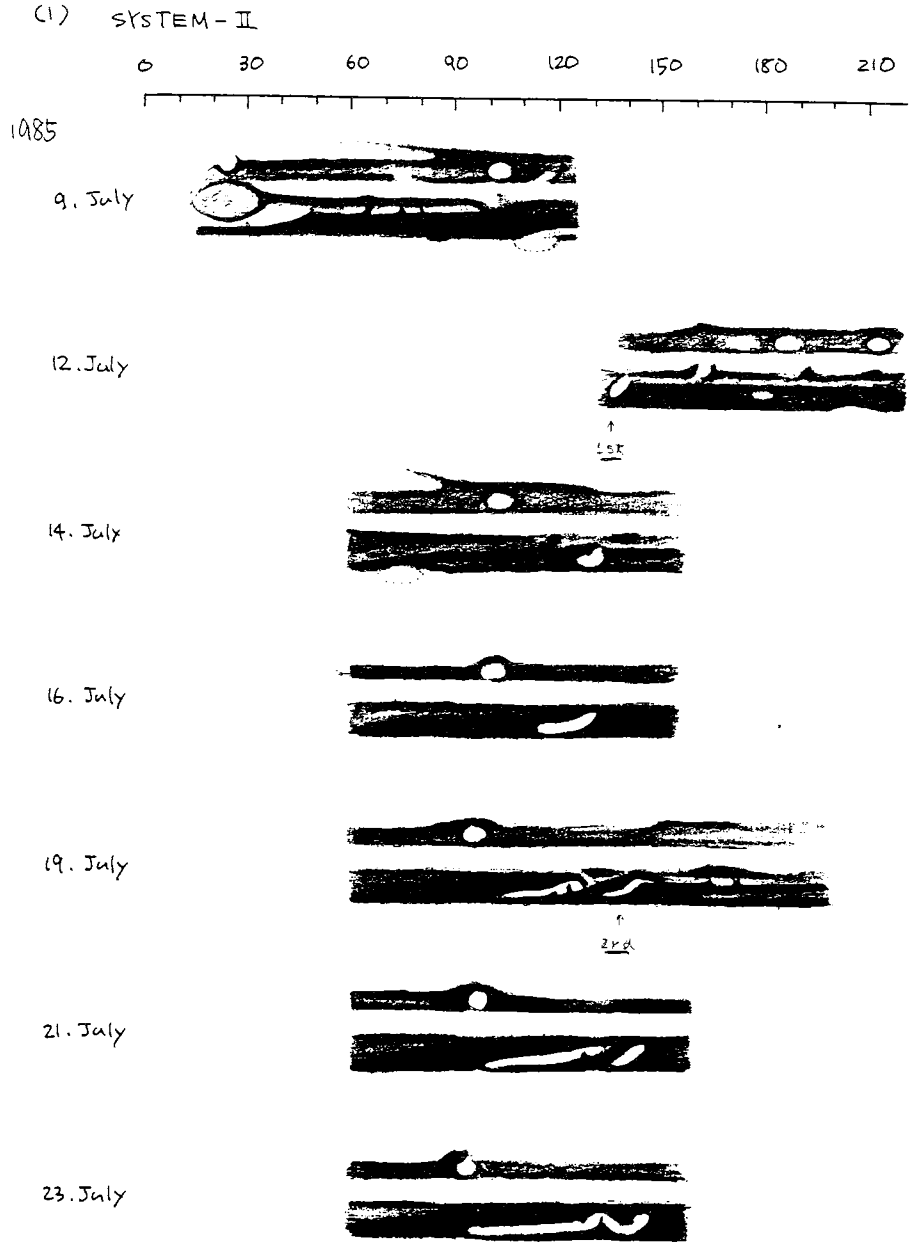


Figure 8. Series of strip-sketches of Jupiter by Isao Miyazaki and T. Asada using 20- and 12.5-cm reflectors on the dates indicated. The SEB is featured, and this page illustrates the initial appearances of the first (1985 JUL 12) and second (1985 JUL 19) outbreaks of the SEB Bright-Streak Disturbance No. 1. The portion of Figure 8 on the next pag also shows the development of the third outbreak on 1985 AUG 07. South at top.

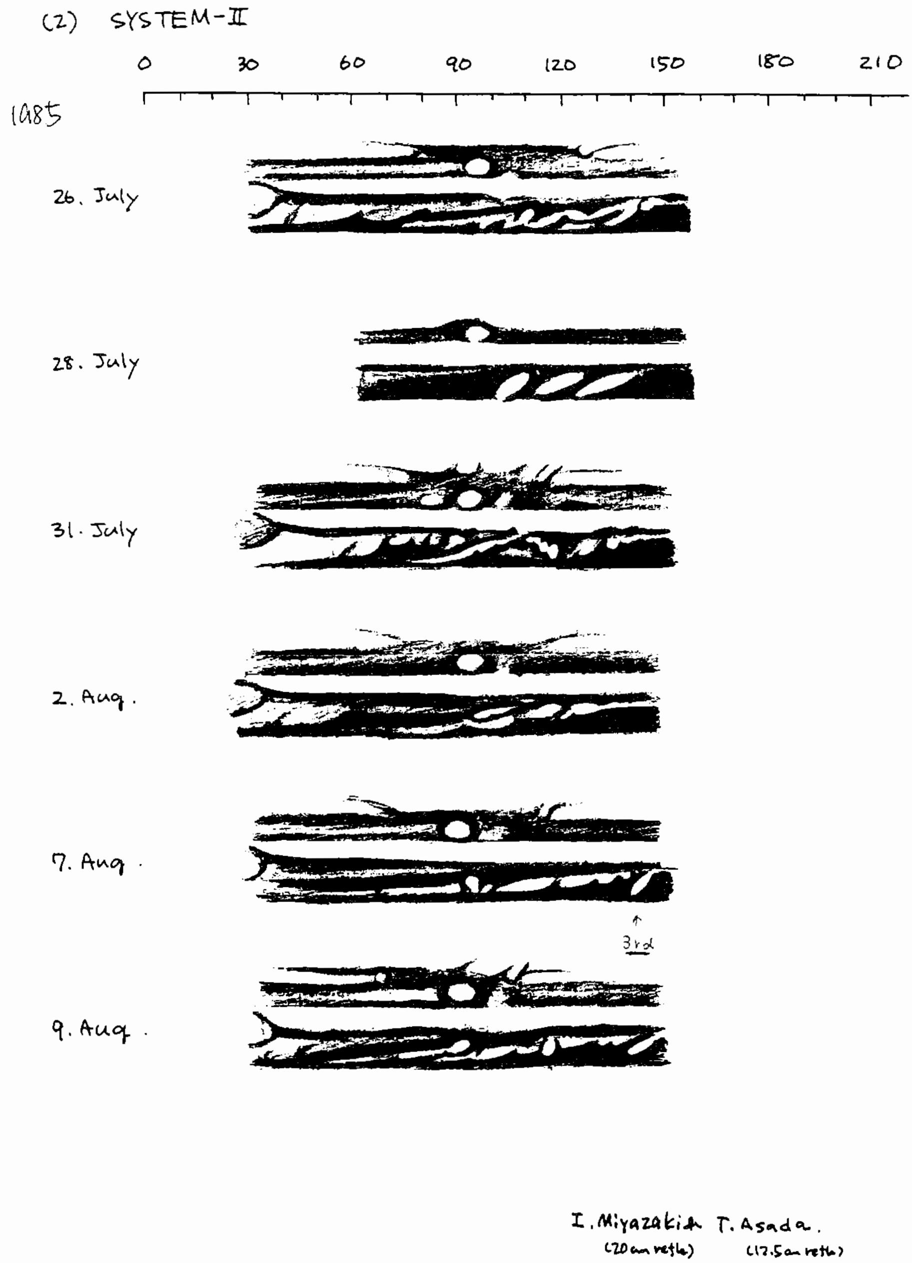


Figure 8.—*Continued.*

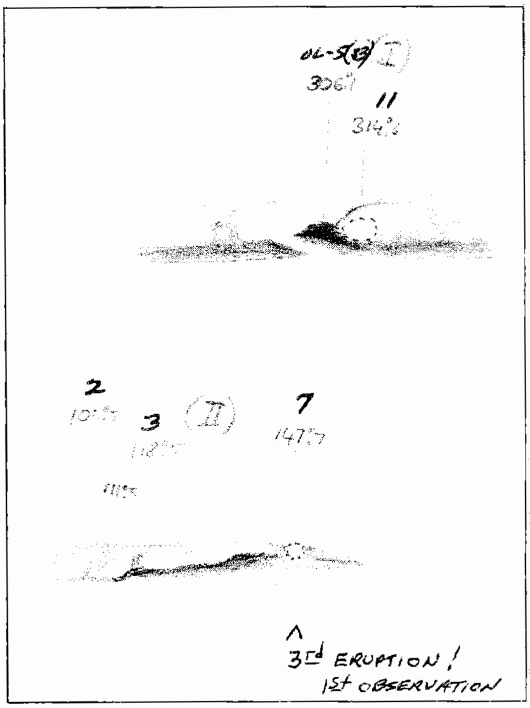


Figure 9 (left). Strip-sketches of Jupiter's NEB (top) and SEB (bottom) on 1985 AUG 05 by Claus Benninghoven, featuring the third outbreak of SEB Bright-Streak Disturbance No. 1. 20-cm reflector at 158× and 192×. Seeing 4-5 and Transparency 3 on the standard A.L.P.O. scales. South at top.

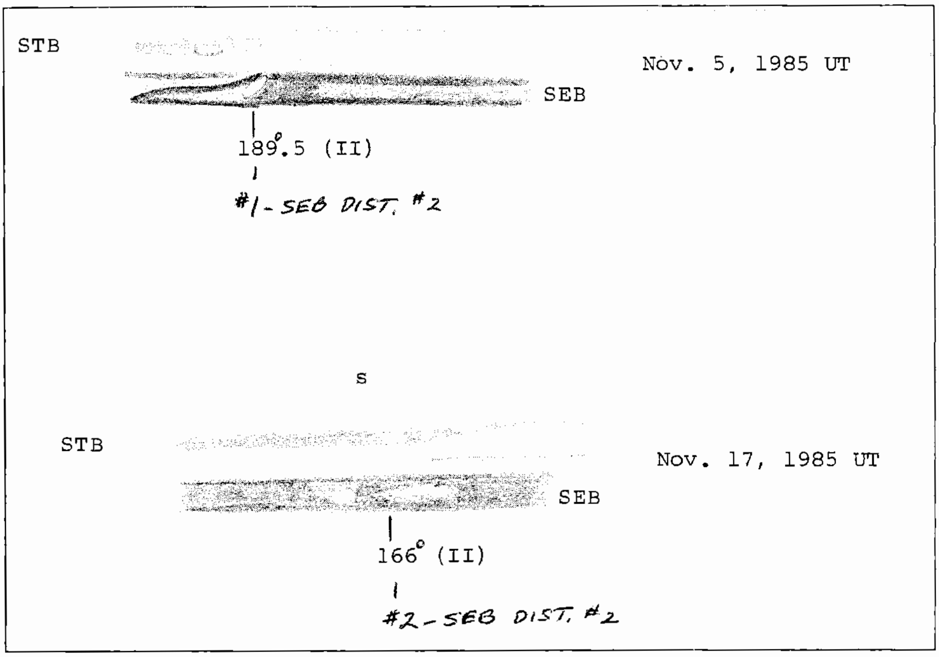


Figure 10 (above). Strip sketches of the Second SEB Bright-Streak Disturbance by José Olivarez with a 32-cm. reflector. The upper sketch was made on 1985 NOV 05 and the lower sketch on 1985 NOV 17. South at top.

THE 1990-1991 MARS APPARITION—A PREVIEW

By: Donald C. Parker, Jeffrey D. Beish, Carlos E. Hernandez, Harry Cralle, and Daniel M. Troiani, A.L.P.O. Mars Recorders

ABSTRACT

The Mars Apparition of 1990-91, centered on the opposition date of 1990 NOV 27, will be favorable from our Northern Hemisphere. This paper describes desirable visual, photographic, and micrometric observations of the planet's polar caps and polar hoods, meteorology and possible dust storms, and changes in its albedo features. A predicted schedule of martian events expected during the apparition is given. Finally, information sources are listed with data on how to participate in the A.L.P.O. Mars Section observing program.

INTRODUCTION

Mars is back! Throughout 1990, the Red Planet will become more prominent in the morning sky until it reaches opposition on November 27. Although Mars' apparent diameter will not be so great as it was in 1988, it will still reach a most respectable 18.1 arc-seconds (18".1) at its closest approach to Earth on November 20, permitting high-resolution photography and quality visual observations of surface features, clouds, and the South Polar Cap (SPC). Moreover, the planet will be very well placed in the sky for observers in our Northern Hemisphere, being north of the celestial equator between mid-June, 1990, and September, 1991, and attaining a declination of +22° during the 60 days centered on closest approach. During much of this apparition, Mars' Southern Hemisphere will be well-presented to our view.

The 1990-91 Apparition will present some interesting opportunities for A.L.P.O. astronomers. The term *apparition* refers to the time span during which a planet is first visible after conjunction in the morning sky to just before the next conjunction, in the evening sky. [The pertinent dates of solar conjunction for this apparition are 1989 SEP 29 and 1991 NOV 08. Ed.] Practically speaking, however, quality telescopic observations of Mars commence when its apparent diameter is greater than 6".0. Furthermore, at the very beginning or end of an apparition, Mars is low in the sky, where the turbulence of Earth's atmosphere is severe. Despite these problems, we encourage A.L.P.O. astronomers to make observations even at such times. A red filter (Wratten 25 or equivalent) lessens the harmful seeing effects because red wavelengths are refracted less than those in integrated light (no filter) and the filter improves the image contrast as well. While little or no fine detail can be discerned when the planet is low in the sky and of small apparent size, large features, such as Syrtis Major, can be seen. If the observer has been regularly recognizing such features and then notes their sudden disappearance, he or she is led to suspect an obscuration, such as a dust storm. In the past, such sightings made independently by several observers have shed new light on the history of martian dust storms, even when the planet subtended an angle of less than 6".0. [Beish *et al.*, 1984]

MARTIAN SEASONS

During most of the 1990-91 Apparition, Mars' South Pole will be tilted earthward, with most of the southern-hemisphere Spring, all of Summer, and part of southern Autumn being observable. Thus, astronomers again can study the regression of the South Polar Cap (SPC) and follow martian antarctic meteorology and some of its arctic weather as well. This apparition should also allow the careful scrutiny of the summer SPC remnant. Because Mars will have an apparent diameter of over 13".0 at southern autumnal equinox, there will be an excellent opportunity to determine whether the remnant disappears completely; or, as was the case in 1988-89, it remains throughout southern Summer.

DUST STORMS—A REVISED VIEW

Mars will reach perihelion [closest to the Sun] on 1990 JUN 30, at which time it will have a respectable apparent diameter of 7".8. Traditionally, perihelion passage, which occurs in Mars' late southern Spring, heralds a period when global dust storms occur. Martian dust storms have received much publicity lately, but in fact there have been *only five* well-documented *global* dust storms on the Red Planet: in 1956, 1971, 1973, and two in 1977. [Martin, 1984] Furthermore, the concept of a true "dust-storm season" on Mars is now open to question; it may well be that dust clouds can occur at any season on Mars. The comprehensive study of martian meteorology performed by Beish and based on A.L.P.O. International Mars Patrol (IMP) data has revealed an increase in the probability of seeing dust storms soon after the planet's southern vernal equinox. [Beish and Parker, 1987] There appear to be three peaks in dust-cloud occurrences: the first near the time of northern summer solstice (090°Ls); the second at 255° Ls, after perihelion passage; and the third at 315°Ls, in southern mid-summer. Ls is the planetocentric longitude of the Sun along Mars' ecliptic; 000°Ls is defined as the planet's northern-hemisphere vernal equinox. Northern Spring begins at 000°Ls, Summer at 090°, Autumn at 180°, and Winter at 270°Ls. For Mars' Southern Hemisphere, these values represent the opposite seasons. *Figure 11* on p. 15 diagrams the orbital positions associated with the four martian seasons. Thus, the 1990-

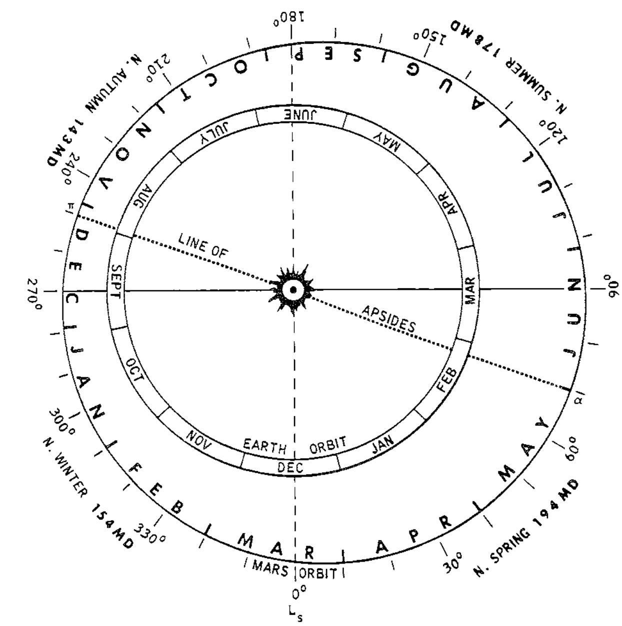


Figure 11. The orbits of Mars and Earth, showing the relationship between terrestrial and martian seasons and Ls. The Line of Apsides of Mars' orbit connects its perihelion point (π) with its aphelion point (α). "MD" designates martian days.

91 Apparition will present an excellent opportunity to monitor the occurrence (or non-occurrence!) of dust clouds. This fact is of considerable importance for our understanding of martian climate and meteorology.

The dust of Mars' storms has once again become the subject of much study among professional planetary scientists. However, these men and women have neither the funding nor manpower for a 24-hour surveillance of the planet. A.L.P.O.'s International Mars Patrol can provide support in this regard as it did during the 1987-89 Apparition. The IMP, initially established by the late C.F. Capen, is a worldwide network of amateur and professional Mars observers who provide 24-hour coverage of Mars. Thanks to recent developments in communications technology, we can now have virtually instantaneous alerts for unusual martian phenomena. (The mechanisms of this alert system will be presented later.) When such an event is sighted, the observer contacts one of the Mars Recorders, who then informs the rest of the IMP network. Upon verification of the event, the appropriate professional astronomers are contacted so that they can conduct detailed investigations. This system proved most successful during the "Thanksgiving Dust Storm" of 1988, and it has been improved since then. Professor Tadashi Asada, the Director of the Mars Section of Japan's Oriental Astronomical Society, is now on Compuserve [a computer telecommunications service. Ed.], so that we can communicate important findings to our colleagues in Japan in a matter of minutes. We are striving to find similar electronic links with observers in other countries. However, the one thing that must be avoided is a false alarm, because our mentors in the professional community will take a dim view of wasting considerable time and money on spurious alerts. For this reason, we have revised our criteria for martian dust activity.

The astute reader will note that nowhere in this paper has the adjective "yellow" been applied to dust. In the past, we have referred to dust storms as "yellow clouds" and "yellow dust storms." We now feel that this description is misleading. First, it is virtually impossible to see or even to photograph accurate colors on Mars without employing very specialized techniques. (For an excellent discussion of martian colors, see Hartmann, 1989.) Traditionally, observers have employed yellow filters better to reveal dust clouds. The problem in this approach is that nearly *every* light feature on Mars is bright through a yellow filter! In November, 1989, we were fortunate to have a professional Mars astronomer spend several days with us in Miami, reviewing IMP dust storm data. Under his guidance, we have revised our definition of dust clouds and storms. The following criteria now apply:

1. Appearance in Red Light.–They must appear bright in red light. Dust storms can be bright in all spectral regions, including violet; but if they are not bright in red, they are most likely not dust. This means that observing and photographing Mars through a red filter is a "must" for IMP astronomers. A Wratten 23A Filter will suffice for instruments of 20 cm (8 in.) or less in aperture, while a W-25 or even a W-29 should be employed with larger instruments.

Photographing Mars through filters presents problems to the amateur observer in that the exposure times are often prolonged beyond the capabilities of his or her drive and seeing conditions. In such cases, observers are *strongly* requested to photograph Mars on color slide film. They can then rephotograph the image through appropriate filters onto black-and-white film. This technique is fully discussed in the following references: Dobbins *et al.*, 1988; and Parker *et al.*, 1986. Those who are unable to use this technique are encouraged to send the Recorders quality copies of their slides for analysis. Copies should be made on Kodak Slide Copy FIlm 5071 in order to insure good grain and color balance. Commercial copies are suggested for this film.

