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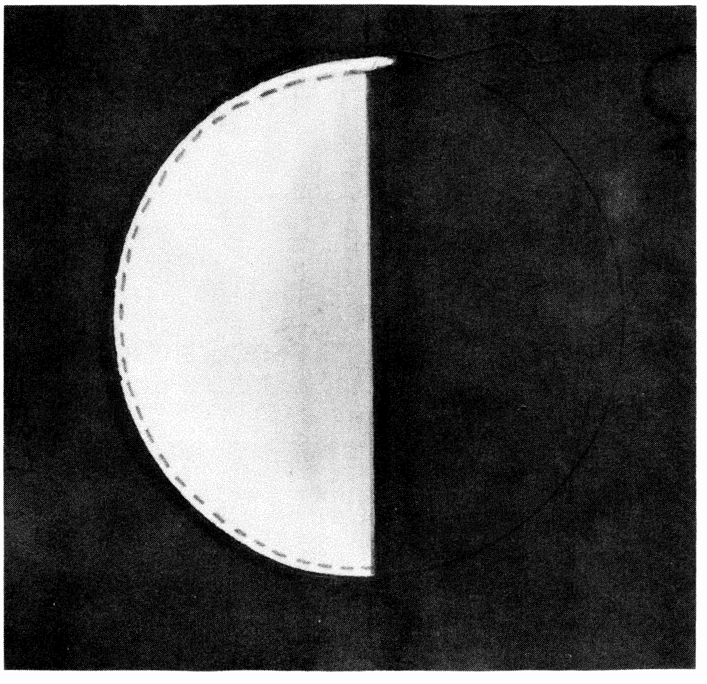

Views will be the brilliant Evening Star on these warm summer evenings. This drawing by Michael B. Smith of Alamogordo, New Mexico on August 26, 1978, 0 hours, 50 minutes — 1 hour 0 minutes, Universal Time (daytime view) 10.6-cm. reflector at 144X. Seeing 9 (extremely good), transparency 5 (clear). Light orange, dark yellow and light blue filters all revealed a very brilliant and thin limb band. Tip of south cusp (upper) needle-sharp and extended slightly on to dark hemisphere. Terminator very straight and uniform. Disk without features. Unilluminated hemisphere easily visible in all filters.

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ASSOCIATION OF LUNAR & PLANETARY OBSERVERS

Founded In 1947

IN THIS ISSUE

JUPITER IN 1979-80: ROTATION PERIODS

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

The highlights of the 1979-80 apparition were: the presence of a South Tropical Zone Disturbance, the Circulating Current of the South Tropical Zone, and the changing of the Red Spot area from the Spot aspect to the Red Spot Hollow aspect late in the apparition.

Some data pertinent to the apparition follow:

Date of Opposition: February 24, 1980.
Solar Declination of Jupiter: $-0^\circ.98$.
Equatorial Diameter: 44".73.
Zenocentric Declination of Earth: $-1^\circ.23$.
Stellar Magnitude of Jupiter: -2.1.
(All data for the date of opposition).

This report is based on 1109 visual central meridian transit observations submitted by 11 observers of the A.L.P.O. When plotted on graph paper, 982 transits form usable drifts for 77 Jovian spots distributed in 11 different atmospheric currents. The contributing observers are listed below by name and number of transits (t) submitted along with the station of observation and telescope(s) employed:

Bagger, Claus. Birkerod, Denmark. 2.4"(6.4 cm) Refr. 170t.
Budine, Phillip W. Walton, New York. 4"(10 cm) Refr. 235t.
Heath, Alan W. Nottingham, England. 12½"(31.3 cm) Refl. 84t.
Lerner, Eric. Cranford, N. J. 6"(15 cm) Refl. 12t.
McIntosh, Patrick S. Boulder, CO. 10"(25 cm) Refl. 11t.
Phillips, Dr. James H. Mt. Pleasant, S. C. 4"(10 cm) Cat., 8"(20 cm) Refl. 64t & strip sketches.
Robotham, Rob. Pt. Rowan,Ontario, Canada. 3¼"(8.3 cm) Refr., 6"(15 cm) Refl. 214t & strip sketches.
Sherrod, Clay. N. Little Rock, Ark. 8"(20 cm) Cat., 14"(35 cm) Refl. Report.
Stelzer, H. J. River Forest, Ill. 14"(35 cm) Refl. 85t.
Tatum, Randy. Richmond, Va. 7"(17.8 cm) Refr. 3t.
Troiani, Daniel. Chicago, Ill. 10"(25 cm) Refl., 16"(40 cm) Refl., and 18½"(46.3 cm) Refr. 231t & strip sketches.

Refr. is refractor, Refl. is reflector, and Cat. is catadioptric.

The distribution of transit observations by months is as follows:

1979, September	10	1980, January	89	May	155
October	35	February	89	June	70
November	24	March	284	July	2
December	81	April	270		

In the tables which follow the first column gives an identifying number or letter to each object; the second column indicates whether the object was dark (D) or bright (W) and whether the preceding end (p), center (c), or following end (f) was being observed. The third column gives the first and last date of observations; the fourth column, the longitudes on those dates. The fifth column gives the longitude at opposition, February 24, 1980, whenever the feature existed at that time. The sixth column gives the number of observed transits. The seventh column indicates the number of degrees in longitude that the marking drifted in 30 days, negative when the longitude decreased with time. The eighth column indicates the standard deviation of this drift. The ninth column shows the corresponding rotation period in hours, minutes, and seconds.

South Temperate Current (S. edge STB, STeZ), System II *

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
FA	Wc	Jan. 6- May 15	146°- 66°	112°	16	$-18^\circ.6$	$1^\circ.2$	9:55:15
B	Wp	Jan.21- Apr. 29	217 -164	200	12	-16.1	1.3	9:55:19
1	Wc	Oct.21- May 18	270 -161	206	28	-15.6	0.6	9:55:19
C	Wf	Oct.21- May 18	275 -168	211	14	-15.3	1.1	9:55:20
DE	Wc	Oct.24- Jun. 21	349 -243	295	40	-13.3	0.3	9:55:22
			Mean Rotation Period:					9:55:19

The three long-enduring white ovals of the STeZ Current continued to be observed by A.L.P.O. members. Their order of conspicuousness was the same as in the 1978-79 apparition, namely: DE, BC, and FA. The length in longitude of the ovals was: BC=11°, DE=12°, and FA=12°. Oval FA was in conjunction with the center of the Red Spot on May 22, 1980 at a longitude of 59°(II). Oval FA accelerated the RS in the direction of decreasing longitude (-3°) as the oval was passing the Red Spot area.

*Readers not familiar with the special terminology of the belts and zones of Jupiter may find it very helpful to refer to the next article immediately following this Jupiter Report.

Great Red Spot (STrZ), System II

Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
RSp	Oct.12-Jul.16	44°-43°	43°	31	-0°108	0°003	9:55:40
RSc	Oct.12-Jul.16	54 -53	55	46	-0.108	0.002	9:55:40
RSf	Oct.12-Jul.16	66 -65	65	32	-0.108	0.003	9:55:40
			Mean Rotation Period:				9:55:40

The Red Spot had a mean length of 22° in longitude for the entire apparition. By mid-March the Hollow aspect, along with the effect of the spots in the Circulating Current, was raising turmoil with the appearance of the Red Spot Area. Some SEBs retrograding spots of the Circulating Current (North Branch) were moving in the direction of increasing longitude north of the Red Spot during early March, and also in mid-May, 1980. The South Branch of the Circulating Current was also very active in the Red Spot Area with dark spots encroaching on the Red Spot region and moving rapidly along the north edge of the South Temperate Belt in the direction of decreasing longitude during these periods: early March, mid-March, early April, mid-April, late April, early May, and mid-May, 1980. Dark material forming near the following end of the Red Spot Hollow was observed by A.L.P.O. observers from March 21 (75°II) to June 27 (75°II). Many observers were calling this material the following end of the Red Spot, which was actually near 65°(II). During the early part of the apparition the RS had a drift in (+) increasing longitude (mean +1°3); however, by early January the negative drift began and predominated for the rest of the apparition.

South Tropical Zone Disturbance (STrZ), System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
1	Dp	Nov.12-Apr.14	255°-190°	217°	16	-12°8	0°8	9:55:23
2	Wc	Feb.29-Apr. 5	202 -180	-	7	-18.3	0.4	9:55:16
3	Wc	Mar. 9-Apr. 5	204 -188	-	5	-17.8	0.3	9:55:16
4	Wc	Feb.29-Mar.22	231 -216	-	5	-18.8	0.3	9:55:15
5	Wc	Oct.21-Apr.22	274 -240	243	12	- 5.6	0.5	9:55:33
6	Wc	Mar.19-May 4	269 -262	-	7	- 4.4	0.6	9:55:35
7	Wc	Oct.25-May 4	316 -293	294	18	- 3.6	0.2	9:55:36
8	Df	Dec. 9-Jun.12	20 -349	354	26	- 5.0	0.2	9:55:34
				Mean Rotation Period:				9:55:26

A major highlight for the 1979-80 apparition was the observation of an outstanding South Tropical Zone Disturbance, which developed during the late 1978-79 apparition and really put on a show during 1979-80! On April 12, 1980 it had a length of 165° in longitude and by June 12, 1980 had attained a length near 200° (196° in longitude) in System II. No. 1 in the table above is the dark preceding end of the STrZ Disturbance. Nos. 2 and 3 are bright white ovals preceding the dark preceding end of the Disturbance and were observed from about early March to early April. Nos. 4, 5, 6, and 7 are all white ovals associated with the STrZ Disturbance. No. 8 is the dark following end of the Disturbance.

In 1979-80 the preceding end (Marking No. 1) was first observed by Robotham on November 12, 1979 at 255° (II) and again on December 29, 1979 at 240°(II), followed by Sherrod on January 1, 1980 at 239°(II). The following end (Marking No. 8) was first observed by Tatum on December 9, 1979 at 20°(II), followed by Budine on December 31, 1979 at 11°(II). A special thanks go to the following devoted observers whose efforts have given us a better understanding of the nature of the South Tropical Zone Disturbance and have made possible the data which follow, namely: Claus Bagger, Patrick McIntosh, Rob Robotham, Clay Sherrod, and Daniel Troiani. Bagger employed a modest 2.4-inch refractor; this fact should be an incentive to all observers with small aperture telescopes.

Readers should now refer to the writer's report in JALPO, Vol. 28, Nos. 11-12, pp. 238-244.

Observational evidence and interpolation of drift curves indicate that the 1979-80 South Tropical Zone Disturbance was first observed during the 1978-79 apparition and that observers had been observing this Disturbance for over a year! The preceding end was observed for 12.1 months and the following end for 12.5 months. Also, one oval (No. 7 in the table above) was seen for 12.1 months (it should be noted that interpolation had to be employed near the time of Jupiter's conjunction with the Sun). Evidence now indicates that Marking No. 3 of the 1978-79 table for the Disturbance was a dark following end feature observed until May 23, 1979 at 307° (II), and actually preceded the developed true following end. The actual following dark end of the STrZ Disturbance was first observed late in the 1978-79 apparition on June 4, 1979 at 30° (II) by Patrick McIntosh. Also, Marking No. 7 in the table above was first observed during 1978-79 by Daniel Troiani on May 8, 1979 at 340° (II). The dark preceding end was first observed (as stated in the 1978-79 report) by Rob Robotham on April 17, 1979 at 283° (II). The Disturbance had attained a length of 115° by June 4, 1979 and increased in length until June 12, 1980,

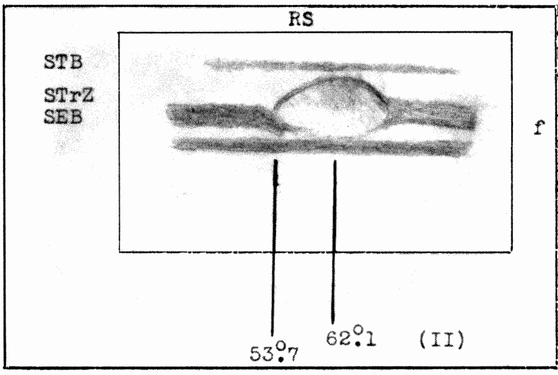

Figure 1. Drawing of the Region of the Great Red Spot on Jupiter by Rob Robotham on March 1, 1980. 6-inch reflector, 160X. Seeing 8 (scale of 0 to 10 with 10 best). Transparency 4 (limiting stellar magnitude). The Red Spot is beginning to be replaced by the Red Spot Hollow. See also text of Mr. Budine's Jupiter Report.

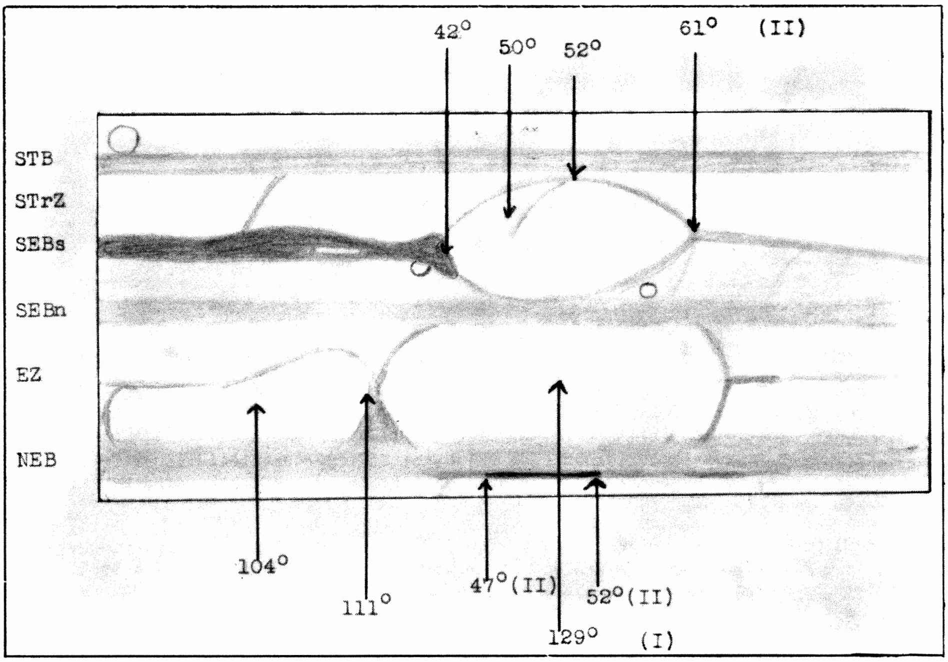

Figure 2. Drawing of the Red Spot Area and its Vicinity by Daniel M. Troiani on April 4, 1980. 10-inch reflector, 283X. Seeing 5.5, transparency 5. The Red Spot Hollow aspect now exists. Arrows show longitudes of various features.

when it was about 200° long. It is now possible to present a rotation period table for four features which were long-lived features of the STrZ Disturbance and had been observed since the late part of the 1978-79 apparition. This table follows (see also Figure 4):

1979-80 South Tropical Zone Disturbance (STrZ), System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
1	Dp	Apr.17,1979-Apr.14,1980	283°-190°	217°	26	-7.°7	0.°3	9:55:30
2	Dc	Apr.17,1979-Oct.4,1979	304 -293	-	11	-1.9	0.2	9:55:38
3	Wc	May 8,1979-May 4,1980	340 -293	294	21	-3.9	0.2	9:55:35
4	Df	Jun.4,1979-Jun.12,1980	30 -349	354	27	-3.3	0.1	9:55:36
				Mean Rotation Period				9:55:35

No. 1 above is the dark preceding end. No. 2 is the same feature as Marking No. 3 in the 1978-79 table. It was last observed on October 4, 1979 by McIntosh at 293° (II). No. 3 is a bright white oval within the Disturbance. No. 4 is the dark following end. It is interesting to note that the preceding and following end periods agree well with

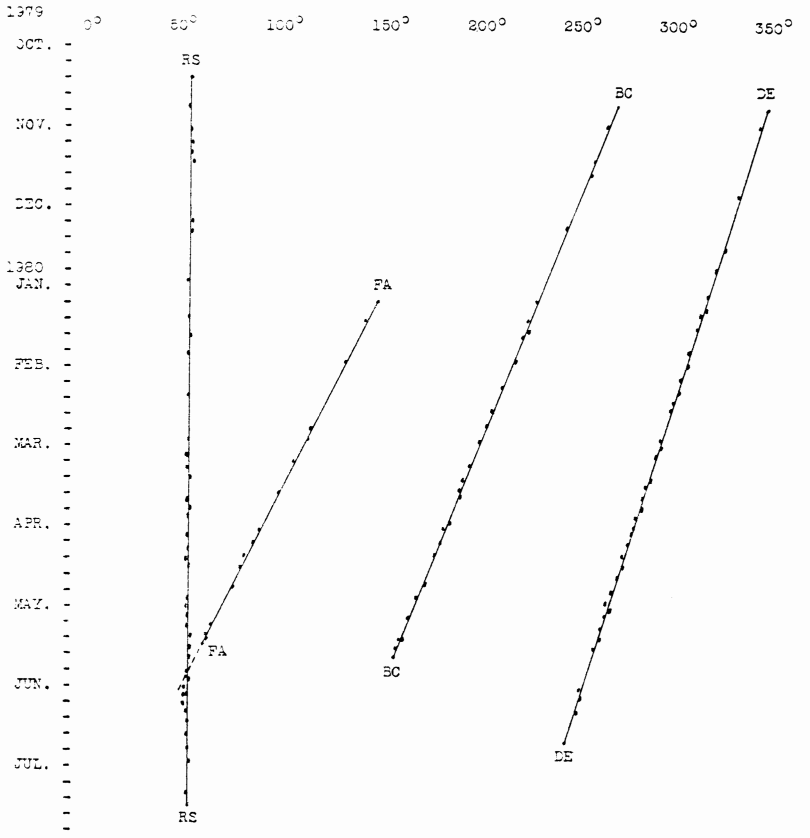

Figure 3. Drift-chart, longitude vs. date, of important features on Jupiter in System II during the 1979-80 apparition. Prepared and contributed by Phillip W. Budine. See also text.

the 1930-31 South Tropical Disturbance periods of 9:55:33 and 9:55:36 respectively; at that time the Disturbance of 1930-31 had a similar length of 202° (Peek's book - The Planet Jupiter). During mid-April to late April, 1980, the following end was moving in the direction of (+) increasing longitude; and a conjunction with the Red Spot was then predicted for mid-June, 1980. However, observational evidence at this time indicates a divergence to decreasing longitude drift (supported by several transits) in early May and continuing to June 12, 1980. Spots of the Circulating Current were observed near the following end of the Disturbance during this period also.

Circulating Current - South Branch (STB-N. edge), System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
1	Dc	Mar.27-May 2	175°-359°	-	7	-146°.7	0°.5	9:52:21
2	Dc	Apr.12-May 10	183 - 56	-	6	-141.1	0.4	9:52:29
3	Dc	Apr.18-May 17	172 - 70	-	6	-102.0	0.6	9:53:22
4	Dc	Mar. 3-Mar. 7	62 - 37	-	3	-125.0	0.2	9:52:50
5	Dc	Mar.24-Apr. 4	61 - 27	-	4	- 85.0	0.5	9:53:45
6	Dc	Mar.31-Apr.13	60 -359	-	5	-122.0	0.4	9:52:54
				Mean Rotation Period:				
					(Nos. 1, 2, 4, & 6):			9:52:39
					(Nos. 3 & 5):			9:53:34

All of the above dark spots were moving rapidly in the direction of decreasing longitude in the South Branch of the Circulating Current, which is found between the following and preceding ends of the South Tropical Zone Disturbance and is formed as a result of the Disturbance. Spots moving rapidly in the SEB_s in the retrograding current reach the preceding end of the South Tropical Disturbance and are deflected; they then move south in latitude across the SEB Z and are picked up by the South Temperate Current

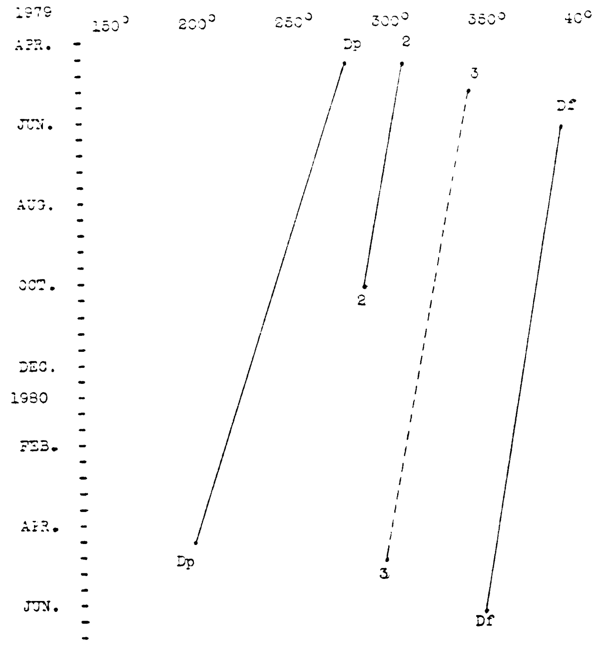

Figure 4. Drift-chart, longitude (II) vs. date, for long-lived features in the 1979-80 South Tropical Zone Disturbance of Jupiter. Prepared and contributed by Phillip W. Budine. See also text.

which moves them rapidly along the north edge of the STB in the direction of decreasing longitude. No. 1 in the table above is the South Branch spot resulting from spot No. 3 of the North Branch table below. Therefore No. 1 marking above is the same spot as No. 3 below. Likewise, Marking No. 2 in the table above is the same spot as No. 4 in the table below. Spots Nos. 3-6 were other STB_n spots moving in the Circulating Current. Spot No. 1 was last seen near the following end of the STrZ Disturbance. Spot No. 2 was last observed just south of the center of the Red Spot on May 10. Spots Nos. 1 and 2 were both first observed preceding the preceding end of the STrZ Disturbance. Nos. 4 and 5 were observed moving along the north edge of the STB past the Red Spot area. No. 6 was last seen near the following end of the Disturbance on April 13, 1980. STB_n dark spots of this current were watched carefully for any possible circulation movements around the Red Spot vortex, but no spots were observed circling the Red Spot as happened in the 1964-65 apparition.

Circulating Current - North Branch (S. edge SEB_s, STrZ), System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
1	Dc	Dec.30-Jan. 6	44° - 80°	-	4	+120°.0	0°.3	9:58:26
2	Dc	Feb.24-Mar. 4	358 - 40	358°	4	+140.0	0.2	9:58:53
3	Dc	Mar. 3-Mar.26	54 -171	-	8	+146.3	0.5	9:59:02
4	Dc	Mar.16-Apr.13	49 -193	-	7	+160.0	0.4	9:59:21
5	Dc	Mar.15-Mar.23	358 - 41	-	4	+143.3	0.3	9:58:58
6	Dc	Jun.13-Jun.22	348 - 14	-	4	+ 86.7	0.5	9:57:40
				Mean Rotation Period:				
				(Nos. 1, 2,& 5):				9:58:46
				(Nos. 3 & 4):				9:59:12
				(No. 6):				9:57:40

Just for cross-reference, it will be noted again that Marking No. 3 above moving along this retrograde SEB_s current becomes Marking No. 1 in the S. Branch Current (STB_n). Also, Marking No. 4 becomes No. 2 in the S. Branch table. SEB_s spots were observed moving rapidly in the direction of increasing (+) longitude. Several such spots passed the Red Spot Area, moving along the narrow channel of the Red Spot Bay north of the Red Spot in the SEB_s Current. Many of these spots were elongated in longitude when passing the RS, and were pointed dark projections along the south edge of the SEB_s in other longitudes.

* * * * *

Note by Editor. Readers are invited to take part in the observations here discussed. The method of central meridian transits is discussed excellently in B. M. Peek's classic book, The Planet Jupiter. Forms for recording such observations can be obtained from Mr. Budine at his address on the back inside cover. Central meridian transits have supplied almost all of our knowledge of atmospheric currents at the visible surface of Jupiter prior to 1965 and are still one of the most useful ways in which the observing amateur can contribute.

