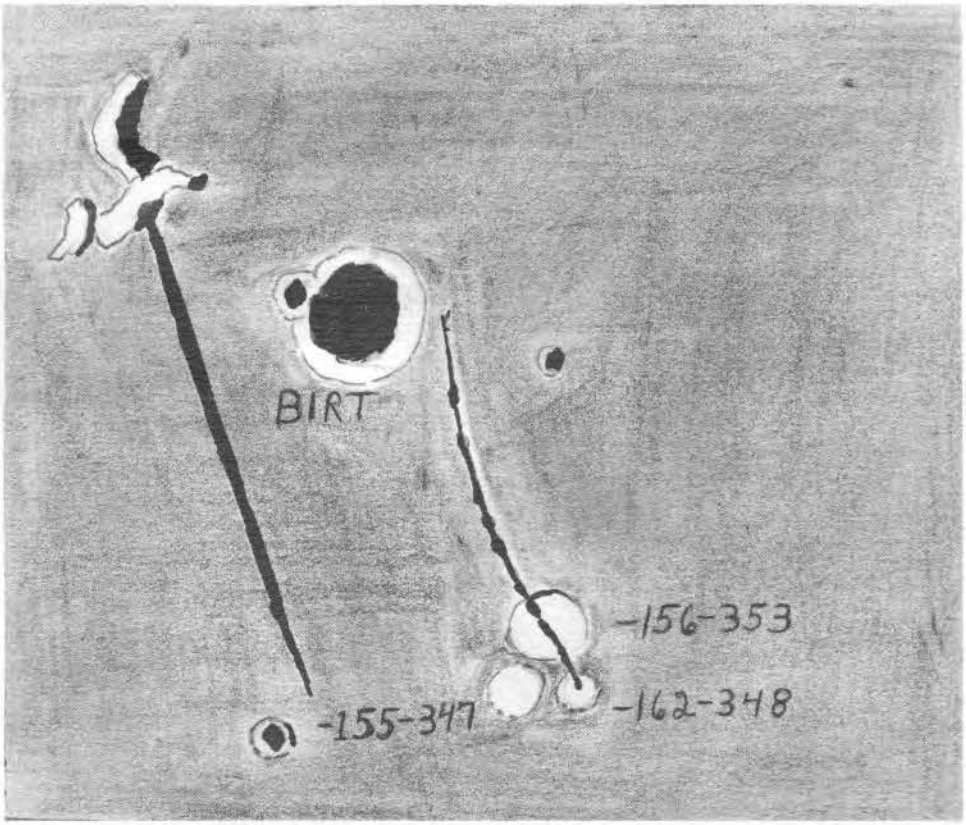
The Journal Of
The Association Of Lunar
And Planetary Observers

The Strolling Astronomer

Volume 22, Numbers 9-10 Published November, 1970



Drawing of three lunar domes north of Birt and west (IAU sense) of the Straight Wall by Reverend Kenneth J. Delano on March 8, 1968 at 1 hr., 30 mins., Universal Time. 12.5-inch reflector at 300X. Lunar south at top, lunar west at right. Colongitude 12.3 degrees. See also text on pages 172-174. This drawing is a sample of the work of the ALPO Lunar Dome Survey.

THE STROLLING ASTRONOMER
Box 3AZ
University Park, New Mexico
88001

Residence telephone 524-2786 (Area Code 505)
in Las Cruces, New Mexico

Founded In 1947

IN THIS ISSUE

OCCULTATION OF TWO GALAXIES BY PLUTO

By: James W. Young, ALPO Remote Planets Recorder

During the last few days of October, 1970, the planet Pluto will pass in front of two faint galaxies in the constellation Coma Berenices. From "A Survey of the External Galaxies Brighter than the Thirteenth Magnitude", by Shapley and Ames (1932), these two galaxies, NGC 4298 and 4302, are 12.5 and 13.2 photographic stellar magnitude, respectively. NGC 4302 is seen nearly edge-on. Referring to Figure 1, the dimensions and position angles of the two galaxies were taken from the blue plate of the Palomar Sky Survey Chart of that area, also illustrated. The positions of the galaxies were precessed from G. Bigourdan ("Annales de l'Observatoire de Paris: Observations 1906", Paris, 1912) to 1950.0. Pluto will be approximately 14.0 visual stellar magnitude.

Although, under the most ideal conditions, Pluto can be seen in a 6-inch telescope, it is recommended that persons with 10-inch apertures or greater attempt observations of this event. The two galaxies are extended objects; therefore their appearance will be smaller than the outlines shown, and somewhat dimmer than the magnitudes indicated.

The area in Coma Berenices will rise at 3:00 A.M. local time; and astronomical twilight will begin at 4:51 A.M. local time, both for 40° north latitude. It is suggested that serious observers find suitable mountain top observing sites since the area will be low in the east before dawn.

Pluto will be about 24" north of NGC 4298 at 14^h U.T. on October 28. This event will be seen best from the Western Hemisphere, locally, in the western part of North America and in Hawaii. The nearly central occultation of NGC 4302 will occur at 22^h U.T. on the following day, best for the Eastern Hemisphere.

Observations of these events forwarded to the address below will be most appreciated and will be considered in any results to be published at a later date.

James W. Young
A.L.P.O. Remote Planets Recorder
Table Mountain Observatory
Jet Propulsion Laboratory
P. O. Box 367
Wrightwood, California 92397, U.S.A.

THE 1967-68 APPARITION OF JUPITER

By: Paul K. Mackal, ALPO Jupiter Recorder

Preface

Twenty-five observers contributed nearly 450 observations of Jupiter during a very active period from early October of 1967 through late June of 1968. Opposition was on February 20, 1968.

1. List of Visual Contributions

(1) P. W. Budine; Binghamton, N. Y.; 10-inch reflector; 4 strip sketches.
(2) J. Dragesco; Cameroons, Africa; 10-inch reflector; 58 full discs.
(3) R. Fite (& T. Preslar); Landis, N. C.; 8-inch reflector; 56 full discs.
(4) R. Gordon; Barrington, N. J.; 3½-inch refractor; 7 full discs.
(5) T. Hasebe; Hiroshima, Japan; 15-cm. reflector; 62 full discs.
(6) A. W. Heath; Nottingham, England; 12½-inch reflector; 5 full discs and an intensity report.
(7) R. Henke; Boulder, Colo.; 10½-inch refractor; 7 full discs.
(8) B. Hicks; Arlington, Va.; 6-inch reflector; 2 full discs.
(9) K. Kriscuinas; Naperville, Ill.; 6-inch reflector; 86 full discs.
(10) D. Louderback; South Bend, Wash.; 8-inch reflector; 2 full discs.
(11) P. K. Mackal; Mequon, Wisc.; 6-inch reflector; 3 full discs and two verbal reports.
(12) E. Mayer; Barberton, Ohio; 15.6-cm. reflector; 3 full discs.
(13) B. Moser; Connellsville, Pa., 8-inch reflector; 10 full discs.
(14) C. M. Norcutt; Conklin, N. Y.; 6-inch reflector; 1 full disc.
(15) T. Osawa; Awaji Island, Japan; 20-cm. reflector; 3 full discs.
(16) J. H. Phillips, Charleston, S. C.; 6-inch reflector; 11 full discs.
(17) T. Preslar (& R. Fite); Landis, N. C.; 8-inch reflector.

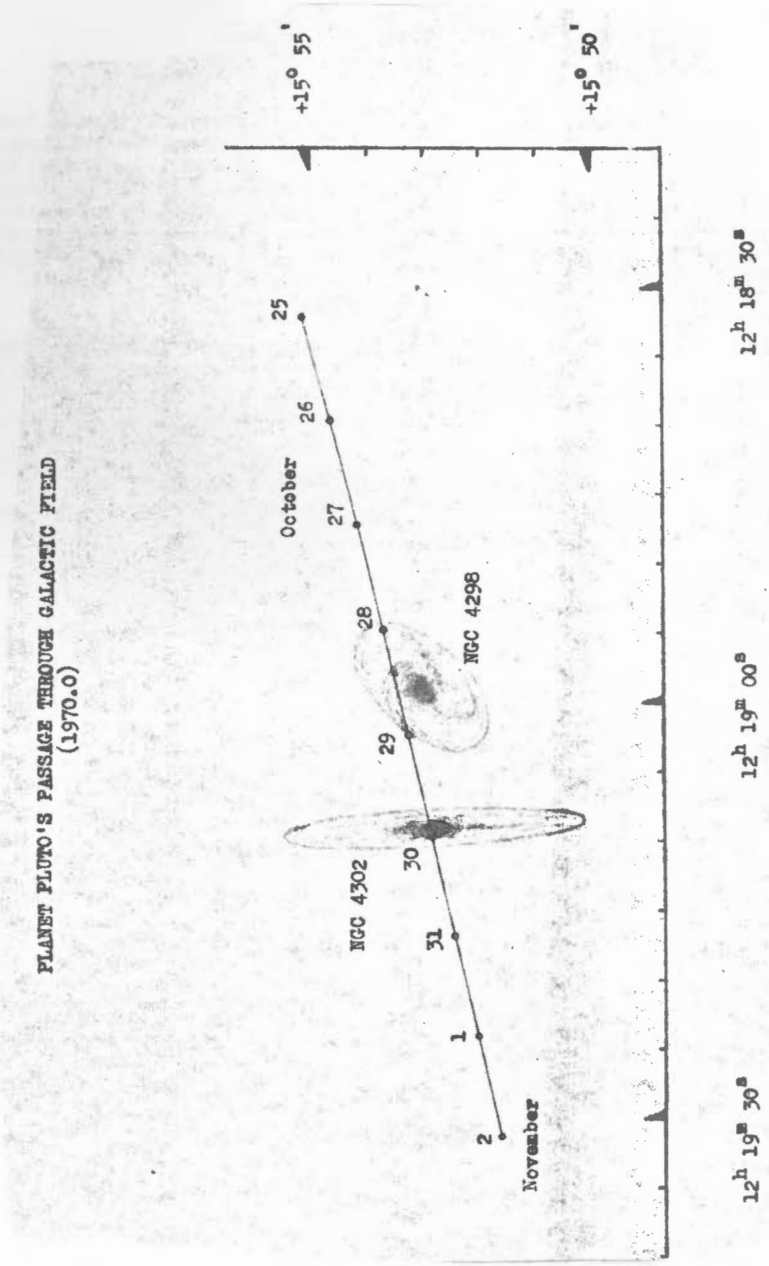


Figure 1. Chart showing passage of the planet Pluto in front of two galaxies in late October, 1970. Contributed by Mr. James W. Young. See also text of Mr. Young's article on pg. 145.

(18) T. Sato; Hiroshima, Japan; 15-cm. reflector; 39 full discs and one strip sketch.
(19) J. Starbird; Topeka, Kans.; 6-inch reflector; 2 full discs.
(20) R. N. Stewart; Indianapolis, Ind.; 10-inch reflector; 1 full disc.
(21) E. Thiede; Madison, Wisc.; 15.6-inch refractor; 7 full discs.
(22) J. Vitous; Riverside, Ill.; 8-inch reflector; 9 full discs.
(23) W. Wacker; Madison, Wisc.; 15.6-inch refractor; 8 full discs.
(24) W. Winkler; Suitland, Md.; 8-inch reflector; 14 full discs.
(25) W. Wooten; Gainesville, Fla.; 8-inch refractor; 3 full discs.

2. List of Photographic Contributions

(1) E. Thiede; Madison, Wisc.; 15.6-inch refractor; 96 negatives.
(2) J. Vitous; Riverside, Ill.; 8-inch reflector; 1 color transparency.
(3) W. Winkler; Suitland, Md.; 8-inch reflector; 4 color prints.

Continuity was rather good with many multiple observations. About 200 of the observations submitted were actually used in the analysis for this report.

3. Qualitative Aspects of Jupiter

North Polar Region

It was mostly gray and inactive with no remarkable changes in intensity. On Oct. 5, '67, Thiede noted a NNNNTB at 200° II across the entire planet. This was called the "North Polar Band" by E. J. Reese and had a very high northerly latitude. In March of 1968 the band was again seen by the Recorder. I also noted a somewhat weak brownish cast to the polar region.

North North North Temperate Belt

It appeared to border the polar region, as is often the case. It was weak in some regions and had definite preceding and following ends. The f. e. was noted by J. Dragesco at 7.5° II on Jan. 22, '68. He also noted the preceding end. T. Sato placed the p. e. at 174° II + 30° on Feb. 13, '68. It was weak and strong in places afterwards. It was obviously drifting and was displacing the sections across the disc. In mid-March the belt as a whole normalized and resumed a belt-like appearance. Wider portions also formed towards the end of the apparition.

North North Temperate Belt, South

Located in the NTeZ and marking off a zone between the NTB and itself, this belt was rather conspicuous and active with a p. e. near the RS longitude throughout Jan., Feb., March, April, and May. Sometimes it darkened and faded very noticeably. It turned out to move in NNTB current B, according to E. J. Reese.

North Temperate Zone

It was often shaded over but was bright for the most part during 1967-68. On Dec. 15, '67, a dusky column was noticed by Thiede between the NTB and the NNNTB in the region where the $NNTB_S$ subsequently formed. At this time both the NTeZ and the NTrZ were shaded a bit. The NTeZ was wide and featureless over the entire disc except where the $NNTB_S$ encroached upon it. From time to time there were weak fragments of a NNTB obliterating the $NNTB_S$ and the NNNTB just south of the NPR. The haze was not observed over the NTrZ at 189° II, according to Wacker. As opposition was approached, the zones became much more clear with a dusky patch remaining at 331° II $\pm$ 30°, according to Sato. This was confirmed by Heath at 303° II $\pm$ 30°. On April 10 Heath called the NTeZ "lightly shaded." By the 25th it was "hazy" only.

North Temperate Belt, North Tropical Zone, and North Tropical Zone Band

The NTB faded noticeably in small telescopes during the 1967-68 apparition. Thiede was first to pick it up on Oct. 3, '67, with the Washburn Observatory Refractor. On Oct. 19 the Recorder noted a very dark section of the NTB at 100° II. On Oct. 30 another such section was noted by Sato at 339° II + 30°. On Nov. 28 Stewart noted a hazy NTrZ and a rather broken NTB at 14° II $\pm$ 30°. Nearing opposition the belt looked conspicuous in larger instruments, but it was still rather faint by comparison to the other belts.

In Jan. of '68 Dragesco noted many kinds of features in the NTB--dark patches and spots imbedded in the belt, light regions on the north side, and fuzzy patches on the south side (which on New Mexico State University Observatory prints suggested a very faint NTB_S). White spots imbedded in the darker sections of the NTB on these prints suggested to José Olivarez a special effect, i.e., very dark sections are likely to be flanked in some way by very bright regions, and conversely.

Near opposition many dark stretches were noticed in the NTB by J. Dragesco, with a few weak spots indicating a dearth of NTB activity setting in at this time. The decline of the belt which followed heralded the fading aspect which was realized in 1969. (See JALPO, Vol. 22, pg. 77.) In small telescopes the belt was nearly lost by June of 1968, even taking into account the distance vector between earth and Jupiter. In the larger professional

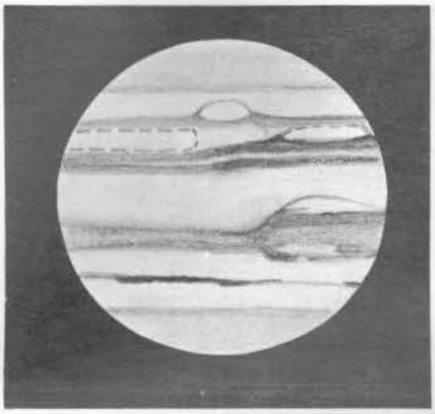


Figure 2. Paul Mackal; Oct. 19, 1967, 10:10 UT; CM 1 - 20°, CM 2 - 100°; seeing 6, transparency 4; 6-inch reflector, 212x. Note the SEB jog, the NEB, and BC.

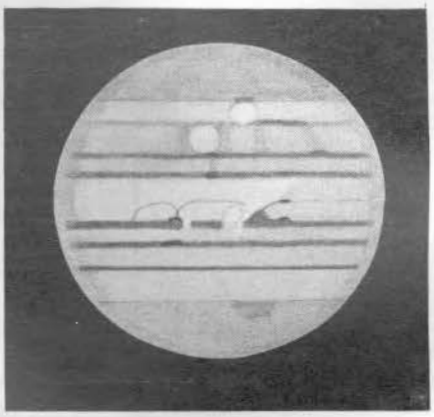


Figure 3. Eric Thiede; Dec. 19, 1967, 9:10 UT; CM 1 - 253°, CM 2 - 229°; seeing 9, transparency 3; 15.6-cm. refractor, 320x. Note STrZ activity and the dark SSTB over DE.

