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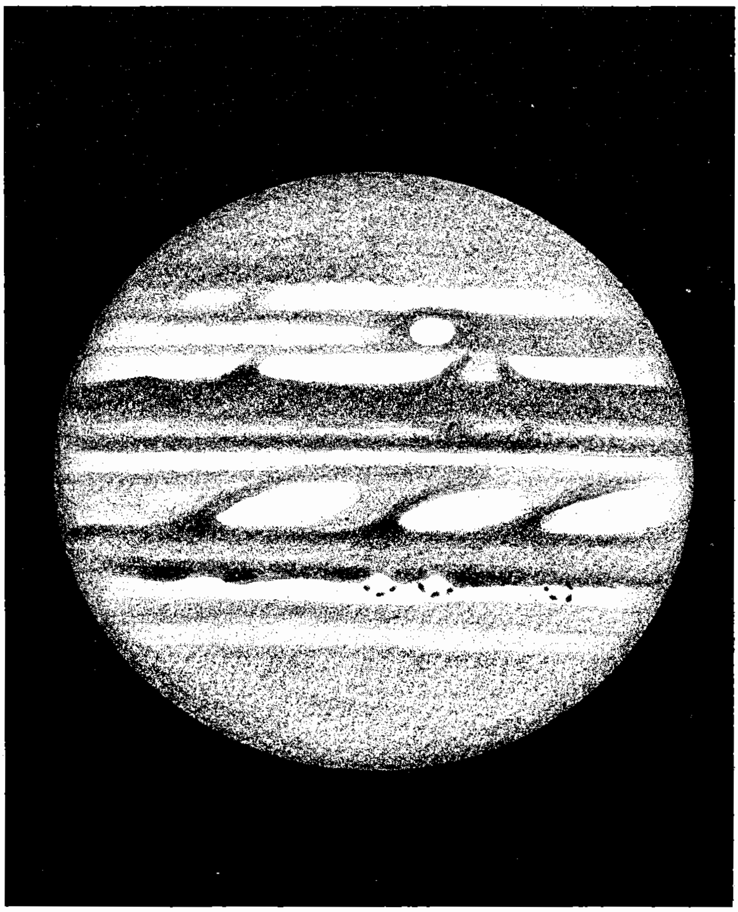

Full disc drawing of Jupiter. Note the shading technique, limb darkening, various intensity of features, and features of the disc. For the student of Jupiter; long-enduring oval BC is in the STB, the STrZ Disturbance is in the STrZ following BC, and note the beautiful festoons and bright ovals on the south edge of the NEB. Drawing by Mark S. Daniels on July 13, 1983 at 4:10 U.T. with a 20-cm reflector at 191X. Seeing very good. Transparency fair. CM1- 168°, CMII-329°.

Every observation (to be of value) must have the following data: Date (U.T.), Time (U.T.), Observer's name, Telescope(s) used (aperture and type), Power(s) used, Seeing on a scale of 0-worst to 10-best, Transparency on a scale of 0-worst to 5-best, and the central meridians for System I and System II for the time of the observation.

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IN THIS ISSUE

MODEST SUGGESTIONS FOR GALILEAN SATELLITE ECLIPSE PHOTOELECTRIC PHOTOMETRY

By: John E. Westfall, A.L.P.O. Assistant Jupiter Recorder, Eclipse Timings

General

Now that photoelectric photometers are becoming fairly widespread, it appears practical to encourage their use for accurately-timed measures of the brightnesses of the Galilean satellites of Jupiter when they are entering or leaving eclipse. This newer method promises to be considerably more accurate than the already-useful visual eclipse timing program conducted by the A.L.P.O. and thus would allow us further to refine the positions and orbits of these bodies.

Our present visual project concentrates on timing the "last speck" (for eclipse disappearance) or "first speck" (reappearance). These particular events are rather poorly defined for photometry; and photoelectric observers would do better to make a series of closely-spaced measures during the course of a satellite's dimming or brightening, paying particular attention to the period when the satellite is half-eclipsed (i.e., 50 percent of its uneclipsed brightness). Because most eclipse disappearances/reappearances take only a few minutes, and because of the need for rapid measures, the usual stellar photometry method of alternating between the object measured and a comparison object (with frequent sky brightness measures as well) will probably not be practical. Instead, one should allow one's unit sufficient time to stabilize before the event occurs, and then calibrate the eclipse measures by a set of careful measures of the satellite when it is completely free of Jupiter's shadow. As a matter of fact, the absolute brightness of the satellite is not required, just the brightness during eclipse relative to the uneclipsed brightness.

The following table should help the observer to determine when a particular satellite is completely outside of Jupiter's shadow. It gives the duration of eclipse disappearance/reappearance in minutes for different near-future apparitions.

	Opposition Date						
Satellite	1985 Aug.4	1986 Sept.10	1987 Oct.18	1988 Nov.23	1989 Dec.27	1991 Jan.29	Maximum Range
I (Io)	4.2	4.3	4.4	4.4	4.3	4.2	4.2-4.5
II (Europa)	5.3	5.5	6.2	6.4	5.7	5.3	5.3-6.5
III (Ganymede)	11.0	11.8	15.8	17.7	13.1	11.1	11.0-18.3
IV (Callisto)	16.7	23.9	----	----	45.2	16.8	16.6-138.6

The above values take into account both the satellite's diameters and the penumbral width at the appropriate distance. The extreme maximum listed for Callisto is for a graze at the northern or southern edge of Jupiter's shadow.

Equipment

Because the Galilean satellites are relatively bright (about 5th magnitude) telescope aperture is not a major problem; and probably a 4-inch (10-cm.) instrument will suffice. It is desirable, however, to employ a photometer aperture that is small in terms of arc-seconds; probably about 25 arc-seconds is a maximum, and smaller is preferable. This implies fairly long focal lengths; short-focus instruments may be used with a Barlow Lens. In order to help minimize the problem of scattered light from Jupiter's bright and nearby disk, the telescope's optics should be of high quality and should be clean. Diffracted light is a problem as well so that unobstructed optics are desirable. Lacking such, catadioptric systems are better than those that employ spiders to hold the secondary. Because of the necessity of holding the satellite in the photometer aperture for an extended period, the mounting should be stable and the clock drive accurate. It will be helpful if the polar axis of the telescope is accurately oriented and if the mounting is rigid even in a brisk wind. However, it is not absolutely necessary that the readings be continuous over the duration of the event. Readings can even be briefly interrupted by resetting the telescope provided that each set of readings is accurately timed.

Most commercially-made or home-built photometers should be adequate; the main consideration is that the photometer aperture be small. The choice of filter depends largely on the response of one's PMT (Photomultiplier Tube), although there is a preference for V or R in order to reduce scattered light; but even "clear" readings are useful. One difficulty, when compared with variable star photometry, is the high time precision needed; 1-second accuracy is minimal, and 0.5 or even 0.2-second accuracy is preferable. The most common way to achieve this is by use of WWV shortwave time signals; the problem is tying them in with the photometer readings. There are at least three methods, in increasing order of sophistication: (i) If you read an ammeter dial, call off the readings into a tape recorder microphone with the WWV signals in the background. (ii) If you employ a stripchart recorder, input the WWV signals into the recorder so as to draw ticks for the 1-second "beeps." (iii) Using an analog-digital card, input the photometer output into a microcomputer that is equipped with a calendar/clock card, pairing each reading with a time.

General Procedure

1. It is unnecessary (and even undesirable, due to the time involved) to employ a "comparison star". Instead, the observer should carefully make a set of readings of the uneclipsed satellite so that the eclipse readings can later be converted to their ratios to the uneclipsed brightness. Because the duration of disappearance/ reappearance is usually only a few minutes, differential atmospheric extinction will usually be negligible. In cases where extinction is not negligible (chiefly low altitudes), the altitude of Jupiter should be computed (say, at 1-minute intervals), and the "normal" extinction coefficient for the site and the band should be applied.
2. During the satellite's disappearance/reappearance, the more readings are obtained, the better. Thus, readings should be made in rapid succession. With sufficient drive accuracy, and a suitable means of recording them (e.g., chart recorder or computer), readings can and should be made continuously. It is particularly important to obtain as many readings as possible near the time of "half brightness."
3. The chief problem of this form of photometry is the background light both scattered and diffracted from Jupiter. Typically, this light varies considerably within the field of view of the telescope. Some ways of reducing this effect have already been mentioned--good and clean optics, preferably unobstructed, and a small photometer aperture. Also, of course, background light will be less of a problem when the satellite is relatively far from Jupiter's disk (i.e., for Ganymede and Gallisto, and also near quadrature--photometry is not practical within a few weeks of opposition). Nonetheless, background light will always be present so that it should be measured and subtracted from the readings. There are several ways to do so; in descending order of accuracy one has:

(i) Measure the brightness of the satellite's location when it is completely eclipsed. This action requires an accurate drive. For an eclipse disappearance, simply hold the telescope on the point where the satellite was last seen. Reappearance is more difficult, requiring an accurate ephemeris telling one where the satellite will appear, and then demanding accurate positioning of the telescope on that point. If all this can be done, this first method will probably be the most accurate.

(ii) Measure the brightness of the point exactly corresponding to the satellite's position, but on the other side of Jupiter (i.e., same distance away but 180 degrees different in Position Angle).

(iii) Average the brightness of the following two points--1 aperture diameter above the satellite (i.e., perpendicular to the satellite-Jupiter line), and 1 diameter below it.

As with "conventional" photometry, one should make sure that there is no field star in the aperture when making sky background readings. In this application, there is also the possibility of another satellite's being there, in which case another of the above methods will have to be used, whatever one's preferences.

Reduction

In terms of results that are potentially useful, the bare minimum consists of a set of readings of the uneclipsed satellite, a set of sky background readings, and a set of eclipse readings (the last with times accurate to at least 1 second), along with the usual supporting data (e.g., instrument description, photometer aperture, band used, timing method, and atmospheric seeing and transparency notes). These "raw data" will be sufficient for someone else to continue the reduction process.

The next step in the reduction consists of plotting a light curve. In order to do so, readings must be corrected for sky brightness and converted to their ratios to uneclipsed brightness. Such light-curves are interesting in themselves. For example, asymmetries give information about albedo variations on the satellites' surfaces. Also, observers with large-aperture telescopes (say, 30 inches or more) might record the 14th-magnitude "tail" (first reported by Kuiper), attributed to refraction in Jupiter's upper atmosphere.

Finally, for comparing the satellite's actual position with that predicted by ephemerides, it is necessary to determine the time of "half-brightness" as accurately as possible. For this, it is not sufficient to identify and take the time of a single reading that happens to indicate half-brightness. Rather, a series of readings on either side of that time are needed. These readings, and their associated times, should then be fitted to a regression equation of this form, $T = A + BL$, where T is the time, L is the brightness compared to uneclipsed brightness, and A and B are the regression coefficients. The time of half-brightness is then estimated by solving the equation for T when $L = 0.500$. Naturally, the more points used the better, but the time span should be short enough that the T-L plot appears linear. Also, the uncertainty of the estimated time, T, should be calculated, expressed by the standard deviation of the estimate. Results should be given to at least 0.1-second precision.

A further step in reduction is possible and ultimately may be necessary, adjusting the half-brightness time for albedo variations on the satellites' disks. This step would require wavelength-specific albedo maps and, most likely, computer simulations of the albedo effects upon eclipse brightness curves.

Conclusion

The A.L.P.O. Jupiter Section's Galilean Satellite Timing Program welcomes carefully made photoelectric timings of eclipse events. Oddly enough, this is a rather neglected field; and we will undoubtedly profit from each other's experiences, revising and refining the techniques described briefly above. Given the workload of our Section Recorders, we would prefer fully-reduced results, which then must be accompanied by the original data so that results can be checked. However, we would rather receive raw data than none at all.

COMET NOTES: IV

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

Alice would have understood; comets get curiouser and curiouser. As of this writing, Comet Halley is lurching toward perihelion a full 2.5 magnitudes fainter than predicted. Cause for worry? Not at all; comets often turn on suddenly and catch up to what we think (or hope) their magnitudes will be. One of the last winter's best observed comets, Levy-Rudenko 1984t, performed admirably, brightening to about 7.8 in January. However, in February it got more and more diffuse and faded rapidly beyond the reach of most amateur telescopes.

The year 1985 opened with an interesting cornucopia of comets, among which were Tsuchinshan I (1984p), a normally faint periodic comet that was visible through small amateur instruments for the first time, Shoemaker (1984s), Arend-Rigaud (1984k), and Shaumasse (1984m). Then we had a lull, since by early April the only comet which was easily observable was an earlier Shoemaker (1984f), faint in the southern sky but with an easily visible tail.

Discovery Statistics

Early in 1985 Don Machholz, a successful hunter of comets, produced an interesting statistical study of the 33 comets that had been discovered by amateurs between the start of 1975 and the close of 1984. The work he produced provides some helpful statistics regarding amateur comet discoveries, eleven of which I cite here:

1. These 33 comets represent a significant minority of the 162 comets that were discovered or recovered during the period.

2. During the decade, an average of 3.3 comets was discovered each year by amateurs, out of an average of 16.2 new or returning comets. (Those of us who have seen lots of comets know what 0.2 of a comet looks like.)

3. Conducting a study of the brightnesses of the professional comet discoveries, Machholz determined that "amateur astronomers would have found perhaps

five more comets if the professional astronomers stopped discovering all comets." These include, among others, Comet West, which may have been picked up as a 10th magnitude glow at the end of 1975, Comet Hartley-IRAS (1983v), which was indeed discovered independently by Levy, and Comet Shoemaker (1984s), which could have been found through amateur instruments shortly after its discovery.

4. Comets do not get found at regular intervals. The shortest interval was essentially no time at all, 1975j and 1975k being found almost simultaneously; the longest involved two comet "droughts" lasting 18 months each.

5. A large proportion of evening finds occurred in the period from 3-7 days past Full Moon, with a second large proportion occurring just before New Moon. The morning discoveries were more evenly distributed from just before Last Quarter to three days before the next Full Moon, with a peak around First Quarter.

6. The "average" morning discovery took place 30.73 minutes before the beginning of astronomical twilight, while the "average" evening discovery occurred 75.47 minutes after its end.

7. The average comet found in the evening was stellar magnitude 10.2, compared to 8.5 for morning finds. Machholz suggests that, among other factors, the morning sky is less intensely covered by searchers, thus allowing comets to brighten more before discovery.

8. Although the heights above the horizon at which comets are found varied widely, the average for evening finds was 24.6 degrees, and for morning discoveries 28.3 degrees. Machholz makes the interesting point that most discoveries took place when the comet was above typical obstructions and horizon haze; thus a traditional requirement that searchers need absolutely perfect horizons may not always be true.

9. Fully 26 people, all male, discovered comets during the decade. William Bradfield led the list with 10 finds, Rolf Meier followed with 4, Shigehisa Fujikawa had 3, and 5 observers had two each.

10. Although the average hunting time per comet was 281.7 hours, the variation in times was enormous, from no time at all for the accidental finds of Berger and Milon, to less than an hour for Mori's second find, to 1700 hours for Machholz's comet.

11. Discoveries were made, for reflectors, once with a 4-inch, once with a 5.8, four times with 6's, once with a 6.2, three times with 8's, twice with 10's, five times with 16's, and once with a 19. With refractors, discoveries happened once with a 3.3-inch, once with a 5, and 11 times with 6's. Only one discovery took place with an 8-inch Schmidt-Cassegrain.

These are but some of the statistics contained in this remarkable book. In addition, Machholz has presented stories and circumstances for the discoveries of each of the comets. This work is available by sending a check for $8 to Don Machholz at 5234 Camden, San Jose, CA 95124; overseas readers should send $12 for air mail delivery.

OBSERVING METEORS: IV

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

Two Roles of the A.L.P.O. Meteors Section

When the A.L.P.O. section for observing meteors was founded two years ago, we perceived a useful role for amateur observations in this field. In the ensuing time, having evaluated the observations we have received, we now see a variety of potentially useful roles for our Section.

Radiant determination is still the most useful thing that amateur observers spaced over a wide area can do. Data concerning meteor radiants have been collected by amateurs for many years, and this work has provided a good base from which radiants for both established and possible new showers can be determined. Unlike the "good old days" of the International Geophysical Year, when funds were freely given to professional groups to sponsor visual programs, there is today very little funding for this purpose. A central advantage of an amateur network is that lack of funds has never concerned us (since we usually have none anyway) and that we are happy to observe practically anything. Meteors work well for us, given those requirements; they appear every month of the year, providing us with ample observing opportunities.

So radiant determination is one goal that we share with other meteor groups around the world, and particularly with the American Meteor Society. But our Section has another purpose, a special one, and that is to introduce new observers to the meteor field. Actually, seduction is a better, more appropriate word to describe the feeling you get when you sit down under a black country sky to observe meteors. You're expecting a performance, waiting for the sky to give you a show that you will never forget.

From what source can we get new observers? Practically anywhere, if the shower with which we start is important enough. A family camping at a mountain lake in August could easily make a pleasant Perseid night, and camp and school groups can organize to observe several good showers. Meteor observing is a superb way to get to know the sky; for the meteors themselves are your teacher, pointing out asterisms and constellations all across the sky.

Meteors and Children

As a meteor observer, you may some day be called upon to share your enthusiasm with someone younger. Here is some information, derived from a Levy publication called "The Universe for Children," that may help:

Why are meteors called shooting stars? I asked this question one sunny morning to a group of eight-year olds. They do indeed look like stars; their apparent brightnesses are even compared to those of the real stars. But try to explain to children how that can be so when a real star is 3 million times the size of the Earth, and a typical shooting star may be no larger than a tiny grain of sand. Even the large meteors. . .

"are like stones," one boy volunteered. "Why not call them 'falling pebbles?'"

And so I do. As I try to make young children understand the facts of science, the best lessons often come from the children themselves.

Meteor radiants are not complicated, and can be related to another effect of perspective, the apparent convergence of the two rails of a railroad track. Ask the children to imagine the parallel tracks of a railroad line; do they appear to converge in the far distance?

I have found that older children (ages 11-14) can be useful meteor watchers, even producing good scientific results. On one memorable night back in 1966, a group of 12 young observers captured 784 meteors in six hours of observation. And one year I decided to try it with children younger still--could 7-year-olds be effective meteor observers? After an interesting night of observing, I found the answer to be a qualified yes. With the young children, I had to consider both their attention span with regard to a lonely nighttime activity, and the effect of cold weather.

With younger children, the results were mixed. When the group was large, peer pressure tended to influence the numbers of meteors seen; when one child saw a meteor, others would suddenly see meteors all over the sky. But as the group thinned, results improved dramatically. During the final half hour, the four remaining children had evolved into interested and alert observers. During the watch, the children recorded 20 meteors.

The most interesting part of the experiment was not so much the accuracy of the children's observations, but their ability to learn to observe. In the space of an hour, four children who had never observed meteors in their lives, and had had but a fleeting experience with any kind of observing, learned how to observe and to enjoy the fascinating meteors.

Recent Observations

Last year's Orionids, coming from Comet Halley, were an opportunity to test the waters for our fledgling Section; the observers worked quite well, but the shower did not: the Orionids were rather weak. It will be important this year to watch both the Eta Aquarids and the Orionids to see whether increased activity takes place.

The most successful shower in recent months was the Quadrantids, a bit strange since the observing window for that shower was just a little over an hour in length, between moonset and dawn at the virtual moment of maximum. We have had reports of strong activity, in the order of 60 meteors per hour per observer, from sites spread across North America.

Meteor Showers Through Mid-1985

Southern Delta Aquarids. The rich and famous part of the shower, maximum being on July 29.

Alpha Capricornids. July 15 - August 10, with maximum on July 30.

Perseids. By far the most famous shower of all. The comet which gave rise to this shower was supposed to have been recovered a few years ago, but apparently it never came. Rates did climb for a few years, but last year they were down somewhat. What about this year?

Kappa Cygnids. August 18, but some are visible from August 9 to October 6.

Kappa Aquarids. Maximum on September 21, but some activity is possible a week before and a week after that date.