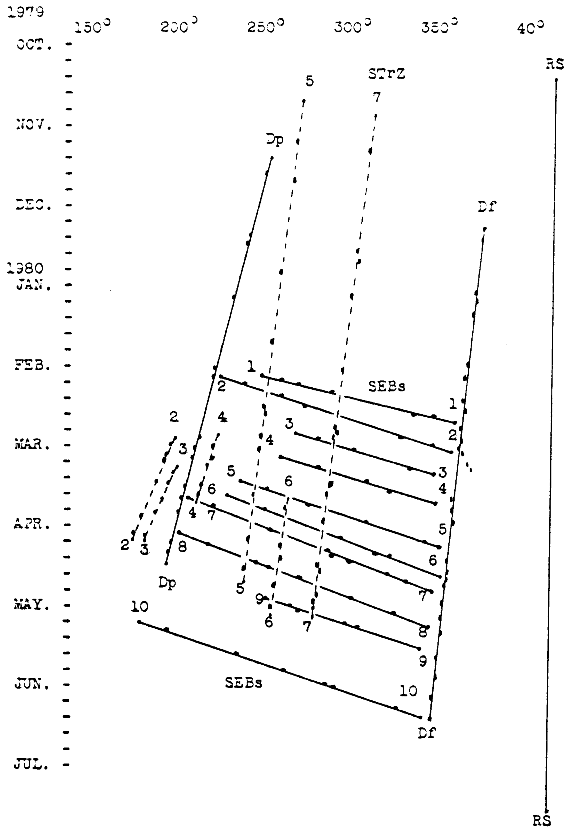

Figure 5. Drift-chart, longitude (II) vs. date, for features in a large South Tropical Zone Disturbance on Jupiter in 1979-80. Prepared and contributed by Phillip W. Budine. Dp is the preceding end of the Disturbance; Df is its following end. The drift-line of the Red Spot (RS) is also shown. Note how SEB_s spots in these longitudes moved very rapidly in increasing longitude. See also text and tables.

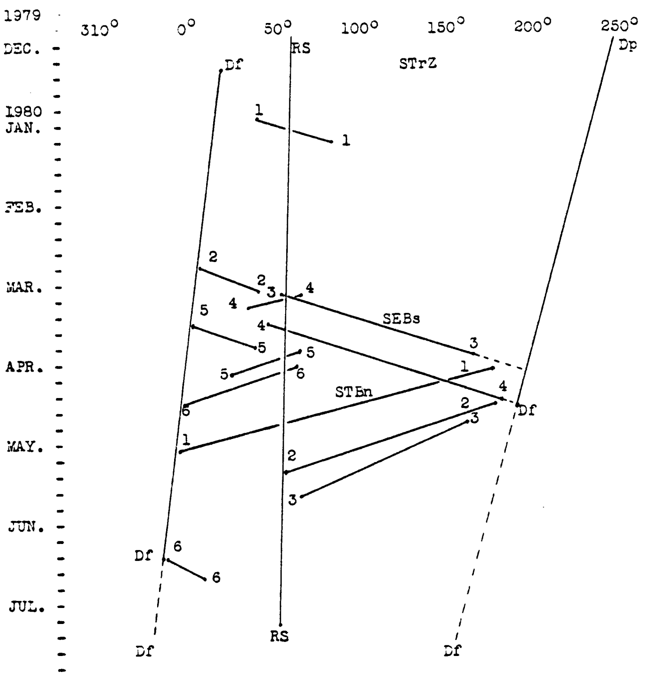

Figure 6. Drift-chart, longitude (II) vs. time, of features in the Circulating Current on Jupiter in 1979-80. Prepared and contributed by Phillip W. Budine. Between the following and preceding ends of the STrZ Disturbance SEB_S spots moved in increasing longitude; STB_n spots, in decreasing longitude. Spots apparently shifted latitude at the preceding end of the Disturbance. See also text and tables.

South edge SEB_s, STrZ, System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
1	Dc	Feb. 5-Feb. 25	252°-354°	352°	6	+145°.7	0°.4	9:59:01
2	Dc	Feb. 5-Mar. 2	230 -354	325	7	+137.8	0.5	9:58:50
3	Dc	Feb.25-Mar. 10	285 -350	-	3	+130.0	0.2	9:58:39
4	Dc	Mar. 4-Mar. 22	275 -351	-	4	+126.7	0.3	9:58:35
5	Dc	Mar.13-Apr. 11	248 -353	-	5	+105.0	0.5	9:58:05
6	Dc	Mar.19-Apr. 21	238 -354	-	6	+105.5	0.6	9:58:06
7	Dc	Mar.19-Apr. 24	206 -353	-	8	+122.5	0.5	9:58:29
8	Dc	Apr. 2-May 9	200 -352	-	7	+126.7	0.5	9:58:35
9	Dc	Apr.30-May 17	275 -350	-	5	+125.0	0.4	9:58:33
10	Dc	May 6-Jun. 17	176 -352	-	6	+160.0	0.3	9:59:21
			Mean Rotation Period (Nos. 2-9):					9:58:29
					(Nos. 1 & 10):			9:59:11

All of the above SEB_s dark spots were moving rapidly in the direction of increasing (+) longitude. These spots have periods similar to the Circulating Current spots but were confined in longitude to lying between the preceding and following ends of the South Tropical Zone Disturbance. These spots were observed in longitudes near the following end of the Disturbance. However, no spots were observed crossing the following end of the STrZ Disturbance.

South edge SEB_s, System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
1	Df	Mar. 21-May 10	35° - 30°	-	12	-1°.8	0°.2	9:55:38
2	Df	Mar. 24-Jun.17	41 - 46	-	17	+1.8	0.1	9:55:43
				Mean Rotation Period:				9:55:41

The two spots above had more linear drifts and were not associated with the rapid SEB_s spots. No. 1 was a dark section of the SEB_s. No. 2 was a dark feature preceding the Red Spot area for most of its life.

South Equatorial Belt Current (S. edge SEB_n, SEB Z), System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
1	Dc	Jan. 6-May 8	89°-102°	98°	13	+3°.2	0°.2	9:55:45
2	Wc	Jan. 6-Apr.18	101 -112	111	16	+3.2	0.2	9:55:45
3	Dc	Mar. 31-Apr.19	149 -127	-	5	-31.4	0.2	9:54:58
				Mean Rotation Period: (Without No. 3)				9:55:45

South Equatorial Current (EZ_s), System I

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
1	Wp	Mar. 9-Jun. 9	56°-127°	-	14	+22°.9	0°.6	9:51:01
2	Wc	Feb. 1-Jun. 9	5 -135	43°	18	+30.2	0.5	9:51:11
					Mean Rotation Period:			9:51:06

Nos. 1 and 2 above are the preceding end and center of a fast moving white oval of the South Equatorial Current B found in the EZ_s. This feature was moving in the direction of increasing (+) longitude, and rapidly passed Markings 4, 7, and 11 of the North Equatorial Current. In 1978-79 a similar feature was observed in the same South Equatorial Current with a period of 9:51:07, and interpolation of the drift curve gives adequate evidence that this spot (Nos. 1-2 above) is actually the same spot of the 1978-79 apparition. Therefore, it has been a long-lived feature of the South Equatorial Current for a period of about 15 months!

North Equatorial Current (S. edge NEB, EZ_n), System I

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
1	Dc	Mar. 16-Apr. 6	3°- 1°	-	6	- 2°.9	0°.5	9:50:26
2	Wc	Oct. 24-May 5	12 - 1	15°	22	- 1.7	0.7	9:50:28
3	Dc	Mar. 21-May 3	29 - 33	-	9	+ 2.9	0.3	9:50:34
4	Wc	Feb. 20-May 8	50 - 43	48	16	- 2.7	0.1	9:50:26
5	Dc	Mar. 22-May 8	78 - 63	-	11	- 9.4	0.8	9:50:17

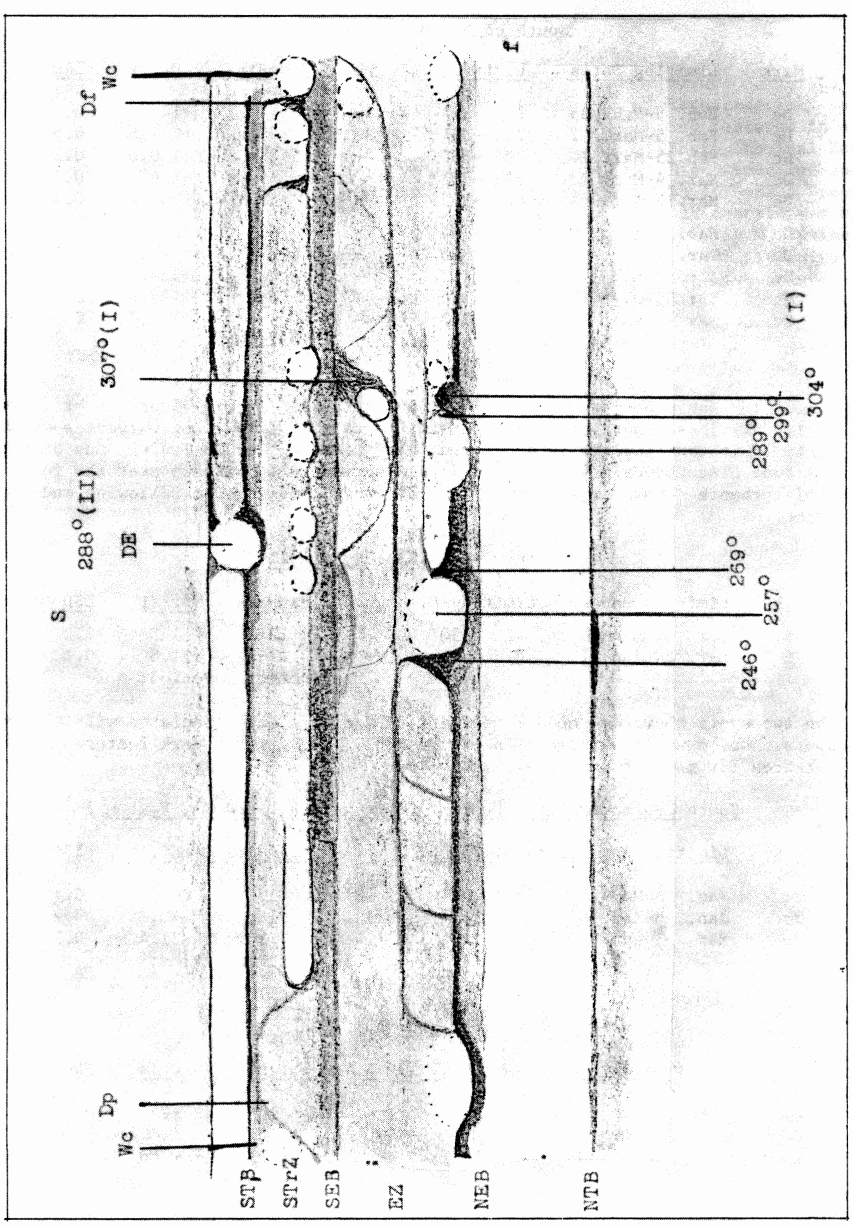

Figure 7. Strip sketch of South Tropical Zone Disturbance and other features on Jupiter by James H. Phillips on March 22, 1980. 8-inch reflector, 182X. Seeing 7-8, transparency 2-3. Arrows indicate the longitudes of various features. Note the preceding (Dp) and following (Df) ends of the Disturbance and South Temperate Zone oval DE.

North Equatorial Current (S. edge NEB, EZ_n), System I (cont.)

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
6	Dc	Apr. 4-May 8	88°- 91°	-	7	+ 2°.7	0°.3	9:50:34
7	Wc	Jan. 1-May 31	93 -102	95	25	+ 1.8	0.1	9:50:32
8	Dc	Nov.17-Feb. 2	107 - 99	-	12	- 3.1	0.2	9:50:26
9	Dc	Dec.31-Mar. 3	115 -111	110	9	- 1.9	0.2	9:50:27
10	Dc	Dec.31-Feb. 2	125 -122	-	6	- 2.7	0.5	9:50:26

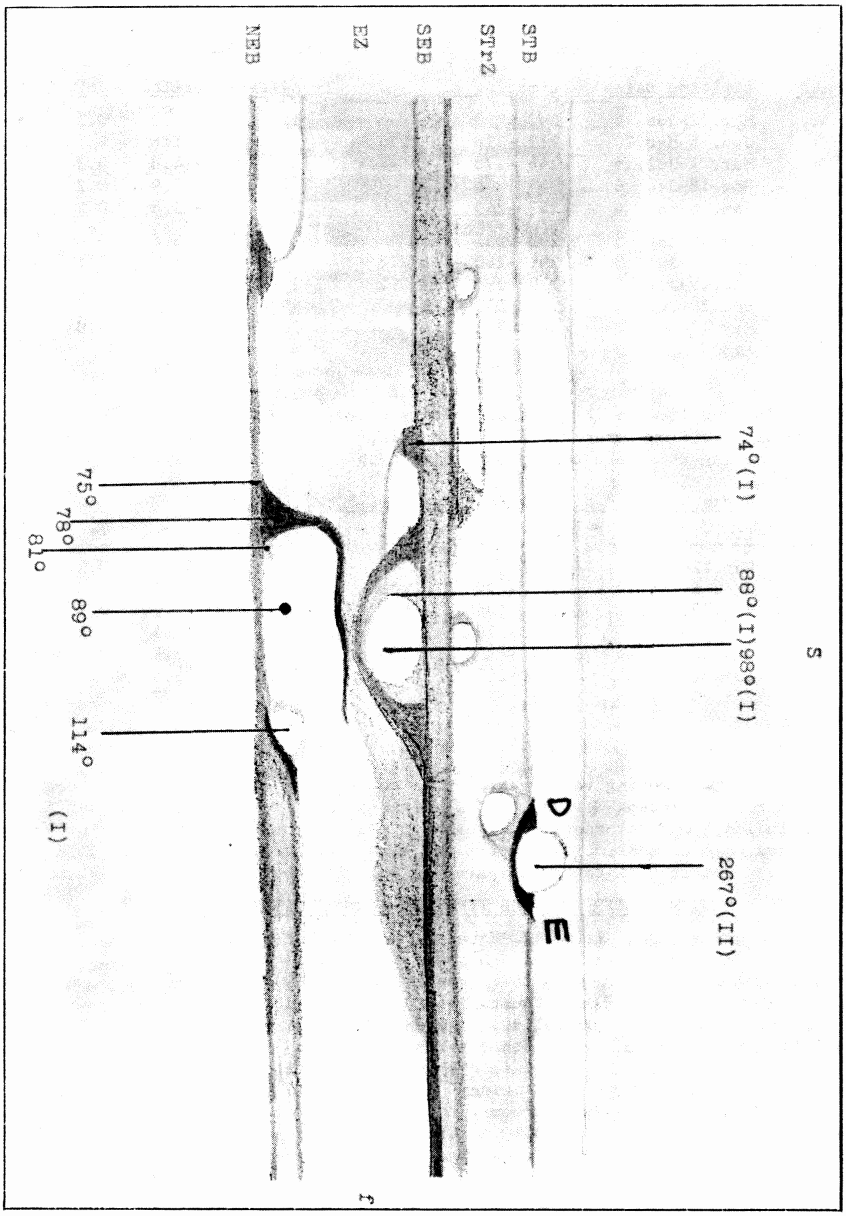

Figure 8. Strip sketch of selected longitudes on Jupiter by James H. Phillips on April 22, 1980. 8-inch reflector, 182X. Seeing 7, transparency 2. (Poor transparency will often allow good views and useful studies of features on the bright planets.) Arrows are again used to indicate longitudes. Note South Temperate Zone Oval DE.

North Equatorial Current (S. edge NEB, EZ_n), System I (Cont.)

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
11	Wc	Feb.18-May 13	122° -115°	124°	13	- 2°.5	0°.1	9:50:27
12	Dc	Mar.17-May 22	156 -146	-	9	- 4.5	0.5	9:50:24
13	Wc	Mar. 3-May 13	172 -162	-	12	- 4.2	0.4	9:50:24
14	Dc	Apr. 6-May 22	176 -146	-	7	-20.0	0.3	9:50:03
15	Dc	Mar. 3-Jun.21	186 -176	-	27	- 2.7	0.1	9:50:26

North Equatorial Current (S. edge NEB, EZ_n), System I (Cont.)

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
16	Wc	Mar.22-Jun. 5	203°-200°	-	12	- 1°.2	0°.1	9:50:28
17	Dc	Jan. 6-Mar.20	212 -216	215	14	+ 1.6	0.1	9:50:32
18	Dc	Mar. 1-Jul.16	246 -178	-	27	-14.8	0.5	9:50:10
19	Dc	Nov.18-Jan. 6	243 -246	-	7	+ 1.9	0.2	9:50:33
20	Dc	Jan. 6-May 4	257 -243	249	22	- 3.5	0.2	9:50:25
21	Dc	Mar.19-May 5	263°-257°	-	9	- 3°.8	0°.4	9:50:25
22	Dc	Dec. 2-Jun. 3	291 -260	278	31	- 5.1	0.1	9:50:23
23	Dc	Dec.29-Jun.10	310 -293	302	29	- 3.1	0.1	9:50:26
24	Wc	Oct.24-Dec.30	329 -320	-	9	- 4.1	0.5	9:50:24
25	Wc	May 11-Jun.22	344 -344	-	15	0.0	0.0	9:50:30
					Mean Rotation Period:			9:50:26
					(Nos. 5, 14, & 18):			9:50:10

Nos. 5, 14, and 18 were the fastest objects observed during 1979-80. No markings were observed in the Slow Current. All the markings (except for the three in the fast current) were moving at a rate common for this North Equatorial Current.

North Tropical Current (N. edge NEB, NTrZ), System II

No.	Mark	Limiting Dates	Limiting L.	L.	Transits	Drift	±SD	Period
1	Dc	Mar.22-Apr.15	89°- 75°	-	4	-17°.5	0°.2	9:55:17
2	Dc	Jan. 6-May 10	130 - 79	110°	20	-12.1	0.6	9:55:24
3	Dc	Feb.19-Apr.12	125 -105	123	14	-11.1	0.7	9:55:26
4	Dc	Mar.16-May 27	119 - 96	-	9	- 9.6	1.0	9:55:27
5	Df	Jan.26-Mar.16	136 -125	130	7	- 6.5	0.9	9:55:32
6	Dc	Dec.28-Apr.22	235 -202	223	27	- 8.5	0.3	9:55:29
7	Dc	Mar.23-May 5	326 -327	-	6	+ 0.7	0.1	9:55:42
				Mean Rotation Period:				9:55:26
				(Without No. 7).				

Marking No. 1 was moving very fast in this current. Feature No. 7 had a nearly linear drift. All markings (except No. 7) were rotating in the North Tropical Current A.

In conclusion, your Recorder thanks each of you for your contributions in 1979-80. We look forward to your continuing support and encourage other observers to join our A.L.P.O. Jupiter Section and to participate actively in observing the Giant Planet.

SOME NOTES ON THE TERMINOLOGY OF JUPITER

By: Walter H. Haas, Director A.L.P.O.

Our Jupiter Section authors in their reports in this journal frequently employ such terms as "SEB Disturbance," "North Equatorial Current," and "STeZ Oval DE." This shorthand is very useful to the Jovian specialist, to whom indeed the diagram on page 11 is apt to be so familiar as to be wearisome. Other readers, however, may know less of the nomenclature applied to features on Jupiter; and indeed they will find little information of this kind in the ordinary astronomy text or magazine. It is our hope that this article may serve to introduce them to such terminology and may thus make Jupiter Reports in this journal more understandable and the entire study of the Giant Planet more rewarding.

Almost the smallest (or poorest!) astronomical telescope shows that the face of Jupiter is crossed by sensibly straight, alternating bright and dark bands. The dark bands are called belts; the bright ones, zones. Since the Earth is never more than a few degrees from the plane of the equator of Jupiter, the middle of the flattened globe will be the equatorial portion of Jupiter. In a similar manner one can define tropical, temperate, and polar regions in both the North and South Hemispheres. These are convenient analogies to the climatic regions of the Earth, but it should not be supposed that they represent anything more than handy nomenclature on the Giant Planet.

Figure 9 is a standardized view of the belts and zones. These abbreviations are often employed: S for south, N for north, B for belt, Z for zone, E for equatorial, Tr (or T) for tropical, Te (or T) for temperate, P for polar, and R for region. Then we can handily employ such mnemonics as NEB for North Equatorial Belt and STrZ for South Tropical Zone. It will be noted that Figure 9 shows the South Equatorial Belt (SEB) to be divided into north and south components (SEB_n and SEB_s) with an intervening South Equatorial Belt Zone (SEB Z). Such is the usual appearance. It also shows the dark oval of the Great Red Spot (GRS or RS) lying in the STrZ. The subscripts s and n are used by Jovian observers - somewhat ambiguously, it must be admitted - to denote a component of a belt,

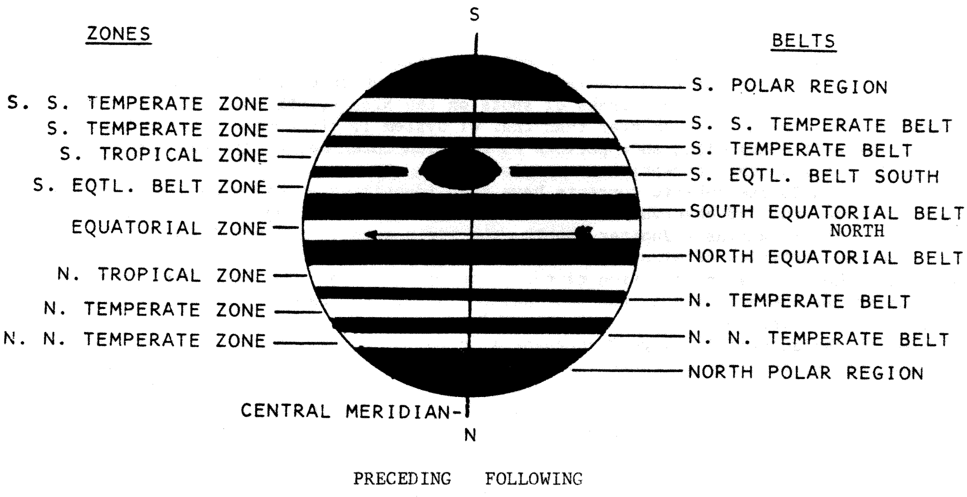

Figure 9. Diagram to show the standard nomenclature of the belts and zones of Jupiter. Contributed by Phillip W. Budine but long used by the Jupiter Section of the British Astronomical Association. Simply inverted view with south at top. See text on page 10 *et seq*.

or the edge of a belt, or even a portion of a zone. Thus NEB_n might designate either the north component of a temporarily divided North Equatorial Belt or the north edge of the single NEB, while EZ_s would refer to the south part of the Equatorial Zone.

Figure 9 is a simply inverted view with south at the top. It hence shows the aspect given by simply inverting telescopes when the planet is near the celestial meridian in middle northern latitudes. The arrow shows the direction of rotational drift of the features. In other words, for the orientation given markings drift from right to left as the planet rotates. This sense of rotation enables us to define *preceding* and *following* as directions on Jupiter. The preceding end of a feature is the first to pass a given point as the planet rotates; it would be the left end of the Red Spot oval in Figure 9. The following end is the last part to pass such a reference point; it would be the right end of the RS. Of course, *east* and *west* can serve as directions in place of *preceding* and *following*. However, astronomers have succeeded in using *east* and *west* in both of the two possible, and thus mutually exclusive, ways over the years. We recommend south, north, preceding, and following as the four points of the Jovian compass.

We digress to call attention to the *central meridian* of longitude on Figure 9, the vertical line joining the south (S) and north (N) ends of the axis. The method of central meridian transits consists of estimating when a feature is exactly midway between the preceding and following edges of Jupiter. The eye is remarkably good at comparing the two distances here required, and with practice the attentive observer can recognize the rotational drift of a Jovian feature in only a few minutes.

