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Photograph of extraordinary Leonid meteor shower on November 17, 1966. The bright star to which the arrows point is Beta Ursae Minoris. The camera was a Miranda 50-mm., F: 1.9 lens, mounted on a 12-inch telescope tracking at the sidereal rate. The stars are hence points; the meteors are roughly parallel streaks. 10-minute exposure on Tri-X film at about 11 hrs. 30 mins., Universal Time on November 17. Photograph by Mr. Scott Murrell at New Mexico State University Observatory. Text on pages 29 - 33.

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ALPO

Founded In 1947

IN THIS ISSUE

THE STAR OF BETHLEHEM*

By: Carl Price Richards

[Foreword by Editor. With this issue expected to be mailed during the Christmas season, we here reprint a special Christmas article much appreciated by many of our early members. The late Carl Richards of Salem, Oregon was one of the best-loved amateur astronomers of his generation. He long gave selflessly of his time and his strength to the science which he loved. He was a charter member of the A.L.P.O. and an officer of the Astronomical League. Perhaps we can do no better than to quote Carl Richards' own words 19 years ago: "I realize, of course, that this article is different from the technical and observational matter which characterizes your publication and is so appropriate to its theme and purpose. But is is Christmas time--and that, too, is different; it is a season when our minds may let up a little and seek to dwell in an atmosphere which is somewhat less technical.

"Maybe an article of this sort will do just that for your readers; it will lead them in an atmosphere which is a little lighter, though still astronomical and, to a limited extent, planetary."]

Legend, miracle or scientific fact?

Around these three themes has ranged the still unsettled controversy concerning the explanation of the story of the wise men and "the star in the east." Throughout the centuries the scanty record of this unusual experience of men of wisdom has been food for the skeptics, confirmation for the believers in miracles, and stimulation for investigation and research to those with scientific leanings. Each year as the Christmas season approaches, the minds of men the world over dwell on the timeless stories of the beginnings of the Christian era, interest is renewed in the events of two thousand years ago, and renewed efforts are made to get at the real facts concerning the various episodes.

It is natural for those whose training and mental inclination lead them to believe in the general law and order of the universe to seek reasonable and scientific explanations for phenomena which, at first, seem baffling, or even impossible. That is the attitude of such individuals toward the story of the Star of Bethlehem. Others, having less scientific background, merely toss it aside as the product of a vivid imagination, prompted by religious enthusiasm to endow a cause with the emphasis of the miraculous and mysterious. This is the course pursued by skeptics who pooh-pooh the whole episode as pure fiction.

Another alternative is to relegate such occurrences to the realm of the supernatural. That simply constitutes an easy way out; it is the method of the "medicine man" of primitive races and of the unlearned of the "civilized" peoples. But, to the intelligent, to those who mentally hunger for explanations of things which satisfy in the light of modern learning, any bewildering phenomenon is at once a challenge to seek and to delve until the truth is revealed.

What is the extent of the story of the star which has been handed down through the ages? It is very meager and limited entirely to the first few verses in the second chapter of the gospel according to St. Matthew. The significant passages are as follows:

> "Behold there came wise men from the east to Jerusalem, saying, Where is he that is born King of the Jews? For we have seen his star in the east, and are come to worship him.
>
> "Then Herod, when he had privily called the wise men, enquired of them diligently what time the star appeared. And he sent them to Bethlehem - - - - - - - they departed; and, lo, the star, which they saw in the east, went before them, till it came and stood over where the young child was. When they saw the star, they rejoiced with exceeding great joy."

Brief as the account is, it has had a tremendous impact upon the thought of people down through the years, to the extent that the star has taken its place as the symbol of the advent of Jesus, even as the cross is the symbol of his sacrificial death. For that reason, if for no other, there is justification in seeking to substantiate the story with scientific laws and facts and to correlate it with proven events.

To do this it is necessary to draw upon man's knowledge of astronomy, which is one of

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the oldest of sciences. The "wise men from the east" themselves were reputedly well versed in knowledge of the heavens and, crude though their knowledge was compared with what the science of astronomy encompasses today, their learning in that direction has much significance in regard to a full appreciation of the story.

Several possibilities have been set forth as affording an explanation of this "star in the east" and a review of them is of interest. These possibilities include such things as the occurrence at the time of the birth of Jesus of certain known periodic astronomical events. In this connection it must be noted that the exact date on which Jesus was born is unknown. But, by correlating the date with contemporary events which are known to have occurred in certain years, it is evident that it must have been during or before 4 B.C.--which was the year Herod the King died--and may have been as early as 11 B.C.

It is natural that the planet Venus should be suggested as being the star which the wise men saw in the east, as it is one of the most prominent objects in the sky, being brighter than any other except the sun and moon. It would meet the requirements from that standpoint, since the wise men, seeking a sign, would only regard as such something of outstanding beauty and brilliance. Its appearance, too, would occur within the years during which the birth of Jesus is known to have taken place, as it shines very brilliantly for a few weeks as a morning star in the east at regular intervals of just over a year and a half. But the Magi, being versed in the movements of the heavenly bodies, would not regard so well known and regular a visitant as Venus as being the sign they sought. Something more unusual must be found to meet the condition.

At rare intervals two or three of the planets approach one another in our view of the sky, and some have thought that a "conjunction" of that nature might have been the "star in the east." Such an event occurred in December,1946, when Venus and Jupiter were brilliant objects close together in the morning sky for about three hours before sunrise; and this spectacle, coming just at Christmas time, recalled to many the story of the wise men and the star.

A similar close approach of the planets Jupiter and Saturn happened in December, 1603, and was observed by Kepler, one of the great astronomers of the years just prior to the invention of the telescope. A few weeks later, these two planets, still close together, were approached by the planet Mars, the three forming a relatively small triangular configuration of stiking beauty. Kepler was greatly impressed and wondered whether something similar could have been the wise men's star. So he set to work calculating the movement of those planets backward through the centuries and found that such a "triple conjunction" had indeed taken place in the year 6 B.C. So rare and impressive an event might well meet the requirements of a sign for the Magi, but it should be observed that no mention is made of more than one star. If there had been three, or even two, that fact, surely, would have appeared somewhere in the story.

Other possibilities to explain the star seen by the wise men include comets and even meteors. The latter may be dismissed as scarcely able to fulfill the conditions. A bright meteor, or fireball as it is sometimes called, is too transitory, only lasting for a few seconds. Even the hazards of translation and of handing the account down through the years would not allow it to be said of a meteor that "it came and stood over where the young child was."

The suggestion that it was a comet is much more reasonable. Comets of sufficient brilliance to serve as a "sign" are of rare occurrence and are prominent objects in the sky, usually for a few weeks. Historical records show that a comet has always been regarded as presaging some important event, so it is very likely that, were such an object visible at that time, it would have been fully sufficient to start the wise men off on their quest. One can readily imagine the impression it would make on the Magi to see the bright nucleus of such a comet leading a long, luminous appendage, with the whole impressive spectacle pointing their direction to the King of the Jews whom they sought.

The possibility that such was the case has induced some to investigate any source which might indicate whether there was a celestial apparition of that kind during a year in which Jesus might have been born. A few years ago it was found that records left by early Chinese astronomers indicate that they observed in the year 4 B.C. a comet bright enough to be seen during daylight hours. If it could be seen in the far east, it was also visible in the near east, so this suggestion merits serious attention as the explanation of the nature of the object which led the Magi to their goal.

There is one other astronomical phenomenon which, possibly more than any other, holds promise of being the true explanation of the Star of Bethlehem. At irregular and unpredictable intervals new stars appear in the sky; they flare up in the course of a few hours from being faint, or even totally invisible, to become stars of great, but varying, brilliancy. Many of them never attain sufficient brightness to be seen without telescopic aid; but every few years there is usually one which can be seen with the unaided eye, becoming as bright, probably, as the stars in the Big Dipper. They retain that brilliancy for only a few days, then gradually fade away, sometimes to disappear entirely from even the largest telescopes. These stars are called "novae," or new stars. Then, occasionally--once in several centuries--there occurs a gigantic outburst, which astronomers call a "supernova," a new star of a magnitude which has been known to attain a brilliance exceeding that of Venus at its brightest.

Such a supernova appeared in the year 1572 and was thoroughly observed and measured with all the instrumental facilities available in those pre-telescope days by Tycho Brahe, the famous Danish astronomer. The records he left concerning it are precise and, coming from one who was a recognized authority on astronomical matters in his day, may be regarded as thoroughly reliable. This supernova was in the constellation of Cassiopeia; and, strangely, only thirty-two years later, in 1604, another supernova appeared in the constellation of Ophiuchus. The former, which is often referred to as Tycho's star, became so bright that it was clearly visible in the sunlight of noonday. The later one is recorded as nearly equalling in brightness the planet Jupiter. Both must have been striking objects, especially as each was in a part of the sky which is never reached by any of the planets.

No other such supernova has been seen during the subsequent three centuries, but telescopic supernovae have been observed on several occasions. Some of these exceeded Tycho's star in actual brightness, termed absolute magnitude; but, owing to their great distance, their apparent brightness, or magnitude, was much less. Some regions of the sky have produced a considerable number of faint novae and supernovae. The well known Andromeda Nebula, a galaxy similar to ours of the Milky Way, but some 800,000 light-years distant, has shown more than a hundred new stars in recent years. Some of them have been of gigantic proportions, one attaining a brilliancy over 200,000 times that of the sun!

Thus, it would appear that, in the Universe at large, the occurrence of new stars, often vastly greater than our own star--the sun--is relatively common. In these days of systematic scientific observation of the celestial sphere, no event of that nature is allowed to go unrecorded. But conditions were very different a thousand or two thousand years ago. The recording then of scientific happenings was a chance affair; and, with no widespread dissemination of information, such records as were made suffered distortion and loss.

It would, then, seem quite reasonable to claim that the star which the wise men saw in the east was a nova--or even a supernova--and their regard of it as "his star" was, to them, sufficient record. Any scientific explanation of it was inconsequential and entirely overshadowed by their view of it as "a sign." If it was noticed by others, no mention of it seems to have been made in contemporary writings or records of any kind.

So science, left with no authentic information, is merely able to speculate. It can make no definite statement, but merely point out the possible, or even probable, explanation. It is not the only instance of science's being baffled and unable to square its facts with the Gospel records. Incidents relative to the birth of Christ, His miracles, and His resurrection conflict considerably with scientific laws; but, it should be noted, they do not, thereby, lose their moral and spiritual values.

On the contrary, such values are enhanced by the aura of mysticism surrounding that timeless story; and the fact remains that whether the Star of Bethlehem be legend, miracle or scientific fact, the story itself is a great reality and a power for good. It has always been, and will continue to be, an inspiration and a solace to untold millions of people down through the centuries.

