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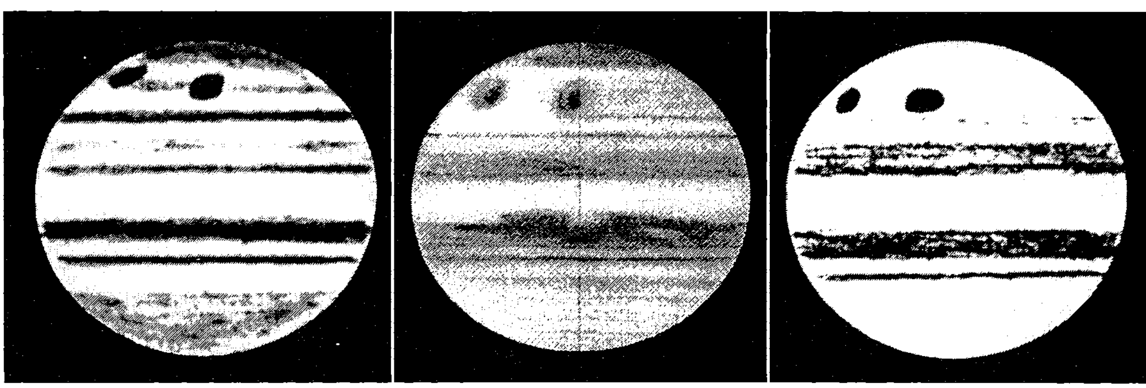

Three near-simultaneous drawings of two of the Comet Shoemaker-Levy 9 Impact Spots on Jupiter; "G" is near the central meridian at the top, while "L" is to its left near the limb. The drawings were made on 1994 July 20 by: Claus Benninghoven, 02h01m UT (left); Richard Cologne, 02h05m-02h25m UT (center); and Matthew Will, 02h10m-02h20m UT (right). South at top; for more information see page 147 of this issue, whose first three articles are devoted to the Shoemaker-Levy 9 impact.

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THE 1994 ENCOUNTER OF COMET SHOEMAKER-LEVY 9 WITH THE PLANET JUPITER: ROTATION PERIODS OF IMPACT SPOTS.

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

This report is based on 938 visual central-meridian transit timings and measured longitudes from photographs and CCD images of Jupiter submitted by 84 A.L.P.O. observers. When plotted on graph paper 716 transits were selected for usable drifts for 30 spots distributed in 13 impact zones in the latitude of the SSTB [South South Temperate Belt]. The contributing observers are listed in *Table 1* (below); with the place of observation and telescope(s) used, where RR = refractor and RL = reflector. Given in the right-hand column are the number of transits submitted (t), together with other forms of observations, where SS = strip sketches, DD = disc drawings, and CCD = CCD images; and also photographs and graphs. The period of observations was from 1994 JUL 18-SEP 25.

Table 1. A.L.P.O. Observers of Comet Shoemaker-Levy 9 Jovian Impact Spots, 1994.

Person	Place	Instrument(s)	Form of Observation
Adachi, Makoto	Otsu-Pref., Japan	31-cm RL	DD
Amirani, Taghi	London, England	*(n.a.)*	Video
Ball, Roger L.	Bristol, TN	32-cm RL	11 t, DD
Beish, Jeff	Miami, FL	40-cm RL	44 t, DD, SS
Benninghoven, Claus	Burlington, IA	32-cm RR	11 t, DD, SS
Beltran, A. Gonzalo Vargas	Boliva, South America	16-cm RL	19 t
Bikker, Ingebord	Leiden, Netherlands	26.6-cm RR	19 t
Bosselaer, Mark (VVS Group)	Berchem, Belgium	20.5-cm RL	229 t, Graphs.
Budine, Phillip W.	Walton, NY	15-cm RR, 7.5-cm RL	12 t, DD, SS
Burton, Dan	College Station, TX	37-cm RL	54 t, DD, Photos
Cameron, Gary L.	Des Moines, IA	13-cm RL	4 t, DD
Clark, M.L. Wilson	W. Australia	30-cm RL	t, DD
Colonge, Richard	Omaha, NE	15-cm RL	DD
Cross, Darrell	Birmingham, AL	20-cm RL	DD, Video
Currier, DeWayne T.	Beale AFB, CA	20-cm RL	DD
Darby, Dale (SUAS)	Sacramento, CA	15-cm RL	DD
Denmark Astronomical Society	Rodovre, Denmark	32-cm RL	Notes
Dobbins, Thomas A.	Coshocton, SC	25-cm RL	CCD
Dressen, Peter	Norderstedt, Germany	20-cm RL	DD
Falsarella, Nelson (REA)	Sao José, Brazil	30-cm RL	DD, Photos
Fischer, Daniel	Königswinter, Germany	40-cm RL	DD
Fox, Jim	Afton, MN	20-cm RR	23 t, DD
Graham, Francis G.	East Pittsburgh, PA	16-cm RR	DD
Haas, Walter H.	Las Cruces, NM	20-cm & 32-cm RL	57 t, SS
Hays, Robert H., Jr.	Worth, IL	15-cm RL	14 t, DD
Heath, Alan W.	Nottingham, England	32-cm RL	18 t, DD
Heller, Jeffrey	San Francisco, CA.	15-cm RL	DD
Hernandez, Carlos E.	Miami, FL	20-cm & 40-cm RL	81 t, DD, SS
Hill, Richard	Tucson, AZ	37-cm RL	28 t, DD, SS
Hua, Chen Dong	Xiamen, P.R. China	11.4-cm RL	DD
Johnson, Gus	Swanton, MD	5-cm & 15-cm RR	DD
Joyce, Dan	Chicago, IL	25-cm RL	DD
Kimball, C. Mike	Newport News, VA	10.8-cm RL	DD
Konnai, Reiichi	Fukushima, Japan	35-cm RL	DD
Kristensen, Morten Bech	Eglved, Denmark	9-cm RR	5 t, DD
Labant, Jim	Racine, IL	35-cm RL	DD
Lehky, Martin	Hradec Kralove, Czech Republic	20-cm RR	DD
Lehman, David J.	Pindale, CA	25-cm RL	12 t, DD, SS
Lopata, Eugene S.	Union City, CA.	25-cm RL	Whole-disk Photom.
Louderback, Daniel	South Bend, WA	15-cm RL	DD
MacDougal, Craig	Tampa, FL	15-cm RL	12 t, DD
MacFarlane, Alan W.	Seattle, WA	27.5-cm RL	Video
Madden, Patrick J.	Washington, DC	7.5-cm RR	DD
Manske, Bob	Madison, WI	28.5-cm RL	12 t
McClelland, Dick	Sidney, NY	20-cm RL	DD
Melillo, Frank J.	Holtsville, NY	20-cm RL	15 t, SS
Militzer, Thomas	Henstedt-Ulzburg, Germany	20-cm RL	DD

(Table 1 continued on p. 146)

Table 1—Continued.

Person	Place	Instrument(s)	Form of Observation
Miyazaki, Iaso	Okinawa, Japan.	40-cm RL	59 CCD
Morris, Woodie F.	Manahawkin, NJ	25-cm RL	I t, DDNiechoy, Detlev
	Goettigen, Germany	20-cm RL	DD
Nowak, Gary T.	Essex Jct., Vt.	25-cm RL	DD
Nyberg, Timo (UPS)	Helsinki, Finland	15-cm & 20-cm RL	DD
Olivarez, Jose	Wichita, KS	20-cm RR, 25-cm RL	3 t, DD
Osawa, Toshihiko	Fukuoka, Japan	31-cm RL	DD
Parker, Donald C.	Coral Gables, FL	40-cm RL	21 t, 55 CCD
Pearsnel, James E.	McMinnville, TN	32-cm RL	CCD
Phillips, Jim	Charleston, SC	22.5-cm RR	CCD
Plante, Phil	Poland, OH	20-cm RR, 40-cm RL	4 t, DD
Post, Cecil	Las Cruces, NM	20-cm RL	23 t, DD, Graphs
Robinson, Robert L.	Morgantown, WV	25-cm RL	9 t, DD
Rosamond, Andre J. & Rosamond, Ayme de	Bundaberg, Australia	32-cm RL	50 t, DD
Sabia, John D.	Clarks Summit, PA	23-cm RR	11 t, DD
Sandel, Jeffery	Cayce, SC	15-cm RL	21 t, DD
Sanford, John	Costa Mesa, CA	30-cm RL	CCD
Schmude, Richard W. Jr.	College Station, TX	36-cm RL	18 t, DD, SS, Photos.
Solano-Ruiz, Manuel	Tenerife, Spain	32-cm RL	DD
Stryk, Ted	Bristol, VA	7-cm RR	DD
Sullivan, Michael W.	Vancouver, B.C.	10.8-cm RL	DD
Sweetsir, Richard A.	Jacksonville, FL	10.2-cm & 32-cm RL	DD
Tatum, Randy	Richmond, VA	17.8-cm RR	3 t
Teichert, Gerard	Hattstatt, France	28-cm RL	5t, DD
Testa, Luigi	Parma, Italy	40-cm RL	CCD
Tomney, James T.	Towson, MD	15-cm RL	2 t, DD
Travnik, Nelson	Campinas, Brazil	15-cm & 17.5-cm RR, 50-cm RL	DD
Troiani, Daniel M.	Schaumburg, IL	20-cm RL	9 t, DD, SS
Viens, Jean-Francois	Quebec, Canada	25.4-cm RL	28 t, DD, SS
Warell, Johan	Uppsala, Sweden	16-cm RR	3 t, DD
Weier, David (MAS Group)	Madison, WI	28.5-cm RL	52 t
Wessling, Richard J.	Milford, OH	7.5-cm RR, 32-cm RL	DD
Westfall, John E.	San Francisco, CA	28-cm & 36-cm RL	Whole-Disk Photom., CCD
Whitby, Samuel	Hopewell, VA	15.2-cm RL	6 t, DD, SS
Whitman, Alan	Pr. George, B.C., Canada	20-cm RL	DD
Will, Matthew	Springfield, IL	15-cm RL	17 t, DD

In *Table 2* (below) the columns contain the following data: a letter identification for each "impact", number for each marking (or part thereof), marking description (D = Dark, p = preceding, c = center, f = following), first date of observation, last date of observation, first longitude observed, last longitude observed, drift of marking in 30 days, and resulting rotation period for that drift. All longitudes are in System II.

Table 2. Comet Shoemaker-Levy 9 Jovian Impact Spots: Rotation Drift Rates and Periods.

Spot	No.	Descr.	Date Range 1994 (UT)	System II Longitudes ° °	30-d Drift °	Rotat. Period h:mm:ss	Mean Period for Spot h:mm:ss
H							9:55:36
	1	Dp	Jul 18-Sep 18	020-000	-09.7	9:55:27	
	2	Dc	Jul 18-Aug 02	025-025	00.0	9:55:41	
	3	Df	Jul 18-Sep 08	031-031	00.0	9:55:41	
E							9:55:26
	1	Dp	Jul 18-Jul 23	075-072	-18.0	9:55:16	
	2	Dc	Jul 18-Aug 21	080-080	00.0	9:55:41	
	3	Df	Jul 18-Jul 24	085-082	-15.0	9:55:20	
A							9:55:30
	1	Dc	Jul 17-Aug 14	113-105	-08.6	9:55:29	
	2	Df	Jul 17-Aug 14	116-110	-06.4	9:55:32	

(Table 2 continued on p. 147)

Table 2—Continued.

Spot	No.	Descr.	Date Range 1994 (UT)	System II Longitudes ° °	30-d Drift °	Rotat. Period h:mm:ss	Mean Period for Spot h:mm:ss
C							9:55:42
	1	Dc	Jul 18-Aug 19	149-148	-00.9	9:55:39	
	2	Df	Jul 18-Jul 31	158-159	+02.3	9:55:44	
K							9:55:34
	1	Dp	Jul 19-Aug 22	187-180	-06.2	9:55:32	
	2	Dc	Jul 19-Aug 17	191-185	-06.2	9:55:32	
	3	Df	Jul 19-Aug 17	196-193	-03.1	9:55:37	
W							9:55:32
	1	Dp	Jul 19-Aug 05	204-199	-08.8	9:55:29	
	2	Dc	Jul 19-Aug 22	210-202	-07.1	9:55:31	
	3	Df	Jul 19-Aug 12	214-211	-03.8	9:55:35	
L							9:55:23
	1	Dp	Jul 20-Aug 27	265-242	-18.2	9:55:16	
	2	Dc	Jul 20-Sep 18	269-246	-11.5	9:55:25	
	3	Dc	Jul 20-Aug 02	276-270	-13.8	9:55:22	
	4	Df	Jul 20-Sep 18	280-263	-08.5	9:55:29	
G-D-S							9:55:36
	1	Dp	Jul 18-Sep 01	294-292	-01.3	9:55:39	
	2	Dc	Jul 18-Sep 03	298-297	-00.6	9:55:40	
	3	Dc	Jul 18-Aug 19	310-305	-04.7	9:55:34	
	4	Dc	Jul 18-Aug 28	320-311	-06.6	9:55:32	
	5	Df	Jul 18-Sep 04	325-320	-03.1	9:55:37	
R							*(n.a.)*
	1	Dc	Jul 21-Jul 25	331-330	-07.5	9:55:30	
Q2							*(n.a.)*
	1	Dc	Jul 22-Jul 25	345-345	00.0	9:55:41	
Q1							9:55:29
	1	Dp	Jul 27-Aug 16	349-335	-21.0	9:55:12	
	2	Dc	Jul 20-Aug 18	353-349	-04.1	9:55:35	
	3	Df	Jul 22-Aug 11	355-355	00.0	9:55:41	
All Spots							**9:55:32.6**

SUMMARY

Even a casual glance at *Table 2* indicates the fairly close agreement of the mean values for the rotation periods of these impact spots. The mean period for the SSTB latitude-range for 39 apparitions from 1952-1994 was in the range of 9h 55m 04s to 9h 55m 06s. The mean period for the radio system (System III) sub-surface regions near the core) is 9h 55m 29.710s. The mean period for each impact spot; as well as the mean rotation period for all spots (9h 55m 33s) tend to fall in the range between the System III radio period and the System II rotational period (9h 55m 40.6s).

The observed longitudes and derived drift rates given in *Table 2* are graphed in *Figure 1* (p. 148). Two drawings of the spot remnants as they appeared in March and April, 1995, are also shown (*Figures 2* and *3*, p. 148). Three related drawings are also shown on the front cover of this issue, whose data are given below.

Data for front Cover Illustrations:

(In all cases, Seeing is on the A.L.P.O. Scale, ranging from 0 = worst to 10 = perfect, Transparency is the limiting magnitude, south is at the top, and the images are simply inverted.)

(left) Claus Benninghoven, 1994 Jul 20, 02h01m UT. 8-in (20-cm) reflector, 158X & 192X. Seeing = 2-3, Transparency = +4.5. Central Meridians: I = 260°, II = 311°.

(center) Richard Cologne, 1994 Jul 20, 02h05m-02h25m UT. 6-in (15-cm) reflector, 174X. Seeing = 6. Central Meridians: I = 263-275°, II = 313-326°.

(right) Matthew L. Will, 1994 Jul 20, 02h10m-02h20m UT. 6-in (15-cm) reflector, 200X. Seeing = 3-4, Transparency = +2. Central Meridians: I = 266-272°, II = 316-323°.

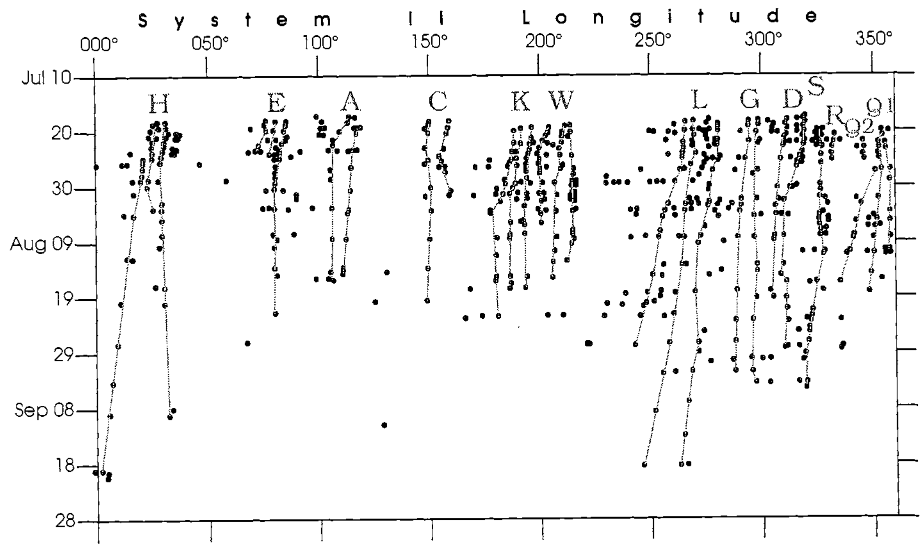
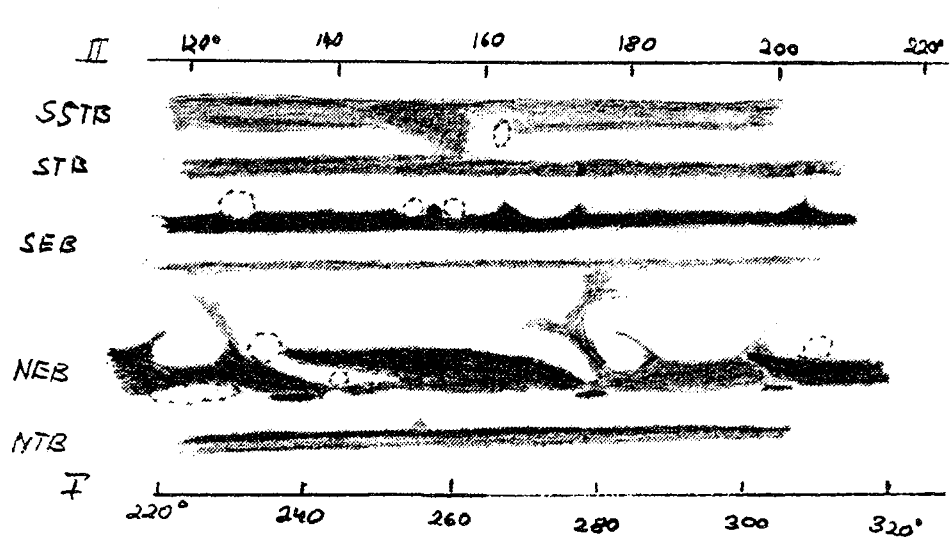


Figure 1. Drift chart of Comet Shoemaker-Levy 9 impact spots on Jupiter during July-September, 1994. When a spot has more than one line, the left one represents the *preceding* edge, the center line the *center*, and the right line the *following* edge.

Figure 2 (left). Drawing of Jupiter by Phillip W. Budine on 1995 MAR 05, 08h50m-09h05m UT with a 15-cm refractor at 167X with W15 (yellow), W25 (red), and W80A (blue) Filters. Transparency (limiting magnitude) +6, Seeing 8 (on the A.L.P.O. scale, with 0 = worst and 10 = perfect). Central Meridians: System I = 111°, System II = 220°. Two dark comet-impact remnants are visible in the South South Temperate Belt (SSTB; uppermost belt) near the left (preceding) and right (following) limbs. The shadow of the satellite Ganymede appears in the lower right. South at top.

Figure 3 (below). Strip sketch by Claus Benninghoven, 1995 APR 02, 09h00m-11h30m UT, with a 12-in (30-cm) refractor at 220X; Transparency 5 (0-5 scale, with 5 best), Seeing 6. Note the dark triangle in the SSTB near System II longitude 150°, possibly an impact remnant. South at top.



Possible Jovian Impact Candidates in the First Half of the Twentieth Century

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

ABSTRACT

Observations of the impact of Comet Shoemaker-Levy 9 make it possible to establish criteria for the visual appearance of similar impacts in the historical record. A search in readily available published reports of synoptic observations of Jupiter covering the period from 1891 to 1943 (pre-spacecraft) found five candidates for possible impacts on Jupiter and one additional marginal candidate.

The impacts of Comet Shoemaker-Levy 9 (SL9) fragments on Jupiter have given a first example of the visual appearance of an event known in advance to be an impact. This event raises the questions of the possibility of historical observations of such impacts on Jupiter and their frequency.

During the period of impacts in the Southern Hemisphere of Jupiter, on 1994 JUL 19 (Universal Time, or "UT," is used in this paper unless otherwise stated), a transit of Ganymede's shadow in Jupiter's Northern Hemisphere was noticed by many observers. Although in the the opposite Jovian hemisphere, there was still confusion with the impact sites by those visual observers less familiar with Jovian morphology and transits. Once the error was realized, the shadow was used as a crude visual photometric comparison with the impact sites. Impact sites were usually seen as being smaller than the satellite shadow but their darknesses were quite comparable to the shadow, easily making them the darkest cloud features intrinsic to the planet. This fact helped set the criteria used here in a search for possible historical observations of Jovian impacts.

Three criteria are used here to distinguish possible impacts from ordinary Jovian meteorological phenomena:

1.) The spots must be very dark, comparable to the darker satellite shadow transits. As indicated above, this was the darkness observed in the SL9 impacts. Dark spots on Jupiter are not uncommon and usually associated with normal Jovian meteorological activity. Such spots are not the intense black observed in the recent impacts and searched for here. An impact spot may be relatively small, but within a larger penumbra-like region of irregular shape as was observed in some of the SL9 sites.

2.) The onset of the spot should be rapid. This means that as consistent and frequent a set of observations as possible would be needed. Occasional photographs or drawings would give too sporadic coverage.

3.) A spot should not be immediately associated with an active disturbance, although it is recognized that a comet or asteroid may not be so particular and may trigger just such an activity outbreak.

The literature search described here did not cover all literature on the subject and includes no original "discoveries" by the author. Rather the data are a sample from readily available sources, designed to examine the possibility that such events may have been observed unknowingly in the past and to gain some understanding of their frequency based on the historical observational record.

Morphological studies of Jupiter were unpopular in the early 20th century, particularly in the United States. As a result, published observations are rare. Such studies were seen as the province of the amateur. At Lick, Yerkes, Allegheny, and the U.S. Naval Observatory, occasional observations were made; but regular synoptic programs were not available until after World War II. Even Lowell Observatory publications concentrated mainly on Mars or the Jovian moons. For this reason, it was necessary to search amateur records of that time, chiefly British, for regular reports on Jovian observations. The British Astronomical Association (B.A.A.) had a very active Jupiter Section (hereafter called the Section) that provided the most consistent record of Jovian activity throughout the search period. Regular reports of Jupiter observations by members of the B.A.A. began in 1893, covering observations from 1891 until mid-World War II in 1943. Within those years ten years of reports were not available, although other journals where observations were often published were searched. This length of coverage on Jupiter appears to be virtually unique [Peek 1958, p.73]. For that reason this search begins with the first report and extends back nine years before the beginning of the present century.

Using amateur observations in this search is not seen as a handicap because the search criteria are such that even a small telescope would reveal these objects to the careful visual observer. Most of the B.A.A. observations were measurements of rotation rates and relative motions of cloud features, but often usable descriptions and drawings of the Jovian clouds accompanied these measurements.

The earliest observation of a candidate spot was during the Apparition of 1895-96. The Section Director at that time, Rev. W.R. Waugh, reported that a Section observer, Mr. C. Roberts, had noted the "North Equatorial Belt was very narrow and dark, with many dark spots." He said further, "These remark-

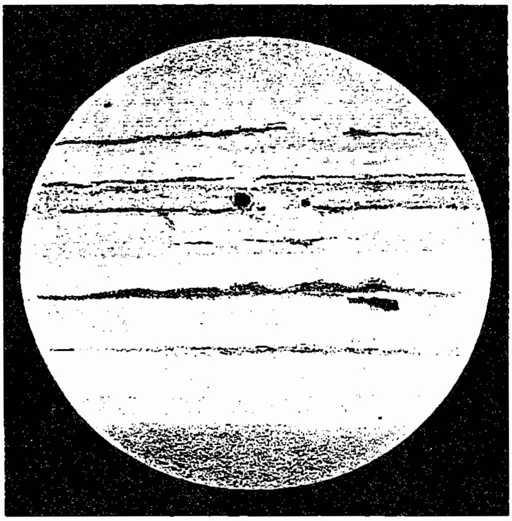


Figure 1. Drawing of Jupiter by T.H. Foulkes on 1895 Oct 24, 17h40m, using a 10.5-in reflector at 200X.

able dark spots were in each case twin spots." These spots were unusual enough to be given separate colloquial names of "The Garnet Spot" and "The Violin;" the former for color and the latter for shape. Among the descriptions and histories of these features was another observation by a Mr. Lunt, who, "sends a further note containing valuable remarks on this interesting theme..." He observed Jupiter on the morning of October 25, 1895 and saw "on the north edge of the North Equatorial Belt, a spot that had all the aspect of a satellite shadow... When first observed at 5 a.m. the spot on the N. tropical zone had not reached the central meridian...This spot was easily visible, though quite light at 6.30 a.m. During intervals of best definition this spot had a triangular outline." Jupiter was under regular surveillance at this time, with transit timings of features being made on 1895 Oct 15, 17, 22, and 27, with other observations interspersed. (See *Figure 1*, above.) No other observer commented on this spot on October 22 or 27, and no one made any transit timings of it. Though the other "dark spots" were noticed and followed in detail for four months they were never compared in darkness to satellite shadows (Waugh 1897).