October Draconids. (Sometimes also called Giacobinids.) Reaches sharp maximum on October 9. This year the parent comet, Giacobini-Zinner, passes perihelion before the shower's date. Astronomers doubt that a huge storm like the one that many observers saw on October 9, 1946, will occur this time; but they are not completely certain that it won't. We recommend vigilant observations to be made that evening, just in case.

A.L.P.O.S.S. SOLAR OBSERVATIONS FOR ROTATIONS 1735-1738

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

During the period covered by this report solar activity was generally on the decline; but reporting by observers, and the number of observers reporting, increased so rapidly that there was an overall increase in the data received by the A.L.P.O. Solar Section (or A.L.P.O.S.S.). This decline in activity did not reach its nadir until rotation 1742 (Nov./Dec., 1983). However, this low was not so low as recent activity levels.

In this report all dates and times referred to will be U.T. (Universal Time) unless otherwise specified. Ordinate compass directions will be abbreviated (N, S, E, W) and assumed to be heliographic, not celestial. No attempts will be made to define other terms used, and readers are referred to THE HANDBOOK FOR THE WHITE LIGHT OBSERVATIONS OF SOLAR PHENOMENA, available from the Recorder for $4.00 (U.S.).

Observers contributing data during this reporting period are:

Observer	Telescope aperture, f-ratio	Type	Stop	Location
Dragesco, J.	127-mm. f/10	Sch.-Cas.	none	Benin, W. Africa
Hardie, B.	127-mm. f/15?	rfr.	?	England
Hill, R.	318-mm. f/6	Newt.	305-mm.	Arizona, U.S.A.
	200-mm. f/10	Sch.-Cas.	none	Arizona, U.S.A.
Maxson, P.	200-mm. f/10	Sch.-Cas.	152-mm.	Arizona, U.S.A.
Nicolini, J.	56-mm. f/15	rfr.	none	Brazil
Otero, J.	76-mm. f/15?	rfr.	none	Venezuela
Tatum, R.	178-mm. f/15	rfr.	89-mm.	Virginia, U.S.A.
Timerson, B.	318-mm. f/4	Newt.	114-mm.	New York, U.S.A.
Treutner, H.	152-mm. f/20	rfr.	?	West Germany
Young, S.	200-mm. f/10	Sch.-Cas.	none	California, U.S.A.

Rotation 1735

This rotation covers the period from 1983, 05 08.39 to 1983, 06 04.60. During this period the mean International Sunspot Number (R_I) was 97 (with a maximum of 132 on 5/13 and a minimum of 60 on 05/31), and the mean American Sunspot Number (R_A) was 95 (with a high of 134 on 05/14 and a low of 63 on 06/01.[1,2]

One of the highlights of this rotation came on to the disk late in rotation 1734. That rotation ended with the spectacular region SESC 4171. Only Hill submitted any data on this region for rotation 1734. Even on the limb on 05/07 this region appeared unusual. The largest umbral spot was surrounded by a penumbra which had many sprawling projections resembling the pseudopodia on an amoeba. There were projections to the S, NE, and N, and two to the NW. Two days later on 05/09, in rotation 1735, the main spot had rotated some 90°; and most of the penumbral projections had coalesced on the N side and had begun to take on a spiral form similar to the famous spiral spot of Feb., 1982 (rotation 1718).[9] There was one smaller spot to the SE that had penumbrae only on the N and S sides. Further out in the same direction there was a larger spot, and to the W there was another (though not so far away), both of which had penumbrae only on the side away from the main, or large, spot. Unfortunately, this region degenerated; and by 05/12 it was only 190 millionths of a solar disk compared to a previous high of 480 millionths on 05/08. Even so, on 05/11 Tatum managed to get some good photographs of an important 1B flare in this region at 14^h22^m and 14^h36^m, U.T.

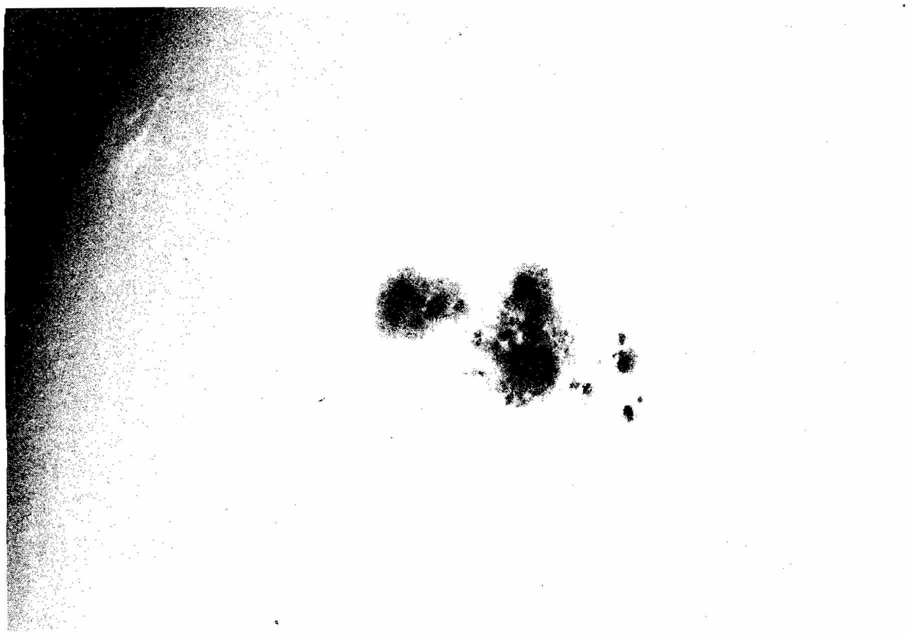

Figure 1. Photograph in white light of active region SESC 4173 during rotation 1735. Taken by Jean Dragesco on May 12, 1983 at 9^h22^m, U.T. with a 5-inch (127-mm.) f/10 Schmidt-Cassegrain telescope and Technical Pan Film 2415. See also text.

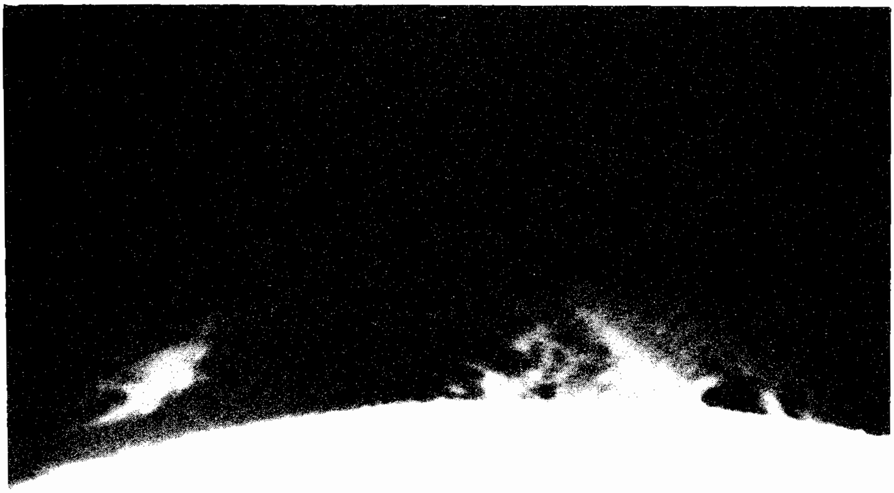

Figure 2. An H-Alpha prominence photograph taken by Randy Tatum on July 2, 1983 at 15^h14^m, U.T. 7-inch refractor stopped to 3.5 inches. Effective focal length 210 inches. Exposure 1/4 second. 2415 Tech Pan Film. Daystar 0.7 Å H-Alpha Filter. Quiet prominence on southwest limb of Sun.

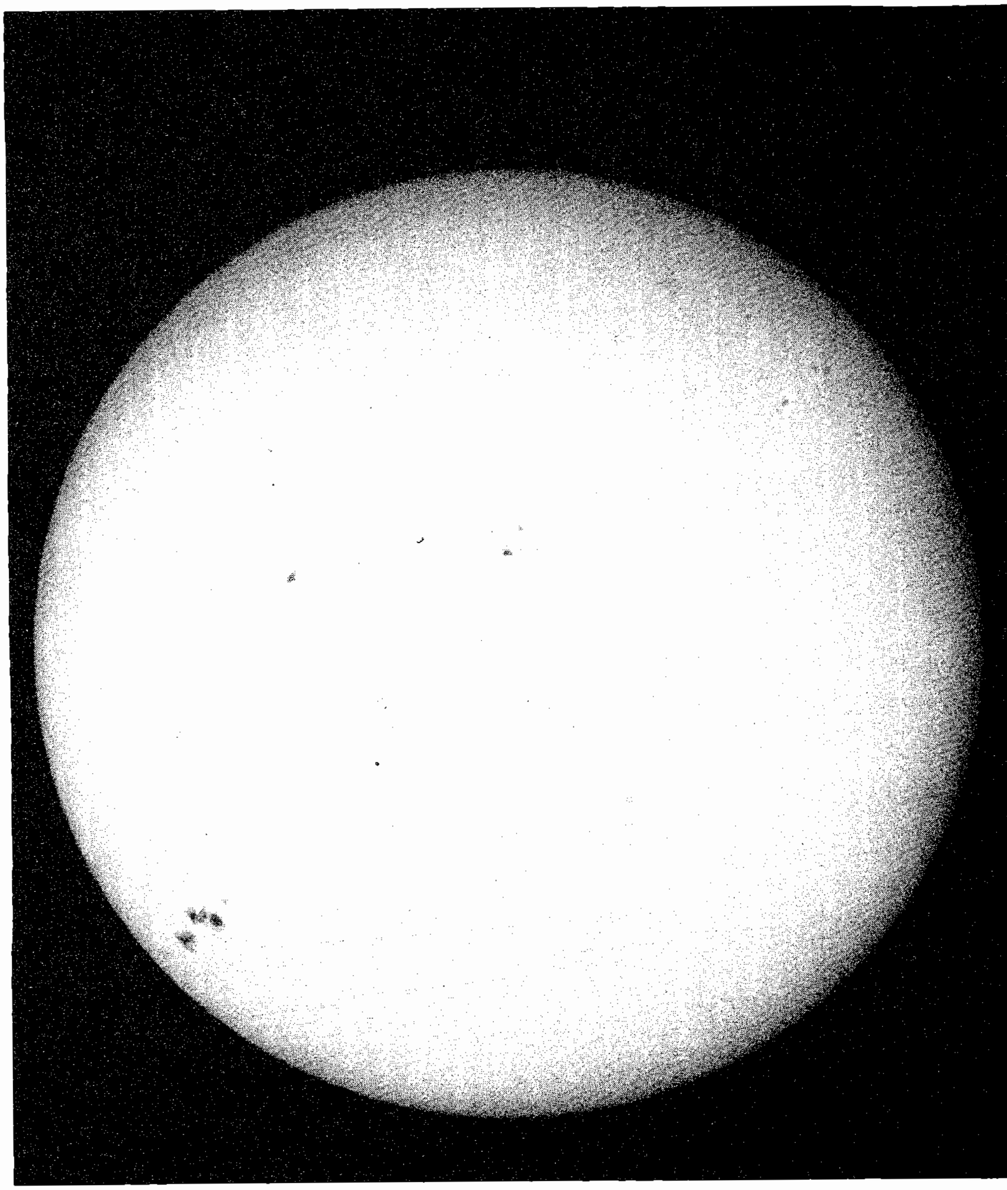

Figure 3. Whole disk white light photograph of the Sun taken by Brad Timerson on May 13, 1983 at $19^{h}47^{m}$, U.T. Note N to mark heliographic north. 12.5-inch f/4 Newtonian reflector used at aperture of 4.5 inches. 2415 film, exposure 1/125 second. Compare to Figure 4 on facing page.

The other highlight of this rotation was region SESC 4173 which had come into existence on 05/07. It reached a maximum extent of about 1500 millionths of the disk on 05/13, and left the disk on 05/15. Coverage by Section observers was sporadic with the most comprehensive work being that of Maxson. His results, plus photographs by Tatum, Timerson, and Dragesco, and drawings by Otero showed this region to be relatively inactive. One photograph by Dragesco showed remarkable detail and is representative of this region (Figure 1).

Rotation 1736

This rotation began on 1983, 06 04.60 and ended on 1983, 07 01.80. The mean R_I was 93 (with high of 143 on 06/23 and a low of 59 on 06/30), and the mean R_A was 98 (with a maximum of 145 on 06/23 and a minimum of 61 on 07/01).[2,3]

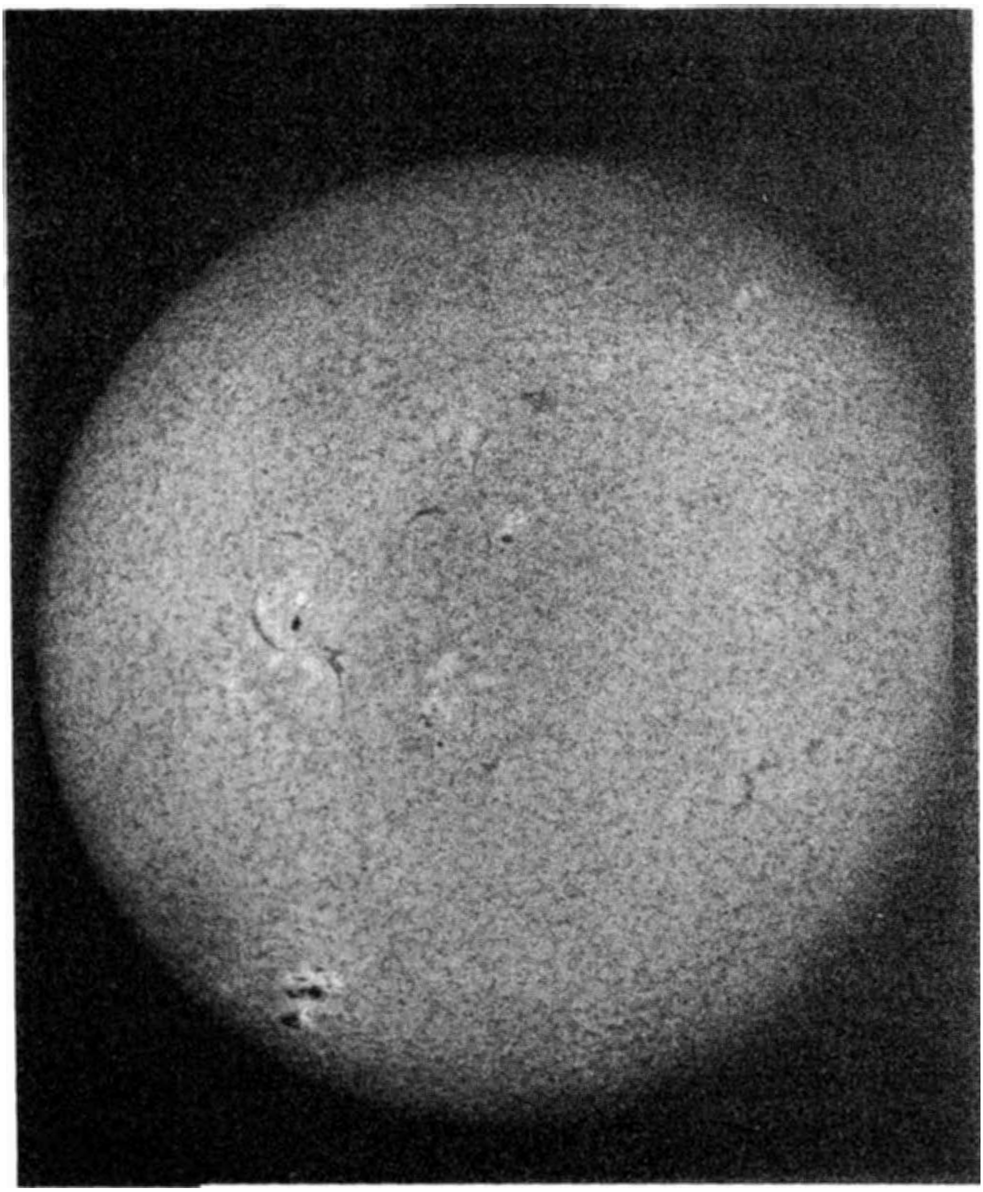

Figure 4. Whole disc H-Alpha photograph of the Sun taken by Randy Tatum on May 13, 1983 at 17^h7^m, U.T. 7-inch f/15 refractor at aperture of 3.5 inches. 2415 film, exposure 1/60 second. Compare to Figure 3, a white light photograph obtained 2 hours and 40 minutes later. Same filter as for Figure 2.

On 05/29 SESC 4201 came on to the disk. This feature was at the same heliographic latitude and longitude as SESC 4173 of the previous rotation and began rotation 1736 on the central meridian. From the beginning of this rotation, 4201 was decreasing in area as light bridges broke up the region. An excellent high resolution photogrpah by Dragesco on 06/05 (Figure 6) shows 4201 almost at its maximum area. A.L.P.O.S.S. coverage was not good enough to get a clear picture of the decay process and internal motions of the umbral spots.

SESC 4204 came on to the disk on 06/04 and was already well developed. Photographs by Timerson and Maxson covered nearly all of the disk transit of this

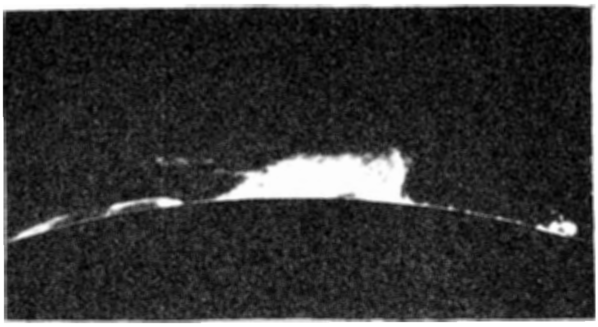

Figure 5. An H-Alpha photograph of a prominence. Taken by H. Treutner on July 3, 1983 at 13^h58^m, U.T. 152-mm. (6-inch) refractor. See also text.

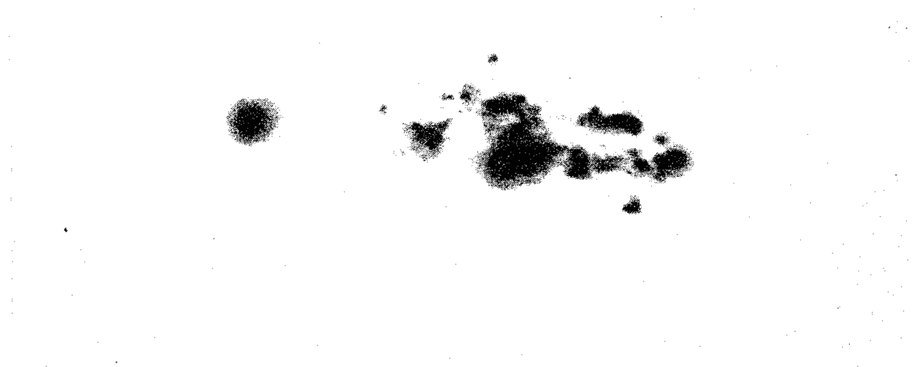

Figure 6. White light photograph of active region SESC 4201 during rotation 1736. Taken by Jean Dragesco on June 5, 1983 at 7^h53^m, U.T. Same telescope and film as for Figure 1. See also text.

region. This group reached a maximum extent on its second day on the disk. Our data show the region crossed by wide light bridges. These steadily increased in area, causing the decay of the region.

The rest of the rotation was characterized by rather quiescent regions of few spots.

Rotation 1737

This rotation covered the period 1983, 07 01.08 to 1983, 07 29.00. During this rotation the mean R_I was 82 (reaching the maximum of 114 on 07/22 and a minimum of 40 on 07/28), while the mean R_A was 83 (with a high of 119 on 07/21 and a low of 36 on 07/28).[3,4]

This rotation was an inactive one as is evidenced by the slim data file. There were many groups, but they tended to be smaller and short lived.