While our diagram gives a useful *standardized* view of the belts and zones, it is also true that the actual pattern varies from year to year, from month to month, and occasionally even from day to day. Neither need it be the same in all longitudes of Jupiter at a given time. For example, the North Temperate Belt (NTB) can vary from being the darkest of all the belts to being almost invisible. The SSTB may disappear, leaving, say, a merged STeZ-SSTeZ between the STB and an SSSTB at the edge of the shaded SPR. If the reader now wonders whether our nomenclature may not sometimes become uncertain, he is absolutely right! However, two circumstances aid greatly in correctly identifying a particular belt or zone: its measured Jovian latitude and the existence of observable atmospheric currents associated with particular known belts and zones.

It was long ago recognized that Jupiter does not rotate as a whole. Intensive studies beginning subsequent to a revival of the Great Red Spot in 1878 showed that two systems of longitude will conveniently represent the motions of most of the clouds. System I is defined to have a sidereal period of rotation of 9 hrs., 50 mins., 30.003 secs. and is applied to that portion of the planet extending from the south edge of the North Equatorial Belt (NEB) to the north edge of the South Equatorial Belt North (SEB_n), inclusive. System II is applied to the rest of the planet and has a sidereal rotation period of 9 hrs., 55 mins., 40.632 secs. These two systems have no physical meaning; they are simply convenient values for representing closely the observed motion of a large number of the atmospheric features at the surface of Jupiter. In recent years radio astronomers have defined a System III, which has a period close to that of System II and which presumably does possess fundamental significance in the meteorology of Jupiter.

A few exceptions exist to the latitudinal distribution of System I and System II stated above. A number of outbreaks of spots on the NTB_s (south edge of NTB) have occurred with periods even shorter than that of System I. Features in the SEB Z (South Equatorial Belt Zone) often show periods of rotation intermediate between System I and System II. A few other exceptions can arise.

More than 20 atmospheric currents have been identified at different Jovian latitudes. Some of these provided observable features during the 1979-80 apparition and appear in the tables of Mr. Budine's Jupiter Report, the first article in this issue.

The more detailed terminology of particular features is beyond the scope of this article. The STrZ is the location of the famous and variable Red Spot, which sometimes also exists as the bright oval Red Spot Hollow (RSH). The same zone also presents at intervals STrZ Disturbances - see Mr. Budine's report. The SEB has been the site of many major characteristic large Disturbances in this century, the first one in 1919. The STeZ is the location of three white ovals, BC, DE, and FA, which have existed from 1940 to the present time. The NEB_s is often the most active latitude on Jupiter.

If this elementary article has been helpful to readers of this journal, we shall try to provide future articles at a similar level on other subjects of interest to the planetary observer. Let us hear your wishes.

THE APPARITION OF COMET SUZUKI-SAIGUSA-MORA 1975 X

By: Daniel W. E. Green, A.L.P.O. Comets Section

Abstract

The A.L.P.O. observations of the long-period comet Suzuki-Saigusa-Mori 1975 X are discussed, and are correlated with data obtained by other observers. The unusual brightness behavior of this intrinsically-faint comet is analyzed, but caution must be used due to the short arc of observations in time and to the nature of the observations themselves and the physical behavior of the comet.

I. Introduction

Comet 1975 X (= 1975k) was discovered on 1975, October 5 as a ninth-magnitude object in Ursa Major by no less than five Japanese observers: Shigenori Suzuki (Aichi), Yoshikazu Saigusa (Yamanashi), Hiroaki Mori (Gifu), Kiyomi Okazaki (Yamagata), and Shigeru Furuyama (Ibaraki), according to IAU Circul r No. 2847. Official procedure dictates that only the three discoverers whose reports first reach the IAU Central Bureau for Astronomical Telegrams may have their names assigned to the comet, and this comet was called "Comet Suzuki-Saigusa-Mori." This diffuse object was found by Mori only 70 minutes after he had discovered Comet Mori-Sato-Fujikawa 1975 XII.

Having passed perihelion on October 15, the comet moved to within 16 million km of the Earth on November 1, 1975, as it passed between the Sun and Earth. Elements computed by Marsden (1979) from 82 observations, considering perturbations by the nine planets (Mercury-Pluto), are:

Epoch = 1975, Nov. 4

T = 1975 Oct. 15.3602, E.T.	$\omega = 152\overset{\circ}{.}0241$	
e = 0.985653	$\Omega = 216.1091$	1950.0
q = 0.838047 AU	i = 118.2381	

An orbital period near 446 years is suggested by these elements. Once beyond its closest approach to the Earth, Comet Suzuki-Saigusa-Mori moved rapidly southward into Southern Hemisphere skies; travelling better than 15° per day at closest approach, it reached declination -50° by November 4.

Several A.L.P.O. observers followed Comet 1975k during October, and the Rev. Leo Boethin contributed some November observations which he made from his site at Abra in The Philippines. In addition to th se observers who are listed in Table I, accompanied by an asterik (*), included are several more observers of this comet who contributed data which were published in the IAU Circulars (Nos. 2849, 2850, 2856, 2858, 2861, 2869, 2877, and 2888) or which were sent directly to this author. The A.L.P.O. observations of Comet 1975 X were published in The International Comet Quarterly (Vol. 3, No. 1, January 1981), as were the observations from other sources (Vol. 3, No. 2, April 1981); this paper will give a general overview of the comet's appearance and an analysis of its unusual brightness behavior.

II. Visual Appearance

Comet Suzuki-Saigusa-Mori was a very diffuse object, the circular coma usually having ambiguous boundaries; some slight condensation was observed at times by some

TABLE I. KEY TO OBSERVERS

(Asterisk indicates those observers who sent observations directly to the A.L.P.O. Comets Section.)

AND01		K. G. ANDERSSON, SWEDEN
BER		A. BERNASCONI, ITALY
BOE	*	LEO BOETHIN, THE PHILIPPINES
BOR	*	JOHN E. BORTLE, NY, U.S.A.
COL		PETER L. COLLINS, MA, U.S.A.
COM01		B. COMSA, CA, U.S.A.
GRE	*	DANIEL W. E. GREEN, NC, U.S.A.
HAD		K. A. HADDOW, ENGLAND
HER		D. HERALD, AUSTRALIA
HUD		B. HUDGENS, MS, U.S.A.
JON		A. F. JONES, NEW ZEALAND
KEE		R. KEEN, CO, U.S.A.
MAL		PAUL MALEY, TX, U.S.A.
MAT02	*	LEONARD MATUSZEWSKI, NJ, U.S.A.
MAY		MARVIN J. MAYO, CA, U.S.A.
MOO		E. MOORE, NM, U.S.A.
MOR		CHARLES S. MORRIS, MA, U.S.A.
POR	*	ALAIN PORTER, RI, U.S.A.
SEA		DAVID A. J. SEARGENT, AUSTRALIA
STE		M. STEWART, NEW ZEALAND
SUM		BRUCE SUMNER, AUSTRALIA
TRU	*	JOSEPH TRUXTON, CA, U.S.A.
WAL	*	DEREK WALLENTINSEN, NM, U.S.A.

observers. The observed angular coma diameter (5!2 to 5!3) on October 12, according to Morris and Bortle, places the diameter then in the vicinity of 160,000 km, this being only three days before perihelion. As the comet drew closer to the Earth in late October, the apparent visual diameter increased to 10' - 12', although this value suggests a true diameter of only half that observed two weeks earlier, a difference probably attributable to observing effects caused by the Earth's atmosphere. Boethin observed the comet until November 22 visually, then noting the fading, ninth-magnitude object as very diffuse with a slight central condensation. Matchett was perhaps the last to observe comet 1975k visually, seeing it at 11th magnitude on November 29 and 30, 1975. The Moon affected observations, being full on October 19.

Some observers (Bortle, Green, and Porter) reported seeing a faint, narrow tail spike up to as much as 1 degree in length at times. An October 10 photograph taken by Moore at the Joint Observatory for Cometary Research with a 37-cm f/2 Schmidt telescope showed the comet with a 1-degree tail in position angle 330°. Another photograph taken two nights later at Woolston Observatory by Haddow apparently revealed no tail, but showed a poorly condensed image surrounded by a 40" coma of total magnitude 8.0.

III. Magnitude Analysis

Comet Suzuki-Saigusa-Mori is a very difficult object to analyze in terms of brightness, as is well depicted by the scatter of data in Figure 11. Forty-seven points were plotted in Fig. 11 on a logarithmic scale of heliocentric distance (abscissa) versus heliocentric magnitude (ordinate). Attempts have been made to represent the magnitude of this comet, but the data resist allowing any order to be made of them.

Table II presents all of the magnitude estimates in the following order: column 1: Chronological numbering of the observations; 2: Date in Universal Time (U.T.); 3: Observed total visual magnitude; 4: Aperture-corrected magnitude to standard of 6.78 cm, after Morris (1973); 5: Instrument size in cm, with type of instrument (Key: L = reflector, B = binoculars, R = refractor, E = naked eye); 6: Heliocentric magnitude (see Green 1980a); 7 and 8: The comet's geocentric (Δ) and heliocentric (r) distances, respectively; 9: log r; 10: Observer (see Table I for Key).

Most of the magnitude observations by far were made when the comet was between 0.85 and 0.87 Astronomical Units (A.U.) from the Sun, and any attempted analysis of these data should be used with extreme caution. The author decided to choose those observations which were most consistent with each other, producing the observations made by four experienced observers (Bortle, Green, Morris, and Wallentinsen). After choosing only one observation per observer per night, 15 observations from October 7-29 (r = 0.852-0.838-0.980 AU) reveal:

$$n = 25.29 \pm 2.75 \text{ (p.e.)}$$

$$H_o = 13.47 \pm 0.48 \text{ (p.e.)},$$

following a least squares regression analysis as described by Green (1980a, b). The absolute magnitude, $H_o = 13.47$, suggests that Comet Suzuki-Saigusa-Mori was intrinsically a very faint comet; and while the parameter n is unusually large, the following formula fits the 15 data points well (see Figure 12):

$$m_1 = 13.47 + 5 \log \Delta + 63.22 \log r,$$

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Figure 10. Photograph of Comet Suzuki-Saigusa-Mori (1975k) by Reverend Ronald Royer of Azusa, CA on October 28, 1975, when the comet was near its brightest. On this date visual observers estimated a stellar magnitude of 5½ and a coma diameter of 10'. The comet was very diffuse, and no nucleus was seen. Reverend Royer took this photograph on IIaO emulsion in a 4-inch f/5 camera. The 3-minute exposure began at 12^h50^m, U.T. Photograph contributed by Dennis Milon, A.L.P.O. Comets Recorder.

where m_1 is the observed total visual, aperture-corrected magnitude within the standard cometary magnitude formula. This fit is graphed with all of the observations of Fig. 11, for analogy, in Figure 13. While this line fits well the October observations made by Northern Hemisphere observers, nothing can really be done to correlate the Southern Hemisphere observations of November, 1975.

Acknowledgements

Dennis Milon, A.L.P.O. Comets Recorder, provided those A.L.P.O. observations which were used in the study of Comet Suzuki-Saigusa-Mori 1975 X. I also thank all those observers who sent me their observations of this comet in 1976, when I announced the need for such data to conduct my study which was published in the J.A.L.P.O. (Vol. 28, Nos. 7-8, August 1980, pp. 134ff.). Dr. Brian G. Marsden kindly supplied computer time at the Smithsonian Astrophysical Observatory for the reduction of the data described in this paper.

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Marsden, B. G. (1979). Catalogue of Cometary Orbits, Third Edition (Cambridge, MA: Central Bureau for Astronomical Telegrams, Smithsonian Astrophysical Observatory), p. 31.
Morris, C. S. (1973). P.A.S.P., 85, p. 470.

TABLE II. MAGNITUDE OBSERVATIONAL ANALYSIS.

No.	Date (U.T.)	Mag.	Corr.	Inst.	H-Mag.	Delta	r	log r	Obs.
1	1975 10 7.410	8.50	8.34	15.0L	8.59	0.894	0.852	-.0696	MOR
2	1975 10 8.340	8.20	8.30	5.0B	8.63	0.860	0.849	-.0711	BOR
3	1975 10 8.350	8.10	7.81	12.0R	8.14	0.860	0.849	-.0711	COL
4	1975 10 8.460	8.10	7.76	13.0R	8.09	0.860	0.849	-.0711	MAL
5	1975 10 9.460	8.20	7.86	13.0R	8.27	0.827	0.846	-.0726	MAL
6	1975 10 11.430	8.30	8.14	15.0L	8.74	0.759	0.842	-.0747	MOR
7	1975 10 12.400	7.80	7.90	5.0B	8.60	0.724	0.840	-.0757	BOR
8	1975 10 12.430	8.30	8.14	15.0L	8.85	0.724	0.840	-.0757	MOR
9	1975 10 12.470	8.10	7.76	13.0R	8.46	0.724	0.840	-.0757	MAL
10	1975 10 14.390	7.50	7.60	5.0B	8.52	0.655	0.838	-.0768	GRE
11	1975 10 15.460	8.20	7.85	25.4L	8.88	0.620	0.838	-.0768	TRU
12	1975 10 17.460	8.30	7.96	13.0R	9.26	0.549	0.839	-.0762	MAL
13	1975 10 18.460	8.00	7.65	25.0L	9.10	0.514	0.839	-.0762	HUD
14	1975 10 18.480	8.00	7.66	13.0R	9.10	0.514	0.839	-.0762	MAL
15	1975 10 19.470	8.00	7.66	13.0R	9.26	0.478	0.841	-.0752	MAL
16	1975 10 20.480	7.90	7.56	13.0R	9.33	0.442	0.842	-.0747	MAL
17	1975 10 21.070	7.50	7.43	8.0B	9.38	0.407	0.845	-.0731	AND01
18	1975 10 21.370	6.50	6.60	5.0B	8.55	0.407	0.845	-.0731	MAT02
19	1975 10 21.400	7.00	7.10	5.0B	9.05	0.407	0.845	-.0731	BOR
20	1975 10 21.480	7.90	7.56	13.0R	9.51	0.407	0.845	-.0731	MAL
21	1975 10 22.390	6.80	6.90	5.0B	9.05	0.372	0.847	-.0721	BOR
22	1975 10 23.380	7.20	7.04	15.0L	9.41	0.336	0.850	-.0706	POR
23	1975 10 23.390	6.80	6.90	5.0B	9.27	0.336	0.850	-.0706	BOR
24	1975 10 23.450	7.00	6.92	11.0L	9.29	0.336	0.850	-.0706	WAL
25	1975 10 24.400	6.50	6.34	15.0L	8.95	0.301	0.853	-.0691	POR
26	1975 10 24.480	7.80	7.46	13.0R	10.07	0.301	0.853	-.0691	MAL
27	1975 10 24.520	6.80	6.90	5.0B	9.51	0.301	0.853	-.0691	TRU
28	1975 10 26.470	5.90	6.08	3.5B	9.24	0.233	0.861	-.0650	WAL
29	1975 10 27.190	6.10	6.14	6.0B	9.63	0.201	0.866	-.0625	BER
30	1975 10 27.480	5.80	5.98	3.5B	9.46	0.201	0.866	-.0625	WAL
31	1975 10 27.500	5.50	5.68	3.5B	9.16	0.201	0.866	-.0625	KEE
32	1975 10 28.410	5.50	5.60	5.0B	9.45	0.170	0.870	-.0605	BOR
33	1975 10 28.490	5.90	6.08	3.5B	9.93	0.170	0.870	-.0605	WAL
34	1975 10 28.540	6.00	6.10	5.0B	9.95	0.170	0.870	-.0605	MAY
35	1975 10 29.190	5.80	5.84	6.0B	10.08	0.142	0.876	-.0575	BER
36	1975 10 29.510	5.50	5.68	3.5B	9.92	0.142	0.876	-.0575	WAL
37	1975 11 4.390	5.20	5.30	5.0B	9.24	0.163	0.914	-.0391	STE
38	1975 11 4.440	6.50	6.43	8.0B	10.37	0.163	0.914	-.0391	BOE
39	1975 11 4.470	5.00	5.13	0.0E	9.07	0.163	0.914	-.0391	HER
40	1975 11 6.420	4.80	4.93	0.0E	8.17	0.225	0.929	-.0320	SEA
41	1975 11 8.450	6.20	6.13	8.0B	8.81	0.292	0.945	-.0246	BOE
42	1975 11 11.400	7.50	7.63	4.5R	9.63	0.397	0.971	-.0128	JON
43	1975 11 11.430	7.10	7.20	5.0B	9.20	0.397	0.971	-.0128	SUM
44	1975 11 12.420	7.80	7.93	4.5R	9.75	0.432	0.980	-.0088	JON
45	1975 11 12.530	7.20	7.04	15.0L	8.87	0.432	0.980	-.0088	SUM
46	1975 11 21.440	8.80	8.54	20.3L	9.18	0.745	1.071	0.0298	BOE
47	1975 11 22.450	8.80	8.54	20.3L	9.08	0.780	1.082	0.0342	BOE

REPORT ON THE A.L.P.O.-LTP OBSERVING PROGRAM

By: Winifred Sawtell Cameron, NSSDC, GSFC, Greenbelt, MD

This on-going observing program has been operating since late 1972. The objectives are to: 1) monitor the Moon for Lunar Transient Phenomena (LTP), 2) establish the normal albedo behavior over a lunation period of the more active LTP sites (100 out of 200 total), some non-LTP comparison sites, and the seismic epicenters obtained from the Apollo seismic experiments under all lighting aspects, including earthlit, by a standardized procedure, and 3) establish an objective seeing scale based on a star's diffraction of out-of-focus disk behavior. Appeals for observers have elicited a large response in inquiries. The number who have reported observations is only a fraction of those.

Briefly, the procedures to be effected by observers are the following:

A) At Full Moon construct an albedo scale by matching grays to Elger's scale in one of the following ways:

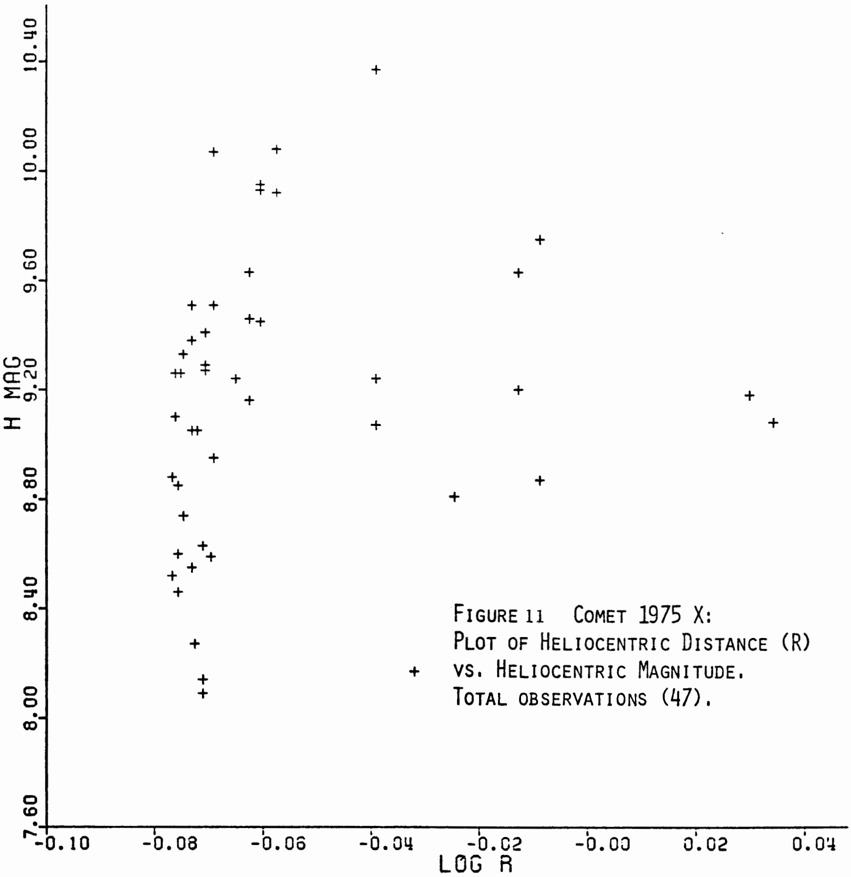

FIGURE 11 COMET 1975 X:
PLOT OF HELIOCENTRIC DISTANCE (R)
VS. HELIOCENTRIC MAGNITUDE.
TOTAL OBSERVATIONS (47).

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1) pencil shadings on a white sheet of paper,
2) pieces of film print (perhaps of a lunar photograph),
3) pieces of exposed film of various densities,
4) photographic gray scale,
5) inserting pieces of exposed film, between the eye and eyepiece and adding together till they extinguish the feature examined (from Elger's example), or
6) use neutral filters in the same ways as in 5).

Values at Full Moon give the true albedo. Once a gray is matched to Elger's scale, then any measure at any time that matches that gray step is the albedo recorded.

B) Select several permanent points in each assigned feature including wall, floor, and central peak, and one outside the feature on the nearby terrain (usually a plain). These are the points always measured and reported.

C) Before observing the Moon estimate the seeing by the following:

1) With the clock drive off, set the star's disk (near the Moon) at the edge of the field of view (FOV) and time (by counting seconds) how long it takes to drift out of the FOV,
2) watch the expansion and contraction of the image and time (by counting) the interval between blow-ups,
3) switch the clock drive on, set the star at the edge of the FOV, and time the interval between darts toward the center (excursions) of the FOV.
4) estimate how far toward the center it darted (in fractions of the FOV),
5) estimate the ratio of the largest blown-up disk to the smallest, and
6) estimate the seeing by some old method as to poor to excellent, or 0-10 (10 best), or the Antoniadi Scale I-V (I best).

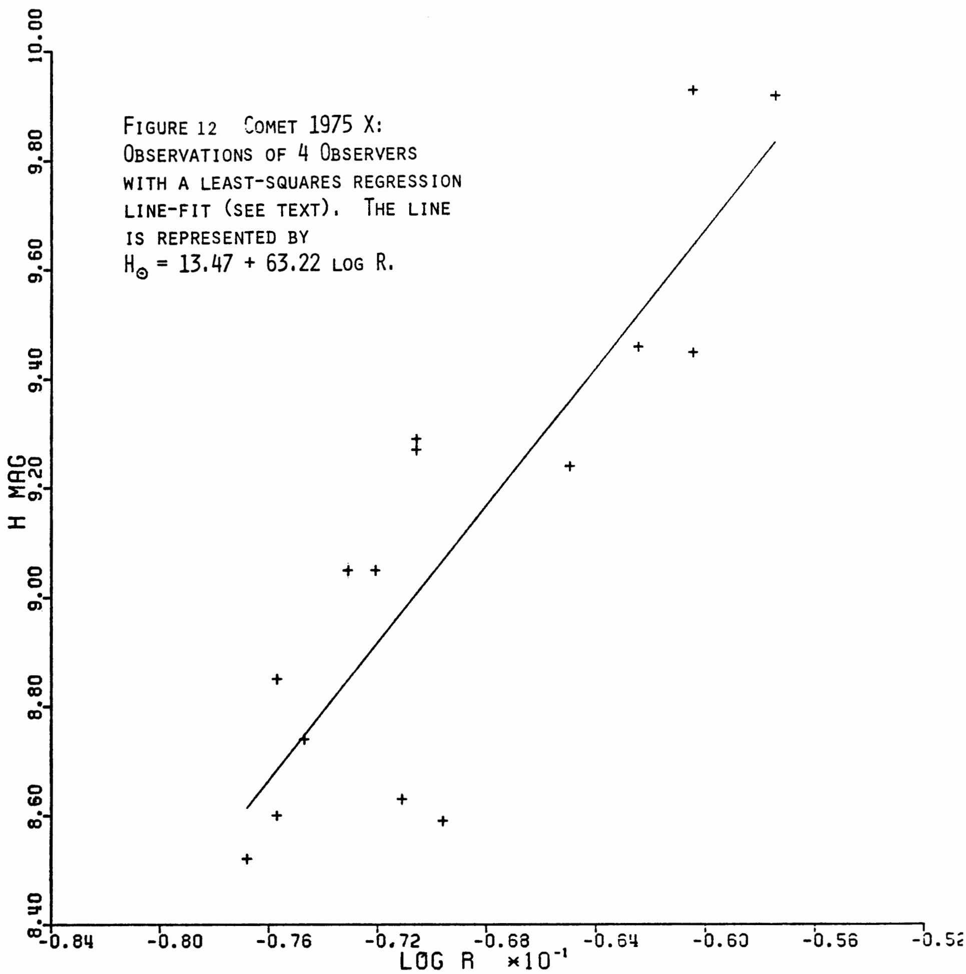

FIGURE 12 COMET 1975 X: OBSERVATIONS OF 4 OBSERVERS WITH A LEAST-SQUARES REGRESSION LINE-FIT (SEE TEXT). THE LINE IS REPRESENTED BY $H_{\odot} = 13.47 + 63.22 \log R$.