During the Apparition of 1908-1909 a number of spots were seen in the North Equatorial Belt. One spot in particular was described by then Section Director T.E.R. Phillips as "a small, but intensely dark spot in about the same longitude as the following portion of the Red Spot hollow. It seems to have appeared early in April, and to have died out at the beginning of May." The report further mentioned that a Mr. Innes, observing from Johannesburg Observatory, described it as the "...darkest marking on Jupiter; it measured 1/2" in diameter." In a drawing by A.M. Newbegin using a 9-inch refractor the spot can indeed be seen as the darkest marking on the planet. Twelve days later a drawing by Rev. T.E.R. Phillips using a 5-inch refractor failed to show it. Sriven Bolton, using an 18-inch reflector showed no clear spot on a drawing made in May 2 but only an elongated darkening on the north edge of the North Equatorial Belt with an attached festoon trailing off to the northeast. (Phillips 1910)

Perhaps the best candidate spot was first observed by F. Sargent on 1921 May 16 in the north edge of the South Equatorial Belt, which "gave the impression of being the shadow of a satellite, an idea immediately recognized as being untenable .... As it approached the central meridian of the planet the spot was observed to be of great intensity, elongated, and surrounded by a penumbra-like shading." (Sargent 1921a, 1921b) These observations were confirmed by T.E.R. Phillips a month after the initial announcement (Phillips 1921). After this discovery, Sargent examined earlier observations in which he found a bright spot in the first week of May near the longitude of the later dark spots. He immediately associated the two: "If these positions for the bright spot, the observed and the inferred, are considered in relation to the dark spot found on the 16th, they are seen to be separated from it by from three to five degrees only, and to have probably shared the same abnormal rate of motion." He then concluded: "It therefore appears that we have an instance of an appreciable area rather than a 'spot' ... and in a state of rapid transition, in the course of which a bright spot formed in a few days on the planet's surface to vanish equally quickly, leaving behind it a mass of non- reflective material probably the product of its activities." It should be pointed out that no transit timings or drawings of this white spot were presented in the reports. Though earlier he estimated a separation of as much as five degrees between these spots, Sargent's conjecture of the "bright spot...leaving behind it..." the black spot cannot be verified. Several paragraphs later he modified his statement on the "rate of motion" and said, "Whilst extremely rare, such a period as here found is not without precedent." Mr. Sargent then cited several examples of such motion from the 18th and early 19th centuries (Sargent 1921b). Clearly this region was under regular observation and this dark spot of "great intensity" developed very rapidly. No observations of this spot were reported after 1921 Jun 03, although observations and transit timings of other features were made to the end of the month. Sargent's report also makes mention that, "[a] small sketch was made, and a covering note added." Unfortunately, neither this sketch nor any other of this region at these dates were published.

On 1932 Jan 31 the Rev. T.E.R.Phillips (still Section Director) noted in the North edge

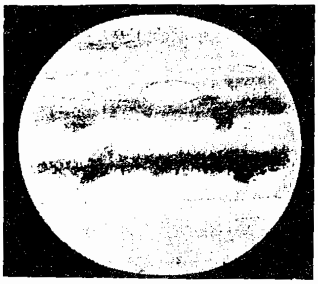


Figure 2. Drawing of Jupiter by T. Brindley on 1932 FEB 13, using an 8-in reflector. Note the dark patch on the north edge of the NEB (north at bottom).

of the North Equatorial Belt, "an extraordinarily dark spot comparable with the shadow of II [Europa] then on the disk." It was observed for a total of four months, during which time 12 transits were recorded; although transit timings were made a month earlier than Phillips' notation, no earlier description was provided. This circumstance may indicate a slow darkening over the intervening month. A poor drawing by T. Brindley on FEB 13 showed a darker patch in this area but no more (see *Figure 2*, above). B. Burrell did a much better drawing on FEB 17 (*Figure 3*, lower left), which recorded a dark knot at that location with a dark streak to the southwest crossing the North Equatorial Belt. By Mar 18, Phillips himself made a drawing of the area, showing the dark spot by then very elongated, about 20 degrees of longitude in length (see *Figure 4*, lower right). Another observation of yet another dark spot was made by A.S.Williams in the same apparition, this time on the South side of the North Equatorial Belt. It was "like an enormous satellite in dark transit - dark but not black." It was observed for a total of three months. Three days before the Williams observation, Phillips, using an 18-inch reflector, made a drawing that covered this region that showed no darkening at all. No other descriptive observations or drawings were available for this area (Phillips 1939).

While not fitting the above criteria perfectly, one observation in 1941 deserves mention and further investigation. Two white spots were seen on the disk on 1941 DEC 27/28 by Hargreaves, in the mid-North Equatorial Belt region. They differed in appearance, and one of them was seen "to have a small and intensely dark spot at its center," which was "slightly eccentric" on the second day of observation (Peek 1958, p.97). This unusual spot lasted only a couple of days. Such white rings were reported around some of the fresh SL9 impacts by visual observers (C. Hernandez, A.L.P.O. Recorder, personal communication); but, because of the failure to meet the criteria set out earlier, the 1941 features can be considered only as poor though interesting impact candidates.

SUMMARY

Many additional spots reported in the historical literature had structure suspiciously similar to that of the SL9 impact sites but failed to meet one or more of the three criteria. These were omitted from this study. The second criterion was the most difficult to satisfy; spots that were reported to have slowly developed are not included here. Unfortunately, there were no cases where an observer specifically stated that a spot was not seen in the last previous visible rotation. It is also interesting to note that at no time during the whole period were dark protuberances on the belts, or "barges" and rods, described as "intensely black" or compared visually to the intensity of satellite shadows.

The larger SL9 impact spots, and particularly clusters of impact spots, formed noticeable notches on the limb as seen in smaller telescopes. The examples cited here (see *Table 1*, p. 152) were not comparable to these largest SL9 impacts and were in each case an isolated spot. Unfortunately, all but one of the included candidates occurred in meteorologically active areas of the planet. This circumstance may

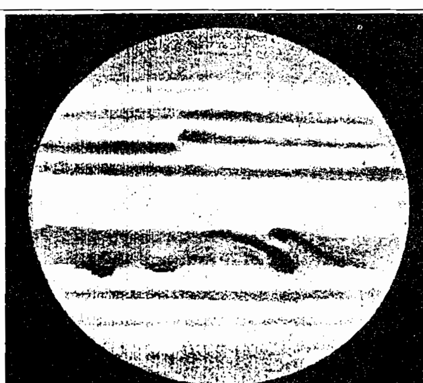


Figure 3. Drawing of Jupiter by B. Burrell on 1932 FEB 17, 09h45m GMT with a 3-in refractor, showing the same dark patch on the north edge of the NEB (north at bottom).

Figure 4. Drawing of Jupiter by T.E.R. Phillips on 1932 MAR 18, 09h30m GMT, with an 18-inch reflector, with the dark spot on the north edge of the NEB elongated (lower right; north at bottom).

well prove fatal to their future candidacy.

Two visual observers related to the author stated that they had observed a deep red color within the SL9 impact sites. None of the spots described here had any indications of colors reported. These effects are highly dependent on the size of the impact, color sensitivity of the observer, aperture of the telescope, and terrestrial atmospheric conditions. None of the instruments here exceeded 45 cm in aperture and only one or two of those were that large. Most were substantially smaller. As stated above, these spots were not comparable to the largest SL9 impacts, making color detection difficult. [Also, given the time period, the reflecting telescopes used must have employed mirrors of speculum metal, or perhaps silvered glass, both inferior in reflectivity to modern aluminum coatings and even possibly introducing false color. Ed.] Again, visual observations of color are highly subjective and easily affected by any number of local conditions and the color sensitivity of the observer's eyes and therefore color was not used as a criterion.

If the historic features listed in *Table 1* (to right) were indeed impact spots, this fact would imply a frequency of at least five impact events per century. But no one would be surprised if, upon further investigation of published and unpublished records, all of these candidates were found to be of Jovian meteorologic origin. If so, the predicted frequency would likely be less than one such event in 50 years. This would tend to agree with a recently published comet splitting recurrence interval estimate of around 80 years. (Melosh & Schenk 1993) Again, it needs to be stressed that this report describes a cursory look at the available reports and is only designed to indicate whether further work is warranted. It is clear that a thorough, comprehensive search of observatory reports, professional unpublished observations, and amateur reports would be useful to see if other such likely spots have been observed than those of the B.A.A. included here.

This work was not given any professional financial support and was undertaken entirely on the author's own time and expense. A more detailed and in-depth investigation was not possible under these circumstances. Finally, the author thanks D.M. Hunten and A.L. Sprague for their patience, support and encouragement.

Table 1. Candidate Historical Jovian Impact Spots.

Date(s)	Observer(s)	Position
1895 Oct 25	Lunt	N. edge, NEB
1909 Apr-May	Phillips, Inns	NTrZ
1921 May-Jun	Sargent, Phillips	SEB
1932 Jan-Mar	Phillips, Williams	NEB (two separate spots)
1941 Dec 27-28	Hargreaves	Mid -NEB (improbable)

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IMPLICATIONS OF A COMETARY COLLISION WITH THE PLANET JUPITER

By: Robert G. Warren

ABSTRACT

Comet P/Shoemaker-Levy 9 was unusual for two reasons. First, while making a close pass of the planet Jupiter, it split into approximately 21 fragments, Second, it was shown that those fragments were in orbits heading toward multiple collisions with that planet. That single collisional event has shown what could happen to the Earth and other Solar-System bodies under similar circumstances, at any time. Have similar collisions already occurred in the Solar System in the past? If so where? What of our supposed safety that we have believed in for millennia, on the surface of this Earth? Could a collision occur again, on this planet?

There are 855 known comets. Of these, 174 are periodic comets with orbital periods of less than 200 years [19]. Another comet, a periodic one, was added to the list by the prolific observing team of Eugene and Carolyn Shoemaker and David Levy on the night of 1993 MAR 24. Images obtained that night of Periodic Comet Shoemaker-Levy 9 showed a "String of Pearls" [16]. Subsequent studies confirmed that the comet had a close encounter with the planet Jupiter on 1992 JUL 08 [12], splitting into approximately 21 fragments.

Any periodic comet has a 1-in-300 chance of fragmenting during any passage through the inner Solar System [14]. A fragmented comet near Jupiter was no shock to the astronomical community. Positional studies of the cometary fragments gave the biggest surprise as, with the accumulation of more positions, orbits were determined for each fragment. Calculations of future motions of those cometary fragments showed that all of them were in descending orbits around Jupiter, and would collide with it during mid-July, 1994 [28].

Contrary to mankind's collective historical record, collisions are not unusual for the Solar System as a whole. Finding craters in the Solar System is neither a new or a difficult task. Space-probe studies of other Solar-System bodies clearly show the surfaces of all the moons and solid planets in the Solar System have been shaped by such collisions.

> "The impact of solid bodies is the most fundamental of all processes that have taken place on the terrestrial planets ... Without impact, Earth, Mars, Venus, and Mercury wouldn't exist. Collision of smaller objects is the process by which the terrestrial planets were born." [31]

Craters on the Moon [5], on Mars [6], and on Venus [7] are all evidence for past collisions with other Solar-System bodies.

From studies of the craters found on the Earth, we believed that we understood the cratering process, Even so, there have remained certain anomalies, such as the chains of craters on Jupiter's moons Callisto and Ganymede found in images taken by the Voyager missions. To date, thirteen crater chains have been identified on Callisto, and three on Ganymede. In any single chain, the diameter of the individual craters is approximately 10 km (6 mi).

Past studies have associated crater chains with scarp formations, fault lines, or as being secondary impact structures. Recently, crater chains on the Jovian moons have been reexamined in light of the interest in Comet Shoemaker-Levy 9 [20]. The conclusion reached was that crater chains might have been formed when cometary fragments collided with the surface of the moons. The interest in Comet Shoemaker-Levy 9 [17], since it was found fragmented, has added to the study of cometary impacts in the Jovian System [28], as well as in the rest of the Solar System.

If crater chains could be caused by collisions of fragments, those fragments could come from asteroids, extinct cometary nuclei, or active comets. Since all three types of objects visit the inner Solar System, the moons and planets of the inner Solar System may have crater chains. Indeed, space-probe images of the planet Mercury and the Moon clearly show several candidates that could be crater chains caused by such collisions.

Our coverage of the planet Mercury is limited, but examination of images of the surface reveals two possible crater chains (see [21] figures 5.22 and 5.29). Study of the original image data might reveal more chains.

The surface of the Earth's Moon clearly shows several crater chains [5, 27]. One such, the Davey chain, crosses a hill in addition to relatively flat terrain [4]. As none of the lunar crater chains have been sampled in situ, the exact nature of their origin will remain controversial until we can visit them. However this does show the need to take a second look at the previously believed association of such features with internal lunar eruptive mechanisms along sub-surface fissures [13].

One question to ask is, would all such collisions occur in linear patterns? What of regions on the moon where a group of craters could be explained as having an origin either from secondary impact cratering [1] or from a collisional event? Could crater groups have been caused by objects that fragmented but lacked the time to spread in their orbits into linear formations that would then form linear chains of craters? This could be an alternative method of forming some of the lunar features that resemble secondary impact fields.

Either way, the presence of crater chains clearly shows the need to continue studying even the surface of the Moon, for we still know so little about it.

Man had never previously witnessed a cometary collision with any Solar-System body (except for the comets, observed by space probes, falling into the sun). Never had we known beforehand that a collision was going to happen, To date, this makes the collision between Comet Shoemaker-Levy 9 and Jupiter unique in our history.

With the advent of Comet Shoemaker-Levy 9, we were able to conduct studies of Jupiter never before attempted. Until this collision, all we had ever been able to see of Jupiter was its upper atmosphere. As the cometary fragments passed through the upper atmosphere we were able to observe plumes of atmospheric materials as they rose above the limb of the planet [9]. We detected atmospheric shock or surface waves radiating outwards from each collision point [25] like the waves radiating away from the point where a rock is thrown into water.

Knowledge of such shock waves can tell us something about what is below the visible cloud layers. Such information can be applied to studies of the Earth's atmosphere. More significant is the realization that such a collision could again happen, as they have in the past, on the Earth.

> "It is now known that the earth bears many scars which record violent encounters with large meteorites in the geologic past." [18]

Such evidence can be seen at any of the over 100 known craters on the surface of the Earth. This evidence is more convincing when standing on the rim of Meteor Crater in Arizona [22]. It is believed one such crater, Chicxulub, a 180-km diameter, 65 million-year old scar under the Yucatan peninsula, is responsible for the demise of the dinosaurs [30].

> "The diameter of the body was calculated to be ten kilometers (about six miles) plus or minus four kilometers."[26]

The calculated diameter of the Chicxulub impacting body is comparable with the diameter of many cometary nuclei, such as comet Halley [15].

Knowing that every year 5-10 new comets are found, such discoveries show the importance of searching for and studying all comets. Where might some of those undiscovered comets be heading? It is easy to create a scenario where a newly discovered comet is on a collision course with the Earth.

Books [23] and movies [24] have thrilled science fiction buffs with such scenarios. Such narratives depict the destruction of civilization as we know it. In reality, right now there could be a comet or an asteroid on a collision course with the Earth.

> "There is a 1 in 10,000 chance that a large (2 km diameter) asteroid or comet will collide with the earth during the next century, disrupting the ecosphere and killing a large fraction of the world's population." [8].

The lower probability limit for such a collision is 1 in 3,000, whereas the chance of dying in an airplane crash is 1 in 20,000, and the chance of dying from botulism food poisoning is 1 in 3 million. For those reasons, the study of comet Shoemaker-Levy 9 was vitally important. How it affected the Jovian atmosphere gave us insight into how the Earth's atmosphere would react to such an event.

> "In particular, it is likely that the comet's fragments will experience multiple major outbursts during their flight through the Jovian atmosphere (a behavior that is quite common among the fireballs of class III, especially IIIb, that strike the Earth's atmosphere),.." [29].

Every year

> "High energy airbursts with the energy of the Hiroshima bomb occur . . ." [8]

and after careful study

> "...Shoemaker calculated that every year, on average, a fragment of Asteroid or Comet self-destructs somewhere in the Earth's atmosphere with the kinetic-energy equivalent of 20,000 tons of TNT .... " [3].

Since the majority of the Earth's surface is covered with water, most airbursts happen over the water. However, on 1908 JUN 30 occurred an airburst that

> "...delivered the equivalent of about 10 million tons of TNT .... " [3],

occurring over the Tunguska region of Siberia.

> "...at an altitude of about 6 km the object shattered in a rapid series of bursts and vaporized, felling trees in a radial pattern over an area of 2,150 square kilometers and incinerating a central area half that size." [11]

If it had occurred 4 hours later, the city of St. Petersburg would have been at ground zero [2]. [The Editor cannot resist commenting on this often-heard statement. If, indeed, the impact had occurred 4h46m later, which would have brought it to the *longitude* of St. Petersburg, it would have struck 6°00' of *latitude* north of the city, missing it by about 668 km.]

So far, we have been lucky. Unfortunately, such luck can not hold forever,

> "Astronomers and geologists know that this was an exceptional circumstance. But they know also that there is no reason whatever why a similar visitation should not fall at any moment upon a more populous region." [2]

Because of its unique collision with the planet Jupiter, Comet Shoemaker-Levy 9 has opened avenues of scientific inquiry heretofore classed as crackpot ideas. Because of the collision, we have witnessed what can happen during such collisions,

Even though we can observe these collisions elsewhere, it is hard for many people to believe that such events can occur here on the Earth. If someone should doubt the possibility of a future collision, let them look at Tunguska [2], or Meteor Crater [22]. The possibility of such collisions in the future, even on the Earth [8] should drive home the importance of keeping our telescopes active by searching for, discovering, and subsequently observing comets and asteroids [10], We should use this information to prevent any possible future demise of our own species on this planet.

CONCLUSION

Comet P/Shoemaker-Levy 9 was just the tip of the iceberg. In the outer Solar System there are millions of as yet undiscovered comets. In the inner Solar System there may be thousands of as yet undiscovered extinct cometary nuclei and asteroids. Some of these objects are in orbits that, at some time in the future, will cross that of the Earth. Some of these Earth-crossing objects will collide with the Earth. To prevent such possible collisions, we must search for those objects.

In these times of concern over how a nation spends its tax dollars, it is vitally important that the world's professional and amateur astronomers work together to collect the observations that may be needed to prevent our demise.

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TELESCOPIC OBSERVATIONS OF MARS: THE 1994-1995 APPARITION

By: Donald C. Parker and Jeffrey D. Beish, A.L.P.O.

Note: This paper is an abstract of a paper delivered by the two authors at the August, 1995, conference on Mars observation at Cornell University.

Our research during the 1994-95 Mars Apparition has concentrated on Martian meteorology and North Polar Cap (NPC) behavior. Measurements of the NPC areocentric latitude were obtained between 022° and 112° Ls from 220 bifilar micrometer and 168 red-light CCD images. While the cap latitudes obtained from CCD measurements averaged 1°.3 higher than those measured with the micrometer, the differences were not significant (P = 0.36 [i.e., this could happen due to chance 36 percent of the time]). In addition, the 36 measurements submitted from red-light video images were not significantly different from the micrometer or the CCD sets (P = 0.84). The resulting regression curve for the 1994-1995 Apparition is fairly smooth, lacking significant periods of retardation (see *Figure 1*, p. 157).

The 1995 NPC regression was statistically compared to those obtained during previous apparitions. Through 060° Ls the 1995 curve was virtually identical to that obtained by Viking in 1978 **[1]**. Analysis of the of 1980 [2], 1982 **[3]**, and 1984 **[4]** regressions with both paired and unpaired nonparametric statistical tests reveal that the 1995 North Cap was consistently and significantly smaller for a given Ls. When the cap latitudes were merged into 5°-Ls increments, the 1995 NPC averaged 4°.8 of latitude farther north than the combined values from the 1980's (see *Figure 2*, p. 157), using the Wilcoxon signed rank test ($P < 0.01$). The 1984 regression displayed unusual retardations between 060° and 110° Ls—a period coinciding with the appearances of five localized aphelic dust storms **[5]**. (See *Figure 3*, p. 158.) Even with the 1984 data omitted, the 1995 cap still averaged 2°.9 of latitude farther north ($P < 0.01$). When all of the raw data from the 1980's are combined and compared to that of 1995 between 022° and 112° Ls, there is no statistically-significant difference. However, this conclusion appears mainly due to the coincidence of values for the summer cap. The 1995 spring (024°-090° Ls) cap was 2°.4 of latitude farther north than the combined 1980 and 1982 values ($0.05 > P > 0.01$). It appears that the 1995 cap started out smaller but regressed at a slower rate (0°.36 areocentric latitude/ °Ls) than the 1980 and 1982 caps (0°.45 /°Ls) during the period between 045° and 090° Ls.

The NPC regressions of the 1960's **[6]** reveal consistently larger caps than the 1980's or 1995 at a given Ls (*Fig. 2*), despite considerable overlap in personnel, equipment, and technique. These data have been corrected for the revised axial tilt determined by Mariner-IX data. During the 1969 Apparition, the NPC displayed unusual regrowth near aphelion and between 100° and 120° Ls **[7]**. Even without the 1969 data, the 1960's North Cap latitude averaged 2°.0 (Wilcoxon test) and 2°.4 (Mann-Whitney test) smaller than those of the 1980's ($P < 0.01$).

Over 200 tricolor CCD images of Mars were obtained and analyzed for meteorological phenomena and are included in our ongoing study **[8]**. Although our statistical analysis is not complete for the 1994-95 Apparition, there was a widespread cloudiness on all sides of Mars during that period. Equatorial band clouds, previously thought to be rare, were especially prevalent. Whether this phenomenon was real or merely the result of better imaging and visual observations remains to be seen. Some interesting relationships between meteorology and NPC behavior appear to be emerging from our meteorological study, which now includes approximately 19,000 observations made over a 30-year period.

During the 1992-93 Apparition, the early spring NPC appeared to be smaller than usual, with the cap's edge latitude being 3°.7 higher than the 1995 cap at 022° Ls (see *Figure 4*, p. 158). Data kindly supplied by the British Astronomical Association **[9]** and the Nordic Mars Observers **[10]** confirmed that this spring cap was smaller than usual. At the same time, there was a statistically-significant increase in 1993 in the frequency of discreet localized and orographic clouds as well as in morning and evening limb clouds. These clouds appeared approximately 30° of Ls earlier than expected. However, by late northern spring and early summer their frequency had dropped below that expected for the season. At the same time, the NPC demonstrated a fairly slow regression rate, being only 0°.137 /°Ls, compared with 1995's 0°.212 /°Ls for the same Ls period.

The next Mars apparition, beginning in late 1996, will present a good opportunity for further NPC study, with opposition occurring at the time of Mars' northern summer solstice. Although the planet's apparent diameter will be at most only 14.17 arc-seconds, its North Pole will be tilted toward the Earth by more than 20° throughout the apparition, permitting high-quality observations of the Arctic regions from Martian mid-spring through late summer. We look forward to the participation of A.L.P.O. Mars observers in studying the fascinating but poorly understood interdependence between the Martian polar caps and the planet's meteorology.