Early in the rotation a nice limb hedgerow prominence was observed and recorded by Tatum (on 07/02, Figure 2) and by Treutner (on 07/03, Figure 5). This prominence was not associated with a white light feature in this rotation but was near the position of SESC 4219 in rotation 1736 and SESC 4196 in rotation 1735. The prominence itself, as a filament when seen in projection, had been on the disk for the 3 previous rotations virtually unchanged.[1,2,3]

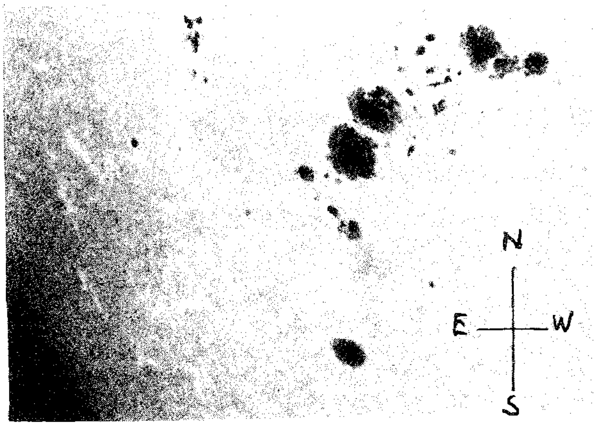

Figure 7. White light photograph by H. Treutner of West Germany of active regions SESC 4263, 4267, 4268, and 4271 during rotation 1738. Taken on July 31, 1983 at 13^h58^m, U.T. 152-mm. (6-inch) refractor. See also text on this page. The diagram of arrows at the lower right shows heliographic directions.

Rotation 1738

This rotation began on 1983, 07 29.00 and ended on 1983, 08 25.24. The mean R_I was 79 (with a high of 131 on 08/01 and a low of 40 on 08/20), while the mean R_A was 78 (with a maximum of 128 on 07/31 and a low of 39 on 08/23).[4,5,6]

During this rotation we received large amounts of drawings, thanks to the diligent efforts of Hardie, Nicolini, and Otero. The first noteworthy active region was actually a complex combination of three regions--SESC 4263, 4267, and 4268. See Figure 7. The largest of these was 4263 and was just on the disk at the beginning of the rotation. Region 4263 was at the same position as 4234 of the previous rotation and was well evolved this time. Photographs and drawings by A.L.P.O.S.S. observers showed this group to have reached a maximum area and complexity on its second day on the disk. Its decay was followed by our observers until 4263 left the disk. An H-Alpha photograph of this region, taken by Tatum, was shown in Journal A.L.P.O., Vol. 30, Nos. 5-6, Jan., 1984, pg. 102, Figure 6. On 08/08, as these regions were leaving the disk, the second largest group of regions, 4278, 4279, and 4280, was coming on to the disk, of which 4278 was the second largest region of the rotation. This whole complex of regions was involved in a large, continuous, facular network well shown in photographs by Timerson. In contrast, the faculae about 4263 and its companion regions were small isolated spots. As 4278-80 crossed the disk, the smaller spots and pores coalesced with the larger spots. On 08/14 the region 4279 (just south of 4278) produced 2 class 1B flares, which were well observed by Tatum. The regions continued to decrease in activity as they went off the disk.[7] Nevertheless, reports came in of large, bright faculae still around the entire complex of regions.

Those A.L.P.O. members who wish to find out more about the Solar Section should contact the Recorder at this address: Richard Hill, 4632 E. 14th Street, Tucson, Arizona 85711, U.S.A.

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Suggestions for Further Reading

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OBSERVER'S GUIDE TO THE PLANET JUPITER

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

Abstract

Visual observations of the planet Jupiter are discussed, including: information as to the visibility of the planet, equipment needed for valuable observations of the planet Jupiter, skills needed for participating in observing, and types of observations to be done, including: drawing the planet, central meridian transits and how to compute them, and other types of observations needed for scientific investigations. This article is primarily directed to the beginner.

Visibility of the Planet

The planet Jupiter (largest of all the planets) can be profitably observed for 10 months out of the year. During this period it will successively assume the positions in the sky of conjunction (aligned Earth-Sun-Jupiter), rising and setting with the Sun; western quadrature (90° west of the Sun), on the meridian at sunrise; opposition (180° from the Sun), rising at sunset-visible all night-setting at sunrise; and eastern quadrature (90° east of the Sun), on the meridian at sunset.

The very best time to view Jupiter is at or near opposition when the planet is visible all night, and its apparent diameter may be as large as 49.8 seconds of arc and its brightness -2.5 stellar magnitude. At any opposition the planet will attain an apparent size of from 43.6 to 49.8 seconds of arc, large enough for serious observations with a small telescope. In 1985 Jupiter will be at opposition on August 4 with an apparent diameter of 48.5 seconds and a brightness of stellar magnitude -2.3. However, its apparent diameter is always at least 30 seconds of arc, large enough to carry out serious observations with a small telescope (32".1 when in conjunction with the Sun in January, 1985).

Equipment for Observing Jupiter

A very small telescope (1.6-inch refractor) will record at 100X the dark belts and bright zones of clouds on Jupiter and at even 30X will show the oblateness of the planet, its yellowish disc, and the four largest satellites (the Galilean satellites). Increasing the aperture (diameter of the lens) to 2.4 inches in a refractor will enable the observer to see the Red Spot (when dark and prominent, or the bright Red Spot Hollow when at its brightest) at a power of only 60X. At a power of 40X Jupiter's apparent diameter is the same as that of the Moon when viewed by the naked eye (with no optical aid). Some detail in the cloud belts (mostly along the belt edges) in the form of dark or bright spots will be observed. Some work of value may be done with a 2.4-inch refractor, but the minimum for more serious work should be a 3-inch refractor or a 6-inch reflector.

A 4-6 inch refractor is a powerful tool for the exploration of Jupiter. It will usually record most details in the belts and zones (with a trained eye) that a 6 to 8 inch reflector will show. It will produce excellent high contrast images, with superb definition (sharpness of image), high resolution, high powers, and a steady image, and will produce a large image scale at its primary focal point because of its long focal length (F/15-F/20). However, the refractor is expensive and is not really portable in apertures over 4 inches.

Most amateurs will use a 6-12 inch reflector, and telescopes in this size range will give research capabilities on the planet Jupiter. Serious research may be done with a 6-8 inch reflector, and the 10-12 inch or larger sizes will permit advanced programs and excellent photographic studies of the planet.

Reflectors intended for primarily planetary studies should be customized or purchased with this type of research in mind. Their focal ratios should be at least F/6 (better if F/7) up to F/8, or even up to F/10-F/12 or higher. The longer focal lengths will produce a larger primary image at the primary focal point. Focal lengths of these types will result in some rather lengthy tubes in the conventional reflectors (Newtonians). If space is a problem and also for observing comfort, in most situations, you may want to obtain or to use a reflector in the

Schmidt-Cassegrain, Cassegrain, or Makustov designs, if of excellent quality. The important things to remember in reflectors for planetary research is that you should keep the diagonal mirror (flat) in Newtonians as small as possible for higher contract planetary images, should keep the tube currents and temperature inside the tube differences with the outside air temperature to a minimum, should make sure the alignment (collimation) of the mirrors is accurate, and should insure that the primary, flat or secondary, and the eyepiece(s) used are of the highest quality.

The last, but by no means least, important link in equipment for observing Jupiter is your eyes. This lens or lenses and the interpretive mind behind them are the really important final link. The observer should be as comfortable as possible, and the eye should be adequately rested and free from strain.

The Jovian observer should observe the planet as often as his or her schedule permits and the weather cooperates. Only by persistent observing and patience will the student of Jupiter become a first-rate experienced observer of the Giant Planet. The beginner at first will see the cloud belts of the planet, but will have difficulty seeing the structural details of the belts and zones. After days, weeks, and months of continued observing, the observer will see the dark spots, projections, festoons, garlands, streaks, bright ovals, and spots which are the detail of Jupiter. This process of educating the eye to detail is called training the eye. One finds a similar process in observing with a microscope. A few hints might be injected here: be comfortable; be sure your optics have reached the same temperature as the outside air (cooled down), which may take 15 minutes to up to 2 hours depending on the size and type of telescope, and whether it was brought from inside to out-of-doors; when observing the planet, concentrate your eye on small areas at a time. You may see the entire planet at once (but not in detail) but concentrate on smaller regions, possibly dividing the planet into quarters, and use averted vision (looking away from the area you are observing while concentrating your mind to that area). The sensitive portion of the retina will perceive more detail in this way, as variable star observers have long practiced.

Before closing this equipment section, I would like to add a few lines about "powers" employed for Jupiter. Experienced observers (including myself) have found that on Jupiter very high powers (over 300X) do not usually perform well. The nature of the planet (brightness and contrast of features and atmospheric conditions) usually permits best powers in the range 150X-250X regardless of aperture. I consistently have used 167X-214X on my 4-inch refractor for many years with the best results. Observers will telescopes up to 12 inches in aperture usually use 195X-250X; to be sure, at times when the seeing is very good, they may employ 350X-400X. The best rule is 30D-40D (30-40X the aperture of the telescope) for most observing (180X-240X on a 6-inch telescope). With excellent seeing you may go to 50D (300X on a 6-inch). The important factors are the diameter of the lens or mirror for light gathering power, the resolution (for seeing fine details), and the observing conditions (seeing and transparency). These all contribute to the visibility of detail on Jupiter, more so than just high power alone.

Drawing the Planet

No, I am not going to tell you in 10 easy lessons (or even 5) how to draw Jupiter. Some observers are gifted in this technique; and they perform with results which are accurate, valuable, and extremely beautiful renditions of the planet's appearance as seen in the telescope! One such observer who immediately comes to mind, and his drawings have been published in many of the astronomical magazines, including on the cover (several times) of our own A.L.P.O. Journal is Mark S. Daniels; and there are others. However, some basic guide-lines can help a serious student to become a fair draftsman of the Giant Planet and then to contribute useful drawings which are accurate and valuable:

1. Draw the planet in a period of time of about 10 minutes. If a longer time interval is used, the markings will have moved in longitude so much that features will be incorrectly placed upon the disc.
2. Don't make a sketch unless seeing is good and adequate detail is resolved.
3. Sketch the larger and more prominent features first, and then position the minor or smaller features relative to the larger ones.
4. Be careful when sketching the belts on the disc. Position them properly in latitude and relative to each other. For example: place the North Equatorial Belt properly in reference to the equator.
5. Draw the markings in their proper sizes relative to the disc and with other features. For example: don't draw the Red Spot or Red Spot Hollow too large relative to the whole disc or other markings.

6. Shadings and contrasts can be more adequately done with an artist's stump and pencils of varying hardness. Erase areas to represent bright spots with a pointed eraser.

7. Do the sketch at the telescope, and check your drawing before leaving the telescope.

8. Experiment with powers; use the best power for the best definition that the observing conditions will permit. Check focus on occasion.

9. Use averted vision for seeing fine detail in concentrated areas of activity.

10. If a feature is active, interacting with other features or is in a "Disturbance" appearance, make a strip sketch or sectional sketch of that region of the planet.

Central Meridian Transits

The most important work that the amateur can do on Jupiter is the recording of central meridian transits of markings visible during the period of observation. To do this is actually relatively simple. All the observer needs is his eyes, a notebook, pencil, telescope (at least a 2.4-inch refractor or 6-inch reflector), and a watch. Check the accuracy of the watch with time signals on your short wave radio, or some other accurate time source.

In order to record transit timings of Jovian features, the observer is first going to have to become familiar with the belts, zones, and other features of Jupiter. To do so, study Figure 8, which gives the standard nomenclature of the planet Jupiter as used by the A.L.P.O. Once the beginner has become familiar with this terminology, he or she may go to the telescope and employ this knowledge in recording central meridian transits.

To make the job easier for the Recorder to identify the markings you have observed and timed, we are going to identify each marking first as either dark or bright. If the marking is dark, we shall identify it with a letter (D) for dark. If the marking is bright, we shall use the letter (W) for white or bright.

Second, we shall use a letter (p) for the preceding end, (c) for the center, and (f) for the following end of a feature as it transits the central meridian. The central meridian is an imaginary line bisecting the planet into equal halves and running through the north and south poles of Jupiter.* As viewed in the Northern Hemisphere the image of Jupiter will be inverted in an astronomical telescope (without a star diagonal). The view in the conventional refractor or reflector will be: south at the top, north at the bottom, east to the left, and west to the right.** Therefore any marking (as well as Jupiter) will drift to the left, east, or preceding direction in your field of view in the telescope when the drive is turned off (if you have a drive). If you don't, the drift will be very evident.

The process for recording the central meridian transit is as follows:

1. Record the time in Universal Time (U.T.) when the object is on the meridian. To convert to U.T. add +5hr. to EST, +6hr. to CST, +7hr. to MST, +8hr. to PST, etc. Record time to the nearest minute.

2. Write in your notebook or on a form the letter D or W and p, c, or f for identifying the feature on the central meridian.

3. Write down the description of the marking (see the illustrations in Figures 10 and 11 identifying dark and bright markings).

4. Locate the marking on the planet. In which belt or zone is the feature found? Write it down.

5. Indicate in which system of longitude (System I or System II) the marking is located. Jupiter, because it is gaseous, requires two (and even more) systems of longitude since the equatorial regions rotate about 5 minutes faster than the remainder of the planet. The longitudes of the transits observed for either System I or II may be computed later at your desk. Remember System I <u>includes</u> <u>south edge</u> of the <u>north component</u> of the South Equatorial Belt (SEB_n), <u>all of the</u> <u>Equatorial Zone (EZ), which includes</u> the EZ_s and EZ_n, and the <u>south edge</u> of the North Equatorial Belt (NEB). System II for transit purposes <u>includes all</u> <u>the remainder</u> of the planet, with a few exceptions. The chief ones are that <u>the</u> <u>south edge of</u> the North Temperate Belt moves in System I, and even more swiftly, and that the South Equatorial Belt Zone, between the SEB components, has a period intermediate between System I and System II.

It is very valuable and is also of great help to the Recorder if observers include strip sketches of active areas in which transits were taken. This practice will serve as an illustrative guide of transit features and will help greatly in

*Strictly speaking, through the Earth-turned pole and the center of the whole, partially unilluminated disc.

**<u>East</u> and <u>west</u> are here defined so that Jupiter rotates from west to east.

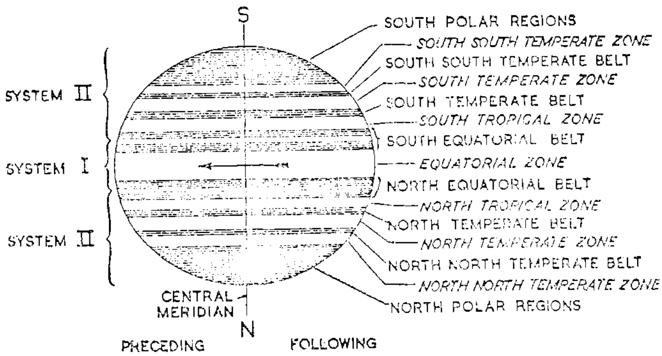


Figure 8. The standard nomenclature of the Giant Planet Jupiter. Typical simply inverting view is shown; note direction of rotation. When visible, the Great Red Spot appears in the S. Tropical Zone (STrZ).

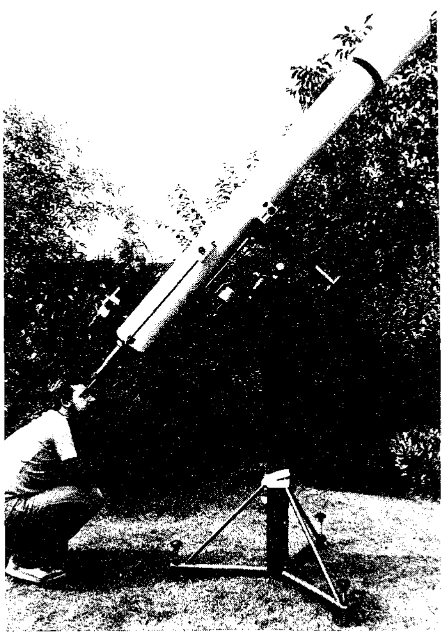


Figure 9. An ideal telescope for advanced serious Jupiter observations: a 150-mm. F/15 refractor. Employing this excellent instrument is A.L.P.O. Jupiter observer Leo Aerts in Belgium.

identifying the features observed.

The observer will benefit greatly in his understanding of the meteorology of Jupiter, and will also assist the task of the Recorder, if he or she will compute his or her own central meridian transits. The process is really quite simple:

1. Look up the longitude for System I or II (whichever applies) for 0^h Dynamical Time in the 1985 Astronomical Almanac for the date of your observation. To convert Dynamical Time longitudes to U.T. (Universal Time) longitudes, increase the values given by 1/2 degree. Other sources may also be used.

2. Write down this longitude on a sheet of paper. Note that the time of your transit will almost always be some other time (instead of 0^h U.T.). If it is 2^h19^m U.T. (for example), you will need to add on the number of degrees Jupiter has rotated since 0^h U.T., in this example in 2^h19^m, for whichever system applies. The following tables will help you in your computation:

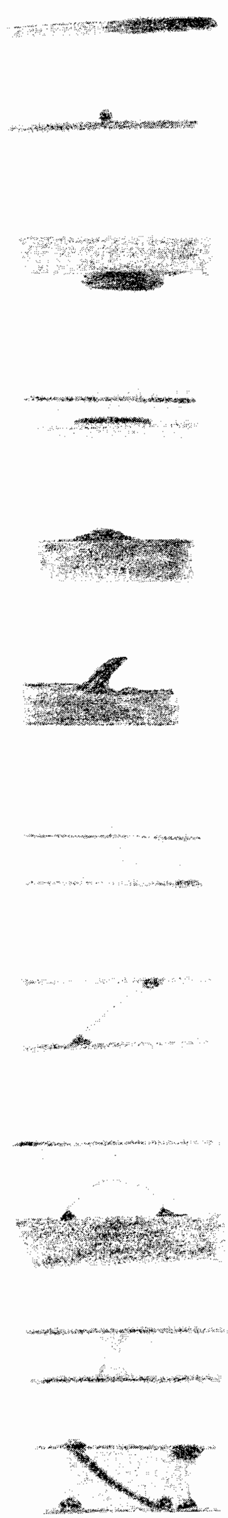
Table I for System I

1m	0°6	6m	3°7
2m	1.2	7m	4.3
3m	1.8	8m	4.9
4m	2.4	9m	5.5
5m	3.0	10m	6.1
	1h 36°58		

Table II for System II

1m	0°6	6m	3°6
2m	1.2	7m	4.2
3m	1.8	8m	4.8
4m	2.4	9m	5.4
5m	3.0	10m	6.0
	1h 36°26		

As an example of the computation, assume your transit was on August 15, 1984 (U.T. date) and the marking was on the south edge of the North Equatorial Belt, and was on the central meridian at 2:19 U.T. You would start with the value from the 1984 Astronomical Almanac for 0^h U.T. in System I, which is a corrected value of 346°1. Since your transit is at 2:19 U.T., you must add the corresponding values for 2:19 U.T. Looking at Table I for System I, we find 1^h is equal to 36°6, therefore 2^h would be 73°2, 10^m is 6°1, and 9^m is 5°5. Therefore: 346°1 (for 0^h U.T.) + 73°2 + 6°1 + 5°5 = 430°9. Subtract 360° when the sum exceeds 360°: 430°9 - 360°0 = 70°9. Your answer is 70°9 or 71° (rounded) in System I.



- DARKER SECTION OF BELT (SECT.)
- CONDENSATION (COND.)
- ELONG. COND.
- ROD
- PROJECTION (PROJ.)
  LOW
- TALL
- VEIL (OR SHADING)
- FESTOON (FEST.)
- LOOP FEST.
- COLUMN (COL.)
- DISTURBANCE (DIST.)

Figure 10. Recommended nomenclature for dark markings (D) at the visible surface of Jupiter. Prepared and contributed by Jupiter Recorder Phillip W. Budine.

The same procedure may be used for calculating values for System II, but use the appropriate tables for System II.

Suggested Visual Observations

1. Disc drawings of the entire planet Jupiter.
2. Strip sketches of the belts and zones and their markings.
3. Detailed sectional sketches of active areas, recording all fine details of those areas observed.
4. Central meridian transits of all visible markings.
5. Close scrutiny of any "disturbed areas," the long-enduring white ovals of the South Temperate Zone, and the Red Spot area.
6. Photographic coverage of Jupiter.