Whatever one's attitude may be to the science behind the story, however, there still remains the basic Christmas message---"On earth peace, good will toward men"---and there never was a time when this old world so sorely needed, as it does at present, to follow the teaching which that message forecast.

LUNAR SECTION: THE STEEP PLACES PROGRAM

By: Charles L. Ricker, A.L.P.O. Lunar Recorder

Several years ago an article appeared in The Strolling Astronomer, by Joseph Ashbrook, on "Steep Places on the Moon".[1] At that time, it was announced that the ALPO would instigate an official program on this project. Observer response was practically non-existent. It was recently decided again to establish an official, coordinated program on this very worthwhile project, and again to try to arouse observer interest.

One may well ask, "Why study steep places on the moon?" There are several good reasons for doing so: 1. It is an almost totally ignored branch of lunar study both by amateurs and professionals. Of course, the reason it has been so neglected is that most observers like to concentrate on features close to the terminator. Even high-quality photography has failed here because the exposures were set for terminator regions. 2. If, as it is generally conceded, it is important to study such parameters as heights, depths, diameters, etc., it is equally important to study the maximum slopes, which is what the steep places program boils down to. From this result, it can be seen that this severely neglected field can be very useful, despite recent space-age accomplishments.

The observational aspect of the program may be roughly divided into two phases which may be pursued concurrently. These are: Phase 1. Discovery of new steep places. The procedure here is simply to make a careful search far from the terminator for lingering flecks of black shadows. Fruitful areas to search would be crater rims, central peaks, interior crater terraces, mountain ranges, isolated peaks, faults, and prominent rilles and valleys. Having found said black shadow, the next step is to carefully describe it and its location. If possible, it would be best to give selenographic coordinates of the object; but if this is not possible, then one should furnish a complete description of the location so that the Recorder may derive the coordinates. Phase 2. Study of already known steep places. An annotated list of over 100 of these has been prepared by Dr. Ashbrook, and is scheduled for publication in the next issue. Each of these objects should be carefully studied from lunar sunrise until such time as the black shadow is no longer visible. The positions of some of these places are in need of refinement, and the given slope values at this time are tentative only. In addition, as new features are discovered, they will likewise require systematic observations in order to refine their parameters.

For a start, the following objects may be systematically observed for steep places, if any, and the location and slopes of same.

The Straight Wall. (Most conspicuous fault.)
Fauth & Fauth A. (Together these form one of the largest secondary craters.)
The Alpine Valley. (Most conspicuous valley.)
Pico & Piton. (Largest isolated peaks in maria.)
Copernicus, Tycho, Theophilus. (Prominent examples of ring plains. Check rims, terraces, and central peaks.)
Plato, Langrenus, Mersenius. (Prominent examples of walled plains.)
Hyginus Cleft, Ariadaeus Cleft, Schroeter's Valley. (Easily observable clefts.)

These objects are listed only as a guide as being the most prominent or easily observable representatives of different types of lunar features, and it would be most instructive to obtain refined slope values and positions of the steep places on these representative features. This will give us useful ideas as to what to expect on the more difficult counterparts of each feature.

As to reporting observations: the following data is essential if the Recorder is to make intelligent use of the observations:

1. Date (by UT). 2. Universal Time. 3. Telescope-type, aperture, magnification. 4. Seeing (0-worst to 10-best possible). 5. Transparency (limiting visual magnitude). 6. Correct identification of feature in which steep place is observed. 7. Coordinates of steep place and/or a description of its location, using IAU directions.

The following data can also be given if the observer wishes to do so.

1. The Sun's selenographic colongitude.
2. The solar altitude, derived from the following approximate formula which is accurate to about 1°.[1] This is sufficient accuracy for virtually all visual slope work.

$$\sin \underline{A} = \cos \underline{B} \sin (\underline{L} + \underline{C})$$

where:

$\underline{A}$ = angular elevation of Sun.
$\underline{B}$ = selenographic latitude of feature. ($\sin \underline{B}$ = eta)
$\underline{L}$ = selenographic longitude of feature. ($\sin \underline{L}$ = $\underline{xi}$ sec $\underline{B}$)
$\underline{C}$ = colongitude of Sun. (No. 1 above.)

It should be emphasized here that should any observer not wish to make these computations, he should not hesitate to submit his observations without them.

What does one need to participate in this program? A good lunar chart is of course a necessity. While a very small telescope may be used with some success, an aperture of from 8" to 12" will probably be necessary to follow the black shadows until they disappear. It is significant that larger telescopes always give larger slope values in this type of work, simply because they can see the shadow after it is no longer visible in a smaller instrument. Again it should be emphasized that observations will be welcome, regardless of experience, aperture, or other considerations. The value of studying "peculiarities" on the lunar surface can be seen by reference to recent articles on lunar domes, and the significant results obtained by the BAA in the study of "overlapping" craters, to mention just a few examples.

With the programs now available to modestly equipped amateurs, we should no longer hear the lament that serious lunar study is no longer available to them. This Recorder is anxious to help promote a renewed interest in lunar observing in this country, and will welcome suggestions or questions about this or other lunar programs of current interest.

Reference

1. Ashbrook, Joseph, "Steep Places on the Moon", Strolling Astronomer, Vol. 17, Nos. 7-8, pp. 136-137, 1963.

THE FORTHCOMING 1967 APPARITION OF MARS

By: Richard E. Wend, former A.L.P.O. Assistant Mars Recorder

The 1967 apparition of Mars will be the last of the current series of four unfavorable approaches of the Red Planet. Beginning with the apparition of 1960-61, opposition has occurred closer to aphelion than to perihelion; and the closest approach of Mars during this period has been considerably greater than the minimum possible distance of 34.6 million miles. Aphelion will occur on December 26, 1966. Between the end of January, 1967 and mid-August of that year the apparent angular diameter of Mars will be 8" or greater; and serious observers should make plans for useful observations during this time.

Opposition will be reached on April 15, 1967; and the closest approach will occur on April 22, when the disk will have an apparent diameter of 15".57 and a stellar magnitude of minus 1.3. The distance of Mars at that time will be 56 million miles. By the time perihelion is reached on December 4, 1967, the magnitude will be plus 1.2, the apparent diameter $5\frac{1}{4}$", and the distance 165 million miles.

Members should submit their observations on standard A.L.P.O. Mars Report Forms, which will make analyzing and appraising more systematic. These forms are available from the Mars Recorder (see inside back cover), and should be returned to him for inclusion in the permanent record of the apparition. To be of value, all observations must include the name and address of the observer, observing station, date and time (identified as U.T., C.S.T., or whatever), telescope aperture and magnification, seeing and transparency conditions, filter used (if any), and any useful comments.

Before making a disk drawing, the observer should study the planet visually for at least fifteen minutes in order to adjust his eye to the degree of contrast present and to familiarize himself with detail. If the more prominent markings are carefully placed on the drawing and the time noted at the start and end of this stage, accuracy can be maintained with the balance of the detail being added within fifteen minutes of the noted time. Since the polar caps can vary greatly during the apparition, it is important that care be taken in delineating them on the drawing. Klaus R. Brasch, A.L.P.O. Mars Reocrder, recommends two imaginary parallel lines (N & S) starting at the extreme edges of the polar cap. An estimate of the distance between the lines, as a fraction of the planet's diameter, is made and is used in the scale drawing on the report form.[1] The north pole of Mars is tilted toward the earth, and this gives us the opportunity to study the northern hemisphere, which is not so well known as the southern hemisphere. The south pole is tilted toward the earth during the most favorable apparitions.

Near opposition, central meridian transit timings of surface detail can be made with sufficient accuracy to make them useful for positional measurements. It is not necessary to have access to WWV; a check with the telephone company for the correct time is sufficiently accurate.

One of the most valuable aids to the study of Mars is the colored filter. The standard Wratten Filters can be used to help overcome image deterioration caused by scattering in the atmospheres of Mars and the earth. They increase hue contrast between areas of different color and tend to reduce irradiation in the observer's eye.[2] Of the standard Wratten Filters, #57 (yellow green) is suggested for white surface haze or clouds on Mars; #47B (deep blue) helps detect high altitude white clouds. To investigate the famous "blue clearing" near opposition #15, #21, and #25 (yellow to red) and #38, #47B, and #48A(blue) are employed. If surface markings are of comparable intensity through both sets of filters, a blue clearing is indicated. Filters are also helpful in studying the effects of the atmospheric hood of polar haze, which has been seen to vary over an interval of as short as a day when observed in blue and green light.

Each observation should be accompanied by an estimate of the visual intensities of surface markings, using a scale of zero to ten, with zero being the apparent brightness of the sky in the vicinity of Mars, and ten the mean brightness of the polar cap. These estimates are carried out without a filter; brightness estimates made with filters should be reported separately with the filter designation included.

References

1. Brasch, K., "Some Notes on the Coming 1964-5 Apparition of Mars", Str. A., Vol. 18, Nos. 7-8, 1964, p. 129.
2. Capen, C., "Filter Techniques for Planetary Observers", Sky and Telescope, Vol. 17, 1958, pp. 517-520.

COMMENT ON A LUNAR HALO

By: Joseph Ashbrook

M. Minnaert's very readable book, The Nature of Light and Colour in the Open Air (Dover, 1954), contains on pages 192-195 an interesting account of the 22° haloes that are very frequently seen surrounding the sun or moon. He points out that the radius of the sharp inner edge of a lunar halo can be determined by noting a star on it; a subsequent calculation of the angular distance of the star from the center of the moon gives the halo radius. According to Minnaert, the best measurements give about 21°50'.

I had a favorable chance to try this observation on the morning of October 7, 1966, when Jupiter and three bright stars were on or near the inner edge of a conspicuous lunar halo. For those objects not exactly on the edge, I estimated their angular distance inside or outside it, in terms of the length of Orion's Belt (2°.8). In this way, the halo radius was found to be 22°.1 from Jupiter, 24°.3 from Procyon, 22°.8 from Alpha Orionis, and 21°.1 from Beta Tauri. The mean is 22°.3. This observation was made at 4:44 a.m. EST, at Weston, Massachusetts.

Of course, the diameter of a halo can be measured directly with a sextant or with a home-made cross-staff, thereby avoiding the calculations required in the star method. For an imporvised cross-staff, arrange a footrule so that its center can slide along a yardstick while these two parts remain perpendicular. The observer notes the distance from his eye at which the footrule just covers a diameter of the halo, and finds the angle either by trigonometry or by applying a protractor to a scale drawing.