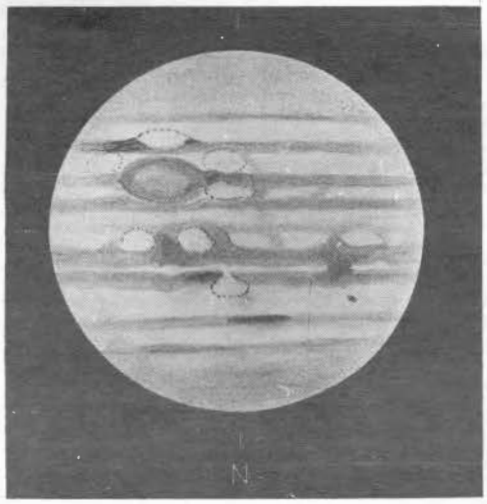


Figure 4. Jean Dragesco; Jan. 27, 1968, 1:16 UT; CM 1 - 6°, CM 2 - 48°; seeing 6, transparency 4; 10-inch reflector, 265x. Note BC in conjunction with the RS and SEBZ activity f. RS.

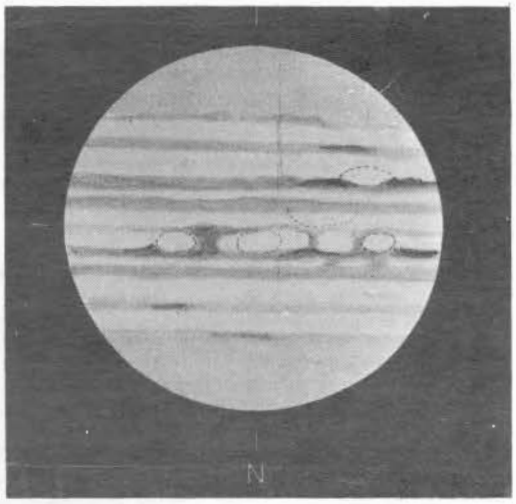


Figure 5. Jean Dragesco; Feb. 11, 1968, 22:47 UT; CM 1 - 284°, CM 2 - 204°; seeing 6, transparency 4.5; 10-inch reflector, 265x. Note white oval in STrZ on the SEBs.

instrument at New Mexico State University the activity was down, and fading was noticeable on prints shown to me by B. A. Smith and E. J. Reese. The NTB was very non-uniform in intensity by July.

The color of the belt was "fawn" to Heath and cooler prior to March of 1968, according to Mackal, than afterwards, when it warmed or reddened concurrently with the rest of the planet and the NPR.

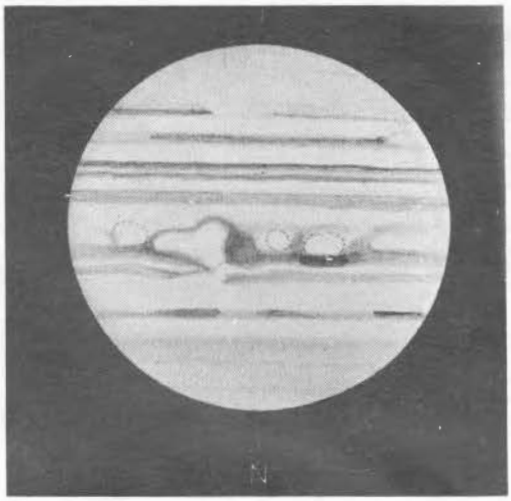


Figure 6. Jean Dragesco; Feb. 12, 1968, 0^h UT; CM I - 329°, CM 2 - 248°; seeing 6, transparency 3; 10-inch reflector, 265x. Note double SEB_s and NEB activity.

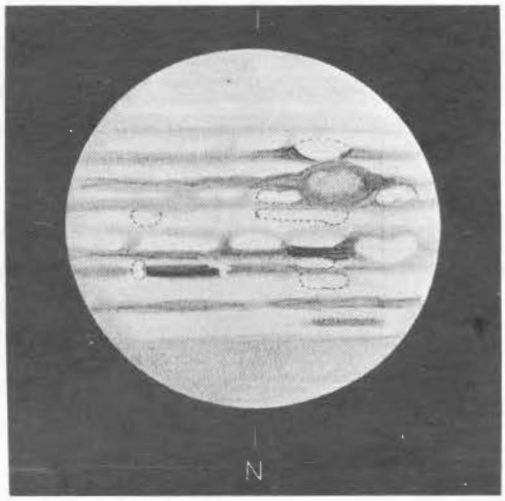


Figure 7. Jean Dragesco; Feb. 15, 1968, 0:34 UT; CM I - 102°, CM 2 - 0°; seeing 6, transparency 4.5; 10-inch reflector, 265x. Note dark sections in the NEB, SEBZ ovals, and $NNTB_s$ fragment.

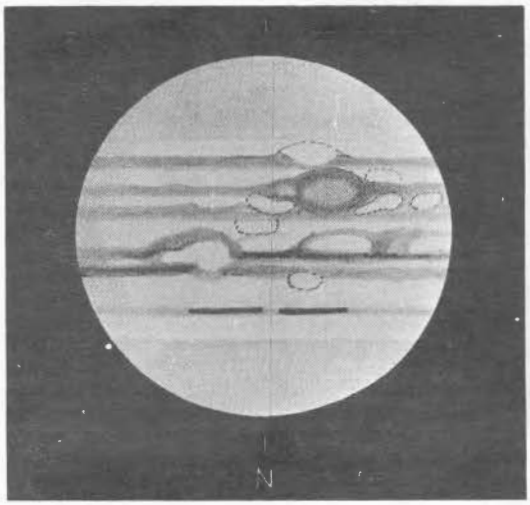


Figure 8. Jean Dragesco; Feb. 22, 1968, 21:22 UT; CM I - 171°, CM 2 - 7°; seeing 6, transparency 5; 10-inch reflector, 265x. Note SEB_s p. RS and SEBZ activity.

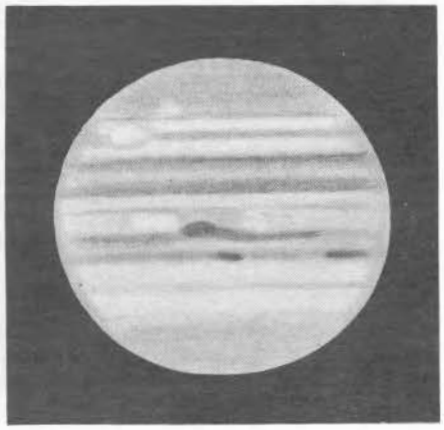


Figure 9. Alan Heath; March 2, 1968, 21:40 UT; CM I - 164°, CM 2 - 291°; seeing good; 12-inch reflector, 190-318x. Note dark SEB and FA.

The North Tropical Zone Band was visible again and was wholly disconnected from the NEB_n. It was very inactive and weak and was hardly noted except close to opposition.

North Equatorial Belt

The NEB complex, including the NEB_n, the NEB Z, and the NEB_s, was called "brownish

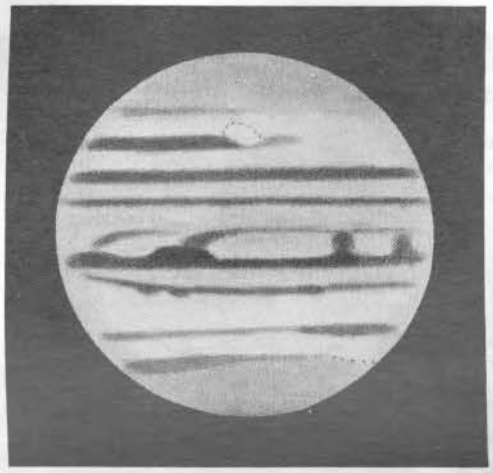


Figure 10. Takeshi Sato; March 3, 1968, 13:08 UT; CM 1 - 10°, CM 2 - 132°; seeing 5, transparency 4.5; 15-cm. reflector, 192x. Note dark NEB_s and weak STB f. DE.

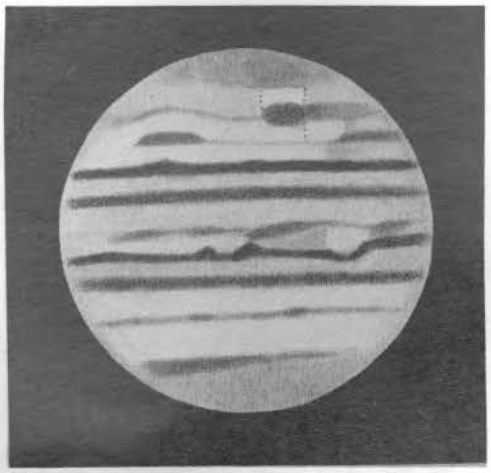


Figure 11. Takeshi Sato; March 4, 1968, 11:45 UT; CM 1 - 117°, CM 2 - 232°; seeing 6.5, transparency 4; 15-cm. reflector, 192x. Note EB, EZ_n activity, and weak STB.

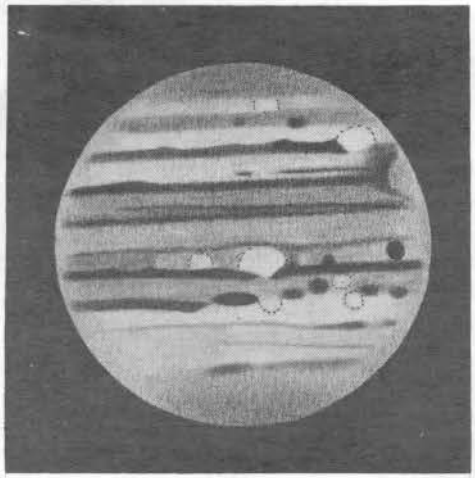


Figure 12. Takeshi Sato; March 9, 1968, 13:35 UT; CM 1 - 254°, CM 2 - 331°; seeing 5, transparency 4; 15-cm. reflector, 192x. Note activity over the entire equatorial region, the double SEB_n, and the STrZBd.

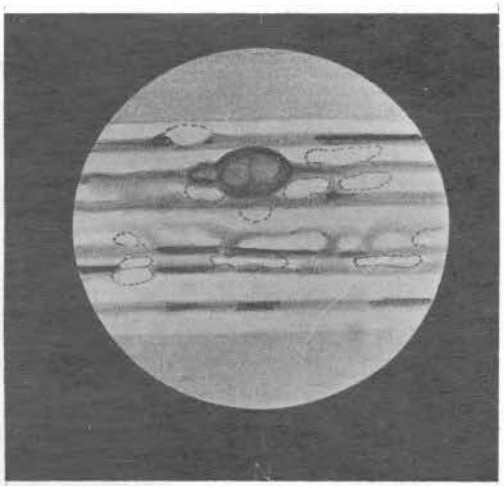


Figure 13. Jean Dragesco; March 10, 1968, 20:58 UT; CM 1 - 322°, CM 2 - 29°; seeing 8, transparency 4.5; 10-inch reflector, 265x. Note SEB and NEB activity. RS interior very weak and ring a dark brown.

fawn" by Heath at opposition but became remarkably warmer afterwards, according to Mackal and Dragesco. It appeared to this Recorder that 1967-68 was in fact the most active apparition for the belt in the 1960's. Indeed, a great deal of activity occurred elsewhere as well, especially in March, indicating an enormous sub-atmospheric eruption from the latitude of the NEB_n southward to the latitude of the SSTB. (In point of fact, a sub-atmospheric eruption entails a great deal of sub-visible interaction of material prior to its rising up to the visible atmospheric surface with visible reinteracting again of spots and

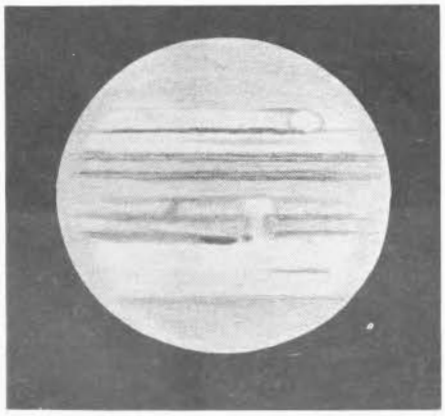


Figure 14. Wynn Wacker; March 31, 1968, 1:57 UT; CM 1 - 63°, CM 2 - 336°; seeing 5, transparency 4.5; 15.6-inch refractor, 320x. Note activity over the equatorial region, double SEB_s, double SEB_n, weak NTB, and dash p. BC.

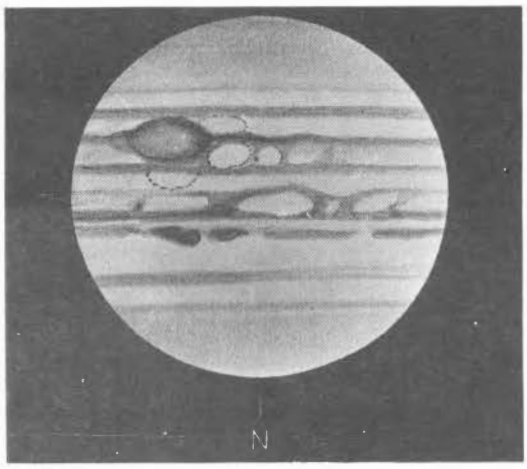


Figure 15. Jean Dragesco; April 13, 1968, 19:45 UT; CM 1 - 246°, CM 2 - 54°; seeing 7, transparency 3.5; 10-inch reflector, 265x.

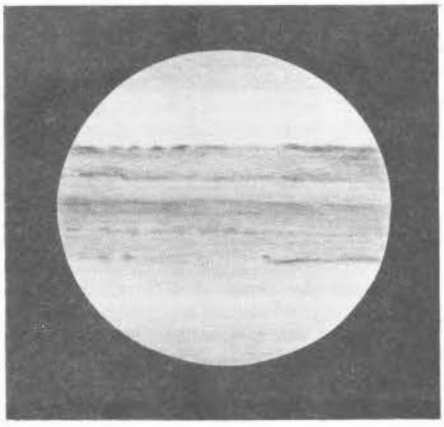


Figure 16. Joseph Vitous; April 16, 1968, 1:13 UT; CM 1 - 42°, CM 2 - 193°; seeing 6.5, transparency 5; 8-inch reflector, 360x. On the original the EZ_n is orange and the EZ_s is yellow.

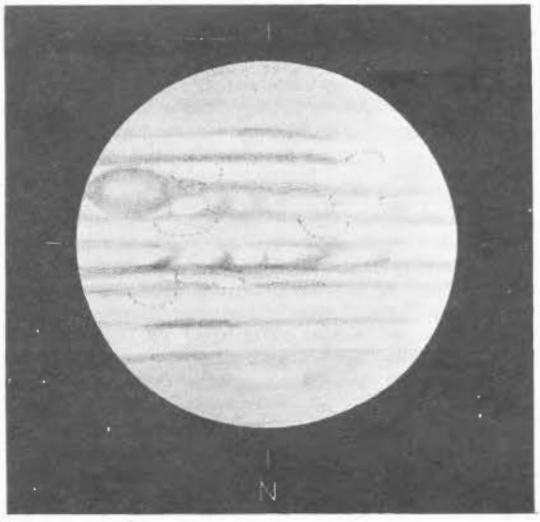


Figure 17. Jean Dragesco; April 23, 1968, 18:38 UT; CM 1 - 343°, CM 2 - 76°; seeing 8, transparency 4; 10-inch reflector, 265x. Note bright spot in the NPR.

speedy dissipation. Such a flare-up is very much different from a "disturbance" by being sudden and covering a rather large area but not continuing to erupt for several months afterwards. A "complex", on the other hand, is a series of eruptions in a restricted area which have definite time intervals of separation much smaller than those associated with consecutive "disturbances".)

By March 10, '68, the NEB was exhibiting its famous double aspect, which was in the process of forming and reasserting itself. Lighter patches were once again visible in the NEB Z. Both components were visible in the early part of the apparition prior to opposi-

tion but appeared to be very well formed after opposition and in the later half of the apparition. Light patches and hazes were noted early by Mackal and Sato. However, these were extended in longitude, and only in the RS region was the double aspect fully developed. Following the RS the NEB was undergoing the doubling aspect near 150° II in mid-December. (It thus appears evident that the time scale for the normalization of the NEB is on the order of half an apparition while that for the SEB is on the order of several apparitions, e.g., from 1966 through 1968.) Reese has said of several regions along the NEB and SEB during 1967-68: "Many spots on Jupiter appear to be manifestations of longer enduring disturbances at a lower level in the atmosphere. Individual spots will fade away, but other spots may later form in the same position." ("Latitude and Longitude Measurements of Jovian Features in 1967-68," E. J. Reese & H. G. Solberg, Jr., p. 15.)

By late January of 1968 the NEB was completely normalized with two components and a light uneven NEB Z on seven discs submitted by J. Dragesco. A few dark spots and some white ovals still connected the two belts, however. This continued to be the situation throughout February on eleven discs by J. Dragesco. Soon brilliant white spots could be seen in the NEB Z, which are shown very well on NMSUO prints by T. Pope. With the increase in activity noted in March, however, the NEB Z remained visible; and in fact the NEB appeared to be more classical in appearance. Gaps in the NEB_s, faint regions, and the like characterized the end of the upheaval which also entailed a brilliant revival of the EB. The NEB_s looked considerably brighter and more active than the NEB_n in this period following the upheaval. A region of confusion between the two components was seen by Henke at 101° I or 279° II on Feb. 25, '68. Dark "barges" were noted on the NEB_s and were of varying color, some very warm in tone. For Heath the belt was brown again by mid-April. The NEB was rather irregular preceding and following the RS region, according to Sato. Whether the NEB_n fed into the NEB_s or conversely is a matter of speculation. The belt was rather normal elsewhere. In May the NEB_s as a whole faded somewhat. However, in June there was a bit of color back again according to Mackal.