Other Suggested Visual Observations

1. Color Estimates. The Jovian Planet exhibits a rich amount of color with tones of red, brown, blue, yellow, white, and grey. For color estimates a reflecting telescope is a must because of its perfect achromatic qualities. Also, the colors are most predominant in apertures of 8-10 inches or larger. The power or magnification should always be the same for these estimates, the eyepiece used should be color-corrected (use orthoscopics or Ploessls) of high quality, and the planet should ideally be at least 40° above the horizon. In recording observations, it is best to use a set of abbreviations for the various colors displayed on the planet. A column for the feature or nomenclature and a column for the color estimate can be recorded; also, a sketch with the belts and zones depicted can be used, and then the estimates may be recorded directly on the sketch. Also, sketches in color are very valuable if executed accurately and realistically.

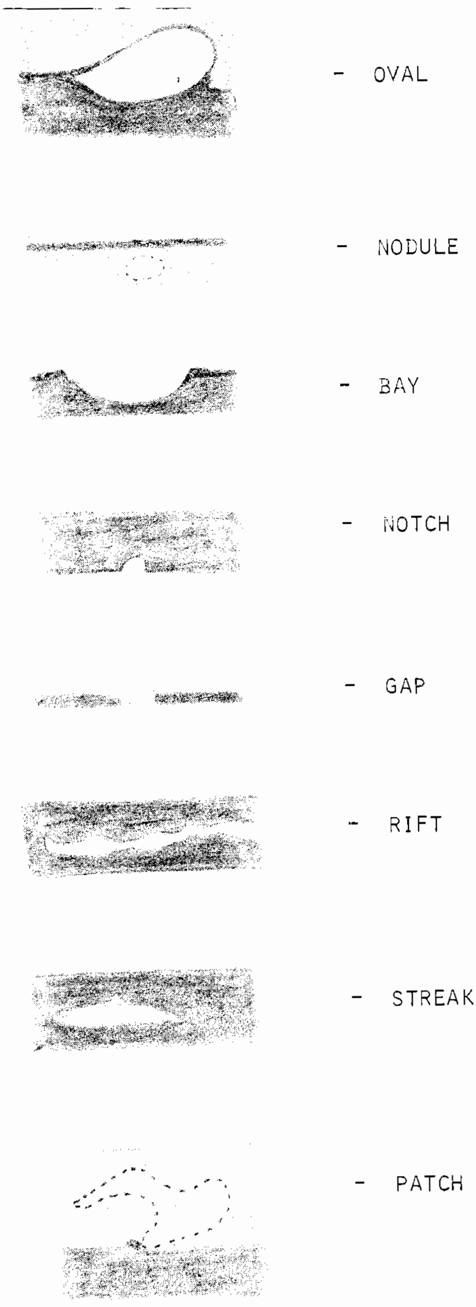
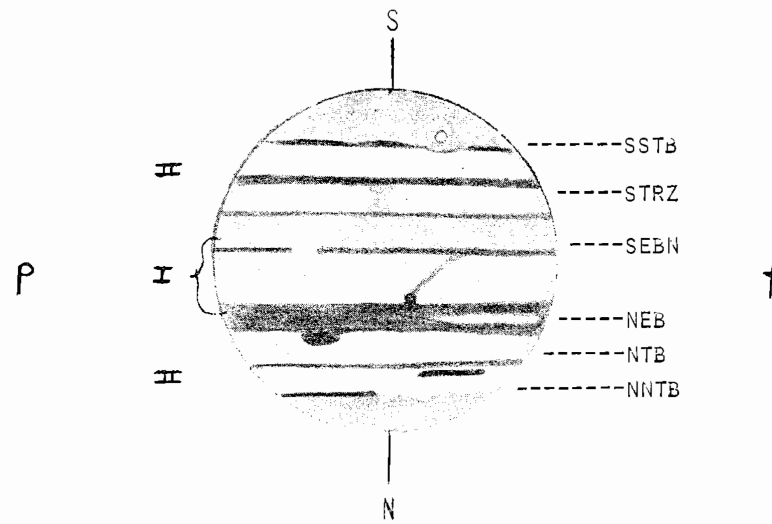


Figure 11. Recommended nomenclature for bright markings (W) at the visible surface of Jupiter. Prepared and contributed by Jupiter Recorder Phillip W. Budine.

Nomenclature for Colors

Nomenclature or Color	Abbreviation	Nomenclature or Color	Abbreviation	Nomenclature or Color	Abbreviation
Brown	Br	White	W	Pink	P
Red	R	Yellow	Y	Orange	O
Blue	Bl	Yellowish-White	Y-W	Ochre	Oc
Bluish-Grey	Bl-G	Reddish-Brown	R-Br	Salmon	S
Grey	G	Tan	T	Cream	C

If two colors (Bl-G) list the more prominent color first.



NO.	U.T.		OBJECT	LOCATION	CM I	CM II
1	3:19	WC	(GAP)	N-SEB_N	175°	-
2	3:41	DC	(ELONG. COND.)	N. EDGE NEB	-	89°
3	3:51	DC	(DUSKY COL.)	STRZ	-	95
4	4:00	DF	(SECT.)	NNTB	-	100
5	4:06	DC	(COND. & BASE FEST.)	S. EDGE NEB	205	-
6	4:26	DP	(ROD)	N. EDGE NTB	-	117
7	4:32	WP	(RIFT)	MIDDLE NEB	-	119
8	4:33	DC	(SF. BASE FEST.)	N-SEB_N	220	-
9	4:37	WC	(V. SM. NODULE)	S. EDGE SSTB	-	122
10	5:06	DF	(ROD)	N. EDGE NTB	-	140

Figure 12. Sample set of central meridian transit observations. Features 1-10 are located on the full disc drawing. The standard abbreviations and nomenclature are used. Both System I and System II for longitude are depicted. Prepared and contributed by Jupiter Recorder Phillip W. Budine.

2. Intensity Estimates. The observer estimates the intensity of the dark belts and bright zones, or selected individual features, by using a scale. The A.L.P.O. Scale is 0-10 where 0 is blackest and 10 is brightest. This scale is much more accurate than vague word descriptions and with some practice can become a very reliable method of recording intensities. It can be recorded in column form with the nomenclature in one column and the intensity number or value in another opposite column. Another method is to record the intensities on a separate sketch from the original, noting the value directly on the second sketch. These observations permit us a valuable record of changes of intensity on the Giant Planet over a period of years, and they also can form a guide for determining any correlations with solar activity.

3. Brightness and Conspicuousness Estimates. To accomplish this observation, the observer simply takes the eyepiece out of focus. Then start focusing the eyepiece slowly, and note the first belt or zone you see. Note this one as No. 1,

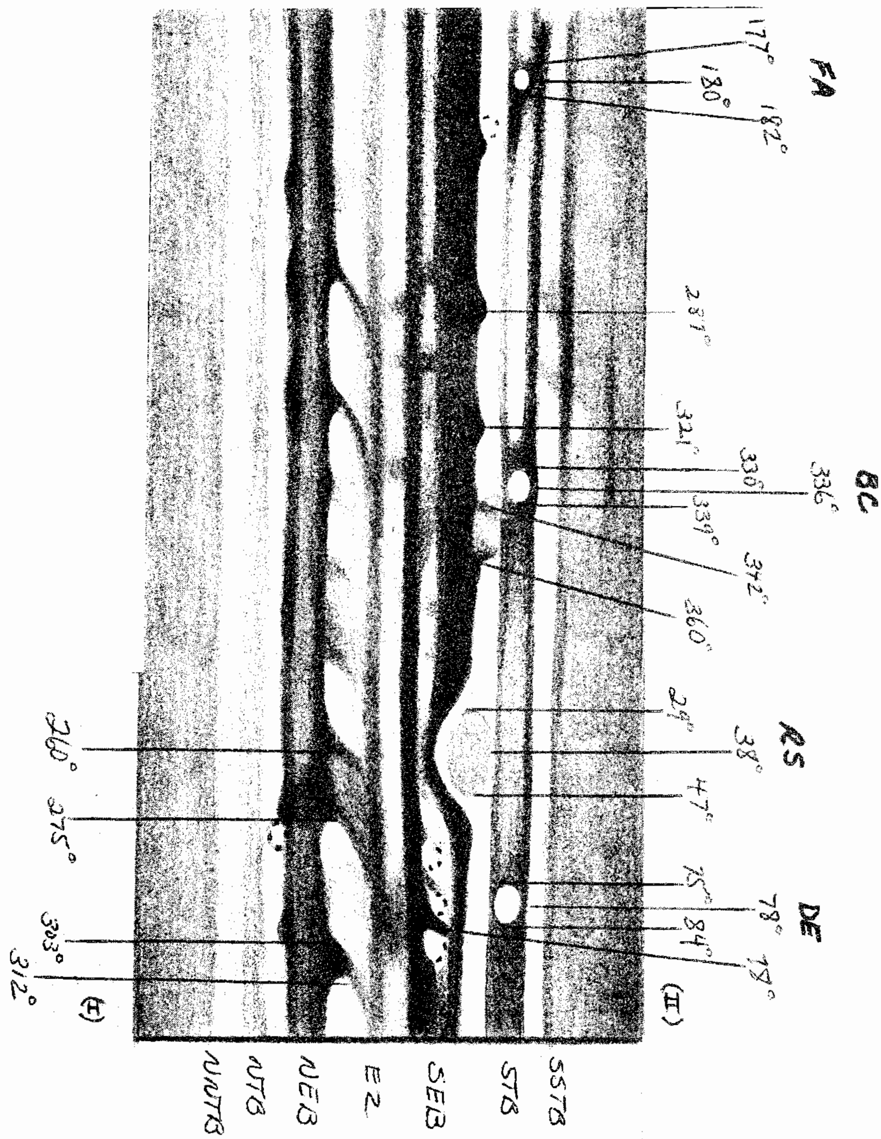


Figure 13. An extended strip sketch of Jupiter depicting the belts and zones from the SSTB to the NNTB and features observed for the period July 16, 17, and 18, 1983. Features observed include: STB ovals FA, BC, and DE, the Red Spot, the STrZ Disturbance, SEB_s projections, and festoons of the SEB Z and south edge of the NEB. Sketch by Mark S. Daniels with a 20-cm. reflector at 191X.

the second one you see as you continue to approach focus is No. 2, and so on. Keep the belts and zones in a separate list. This list will tell us the order of prominence of the belts and zones.

4. Photography. While this field of observation is not strictly speaking "visual", it is a very important field of observation of the planet Jupiter. Excellent books are avilable on this subject. A few I would recommend are: Outer Space Photography by Dr. Henry E. Paul, Amphoto; A Complete Manual of Amateur Astronomy by P. Clay Sherrod with Thomas L. Koed, Prentice-Hall, Inc.; and The Amateur Astronomer's Handbook by James Muirden, Harper & Row.

Final Notes

The front cover drawing is an excellent example of the limb darkening of Jupiter and of the shading technique employed by many observers. In truth, a new observer can scarcely be expected to match the artistic quality ofMr. Daniels' full disc drawing. In truth also, however, beginners who carefully follow the recommendations and suggestions in this article can learn to make drawings which are accurate and scientifically useful.

Every observation of Jupiter in order to be of value must have the following data: the date and time in Universal Time; the observer's name, address, and location; the telescope used (aperture and type); the magnifying power or powers; the seeing (the usual scale runs from 0 for worst to 10 for perfect); the transparency as the limiting naked eye stellar magnitude corrected when necessary for moonlight and twilight; and any color filters used in the observation. The central meridian is computed in both System I and System II for the time of the observation. (Sometimes transparency is estimated on a scale of 0 for worst to 5 for best.)

The types of observations discussed above will be valuable to the A.L.P.O. Jupiter Section in 1985. We encourage you to submit your Jupiter observations to the A.L.P.O. in 1985. We shall gratefully acknowledge any observational contribution of any type and shall endeavor to assist you in every possible way. All of the above kinds of observations, along with any correspondence, should be mailed at frequent intervals to my address at: 5435 S. Country Club Road, #16, Tucson, Arizona 85706.

SYNOPTIC REPORT FOR THE 1980-81 APPARITION OF THE PLANET JUPITER (Concluded)

By: P. Karl Mackal, A.L.P.O. Assistant Jupiter Recorder

[Foreword. This article is a continuation of the Jupiter Report on pages 2-10 of Journal ALPO, Vol. 31, Nos. 1-2, February 1985. Readers may find it helpful to refer to the earlier portion of Dr. Mackal's article. Those not familiar with the nomenclature of Jupiter are invited to study Figure 8 on page 59 in connection with this article. We thank the author for supplying so many drawings and photographs and can certianly recommend to the Jupiter specialist a careful study of the pages of illustrations.]

The gap in the STrZ Band was depicted over its entirety on April 2, 1981 by Dragesco, at 265°II. (See Figure 14.) A wonderful photo was taken of it by him five days later at 255°II. (See Figure 15.) Exactly 43 minutes later on April 7 he drew a festoon in the STrZ well following the gap at 281°II. (See Figure 16.) Ironically, it was not associated with the STrZ Disturbance! A photograph of this feature taken on April 10, 1981 shows it well preceding 324°II. (See Figure 17.) Another photograph of the gap between the following end of the STrZ Disturbance and this isolated festoon was taken by Dragesco on April 12, 1981, at 263°II. (See Figure 18.) In a drawing 21 minutes later, the festoon was placed by him about 10° short of the CM at 275°II. (See Figure 19.) Not only was the STrZ Band obliterated by this bright white clearing, but so too was the STB. (See Figure 20.) It is quite possible that the A.L.P.O. observers failed later on to report any slow-moving spots, which may have been associated with the STrZ branch of the suspected SEB Disturbance, due to this gap! On April 17, 1981, the STrZ Band was faintly visible at 311°II, on a photo taken by Dragesco. (See Figure 21.) The tenuous region of the SEB Z well following the RSH (or GRS) was photographed on April 18, 1981, at 91°II. Also, DE was approaching the CM, see Figure 22. By April 22, 1981, at 312°II, it was clear that the clearing in the STrZ had begun to obscure the isolated festoon in the region, just as it had already begun to do on April 17, 1981. (See Figure 23 by Dragesco.) On April 27, 1981, Heath reported that the Red Spot Hollow (or Great Red Spot) was "well seen and bright when near the CM, but when near the limb it was a diffused gray color." (B.A.A. intensity report for 1980-81.) On April 28, 1981, Dragesco took a photograph of the SEB region at 136°II, showing a white oval in the SEB Z, flanked by two dusky festoons, very soon to be associated with the so-called Disturbance of this belt. (See Figure 24.) Clay Sherrod made a strip sketch of the same region on the day of the suspected eruption, April 30, 1981. (See Figure 26.) Is this a discovery drawing? If so, then what about the April 28 photograph?

On May 5, 1981 Tatum observed the so-called SEB Disturbance near 100°II. (See Figure 25.) Phil Budine made another strip sketch of the region in question on May 7, 1981. (See Figure 27.) Perhaps of equal or greater importance than all this is the fact that he showed the GRS (Great Red Spot) quite prominent once again. Requoting Heath for May 14, 1981, he noted "a hint of the [GRS] with a slightly darker south edge at intensity 1.5." (B.A.A. intensity report for 1980-81.) By May 17, 1981, very little was left of the suspected SEB event, according to Carlino. (See Figure 28.) A heavy, mottled GRS was seen by Dragesco on May 19,

(text continued on page 69)

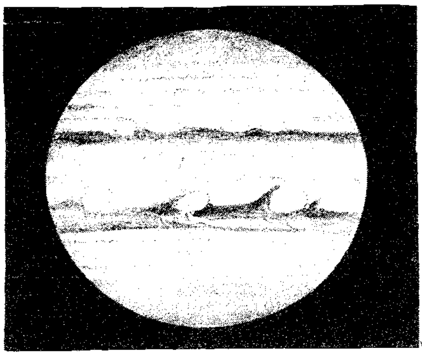


Figure 14. Drawing by Jean Dragesco. April 2, 1981. $23^{h}33^{m}$, U.T. CM(I) = 242°. CM(II) = 265°. 355-mm. reflector, 244X and 322X. All drawings and photographs accompanying Dr. Mackal's article are simply inverted views with south at the top.

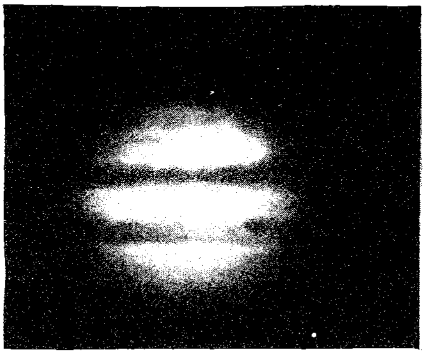


Figure 15. Photograph by Jean Dragesco. April 7, 1981. $22^{h}24^{m}$, U.T. CM(I) = 270°. CM(II) = 255°. 355-mm. reflector.

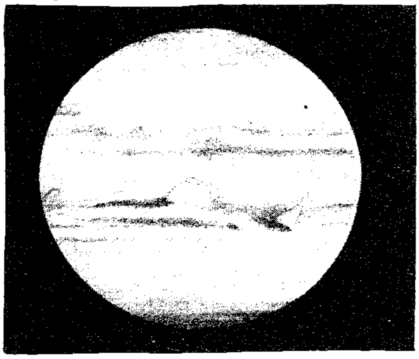


Figure 16. Drawing by Jean Dragesco. April 7, 1981. $23^{h}7^{m}$, U.T. CM(I) = 296°. CM(II) = 281°. 355-mm. reflector, 244X and 322X. Drawing made 43 minutes after the photograph of Figure 15.

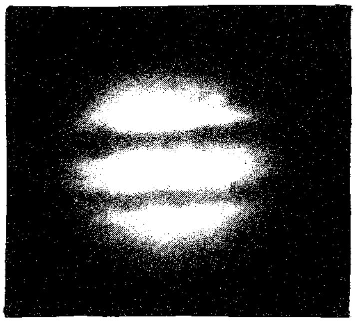


Figure 17. Photograph by Jean Dragesco. April 10, 1981. $21^{h}47^{m}$, U.T. CM(I) = 1°. CM(II) = 324°. 355-mm. reflector.

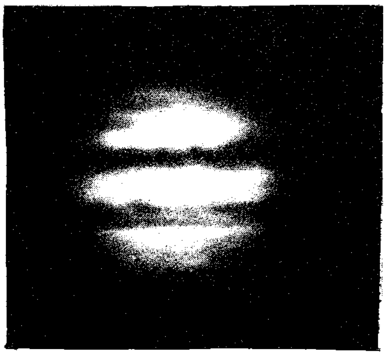


Figure 18. Photograph by Jean Dragesco. April 12, 1981. $21^{h}44^{m}$, U.T. CM(I) = 315°. CM(II) = 263°. 355-mm. reflector.

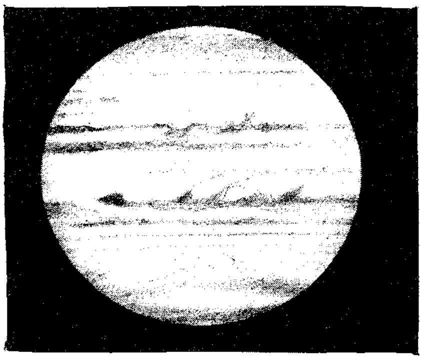


Figure 19. Drawing by Jean Dragesco. April 12, 1981. $22^{h}5^{m}$, U.T. CM(I) = 328°. CM(II) = 275°. 355-mm. reflector, 244X and 322X. Drawing made 21 minutes after the photograph of Figure 18.

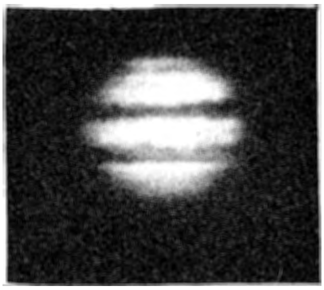


Figure 20. Photograph by Jean Dragesco. April 14, 1981. 22^h50^m, U.T. CM(I) = 312°. CM(II) = 243°. 355-mm. reflector.