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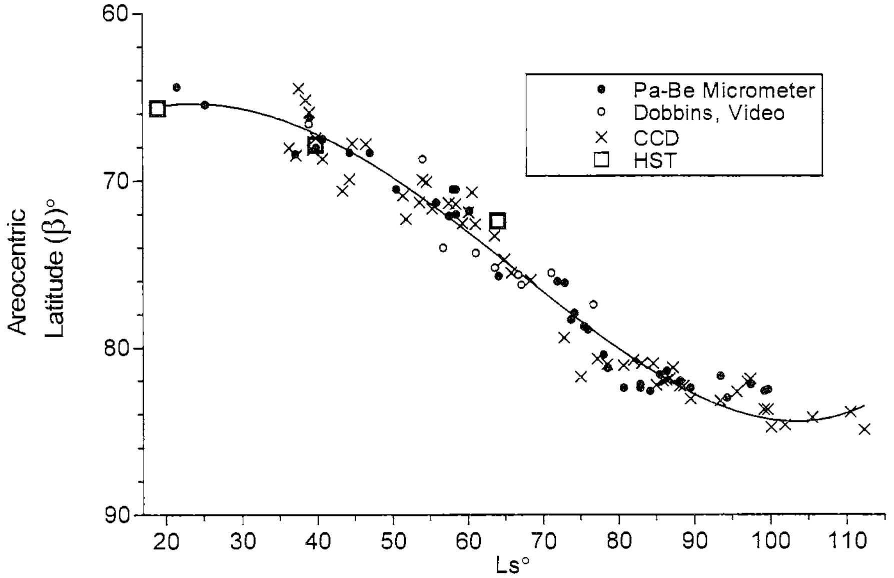

Figure 1. Observed areocentric latitudes of the south edge of the Martian North Polar Cap in the 1994-95 Apparition. "Pa-Be Micrometer" represents Parker and Beish micrometer measurements; "Dobbins, Video", T. Dobbins video images; "CCD", CCD images; "HST", Hubble Space Telescope images.

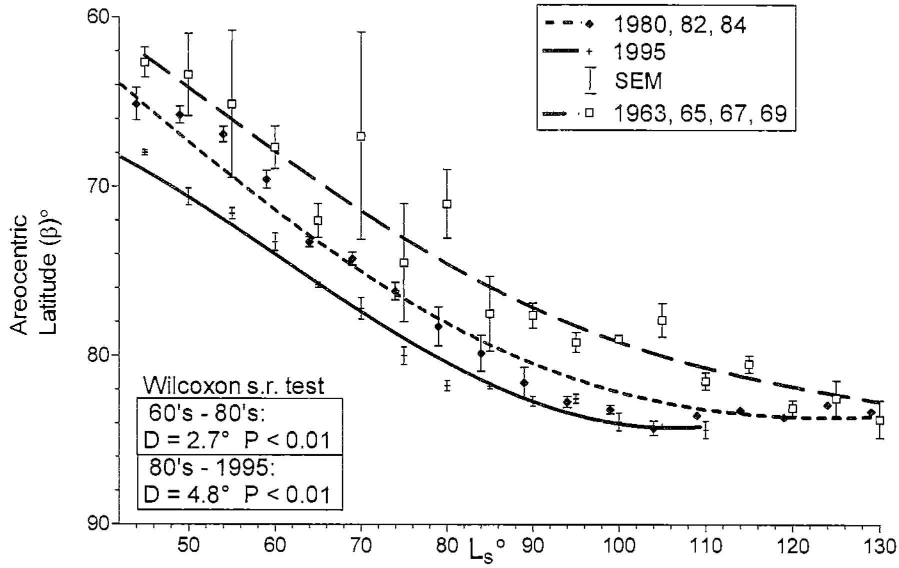

Figure 2. Martian North Polar Cap regression curves for the 1963-1969, 1980-1984, and 1994-95 Aphelic Apparitions. (During perihelic apparitions the north polar area is not exposed to our view.) "SEM" represents the standard error of the measures.

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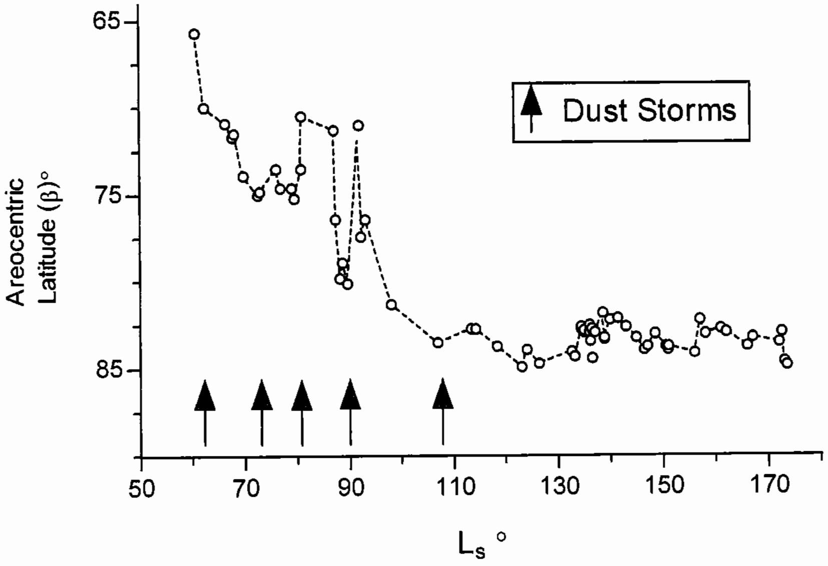

Figure 3. The regression curve of the Martian North Polar Cap in the 1984 Apparition, with the areocentric longitudes (Ls) of dust storm occurrences indicated by arrows.

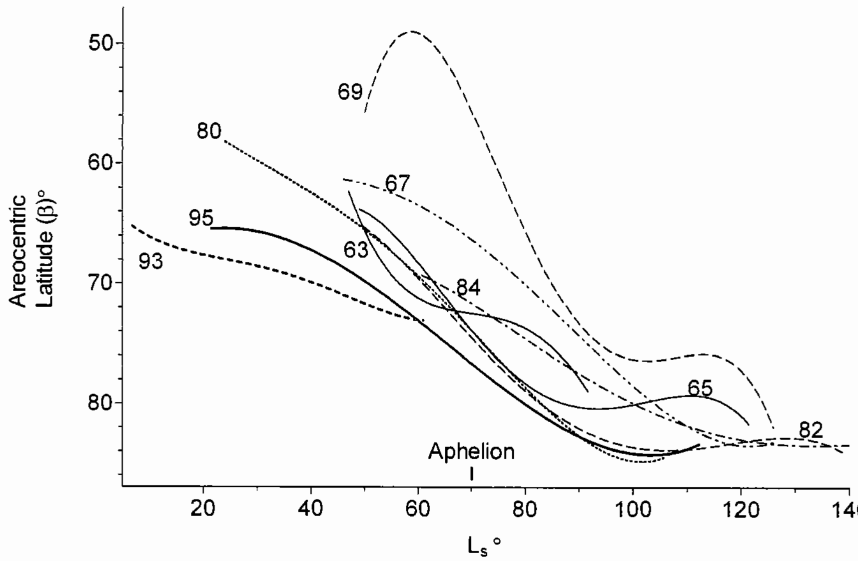

Figure 4. Smoothed curves representing the regression of the Martian North Polar Cap in the 1963-1969, 1980-1984, and 1993-1995 Aphelic Apparitions.

THE 1992-93 EASTERN (EVENING) APPARITION OF VENUS: VISUAL AND PHOTOGRAPHIC OBSERVATIONS

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

ABSTRACT

This report summarizes visual and photographic observations of Venus for the 1992-93 Eastern (Evening) Apparition, based on data submitted by A.L.P.O. Venus Section observers in the United States, Canada, the United Kingdom, Germany, and Sweden, including the instrumentation and sources of data used for those observations. Comparative studies focus on observers, instruments, and visual and photographic data. The report includes illustrations and a statistical analysis of the categories of features in the atmosphere of Venus; including cusps, cusp-caps, and cusp-bands, seen or suspected at visual wavelengths, both in integrated light and with color filters. Terminator irregularities and the apparent phase are discussed, as well as coverage based on results from the continuing monitoring of the dark hemisphere of Venus for the Ashen Light.

INTRODUCTION

Observers submitted a total of 216 visual drawings and photographs for the 1992-93 Eastern (Evening) Apparition. The chronology of the apparition is presented in *Table 1* (to the right).

Observational coverage was very good, with individuals starting their programs early in the apparition, and following through until Venus reached Superior Conjunction. The "observing season," or observation period, ranged from 1992 JUN 27 to 1993 APR 01, with the maximum emphasis during the period of 1992 December through 1993 March (81.0 percent of the total observations). *Figure 1* (below) shows the distribution of observations

Table 1. Geocentric Data in Universal Time (UT) for the 1992-93 Eastern (Evening) Apparition of Venus. ***[A.L.P.O.; 1991, 1992]***

			d	h
Superior Conjunction..................	1992	JUN	13	16
First Observation (Elong. 4°E).....		JUN	27	--
Greatest Elongation East (47°)....	1993	JAN	19	16
Dichotomy (predicted).................		JAN	21	21
Greatest Brilliancy (-4.6).............		FEB	25	--
Last Observation (Elong. 8°W).		APR	01	--
Inferior Conjunction.....................		APT	01	13

Apparent Diameter (observed range):
9".64 (1992 JUN 27) - 59".12 (1993 APR 01)

Phase Coefficient (*k*; observed range):
0.998 (1992 JUN 27) - 0.009 (1993 APR 01)

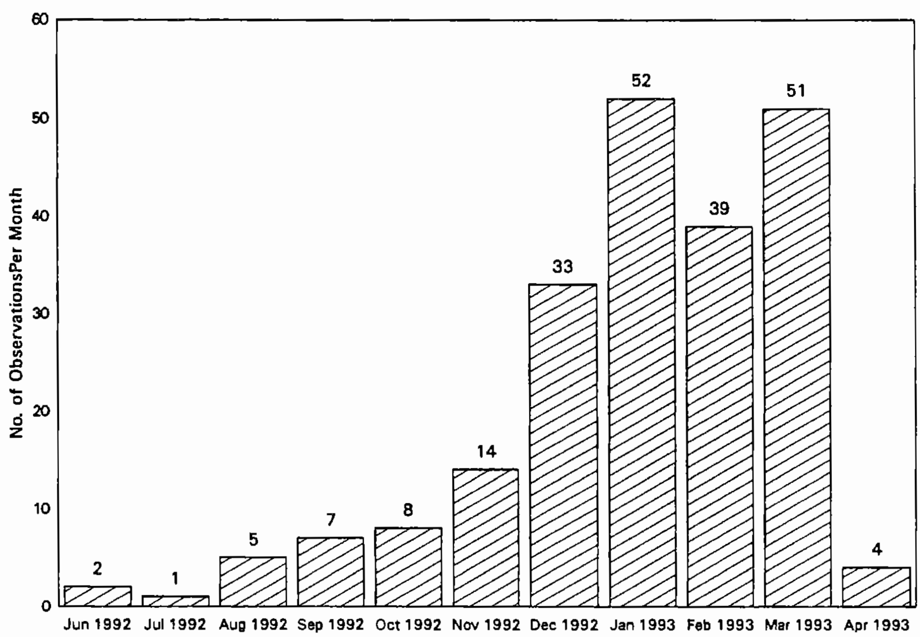

Figure 1. Number of A.L.P.O. Venus Observations contributed by month for the 1992-93 Eastern (Evening) Apparition. A total of 216 observations were received.

for each month during the observing season. As in many previous apparitions, the observational activity in 1992-93 increased throughout the period when Venus was at greatest brilliancy and maximum elongation from the Sun.

Fourteen individuals submitted visual and photographic observations of Venus during the 1992-93 Apparition. These observers are listed in *Table 2* (below) with their observing sites, number of observations, and instruments used.

Figure 2 (p. 161) shows the distribution of observers and contributed observations by nation of origin for this apparition. One-half of the observers were located in the United States, but those individuals only accounted for 34.7 percent of the observations received. As in previous years, our programs remain international in scope.

The types of telescopes used to make the observations are depicted in *Figure 3* (p. 161). The majority (86.6 percent) of the observations were made with telescopes 15.2 cm (6.0 in) aperture or greater.

In terms of atmospheric conditions, the mean Seeing was 4.1, or "fair," on the standard A.L.P.O. Seeing Scale that ranges from 0.0 (worst seeing conditions) to 10.0 (perfect). The mean Transparency, expressed as the limiting stellar magnitude in the vicinity of Venus for dark skies, was about +3.9. However, during 1992-93, virtually all observations were made against a light (or twilight) sky.

This Recorder is grateful to the observers mentioned in this report who contributed data to the A.L.P.O. Venus Section in support of our continuing effort to encourage and coordinate long-term, comprehensive studies of Venus. Good cooperation continues from such groups as the British Astronomical Association, the Vereinigung der Sternfreunde in Germany, and the Swedish Amateur Astronomical Society, as well as others throughout the World.

OBSERVATION OF VENUSIAN ATMOSPHERIC DETAILS

The various methods and techniques for carrying out visual studies of the characteristically vague and elusive "markings" in the atmosphere of Venus are outlined in the appropriate Venus Section publications. New A.L.P.O. Venus observers should thoroughly

Table 2. Participants in the A.L.P.O. Venus Observing Program During the 1992-93 Eastern (Evening) Apparition.

Observer	Observing Site	Number of Observations	Telescope(s) Used
Benton, Julius L.	Wilmington Island, GA	5	8.3-cm (3.3-in) Refractor
		5	12.8-cm (5.0-in) Refractor
		10	15.2-cm (6.0-in) Refractor
Buggenthien, Rüdiger	Göttingen, West Germany	4	15.2-cm (6.0-in) Refractor
Gélinas, Marc A.	Ile-Perrot, Que., Canada	6	15.2-cm (6.0-in) Refractor
Graham, Francis G.	East Pittsburgh, PA	1	6.4-cm (2.5-in) Refractor
		1	10.2-cm (4.0-in) Refractor
		18	17.8-cm (7.0-in) Refractor
		2	40.6-cm (16.0-in) Newtonian
Haas, Walter H.	Las Cruces, NM	4	20.3-cm (8.0-in) Newtonian
		13	31.8-cm (12.5-in) Newtonian
Heath, Alan W.	Nottingham, UK	25	30.5-cm.(12.0-in) Newtonian
Johnson, Andrew P.	North Yorkshire, UK	26	21.0-cm (8.3-in) Newtonian
Melillo, Frank J.	Franklin Square, NY	4	20.3-cm (8.0-in) Schmidt-Cass.
Niechoy, Detlev	Göttingen, West Germany	1	6.0-cm (2.4-in) Refractor
		10	10.2-cm (4.0-in) Refractor
		60	20.3-cm (8.0-in) Schmidt-Cass.
		1	30.5-cm (12.0-in) Newtonian
Nowak, Gary T.	Essex Jct., VT	7	25.4-cm (10.0-in) Schiefspiegler
Schmude, Richard W.	Los Alamos, NM	3	35.6-cm (14.0-in) Schmidt-Cass.
Stryk, Ted	Bristol, VA	1	5.0-cm.(2.0-in) Refractor
		1	25.4-cm (10.0-in) Newtonian
Viens, Jean-Francois	Charlesbourg, Que., Canada	5	11.4-cm (4.5-in) Newtonian
Wardell, Johann	Uppsala, Sweden	3	16.0-cm (6.3-in) Refractor

Total Number of Observers.................... 14
Total Number of Observations... 216

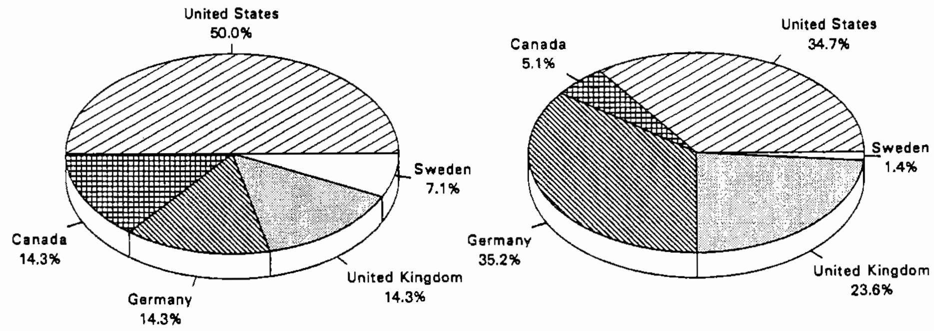

Figure 2. Relative distribution of observers (left) and observations (right) by nationality for the 1992-93 Eastern (Evening) Apparition of Venus.

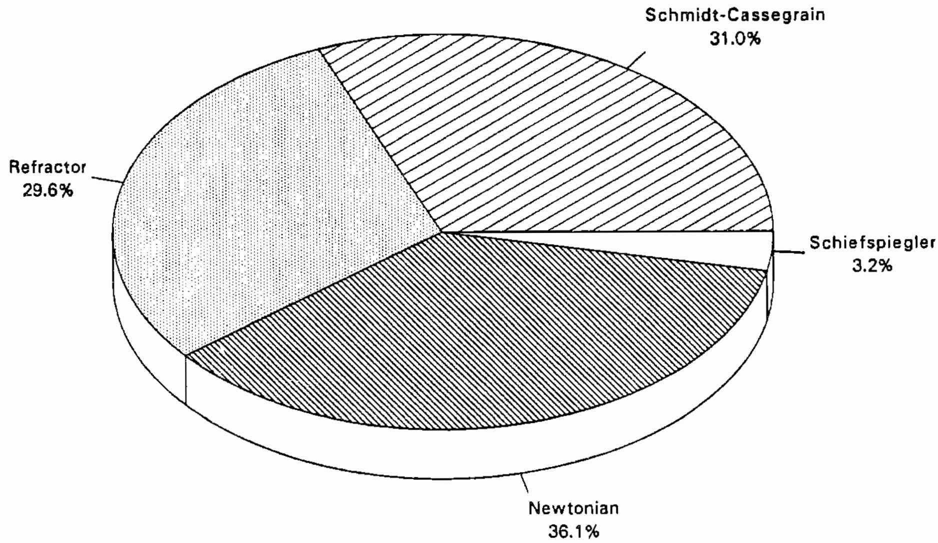

Figure 3. Relative distribution of observations by type of instrument for the 1992-93 Eastern (Evening) Apparition of Venus.

study these sources as well as previous apparition reports that have appeared in this Journal.

All of the observations used for this report were made at visual wavelengths, and samples of these observations in the form of drawings and photographs accompany this report to aid the reader in interpreting the phenomena reported or suspected on Venus in 1992-93 (see *Figures 6-30*, pp. 166-169).

The visual and photographic data for the 1992-93 Apparition report essentially all of the categories of dusky and bright features on Venus that are described in the literature cited above. *Figure 4* (p. 162) shows the relative frequency by which the specific forms of markings were reported. More than one type of marking or feature were shown in many of the observations, so that totals of over 100 percent are possible. Without question, there is some subjectivity in the reporting of the elusive, vague markings of Venus, which must affect the values shown in *Figure 4*. Even so, our tentative conclusions derived from these data appear acceptable and reasonable.

The dusky markings of the atmosphere of the planet are usually extremely difficult to detect, both for the novice as well as the experienced visual observer, and it is now widely accepted that good ultraviolet (UV) photographs or CCD images of Venus will tend to reveal more of these subtle shadings. So, the A.L.P.O. Venus Section actively seeks UV photographs and CCD images because many features look different in these short wavelengths of light than in the visual region of the electromagnetic spectrum, particularly radial dusky patterns. Even so, *Figure 4* shows that only 38.3 percent of the drawings and other visual observations of Venus during the 1992-93 observing season showed no shadings or markings of any kind. This is somewhat similar to the situation in other recent apparitions, but not for many of the observing seasons before 1988-89. In the photographs taken at visual wavelengths there were absolutely no indications of markings on Venus, even

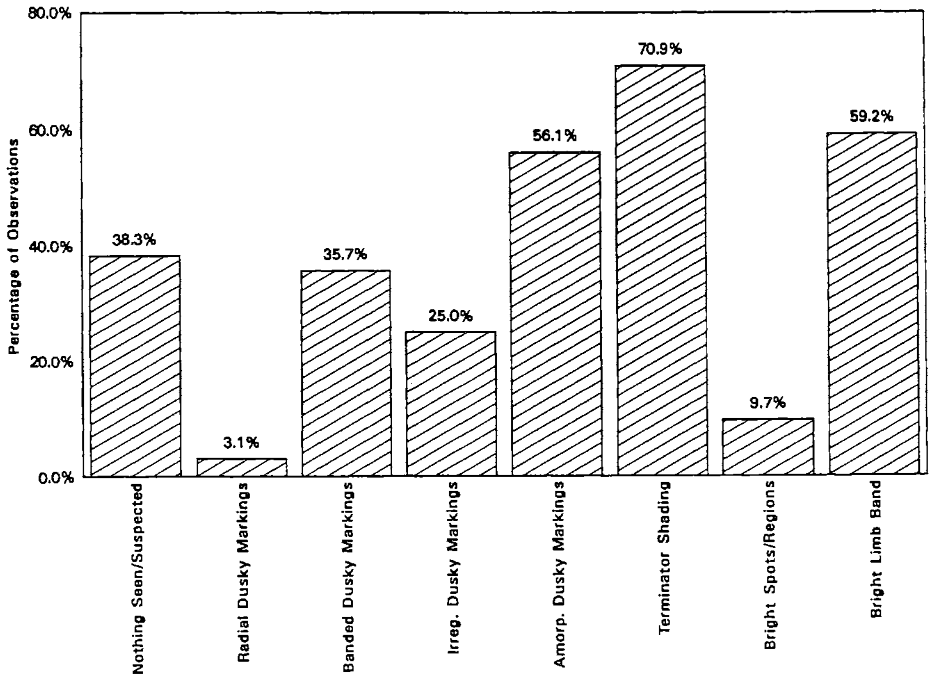

Figure 4. Relative frequency of reports of types of markings and other features for the 19992-1993 Eastern (Evening) Apparition of Venus.

though visual observers reported seeing banded, radial, irregular, and amorphous dusky markings. A contributing factor for the visual detections is the increased use by our observers in recent apparitions of standard, systematic techniques with variable-density polarizers and color filters.

Figure 4 shows that more than half (51.6 percent) of the dusky features that were reported fell in the category of "Amorphous Dusky Markings." Other dusky shadings were distributed among the categories of "Banded Dusky Markings" (35.7 percent) and "Irregular Dusky Markings" (25.0 percent), while only 3.1 percent of the observations indicated "Radial Dusky Markings" in 1992-93.

Terminator shading was fairly prominent during the 1992-93 Apparition, visible in 70.9 percent of the observations, as shown in *Figure 4*. The usual tendency existed for the terminator shading to lighten (i.e., assume a higher intensity value) as one proceeded from the terminator toward the sunlit limb of the planet. This gradation in brightness often ended at the Bright Limb Band, and frequently this terminator shading extended from one cusp region to the other. Unlike the many drawings received during 1992-93, photographs rarely suggested that terminator shading was present.

The mean relative intensity for all of the dusky features on Venus in 1992-93 ranged from 8.5 to 8.8, on the standard A.L.P.O. Scale, which ranges from 0.0 for completely black to 10.0 for the brightest possible surface features.

The A.L.P.O. Scale of Conspicuousness ranges from 0.0 for "definitely not seen" up to 10.0 for "certainly seen." This scale was also used rather effectively during the 1992-93 observing season. The dusky markings in *Figure 4* were assigned a mean conspicuousness of 5.0 during the apparition, meaning that all of these features lay somewhere between vague suspicions and strong indications of actual presence on Venus.

Figure 4 also shows that "Bright Spots or Regions," exclusive of the cusp areas, were infrequently perceived; they averaged about 9.5 in mean relative intensity. A very small number of drawings showed these bright spots or mottlings, and photographs were completely devoid of these features.

Color-filter techniques were employed systematically during the 1992-93 Eastern Apparition. These methods generated favorable results when compared with studies in integrated light (i.e., unfiltered). The overall visibility of most of the atmospheric phenomena on Venus was improved by the usage of Wratten and Schott color, and variable-density polarizing, filters.

THE BRIGHT LIMB BAND

Figure 4 shows that 59.2 percent of the observations submitted in the 1992-93 Apparition described an obvious "Bright Limb Band" on the sunlit hemisphere of Venus. When this brilliant band was reported, the feature was continuous from cusp to cusp in 67.2 percent, and was broken or only partially visible in 32.8 percent, of the positive reports. The mean numerical intensity of the Bright Limb Band was 9.8; its visibility was significantly enhanced when using color or polarizing filters.

Terminator Irregularities

The terminator of Venus is the geometric curve that separates the sunlit and dark hemispheres of the planet. During the 1992-93 Apparition, 31.1 percent of the observations called attention to an asymmetric or irregular terminator. When the terminator was not seen as a regular geometric feature, amorphous and irregular dusky markings, and to a diminishing extent banded and radial dusky shadings, appeared to merge with the terminator shading and with possible reported deformities. As with other observations during this apparition, successful filter techniques probably enhanced the visibility of any terminator irregularities and associated dusky atmospheric features. Also, the phenomenon of irradiation may cause brilliant features adjacent to the terminator to protrude into the dark hemisphere, and dark features to protrude into the sunlit hemisphere.

Cusps, Cusp-Caps, and Cusp-Bands

The most contrasting and conspicuous features sometimes seen in the atmosphere of Venus are located at or near the planet's cusps, usually when the phase coefficient, *k*, lies between 0.1 and 0.8 (the phase coefficient is the fraction of the disc that is illuminated). These cusp-caps are occasionally bounded by dark, often diffuse, peripheral cusp-bands. *Figure 5* (below) depicts the visibility statistics for Venus' cusp features throughout 1992-93.