If copies are made at home, we suggest Fujichrome CDU Film. Following the advice of John Sanford, we have tried this film and have found it much easier to use than Kodak 5071. If original photographs are submitted, we cannot guarantee their return.

We would like to take this opportunity to commend those observers who have regularly submitted color-filter photographs of Mars during past apparitions. These persons include B. Flach-Wilken (Germany); B. Adcock (Australia); and T. Akutsu, T. Ishibashi, N. Matsumoto, and T. Nakugami (Japan).

2. Movement.–The *sine qua non* of martian dust cloud identification is movement with the obscuration of previously well-defined albedo features. Absence of this criterion disqualifies a candidate feature from the category of dust cloud.

3. Shadows.—We have proposed that, when these clouds reach heights of several kilometers, they may cast shadows that are observable from Earth There are numerous reports of anomalous transient dark surface markings that appeared near yellow clouds, especially when the solar phase angle was reasonably large. [Slipher, 1962] Anomalous dark markings were indeed seen in conjunction with both 1988 dust storms. [This is presumably not an absolute criterion because such shadows would be difficult to see even with a large phase angle and very high clouds. Ed.]

In addition to possible dust storms, there will be a number of other martian phenomena to watch for during the 1990-91 Apparition, with dates as shown in *Table 1*, below.

Table 1. Calendar of Events—Mars, 1990-91.

In this table, *TD* is the terrestrial U.T. date and *Ls* is defined in the text (p. 14). "Phenomena" describes possible seasonal events as well as predictable phenomena (*Dia.* means angular diameter; *De*, planetocentric declination of Earth). Directions are abbreviated (N, S, E, W) with east and west in the IAU sense (Solis Lacus west of Meridiani Sinus).

TD	Ls	Phenomena
1990		
MAR 06	180°	S. VERNAL EQUINOX. SPC at maximum diameter. Is S. Polar Hood (SPH) present? Look for NPH. Mars rises ca. 2 hr.before Sun. Dia. = 4".9; De = -13°.
APR 01	195°	Mars rises over 2 hr. before the Sun. Major albedo features discernible. SPC large and bright. E. border of Syrtis Major withdrawing? In violet light, are orographic clouds present over Tharsis-Amazonis? Dia. = 5".4; De = -19°.
APR 27	211°	SPC rifts developing. Watch for dust clouds (red filter) and orographic clouds (violet filter). Dia. = 6".0; De = -23°.
MAY 12	220°	Novissima Thyle appears as a bright SPC projection. Dia. = 6".3; De = -24°.
MAY 21	225°	S. Hemisphere mid-Spring. Dust clouds? Orographic clouds over Tharsis volcanoes–W-shaped cloud? Maximum earthward tilt of S. pole for apparition (De = -24°), affording good views of SPC. Has Novissima Thyle separated from SPC to become Mts. of Mitchel (Novus Mons)? With Dia. = 6".6, are Rima Australis and Magna Depressio visible in SPC?.
JUN 05	235°	Rapid SPC regression.Dia. = 7".0; quality micrometer measurements of SPC possible. De = -24°.
JUN 29	250°	Mars near perihelion (JUN 30). Dia. = 7".8; views of surface details better. Rapid SPC retreat. W-clouds possible. Dust clouds? Is Novus Mons detached from SPC? De = -21°.
JUL 15	260°	Late S. Spring. SPC now under 20°in diameter. Watch for dust clouds (red filter). Numerous white patches possible on surface. Dia. = 8".4; De = -18°.
JUL 30	270°	S. SUMMER SOLSTICE. SPC continues regression. Dia. = 9".1; De = -15°.
AUG 16	280°	Dia. = 9".9; some photography now possible. Discrete (white) clouds and white areas should be minimal. SPC small, offset from pole. De = -11°.
SEP 01	290°	SPC retreat slows; stable remnant. Is Syrtis Major narrow or blunted? Possibility of dust storms again increasing. De = -8°; large N. Winter NPH should be prominent. Measure latitude of NPH—does it retreat or disappear when dust storms are present? Dia. = 11".0.

-over-

SURFACE FEATURES

Table 1.—Continued.

TD	Ls	Phenomena
1990		
SEP 14	298°	Dia. = 12".0; begin high-resolution work and quality photography. De = -6°.
OCT 13	315°	High probability of dust storms. De = -3°, affording good view of both polar regions—including large NPH. Look for tiny SPC remnant near S. limb, offset from pole and easier to see near central meridian 030°W. Is SPC remnant visible in mid-Summer? Dia. = 15".0.
NOV 09	330°	Continued alert for dust storms. SPC remnant visible? Antarctic haze present? Is NPH variable, occasionally bright? (Use violet filter for NPH observations and measurements.) Dia. = 17".7; De = -5°.
NOV 20	336°	CLOSEST APPROACH TO EARTH. Dia. = 18".1; De = -7°.
NOV 27	340°	OPPOSITION. Late S. Summer: Is SPC remnant still present? Photographs needed of SPC. De = -9°; NPH still observable. Watch for signs of NPH thinning. Are S. polar hazes present. Dia. = 17".9.
DEC 17	350°	De = -12°, so NPH should be easily visible if present. Closely monitor NPH from now on; when does it disappear and the NPC appear? If the SPC remnant still present? Look for it between longitudes 0-60°. Any evidence of the SPH? Watch Syrtis Major for signs of expansion to the E. Dia. = 16".0.
1991 JAN 05	000°	S. AUTUMNAL EQUINOX. Carefully monitor antarctic region for evidence of SPC remnant and/or hazes. Will SPH form? N. VERNAL EQUINOX. Monitor arctic closely for the date of disappearance of NPH. Watch for possible reformation of NPH. NPC at maximum extent, with edge near +55° areocentric latitude. De = -13°. Dia. = 13".2; begin micrometer/reticle NPC measures, using red or orange filters.
FEB 01	013°	Dia. = 10".0; photography difficult but visual observations and NPC measures still possible. Monitor antarctic for SPC remnant and hazes. Are Hellas and Argyre brightening? De = -11°.
FEB 24	024°	Dia. = 8".0; now rapidly shrinking. Early N. Spring. Continue NPC measures; is NPC fairly static or entering rapid-retreat phase? De = -7°; S. polar regions becoming difficult to observe. Any signs of SPH?
MAR 14	032°	Limb clouds and hazes should start to increase. Look for them in violet light. What is the size and shape of Syrtis Major? Dia. = 7".0; De = -3°.
APR 04	042°	N. Mid-Spring. Is NPC beginning rapid retreat? Are limb arcs increasing in frequency or intensity? Use filters! Are there antarctic hazes, SPH? Cloud activity increases. Dia. = 6".0; De = +2°.

Several regions have displayed long-term, or "secular," changes in recent years, and should be monitored closely during the 1990-91 Apparition. These include: **Solis Lacus** (085°W/28°S); **Daedalia-Claritas** (115°W /30°S); **Phasis** (109°W/30°S); eastern **Sirenum M.** (145°W/35°S); southern **Memnonia** and **Zephyria** (180°W/10°S); **Trivium Charontis** (198°W/20°N); **Cerberus II** (212°W/ 10°N) and **III** (240°W/18°S); **Elysium** (215° W/20°N); **Hyblaeus** (230°W/30°N); **Nilo-Syrtis** and **Syrtis Major** (280°W/20°N). In addition, the **Libya-Isidis** area (275°W/10°N) should be scrutinized to see whether **Nodus Laocoöntis** (246°W/20°N) and **Nepenthes-Thoth** (265°W/15°N) are still markedly faded.

THE A.L.P.O. MARS SECTION—1990

We wish to thank the 300 IMP observers who submitted over 7,000 drawings, photographs, and micrometer measurements of Mars during the 1987-89 Apparition. Such an effort is most gratifying, but has required some reorganization of the Mars Section. In addition to adding new Recorders, we have assigned each Recorder to observers in a terrestrial region. Each observer should correspond with the Recorder for his or her area, as described in "Announcements" in the *J.A.L.P.O.* of July, 1989, on p. 141. In order to minimize the confusion, we have set the following guidelines for our observers:

1. *Observations.*—Send these to your appropriate Recorder. If you wish their arrival confirmed, enclose a stamped, self-addressed postcard with your material. This is the cheapest and easiest way, and we cannot otherwise acknowledge all the observations received. Drawings should be made on 42-mm diameter disks, or on the standard British Astronomical Association 2-inch disks. We use overlay templates for data reduction, and other sizes are unacceptable. Photographs should be about 1 inch in diameter so that they can be published properly, but any photographs (except negatives) will be used! We welcome videotapes in VHS or S-VHS format. Do not send originals; please edit your videos, including date and time on them, with no more than 5 minutes per observing session.

*2. **Observing Forms.***—Send a stamped, self-addressed envelope (SSAE) to Recorder Beish or Recorder Parker. They will return it with an A.L.P.O. Mars Section observing form enclosed, from which you can make copies. Upon request, a copy of Ebisawa's excellent map of Mars will also be included.

All observations must contain the observer's name, the U.T. date, the starting and ending U.T.'s; the seeing and transparency; and the telescope, magnification(s), and filter(s) employed. Mark drawings and photographs with "South" and "Preceding" [i.e., celestial west or martian east] so that we know the orientation. Other information, such as C.M. [central meridian] and Ls, is not required but is appreciated.

*3. **Correspondence.***—All correspondence should contain an enclosed SSAE. Remember that the A.L.P.O. has a *volunteer* staff, in terms of both time and money!

*4. **The Martian Chronicle.***—This is a Mars Section newsletter which the Recorders send to interested parties during the apparition. It contains observations by IMP members, observing tips, and current updates on the apparition. Those who wish to subscribe should send 6-8 SSAE's to Recorder Beish or Recorder Parker. Overseas members may send International Postal Certificates with their envelopes. We wish to thank the many observers abroad who did this during the last two apparitions; their help was much appreciated.

*5. **The A.L.P.O.***—Membership in the A.L.P.O. is not required for the IMP. However, we strongly urge our observers to join if only for the reason that they can then see the fruits of their labor in print in the apparition reports and other papers in the *Strolling Astronomer* [or *J.A.L.P.O.*, which is available only to members and is included in the membership dues]. Obtaining the *J.A.L.P.O.* also gives one the opportunity to read about others' observational techniques and methods of data reduction. In addition, the observer may find other fields which stimulate his or her interest.

*6. **Observing Aids.***—a. *Mars Observer's Handbook*, by J.D. Beish and C.F. Capen. This is being republished by the Institute for Planetary Research Observatories. It is a 55-page, copiously illustrated book on Mars observing techniques, including how to make drawings and micrometer measurements, tips on photography, the use of filters, and much more. Send $US 10.00 to Jeffrey D. Beish, 9460 Toni Drive, Miami, FL 33157 U.S.A.

b. The *A.L.P.O. Solar System Ephemeris: 1990*. This contains the complete ephemerides for the Sun, Moon, planets, minor planets, selected comets, and meteors. This is a "must" if one is to get full enjoyment from one's observing. Send $US 6.00 ($US 8.50 if outside North America) to: A.L.P.O., P.O. Box 16131, San Francisco, CA 94116 U.S.A.

c. *Introduction to Observing and Photographing the Solar System*, by T.A. Dobbins, D.C. Parker, and C.F. Capen. This contains both theoretical and observational information on Solar System objects. It has very detailed chapters on Mars, astrophotography, micrometry, and other subjects, along with a Foreword by A.L.P.O. Founder, Walter H. Haas. It is available for $US 19.95 (hardcover) from: Willmann-Bell, Inc., P.O. Box 35025, Richmond, VA 23235 U.S.A. (telephone (804) 320-7016).

d. *IMP Astronomical Calculator (IMPAC)* is a computer program containing complete ephemerides of Mars and Jupiter for any date. It includes rising and setting times, altitudes, and azimuths for Solar System objects for the observer's location. It incorporates an automatic correction for Daylight Time, lunar phases for star-party planning, telescope and mirror-cell design, a comprehensive astrophotography program, subroutines for color filter calculations, and automatic computation of martian polar cap and jovian belt latitudes from the observer's input. It is for the IBM-XT, -AT, or compatibles, with monochrome, EGA, or VGA display. For a 5.25-inch diskette, send $US 49.95 to J.D. Beish at the address above.

*7. **Storm Warning.***—Any special or unusual martian phenomenon should be reported immediately to the Recorders so that other observers can be alerted. To facilitate communication, both Recorder Beish and Recorder Parker will monitor Compuserve daily during the apparition. Please send messages to both Parker (72317,3157) and Beish (72317,3306). If you have no access to a modem, Recorder Troiani has kindly volunteered his telephone number: (708) 529-1716.

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Mars, 1988: A Photo-Visual Study

By: Klaus Brasch, Biological Science, The University of Tulsa, Tulsa, OK 74104

Abstract

This article describes a method for obtaining hybrid photo-visual renditions of planetary images by using nearly simultaneous drawings and photographs. The resultant images provide better positional accuracy than do ordinary sketches and finer detail than is usually recorded photographically.

Introduction

Experienced planetary observers are quite aware that much finer detail can be detected visually through a good telescope than is usually captured with it on film. The reasons for this are well-known. [Dobbins *et al.* 1988, p. 21]. Moments of truly steady seeing are usually brief, of the order of a few seconds at best. Catching such intervals photographically, therefore, is literally a shot-in-the-dark proposition. The eye and the brain, on the other hand, are able to scan extended images and thereby integrate fleeting detail over successive periods of good seeing. Unfortunately, translating such visual images into accurate drawings is also not easy. Even a skilled observer is often more interpretive than objective, and hence usually inaccurate in positioning the detail seen. I attempted to circumvent these difficulties, during the past 1987-89 Apparition of Mars, by combining the objective aspects of photography with the broader contrast range and higher-resolution capabilities of visual observations.

Materials and Methods

All observations were carried out with a Celestron-14 Schmidt-Cassegrain telescope (aperture 35.6 cm) at a suburban site near Tulsa, Oklahoma, at an elevation of 625 feet (191 m). The telescope was used visually with magnifications of 313× and 434×, and photographically at an equivalent focus of f/200 by means of eyepiece projection. Exposures were 2-3 seconds on Kodak Technical Pan Film, developed in Kodak HC-110 (dilution D), and fixed 3 minutes in Kodafix. Images were printed on Kodak Polyfiber Ns Paper, with a semi-matte finish in order to aid the later addition of detail by hand.

Each observing session began with a 10-minute scrutiny of Mars' disk in order to become familiar with its overall aspect, including the position of the polar cap, the other major dark and light features, clouds, and haze. This always included inspection with a standard array of color filters: red (W25), yellow (W15), yellow-green (W11), and violet (W47). Then followed a 20-30 minute sequence, alternating between sketches and photographs. The major features were positioned first in the drawings, and then fine detail was added as it came into view. The Universal date and time, seeing, transparency, filter(s), and so forth were recorded for each session.

The final photo-drawings were made by enlarging all negatives so that the disk fitted the standard 42-mm diameter A.L.P.O. Mars Section format, exposed to make a relatively light, under-developed print. Filter settings for standard contrast grades 3-4 were used in all cases. After drying, flattening, and mounting the enlargements on cardboard, details recorded visually on sketches were transposed to the prints by hand. For this purpose, a set of soft black and white pencils, a fine-tipped eraser, and an artist's smudging pencil were used. The relative contrast of all features was greatly exaggerated.

Results and Conclusions

Systematic observation of Mars began on 1988 JUL 03 and ended on NOV 17. The planet's apparent diameter exceeded 14 arc-seconds throughout that period. Seeing conditions were remarkably good overall, averaging 5-6 on the standard A.L.P.O. scale (from 0 for worst to 10 for best). Sixty-two drawings were obtained during this interval, and about half that many usable photographs. Good visual coverage was obtained of the entire surface of Mars. However, photographic coverage was adequate only from longitude 230° westward to 130°. All data were forwarded to the A.L.P.O. Mars Section for full analysis.

Figures 12-17 (pp. 20-21) and the front cover are the best images obtained using the integrative photo-visual methods. *Figure 18* (p. 21) shows the original photograph and sketch from which *Figure 15* (p. 20) was generated. It is clear that the positional accuracy of major features is far greater in the photo-drawings than in the ordinary sketches. As a result, finer and more elusive details, including clouds and haze, can also be located more accurately.

The extended spectral sensitivity of Kodak TP Film, coupled with the planet's ochre color, is akin to using a red filter when photographing Mars. [Sherrod 1981, p. 153] Consequently, dark albedo features appear contrasty, but atmospheric phenomena are not recorded very distinctly. Therefore, clouds and haze that were detected visually, with and without filters, were highlighted by hand. This process is particularly well illustrated in *Figures 15* and *16* (pp. 20-21), where limb haze, a north polar hood, and bright cloud-like areas are evident at several locations.

Clearly, these photo-drawings of Mars are hybrid images, because they integrate information obtained at different wavelengths that is not recorded together on either drawings or photographs by themselves. Although this approach is relatively complex, the accuracy and total information content of the results are well worth the added effort. Moreover, the esthetically pleasing aspect of the resultant images is an added bonus.

REFERENCES

Dobbins, T.A.; Parker, D.C.; and Capen, C.F. (1988). *Introduction Observing and Photographing the Solar System*. Richmond: Willmann-Bell.

Sherrod, P.C. (1981). *A Complete Manual of Amateur Astronomy*. Englewood Cliffs, NJ: Prentice-Hall.

Note: *Figures 12-17* (and the front cover) are all photo-visual drawings of Mars by Klaus Brasch, using a 35.6-cm Schmidt Cassegrain following the methods described in the text. With each photo-drawing, besides the Universal date and time, are: Ls = areocentric longitude of the Sun (see previous article, p. 14), CM = central meridian, De = areocentric latitude of Earth, phase = proportion of disk sunlit, and Dia. = apparent diameter of the disk in arc-seconds. South is at the top, and martian west to the right, in all these views.

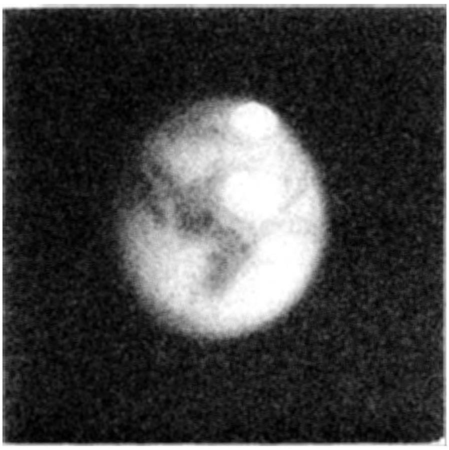

Figure 12. 1988 AUG 25, 07h 30m U.T. Ls = 259°, CM = 281°, De = -20°.0, phase = 0.94, Dia. = 21".1.

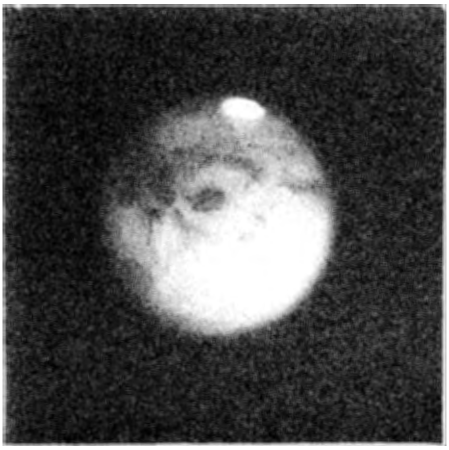

Figure 13. 1988 SEP 13, 06h 00m U.T. Ls = 271°, CM = 088°, De = -25°.2, phase = 0.99, Dia. = 23".5.

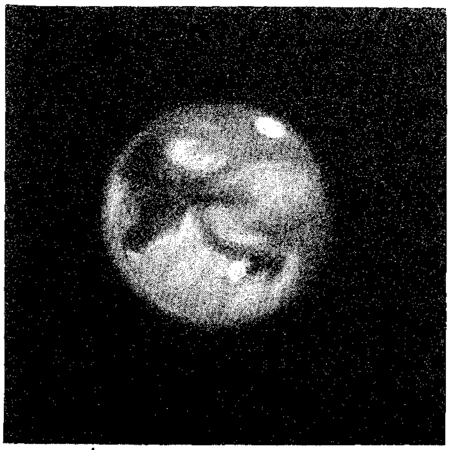

Figure 14. 1988 SEP 26, 05h 05m U.T. Ls = 279°, CM = 320°, De = -24°.8, phase = 1.00, Dia. = 23".8. Two days before opposition, and four days after closest approach to the Earth.