Figure 21. Photograph by Jean Dragesco. April 17, 1981. 22^h11^m, U.T. CM(I) = 42°. CM(II) = 311°. 355-mm. reflector.

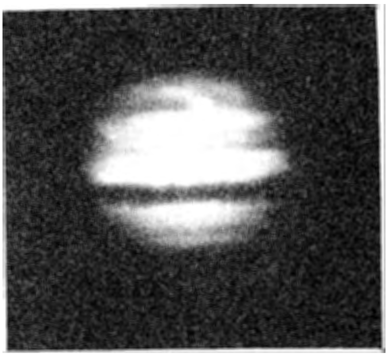


Figure 22. Photograph by Jean Dragesco. April 18, 1981. 21^h55^m, U.T. CM(I) = 190°. CM(II) = 91°. 355-mm. reflector.

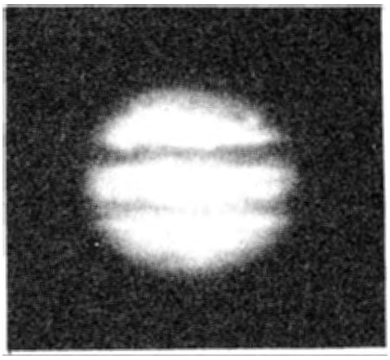


Figure 23. Photograph by Jean Dragesco. April 22, 1981. 21^h21^m, U.T. CM(I) = 81°. CM(II) = 312°. 355-mm. reflector.

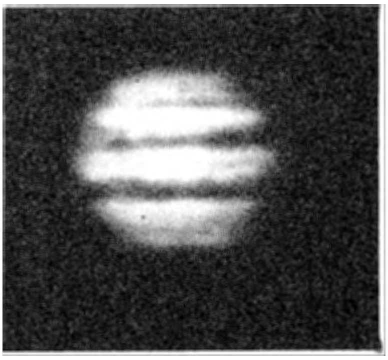


Figure 24. Photograph by Jean Dragesco. April 28, 1981. 21^h24^m, U.T. CM(I) = 310°. CM(II) = 136°. 355-mm. reflector.

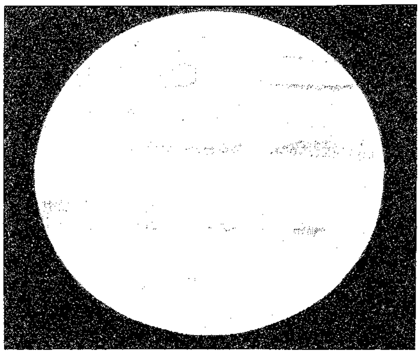


Figure 25. Drawing by Randy Tatum. May 5, 1981. 1^h20^m, U.T. CM(I) = 322°. CM(II) = 100°. Seeing 8 (scale of 0 to 10 with 10 best). Transparency 6 (estimated naked-eye limiting stellar magnitude).

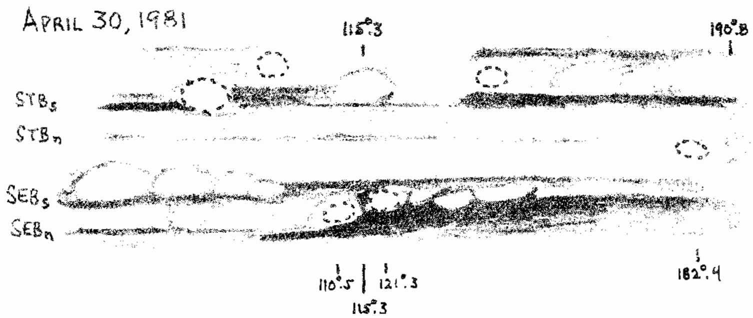


Figure 26. Strip sketch by Clay Sherrod on April 30, 1981. Drawn to show a suspected SEB (South Equatorial Belt) Disturbance. The numbers at the top and bottom are longitudes in System II.

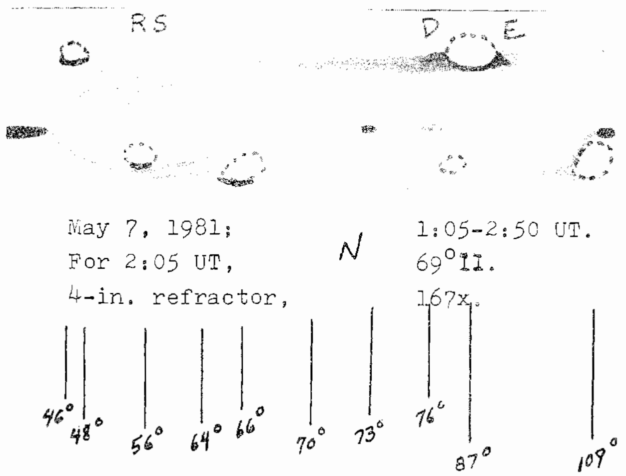


Figure 27. Strip sketch by Phillip W. Budine on May 7, 1981. Drawn to show a suspected SEB Disturbance. The numbers at the top and bottom are longitudes in System II. Seeing 7, transparency 5 (same scales as for Figure 25.)

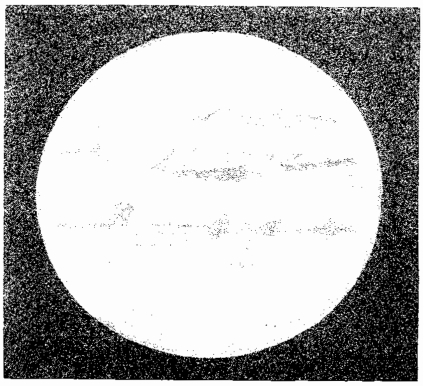


Figure 28. Drawing by L.M. Carlino on May 17, 1981 at 0^h38^m, U.T. 12.5-inch reflector, 175X. CM(I) = 31°. CM(II) = 78°. Seeing 5, transparency 4.

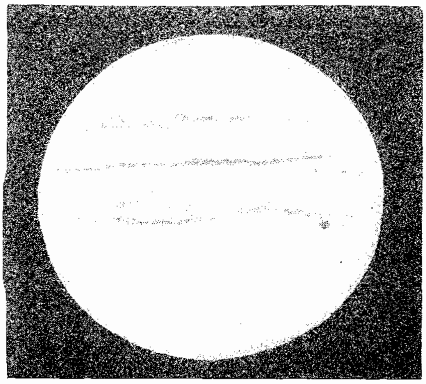


Figure 29. Drawing by L.M. Carlino on June 3, 1981 at 1^h12^m, U.T. 8-inch reflector, 160X. CM(I) = 215°. CM(II) = 132°. Note shadow of J.I at N. edge of North Equatorial Belt near right limb of planet.

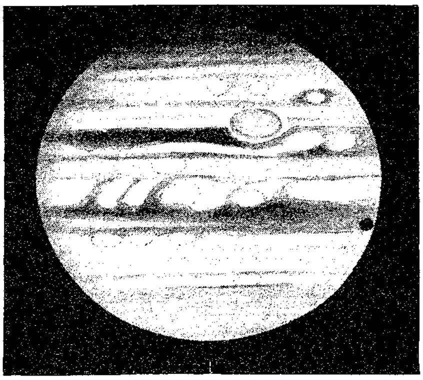


Figure 30. Drawing by Jean Dragesco on May 19, 1981 at 21h 06m U.T. CM(I) = 15 Deg. CM(II) = 40 Deg. 355-mm reflector, 244X and 322X. Note the shadow of J. I just inside the following (right) limb at the north edge of the North Equatorial Belt.

Figure 31. Photograph by Jean Dragesco on May 19, 1981 at 21h 15m U.T., only 9 minutes after the drawing of Figure 30. CM(I) = 21 Deg. CM(II) = 46 Deg. 355-mm Reflector.

Figure 32. Drawing by L.M. Carlino on June 18, 1981 at 01h 00m U.T. CM(I) = 54 Deg. CM(II) = 217 Deg. 8-inch reflector, 130X. Seeing 4, transparency 4.

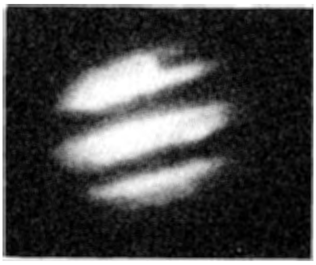
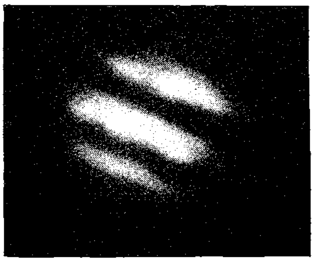


Figure 33. Photograph by Donald C. Parker on July 3, 1981. CM(I) = 266 Deg. CM(II) = 314 Deg. 32-cm. reflector. Seeing 7.5, transparency 4. Exposure 3 seconds at f/96.

Figure 34. Photograph by Donald C. Parker on July 7, 1981. CM(I) = 191 Deg. CM(II) = 209 Deg. 32-cm. reflector. Seeing 6, transparency 4.5 Exposure 3.5 seconds at f/96.



(text continued from page 64)

1981. (See Figures 30 and 31). With the sudden resurgence of the GRS, there also appeared to be a dissipation of the StrZ Disturbance. The SEB Z appeared to fill up by June 3, 1981, at 132°II, according to Carlino. (See Figure 29). The bright white gap (or clearing) in the StrZ (intensity about zero,* according to Heath) was quite evident on a June 18, 1981 disc at 217°II. (See Figure 32 by Carlino.) Over what remained of the apparition, the area covered by this clearing widened at a fast pace indeed. According to Parker, it covered 105° of System II longitude from July 3 to July 7, 1981! (See Figures 33 and 34.)

The intensities mentioned in the text are on a scale of 0 (black shadows) to 10 (most brilliant features).

COMPARISON OF BRIGHTNESSES OF LUNAR FEATURES BY THREE METHODS OF OBSERVATIONS (Concluded)

By: Winifred Sawtell Cameron, NSSDC-GSFC, Greenbelt, MD, A.L.P.O. Lunar Recorder

[Foreword by Editor. The first part of Mrs. Cameron's paper appeared in Journal ALPO, Vol. 31, Nos. 1-2, pp. 33-40. It will be almost essential to review that reference in order to read this second and final part with understanding. We regret the need to divide this paper, but the number of pages in an issue is limited.]

For features with two methods of brightness measures, consult Table 5 (5a and 5b) and Figure 35. Table 5 gives the averages under each method for each day of the Moon's age available, and Figure 35 is a plot of the data in Table 5. There were two features with measures under both the CED and the Vmag method, 7 of CED vs. Albedo, and 7 of Albedo vs. Vmag photometry. The two features measured by CED and Vmag behaved rather similarly and synchronously under the two methods. The CED vs. Albedo behavior was similar in most of the features, but Pico and Manilius appeared to disagree. In the albedo vs. Vmag, only Aristoteles appeared to be grossly different, and here the two methods were opposite in behavior. These differences in behavior require much more information and many more measurements to determine why or even if they really occur. In some cases, there were single measures for a particular day of the Moon's age. It is the author's opinion that a minimum of 10, and preferably 20 or more individual measures, for each day of age is required to establish a normal brightness. Rarely has this goal been achieved among the observers. The ideal would be to have 10 or more for each degree of colongitude, instead of for every day of age (12° of colongitude).

Table 6 and Figure 36 present the data in the same way as before for one method, but with more than one observer contributing to the averages. There were 6 under the albedo and one for CED. In Figure 36, we can compare the behavior of features with each other over a lunation. Censorinus and Mare Nubium (one a bright feature and one a dark surface) show decreases in brightness around Full Moon, particularly within the magnetic tail. The others are usually bright then. Censorinus, being a rayed crater, behaves surprisingly differently from most rayed craters around Full Moon when the retroreflecting property of the rays (glass beads) is most prominent, which is why the rays show best at Full Moon. For Censorinus, this aspect is not the case! And several observers agree. There are really too few measures for Mare Nubium and the Cobra Head to establish their complete behavior.

Finally, we have the cases of features observed by just one method and with only one observer reporting measures. These may be found in Table 7 and Figure 37 for their behavior. Again, the coverage varies, some of the features having full representation for a lunation (all phases) and some with very meager data, too few to establish all normal aspects. Nevertheless, we have some indication of the albedos or brightnesses of 82 features. If anyone observing an LTP gives the brightness in any of the methods considered, we can estimate it in either of the other two methods by means of Figure 38. In this figure in (a) is plotted average CED values against albedo averages. One can read off the graph the value of brightness under one method when knowing the value of the other. The same is true of the other two graphs (b, c), so that we can really get the values in all three methods. Graphs a and c exhibit unexpected behavior. One would expect a straight line correlation between two methods - either flat, positive, or negative in

*Presumably meaning intensity about ten. - Editor

Features with Two Methods of Brightness Measures (White Light)

ALBEDO-PHOTOMETRY

	Taruntius		Madler		LeMonnier		Godin		Aristoteles		Eratosthenes		Copernicus	
METHOD	Vmag	Albedo	Vmag	Albedo	Vmag	Albedo	Vmag	Albedo	Vmag	Albedo	Vmag	Albedo	Vmag	Albedo
AGE/OBS.	W-P	K	W-P	B	W-P	Le	W-P	P	W-P	CA	W-P	B,Le	W-P	G
$3^{d}0-3^{d}9$		too bright by ~ 1 step ↓												
4.0-4.9		6.37												
5.0-5.9		6.52				5.00						5.25		
6.0-6.9		6.68				-		6.00		5.68		-		
7.0-7.9		6.66		4.00		-		6.02		-		-		
8.0-8.9		6.73		4.22		-		6.42		4.98		4.00		
9.0-9.9		6.62		-		-		6.03		5.42		-		
10.0-10.9		6.64		3.00		-		6.64		5.42		3.80		
11.0-11.9		6.62		-		-		6.84		5.44		-		6.50
12.0-12.9	3.97	6.66	3.46	-	4.43	5.83	3.60	7.04	3.82	4.65	4.25	5.12(5.54)	3.90	6.50
13.0-13.9	3.52	6.66	3.19	4.00	3.85	-	3.14	7.32	3.36	4.50	3.595	4.30	3.26	-
14.0-14.9	3.665	6.67	3.36	4.75	4.04	6.62	3.32	7.35	3.52	4.38	3.83	4.88	3.39	7.50
15.0-15.9	3.56	6.85	3.21	3.50	3.77	-	3.07	7.60	3.24	4.50	3.51	4.40	3.085	7.50
16.0-16.9	3.91(403)	6.64	3.56	5.00	4.28	6.00	3.39	7.58	3.60	-	3.80	4.98	3.33	-
17.0-17.9	4.865	7.02	3.99	-	4.78	2.00	3.70	7.12	3.96	4.62	4.08	4.20	3.52	6.50(8.00)
18.0-18.9				4.34				6.36		-		3.80		-
19.0-19.9				5.00				6.60		5.03		-		7.50
20.0-20.9								6.12				-		
21.0-21.9								5.92				4.00		

OBSERVERS

Vmag	Albedo	
W-P=Wildey & Pohn	B-Bartlett	K=Kapral
	CA=Caruso	Le=Lecroy
	G=Calgocy	P=Porter

Table
()=values without anomalies

Table 5a. Observed average brightness vs. age of Moon for lunar features observed by two different methods. Refer also to discussion in Lunar Recorder Cameron's text on pg. 69 *et seq.* All illustrations in this report were contributed by Mrs. Winifred Cameron.

slope, but most likely positive. Figure 38b does show the expected relationship. There is much scatter in the graphs, and the means (solid and dashed lines) were eyeball means. Not much reliability can be placed on these data, for in many cases data are really meager. We do, however, have a somewhat better idea of how the features measured do act through a lunation and what the values are. We can even make a guess as to the albedo of the reported brightness change in an LTP if we assume they really know it was brighter (or dimmer) than normal for any of the 82

Features with Two Methods of Brightness Measures (White Light)

	CED-PHOTOMETRY				CED-ALBEDO													
	Stevinus"1"		Bullialdus		Messier		Messier A		Manilius		Piton		Pico		Alphonsus		Gassendi	
METHOD	CED	Vmag	CED	Vmag	CED	Albedo	CED	Albedo	CED	Albedo	CED	Albedo	CED	Albedo	CED	Albedo	CED	Albedo
AGE/OBS.	F	W-P	C,F,Pt	W-P	MC	H	JC,MC	H	C	B	A,C,F JC,Pd	Hu,L	A,C,F, JC,MC,Pd	H	Pt	K,Le,P, CA	F,JC, Pt	K
3d0-3d9	3.00						1.65						0.2¢					Too
4.0-4.9	–						2.10						–					bright
5.0-5.9	3.25						1.60						–			8.75¢		by
6.0-6.9	3.00				2.90	5.20	2.60	5.00			2.95		–			–		~2
7.0-7.9	3.175					4.71	2.87	5.00	3.30	5.00	3.64		3.50		2.80	7.00		steps
8.0-8.9	3.05					6.20	2.85	6.00	3.35	–	2.80		3.34		3.00	5.70		
9.0-9.9	3.05		3.26			5.325	3.05	6.00	(3.45) 3.57	–	2.92		3.26	5.50	–	6.08		
10.0-10.9	3.26		3.32			6.04		6.35	3.325	–	2.93		3.00	5.15	3.10	6.26	(3.575) 3.76	6.32
11.0-11.9	3.24		3.21			3.50		–	(3.30) 3.44	–	2.87		3.07	–		6.57	3.14	7.00
12.0-12.9	3.24	2.90	3.31	4.01		8.00		–	3.56	–	2.75		3.19	–		6.74	3.34	7.40
13.0-13.9	3.35	2.56	3.28	3.465		8.00		8.00	–	5.25	2.77	5.15#	3.30	4.75		6.66	3.43	7.52
14.0-14.9	3.17	2.815	3.17	3.635		8.00		7.40	3.675	–	2.83	–	3.37	6.50		5.92	3.40	7.66
15.0-15.9	3.40	2.65	3.03	3.27		7.60		6.80	3.30	5.90	2.87	6.14#	(3.35) 3.60	4.66		6.47	3.30	7.83
16.0-16.9	–	3.27	3.37	(3.535) 3.38					3.30	5.50	2.77	4.86	(3.10) 3.73			5.77	3.60	7.66
17.0-17.9	–	–	3.17	3.81						–	2.25	–	3.50			5.58	–	7.73
18.0-18.9	3.40		3.20							4.33	2.46	5.58# 6.5	3.37			6.92	3.30	7.58
19.0-19.9			3.20							4.00	2.70	6.35# 7.25	3.40			5.73	3.30	–
20.0-20.9			2.80							4.60	2.43	4.62#	–			–		–
21.0-21.9													3.40			5.56		6.79
22.0-22.9													3.60					–
23.0-23.9																		7.52
24.0-24.9																		–
25d0-25d9																		5.92

OBSERVERS

Vmag: W-P=Wildey & Pohn

CED: A=Amery, C=Chapman, F=Foley, JC=J.Cook, MC=M.Cook, Pd=Pedler, Pt=Peters

Albedo: B-Bartlett, CA=Caruso, G=Calgocy, H=Hill, Hu=Huddleston, K=Kapral, L=Louderback, Le=Lecroy, P=Porter

Table: #=blue & red combined measures; ¢=in dark; ()=values without anomalies

Table 5b. Observed average brightness vs. age of Moon for lunar features observed by two different methods. See also text.

features. We could say it was brighter than a given albedo at that age. If they have any indication of how much brighter, then we may be able to give a limiting albedo. I plead to all observers, if any LTP is noted, please try to estimate brightness in some way; at least compare it with other features. Keeping Elger's albedo scale handy for comparison would be most helpful to analysts. This scale can be found in Elger (1895).