From *Figure 5*, it can be seen that, when the northern and southern cusp-caps were detected, considerably more than half of the time they were of equal size and brightness. There were instances, however, when either the northern or southern cusp-cap was the larger, the brighter, or was both. In a little more than half of the observations received, neither cusp-cap could be detected. The mean relative intensity of the cusp-caps was about 9.6 during the 1992-93 Apparition.

The cusp-caps were fairly frequently bordered by dusky cusp-bands, with a mean relative intensity of about 6.0; however, approximately as often, neither cusp-band was reported, as *Figure 5* shows.

Cusp-Extensions

As illustrated in *Figure 5*, in 83.2 percent of the observations, there were no reported cusp extensions beyond the 180° expected from simple geometry, in both integrated light and with color and polarizing filters.

During the latter part of the apparition, when Venus was a crescent, reports were received of both cusps ranging from 2° to 45° beyond the anticipated 180°. Indeed, the extensions of both cusps were frequently reported as being joined, forming a spectacular halo fully encircling the dark hemisphere of Venus. These cusp extensions were depicted on drawings, enhanced by color filters and polarizers, but were not visible on photographs that were submitted. As expected, cusp extensions are next to impossible to capture on film, since they are significantly fainter than the sunlit regions of Venus.

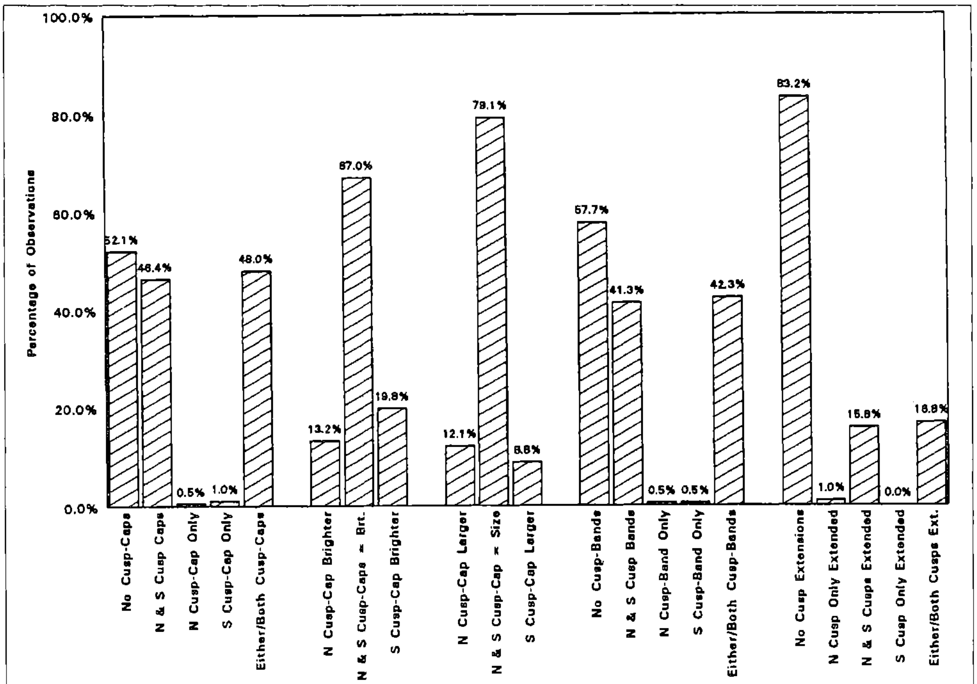

Figure 5. relative frequency of reports of Cusp-Caps, Cusp-Bands, and Cusp-Extensions during the 1992-93 Eastern (Evening) Apparition of Venus.

Table 3. Observed versus Predicted Dichotomy of Venus: 1992-93 Eastern (Evening) Apparition.

Quantity		J. Benton	M.A. Gélinas	A. Heath	J.F. Viens	Mean and Standard Error
		Observer				
Date (1993 JAN):	Observed (O)	18.05 d	15.50 d	17.69 d	18.83 d	17.52 ±0.71 d
	Predicted (P)	21.88	21.88	21.88	21.88	--------
	Difference (O - P)	-3.83	-6.38	-4.19	-3.05	-4.36 ±0.71
Phase Coefficient:	Observed (O)	0.500	0.500	0.500	0.500	--------
	Predicted (P)	0.520	0.533	0.522	0.516	0.523±0.004
	Difference (O - P)	-0.020	-0.033	-0.022	-0.016	-0.023±0.004

ESTIMATES OF DICHOTOMY

The "Schröter Effect" on Venus, a discrepancy between the predicted and the observed dates of dichotomy (half-phase), was reported in 1992-93. The predicted half-phase occurs when $k = 0.500$, and the phase angle, i, between the Sun and the Earth as seen from Venus, equals 90°. The observed minus predicted discrepancies for 1992-93 are given in *Table 3* (above).

THE ASHEN LIGHT AND OTHER DARK-HEMISPHERE PHENOMENA

The term *Ashen Light*, first reported by G. Riccioli in 1643, refers to an extremely elusive, faint illumination of the dark hemisphere of Venus. It resembles, but does not have the same origin, as Earthshine on the dark portion of the Moon. It is often held that Venus must be viewed against a dark sky in order to perceive the Ashen Light, but the planet is very low in the sky at those times and suffers greatly from the effects of poor seeing and glare in contrast with the dark sky background.

Table 4 (pp. 165-166) summarizes the dates during 1992-93 when there were positive and negative observations of the Ashen Light. There are several dates when there were near-simultaneous observations of the Ashen Light. What appears to be a simultaneous sighting of this phenomenon took place on 1993 MAR 22. Positive and negative reports of the Ashen Light sometimes occurred on the same date and at approximately at the same time, and this is certainly indicative of the elusive nature of this dark-hemisphere illumination. Nevertheless, on some occasions during the 1992-93 Apparition observers suspected, and in some cases were certain of, the presence of the Ashen Light both in integrated light and when using color filters.

There were a few instances when observers suspected that the dark hemisphere of Venus looked actually darker than the background sky, but this phenomenon is almost certainly a contrast effect.

CONCLUSIONS

Atmospheric activity on Venus during the 1992-93 Eastern (Evening) Apparition was fair to moderate in frequency. It is of considerable interest to compare these results with those of previous evening observing seasons, as well as with morning apparitions of the planet. Our studies of the Ashen Light, which were intensified during the Pioneer Venus Orbiter Project, are continuing on a regular basis. There continues to be a very welcome international cooperation of individuals and organizations throughout the World in our investigations of Venus. The systematic and, one hopes, simultaneous monitoring of the planet by regular, dedicated participants over the span of many years continues to be our principal goal, and we invite interested readers to join us in our commitment to gather reliable and scientifically useful information about the planet Venus.

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Table 4. Ashen-Light Observations: 1992-93 Eastern (Evening) Apparition of Venus.

1992-93 UT Date & Time	OBS	Instrument	Filter	Ashen Light
1992 DEC 18				
16:01-16:31	DN	20.3 SC 225	W15	S (vague)
			W47	NS
			W25	S (vague)
19:05-19:25	MAG	20.3 SC 225	IL	NS
			W25	NS
			W15	NS
			W38	NS
23:00-23:20	GTN	25.4 Schf 211	IL	NS
DEC 25				
14:12-15:07	DN	20.3 SC 225	IL	NS
			W15	N
			W47	NS
			W25	S (vague)
DEC 28				
15:50-17:27	DN	20.3 SC 225	IL	NS
			W15	NS
			W47	S (vague)
			W25	NS
			RG610	NS
			BG3	NS
16:30	AWH	30.0 New 190	IL	NS
			W25	NS
			W44	NS
			W47	NS
DEC 30				
15:39-17:07	DN	20.3 SC 225	IL	NS
			W15	S (vague)
			W47	NS
			W25	S (vague)
			RG610	NS
			BG3	NS
1993 JAN 08				
16:15	AJ	21.0 New 195	IL	NS
			W15	NS
			W58	NS
16:23-16:55	DN	20.3 SC 225	IL	NS
			W15	S (vague)
			W47	NS
			W25	NS
			RG610	NS
			BG3	NS
16:30	AWH	30.0 New 190	IL	NS
23:00-23:10	FJM	20.3 SC 307	IL	NS
			W47	NS
JAN 14				
15:40-16:30	AJ	21.0 New 195	IL	NS
			W15	NS
16:40-17:05	AWH	30.0 New 190	IL	NS
16:40-17:26	DN	20.3 SC 225	IL	NS
			W15	S (vague)
			W47	NS
			W25	NS
			RG610	NS
			BG3	NS
FEB 18				
00:55-01:32	WHH	31.0 New 366	IL	NS
			W47	S (vague)
			W58	NS
			W12	NS
			W21	NS
			W80A	NS
FEB 28				
11:02-19:48	DN	10.2 Refr 214	IL	S (vague)
			W15	NS
			W16	DS
			W47	NS
			W25	NS
			RG610	NS
			BG3	NS
1993 UT				
1993 FEB 28				
16:40-17:35	AJ	21.0 New 195	IL	NS
			W15	NS
18:00	AWH	30.0 New 190	IL	NS
23:30	FG	16.0 Refr 600	IL	NS
			W47	NS
MAR 06				
16:10-17:10	AJ	21.0 New 195	W15	S (vague)
23:20	FG	16.0 Refr 600	W47	S (glow throughout dark hemisphere
MAR 07				
19:11-20:01	DN	10.2 Refr 214	IL	DS
			W15	DS
			W16	DS
			W47	NS
MAR 09				
17:40-18:15	AJ	21.0 New 195	IL	NS
			W15	NS
18:44-19:30	DN	10.2 Refr 214	IL	DS
			W16	DS
			W25	DS
			W47	S (vague)
MAR 13				
11:35-12:06	DN	20.3 SC 225	IL	DS
			W15	NS
			W25	NS
			W47	NS
17:15-18:00	AJ	21.0 New 195	IL	NS
			W15	NS
18:15	AWH	30.0 New 190	IL	NS
MAR 14				
08:42-09:34	DN	20.3 SC 225	IL	DS
			W25	NS
			W15	S (vague)
			W47	S (vague)
18:15	AWH	30.0 New 190	IL	NS
MAR 15				
18:33-19:26	DN	20.3 SC 225	IL	NS
			W25	DS
			W16	NS
			W47	NS
23:30	FG	16.0 Refr 600	IL	NS
			W47	NS
MAR 19				
13:01-18:40	DN	20.3 SC 225	IL	S (vague)
			W25	NS
			W15	NS
			W47	NS
23:25-23:40	JFV	11.5 New 150	IL	NS
MAR 20				
12:27-19:20	DN	20.3 SC 225	IL	NS
			W25	NS
			W15	DS
			W47	DS
17:50	AWH	30.0 New 190	IL	NS
MAR 22				
18:15-19:10	AJ	21.0 New 195	W15	StS
23:00-23:10	FJM	20.3 SC 307	IL	NS
			W47	NS
23:15-23:55	JLB	15.2 Refr 262	IL	StS
			W47	S (vague)
			W58	NS
			W25	NS
23:30-23:50	GTN	25.4 Schf 150	IL	VStS
MAR 23				
18:03-18:33	DN	10.2 Refr 214	IL	NS
			W25	NS
			W16	S (vague)
			W47	NS

— Continued on p. 166 —

Table 4—Continued.

1993 UT Date & Time	OBS	Instrument	Filter	Ashen Light
1993 Mar 25				
18:30-19:10	AJ	21.0 New 195	IL	S (vague)
			W15	S (vague)
23:40	FG	16.0 Refr 600	IL	NS
			W47	NS
Mar 26				
12:14-18:36	DN	10.2 Refr 214	IL	S (vague)
			W25	NS
			W15	S (vague)
			W47	S (vague)
22:15-22:25	JFV	11.5 New 150	IL	NS
23:00-23:20	FJM	20.3 SC 307	IL	NS
			W47	NS
Mar 27				
00:03	FG	16.0 Refr 600	IL	NS
			W47	NS
12:58-18:28	DN	10.2 Refr 214	IL	NS
			W25	NS
			W16	NS
			W47	S (vague)
22:40-22:50	JFV	11.5 New 150	IL	NS
Mar 28				
17:20-17:25	JFV	11.5 New 150	IL	NS
18:06-18:24	DN	10.2 Refr 214	IL	NS
			W25	DS
			W16	NS
			W47	NS
Mar 29				
11:00	RB	15.2 Refr 200	RG610	DS
18:03-18:15	DN	10.2 Refr 214	IL	S (vague)
			W25	NS
			W16	NS
			W47	NS
1993 Mar 30				
08:43-18:10	DN	10.2 Refr 214	IL	S (vague)
			W25	S (vague)
			W16	NS
			W47	NS
Apr 01				
12:00	RB	15.2 Refr 200	RG610	DS
Apr 02				
11:30	RB	15.2 Refr 200	RG610	S (vague)
Apr 04				
16:30-16:40	JFV	11.5 New 150	IL	NS
Apr 05				
10:30	RB	15.2 Refr 200	RG610	S (vague)

NOTES:

OBS = Observer; JLB = J.L. Benton, Jr.; RB = Rüdiger Buggenthien; MAG = M.A. Gélinas; FG = F.G. Graham; WHH = W. H. Haas; AWH = A.W. Heath; AJ = A.P. Johnson; FJM = F.J. Melillo; DN = D. Niechoy, GTN = G. Nowak; JFV = J.-F. Viens.
Instrument; aperture in cm, type (New = Newtonian, Refr = Refractor, SC = Schmidt-Cassegrain, Schf = Shiefspiegler), magnification.
Filter: BG3 = orange, RG610 = orange; W12 = yellow, W15 = yellow, W16 = yellow, W21 = orange, W25 = red, W38 = blue, W47 = dark blue, W58 = green, W80A = light blue; IL = integrated light (no filter).
AL = Ashen Light Visibility: NS = nothing seen or suspected, S = suspected, StS = strongly suspected, VStS = very strongly suspected, and DS = definitely seen by the observer.

SELECTED DRAWINGS AND PHOTOGRAPHS: 1992-93 EASTERN (EVENING) APPARITION OF VENUS

Notes: *Figures 6-30* are oriented with celestial south at the top and celestial west to the left (simple inverted views). Unless otherwise stated, and when given, Seeing (S) is on the standard A.L.P.O. Scale, ranging from 0 for worst to 10 for perfect; while Transparency (T) is the limiting naked-eye stellar magnitude. *k* is the computed phase coefficient, *d* is the computed angular disk diameter, and telescope abbreviations are as in *Table 4* of the text.

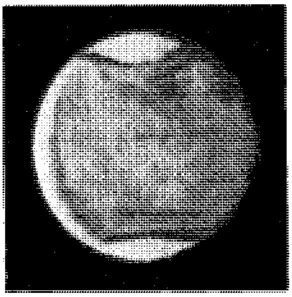

Figure 6. D. Niechoy. 1992 Aug 01, 10:28 UT. 20-cm SC, 225X, no filter. k = 0.972, d = 10".0. Compare with *Figure 7* (to right).

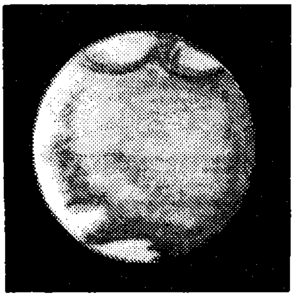

Figure 7. D. Niechoy. 1992 Aug 01, 10:34 UT. 20-cm SC, 225X, W25 (red) filter. k = 0.972, d = 10".0.

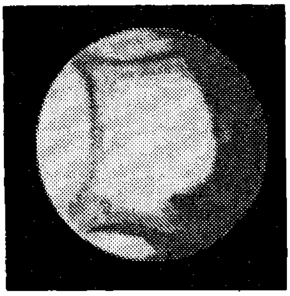

Figure 8. D. Niechoy. 1992 Sep 25, 12:27 UT. 20-cm SC, 225X, no filter. k = 0.882, d = 11".6. Compare with *Figure 9* (p. 167).

SELECTED DRAWINGS AND PHOTOGRAPHS: 1992-93 EASTERN (EVENING) APPARITION OF VENUS

Notes: *Figures 6-30* are oriented with celestial south at the top and celestial west to the left (simple inverted views). Unless otherwise stated, and when given, Seeing (S) is on the standard A.L.P.O. Scale, ranging from 0 for worst to 10 for perfect; while Transparency (T) is the limiting naked-eye stellar magnitude. *k* is the computed phase coefficient, *d* is the computed angular disk diameter, and telescope abbreviations are as in *Table 4* of the text.

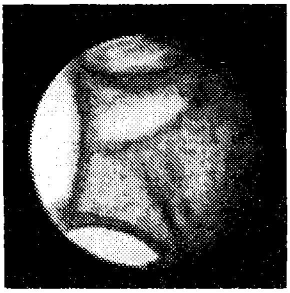

Figure 9. D. Niechoy. 1992 SEP 25, 12:37 UT. 20-cm SC, 225X, W15 (yellow) Filter. k = 0.882, d = 11".6.

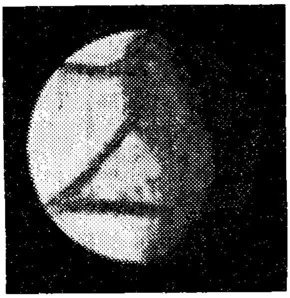

Figure 10. D. Niechoy. 1992 NOV 01, 15:22 UT. 20-cm SC, 225X, W47 (blue) filter. k = 0.797, d = 13".5. Compare with *Figure 11* (below).

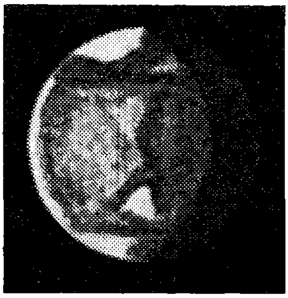

Figure 11. D. Niechoy. 1992 NOV 01, 15:27 UT. 20-cm SC, 225X, W15 (yellow) Filter. k = 0.797, d = 13".5.

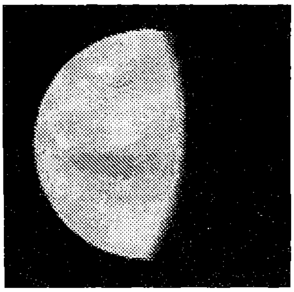

Figure 12. R. Schmude, Jr. 1992 Nov 27-28, 23:52-00:04 UT. 36-cm SC, 325X, W47 (blue) Filter. S = 5.5. k = 0.722, d = 15".7.

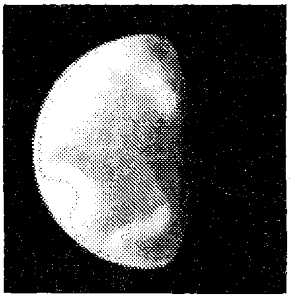

Figure 13. A. Johnson. 1992 DEC 08, 15:55 UT. 21-cm New, 195X, no filter. k = 0.687, d = 16".8. S = moderate; T = fair. Phase estimated as 0.67.

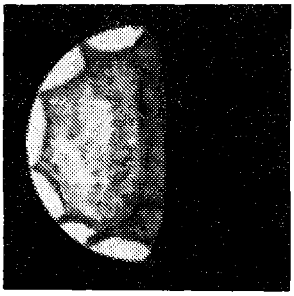

Figure 14. D. Niechoy. 1992 DEC 28, 16:07 UT. 20-cm SC, 225X, W25 (red) Filter. k = 0.613, d = 19".7. Compare with *Figure 15* (top right).

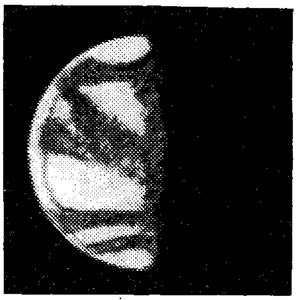

Figure 15. D. Niechoy. 1992 DEC 28, 16:17 UT. 20-cm SC, 225X, W15 (yellow) Filter. k = 0.613, d = 19".7.

Figure 16. G. Nowak. 1993 JAN 02, 23:00-23:30 UT. 25-cm Schf, 150X, no filter. k = 0.591, d = 20"6. S = 5.5; T = +4.0. Note "sawtooth" terminator in Northern Hemisphere.

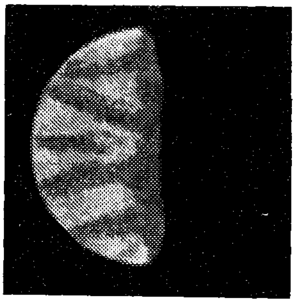

Figure 17. D. Niechoy. 1993 JAN 03, 15:47 UT. 20-cm SC, 225X, W47 (blue) Filter. k = 0.588, d = 26".7. Compare with *Figures 18* and *19* (p. 168).

SELECTED DRAWINGS AND PHOTOGRAPHS: 1992-93 EASTERN (EVENING) APPARITION OF VENUS

Notes: *Figures 6-30* are oriented with celestial south at the top and celestial west to the left (simple inverted views). Unless otherwise stated, and when given, Seeing (S) is on the standard A.L.P.O. Scale, ranging from 0 for worst to 10 for perfect; while Transparency (T) is the limiting naked-eye stellar magnitude. *k* is the computed phase coefficient, *d* is the computed angular disk diameter, and telescope abbreviations are as in *Table 4* of the text.

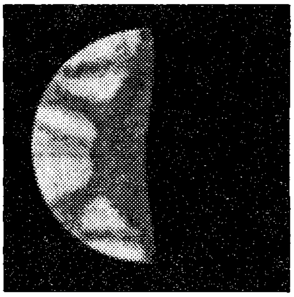

Figure 18. D. Niechoy. 1993 JAN 03, 16:02 UT. 20-cm SC, 225X, BG3 (orange) Filter. k = 0.588, d = 20".7.

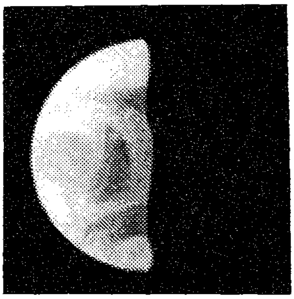

Figure 19. A. Johnson. 1993 JAN 03, 16:10 UT. 21-cm New, 195X, no filter. k = 0.588, d = 20".7. S = moderate - very bad; T = fair. Phase estimated as 0.50.

Figure 20. A. Johnson. 1993 JAN 14, 16:05 UT. 21-cm New, 195X, no filter. k = 0.537, d = 23".0. S = slight undulations, calm moments; T = good. Phase estimated as 0.50.

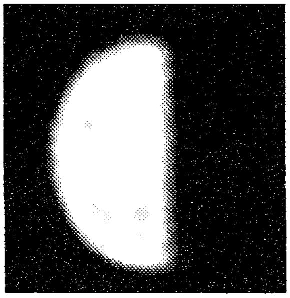

Figure 21. A. Heath. 1993 JAN 24, 16:50 UT. 30-cm New, 190X, no filter. 1/25-sec exposure. k = 0.485, d = 25".7. Compare with *Figures 22* and *23* (below)

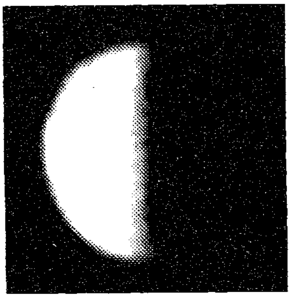

Figure 22. A. Heath. 1993 JAN 24, 16:50 UT. 30-cm New, 190X, W25 (red) Filter. 1/25-sec exposure. k = 0.485, d = 25".7.

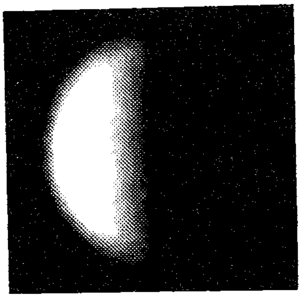

Figure 23. A. Heath. 1993 JAN 24, 16:50 UT. 30-cm New, 190X, W47 (blue) Filter. 1/25-sec exposure. k = 0.485, d = 25".7.

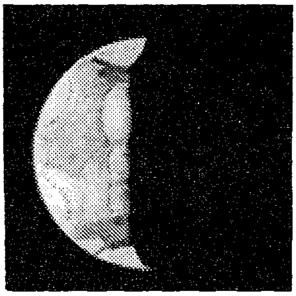

Figure 24. A. Johnson. 1993 FEB 06, 15:40 UT. 21-cm New, 195X, no filter. k = 0.407, d = 30".1. S = slight undulations, calm moments; T = good. Phase estimated as 0.41.