Note by Editor. Readers are invited to use the methods described above to measure lunar haloes which they see during the coming months and to report their results either to the Editor or to Dr. Ashbrook. His address is 16 Summer Street, Weston, Massachusetts 02193. It will be interesting to see how well such measures agree with each other.

MERCURY: RESEARCH PROJECTS FOR THE SMALL OBSERVATORY

By: Richard G. Hodgson, A.L.P.O. Mercury Recorder

1. Introduction

As every experienced observer is well aware, the planet Mercury is not easily studied. Its small disc, comparatively brief apparitions, and angular proximity to the Sun have caused many to neglect the planet. The recent discovery, based on radar studies, that Mercury rotates in 58 or 59 days[1] has discouraged many of those who made drawings and maps of its surface under the older assumption that the planet always keeps the same surface toward the Sun. Examination of these older observations, however, reveals a considerable measure of disagreement,[2] which indeed such a false assumption would help to engender. The newly-discovered rotation rate for Mercury means that we must begin again mapping the planet through 360° of longitude, rather than only the 180° of the earlier maps*. Far from causing discouragement, a more accurate knowledge of Mercury's rotation should serve to unscramble some of the former discrepancies, and enable more accurate interpretation of surface detail.

To participate fully in the research projects for the planet Mercury given here, one should have use of a refractor of at least five inches aperture, or a reflector of at least six inches. Smaller telescopes than these may be able to participate in a limited way, but must frankly recognize the truth that Mercury is not an easy object to observe. To make scientifically useful observations, larger apertures and more sophisticated instrumentation are needed today than was the case years ago. Setting circles and a clock drive are of great value, particularly for daylight observing. Astrophotography can also be of great assistance in some aspects of the work, especially during the precious moments of total solar eclipse. Because most observers in the past have concentrated on the Sun on such occasions, these rare opportunities to study Mercury when well placed in the sky have been neglected. Past neglect provides the present generation of astronomers with the opportunity for useful research.

2. Research Projects

I. SURFACE FEATURES (minimum aperture: 5" refractor or 6" reflector). Disc drawings recording (1) surface features which are clearly seen; (2) terminator appearance, including cusps and any other irregularities; and where possible, (3) intensity estimates[3] and (4) color estimates (the last made preferably with reflectors).

At the present time the careful observation and recording of surface features is of great importance. A number of good quality disc drawings could serve to confirm (or to contradict) the recently announced rotation period. <u>This work should therefore receive first attention</u>.

Most of the earlier A.L.P.O. observations of Mercury were made in morning or evening twilight, when the planet was low in the sky. The Recorder would urge members to undertake daylight observing, when Mercury is higher in the sky, especially mid-morning views before the Sun's heat has disturbed the atmosphere. Another unusual opportunity is that of observing Mercury during total solar eclipse, if it is near elongation and high in the sky. The use of filters to reduce glare should also be studied.

To facilitate comparison, the Recorder would prefer that Mercury's disc be drawn on a scale of 5 mms. per second of arc in diameter. (Semi-diameters are given for each day of the year in <u>The American Ephemeris and Nautical Almanac</u>). Needless to say, each disc drawing should be accompanied by a statement giving the telescope type and aperture, the date and hour (in U.T.), magnification used, and observing conditions.

II. STUDIES OF PHASE ANOMALY, INCLUDING OBSERVATION OF DICHOTOMY. It is well known that a difference between the observed and theoretical phase of Mercury has often been noted, although this is less pronounced than in the case of Venus. Thus the moment of dichotomy, when Mercury's disc is exactly half illuminated as seen from the Earth, often differs between geometry and observation. This effect has already been amply observed and discussed;[4] in the opinion of the Recorder further observations will probably not yield much new scientific information, but some A.L.P.O. members may wish to continue this study. (Somewhat smaller telescopes than the size previously indicated can be useful in the study of phase anomaly, especially in observing dichotomy).

*Actually, the librations in longitude under the assumption of a synchronous rotation display a total of about 225° of longitude.

III. OCCULTATIONS (observation possible with telescopes of all sizes). Whenever Mercury occults a distant star, as occasionally happens, the event is worth observing and timing. Future occultations by Mercury will receive prior notice in The Strolling Astronomer.

IV. TRANSITS OF MERCURY. Observation of Mercury as it crosses the face of the Sun, including timing of ingress and egress, is of considerable importance. The next transits will be on 1970, May 9 and on 1973, November 10. (Small telescopes, if equipped for solar observing, can participate in this work).

V. SATELLITE SEARCH. While it is commonly supposed that Mercury has no satellite (and this is probably the case), data from transits merely excludes satellites larger than about 25 miles in diameter, i.e., down to about magnitude 9. This might seem sufficient indication that Mercury is moonless until one recalls that at this level of completeness the satellites of Mars would still be undetected, as would also be a number of satellites of the outer planets. Clearly, work carrying the search down to fainter magnitudes is needed; this work is possible from Earth only during a total solar eclipse. Such work would require use of a moderate size astrographic camera, accurately guided.[5]

VI. INTRAMERCURIAL MINOR PLANET SEARCH. Using similar techniques to those involved in the above satellite search, A.L.P.O. members can search for any possible intramercurial planets during total solar eclipses. Our present state of knowledge on this subject is only sufficient to exclude all minor planets larger than about 40 miles in diameter.[6]

VII. HISTORICAL RESEARCH. In addition to new observations, a critical examination of disc drawings made in former years, fitted to the newly discovered rotation rate, may supply important information on surface features. Here is something for the Mercury observer to do on cloudly nights; indeed even those without telescopes may assist in the study of Mercury in this way.

3. Reports on Mercury

Members of the A.L.P.O. are urged to submit their observations to the Recorder at regular intervals. If there is an adequate response, the Recorder hopes to report the progress of Mercury studies twice a year in the pages of The Strolling Astronomer.

References

1. Cf. Sky and Telescope, XXXI, 213 (April, 1966).
2. Cf. Werner Sandner, The Planet Mercury, London, Faber and Faber, 1963, pp. 33-46.
3. See intensity scale suggested by Geoffrey Gaherty, Jr., in Strolling Astronomer, Vol. 18, Nos. 1-2 (published July, 1964), p. 30.
4. Strolling Astronomer, Vol. 18, Nos. 11-12 (published July, 1965), pp. 222-231.
5. Cf. Gerhard Kuiper and Barbara Middlehurst, The Solar System III: Planets and Satellites, pp. 575ff.
6. Ibid.

ADDITIONS TO THE A.L.P.O. LUNAR PHOTOGRAPH LIBRARY: ORBITER-I PHOTOGRAPHS

By: John E. Westfall, A.L.P.O. Lunar Recorder

The latest addition to the A.L.P.O. Lunar Photograph Library consists of thirteen Orbiter-I lunar photographs. These were kindly supplied to the A.L.P.O. by NASA and, for the most part, were taken over the period August 18-23, 1966. Two of these photographs are reproduced here on pages 10 and 11, with one of the center of the earthside hemisphere, and one of the approximate center of the averted lunar hemisphere.

At this time, identification of positions and features in many of the Orbiter photographs is uncertain; those readers familiar with the Mare Smythii area will find particular enjoyment in attempting to identify features! Also, some paired photographs can be viewed stereoscopically: 1115+1122 and 1129+1152.

Below are listed the Orbiter-I photographs in the A.L.P.O. Lunar Photograph Library; these are available for loan on the same basis as the other photographs in the library (all photographs below are 8 X 10 inch prints):

Code No.: 66-H-	Resolution	Identification	Scale*
1114	Medium	Western edge of Mare Smythii	590T NS 630T EW
1115	Medium	Mare Smythii--ca. 87° East longitude	630T NS 630T EW
1116	High	Mare Smythii--ca. 86°.7 East longitude, 2°.2 North latitude	76 T NS 83 T EW
1117	High	Mare Smythii--ca. 86°.7 East longitude, 1°.4 North latitude	71 T NS 83 T EW
1119	High	Mare Smythii--ca. 86°.7 East longitude, 1°.4 North latitude. (NOTE: this appears to be a different location than 66-H-1117)	75 T NS 82 T EW
1122	Medium	Mare Smythii--adjoins 66-H-1114 on south	590T NS 620T EW
1129	Medium	Mare Smythii--ca. 89° East longitude, 0°40' North latitude	700T NS 770T EW
1146	------	Limb of moon with crescent Earth in background	------- -------
1152	Medium	Mare Smythii--ca. 90° East longitude, 0° latitude	730T NS 770T EW
1153	High	Near center of averted hemisphere--ca. 150° East longitude, 5° South latitude	690T NS 710T EW
1154	High	Mare Smythii--ca. 83° East longitude, 0° latitude	310T NS 300T EW
1300	------	Sinus Medii--ca. 1°.4 West longitude, 0°.2 South latitude	290T NS 220T EW
1301	Medium	Northeastern portion of Flamsteed P (Surveyor-I landing area)	200T NS 170T EW

*Scale: 590T NS = 1/590,000 North-South scale, 630T EW = 1/630,000 East-West scale, etc.

NOTE: The new address of the Lunar Photograph Librarian, effective immediately, is:

John E. Westfall
1530 Kanawha Street, Apt. 110
Adelphi, Maryland 20783

PLANETARY OCCULTATIONS AND APPULSES IN 1967

By: Gordon E. Taylor, H. M. Nautical Almanac Office

1. The following occultations by Venus have been predicted:

Date	Star	Area of Visibility	Station	Disappearance U.T.	P	Reappearance U.T.	P
June 8	B.D.+22° 1915 ($7^m.4$)	E. of S. Africa	Johannesburg	16^h15^m	133°	16^h22^m	257°
		part of Asia	Dushanbe	16 15	53	16 20	336
Dec. 27	34 Librae ($5^m.9$)	S.E. Asia	Zô-Sè	21 32	78	21 37	314