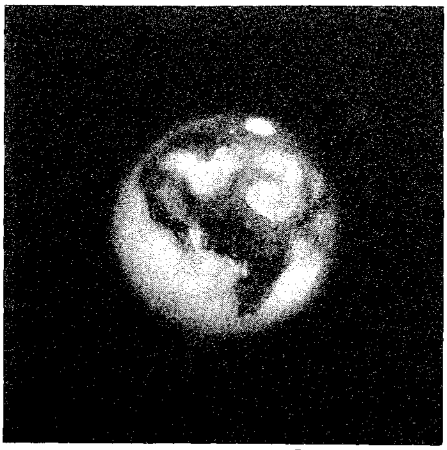

Figure 15. 1988 OCT 01, 04h 40m U.T. Ls = 282°, CM = 270°, De = -24°.6, phase = 1.00, Dia. = 23".5. See *Figure 18* (p. 21) for the original photograph and drawing that were used to make this photo-drawing.

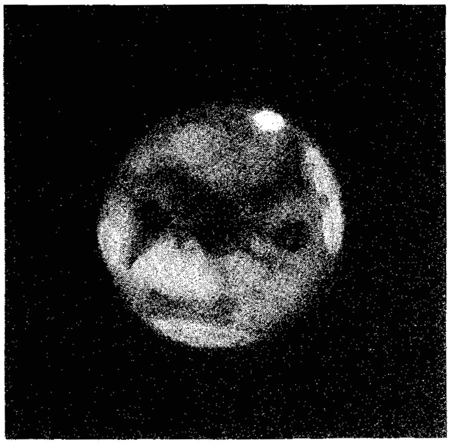

Figure 16. 1988 OCT 25, 05h 00m U.T. Ls = 297°, CM = 061°, De = -22°.3, phase = 0.96, Dia. = 19".7.

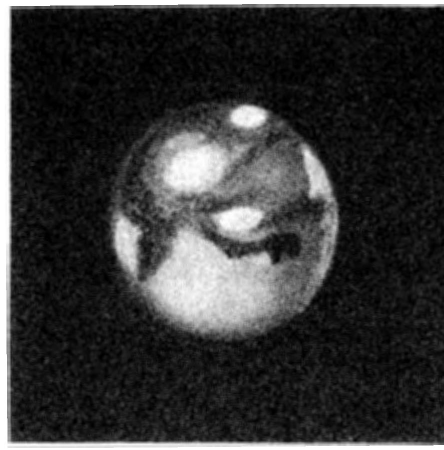

Figure 17. 1988 NOV 01, 03h 00m U.T. Ls = 301°, CM = 328°, De = -21°.4, phase = 0.95, Dia. = 18".4.

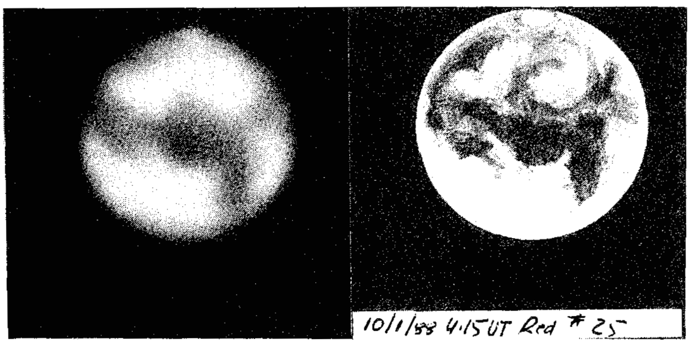

Figure 18. Paired photograph (left) and drawing (right) of Mars by Klaus Brasch on 1988 OCT 01, used together to prepare the photo-drawing seen in *Figure 15* (p. 20), where pertinent data are given. The drawing was done with a Wratten 25 (red) Filter.

OBSERVATION AND COMMENTS

Most observers, and certainly all *solar* observers, are aware that we are approaching a maximum in the solar activity. Some estimate that it will occur in February, 1990, about the time you receive this issue. In recent months, a number of large, active, and spectacular sun-spot groups have been sighted. To the left is a photograph of activity region "SESC 5528" taken in June, 1989, by Solar Section Recorder Randy Tatum.

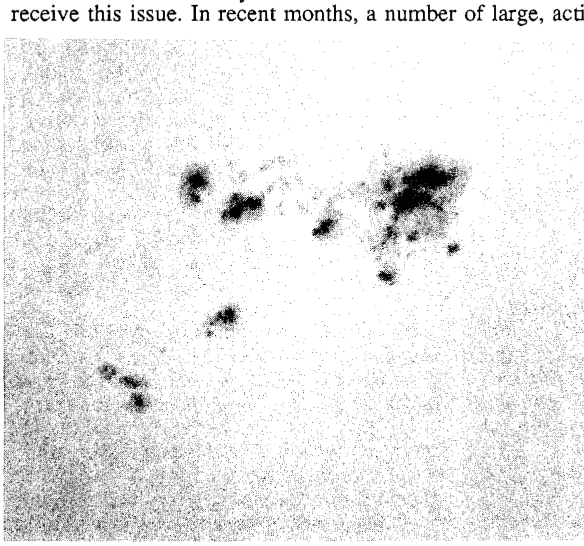

Figure 19. Solar photograph by Randy Tatum on 1989 JUN 14, 13h 38m U.T. featuring activity region SESC 5528. Seeing conditions were excellent for this view, taken with a 7-in. (18-cm) refractor, stopped down to 3.5 in. (9 cm), an effective focal length of 210 in. (533 cm) and a Daystar 0.9-Å T-Scanner Filter tuned to red. 1/30-second exposure on Kodak Technical Pan 2415 Film, developed in D-19. North at top.

AN OBSERVER'S ACCOUNT OF THE OCCULTATION OF 28 SAGITTARII BY SATURN: 1989 JUL 03

By John Francis Borra, A.L.P.O.

ABSTRACT

This report describes the very rare occultation of a bright star by Saturn's Globe and Rings as seen through a small telescope. It notes the attenuation of starlight by the Rings during the event, important in judging their optical thickness. Included is a series of drawings based on notes made at the eyepiece.

LOCATION, INSTRUMENT, ATMOSPHERIC CONDITIONS, AND METHOD

I observed the occultation of 28 Sagittarii on 1989 JUL 03 from a small municipal park near Kansas City, Missouri. The entire series of Ring and Globe events was visible from this location, and the closest approach of Saturn's center to 28 Sgr occurred while Saturn was near the meridian. [For more information, see: "Saturn Occults a Bright Star: 1989 JUL 03," *J.A.L.P.O.*, *33*, Nos. 4-6 (April, 1989), 87-88.]

The telescope I used was an 89-mm aperture, 1300-mm focal length Maksutov-Cassegrain. An 8-mm eyepiece and a 1.67× negative [Barlow] lens were used throughout the observing session, giving a magnification of about 271×.

The observing session lasted from 05h 30m U.T. [Universal Time; used throughout this report] to 09h 30m. Transparency was fairly good at the beginning of this period, but heavy fog developed during it. By 09h 30m, Titan was invisible through the telescope, and only stars of the first magnitude were visible to the naked eye. Saturn itself was faint by that time, very low and amidst the glow of distant sodium-vapor lights.

The atmospheric seeing was very good throughout the session, especially considering Saturn's low altitude. Before the involvement of 28 Sgr with the Ring system, the star's primary diffraction ring was visible, appearing perfectly round and regular; the Airy Disk of the star was steady and hard-edged.

I was unable to receive audio time signals during the session and often delayed lifting my eye from the ocular in order to check my watch for fear of missing a sudden fluctuation in starlight. Therefore, the times cited here are only estimates, accurate to about one minute.

VISUAL IMPRESSIONS

The telescope field was one of fascinating contrasts. The planet's disk was its characteristic gold. The broad gray polar hood and the narrow brown North Equatorial Belt were evident. The Equatorial Zone was pale and the Crape Band [the C, or "Crepe," Ring projected upon the Globe] was dark gray.

In contrast, the Rings appeared white, but of varying intensities. The A [outer] Ring was distinctly gray beside the outer edge of the B [middle] Ring. The B Ring graded in intensity from its outer edge, which was brightest, to its inner edge, which was a very subtle gray. The C Ring was invisible except where crossing Saturn's Globe. The Cassini Division [the gap between the A and the B Rings] was visible along most of its circumference.

The star 28 Sgr appeared a distinct, though pale, pink. This was a pleasant surprise; although the star is of spectral class K, I had not expected to see the color because of the high magnification-to-aperture ratio used. Undoubtedly, the proximity of the white Rings and the yellow Globe of Saturn intensified the perceived contrast.

I kept constant watch of the star beginning about 10 minutes before the expected occultation by the F Ring. [The F Ring is a narrow Ring outside the A Ring, not directly visible from Earth. Its predicted occultation was at 06h 03m U.T.; the predicted times given here are *geocentric* and may differ by several minutes from those observed at Kansas City] No attenuation was noted at the F Ring.

At 06h 01m, the star vanished at the outer edge of the A Ring and stayed invisible until it appeared a few minutes later, greatly attenuated, about halfway across that Ring. It remained dimmed until reaching the A Ring's inner edge. [The predicted period of A-Ring occultation was 06h 06m - 06h 18m.]

At 06h 11m, the star quickly brightened, nearly attaining its original luster, but lacking its primary diffraction ring. I suspect that, while the star actually may have recovered its original unocculted brightness, it appeared somewhat dimmed only due to the proximity of Saturn's bright Rings and to the thickening fog at my site. The star remained constant at this brightness until 06h 15m, at which time it disappeared, having apparently encountered the bright outer edge of the B Ring. [From the position of the star at that time, the implication is that 28 Sgr passed through the Cassini Division between 06h 11m and 06h 15m; the predicted geocentric period for this passage was 06h 18m - 06h 20m.]

The star then remained invisible until roughly 06h 30m; when it appeared for several seconds, extremely faint. This was a vague, difficult sighting of very uncertain duration.

At 06h 34m, the star rapidly brightened, again nearly reaching its unocculted brightness. In the eyepiece, it appeared then to have crossed from the inner edge of the B Ring into the C Ring. [The predicted time for this was 06h 41m.] However, 28 Sgr remained steady for only one or two minutes. As it crossed the outer portion of the invisible C Ring, the star made a series of fascinating disappearances. It would dim in the span of a second or two, vanish momentarily, and suddenly reappear. These dips occurred several times, at intervals of several seconds, and each time the star recovered to a steady maximum. This brief series of fluctuations, repeated during the egress events, was among the highlights of the night.

During the remainder of its approach to the planet's limb, the star's light remained perfectly steady. However, the star appeared a little fainter then it did prior to involvement and lacked the diffraction ring. I am certain that this was a result of the attenuating effect of thickening fog and not of ring material.

Another highlight was the star's disappearance at Saturn's limb. At 06h 52m, the star gradually disappeared, taking perhaps 3 seconds to do so; a moment elapsed and the star recovered full brightness within about 1 second; then vanished instantly and finally. [Globe ingress was predicted for 06h 53m.]

Dew on the corrector lens severely hampered contrast during the last half of the occultation, covering the egress events. When I witnessed emersion from the disk, I immediately lifted my eye from the telescope to check the time and may have missed the phenomena that I had seen at immersion. Al-though I was seated comfortably, I was fatigued and the severe dewing had become a distraction. Also, trees near the horizon obstructed the view during the final F-Ring crossing. For these reasons, I hesitate to compare the visibility of the star during the last half of the occultation with its visibility during the first half.

THE ILLUSTRATION

My series of drawings of the events appears in *Figure 20* to the right. High magnification (271×) was chosen for this observation in order to render a comfortable image scale and to increase contrast between the Rings and the star. I took brief notes at the eyepiece and executed the illustration during the following week using gouache and pencil on illustration board. Care was taken to render contrasts with reasonable faithfulness In the drawings, celestial north is at the top and celestial west to the left. [Thus the drawings are reversed left-to-right. Ed.] From top to bottom, the five drawings are summarized as follows:

05h 30m U.T. The star appeared brightest prior to contact with the Rings, and displayed a strong primary diffraction ring and a pale pink color. The Airy Disk appeared markedly brighter than a similar area of the Rings and planet.

06h 09m U.T. The star disappeared completely at the outer edge of the A Ring, but reappeared about halfway across it. When it reappeared as shown here, it was very much fainter and possessed no diffraction ring.

06h 13m U.T. While crossing the entire breadth of the Cassini Division, the star remained steady, appearing almost as bright as it had while unocculted, but lacking a diffraction ring.

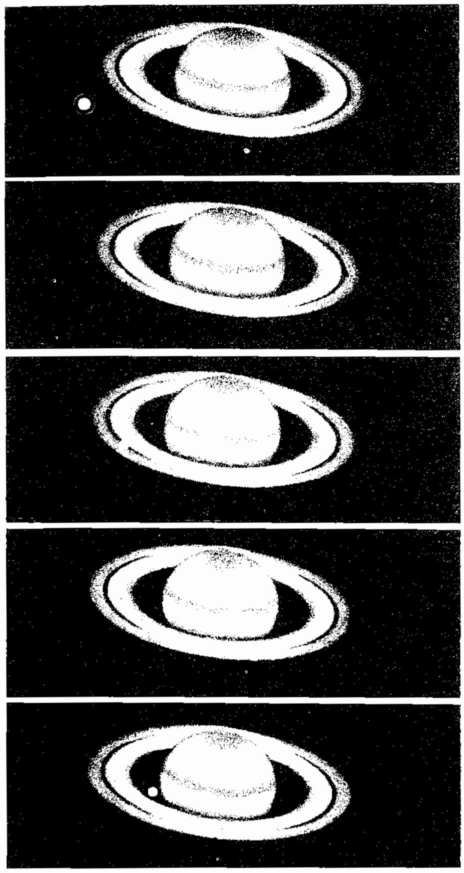

Figure 20. Five stages in the occultation of 28 Sagittarii by Saturn on 1989 JUL 03, drawn by John Francis Borra and based on his observations with an 89-mm telescope at 271× in very good seeing. Celestial north is at the top and celestial west at the left in this reversed view. Also see text.

06h 30m U.T. The star was invisible during its passage behind the B Ring except for a brief appearance at this time, when it was very faint and difficult to hold in sight.

06h 45m U.T. The star was halfway between the visible inner edge of the Ring System and the Globe. Then 28 Sgr appeared as bright here as it had when crossing the Cassini Division, even though it should have been behind the C Ring at this point.

[Note: This report is published here, not as a technical objective record of this unusual event, but rather to illustrate the visual impression of the spectacle; to communicate one of the joys of observing. A more detailed and technical report, incorporating many observers' contributions, is being prepared by our Saturn Recorder and will be published in a later issue. Ed.]

A.L.P.O. SOLAR SECTION OBSERVATIONS FOR ROTATIONS 1808-1812 (1988 OCT 19 TO 1989 MAR 04)

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

ABSTRACT

This report summarizes A.L.P.O. Solar Section observations for Rotations 1808-1812 (1988 OCT 19-1989 MAR 04), particularly in terms of the morphology and development of sunspot groups. Eighteen observers in five nations contributed visual drawings and integrated-light and Hydrogen-α photographs. Solar activity continued to increase in this period, peaking at a record height in Rotation 1810 (1988 DEC-1989 JAN).

INTRODUCTION

The period covered by this report had the highest levels of solar activity ever seen by the A.L.P.O. Solar Section; and the number of reporting observers increased, giving us a good selection of data. The participating observers are listed in *Table 1* (to the right). Some data were not available for this report as they were on loan. Even so, we had data for nearly every day in this five-rotation period.

The mean International Sunspot Number (**RI**) for this period was 152.6, while the mean American Sunspot Number (**RA**) was 152.5; to be contrasted with the values of 114.6 and 115.3, respectively, for the previous five-rotation period. [**1-8**]. In the latter period, the highest daily **RI** for any rotation was 255, and the highest **RA** was 253; both occurring on 1988 DEC 22. The lowest daily **RI** was 69, on 1988 NOV 27; and for **RA** was 67, on the day before. This reporting period opened with the lowest whole-rotation **RI**, 122.7 for Rotation 1808, for any rotation of the five, which was still higher than the one for the last rotation (1807) of the previous reporting period. Activity peaked in Rotation 1810 with mean counts of **RI** = 189.7 and **RA** = 190.7. Rotation 1810 had *no* days when either daily count was below 115! *Figure 21* (p. 25) graphs both forms of Sunspot Number during this reporting period. All this activity gave our observers a lot to do.

Because of the high activity levels, it is impossible comprehensively to summarize every rotation. Instead, one or two activity regions are selected from each rotation as representatives of the best activity. It is interesting that only two of the twelve largest regions in this five-rotation period were in the the Sun's Southern Hemisphere.

As usual, the term "group" will refer only to white-light collections of sunspots, while "region" will refer to the entire area of activity in all wavelengths. Region numbers are assigned by the Space Environmental Services Center (SESC) of the National Oceanic and Atmospheric Administration (NOAA) in Boulder, Colorado. All times used here are in Universal Time (U.T.), and all directions are heliographic and are abbreviated (e.g., N, SW). Other terms and abbreviations used here are defined in *The Handbook for the White Light Observation of Solar Phenomena* (available from this Recorder for $US 6.00).

Table 1. Observers Contributing to This Report.

Observer	Telescope cm.	f/	Type	Location
Dragesco, J.	36	10	S.-C.	France
Garcia, G.	20	10	S.-C.	Illinois, USA
Garfinkle, R.	25	10	S.-C.	California, USA
Glaser, P.	20	10	S.-C.	California, USA
Hill, R.	6	13	Refr.	Arizona, USA
Lao, F.	6	5	Refr.	Philippines
Luciuk, M.	20	10	S.-C.	New Jersey, USA
Maxson, P.	15	6	New.	Arizona, USA
McCarter, L.	7.5	?	?	Texas, USA
Melillo, F.	20	10	S.-C.	New York, USA
Morris, R.	5	30	Refr.	Colorado, USA
Rousom, J.	13	10	New.	Ontario, Can.
Tao, Fan-Lin and Chang, Grace	13	?	Refr.	Rep. of China
Tatum, R.	18	15	Refr.	Virginia, USA
Timerson, B.	18	8.3	New.	New York, USA
VanHoose, D.	11	7.8	New.	Indiana, USA
Winkler, W.	25	6	New.	Texas, USA

Notes:"cm." is the aperture of the telescope in centimeters; "f/" is its focal ratio; "New." is Newtonian; "Refr." is refractor; and "S.-C." is Schmidt-Cassegrain. Aperture stops were reported used by: Dragesco (10 cm), Garcia (7.5 cm), Melillo (7.5 cm), and Tatum (8.5 cm).

Rotation 1808
(1988 OCT 19.22 to 1988 NOV 15.52)

Sunspot Number	Mean	Maximum (Dates)	Minimum (Date)
RI	122.7	159 (Nov 12)	95 (Nov 08)
RA	126.6	171 (NOV 15)	98 (Nov 08)

As mentioned in the Introduction, this reporting period's opening rotation had the lowest International Sunspot Numbers. There were only two groups that attained naked-eye visibility, the largest being **SESC 5200**.