Referring back to Table 1, on pg. 35 of JALPO, Vol. 31, Nos. 1-2, this gives a sample albedo chart which I construct from the observer's measures. Those figures circled are ones that appear to be anomalous compared with the other

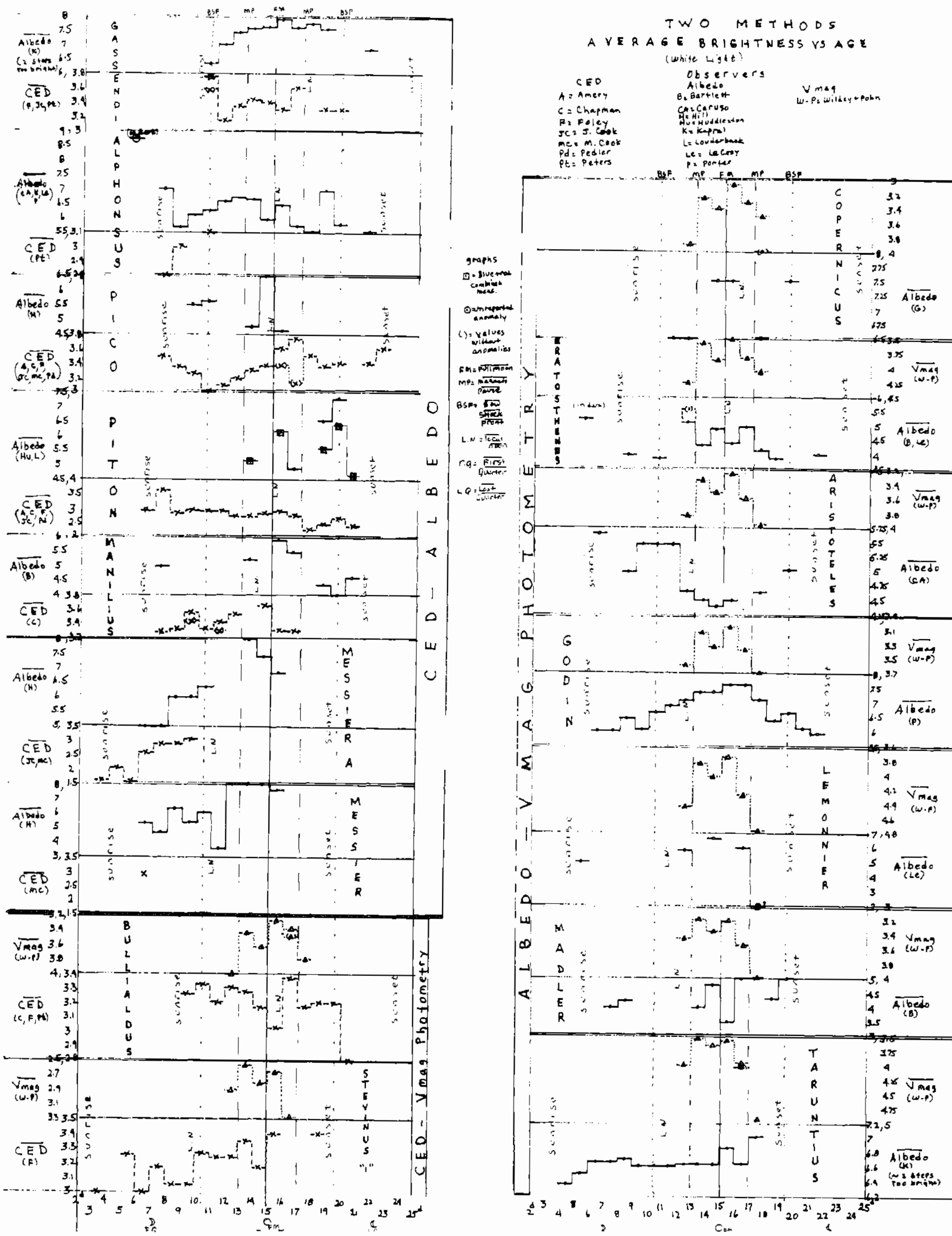


Figure 35. Graphical representation of data from Tables 5a and 5b, the observed average brightness vs. age of the Moon for lunar features observed by two different methods. See also Mrs. Cameron's text.

measures for the same age. In the case of the ones at age 8 days there are only 2 measures, both obtained on the same night. Ordinarily one couldn't say whether it was anomalous or not; but if compared with values for ages before and after, it was decidedly anomalous, and only point A (south wall of Calippus) was abnormal. This result suggests that the measure was not owing to the passage of a cloud as the other parts of the crater were unaffected. The measure is probably a real LTP but was not noted by the observer because there was no change and he didn't know (and shouldn't) what the albedo should be for that age. In the cases of decreases in brightness it is difficult to rule out that the change wasn't owing to haze or (white light) ONE METHOD - MORE THAN ONE OBSERVER

METHOD	ALBEDO						CED
Feature	Eimmart	Cape Agarum	Hyginus N	Clavius	Mare Nubium Seismic Area	Cobra Head	Censorinus
AGE/OBS.	L,Fr,K	G,Le,K,L	K,T	Le,P	H,L,Ly	L,P	A,C,F,JC,MC,Pt
$2^{d}0-2^{d}9$	6.56	5.77					
3.0-3.9	6.76	6.80					3.50
4.0-4.9	7.36	6.76					-
5.0-5.9	7.62	6.90		(in dark)6.84			3.48
6.0-6.9	7.26	7.09	4.00	-			3.72(3.56)
7.0-7.9	7.27	7.15	6.12	-			3.64(3.56)
8.0-8.9	7.34	7.23	4.40	-			3.79
9.0-9.9	7.44	7.27	6.50	5.04	6.22		3.82
10.0-10.9	7.32	7.19	4.54	5.42	5.09		3.99
11.0-11.9	7.21	7.09	6.31	6.02	-		3.73
12.0-12.9	8.00	7.26	6.50	7.05	-	8.00	3.65
13.0-13.9	7.62	7.275	6.50	6.29	4.25	7.75	3.59
14.0-14.9	7.26	7.13	6.45	7.59	-	-	3.62
15.0-15.9	6.60	6.59	4.64	7.31	6.25**	7.00	3.68
16.0-16.9	5.34(7.16)	6.90	6.33	6.64	-	-	3.67
17.0-17.9	7.08	5.98	6.50	6.22	2.67	-	2.85
18.0-18.9			4.64	6.47	7.63***	6.69	3.13
19.0-19.9				6.10	6.25***	5.84(6.54)	3.70
20.0-20.9				5.88	6.94***	6.50	
21.0-21.9				6.20		6.12	
$22^{d}0-22^{d}9$				6.10			

Table

()=values without anomalies

**=white, blue & red light average

***=blue & red light average

Observers

Albedo

CA=Caruso
Fr=Frank
G=Galgocy
H=Hill
K=Kapral
Le=LeCroy
L=Louderback
Ly=Lynch
P=Porter
T=Traub

CED

A=Amery
C=Chapman
F=Foley
JC=J. Cook
MC=M. Cook
Pt=Peters

Table 6. Observed average brightness vs. age of Moon for features observed by one method and more than one observer. Refer also to text on page 69 et seq.

cloud, unless only one point out of several is anomalous. Brightenings could be the passing off of a cloud, but the same argument pertains if only 1 or 2 points change. If the observer is certain there were no clouds, then a real anomaly is probable. Variations, when timed, can be checked against seeing measures.

In summary, we have here some varying coverage of data on brightness behavior throughout a phase period (lunation) in at least one method for 82 lunar features. Most of the features are LTP ones; but some are non-LTP comparison sites and some are seismic epicenters as established from the seismic experiments on the Apollo missions. These were assigned because there was the suggestion by Barbara Middlehurst that these sites may be LTP sites or are related to them as tidally-induced phenomena. It is known that the deep-focus moon quakes are induced by tidal

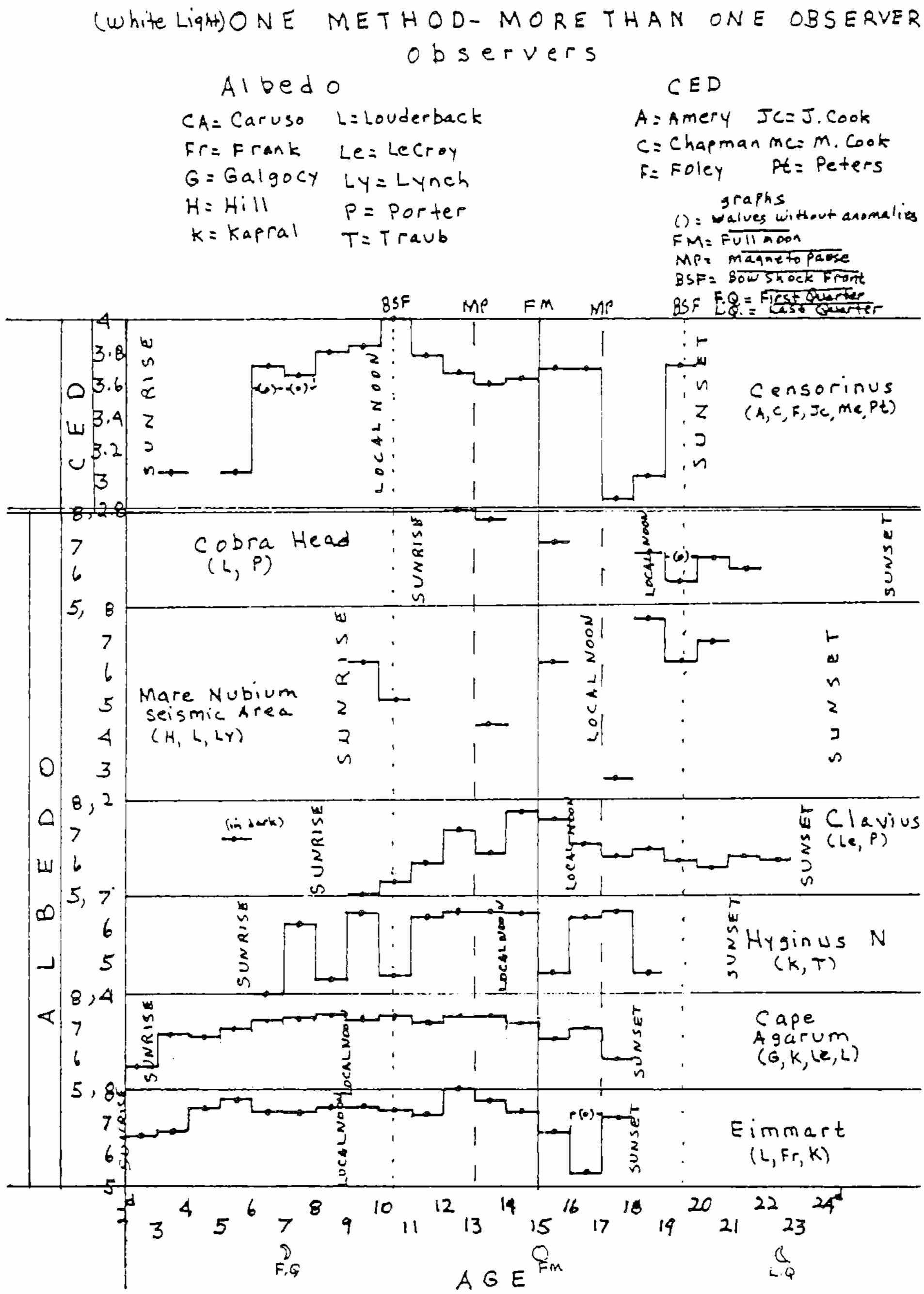


Figure 36. Graphical representation of data from Table 6. Observed average brightness vs. age of Moon for features observed by one method and more than one observer. White light, as always in this report. See also text.

effects (Nakamura, 1976), but the tidal correlation found by Middlehurst (1966) for LTP for 145 observations has dissipated with subsequent and more observations (700+ & 1200+, Cameron 1972, 1977). Where she found narrow peaks at perigee and apogee, I found none at apogee and a double-humped curve with peaks at 0.7 and 1.0 (perigee) phase of the anomalistic period (Cameron 1972, 1977). There is a definite, deep, minimum of LTP at about 0.3 (where one would expect an absence of them under the tidal hypothesis), and a broad maximum from 0.6 to 1.1 phase (apogee is

ONE METHOD - ONE OBSERVER (white light)

AGE/Feature	Dion.	M.VaP.	Arst.	Anax.	Theb.	Kepl.	O.Pro.	Byrg.	Birt.	Danl.	Arag.	Picd.	Petr.	Gocl.	Seis. 49E	Lang.	Cleo.	Posi.	Atls.	Daws.	Lubb	Plin	Hers.	Linn	Good	Macr
	V		M		A		G			C E	D			A		L		B		E		D		O		
2^d0–2^d9																										
3.0–3.9												3.75	3.75													
4.0–4.9												4.00	3.50	5.68			5.65		6.46							8.17
5.0–5.9												-	-	6.70	5.06	[8.20]	6.72	6.12	5.33	5.49					4.67	
6.0–6.9												-	-	7.08	4.91	[7.00]	7.00	6.29	6.21	4.46	5.00	7.43			-	
7.0–7.9												4.25	3.60	6.99	-	[7.46]	7.12	6.70	6.87	4.93	5.00	7.40			-	
8.0–8.9											3.30	4.38	3.20	7.01	5.08	-	7.34	6.86	6.81	4.73	6.00		7.32	6.04 [7.75]	-	
9.0–9.9										2.80	3.40	-	-	6.68	4.75	[8.43]	7.05	6.62	6.92	5.31	6.00		-	5.32 [6.75]	-	
10.0–10.9										-	3.30	3.33	3.20	6.83	5.00	[7.76]	7.08	7.01	6.91	6.08	6.11		7.42	5.54 [7.25]	-	
11.0–11.9										-	2.80	3.33	4.40	6.89	5.00	-	7.08	6.91	6.93	6.26	-		-	-	-	
12.0–12.9	3.42	3.47	4.07	3.62	3.65	4.14	3.02	-	3.83	-		4.40	3.80	6.74	5.08	[8.21]	7.18	6.85	6.73	6.23	-		-	-	7.75	
13.0–13.9	2.97	3.95	3.44	3.06	3.12	3.42	4.53	3.98	3.34	-		4.10	3.80	6.79	5.05	[7.17]	7.14	6.88	6.54	6.16	-		-	5.57 [8.00]	-	
14.0–14.9	3.25	4.07	3.68	3.17	3.29	3.65	4.48	3.33	3.55	2.97		4.60	3.90	6.80	5.38	[7.56] [7.28]	7.21	7.00	6.95	6.25	5.80		-		7.82	
15.0–15.9	3.04	3.75	3.38	2.87	3.03	3.15	3.83	2.82	3.31	-		4.25	3.80	7.07	5.00	[6.70]	7.22	7.10	6.53	5.56	6.60		7.42		-	
16.0–16.9	3.41	4.18	3.72	3.17	3.37	(3.48) 3.32	4.12	2.87	3.60	3.00		-	-	6.99	-	[7.70]	6.96	7.09	6.91	5.66			-		7.00	
17.0–17.9	3.68	4.40	4.00	3.40	3.65	3.58	4.32	3.02	3.82			4.25	4.00	6.80	4.96		6.60	7.10	6.70	5.00			-		6.00	
18.0–18.9													4.00	5.67				7.05	6.88	5.55			7.42			
19^d0–19^d9																				6.22						

AGE/Feature	Alba.	Cali	WhSp. Walt.	Wilh.	Mers.	Mari	Ptol.	Pont	Seis A20	Grim.	Parr.	Lyel.	Hero	Land	Seis. A16	Apia.	Carl	Lexe.	Schl.	Schk	Warg	Alpe.	Phil	Capu	Ricc
							A		L			B		E			D		O						
6^d0–6^d9	6.90	(6.82) 4.29						6.38							3.80										
7.0–7.9	6.53	6.25	5.33					5.83				4.33			4.53										
8.0–8.9	6.64	5.00 7.50	(4.50) 3.50				3.20	-				4.57			5.32	5.93		5.95							
9.0–9.9	7.00	7.12	6.00				-	-			5.02	-		4.89	5.25	-	4.39	5.80				7.80			
10.0–10.9	6.93	5.30 6.21	5.69		5.50		3.20	-	5.87		5.49	3.86		5.16	5.51	5.88	5.43	(6.32) 6.06	(5.28) 4.80				4.00		
11.0–11.9	7.01	4.25	6.12	6.33	5.50		-	-	6.76		5.53	-	3.50	5.59	5.83	-	-	-	-						
12.0–12.9	7.07	-	-	7.33	-		-	-	6.62		6.08	-	3.50	5.53	5.67	-	-	-	-						
13.0–13.9	7.27	5.45	6.14	-	5.90	5.00	-	-	6.63	2.26	5.67	4.46	-	5.69	5.77	-	5.00	6.58	4.64		4.93				
14.0–14.9	7.04	-	-	6.75	-	4.00	-	-	6.50	2.50	5.53	3.88	3.25	5.51	5.88	-									
15.0–15.9	7.17	6.87	5.88	6.75	6.12	5.80	4.00	5.88	6.67	2.80	5.75	4.68	3.25	5.84	5.70	5.95				3.73			5.48	8.00	2.70
16.0–16.9	7.04	6.44	6.62	7.33	6.00	-	-	6.06	6.60	-	4.56	3.00		5.84	5.58	-				-				-	
17.0–17.9	7.00	5.69	6.62	6.75	5.81	5.83	-		6.50	2.60	-	-		5.88	-	-				-				-	
18.0–18.9	7.15	6.38	7.25		6.62		3.00		6.50	-	5.72	4.40		5.41	5.39	5.95				-				[7.62]	
19.0–19.9		5.88	6.25		-				-	3.03	5.24			5.60	5.06					-				[6.28]	
20.0–20.9		4.50	7.50		6.12				-	-	6.10			5.40	3.90					-				[6.94]	
21.0–21.9			8.00		8.00				7.00	-	5.86			5.65	4.21					-					
22.0–22.9					5.32				-	-	3.90			5.10						3.73			5.15		
23.0–23.9									7.00	-				3.96										6.62	
24.0–24.9										2.85			4.50	5.25											
25^d0–25^d9													5												

KEY

( ) : anomalous

( ) = without anomalie

[ ] = blue & r measures

Table 7. Observed average brightness vs. age of Moon for features observed by one method and one observer. See also text.

at 0.5, perigee is at 0.0 or 1.0), where there are slightly higher values at 0.7 and 1.0 phases (giving the double hump). One would expect a minimum at 0.75 under the tidal hypothesis, but one gets the strongest peak there. Actually, the numbers of observations for each 0.1 interval of the anomalistic period from 0.6 to 1.1 phase are almost equal, and do not vary more than 10%. No reports of LTP (and few or no possible anomalies) have been reported at the seismic sites. The distributions of the LTP, deep-focus seismic, and shallow seismic (not tidally-

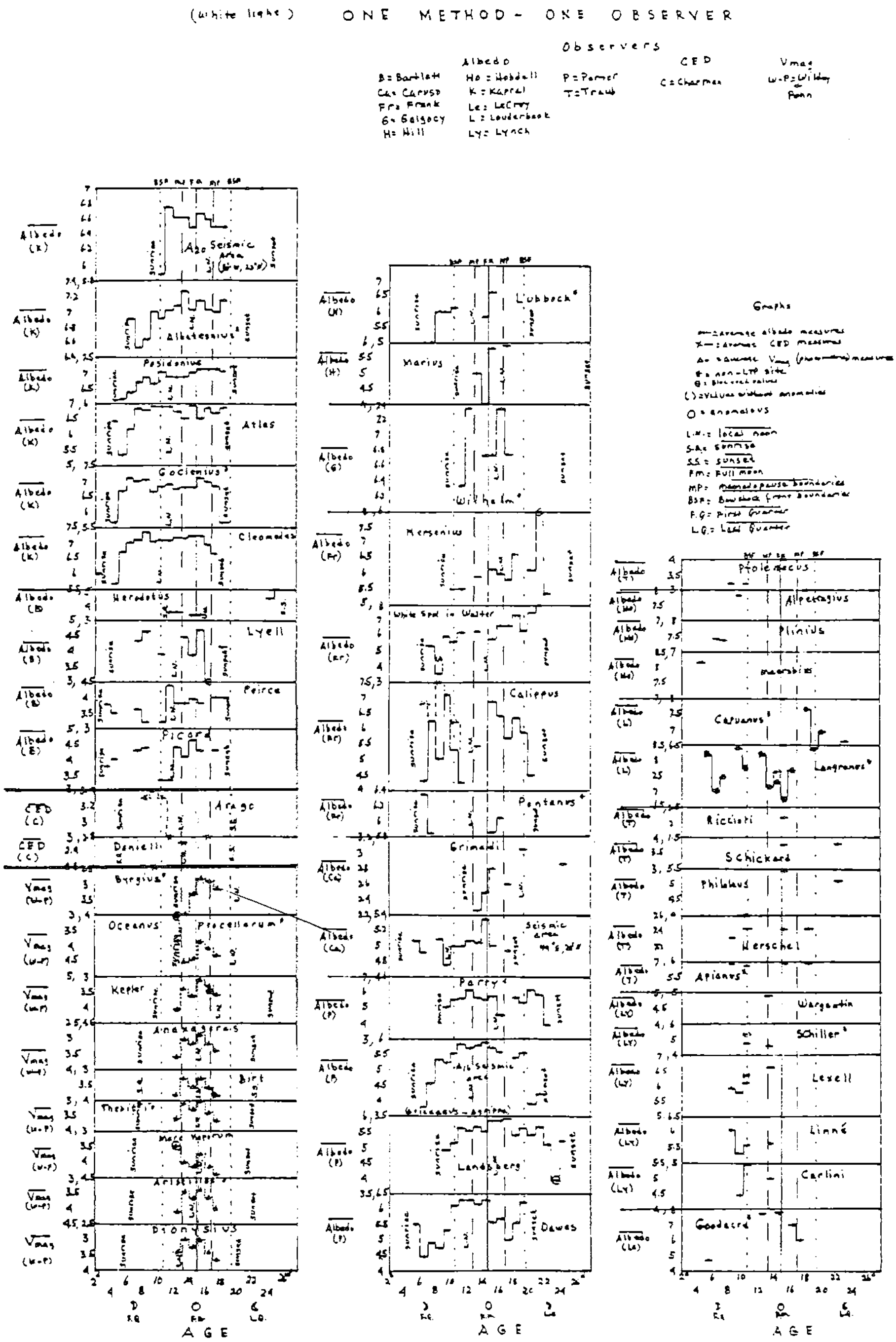


Figure 37. Graphical representation of data for lunar features observed by one method and one observer. Refer also to text.

related) sites are all different (Cameron 1977); therefore, I would not expect to find a correlation with LTP for the seismic sites, but if any, it would be more likely to be with the shallow-focus, tidally-unrelated sites, as I think the LTP are not tidally-related, or at least not strongly so.