2. The following occultation by Mars has been predicted:

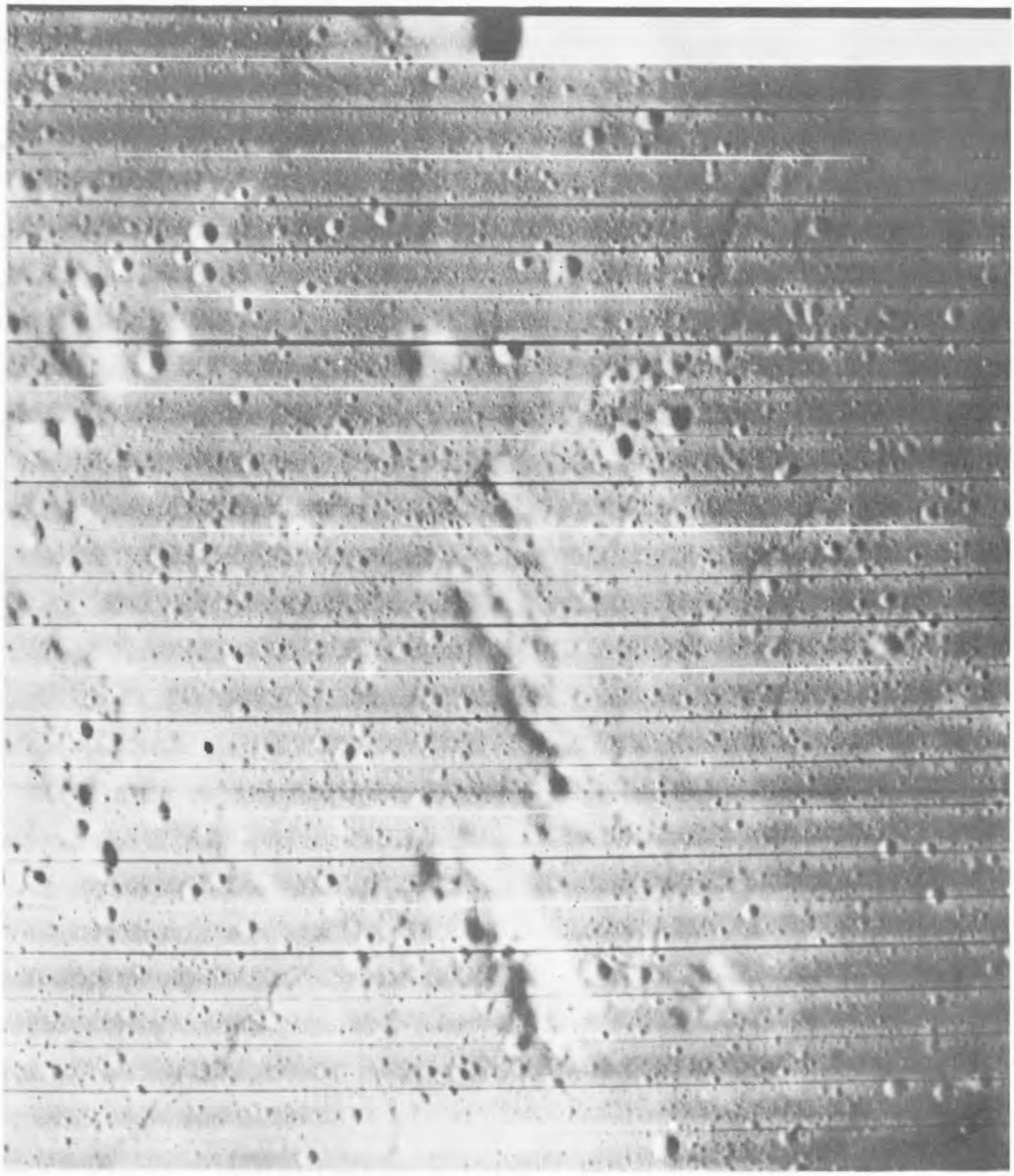

Figure 1. Orbiter-I photograph of a hilly area in Sinus Medii near the center of the earth-side lunar hemisphere. The sun is to the right, north at the top. The area covered is approximately 26 miles North-South and 40 miles East-West.

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Date	Star	Area of Visibility	Station	Disappearance U.T.	P	Reappearance U.T.	P
Mar. 19	B.D.-9° 3851 ($8^m.6$)	S. America	La Plata	03^h37^m	326°	04^h04^m	66°

3. A close appulse of Neptune to B.D. -17°4372 ($9^m.1$) occurs on December $22^d05^h26^m$, Neptune passing 2" S. of the star.

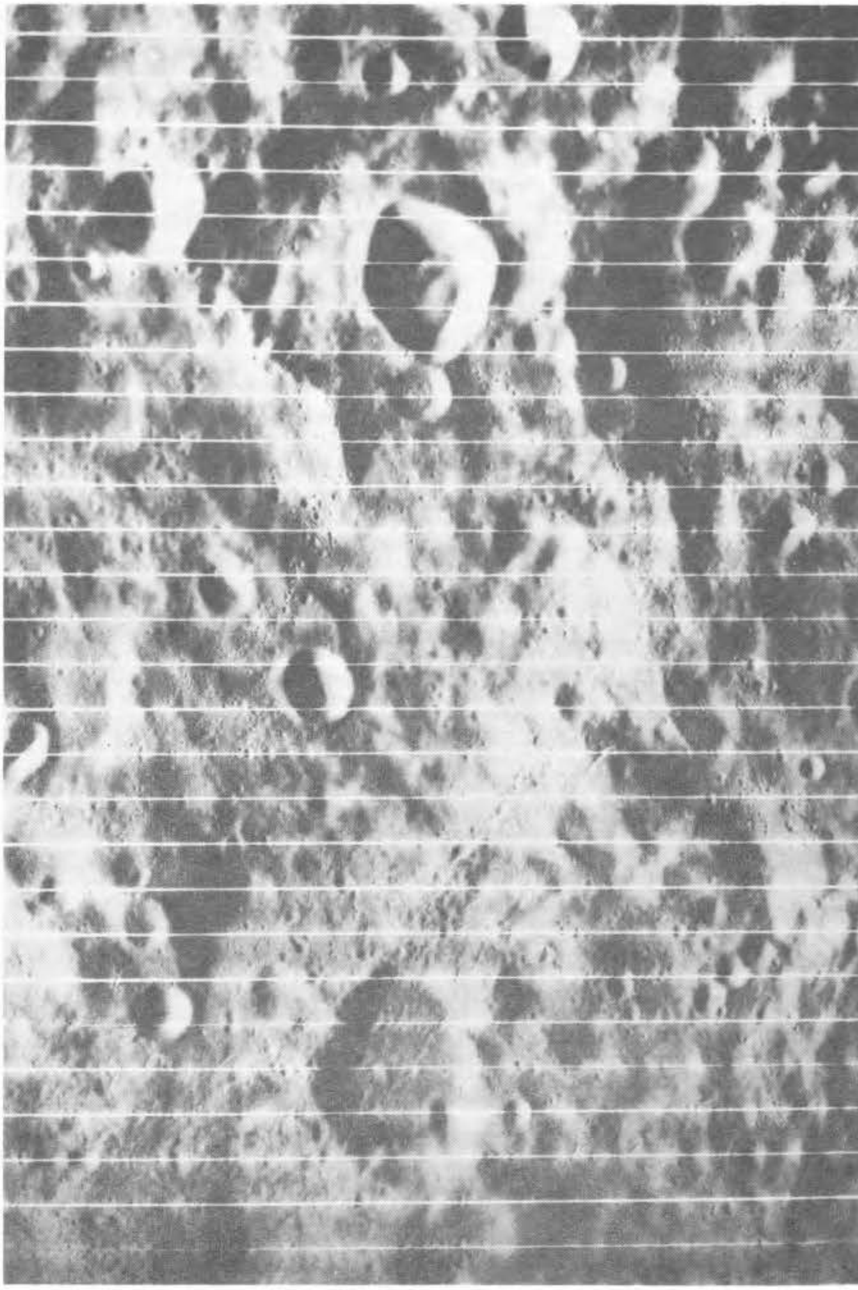

Figure 2. Photograph of an area near the center of the moon's averted hemisphere, taken on August 20, 1966 by Orbiter-I from an altitude of 1295 kilometers and showing an area approximately 73 by 100 miles. North is at the top, the sun is to the left.

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4. Venus may pass in front of the radio source 3C. 172 on May $22^d 09^h.4$.

Postscript by Editor. We are indebted to Dr. Taylor of the Royal Greenwich Observatory for once again supplying this advance information about occultations of stars by planets. We again invite observers who are properly placed to try to observe these unusual phenomena and to report their findings to us. Observers in the United States will be disappointed that none of the 1967 occultations will be observable in this country.

REPORT ON THE 1964-65 APPARITION OF MARS, PART I

By: Klaus R. Brasch, A.L.P.O. Mars Recorder

Introduction

The 1964-5 apparirion of Mars was the third in the current series of four near-aphelic approaches of the planet. As such, it was an unfavorable apparition, with the planet's apparent diameter not exceeding 14" of arc at opposition. This event took place on March 9, 1965, when Mars was about 62 million miles away.

A number of useful and systematic observations were submitted, nevertheless; and the Recorder would like to take this opportunity to thank all those who contributed towards that end. Below is a list of observers from whom material was obtained:

Observer	Station	Telescope	No. Observations
C. Bascur	Centro de Investigationes en Coheteria y Astronomia Chile	25 cm.Refl.	7
K. Brasch	Rosemere, Que., Canada	20 cm.Refl.	10
P. Budine	Binghamton, N.Y.	10 cm.Refr.	9
C. Capen	Table Mountain Observatory	-	photographs
C. Cyrus	Baltimore, Maryland	32 cm.Refl.	9
K. Delano	New Bedford, Massachusetts	32 cm.Refl.	92
R. Doucet	Cap de la Madeleine, Que., Canada	20 cm.Refl.	37
J. Dragesco	Le Vésinet, France	26 cm.Refl.	21
M. Francoeur	Cap de la Madeleine, Que., Canada	20 cm.Refl.	3
W. Haas	Las Cruces, New Mexico	32 cm.Refl., 16 cm.Refl.	24
A. Heath	Long Eaton, England	32 cm.Refl.	29
H. Jamieson	Muncie, Indiana	25 cm.Refl.	1
S. Niel, Jr.	Totowa Boro, N.J.	7 cm.Refl.	1
J. Olivarez	Edinburg, Texas	48 cm.Refl.	9
K. Schneller	Cleveland, Ohio	20 cm.Refl.	various
K. Simmons	Jacksonville, Florida	15 cm.Refl.	7
M. Suárez	Puerto Rico	7 cm.Refl.	3
W. Wooten	Glendale, Florida	15 cm.Refl.	49

Atmospheric Phenomena

Several distinct types of atmospheric phenomena have been observed on Mars, and variously classified according to their color, location, and visibility in light of different wavelengths. Generally speaking, and for the purposes of this report, the following broad distinctions are recognized: 1- clouds, including the so-called white, yellow, and blue clouds; 2- evening and morning limb haze or veils; 3- polar cap and polar region haze.

a) Clouds

In this category are included only those markings which were clearly reported as clouds. This encompasses temporary bright patches observed over various regions of the planet's disk, and those limb clouds which could be readily defined and hence easily differentiated from the common arc-shaped, diffuse limb brightening. No further subdivisions of cloud types were attempted, because these distinctions are not readily apparent on the observations submitted.