SESC 5200 was first observed, in white light by the writer, on 1988 OCT 18 (the end of Rotation 1807) as a large, fairly symmetrical spot comprising over a half-dozen umbrae in a massive penumbra, followed by three smaller spots with penumbrae. These were surrounded by 5 to 7 umbral spots. *Figure 22* (p. 26) shows this group's development from OCT 18 to OCT 28. In an H-α photograph,

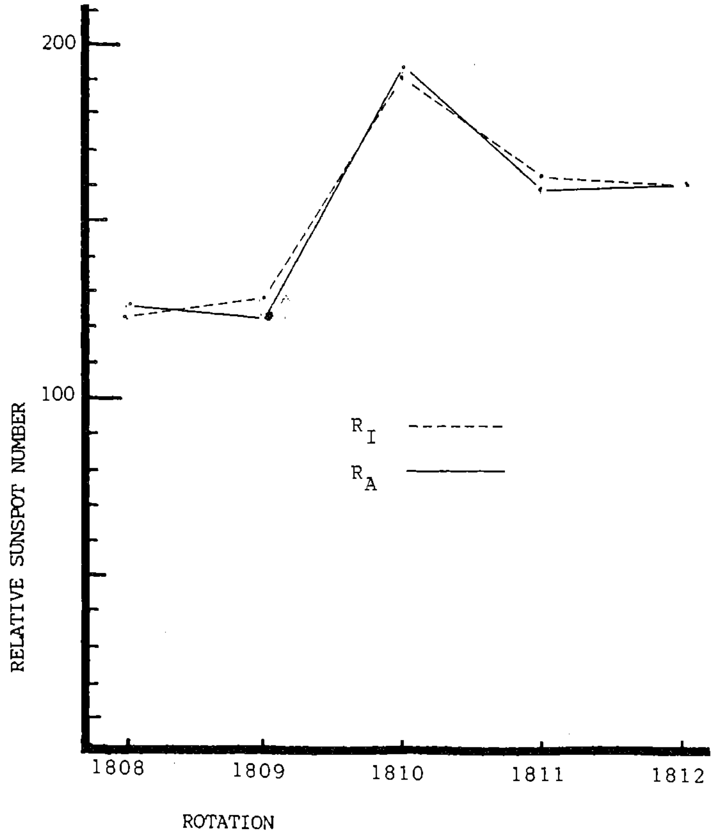

Figure 21. Graphs of means of **RI** (International Sunspot Number) and **RA** (American Sunspot Number) for Solar Rotations 1808-1812.

made careful measures of the group and found it to extend 120,300 by 56,150 mi. (193,600 by 90,400 km), using a disk size of 27 in. (69 cm). This size works out to be roughly 1400 millionths of the visible solar disk. From this point on, the region began a process of consolidation and decay. On OCT 24, the follower was consolidating, and then consisted of one large spot of mostly penumbral material surrounded by many small spots with penumbrae. The leader was a collection of small spots with penumbrae. As the group decayed further on the next day, OCT 25, it was seen as a cluster of about twelve spots with penumbrae. By the 26th these spots were still decreasing in size, some losing penumbrae and surrounded by

Morris showed a large leader spot followed by a plage divided in two parts N-S. On OCT 20, Rousom noted the large leader, but as no longer symmetrical. It was now followed by more and smaller spots with penumbrae. The leader was divided by thin light bridges, and the whole group had more small umbral spots and pores in attendance. In an H-α photograph, Tatum observed material being ejected to the W from the leader. The plage was appearing to break up, and the fibrils around the region were poorly organized. [A *plage* is a bright patch, and a *fibril* a short-lived strand of gas, visible in monochromatic light. Ed.] On the 21st, the white-light group consisted of about a dozen spots with penumbra. The old leader spot was then only slightly larger than before. There was no apparent organization. With an area by all accounts over 500 millionths of the disk, 15° heliographic in diameter, this region was visible to the naked eye.

A day later, on OCT 22, Garcia, Lao, and Maxson saw that this group had divided into two sections. The leading section had four or five spots with penumbrae, and the following had ten to twelve smaller spots with penumbrae. The group's area was larger as well, but the maximum area was not reached until the next day, OCT 23. McCarter was the only observer who submitted data for that day. He

many umbral spots. In H-α, the follower was seen amidst bright plage and the leader in faint plage. The region continued to decay until it went around the limb, but was then only a collection of small spots with disorganized penumbrae surrounded by many faculae. [*Faculae* are bright patches seen in integrated light. Ed.]

Rotation 1809
(1988 NOV 15.52 to 1988 DEC 12.84)

Sunspot Number	Mean	Maximum (Dates)	Minimum (Dates)
RI	128.0	196 (Nov 17)	69 (Nov 27)
RA	125.4	181 (NOV 16)	67 (Nov 26)

This rotation was typified by many small groups with many pores and umbral spots. Groups were short-lived, existing for one rotation or less. The largest groups barely made it to naked-eye visibility.

SESC 5229 was first seen on NOV 09 (in Rotation 1808) as a large symmetrical spot with penumbra preceded by a smaller spot with few faculae in attendance. In a better view on the next day, NOV 10, the group could be seen as three collections of spots, some with penumbrae, aligned in an E-W line, followed by faculae. A H-α observation by

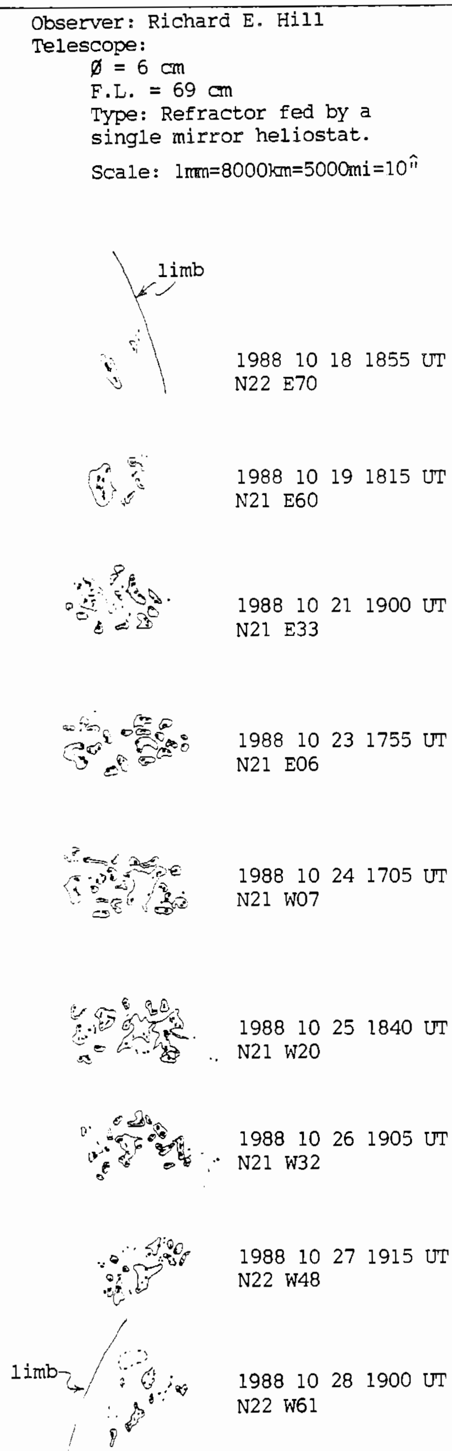

Figure 22. Series of drawings by Richard E. Hill showing the development of SESC 5200. North is at the top and heliographic east to the right; heliographic latitudes and longitudes, in degrees, are shown under each date. [Due to reduction, the actual scale is about 70 percent of that indicated.]

Morris showed the entire region surrounded by plage, brightest around the middle spot. By NOV 11, the three collections extended through 15° heliographic, although the spots were small. Surprisingly, there were few umbral spots and pores.

NOV 12 saw the lead spot split into two spots, with their penumbrae aligned E-W and just touching each other. The middle and following spots each consisted of two spots, with penumbrae aligned N-S with umbral spots between them. The leader spots had closed up significantly by NOV 13; the gap by then being just a light bridge cutting in from the S among the five or six umbrae in the single penumbra. The middle spot had also consolidated into two umbrae in one penumbra. Several umbral spots with rudimentary penumbrae lay between the leader and the middle spots. Following these was one big spot, consisting of three umbrae in one penumbra with a bit of detached penumbra to the N. H-α data showed only middle and follower spots in a bright plage with a small break between them. Dissolution was definitely underway when, on NOV 14, the middle spot consisted of only umbral spots and pores with some rudimentary penumbrae. The follower spot was now composed of over a half-dozen umbrae in one penumbra, aligned approximately E-W with an extension to the N. The leader was unchanged. Decay continued over the next three days. *Figure 23* (p. 27) shows the general appearance of SESC 5229 in H-α. The last hurrah occurred on NOV 18, when the middle spot formed a penumbra. The other spots were still becoming smaller. However, by the next day, NOV 19, when very near the limb, all the spots were reduced, and the entire group was surrounded by faculae. This was the last day of good data for this region because it reached the limb on NOV 20.

Rotation 1810
(1988 DEC 12.84 TO 1989 JAN 09.17)

Sunspot Number	Mean	Maximum (Date)	Minimum (Date)
RI	189.7	255 (DEC 22)	120 (JAN 04)
RA	190.7	253 (DEC 22)	116 (JAN 04)

As with the immediately previous rotation, this rotat-ion's groups were small and short-lived, with small spots. There were many groups composed entirely of umbral spots, never evolving past Class B [a sunspot group with a more or less distinct formation of the main spots (bipolar structure); spots without umbra. Ed.] This large number of groups gave this rotation the highest sunspot numbers of this reporting period.

The first observations on file of **SESC 5278** and **5280** were on DEC 16; by Hill, Morris, and Winkler, when the regions had been on the disk for four days. **SESC 5278** consisted of four collections of umbrae with penumbrae, the leader spot being the largest. It was followed by **SESC 5280**, which was three

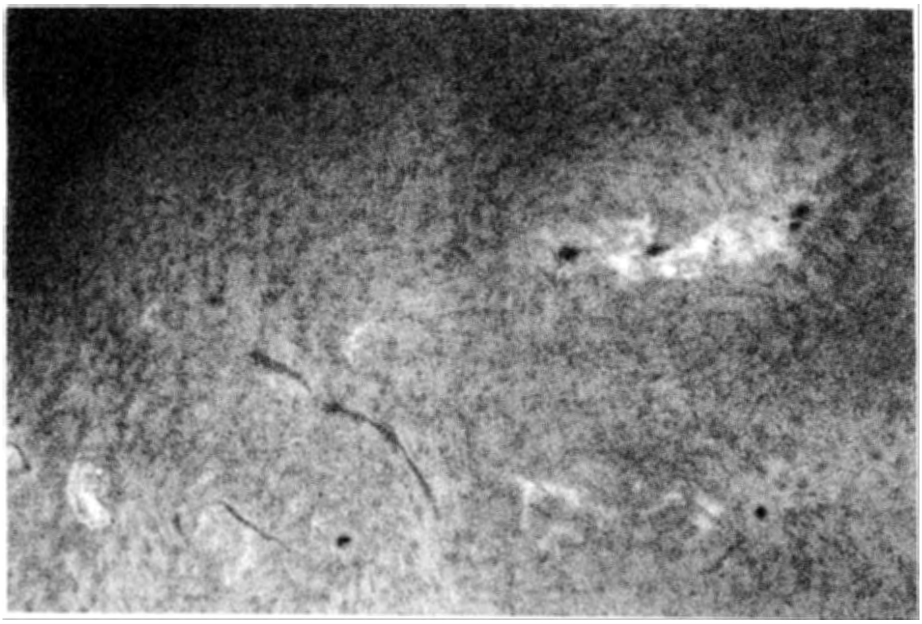

Figure 23. Hydrogen-α photograph of SESC 5229 by Randy Tatum on 1988 NOV 15 at 15h 45m U.T. He used a 7-inch (18 cm) refractor at f/30 with a 0.5Å Daystar ATM Filter and Kodak 2415 Film exposed at 1/15 second and developed in D-19. North at top; east to left.

collections of umbrae with penumbrae arranged roughly E-W. There were many umbral spots and pores around these groups. Morris' H-α observation showed this region to be fairly complex. There was a faint plage around SESC 5278 and a bright plage around the middle and follower spots of 5280. On the next day, DEC 17, the three smaller (following) collections of SESC 5278 had moved N of the larger leader. There was also more activity in SESC 5280. A superb photograph by Maxson, with 1 arc-second resolution, is reproduced below as *Figure 24*. It shows the leader to be teardrop-shaped; elongated E-W with a trailing piece containing several umbrae surrounded on the N side by rudimentary penumbrae. S of this detached piece were a half-dozen umbrae and bits of detached penumbrae. These were followed by another spot; about as large as the detached portion of the leader, surrounded by rudimentary penumbrae and attended by a few umbral spots. In H-α the plages were fainter but about the same in area and position with respect to the spots.

There was little or no change on the next day, DEC 18; but on DEC 19, with the two regions on the central meridian, there were major changes. In SESC 5278, the spots were merging into one penumbra. The smaller spots that were coalescing into the leader were once again following it. Due to the spottiness of data, it is impossible to determine whether the leader pulled ahead or the smaller spots dropped behind. The lead spot in SESC 5280 had moved S of the follower in SESC 5278. The follower spot in SESC 5280 was smaller than before, with many umbral spots between leader and follower. On DEC 20, SESC 5278 was breaking up. All spots were decreasing in size. The leader of SESC 5280 appeared to be coalescing with the follower of SESC 5278, by now only a few umbral spots. In H-α, the plage was seen to be decreasing rapidly in complexity, size, and intensity. From this time on, spot numbers and sizes both decreased. As it neared the limb, SESC 5278 became only two spots with penumbrae, aligned SW-NE. Meanwhile, the leader of SESC 5280 formed an equilateral triangle with the two SESC 5278 spots. There were few faculae seen as SESC 5278 went around the limb.

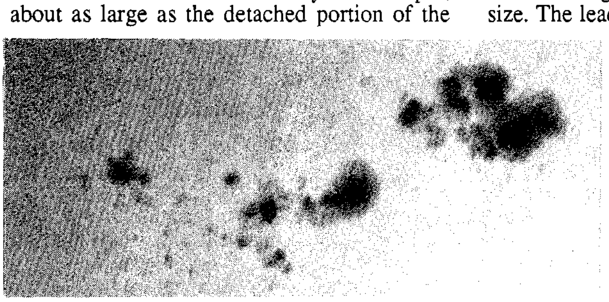

Figure 24. Photograph of SESC 5278, taken by Paul Maxson on 1988 DEC 17 at 18h 10m U.T. 6-inch (15 cm) reflector used at f/30 with a Wratten 11 (yellow-green) Filter and Kodak 2415 Film at 1/250 second, developed in D-19. North at top and west to the right.

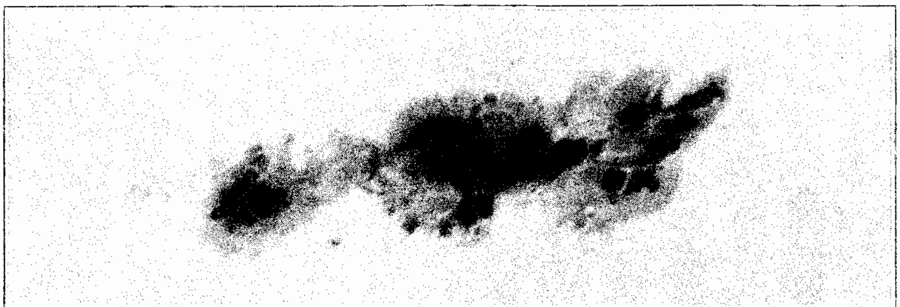

Figure 25. White-light photograph of solar activity group SESC 5312 by Jean Dragesco. 1989 JAN 15, 11h 10m U.T. 36-cm. Schmidt-Cassegrain, stopped to 10 cm. at f/60; exposed 1/1000 second on Kodak 2415 Film. North at top, west to the right.

Rotation 1811
(1989 JAN 09.17 TO 1989 FEB 05.51)

Sunspot Number	Mean	Maximum (Dates)	Minimum (Date)
RI	162.3	229 (JAN 12)	114 (JAN 21)
RA	159.2	206 (JAN 13)	114 (JAN 21)

Although sunspot numbers were lower this rotation than in the previous one, the sizes of the groups increased. In fact, the largest group of the reporting period, **SESC 5312**, occurred in this rotation.

First observed on JAN 07 (during Rotation 1810) by Garfinkle and Maxson, **SESC 5312** was then seen two days off the limb; when it was large and complex, preceded by a smaller spot with penumbrae, reminiscent of SESC 5229 as seen on 1988 NOV 09. This time, though, there were many faculae in attendance. The next day, JAN 08, many light bridges were seen intruding into the large spot, with several umbral spots surrounding it. Even though this group was then only three days off the limb, it was already a naked-eye group. Roussom, on JAN 09, observed the large spot as elongating E-W. On the small leader spot a following section had detached. There appeared to be more umbral spots surrounding the large spot. Tatum, observing in H-α, found the entire region in a bright plage. No further observations were available until JAN 12. At that time, the large spot was still complex; with many umbrae contained in a massive penumbra elongated E-W, while a large penumbral appendage had formed to the NW.

On JAN 13, the leader half of the large spot was crossed by many light bridges, cutting through many umbrae. The middle of the spot contained several large umbrae, and the following part was a nearly detached symmetrical spot connected to the main body by only a thin thread of penumbral material. Only a day later, on JAN 14, consolidation was taking place, as shown by white-light photographs by Garfinkle, Maxson, and Timerson. The light bridges were for the most part gone, and the detached portion was closer to the main body and was still connected by a penumbral bridge. In H-α, Melillo, Morris, and Tatum observed a plage ring around the region with a thin bright crack, similar to a light bridge, separating the following portion. Excellent photography by Dragesco (as always!) on JAN 15 showed the spot still to be single and large, and is shown above as *Figure 25*. The lead portion consisted of a N-S row of umbrae crossed by light bridges. The middle portion contained four large umbrae; and the following part had only a few very small umbrae within a large penumbra, now connected by a broad penumbral bridge. There were almost no pores or umbral spots in attendance. In H-α, bright ribbons were seen cutting through the middle part of the spot. These features probably indicated the dividing line of the magnetic polarities in the group. On the next day, JAN 16, the group was largely the same, although the umbrae in the leading portion were reduced. On JAN 17 dissolution was definitely underway. The leading portion was then detaching and shrinking while other portions were reducing in area. H-α observations showed little plage remaining, although there was an interesting filament arc extending from the middle portion to the leader. The last observations of SESC 5312 were made on JAN 20, when the lead portion had detached completely, and there were many faculae as the group neared the limb.

Rotation 1812
(1989 FEB 05.51 to 1989 MAR 04.85)

Sunspot Number	Mean	Maximum (Date)	Minimum (Date)
RI	160.4	216 (FEB 12)	98 (MAR 04)
RA	160.4	216 (FEB 12)	99 (MAR 04)

As remarkable as it may seem, the numbers above are correct! The total of the daily sunspot numbers for either the International or the American system differed by only one; or in this case, by 0.02 percent. The highs and lows also are correct, even though they look like a transcription error. As was usual in this reporting period, the two largest regions in this rotation were in the Northern Hemisphere.

The largest region, **SESC 5354**, came onto

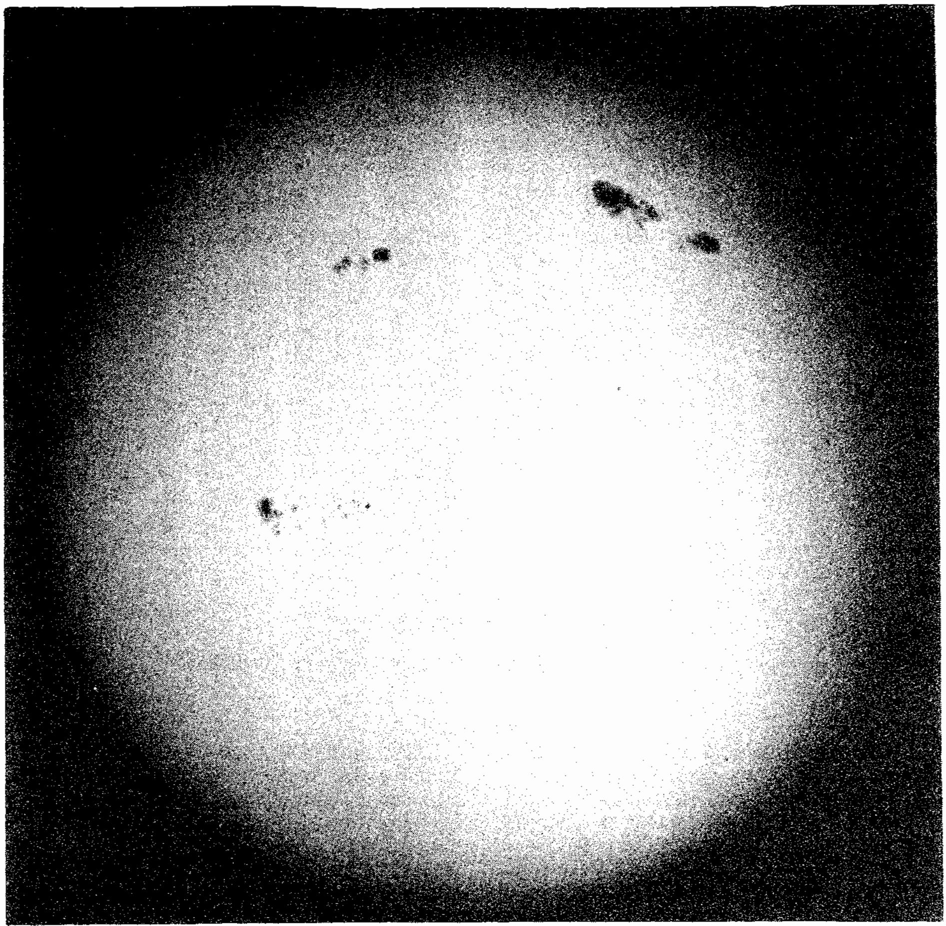

Figure 26. Full-disk, white-light solar photograph by Gordon Garcia. 1989 FEB 12, 17h 32m U,T. 20-cm. Schmidt-Cassegrain, stopped to 75mm at f/27, using Solar Skreen and Wratten 11 (yellow-green) Filter. 1/1000-second exposure on Kodak 2415 Film, developed in D-19. SESC 5354 is the large sunspot group to the upper right. North at top, west to the right.

the disk on 1989 FEB 04 (during Rotation 1811). Even before it came onto the disk, Dragesco made observations of large prominences hovering over the region on FEB 01 and 02. Clearly, this was to be an active region, although we unfortunately received no further observations until FEB 10, when the leader spot comprised a half-dozen umbrae in one penumbra. It was followed by a large spot with smaller umbrae to its S and W; all connected by penumbral bridges. On FEB 11, Garcia, Garfinkle, Rousom, and VanHoose observed the lead spot as unchanged, but the follower was by then two large spots, each composed of many umbrae in each penumbra.