Equatorial Zone, north; Equatorial Band; and Equatorial Zone, south

An EB disturbance of considerable magnitude took place in 1967-68, and again it appeared to be formed by festoons from the NEB_s extending into the EZ. The festoons developed prior to the EB. However, the EB does not form strictly concurrently with an NEB upheaval. To some extent the EB itself is produced by sub-atmospheric eruption, which is much less significant or time-consuming in comparison to the March upheaval of the NEB. As long as we do not know what proportion of the EB darkness is directly related to the NEB eruption, we should keep the present nomenclature for the equatorial region of Jupiter.

In early 1968 and late 1967 the EZ was rather bright and highlighted a very weak EB. By January the EB could be traced across the entire planet. Heath regarded the EZ as "yellowish brown" at this time. Darker sections of the EB were related to darker parts of the NEB_s. By February 23, '68, the EB was widening out and was forming. It was rather faint in places, however. By mid-March the EB was "light orange", according to Rev. Delano. The EZ became "yellowish orange" as well. Warmth in the EZ had been noted first by Wacker on March 3, '68, at 39°I. Vitous called the EZ orange on March 30. The EB continued to grow until it rivalled its 1938 appearance, according to E. J. Reese, while the EZ_s and EZ_n became more dusky and warm in color.

South Equatorial Belt and South Tropical Zone

The SEB was considerably evident in 1967-68 but was not so active as it had been in 1966-67. Although complex activity occurred in the SEB Z, little activity took place in the SEB_n and SEB_s respectively. The belt was normalized in this period.

On Oct. 19, '67, Mackal noted a southward-shifted section of the SEB, which thus created a narrow STrZ. Both the SEB_n and SEB_s were conspicuous, and the SEB Z was rather narrow and hard to make out. The jog mentioned was located at 96° II. It proceeded in the following direction and was considerably darker than the SEB in the preceding direction! Another jog had been noted earlier by Budine and Mackal. In Nov. and Dec. of '67 the SEB Z became more clear, according to Sato. Both the SEB components were somewhat thinner; and the SEB Z widened, according to Wacker and Thiede. Detail in the SEB Z was picked up by Budine on Dec. 30, '67, preceding and following the RS. Bartlett noted festoons, and Dragesco saw white spots in the RS region as well during early 1968. Very little is known about the motions of these complicated regions; and Fox, Reese, and Budine have reported to date no abnormalities.

White spots following the RS were common from late January on. All evidences of the jogs had disappeared. This was the beginning of normalization, or the last phase of the

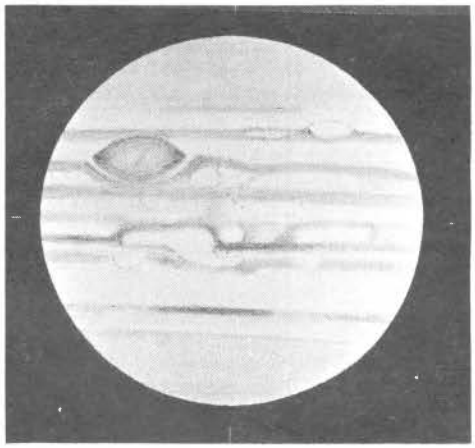


Figure 18. Drawing of Jupiter by Jean Dragesco on May 19, 1968 at 19^h26^m, U.T. CM1 - 156°; CM2 - 49°. Seeing 7, transparency 4.5. 10-inch reflector, 265X. Note change in shape of RS and NEB activity.

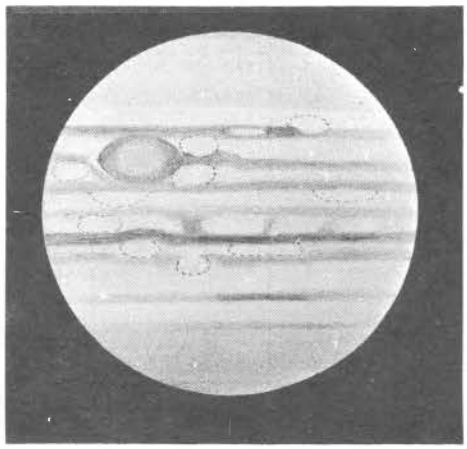


Figure 19. Drawing of Jupiter by Jean Dragesco on June 5, 1968 at 18^h35^m, U.T. CM1 - 286°; CM2 - 50°. Seeing 4, transparency 5. 10-inch reflector, 265X. Note "Olivarez Effect" in STB.

stablization of the SEB which had begun in 1966.

Curious interactions between the RS and the SEB occurred from mid-February through early April, according to Budine, Mackal, Dragesco, and Gordon. The Hollow aspect almost completely disappeared; and central regions of the RS faded out entirely, to such an extent that Heath stated that the RS had a hole in it. When the NEB erupted, there was a bit of an eruption in the SEB_s, while the SEB_n was fairly weak except in the RS region. For Heath and others the SEB was darker than the NEB in March. (This state of affairs has led me to suggest that the SEB_s is closely related to the RS and may account for its structural changes, assuming a splitting up of the SEB_s when the Red Spot is in its ringed aspect.)

On March 6, '68, Sato noted an extra belt in the SEB Z at 294° II. It was extended and connected to the SEB_n near the preceding end of the RS as a distinct second component to the SEB_n. This aspect was noted first by Sato in early March, and then in late March by Mackal. The SEB_s was also double on March 29, '68; but there was just a weak disconnected STrZBd prior to mid-March. Dragesco noted the joining of the two to form a second component of the SEB_s on March 10, '68. The SEB Z was very active in this period and can be seen especially well on NMSUO prints of Jupiter. Wacker noted a double SEB_n and a double SEB_s often in April. By June the doubling appeared to be gone, according to Mackal.

The STrZ was very bright and inactive in 1967-68 compared to 1966-67. Budine noted some activity from 221° to 306° II in the earlier part of the apparition. Dragesco and Mackal noted some very weak festoon activity as well. For Heath the STrZ was ranked brilliant and clear. With the development of the SEB in March it was suspected that the RS might fade out completely; but instead it merely came back again from its skeleton aspect, as it had previously done in 1966-67! The RS was obvious enough but in areal extent was somewhat limited with only the rings showing from time to time in March and April. It revived fully during the 1968 conjunction of Jupiter with the Sun.

South Temperate Belt, South Temperate Zone, South South Temperate Belt, and South Polar Region

By March 25 the STB was the darkest belt on Jupiter, according to Heath. It was weak at the beginning of the apparition, according to observers in Wisconsin. A preceding dark end was noted by Dragesco on March 21 at 225° II, and a following end was very dark at 157° II on March 20. Also a dark streak was noted in the STB.

Activity south of the STeZ white ovals was noticeable in 1967-68. A darker SSTB was noted following DE on Dec. 16, '67, by Wacker and a dark spot over FA-c (center). Dragesco also noted a dark streak or dash in the SSTB south of BC-p to BC-c at 37° II on March 20, '68. The region south of BC faded somewhat by the end of the apparition. An SSTB dark

section was also noted.

The SPR was featureless, and its intensity was stable like that of the NPR.

4. Addendum

The following observers also sent full disc drawings to the Jupiter Recorder for the 1967-68 apparition:

(1) J. Dragesco; Cameroons, Africa; 10-inch reflector, 265X; 39 full discs.
(2) H. Masuda; Hiroshima, Japan; 10-inch reflector, 216X; 28 full discs.
(3) T. Sato; Hiroshima, Japan; 15-cm. reflector, 192X; 59 full discs.

This work arrived too late to be included in the qualitative report above. My deepest apologies are extended to these three gentlemen.

Note on Orientation of Jupiter Drawings Accompanying This Article. Figures 2 to 19, inclusive, all show the simply inverted image of Jupiter as it is observed in the Northern Hemisphere. In other words, south is at the top; and the rotational shift of the markings is from right to left.

ORBITAL INCLINATIONS AS A FACTOR IN SATELLITE LIGHT VARIATIONS: A GENERAL DISCUSSION WITH SPECIAL REFERENCE TO MIMAS, ENCELADUS, AND IAPETUS

By: the Rev. Richard G. Hodgson

(Paper read at the A.L.P.O. Convention at Sacramento, Calif., August 20-22, 1970.)

I. Light Variations of Satellites

The study of light variations of the satellites of the Solar System has been a field of increasing interest in recent years. Most studies made thus far have concentrated on light variations of satellites in relation to their orbital position with respect to their primary planets, the assumption being made that these satellites, like our Moon, keep the same face toward their primary planet. In most cases this assumption may be correct, although for many satellites the matter has not been proven beyond all doubt.

This paper is written to emphasize a long-term factor in satellite light variations, namely, the orbital inclination of satellites to our view, which results in presentation to our sight alternately of north polar regions followed by south polar regions over the course of their primary planet's revolution around the Sun. If some satellites have polar regions of considerably different albedo, this could produce a significant difference in their brightness over their period of revolution around the Sun. In the case of the satellites of Saturn and Uranus, for example, the periods involved -- 29½ and 84 years respectively -- are too long to make for a convenient research project; yet the effect of different polar presentations on the brightness of these satellites deserves investigation, even if more than one lifetime may be required.

In the course of emphasizing the orbital inclinations of satellites as a factor in their light variations one cannot, of course, neglect other factors which also affect light variations. A few large satellites may possess atmospheres which may cause such variations. Saturn's satellite Titan -- the only satellite positively known to have a significant atmosphere in the Solar System -- may have its brightness and color changed by clouds. It is also possible that some of Jupiter's largest satellites may have very thin atmospheres, out of which there may be some precipitation caused by a temperature drop occasioned by an eclipse. Such precipitation, suspected on Io, has been reported to enhance its brightness for a brief time. Other factors include phase of illumination (not significant beyond Jupiter), the distance of the satellite from the Sun and from the Earth, and variations in surface albdeo. In case of small satellites irregularities in shape may be significant.

While the major portion of variation in albedo may be due to changes in the longitude of the central meridian presented to our view (which tend to be short-term variations related to orbital position of the satellite with respect to its primary planet in the case of satellites with captured rotations), changes in the latitude presented to our view must also be considered.

A problem intrudes at this point. Since for most satellites in the Solar System our Earth-based telescopes are inadequate to distinguish any surface detail, how can we hope to know what latitude or longitude is being presented to us at a given time? In truth we cannot know this with precision as we know it, for example, in the case of our Moon. If we are willing to make several plausible assumptions regarding the satellite's axial rotation, its axial inclination to the plane of its orbit around its planet, and to assume that its librations in latitude and longitude are fairly small (i.e., librations similar to those for our Moon or less), we may be able to determine the orientation of the satellite's surface to our view with sufficient accuracy to conduct studies of light variations on this basis.

Given the four to five billion year age of our Solar System, and tidal forces present, it is plausible to assume that inner satellites revolving around their primary planets in orbits of small eccentricity and of small inclination to the planet's equatorial plane probably have captured rotations, unless of course there is observational evidence to the contrary. Satellites with orbits remote from their planets, or having highly eccentric orbits or highly inclined orbits are less likely to have captured rotations. In the case of satellites with probable captured rotations one further assumes that the satellite's axis of rotation is nearly perpendicular to its orbital plane, again because tidal forces would tend to make this the case. This may not be true in every case due to unusual circumstances; but unless there is observational evidence to the contrary, it is a good working hypothesis.

For those satellites which probably have captured rotations, therefore, we can determine with approximate accuracy the latitude and longitude presented to our view at a given time, and can therefore investigate not only short-term light variations due to their revolution around their primary planet, but also the longer term variations which may be due to the changing presentation of their polar regions. This latter effect is not significant in the case of the five inner satellites of Jupiter because of their small inclination to our line of sight (about 3 degrees). In the case of Mars the inclination of 24 degrees is significant; but observational problems are almost insurmountable, at least with Earth-based telescopes. The inclinations of Saturn (almost 27 degrees), Neptune (29 degrees), and especially Uranus (98 degrees) may involve many of their satellites in inclinations to our view which make polar presentation a considerable factor in the study of their light variations.

In this paper I should like to examine the possible effect of varying polar presentations in the case of the relative brightness of Mimas and Enceladus, and also to consider the unusual case of Iapetus, all of these being satellites of Saturn.

II. The Relative Brightness of Mimas and Enceladus

On 1969, September 30, using my 32-cm. ($12\frac{1}{2}$-inch) Newtonian reflector at Dordt College Observatory, Sioux Center, Iowa, and aided by the best observing conditions of the apparition, I observed both Enceladus and Mimas near eastern elongation. Enceladus was first seen at 5^h35^m, U.T., and Mimas at 6^h40^m, using 320X. No occulting bar was used. At 7^h07^m both were clearly seen with averted vision, and I was surprised at the relative brightness of Mimas. It appeared to be very nearly as bright as Enceladus -- not more than 0.1 or 0.2 magnitudes fainter in my judgement, with no correction being made for Mimas' deeper involvement in the glare of Saturn and its rings.

Assuming Enceladus to be magnitude 11.8, based on 2 photoelectric measures made at McDonald Observatory in 1951 and $1956\frac{1}{2}$, this comparison would indicate 11.9 or 12.0 magnitude for Mimas. Correcting somewhat for glare, probably 11.9 is the more accurate figure. This is distinctly brighter than the 12.1 magnitude derived from earlier visual estimates. (Photoelectric measures of Mimas were not undertaken at McDonald Observatory due to the satellite's proximity to the rings).[2]

While a single observation may not have much weight, it does serve to raise some questions. Could Mimas be somewhat brighter and/or larger than previously thought? Or alternately, could it be that in September of 1969 Enceladus was somewhat fainter than the McDonald Observatory findings? Neither satellite has been noted for light variations during orbital revolution, although this possibility deserves further investigation. Could it be a matter of polar presentation? In possible support of the last alternative it should be stated that on September 30 the Earth was 18.1 degrees south of the ring plane, and therefore presumably had a view which included the south polar regions of Mimas and Enceladus. When the McDonald Observatory studies of Enceladus were carried out in 1951 and 1956, the north polar regions of these satellites were somewhat presented. If Enceladus should have a dark south polar region, or Mimas a very bright south polar region (which is less

likely considering the high albedos generally assumed for these inner satellites[3]), the two satellites might now be nearly equal in brightness because of the south polar presentation. The previously reported 0.3 magnitude difference might exist during north polar presentation, and possibly not at other times.

The remark of William Herschel made in 1789 that he found Mimas "incomparably" fainter than Enceladus was made at a time when Saturn's rings were almost edge-on to our line of sight.[4] He did not have a southerly view of the satellites at that time. Certainly the view of Mimas compared with Enceladus on 1969 September 30 was not in agreement with Herschel's words, and would argue for some variability.

It would be unwise to infer too much from limited observations, but clearly here is a matter deserving careful study over an extended period of time.

III. Iapetus

1. The Iapetus Problem Stated

After Cassini discovered Iapetus in 1671 he soon found that he could observe the satellite only near western elongation, due in part to its remarkable 2 magnitude light variation over the course of its 79-day period of revolution around Saturn, and in part to the general inadequacy of seventeenth century telescopes. It remained for William Herschel over a century later to make the first systematic observations of Iapetus throughout its revolution around Saturn. It is evident from this behavior that Iapetus keeps the same side toward Saturn, and that the light variation is due to its having a bright and a dark side.

In recent years the apparent visual magnitude of Iapetus has been assumed to fluctuate between a broader maximum of 10.2 at western elongation and a narrower minimum of 12.3 at eastern elongation. This view is based upon photoelectric observations made on seventeen nights between 1951 and 1953 at McDonald Observatory.[5] Thus the range is brightness was found to be 2.1 magnitudes.

In contrast with these findings are observations by Patrick Moore of Great Britain made between 1966, July and 1967, January, which gave magnitudes of as much as 8.7 for maximum and a brighter minimum of about 11.1.[6] These conclusions rest upon visual estimates made with a 25-cm. refractor at Armagh Observatory in Northern Ireland. Being visual estimates, they are doubtless subject to greater probable error than the photoelectric observations undertaken at McDonald Observatory; yet it is difficult to understand how an experienced visual observer could have an error of 1 to $1\frac{1}{2}$ magnitudes so consistently.

While observing Saturn on 1969, October 17 (U.T.) with my 32-cm. Newtonian reflector at Dordt College Observatory, I was struck by the brightness of Iapetus although it was then far from western elongation, which was on November 12. Immediately an intensive observing program was begun, which also involved several of my students. Patrick Moore's article on Iapetus was discovered shortly thereafter. We found that observations in late 1969 generally confirmed Moore's estimates, although the brightest estimated magnitude attained during a broad maximum (the week ending with western elongation) was 9.0, not 8.7. This is not a significant difference, however. Our observations are shown in Figure 20.

It also should be noted that the maximum centered not exactly at western elongation as is commonly supposed, but came 4 or 5 days prior to elongation. The reported maxima obtained by Moore were also recorded a few days prior to western elongation although he does not speak of it as such.[7]

Iapetus' minimum in late 1969 near eastern elongation (December 20) was not well observed at Dordt College Observatory due to poor weather. Two observations near eastern elongation were estimated at magnitude 11 to $11\frac{1}{2}$, in fair agreement with Moore; but these may not have been exact minima. In 1970, January and February Iapetus was distinctly fainter than on its previous revolution as compared with Rhea and Titan.