Figures 3 and 4 illustrate the types of clouds most frequently reported. Often, when located near the limb or terminator, clouds appear to protrude beyond these boundaries, indicating that they are indeed elevated from the surface of the planet. [However, one must be very wary of the effects of irradiation on brighter areas at the edge of the disc of Mars. This phenomenon can cause clouds falsely to appear to project beyond the limb or terminator. --Editor]

An illustration of the cumulative cloud detail reported throughout the apparition is given in Figure 5. A general outline chart of the IAU map of Mars has been used, and the cloud phenomena observed are shown in dotted outline. The numbers associated with each feature represent the frequency with which clouds were reported in that general area. Included on the map, and designated by the letter M, is the outline of a cloud whose position was determined micrometrically by K. Schneller. Only those clouds are shown which were definitely reported as such, with or without filters, and then only when their position could be associated with a specific surface region.

It will be noted that clouds were commonly seen near the Syrtis Major and Tempe regions, and frequently appeared to border some of the more prominent dark markings. This result may in part be due to a contrast effect since clouds would presumably not be recognized as readily over the desert regions.

Of special interest is a set of observations made by K. Delano on March 20, 1965, between UT 2^h00^m and 3^h45^m (Figure 6). On this occasion, a morning mist or clouds apparently rendered Syrtis Major almost invisible until the planet's rotation carried the feature towards the center of the disk into more direct sunlight. This, presumably, is an example of an early morning cloud formation which was later dissipated by the sun's heat. Unfortunately, no other simultaneous observations of the occurrence are available.

The use of filters can be invaluable in bringing out contrast of cloud detail and atmospheric phenomena in general. An example of such work is provided by the series of observations in Figure 7. The fact that this feature was visible predominantly in filters which transmit light of short wavelength suggests that it was indeed an atmospheric phenomenon at some elevation from the planet's surface.

b) Limb Haze or Veils

Limb brightening is a not uncommon occurrence on Mars and a phenomenon which manifests itself most clearly in green and blue light. In deep blue light, e.g., with a Wratten 47-B Filter, the edge of the disk will generally appear brighter than the center. Normally, moreover, the planet will have an essentially featureless appearance when viewed in this light, except on the relatively rare occasions when the so-called "blue clearing" phenomenon is indicated. On such occasions, detail usually only visible at longer wavelengths of light may temporarily appear with considerable intensity. No observations of this phenomenon were definitely reported among the many filter observations submitted.

More common, and of more immediate interest, are limb brightenings in the form of haze or clouds. Such clouds, though often evident without aid, are usually more readily discernible with blue filters. Their appearance is frequently that of an arched veil, while at other times they take the shape of bright diffuse patches, similar in form and intensity to the polar caps. Clouds of this nature are thought to be situated at relatively high altitudes and to represent local morning or evening condensations which dissipate in direct sunlight. Figures 8 and 9 are typical examples of observations carried out in integrated light as well as with deep blue filters. In each case, limb haze activity, suspected without the filters, became much more evident with them.

The North Polar Cap

By the time that systematic observations of Mars were begun in 1964-5, spring was well advanced in the northern hemisphere. As a result, only the latter stages of the polar cap shrinkage could be followed, the span between heliocentric longitude 150° to 210° being covered. The summer solstice of the northern hemisphere took place at 178°.

Figure 10 depicts the behavior of the north cap as measured and averaged from about eighty suitable drawings. In each case, following a correction for axial tilt of Mars, the areocentric angle subtended by the northern cap at the center of the disk was measured, and was plotted as a function of the heliocentric longitude of the planet. The dots represent measurements from drawings; the triangles are micrometric measurements secured by K. Schneller.

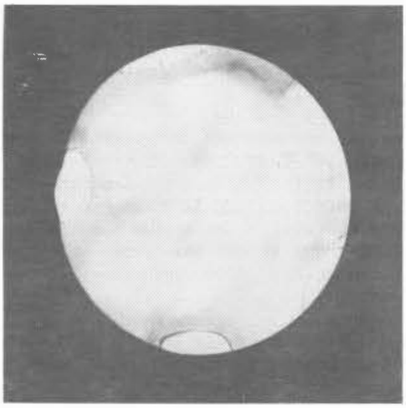

Figure 3. Drawing of Mars by J. Dragesco on February 18, 1965 at 1^h10^m, U.T., with a 26-cm. reflector. 260X, 330X. Seeing 2-3, transparency 5. C.M. = 134°. Note the apparently projecting cloud on the terminator (left edge of disk).

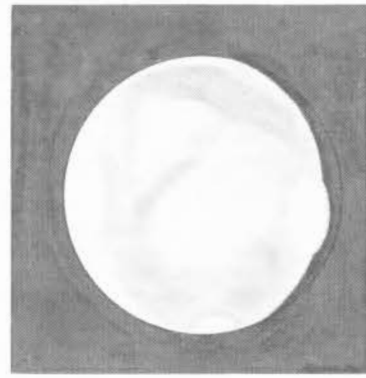

Figure 4. Drawing of Mars by K. Brasch on May 1, 1965 at 3^h5^m, U.T., with a 20-cm. reflector. 370X. Seeing 0-3, transparency 5. C.M. = 243°. Large cloud on terminator (right side of disk), brighter with Wratten Filter 47 (blue).

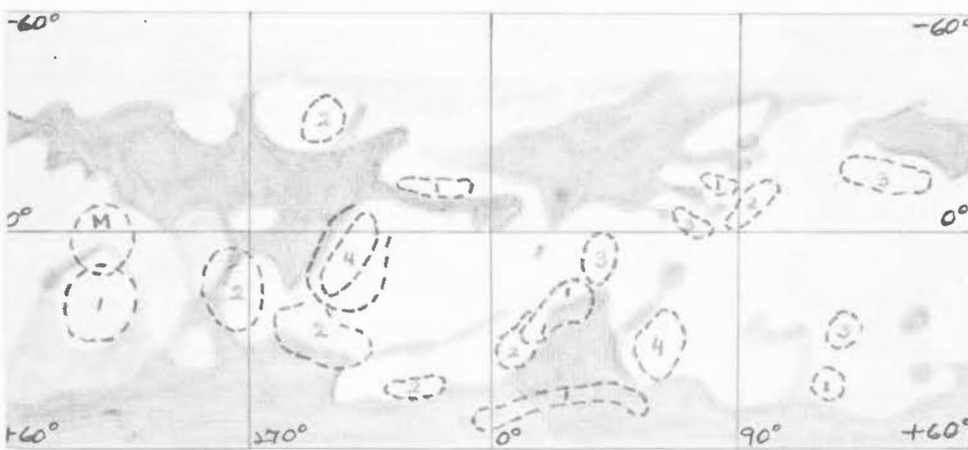

Figure 5. Chart of Mars to show cumulative cloud detail recorded by the A.L.P.O. Mars Section during the 1964-5 apparition. The dotted outlines show the positions of clouds on an IAU chart of Mars. See also text of Mr. Brasch's article, page 13.

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It is apparent from the graph that, except for fluctuations due to observational error and temporary polar region haze, the cap shrank in the customary predictable manner from heliocentric longitude 150° to about 180°. After this point, however, and almost exactly at the time of the northern solstice, a prominent polar haze cover evidently developed quite suddenly and persisted from then on to the end of the apparition. The net effect of this phenomenon was to give the cap an enlarged appearance, though less intense and more diffuse in outline than normal. Although it was accentuated in the light of shorter wavelengths, the polar haze was quite evident both with and without filters and, while undergoing fluctuations in size and intensity, had not disappeared completely at the time that observations were discontinued.

It can hardly be argued that the above phenomenon is anything but atmospheric in nature, both on account of its sudden development and its enhanced appearance in blue light.

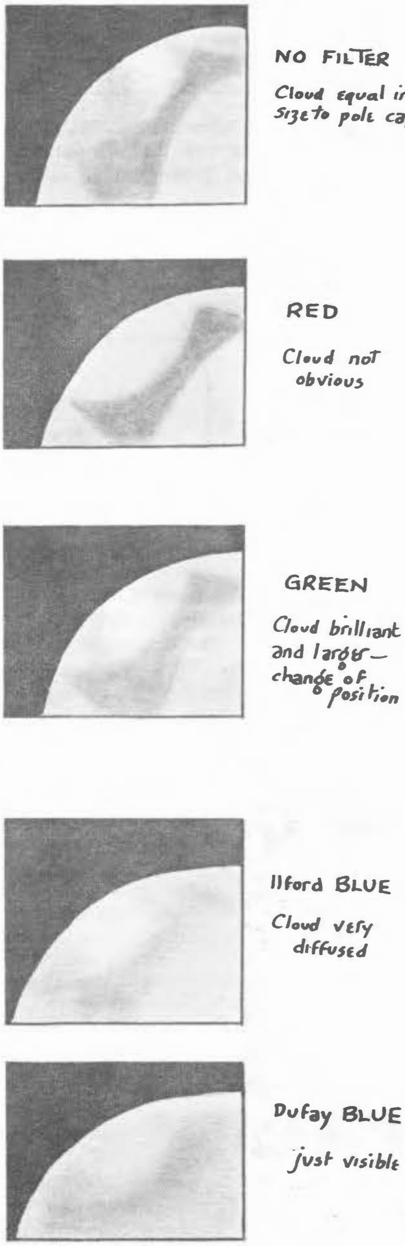

Figure 7. Observations of a cloud on Mars by Alan W. Heath with different color filters. April 11, 1965, 20^h U.T. 12-inch reflector, 318X. Cloud on south limb over region of Hellas. C.M. = 313°.

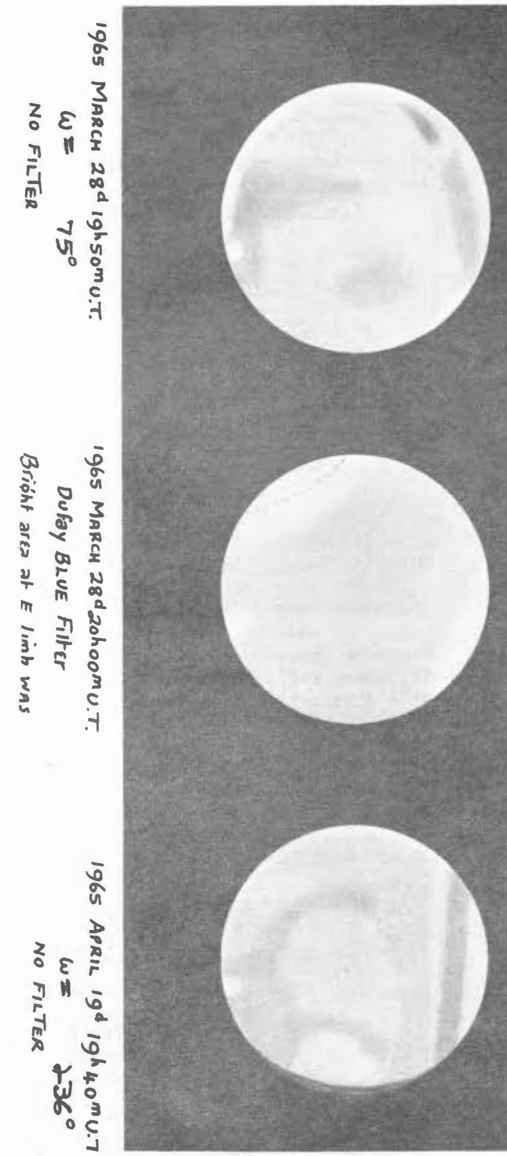

Figure 8. An example of observations of limb haze or veils with integrated light and with a deep blue filter. Alan W. Heath, 12-inch reflector. The limb haze activity became far more obvious with the blue filter. On March 28 Mr. Heath found the limb bright area much smaller at 21^h0^m, U.T., as shown by the dotted outline.