On the next day, FEB 12, the leader developed a penumbral streamer to the SE, shaped like a hood. The appearance of this group at that time is shown in *Figure 26*, above. The follower was by then a large spot with a smaller, fragmented spot on its leading side. This smaller spot appeared to be in the process of being absorbed. Although only one day from central-meridian passage, already faculae were observed around the group! On FEB 14, the smaller, following spot was nearly gone. It consisted of only a few very small umbral spots in a rudimentary penumbra. Umbrae in the larger portion of the follower had formed two parallel rows with a few other scattered umbrae in a large penumbra. The leader was reduced in area and had one main umbra with a few very small ones. Throughout and around the group were bright faculae. It is a pity that we lack H-α observations for this region. The plage must have been huge. Glaser was our only observer on FEB 15 as the group neared the limb. The lead spot was largely the same, while the follower had coalesced. Both appeared smaller, although some of this aspect was undoubtedly due to foreshortening. The entire region was riddled with faculae extending almost to the center of the disk. On FEB 17, only the follower spot was visible. Following this was a large N-S line of bright faculae. Again, a view in H-α or in the Calcium K-line would have been very desirable.

Conclusion

As this report is published, we should be at solar maximum. Average daily sunspot numbers may be as high as 220, giving our observers plenty to do. The present rate of data submission attests to these high numbers. The number of our observers also continues to increase. Many of these new observers have mistakenly been sending data to this Recorder. I would remind them here, as Co-Recorder Paul Maxson has in the monthly Solar Section publication, *The Rotation Report*, that all data are to be sent to Paul directly. This is important because he must enter new data into the computer file as soon as possible. In this way, we can be always ready to fill data requests from the professional astronomical community. When data come to me, they can often be delayed for as long as a month. This can cause terrible backups for Paul.

With the Sun reaching the peak of one of the most active solar cycles in history, I urge all telescope owners to get out and observe this remarkable event. [Be sure to employ suitable safety precautions. Ed.] Record your observations and send them to us. Thus, you can enjoy and preserve time spent at the telescope and add to science through your hobby.

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4.) ________, No. 534, February, 1989.
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6.) ________, No. 536, April, 1989.
7.) ________, No. 537, May, 1989.
8.) Hill, Richard E. "A.L.P.O. Solar Section Observations for Rotations 1803-1807 (1988 JUN 05 to 1988 OCT 19)." *J.A.L.P.O.*, *33*, Nos. 7-9 (July, 1989), pp. 127-135.

Observing Meteors: XVI

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

With this column, I wish to congratulate Robert Lunsford on his accession to the Recordership of our Meteors Section. [Mr. Lunsford was confirmed as Meteors Recorder at the A.L.P.O. Business Meeting in Pasadena, California, in August, 1989. Ed.] He has undertaken a difficult task; the encouragement and collection of observations of meteors, and I wish him the best of luck.

Since its founding in 1983, the Meteors Section has had two purposes. The first is to encourage new observers to take on the study of meteors as an observing activity, which is a form of work unlike any other field that the Association of Lunar and Planetary Observers has to offer. It is work that usually is not done with the aid of a telescope, although telescopic meteor showers do exist. However, this naked-eye work can be quite important, for in observing meteors we study events in our atmosphere not far above us.

The other purpose of our Section, of course, is the archiving of observations. This difficult task involves the collection and arrangement of observations from persons all over the world, and provides an understanding of meteor-shower activity from many locations. For example, from such observations we could conceivably learn that a shower, such as the Perseids, near maximum might have had peaks and troughs of activity that were separated by only a few hours. This would be indicated by observers at differing times and locations reporting very different meteor zenithal hourly counts [*ZHR*; the expected rate of meteors at the zenith under ideal circumstances] under similar conditions.

It is the uniquely non-telescopic observing nature of the meteor field which has always attracted me to it, starting with the early days of Perseid-watching from my Grandfather's cottage near Ripon, Quebec. In 1962, the Perseids were thick; a mighty shower that impressed me as the major one of the year, just as the astronomy books said. It was surprising to see this shower fade away, so to speak, in the mid-80's, although in Summer, 1989, it appeared to have regained its earlier strength.

In those early days I knew nothing about the winter showers of the Geminids and Quadrantids, because then it was usually cloudy. (I do remember seeing one Geminid in one hour on a maximum night around 1961!) What I was missing! In 1989, the sky was so crowded with Geminid meteors that I thought this must now be the year's major shower; and for sheer numbers, it is.

Numbers per hour is not the only factor that characterizes meteor showers. Actually, one of my favorite showers is the Taurids, peaking at the end of October, but furnishing a beautiful display of fireballs well into November. These remnants of Encke's Comet have been rather steady visitors over the years; always welcome and always exciting.

The Meteors Section can cater to those who are interested in this sort of casual observing of meteors, although we do emphasize the needs of the observer who is serious about careful and accurate meteor watching. Under Robert Lunsford's direction, the Section should continue to provide for the A.L.P.O. an observing outlet with a difference.

RECENT A.L.P.O. METEOR OBSERVATIONS

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

1989 U.T. Date	Observer	Location	U.T.	Number and Type of Meteors Seen	Comments (+N = Limiting Magnitude)
AUG 26	J. Kenneth Eakins	California	07:10-08:10	1 Sporadic (Sp.)	+5.1
	"	"	08:10-09:10	1 Sp.; 2 ι Aqr?	+5.1
SEP 04	J. Kenneth Eakins	California	07:45-08:45	5 Sp.; 2 ι Aqr?	+5.1
	"	"	08:45-09:45	2 Sp.; 2 ι Aqr?	+5.1
OCT 01	J. Kenneth Eakins	California	07:50-08:50	2 Sporadic	+5.1
	"	"	08:50-09:50	7 Sporadic	+5.1
02	J. Kenneth Eakins	California	09:45-10:45	4 σ Ori; 6 Sp.	+5.1
	"	"	10:45-11:45	1 σ Ori; 5 Sp	+5.1
08	J. Kenneth Eakins	California	07:00-08:00	3 Sporadic	+5.1
	"	"	08:00-09:00	3 Sporadic	+5.1
23	Dick Brown	N. Carolina	03:20-04:20	1 Sp.; 2 Ori	+4.2
	Nancy Brown	"	03:20-04:20	1 Ori	+4.1
	Deborah Carroll	"	03:20-04:20	3 Sp.; 3 Ori	+4.2
	Rex Carroll	"	03:20-04:20	1 Sporadic	+3.9
	Barbara Hands	"	03:20-04:20	(none seen)	+3.9
	Dennis Hands	"	03:20-04:20	1 Sporadic	+3.9
	Mary Krieg	"	03:20-04:20	(none seen)	+5.2
	Bobby Trail	"	03:20-04:20	1 Sporadic	+5.0
	Rod Trail	"	03:20-04:20	1 Sporadic	+4.6
	Dick Brown	"	04:20-05:20	4 Sp.; 1 Ori	+5.2
	Nancy Brown	"	04:20-05:20	(none seen)	+5.2
	Deborah Carroll	"	04:20-05:20	2 Sporadic	+5.2
	Rex Carroll	"	04:20-05:20	(none seen)	+5.0
	Barbara Hands	"	04:20-05:20	(none seen)	+3.2
	Dennis Hands	"	04:20-05:20	2 Sporadic	+4.2
	Mary Krieg	"	04:20-05:20	(none seen)	+5.3
	Rod Trail	"	04:20-05:20	2 Sporadic	+5.1
NOV 04	George Gliba	Maryland	08:30-09:30	1 S. Tau; 1 And; 6 Sporadic	+5.3; Hazy
17	Roger Venable	Georgia	08:49-09:49	10 Leo; 2 Sp.	+5.5; Leo ZHR = 15
	George Gliba	Maryland	10:00-10:50	10 Leo; 1 Sp.	+4.5; Haze+Aurora
19	Deborah Carroll	N. Carolina	04:03-05:03	(none seen)	+2.9; 50% cloudy
	Rex Carroll	"	04:03-05:03	(none seen)	+2.5; 50% cloudy
	Dennis Hands	"	04:03-05:03	(none seen)	+2.9; 50% cloudy
	Mary Krieg	"	04:03-05:03	(none seen)	+2.9; 50% cloudy
	Deborah Carroll	"	05:21-06:21	(none seen)	+2.9; 20% cloudy
	Rex Carroll	"	05:21-06:21	(none seen)	+2.5; 20% cloudy
	Dennis Hands	"	05:21-06:21	3 Sporadic	+4.0; 15% cloudy
	Mary Krieg	"	05:21-06:21	3 Sporadic	+4.0; 15% cloudy
	Deborah Carroll	"	06:34-07:34	2 Sporadic	+2.9; 5% cloudy
	Rex Carroll	"	06:34-07:34	2 Sporadic	+2.9; 5% cloudy
	Dennis Hands	"	06:34-07:34	2 Sporadic	+5.2; 5% cloudy
	Mary Krieg	"	06:34-07:34	1 Sporadic	+5.2; 5% cloudy

Abbreviations: And = Andromedid; Aqr = Aquarid; Leo = Leonid; Ori = Orionid; Sp. = Sporadic; Tau = Taurid; ZHR = zenithal hourly rate.

Note by Editor: As in the previous meteors report, the values above represent "raw data," and (except for the 1989 NOV 17 Venable observation) have not been converted into zenithal hourly rates. The *predicted* dates for the showers above were: N. ι Aquarids maximum AUG 20, duration JUL 15-SEP 20; Orionids maximum OCT 21.1, duration 2 days; S. Taurids maximum NOV 02, duration SEP 18-NOV 30 for both N. and S. Taurids; Annual Andromedids maximum OCT 03, duration SEP 25-NOV 12; Leonids maximum NOV 16.9.

COMET CORNER

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

PRESENT COMET ACTIVITY

Several comets are visible to us as 1990 begins. This is due in part to an increase in comet discoveries for the last half of 1989. [*Added in Proof:* This report was submitted on 1989 NOV 11. Two recent discoveries, Comet Austin 1989c1 and Comet Skorichenko-George 1989e1, are described in the two following articles. Due to the recovery of P/ Van Biesbroeck by James Gibson on 1989 DEC 30, making 34 comet discoveries and recoveries in 1989, that year set a new record for the number of comets. Ed.] A brief description and schedule of each visible comet follow, with selected ephemerides in the next section.

Periodic Comet Schwassmann-Wachmann 1.—This comet often remains at magnitude 17; but it has been known to have outbursts, becoming as bright as magnitude 10. It was closest to the Sun on 1989 OCT 26 in its 15-year orbit. That event apparently increased its brightness; it was fainter than magnitude 14 for the first half of 1989, and between magnitudes 12.5 and 14.0 for the rest of that year. During early 1990 it is well-placed in our evening sky. Please report *all positive and negative* observations of it to me.

Comet Okazaki-Levy-Rudenko (1989r).- Discovered in late August, 1989, and closest to the Sun on 1989 NOV 11, this comet will be in the southern-hemisphere evening sky, pulling away from both the Earth and the Sun. It begins 1990 at 1.10 AU [*astronomical unit*; 149.6 million km. Ed.] from the Earth and 1.20 AU from the Sun; by early March these distances are 2.35 and 2.10 AU respectively.

Comet Helin-Roman-Alu (1989v).— This was the first of three comets found by this three-person team in October, 1989. It was closest to the Sun in mid-December and is circumpolar for much of the Northern Hemisphere during early 1990, favoring the morning sky. This comet remains less than 1 AU from the Earth until mid-March, 1990.

Periodic Comet Tuttle-Giacobini-Kresak—This comet orbits the Sun every 5.46 years and should be closest to the Sun at 1.06 AU on 1990 FEB 08. With a history of outbursts, it will be making a brief appearance in the morning sky early in 1990.

Periodic Comet Schwassmann-Wachmann 3.—Not to be confused with "SW1," this comet has an orbital period of 5.35 years and will be closest to the Sun on 1990 MAY 19 at 0.94 AU. It is intrinsically faint with an absolute magnitude [theoretical magnitude at 1 AU from both the Earth and the Sun. Ed.] of 12, but good placement makes this a favorable return.

COMET EPHEMERIDES

Tables 1-4 (below and p. 33) give ephemerides for several of the above comets in the first part of 1990. Under "Sky," "E" indicates evening and "M" morning.

Table 1. Ephemeris of Comet Okazaki-Levy-Rudenko (1989r).

1990 U.T. Date	1950.0 Position Right Ascension (h m)	1950.0 Position Declination (° ')	2000.0 Position Right Ascension (h m)	2000.0 Position Declination (° ')	Elongation from Sun (°)	Sky	Total Magnitude
FEB 23	02 28.3	-59 31	02 29.7	-59 18	67	E	+12.6
28	02 34.4	58 36	02 35.8	58 23	67	E	12.8
MAR 05	02 40.8	-57 47	02 42.3	-57 35	67	E	+13.1

Table 2. Ephemeris of Comet Helin-Roman-Alu (1989v).

1990 U.T. Date	1950.0 Position Right Ascension (h m)	1950.0 Position Declination (° ')	2000.0 Position Right Ascension (h m)	2000.0 Position Declination (° ')	Elongation from Sun (°)	Sky	Total Magnitude
FEB 23	14 01.5	+64 40	14 02.9	+64 26	114	M	+12.5
28	13 17.3	63 08	13 19.2	62 52	119	M	12.7
MAR 05	12 38.8	+60 42	12 41.0	+60 26	123	M	+12.9
10	12 07.3	57 37	12 09.8	57 20	126	M	13.1
15	11 42.7	54 07	11 45.4	53 50	128	M	13.4
20	11 23.9	50 28	11 26.7	50 11	129	M	13.6
25	11 09.8	46 49	11 12.6	46 33	130	M	13.9
30	10 59.4	43 17	11 02.2	43 01	129	M	14.2
APR 04	10 51.8	+39 56	10 54.6	+39 40	127	M	+14.4

Table 3. Ephemeris of Periodic Comet Tuttle-Giacobini-Kresak.

1990 U.T. Date		1950.0 Position Right Ascension (h m)		1950.0 Position Declination (° ')	2000.0 Position Right Ascension (h m)		2000.0 Position Declination (° ')	Elongation from Sun (°)	Sky	Total Magnitude
FEB	23	18	11.1	-14 45	18	14.0	-14 44	61	M	+11.3
	28	18	30.8	14 27	18	33.7	14 25	61	M	11.5
MAR	05	18	49.5	-14 05	18	52.3	-14 01	62	M	+11.8
	10	19	07.2	13 38	19	10.0	13 33	63	M	12.1
	15	19	23.8	13 07	19	26.6	13 01	63	M	12.4
	20	19	39.5	12 34	19	42.3	12 27	64	M	12.7
	25	19	54.2	12 00	19	57.0	11 52	66	M	13.1
	30	20	08.0	11 24	20	10.7	11 15	67	M	13.4

Table 4. Ephemeris of Periodic Comet Schwassmann-Wachmann 3.

1990 U.T. Date		1950.0 Position Right Ascension (h m)		1950.0 Position Declination (° ')	2000.0 Position Right Ascension (h m)		2000.0 Position Declination (° ')	Elongation from Sun (°)	Sky	Total Magnitude
MAR	05	15	33.7	+01 47	15	36.3	+01 37	112	M	+13.4
	10	15	52.7	01 12	15	55.2	01 03	111	M	13.0
	15	16	13.9	+00 31	16	16.4	+00 24	111	M	12.6
	20	16	37.8	-00 18	16	40.4	-00 24	109	M	12.1
	25	17	05.0	01 16	17	07.6	01 20	107	M	11.7
	30	17	35.9	02 25	17	38.5	02 27	104	M	11.3
APR	04	18	10.7	-03 44	18	13.3	-03 43	100	M	+10.9
	09	18	49.2	05 10	18	51.9	05 06	095	M	10.6
	14	19	30.5	06 36	19	33.1	06 30	090	M	10.3
	19	20	12.9	07 55	20	15.6	07 46	085	M	10.0
	24	20	54.7	08 58	20	57.4	08 47	080	M	10.0
	29	21	34.1	09 42	21	36.7	09 28	075	M	9.8
MAY	04	22	10.0	-10 05	22	12.7	-09 50	072	M	+9.8
	09	22	42.2	10 11	22	44.8	09 55	069	M	9.9
	14	23	10.7	10 02	23	13.3	09 45	068	M	10.0
	19	23	36.0	09 42	23	38.6	09 25	067	M	10.1
	24	23	58.4	09 15	00	01.0	08 58	066	M	10.3
	29	00	18.5	08 42	00	21.0	08 25	066	M	10.5

COMET AUSTIN (1989C$_1$): A NEW BRIGHT COMET?

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

A new comet was discovered by Rodney Austin of New Plymouth, New Zealand on 1989 DEC 06, when it was at magnitude +11. The comet, designated Comet Austin 1989c1, is expected to brighten to naked-eye visibility in the Spring of 1990. Such a prediction assumes a "normal" brightness pattern; one which the comet may not choose to follow! [Many of us will remember our disappointment at the unexpectedly poor performance of "the comet of the century," Comet Kohoutek, in 1973-74. Ed.]

From the Southern Hemisphere, this comet will be visible in the evening sky until mid-March, 1990. Following perihelion passage, in early May it will be visible in their northern morning sky.

For northern-hemisphere observers, the comet will be visible in the southern sky beginning in late January. It will set within two hours of the end of astronomical twilight in early 1990; by early April it will set at the end of astronomical twilight. It then will enter the morning sky as it passes north of the Sun. Through the rest of April and May, Comet Austin's elongation from the Sun will increase, but its brightness will remain nearly constant as it approaches to within about 21 million miles (34 million km) of the Earth in May. It then passes through opposition to the Sun, into the evening sky. As June opens, the comet will be up nearly all night. During the summer months, it will dim in the southern evening sky.

The preliminary orbital elements, computed by Daniel Green and printed in IAU *Circular 4921*, are:

Time of Perihelion....... 1990 APR 10.304 ET
Distance at Perihelion..... 0.34878 AU
Argument of Perihelion... 061°.850
Ascending Node.............. 074°.839
Inclination........................ 59°.053
Eccentricity................... 1.00 (parabolic)

The predicted distances in astronomical Units (AU) of Comet Austin from the Sun and the Earth are:

1990 Date		Dist. from Sun	Dist. from Earth
FEB	23	1.17 AU	1.73 AU
MAR	05	0.98	1.61
	15	0.77	1.49
	25	0.57	1.35
APR	04	0.39	1.17
	14	0.37	0.94
	24	0.52	0.71

The orbital elements above provided the following ephemeris for Comet Austin, expected to be accurate to within 2° by late May. The total visual magnitudes are estimates based upon an "absolute magnitude" of +5.5 and a distance coefficient of 4.0.

Table 1. Ephemeris of Comet Austin (1989c_1).

1990 U.T. Date		1950.0 Position Right Ascension h	m	Declination °	'	2000.0 Position Right Ascension h	m	Declination °	'	Elongation from Sun °	Sky *	Total Magnitude
FEB	23	01	03.4	-22	53	01	05.8	-22	37	41	E	+7.4
	28	01	09.5	19	09	01	11.9	18	53	38	E	6.9
MAR	05	01	15.9	-15	09	01	18.4	-14	54	35	E	+6.4
	10	01	22.5	10	51	01	25.0	10	35	31	E	5.9
	15	01	29.1	06	09	01	31.6	05	53	28	E	5.3
	20	01	35.6	-01	00	01	38.2	-00	45	25	E	4.5
	25	01	41.5	+04	42	01	44.1	+04	57	22	E	3.7
	30	01	46.0	11	01	01	48.6	11	16	20	E	2.8
APR	04	01	47.2	+17	51	01	49.9	+18	06	19	E	+1.8
	09	01	42.3	24	42	01	45.1	24	57	19	E	1.1
	14	01	29.0	30	21	01	31.8	30	36	21	E	1.0
	19	01	09.2	33	58	01	11.9	34	14	25	M	1.4
	24	00	46.0	35	43	00	48.7	35	59	29	M	1.9
	29	00	20.7	36	05	00	23.4	36	21	35	M	2.3
MAY	04	23	52.4	+35	17	23	54.9	+35	34	42	M	+2.6
	09	23	18.1	33	11	23	20.5	33	27	52	M	2.8
	14	22	33.4	28	58	22	35.7	29	13	66	M	2.8
	19	21	32.5	20	49	21	34.8	21	02	85	M	2.7
	24	20	13.7	+06	46	20	16.2	+06	55	112	M	2.8
	29	18	49.2	-09	54	18	52.0	-09	50	142	M	3.2
JUN	03	17	38.4	-21	53	17	41.4	-21	54	167	M	+4.0

*E = Evening, M = Morning.