If we study the histograms, we find among the data that several features were measured by three methods, several more by two methods, quite a few by more than one observer in one method, and the majority observed by one observer in one method. The brightness behavior of features can be compared among observers and

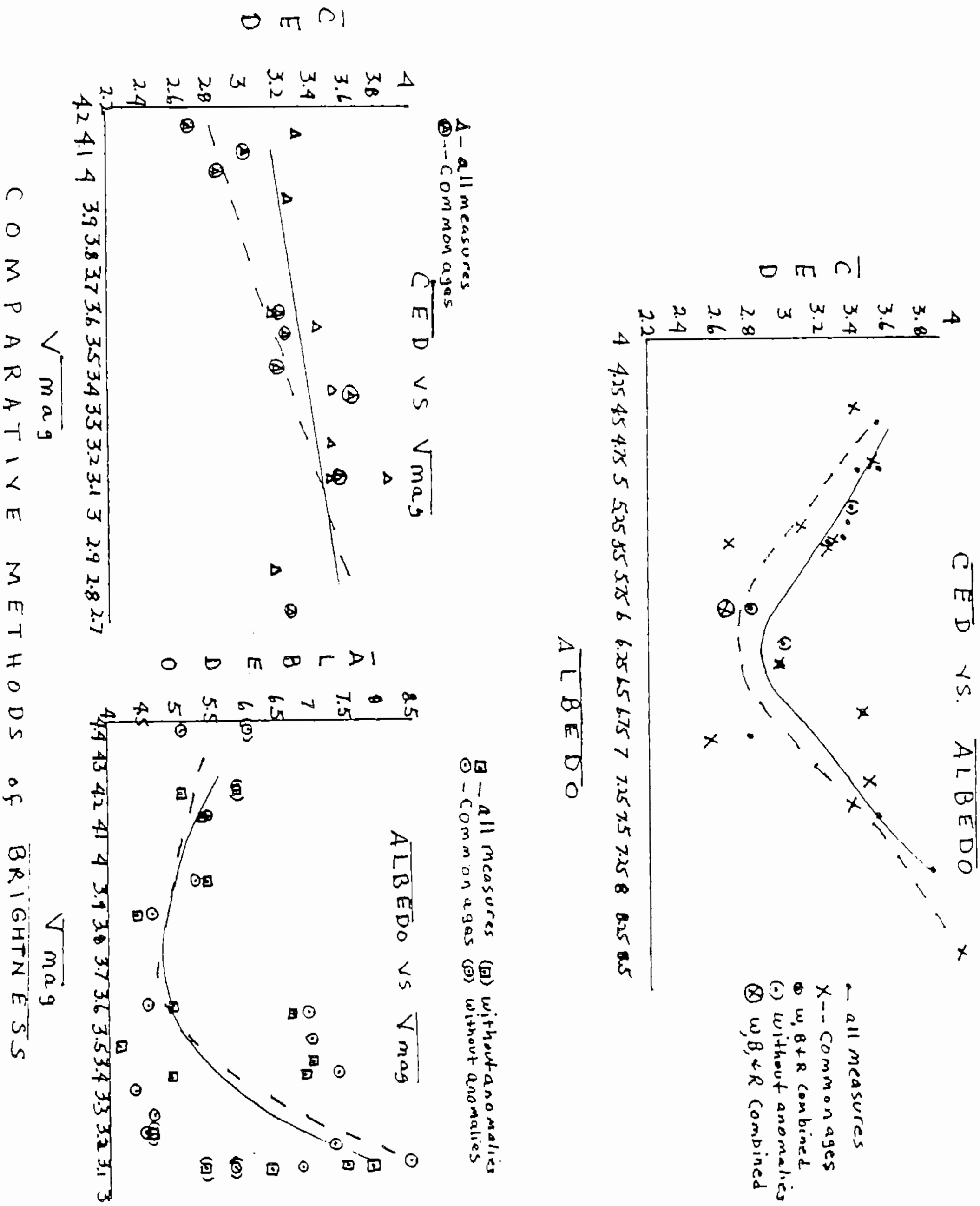


Figure 38. Rough graphical comparison of any two of the three methods discussed in Lunar Recorder Cameron's report. The curves permit an approximate conversion of an albedo measured by one method to its value for another method. Refer also to discussion in text.

with each other. We find correlated behavior in many cases, but in several we find differing behavior between methods. From Figure 38 the corresponding albedo, or CED, or Vmag can be extracted knowing the value from one method. This would be a somewhat crude estimate since the scatter is quite large. Perhaps, in time, these graphs can be improved. It is urged that all observers make some attempt to indicate brightness for LTP. A habit of estimating it at all times would be most useful. I also make a plea for more observers to participate in these programs. Auxiliary equipment would be most helpful. It would be good to establish a photographic albedo scale (many photos at each day of age, preferably at least two during an observing session, separated by 15 minutes oR so. Even photographs of the whole Moon at once could be useful. Both color and black-or-white would be invaluable. Monitoring by photoelectric, polarimetric, and spectral methods would be very valuable.

From the above discussion one can see that the chance of catching an anomaly in a given night is quite high, at least 1/4 of the time; but for individual measures the frequency goes down to less than 10 % and is more like one in thirty times. Anyone wishing to join in the ALPO-LTP observing program please contact me at La Ranchita de la Luna, 200 Rojo Drive, Sedona, AZ 86336.

I thank all those who contributed observations to the ALPO-LTP observing program, several of whom were dedicated long-term contributors. I also thank the members of the Lunar Section of the British Astronomical Association, particularly Peter Foley who forwarded the CED observations to me, for their devoted efforts on lunar observations and LTP reporting, without which this paper could not have been produced.

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THREE WESTERN (MORNING) APPARITIONS OF THE PLANET VENUS: VISUAL AND PHOTOGRAPHIC OBSERVATIONS.

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

Abstract. Visual and photographic observations of the planet Venus for the 1978/9, 1980/1, and 1982 western (morning) apparitions are summarized, emphasizing the instruments and sources of data used. For all three observing periods, there is a discussion of the features seen or suspected on the apparent surface of Venus in visual light, including cusps, cusp-caps, cusp-bands, the Ashen Light and other curious dark-hemisphere phenomena, as well as dichotomy estimates. Comparative notes on observers, instrumentation, visual and photographic data, and illustrations accompany the report to increase one's overall appreciation of the variable, elusive phenomena observed throughout these three apparitions by A.L.P.O. Venus Section participants. The October 5, 1980, lunar occultation of Venus is also described.

Introduction

This summary report concerns visual and photographic observations of the planet Venus for the following three apparitions, whose geocentric phenomena occurred on the following dates in Universal Time (UT)[1]:

	1978/9 Western (Morning) Appar.	1980/1 Western (Morning) Appar.	1982 Western (Morning) Appar.
Inferior Conj.	1978 NOV 07 21 h	1980 JUN 15 07 h	1982 JAN 21 10 h
Stationary	NOV 26 16	JUL 06 17	FEB 10 14
Greatest Brill.	DEC 14 05 (-4.4)	JUL 22 02 (-4.2)	FEB 25 01 (-4.3)
Gtst. Elong. W.	1979 JAN 18 06 (47°)	AUG 24 19 (46°)	APR 01 18 (46°)
Superior Conj.	AUG 25 12	1981 APR 07 09	NOV 04 02

A total of 30 observations were received for the 1978/9 period, 12 observations for the 1980/1 apparition, and 22 for the 1982 observing season. The distribution of observations by month for these three apparitions is given in Figure 39 (p. 79).

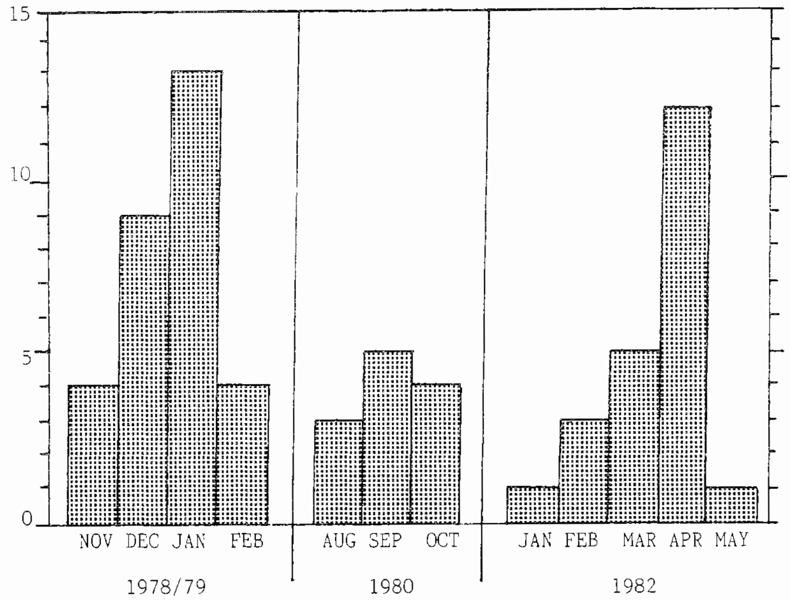


Figure 39. Frequency of observations of Venus by month for the western (morning) apparitions of 1978/9, 1980/1, and 1982.

Examining Figure 39, it is apparent that Venus was very sparsely observed during all three of these morning apparitions, but particularly so in 1980/1. Figure 39 also indicates that, with the possible exception of 1980/1, individuals began their programs for Venus very early in each apparition, with most observations near the times of greatest brilliancy and maximum elongation.

A limited number of drawings and photographs of Venus were submitted during each apparition, and examples of these appear as illustrations in order to clarify the descriptions in the text.

The following eight individuals submitted observations of the planet Venus during the three apparitions covered by this report:

Observer and Location	Number of Observations 1978/9	1980/1	1982	Instrument (Aperture and Type)
Benton, Julius L. New Hope, Pennsylvania . . .	6	3	2	8.3 cm. & 10.2 cm. Refr's.
Heath, Alan W. Nottingham, England.	19	4	2	30.0 cm. Newtonian Refl.
Hobdell, B. St. Petersburg, Florida. . .	-	1	-	20.0 cm. Newtonian Refl.
Hollis, A.J. Cheshire, England.	-	-	2	30.0 cm. Newtonian Refl.
Louderback, Daniel South Bend, Washington . . .	1	-	-	20.0 cm Newtonian Refl.
McNamara, Geoff Sutherland, NSW, Australia .	-	-	15	15.0-cm. Maksutov & 20.0-cm. Schmidt-Cass. Refl's.
Makstrowicz, M. Moisson, France.	-	-	1	7.5 cm. Refr.
Robothem, Robert Port Rowan, Ont., Canada . .	4	4	-	5.0 cm. & 8.3 cm. Refr's.
TOTAL.	30	12	22	-----

The author extends his warmest thanks to this team of observers for their dedicated, continued participation in the programs of the A.L.P.O. Venus Section. In view of the number of observers in other nations, our efforts are becoming truly international. We hope that this trend will continue, and American observers are encouraged to participate in programs of similar nature coordinated by organizations like the A.L.P.O. overseas.

Visual Observations of Apparent Surface Details

Earlier reports which have appeared in this Journal have given detailed summaries of the usual procedures for making visual investigations of the planet Venus. Such methods have also been thoroughly discussed in the various Venus Section pamphlets [2]. The novice is encouraged to study the available literature in order to gain an appreciation of the problems in observing Venus. Of course, the author will be delighted to assist the reader in the interpretation and understanding of the data accumulated by A.L.P.O. Venus observers.

As mentioned above, coverage of Venus was rather poor during each of the three apparitions described here. It is worth noting that Venus was observed in a generally twilit sky for most of each of these three periods. Past reports for Venus, containing a greater number of observations, have categorized dusky markings and bright atmospheric phenomena as "Banded", "Radial", "Irregular", and "Amorphous" Dusky Markings, and "Terminator Shadings", "No Markings", and "Bright" Spots or Regions (exclusive of the cusps). A quantitative treatment usually followed, giving the percentages of the total observations which could be placed into thse categories. Because of the paucity of observations, particularly drawings, for the 1978/9, 1980/1, and 1982 western apparitions, such a statistical breakdown was simply impossible in this report. Analysis, however, has produced some limited but useful quantitative results that should be of interest to anyone who has been following Venus.

Most of the observations that were submitted for these three apparitions indicated that the disk of Venus was devoid of any shadings or markings. This impression was not unusual, because both novice and experienced observers frequently have reported Venus as a completely blank disk, regardless of aperture. Any dusky features that were detected, and depicted on drawings, throughout these three morning apparitions could only roughly be grouped as "Amorphous Dusky Markings," and individuals generally agreed that such features were quite ill-defined, with indefinite boundaries, and without distinct form. Seeing conditions were often very poor, and the confidence level with respect to the actual presence of shadings in Venus' atmosphere was correspondingly low, independent of aperture. The average intensity of suspected dusky shadings was about 8.0 for all three apparitions, using the "Standard A.L.P.O. Visual Numerical Intensity Scale," where 0.0 represents black (shadws) and 10.0 refers to the brightest features of all. The bright illuminated hemisphere of Venus, for all areas lacking the categorized featuers mentioned ealier, had an average intensity of 8.2 to 8.5 during the apparitions in question, so the inconspicuousness of the amorphous features at 8.0 should be obvious.

All photographs that were submitted for these three apparitions were taken at visual wavelengths, and they all depicted the disk of Venus as totally featureless. Photography of the planet, like visual drawing, was carried out under less-than-desirable seeing conditions.

Bright spots and regions, except the cusp regions and the bright limb band areas, were rarely noted during any of the three apparitions; when suspected in rather poor seeing, their average intensity was about 9.0. Photographs did not indicate any bright spots or regions during these three apparitions.

It is useful to note the range of phase value ($\underline{k}$) for Venus. $\underline{k}$ is the ratio of the apparent illuminated area of the disk to the total disk circle area as seen from Earth, ranging from 0.0 when Venus is at inferior conjunction to 1.0 when at superior conjunction. For the period of observational coverage in each apparition, $\underline{k}$ varied as follows [1]:

1978/9 Western Apparition. . . 1978 NOV 20 - 1979 FEB 08; $\underline{k}$ = 0.050 - 0.598

1980/1 Western Apparition. . . 1980 AUG 16 - 1980 OCT 05; $\underline{k}$ = 0.449 - 0.686

1982 Western Apparition. . . . 1982 JAN 10 - 1982 MAY 02; $\underline{k}$ = 0.047 - 0.634.

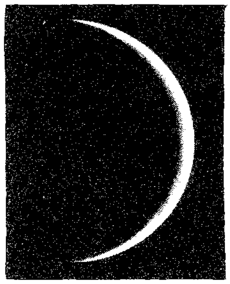


Figure 40. Drawing on 20 NOV 1978, at 07:30 U.T. 30-cm. Refl. (reflector), 190X. Seeing 4 (on a 0-10 scale). k (phase) = 0.05. (All Venus illustrations have south at the top.)

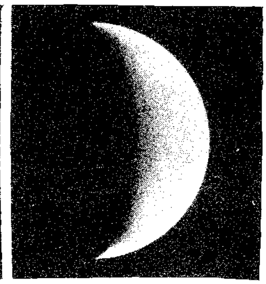


Figure 41. Drawing on 16 DEC, 1978, at 09:00 U. T. 30-cm. Refl., 190X. Seeing 4; k = 0.28. Note northern cusp cap.

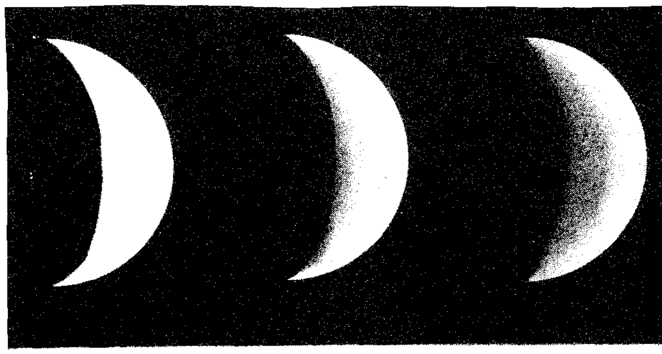


Figure 42. Multicolor drawings on 17 DEC 1978, 08:50 U.T. 30-cm. reflector, 190X. Seeing 3; k = 0.29. The bright limb band is most prominent with the blue filter.

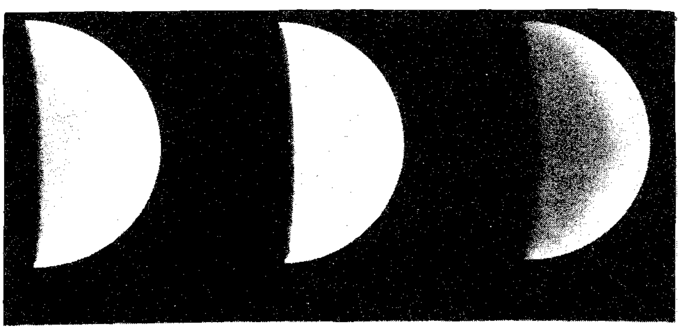


Figure 43. Multicolor drawings on 13 JAN 1979, 08:00 U.T. 30-cm. Refl., 190-318X. Seeing 3; k = 0.47.

The above data show that each of the three observing periods included the date of theoretical dichotomy, when k = 0.500. Venus was not observed near full phase because k never exceeded 0.686. Dichotomy observations are discussed later.

Some of the amorphous markings reported on Venus during the three apparitions. as elusive as they were, were apparently associated with the terminator of the planet. The contribution of these features to terminator shading was not clear. An ill-defined terminator shading, extending from cusp to cusp, was reported in poor seeing conditions during 1978/9, 1980/1, and 1982, having an overall intensity of 7.5 and showing a gradation toward lighter intensity as the distance sunward from the terminator increased. Terminator shading was not readily apparent on photographs taken during these three apparitions, but it was shown on drawings.