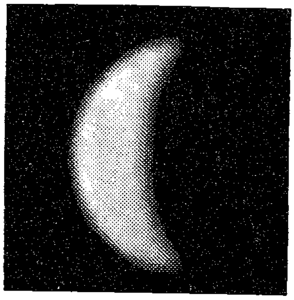

Figure 25. R. Schmude, Jr. 1993 FEB 22, 20:51 UT. 36-cm SCT, f/54, no filter. 1/2-sec exposure on TP2415 Film. k = 0.287, d = 37".9.

Figure 26. A. Johnson. 1993 MAR 09, 17:45 UT. 21-cm New, 195X, no filter. k = 0.160, d = 47".3. S = moderate; T = fair. Phase estimated as 0.16.

Selected Drawings and Photographs: 1992-93 Eastern (Evening) Apparition of Venus

Notes: *Figures 6-30* are oriented with celestial south at the top and celestial west to the left (simple inverted views). Unless otherwise stated, and when given, Seeing (S) is on the standard A.L.P.O. Scale, ranging from 0 for worst to 10 for perfect; while Transparency (T) is the limiting naked-eye stellar magnitude. *k* is the computed phase coefficient, *d* is the computed angular disk diameter, and telescope abbreviations are as in *Table 4* of the text.

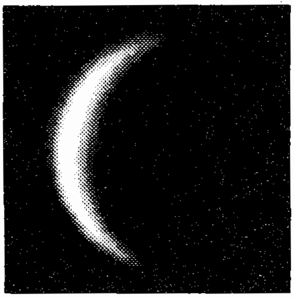

Figure 27. A. Heath. 1993 MAR 11, (no UT given). 30-cm New, 190X. k ≈ 0.135, d ≈ 49".3.

Figure 28. A. Heath. 1993 MAR 13, 18:15 UT. 30-cm New, 190X. k = 0.117, d = 50".7.

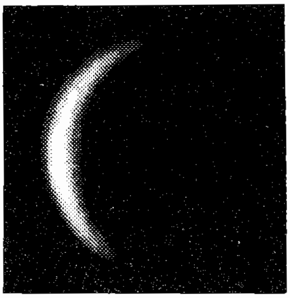

Figure 29. A. Heath. 1993 MAR 14, 18:15 UT. 30-cm New, 190X, 1/25-sec exposure. k = 0.108, d = 51".4.

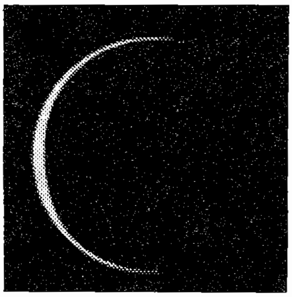

Figure 30. A. Johnson. 1993 MAR 24, 18:55 UT. 21-cm New, 195X, no filter. k = 0.032, d = 57".4. S = poor; T = good. Phase estimated as 0.05.

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METEORS SECTION NEWS

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

Table 1. Recent A.L.P.O. Meteor Observations.

1994 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+N = Limiting Magnitude)
AUG 11	Peter Wlasuk, FL	03:50-06:50	75 PER, 9 KCG, 14 SPO	+6.3
12	Peter Wlasuk, FL	04:04-06:15	20 PER, 3 KCG, 4 SPO	+5.3; 50% cloudy
14	Richard Taibi, MD	06:50-09:00	32 PER, 17 SPO	+6.0
SEP 05	Richard Taibi, MD	05:52-07:50	1 SPI, 2 SPO	+6.3
12	Richard Taibi, MD	07:18-09:46	6 AUR, 3 DAS, 15 SPO	+5.7
30	Kathy Machin, KS	01:31-02:31	4 SPO	+6.0
	Carroll Iorg, KS	01:31-02:31	3 SPO	+5.8
OCT 01	John Gallagher, NJ	04:25-06:07	4 SPO	+6.8
02	Robert Hays, WY	09:02-10:02	3 NPI, 1 SPI, 1 SOR, 16 SPO	+6.8
03	John Gallagher, NJ	04:45-06:57	1 GPI, 3 NPI, 1 ORI, 1 STA, 8 SPO	+7.4
	James Riggs, CA	08:00-12:30	15 DAO, 14 STA, 1 OCC, 2 AND, 5 OAR, 1 OCE, 38 SPO	+6.9
04	John Gallagher, NJ	04:55-07:05	2 SOR, 1 ORI, 1 STA, 7 SPO	+7.3
05	Mark Davis, SC	07:35-09:05	1 ORI, 2 SOR, 16 SPO	+5.6
06	John Gallagher, NJ	04:55-07:03	1 ORI, 1 STA, 3 NTA, 1 DAO, 3 SPO	+7.4
	Mark Davis, SC	07:11-09:11	1 SOR, 21 SPO	+5.5
	Robert Lunsford, CA	09:30-12:45	3 STA, 1 ORI, 1 OAR, 2 NPI, 1 SOR, 1 AND, 31 SPO	+6.5
	David Holman, WA	10:26-11:09	1 STA, 1 NTA, 1 ORI, 13 SPO	+5.9
07	George Zay, CA	02:23-12:46	6 DAS, 9 SPI, 2 SOR, 1 GIA , 4 ORI, 1 STA, 1 NTA, 29 SPO	+5.7
	John Gallagher, NJ	05:05-07:13	1 ORI, 1 AND, 5 SPO	+7.3
	Robert Lunsford, CA	09:00-12:45	4 SPI, 1 STA, 2 ORI, 1 NPI, 2 SOR, 29 SPO	+6.7
	David Holman, OR	11:08-13:00	1 STA, 1 NTA, 2 SOR, 1 ORI, 30 SPO	+6.2
08	John Gallagher, NJ	04:50-06:56	1 STA, 3 EGE, 1 OAR, 2 SPO	+7.3
	David Holman, OR	09:09-12:45	1 STA, 4 NTA, 1 SOR, 4 ORI, 43 SPO	+6.2
09	Michael Morrow, HI	07:30-10:40	11 SPO	+6.5; 20% cloudy
	Tom Giguere HI	07:45-08:45	1 GIA, 4 SPO	+6.0; 20% cloudy
	David Holman, CA	09:05-12:10	2 NTA, 3 SOR, 36 SPO	+5.4
	Tom Giguere, HI	09:25-10:25	7 SPO	+6.5; 10% cloudy
11	John Gallagher, NJ	05:00-07:10	1 ORI, 1 STA, 1 OCY, 1 OCE, 6 SPO	+7.5
12	John Gallagher, NJ	05:05-07:22	2 ORI, 1 DAO, 5 EGE, 9 SPO	+7.4
13	John Gallagher, NJ	04:45-05:48	3 SPO	+7.2
16	John Gallagher, NJ	04:40-06:47	1 ORI, 2 STA, 3 OAR, 2 SPO	+7.2
17	John Gallagher, NJ	05:35-07:50	4 ORI, 2 EGE, 10 SPO	+7.2
	James Riggs, CA	10:45-13:30	8 ORI, 2 DAO, 1 STA, 3 EGE, 1 OCE, 8 SPO	+6.0
18	George Zay, CA	06:59-13:06	3 ORI, 8 EGE, 1 STA, 3 NTA , 1 SPO	+4.6
19	George Zay, CA	07:00-13:06	6 ORI, 2 EGE, 1 STA, 3 SPO	+4.6
20	George Zay, CA	06:48-13:06	4 ORI, 4 EGE, 9 SPO	+4.6
21	George Zay, CA	06:42-13:05	15 ORI, 4 EGE, 1 STA	+4.6
22	John Gallagher, NJ	03:50-05:28	1 NPI, 5 SPO	+6.4
	Tom Giguere, HI	08:00-10:00	2 SPO	+3.0; 35% cloudy
	Michael Morrow, HI	08:00-10:30	2 SPO	+4.0; 45% cloudy
23	Michael Morrow, HI	06:00-11:30	2 ORI, 2 SPO	+5.0; 30% cloudy
	Tom Giguere, HI	08:45-11:00	3 ORI	+3.5; 10% cloudy
29	Richard Taibi, MD	03:37-06:02	2 ORI, 18 SPO	+5.9
31	John Gallagher, NJ	05:30-07:41	4 ORI, 3 NTA, 1 PEG, 1 LMI, 1 SPO	+7.1
	Richard Taibi, MD	06:34-07:43	2 ORI, 3 STA, 1 SPO	+5.9
Nov 01	George Zay, CA	03:00-13:05	5 ORI, 11 STA, 7 NTA, 48 SPO	+5.6

Table 1 continued on pp. 171-174 with notes on p. 174.

Table 1—Continued.

1994 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+N = Limiting Magnitude)
Nov 01	Robert Lunsford, CA	09:00-13:00	13 STA, 6 NTA, 6 ORI, 2 EGE, 30 SPO	+6.3
02	George Zay, CA	02:45-06:00	3 NTA, 12 SPO	+5.6
03	John Gallagher, NJ	05:45-08:02	1 NTA, 1 DER, 1 SOR, 1 DAO, 1 EGE, 2 LEO, 1 OCE, 9 SPO	+7.5
04	David Holman, CA	02:25-13:12	7 STA, 15 NTA, 3 ORI, 38 SPO	+6.4
05	David Holman, CA	02:21-12:22	3 STA, 3 NTA, 8 ORI, 63 SPO	+6.1
06	John Gallagher, NJ	05:45-07:13	1 NTA, 2 SPO	+7.3
07	John Gallagher, NJ	05:35-07:45	2 AMO, 1 STA, 6 SPO	+7.5
11	John Gallagher, NJ	05:40-07:44	1 NTA, 1 LMI, 3 SPO	+7.3
	Robert Hays, IN	06:20-07:50	3 STA, 2 NTA, 15 SPO	+5.8
12	John Gallagher, NJ	05:20-07:29	2 NTA, 1 DAO, 3 SPO	+7.5
	Richard Taibi, MD	06:15-07:45	1 NTA, 7 SPO	+6.0
14	George Zay, CA	07:59-13:17	3 NTA, 1 STA, 1 LEO, 15 SPO	+5.5
17	Robert Lunsford, CA	09:15-13:30	26 LEO, 25 SPO	+5.3
18	James Riggs, CA	11:45-13:45	6 LEO, 9 SPO	+2.0
20	Dennis Hands, NC	00:20-01:20	1 SPO	---
	Barbara Hands, NC	00:20-01:20	1 SPO	---
	John Gallagher, NJ	05:30-07:04	2 SPO	+7.0
23	John Gallagher, NJ	06:00-08:04	1 DER, 2 SPO	+7.5
24	John Gallagher, NJ	05:35-07:42	1 NTA, 1 DER, 1 LEO, 5 SPO	+7.5
26	John Gallagher, NJ	06:15-08:01	1 GEM, 3 SPO	+7.3
27	John Gallagher, NJ	04:50-06:40	1 NTA, 1 11C, 7 SPO	+7.5
28	Robert Lunsford, CA	11:15-13:45	6 SPO	+5.2
29	John Gallagher, NJ	05:55-08:05	1 NTA, 2 GEM, 1 MON, 6 SPO	+7.5
	Robert Lunsford, CA	11:00-14:30	12 SPO	+4.7
30	Robert Lunsford, CA	10:30-13:30	18 SPO	+5.7
Dec 01	John Gallagher, NJ	06:10-08:18	1 LEO, 1 GEM, 6 SPO	+7.5
	Robert Lunsford, CA	11:30-13:30	6 SPO	+5.2
02	John Gallagher, NJ	05:30-07:41	3 GEM, 2 ORN, 8 SPO	+7.5
03	Richard Taibi, MD	04:27-07:00	4 ORS 1 NTA, 1 HYD, 8 SPO	+6.1
	John Gallagher, NJ	05:30-07:37	1 ZPU, 6 SPO	+7.5
08	George Zay, CA	03:34-13:30	8 GEM, 8 ORS, 5 MON, 9 HYD, 43 SPO	+5.6
	John Gallagher, NJ	05:45-07:57	2 GEM, 1 ZPU, 1 SPU, 9 SPO	+7.5
	Richard Schmude, TX	06:35-06:55	1 GEM	+5.0
	Robert Lunsford, CA	07:30-13:30	10 GEM, 2 ARI, 10 ORS, 6 MON, 8 HYD, 4 COM, 2 11C, 43 SPO	+6.3
09	George Zay, CA	04:41-13:35	10 GEM, 5 MON, 5 ORS, 8 HYD, 6 COM, 42 SPO	+5.5
	Robert Lunsford, CA	10:10-13:40	10 GEM, 3 ORS, 7 MON, 8 HYD, 8 COM, 3 ORN, 33 SPO	+6.4
10	Robert Lunsford, CA	08:15-09:15	3 GEM, 1 MON, 1 SPO	+5.4
12	John Gallagher, NJ	04:50-09:50	36 GEM, 1 ORN, 1 ARI, 1 HYD, 1 11C, 2 COM, 1 ORS, 11 SPO	+7.5
	Richard Taibi, MD	07:50-10:32	25 GEM, 2 HYD, 1 COM, 20 SPO	+5.9
	Michael Morrow, HI	13:05-14:35	2 HYD, 6 ORS, 3 MON, 4 GEM, 2 ORN, 32 SPO	+6.5
13	John Gallagher, NJ	05:00-07:00	16 GEM, 1 SPO	+7.3; 45% cloudy
	Peter Wlasuk FL	05:00-08:00	72 GEM, 9 SPO	+5.6
	John Gallagher, NJ	07:30-09:30	24 GEM, 1 COM, 9 SPO	+7.5; 60% cloudy
	Richard Schmude, TX	09:16-09:34	2 GEM	+5.0; 40% cloudy
	Phyllis Eide, HI	13:00-14:35	5 GEM, 14 ORS, 33 SPO	+6.3
	Michael Morrow, HI	13:00-14:30	15 GEM, 1 ORN, 4 MON, 3 ORS, 75 SPO	+5.7
14	James Riggs, CA	05:40-07:00	9 GEM, 7 SPO	+2.5
	Phyllis Eide, HI	06:00-08:30	23 GEM, 11 SPO	+4.5
	Michael Morrow, HI	06:00-08:30	23 GEM, 1 ORN, 9 SPO	+4.0; 40% cloudy
	David Holman, CA	07:56-09:25	15 GEM, 6 SPO	+5.0; 10% cloudy

Table 1 continued on pp.172-174 with notes on p. 174.

Table 1—Continue

1994-95 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+*N* = Limiting Magnitude)
Dec 14	James Riggs, CA	08:00-09:00	7 GEM, 6 SPO	+3. 0
	James Riggs, CA	10:00-12:41	44 GEM, 36 SPO	+4.5
16	John Gallagher, NJ	06:25-08:13	2 GEM, 7 SPO	+6.6
21	James Riggs, CA	01:38-03:31	1 URS, 9 SPO	+2.8
	Robert Lunsford, CA	10:30-14:00	4 URS, 2 COM, 13 SPO	+5.5
22	James Riggs, CA	01:45-05:00	5 URS, 41 SPO	+5.5
	John Gallagher, NJ	05:25-07:28	1 ORN, 2 COM	+7.0
23	James Riggs, CA	01:56-03:00	2 URS, 7 SPO	+4.0
	David Holman, CA	02:27-06:41	1 URS, 13 SPO	+6.1
	James Riggs, CA	04:00-06:00	1 URS, 12 SPO	+5.0
27	John Gallagher, NJ	05:55-07:59	1 GEM, 2 COM	+7.5
28	John Gallagher, NJ	05:45-07:34	1 DCA, 1 URS, 2 SZA, 5 SPO	+7.5; 15% cloudy
29	John Gallagher, NJ	05:15-06:53	1 ARI, 1 COM, 1 QUA, 5 SPO	+7.3; 5% cloudy
30	George Zay, CA	04:08-13:51	5 COM, 20 SPO	+5.8
	John Gallagher, NJ	05:20-07:28	1 COM, 1 NZA, 5 SPO	+7.5
31	John Gallagher, NJ	05:30-07:39	1 COM, 1 OCM, 7 SPO	+7.5
	Richard Taibi, MD	06:41-08:14	2 COM, 7 SPO	+5.4
	David Holman, CA	07:35-13:54	2 COM, 74 SPO	+6.3
Jan 02	David Holman, CA	02:30-03:30	4 SPO	+6.0
	David Holman, CA	08:10-13:45	2 COM, 48 SPO	+6.3
	Robert Lunsford, CA	11:00-13:45	6 QUA, 7 SPO	+5.3
03	John Gallagher, NJ	04:55-07:00	1 QUA, 1 AHY, 1 OCM , 3 SPO	+7.5
	David Holman, CA	05:08-06:08	*None Seen*	+6.1
	Mark Davis, SC	05:40-07:10	4 QUA, 15 SPO	+5.4; 10% cloudy
	Michael Morrow, HI	11:35-14:00	4 QUA, 18 SPO	+6.0
	Phyllis Eide, HI	13:00-13:40	6 QUA, 8 SPO	+5.5
03/04	Rainer Arlt, Germany	19:33-03:00	205 QUA, 50 SPO	+6.1
	Lars Hermansson, Sweden	22:27-00:32	35 QUA, 5 SPO	+5.3
	Johan Warell, Sweden	22:27-00:32	35 QUA, 3 SPO	+5.3
04	Pierre Martin, Ontario	02:33-03:33	19 QUA, 2 SPO	+4.4; 10% cloudy
	Vic Winter, KS	05:48-11:15	31 QUA, 9 SPO	+5.7
05	John Gallagher, NJ	05:25-07:31	1 AHY, 1 OCM, 5 SPO	+7.5
	Mark Davis, SC	08:07-10:07	5 QUA, 16 SPO	+5.7
06	John Gallagher, NJ	05:50-08:01	2 ALE, 1 SZA, 1 URS, 1 RGE, 1 COM, 1 DCA, 1 CSG, 4 SPO	+7.5
07	Lucy Deming, TX	01:30-03:00	*None Seen*	+6.0
	Graham Wolf, New Zealand	09:00-10:00	2 SPO	---
	Graham Wolf, New Zealand	12:00-14:00	5 SPO	---
08	Mark Davis, SC	05:18-07:18	3 DCA, 24 SPO	+5.8
10	Graham Wolf, New Zealand	09:00-15:00	4 ACR, 14 SPO	---
	Michael Morrow, HI	13:00-14:30	15 SPO	+7.0
11	Graham Wolf, New Zealand	09:00-15:00	14 ACR, 15 SPO	---
	Michael Morrow, HI	13:00-14:00	8 SPO	+6.5
12	Graham Wolf, New Zealand	09:00-15:00	2 ACR, 12 SPO	---
13	Graham Wolf, New Zealand	09:00-12:00	1 ACR, 5 SPO	---
14	Graham Wolf, New Zealand	09:00-12:00	2 ACR, 6 SPO	---
15	Graham Wolf, New Zealand	09:00-12:00	5 ACR, 6 SPO	---
18	Lucy Deming, TX	06:15-07:30	1 SPO	+5.8
20	Michael Morrow, HI	06:00-07:30	4 SPO	+5.5
	Lucy Deming, TX	07:15-08:15	1 SPO	+5.8
21	Michael Morrow, HI	06:15-07:15	5 SPO	+6.0
	Graham Wolf, New Zealand	09:00-11:00	1 ACR, 4 SPO	---
22	Michael Morrow, HI	06:30-08:00	7 SPO	+6.5
	Graham Wolf, New Zealand	09:00-10:30	1 ACR, 2 SPO	---
23	Michael Morrow, HI	06:00-07:30	3 SPO	+6.5
	Lucy Deming, TX	07:00-08:15	1 SPO	+5.9
26	Michael Morrow, HI	07:30-08:30	2 SPO	+6.5

Table 1 continued on pp. 173-174 with notes on p. 174.

Table 1—Continued.

1995 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+N = Limiting Magnitude)
JAN 27	Michael Morrow, HI	06:30-07:30	6 SPO	+6.5
28	Michael Morrow, HI	05:55-07:55	1 DCA, 9 SPO	+6.5
	Graham Wolf, New Zealand	09:00-15:00	1 ACN, 10 SPO	---
	George Zay, CA	09:15-13:49	36 SPO	+5.8
29	Michael Morrow, HI	06:15-07:15	2 SPO	+6.5
	George Zay, CA	06:30-13:49	37 SPO	+5.6
	Graham Wolf, New Zealand	09:00-11:00	4 ACN, 3 SPO	---
	Graham Wolf, New Zealand	12:00-14:00	4 ACN, 4 SPO	---
30	John Gallagher, NJ	06:00-08:08	1 RGE, 7 SPO	+7.5
31	Graham Wolf, New Zealand	09:00-11:00	1 ACN, 1 SPO	---
	Robert Lunsford, CA	11:00-14:00	4 SPO	+5.9
FEB 01	John Gallagher, NJ	05:10-07:13	3 SPO	+7.5
	Michael Morrow, HI	06:45-08:15	6 SPO	+6.5
	Robert Lunsford, CA	11:00-14:00	6 SPO	+5.5
	Graham Wolf, New Zealand	11:00-14:00	3 TCE, 2 ACE, 1 OCE, 5 SPO	---
02	Graham Wolf, New Zealand	08:30-09:00	*None Seen*	---
	Robert Lunsford, CA	10:00-13:00	5 SPO	+5.9
03	John Gallagher, NJ	05:15-06:09	2 SPO	+7.5; 10% cloudy
	Michael Morrow, HI	05:45-07:15	2 DCA, 3 SPO	+5.8
04	George Zay, CA	02:30-13:35	1 VIR, 1 TCE, 1 DLE , 18 SPO	+5.9
	Michael Morrow, HI	06:30-07:30	1 SPO	+5.5
	Graham Wolf, New Zealand	13:00-13:30	*None Seen*	---
05	George Zay, CA	05:36-13:38	6 VIR, 2 TCE, 4 DLE, 33 SPO	+5.8
	Graham Wolf, New Zealand	09:00-16:00	1 TCE, 10 ACE, 5 OCE, 20 SPO	---
	Phyllis Eide, HI	13:50-14:50	3 SPO	+6.2
	Michael Morrow, HI	13:50-14:50	6 SPO	+6.0
06	George Zay, CA	06:47-13:37	7 VIR, 3 TCE, 37 SPO	+5.9
	Graham Wolf, New Zealand	09:00-10:30	1 ACE, 1 SPO	---
	Robert Lunsford, CA	10:45-13:45	38 SPO	+6.3
07	John Gallagher, NJ	05:30-06:32	1 SIL, 3 SPO	+7.1
	Robert Lunsford, CA	10:15-13:45	24 SPO	+5.9; 10% cloudy
08	Graham Wolf, New Zealand	08:30-16:00	3 TCE, 16 ACE, 3 OCE, 25 SPO	---
09	Graham Wolf, New Zealand	08:30-16:00	2 TCE, 9 ACE, 4 OCE, 15 SPO	---
11	Graham Wolf, New Zealand	13:00-16:00	2 TCE, 4 ACE, 3 OCE, 8 SPO	---
12	Graham Wolf, New Zealand	08:30-16:00	5 TCE, 9 ACE, 10 OCE, 19 SPO	---
13	John Gallagher, NJ	04:35-06:37	1 SPO	+6.7
19	John Gallagher, NJ	05:55-07:56	*None Seen*	+7.1
20	Phyllis Eide, HI	06:05-08:05	4 SPO	+6.0
	Michael Morrow, HI	06:05-08:05	7 SPO	+6.0
21	Michael Morrow, HI	06:30-07:30	1 SPO	+5.5
22	Michael Morrow, HI	06:15-07:15	1 SPO	+4.8; 50% cloudy
24	David Holman, CA	02:50-05:00	2 DLE, 7 SPO	+6.4
	Michael Morrow, HI	07:45-09:45	3 FSL, 4 SPO	+6.0
	Graham Wolf, New Zealand	14:00-16:30	3 DLE, 5 SPO	---
25	John Gallagher, NJ	05:20-07:25	2 SIL, 1 SPO	+7.5
	Graham Wolf, New Zealand	08:30-11:00	4 SPO	---
	Graham Wolf, New Zealand	12:00-14:00	2 DLE, 1 VIR, 5 SPO	---
26	George Zay, CA	03:12-13:19	1 VIR, 4 DLE, 22 SPO	+5.8
	Graham Wolf, New Zealand	09:00-13:00	2 GNO, 2 VIR, 4 DLE, 8 SPO	---
27	Graham Wolf, New Zealand	09:00-16:00	1 GNO, 3 VIR, 4 DLE, 15 SPO	---
28	David Holman, CA	03:38-13:15	3 VIR, 31 SPO	+6.3
	Graham Wolf, New Zealand	09:00-15:00	2 GNO, 1 VIR, 18 SPO	---

Table 1 continued on p. 174 with notes.

Table 1—Continued.