Added by Editor

Because Comet Austin promises (but does not guarantee) to be a rather spectacular object this Spring, the next page contains *Figures 27* and *28*, which together plot the comet's predicted path from 1990 FEB 01 to MAY 15. Note that this path is based on a preliminary orbit, and thus the comet may differ from it by perhaps 2°.

The approximate dates during this period when moonlight should not interfere with comet observations are MAR 13-28, APR 12-16, APR 23-MAY 09, and MAY 22-31.

Assuming that the predicted path is correct, Comet Austin will pass near several interesting celestial objects (celestial directions are abbreviated; times are U.T.):

MAR 26, 02h, 1°.2 W of NGC 676 galaxy
MAR 28, 08h, 6°.1 S of 1.5-day Moon
APR 03, 04h, 5°.3 NNE of Mercury
APR 13, 18h, 0°.5 SW of M33 galaxy
APR 20, 00h, 1°.0 SW of NGC 404 galaxy
MAY 21, 01h, 0°.8 NW of NGC 7006 cluster
MAY 28, 19h, 0°.3 NW of M26 cluster
MAY 30, 10h, 0°.1 SE of M16 bright nebula

Note that, if it follows the predicted orbit, Comet Austin will pass across the outer portions of M33 and M26.

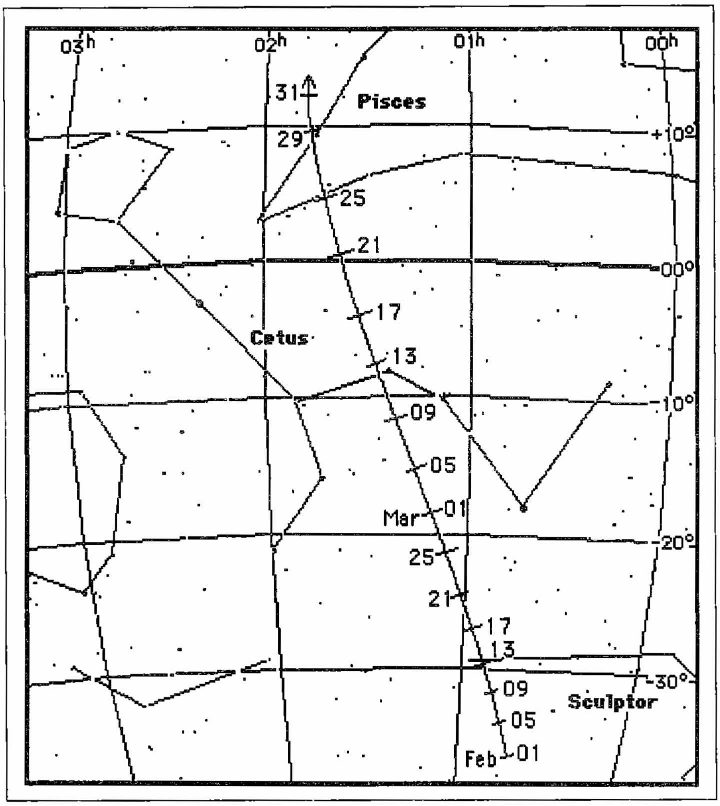

Figure 27. Predicted path of Comet Austin through the constellations of Sculptor, Cetus, and Pisces; 1990 FEB 01 - MAR 31. Limiting magnitude approximately +6. 1990 coordinates. Plotted by Voyager program © Carina Software.

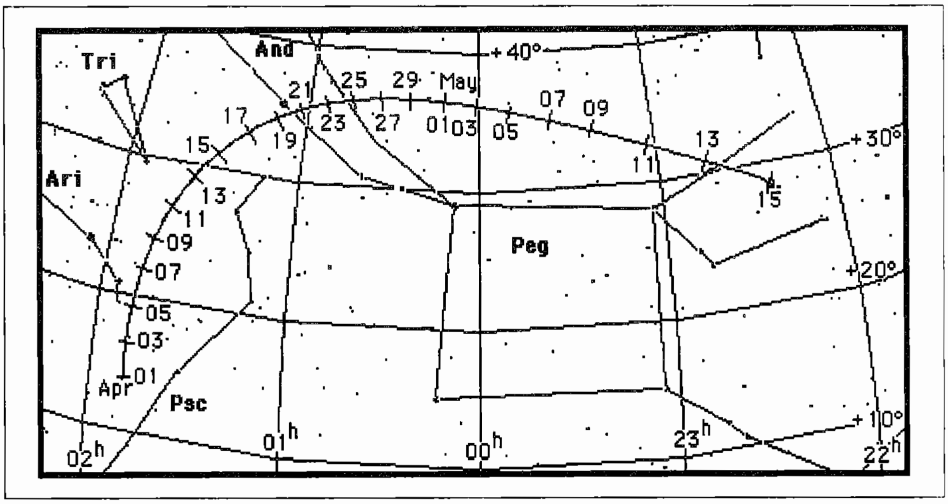

Figure 28. Predicted path of Comet Austin through the constellations of Pisces, Aries, Triangulum, Andromeda, and Pegasus; 1990 APR 01-MAY 15. Limiting magnitude approximately +6. 1990 coordinates. Plotted by Voyager program © Carina Software.

A.L.P.O. COMET UPDATE: COMET SKORICHENKO-GEORGE ($1989E_1$)

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

Boris Skorichenko of the Soviet Union and Douglas George of Kenata (near Ottawa), Canada discovered this comet on 1989 DEC 17. It was then at magnitude +10.5 in the northern evening sky. Skorichenko was using a 6-in. (15-cm) reflector, while George was using a 16-in. (41-cm) reflector and had searched for 65 hours for comets.

Comet Skorichenko-George will be closest to the Sun on 1990 APR 14 at 1.68 AU (astronomical units). Through April, it will remain in the northern-hemisphere evening sky at magnitude +8 to +9. Its elongation will decrease because it reaches perihelion opposite the Earth in relation to the Sun.

This comet's orbital elements, calculated by S. Nakano, are from IAU *Circular 4929*:

Time of Perihelion	1990 APR 14.039 ET
Distance at Perihelion	1.67954 AU
Argument of Perihelion	134°.543
Ascending Node	277°.536
Inclination	59°.065
Eccentricity	1.00 (parabolic)

These elements were used to calculate the ephemeris listed below.

Table 1. Ephemeris of Comet Skorichenko-George ($1989e_1$).

1990 U.T. Date		1950.0 Position Right Ascension		1950.0 Declination		2000.0 Position Right Ascension		2000.0 Declination		Elongation from Sun	Sky	Total Magnitude
		h	m	°	'	h	m	°	'	°		
FEB	23	22	55.7	+38	27	22	58.0	+38	43	49	Eve.	+8.9
	28	23	15.5	39	29	23	17.8	39	46	49	Eve.	8.8
MAR	05	23	36.1	+40	26	23	38.5	+40	42	48	Eve.	+8.7
	10	23	57.4	41	15	00	00.0	41	32	47	Eve.	8.7
	15	00	19.4	41	55	00	22.1	42	12	46	Eve.	8.7
	20	00	41.9	42	26	00	44.6	42	42	44	Eve.	8.6
	25	01	04.7	42	45	01	07.5	43	01	43	Eve.	8.6
	30	01	27.5	42	54	01	30.4	43	09	42	Eve.	8.6
APR	04	01	50.2	+42	50	01	53.2	+43	05	40	Eve.	+8.6
	09	02	12.5	42	36	02	15.7	42	50	38	Eve.	8.6
	14	02	34.4	42	10	02	37.6	42	23	36	Eve.	8.6
	19	02	55.5	41	35	02	58.8	41	47	35	Eve.	8.7
	24	03	15.9	40	50	03	19.2	41	01	33	Eve.	8.7
	29	03	35.5	39	58	03	38.8	40	08	30	Eve.	8.8
MAY	04	03	54.1	+38	59	03	57.5	+39	08	28	Eve.	+8.8
	09	04	11.9	37	54	04	15.2	38	02	26	Eve.	8.9
	14	04	28.7	36	44	04	32.1	36	51	24	Eve.	8.9
	19	04	44.7	35	31	04	48.1	35	36	22	Eve.	9.0
	24	04	59.9	34	14	05	03.2	34	18	19	Eve.	9.1
	29	05	14.3	32	55	05	17.6	32	57	17	Eve.	9.2

COMING SOLAR SYSTEM EVENTS: FEBRUARY-APRIL, 1990

WHAT TO LOOK FOR

This column is intended to alert our readers about events happening in the Solar System during the next three months, including the visibility conditions for major and minor planets, the Moon, comets, and meteors. More detailed information can be gotten from the 1990 edition of the *A.L.P.O. Solar System Ephemeris*. (See p. 48 of this issue to learn how to obtain this publication.) All dates and times are in Universal Time (U.T.), which is found by adding 10 hours to H-AST (Hawaii-Aleutian Standard Time), 9 hours to AST (Alaska Standard Time) or H-ADT, 8 hours to PST or ADT, 7 hours to MST or PDT, 6 hours to CST or MDT, 5 hours to EST or CDT, and 4 hours to EDT. Note that this addition may put you into the next U.T. day!

JUPITER AND VENUS CONTINUE PROMINENT

As in the previous three-month period, **Jupiter** and **Venus** continue to be easy to observe. **Jupiter** is conveniently located in Gemini in the evening sky, transiting before midnight and then very high for northern observers. As we go to press, Jupiter's South Equatorial Belt continues to be very faint, and its North Equatorial Belt to be disturbed; however, the Great Red Spot has recovered its prominence somewhat.

Venus is now a prominent object in the morning sky, reaching its greatest brilliancy (magnitude -4.6) on FEB 19, when its 23-percent sunlit disk subtends 43 arc-seconds. Its greatest elongation west of the Sun, 46°.5, falls on MAR 30. For about a week near that time, estimate the phase (proportion sunlit) of its 25 arc-second disk, which should in theory be half-illuminated.

Speeding around the Sun, **Mercury** undergoes two apparitions in our period. In the morning sky, it reaches greatest elongation west (25°.2) on FEB 01, and remains over 15° from the Sun between JAN 15 and FEB 28; this apparition favors our Southern Hemisphere. Next, Mercury passes solar conjunction on MAR 20, and enters the evening sky in an apparition more favorable to the Northern Hemisphere. It is over 15° from the Sun from APR 04 -23, and at greatest eastern elongation (19°.6) on APR 13.

Mars is now well into its 1989-91 apparition, but is still in the southeast sky before dawn. By the end of April it has moved 63° from the Sun, at magnitude +0.8, and its disk has grown to 6 arc-seconds; the traditional minimum size for serious observation.

Also in the morning sky, **Saturn** is growing more convenient to observe, reaching *quadrature* (90° from the Sun) on APR 15, at magnitude +0.6, when its disk will measure 15 by 17 arc-seconds and its Rings, tilted 22° north to our line of sight, measure 14 by 37 arc-seconds. Also, on FEB 28, 17h, Saturn passes 1°.0 to the north of Mars.

The rather-crowded morning sky also now contains **Uranus** and **Neptune**; both, like Saturn, in Sagittarius.

Three fairly-bright **minor planets** reach opposition during the February-April period; their 10-day ephemerides are published in the *A.L.P.O. Solar System Ephemeris: 1990.*

	Opposition Data		
Minor Planet	1990 Date	Magnitude	Declination
18 Melpomene	MAR 07	+10.0	10°N
23 Thalia	APR 01	+9.7	12°N
6 Hebe	APR 28	+9.9	09°N

Note that, although not in opposition, the minor planets **Ceres**, **Pallas**, and **Vesta** will all be of magnitudes +8 to +9 in this period. Finally, **1627 Ivar** zips past the Earth in April and May.

THE MOON

During the current three-month period, the schedule for the Moon's **phases** is:

New Moon	First Quarter	Full Moon	Last Quarter
JAN 26.8	FEB 02.8	FEB 09.8	FEB 17.8
FEB 25.4	MAR 04.1	MAR 11.5	MAR 19.6
MAR 26.8	APR 02.4	APR 10.1	APR 18.3
APR 25.2	MAY 01.8	MAY 09.8	MAY 17.8

The 1990 FEB 09 Full Moon is notable because it marks a total lunar eclipse, described on p. 184 of the October, 1989, issue. (The JAN 26 New Moon was marked by an annular solar eclipse.)

During this season, the First-Quarter Moon will be well-placed, and the Last-Quarter Moon poorly placed, for observers in the Earth's Northern Hemisphere; the opposite is true for those south of the Equator.

The other significant lunar visibility condition is the Moon's **librations**, or E-W and N-S tilts in relation to the Earth. Extreme librations occur on the following dates in February-April, 1990:

North	West	South	East
FEB 17	FEB 23	MAR 02	MAR 08
MAR 16	MAR 23	MAR 29	APR 04
APR 12	APR 20	APR 26	MAY 02

The lunar east and west directions above follow the International Astronomical Union usage, with Mare Crisium near the *east* limb. Lighting and libration conditions combine for a favorable view of the west limb on 1990 FEB 21-24, and of the west and southwest limbs on MAR 20-25 and APR 18-23.

OCCULTATIONS

March and April are notable for a number of occultations of stars by Mars, Titan, and several minor planets. The data that follow give the date, occulting object, visual magnitude of star, and zone visible, for these events.

MAR 09.66 **39 Laetitia**, +8.2. NW USSR, Pacific Ocean
MAR 11.90 **444 Gyptis**, +7.7. Middle East, N. Africa
MAR 13.50 **78 Diana**, +9.0. E Australia, China
MAR 18.41 **Titan**, +9.2. SW South America
MAR 25.91 **165 Lorely**, +8.5. W-N Africa, Cnt-E Europe
APR 21.59 **345 Tercidina**, +9.3. Indonesia, N-E Australia, New Zealand
APR 28.15 **Mars**, +6.4. Cnt-S Africa.

The only occultation of a bright planet by the Moon is one of **Mars** on MAR 22, at about 18h, which will be a daylight event except in the South Pacific. The Red Planet will then be 54° west of the Sun, at magnitude +1.0 and 5.2 arc-seconds in diameter. To observe this event, first find the Moon; then, in the telescope, locate Mars. A red, or even a polarizing, filter should heighten the contrast. The zones in North America from which this event is visible are mapped in *Figure 29* (p. 38). The predicted immersion and emersion times, in that order, for some North American stations are given below. In parentheses are the abbreviations used in *Figure 29*.

Los Angeles (LA)	$18^h16.0^m$	19^h 25.7^m
Northern California (NC)	18 22.1	19 12.2
New Mexico-Arizona (NA)	18 23.5	19 37.2
Denver (De)	18 29.6	19 36.5
Austin (Au)	18 35.4	19 41.2
Kansas City (KC)	18 35.5	(low altitude)
Winnipeg (Wi)	18 37.1	(low altitude)
Chicago (Ch)	18 38.1	(not visible)
Atlanta (At)	18 45.8	(not visible)

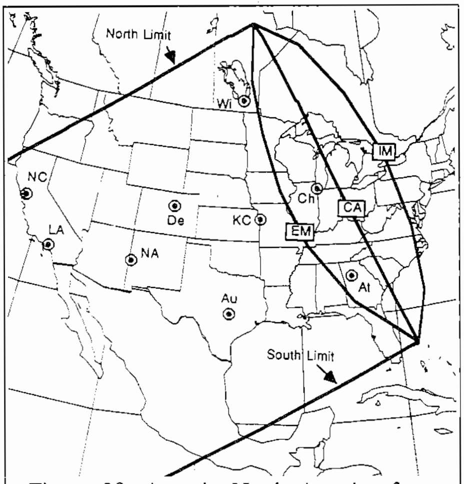

Figure 29. Area in North America from which the 1990 MAR 22 daytime occultation of Mars will be visible. For location abbreviations, see previous page. The emersion will be visible from places west of the line "EM,"; the closest approach of the Moon to Mars west of "CA," and the immersion west of "IM."

There are three **bright-star occultations** during these three months; all of **Antares** (magnitude +1.2): 1990 FEB 18, 16h, 80°W of the Sun; visible from Australia, New Zealand, and SW South America. MAR 18, 00h, 107°W of the Sun; from Africa, Madagascar, and Australia. APR 14, 07h, 134°W of the Sun; from South America.

The series of passages of the Moon across the **Pleiades** continues: MAR 03, 04h, 39-percent sunlit Moon; visible from Canada and the United States. MAR 30, 10h, 18-percent Moon; from E Asia and W Alaska. APR 26, 20h, 4-percent Moon; from the Azores and W Europe. Likewise, the **Beehive** (M44; *Praesepe*) cluster is twice occulted: APR 04, 07h, 69-percent Moon; from the Pacific Ocean. MAY 01, 14h, 47-percent Moon; from SW Australia.

PLENTY OF COMETS

Even were there no new discoveries, there will be six comets observable in moderate instruments in early 1990: Levy-Rudenko (1989r), Helin-Roman-Alu (1989v), P/Tuttle-Giacobini-Kresak, P/Schwassmann-Wachmann 3, Austin (1989c1), and Skorichenko-George (1989e1). Comet Austin may become a bright naked-eye object in March, April, and May. These are all described in the previous three articles on current comets (pp. 32-36).

METEORS

(Contributed by Robert D. Lunsford, A.L.P.O. Meteors Recorder)

The annual **Delta Leonid** maximum falls on FEB 27 with no lunar interference. Its peak rates are usually 3-5 meteors per hour under dark skies.

March ushers in the annual **Virginid** complex with the **Pi Virginids** on MAR 06. Many radiants appear in Virgo during both March and April. None produces more than 5, and most average less than 1, meteors per hour.

The **Lyrids** peak on the morning of APR 21 under excellent conditions. No strong activity has been seen since 1982 but surprises could occur. Their average zenithal hourly rate is 15 from dark sites with a limiting magnitude of +6.5 or better.

THE A.L.P.O. CONVENTION: PASADENA, 1989

By: Peter Rasmussen, A.L.P.O.

The 39th Convention of the Association of Lunar and Planetary Observers was highlighted by the Voyager-2 Neptune encounter. In order to participate in this event, we met at the Pasadena Convention Center in Southern California, on August 22-26, 1989, with the Western Amateur Astronomers and the Planetary Society.

The annual convention was honored during its Banquet and Bar-B-Q/Star Party by the presence of the only living planet discoverer, Dr. Clyde Tombaugh. Having such a distinguished guest take part in the festivities enhanced the pride we feel as an organization. Dr. Tombaugh has also made an important contribution to astronomy by helping establish a post-graduate scholarship fund for astronomers through the New Mexico State University.

The convention began with two tours. The first, visiting the world-famous Palomar Observatory in the company of fellow amateurs, was a rewarding opportunity. By listening to the comments others on the tour made about the 200-inch Hale Reflector, I could see how such an instrument is so important to modern astronomical work. The other stop on Palomar Mountain was the 48-inch Schmidt Telescope that is currently conducting the northern portion of the new "All Sky Survey."

Wednesday's tour visited the California Museum of Science and Industry, followed by the Martin Marietta Manufacturing Facility. The highlight of the former was a giant-screen IMAX film taken from Space Shuttle missions. The Martin Marietta visit included a walk-through of the proposed space station "Freedom."

The A.L.P.O. was well-represented in the paper sessions on August 24-26. Our

Figure 30. Past and present A.L.P.O. staff in front of (indeed almost part of) the A.L.P.O. exhibit at Pasadena in 1989. From left to right are P. Karl Mackal, Jupiter Recorder; Mars Recorders Donald C. Parker, Jeff D. Beish, and Dan Troiani; and longtime member and past Recorder Thomas Cave.

Figure 31. Presentation of the 1989 Walter H. Haas Observing Award to Jeff D. Beish (left) by Donald C. Parker. In the right foreground are Dr. and Mrs. Clyde Tombaugh.

contributions there were: Julius Benton, "Visual Photometry of Saturn: Making Intensity Estimates"; Phil Budine, "Jupiter's North Equatorial Belt Disturbances in 1988-89"; Daniel Costanzo, "A New Technique for Visually Observing Mars"; Daniel Fischer, "Planetary Observing—a European Perspective"; Dan Joyce, Dan Troiani, and James Carroll, "CCD Video and the Solar System"; Alan MacFarlane, "Video Astronomy"; P. Karl Mackal, "The Red Spot on Jupiter: An Inverted Taylor Column over a Depression"; Don Parker and Jeff Beish, "The Occultation of 28 Sagittarii by Saturn on 03 July, 1989" as well as "The Spectacular Perihelic Apparition of Mars, 1987-89"; Richard Schmude, "Observations of Mars During 1988-89: A Personal Account"; and John Westfall, "Video Mapping of the Moon."