2. Problems of Making Visual Comparisons

Perhaps before setting forth a possible answer to the Iapetus problem it would be well to mention some of the observational problems involved in making visual comparisons. Iapetus' brightness is usually difficult to measure because of Saturn's glare, and because of the lack of suitable comparison objects. Whenever possible, stars in the same field of view should be used provided they are well removed from Saturn's glare, and their magnitude is accurately known. One must be especially cautious if the comparison stars are of late

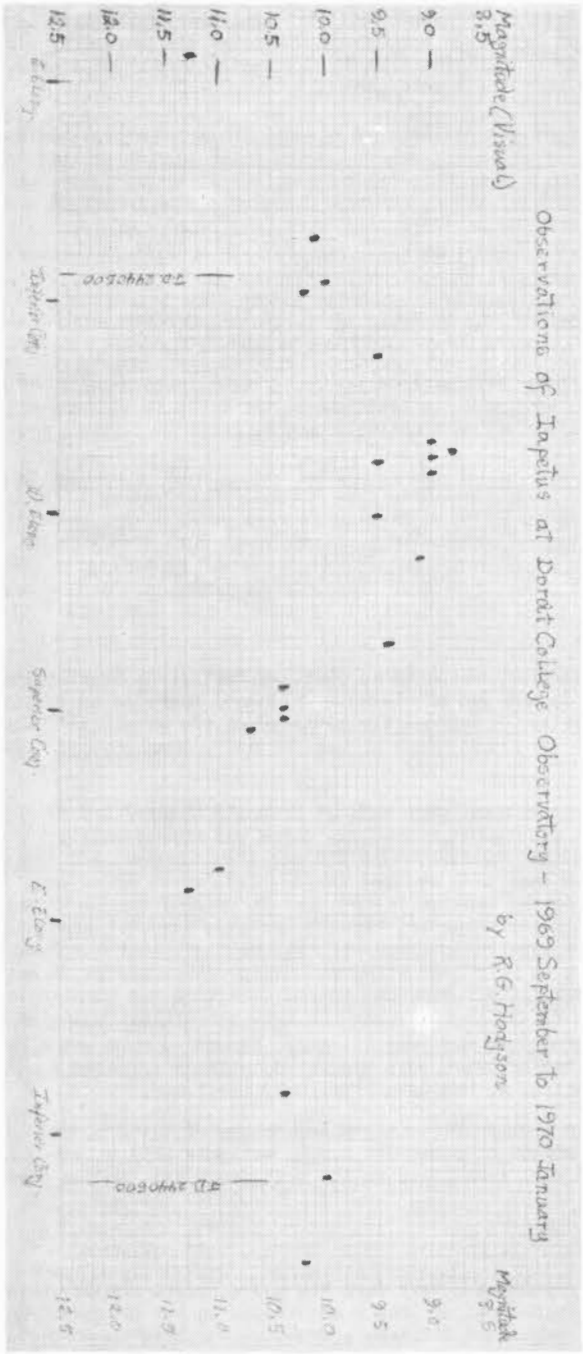


Figure 20. Sample set of observations of the brightness of satellite Iapetus of Saturn. Contributed by Richard G. Hodgson. See also text of Reverend Hodgson's article in this issue. The observations show the long-familiar light variation of about two stellar magnitudes between western elongation and eastern elongation.

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spectral type (K, M, N, R, or S) as they will tend to look brighter to the human eye than they really are. With these orange and red stars one must use a "quick glance" approach. Also one must realize that magnitudes given in some catalogues may be seriously in error -- I have found this to be the case with The Smithsonian Astrophysical Observatory Star Catalog, for example.

An alternative to using stars for comparison is the use of other satellites of Saturn, particularly when at or near elongation. They have the advantage of often being available, which is less true of comparison stars. Titan, Rhea, and sometimes Dione and Tethys are useful in this way, provided one is willing to assume that the accepted photoelectric magnitudes are correct, and that these satellites are almost invariable in brightness. Probably neither assumption is strictly correct; but use of these satellites, in spite of some imprecision involved, is helpful in making visual estimates. Another problem is that these satellites are usually involved to some degree in Saturn's glare, hence the necessity of using them as comparison objects only near their elongations and when observing conditions are good.

Of course a much superior approach is through photoelectric photometry which ought to be used if available. In the absence of photoelectric measures, however, visual estimates are of value if made with care.

3. A Possible Answer to the Iapetus Problem

As indicated earlier, Iapetus varies by about 2 magnitudes in its 79-day revolution. Judging from the light curve (Figure 20) there appears to be a Great Dark Area (quite poss-

ibly a nearly circular mare) which is somewhat less than hemispheric in size, located on one side of Iapetus. This Great Dark Area completely dominates the preceding side of the satellite. One cannot avoid the speculation that it may be the result of a massive collision with another body, probably in the remote past.

Can the seemingly discordant observations of McDonald Observatory on the one hand, and those of Patrick Moore and myself among others on the other hand be pulled together into an approximate harmony? I think that this may be possible if we take into account the inclination of Iapetus to our line of sight, and the changing presentation of its polar regions to our view. There may well be another, long-term ($29\frac{1}{2}$ year) cycle in addition to the well-known 79-day cycle. This long-term cycle may involve a light variation of about 1 magnitude.

One must remember that Iapetus has an orbit inclined 14.7 degrees to the plane of Saturn's equator, unlike Saturn's other satellites (except Phoebe) which revolve in orbits very close to the planet's equatorial plane. Saturn itself is inclined 26° 44' to the ecliptic. In the present era these inclinations partially supplement each other with the result that for some years the Iapetocentric latitude of the Earth is alternately about 14 to 24 degrees north and then, after a few transition years, 14 to 24 degrees south.

Given this long-term cycle of polar presentations over the Saturnian year, the recent visual estimates and the photoelectric measures from McDonald Observatory might be reconciled if (1) the north polar region (NPR) on Iapetus is very dark, either because of a dark "Mare Borealis" in that locality, or because part of the Great Dark Area extends to that region (the latter I consider more likely), and if (2) the south polar region (SPR) on Iapetus is contrastingly quite bright. I believe that such is probably the case and would welcome photoelectric measures and visual estimates by experienced observers during the 1970-1971 apparition.

One does not like to posit such contrasts as just set forth; but considering what we know already about Iapetus, it is not out of character. Indeed there is no reason to assume the Great Dark Area on Iapetus is necessarily centered on the satellite's equator -- its center might well be located somewhat north of that equator, thus involving the NPR, but not the SPR.

When the photoelectric observations were made at McDonald Observatory in 1951 to 1953 (Daniel L. Harris does not give exact dates) the Earth was approximately 15 to 23 degrees north of the plane of Iapetus' equator. The NPR was then exposed, and the SPR was hidden from view. What may have been thus secured is the light curve at or near long-term minimum. When Patrick Moore observed Iapetus in 1966 and early 1967 the Earth was 12 to 14 degrees south of the plane of Iapetus' equator; the SPR was then somewhat presented, and much of the NPR was hidden. His observations may reflect the light near the long-term maximum. When Iapetus was observed in late 1969 at Dordt College Observatory the Earth was 22 to 23 degrees south of the satellite's equator, so that the view was substantially similar to that of Moore in 1966-1967. It is also possible that the orbital position of maximum and minimum in the short-term cycle may vary slightly, depending upon which pole is tilted toward the Earth. With the southern pole presented, maximum appeared to come several days prior to western elongation, as has been previously mentioned.

In late 1970 we shall have another favorable presentation of the SPR, and Iapetus should be bright. Hopefully a number of observers may investigate this matter. A reversion to presentation of the NPR will take place in the next few years, so the opportunity should not be missed.

4. Extremes in Albedo

If this model of Iapetus involving a very dark NPR and a bright SPR is correct, Iapetus must vary by about 3 magnitudes rather than 2 magnitudes in the course of Saturn's revolution around the Sun. A 3 magnitude difference would mean a brightness factor of 16 times between extreme maximum and extreme minimum. If the range is somewhat larger, say from 8.8 to 12.3 ($3\frac{1}{2}$ magnitudes), the brightness factor would have to be 25.1 times! The dark areas would have to have an albedo of no more than 0.03 to 0.05, like dark charcoal. This value is extreme, but not impossible; for the minor planet Ceres is believed to have an albedo of 0.032.[8] The bright areas on Iapetus -- perhaps covered with water ice and/or ammonia ice -- would have to have an albedo of 0.60 to 0.80. This value is high, but not unknown: some of Saturn's inner satellites are believed to have albedos of 0.80.[9] Thus such large variations in magnitude as suggested in this paper, while extraordinary, are physically possible. Such a model of Iapetus, while proposing a world of extreme contrast,

may serve to bring into accord present discrepancies regarding its magnitude.

IV. The Satellites of Uranus

In view of their very high orbital inclination the satellites of Uranus should be examined photoelectrically for light variations due to changes in possible polar presentations over the 84 year Uranian period of revolution around the Sun. We do not know if the satellites of Uranus have captured rotations (the evidence is uncertain on this point); but being too small to retain atmospheres, and being probably rocky (to judge from their high probable densities), they might well have variations in the brightness of their northern and southern hemispheres.

It is interesting that the older estimates placed Titania and Oberon at the 16th stellar magnitude; more recent photoelectric measures give 14th magnitude. Quite possibly the old estimates were wrong -- or could it be that they were measuring different hemispheres of these satellites? Additional photoelectric measures in the future should serve to clear up this matter.

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1. Harris, D. L., in Planets and Satellites (Kuiper, G. P., and Middlehurst, B., editors), pg. 294. University of Chicago Press, Chicago, 1961.

2. Ibid.

3. See Kuiper, G. P., The Atmospheres of the Earth and Planets, revised edition, University of Chicago Press, Chicago, 1952.

4. Quoted in Alexander, A. F. O'D., The Planet Saturn, pg. 130.

5. Harris, D. L., in op. cit., pp. 295-297.

6. Moore, P., The Journal of the British Astronomical Association, vol. 79, no. 2, pp. 121-123 (1969).

7. Ibid.

8. Richter, N., quoted in Roth, G. D., The System of Minor Planets, pg. 121. Faber and Faber, Ltd., London, 1962.

9. Kuiper, G. P., The Atmospheres of the Earth and Planets, revised edition, p. 308.

Appendix: Iapetus Observations at Dordt College, 1969-70

The following is a list of the Iapetus observations made by Richard G. Hodgson at Dordt College Observatory, Sioux Center, Iowa during the 1969-1970 apparition of Saturn, which prompted the preceding paper on satellite light variations. The observations are shown graphically in Figure 20.

U.T. Date, Time	Julian Day	Magnitude
1969 Sept. 30, 5^h	2440494.7	11 to $11\frac{1}{2}$
(Oct. 3, 1^h9 - Iapetus at Eastern Elongation)		
Oct. 17, 3^h	2440511.7	10.1
Oct. 21, 4^h	515.7	10.0
Oct. 22, 2^h	516.6	10.2
(Oct. 23, 13^h - Iapetus at Inferior Conjunction)		
Oct. 28, 3^h	2440522.6	9.5
Nov. 5, 3^h	530.6	9.0
Nov. 6, 5^h	531.7	8.8
Nov. 6, 10^h55^m	532.0	9.0
Nov. 7, 5^h30^m	532.7	9.5
Nov. 8, 5^h30^m	533.7	9.0
(Nov. 12, 6^h9 - Iapetus at Western Elongation)		
Nov. 12, 9^h	2440537.9	9.5
Nov. 16, 3^h30^m	541.7	9.1
Nov. 24, 4^h	549.7	9.4
Nov. 28, 2^h	553.6	10.4

U.T. Date, Time	Julian Day	Magnitude
1969 Nov. 30, 3^h	2440555.6	10.4
(Nov. 30, $21^h.5$ - Iapetus at Superior Conjunction)		
Dec. 1, 4^h40^m	2440556.7	10.4
Dec. 2, 6^h	557.8	10.7
Dec. 15, 5^h	570.7	11.0
Dec. 17, 3^h30^m	572.7	11.3
(Dec. 20, $4^h.9$ - Iapetus at Eastern Elongation)		
1970 Jan. 5, 1^h10^m	2440591.6	11.4
(Jan. 9, $23^h.1$ - Iapetus at Inferior Conjunction)		
Jan. 13, 1^h15^m	2440599.6	10.0
Jan. 21, 0^h15^m	607.5	10.2
(Jan. 30, $6^h.1$ - Iapetus at Western Elongation)		

Note: The magnitudes are visual estimates. Although observations were more limited in early 1970 due to poor weather, it would appear that Iapetus was fainter as it approached western elongation in January than it had been in October and November of 1969. This matter deserves further investigation.

AN ABSORPTION SPECTRUM FROM THE CENTRAL PEAK OF THE LUNAR CRATER ALPHONSUS

By: Daniel H. Harris, Lunar and Planetary Laboratory and
Steward Observatory, University of Arizona.

(Paper read at the A.L.P.O. Convention at Sacramento, Calif., August 20-22, 1970.)

Over the last few years several persons have requested details of my observation of an absorption band in the spectrum of the Alphonsus central peak. This paper should satisfactorily document that observation.

On June 26, 1966, Edmund Arriola and I used the 48-centimeter f/7 Newtonian telescope at the Whittier College Observatory to make visual and spectroscopic observations of the moon. That evening we talked with several other observers by telephone patch into the Astronet radio network. Simultaneously our preliminary visual inspection of known activity areas showed no Lunar Transient Phenomenon activity. Because we arrived at the observatory late and the moon was low and faint through haze, it would have been wasteful to spend the hour needed to mount, balance, and align the spectrograph. So I mounted the spectroscope instead. This spectroscope has a beam-splitter which feeds a filar micrometer guide eyepiece. When set properly, the micrometer wires indicate the position on the lunar image of the spectroscope entrance slit. The spectrum is then viewed directly by eye.

Shortly after the spectroscope adjustments were completed, we telephoned Astronet for another report. Astronet was reporting activity in several areas. However, my visual and spectroscopic survey showed all areas normal. Then two of the Astronet observers simultaneously reported activity at the central peak of Alphonsus, which was then becoming visible at the sunrise terminator. At 9:30 P.M. Pacific Daylight Time, or 04:30 Universal Time on June 26, with seeing 4 to 5 on a scale of ten, and stars of the first magnitude just visible near the moon, I first examined the Alphonsus spectrum. With the spectroscope slit oriented east to west, the spectra of the central peak and the crater walls appeared as three parallel streaks, with the shadowed crater floor between them. The central peak spectrum when compared with the spectra of the crater walls at about 1 nm (one nanometer is 10^{-9} meters or 10 Angstroms) resolution showed a violet degraded absorption band, or possibly a band system, at 475 nm on the wave-length reticle. Simultaneously, the guide eyepiece showed the normal appearance of the central peak. For confirmation, I asked Mr. Arriola to examine the central peak spectrum, without telling him what I had seen. He also saw a violet degraded blue absorption in the central peak spectrum. It was our misfortune that a fog was then rapidly closing in. By the time I had broadened the slit enough for my second look, to about 4 nm resolution, the transparency was down to magnitude zero. Careful examination then showed that the band head was at 485 nm, with absorption detectable to about 450 nm (see Figure 21). Observation ceased at 04:40 U.T., when the transparency became minus one. During the entire set of observations, the visual appearance of the central peak was normal.

The wave-length measures show a difference which was most likely due to the in-

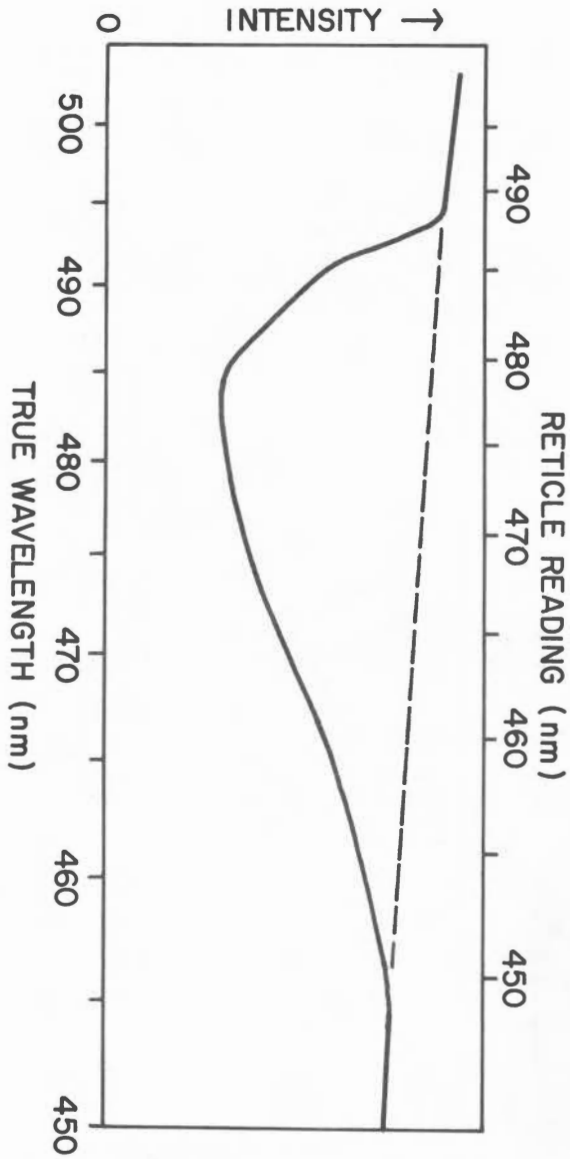

Figure 21. Composite visual estimate of the intensity of the Alphonsus central peak in the blue spectral region at 4^h35^m, U.T., June 26, 1966. The dashed line shows the normal continuum. Contributed by Daniel H. Harris and discussed in text of his article in this issue.