1995 UT Date	Observer and Location	Universal Time	Number and Type* of Meteors Seen	Comments (+N = Limiting Magnitude)
MAR 01	Phyllis Eide, HI	08:30-10:00	6 SPO	+6.0
	Michael Morrow, HI	08:30-10:00	10 SPO	+6.3
	Graham Wolf, New Zealand	09:00-16:00	2 GNO, 2 VIR, 14 SPO	---
02	Graham Wolf, New Zealand	09:00-12:00	2 GNO, 2 VIR, 6 SPO	---
03	Graham Wolf, New Zealand	09:00-11:00	1 GNO, 4 SPO	---
04	Graham Wolf, New Zealand	10:00-14:00	3 VIR, 2 DLE, 8 SPO	---
05	Graham Wolf, New Zealand	08:00-11:00	1 GNO, 7 SPO	---
	George Gliba, FL	08:30-09:30	4 VIR, 7 SPO	+6.4; 25% cloudy
07	George Zay, CA	06:47-13:06	1 VIR, 6 DLE, 3 TCE, 22 SPO	+5.9
	Graham Wolf, New Zealand	08:00-11:00	1 GNO, 5 SPO	---
08	Graham Wolf, New Zealand	10:00-12:00	2 GNO, 5 SPO	---
09	Graham Wolf, New Zealand	08:00-11:00	1 GNO, 2 SPO	---
	Robert Lunsford, CA	10:15-13:15	17 SPO	+5.5
11	Graham Wolf, New Zealand	08:00-12:00	4 GNO, 9 SPO	---
13	Graham Wolf, New Zealand	14:00-17:00	4 GNO, 8 SPO	---
14	Graham Wolf, New Zealand	14:00-17:00	5 GNO, 7 SPO	---
21	Michael Morrow, HI	07:15-08:30	3 SPO	+6.0
	Graham Wolf, New Zealand	08:00-10:00	3 SPO	---
22	Graham Wolf, New Zealand	08:00-10:00	8 SPO	---
	Robert Lunsford, CA	10:00-13:00	2 SPO	+4.4; 50% cloudy
25	George Zay, CA	07:00-12:50	1 VIR, 21 SPO	+5.8
26	George Zay, CA	03:16-12:44	3 ASC, 2 VIR, 21 SPO	+5.7
27	Robert Lunsford, CA	08:30-13:00	29 SPO	+5.8
28	Robert Lunsford, CA	11:30-13:00	6 SPO	+5.8
29	Robert Lunsford, CA	07:30-13:00	1 VIR, 1 ASC, 22 SPO	+5.7
	David Holman, CA	11:21-12:38	11 SPO	+5.5
30	Michael Morrow, HI	06:30-07:30	2 SPO	+5.8
	David Holman, CA	11:24-12:36	2 VIR, 17 SPO	+6.4
31	George Zay, CA	07:05-12:40	1 ASC, 1 VIR, 16 SPO	+5.8
	David Holman, CA	09:43-12:32	1 VIR, 40 SPO	+6.5

* *Key to Abbreviations*

ACE	Akpha Carinid
ACN	Alpha Centaurid
ACR	Alpha Crucid
AHY	Alpha Hydrid
ALE	Alpha Leonid
AMO	Alpha Monocerotid
AND	Annual Andromedid
ARI	Delta Arietid
ASC	Alpha Scorpiid
AUR	Alpha Aurigid
COM	Coma Berenicld
CSG	Chi Sagittarid
DAO	Delta Aurigid (Oct)
DAS	Delta Aurigid (Sept)
DCA	Delta Cancrid
DER	Delta Eridanid
DLE	Delta Leonid
EGE	Epsilon Geminid
11C	11 Canis Minorid
FSL	February Sigma Leonid
GEM	Geminid
GIA	Giacobinid
GNO	Gamma Normid
GPI	Gamma Piscid
HYD	Sigma Hydrid
KCG	Kappa Cygnid
LEO	Leonid
LMI	Leo Minorid
MON	Monocerotid
NPI	Northern Piscid
NTA	Northern Taurid
NZA	North Zeta Aurigid
OAR	October Arietid
OCC	October Cetid
OCE	Omega Centaurid
OCM	Omega Canis Majorid
OCY	October Cygnid
ORI	Orionid
ORN	North Chi Orionid
ORS	South Chi Orionid
PEG	Pegasid (Nov)
PER	Perseid
QUA	Quadrantid
RGE	Rho Geminld
SIL	Sigma Leonid (Feb)
SOR	Sigma Orionid
SPI	Southern Piscid
SPO	Sporadic
SPU	Sigma Puppid
STA	Southern Taurid
SZA	South Zeta Aurigid
TCE	Theta Centaurid
URS	Ursid
VIR	Virginid
ZPU	Zeta Puppid

A.L.P.O. SOLAR SECTION OBSERVATIONS FOR ROTATIONS 1856-1861 (1992 MAY 20 TO OCT 31)

By: Randy Tatum, A.L.P.O. Assistant Solar Recorder

ABSTRACT

This report summarizes A.L.P.O. observations for Rotations 1856-1861 in terms of the morphology and development of sunspot groups. Seven observers from three countries contributed visual drawings and photographs in integrated and Hydrogen-α light.

INTRODUCTION

The mean International Sunspot Number, **RI**, for the six-rotation period was 74.0, with a high mean of 88.4 for Rotation 1861 and a low mean of 52.5 for Rotation 1859. The mean American Sunspot Number, **RA**, for the period was 74.2 with a high mean of 93.4 for Rotation 1861 and a low mean of 48.4 for Rotation 1859. The highest daily **RI** was 161 on 1992 JUL 15, and the highest daily **RA** was 151 on JUL 16. *Figure 1* (below) graphs the rotational mean Sunspot Numbers and the number of Active Regions for this period.

Activity was in general moderate, with 16 AR's (Activity Regions) developing to class-E groups (for the definitions of classifications, see the *Solar Classification Key* on p. 180), nine of which were in the Sun's Northern Hemisphere. The Southern Hemisphere produced eight groups with a delta configuration, twice as many as the north.

The times used in this report are all Universal Time (UT). Cardinal directions are abbreviated (e.g., N, SW) and are heliographic as are angular dimensions. "Preceding" (p) means celestial west and "Following" (f) celestial east. "Groups" are white-light collections of sunspots. "Regions" are entire magnetically associated areas around sunspots in all wavelengths. Active regions are enumerated in this report with the prefix AR, and are designated as such by the Space Environment Services Center (SESC) of NOAA in Boulder, Colorado. AR positions are given in the form (latitude, longitude).

Table 1 (p. 176) lists the observers who submitted data for this reporting period. The terms and abbreviations used in this report are explained in the book, *The New Observe and Understand The Sun*, which is available for $US 5.75 from: Astronomical League Sales, 1901 South Tenth St., Burlington, IA 52601). A.L.P.O. Solar Section observing forms are available from Recorder Paul Maxson (address on inside back cover).

ROTATION 1856 (1992 MAY 20.67 to JUN 16.87; 36 Active Regions)

Quantity	Mean	Maximum (Dates)	Minimum (Dates)
RI	70.3	113 (MAY 23)	30 (MAY 30)
RA	70.3	108 (MAY 22)	29 (MAY 31)

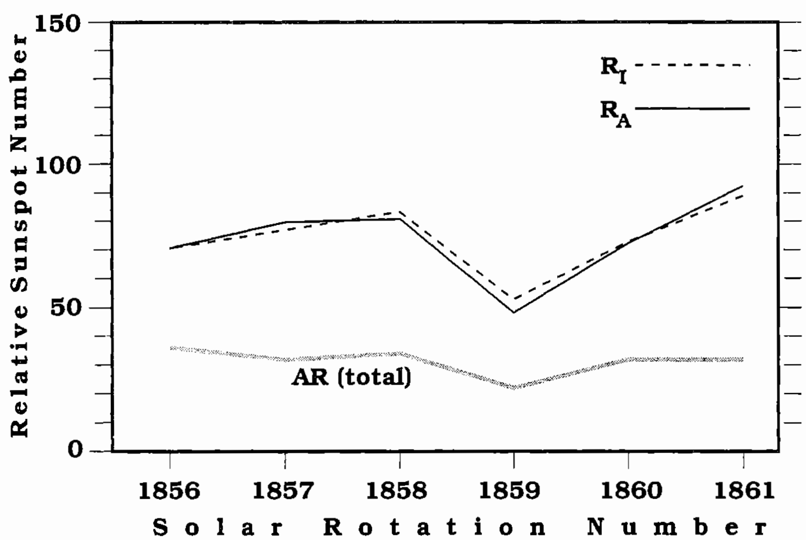

Figure 1. Graph of rotational means of RI (Relative International Sunspot Number), RA (Relative American Sunspot Number), and total number of Active Regions (AR), for Rotations 1856-1861.

Table 1. Observers Contributing to the A.L.P.O. Solar Section Report, Rotations 1856-1861 (1992 MAY 20-OCT 31).

Observer	Telescope Aper.	Telescope Stop	Telescope f/	Telescope Type	Location
Garcia, G.	12	-	8.4	Refr.	Illinois, USA
Maxson, P.	25.4	15	10	New.	Arizona, USA
Melillo, F.	20.3	6.3	11	S.-C.	New York, USA
Rousom, J.	10.2	-	15	Refr.	Ontario, Canada
Tao, Fan-Lin	25.4	-	15	Refr.	Rep. of China
Tatum, R.	18	-	15	Refr.	Virginia, USA
Timerson, B.	15.2	-	8.3	New.	New York, USA

Notes: Aper. = telescope aperture, followed by the aperture of the *stop* if any; both in cm. *f/* = focal ratio; *New.* = Newtonian; *Refr.* = refractor; and *S.-C.* = Schmidt-Cassegrain.

AR 7172 (N22°, 328°) was in the NE quadrant of the solar disk as the rotation began. On MAY 20 and 22 this region was drawn in white light by Rousom and photographed by Melillo in H-α. This group was classed EKI, β and had a typical prominent p-spot with several small f-spots. The magnetic inversion line was marked by a plage corridor that separated negative polarity p-spot and plage from the positive f-spots and plage. Dark, curved fibrils; which follow the transverse magnetic field parallel to the sun's "surface", connected the p-spot to the region of opposite polarity. Rousom counted 35 spots in AR 7172 on MAY 20 and 41 on MAY 22.

ROTATION 1857 (1992 JUN 16.87 to JUL 14.07; 32 Active Regions)

Quantity	Mean	Maximum (Dates)	Minimum (Dates)
RI	76.5	133 (JUL 11)	38 (JUN 27)
RA	80.0	142 (JUL 12)	33 (JUN 27)

Maxson and Timerson photographed an interesting delta group from JUN 23 to 25 approaching the W limb. It formed on the disk on JUN 15 and remained insignificant until central-meridian passage on JUN 20. This group, **AR 7205** (N11°, 313°), grew to class DKC, βγδ by JUN 24. Four medium-to-large umbrae were located within a large irregular penumbra with the largest being the old f-spot.

AR 7216 (N14°, 116°), classed FKI, βγ, was the best-observed region of this rotation. Garcia, Maxson and Timerson made white-light photographs from JUL 01 to its central-meridian passage on JUL 05. The larger penumbra on JUL 04/05 contained three umbrae separated by light bridges. The four to five medium-size f-spots in the region each had an irregular partial penumbra. In large sunspot groups the f-spot is seldom a single regular spot. AR 7216 reached a length of 18° and changed little during this period.

Attention then shifted to the Sun's Southern Hemisphere with the appearance of a 25°-long stream of sunspots. The stream was divided into two regions. **AR 7220** (S12°, 030°) was a mature EKC, βγδ-class when Rousom and Tao drew it on JUL 09. The larger, regular p-spot was connected to numerous small f-spots by a section of penumbra. Closely following AR 7220 was **AR 7222** (S11°, 015°), which had four to five small umbrae with the p and f spots beginning to form penumbras. Garcia photographed the region in white light and H-α on JUL 11; the white-light image is shown in *Figure 2* (below). By then, the two f-spots of AR 7220 had grown, but were still smaller then the p-spot. AR 7222 had now developed into a class-E group with a cluster of umbrae at its p and f ends. At 14° in length, it had surpassed AR 7220 in length. On JUL 15 a Maxson photograph showed AR 7222's p-spot to be the largest in the complex. Tatum videotaped long field-transition arches crossing the magnetic inversion line and connecting the p-spot and several smaller f-spots that were

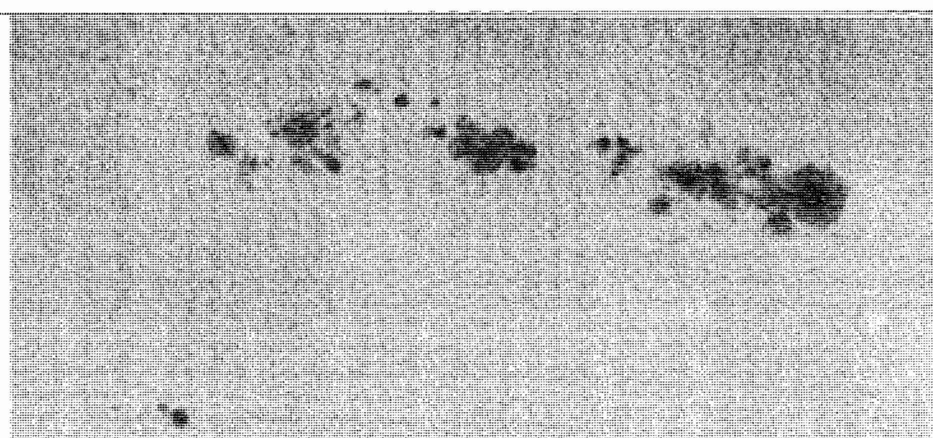

Figure 2. White-light photograph of AR's 7220 and 7222 by Gordon Garcia. 1992 JUL 11, 18h40m UT. 13-cm Refr., f/40; 1/1000-sec on TP2415 Film. Reproduction scale 7 arc-sec/mm. N. at top.

aligned N-S. By JUL 15 the p-spot of AR 7220 was all that remained and the penumbra had shrunk. AR 7222, now class FKI, βγδ, was moving closer to AR 7220 with the westward motion of the its p-spot.

ROTATION 1858 (1992 JUL 14.07 to AUG 10.28; 34 Active Regions)

Quantity	Mean	Maximum (Dates)	Minimum (Date)
RI	83.5	161 (JUL 15)	37 (JUL 25)
RA	80.6	151 (JUL 16)	33 (JUL 25)

The AR 7220/7222 complex returned to the disk on AUG 01 and was designated **AR 7248** (S12°, 029°), classed EKI, βγδ. The two main sunspots of AR 7248 were believed to be the surviving p-spots of AR 7220 and 7222. Hence both should be positive polarity, the leading polarity for the Southern Hemisphere for cycle 22; Mt. Wilson magnetograms confirmed this.

AR 7248 and its environs were photographed in very fine detail by Garcia on AUG 09. He used one layer of Solar Screen, a W58 green filter and a 1/1000-sec exposure to "freeze" a moment of superb seeing. A great deal of information can be gleaned from this one-arc sec resolution photograph, shown in *Figure 3* below, concerning the structure of features in the sun's photosphere. Photospheric granulation varies in size, shape and brightness. Near sunspots granulation is smaller, and in places distorted. The distortion occurs near areas of spot formation (pores) and shear (magnetic inversion line). Another feature that occurs near sunspots is faint, linear dark filaments or lanes that appear to be the alignment of intergranular lanes. Granulation is usually elongated here. The dark filaments are related to the darker penumbral filaments. These white-light features should not be confused with H-α filaments in the corona or H-α chromospheric fine structures. Small imperfections in the film emulsion mimic these features.

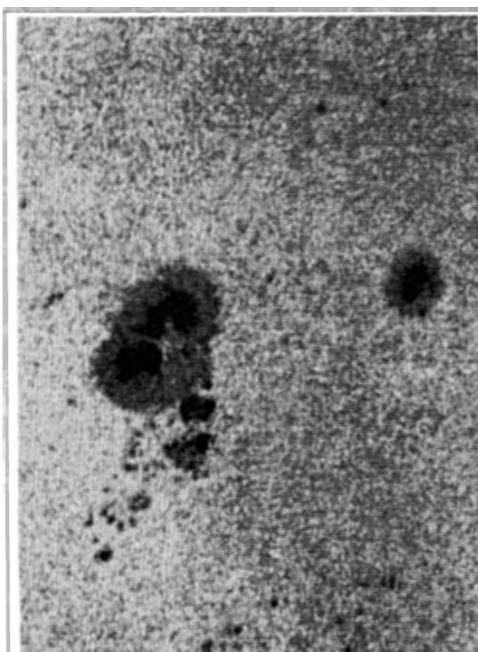

Figure 3. Green-light photograph of AR 7248 by Gordon Garcia. 1992 AUG 09, 16h14m UT. 13-cm refractor, f/74; 1/1000-sec on TP2415 Film. Reproduction scale 3-4 arc-sec/mm. N. at top.

In AR 7248, the primary sunspot had an oval penumbra. On the spot's SW side the penumbra was brighter and protruded into the umbra with two bright light bridges. A fainter light bridge separated the darker N half of the umbra from the lighter S half. S of the principal spot was an area with several pores and a few small umbrae with rudimentary penumbra. Here granulation appeared distorted or smeared. There was a smaller regular sunspot W of the principal spot which was probably the old p-spot of AR 7220.

ROTATION 1859 (1992 AUG 10.28 to SEP 06.53; 22 Active Regions)

Quantity	Mean	Maximum (Date)	Minimum (Date)
RI	52.5	96 (AUG 16)	20 (AUG 25)
RA	48.4	96 (AUG 16)	16 (AUG 25)

AR 7260 (N17°, 257°) was photographed by Maxson on AUG 12-16. Its most prominent feature was a large p-spot, and only a few small f-umbrae could be seen before AUG 18. Magnetograms showed the f-spots to be of mixed polarity.

Garcia took advantage of superb seeing conditions on AUG 16 and photographed a wealth of detail around AR 7260, reproduced in *Figure 4* (p. 178). The complex penumbral detail of the large p-spot had a variable structure. On its S side, dark and bright penumbral filaments ran radially from the umbra. On the NE side, the radial features had a braided appearance. Here at the edge of the umbra, small, bright, elongated granules were seen against the dark umbra. They were smaller than normal photospheric granulation. The rest of the edge of the umbra had a normal jagged appearance resulting from the radial penumbral filaments. The NW side of the penumbra was amorphous, lacking fine details. One bright filament on the W side of the umbra connected with several small bright points within the umbra to form a "Y"- shaped light bridge. Numerous small pores and rudimentary penumbrae were visible, especially on the E side of the p-spot. A H-α photograph of this region taken four days later by Melillo is shown in *Figure 5* (p. 178). Timerson photographed AR 7260 from AUG 19-22. The p-

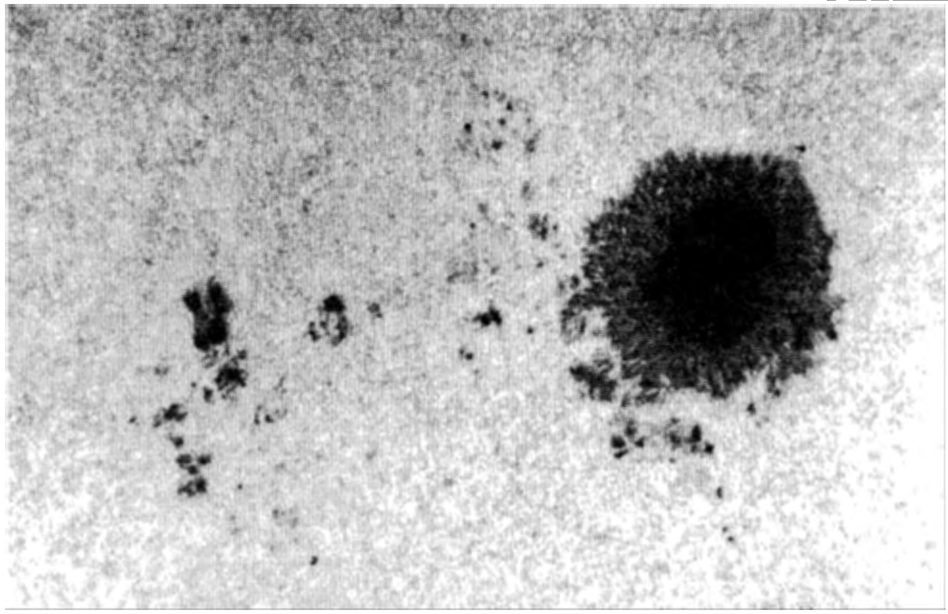

Figure 4. Green-light photograph of AR 7260 by Gordon Garcia. 1992 AUG 16, 16h06m UT. 13-cm refractor, f/74; 1/1000-sec on TP2415 Film. Reproduction scale 3-4 arc-sec/mm. N. at top.

spot's light bridge became more conspicuous following central-meridian passage. A bright "Z"-shaped light bridge was obvious in Melillo's white-light photograph on AUG 22.

On AUG 19 from 1617-34 Garcia photographed in H-α a bright eruptive prominence on the W limb. The 0.5Å filter was tuned 2.5Å to the blue side of the H-a line. For a prominence or filament to be visible 2.5Å shorter in wavelength than H-α it must have a line-of-sight velocity of 115 km/sec towards the Earth! This feature probably was not visible in the core of H-α. It is of benefit to rapidly tune an H-α filter in order to study high-speed solar phenomena. As most eruptions last only 15-30 minutes, filters using temperature-controlled ovens react too slowly. Installing the filter in a gimbal allows it to tilt, shifting the bandpass. Overall, these are the best quality H-α filters for photography. In addition, recording such phenomena on video is more instructive and efficient than still photography.

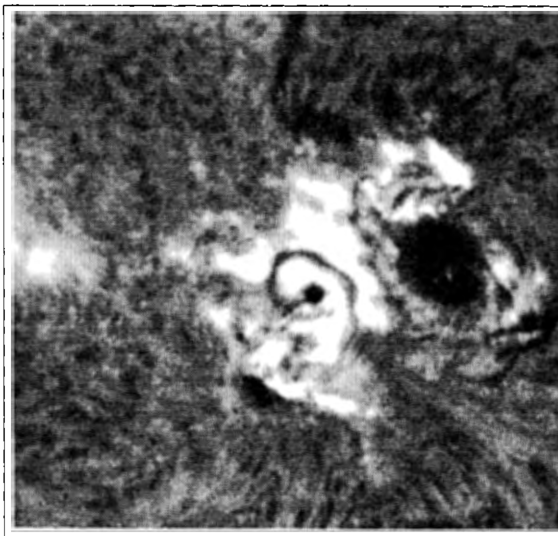

Figure 5. H-α photograph of AR 7260 by Frank J. Melillo. 1992 AUG 20, 22h30m UT. 20-cm Schmidt-Cassegrain, 6-cm off-axis stop, 2000-mm focal length. 1/4-sec on TP2415 Film with a Daystar 0.6-Å H-α filter. North at top.

ROTATION 1860 (1992 SEP 06.53 to OCT 03.80 ; 32 Active Regions)

Quantity	Mean	Maximum (Dates)	Minimum (Dates)
RI	72.7	98 (OCT 02)	38 (SEP 08)
RA	72.4	104 (OCT 03)	44 (SEP 07/08)

The large sunspot of AR 7248 returned for another disk passage and was numbered **AR 7294** (S11°, 046°). For most of this passage only one large, regular sunspot could be seen. It was then a class HH group. A few small f-spots were temporarily observed from SEP 30-OCT 02, which changed the classification to CHO. AR 7294 was well observed by Garcia, Maxson and Tao.

ROTATION 1861
(1992 OCT 03.80 TO OCT 31.09 ; 32 Active Regions)

Quantity	Mean	Maximum (Dates)	Minimum (Dates)
RI	88.4	131 (OCT 28)	36 (OCT 13)
RA	93.4	134 (OCT 26/28)	43 (OCT 13)

The most interesting region of the rotation appeared on OCT 23 in the SE quadrant of the solar disk. Garcia, Maxson and Tao recorded the impressive growth of **AR 7321** (S25°, 070°) between OCT 24 and 25. On OCT 24 it contained two average spots of equal size 5°apart. Little penumbra could be seen between the p- and f-spots. In 24 hours AR 7321 became the dominant active region on the disk! The now-large p- and f-spots were enclosed in a elongated, irregular penumbra. At S25°, AR 7321 was at a much higher latitude than the other regions, which were near S12°. The overall appearance of the disk on OCT 25 is shown in *Figure 6* (below). The tilt of the line connecting the p- and f-spots with respect to the solar equator was 60° on OCT 24 and 50° the next day. It is interesting that the p and f-spots had formed with the "wrong" polarity for the Southern Hemisphere! Groups with an inverted delta configuration that violate the Hale-Nicholson law of sunspot polarity are usually the source of large flares. AR 7321 produced many small-to-medium flares, but only one major X-flare. Near the W limb on OCT 30, the area of 7321 peaked at 1633 millionths of the solar disk and was classed EKC, βγδ.