****

An observing session should have at least two measures of every point of each feature visible separated by a minimum of ten minutes in time. All measures are reported to me monthly, but LTP reports should be sent in immediately. If an anomaly is noted, minute detail as to color, obscuration, albedo, variations (with timings), hue of color, motions, etc. should be made. Comparison with other features especially north or south of the anomaly and with similar structure and albedo should also be made. Instructions for procedures, Elger's scale, and reporting forms are provided. I assign four LTP, one non-LTP comparison feature, and one seismic epicenter site to each observer. In this way I can assure that all 100 LTP features and all seismic zones will be covered. In a few instances observers requested more features to monitor.

From 1972 to the present (August, 1980), there were 68 inquiries, three of which were professional astronomer groups, with recording equipment (none of which have reported any observations). All 100+ LTP and seismic sites were distributed among the 68 inquirers with many duplicates. Table 1 lists all inquirers who were assigned features. Of the 68 inquirers, 13 have reported observations (asterisked). These 13 cover 64 features, of which 17 were duplicated, 1939 nights, and 15,094 individual measurements of albedos through August, 1980. Among the 1939 nights there were 52 nights on which LTP with 105 individual measures were reported. These figures represent 2.7 percent of nights and 0.7 of one percent of individual measures. Table 2 summarizes the 13 observers' reports. Some of the 13 have dropped out, as can be seen in the last column which gives the date of the last reported observations. Two of the reporters (superscript 1) are not actual members of the program, but they send measures of albedos similar to the A.L.P.O. method on an irregular basis.

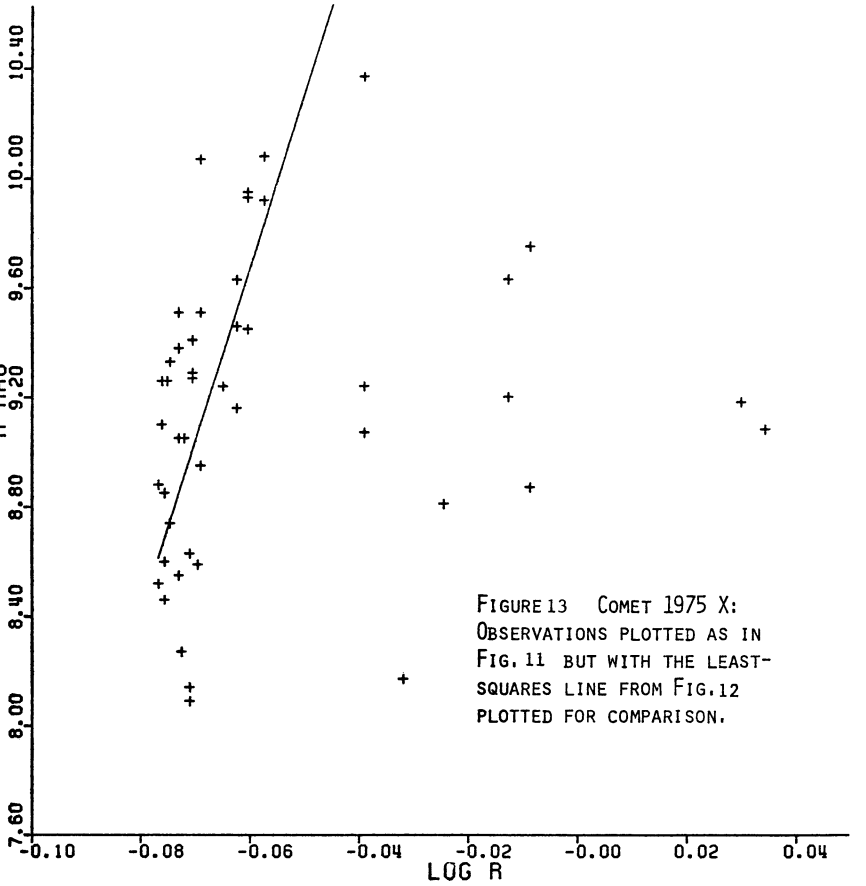

FIGURE 13 COMET 1975 X: OBSERVATIONS PLOTTED AS IN FIG. 11 BUT WITH THE LEAST-SQUARES LINE FROM FIG. 12 PLOTTED FOR COMPARISON.

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Upon receipt of the observations I construct albedo charts of albedo vs. Moon's age, a typical one of which may be seen in Table 3. (Commas separate measures during a night, and semicolons separate nights of observation.) Figure 14 shows the average behavior of each point in graphical form. Pertinent information, e.g., sunrise and sunset, lunar phases, and magnetic tail boundaries are indicated at the top. Note that the nearby plain (Mare Crisium) point is always of lower albedo than the Cape, and point C appears to deviate from the other points. Point A is the brightest generally. Occasionally I find measures that differ from the average or surrounding Moon's age measures by four half-steps or more on Elger's scale (circled in Table 3). Since LTP of as little as one-half step have been reported, I think 4 half steps is a significant deviation and can be considered a possible anomaly. Point E was quite low in the second night's measure but the Sun's altitude was only 4^{o}. However, on the first night's measures, the altitude was only 9^{o} so the 4's may be anomalously low since the other points weren't so far off. The one other anomaly was in the nearby plain comparison point. This region of M. Crisium is subject to LTP. Most points tend to brighten slightly at or near Full Moon. The possible anomalies were not noted by the observer. A number of reasons could account for this; e.g. the observers didn't know or remember (and shouldn't) what the normal albedo was. Also, there were no variations in albedo during observation to command their attention. There was no color or obscuration associated with the unusual albedo to gain attention. In Table 2 we could apply the same analysis. Here (considering each feature separately) we find 152 nights and 285 individual anomalous measures which equal 7.8% and 1.9% respectively. We find the total nights of reported and possible anomalies was 204/1939 and the total of individual measures was 390/15,094. These are 10.5% and 2.6% respectively. This result suggests that once in about 10 nights or once in about 40 individual measures one might record an anomaly. I encourage my observers to compare their night's measures to previous ones for the same phase after observing; and if they differ from previous ones of the same age (or surrounding ages) by 4 one-half steps or more, to go back and observe such features carefully.

TABLE 1. A.L.P.O. - LTP OBSERVING PROGRAM

Name	Location	Telescope	Entered
S. Anthony	Warren, PA		1973
Astron. Club	Cranston, NJ		
J. Barclay	Calounora, Australia		
J. Bartlett[1]*	Baltimore, MD	3R-5L	1972
L. Beaumont	Watertown, NY		1974
I. Beck	Wadsworth, OH		1972
J. Benton	New Hope, PA		1980
B. Blakelee	Scotch Plains, NJ		1975
R. Borek	Lancaster, CA		1972
M. Boschat	Halifax, N.S.	8L, Filters	1979
J. Caruso*	Elmira, NY	2.4R	1978
G. Chevalier	Quebec, Canada		1973
R. Clutter#	Pittsburgh, PA		1972
Dr. N. Comins	Orono, ME	8L, 12L	1978
C. Culley	New York, NY		1980?
Dr. F. Dachille[w]	University Park, PA	12L	1974-1977[w]
J. Da Silva	Parana, Brazil		1972
E. Davis*	Youngstown, PA	6L	1972
R. Dezmelyk	Warren, PA		1973
Dr. A. Fennelly	Bowling Green, KY	Filters, polarim.	1974
P. Foley[1],*	Kent, England	12L, CED, blink	1978
Dr. J. Fontana	Peekskill, NJ		1973
M. Fornarucci	Garfield, NJ		1972
B. Frank*	Fairport, NY	6L	1972
J. Galgocy*	Washington, PA	2R	1973
D. Gens	Youngstown, PA	6L	1972
R. Gordon	Nazareth, PA		
T. Gorman	Columbus, OH	3R	1978
D. Harrold	Cleveland, OH		1972
R. Hill*	Greensboro, NC	10L, 6L	1972
B. Hobdell+	St. Petersburg, FL	2.4R	1980
M. Huddleston	Mesquite, TX	6L	1972
P. Jean	Montreal, Canada	4R	1972
C. Kapral*	Parlin, NJ	2.4R	1978
Z. Kleinman	Harrisburg, PA		1972
J. LeCroy*	Springfield, VA	4.5L	1975
C. Leroy	Pittsburgh, PA	2R	
C. Lord	Santa Monica, CA	6L, Blink, Photom.	
D. Louderback*	South Bend, WA	2.5R, 8L	1979
T. Lynch*	Pittsburgh, PA	6L	1973
L. Maleske	Las Cruces, NM		1972
G. Marasco	Taylor, MI		1973
R. McClellan	Canoga Park, CA	R	1973
G. Perrson	Hvidore, Denmark		1972
R. Peterson	W. Palm Beach, FL		1973, 1978
G. Poole	Cleveland, England		1974
A. Porter*	Narragansett, RI	6L	1972
Dr. H. Povenmire	Indian Harbor Beach, FL		1976
Dr. R. Powaski	Euclid, OH		
T. Sato	Hiroshima, Japan	8L	1974
J. Sedge	Monticello, AL		1976
R. Speck	Hamilton, Ontario		1980
H. Stelzer	River Forest, IL		1972
C. Stephens	Bakersfield, CA		
T. Traub*	Warren, PA	8L	1972

*=reported data
L=reflector
R=refractor
w=withdrawn

CED=crater extinction device
[1]=not ALPO-LTP member
+=reported after Sept. 1980
#=Apollo 17 watch only

(Table 1 continued on page 22)

Kapral
Parlin, NJ
2.4R

CAPE AGARUM (66°E, 14°N)

S.R.Col=294°≈2^d age
S.S.Col=114°≈17^d age
L.N.Col= 24°≈9^d age

Table 3 ALBEDOS

Age	Point A (South)	AV	Point B (North)	AV	Point C (West)	AV	Point D (East)	AV	Point E (Central)	AV	Point F (nearby plain)	AV
0.^{d}0-0.^{d}9 … 1.^{d}0-1.^{d}9	DARKSIDE					Sunrise						
2.^{d}0-2.^{d}9	5.5,6;5,6;	5.6	6,6;0,0;	6	5,5.5;0,0;	5.2	5.5,5.5;5.5,5.5;	5.5	6,6;4,4;?	5	6,6;5,5;	5.5
3.0-3.9												
4.0-4.9	8,8;6.5,6.5;7,7;6.5,6.5;7,7.5;	7	7,7.5;6.5,6.5;7,7;6.5,6.5; 7.5,7.5;	7	7.5,7.5,6,6.5;6.5,6.5;6.5,6.5;7,7;	6.8	8,7.5;6,6;6.5,7;6.5,6.5;7,7;	6.8	7.5,7.5;6.5,6.5;7,7;7,7;7.5,7.5;	7.1	6.5,7;6.5,6.5;6.5,6.5; 6,6;6.5,6.5;	6.4
5.0-5.9	8,7.5;7.5,7.5;7,7;7,7;7,7.5;	7.3	75,75;7,8;7,7.5;7,7;7.5,7.5;	7.4	6,6;7,7.5;7,7;6.5,6.5;7,7;	6.8	7.5,7;7.5,7.5;7,7;7,7;7,7;	7.2	6.5,6.5;7.5,7.5;7.5,7;6.5,7;7,7;	7	4 4.5;6.5,6.5;6.5,6.5; 6.5,6.5;6.5,6.5;	6
6.0-6.9	75,7.5;7.5,7.5;6.5,7;7,7;	7.2	7,7;7,7;6.5,6.5;7,7.5;	6.9	7,7;7.5,7;7,7;7,7;	7.1	7,7;7,7.5;7,7;7,7;	7.1	7.5,7.5;7,7;7,6.5;7,7;	7.1	6,6.5;6.5,6.5;6.5,6, 6.5,6.5;	6.4
7.0-7.9	7,7;7.5,7;7,7;	7.1	6.5,7;7,7;7,7;	6.9	7,7;7,7;7,7;	7	6.5,7;7.5,7.5;7,7;	7.1	7,7;7,7;7,7;	7	6.5,6.5;7,6.5;6.5,6.5;	6.6
8.0-8.9	7.5,7;7.5,7;	7.2	7,7.5;7,7;	7.1	7,7;7,7;	7	7,7;7,7;	7	7,7;7,7.5;	7.1	6.5,6.5;6.5,6.5;	6.5
L.N. 9.0-9.9	7.5,7.5;7.5,7.5;	7.5	7,7.5;7.5,7.5;	7.4	7,7;7,7;	7	7, 7.5;7,7;	7.1	7,7.5;7,7;	7.1	6.5,6.5;6.5,6.5;	6.5
10.0-10.9	7,7.5;7.5,7.5;7,7.5;7.5,7.5;	7.4	7,7;7.5,7.5;7,7;7.5,7.5;	7.2	6.5,7;7.5,7;7.5,7;7,7;	7.1	7,7;7.5,7.5;7,7;7,7;	7.1	7,7;7.5,7;7,7;7,7;	7.1	6,6.5;6.5,6.5;6.5,6.5; 6.5,6.5;	6.4
11.0-11.9	7,7;7.5,7.5;7.5,7;7.5,7.5;	7.3	6.5,6.5;7.5,8;7,7.5;7,7.5;	7.2	7,7;7,7;7.5,7;7,7;	7.1	7,7;7.5,7.5;7,7;7,7;	7.1	7,6.5;7.5,7;7,7;7,7;	7	6.5,6;7,6.5;6.5,6.5; 6.5,6.5;	6.5
12.0-12.9	7.5,7.5;7.5,8;7.5,7.5;7,7;	7.4	7,7;7.5,7.5;7.5,7.5;7.5,7.5;	7.4	7,7.5;7.5,7.5;7,7;7.5,7.5;	7.3	7.5,7.5;8,7.5;7,7.5;7,7;	7.4	7.5,7;7.5,7;7,7;7,7;	7.1	6.5,6.5;7,6.5;6.5,6.5; 6.5,6.5;	6.6
13.0-13.9	7.5,7.5;7.5,7.5;7,7.5;7,7;7,7;	7.2	8,8;7,7.5;7,7.5;7,7;7.5,7;	7.4	7.5,8;7,7;7.5,7;7,7.5;7,7;	7.2	7,7.5;7.5,8;7,7;7,7.5;7,7;	7.2	7.5,8;7.5,7.5;7,7;7,7;7.57;	7.3	7,7;7,7;6.5,6.5;6.5,6.5; 6.5,6.5;	6.7
14.0-14.9 full moon	7.5;7.5, 7.5;7.5,7.5;	7.5	7;7.5,7.5;7.5 ,7;	7.3	7.5;7.5,7;7,7;	7.2	7;7,7.5;7,7;	7.1	7;7,7;7,7;	7	6.5;6.5,6.5;6.5,6.5;	6.5
15.0-15.9	7.5,7.5;	7 5	7.5,7.5;	7.5	7.5,7.5;	7.5	7,7;	7	7,7;	7	6.5,6.5;	6.5
16.0-16.9	7,7;	7	7,7.5;	7.2	7.5,7;	7.2	7,7;	7	6.5,6.5;	6.5	6.5,6.5;	6.5
17.^{d}0-17.^{d}9						Sunset						
18.^{d}0-18.^{d}9 … 29.^{d}0-29.^{d}5	Lunation AV	7.2		7.1		7	DARKSIDE	7		6.9		6.4

In addition to the albedo charts, I keep a table of auxiliary data by which I can analyze the data with respect to hypotheses of causes. This analysis will not be reported here; but previous analyses can be found in Cameron, 1974, 1979. I also have not yet analyzed the seeing measures. These will constitute future reports. When the albedo charts are sufficiently filled in, I supply copies to the observers so that they can see their progress and places where more observations are needed, and can use such charts to compare with their night's measures (after observations are made) to catch any unnoticed anomalies for checking upon.

In summary, the A.L.P.O.-LTP observing program has partially achieved some of its objectives. The partial success is a consequence of too few observers being active. Those

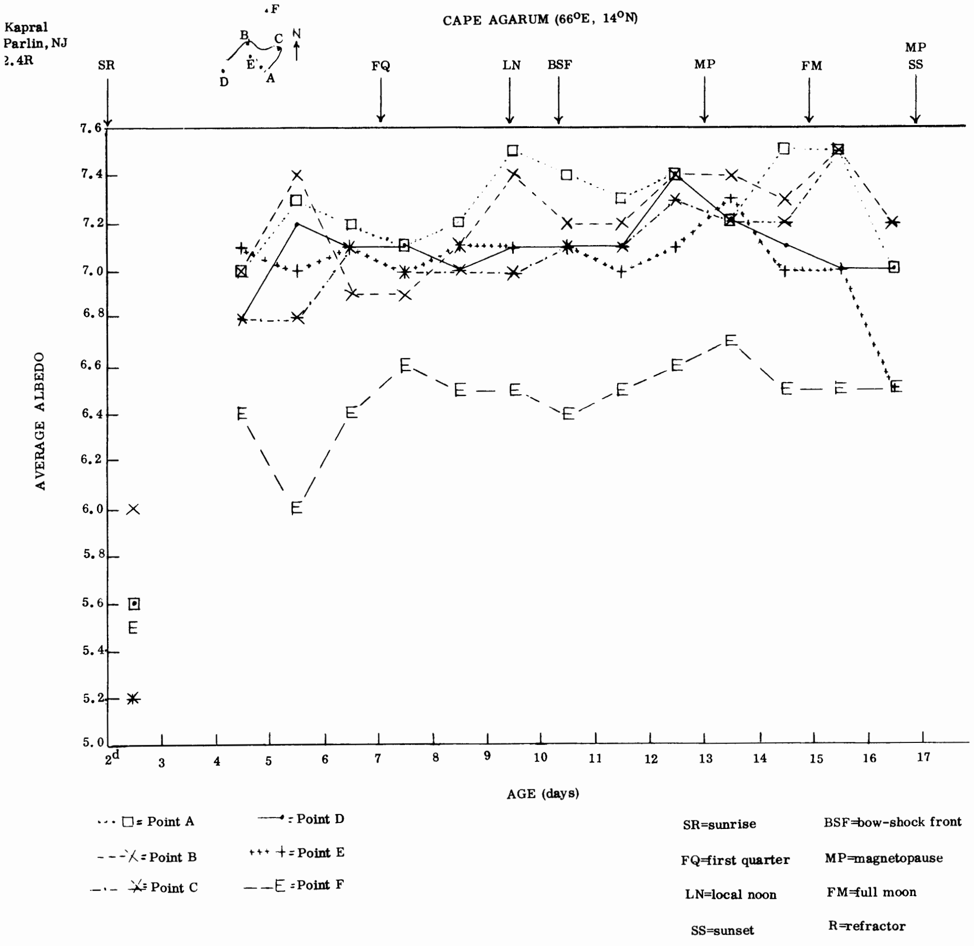

Figure 14. Sample albedo graph in A.L.P.O. Lunar Transient Phenomena Program. Prepared by Lunar Recorder Winifred Cameron. Observed albedo is plotted as a function of the Moon's age. See also text on page 18 and Table 3.

who have participated have done so in varying degrees as can be seen in Table 2. A number of possible anomalies is revealed in the albedo charts constructed from the observations for each feature. Possible anomalies are rarely found in the non-LTP comparison sites, the nearby plain comparison points, or in the seismic epicenters. This result lends validity to the concept that the LTP sites are really places of anomalous temporary behavior on the Moon. Similar anomalies (Cameron, 1980) were found in the photometric measures of albedo in three colors (UBV) of lunar features made by two professional astronomers (Wildey and Pohn, 1964). These permanent record anomalies appear to confirm the visual and permanent record reports of LTP from amateurs and professionals. I plead for more of those observers who inquired of the A.L.P.O.-LTP program and were assigned features now to observe and to report their measures.

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Wildey, R.L. and Pohn, H.A., 1964, "Detailed Photoel. Photom. of the Moon," Astron. J., 69, (8), 619-634 (August).

TABLE 1. A.L.P.O. - LTP OBSERVING PROGRAM (Cont.)

Name	Location	Telescope	Entered
D. Tweet	St. Paul, MN		1974
M. Valentine	Clarendon, PA		
J. Van der Stucken	Sonora, TX		1974
G. Vargo	Pittsburgh, PA		1973
R. Walker	Sayre, OH		
J. West	Bryan, TX	6L	1973
B. Williams	Memphis, TN		
F. Williams	Dublin, Ireland		
T. Williams	Cherry Hill, NJ		1974
W. Wilson	New Cumberland, PA		1974
R. Wright[w]	Silver Spring, MD	4R	1974-1976[w]
J. Zajac	Sugarload, PA		1977

*=reported data
L=reflector
R=refractor
w=withdrawn

CED=crater extinction device
[1]=not ALPO-LTP member
+=reported after Sept. 1980
#=Apollo 17 watch only

TABLE 2. REPORTING OBSERVERS

Name & Equip.	Features		IAU Selenographic Coördinates	No. of Meas. N	No. of Meas. I	No. of LTP Rept. N	No. of LTP Rept. I	No. of Poss. Anom. N	No. of Poss. Anom. I	Date Last Rept.
James	Proclus		46°E, 16°N	281	592					
Bartlett*	Plato		9 W, 51 N							
3R-5L	Eratosthenes	LTP	12 W, 13 N	13	29					
	Aristarchus		47 W, 23 N	22	49					
	Herodotus		48 W, 22 N	6	10					
James	Theophilus		26 E, 11 S	23	497	2	4			8/31/79
Caruso	Alphonsus	LTP	4 W, 13 S	16	336	1	3			
2.4R	Plato		9 W, 51 N	16	268	1	1			
	Grimaldi		65 W, 5 S	9	174					
	Aristoteles	Non-LTP	17 E, 50 N	21	390					
	A_{25} Seismic		49 E, 25 N	23	296					
Edith Davis	Manilius		8 E, 15 N							6/27/75
6L	Plato	LTP	9 W, 51 N	1	12					
	Clavius		11 W, 58 S	1	12					
	Lambert		21 W, 25 N							
	Catharina	Non LTP	24 E, 18 S							
	A_{20} Seismic		30 W, 22 N							
Peter	Proclus		46 E, 16 N	79	84			8	12	4/20/80
Foley*	Censorinus		33 E, 1 S	86	94			7	8	
12L CED	Piton		3 W, 39 N	91	105	2	2	29	32	
Blink	Pico		9 W, 46 N	27	29			2	2	
filters	Tycho	LTP	11 W, 42 S	27	29			3	3	
	Bullialdus		22 W, 20 S	21	21			2	2	
	Gassendi		40 W, 16 S	37	37					
	Aristarchus		47 W, 23 N	61	117	30(3)	43(15)	10	10	
	Stevinus "1"	Non-LTP	52 E, 33 S	17	18			1	1	
Bruce Frank	Eimmart		65 E, 24 N	20	122			2	2	9/5/76
6L	Calippus	LTP	10 E, 38 N	22	124	2	6	6	11	
	White Spot	in Walter	1 W, 33 S	21(2)	112			2	4	
	Mersenius		46 W, 21 S	18	95			1	2	
	Pontanus	Non-LTP	14 E, 28 S	5	30					
	Seismic		67 E, 17 N	26	152			2	2	
James	Cape Agarum		66 E, 14 N	8	97			2	4	9/30/73
Galgocy	Plato	LTP	9 W, 51 N	6	69					
2R	Tycho		11 W, 42 S	7	83					
	Copernicus		20 W, 9 N	6	69					
	Wilhelm	Non-LTP	20 W, 45 S	6	69					
	A_{14} Seismic		54 W, 45 S	0	0					

*not ALPO-LTP member, but reports albedos, ( ) reported as LTP, others mention color on Aristarchus, but none elsewhere.