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creased brightness of the spectrum for the second measure, although there may have been a change intrinsic to the band. The better view of the band detail for the second measure closely represented the band head, while the first measure probably indicated the apparent center of absorption. Other errors, such as parallax between the wave length reticle and spectrum, may have contributed. All estimates were uncertain by about 3 nm (probable error).

After observation ceased, the spectroscope was carefully stored to preserve its adjustments. On the following day the solar 486 nm Hβ line read 480 $\pm$ 1 nm on the reticle scale. Thus, the corrected band head should be at 491 $\pm$ 4 nm.

An examination of molecular spectra shows that most common molecules with bands near this wave length have red degraded bands. The few molecules with violet degraded bands show complex narrow bands and additional bands which we did not see. A comprehensive search of the literature gave thirty possible diatomic molecules and fifty possible polyatomic molecules, none of which could be matched to the observed spectrum individually or in combination.

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MOTION OF CLOUD OBSERVED ON MARS OVER CASIUS TO AMAZONIS REGIO

By: Toshihiko Osawa, Hyogo, Japan

Abstract

From Aug. 24 to Sept. 5, 1969, a thin but large-scale yellow cloud was observed to move over Casius and Utopia to Amazonis Regio. Observation indicates that the average velocity of motion of the cloud was 6 meters/sec. As the cloud happened to move in parallel with the isotherms on Mars, the height of the cloud was estimated as about 2 kms. with the aid of the concept of thermal wind from meteorology.

The direction of drift of the cloud was in agreement with that of the westerly which was expected from Mintz's General Circulation Model of Mars to appear in the fall to winter of the northern hemisphere of Mars. The behavior of the cloud which then prevailed over high latitudes to the north polar region was suggestive of the mechanism of its occurrence.

1. The Results of Observation.

Although the observing conditions were by no means sufficient as regards seeing, weather, and low-altitude of the planet, together with the decreasing diameter of Mars, the observation of the cloud is summarized below. The observations were made with an 8-inch reflector at 286X and 333X.

Aug. 24, 1969	The triangle including Casius and Utopia was invisible (Fig. 22).
Aug. 28	Casius, Utopia, and Aetheria had faintly re-appeared.
Aug. 31	The dark shading of Utopia and Laocoöntis was recovered. Cerberus was faint and almost disappeared. The triangular marking composed of Trivium Charontis, Hades, and Propontis was the darkest mark in the visible northern hemisphere of Mars.
Sept. 2	Trivium Charontis began to disappear. It was difficult to see any difference between Elysium and Cebrenia. A dusky marking was seen in the north polar region.
Sept. 3	The marking west of Elysium, which was not especially dark at opposition, had darkened. The marking in the southern hemisphere was dark next to it. Eunostos, Hyblaeus, and Nodus Laocoöntis were visible as a dusky shading. Trivium Charontis and Propontis were very faintly seen in a good moment.
Sept. 4	Trivium Charontis had disappeared. Nothing was to be seen over Elysium to Amazonis, while Mesogaea was dark.
Sept. 5	Trivium had darkened and was the darkest feature in the visible N. hemisphere. The cloud appeared to be present on Zephyria to Amazonis Regio (Fig. 23).
Sept. 6	Memnonia was covered with cloud. It was difficult to distinguish the cloud from that which often appeared in the evening over this area (Fig. 23).

2. Summary of the Motion of the Cloud.

Allowing for inaccuracy resulting from the fact that the regions where the cloud was observed were largely free of dark markings, the writer plotted the positions of the cloud on a map of Mars as Fig. 26.

The positions of the main markings depend on the map of Mars by S. Ebisawa[1], with necessary features added according to writer's 1969 observations. The estimated central positions from drawings and the average motion of the cloud are as follows:

	Lat.	Long.	Velocity kms./hr.	Velocity meters/sec.
Aug. 24-28	+41° - +33°	262° - 237°	13	4
Aug. 28-31	+33 - +31	237 - 223	10	3
Aug. 31-Sept. 2	+31 - +32	223 - 216	8	2
Sept. 2-3	+32 - +27	216 - 208	21	6
Sept. 3-4	+27 - +26	208 - 191	38	10
Sept. 4-5	+26 - +16	191 - 173	48	13

The above observations show that the cloud presumably originated in Casius or its neighborhood, and moved eastward as far as Amazonis, with a general tendency of later acceler-

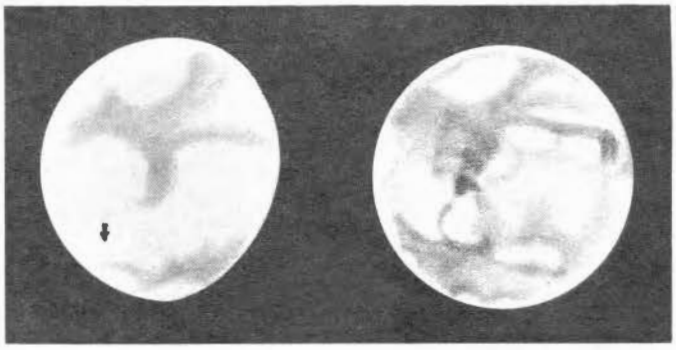

Figure 22. Drawings of Mars in 1969 by Toshihiko Osawa with an 8-inch reflector. Left drawing on August 24, right drawing on June 10. As compared to the right drawing, the area denoted by the arrow on the left drawing was covered on August 24 by a large Martian cloud.

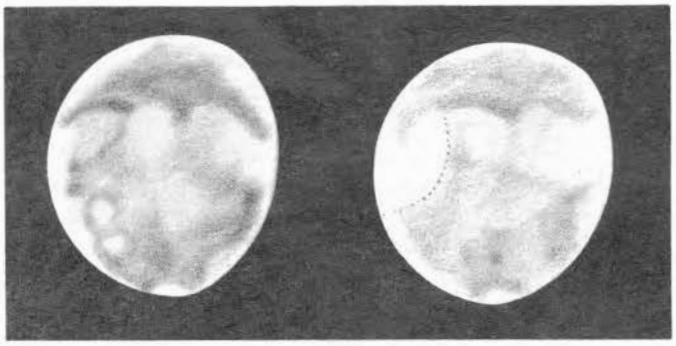

Figure 23. Two more drawings of Mars in 1969 by Toshihiko Osawa with an 8-inch reflector. Left drawing on September 5, showing the final stage of the moving cloud. Right drawing September 6, showing a possible survival of the cloud.

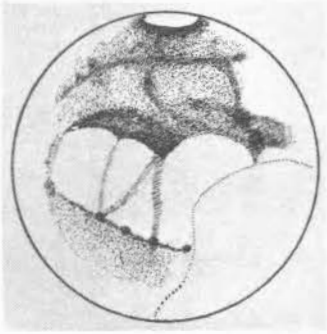

Figure 24. Sketch of Mars to show clouds observed in 1909 by E. M. Antoniadi. Contributed by T. Osawa. Compare to discussion in text.

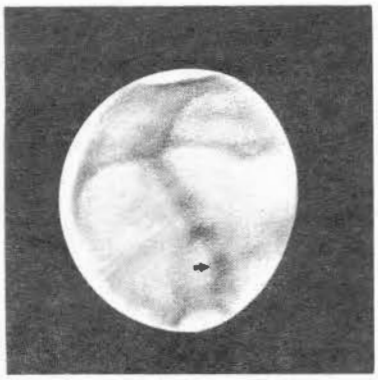

Figure 25. Drawing of Mars by Toshihiko Osawa on August 12, 1969. The arrow shows the intensification of the Issedon canal. See also text.

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ation. It was 2400 kms. in diameter.

A similar observation was made in the fall of 1909 by E. M. Antoniadi (Fig. 24). Both clouds occurred in late autumn to early winter in the northern hemisphere of Mars.

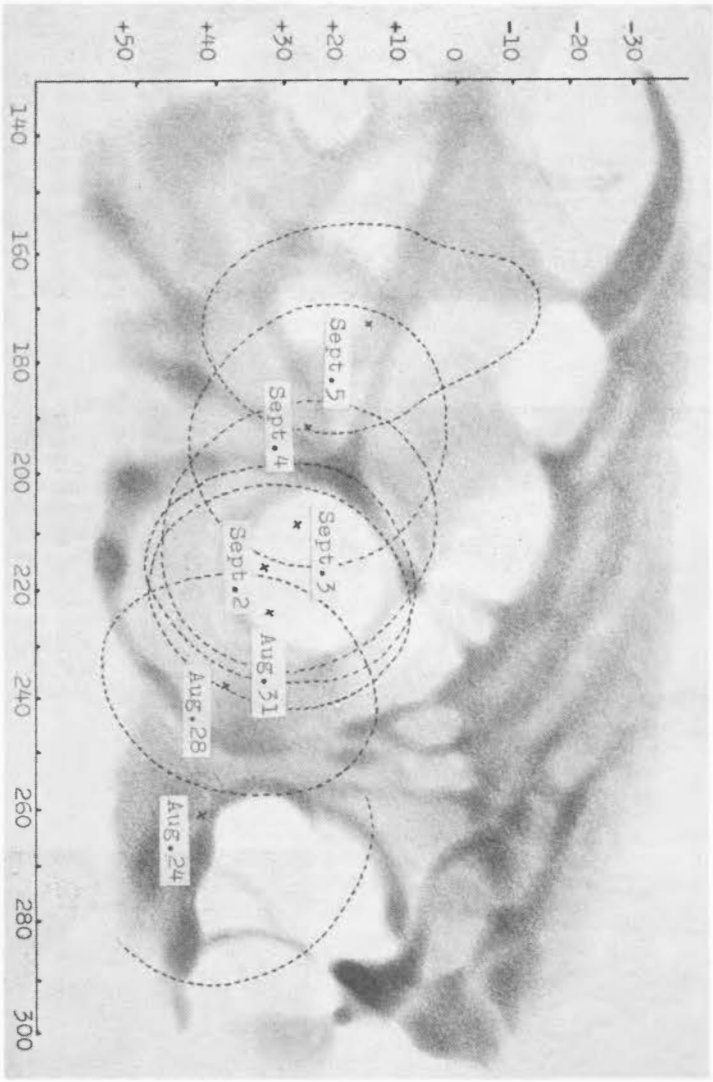

Figure 26. The motion over the surface of Mars of the cloud observed in 1969 by T. Osawa. See also text.

3. Estimation of the Height of the Cloud.

It is interesting to compare the path of the observed cloud with an isothermal map of the planet.[2] It would be most desirable, but data are not available now, to use the isotherms when the cloud was actually observed. Therefore, the writer chose those isotherms in Martian northern winter given by Gifford and assumed that these isotherms are the same as when the cloud was seen. The center positions of the cloud observed were plotted on Gifford's iosthermal map. See Figure 27.

It is evident that the path of the cloud was parallel to the isotherm of 260° K. Theoretically the concept of the thermal wind is applicable to this case. Thus, the vertical shear of the geostrophic wind is expressed as:

$$\frac{\partial u}{\partial z} = -\frac{g}{fT} \cdot \frac{\partial T}{\partial y}, \quad \frac{\partial v}{\partial z} = \frac{g}{fT} \cdot \frac{\partial T}{\partial x},$$

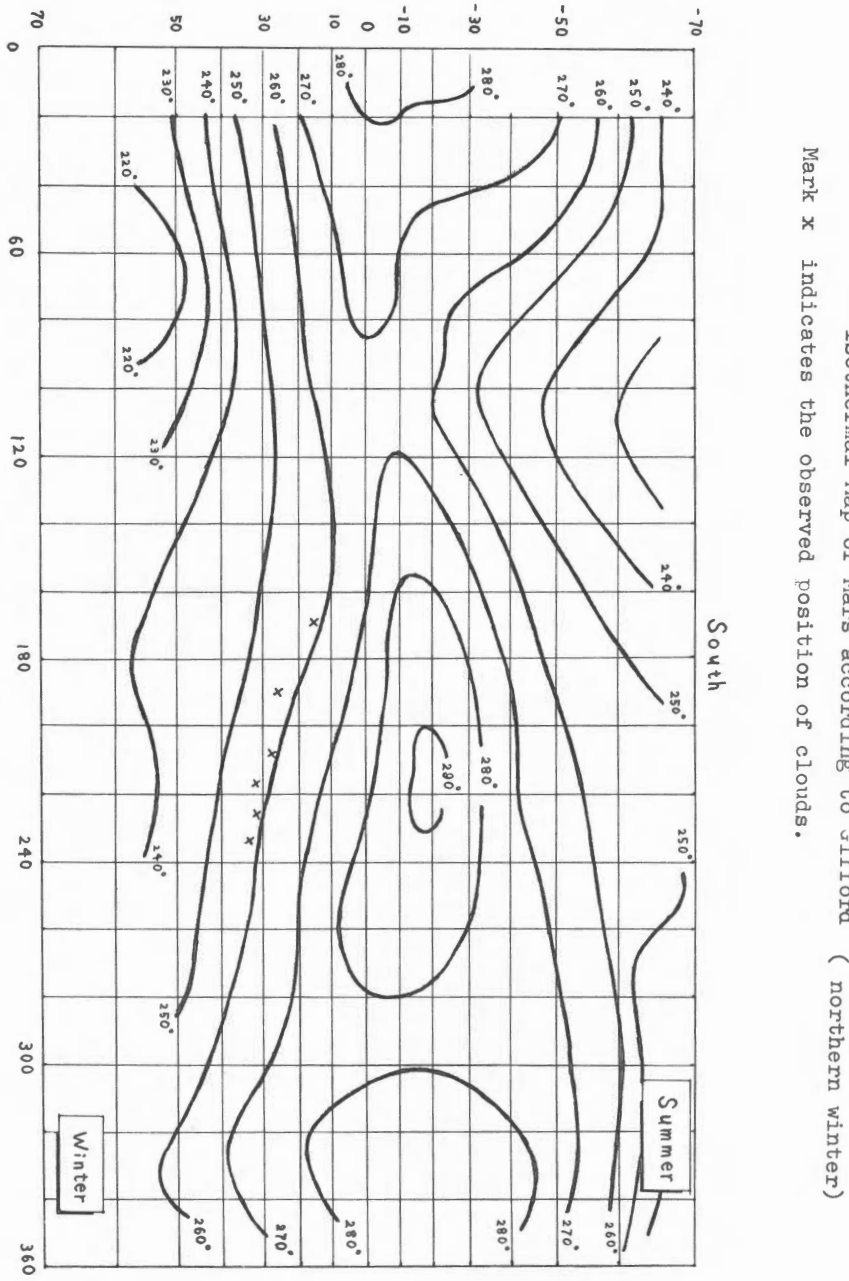

Figure 27. Isothermal map of Mars in the winter of its northern hemisphere, according to Gifford. The X's are the positions of the moving cloud observed by Toshihiko Osawa from August 24 to September 5, 1969. The temperatures are in Kelvin degrees. The usual latitude and longitude scales are given on the margins.

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where
u: west-east component of thermal wind.
z: height.
v: south-north component of thermal wind.
g: gravity acceleration on Mars.

f: Coriolis Factor, where $f = 2\Omega \sin \phi$.
x: west-east coördinate.
Ω: angular velocity of rotation of Mars.
T: temperature (°K).
y: north-south coördinate.
ϕ: latitude considered.

If we take the values (temperature gradient) which were read from Fig. 27:

$$\frac{\partial T}{\partial x} \cong 3 \times 10^{-3} \text{ deg./km.}, \quad \frac{\partial T}{\partial y} \cong -1.1 \times 10^{-3} \text{ deg./km.},$$

then the vertical shear is obtained from the formulas above as:

$$\frac{\partial u}{\partial z} = 2.0 \text{ to } 2.5 \times 10^{-3} \text{ sec.}^{-1}, \quad \frac{\partial v}{\partial z} = 0.53 \text{ sec.}^{-1}.$$

Allowing for inaccuracies due to the pertinent wind velocity on the ground, we make a rough estimation that the height of the cloud was about 2 kms. Individual values fluctuate from 1.0 to 4.3 kms., increasing as time passed. This height lies among the speculations previously made, viz., less than 5-10 kms., a value summarized by Michaux.[3]

4. A Suggestion for the Mechanism of Occurrence.

The early stage of occurrence and development was not fully followed. However, it may be suggestive of the mechanism of occurrence to consider the behavior of changing cloud which was observed near high to middle latitudes in the northern hemisphere.