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Such observations lend support to the concept that the polar cap shrinkage can be attributed, in part at least, to the action of evaporation or sublimation.

General References

1) Capen, C., "Filter Techniques for Planetary Observers", Sky and Telescope, 17, 1958, p. 517.
2) de Vaucouleurs, G., Physics of the Planet Mars, Faber & Faber, 1954.
3) Miyamoto, S., "Meteorological Observations of Mars During the 1962-63 Opposition", Contribution from the Institute of Astrophysics and Kwasan Observatory, 1963.

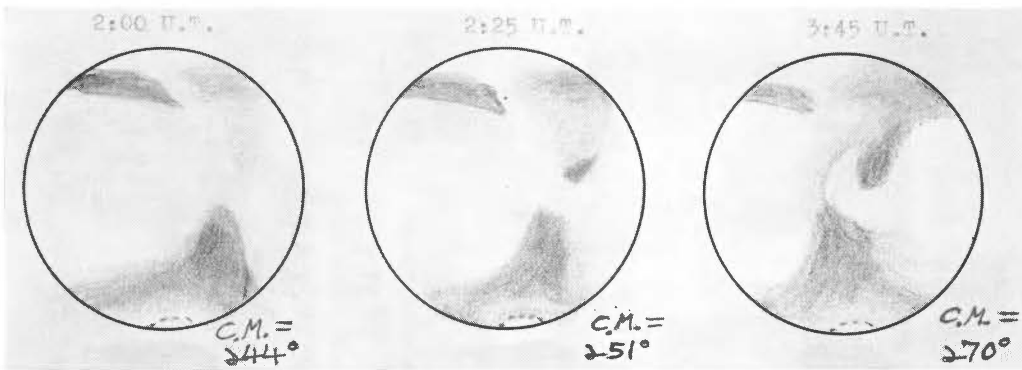

Figure 6 (above). Series of drawings of Mars by Kenneth J. Delano on March 20, 1965 with a 12.5-inch reflector at 300X. Seeing 4 to 3, transparency 6. The drawings show the progressive dissipation of a forenoon mist or haze over Syrtis Major. Text on page 13. The northern part of Syrtis Major was almost invisible at 2:00, U.T., as dark as Mare Cimmerium by 2:30, and the darkest part of Mars by 3:45.

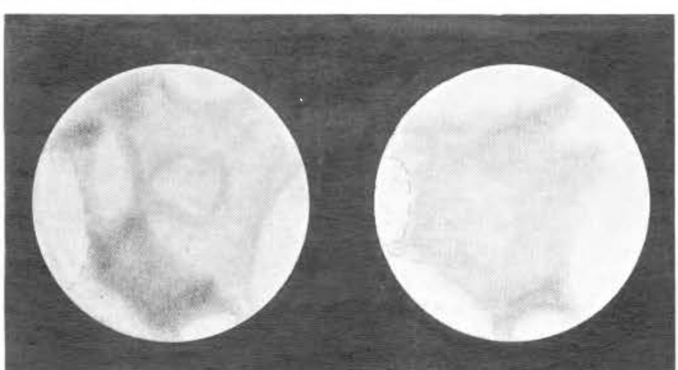

Figure 9 (left). Drawings of Mars by Klaus R. Brasch on March 1, 1965 at 3^h25^m, U.T. 20-cm. reflector, 250X. Seeing 0-4, transparency 6. C.M. = 71°. Left drawing, integrated light; right drawing, Wratten 47-B Filter (blue). Another example of the enhancement of limb haze activity in the shorter visual wavelengths.

Postscript by Editor. We append to Mr. Brasch's Mars Report some Mars drawings and photographs kindly forwarded by Mr. C. F. Capen of the Table Mountain Observatory. These represent a small portion of a considerable amount of material supplied by Mr. Capen for the 1964-5 apparition of Mars. We are extremely glad for the opportunity to study these records and express our thanks to Mr. Capen and to the Jet Propulsion Laboratory for making them available. In addition to their intrinsic interest, these drawings and photographs may help guide our Mars observers about what to expect to see during the 1966-7 apparition now beginning. New students of Mars may also wish to study Mr. Wend's preliminary article on the 1967 apparition on pages 5 and 6 of this issue. It may be worth remembering that the season on Mars will be a little later at the 1967 opposition than at the 1965 opposition and that the maximum angular diameter of the planet will be a little greater.

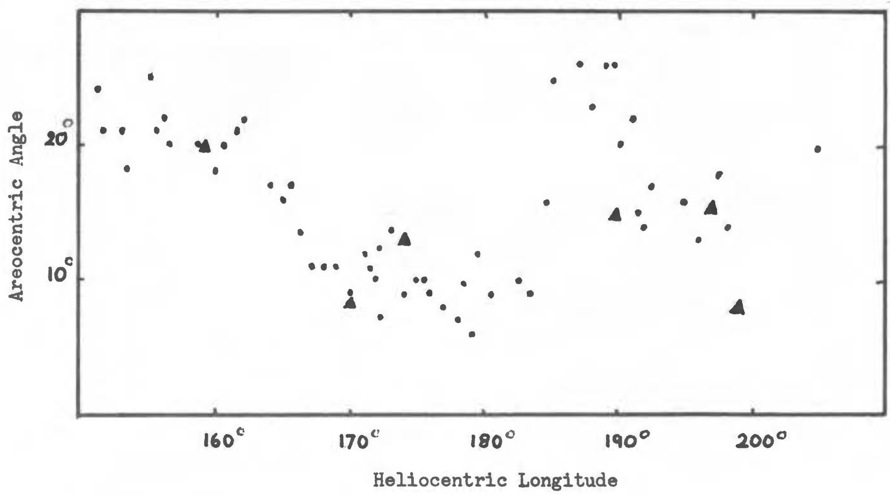

Figure 10. The dwindling of the north polar cap as measured by the A.L.P.O. Mars Section during the 1964-5 apparition. Dots are measures from drawings; triangles are micrometric measurements. The areocentric angle corrected for axial tilt is plotted against the heliocentric longitude of Mars, with the summer solstice of the northern hemisphere falling at heliocentric longitude 178°. Near that time, as the measures indicate, the surface cap was replaced by a polar haze of greater size and lesser brightness.

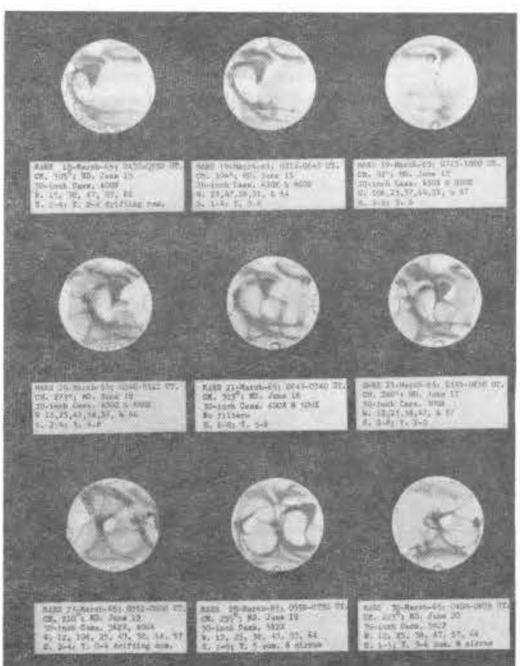

Figure 11. Mars drawings in 1965 by C. F. Capen, Table Mountain Observatory of the Jet Propulsion Laboratory. MD is the Martian Date.

MARS 20-March-65; 0340-0525 UT.
CM. 273°; MD. June 16
30-inch Cass. 450X & 800X
W 15,25,47,38,57, & 64
S. 2-4; T. 6.8 C. Capen

Figure 12. Mars drawing by C.F. Capen.

MARS 15-March-65; 0830-1100 UT.
CM 23°-59°.5; MD. June 13
30-inch Cass. 400X, 450X
W. 106, 25, 57, 64, 38, 47
S. 3-6; T. 6+ Decl. ⊕ +21°.2

Figure 13. Mars drawing by C.F. Capen.

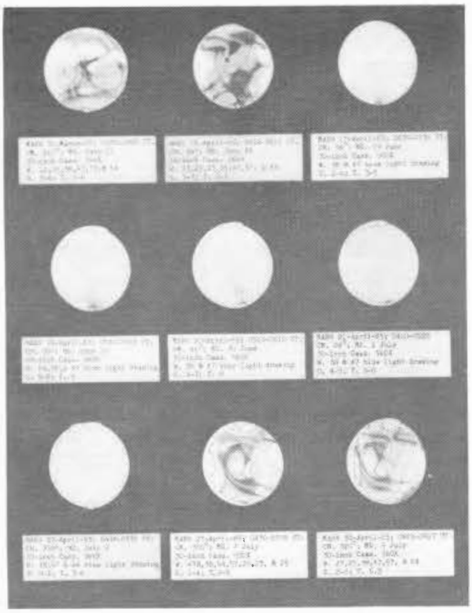

Figure 14. Mars drawings in 1965 by C.F. Capen.

MARS 27-March-65; 0351-0600 UT.
CM. 210°; MD. June 19
30-inch Cass. 562X, 400X
W. 12, 106, 25, 47, 38, 64, 57
S. 2-4; T. 0-4 drifting cum.

Figure 15. Mars drawing by C. F. Capen.

Red light image

Figure 16. Table Mountain Observatory red light photograph of Mars. April 30, 1965. 7^h37^m, U.T. View typical of longer visual wavelengths with surface features well shown. Syrtis Major near center of disk.