TABLE 2. REPORTING OBSERVERS (Cont.)

Name & Equip.	Features		IAU Selenographic Coordinates	No. of Meas. N	No. of Meas. I	No. of LTP Rept. N	No. of LTP Rept. I	No. of Poss. Anom. N	No. of Poss. Anom. I	Date Last Rept.
Rick Hill	Messier		46°E, 3°S	17	142			2	7	11/5/73
10L, 6L	Messier A	LTP	45 E, 3 S	12	102			2	2	
	Pico		9 W, 46 N	9	66			3	5	
	Marius		51 W, 12 N	6	36			2	2	
	Lubbock	Non-LTP	40 E, 6 S	9	84	1	1	2	2	
	A_6 Seismic		27 W, 24 S	7	48			1	1	
Charles	Cape Agarum		66 E, 14 N	38	450			1	2	9/7/80
Kapral	Eimmart		65 E, 24 N	18	228			1	1	
2.4R	Cleomedes		56 E, 27 N	18	210					
	Taruntius		46 E, 6 N	18	245					
	Atlas		43 E, 46 N	18	210					
	Posidonius		29 E, 32 N	16	217					
	Theophilus	LTP	26 E, 11 S	33	441			2	3	
	Hyginus N		6 E, 9 N	13	150					
	Alphonsus		4 W, 13 S	15	203			1	2	
	Plato		9 W, 51 N	22	258					
	Gassendi		40 W, 16 S	18	248	1	1	1	2	
	Aristarchus		47 W, 23 N	9	122					
	Goclenius		45 E, 10 S	18	210					
	Albategnius	Non-LTP	5 E, 12 S	23	285					
	A_{20} Seismic		30 W, 23 N	19	222					
James	Cape Agarum		66 E, 14 N	6	60					
LeCroy	Alphonsus	LTP	4 W, 13 S	6	60			1	2	2/15/76
4.5L	Clavius		12 W, 58 S	6	50			2	3	
	Eratosthenes		12 W, 14 N	6	40			2	3	
	Goodacre	Non-LTP	13 E, 30 S	6	40			2	3	
	A_{18} Seismic		30 E, 26 N	6	40			1	2	
Daniel	Cape Agarum		6 E, 14 N	9	51	1	1			4/30/80
Louderback	Piton	LTP	3 W, 39 N	4	18	1	1			
2.5R,8L	Aristarchus		47 W, 23 N	7	56	3	7			
filters	Cobra Head		48 W, 24 N	3	6					
	Langrenus	Non-LTP	60 E, 8 S	2	3					
	HFT Seismic		27 W, 35 S	1	12					
Thomas	Linné		11 E, 27 N	7	80					6/14/73
Lynch	Lexell	LTP	5 W, 35 S	8	89			2	3	
6L	Carlini		24 W, 34 N	7	64			3	6	
	Wargentin		60 W, 50 S	6	48					
	Schiller	Non-LTP	39 W, 51 S	6	51					
	Seismic		28 W, 21 S	6	64					
Alain	Dawes		27 E, 17 N	86	910	1	15	8	32	8/19/78
Porter	Godin		10 E, 2 N	75	491			9	23	
6L	Alphonsus		4 W, 13 S	19	280	2	14	-	-	
	Plato	LTP	9 W, 51 N	16	359	1	2	3	8	
	Clavius		12 W, 58 S	66	1410			12	38	
	Landsberg		26 W, 1 S	62	790			5	20	
	Aristarchus		47 W, 23 N	10	154	2	-	1	1	
	Cobra Head		48 W, 24 N	4	53			2	6	
	Parry	Non-LTP	16 W, 8 S	38	535	1	3	2	5	
	A_{16} Seismic		11 E, 6 N	58	679					
Thomas	Hyginus N		6 E, 9 N	5	44					1/28/77
Traub	Herschel	LTP	3 W, 5 S	5	66					
8L	Philolaus		30 W, 70 N	3	14					
	Riccioli		75 W, 2 S	3	13					
	Apianus	Non-LTP	7 E, 26 S	5	55					
	A_{14} Seismic		53 W, 45 S	3	11					

*not ALPO-LTP member, but reports albedos, ( ) reported as LTP, others mention color on Aristarchus, but none elsewhere.

Note by Editor. We heartily underscore Winifred Cameron's request for increased observational activity in the A.L.P.O. - LTP program on the part of the many registered observers in Table 1; and we would surely welcome a goodly influx of new, active observers. It may be worthwhile to remind young readers that the 1960's witnessed tremendous amateur enthusiasm for LTP's (Lunar Transient Phenomena). Indeed, some eager chaps seemed able to record all kinds of activity on the lunar surface whenever they went to the telescope! It was disturbing that at the same time skilled and experienced lunar observers, such as Elmer Reese and Alika Herring, reported no such events. Ms. Cameron has described in her paper a lunar project with needed controls which is capable of giving valid scientific results. Those who complain that there is no longer anything to observe on the Moon here have an opportunity.

NEW STATISTICAL MEASUREMENTS OF SATURN'S RINGS

By: E. Sassone-Corsi and P. Sassone-Corsi,
Observatoire de Paris, Section d' Astrophysique, 92190, Meudon, France

Abstract

The determinations of the dimensions of Saturn's rings have always been of a sporadic type and have at most covered time intervals of a few years. This paper gives the results of the analysis of a group of photograms taken of the planet between 1909 and 1975. These results demonstrate variations in the dimension of Rings A and B and Cassini's Division with regard to both time and Saturnicentric latitude.

I. Introduction

The first reliable measurement of the dimensions of Saturn's rings was effected by W. Struve in 1826 by a filar micrometer (Struve, 1828). The most recent measures are those of Dollfus and Focas, who have used a double image micrometer (Dollfus, 1970a and Dollfus, 1970b), Coupinot (1973) who has used photographic photometry on Guérin plates obtained at Pic-du-Midi, and Pollack (1975). The measures secured up to now have always covered comparatively short periods, never longer than some years.

The aim of this work was to analyze the dimensions of Saturn's rings measured on high-resolution film plate photograms, in a systematic manner and during long periods. On the basis of a large number of measures, made on plates secured from 1909 to 1975, the following was concluded:

a) Mean values of the dimensions of the rings and the respective errors are related to the Saturnicentric latitude (B);
b) Analysis of these data as related to time shows the existence of slight variations in the dimensions of the rings.

Hence, the possible causes of the observed variations are discussed qualitatively.

II. Materials and Methods

At the IAUPPC (Planetary Photographic Center of International Astronomical Union) of Meudon (Paris), 159 high-resolution photograms taken of the planet were selected. This photographic material was obtained from the following observatories: Athens, Juvisy, Lick, Lowell, McDonald, St. Martin-de-Peille (Monaco), New Mexico State University, Pic-du-Midi, Swedish Astrophysical Station, and Table Mountain. All the photos were chosen considering similar conditions of spectrum window and exposure time.

It is important to note that all these observatories are in the terrestrial North Hemisphere. The Saturnicentric latitude, relative to the available plates, ranges from $B = -27^{o}$ to -9^{o} and from $B = + 9^{o}$ to $+27^{o}$; the time interval covered is from September 10, 1909 to December 24, 1975 (Figure 15).

The measures were made by photodensitometric and micrometric reliefs both on the original photograms carried out at the Observatory of Pic-du-Midi, and on negative reproductions on the IAUPPC. The photodensitometer used was a Joyce-Loebl.

Since it is impossible to know the real focal length for the individual photos, the measures are made relative to the major axis of the rings. This choice is not excessively important if we consider the analysis later made on the photograms.

The measures gave the widths of Ring A, of Cassini's Division, and of Ring B, all related to the major axis of the rings as unity. Ring C was excluded from the measures because it almost always has a vague inner edge. For the same reason, Ring D was not considered (Guérin, 1973).

Figure 16 shows a typical microdensitometric tracing of the rings at the ansae.

III. Results

Figure 17 shows the distribution of the measured dimensions of Ring A, Cassini's Division, and Ring B in relation to Saturnicentric latitude (B).

Examining Figure 17, we can note:

TABLE I. Average dimensions of the Rings of Saturn for $B<0^{\circ}$ and $B>0^{\circ}$. The unit, or 100%, is the major axis of the rings.

	$B<0^{\circ}$	$B>0^{\circ}$
Ring A	5.41% ± 0.14	4.81% ± 0.23
Cassini's Division	1.73% ± 0.09	1.81% ± 0.23
Ring B	9.60% ± 0.24	9.42% ± 0.36

TABLE II. Results of Different Observers in Measuring the Dimensions of Saturn's Rings

	Sassone-Corsis	Dollfus (1970a)	Coupinot (1973)	Pollack (1975)
Outer edge of Ring A	39".45 ± 0".10(*)	39".45 ± 0".10	39".8	39".64 ± 0".29
Inner edge of Ring A	35.41 ± 0.17	34.80 ± 0.12	35.4	35.14 ± 0.29
Outer edge of Ring B	34.01 ± 0.15	34.10 ± 0.10	33.9	33.74 ± 0.29
Inner edge of Ring B	26.51 ± 0.20	26.68 ± 0.22	26.6	26.42 ± 0.29

(*) - Dollfus (1970a, 1970b)

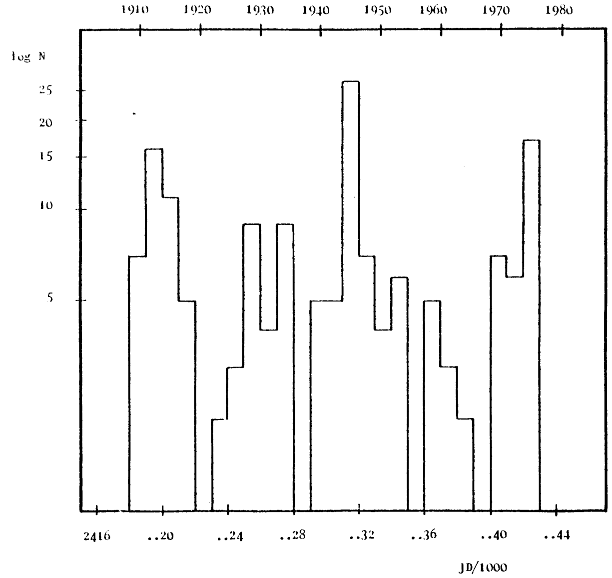


Figure 15. Histogram to show distribution over time of photograms used to measure the dimensions of the rings of Saturn. Year at top, Julian Day at bottom, log of number of photograms on vertical scale. Figures 15-18 were prepared and contributed by E. and P. Sassone-Corsi to illustrate their paper appearing on page 24 _et_. _seq_.

a1) The more $B \rightarrow 0^{\circ}$, the greater the tendency for an average increase of the measuring error in the three zones of the rings considered;

a2) The measuring errors are on the average greater for $B>0^{\circ}$ than for $B<0^{\circ}$ (see Table I);

a3) The mean dimensions for Ring A and Ring B are greater for $B<0^{\circ}$ than for $B>0^{\circ}$ (see Table I).

Figure 18 indicates:

b1) For Ring A, the straight line which best fits the set of experimental discrete points is:

$$Y = 4.26\ (\pm\ 0.24) + 3.2 \times 10^{-5}\ (\pm\ 8 \times 10^{-6})\ X$$

In this case, the angular coefficient appears positive.

b2) For Cassini's Division, the straight line which best fits the set of experimental discrete points is:

$$Y = 2.08\ (\pm\ 0.15) - 1.1 \times 10^{-5}\ (\pm\ 5 \times 10^{-6})\ X$$

Here the angular coefficient appears negative.

b3) For Ring B, the straight line which best fits the set of experimental discrete points is:

$$Y = 7.15\ (\pm\ 0.35) + 7.9 \times 10^{-5}\ (\pm\ 1.1 \times 10^{-5})\ X$$

Here the angular coefficient appears positive.

Mean dimensions of the rings, calculated on the basis of all the determinations carried out and expressed in percent of the major axis, are:

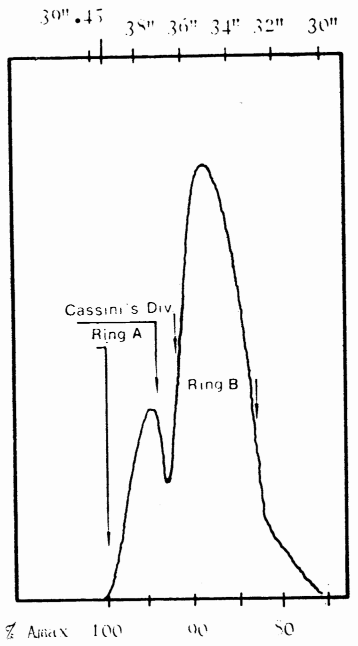
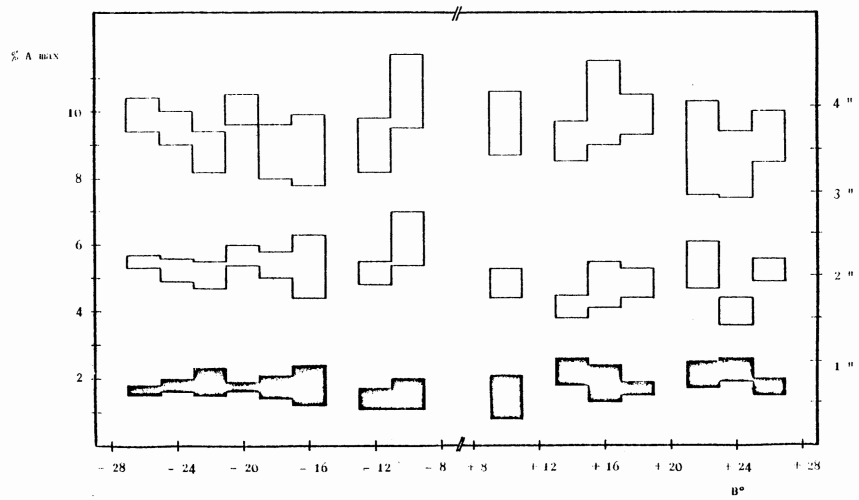


Figure 16 (left). Typical microdensitometric tracing of the rings of Saturn at the ansae. Arrows show positions measured. Pic-du-Midi photograph on January 30, 1944.

Figure 17 (below). Measured dimensions of Saturn's rings vs. Saturnicentric latitude (B). Top row of squares, Ring B; middle row, Ring A; bottom row, Cassini's Division. Horizontal scale: B in degrees. Vertical scale; measured widths as a percentage of the major axis of the rings (left) and in seconds of arc assuming the major axis to be 39".45 ± 0".10 (right).



Ring A	5.11% ± 0.20	2".02 ± 0.18
Cassini's Division	1.77% ± 0.11	0".70 ± 0.14
Ring B	9.51% ± 0.27	3".75 ± 0.21

The values were calculated in seconds of arc assuming the major axis to be equivalent to 39".45 ± 0.10 (at 9.539 Astronomical Units) (Dollfus, 1970a; Dollfus, 1970b).

IV. Discussion

In Table II our results are compared with those of Dollfus (1970a, 1970b), Coupinot (1973), and Pollack (1975).

A possible explanation of what was observed at point a1) in "Results" is that during the period when the value of B is numerically low, determination of the dimensions of the rings is objectively difficult.

Since the declination of Saturn decreases with the increase of B, then in the North Hemisphere the height above the horizon also decreases. This implies a decreased quality

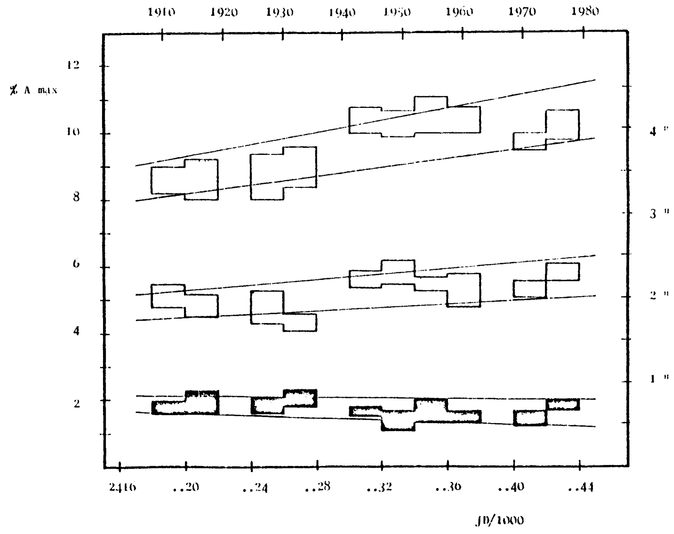


Figure 18. Measured dimensions of Saturn's rings as a function of time, year at top and Julian Day at bottom. Ring A, Ring B, and Cassini's Division identified as in Figure 17. Vertical scales same as in Figure 17. See also discussion in text.

and lesser frequency of observation (see Figure 15). This fact could explain point a2).

In planetary photography there is a tendency to reduce the exposure with relation to the height of the object above the horizon in order to reduce the seeing effects. This could partly explain point a3).

Steady increases of the dimensions of Ring A and Ring B and the contemporaneous slight decrease of the width of Cassini's Division, see Figure 18 and points b1), b2), and b3), may be explained by the constant improvement with time of the photographic technique. Nevertheless, the phenomenon might also be explained by a possible variation of the physical equilibrium of the structure of Saturn's rings.

V. Acknowledgments

We are grateful to Professors A. Dollfus and R. Servajean for their hospitality at IAUPPC, Meudon, and for valuable advice and interesting discussions. We are indebted to Prof. A. Dollfus for critical reading of this manuscript. We also thank Mrs. Neyvoz, Mrs. Barthalot, and Mrs. S. Hafkin.

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BOOK REVIEWS

Bound For The Stars, by Saul J. Adelman and Benjamin Adelman, Prentice-Hall, Inc., Englewood Cliffs, N. J. 335 pages, hardbound. Price $17.95.

Reviewed by Jose Olivarez, Director, Wichita Omnisphere

Is there any real hope of our achieving the level of science and technology that will enable us actually to voyage to the stars? This is the question which is boldly taken up by astrophysicist Saul J. Adelman and science writer Benjamin Adelman in this thoroughly documented and clearly written book. In essence this book is an absorbing and far-sighted look at the problems that must be surmounted in future planetary and interstellar space exploration. Indeed, the ideas of many scientists and engineers on all facets of space exploration are examined. The result is Bound For the Stars, which the authors say is a suggested practical course of action for the space enterprise.

Expectedly, the book opens with a look at the origin of life and the possible existence of extraterrestrial intelligences. Indeed, the search for life outside the Earth has been a major incentive for space exploration (and to some it is the only one). But the authors feel that this incentive has been so overplayed by the media that many people now believe that space exploration is pointless if life is not found elsewhere. They assert that this belief is a dangerous assumption because the absence of life from all other planets except the Earth would be very interesting and meaningful. To their mind, we are "bound for the stars" in either case, and the 300 pages which follow their introduction present a thoroughly documented and convincing case on how it may be done.

The first 10 Chapters of Bound For The Stars are devoted to the various plans that have been developed over the years for Solar System exploration and also look at the problems which we shall have to overcome on our journey to the stars. For example:

Chapter 4 looks at the hazards to space exploration. The problems of space radiation and the effects of weightlessness are described.

Chapter 5 explores the most critical element in our space enterprise - propulsion. (Interestingly, nuclear space propulsion is cited as the only means of deep space exploration available today.)

Chapter 6 looks at the prospect for colonizing Earth-Moon space, including solid suggestions for space colonies, solar power satellites, and a Lunar Base.

Chapters 7 through 10 deal with Solar System exploration and look at the critical aspects of planetary navigation and travel.

Chapters 12 through 19 are devoted to interstellar flight and offer the best formulated plans for Man's initial interstellar voyage. In the opening chapter, the authors are careful to point out that interstellar flight is extraordinarily difficult to achieve in view of the immense distances involved, the almost incredible velocities demanded, and the unprecedented requirements of energy. Nevertheless, the chapters which follow make the reader forget the difficulties inherent in interstellar flight plans and make their realization almost accessible:

Chapter 12 is devoted to Starships: Project Orion (a starship propelled by atom bombs), laser-powered starships, Project Daedalus, and the Interstellar Ramjet (which may be the most effective starship yet imagined).

Chapter 15 looks at what it would be like on board the first interstellar starship, and Chapter 16 discusses the problems which will be faced in organizing the first interstellar expedition.

Bound For The Stars is a rich source of solid information on what is being done (and what is possible) in Man's plans for Solar System colonization and interstellar space exploration. It deals with the most critical aspects of space intelligently and succeeds in making a fascinating and favorable case for space travel. Indeed, this book is an excellent report on the space effort (past and future) for all serious students of space science and for all those who would agree with Commander John Young (commander of the first Space Shuttle) that we are bound for the stars!

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Planets and Moons, by William J. Kaufmann, W. H. Freeman and Company, San Francisco, CA 94104. 219 pages, illustrated. 1979. Price $14.00 hardbound, $7.50 softbound.

Reviewed by Gail O. Clark, Pocatello, Idaho

The primordial interstellar dust cloud, sinuously curling and slowing writhing, ever so slowly, was interrupted in its solitary existence eons ago, and in some manner became imperceptibly compressed. Perhaps during the majestic sweep of a spiral arm of the galaxy, a coalescence resulted which eventually condensed the dust, wandering atoms, and other cosmic debris into the configuration we know today as the Solar System.

Commencing with such a possible scenario, William Kaufmann grips the curious reader's imagination; and in an interest-filled tour of our corner of the galaxy, entertains and enlightens throughout the nine chapters of this third volume in the popular Kaufmann trilogy. This book - like the two others - (Stars and Nebulas and Galaxies and Quasars) is a prime example of popular knowledge packaged in a slick, organized, and easily digested format.

Foremost, Planets and Moons is a book about the Solar System. It is an expertly guided tour of the planets, beginning with the fiery arena of Mercury and moving outward planet-by-planet to the frigid regions of Pluto, with cursory examinations of the moons found along the way.

The text is intelligible, non-technical, and will give the reader little trouble in understanding the basics which describe our niche in the universe.

The volume is replete with sharp black-and-white photographs, nearly all recent, and each handily captioned and placed adjacent to the pertinent textual matter. The eight color plates are standard NASA color photographs which, while pretty, do not add appreciably to the book, except possibly to the cost. Most readers will recognize several of these shots; however, the many line drawings, charts, and tables are useful and effective devices that do add value to the volume. A very brief bibliography precedes an up-to-date appendix of orbital, physical, and satellite data about the planets.

Probably the high point of the book is the author's ability to enhance the excitement inherent in getting to know the Solar System. Kaufmann does this in a readable and engrossing manner; his style is smooth, and his descriptions are lucid, vivid, and colorful.

Regarding a comparison of the Earth's and Jupiter's magnetic field, Kaufmann says, "If you could see Jupiter's magnetic field at night with your naked eyes, it would appear sixteen times as large as the full moon..."

The author alludes to the seasons on Uranus, "...during summer in the northern hemisphere, the sun appears suspended for years nearly overhead at the North Pole."

While his analogies are descriptive and provocative to the mind's eye, a great deal of sound, factual information is presented. Planets and Moons is a superior introductory level book which gives an accurate, exciting survey of the Solar System. Most readers will enjoy the trip.

* * * * * *

The Search for Gravity Waves, by Paul Charles William Davies. Cambridge University Press, United Kingdom. 1980. Natural History Book Club Edition. Price $10.95.

Reviewed by Paul K. Mackal, A.L.P.O. Jupiter Recorder

Paul Davies' new book about gravity is a must for high school physics, astronomy, and mathematics teachers in America and for advanced seminar students in high schools. It is excellent reading for undergraduate science majors and such graduate students internationally who take more than a benign interest in the larger scientific problems of our day. Indeed, it is an excellent introduction to the cosmological problem from the perspective of our own planet, Earth, and the Solar System.

Most of the mathematical equations are satisfactory and can be worked out by hand, though several key transformations seem to be missing on pp. 88 to 92. The mathematical equations in this book are not formidable. However, on pp. 96 to 97, the connection between a statistical (and a differential) equation is left for the high school teacher (or reader) to work out. Certain physical assumptions are made by Paul Davies throughout the work which appear lacking in parsimony, e.g. on p. 81. Remarks made at the top of p. 94 are vague and should be expanded.