Our old friend, the p-spot from the July region, AR 7222, survived to transit the solar disk a fourth time. Now known as **AR 7319** (S09°, 047°) its strong westward or prograde motion had ceased. This region's appearance was similar to the previous passage with the addition of a few more f- spots. AR 7319 was class DSO when it crossed the central meridian on OCT 28.

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2.) ________. No. 576, August, 1992.
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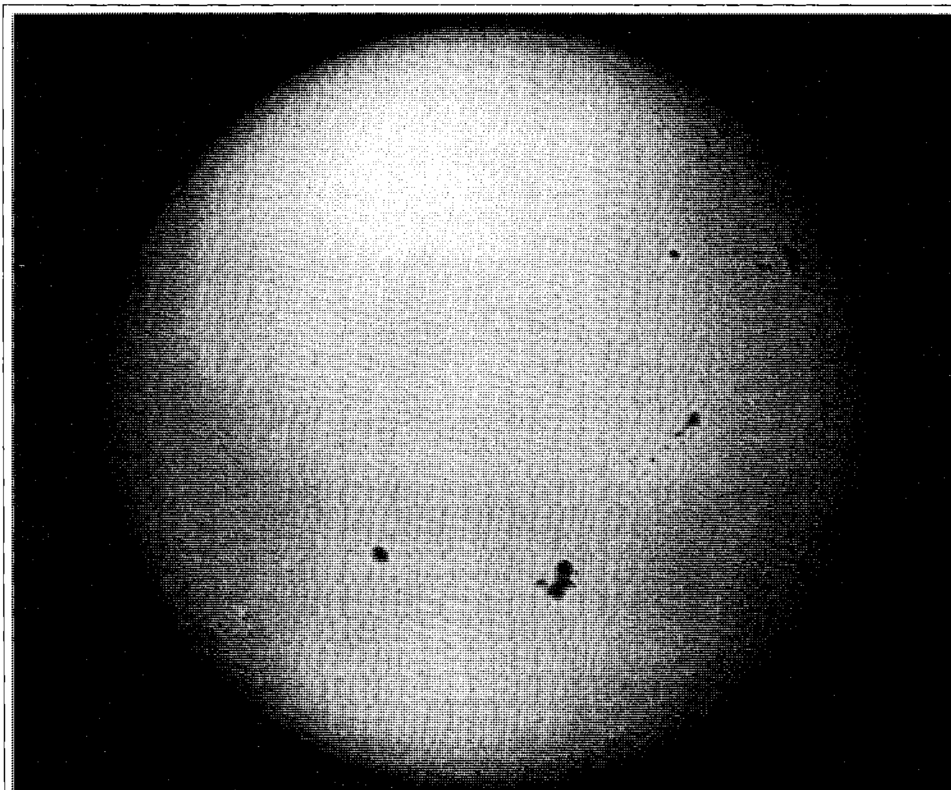

Figure 6. Whole-disk photograph in green light by Gordon Garcia. 1992 OCT 25, 17h06m UT. 13-cm refractor, f/17.7; 1/250-sec on TP2415 Film. N. at top.

SOLAR CLASSIFICATION KEY:

Groups (Modified Zurich System)

First Letter—**A** = Single pore or non-polar group of pores. **B** = Bipolar; without penumbrae. **C** = Bipolar; penumbra on one end. **D** = Bipolar; penumbrae at both ends; length <10°. **E** = Bipolar; penumbrae at both ends; length 10°-15°. **F** = Bipolar; spots at both ends; length >15°. **H** = Unipolar; penumbra; diameter >2°.5.

Second Letter (Penumbra of Largest Spot)—**X** = No penumbra. **R** = Rudimentary penumbra partly surrounds largest spot. **S** = Small, symmetric penumbra, elliptical or circular; single umbra or compact cluster of umbrae; <2°.5 N-S. **A** = Small, asymmetric penumbra; irregular; <2°.5 N-S. **H** = Large symmetric penumbra; >2°.5 N-S. **K** = Large asymmetric penumbra; >2°.5 N-S.

Third Letter (Spot Distribution)—**X** = (Unipolar). **O** = Open; few or no spots between leader and follower. **I** = Intermediate; numerous spots between leader and follower. **C** = Compact; many large spots between leader and follower.

Magnetic Characteristics

α = Unipolar. β = Bipolar. γ = Complex polarity. δ = Opposite polarity umbrae in a single penumbra.

Flares

Class (values are areas in millionths of solar disk)—**S** = Subflare; <100. **1** = 100-250. **2** = 250-600. **3** = 600-1200. **4** = >1200.

Brilliance—**f** = Faint. **n** = Normal. **b** = Bright.

X-Ray Importance (Peak Flux in watts/sq. meter; followed by numerical multiplier)

B = 10^{-6}. **C** = 10^{-5}. **M** = 10^{-4}. **X** = 10^{-3}.

Figure 7 (to right). Dr. Jean Dragesco is a longtime contributor to the A.L.P.O. and a renowned observer and photographer. Here he is using a 18-cm Starfire refractor on a Takahashi mount to observe Jupiter. This is one instrument he uses to make high-resolution photographs of the Sun.

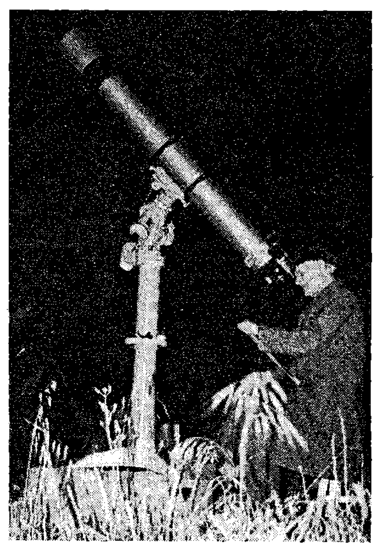

Figure 8 (below). Gordon Garcia makes excellent high-resolution photographs and drawings of the Sun. Gordon is pictured with his 13-cm Astrophysics Starfire refractor with a full-aperture Baader Planetarium white-light solar filter. He is currently experimenting with a CCD camera for solar imagery.

We plan to include more photographs of Solar Section observers in future articles.

THE 1995 CONVENTION OF THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS: NOTES AND PHOTOGRAPHS

The Association of Lunar and Planetary Observers held its 45th Convention last summer, meeting at the Days Inn East Hotel in Wichita, Kansas, for August 1-5, 1995.

About 40 of our members attended this event, and we extend particular thanks to Jose and Louise Olivarez for local arrangements and to Beth Westfall for the meeting logistics. We also thank the members and staff who contributed papers and displays.

The sessions themselves lasted four days, with a mixture of individual and group papers, discussion sessions, the Board of Directors Meeting, a banquet, and a field trip.

This report lists the papers and other events of the meeting (*Table 1*, below), but chiefly describes the convention by means of the photographs that follow (*Figure 1-12*, pp. 182-183). The business activities of the convention are summarized in the minutes of the Board of Directors Meeting following this report (pp. 184-185).

Table 1. Chronology of Activities, 45th Convention of the A.L.P.O.

Papers

Walter H. Haas, "Was the A.L.P.O. Necessary? Is the A.L.P.O. Necessary?"
Richard J. Schmude, Jr., "Wideband Photometry of Uranus and Neptune in 1995."
Daniel M. Troiani, "Review of the 1994-1995 Martian Apparition."
Don E. Machholz, "The Discovery and Apparition of Periodic Comet Machholz 2."
Phillip W. Budine, "Observing Jupiter: Jovian Nomenclature, Central Meridian Transits, Rotation Periods, and Statistics."
Phillip W. Budine, "Jupiter Update: The Appearance of Jupiter in 1994-1995."
Carlos Hernandez and Phillip W. Budine, "The Shoemaker-Levy 9 Impact With Jupiter."
Jose Olivarez, "Update on the Olivarez Blue Features of Jupiter's Equatorial Zone."
Bob Manske and David Weier, "The Jupiter Database Program."
David Weier, "A.L.P.O. Computing Section Survey and Software Demonstration."
David O. Darling, "The Darling Clementine LTP Program."
Harry D. Jamieson, "The Lunar Dome Survey: A Progress Report."
John E. Westfall, "A Lunar Terminator Tour via CCD."
Michael Reynolds, "Chabot Observatory: Past, Present, and Future."
Thomas R. Cave, "A Near Perfect Planetary Telescope."
Michael Mattei, "Ludwig Schupmann's Medial Telescope."
Timothy Robertson and Matthew L. Will, "The A.L.P.O. Lunar and Planetary Training Program: A Progress Report and Analysis of the Training Program's First Year Activities Since Its Revision."
Robert Landis, "Planetaria and the Space Telescope Science Institute."
Richard G. Hodgson, "Avoiding Babel: Clarifying Our Astronomical Vocabulary and the Current Revolution in Solar System Studies."
Julius L. Benton, Jr., "The 1995-96 Edgewise Presentation of Saturn's Rings: An Observational Update."
Daniel P. Joyce, James P. Carroll, and Daniel M. Troiani, "Up-to-Date CCD, 1995."
Thomas A. Dobbins, "Capturing the Moon and Planets on Videotape: An Economical Approach to CCD Without a Computer."
Michael Reynolds, "Eclipse Experiences."
Rik Hill and Beth Westfall, "The A.L.P.O. Page on the World-Wide Web."

Other Events

Welcome and Announcements; Jose Olivarez, Walter H. Haas, and John Westfall.
Open Discussion: "Whither the Lunar Section?"
Open A.L.P.O. Board of Directors' Meeting.
Optional Field Trip: Science Center and Planetarium Show; Dinner in Old Town; Tour and Observing at Lake Afton Public Observatory.
Open Discussion: "Goals and Methods in Training and Education."
Show-and-Tell: "Recent Eclipses and Occultations."
Award Banquet: Presentation of Walter H. Haas Award for 1995; Invited Speaker: Robert Landis, Space Telescope Science Institute, "The Solar System via the Hubble Space Telescope."
General Discussion: The Role of the Computing Section; Contents of the A.L.P.O. Solar System Ephemeris.

Figure 1. Group portrait of the attendees at the 45th A.L.P.O. Convention, in Wichita, Kansas.

Figure 2. A.L.P.O. Comets Recorder Don E. Machholz on the topic "The Discovery and Apparition of Periodic Comet Machholz 2."

Figure 3. Computing Section Recorder Bob Manske demonstrates his Jupiter Database program.

Figure 4. veteran observer and telescope-maker Thomas R. Cave describes "A Near Perfect Planetary Telescope."

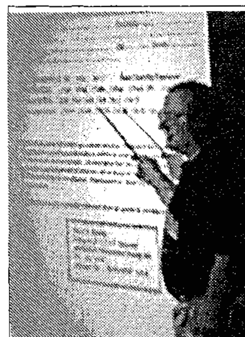

Figure 5. Lunar Transient Phenomena Recorder David O. Darling describes cooperation with the NASA-DOD Clementine Mission in "The Darling Clementine LTP Program."

Figure 6. One of the annual Banquet events is the presentation of the Walter H. Haas Observing Award. Here, Jose Olivarez (right) displays the award to Walter Haas, who accepts it on behalf of Elmer J. Reese. Mr. Reese received the award in recognition of several decades of Jupiter observations and research.

Figure 7. Also at the 1995 Banquet, outgoing A.L.P.O. Executive Director John Westfall (right) receives an award of appreciation from the incoming Executive Director, Phillip Budine.

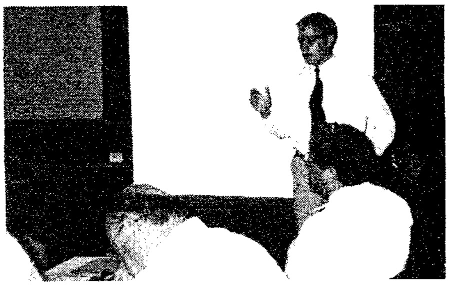

Figure 8. The guest Banquet speaker, Robert Landis of the Space Telescope Science Institute speaks on "The Solar System via the Hubble Space Telescope."

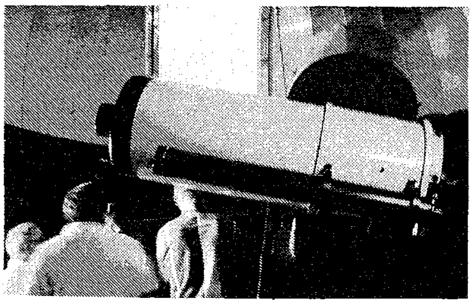

Figure 9. One of the Convention highlights was a visit to the Wichita Omnisphere and Science Center, followed in the evening by a field trip to Lake Afton Public Observatory. Here, A.L.P.O. members inspect the Observatory's 16-in catadioptric reflector prior to observing the Moon and Jupiter

Figure 10. Some A.L.P.O. staff members line up at the podium. From left to right: Jose Olivarez, Elizabeth Westfall, Matthew Will, Walter H. Haas, Michael Mattei, Phillip Budine, John Westfall, Harry Jamieson, and Daniel Troiani.

Figure 11. The annual A.L.P.O. Board of Directors Meeting was held in Jose Olivarez' library with part of his "telescope arsenal." From left to right are John Westfall, Phillip Budine, Walter Haas, Jose Olivarez, Harry Jamieson, and Elizabeth Westfall. (Board member Donald Parker, and new Board member Julius Benton, are not shown.)

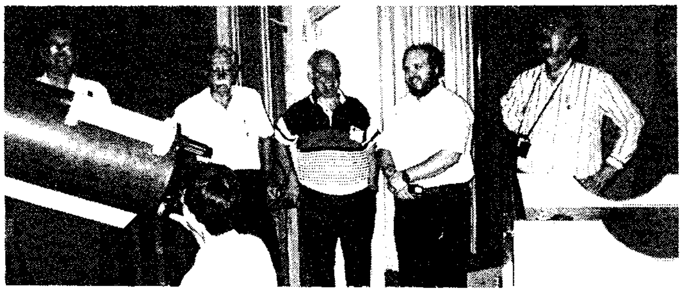

Figure 12. Another highlight at the Olivarez home was group observing of the Moon through Jose Olivarez' 10-inch folded refractor (on left).

Photograph Credits:

Figures 1, 3, 5, and 9; John Westfall. Figures 2, 4, and 10; Jose Olivarez. Figures 6, 7, 8, and 12; Gary Cameron. Figure 11, Louise Olivarez.

MINUTES OF THE A.L.P.O. BOARD MEETINGS, WICHITA, KANSAS, AUGUST 2 AND 3, 1995

Minutes taken by: Elizabeth W. Westfall, A.L.P.O. Board Secretary

The A.L.P.O. Board of Directors met in connection with the A.L.P.O. 1995 Convention in Wichita, Kansas. As required by the A.L.P.O. Constitution, the August 2nd Board Meeting was a closed meeting. In the interest of gaining members' input and to inform the membership, a second, open, Board meeting was held on August 3rd.

WEDNESDAY, AUGUST 2, CLOSED BOARD MEETING

I. New Business.

A. Confirmation of Board of Directors: reconfirmed Phillip W. Budine, Walter H. Haas, Harry D. Jamieson, Jose Olivarez, Donald Parker (absent), Elizabeth W. Westfall, and John E. Westfall

B. Nomination of Julius L. Benton, Jr., for Board Membership, approved.

C. Nomination of Michael Mattei for Board Membership, not approved.

D. 1996 Convention. Approved meeting with the Astronomical League in Rockford, IL, on July 24-27. Also approved a mini meeting (papers/workshops only) based on an invitation from the Tucson Amateur Astronomers to meet with them in Tucson on the weekend prior to the Division for Planetary Sciences Meeting in October.

E. 1997 Convention. We accept the invitation from the Astronomical League to meet with them in or near Philadelphia in Summer, 1997, for a joint 50th-Anniversary meeting. This annual convention will include the usual paper and award sessions. We will also hold a weekend A.L.P.O. 50th-birthday celebration in Las Cruces, home of the founding Director and of many of the charter or early A.L.P.O. members. The emphasis will be on the history of the A.L.P.O.. To avoid schedule conflicts, the two meetings in 1997 will be scheduled far apart during the summer.

F. Staff Confirmations. Carlos E. Hernandez was confirmed as Assistant Jupiter Recorder (while remaining a Mars Recorder).

G. Staff Resignation. The Board accepts the resignation of Jeff Beish as Mars Recorder, and recognizes the substantial and capable work he has done for many years.

H. Lunar Selected Areas Program. Julius Benton, Lunar Recorder, Selected Areas Program, had requested that the Program be canceled due to lack of observer interest. The Board, with the agreement of the Recorders affected, will move the Lunar Selected Areas to the Training Program under Matt Will.

I. A.L.P.O. Participation in Universe'96 *et seq.* In 1995, the Astronomical Society of the Pacific charged us $100 for our information table. In addition, we passed out about $100 worth of literature. The Board approved the expense of participating in this annual astronomy event, as it is good exposure for the A.L.P.O.

J. A.L.P.O. Editorial Policy. At previous annual meetings, members have requested changes and additions to publications. Guidelines for content of the various publications are as follows:

Journal—Continue as in the past, but discontinue "Coming Solar-System Events," as such material is readily available in other publications.

Monograph Series—See details under A.L.P.O. Financial Reports. This series will include annual meeting proceedings, as well as publications which are too long to be included in the Journal, or are of a specialized nature.

Web Page—Rik Hill has agreed to establish and maintain a World-Wide Web Page. To provide consistency in how the organization is presented on line, initial Web page material should be submitted to Editor John Westfall before being forwarded to Rik for posting.

K. Status of Newsletter (*Through the Telescope*). Four pages, continue to mail first class, consider subscriptions for the last 2 issues of 95-96. First priority is material received from Recorders, especially what they think should be observed in the coming months. Jeff Beish resigned as editor, Elizabeth Westfall agreed to become editor. Continuation of the newsletter will be reviewed again in one year.

L. A.L.P.O. Fundraising Plan. The Board discussed the need for long-term fundraising to provide working capital for some of the projects mentioned. Several plans were discussed and will be researched. Requests for funds will be put in the newsletter.

M. Resignation of John Westfall as Executive Director. John Westfall will resign as A.L.P.O. Executive Director and Chair of the Board of Directors, effective at the end of our 1995 Meeting. He will retain his Editorship, Board membership, and Section Recorderships, and is will continue as the A.L.P.O. representative on the Hubble Space Telescope Amateur Astronomy Working Group. The Board accepted these changes

N. Election of New Executive Director. Phillip W. Budine was elected as new Executive Director.

O. Election of New Associate Director Harry D. Jamieson was elected as new Associate Director.

THURSDAY, AUGUST 3, A.L.P.O. REPORTS (OPEN BOARD MEETING)

The new Executive Director Phillip W. Budine received various materials from outgoing Director John Westfall, and chaired the remainder of the meeting.

A. Finances (change since 1994 report in parentheses):

San Francisco Bank Account (Westfall, 7/28/95) . . . $ 1130.76 (1049.37)
Amount owed Director (7/28/95) . . -9.38 (-115.24)

B. Publications.

1. Journal. 639 subscribers for the July, 1995 issue; 79 percent in the United States, 21 percent elsewhere. In the last year, we published three quarterly issues: Vol. 37, No. 1 (October, 1994); Vol. No. 2 (March, 1995); and Vol. 38, No. 3 (July, 1995). Each issue contained 48 pages.

2. Solar System Ephemeris (1995 edition). About 125 copies distributed to date; with 28 complimentary; the rest were sold at $8.00 domestic or $10.00 foreign. The 1995 edition had 136 pages; 125 copies were printed at a cost of $771.75. Postal costs to date are $373.48, making a total of $1145.23. Mark Davis is continuing generously to handle production and distribution and the Computing Section will supply most of the contents beginning with the next issue (1996).

3. A.L.P.O. Monographs. Occasionally the A.L.P.O. has a need for publishing, or receives, worthwhile, manuscripts that are too long for the *Journal*. Accordingly, the Editor has begun publishing an A.L.P.O. Monographs series. Monograph No. 1 is the Proceedings of our 1993 Convention; 25 were photocopied at a cost of $179.27, and are being sold at this Convention for $8.00 each. Monograph No. 2 is the Proceedings of our 1994 Convention; 25 were photocopied at a cost of $122.31, and are being sold at this Convention for $5.00 each. It is intended that these Monographs will be sold at cost or slightly above, and Monograph prices for mail sales will include postage. Monograph No. 3 is planned to be a translation by William Sheehan of *Schiaparelli's Astronomical and Physical Observations of the Axis of Rotation and the Topography of the Planet Mars, First Memoir, 1877-1878*, at a cost in the range of $6-8 per copy excluding postage.

C. Foreign Membership Fund.

Balance 6/14/94 . . . .$ 620.00
1 Allocation (Z.Brylowski) . . -20.00
Balance 7/28/95 . . . . $ 40.00

D. International Solar System Observers Fund (ISSOF).

Balance . . . . $ 25.77

The ISSOF is administered by Paul H. Bock, Jr. There has been no recent activity, with no donations of funds or materials.

E. Membership Trends.

Issue	Date	U.S.A	Abroad	Total
37, 4	4/94	470	128	598
38, 3	7/95	502	137	639
14-month Change		+32	+9	+41(+6.9 %)

Reports from Section Recorders attending Upon Section Activities for 1994-95 and Plans for 1995-96

A. Lunar Selected Area Program (Julius Benton and Matt Will). These two Recorders will work together to see if there will be more interest with it being part of the Training Program. Participation will be reviewed in one year.

B. Lunar Dome Survey (Harry Jamieson). The Lunar Dome Survey is being converted from paper to computer.

C. Jupiter (John Westfall). A new Galilean Satellite eclipse timing report will be finished soon.

D. Saturn (Julius Benton). The Section has been very active because of the interest in the ring-plane crossings. A section newsletter has started, and Julius encourages observers (including non-members) to join.

E. Lunar Transient Phenomena (David Darling. Participation has been very encouraging. He continues to have many foreign observers from the Clementine project. [Comment from several sections: the number of United States observers has stayed constant, but there has been a growth in foreign observers.]

F. Jupiter (Phillip Budine). The Jupiter Section is working with the Computing Section to create a databank of information.

G. Mars (Dan Troiani). Jeff Beish has resigned as Recorder, but will work with Dan Troiani in reviewing data. The are pushing publication of the Apparition report because of demand from professionals for the report.

H. Comets (Don Machholz). Comet reports depend, of course, on comet activity. Don is sending out regular reports to a wide variety of publications about comets to watch for.

I. Instruments (Mike Mattei). Several members have sent instruments to him to be checked. The section will begin publishing reviews of instruments. They will also begin to review astronomy software, which is acceptable to the Computing Section.

J. The Training Section and Computer Section each gave a detailed report of activities as part of a paper, which will appear in the Proceedings.

There being no additional business before the Board, the Board Meeting was adjourned.

Changes Since the Meeting:

Phillip Budine has resigned as Executive Director, being succeeded by Harry D. Jamieson. Jose Olivarez is now Associate Director and John Westfall is Treasurer.

Monograph Number 3 is available, and is a reprinting of the Wilkins Moon Maps (see page 169).

Our Readers Speak

(Letters May be edited for style.
The writers are responsible for their opinions, not the A.L.P.O.)

(Forwarded to Editor by Jeff D. Beish)

I always look forward to reading the A.L.P.O. newsletter *Through the Telescope*. Congratulations on this enjoyable publication. I'd like to offer a few comments on your article entitled "Black Tubes for Reflecting Telescopes" in the March, 1995 issue. Your article is full of good advice for builders of all kinds of telescopes, but I worry that your comments on tube color may lead us into a new generation of all-black (and thus boring) telescope tubes. Allow me to suggest some physics that may restore the artistic freedom of telescope painters across the nation.

You correctly point out that a major aspect of stabilizing temperatures in a telescope is the "color" of the coating on the outside of the tube. Heat will radiate from a black (high emissivity) surface faster than it will radiate from a shiny (low emissivity) surface. But, that doesn't mean that a telescope painted black will always have significantly better radiation exchange with its environment than one painted white. The amount of radiative energy (heat) exchanged between two surfaces depends on: the temperature difference of the two surfaces; the emissivity (blackness) of the surfaces averaged over wavelengths at the peak of the appropriate blackbody curve; and the relative angular extent (view factor) of the surfaces.

In visible light, black surfaces absorb and reradiate heat much more efficiently than white or reflective surfaces. Light from the sun—with a 5000 K blackbody peak at a wavelength of 0.5 microns—provides the standard reference against which we define colors. However, our common sense definitions of black and white may fail us at other wavelengths appropriate to different blackbody temperatures. Normal terrestrial objects (i.e. telescopes) have temperatures around 260-300 K and thus have the peak of their blackbody radiated energy at wavelengths around 10 microns— in the so-called "thermal infrared"'. Essentially all painted surfaces appear "black" (high emissivity) at a wavelength of 10 microns, so any painted telescope tube will radiate effectively to its surroundings regardless of the color of the paint. Typically, only metallic surfaces have low emissivity in the thermal infrared.