At times throughout the apparitions, Venus was observed with color filters, and the use of these accessories often helped to enhance the visibility of shadings and other ill-defined atmospheric features if the filters were

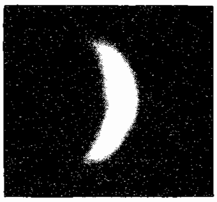


Figure 44. Photograph by Alan W. Heath on 15 FEB 1982, 06:50 U.T. 30-cm. Refl. 318X (eyepiece projection), 1/25-sec. Exposure. $\underline{k}$ = 0.17.

not too dense, or used with too high a magnification. Such filters were not used frequently enough to make analytical studies possible. Such colorimetric work with filters of known wavelength characteristics systematically applied to Venus can be valuable, and the reader is encouraged to do so.

Cusps, Cusp-Caps, and Cusp-Bands

Generally, the most conspicuous features on Venus are seen at or near the cusps, frequently when the phase of the planet lies between $\underline{k}$ = 0.1 and 0.8. Cusp caps, as these features are often called, are occasionally visible, and are frequently bounded by dark, somewhat diffuse cusp-bands.

The scarcity of observations precluded statistical studies of cusp phenomena. In contrast with the 1978/9 apparition, the cusp-caps were seldom seen on the few dates that Venus was observed in 1980/1 and 1982. When seen during the latter two apparitions, observers noted in marginal or poor seeing that the two cusp-caps were equal in intensity, averaging about 9.7, were similar in shape and form, and devoid of associated cusp-bands. No reports were received for 1980/1 or 1982 in which individuals indicated a single cusp-cap in the northern or southern hemisphere of Venus.

It was during the 1978/9 apparition that reports of cusp-caps were more plentiful, with the northern cusp-cap being consistently slightly brighter (0.3 intensity) than its southern counterpart. Aside from this difference in intensity, the two cusp-caps appeared similar in overall shape and form, and there were no obvious cusp-bands reported. The intensity of the cusp-caps in 1978/79 was about 9.8, when both were averaged. Seeing conditions were poor in 1978/9, as in 1980/1 and 1982.

Extension of the Cusps

No extensions of the cusps of Venus were reported for the 1978/9, 1980/1, and 1982 apparitions, and these phenomena were not apparent on photographs or drawings.

Bright Limb Band

Most of the observations in the three apparitions called attention to the bright limb band opposite the terminator of Venus. In all three periods, the average intensity of this feature, which was generally narrow and continuous from cusp to cusp along the illuminated limb of Venus, was 9.6 . As in past apparitions, the visibility of the bright limb band in 1978/9, 1980/1, and 1982 was independent of the appearance of the cusp-caps.

Terminator Irregularities

The terminator of Venus is the geometric curve separating the illuminated and the dark hemispheres of the planet, and displayed only minor deformations throughout all three of the morning apparitions covered here. No statistical analysis was possible due to the small number of observations.

Ashen Light and Other Dark-Side Phenomena

No reports of visible or suspected dark-hemisphere phenomena on Venus were submitted for 1978/9, 1980/1, or 1982.

Estimates of Phase and Date of Dichotomy

The "Shroeter Effect" of Venus, a discrepancy noted between the predicted and observed dates of dichotomy or half-phase, was noted in 1978/9 and 1982 but not in 1980/1. The predicted dates of dichotomy (when k = 0.500, and the phase angle, i = 90 Deg.) as calculated by the author from the appropriate ephemeris for each apparition, were [1,3]:

1978/9 Western (Morning) Apparition . . . 1979 JAN 18, 03h.6 U.T.
1980/1 Western (Morning) Apparition . . . 1980 AUG 24, 09h.8 U.T.
1982 Western (Morning) Apparition . . . 1982 APR 02, 14h.6 U.T.

For the same periods, the observed dates of dichotomy were:

1978/9 Western (Morning) Apparition. --Mr. Alan W. Heath of Nottingham, England, using a 30.0 cm. Newtonian at 190X in twilight, reported:

> The determination of dichotomy date proved difficult due to an interruption of observations by bad weather at the critical time. The closest observation to theoretical dichotomy was that of January 13 at which time (18h 00m UT) the terminator was definitely concave. In poor seeing I next observed on January 24 (07h 30m UT) and felt that the terminator was straight in no filter and yellow although the cusps were slightly rounded. It would seem that dichotomy was later than predicted by nearly a week.

1980/1 Western (Morning) Apparition. --No definitive observations.

1982 Western (Morning) Apparition. --Apparent dichotomy was reported on 1982 APR 14, 07h.4 U.T. by Mr. Geoff McNamara of Sutherland, N.S.W., Australia, using a 20.0 cm. Schmidt-Cassegrain at 160X and a 15.0 cm. Maksutov at 128X, employing orange, neutral density, and blue filters and integrated light. This gives a discrepancy of + 11d 16h.8 (observed minus predicted).

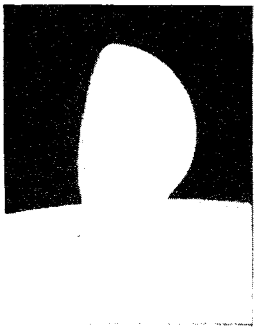
An Occultation of Venus in 1980

A rather beautiful and interesting lunar occultation of Venus, followed by one of the bright star Regulus, took place in the British Isles on the morning of 1980 OCT 05. Neither event was observable from the United States, and only one report of the Venus event was received from the United Kingdom.

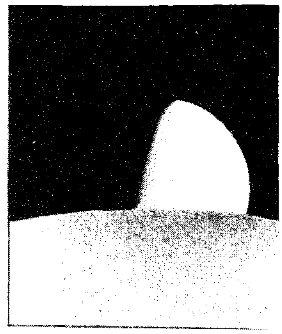
Mr. Alan W. Heath of Nottingham was observing Venus during the early morning hours of 1980 OCT 05 using his 30.0 cm. Newtonian at 190X and 318X in fairly good seeing and integrated light. Heath remarked that the skies were relatively clear, with only light haze and patches of clouds. Moonrise took place at 01:58 U.T., and Heath prepared to observe the phenomenon at about 05:00 U.T. It is of special note that some ephemerides had predicted a total occultation of Venus for British observers located north of 52 Deg. N latitude. With Heath's observing station at about 53 Deg. N, near the northern limit of the partial occultation phases, it was likely that he would be able to observe a total occultation of Venus. In fact, he did record both the disappearance and reappearance of Venus, and his observational notes are worth summarizing (all times are 1980 OCT 05, U.T.):

05:12 . . . Venus very close to the Moon.
05:21 . . . Venus estimated to be 2-1/2 Venus-diameters from the lunar limb, the differences in brightness between Venus and the Moon being most striking.
05:26 . . . First Contact: Venus' northern cusp in contact with the Moon's limb.
05:27 . . . Estimated 1/10 of Venus hidden by limb of Moon.
05:28 . . . Almost half of Venus now hidden.
05:29.5 . . Estimated 1/6 of Venus still visible.
05:30 . . . Just the extreme southern cusp of Venus detected, and it "looked like a brilliantly lit lunar mountain peak just before extinction."
05:30.5 . . Second Contact: Venus invisible now.
05:40 . . . Third Contact: Reappearance of Venus.

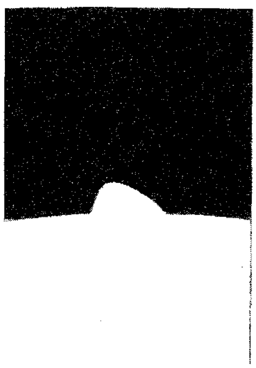
The total occultation, as seen from Heath's location, lasted about 9.5 minutes. Several photographs and drawings by him appear on page 84 as Figures 45 and 46.



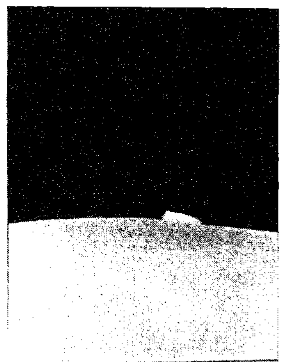
$05^h 27^m$



$05^h 28^m$



$05^h 29\frac{1}{2}^m$



$05^h 30^m$

Figure 45. Sequential drawings by Alan W. Heath of the immersion of Venus from its occultation by the Moon on 05 OCT 1980. 30-cm. reflector, 100X.

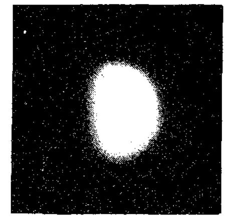


Figure 46. Photograph by Alan W. Heath of Venus after emersion from lunar occultation; 05 OCT 1980, at 05:49 U.T. 30-cm. Refl., 318X (eyepiece Proj.), 1/10-second Exp. on HP-5. $\underline{k}$ = 0.69.

Conclusions

Although Venus was sparsely observed during the three western apparitions of 1978/9, 1980/1, and 1982, some very interesting observations were made. Also of interest was the account by Heath of the occultation of Venus by the Moon in October, 1980, even though some might question the scientific value of such an observation. Certainly, much of the fascination and enjoyment of astronomy is derived from viewing such spectacles simply for their esthetic qualities. From a more scientific perspective, the dichotomy estimates continue to be worthwhile, as do continued observations of Venus' atmospheric phenomena. Individuals are encouraged to participate in our visual and photographic pursuits and the writer will be pleased to provide information and assistance to those with a sincere interest in becoming a part of our program.

Finally, the author is grateful to those individuals who helped make this report possible by means of their continued support and participation.

References

1.) U.S. Naval Observatory, American Ephemeris and Nautical Almanac. Washington, DC: U.S. Government Printing Office, annual publication. The 1978, 1979, 1980, 1981, and 1982 volumes were used for this report.

2.) Benton, Julius L., An Introduction to Observing the Planet Venus. Savannah, GA: Review Publishing Co., Inc., 1973.

3.) Meeus, Jean, "Theoretical Dichotomy of Venus, 1960-2000." J.B.A.A. , 90 (5), 1980, 442-443.

BOOK REVIEWS

Halley's Comet, 1755-1984: A Bibliography. Compiled by Bruce Morton. Greenwood Press, 88 Post Road West, Box 5007, Westport, CT 06881, 1985. 280 pages, price $ 35.00.

Reviewed by David H. Levy

How timely it is for a general reference source about Halley's Comet! Published just last March, Halley's Comet, 1755-1984: A Bibliography will probably become one of the most useful of the dozens of Halley books now orbiting the comet sphere.

This bibliography covers books, articles, newspaper editorials, poems, and scientific papers. Arranged by year, each entry contains standard bibliographic data, as well as having a consecutive number for easy finding and cross referencing.

Obviously the compiler, Bruce Morton, has done an enormous amount of reseach in his field. Head Reference Librarian at Montana State University, Morton has brought his dual expertise in bibliographic methods and in comets to perform a valuable service. The 1301 entries bring to the reader the dimension of the scope of literature about this famous comet.

Perhaps the most valuable part of this reference is the annotations. Each entry contains several lines of description, normally in the style of the work cited, so that we can understand both the content and the style of each cited reference. The annotation does something else, however; it gives us the chance to read through this source as a book on its own, rather than as an index that refers us to something else. An evening spent reading these annotations helps us to follow the road of progress of our understanding of comets, from both scientific and social standpoints.

The only problem that I encountered was the compiler's decision to list all entries chronologically without regard to their genre. The result is, on some pages, a hodgepodge of entries in which serious scientific studies are listed along with articles of lesser importance. For example, entry 1271, Stephen Edberg's famous International Halley Watch Amateur Observer's Manual , and entry 1275, David Yeomans' classic The Comet Halley Handbook , are followed by references, of equal length, about a Halley's Comet Society which toasts the comet every year (entry 1277) and several entries relating to selling comet memorabilia. I realize that these entries are important to our understanding the social effects of the comet's many appearances, and do not object to their inclusion, but I wish that some way could be found, perhaps even through the numbering system, to differentiate the scientific and educational entries from those more frivolous.

That one difficulty aside, I recommend this book highly. It provides fascinating reading, which is most unusual for a bibliography. If you have a serious interest in any of the scientific or social aspect of comets, this book is an absolute must for your library.

Measuring the Universe. By Albert Van Helden. The University of Chicago Press, 5801 S. Ellis Ave., Chicago, IL 60637, 1985. viii + 203 pages. Price $ 30.00.

Reviewed by William G. Dillon

Albert Van Helden has written a fascinating and scholarly account of Western man's quest to measure the universe he inhabits. The time period covered is from the Third Century B.C. to the mid-Eighteenth Century A.D. After an overview in Chapter 1, Van Helden covers the contribution of the Greeks in Chapter 2. The solstice-shadow method of Eratosthenes forged the first link in the astronomical distance chain by measuring the Earth's radius. The eclipse diagram of Aristarchus and his method of lunar dichotomy formed the basis for estimating the relative and absolute distances to the Sun and Moon for the next two thousand years!

Chapters 3 and 4 examine the incredible impact of Ptolemy, whose work became dogma for the next millennium and a half. Not only did Ptolemy provide the model and mathematical framework for predicting planetary positions, he was also the source for the planetary distances and sizes that were the heritage of all educated Europeans.

Chapters 5 and 6 cover the beginning of the end for the Ptolemaic system with the work of Copernicus, Tycho, and Kepler. From the heliocentric theory of Copernicus, the relative distances and order of the planets followed. The problem then was to measure the true distance between any two objects in the Solar System in order to establish an absolute scale. This was to be a major preoccupation and frustration for succeeding generations of astronomers.

Tycho recorded stellar and planetary positions with the most accurate instruments of his time. Tycho's observations led Kepler to his three laws of planetary motion and placed a lower limit on the distance to the stars more than an order of magnitude greater than in the accepted Ptolemaic model. Galileo noted that the telescope had shown that the accepted angular sizes of the planets were gross overestimates. Nevertheless, it was not until the transit of Mercury in 1631 that these errors became widely evident.

In the remaining chapters Van Helden discusses the impact of the micrometer and of attempts to measure the parallax of Mars (and thus to establish an absolute distance scale). Though historians generally credit Cassini or Flamsteed in 1672 with successfully measuring the parallax of Mars, Van Helden argues that instrumental errors swamped the quantity being measured. The absolute scale was not reliably measured until the 1761 and 1769 transits of Venus.

The author conveys the sweep and drama of this history in clear, clean prose. At times his book reads like a detective novel as the latest findings in historical astronomy fit into place. The book is thoroughly documented with nearly 600 references cited, 13 figures, 19 tables, and an extensive Bibliography and Index. I highly recommend this book to anyone with the slightest interest in the history of astronomy.

IN MEMORIAM: PETER HEDERVARI, 1931-1984.

On June 27th last year, the A.L.P.O. lost one of its most active and influential members, Dr. Peter Hedervari. Born in Budapest in 1931, he passed away from a heart attack at the relatively young age of 53.

After finishing secondary school, he studied at the Mathemathics Department of Eotvos Lorand University; then he joined the Budapest Geographical and Cartographical Institute, and later the Eotvos Lorand Geophysical Institute. In 1963 he became Chief Librarian at the Gamma Precision Scientific Instruments factory. Also, starting in 1968, he was a columnist for the weekly popular scientific and technical magazine Elet es Tudomany (Life and Science).

He received a Master's of Arts degree in Geography at Eotvos Lorand University in 1969, and his Doctoral degree in 1970. From 1972, he was a full-time freelance science writer. A tireless science popularizer and writer, beginning in the 1950's he published over 2000 short articles in major magazines and newspapers. His main interests were astronomy and geophysics, followed by space research, meteorology, geography, and paleontology. This energetic man also produced some 15 books!

After the death of his wife, Georgiana, he named his private observatory for her, there observing comets, sunspots, and the Moon. His lunar work included serving for several years as Vice-President of the International Lunar Society. Recently, he became interested in lunar photometry, and A.L.P.O. members may wish to refer to articles by him in our Journal : "A Proposed Photoelectric Program for A.L.P.O. Lunar Observers" (29 , 7/8 [August, 1982], 147-150), and "On the Albedos of Some Lunar Features" (30 , 1/2 [June, 1983], 9-10), as well as his contribution of Chapter 4, "Lunar Photometry," in the Solar System Photometry Handbook (Russell M. Genet, ed.,1983, 4-1 - 4-20).

Unfortunately, Dr. Hedervari will not see Comet Halley, although he had made extensive plans to observe it both visually and photographically, and he undoubtedly would have made a valuable contribution in this area, as he had already done in so many others.

(The editor thanks Mr. Janos Papp of Budapest, Hungary, for many of the details in the above obituary.)

NOTIFICATION: A.L.P.O. DIRECTOR/EDITORSHIP

Professor Walter H. Haas, the Founder and Director/Editor of the Association of Lunar and Planetary Observers, is suffering from a spinal ailment which has restricted his activities. However, members will be pleased to know that his initial serious condition has improved to the extent that he is currently resting at home and doubtless would appreciate receiving personal mail and cards at his home address (given for our Librarian, Mrs. Haas, on our inside back cover).

At present, however, he is unable to maintain the laborious task of A.L.P.O. Director/Editor, and has transferred these duties to the Acting Director/Editor John E. Westfall (address on inside back cover). Prof. Haas remains active in an advisory capacity and has the title "Founder/Director Emeritus." Until further notice, all A.L.P.O. business correspondence, including subscriptions, inquiries, and manuscripts, should be addressed to Dr. Westfall at the address given for him.

Despite the obvious difficulties caused by these recent events, we plan to conduct "business as usual" and, with this issue, to resume our normal quarterly publication schedule. I am sure all of us join in wishing Walter Haas a speedy recovery.

ANNOUNCEMENTS

Solar Section Given Permanent Status. All those attending the June 22, 1985, A.L.P.O. Business Meeting, at Tucson, Arizona, voted in favor of granting permanent status to the A.L.P.O. Solar Section (ALPOSS). Thanks to the efforts of Solar Section Recorder Richard Hill, together with Assistant Recorders Paul Maxson and Randy Tatum, this Observing Section has performed impressively, generating regular "Rotation Reports" every 27 days as well as special studies published here and elsewhere. These Solar Section staff members have also contributed a 1986 Solar ephemeris to the *A.L.P.O. Solar System Ephemeris* , described below.

Mailing Labels. A.L.P.O. subscription records have now been placed on computer files. Beginning with this issue, the first line of each mailing label will give the volume and issue number of the expiration of subscription for each person receiving this *Journal* . For example, if your subscription expires with this issue, the code will read "31.04", indicating Volume 31, Nos. 3/4. Please inform the Acting Director/Editor if you feel that this information is incorrect.

A.L.P.O. Staff Address Changes. Besides the Director/Editor changes described in the Notification above, the following staff have changed their mailing addresses:

Mr. Phillip W. Budine, A.L.P.O. Jupiter Recorder, now resides at: 2 Hillside Terrace, Walton, NY 13856.

The A.L.P.O. Lunar Recorder for Lunar Transient Phenomena, Mrs. Winifred S. Cameron, now is located at: La Ranchita de la Luna, 200 Rojo Drive, Sedona, AZ 86336.

1986 A.L.P.O. Convention. At the Tucson A.L.P.O. Business Meeting, in June, 1985, those attending voted unanimously to accept the invitation of the Astronomical League to join them at ALCON'86 , to be hosted by the Baltimore Astronomical Society on August 6-10, 1986. The meeting will be held on the Johns Hopkins University campus in Baltimore, and will include the participation of the Space Sciences Institute, in honor of the launch of the Space Telescope. Future issues of this *Journal* will give further details.

New Publications of the A.L.P.O. Copies of the Lunar Photoelectric Photometry Handbook are available from Lunar Recorder John E. Westfall (address on the inside back cover) at a cost of $ 4.00. This 43-page booklet describes how to conduct and reduce accurate photoelectric observations of local lunar areas, with computer programs, and a catalog and maps of 298 lunar comparison sites.

A second publication, expected to be available in October for $ 5.00, is the first issue of the A.L.P.O. Solar System Ephemeris, for 1986. About 80 pages in length, it gives basic data for the Solar System, and predictions, intended for observers, for Solar and Lunar eclipses, the Sun and Moon, the major planets and satellites, minor planets, meteors, and comets. For further information, write the Acting Director John E. Westfall (address on inside back cover).

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

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