On p. 22, the series expansion for $E = mc^2$ is not given. It should be, in my estimation. Also, the geometrical diagrams in this book are not complete in all detail, though there are more than enough of them in places. In particular, the reader should be wary of the weak section in the book, "The General Theory of Gravity" (on pp. 46-48). It should have been omitted. Also, some electro-magnetic diagrams are neither adequately rendered nor properly annotated, as succintly as one would wish. On p. 94 (and again on p. 125) the author fails to mention anti-gravitons. Critical formulae on p. 99 have not been put side by side with those of the appendix. (Viz., 4.5 with A.13 and 4.6 with A.12.) This arrangement is not convenient for the reader. The implications for Fred Hoyle's thesis are omitted on pp. 116-117.

Paul Davies should be congratulated on trying to reconcile quantum theory, general relativity, and Newtonian physics! However, a lot more work needs to be done. Concerning gravity-wave telescopes, they should be situated in a solar orbit in order to note the bending of gravity waves, according to de Broglie theory. Gravity (anti-gravity) waves should be straighter than anti-photon (photon) waves, not just faster than light. Our Sun is a gravity wave deflector for such a telescopic mass. Finally, we need to detect other ponderable masses about the size of our own universe in the skies. We need to know what role gravity-wave telescopes will play in this continuing saga to expand our knowledge of the universe to the very farthest reaches of the cosmos!

NEW BOOKS RECEIVED

By: J. Russell Smith, Dale P. Cruikshank, and Gail O. Clark

An Introduction to Relativity, by S. K. Bose. John Wiley and Sons, One Wiley Drive, Somerset, N.J. 08873. 1980. Price, paperback $9.95. Notes by J. Russell Smith.

This work is a mathematical treatise which grew out of a course taught by the author. The chapters are Physical Principles, General Tensors, Influence of Gravitation on Physical Systems, Einstein's Field Equations, The Schwarzschild Line-Element and Its Consequences, Stellar Structures, Gravitational Collapse, Cosmology, and The Early Universe.

The Appendix consists of the value of some physical quantities in geometrical units. This is followed by a suitable Index.

* * * * * *

Computational Spherical Astronomy, by Laurence G. Taff. John Wiley and Sons, Inc., One Wiley Drive, Somerset, N.J. 08873. 1981. 233 pages. Hardbound. Price $28.95. Notes by Gail O. Clark.

Designed for those with keen interest in deriving positions, distances, and motions of stars and Solar System bodies, this volume presupposes a command of algebra, calculus, and trigonometry. Curiously for this presentation level, minimal knowledge of astronomy is assumed. Formulae are given, sample calculations are shown, and an excellent 40-page glossary is included.

* * * * * *

The Physics-Astronomy Frontier, by Fred Hoyle and Jayant Narlikar. 1980. 317 illustrations. Price, hardbound $19.95. W. H. Freeman and Co., San Francisco, CA 94104. Notes by Dale P. Cruikshank.

Hoyle and Narlikar have produced a most interesting, innovative, and fascinating book on astronomy from the point of view of the physicist. The treatment is, amazingly, almost completely nonmathematical, yet it covers matter, radiation and fundamental astronomy, all in preparation for a detailed and highly readable presentation of the modern ideas of stellar evolution (black holes and related phenomena in particular), cosmology, and space-time physics. While the planets are scarcely mentioned, except for scale (Jupiter isn't listed in the index!), the avid reader of astronomy at the university level will be fascinated by this remarkable new book by acknowledged experts in the field. This is an excellent text for a one-semester course in modern cosmology and related aspects of current astronomy, though it should not be taken as a complete text of modern astronomy, since its treatment is rather more narrowly confined.

* * * * * *

Stones From the Stars: The Unresolved Mysteries of Meteorites, by T. R. LeMaire. Prentice Hall, Inc., Englewood Cliffs, N.J. 07632. 1980. 185 pages. Price $9.95, hardcover. Notes by J. Russell Smith.

If you are interested in meteors and meteorites, you no doubt would like to have this book. Part I has four chapters on Interplanetary Visitors. Part II has five chapters on the Geography of Meteorites, and Part III has three chapters on Star-Wounds. The author discusses the Siberian Fix in the Conclusion. The book also has a suitable bibliography and Index.

PREDICTIONS FOR THE INDONESIAN TOTAL SOLAR ECLIPSE OF 1983

By: Fred Espenak, Infrared and Radio Astronomy Branch, NASA, Goddard Space Flight Center

Abstract

Out of the 228 solar eclipses occurring during the 20th century, 71 of them are total eclipses. Many of these events are of short duration or occur in relatively inaccessible regions of the Earth. The celestial mechanics of the total eclipse of 1983 will result in a very favorable opportunity to study the physics of the Sun. The author will present computer predictions for this eclipse and will discuss the general characteristics and local circumstances from various points along the eclipse path.

About the Author

Fred Espenak is an infrared astronomer at NASA/Goddard Space Flight Center in Greenbelt, Maryland. His current research involves the modeling of planetary atmospheres using data from Voyager and ground observatories. As a result of his work, Mr. Espenak helped discover the first natural laser which occurs in the CO_2 atmosphere of Mars. Mr. Espenak is a veteran of six total solar eclipse expeditions, and he calculated all predictions used in this paper.

A total solar eclipse of exceptionally long duration will occur on June 11, 1983. As the Moon crosses the ascending node of its orbit, it will obscure the Sun's disk for over five minutes along a narrow corridor on the Earth. The Moon's cone-shaped umbral shadow will delineate a path across the Indian Ocean, through the islands of Indonesia and New Guinea and then head out over the Coral Sea. Outside the path of totality, a partial eclipse will be widely visible from Southeast Asia, the Philippines, Indonesia and all of Australia (see Fig. 19).

The total eclipse will begin at sunrise (3:11 U.T.) in the Indian Ocean, some 1800 kilometers southeast of Madagascar. The umbra will define a path 130 kilometers wide, and the total phase will last 2 1/2 minutes at the center line. During the next hour, the shadow will sweep northeast across 7200 kilometers of ocean with no major landfall. The path of totality will finally bring the umbra to land as it crosses the southern coastline of Java at 4:26 U.T. (Figures 20 and 21). By this time, the width of the path will have grown to 195 kilometers. As the umbra travels inland, the city of Jogjakarta will be plunged into darkness for 300 seconds while the eclipsed Sun stands 59° above the northern horizon. The shadow will cross the island in six minutes and reach the northern shore of Java at 4:32 U.T. Here, observers in the town of Tuban will witness 5 minutes and 7 seconds of totality during local apparent noon. Southeast of the center line, the seaport city of Surabaja will enjoy 4 minutes and 20 seconds of total eclipse.

Shortly after the shadow leaves Java, the eclipse will reach its maximum duration of 5 minutes and 10 seconds (Lat.= 6°15' South, Long.= 114°11' East). At this instant, the axis of the shadow will pass closest to the Earth's center (4:43 U.T.). Continuing along its inevitable course, the umbra will sweep out over the Java Sea, where many small islands lie in its path. At 4:57 U.T., the shadow will reach the southwestern coast of Celebes (Sulawesi), where the city of Makasar stands near the center line. The duration of totality here will be 5 minutes and 5 seconds, and the Sun will have an altitude of 58°. The umbra will now be traveling almost due east as it crosses southern Celebes and moves out over the Banda Sea. As the path curves southward, the islands making up Kepulauan Kai and Kepulauan Aru will pass under the Moon's shadow.

The umbra will pick up speed as it races across the Arafura Sea, reaching the southern coastline of New Guinea at 5:50 U.T. The path inland will cross swampy terrain before it sweeps out over the Gulf of Papua. Returning again to the southern coast of New Guinea, the umbra will engulf Port Moresby. By this time, the width of the path will have shrunk to 165 kilometers. The total eclipse will last 3 minutes and 16 seconds while the late afternoon Sun stands 24° above the horizon. Traveling across the Coral Sea, the last landfall occurs among islands of the New Hebrides. An observer there will see the Sun set in total eclipse as the umbra leaves the Earth's surface (6:15 U.T.).

In spite of the fact that Indonesia experiences some of the highest annual rainfall on Earth, the weather prospects for the solar eclipse are quite encouraging. The eclipse occurs during the east monsoon season which brings winds out of Australia lying to the southeast. Since this continent is just beginning winter, the air can be characterized as relatively cool and dry. However, the humidity and temperature of this air mass quickly increase as it crosses the Timor Sea. Nevertheless, most rainfall occurs during short, intense thunderstorms, often during the middle or late afternoon. The path through western Indonesia will bring the umbra through this region at local apparent noon and will therefore be somewhat more favorable than for points to the east, which will witness totality later in the day. In particular, satellite photographs indicate a 70% probability of clear skies over Java and western Celebes at eclipse time.

This eclipse occurs three years after sunspot maximum, and the corona may very well display structures which are characteristic of both low and high sunspot activity. The corona observed during the 1973 eclipse was of this type since it had some large equatorial streamers (high activity) to the west while delicate polar plumes (low activity) were visible in the northern quadrant. The prospects of observing a prominence along the Sun's limb are not very promising, although it always remains a distinct possibility at any eclipse.

During totality, observers will have a fine opportunity to gauge the sky darkness since the Sun will be placed among the bright winter constellations (Figure 22). Aldebaran (m_v = + 1.1) will be only 11° southwest of the Sun while Betelgeuse (m_v = + 0.5 but variable) will shine 17° to the southeast. Capella (m_v = + 0.2), Pollux (m_v = + 1.2), and Procyon (m_v = + 0.5) will be located 23° north, 29° east, and 32° southeast, respectively. Probably the easiest star to observe will be Sirius (m_v = -1.5) which will be 43° southeast of the eclipsed Sun. Three planets will also be favorably placed during totality. Mercury (m_v = + 0.5) will be at greatest western elongation 24° from the Sun. After having just emerged from solar conjunction, Mars (m_v = + 1.7) will be a scant 2° west of the Sun and should form a striking sight if the corona and sky are not too bright. Finally, Venus (m_v = -3.9) will be the most conspicuous object besides the eclipsed Sun and will probably be visible several minutes before the commencement of totality. Venus will be located 45° east of the Sun in Cancer. The visibility of all these objects is strongly dependent on the transparency and darkness of the sky during the eclipse. If a moderate to heavy layer of cirrus clouds is present, Venus may be the only one seen.

The total eclipse of 1983 is a member of Saros series 127. This family started with 20 partial eclipses visible in the north polar regions beginning in 991 A.D. The first central eclipse occurred during 1352 and was total for a maximum of two minutes. Since that year, every member of the series has resulted in a total eclipse with an average duration of four to five minutes. As is the nature of all odd numbered Saros series, the path of each successive member of this group has shifted in a generally southward direction. The next member of this series will take place on the summer solstice during the year 2001. The path of totality will bring the umbra across the South Atlantic, southern Africa, and the Indian Ocean. The last total solar eclipse of Saros 127 will occur in 2091. Thereafter, partial eclipses will be visible from the south polar regions. A partial eclipse in 2434 will end the series, which will have produced 42 total and 39 partial eclipses.

(Text continued on page 34.)

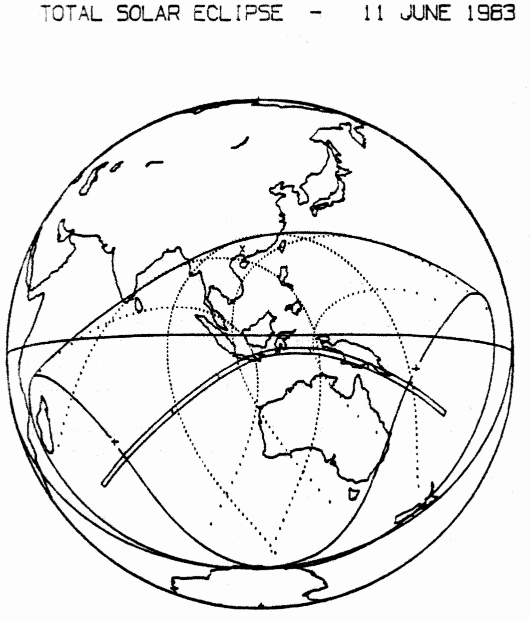

Figure 19. The entire umbral path of the 11 June, 1983 total solar eclipse as seen from the zenith of the point of maximum eclipse in the Java Sea. The path of the penumbra is also depicted, as well as its outline at hourly intervals (dotted curves). Figures 19-22 were supplied by Mr. Fred Espenak. See also text on pg. 30 *et seq*.

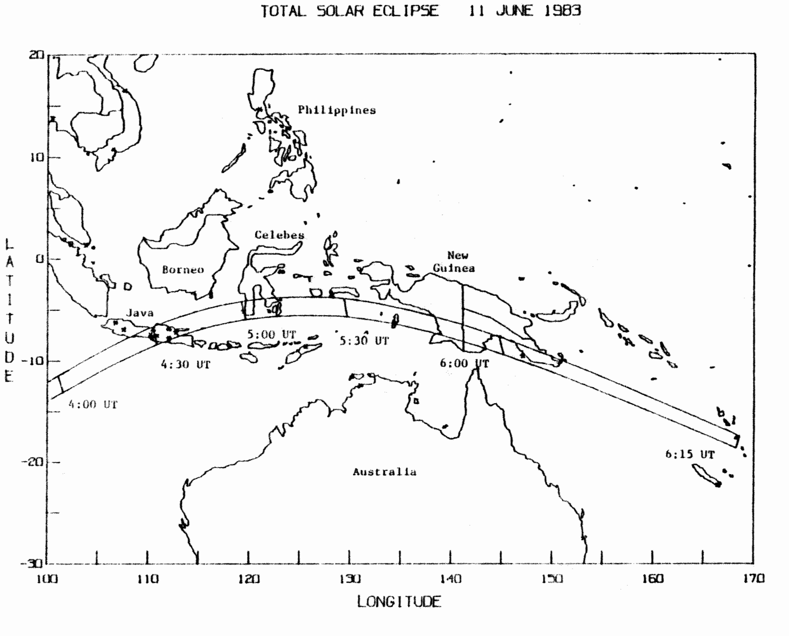

Figure 20. The umbral path through Indonesia will be 200 kilometers wide, and observers in the path can expect to witness up to 5 minutes and 10 seconds of total eclipse. The umbra leaves the Earth among the islands of the New Hebrides.

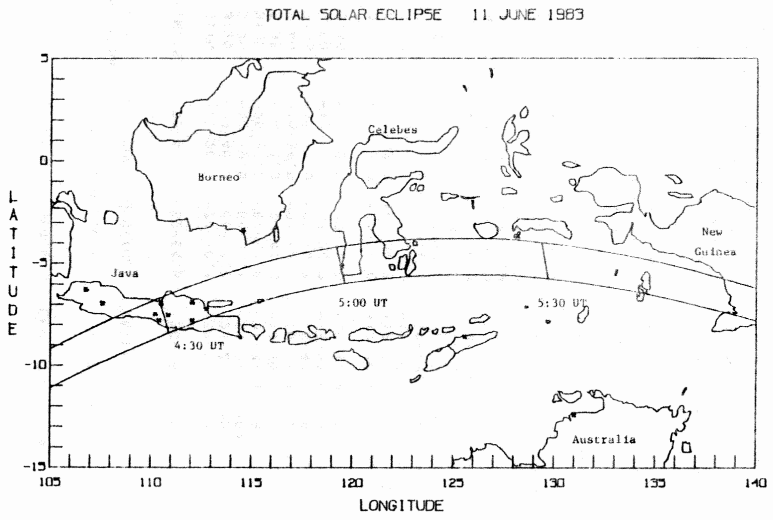

Figure 21. As the umbra sweeps over Indonesia, many small islands as well as Java and southern Celebes will be engulfed by the Moon's shadow. The locations of many cities listed in Table III are represented as '*''s on this map.

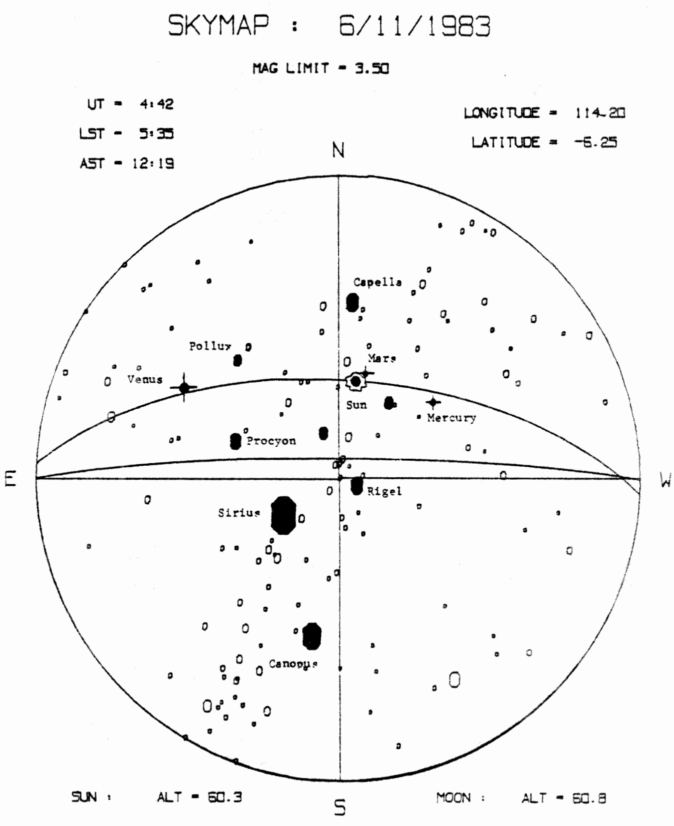

Figure 22. During totality, Venus, Mars, and Mercury should be visible, as will many of the brighter stars (shaded) of the winter skies. This map depicts the celestial hemisphere from the Indonesian section of the eclipse path.

Predictions for the 1983 eclipse are presented in Tables I-IV and were generated on an IBM 360/91 computer using algorithms primarily from the Explanatory Supplement to the Ephemeris (1961) and from Meeus's Canon of Solar Eclipses (1966). Table I defines the limits and the center line for the path of totality at five minute intervals and lists the ratio between the apparent diameters of the Moon and the Sun. The next two columns give the altitude and azimuth of the Sun at mid-totality. The major and minor axes (kilometers) describe the ellipticity of the umbral shadow on the Earth, and the width of the path of totality (kilometers) follows. Finally, the duration of totality is listed in minutes and seconds.

Table 1

PATH OF UMBRA AND CENTER LINE DATA - TOTAL SOLAR ECLIPSE OF 6/11/1983

UNIVERSAL TIME	NORTHERN LIMIT LATITUDE	NORTHERN LIMIT LONGITUDE	SOUTHERN LIMIT LATITUDE	SOUTHERN LIMIT LONGITUDE	CENTER LINE LATITUDE	CENTER LINE LONGITUDE	RATIO	ALT	AZ	MAJOR AXIS	MINOR AXIS	PATH WIDTH	DURATION TOTALITY
LIMITS	-35-41.1	-59-54.6	-36-46.1	-60-27.5	-36-13.4	-60-11.2	1.0361	0.0	60.8	-	121.3	129.2	2:10.1
3:15	-28-20.3	-74-20.4	-30-15.0	-73-38.8	-29-16.4	-74 -2.1	1.0405	14.3	52.7	550.2	135.6	143.0	2:42.8
3:20	-24-46.3	-80-24.0	-26-27.8	-80-18.1	-25-36.4	-80-22.1	1.0428	21.8	48.7	385.1	143.0	150.6	3: 2.8
3:25	-22 -9.5	-84-35.1	-23-47.0	-84-42.8	-22-57.8	-84-39.7	1.0444	27.3	45.7	323.0	148.2	156.2	3:18.6
3:30	-20 -1.2	-87-53.8	-21-37.1	-88 -9.2	-20-48.8	-88 -2.1	1.0457	31.8	43.1	288.6	152.3	160.9	3:32.4
3:35	-18-11.3	-90-41.3	-19-46.6	-91 -1.6	-18-58.6	-90-52.0	1.0468	35.8	40.6	266.3	155.6	165.1	3:44.7
3:40	-16-34.5	-93 -8.0	-18 -9.7	-93-31.7	-17-21.8	-93-20.3	1.0477	39.3	38.2	250.5	158.5	168.9	3:56.0
3:45	-15 -7.9	-95-19.7	-16-43.5	-95-45.8	-15-55.4	-95-33.1	1.0485	42.4	35.6	238.8	161.0	172.4	4: 6.5
3:50	-13-49.7	-97-20.3	-15-25.8	-97-48.2	-14-37.5	-97-34.6	1.0492	45.3	32.9	229.7	163.2	175.6	4:16.1
3:55	-12-38.5	-99-12.5	-14-15.2	-99-41.6	-13-26.6	-99-27.3	1.0498	47.9	30.1	222.6	165.1	178.7	4:24.9
4: 0	-11-33.4	-100-58.0	-13-10.9	-101-28.0	-12-21.9	-101-13.3	1.0503	50.2	27.0	217.0	166.8	181.7	4:33.1
4: 5	-10-33.8	-102-38.5	-12-12.1	-103 -9.0	-11-22.7	-102-54.0	1.0507	52.4	23.7	212.4	168.2	184.4	4:40.5
4:10	-9-39.1	-104-14.9	-11-18.2	-104-45.7	-10-28.4	-104-30.5	1.0511	54.3	20.1	208.8	169.4	187.1	4:47.1
4:15	-8-48.9	-105-48.1	-10-28.9	-106-19.0	-9-38.7	-106 -3.8	1.0515	55.9	16.3	205.9	170.5	189.5	4:53.0
4:20	-8 -2.9	-107-19.0	-9-43.8	-107-49.8	-8-53.2	-107-34.6	1.0518	57.3	12.1	203.6	171.4	191.8	4:58.1
4:25	-7-21.0	-108-48.2	-9 -2.8	-109-18.6	-8-11.7	-109 -3.6	1.0520	58.5	7.6	201.9	172.1	193.9	5: 2.4
4:30	-6-43.0	-110-16.3	-8-25.5	-110-46.2	-7-34.1	-110-31.3	1.0522	59.4	2.9	200.6	172.7	195.7	5: 5.9
4:35	-6 -8.6	-111-43.6	-7-52.0	-112-13.0	-7 -0.2	-111-58.4	1.0523	60.0	358.0	199.9	173.1	197.3	5: 8.5
4:40	-5-38.0	-113-10.8	-7-22.0	-113-39.4	-6-29.8	-113-25.2	1.0524	60.3	353.0	199.6	173.3	198.6	5:10.2
4:45	-5-10.9	-114-38.3	-6-55.6	-115 -6.1	-6 -3.1	-114-52.2	1.0524	60.3	347.9	199.7	173.4	199.5	5:10.9
4:50	-4-47.5	-116 -6.4	-6-32.7	-116-33.3	-5-40.0	-116-19.9	1.0524	60.0	342.9	200.2	173.4	200.1	5:10.8
4:55	-4-27.7	-117-35.7	-6-13.3	-118 -1.7	-5-20.4	-117-48.7	1.0523	59.4	338.1	201.2	173.2	200.3	5: 9.7
5: 0	-4-11.6	-119 -6.6	-5-57.6	-119-31.6	-5 -4.5	-119-19.0	1.0522	58.6	333.5	202.6	172.9	200.1	5: 7.6
5: 5	-3-59.3	-120-39.5	-5-45.5	-121 -3.5	-4-52.3	-120-51.4	1.0521	57.4	329.2	204.5	172.3	199.5	5: 4.5
5:10	-3-50.9	-122-15.1	-5-37.3	-122-38.0	-4-44.0	-122-26.4	1.0518	56.0	325.3	207.0	171.7	198.4	5: 0.5
5:15	-3-46.7	-123-53.8	-5-33.1	-124-15.8	-4-39.8	-124 -4.6	1.0516	54.4	321.7	210.2	170.8	196.9	4:55.6
5:20	-3-46.8	-125-36.4	-5-33.2	-125-57.6	-4-39.9	-125-46.8	1.0512	52.5	318.4	214.1	169.8	195.0	4:49.7
5:25	-3-51.7	-127-23.8	-5-37.8	-127-44.1	-4-44.6	-127-33.7	1.0509	50.4	315.5	218.8	168.6	192.6	4:42.8
5:30	-4 -1.7	-129-16.8	-5-47.5	-129-36.6	-4-54.5	-129-26.4	1.0504	46.0	312.9	224.8	167.1	189.9	4:35.0
5:35	-4-17.4	-131-17.0	-6 -2.8	-131-36.3	-5-10.0	-131-26.3	1.0499	45.4	310.5	232.1	165.4	186.8	4:26.3
5:40	-4-39.6	-133-25.8	-6-24.5	-133-45.1	-5-31.9	-133-35.1	1.0492	42.6	308.4	241.5	163.5	183.2	4:16.7
5:45	-5 -9.4	-135-45.7	-6-53.8	-136 -5.5	-6 -1.4	-135-55.1	1.0485	39.5	306.5	253.5	161.2	179.3	4: 6.1
5:50	-5-48.2	-138-20.0	-7-32.2	-138-41.0	-6-40.1	-138-30.0	1.0477	36.0	304.8	269.5	158.5	175.0	3:54.4
5:55	-6-38.7	-141-14.0	-8-22.4	-141-37.5	-7-30.3	-141-25.1	1.0467	32.1	303.2	292.1	155.3	170.1	3:41.5
6: 0	-7-44.8	-144-36.7	-9-28.7	-145 -4.7	-8-36.5	-144-49.9	1.0455	27.6	301.6	326.6	151.5	164.6	3:27.2
6: 5	-9-14.8	-148-45.9	-11 -0.5	-149-23.3	-10 -7.3	-149 -3.5	1.0440	22.2	300.1	387.6	146.6	158.1	3:10.7
6:10	-11-30.8	-154-30.4	-13-24.4	-155-34.1	-12-26.8	-155 -0.1	1.0418	14.9	298.2	541.8	139.7	149.5	2:50.1
LIMITS	-17-30.6	-168-30.8	-18-40.5	-168 -9.7	-18 -5.4	-168-20.2	1.0372	0.0	294.3	-	124.8	132.8	2:13.9