(1) The N. Polar Cap disappeared in early May (Ls. = 150°).
(2) However, up to mid-June a light or neat, small, white cloud was observed in the north polar region. From the look of the cloud, the writer wondered whether it would be possible to detect a tiny polar cap with large apertures. Indeed, Dr. G. de Vaucouleurs was successful in observing the true north cap on May 31, June 1, and June 5, according to IAUC 2153.
(3) At the end of June (Ls. = 180°) large, white clouds developed in the north polar region, especially in Mare Acidalium and Utopia and their vicinity. They were very changeable, but the southern boundary advanced southward in July and August.

Considering the observational fact that Utopia and Mare Acidalium area are the main routes through which substances which comprise the North Polar Cap are carried to the southern hemisphere, the formation and increased abundance of north polar clouds suggest substances which are carried from the melting of the South Polar Cap.

Probably due to the influence of the migration of south polar substances and possibly to the unusual route, Ganges canal and Issedon canal darkened from August 8 to 13, 1969. The increase in intensity of Issedon canal was one of the most unusual phenomena in the last apparition of the planet. (Fig. 25). The symptom was well shown on Mariner 7 photographs of Mars, and this phenomenon lasted until October when the writer had his last view of the region.

Clouds over Utopia as well as Mare Acidalium were changeable. The writer observed a mass of cloud which spread on July 19 to the north of Utopia, fully expanded on July 20 to Utopia-Casius when the irregular markings were visible through the rarefied cloud. This cloud further became faint and decreased in size on July 21 and had almost disappeared on July 22. This observation would suggest that the Utopia region is provided with a local, meteorological condition (possibly of topographical nature) where an outbreak of cloud is liable to occur irrespective of the melting of the North Polar Cap. Almost the same change took place in Mare Acidalium in the middle of August, 1969.

In connection with the occurrence of yellow cloud, a large cloud was seen in the north polar region on Aug. 19 and 20. On Aug. 24 Casius and the Utopia region were hidden behind the cloud, and Boreosyrtis and its adjacent marking to the west were left uncovered. Soon after this date, a yellow cloud developed and advanced eastward as the writer described at the beginning of this paper.

Y. Mintz has carried out a theoretical analysis of the flow regimes resulting from the expected poleward temperature gradient on Mars as a function of season.[4] He postulated a generally stable symmetric regime in early fall and late spring with a change to a wave regime in winter. In view of his model, it is intersting to note that the direction of the observed drift of our cloud is well in accordance with that deduced from his theory and that the cloud occurred at the transitional stage from symmetric to wave regime of his theory.

The massed substances on the north polar region, which had issued from the South Polar Cap and flowed in, may have acted as a trigger. The topographical nature of this region might have played a role to give rise to an ascending current, which carried dust particles to westerlies. At any rate, the observed cloud was by no means a mere duststorm from the fact that after the passage of the cloud some markings intensified vividly.

References

1. Sky and Telescope, October, 1965. Strolling Astronomer, Vol. 14, Nos. 9-10.

2. Gifford, F. "Surface Temperature of the Planet Mars: 1926 to 1943." The Study of Planetary Atmospheres, a Final Report, Lowell Observatory, Sept. 30, 1952. pp. 208-249.

3. Handbook of the Physical Properties of the Planet Mars, NASA, 1967, page 101.

4. Mintz, Y. "The General Circulation of Planetary Atmospheres. The Atmosphere of Mars and Venus", W. W. Kellog and C. Sagan, EDS. National Academy of Sciences, pp. 107-146, 1961. This paragraph was cited from the summary by C. M. Michaux in Handbook of the Physical Properties of the Planet Mars, NASA.

BOOK REVIEW

Astronomy and Astrophysics Abstracts. Vol. 1, Literature 1969, Part I. Edited by W. Fricke, U. Güntzel-Lingner, F. Henn, D. Krahn, and G. Zech. Published for the Astronomisches Rechen-Institut by Springer-Verlag, Berlin, Heidelberg, and New York. Charter price $15.90 per part.

Reviewed by Richard G. Hodgson

In accordance with the wishes of the International Astronomical Union this volume begins a new series of bibliographies to be issued semi-annually in the English language by the Astronomisches Rechen-Institut of Heidelberg and succeeds the Astronomisches Jahresbericht founded in 1899. Covering astronomy, astrophysics, and related subjects, this is the definitive world-wide bibliography containing almost complete coverage of all serious papers and books published. Abstracts are given for many of the more important articles. About 5000 items are included in this initial offering gleaned from approximately 400 periodicals. Readers of The Strolling Astronomer will be pleased to find our Journal included.

Astronomy and Astrophysics Abstracts is a very valuable tool for those serious amateurs and professional astronomers engaged in research. Many of us may find a standing subscription order expensive, but it is worth considering. An alternative approach would be to persuade a near-by college or university library to order it.

One word of caution: in the future writers should always sign themselves in the same way to avoid being doubly listed. I note, for example, that our Rev. Kenneth Delano is listed twice as "Delano, K." and "Delano, K. J." The computer making up the author index failed, of course, never having had the pleasure of meeting Ken Delano personally. Such blemishes are minor, however, and do not diminish the great value of this series. Orders may be placed with Springer-Verlag, New York, Inc., 175 Fifth Avenue, New York, N. Y. 10010.

THE 1970 ALPO CONVENTION AT SACRAMENTO

By: Richard E. Wend

The eighteenth annual convention of the Association of Lunar and Planetary Observers was held on August 20-22, 1970, at the Mansion Inn, Sacramento, California. As in the past four years, it was a joint convention with the Western Amateur Astronomers. The host society was the Sacramento Valley Astronomical Society.

Beginning with Wednesday evening (August 19), and continuing during the two following evenings, trips in private cars were arranged to the host society's observatory at Colfax, where a superb 12½" Yolo telescope is housed. The instrument has a focal length of 209", and the tilted mirror system avoids all obstructions in the optical path. Some visitors brought their own portable telescopes to the observing site, and reflectors as large as 18" and 24" were set up. Skies were clear all three nights.

A new attraction of this year's convention was an informal slide show, held on Thursday evening. There was standing room only as slides were shown of the March, 1970 solar eclipse, comets, planets, the moon, observatory construction, and a wide range of other astronomical subjects. This proved to be a popular part of the program, and should become a regular feature of future conventions.

On Friday evening a planetarium show was presented at Mather Air Force Base, just outside of town.

A large exhibit area at the Mansion Inn displayed photographs, projects, and equipment. Of special interest was a well-made Schiefspiegler - a smaller tilted mirror system than the Yolo, without a warping harness.

The formal sessions began Thursday morning with a keynote address by William W. Hunt on "Astronomy and Involvement". Then Dr. Leonard V. Kuhi of the University of California at Berkeley gave a Morrison lecture on "Pulsars: Messages from Outer Space?"

The paper session began with observational topics. Dr. A. B. Gregory spoke on "Methods of Double Star Observation." Rev. Kenneth Delano spoke on "The Brightness of Iapetus". He reported a magnitude variation of 9.0 to 10.6 in 1968-69 and from 8.6 to 11.5 in 1969-70. He noted that Patrick Moore in England observed a range of 8.7 to 11.1 in 1966-67. This range compares with a generally accepted range of 10.2 to 12.3. Rev. Richard G. Hodgson presented a paper titled "Orbital Inclinations as a Factor in Satellite Light Variations: A General Discussion with Special Reference to Mimas, Enceladus and Iapetus." He found a magnitude variation of 9.0 to 11 or 11½ for Iapetus, and suggested that the difference of more than a magnitude between the generally accepted values and the more recent values of these two papers may be due to substantial changes in orbital inclination of Iapetus added to Saturn's inclination. Thus the dark side of Iapetus would present varying aspects to the earth.

ALPO Mars Recorder Charles Capen gave a paper on "Possible Martian Yellow Clouds in 1971". He described yellow-white clouds that appeared in 1956 and 1969 when the thermal equator was in the southern hemisphere of Mars. He warned of the possibility that similar clouds may appear during the favorable perihelic apparition of 1971. Tom Cave discussed "Interpretations of Mariner VI and VII Photographs." The Martian oases appear to be large impact craters. Barnard saw a Martian crater with a 36" telescope in 1892, but didn't publish the observation at the time. Dr. Clarence Custer spoke on "Little Known Facts on Comet Bennett", calling attention to its complex structure, with multiple jets and complicated gas tail and dust tail. Richard Wend spoke on "The Goals of the ALPO Jupiter Section", describing the new Advanced Observer's Handbook for amateur Jupiter observers.

Friday's session was highlighted by a talk on "A National Airborne Infrared Observatory", by Robert Cameron of the Ames Laboratory, National Aeronautics and Space Agency. A 36" Cervit mirror with gold coated optics is to be mounted in a Lockheed C-141 Aircraft, with air pressure seals so that no window is in front of the totally reflecting optics.

Five papers on the total eclipse of the sun were presented by Ernest Piini, Claude Hess, Leonard Farrar, John Laborde, and Bill Fisher. In addition to slides and movies of totality, the elusive shadow bands were discussed in considerable detail. Leonard Farrar, a commercial printer, also gave a paper "About the Color of This and That, Like Jupiter's Red Spot". A printer's color selector with 501 color swatches was described, with the Red Spot currently being nearest P.M.S. 143.

Mercury Recorder Richard Hodgson reported on "ALPO Observations of the 1970 Transit of Mercury". No satellite of Mercury was observed, and the black drop was not reported. ALPO Director Walter Haas spoke on "Little Rainbows" - the effect of differential refraction. He advised the use of filters for all low angle observations and pointed out that observations of Lunar Transient Phenomena are affected by differential refraction. Daniel Harris presented a paper on "An Absorption Spectrum of the Central Peak of Alphonsus", in which he described a violet degraded absorption band (coincident with a report of Lunar Transient Phenomena by two visual observers). He also told of a simple spectrograph for amateurs. Additional papers on Friday were on Fiberglass telescope tubes (Norman James), chain drives for large telescopes (George Carroll), A 16½" Argunov Telescope (Richard Buchroeder), and films for long exposures (Gerald Schad).

Saturday's featured speaker was Dr. Ian MacGregor of the University of California - Davis, who spoke on "Results of Studies of Lunar Samples from Apollo 11 and 12". He called attention to a continuous series of impact craters of all sizes right down to micro-

Figure 28. Tom Cave speaking to WAA-ALPO Convention at Sacramento, Calif. on Aug. 20-22, 1970.

Figure 29. Dennis Milon at the speaker's rostrum during Sacramento Convention.

Figure 30. Chick Capen and his "first telescope" - a bit of humor at banquet of Sacramento Convention. Mrs. Gina Capen at left.

Figure 31. Presentation of the G. Bruce Blair Award of the Western Amateur Astronmers to Mr. Charles Capen during Convention Banquet.

Figure 32 (left). Kenneth Delano (left) and Dennis Milon having an informal discussion in the Mansion Inn meeting room.

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All illustrations on pages 169 and 171 are based on color transparencies taken by Mr. Steve Fleming of San Diego, Calif. Mr. Fleming supplied the photographs for publication in this journal at the request of Mr. Richard Wend, the author of the article here about the WAA-ALPO Convention at Sacramento. Mr. John Ledbetter of the Physical Science Laboratory at New Mexico State University prepared the original slides for reproduction as illustrations in this journal. He made a positive well-contrasting black-and-white print from each slide for this purpose. We thank all these persons who have made possible this coverage in pictures of the last A.L.P.O. Convention.

scopic ones. Chemical analysis of the samples showed not only a different proportion of elements on the moon, but also a different ratio of isotopes of individual elements. Based on these findings, Dr. MacGregor does not now believe that tektites come from the moon.

In the Saturday paper session, ALPO Comets Recorder Dennis Milon gave the "News from the Comet Section". He mentioned color transparencies of Comet Bennett that showed the blue gas tail, apart from the dust tail. This was one of three naked eye comets of the past year. Tom Cragg, ALPO Saturn Recorder, gave a report on "The Edge-On Apparition of Saturn in 1966-67". He spoke of the faded Equatorial Zone, the conspicuous North Tropical Zone, and the low albedo of Titan - surprising for a satellite with an atmosphere.

Harry Jamieson, one of the ALPO Lunar Recorders, prepared a paper on "Two New Programs in the ALPO Lunar Section." In his absence, it was read by another Lunar Recorder, Rev. Kenneth Delano. The first of the new programs is the Bright and Banded Craters Program, which will catalog these special craters and investigate the brightening of some craters with increasingly higher solar lighting, while others become inconspicuous. The second new program is the Vertical Profile Study, which will concentrate on previously ignored features. Grace A. Fox, who probably has attended more ALPO conventions than any other non-staff member, gave an informal talk on "Hobbies Lead to Science". The final paper was "An Observational Model of the White Ovals of Jupiter", by Paul K. Mackal, ALPO Jupiter Recorder. In his absence, the paper was read by Richard Wend. The three long-enduring white ovals have been continuously visible for several decades and appear to repel each other.

After a fine banquet on Saturday evening, the G. Bruce Blair Medal was presented to Charles F. Capen, ALPO Mars Recorder, who gave a Morrison lecture on "The Amateur In Planetary Astronomy", illustrated by a number of his fine color slides.

The report on the business session is elsewhere in this issue. Next year's A.L.P.O. convention will be in Memphis, Tennessee, in conjunction with the National Convention of the Astronomical League. The dates are August 18-22, 1971; and the location is Southwestern College.

LUNAR NOTES

By: John E. Westfall, Kenneth J. Delano, Charles L. Ricker, and H. W. Kelsey, A.L.P.O. Lunar Recorders

I. Additions to the A.L.P.O. Lunar Photograph Library: Apollo-10 and Additional Apollo-8 Photographs (John E. Westfall).

Apollo-10 Photographs

The A.L.P.O. Lunar Photograph Library has received twenty 8 X 10 inches black and white enlargements from 70-mm. photographs taken by the Apollo-10 Astronauts in May, 1969. Formats are given below as follows: VERT = vertical or near-vertical, L-OBL = low oblique (tilted--limb does not appear), H-OBL = high oblique (tilted--limb appears). Further, "S" indicates fractional scale, and solar lighting is shown by: L-Sun = low solar altitude, M-Sun = medium solar altitude, H-Sun = high solar altitude. The following photographs overlap each other (if the overlapping photographs are at about the same scale, they may be viewed stereoscopically; such pairs are shown by an asterisk):

AS10-27-3905*, 32-4782*, 33-4948, 34-5169
28-4046, 32-4847
30-4451, 32-4725

Code Number	Format	Description
AS10-		
27-3905	L-OBL	E. part Sinus Medii-Blagg and Bruce (01°.1 N/04°.3 E). S = 1/580,000; H-Sun.
28-4046	VERT	S. part Mare Tranquillitatis, S. of Maskelyne G (00°.4 N/27°.5 E). S = 1/370,000; M-Sun.
30-4436	L-OBL	S. part Mare Tranquillitatis, N. of Censorinus X, W. of Lubbock S (01°.0 N/37°.5 E). S = 1/350,000; H-Sun.
30-4449	H-OBL	Manners-Ariadaeus Rille (05°.0 N/17°.5 E). S = 1/300,000; M-Sun.
30-4451	L-OBL	Sabine-Ritter-Schmidt (01°.0 N/21°.0 E). S = 1/300,000; M-Sun.

Figure 33. The display of the ALPO Comets Section at the WAA-ALPO Sacramento Convention. Contributed and arranged by Dennis Milon, ALPO Comets Recorder.

Figure 34. Another part of the display of the ALPO Comets Section.

Figure 35. Another portion of the Exhibit Room during the Convention. Sample copies of The Strolling Astronomer in the foreground and Jupiter drawings.

Figure 36. Discussion group during Sacramento Convention. Left to right: Dick Hodgson, Walter Haas, Tom Cragg, and Dick Wend.

Figure 37 (left). Reverend Kenneth Delano presenting paper.

Figure 38 (left). Walter Haas giving paper at Sacramento.

Code Number	Format	Description
AS10-		
31-4545	L-OBL	N. of Delambre (00°.4 S/16°.9 E). S = 1/400,000; L-Sun.
31-4566	L-OBL	Taruntius (05°.7 N/46°.4 E). S = 1/300,000; H-Sun.
31-4630	L-OBL	Arago (05°.9 N/22°.0 E). S = 1/260,000; H-Sun.
32-4716	H-OBL	Theophilus-Cyrillus (12°.5 S/25°.3 E). S = 1/500,000; M-Sun.

Code Number	Format	Description
AS10-		
32-4725	L-OBL	Sabine B, C, D (00°.4 N/23°.9 E). S = 1/200,000; M-Sun.
32-4734	H-OBL	Triesnecker-Chladni-Murchison (05°.0 N/01°.0 W). S = 1/400,000; L-Sun.
32-4782	VERT	Rhaeticus-Rhaeticus C, L, M, N (00°.5 N/03°.1 E). S = 1/600,000; L-Sun.
32-4811	H-OBL	Agrippa-Hyginus Rille-S. part M. Vaporum (07°.2 N/07°.4 E). S = 1/950,000; L-Sun.
32-4847	L-OBL	Moltke-Hypatia I Rille (01°.2 S/25°.4 E). S = 1/540,000; M-Sun.
33-4908	L-OBL	Gutenberg-Gutenberg E, G (06°.6 S/40°.4 E). S = 1/400,000; L-Sun.
33-4948	VERT	Rhaeticus-Rhaeticus A (01°.4 N/05°.7 E). S = 1/400,000; L-Sun.
34-5120	L-OBL	Maskelyne A-Censorinus (00°.5 S/32°.5 E). S = 1/570,000; L-Sun.
34-5139	L-OBL	Messier A, D, E (03°.2 S/45°.5 E). S = 1/300,000; H-Sun.
34-5167	VERT	Godin C (01°.5 N/08°.4 E). S = 1/110,000; L-Sun.
34-5169	VERT	Rhaeticus B (01°.5 N/07°.2 E). S = 1/130,000; L-Sun.