The amateur astronomer should probably paint the inside of the telescope tube black to reduce the amount of scattered light. Radiation exchanged inside a closed cavity like a telescope tube is not affected by the surface coating since the photons just keep bouncing around until they are absorbed or until they escape from the end of the tube.

For general use, the outside of the tube may be painted any color which suits the taste of the owner. The painted surface will radiate to the sky and eventually cool below the surrounding air temperature. Telescope tubes, and indeed the whole earth, radiate heat to the cold sky because the night sky has an effective temperature of around 235 K. The sky would be much colder if it were not for the so-called "greenhouse gases" in the atmosphere which block many infrared wavelengths. The effective temperature of the sky varies with location and season. Deserts and high mountains tend to have colder skies because there is less water vapor to block the thermal infrared radiation. External surfaces of telescopes or domes which cool below the ambient air temperature can have two unwanted effects. They can collect dew which then drips on the optics, or they can create plumes of cold air (cooled by conduction from the surface) which negatively affect seeing in the same way that plumes of hot air do. At least a little bit of cooling by radiation to the sky is desirable as it compensates some of the excess heat which may be stored in the mass of the telescope structure.

For telescope tubes or domes which are exposed to direct sunlight during the day, TiO_2 (titanium dioxide) white paint is a very effective coating. This special paint does the best job of reflecting away solar radiation during the day. TiO_2 white paint appears quite "black"' at thermal infrared wavelengths so it radiates well to the sky at night. About 20 years ago, astronomers with white domes began to notice excess seeing caused by air cooled by being in contact with the radiatively cooled dome surface. Measurements at the Multiple Mirror Telescope have shown that a TiO_2-painted surface may be as much as 6 K below the surrounding air temperature on a clear calm night. To bring the dome or telescope tube back into equilibrium with the nighttime air, we need a coating which has low emissivity at thermal infrared wavelengths. An example of such a coating is the shiny aluminum tape which is seen on many newer telescopes and domes (e.g. Multiple Mirror Telescope, WIYN 3.5-meter, MDM Hilter 2.4-meter). Note that the shiny aluminum surface actually gets hotter than the white surface in the daytime because it cannot easily radiate away the solar heat that it does absorb. These telescopes compensate for this effect by having very lightweight domes which don't hold much heat after the sun goes down.

I hope this discussion clears up the issue of telescope tube and dome colors.

John M. Hill

**LBT Director, Steward Observatory,
University of Arizona, Tucson, AZ 85721**

July 29, 1995

DENNIS MILON, 1940 - 1995

Notes By: Michael Mattei

On October 9, 1995, Dennis Milon, former Comets Recorder of the A.L.P.O., passed away after a long illness. Dennis was Comets Recorder for twenty years, from 1964 to 1984. During this time he corresponded with observers all over the world to encourage them to make observations of comets, and to publish in our *Journal* the results and analysis of their observations.

Dennis was from Houston, Texas, and was a lover of the West and western art. He attended the University of Arizona from 1963 to 1967. In the spring of 1967, Dennis started work at *Sky and Telescope* magazine. He was editor of the amateur section of the magazine, and later moved to the photography section where he printed all of the color photographs for the magazine. He worked there from 1967 to 1991. Subsequently, Dennis worked at the American Association of Variable Star Observers as a technical assistant for a short time before his illness.

Dennis was known best for his photography. He was perhaps the best amateur photographer of the Moon and planets, using a small telescope. His photograph of the Moon that appears on the front cover of our *Journal*, Volume 18, numbers 5-6, taken with a 4-inch refractor, is one example of his work. Dennis had a complete set of photographs of the great dust storm on Mars in 1971. Also, he was the first person to report the storm to professional

astronomers, who were unaware that a storm was raging on Mars.

One look at his lunar and planetary photographs shows all the detail of professional observatory quality work. In his famous 1966 photograph taken during the great Leonid meteor shower, he captured on film meteors, streaking from the sickle of Leo. In the middle of this shot are two meteors coming straight on; they appear as dots among the star trails. This is truly a unique meteor photograph.

In 1975, while on a trip to Yellowstone Park, Dennis became co-discover of Comet 1975h, Kobayashi-Berger-Milon. A photograph of Dennis and Doug Berger appear on the front cover of this *Journal*, Volume 25, numbers 9-10, and in its pages are photographs of their comet.

Dennis leaves behind his wife Betty, his son Scott, and many memories.

HAROLD J. STELZER, 1909-1994

Notes By: Gordon Garcia

Harold J. Stelzer of River Forest, Illinois. Harold passed away on October 7, 1994 after a long illness.

A long-time member of the Chicago Astronomical Society, he became an active observer after his retirement from Sears, Roebuck and Company in 1969. From his backyard site he became a keen observer of the Solar System. He was a sustaining member of the Association of Lunar and Planetary Observers.

Harold began making variable star observations with a photoelectric photometer about 1979 and submitted observations to the IAPPP for many years. He is included as a contributor in many scientific papers on variable stars and was considered a national expert on photoelectric photometry.

He also contributed for many years to the Solar Division of the American Association of Variable Star Observers (AAVSO). Every clear day, Harold would make a whole-disc drawing and sunspot count. He also provided data to several international solar observers.

Harold developed a unique method for observing the Sun directly. His method, using binocular vision and a solar grid assembly attached to the telescope, is featured in the Astronomical League publication, *Observe and Understand the Sun.*

I first met Harold in 1982. I read his article in *Observe and Understand the Sun* and decided to pursue his method of direct solar observation. I called him and he immediately invited me to his home to see how he observed. I found that, instead of listening to him explain how he observed, I was going to explain to him how I would make my first drawing! Harold handed me an observing form and pencil and told me to sit at his telescope and complete a solar drawing. Although it took some time, I did complete my first drawing and was hooked. I continued my association with Harold and enjoyed many a discussion with him on solar observing. Harold was more than my friend, he was my mentor. He was a very serious observer, but would find time to share his knowledge with anyone that had an interest. He will be missed by all who knew him.

COMET CORNER

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

(This issue's column is a summary of several recent communications from Mr. Machholz.) Comet activity picked up in Summer, 1995, with several discoveries, two of which are described here.

COMET SUMMARY

Comet 1995 O1 (Hale-Bopp).—Alan Hale of Cloudcroft, New Mexico, and Thomas Bopp of Glendale, Arizona, discovered this comet while observing M70 on 1995 JUL 23. Hale is a well-known comet observer who has done some comet hunting but was not doing so when he found this one. At the same hour, Bopp was observing M70 through the 17-in telescope of his friend, Jim Stevens, when he noticed the comet nearby. He promptly drove 90 miles home to report it. Bopp doesn't own anything bigger than a spotting telescope, but has been involved in astronomy for 25 years.

Two days later, Gerry Rattley of Gilbert, Arizona, independently discovered this comet.

Comet Hale-Bopp appears to be a very large comet and may become very bright in Spring, 1997. Note, however, that brightness predictions for comets with no previous observational history are very uncertain. Although it will not reach perihelion until 1997 MAR 31, it should reach naked-eye visibility as early as Summer, 1996. Its ephemeris is given in *Table 1*, to the right.

Comet 1995 Y1 (Hyakutake).—Yuji Hyakutake of Japan discovered this object with 25X150 binoculars on 1995 DEC 25, when it was at magnitude +10.5. It will be in our sky through May, 1996, and its ephemeris for February and early March is given in *Table 2*, to the right.

EPHEMERIDES

Notes: In the "Elongation from Sun" column, **E** refers to visibility in the evening sky, and **M** to morning visibility. "Total Mag." values are forecasts of visual total magnitudes and are subject to considerable uncertainty. Orbital elements follow our ephemerides (*Table 3*, below) for those who wish to compute their own ephemerides.

Table 1. Ephemeris of Comet Hale-Bopp = 1995 O1.

1996 UT Date (0h UT)		2000.0 Coörd. R.A. h	m	Decl. °	Elongation from Sun °	Total Mag.
				(5-day interval)		
FEB	02	19	14	-23.4	026 M	+9.3
	07	19	17	-23.1	030 M	+9.3
	12	19	20	-22.8	034 M	+9.2
	17	19	23	-22.5	039 M	+9.1
	22	19	26	-22.2	043 M	+9.0
	27	19	29	-21.9	048 M	+9.0
MAR	03	19	31	-21.6	052 M	+8.9
	08	19	34	-21.3	056 M	+8.8
	13	19	36	-20.9	061 M	+8.7
	18	19	38	-20.6	065 M	+8.6
	23	19	40	-20.3	070 M	+8.5
	28	19	42	-19.9	074 M	+8.4
				(20-day interval)		
APR	12	19	45	-18.8	088 M	+8.1
MAY	02	19	44	-17.3	107 M	+7.7
MAY	22	19	36	-15.6	128 M	+7.2
JUN	11	19	19	-13.8	150 M	+6.7
JUL	01	18	55	-11.9	168 M	+6.3
JUL	21	18	26	-9.9	154 E	+5.9
AUG	10	18	00	-8.1	130 E	+5.6
AUG	30	17	41	-6.6	107 E	+5.4
SEP	19	17	31	-5.5	086 E	+5.1
OCT	09	17	31	-4.6	068 E	+4.8

Table 2. Ephemeris of Comet Hyakutake = 1995 Y1.

1996 UT Date (0h UT)		2000.0 Coörd. R.A. h	m	Decl. °	Elongation from Sun °	Total Mag.
FEB	02	17	10	-9.0	057 M	+8.5
	07	17	36	-5.4	057 M	+8.4
	12	18	02	-1.7	056 M	+8.3
	17	18	27	+2.2	055 M	+8.2
	22	18	52	+6.0	055 M	+8.2
	27	19	17	+9.7	054 M	+8.3
MAR	03	19	41	+13.2	053 M	+8.4
	08	20	04	+16.3	052 M	+8.5
	13	20	26	+19.1	052 M	+8.6

Table 3. Orbital Elements of Current Comets.

Comet Designation	Perihelion Passage (T)	Perihelion Dist. (q; AU)	Perihelion Argument (ϖ)	Longitude of Asc. Node (Ω)	Inclination (i)	Eccentricity (e)
1995 O1/Hale-Bopp*	1997 MAR 31.91	0.917555	130°.375	282°.472	088°.892	0.99693
1995 Y1/Hyakutake†	1996 FEB 24.34	1.0536	046°.440	195°.749	054°.495	1.00000

* Epoch 2000. Period 3000-5000y. [*MPC 25513*]

† Epoch 2000. [*MPC 26374*]

ASSOCIATION AFFAIRS

Staff Changes.—As a result of the A.L.P.O. Board Meeting in July, 1995 (see pp. 184-185) and more recent events, there are several staff changes to report:

Directorship: Following the "Rules of Succession" adopted in 1994, **Harry D. Jamieson** is now our Executive Director. Phillip W. Budine was appointed Executive Director at our 1995 annual meeting, but has recently resigned for personal reasons. This has resulted in two further changes; **Jose Olivarez** has become Associate Director and **John Westfall** has become Treasurer (California articles of incorporation forbid the same person serving as Executive Director and Treasurer). All three persons continue their other duties; Harry Jamieson continues as Membership Secretary and Lunar Recorder; Jose Olivarez as Jupiter Recorder and Book Review Editor; and John Westfall as Editor, Assistant Jupiter Recorder and Mercury/Venus Transit Recorder. Phillip Budine will continue as an A.L.P.O. Board Member.

Board Membership: Julius L. Benton, Jr. has been appointed to the A.L.P.O. Board of Directors. Dr. Benton has served as Recorder of the Saturn Section since 1971, the Venus Section since 1972 and of the Lunar Selected Areas Program since 1983; note his Venus Report on pages 159-169 of this issue.

Mars Section: Jeffrey D. Beish has resigned as Mars Recorder. His duties will be performed by the remaining Mars Section Recorders, Donald C. Parker, Daniel M. Troiani, and Carlos E. Hernandez. Jeff Beish has observed Mars and analyzed Martian meteorology for many years. He was Assistant Mars Recorder in 1981-1986, and a Mars Recorder from 1986-1995; we are glad to report that he will continue informally to work with the Section recorders.

Jupiter Section: For personal reasons, Phillip W. Budine has also resigned as Jupiter Recorder. The Jupiter Section will be administered by existing Recorders Jose Olivarez, Carlos Hernandez, and John Westfall. Phil Budine was an Assistant Jupiter Recorder from 1967-1971 and 1972-1973 and a Jupiter Recorder from 1973 until now. Note his article on the rotation periods of the Shoemaker-Levy 9 impact spots on Jupiter on pages 145-148 of this issue.

We note also that **Dr. Carlos E. Hernandez** has been appointed as a regular Assistant Jupiter Recorder, having served previously in an acting capacity.

A.L.P.O. Convention for 1996.—The A.L.P.O. will hold its 46th Convention on July 24-27, 1996, meeting with the Astronomical League in Rockford, Illinois. The League is preparing an information mailing to go to A.L.P.O. members. Meanwhile, mark your calendar and also consider giving a paper; if so, supply Director Jamieson with an abstract by May 15, 1996. You might also wish to bring a display. We will give more information on our meeting in the next issue.

A.L.P.O. Paper Session.—An A.L.P.O. paper session is being organized, to be held in Tucson, Arizona, on the weekend before the week-long Division of Planetary Science meeting to be held there in October, 1996. We hope to inform DPS registrants, largely professional planetary astronomers, of our prior paper session so that they will have an opportunity to attend. Naturally, to give a paper session, we need to have papers, so consider spending a weekend in Tucson and presenting the results of your solar-system studies.

A.L.P.O. Monographs.—Our organization has begun a monograph series, with the first three A.L.P.O. monographs now available. See page 169 for further details.

Through the Telescope.—The A.L.P.O. Newsletter continues, and is now being edited by Elizabeth Westfall (her address is: Through the Telescope, P.O. Box 16131, San Francisco, CA 94116). The newsletter needs short articles by members, including "autobiographies" telling about their astronomical interests. This publication is supported solely by donations and we will be very grateful to those who contribute. We wish here to express considerable gratitude to James Phillips, responsible for A $1000 contribution, the majority of which will support the next several issues of this magazine.

A.L.P.O. World-Wide Web Page.—Our Assistant Solar Recorder, Richard E. Hill, has generously devoted his time to establishing and maintaining an A.L.P.O. home page on the World-Wide Web; its WWW address is http://www.lpl.arizona.edu./alpo/ . We also thank the University of Arizona, Lunar and Planetary Institute for proving a host computer for this page. All staff who have Section news to put on our page should send it to the A.L.P.O. Editor, John Westfall, who will edit contributions and forward them to Rik Hill.

Eclipse Web Page.—The A.L.P.O. Lunar Eclipse/Solar Eclipse Recorder, Francis Graham, now has a WWW site which includes eclipse and other observations. Its address is http://nimitz.mcs.kent.edu/~banderso/graham.html. Recorder Graham can also be reached directly at fgraham@ksuvxl.kenteliv.kent.edu.

A.L.P.O. Solar System Ephemeris, 1996.—The A.L.P.O. *Solar System Ephemeris*, an annual publication begun in 1986, is now produced by the A.L.P.O. Computing Section. To obtain a copy of the 1996 edition, write to its distribution: Mark A. Davis, 7304 Doar Rd. Awendaw, SC 29429. The price is $8.00 for orders from North America (including first-class postage) or $10.00 for overseas air mail.

BEYOND THE A.L.P.O.

Riverside Telescope Makers Conference.—A Memorial Day weekend tradition, the 28th Annual Riverside Telescope Makers Conference will be held on May 24-27, 1996. The guest speakers will be Ashley McDermott, RTMC organizer; Leif Robinson, Sky & Telescope editor; and Robert Burnham, Astronomy Magazine editor. Other events include a swap meet, commercial exhibitors, a beginner's program, paper sessions, a CCD showcase, and of course the star party.

The conference site will be the Y.M.C.A. Camp Oakes, eight miles east of Big Bear City in the San Bernardino Mountains in southern California. Per-person costs prior to May 1st range from $10.00 daily use fee to $68.00 for eight meals and dorms/camping, with several options in between. Prices go up substantially after May 1st. For further information and registration materials call and leave a message at 909-948-2205.

Latin American Comets Workshop.—The "I Workshop Latinoamericano de Cometas," sponsored by the Asociacion Argentina Amigos de la Astronomiá and the Liga Ibero-Americana de Astronomiá, will be held in Buenos Aires, Argentina, on June 7-9, 1996. For more information, contact: I Workshop Latinoamericano de Cometas, Asociacion Argentina Amigos de la Astronomiá, Av. Patricias Argentinas 550, 1405 - Capital Federal, Argentina (E-mail: cometwor@aaaa.org.ar).

International Union of Amateur Astronomers.—The IUAA has announced its Ninth General Assembly, to be held at the Seminary St. Beat, Lucerne, Switzerland, on June 18-21, 1996. The "Congress on Amateur Astronomy Today" is sponsored by the IUAA, its European Section, the Société Astronomique de Suisse, and the Astronomische Gesellschaft Luzern. Topics will include the Sun, Air and Light Pollution, Modern Instrumentation for the Amateur, International Collaboration, and History of Astronomy-tour to the former Swiss Federal Observatory. Meetings will be 8 AM - 5 or 6 PM, with evenings free for sightseeing. For additional information, contact A. Tarnutzer, Hirtenhofstrasse 9, CH-6005, Luzern, Switzerland.

Twenty-Seventh Annual Lunar and Planetary Science Conference.—This is one of the two major annual Planetary Science conferences, to be held in Houston, Texas, on March 18-22, 1996. Information about this event can be had from: 27th LPSC, Publications and Program Services Department, Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston, TX 77058-1113 (telephone: 713-486-2166; FAX: 713-486-2160).

A.L.P.O. VOLUNTEER TUTORS

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

Julius L. Benton, Jr.
305 Surrey Road
Savannah, GA 31410
Instrumentation and Equipment Selection; Mercury; Venus

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

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

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

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

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

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

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

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

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

José Olivarez
1469 North Valleyview Ct.,
Wichita, KS 67212
Instrumentation and Equipment Selection; General Literature

Fred Pilcher
Illinois College,
Jacksonville, IL 62650
Minor Planets

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

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

Andrew M. Sorenson
RR 4, Box 4A
Jefferson, IA 50129-9701
Drawing Skills

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

Daniel M. Troiani
629 Verona Ct.
Schaumburg, IL 60193
Mars; Video/CCD Imaging

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

PUBLICATIONS OF THE ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

(All Section Publications on p. 192 must be ordered directly from the appropriate Recorders.)
(Checks must be in U.S. funds, payable to an American bank with bank routing number.)

◆◆

Order from: Mark A. Davis, 7304 Doar Rd. Awendaw, SC 29429 USA

The A.L.P.O. Solar System Ephemeris: 1996. $8.00 in the United States, Canada, and Mexico; $10.00 elsewhere (airmail included). Contains tables, graphs, and maps describing the positions and appearances of the Sun, Moon, each major planet, the brighter planetary satellites, Minor Planets, meteors, and comets. Make payment to "A.L.P.O."

◆◆

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

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

◆◆

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

① ***A.L.P.O. Section Directory—1995.*** *Free*; just send a stamped, self-addressed envelope. An 8-page description of each Observing Section's personnel, projects, and publications.

② ***A.L.P.O. Membership Directory.*** $5.00 in North America; $6.00 elsewhere. Continuously-updated list of members on MS-DOS diskette; specify 3.5-in or 5.25-in disk and whether DBASE or ASCII format. Make payment to "A.L.P.O." *Provided at the discretion of the Membership Secretary.*

◆◆

Order from: Walter H. Haas, 2225 Thomas Drive, Las Cruces, NM 88001, U.S.A:

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

1 (1947); 6. *7* (1953); 2, 3, 4, 5, 7, and 8. *8* (1954); 3-4, 5-6, and 7-8. *9* (1955); 1-2.
10 (1956); 5-6, 9-10, and 11-12. *11* (1957); 11-12. *21* (1968-69); 3-4 and 7-8.
23 (1971-72); 3-4, 7-8, 9-10, and 11-12. *25* (1974-76); 1-2, 3-4, and 11-12.
26 (1976-77); 3-4, 5-6, and 11-12 [each $1.75]. *27* (1977-79); 3-4, and 7-8 [each $1.75].
31 (1985-86); 5-6 and 9-10 [each $2.50]. *32* (1987-88); 5-6 [each $2.50].
33 (1989); 4-6, 7-9, and 10-12 [each $2.50]. *34* (1990); 2 and 4 [each $2.50].
35 (1991); 3 [$2.50]. *37* (1993); 1, 2, 3, and 4 [each $2.50].
38 (1994-); 1, 2 and 3 [each $2.50]. ***Current Issue*** [*38*, 4]—$3.00.

KEEPING YOUR MEMBERSHIP CURRENT—

A.L.P.O. memberships include a subscription to the *Strolling Astronomer (J.A.L.P.O.)*; the top line of your mailing label gives the volume and issue number for which your membership will expire (e.g., "38.4" means Vol. 38, No.4). We include a *First Renewal Notice* in that issue, and a *Final Notice* in the next one.

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

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

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

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

PUBLICATIONS OF THE SECTIONS OF THE A.L.P.O.

Order the following directly from the appropriate Section and person; use the address on the inside back cover unless another address is given below.

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

Mars (Troiani): (1) *Martian Chronicle*; send 8-10 SASE's; published approximately monthly during each apparition. **(2)** *Observing Forms*; send SASE to obtain one form which you can copy; otherwise send $3.60 to obtain 25 copies (make checks out to "J.D. Beish").

Mars (Astronomical League Sales, 1901 South 10th St., Burlington, IA 52601): *ALPO's Mars Observer Handbook*, $9.00.

Jupiter (Olivarez): *Jupiter Observing Forms.* $4.00 postpaid ($7.00 overseas) for 25 forms; make checks payable to "Jose Olivarez." These forms are for disk drawings, descriptive reports, and central meridian transits.

Jupiter (Westfall): *Timing the Eclipses of Jupiter's Galilean Satellites*; send a SASE with 55 cents in stamps. This is the project "Observing Kit" and includes a report form. Indicate if you are interested in photoelectric observations, including the "Io Patrol." (Predictions for Galilean Satellite eclipses are given in the *A.L.P.O. Solar System Ephemeris* for each year.)

Saturn (Benton): (1) *The ALPO Saturn Observing Kit*, $17.50. Includes introductory description of ALPO Saturn observing programs for beginners, a full set of observing forms, and a copy of *The Saturn Handbook.* **(2)** *Observing Forms Packet*, $8.50. Includes observing forms to replace the quantity provided in the Observing Kit above. Specify the Saturn Forms. *(See note for Venus.)*

Solar (Maxson): (1) *Solar Rotation Reports*; send SASE's to receive this monthly newsletter. **(2)** *ALPO Solar Section Catalog of Data Vol. II*, $5.00. A list of over 6000 solar observations, observer profiles and Section history in the Solar Section available to aid in professional or amateur research. The first printing was in March, 1991; a second printing is based on demand.

Solar (Hill): *Handbook for the White Light Observation of Solar Phenomena*, $6.00. (A second volume of this Handbook is in preparation, with articles by the observers detailing their techniques and equipment.)

Solar (Graham): *Solar and Lunar Eclipse Observations 1943-1993*; $25.00 postpaid. (A *Handbook for Solar Eclipses* is under preparation.)

Lunar (Benton): (1) *The ALPO Lunar Section's Selected Areas Program (SAP)*, $12.50. Includes a full set of observing forms for the assigned or chosen lunar area or feature, together with a copy of the *Lunar Selected Areas Program Manual.* **(2)** *Observing Forms Packet*, $8.50. Includes observing forms to replace the quantity provided in the Observing Kit above. Specify the *Lunar* Forms. *(See note for Venus.)*

Lunar (Graham): (1) Forms with explanations (in English or German); send a SASE. **(2)** *Lunar Photometry Handbook*, $5.00 Ppd. paperbound, $15.00 Ppd. hardbound. **(3)** Orders are now being accepted for a *Lunar Eclipse Handbook*, $3.00 paperbound plus $1.00 shipping and handling. **(4)** *Solar and Lunar Eclipse Observations 1943-1993*; $25.00 postpaid.

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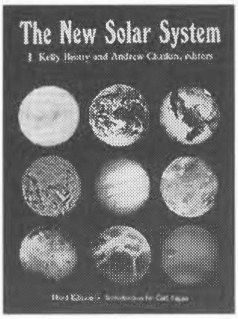

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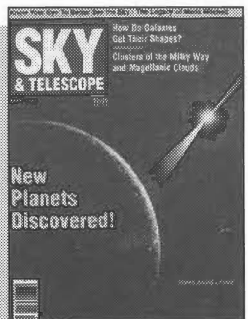

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