Table 2

LOCAL CIRCUMSTANCES ON CENTER LINE - TOTAL SOLAR ECLIPSE OF 6/11/1983

LATITUDE	LONGITUDE	FIRST CONTACT	P	V	ALT	SECOND CONTACT	P	V	MAXIMUM ECLIPSE	TOTAL PHASE	ALT	THIRD CONTACT	P	V	FOURTH CONTACT	P	V	ALT
-29-16.4	-74 -2.1	2:10:28	249	12	3	3:13:39	68	199	3:15: 0	2:43	14	3:16:22	248	19	4:27:44	68	210	26
-25-36.4	-80-22.1	2:11:44	248	11	9	3:18:29	67	199	3:20: 0	3: 3	22	3:21:32	247	20	4:37:46	67	215	33
-22-57.8	-84-39.7	2:13:45	247	10	15	3:23:21	67	201	3:25: 0	3:19	27	3:26:40	247	21	4:46:40	67	219	39
-20-48.8	-88 -2.1	2:16: 8	247	10	19	3:28:14	67	202	3:30: 0	3:32	32	3:31:47	247	23	4:54:58	67	224	43
-18-58.6	-90-52.0	2:18:43	246	10	23	3:33: 8	66	204	3:35: 0	3:45	36	3:36:53	246	25	5: 2:50	68	229	46
-17-21.8	-93-20.3	2:21:28	246	11	26	3:38: 2	67	206	3:40: 0	3:56	39	3:41:58	247	27	5:10:21	68	235	49
-15-55.4	-95-33.1	2:24:21	246	11	29	3:42:57	67	208	3:45: 0	4: 6	42	3:47: 4	247	29	5:17:33	68	241	51
-14-37.5	-97-34.6	2:27:20	246	12	32	3:47:52	67	211	3:50: 0	4:16	45	3:52: 8	247	32	5:24:27	69	247	52
-13-26.6	-99-27.3	2:30:24	246	13	35	3:52:48	67	214	3:55: 0	4:25	48	3:57:13	247	36	5:31: 5	70	253	53
-12-21.9	-101-13.3	2:33:34	246	14	37	3:57:44	67	217	4: 0: 0	4:33	50	4: 2:17	248	39	5:37:26	70	260	54
-11-22.7	-102-54.0	2:36:49	246	15	40	4: 2:40	68	221	4: 5: 0	4:40	52	4: 7:21	248	43	5:43:32	71	266	54
-10-28.4	-104-30.5	2:40: 9	247	17	42	4: 7:37	68	225	4:10: 0	4:47	54	4:12:24	249	47	5:49:23	72	272	54
-9-38.7	-106 -3.8	2:43:33	247	19	44	4:12:34	69	230	4:15: 0	4:53	56	4:17:27	249	52	5:54:59	73	278	54
-8-53.2	-107-34.6	2:47: 4	247	21	46	4:17:31	70	235	4:20: 0	4:58	57	4:22:29	250	57	6: 0:20	74	284	54
-8-11.7	-109 -3.6	2:50:40	248	23	49	4:22:29	70	241	4:25: 0	5: 2	58	4:27:31	250	63	6: 5:28	74	290	53
-7-34.1	-110-31.3	2:54:22	248	26	51	4:27:27	71	246	4:30: 0	5: 6	59	4:32:33	251	69	6:10:23	75	295	52
-7 -0.2	-111-58.4	2:58:11	249	29	52	4:32:26	72	252	4:35: 0	5: 8	60	4:37:34	252	75	6:15: 5	76	299	51
-6-29.8	-113-25.2	3: 2: 7	249	32	54	4:37:25	73	259	4:40: 0	5:10	60	4:42:35	253	81	6:19:35	77	304	49
-6 -3.1	-114-52.2	3: 6:11	250	36	56	4:42:25	74	265	4:45: 0	5:11	60	4:47:35	254	88	6:23:55	78	308	48
-5-40.0	-116-19.9	3:10:23	251	40	57	4:47:25	74	271	4:50: 0	5:11	60	4:52:35	255	94	6:28: 4	79	312	46
-5-20.4	-117-48.7	3:14:46	251	45	59	4:52:25	75	278	4:55: 0	5:10	59	4:57:35	256	100	6:32: 3	80	315	45
-5 -4.5	-119-19.0	3:19:19	252	51	60	4:57:26	76	284	5: 0: 0	5: 8	58	5: 2:34	257	106	6:35:52	81	319	43
-4-52.3	-120-51.4	3:24: 3	253	57	61	5: 2:27	77	290	5: 5: 0	5: 5	57	5: 7:32	258	112	6:39:34	81	322	41
-4-44.0	-122-26.4	3:29: 1	254	63	62	5: 7:29	78	295	5:10: 0	5: 1	56	5:12:30	259	117	6:43: 7	82	325	39
-4-39.8	-124 -4.6	3:34:12	255	70	62	5:12:32	79	300	5:15: 0	4:56	54	5:17:27	260	122	6:46:32	83	327	37
-4-39.9	-125-46.8	3:39:39	256	78	62	5:17:35	80	305	5:20: 0	4:50	52	5:22:24	261	127	6:49:50	84	330	35
-4-44.6	-127-33.7	3:45:22	257	86	62	5:22:38	81	310	5:25: 0	4:43	50	5:27:21	262	131	6:53: 1	85	332	33
-4-54.5	-129-26.4	3:51:23	258	94	61	5:27:42	82	314	5:30: 0	4:35	48	5:32:17	263	135	6:56: 5	85	334	31
-5-10.0	-131-26.3	3:57:44	260	102	60	5:32:46	83	318	5:35: 0	4:26	45	5:37:13	263	139	6:59: 2	86	336	28
-5-31.9	-133-35.1	4: 4:26	261	109	58	5:37:51	84	322	5:40: 0	4:17	42	5:42: 8	264	143	7: 1:53	87	338	25
-6 -1.4	-135-55.1	4:11:30	262	117	55	5:42:57	85	325	5:45: 0	4: 6	39	5:47: 3	265	146	7: 4:35	87	340	22
-6-40.1	-138-30.0	4:18:59	263	124	52	5:48: 2	86	328	5:50: 0	3:54	36	5:51:57	266	149	7: 7: 9	88	341	19
-7-30.3	-141-25.1	4:26:55	264	130	49	5:53: 9	87	331	5:55: 0	3:42	32	5:56:50	267	152	7: 9:33	88	343	16
-8-36.5	-144-49.9	4:35:24	266	136	44	5:58:16	88	334	6: 0: 0	3:27	27	6: 1:43	268	154	7:11:43	89	344	12
-10 -7.3	-149 -3.5	4:44:35	267	141	38	6: 3:24	88	336	6: 5: 0	3:11	22	6: 6:35	268	156	7:13:31	89	345	7
-12-26.8	-155 -0.1	4:55: 1	268	147	30	6: 8:35	89	338	6:10: 0	2:50	15	6:11:25	269	159	7:14:36	90	346	1

Table II gives the local circumstances for an observer at each point along the center line at five minute intervals. The Universal Times of each contact are listed along with the position angles 'P' and 'V' and the altitude of the Sun at that instant. First and fourth contacts mark the beginning and ending of the partial phase of the eclipse. Second and third contacts denote the commencement and termination of totality. Each contact defines an instant when one edge of the Moon's disk is tangent to the edge of the Sun's disk. The position angle 'P' is measured eastward (counter-clockwise) from the north

Table 3

LOCAL CIRCUMSTANCES FOR THE TOTAL SOLAR ECLIPSE OF 6/11/1983

GEOGRAPHIC LOCATION	LAT	LONG	FIRST CONTACT	SECOND CONTACT	THIRD CONTACT	FOURTH CONTACT	MAXIMUM ECLIPSE	MAG	ALT	AZ	DURATION	PATH WIDTH
TANANARIVE, MAD.	-18.85	-47.67				3:49:33	3:21: 8	0.297	0.0	65.6		
COLOMBO, CEYLON	6.97	-79.87	3: 4:16			4:15:48	3:38:57	0.116	43.9	64.6		
BANGKOK, THAI.	13.83	-100.45	3:24:47			5:28:34	4:25: 0	0.271	74.7	51.2		
RANGOON, BURMA	16.77	-96.15	3:38:24			5: 1:31	4:19: 5	0.120	71.3	67.3		
MANILA, PHIL.	14.62	-121.00	3:58:57			6:27:48	5:15:31	0.422	69.1	296.8		
SINGAPORE, MALAYA	1.33	-103.83	2:53:45			5:52:54	4:19:36	0.689	65.9	25.1		
SAIGON, N.V.	10.77	-106.57	3:20: 8			5:55:49	4:36:26	0.444	77.2	16.6		
HUE, V.N.	16.47	-107.70	3:41:14			5:48:46	4:44:23	0.279	83.4	6.6		
HANOI', V.N.	21.07	-105.83	4: 2:32			5:26: 0	4:43:59	0.114	86.7	52.1		
CANTON, CHINA	23.12	-113.25	4:20:29			5:41:47	5: 1:17	0.110	81.8	271.3		
BANDUNG, JAVA	-6.95	-107.57	2:48:38			6: 1:56	4:21:43	0.973	59.3	12.0		
DJAKARTA, JAVA	-6.28	-106.75	2:47:42			5:59:53	4:19:59	0.944	59.7	14.5		
JOGJAKARTA, JAVA	-7.80	-110.40	2:53:54	4:26:55	4:31:55	6: 9:48	4:29:25	1.000	59.1	3.4	4:59.9	195.5
KEDIRI, JAVA	-7.80	-112.05	2:57:44	4:33:15	4:35:48	6:14:37	4:34:32	1.000	59.1	358.1	2:33.4	197.2
MEGELANG, JAVA	-7.48	-110.20	2:53:42	4:26:36	4:31:34	6: 9:29	4:29: 5	1.000	59.4	3.9	4:57.4	195.4
SEMARANG, JAVA	-6.97	-110.48	2:54:46	4:28:28	4:32:22	6:10:45	4:30:25	1.000	60.0	2.8	3:54.0	195.9
SURABAJA, JAVA	-7.23	-112.75	2:59:52	4:35: 3	4:39:24	6:17: 6	4:37:14	1.000	59.6	355.6	4:20.7	197.9
SURAKARTA, JAVA	-7.53	-110.83	2:55: 5	4:28:26	4:33:31	6:11:19	4:30:59	1.000	59.4	1.9	5: 5.0	196.0
TUBAN, JAVA	-6.90	-112.05	2:58:26	4:32:46	4:37:53	6:15:23	4:35:19	1.000	60.0	357.7	5: 7.7	197.4
BANDJERMASIN, BORNEO	-3.37	-114.55	3: 7:56			6:24:37	4:46:16	0.948	62.8	346.8		
MAKASAR, CELEBES	-5.15	-119.47	3:19:41	4:57:52	5: 2:57	6:36:11	5: 0:25	1.000	58.2	333.2	5: 5.5	200.1
DILI, TIMOR	-8.58	-125.58	3:36:50			6:47: 3	5:16:59	0.914	49.9	322.5		
AMBON, CERAM	-3.68	-128.17	3:48: 5			6:54:23	5:27:11	0.993	50.1	313.5		
PORT MORESBY, PAPUA	-9.50	-147.12	4:40:30	6: 1:10	6: 4:27	7:12:45	6: 2:49	1.000	24.4	300.8	3:16.7	161.1
NOUMEA, N.CALEDONIA	-22.27	-166.43	5: 4:31				6:10:35	0.880	0.4	295.2		
ADELAIDE, AUSTL.	-34.77	-139.13	4:22:44			6:25:38	5:26:57	0.347	20.2	319.7		
BRISBANE, AUSTL.	-27.50	-153.17	4:47: 4			6:57:51	5:56:37	0.604	11.2	303.5		
CANBERRA, AUSTL.	-35.35	-149.17	4:40:29			6:38:23	5:42:24	0.399	11.7	309.6		
DARWIN,AUSTL.	-12.42	-131.00	3:53:49			6:53:18	5:29:44	0.819	41.5	316.9		
HOBART, AUSTRL.	-43.00	-147.50	4:38:12			6:16:55	5:29:17	0.257	9.4	314.2		
MELBOURNE, AUSTL.	-37.87	-145.13	4:34:34			6:27: 3	5:33:15	0.325	13.8	314.5		
PERTH, AUSTL.	-31.83	-116.17	3:16:30			5:45:28	4:30:34	0.412	35.0	355.3		
SIDNEY, AUSTL.	-33.92	-151.28	4:43:31			6:43:54	5:46:54	0.445	10.5	307.2		
AUCKLAND, N.ZEALAND	-36.88	-174.75	5: 0:38				5:11:50	0.157	1.2	298.3		

point of the Sun's disk to the point of contact. The position angle 'V' is also measured eastward but from the zenith point of the Sun's disk to the point of contact. The instant of maximum eclipse (mid-totality) is also given along with the duration of totality (minutes and seconds) and the Sun's altitude.

Table III presents the local circumstances for a number of cities, some of which lie within the path of totality. Each city's geographic coordinates (north = +, south or east = -) are listed with the Universal Times of the eclipse contacts as seen from these

Table 4

TOTAL SOLAR ECLIPSE OF 6/11/1983 JD = 2445496.697 SAROS 127

SUN : α = 5 15 15 MID-ECLIPSE ET = 4:43:32.3 CONTACT ET : P1 = 2:10:24.4

δ = 23 3 8 CONJUNCTION ET = 4:34:16.7 U1 = 3:12:10.4

U2 = 6:14:59.9

P2 = 7:16:39.9

BESSELIAN ELEMENTS : TAN(F1) = 0.004604 TAN(F2) = 0.004582 M´ = 14.9994

HOUR(ET)	X	Y	X´	Y´	SIN δ	COS δ	L1	L2	M
24	-2.56308	-0.96022	0.0093359	0.0016803	0.39124	0.92030	0.53668	-0.00937	180.15277
1	-2.00246	-0.86001	0.0093390	0.0016763	0.39128	0.92028	0.53665	-0.00941	195.15194
2	-1.44184	-0.75980	0.0093421	0.0016723	0.39132	0.92026	0.53662	-0.00945	210.15111
3	-0.88122	-0.65959	0.0093452	0.0016683	0.39136	0.92024	0.53659	-0.00949	225.15028
4	-0.32043	-0.55961	0.0093475	0.0016641	0.39141	0.92022	0.53652	-0.00955	240.14972
5	0.24047	-0.45990	0.0093490	0.0016597	0.39145	0.92020	0.53644	-0.00964	255.14917
6	0.80142	-0.36046	0.0093495	0.0016551	0.39150	0.92018	0.53632	-0.00975	270.14833
7	1.36239	-0.26129	0.0093492	0.0016504	0.39154	0.92016	0.53619	-0.00989	285.14778
8	1.92336	-0.16212	0.0093489	0.0016457	0.39158	0.92014	0.53606	-0.01003	300.14723
9	2.48433	-0.06295	0.0093486	0.0016410	0.39162	0.92012	0.53593	-0.01017	315.14668

locations. The time of maximum eclipse follows, and the magnitude of the eclipse defines the fraction of the Sun's diameter obscured at that instant. The Sun's altitude and azimuth at maximum eclipse are tabulated next. The duration of totality (minutes and seconds) and width of the path of totality (kilometers) are given where applicable.

Table IV lists the Ephemeris Times (E.T.) of important events during the eclipse and the Besselian elements used for the eclipse predictions. Items P1 and P2 denote the instants of the penumbral shadow's initial and final contacts with the Earth, while U1 and U2 are the corresponding instants for the umbral shadow. Items X and Y are the coordinates of the intersection of the umbral shadow axis with the fundamental plane, in units of Earth radii. X' and Y' are the rate of change per minute of X and Y. Here L1 and L2 are the radii of the penumbral and umbral shadow cones on the fundamental plane, in units of Earth radii. Item M is the difference, in degrees, between the ephemeris sidereal time and the right ascension along the direction of the shadow axis. Item M' is the rate of change per hour of M. Finally, F1 is the angle between the penumbral cone and the shadow axis, and F2 is the angle between the umbral cone and the shadow axis. All elements are listed in

Ephemeris Time (E.T.). A value for ΔT of 55.0 seconds has been used to convert the predictions to Universal Time (U.T. = E.T. - ΔT). A correction of 1.34 seconds has been applied to the lunar ephemeris in order more closely to relate it to the same equinox as the solar ephemeris.

The next total solar eclipse will occur on November 22-23, 1984 and will be visible from the South Pacific.

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WHAT IS NEW ON MARS - MARTIAN 1979-1980 APPARITION REPORT II

By: C. F. Capen and D. C. Parker, A.L.P.O. Mars Recorders

Abstract

A summary of the activity of the A.L.P.O. Mars Section, a listing of the contributing observers, and a brief discussion of the salient surface albedo features and atmospheric phenomena observed upon Mars during the 1979-80 apparition are given. A description of a different spring-summer thawing North Polar Cap, the unexpected Rima Tenuis, indications of a changing Martian climate, normal seasonal cloud activity, extensive violet-clearing, and changes within two major secular features are presented. This Martian year was unusual and exciting to those who observed the Red Planet.

Mars Observing Program

A.L.P.O. planetary astronomers showed great interest in the study of the Red Planet during the 1979-80 apparition, even though the apparent disk diameter of Mars was the smallest since 1948. This continuing interest in Mars was most fortunate because the planet exhibited many interesting seasonal phenomena as well as two provocative secular events which were picked up by many of the contributing astronomers. The received Mars observations, photos, and intensity estimates have all been chronologically filed in two large books (Ref. 1).* Fortunately, 95% of the contributed data was presented on the Standard A.L.P.O. Mars Observation Report Form, which shortened filing time and made a more homogeneous set of data for analysis. About 75 Mars Observing Kits were mailed for use during the 1980 to 1984 apparitions. The data thus far received indicate good longitude coverage around the planet during most months of observation, which is necessary to study diurnal behavior of clouds and frosts throughout a Martian day. Several new observers joined the International Mars Observing Program and are located in Canada, Europe, England, and Japan, which thus extended the daily coverage. The observations obtained this apparition sampled all four Martian seasons! They cover the period from June 6, 1979 U.T. (4".2 disk diameter, $300^{\circ}L_s$, Martian northern mid-winter; D. Parker) to Oct. 22, 1980 U.T. (4".5 disk diameter, $187^{\circ}L_s$, northern early autumn; J. Beish), as shown in Fig. 23.

At the time of the completion of this A.L.P.O. Report, Jan., 1981, a total of 1,118 visual disk drawings, 45 multicolor photographs, 6 photovisual images, thousands of photometric intensity estimates, 145 filar micrometer measurements of the NPC (North Polar Cap), and 1 Mars map have been contributed to the A.L.P.O. Mars Section's 1979-80 Observing Program from 41 planetary astronomers. It is evident from the quality of the Mars observations that better instrumentation, use of accessories, and observational techniques were used during this aphelic apparition because fully 98% of the received reports was useful for analysis. More and larger refractors were used, i.e., 5, 7, 9, and 12 inch objectives. The average telescope aperture used during the 1979-80 apparition increased to 11 inches (27.4cm). Most Mars photos were secured with reflecting telescopes. Also, see Ref. 5.

Unfortunately, about 20% of the contributing A.L.P.O. astronomers did not use color filters for their observations, and consequently missed some of the atmospheric phenomena and failed to heighten the contrast of fine surface details. To solve the "Martian Problem,"

*The references are all at the end of this article in a later issue.

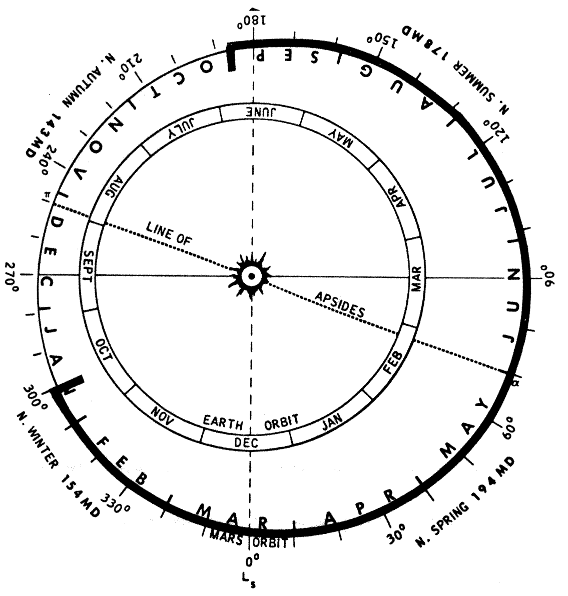

Figure 23. Seasonal coverage of Mars during its 1979-80 apparition by members of the A.L.P.O. Mars Section. The orbit of Mars is graduated in degrees of L_S, the areocentric longitude of the Sun so chosen as to be 0^o at the vernal equinox of the Martian North Hemisphere.

we need color filter cross-checking, or blinking, visual observations and photos taken in violet and blue light vs. yellow light. For color filter techniques, consult your A.L.P.O. Mars Observing Kit and obtain a basic set of filters, e.g., yellow W-12 or W-15, green W-58, blue W-38, red W-23 or W-25, and violet W-47. (Mars Observing Kit available at cost $4.75 pp. from Mars Recorder, C. F. Capen; and color filters, oculars, and other observational accessories can be purchased at considerable discount to A.L.P.O. astronomers from Valdis Photo, 223 W. Silver Spruce, Flagstaff, AZ 86001.)

This voluminous observational material is currently being studied by the Mars Recorders, and several papers are in preparation. Already three papers have come out of the 1979-80 Mars data: "The Regression of the Martian North Polar Cap in 1979-1980" by D. C. Parker and C. F. Capen and "The Martian Aphelic Apparitions of 1978 and 1980 - A.L.P.O. Mars Section Reports" by C. F. Capen and D. C. Parker were given at the ASTRO '80 Convention held in Tucson, July, 1980; and "Return of The Martian Rima Tenuis" by C. Capen was read at the Division of Planetary Sciences - AAS Annual Conference held in Tucson, October, 1980, and its abstract was published in the Bulletin of the American Astronomical Journal (Ref. 2). Another paper, "Exploring the Martian Arctic," has been completed for publication in a national astronomical magazine. This popular article compares A.L.P.O. micrometer measurements of the thawing 1979-80 North Cap with those of similar past Martian seasons, arctic cloud behavior, and a changing Martian polar climate.