Additional Apollo-8 Photographs

This list, containing 14 newly-received Apollo-8 photographs, supplements the listing given in The Strolling Astronomer, Vol. 22, Nos. 5-6 (June, 1970), pp. 85-88. Data are indicated as in the Apollo-10 listing above, with the exception that "SA" indicates solar altitude. Overlapping photographs are:

AS8-13-2219*, 13-2220*, 13-2222* 13-2242*, 13-2243*

AS8-13-2277, 13-2284, 13-2291 13-2336, 13-2347, 13-2350

Code Number	Format	Description
AS8-		
13-2219	L-OBL	Goclenius U-Crozier (11°.75 S/50°.75 E). S = 1/600,000; SA = 19°.
13-2220	L-OBL	Goclenius U-Crozier-Bellot (11°.92 S/49°.5 E). S = 1/600,000; SA = 18°.
13-2222	L-OBL	Bellot-Goclenius-Magelhaens A-Colombo (11°.5 S/47°.5 E). S = 1/600,000; SA = 15°.
13-2229	L-OBL	Capella-Capella M (5°.5 S/37° E). S = 1/450,000; SA = 6°.
13-2242	H-OBL	Daguerre-Fracastorius (15° S/35° E). S = 1/800,000; SA = 2°.
13-2243	H-OBL	Isidorus-Daguerre-Fracastorius (15° S/35° E). S = 1/800,000; SA = 3°.
13-2257	VERT	N.E. of Maskelyne A (0°.5 N/35°.5 E). S = 1/350,000; SA = 5°.
13-2277	H-OBL	Maskelyne F (4° N/35° E). S = 1/400,000; L-Sun.
13-2284	L-OBL	Maskelyne H (5° N/33° E). S = 1/250,000; L-Sun.
13-2291	L-OBL	E. of Maskelyne H (5° N/34° E). S = 1/200,000; L-Sun.
13-2336	H-OBL	Jansen F-Vitruvius (15° N/31° E). S = 1/600,000; SA = 1°.
13-2347	H-OBL	Jansen F-Vitruvius (15° N/30° E). S = 1/600,000; SA = 1°.
13-2350	H-OBL	Jansen K-Vitruvius (15° N/30° E). S = 1/600,000; SA = 1°.
18-2858	H-OBL	Mare Fecunditatis-Mare Tranquillitatis (08° N/33° E). S = 1/2,700,000; L-Sun - M-Sun.

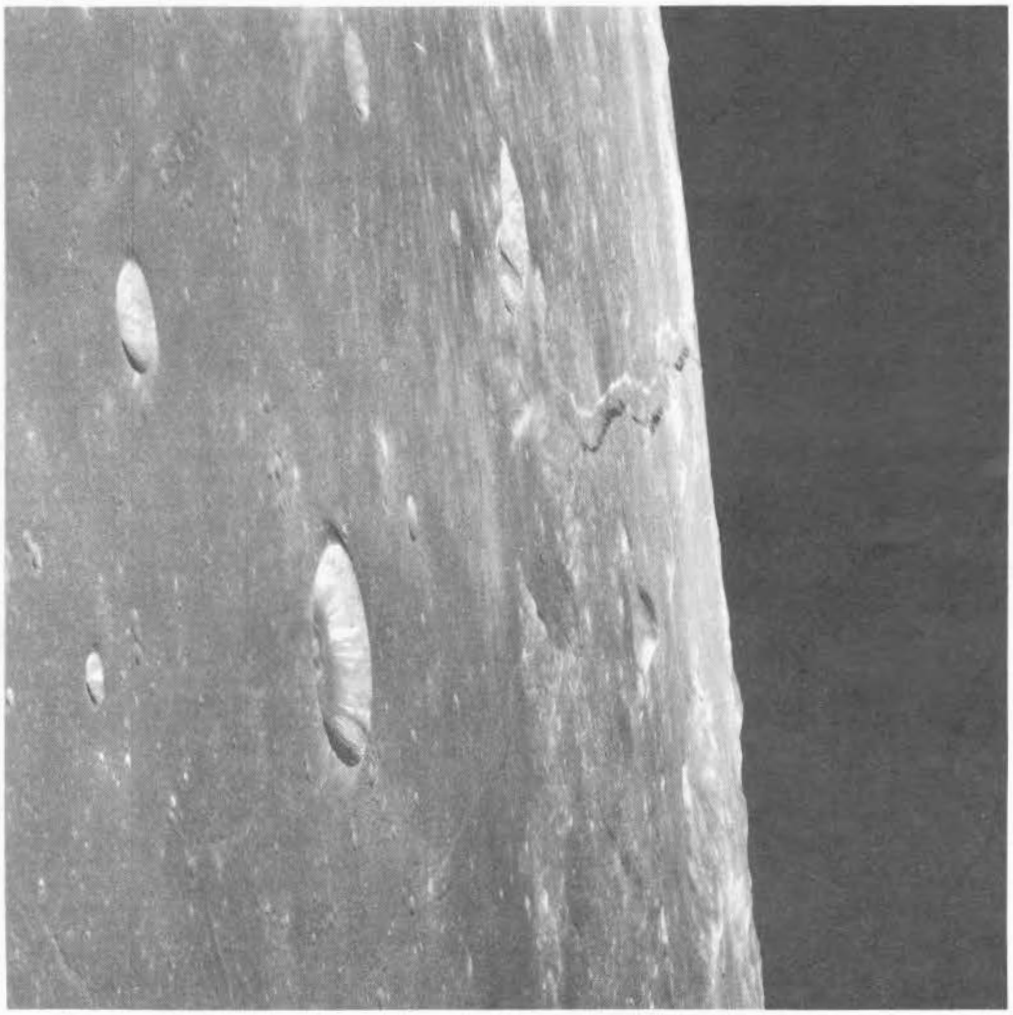
Postscript by Editor. The readers of this journal are most heartily invited to use our growing Lunar Photograph Library, including the excellent new additions listed above. There is a brief general description of the Library and the conditions for its use in Str. A., Vol. 22, Nos. 5-6, pg. 84.

II. The Lunar Dome Survey (Kenneth J. Delano)

The June, 1970 issue of The Strolling Astronomer carried a request for observations of lunar domes in the Marius hills region of the moon during the summer months. Randy Lambert of Mesquite, Texas was the only person who submitted a report. Using a six-inch reflector, he found the confirmed dome located at 51°38' W and 8°59' N (-717+345) and noted that it appeared triangular in shape. The southern part of the dome had darker shadow than the northern portion, thus suggesting a greater height or steeper slope there. He found no indication of surface detail. Observers with larger telescopes have detected a three-mile-wide crater near the top of this dome.

If the lunar dome program is to continue, greater interest and more observations will have to be evidenced. The very poor response to the call for observations of domes

Figure 39. Oblique view from Apollo-10, looking west (IAU) along the Ariadaeus Rille. Western Mare Tranquillitatis appears in the left part of the frame, containing (below center) the 16 km. crater Manners. North is to the bottom. A.L.P.O. Lunar Photograph Library photograph number AS10-30-4449. Available for loan to A.L.P.O. members.



in the Marius region may have been due to the difficulty of distinguishing domes in that notably complex area, and may also have been due to a combination of poor seeing conditions on the specified dates and personal schedules of summer-time activities.

Reports of domes found anywhere on the moon are always most welcome; but this time we will concentrate attention on western Mare Imbrium, in the immediate vicinity of the craters Diophantus and Delisle. The A.L.P.O. catalog of domes lists six domes in this area, but several more unconfirmed domes have been reported. Because domes show up best under low solar illumination, observe the Diophantus-Delisle region when it lies on or very near the terminator, i.e., about two or three days after the First and Last Quarter phases of the moon. A report of all observations received within the next three months will be published shortly afterwards.

Postscript by Editor. We take pleasure in calling attention at this point to the front cover drawing, which shows three domes at the north end of a cleft near the crater

Figure 40. Apollo-8 oblique view looking north in northern Mare Tranquillitatis. The large shadow-filled crater near the horizon is Vitruvius, 28 kms. in diameter. At bottom center is Jansen F, a 10 km. crater. Note the complex system of ridges between Jansen F and Vitruvius, as well as the unusual ring structure near the right margin. A.L.P.O. Lunar Photograph Library photograph number AS8-13-2347.

Birt and the Straight Wall. It occurred to us that a sample drawing might help to show beginning observers of lunar domes what to look for and what to record at the telescope. Speaking of this drawing, Reverend Delano wrote on October 8, 1970 in part as follows:

> "What it lacks in artistic value may be compensated for by the variety of interesting formations in this small area of the Moon. (The numerals adjacent to the domes are the identifying xi and eta coordinates of those domes.)
>
> "Contributors to the ALPO Lunar Dome Survey have been accustomed to sending in only crude sketches (for the most part) of the domes and their environs solely for the purpose of showing locations and shapes, not with much artistry in mind. That's true of myself too. Occassionally, as with the enclosed Birt drawing, I do strive for a more picturesque rendering of what I observed."

With this appeal to both the artists and the non-artists among you, lunar observers, surely you can give a bit more support to our Lunar Dome Survey - Reverend Delano will warmly welcome your efforts!

III. The Selected Areas Program (Charles L. Ricker and H. W. Kelsey)

Observing activity has remained rather low since the last "Lunar Notes", but observ-

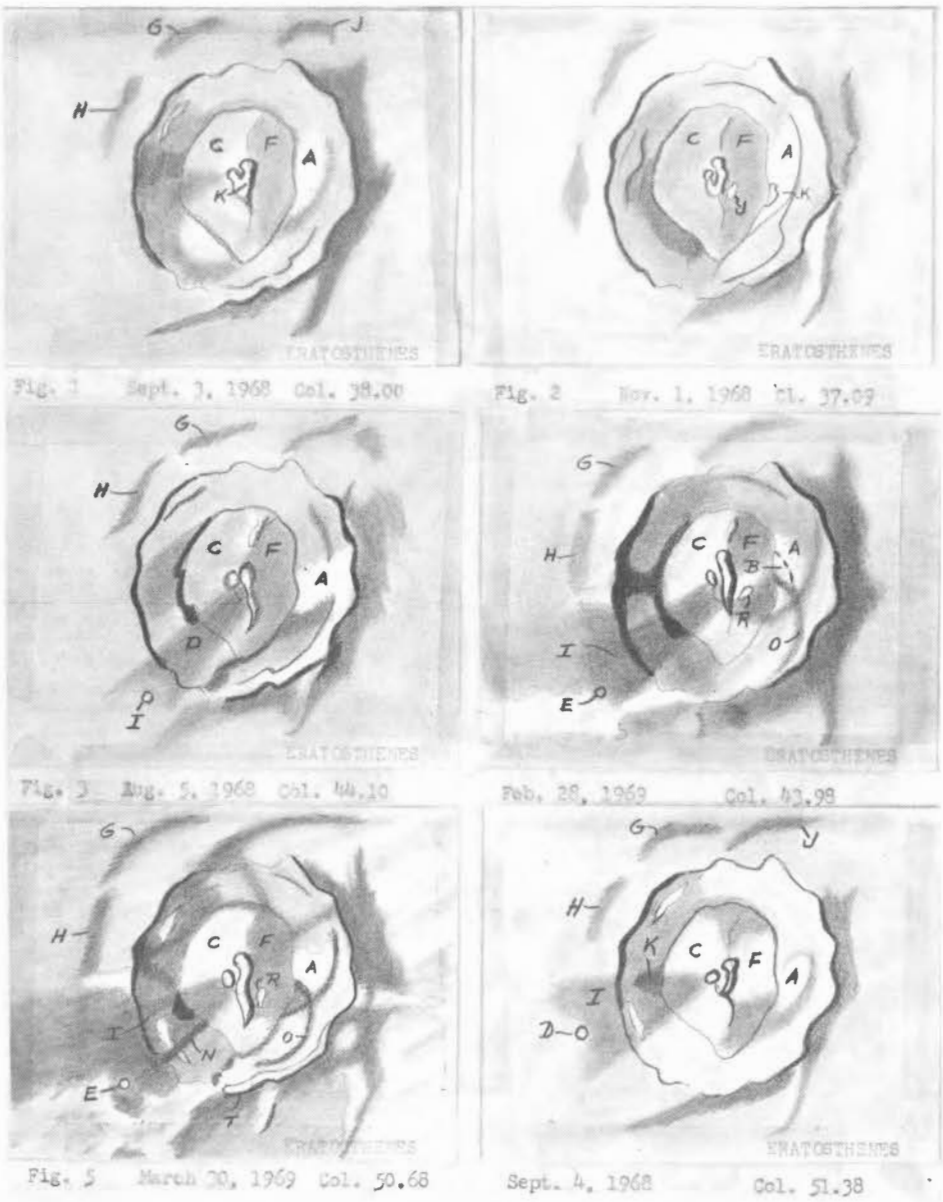


Figure 41. Some sample drawings of the lunar crater Eratosthenes by Mrs. Inez Beck, Wadsworth, Ohio, with a 6-inch reflector. Part of a file of more than 150 observations of Eratosthenes by Mrs. Beck. The pairs of drawings near the same colongitude shown here were chosen by Lunar Recorder Charles L. Ricker. See text of "Lunar Notes", Section III.

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ations have been received from the following observers: Inez Beck, Steven Szczepanski, William Richrath, Chet Eppert, Christopher Vaucher, Ronald Fournier, James Maher, and Michael Djonne. In addition, a number of inquiries have been received concerning the Selected Areas Program; and some of these look quite promising.

Orders for the "Lunar Observers' Manual" have continued at a steady rate, but unfortunately have not appeared to create a significant number of new observers. Come on now, surely in the whole ALPO there are potential observers who can participate in the varied programs your Lunar Section now offers!

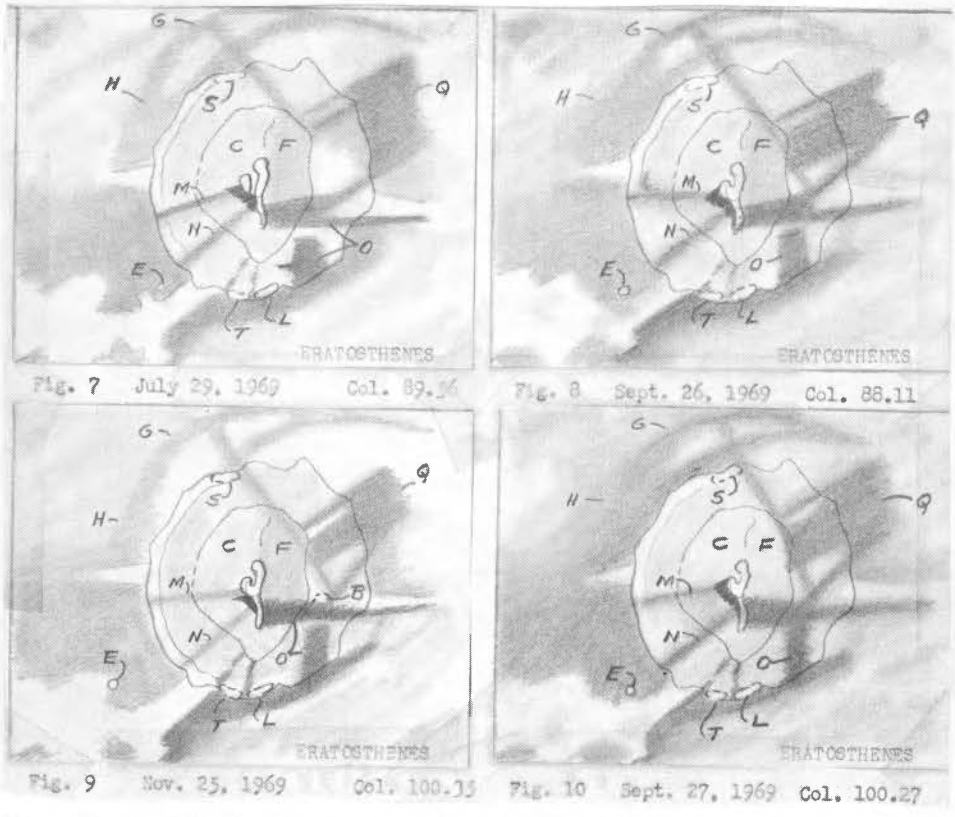

Figure 42. **Additional drawings** of the lunar crater Eratosthenes by Mrs. Inez Beck. The pairs of drawings shown here were selected by Mr. Charles Ricker. See also text of "Lunar Notes", Section III.

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New forms and instruction sheets are now ready for distribution, and may be obtained merely by writing to Lunar Recorder Ricker.