Were the above not enough, the A.L.P.O. also conducted a lengthy Solar System Video Workshop on Saturday afternoon, chaired by veteran videographer Alan MacFarlane, with the showing of impressive video imagery by several A.L.P.O. members. The A.L.P.O. Exhibit, contributed to by the Lunar, Solar, Mars, and Jupiter Sections, was prominent and drew some favorable comments. The remaining A.L.P.O.-specific activity, our annual Business Meeting, has already been reported on (*J.A.L.P.O.*, *33*, Nos. 10-12, October, 1989, pp. 179-181).

What helped make this a memorable experience, particularly for A.L.P.O. members, was the Voyager-2 flyby for Neptune and its major satellite Triton, which was televised in the Convention Center as soon as the images were received and processed, in a marathon session Thursday night, August 24th-25th.

The W.A.A.-A.L.P.O. Banquet was held Friday evening, distinguished by an address on the discovery of Pluto made by the discoverer, Clyde Tombaugh. During the Banquet, the A.L.P.O.'s annual Walter H. Haas Observing Award was presented to Jeffrey D. Beish. As an A.L.P.O. Mars Recorder and a statistician, Jeff has contributed immensely to the acquisition and interpretation of data collected during many Mars apparitions. As Walter Haas could not attend, Donald Parker presented the award along with a 2-year A.L.P.O. membership.

After a fun-filled week of convention activities, there was no better way to celebrate than under the stars. On Saturday night, August 26, a Bar-B-Q/Star Party was held at Monterey Park Observatory, where the group observed through the Los Angles Astronomical Society's new computer-controlled 31-inch Newtonian reflector. Once again, convention-goers had a chance to meet and talk with Clyde Tombaugh. These many enjoyable days and nights spent with friends has made me enthusiastic about next year's convention.

OBITUARY: DR. JAMES Q. GANT

Information Furnished by Walter H. Haas

Ms. June Lo Guirato and her father, Mr. Michael Lo Guirato, both members of the National Capital Astronomers in Washington, D.C. have informed us of the death of Dr. James Q. Gant on September 2, 1989, at the age of 83. Dr. Gant was a charter member of the Association of Lunar and Planetary Observers in 1947 and was a regular and valued supporter over the intervening years. The Lo Guirato family has made a gift of one hundred dollars ($100.00) to the A.L.P.O. in memory of Dr. Gant. Their generosity is greatly appreciated.

A memorial article about Dr. Gant's life and astronomical work will appear soon in this *Journal*. We extend our deep sympathy to his family and many friends.

BOOK REVIEW

Edited by José Olivarez

Introduction to Basic Astronomy with a PC. By J.L. Lawrence. Willmann-Bell, Inc., P.O. Box 35025, Richmond, VA 23235. 1989. vi + 130 pages. Price $19.95 paper, includes 5.25-inch diskette (ISBN 0-943396-23-9).

Reviewed by Jeffrey K. Wagner

In recent years, the computer has become almost as important a tool in astronomy as the telescope. The microcomputer boom of the 1980's has given amateur astronomers machines with computational power that would have been the envy of professionals just a few decades ago. Not surprisingly, the amateur with a microcomputer has a wide choice of commercial programs and books of programs from which to choose. Most commercial programs come with only minimal instructions and documentation, while many books of programs require hours of tedious typing of the programs before they can be run. This is not the case with *Introduction to Basic Astronomy with a PC*, which is a book that comes with a diskette containing the programs, so no typing is necessary. However, the package is much more than just a diskette and instructions. Unlike most books of astronomical programs, the programs are not even listed in the text, because there is no need to enter them. (Anyone wishing to study the author's programming technique can list the programs on screen or to a printer.) Without program listings, what does the book contain? Each program is described in detail, and step-by-step discussions of sample calculations are given, with the intermediate results listed. The book is a pleasant surprise compared with many astronomical programming books that this reviewer has seen: This book has numerous clear diagrams, as well as photographs illustrating telescopes, celestial objects, and other subjects being discussed. The end result is an attractive, easy-to-read work.

The book contains ten chapters, of which the last is a list of useful astronomical aids. The other nine chapters correspond to the nine BASIC programs contained on the diskette. All of the programs perform several computational tasks, and each one has an easy-to-follow menu describing the various choices. Chapter 1 is an introduction, and the first program is one which allows the user to enter a data file of the stars in various constellations. Chapter 2 and its program describe unit conversions of interest to astronomers. Chapter 3 deals with optical calculations involving telescopes, while Chapters 4 and 5 cover time and coordinate conversions, respectively. The program in Chapter 6 calculates star locations in the sky, and rising and setting times, and also draws sky maps for any time and location. Chapters 7, 8, and 9 contain positional and other calculations involving the Sun, Moon, and the planets.

The book and the programs have many points in their favor. The price is relatively inexpensive, and the programs fill nearly all the needs of an amateur astronomer. About the only significant omissions [except for specialized lunar and planetary calculations, Ed.] are eclipse predictions and orbit determinations from observational data. The programs can be set either to simply give final answers, or instead to show the results of all intermediate steps. The only problem that the reviewer encountered in running the programs was that the star map plots are reversed, with the constellations shown as on an old-fashioned star globe. I assume that this is a program "bug" which can easily be fixed. Only one general feature of the programs bothered me: The user must enter the latitude, longitude, and time zone every time a calculation involving them is made. It would be simpler if this information could be saved on the disk and used as the default for all calculations.

Beyond the above, the only possible drawback that I see for this book is that it is designed specifically only for IBM-PC's and compatibles. I recommend that anyone using such a system and interested in astronomical calculations should buy this book.

NEW BOOKS RECEIVED

Notes by José Olivarez and J. Russell Smith

Astronomy's Astrophotography Series. Astronomy Magazine, Kalmbach Publishing Co., P.O. Box 1612, Waukesha, WI 53187. Price $ 16.95 per set.
[Notes by José Olivarez]

Astronomy Magazine has captured the wonders of the universe with three beautiful astrophotography sets. Featuring 11×14-inch reproductions of popular celestial objects, the sets are: "The Finest Galaxies" (6 color prints), "Kim Zussmann's Precision Astrophotography" (10 black-and-white prints), and "Deep-Sky Photography from Jack Newton" (6 color prints). The sets include a sturdy folder for storage and an insert describing the photography. The prints are suitable for framing.

A History of Astronomy. By A. Pannekoek. Dover Publications, Inc., 31 East 2nd Street, Mineola, NY 11501. 521 pages. Price $11.95 paper (ISBN 0-486-65994-1).
[Notes by José Olivarez]

This carefully reasoned history of astronomy is an unaltered republication of the hardback edition published by Allen & Unwin in 1961. This wonderful history has been out of print for many years, but now it is available again as a durable Dover paperback. Few histories of astronomy offer the special human dimension of this book. Highly recommended!

Relativity in Astrometry, Celestial Mechanics and Geodesy. By Michael H. Soffel. Springer-Verlag New York, Inc., 175 Fifth Avenue, New York, NY 10010. 1989. 204 pages. Price $59.00 cloth (ISBN 0-387-18906-8).
[Notes by José Olivarez]

In the preface, the author states, "*Relativity in Astrometry, Celestial Mechanics and Geodesy* represents a significant contribution to modern relativistic celestial mechanics and astrometry. In these branches of astronomy, the theory of general relativity is used nowadays as an efficient practical framework for constructing accurate dynamical theories of motion of celestial bodies and discussing high-precision observations. The author develops the useful tools for this purpose and introduces the reader into the modern state of art in these domains."

The Sun, An Introduction. By Michael Stix. Springer-Verlag New York, Inc., 175 Fifth Avenue, New York, NY 10010. 1989. 390 pages, 192 figures. Price $89.00 cloth (ISBN 0-387-50081-2).
[Notes by José Olivarez]

This book aims at illustrating the application of the rules of physics to a star like the Sun. It has been written for students of physics at an intermediate level and assumes that the reader knows the basic laws of thermodynamics and of hydrodynamics, and Maxwell's equations. The increasing numbers of observations of solar phenomena on neighboring stars make this book valuable, not only for students specializing in solar physics, but also to researchers interested in stellar structure and the solar-stellar connection.

Introduction to Stellar Astrophysics. Volume 1. By Erika Bohm-Vitense. Cambridge University Press, 40 West 20th Street, New York, NY 10011. 1989. 244 pages. Price $59.50 cloth (ISBN 0-521-34402-6); $22.95 paper (ISBN 0-521-34869-2).
[Notes by José Olivarez]

Volume One of this series of three textbooks is subtitled *Basic Stellar Observations and Data*. The topic is stellar astronomy or, more accurately, stellar astrophysics. This volume is concerned mainly with finding out about the global properties of stars, such as brightnesses, colors, masses, and radii. There is a separate chapter on the Sun and a final one on interstellar absorption. The usefulness of this text is enhanced by the inclusion of problems for students. This text was written for students in their junior and senior years in astronomy, but is understandable to educated laypersons with some basic knowledge of physics and mathematics.

NGC 2000. Edited by Roger J. Sinnott. Cambridge University Press,40 West 20th Street, New York, NY 10011. 1989. 273 pages. Price $19.95 paper (ISBN 0-521-37813-3).
[Notes by J. Russell Smith]

The contents of this book are: "Introduction," "References," "NGC 2000.0," "Right Ascension of NGC Objects," and "Right Ascension of IC Objects." This work is for the more advanced astronomer, not the beginner.

Voyage Through the Universe. By the Editors of Time-Life Books. Time-Life Books, 5240 West 76th Street, Indianapolis, IN 46268. 143 pages, color illustrations. Price not given.
[Notes by J. Russell Smith]

This series' contents are: "Breaking the Bonds of the Earth," "The First Spacefarers," "Leap to the Moon," and "An Alien Realm," followed by a glossary, bibliography, and index. This is a series that you would wish to have on your shelf.

The Dark Matter. Contemporary Science's Quest for the Mass Hidden in Our Universe. By Wallace Tucker and Karen Tucker. William Morrow and Co., 105 Madison Avenue, New York, NY 10016. (Order from Wilmer Warehouse, 39 Plymouth Street, Fairfield, NJ 07006.) 1988. 254 pages, illustrations, index. Price $16.95 cloth (ISBN 8-688-06112-5).
[Notes by J. Russell Smith]

The chapters of this book are: "Dark Matter," "The Galactic Disk: First Evidence of Dark Matter," "The Galactic Disk: Dark Matter Candidates," "Beyond the Luminous Edge: A Galactic Envelope of Dark Matter," "Cosmions: Hot and Cold," "The Turning Point: Dark Matter in Spiral Galaxies," "Dwarf Galaxies," "Hot Gas and Dark Matter," "Gravitational Lenses: Detecting Dark Matter with Bent Light," "Dark Matter in Groups and Clusters of Galaxies," "The Search for Dark Matter in the Local Superclusters," "The Search for a Universal Sea of Dark Matter," "Dark Matter and the Inflationary Universe," "Dark Matter and Model Universes," "Dark Matter or a New Law of Gravity?", "An Evaluation of the Dark-Matter Mystery," and "The Dark-Matter Mystery: A State of Crisis," followed by a bibliography and index. This book is by two well-qualified writers. If you are interested in this subject, I recommend it.

Oasis in Space: Earth History from the Beginning. By Preston Cloud. W.W. Norton and Company, 500 Fifth Avenue, New York, NY 10110. 1987. 508 pages, appendix, Supplemental Reading, index. Price $29.95 cloth (ISBN 0-393-01952-7).
[Notes by J. Russell Smith]

This excellent book contains the following sections: "The Nebula and the Planets," "The Hadean Earth," "On Reading the Rocks," "The Alchemists' Revenge," "Symphony of the Earth," "Search for a Crust: The Oldest Earth Rocks," "The Later Archean: Mini-oceans, Protocontinents and the Phantom Global Sea," "The Proterozoic Revolution: How Continents Grow," "The Older Proterozoic Earth and the Emerging Biosphere," "Younger Proterozoic History: The Restless Continents," "The Longest Winter," "The Paleozoic: Prelude to the Modern World," "The Mesozoic: Reptilian Heyday," "Biological Change on the Mobile Earth," "Evolution and Extinction," "The Penultimate Scene: The Cenozoic Era," "The Human Habitat," and "The Epilogue," followed by "Appendix: Supplemental Reading" and the index. I recommend this book, but not for the beginner.

RTMC 88—Proceedings of the Riverside Telescope Makers Conference. (May 27-30, 1988; Camp Oakes, Big Bear, California). Edited by John Sanford. Orange County Astronomers Publications, 2215 Martha Avenue, Orange, CA 92667. 1988. 92 pages, illustrations. Price $12.00 postpaid domestic; $16.00 air or $13.00 surface elsewhere.
[Notes by J. Russell Smith]

The papers in this collection are: "Astrophotography Today," "Gemini Challenge: Reagan Uses Wrong Stars," "Photographic Astrometry with a Single-Axis Micrometer," "Eliminating Stray Light in Schmidt-Cassegrain Telescopes," "Reflecting on a Classic Refractor," "Astronomy in Greece," "Astronomy Forum Computer Conference," "14.5-inch Binoculars," "List of Merit Award Winners," "A Nearly Perfect Eyepiece for Newtonian Telescopes," "Serious Astrophotography with the Haig Mounting," "The Pegasus and Perseus: Two Compact Newtonians for Scanning the Southern Skies," "Portable All-Sky Reflector with 'Invisible' Camera Support," and "Adventures in Astrophotography with a Small Telescope." I think that this is a book that you will wish to own.

Coming of Age in the Milky Way. By Timothy Ferris. William Morrow and Co, 105 Madison Avenue, New York, NY 10016. 1988. 495 pages, illustrations, index, glossary. Price $19.95 cloth (ISBN 0-688-05889-2).
[Notes by J. Russell Smith]

This book is divided into three sections: "One: Space" (11 chapters), "Two: Time," (3 chapters), and "Three: Creation" (6 chapters), followed by a glossary, "A Brief History of the Universe," "Notes," a bibliography, and an index. I recommend this outstanding volume.

The Universe from Your Backyard: A Guide to Deep Sky Objects from Astronomy Magazine. By David J. Eicher. Cambridge University Press, 40 West 20th Street, New York, NY 10011. 1988. 188 pages, illustrations, bibliography, index. Price $24.95 cloth (ISBN 0-521-36299-7).
[Notes by J. Russell Smith]

After a Foreword and a Preface, the author covers the constellations, which are shown in color. There are also many illustrations in black-and-white. You will be glad to have this book as a reference.

Relatively Speaking–Relativity, Black Holes and the Fate of the Universe. By Eric Chaisson. W.W. Norton and Company, 500 Fifth Avenue, New York, NY 10110. 1988. 254 pages, illustrations, index. Price $15.95 cloth (ISBN 0-393-02536-5).
[Notes by J. Russell Smith]

This book's sections are: "Remote Galaxies," "Basic Questions," "Historical Problems," "The Special Theory of Relativity," "Strange Consequences," "The General Theory of Relativity," "Relativistic Tests," "More About Curved Spacetime," "Einstein, the Man," "Cosmological Principles," "Evolutionary Models of the Universe," "Other Universe Models," "Cosmological Tests," "Nature of the Singularity (Black Holes)," "Highlights of Stellar Evolution," "Disappearing Matter," "Properties of Black Holes," Space Travel Near Black Holes," "Observational Evidence," "Epilogue: Beyond Relativity," and "Selected Further Reading," followed by the index.

The Beauty of Light. By Ben Bova. John Wiley and Sons, 605 Third Avenue, New York, NY 10158-0012. 1988. 350 pages, illustrations, bibliography, index. Price $24.95 cloth (ISBN 0-471-62580-9).
[Notes by J. Russell Smith]

This book's sections are titled "To See," "To Learn," "To Use," and "To Seek," which total some 21 chapters. I believe that you would like to have this book on your shelf.

Origin and Evolution of Planetary and Satellite Atmospheres. Edited by S.K. Atreya, J.B. Pollack, and M.S. Matthews, with 50 collaborating authors. The University of Arizona Press, 1230 North Park, No. 102, Tucson, AZ 85719. 1989. 900 pages, color illustrations, glossary, bibliography, index. Price $45.00 cloth (ISBN 0-8165-1105-5).
[Notes by J. Russell Smith]

This thick volume is divided into five parts: "The Early Solar System" (four chapters), "Primitive Bodies" (four chapters), "Terrestrial Planets" (six chapters), "Outer Planets" (four chapters), and "Satellites" (four chapters). The colored illustrations are collected together into a "Color Section." This is an outstanding work, which I recommend for the advanced amateur.

Cosmological Constants—Papers in Modern Cosmology. By Jeremy Bernstein and Gerald Feinberg. Columbia University Press, 562 West 113th Street, New York, NY 10025. 1989. 352 pages. Price $38.00 cloth (ISBN 0-231-06376-8).
[Notes by J. Russell Smith]

The four sections of this book are titled: "The Expanding Universe," "Three Degrees Above Zero," "Formation of the Light Elements," and "The Very Early Universe." I found this to be an outstanding work and recommend it to all interested in this topic.

Particle Physics in the Cosmos. Readings from Scientific American. Edited by Richard A. Carrigan, Jr., and W. Peter Trower. W.H. Freeman and Company, 41 Madison Avenue, New York, NY 10010. 1989. 228 pages, illustrations, bibliography, index. Price $9.95 paper (ISBN 0-7167-1919-3).
[Notes by J. Russell Smith]

This collection's contents are: "Dark Matter in the Universe," "The Structure of the Early Universe," "The Large Scale Structure of the Universe," "The Unified Theory of Elementary Particles and Forces," "Gauge Theories of the Forces Between Elementary Particles," "The Decay of the Proton," "The Search for Proton Decay," "Superheavy Magnetic Monopoles," "Deuterium in the Universe," "The Cosmic Asymmetry Between Matter and Antimatter," "The Inflationary Universe," and "The Future of the Universe," followed by "The Authors," the bibliography, and the index. This book is technical in nature.

The Fundamentals of Stellar Astrophysics. By George W. Collins II. W.H. Freeman and Company, 41 Madison Avenue, New York, NY 10010. 1989. 512 pages, index. Price $47.95 cloth (ISBN 0-7167-1993-2).
[Notes by J. Russell Smith]

This book's first section, "Stellar Interiors," contains eight chapters. The second, "Stellar Atmospheres," contains eight, followed by the "Epilogue" and the index. With its equations, this book is definitely for the student advanced in mathematics.

Deep-Sky Observing With Small Telescopes. By David J. Eicher and the Editors of *Deep Sky*. Enslow Publishers, Inc., Bloy Street and Ramsey Avenue, Box 777, Hillside, NJ 07205. 1989. 336 pages, illustrations, index. Price $18.95 paper (ISBN 0-89490-075-7).
[Notes by J. Russell Smith]

After a Preface and a Foreword, the contents of this book are: "Introduction to Deep-Sky Observing," "Double Stars," "Variable Stars," "Open Star Clusters," "Globular Clusters," "Planetary Nebulae," "Bright and Dark Nebulae," "Galaxies," "Appendix 1: Reflections on Deep-Sky Observing, "Appendix 2: Bibliography," "Appendix 3: The Messier Catalog," and "Appendix 4: Telescope Manufacturers." This is an excellent book.

Fifty Year Canon of Lunar Eclipses: 1986-2035. NASA Reference Publication 1216. By Fred Espenak. National Aeronautics and Space Administration, Washington, DC 20546-0001. 1989. 225 pages, illustrations. Price not stated.
[Notes by J. Russell Smith]

This book's contents are: "Introduction," "Section 1—Lunar Eclipse Catalog: 1901-2100," "Section 2—Eclipse Paths and Global Maps: 1901-2100," "Section 3—Eclipse Paths and World Maps: 1986-2035," "Appendix A—Lunar Eclipses," and "Appendix B—Program MONECL." If you are interested in eclipses of the Moon, I am sure that you will want this book.

Origins, The Darwin College Lectures. Edited by A.C. Fabian. Cambridge University Press, 40 West 20th Street, New York, NY 10011. 1989. 184 pages, illustrations, index. Price $19.95 cloth (ISBN 0-521-35189-8).
[Notes by J. Russell Smith]

After a List of Contributors, Preface, and Introduction, the contents of this collection are: "Origin of the Universe," "Origin of the Solar System," "Origins of Complexity," "Human Origins and Evolution," "Origin of Social Behavior," "Origins of Society," and "Origins of Language." This is a book for the more advanced student, but I recommend it.