TABLE I. A.L.P.O. Observers, 1979-1980 Martian Apparition

Leo Aerts	Heist-op-den-Berg, Belgium	4-in (10 cm)Rf.*
John Barnett	RAS Observatory, Richmond, VA.	5-in (13cm)Rf., 7-in (18cm)Rf.
Richard Baum	Chester, England	5-in (13cm)Rf.
Donald Beish	Miami, Fla.	8-in (20cm)Cat.
Jeff Beish	Miami, Fla.	8-in (20cm)Cat., 24-in (61cm)Rf.
Len Beirman	Flagstaff, AZ.	12-in (31cm)Rf., 24-in (61cm)Rf.
Michael E. Boschat	Halifax, Nova Scotia, Canada	5-in (13cm)Cat.
F. D. Bruner	Hope, Ind.	8-in (20cm)Cat.
Charles F. Capen	Flagstaff, AZ.	12-in (31cm)Rf., 24-in (61cm)Rf.
Regulus W. Capen	Flagstaff, AZ.	12-in (31cm)Rf., 24-in (61cm)Rf.
Prof. Jean Dragesco	Cotonou, Republique Populaire du Bénin, Eq. Africa	8-in (20cm)Cat.
Charles L. Evans	Hampton, VA.	10-in (25cm)Cass.
Ray Fahré	Aiea, HI.	8-in (20cm)Rl.
C. A. Fausel	Waterford, MI.	6-in (15cm)Rl.
Maurice Gavin	Surrey, England	8-in (22cm)Rl, 12-in (30cm)Rl.
Alan Heath	Nottingham, England	12-in (30cm)Rl.
Mike Holland	RAS Observatory, Richmond, VA.	7-in (18cm)Rf.
D. Louderback	South Bend, WA.	8-in (20cm)Rl.
Paul Maxam	Phoenix, AZ.	8-in (20cm)Rl.
Alan Macfarlane	Seattle, WA.	8-in (20cm)Cat.

*Abbreviations in this column: Rf=refractor, Rl=reflector, Cat=catadioptric, Cass=Cassegrain.

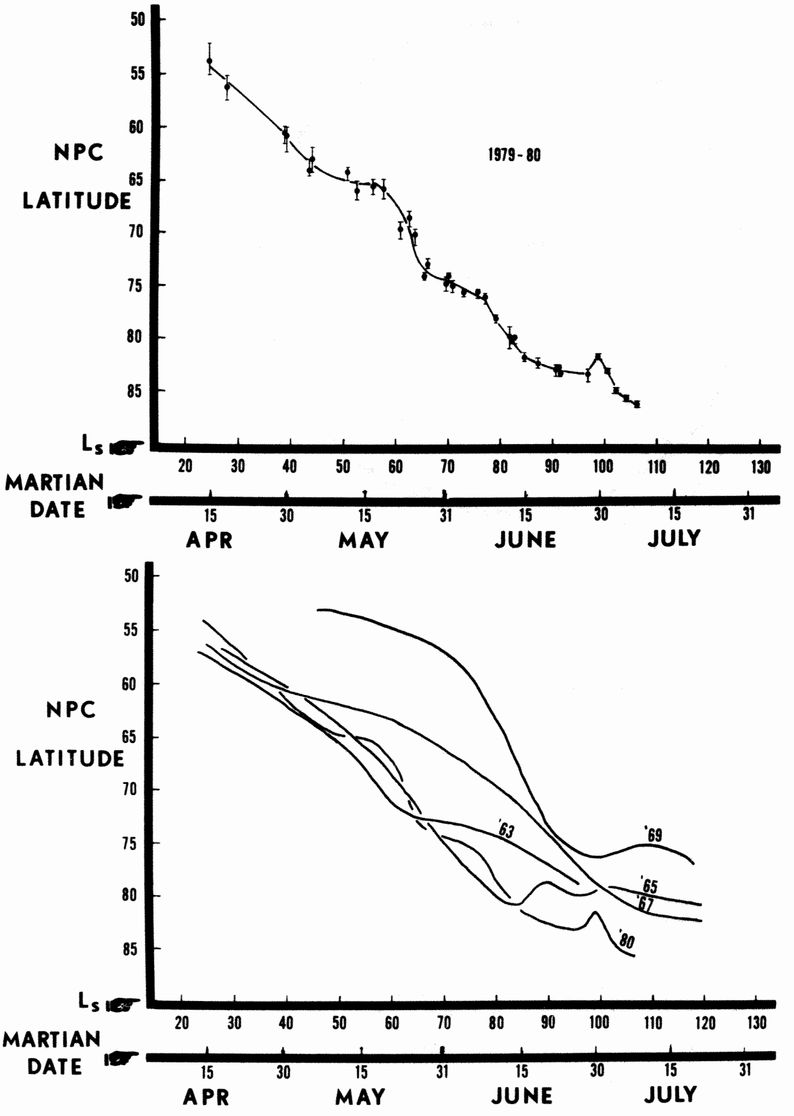

Figure 24. Micrometer measures of the diameter of the shrinking North Polar Cap during Martian northern spring and early summer. The latitude of the south edge of the cap is plotted against L_S. Top: Regression curve derived by Dr. Don Parker for 1979-80 apparition. The central dots are averaged values, and the vertical bars indicate the maximum-minimum range of micrometer measurements. Bottom: Comparison of Don Parker's 1979-80 curve and those obtained by C. and V. Capen for the 1963, 1965, 1967, and 1969 apparitions. It is evident from these curves that the summer north cap in 1980 was smaller than at the same Martian season in the 1960's, indicating a warmer northern summer in 1980. Refer to text of report by Messrs. Capen and Parker for details.

TABLE I. A.L.P.O. Observers, 1979-1980 Martian Apparition (Contd.)

Charles McRae	Coral Gables, Fla.	12-in (32cm)Rl.
Jeff Moore	Norman, OK.	10-in (25cm)Rl.
Michael J. Morrow	Hale Hoku Obs., Ewa Beach, HI	16-in (41cm)Rl.
Morimasa Nakajima	Yokohama, Japan	8-in (20cm)Rl.
Stephen J. O'Meara	Cambridge, MA.	9-in (23cm)Rf.

TABLE I. A.L.P.O. Observers, 1979-1980 Martian Apparition (Contd.)

Dr. Donald C. Parker	Coral Gables, Fla.	24-in (61cm)Rf., 12-in (32cm)Rl.
Dr. Thomas Peterson	Gadsden, AL.	14-in (36cm)Cat.
Kermit Rhea	Chillicothe, OH.	3-in (7.5cm)Rf.
Bill Roberts	Atlanta, GA.	14-in (36cm)Cat.
Rob Robotham	Port Rowan, Ontario, Canada	3-in (8.3cm)Rf.
James Rolf	Flagstaff, AZ.	15-in (39cm)Rl., 24-in (61cm)Rf.
John Sanford	Orange, CA.	8-in (20cm)Cat.
Christian Schambeck	Adelshofen, W. Germany	4.5-in (11cm)Rl.
Clay Sherrod	Arkansas Sky Obs., Little Rock,Ark.	7-in (18cm)Cat.
Paul E. Stegmann	Fairview, N.J.	6-in (15cm)Rl.
Gary Snyder	RAS Obs., Richmond, VA.	7-in (18cm)Rf.
Randy Tatum	RAS Obs., Richmond, VA.	6-in (15cm)Rl., 7-in (18cm)Rf.
Daniel M. Troiani	Chicago, IL	10-in (25cm)Rl., 12-in (32cm)Cass.
Dr. John E. Westfall	San Francisco, CA	10-in (25cm)Cass.
Annette Wilson	Peoria, AZ.	8-in (20cm)Rl.
Howard Zeh	Temperance, MI.	14-in (36cm)Cat.

We wish to acknowledge the most helpful summary reports and special notes received from Alan Heath, Michael Boschat, Maurice Gavin, Rob Robotham, Jeff Beish, Richard Baum, Morimasa Nakajima, Patrick Moore, and Clay Sherrod. Our esteemed colleague, Toshihiko Osawa, unfortunately could not observe Mars in 1979-80; but he kindly kept in touch with A.L.P.O. Mars Section members, received the "Martian Chronicle '80," and contributed valuable information concerning Japanese studies of the Martian climate.

The Martian Arctic

The northward axial tilt of Mars relative to Earth favored the observation of the seasonal behavior of the Martian Arctic with its thawing North Polar Cap during the spring and summer seasons. The NPC broke through the extensive North Polar Hood during the first week of Oct., 1979, at about $5^{o}L_{s}$, when it was March 26 (MD) upon Mars. The NPH continued to dissipate intermittently over the next several weeks, when the NPC was seen clear, bright, and in full compass, or again, dull gray and covered temporarily by Arctic hazes. According to micrometer measurements of the diameter of the new spring cap made by D. Parker, it was then of normal size with a 72^{o} diameter and its averaged edge located on the 54^{o} North parallel. The derived regression or thawing curve shows a normal retreat of the cap edge from 24^{o} through $60^{o}L_{s}$; afterwards, the regression rate continued at an abnormally high rate to the end of the micrometer measurements in early summer, at $106^{o}L_{s}$, when compared to similar seasons' regression curves obtained in the 1960's by the Capens and S. Miyamoto (Refs. 3 & 4). According to these past measurements of the NPC diameter, the regression curve usually starts to level off just past the summer solstice, 90^{o} - $100^{o}L_{s}$, when the edge of the cap has retreated to about 80^{o} N. areocentric latitude, indicating a slower thawing rate which continues to mid-summer. The 1980 regression curve did not halt at this time but instead continued at a high, steady rate to the last micrometer measurement, causing an unusually small North Cap of only 8^{o} diameter. At this Martian season, $105^{o}L_{s}$, the cap is normally 18^{o} - 20^{o} in diameter. Further, independent observations from June through August, 1980, 114^{o} - $159^{o}L_{s}$ acquired by M. Nakajima, J. Beish, D. Troiani, C. Evans, D. Beish, R. Robotham, and C. Capen confirmed the unusually small diameter of the North Cap remnant. Evidently, the Martian Arctic climate was warmer than usual in 1980.

The NPC often stops thawing temporarily when Arctic hazes are observed to form over the North Polar Region during the maximum rate of regression just before the northern summer solstice, when Mars is close to aphelion near $70^{o}L_{s}$. When this remarkable anomalous inflection is noted in the regression curve, the NPC sometimes measures 2^{o} to 4^{o} larger in diameter. Dr. Clyde Tombaugh has repeatedly observed these temporary hazes over the NPC during this season, which he has designated the "aphelic chill." Miyamoto et al. have also observed the temporary halt in the thawing phase of the NPC, as well as a slight increase in its diameter during the 1960 and 1963 apparitions (Ref. 4). It is at this time that the Arctic hazes take on the characteristics of a temporary polar hood and fresh cap deposits appear and at times increase the diameter of the NPC. Two such inflections were noted in the 1980 NPC regression curve. See Figure 24. One occurred during Martian mid-May around $55^{o}L_{s}$ when the North Cap width remained static for a few days, and another occurred the last of Martian June around $98^{o}L_{s}$ when the NPC briefly increased in diameter.

(To be continued)

ANNOUNCEMENTS

Honor Achieved by Dr. Donald Parker. Don Parker, A.L.P.O. Assistant Mars Recorder, has won first place in the planetary division of Star and Sky magazine's 1980 Astrophoto Contest. His winning photograph, a black-and-white print of Jupiter taken on February 15, 1979, appeared in the August, 1980 issue of Star and Sky and also in the Jupiter Report published in the December, 1980 Journal A.L.P.O. (Vol. 28, Nos. 9-10, Figure 36 on page 193). Dr. Parker used a 12.5-inch (32-cm.) Newtonian with eyepiece projection through a planetary camera of his own design. (This camera was described in The Astrograph, June-July, 1980.) Darkroom techniques used were developed by A.L.P.O. Mars Recorder Charles Capen and have been discussed in detail by Recorders Capen and Parker in several recent issues of Journal A.L.P.O.

Free Index to Astronomy Articles in Scientific American. A complete subject index to astronomy articles which appeared in Scientific American magazine between 1960 and 1981 is being made available as a public service by the Astronomical Society of the Pacific. These non-technical articles were written by prominent scientists actively engaged in the research they were describing.

In order to obtain a copy of the index, send a long, self-addressed envelope with at least 35¢ postage on it to Astronomy Index, A.S.P., 1290 24th Avenue, San Francisco, CA 94122.

Ashley McDermott to Receive G. Bruce Blair Medal. The annual G. Bruce Blair Gold Medal of the Western Amateur Astronomers will be presented this year to Professor Ashley Thomas McDermott of the College of the Desert at Palm Desert, CA. The award will be given at the WAA Convention at Orange, CA in late July, 1981. Professor McDermott has popularized astronomy extensively in southern California and is at present the Public Information Officer of the WAA. His services at WAA Conventions over the years have been frequent and considerable. He has been a staff member of the Jet Propulsion Laboratory, the Griffith Observatory, the Chabot Observatory, and the San Diego State College Observatory. The Blair Award is given in recognition of outstanding contributions to amateur astronomy.

Reorganization of A.L.P.O. Mars Section. For some time Mars Recorder Capen has been conscious that the A.L.P.O. collection of Mars meteorological data from 1967 to 1980 has become too voluminous for easy study or analysis. A reading of the Mars Report on pages 38-41 will surely support this point of view. After the A.L.P.O. Convention in July, 1980, C. F. Capen and Jeff Beish of Miami, FL began to study how best to handle our snowballing data. Mr. Beish is employed in the Delta Airlines' computer center. After many letters and phone calls, the two men came up with a method of storage of the data collected for each apparition and with programs for seasonal comparison of Martian weather data in the forms of graphs and tables. The general plan is being tested on cloud, haze, and bright frost data from the 1969 Mars observations. As of early May, 1981, results look promising.

The extra work load here required has caused us to expand the Mars Section staff to include Mr. Jeff Beish as an Assistant Mars Recorder. We warmly welcome him to our volunteer staff. The three Mars Recorders and their general areas of expertise are: Capen, meteorology; Parker, photography; and Beish, statistics.

A Thank-You to Sky and Telescope. We wish to express our appreciation to Sky and Telescope magazine for their description of the work of the A.L.P.O. on page 543 of their June, 1981 issue. More specifically, we want to thank Editorial Assistant Stephen J. O'Meara for this publicity. The notes on the A.L.P.O. were included in a two-page article on publications and services available to the active amateur observer. It has been most gratifying that up to the present time (June 26, 1981) we have had more than sixty inquiries as a result of this item.

Conference of Astronomical Association of Northern California. The 1981 meeting of this West Coast group will be on Saturday, September 12, and Sunday, September 13, at the El Rancho Tropicana Hotel Convention Center, 2200 Santa Rosa Ave., Santa Rosa, CA. The keynote speaker will be Dr. Joseph Silk, who authored the excellent science book, The Big Bang, last year. He will speak on the early universe. Other professional speakers will be Dr. Don Goldsmith, the AANC professional award winner for 1981; Mr. Robert Truax, who has developed privately the "Volksrocket" and is currently seeking volunteers to be the first to ride into space in his incredible machine; and several NASA speakers, who will report on the coming Voyager fly-by of Saturn in August, 1981. The AANC Conference will also include amateur papers, an astrophoto contest, a telescope making contest, a planetarium show at Santa Rosa Junior College's very modern planetarium, commercial exhibits, a swap meet, and tentatively a panel discussion among three or more of the professional speakers. The registration fee is ten dollars per person prior to August 31, 1981. Early registration is strongly encouraged. Readers desiring more information should contact the Conference Chairman, Mr. George Loyer, 1720 Bryden, Santa Rosa, CA 95404, telephone AC 707-544-1787.

Pocket Calculator Program to Find Close Encounters of the Astronomical Kind. Townsend and Associates, 3521 San Juan Ave., Oxnard, CA 93033 are offering for sale to teachers, scientists, and amateur astronomers an electronic calculator program designed for the Texas Instruments Model 59. The only user skills required are a working knowledge of high school algebra and trigonometry, practical astronomy, and TI-59 manipulations. Sources of orbital elements for astronomical bodies are also necessary tools. The program will calculate the time and minimum separating distance between two astronomical bodies moving in elliptical orbits over a specified search time interval. The two bodies may be chosen from among comets, asteroids, meteoroidal swarms, and planets. More complex programs for more advanced treatments of the encounter problem were being developed and tested by Townsend and Associates as of May 12, 1981. Examples of the application of the current program are the close approach to the Earth of an asteroid and the occurrence of a meteor display.

Special Thanks to J. Russell Smith. The Editor, the Recorders, and the readers of this journal owe a special vote of thanks to the A.L.P.O. Secretary, Mr. J. Russell Smith. He has capably and cheerfully conducted a large part of our routine--and sometimes far from routine-- correspondence and A.L.P.O. business with book agencies, young novice observers, foreign members with special problems, and contributors of papers for possible publication, to name but a few. In spite of greatly increased postal costs, he has given this service very largely at his own expense. Amateur societies often owe much to a few hard-working volunteers, and the functioning of the A.L.P.O. is in large measure due to Secretary Smith.

Other Staff Changes. Besides the changes in the Mars Section noted above, the services of Mr. Roy Parish as a Lunar Recorder and of Mr. Richard Hull as an Assistant Jupiter Recorder are being terminated. Both men have found changes in their personal interests, as we sometimes do, and perhaps also in the support given by the general A.L.P.O. membership. We thank them very much for the help they furnished while they served as Recorders.

Sustaining Members and Sponsors. The persons listed below support the work of the A.L.P.O. by voluntarily paying higher dues, $40 per volume for Sponsors and $20 per volume for Sustaining Members. (These are the new current rates.) The generous assistance of all these colleagues is here gratefully acknowledged. If there are errors in the lists, it is the fault of the Editor, who would appreciate being informed of them.

Sponsors - Philip and Virginia Glaser, Dr. John E. Westfall, Dr. James Q. Gant, Jr., Ken Thomson, Reverend Kenneth J. Delano, Frederick W. Jaeger, Harry Grimsley, Darryl J. Davis, Michael McCants, Dr. A. K. Parizek, Raleigh Crausby, Robert M. Adams, and Oscar Monnig.

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Concerning the A.L.P.O. Observing Manual. Though the ad from Schramm and Groves on page 44 might usually be expected to stand on its own, some background may be helpful for many of our readers.

In the early and middle 1960's Dr. Clark R. Chapman and Dr. Dale P. Cruikshank undertook to compile and edit an A.L.P.O. Observing Manual. At that time the future academic doctors were Recorders in the A.L.P.O. and among its most active observers. Other leading lunar and planetary observers of that period wrote chapters on different subjects, eventually producing a manuscript with tables, photographs, and other illustrations more than 600 pages long. Repeated efforts to find a publisher failed, though some companies held the manuscript for several months before reaching a negative decision. The Observing Manual was also regularly discussed at the annual Business Meetings into the early 1970's. Many ideas were offered; but the necessary combination of willing workers, sufficient funding, and a workable procedure never materialized. In 1977 Attorney Byron Groves of Santa Ana, CA obtained one of two extant copies of the Manual and brought it to the attention of the A.L.P.O. Convention that year. Since then Mr. Groves has sparked a revival of interest in the Manual, in truth without much encouragement from others. The updating of textual material now 15 years old or more is a herculean task which Editors Chapman and Cruikshank, the original chapter authors, and the present Section Recorders have all felt unable to undertake. Nevertheless, there is a tremendous amount of valuable material for the modern observer in the pages of two volumes now being offered by Schramm and Groves. The Editor commends the set highly to the attention of our readers.

New Prices. Greatly increased postal rates and other increased costs have forced us to raise the price of this journal. Certain possible ways to reduce our costs are being studied, but a price hike is at present necessary to remain in business. The third class domestic mail rates for the weight of this journal are now the same as the first class rates! The new schedule of our prices is:

1 volume, 6 issues, U.S.A., Canada, and Mexico	$10.00
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Single issue (recent and in stock)	$ 2.00
Sustaining Member, 1 volume, 6 issues	$20.00
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Astrocon 81 (including the 1981 A.L.P.O. Convention). This gathering is the Astronomical League's National Convention held in conjunction with the Association of Lunar and Planetary Observers and the International Amateur and Professional Photoelectric Photometry. The place is Kutztown State College at Kutztown, PA; and the dates are Monday, August 10, to Sunday, August 16. The host is the Lehigh Valley Amateur Astronomical Society, Inc. of Allentown, PA. General information can be obtained from the Convention Chairman, Mr. Kenneth H. Mohr, 761 E. Rock Rd., Allentown, PA, 18103, telephone AC 215-797-2115. A full and remarkable program comprises seven bus tours, six invited keynote speakers, three on-campus planetarium shows, an Astro-Art Exhibit, workshops, an Astrophotography Exhibit and Competition, a Telescope Fair and Competition, paper sessions, commercial and group exhibits, business meetings of the participating groups, an Awards Banquet, and tours of the Pulpit Rock Astronomical Park, where the host society has a large complex of telescopes.

A.L.P.O. members are urged to support this meeting by their attendance, and registration should really soon follow their receipt of this issue. Julius Benton, address on back inside cover, still wants good display material for an A.L.P.O. Exhibit. Photographs, drawings, and charts of good quality are suitable items. At this time (June 29, 1981) the Editor knows of eight intended A.L.P.O. papers on several of our active programs from Recorders and other leading members. The Papers Chairman for Astrocon 81 is Mr. R. F. Cressman, 2082 Hopewell Road, Bethlehem, PA 18017, phone (215) 867-7654. The A.L.P.O. Business Meeting is scheduled for 8 P.M. on Friday, August 14. A Lunar and Planetary Workshop on Saturday afternoon is being organized by Associate Director John Westfall; it will be about one hour long.

A few more details about Astrocon 81 may be worth presenting. It is expected that this meeting may well be the largest gathering ever in the United States of astronomy enthusiasts. The bus tours will be on August 11 (Tuesday) and 12. There is a choice of tours to Atlantic City, New York City, Philadelphia, Washington, four neighboring observatories, historic Pennsylvania, and science industries, as well as Pulpit Rock. The main days for paper sessions and invited speakers will be August 13 to 16, with the banquet on August 16 (Sunday). Registration for this Convention is $8.00 per person before August 1. Housing on campus with double occupancy of rooms is $55.00 per person for seven days or $45.00 per person for five days. A meal package ticket of $30.00 includes three meals on Thursday, Friday, and Saturday plus breakfast on Sunday. The banquet on Sunday afternoon is $11.00. The Proceedings will include brief biographies of the keynote speakers and synopses of their talks, abstracts of all papers, a roster of Convention delegates, the group photograph, and many illustrations. The price is $8.00. The keynote speakers and their subjects are: Professor George O. Abell, UCLA, "Fads and Myths in the Name of Astronomy" and "The Great Successes of Modern Cosmology"; Dr. William E. Brunk, NASA, "The Voyager Missions to Jupiter and Saturn"; Professor Frank D. Drake, Cornell University, "The Search for Intelligent Life in the Universe"; Professor Owen Gingerich, Harvard University, "Copernicus, Tycho and the New Astronomy"; Professor George F. Reed, Westchester State College, "The Man Who Was Murdered by Newton"; and Professor Harry L. Shipman, Delaware University, "Space Astronomy: The Search for Black Holes."

With some help from his personal computer, John Westfall is planning a schedule of planetary events during the days of the Kutztown meeting. Skies will hopefully cooperate.

WE HOPE TO SEE YOU AT ASTROCON 81!

The Strolling Astronomer

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NOTICE

In order to facilitate the reproduction of drawings in future issues readers are requested to exaggerate contrasts on drawings submitted. Extremely faint marks cannot be reproduced. Outlines of planetary discs should be made dark and distinct. It is not feasible to reproduce drawings made in colors. Following these precepts will permit better reproductions.

Persons requiring prompt acknowledgement of correspondence or contributed observations from staff members are requested to furnish stamped, self-addressed envelopes.

STAFF