The series of drawings of Eratosthenes shown as Figures 41 and 42 were taken from a file of over 150 observations of this formation by Mrs. Inez Beck, using her 6" refl. at Wadsworth, Ohio. Several interesting facts emerge from a study of these drawings.

1. Eratosthenes undergoes drastic changes in appearance throughout a lunation.

2. Each pair of observations was made at nearly identical colongitudes, and even a cursory examination shows extreme differences between figures 1-2, 3-4, and 5-6 on Figure 41. Such unexplained differences were described many years ago by W. H. Pickering, who called them the "Moving Bands of Eratosthenes". To this writer's knowledge, Mrs. Beck's study is the first since that time which includes sufficient observations over a sufficient length of time to demonstrate the reality of these changes. At this point, it appears impossible to predict in advance just what aspect will appear at any given colongitude.

3. Figures 7-8 and 9-10 on Figure 42 show that the changes do not always occur. Many other observations in the file verify this.

4. It would appear that what is needed now is an even longer series of observations in order that some pattern can be discerned. Several series by other observers are very desirable in order to confirm these conclusions. It should be pointed out that Eratosthenes in <u>not</u> an easy formation to draw. In fact, many observers have difficulty even finding it under high-sun conditions!

Here is a real challenge for some of you who are willing to observe one formation every available night for several years. Mrs. Beck's beautiful series certainly demonstrates very startlingly just what a persevering amateur can accomplish using strictly

visual methods and modest instrumentation. May there be many imitators! Another interesting project would be to compare one's own observations at similar colongitudes with those illustrated here.

ALPO BUSINESS MEETING AT SACRAMENTO

This meeting was held on August 22, 1970 at 3:00 P.M. in one of the rooms of the Mansion Inn in Sacramento, California. Minutes were kept by Mr. Richard Wend, and this report is based upon his minutes. About 16 members were present. However, people came and went during the meeting; and several of the attendees were non-members. The Director acted as Chairman. It was voted to express our appreciation to the Sacramento Valley Astronomical Society, the host society at this ALPO Convention, for their hospitality and for splendid planning and managing of the Convention.

Director Haas gave a brief report on the status of the membership, as compared to previous years. There are now about 830 members, a small decline from the all-time high in 1969. He also presented a financial report and included a breakdown of the cost of the various aspects of producing The Strolling Astronomer. Bulk mailing of the journal was discussed, and so was the possibility of incorporating as a non-profit organization. No action was taken on these matters other than to refer them to the Director to act upon or not at his discretion.

Mr. Haas read a letter deploring those instances when the Recorders do not acknowledge observations or correspondence. This letter was written by Mr. Harry Jamieson, one of the Lunar Recorders. It was decided to remind ALPO Recorders of this obligation and also to state on the list of staff members on the back inside cover of each issue that persons requiring a prompt reply from Recorders should furnish a stamped, self-addressed envelope. Mr. Barry of Phoenix presented this recommendation as a motion.

The unpublished ALPO Observer's Manual, co-edited by Dale Cruikshank and Clark Chapman, was discussed. Mr. Haas read a letter from Dr. Cruikshank, dated August 2, 1970, suggesting that the Handbook be updated to the present time and then be reproduced by offset printing. It was further suggested that pre-publication costs could be borne by interested ALPO members and others, who would realize a small profit if the Manual sold in sufficient quantities. The Manual could be advertised in Sky and Telescope, The Strolling Astronomer, and elsewhere. The Director was instructed to contact the printer of The Strolling Astronomer for a quotation on the cost of printing, say, 500-700 copies of the ALPO Observer's Manual. It was suggested that an attractive price barely above cost could be offered for a limited period of three months; after that, the price would be higher.

Mr. Richard Hodgson suggested a looseleaf format for the Manual as a great convenience at the telescope. Mr. Hodgson moved that the appropriate Recorders and authors of chapters in the Manual be consulted about any revisions of their work. The motion passed. Mr. Dennis Milon remarked that Mr. Leonard Farrar, the new President of the WAA, is a commercial printer and might well be consulted for his professional opinion on printing matters.

The WAA kindly invited us to hold our 1971 Convention in Honolulu, Hawaii with them. Discussion followed. It was pointed out that only a few ALPO members would be able to attend a Hawaiian Convention and that all ALPO Conventions since 1965 had been in the West or Southwest. It was moved by Tom Cragg and seconded by Tom Cave to hold our 1971 Convention in Memphis, Tennessee in conjunction with the National Convention of the Astronomical League, provided that such a proposal would be acceptable to the League. Mr. Richard Wend agreed to contact the League on this matter. The formal invitation from the League soon came, and we shall meet with them next year; more details are given under "Announcements".

The ALPO expressed its thanks to the WAA for their gracious invitation to Hawaii and our regret in declining.

Reverend Richard Hodgson took the chair to preside over discussion of the proposed ALPO Constitution. Its text appeared in The Strolling Astronomer, Vol. 22, Nos. 3-4, pp. 41-43. Several changes were voted after debate, and the amended Constitution was overwhelmingly approved by the members at the business meeting. It must now be submitted by mail to the whole ALPO membership; they will receive the amended complete text and a ballot to vote yes or no on its adoption. If it is adopted, officers must be chosen as described in the Constitution.

At this writing (October 17, 1970) the exact mechanical procedure for polling the membership has not been chosen. The present organization and procedures in the ALPO will

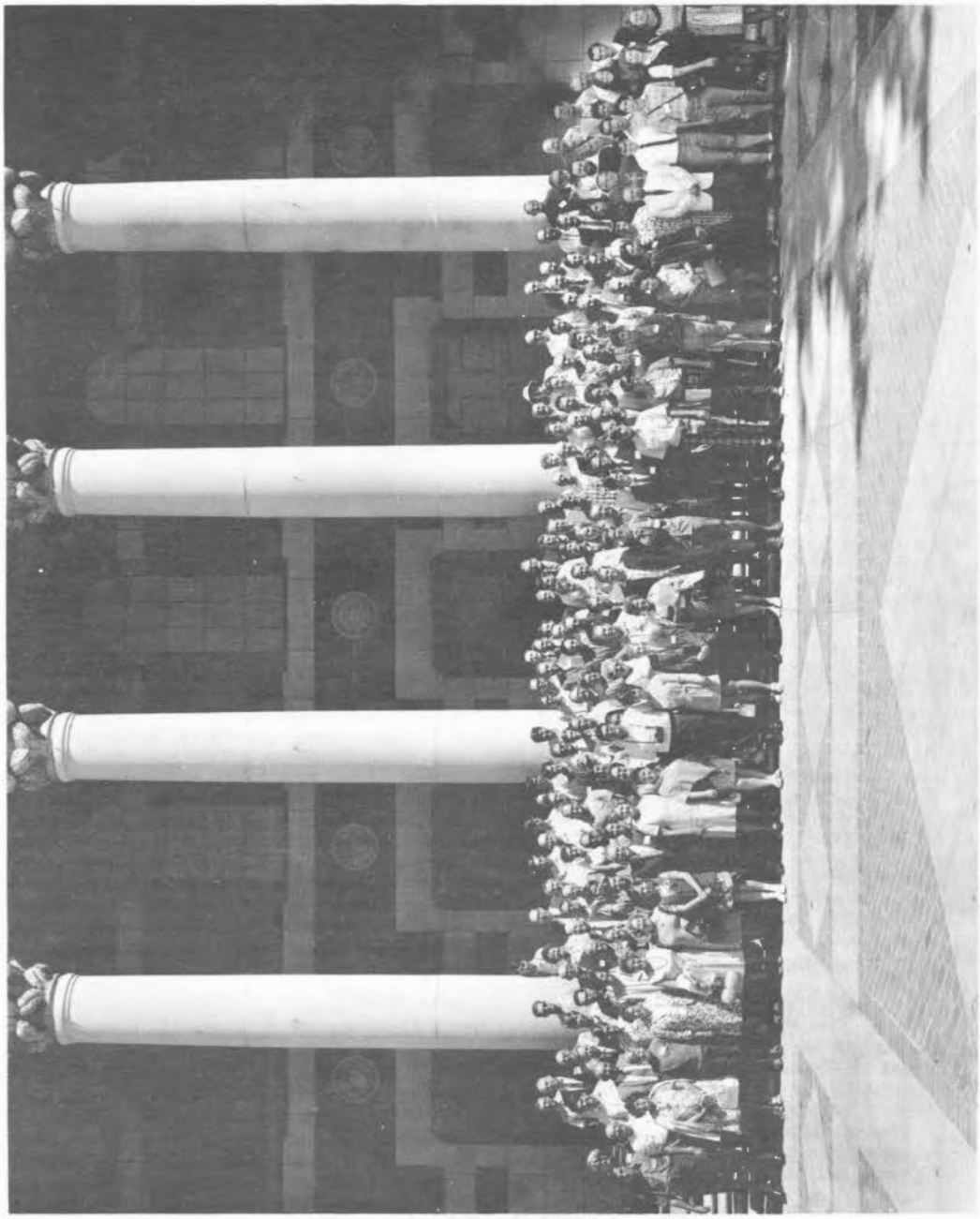

Figure 43. Group photograph of WAA-ALPO Convention at Sacramento, California, August 20-22, 1970. Taken by Pope Studios in Sacramento.

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remain in force until the 1971 business meeting.

The Director thanks all ALPO members who attended the business meeting just described and who took part in the discussions there. Such assistance is very valuable to the Director in trying to choose policies and procedures which will best serve our very scattered, and often silent, membership.

ANNOUNCEMENTS

Changes in Training Programs. Mr. Clark Chapman has found it necessary to give up the supervision of the Lunar Training Program and the Lunar and Planetary Training Program under the severe pressure of advanced graduate studies. Mr. Chapman's services to the ALPO have been numerous and considerable; it is fitting at this time to express our deep appreciation for his help in training new observers and our regret that he is not at present able to continue. Mr. Chapman reports that the first "graduate" of the Lunar and Planetary Training Program is Mr. Ernst H. Mayer of Barberton, Ohio. We commend Mr. Mayer upon his most successful completion of the required series of observations.

Our training programs are being reorganized, and it is planned to describe in our next issue what we can now offer to new members and to others wishing to improve their skills in observing. For the present a Lunar Training Program is being continued, and the Recorder in charge is Charles L. Ricker, 403 W. Park St., Marquette, Michigan 49855. All interested persons should write to Mr. Ricker.

Mr. Chapman has kindly offered to continue to correspond with observers already enrolled in his original training programs.

Lunar Libration Cloud Section. This program is being discontinued for lack of interest. We thank Mr. Walter Krumm, who has been the Recorder, for his efforts in supervising the Section and in trying to stimulate observational studies of the elusive Lunar Libration Clouds. Perhaps the deteriorating skies over metropolitan areas (and elsewhere!) have helped to discourage potential observers.

Error in Address for Phillip W. Budine. In the present address of our Assistant Jupiter Recorder the correct zip code is 08046. It was wrongly given as 08064 in our last issue.

Coming 1971 Convention with Astronomical League. In a letter written on September 9, 1970 Mr. W. C. (Bud) Shewmon, the President of the Astronomical League, graciously invited the Association of Lunar and Planetary Observers to participate in the 1971 National Convention of the Astronomical League. The place is Southwestern College in Memphis, Tennessee. The dates are August 18 to 22 (3 full days). The host is the Memphis Astronomical Society; and the Convention Chairman is Mr. William J. Busler, one of their members and the Vice President of the League. Dormitory space for 700 people is available at a charge of $5.00 per night, and three meals can be obtained for $5.00 per day or less. Ample meeting space and exhibit space are available. More details will be carried in future issues of this journal.

The Atlas of the Universe (Book). We have received a review copy of this remarkable book, but too late for reviewing in this issue. The author is Mr. Patrick Moore, and the publisher is Rand McNally. The price is $29.95 before Christmas, which is partly the reason for this notice, and $35.00 afterwards. There are 272 pages and nearly 1,500 maps, illustrations, and photographs. There is a foreword by Sir Bernard Lovell, the famous astronomer, and an epilogue by Dr. Thomas O. Paine, NASA administrator. In the intervening pages Mr. Moore describes and explains clearly and informatively the story of Man's expanding acquaintance with his universe. The beginner will find a very useful Beginner's Guide to the Heavens and a 10,000-entry index. The advanced specialist will find new full-color maps of the earth, the moon, Mercury, and other objects designed especially for The Atlas of the Universe. No less than 176 pages are printed in 4 and 6 colors. We must agree with the publisher's summary: "Ideal space-age reference for family or library".

International Astronomical Camp at Bologna, Italy in 1971. Mr. Paolo Pizzinato in Italy calls to our attention plans for an astronomical camp in Italy from July 28 to August 11, 1971, similar to highly successful ones already held in Germany. The camp will be organized by the Associazione Astrofili Bolognesi and the Unione Astrofili Italiani under the auspices of the International Union of Amateur Astronomers. The general director will be the I.U.A.A. President, Dr. Luigi Baldinelli. He writes in part: "The camp will be a meeting of youths of every nationality who are interested in astronomy from a practical point of view, and it will provide an opportunity for an exchange of ideas and experiences. The work that will be carried on in the camp will include lectures, discussions, and astronomical observations. English and French will be the official languages of the camp. The participants will have at their disposal complete instruments, a dark room, a library, etc. The total price will be no more than $35.00."

The camp is intended for young astronomers. Since the number of participants will be limited, interested persons should write as soon as possible to this address:

I.U.A.A. (International Union of Amateur Astronomers)
40121 Bologna, piazza dei Martiri 1, Italy

A SUGGESTED COLOR STANDARD FOR VISUAL OBSERVATIONS

By: Leonard P. Farrar, President, Valley Amateur Astronomers

During the recent 1970 W.A.A.-A.L.P.O. Convention, I presented a paper on a color selector book, used extensively in the printing business. The original idea was that this color book, specifically the "Pantone Color Paper Picker", costing $1.25, provided us with 501 specific colors that we could use for a comparison standard when observing the objects of our Solar System. Objects I have done some work with include the nucleus of Comet Abe, the Moon, Mercury, Mars, Jupiter, Neptune, and a couple of variable stars.

The 501 basic colors are in no wise the limit as it is possible to judge between two colors of one page, as well as colors of different pages. I would here suggest that the value of two color estimates be written as a fraction (PMS 124 1/3 PMS 125), meaning simply one-third of the way between PMS 124, the base color, and PMS 125, the lesser tone. This system will provide at least a starting place.

There are a number of problems. The first one that came up was the problem of a standard light source. Chick Capen provided two answers. For the large apertures use a desk lamp since dark adaptation isn't particularly a problem. The other solution, the one I use, is a pen light with the bulb painted black, and then lightly scratched to allow a minimum of light through. Nickel-Cadmium batteries assure a constant light source between recharges. Whatever the light source, an observer's report should state what was used. Another problem is that the book has each color printed at full intensity, while everything you observe will, with few exceptions, be anything from a tinge to some percent of the basic color. Originally I suggested A to J as a tint scale, but this does not seem to me to be adequate. Several people brought up the point that they were color blind, generally, as well as selectively. Tom Cragg suggested that it might be possible to pick the color by viewing both the source and the book through filters of known value. One comment on color blindness by way of encouragement to those who are afflicted: personal experience suggests that seeing color is a trainable ability.

Pantone Company prints and sells a variety of color books and markets them worldwide. Your local art store will have them or can direct you to some one who does. The book I recommend, the Color Paper Picker, is, as stated, $1.25. You may also write Pantone Inc., 461 8th Ave., New York, N.Y. 10001.

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STAFF

EDITOR
Walter H. Haas
Box 3AZ
University Park, New Mexico 88001

SECRETARY
Atty. David P. Barcroft
Box 3AZ
University Park, New Mexico 88001

LIBRARIAN
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P. O. Box 30163
Cleveland, Ohio 44130

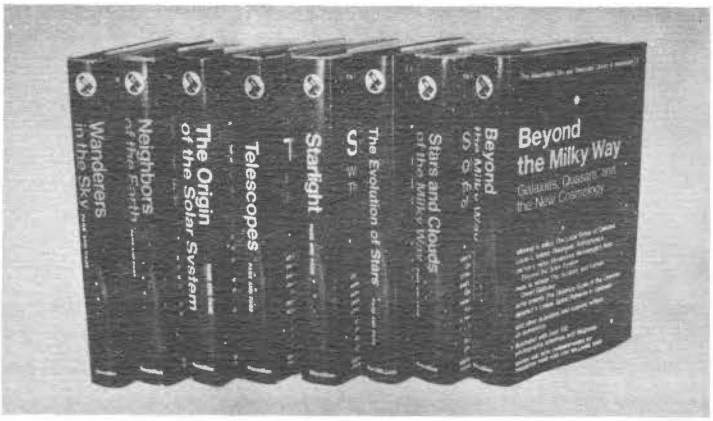
John E. Westfall
Department of Geography
San Francisco State College
1600 Holloway Avenue
San Francisco, California 94132

Kenneth J. Delano
(Lunar Dome Survey)
22 Ingell St.
Taunton, Massachusetts 02780

Charles L. Ricker
403 W. Park St.
Marquette, Michigan 49855

H. W. Kelsey
3439 Mono Drive
Riverside, California 92506

LUNAR TRAINING PROGRAM
Charles L. Ricker
403 W. Park St.
Marquette, Michigan 49855



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