Cosmic Rays. By Michael W. Friedlander. Harvard University Press, 79 Garden Street, Cambridge, MA 02138. 1989.176 pages, illustrations, index. Price $27.50 cloth (ISBN 0-674-17458-5).
[Notes by J. Russell Smith]

The chapters of *Cosmic Rays* are: "The Early Days," "Identifying Cosmic Rays," "The Earth's Magnetic Influence," "Particles from the Sun," "Cosmic Rays in the Galaxy," "The Energy Spectrum," "Nuclear Clues," "The Origin of Cosmic Rays," "Cosmic Rays with Little or No Mass," "The Subnuclear World," and "Footprints and Souvenirs," followed by "Works Cited," "Bibliographical Notes," and the index. I heartily recommend this book to those interested in this subject.

Data in Astronomy. By Carlos Jaschek. Cambridge University Press, 40 West 20th Street, New York, NY 10011. 1989. 198 pages, index. Price $49.50 cloth (ISBN 0-521-34094-2).
[Notes by J. Russell Smith]

The chapters of this book are: "Observations," "Observatories," "Data," "Archiving of Observations," "Presentation of Astronomical Data," "Designation of Astronomical Objects," "Catalogues," "The Growth of Data," "Data Banks and Bases," "Data Centers," "The Publication of Scientific Information," "International Data Organizations," "Conclusion," and "Notes on Chapter 13," followed by the Index. I am sure that you would like to have this book on your shelf.

Atlas of Uranus. By Garry Hunt and Patrick Moore. Cambridge University Press, 40 West 20th Street, New York, NY 10011. 1989. 96 pages, color illustrations, index. Price $24.95 cloth (ISBN 0-521-34323-2).
[Notes by J. Russell Smith]

After a Preface and an Introduction, the contents of *Atlas of Uranus* are: "Uranus in the Solar System," "William Herschel," "The Discovery of Uranus," "Pre-Discovery Observations," "Early Theories of Uranus," "The Rotation of Uranus," "Discovery of the Rings," "Space Probes to the Planets," "The Voyager Space-craft," "Earlier Results from the Voyagers," "Approach to Uranus," "The Magnetosphere of Uranus," "The Rings," "The Structure of Uranus," "The Satellite System," "The Larger Satellites," "Oberon," "Titania," "Umbriel," "Ariel," "Miranda," "The New Satellites," and "Beyond Uranus." This is an excellent book.

The Guide to Amateur Astronomy. By Jack Newton and Philip Teece. Cambridge University Press, 40 West 20th Street, New York, NY 10011. 1989. 327 pages, illustrations, index. Price $24.95 cloth (ISBN 0-521-34028-4).
[Notes by J. Russell Smith]

This book is divided into five major Parts: "Amateur Fundamentals: Getting Started," "Guide to the Night Sky," "Amateur Observing: Advanced Projects and Techniques," "A Complete Guide to Astrophotography," .and "The Build-it-yourself Astronomer." These are followed by four appendices, an Epilogue, bibliography, and index. The book is a *must* for your bookshelf.

Handbook for Visual Meteor Observations. Edited by Paul Roggemans. Sky Publishing Corporation, 49 Bay State Road, Cambridge, MA 02138. 1989. 193 pages, illustrations. Price $19.95.
[Notes by J. Russell Smith]

The chapters of this book are: "Introduction," "Introductory Concepts," "Preparing an Observation Night," "How to Hold a Meteor Watch," "After the Watch," "Shower Association," "Magnitude Distribution," "Zenith Hourly Rate," "The Double Count Method," "Fireballs," "Observing Fireballs," and "Major Meteor Showers." I recommend this book to those interested in meteors.

The Big Bang. By Joseph Silk. W.H. Freeman and Co., 41 Madison Avenue, New York, NY 10010. Second revised edition, 1988. 485 pages, illustrations, glossary, index. Price $14.95 paper (ISBN 0-7167-1812-X).
[Notes by J. Russell Smith]

The contents of *The Big Bang* are: "Introduction to Cosmology," "Origins of Modern Cosmology," "Observational Cosmology," "Evidence of the Big Bang," "Cosmological Models," "The First Millisecond," "Thermonuclear Detonation of the Universe," "The Primeval Fireball Emerges," "Origin of the Galaxies," "Evolution of the Galaxies," "Giant Clusters of Galaxies," "Radio Galaxies and Quasars," "Formation of the Stars," "The Morphology of Galaxies," "Origin of the Heavy Elements," "Formation of the Solar System," "Into the Infinite Future," "Alternatives to the Big Bang," and "Mathematical Notes." These are followed by "For Further Reading," a glossary, illustrations credits, and the index. I recommend this book.

The Cosmic Inquirers: Modern Telescopes and Their Makers. By Wallace Tucker and Karen Tucker. Harvard University Press, 79 Garden Street, Cambridge, MA 02138. 1986. 256 pages, illustrations, bibliography, index. Price $20.00 cloth (ISBN 0-674-17435-6).
[Notes by J. Russell Smith]

The contents of this book are: "The Mushrooms of San Augustin: The Very Large Array," "A High-Energy Astrophysicist and the Einstein X-Ray Observatory," "Lines and Spaces: Gamma-Ray Astronomy," "Dewars and Thinkers: The Infrared Astronomical Satellites," "Where the Stars Don't Twinkle: The Space Telescope," and "Epilogue." While the copyright date is 1986, there is much of value here if you are interested in this subject.

The Colour Atlas of Galaxies. By James W. Wray. Cambridge University Press, 40 West 20th Street, New York, NY 10011. 1988. 192 pages, 94 color plates. Price $79.50 cloth (ISBN 0-521-32236-7).
[Notes by J. Russell Smith]

After the Acknowledgements and Foreword, the contents are: "Introduction," "Observational Aspects," "Technical Aspects," "Colour Properties of Galaxies," "Supplementary Data," "Tables of Galaxies Illustrated in the Atlas," The Illustrations," and "Continuation of Descriptions."

The Cambridge Atlas of Astronomy. Edited by Jean Audouze and Guy Israel. Cambridge University Press, 40 West 20th Street, New York, NY 10022. Second Edition, 1988. 432 pages, color illustrations, index. Price $90.00 cloth (ISBN 0-521-36360-8).
[Notes by J. Russell Smith]

The contents of this atlas are: "Introduction," "Astronomy Today," "The Sun," "The Solar System," "The Stars and the Galaxy," "The Extragalactic Domain," "The Scientific Perspective," "Sky Map," and "Further Reading," followed by a glossary and index. I heartily recommend this book. If you had just one book on astronomy, it should be this one.

ANNOUNCEMENTS

A.L.P.O. BUSINESS

Revival of Jupiter's North Temperate Current C.—On 1990 FEB 10, Isao Miyazaki observed a revival of this feature, in the form of a 3°-long bright spot. This was confirmed on FEB 12 and 15, when the spot had grown to 5° in length. As we went to press (1990 FEB 25), the spot was located at zenographic latitude 23°.5 N, at the south edge of the North Temperate Belt, and at System I longitude 003°, with a reported *daily* drift rate of -5°.005 in System I (period 09h 47m 09.2s). Drawings, photographs, and especially transit timings are needed for this current, and should be communicated immediately to Jupiter Recorder Phillip Budine (address below).

Staff Address Changes.—Two of our Section Recorders have moved since the previous issue. Their *new* addresses are:

Phillip W. Budine, *Jupiter Recorder*
3 Hillside Terrace
Walton, New York 13856

Francis G. Graham, *Solar and Lunar Recorder*
Kent State University
400 E. 4th Avenue
East Liverpool, Ohio 43920

A.L.P.O. Supporters.—The A.L.P.O. continues to need the generosity of persons willing to contribute $20 per year, which qualifies one as a *Sustaining Member*; or by becoming a *Sponsor* with a donation of $40 or more. Our current list of ***Sponsors*** is: **Dr. Julius L. Benton, Jr.; Paul H. Bock, Jr.; James R. Brunkella, Darryl J. Davis, Philip** and **Virginia Glaser, Erland I. Jensen, Patrick S. McIntosh, José Olivarez, Dr. A.K. Parizek, Jim Phillips, Kenneth Schneller,** the **Ventura County Astronomical Society, Richard J. Wessling,** and **Phillip D. Wyman.**

Our ***Sustaining Members*** are: **Butch Bradley, Reginald F. Buller, Nancy J. Byrd, Harvy W. Herman, Harry D. Jamieson,** the **Kansas Astronomical Observers, H.W. Kelsey, Daniel Louderback, David McDavid, Lee Morrow, W.R. Pettyjohn, David J. Raden, Louis A. Renzulli,** the **Richmond Astronomical Society, Peter C. Scott, Lee Smojver, Don Spain, Richard Stanton, Michael E. Sweetman, Barry B. Thompson, Ken Thomson, William A. Vance, Joseph P. Vitous, Dr. Gary K. Walker, Jack Whorwood,** and **Matthew Will.**

Our thanks to these generous people. If you think your name should be above but isn't, please inform our Membership Secretary, Harry D. Jamieson (address on inside back cover).

New Jupiter Handbook.—Assistant Jupiter Recorder Paul K. Mackal (address on inside back cover) is now accepting advance orders for *The New A.L.P.O. Jupiter Handbook*, for $15.95 per copy (this includes postage for the United States and Canada). This 200-page, multi-authored publication should be available in March or April.

THE REST OF THE UNIVERSE

Hubble Space Telescope.—The HST is scheduled for launch this April. For its first year of operation, five amateur astronomers have been awarded a total of 17 hours of observing time. The A.L.P.O. is proud to have served on the Amateur Astronomers Working Group which recommended these people, each followed by his or her topic: **John Hewitt**, for a search for comet clouds around novae; **Peter J. Kandefer**, investigating the magnetism of Epsilon Ursae Majoris; **Ana M. Larson**, a search for protoplanets around other stars; **James J. Secosky**, Io's post-eclipse brightening; and **Raymond E. Sterner II**, the luminous arcs of galaxies.

Astronomical Society of the Pacific.—As mentioned in the previous issue, the A.S.P. is holding its 102nd Meeting in Boston; on July 13-18, 1990, which will include a symposium for professionals and amateurs on *Automated Observatories and Global Networking* on July 13-15. For more information on this meeting, write: A.S.P., Meeting Information, 390 Ashton Ave., San Francisco, CA 94112.

The A.S.P. has also available their *1990 Catalog*; send two first-class stamps to Catalog Requests, A.S.P., at the above address. Two items in it of especial interest are: *The Planetary System*, a 100-slide set selected by David Morrison, for $97.95; and *Neptune Kit*, containing 12 slides and a booklet by William Kaufmann, at $17.95. (Prices include handling and domestic U.P.S. shipping.)

Astronomy Day/Week Reminder.—Besides Astronomy Day (Saturday, April 28, 1990); there is now an *Astronomy Week*; on April 23-29. Either or both events are opportunities for A.L.P.O. members to educate the public about their field; by themselves or in cooperation with a local astronomical group. One way to reach the public is via telescopic viewing; and we note that Jupiter, a waxing crescent Moon, and even Comet Austin (see pp. 33-35) might well be shown to the public.

Baja Conference Reminder.—Some registrations and hotel spaces remain available for the *Research Amateur Astronomy Symposium* in La Paz, Baja California Sur, Mexico, on July 8-12, 1991. On July 11 an unusually long total solar eclipse will be visible from La Paz. The symposium will include bilingual paper sessions, poster sessions, a welcome party, and an historical field trip to the observation sites for the 1769 Transit of Venus. For information, write to: Corporation for Research Amateur Astronomy, P.O. Box 16542, San Francisco, CA 94116 U.S.A.

1990 A.L.P.O. CONVENTION PREVIEW

As previously announced, the A.L.P.O. will hold its 40th Convention at St. Louis, MO, with the Astronomical League meeting, *ALCON '90*, on July 31-August 4, 1990.

The site will be Washington University in St. Louis. Air-conditioned accommodations will be in Elliot Hall on campus at $14.00 per day single occupancy and $12.00 per person double. Meal tickets are $14.25 per day, covering breakfast, lunch, and dinner. Make meal and dorm reservations prior to July 1.

Registration for all five days is $30.00 per person before July 1, and $35.00 thereafter. The daily registration fee will be $7.50.

Registration payment, for the convention itself, lodging, and meals, should be payable to "ALCON'90" and sent to: Stephen Best, 6943 Amherst Avenue, St. Louis, MO 63130.

The official airline is TWA, offering a 40-percent discount on unrestricted Coach fare and 5-percent off on Excursion fares. To make reservations, call 800-325-4933 or 314-291-5589 Mon.-Fri., 7:15 AM-7:00 PM CST; be certain to cite reservation code B9912057.

The A.L.P.O. is planning several activities in St. Louis, including a paper session, a workshop, and our usual exhibit of section activities. A members' business meeting will be held, prior to a Board of Director's meeting. We welcome hearing your ideas on topics for the workshop, and agenda items for the members' meeting.

All members are welcome to present papers. If so, please send an abstract to the Director (address on inside back cover) no later than June 15th, including in it the amount of time needed (20 minutes maximum) and any audio-visual needs. Plan to bring a camera-ready copy of the paper to the meeting.

A special event hosted by the A.L.P.O. is described in the box below—we welcome materials for this from both members and non-members. Dust off those drawings!

More information will follow.

ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

SOLAR SYSTEM PORTRAITURE DISPLAY AND CONTEST

1990 JUL 31-AUG 04

PURPOSE: To encourage and reward the science and art of scientifically useful visual representation of the bodies of the Solar System. All entries will be placed on display at the Astronomical League-Association of Lunar and Planetary Observers Annual Convention; the artist may choose to have one or more of his or her entries placed in the contest as well.

RULES

DISPLAY ENTRIES.—

1. The artist shall place each entry in one of the categories: Sun, Moon, Planets, Other.

2. Each artist is limited to one entry in each category. A series of representations, mounted together, is considered a single entry.

3. Each entry shall be mounted on 9X12-inch cardboard with the artist's name and mailing address clearly indicated on the back.

4. Each entry shall be a representation of what the artist saw through personal observation. Any two-dimensional drawing medium is suitable; including but not limited to drawings, paintings, photovisual representations, computer paintings, drawings, and so forth.

5. Any observational documentation shall be placed on the front of the entry.

6. All entries must be received at the following address prior to July 1, 1990: A.L.P.O., 2775 - 39th Avenue, San Francisco, CA 94116 U.S.A.

7. All entries must be accompanied by a stamped, self-addressed return envelope.

CONTEST ENTRIES.—

Contest entries must also conform to Rules 1-7 above.

8. If a display entry is also to be judged in the contest, the artist must clearly write "CONTEST" on the back of the entry next to his or her name.

9. Each contest entry will be judged by the following criteria, in descending order of weighting: (1) ACCURACY; (2) DOCUMENTATION; (3) LEVEL OF DETAIL; (4) NEATNESS AND ATTRACTIVENESS.

10. At their discretion, the Judges may award a First-Prize Certificate and/or Certificates of Merit in each category. Decisions of the judges are final.

11. Certificates will be presented at the 1990 Convention Banquet.

PUBLICATIONS OF THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

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Available from: A.L.P.O., P.O. Box 16131, San Francisco, CA 94116, U.S.A.
(All Section Publications must be ordered directly from the appropriate Recorders.)

① ***The A.L.P.O. Solar System Ephemeris: 1990.*** $6.00 in the United States, Canada, and Mexico; $8.50 elsewhere (airmail included). 100 pages of tables, graphs, and maps describing the positions and appearances of the Sun, Moon, each major planet, the readily observable planetary satellites, Minor Planets, meteors, and comets. Make payment to "A.L.P.O."

② ***An Introductory Bibliography for Solar System Observers.*** *Free* for a stamped, self-addressed envelope. A 4-page list of books and magazines about Solar System bodies and how to observe them. The current edition was updated in September, 1989.

◆◆◆

Available from: A.L.P.O. Membership Secretary, P.O. Box 143, Heber Springs, AR 72543, U.S.A.—*The A.L.P.O.'s Observing Sections--1988/89.* *Free*; just send a stamped, self-addressed envelope. A 12-page description of each Observing Section's personnel, projects, and publications.

◆◆◆

Available from: Walter H. Haas, 2225 Thomas Drive, Las Cruces, NM 88001, U.S.A.— Back issues of ***The Strolling Astronomer (J.A.L.P.O.).*** The following are still in stock but may not long remain so. In this list, volume numbers are in ***italics***, issue numbers are not, years are given in parentheses, and prices are $1.50 per issue unless otherwise stated. Discounts can be arranged for purchases over $20. Make payment to "Walter H. Haas."

1 (1947); 4 and 6. *8* (1954); 7-8. *11* (1957); 11-12. *15* (1961); 11-12. *18* (1964); 11-12.
19 (1965-66); 5-6 and 7-8. *20* (1967-68); 7-8 and 9-10. *21* (1968-69); 3-4 and 7-8.
22 (1970-71); 7-8. *23* (1971-72); 3-4, 7-8, 9-10, and 11-12.
25 (1974-76); 1-2, 3-4, 7-8, 9-10, and 11-12.
26 (1976-77); 1-2, 3-4, 5-6, and 11-12. [each $1.75]
27 (1977-79); 3-4, 5-6, 7-8, 9-10, and 11-12. [each $1.75]
28 (1979-81); 1-2, 3-4, and 7-8. [each $1.75] *30* (1983-84); 3-4. [each $2.50]
31 (1985-86); 1-2, 3-4, 5-6, 7-8, and 9-10. [each $2.50]
32 (1987-88); 1-2, 5-6, and 11-12. [each $2.50] *33* (1989); 1-3, 4-6, 7-9, and 10-12. [each $2.50]
Current Issue [*34*, 1]—$3.00.

KEEPING YOUR MEMBERSHIP CURRENT—

Because all A.L.P.O. memberships include a subscription to the *Strolling Astronomer (J.A.L.P.O.),* the top line of your mailing label gives the volume and issue number for which your membership will expire (e.g., "34.01" means Volume 34, Number 1). We also include a *First Renewal Notice* in that issue and, if necessary, a ***Final*** *Renewal Notice* with the following issue.

Please also let the Membership Secretary know if your address changes.

CONTRIBUTING TO *THE STROLLING ASTRONOMER (J.A.L.P.O.)*—

We welcome reports and observations from our readers and our staff. Please submit typewritten, doubled-spaced copy. For articles more than two pages in length, begin with a 75-150 word abstract (our magazine is abstracted). Cite pertinent references in full, including page numbers. Fully document observations with the name and address of the observer; the observing site if different from the observer's address; the date and time in Universal Time; the telescope type, aperture (cm. preferred), and magnification; filters used if any; atmospheric conditions (seeing on the 0-10 A.L.P.O. scale; transparency as the limiting stellar magnitude in the vicinity of the object); and other data as pertinent to the object observed. Illustrations are welcome, although we cannot publish color. For low-contrast objects, contrasts should be exaggerated on drawings and photographs. Also, be sure to indicate celestial north or south, as well as celestial east or west if the image is laterally reversed.

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

THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

Founded in 1947, the A.L.P.O. now numbers over 700 members. Our dues include a subscription to this quarterly Journal, The Strolling Astronomer, and are $14.00 for one year ($24.00 for two years) for the United States, Canada, and Mexico; and $16.00 for one year ($29.00 for two years) for other countries. One-year Sustaining Memberships are $20.00; Sponsorships are $40.00.

Our advertising rates are $85.00 for a full-page display Ad., $50.00 for a half-page, and $35.00 for a quarter-page. Classified Ads. are $10.00 per column-inch. There is a 10-percent discount for a 3-time insertion on all advertising.

Dues and advertising payments should be by check in U.S. funds payable to "A.L.P.O." When writing our staff, please furnish stamped, self-addressed envelopes.

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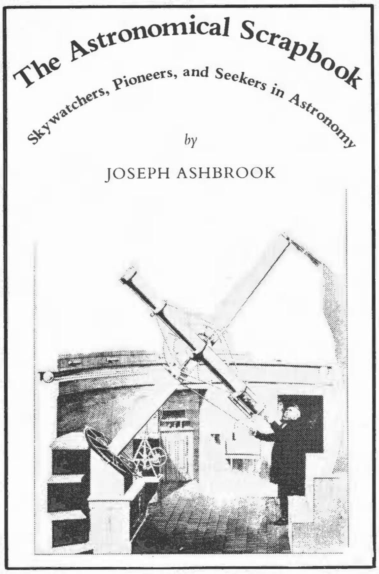

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