Violet light image

Figure 17. Table Mountain Observatory violet light photograph of Mars. April 30, 1965. 7^h17^m, U.T. View representative of shorter visual wavelengths with surface features indistinct and atmospheric detail enhanced. Polar caps evidently primarily atmospheric features on this date.

PLANETOLOGICAL FRAGMENTS - 5

The Composition of Saturn's Rings

In 1952 Kuiper published his result that the reflectivity of Saturn's rings matches that of the polar caps of Mars, which he considered to be composed of water frost. Additional spectra were obtained more recently by T. C. Owen, and his laboratory comparisons showed that the reflectivity of a solid block of water ice matches that of the rings more closely than does the frost reflectivity. The persistence of ice under the conditions of the high vacuum of space can be accounted for because of the very low vapor pressure of this substance at the temperature of the rings, which is about -183°C. Younkin and Munch have contested Owen's result with evidence that the reflectivity ratios he used are altered by a continuous absorption in the Saturn comparison spectrum. Thus, any evidence for ice would be masked in that part of the spectrum.

Meanwhile, L. Mertz and I. Coleman have obtained very good infrared spectra of the rings, and these show an unusual absorption at about 1.7 microns (recall that the eye is not sensitive beyond about 0.7 microns). Laboratory comparisons show that a similar absorption feature occurs in the spectrum of a polymer of formaldehyde called paraformaldehyde. The formation of formaldehyde at the low temperature of the rings can be understood if the primordial gases there are composed of H_2 and CO, which can yield formaldehyde under the influence of solar ultraviolet radiation. This formaldehyde would immediately solidify, and the subsequent sublimation would be minimal owing to the low vapor pressure of the solid. Mertz and Coleman find that true formaldehyde (the monomer) does not give the same spectrum as the rings, although the polymer (a powder) does. They feel that it is possible that continued reaction of solid formaldehyde with the solar wind and ultraviolet radiation might produce the polymer in the form of the powder, which would remain to give the spectral features we now observe.

As with many other problems in planetology, there are lines of conflicting evidence here. First, there are other spectra of the rings of Saturn made by V. I. Moroz in the Soviet Union. These are of lower resolution than the Mertz-Coleman spectra, but show no trace of the absorption that is attributed to paraformaldehyde. Second, there are many, many substances having absorptions in the region of 1.7 microns. Some of these in a gaseous state are CO_2, H_2S, CH_3NH_2, C_2H_2, and C_2H_4 (Cruikshank and Kuiper, to be published). Certain of these gases have similar, though broader, absorptions when they appear in the solid state, as is expected at the temperature of the rings of Saturn. Hence, the identification by Mertz and Coleman is not the only possibility, as they admit. Third, we might note that Kuiper's original comparison of the rings to the Martian polar caps is subject to some errors. Further, there is new thinking that the polar caps are composed of solid CO_2 instead of water ice. This latter point may well be clarified during the apparition of Mars in the spring of 1967. Likewise, the opening of the rings of Saturn in coming years will provide opportunity for further detailed study of the composition of these fascinating features.

Infrared Reflectvity of the Moon

The astronauts aboard Gemini 7 made some useful infrared observations of the moon during their flight in December, 1965. Using interferometers with infrared-sensitive detectors, they measured the albedo of the moon at several points between 1.0 and 2.8 microns (10,000 and 28,000 Ångstroms). These observations would have been much more difficult from ground-based observatories because water vapor in the earth's atmosphere absorbs infrared radiation very strongly in discrete parts of the spectral interval mentioned above. While radiation received from the moon is purely reflected sunlight out to about 2.1 microns, that radiation of wavelength longer than this limit is a combination of reflected sunlight and thermal emission from the "hot" moon itself. For that reason, any albedo, or reflecting power, measurements beyond 2.1 microns must be corrected for the thermal emission. Even at 3 microns, this emission amounts to only about 5%, however. If the moon were hotter, the thermal emission would be significant at shorter wavelengths.

We usually read in textbooks that the albedo of the moon is 7%, roughly that of a schoolroom blackboard surface. Albedo is wavelength dependent, however; and the results of Gemini 7 show that at infrared wavelengths, the albedo is somewhat higher than at visual wavelengths. For example, the albedo at 1 micron is 12%, at 2 microns it is 19%, and at 2.8 microns it is 20%. Here the albedos are Bond albedos, defined as the ratio of the light scattered and reflected in all directions from an object (or section of the lunar surface) to the total light received by it (from the sun).

The results of Gemini 7 are in general accord with those of Stratoscope II, which flew in November, 1963, and recorded the spectrum of the moon (for the first time) from above most of the earth's atmosphere.

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Mertz, L., and Coleman, I., Astronomical Journal, 71, pp. 747-748, 1966.

Moroz, V. I., Astronomichiskii Zhurnal, 43, pp. 579-592, 1966 (in Russian).

Owen, T. C., Science, 149, pp. 974-975, 1965.

Younkin, R., and Münch, G., Astronomical Journal, 71, p. 188, 1966 (abstract).

DPC

ARISTARCHUS: THE VIOLET GLARE

By: James C. Bartlett, Jr.

ITEM: "Schm. has repeatedly found the 'nimbus,' or darker space round the wall, of a violet hue...."[1] "On the summit of the peak δ, Gaudibert has seen a small crater opening; and it is remarkable that this mountain has been seen as a misty bluish-tinted mass at a time when every surrounding object stood out as sharp and as distinct as possible...."[2] "I have seen on several occasions a faint bluish tint on the slopes of the inner N.E. wall soon after sunrise...."[3]

ITEM: "The persistent recurrence, indeed, of similar appearances under circumstances less amenable to explanation inclined Webb to the view that effusions of native light actually occur. More cogent proofs must, however, be adduced before a fact so intrinsically improbable can be admitted as true."[4]

Item: "Does any portion of the lunar surface exhibit luminescence....? Indications that this may indeed be the case have been accumulating for some time...."[5] To which one might add the interesting fact that Kozyrev has obtained spectra from the rays surrounding Aristarchus which show two bright bands at 3900 Å and 4300 Å, which is to say in the violet region.

Having thus established a) that reports of bluish and violet tints in and around Aristarchus have a certain antiquity, and b) that recent astrophysical work now makes them respectable, I shall venture an account of such phenomena as they have appeared to me over the past seventeen years. But first some explanation of terminology is in order.

By "violet glare" is meant the appearance of a usually bright, fluorescent-like radiance chiefly affecting the eastern rim of Aristarchus (I.A.U. sense here and hereafter), the East Wall Bright Spot (EWBS), the central peak (rarely), and occasionally the northern and western walls of the crater. Under this heading, however, it may be convenient to include certain related appearances which probably are of the same nature but are modified by local differences in surface structure or composition, e.g., the faint bluish radiance occasionally seen on the floor and walls, the deep violet tinge frequently seen in the dark nimbus surrounding the crater, the pure violet hue sometimes observed in the area VA, N. and N.E. of Aristarchus, and the usually pale violet radiance which now and then bathes the plateau, m, still farther north (see Figure 18).

Like certain Aristarchean phenomena previously considered in this series by the writer, the appearance of the violet glare is independent of colongitude. Thus its manifestation for the same, or for closely comparable, colongitudes may vary widely as to intensity, color, and place; and not infrequently it may be completely absent. Insofar, then, as it depends upon the sun, it does not depend upon the sun's visible light nor upon the sun's altitude. We may suppose, therefore, that the phenomenon is in the nature of a true fluorescence, triggered not by the electromagnetic radiation but by the particle emission of the sun. Kopal, indeed, ascribes lunar luminescent phenomena in general to this specific cause.[7]

While this may be a sufficiently accurate picture of the general modus operandi, there is considerable reason to believe that in specific instances purely local influences of unknown character may play a part. I refer to sudden and unexplained fluctuations in intensity and even in color, one example of which we shall examine in detail a little later. Related also to this problem may be the well attested variations in the general intensity of Aristarchus in earthlight, which was observed by Smyth to vary from the 6th to the 10th stellar magnitude.[8]

The color of the violet glare is also subject to variation, ranging from pure violet to a bright blue-violet, which indeed is more common than a pure violet hue. Occasionally one hue is observed to change into the other; and on one occasion, unique in my records, I observed a change from violet to brown.

On Dec. 12, 1954 (U.T. date) near colongitude 101°, with a 5-inch reflector at 150x and 180x, I found a strong violet glare along the entire rim of the east wall and bordering the EWBS; this violet glare also passed around the north wall to end on the N.W. wall at the position of the wall band theta.* Such was the appearance at 2^h20^m, U.T. Just 15 minutes later, at 2^h35^m, the violet color had disappeared, to be replaced by a brownish tone which occupied the same position as the original violet hue. As this phenomenon was completely unique, I continued observation with care. Within a few minutes the brownish tint was seen to fade out, and at 2^h55^m the violet glare suddenly reappeared strongly but again faded to invisibility by 3^h00^m, this time, however, not to be succeeded by a brownish color. I then rested my eyes in complete darkness for several minutes, but on returning to the telescope still could not see any trace of the violet glare. Then, at 3^h08^m, it suddenly returned with full intensity; but what happened thereafter I am unable to say, having to end observation at that time. I had never before observed such a color transformation in the violet glare, and I have never observed one since.

The quality of the glare is also subject to unexplained variations. When strongly developed it resembles what its name implies, a bright blue-violet glare as from a highly reflective surface; but on other occasions this appearance is replaced by that of a soft, pale violet radiance, while on still other occasions the appearance is suggestive of a pale violet-tinted mist filling the whole crater. Thus on July 24th, 1954, 7^h19^m, col. 196°.11, with a 5-inch reflector at 150x, I found the bowl of Aristarchus filled with a very pale violet tint which overflowed, as it were, onto the glacis (east side) and even beyond the nimbus to the mare surface. As floor details were sharp, however, it may be doubted that a mist was involved.

It appears clear that there is some fundamental difference in quality between the brilliant glare on the wall rim and the soft, pale radiance occasionally seen filling the whole crater, which difference presumably relates to site; yet this conjecture is by no means certain, for a soft, pure violet radiance is also occasionally seen along the rims which usually display the brighter blue-violet glare.

The influence of position, however, is clearly shown when one considers the dark nimbus around the crater, the surface VA, and the plateau, m. No glare is ever seen within the nimbus, nor is there any suggestion of radiance; rather the nimbus simply appears to be dark violet by inherent color. That this is not the case, however convincing the appearance, is demonstrated by the fact that the violet color is not always present, nor when present is it always of the same intensity; but though it may vary from a moderate to a very dark violet, blue-violet or blue tones are not observed.

Like the nimbus, the surface VA exhibits pure violet tints, not so dark as those affecting the nimbus but not so pale as those on the plateau, m. Again, like the nimbus color, the hue of the area VA is suggestive of inherent surface color, and nothing like a glow or a glare is ever observed (at least I have observed none); but again a violet tint in this particular surface area is more often absent than present, which would hardly be the case with inherent color.

The plateau, m, exhibits still other variations on a theme. Here the appearance is often, if not generally, suggestive of an emission of a very pale, pure violet radiance. Like the nimbus, like the surface VA, and, indeed, like the crater itself, this violet tint is not always present; but when it is well developed, one has the impression that the sur-

*Use Figure 18 to identify this wall band and other features mentioned in the text.

face of the plateau is bathed in pale violet light. At other times (rarely) the appearance forcibly suggests a violet-tinted mist, and definition over the plateau is apt to be fuzzy while adjacent features remain sharply defined. The hue may also vary from a very pale to a brighter violet; but to date I have never observed a blue-violet or blue tint here.

The existence of an occasional pure blue radiance appears to be wholly confined to Aristarchus itself. That it is substantially of the same nature as the violet phenomenon is indicated by the mode of occurrence, and like the latter it may be manifest as a bright glare or as a pale blue radiance. In the form of a blue glare, often quite vivid, it seems to be confined to very early morning colongitudes when it may sometimes be seen forming a band of color at the base of the inner west wall; but its appearance is comparatively rare, and in many lunations it is not seen at all.

Closely allied to this phenomenon is an occasional blue tint on the floor, generally seen shortly after sunrise over the floor but, like the blue glare at the inner base of the west wall, as often absent as present. This color certainly varies, from a pale blue tint through light blue-gray to drab, i.e., from one appearance to the next, not while under observation. The best general description is that the color closely resembles that of blue clay; but the normal sunrise color of the floor is a neutral gray. No glare is associated with this blue floor color.

Like the violet radiance which occasionally affects the floor of Aristarchus, the blue tint is also found on the walls but is always confined to the inner walls, whereas the violet hue may also occur on the glaces, though almost always confined to the eastern glacis. The appearance of a blue radiance on the inner walls is random with respect to colongitude in the sense that it does not always manifest itself at the same or closely comparable colongitudes; but a general relation is shown by the fact that it most often appears at mid-afternoon on Aristarchus.

Like the violet glare, the blue radiance shows a preference for definite sites. The violet glare, for instance, is generally confined to the eastern rim, especially the northeastern rim. In like manner, the blue radiance is most commonly found on the inner northwestern wall; but this selectivity is relative rather than absolute, which is also the case with the violet glare. Both phenomena occasionally extend the area of manifestation beyond their normal positions, and once-- and only once--I observed the blue radiance uniformly distributed over all four walls. Thus on August 18th, 1957, at 6^h58^m, colongitude 182°43, with transparency 5 and seeing 8, and with a 5-inch reflector at 110x and 180x, I found the inner walls comparatively dull (estimated 6° bright) and uniformly tinted a pale blue-gray; at the same time the floor was a dazzling white, estimated as 9°. [The scale of brightnesses is from 0° for black shadows to 10° for the most brilliant features.--Editor]

The independence rather than the interdependence of these several phenomena would indicate a) that they are triggered independently by different kinds of solar corpuscular radiation, or b) that local influences act to modify the apparent excitation. Thus a strong violet or blue-violet glare is often present on the eastern rim without a corresponding violet hue in the nimbus, which then is merely a very dark gray. The area VA and the plateau, m, sometimes do and sometimes do not exhibit violet tints coincidentally with the appearance of a violet glare in Aristarchus itself. Sometimes, too, the nimbus may exhibit a strong violet hue when violet tints are completely absent from the crater; and sometimes crater, nimbus, and contiguous areas all show simultaneous violet tints.

The question of actual fluctuation while under observation is one which has to be approached with great caution, for experience has shown the violet glare to be very sensitive to atmospheric changes. Thus I have often observed apparent fluctuations which unquestionably were related to short-term variations in the seeing. On such occasions the development of turbulence was sufficient to extinguish the color which, however, returned strongly as soon as stability was restored. The transit of thin cirri will also quench the color. Nevertheless, short-term fluctuations are observed which cannot thus be explained. We have already considered one such case, and it is to be regretted that lack of space prevents a review of other examples.

Statistics would indicate that the complex of appearances listed under the general heading of "the violet glare" is one which is rather consistently visible. Thus of the 163 comparison colongitudes given in the following table, some manifestation of the phenomenon occurred for 109 of them--a percentage visibility of 66%.

But if the phenomenon is so common, why is it not more frequently reported? This is

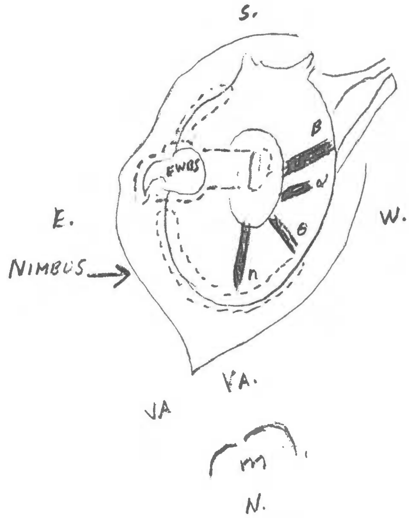

Figure 18. Key chart of lunar crater Aristarchus and surroundings to show features referenced by J. C. Bartlett in his article on "the violet glare" in this issue. This terminology is not standard but will assist in following Dr. Bartlett's text. The dotted lines indicate the areas affected by the violet glare.

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a legitimate question which must be met forthrightly. The answer would appear two-fold: Unless a systematic record is kept, the possibility that the phenomenon may be present for any random observation is reduced to chance. Secondly, there is the clearest evidence that the phenomenon--which is a delicate one at best--cannot be seen at all by those whose vision is less sensitive in the blue end of the spectrum. I have had some striking experiences which graphically illustrated the fact.

The moral is that visual confirmation alone cannot be conclusive; rather confirmation must be sought by spectroscopic and other techniques. One such method, easily available to the private observer, is the photographic one. Two photos nightly, one with red-sensitive and the other with blue-sensitive film, should certainly pinpoint those areas of the crater which are brighter in blue and at the same time would provide an automatic record of variations. Even single shots with blue-sensitive film should in time indicate variation.

Probably it is superfluous to mention the elementary precautions which may be taken to guard against instrumental chromatic aberration, though perhaps useful as indicating that the author is at least aware of them. The crater Aristarchus, for one thing, should be examined for color only in the center of the field, never towards the edges. If color is seen, or suspected, the crater should be moved through the field quadrants in order to determine if shift of position has any effect; or, while keeping the crater centered in the field, one should rotate the eyepiece through 360°; or another eyepiece may be substituted. I have myself substituted not only different eyepieces but different telescopes on occasion. If the color remains in the same place and of substantially the same hue, I would venture to suppose that it must be objective.

A critical study of the table below will show that the violet glare phenomenon has no fixed relation to colongitude, and that it may vary dramatically as to site, hue, quality, and even presence for strictly comparable colongitudes; but some degree of general relation is shown by the fact that it appears to be more consistently visible for the range of 95° through 155° of colongitude than for other ranges. The earliest colongitude at which I have so far observed it has been 47°.9, and the latest has been 196°.11. The extreme range of visibility, as so far observed, would thus be through 148°.21 of colongitude.

Such is one of the most remarkable of the luminescent phenomena associated with Aristarchus, as it has appeared to me. The cause ? I do not believe that we need invoke Selenites performing atomic experiments. Fluorescence of surface materials triggered by random corpuscular radiation from the sun will do quite as well, I fancy.

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3. Goodacre, Walter. Appendix to moon section of Webb's Celestial Objects, p. 162.
4. Clerke, Agnes M. History of Astronomy During the Nineteenth Century; Adam and Charles Black, London, 1902; fourth edition, pp. 266-67.
5. Kopal, Zdenek. The Moon, Our Nearest Celestial Neighbor; Academic Press, Inc., N. Y.,

1964; p. 73.
6. Ibid.; p. 78.
7. Ibid.; p. 74.
8. Webb, T. W. Celestial Objects; p. 129.

Table I. Observations of the violet glow in Aristarchus and vicinity
by James C. Bartlett, Jr.

Colongitude	Universal Time	U.T. Date	Remarks
47°.50	3^h56^m	June 28, 1958	Absent
47.90	2 52	July 26, 1950	Blue glare, base inner W. wall
47.88	23 25	Nov. 15, 1964	Absent
49.05	2 38	May 23, 1964	Absent
49.46	3 13	Mar. 25, 1964	Absent
49.88	2 11	July 21, 1964	Absent
49.95	1 15	Sept. 18, 1964	Craterlet, base N.W. wall; bluish
50.36	3 39	June 20, 1956	Blue glare, base inner W. wall
50.62	2 34	Oct. 16, 1956	Blue glare, base inner W. wall
50.72	1 36	Mar. 13, 1957	Absent
52.71	3 10	Sept. 6, 1957	Absent
52.93	3 36	May 30, 1958	Absent
53.18	2 30	June 27, 1950	Blue glare, base inner W. wall
54.64	2 40	July 2, 1955	Absent
55.27	1 17	Nov. 15, 1956	Faint blue radiance, base inner W. wall
55.99	3 21	June 22, 1964	Absent
56.08	3 40	Aug. 30, 1955	Floor, base inner W. wall, N.W. wall; faint bluish glare.
57.37	1 06	Nov. 3, 1949	Blue glare, base inner W. wall
57.84	3 35	Nov. 6, 1955	Absent
57.98	5 15	Aug. 20, 1964	Absent
58.49	3 00	May 1, 1958	Entire sunlit area of floor, bluish
58.58	3 20	June 1, 1966	Entire sunlit area of floor, bluish
58.75	3 40	Sept. 8, 1965	Absent
59.02	1 43	July 13, 1954	Absent
59.77	4 04	June 29, 1958	Floor; very pale bluish tint
60.23	2 48	Nov. 27, 1955	Floor; blue clay color
60.30	0 37	Mar. 26, 1964	Floor; blue clay color
60.39	3 20	Apr. 5, 1955	E. wall and glacis; violet; uncertain
60.56	3 56	July 27, 1950	Absent
61.77	2 58	Sept. 9, 1955	Floor; blue clay color
62.13	4 14	Aug. 1, 1955	Absent
62.72	3 26	July 22, 1964	Absent
65.15	3 40	May 31, 1958	Pale blue-gray floor; violet band east base of central peak
65.46	1 25	Oct. 10, 1954	Absent
65.86	3 27	June 28, 1950	Blue glare, rim of W. wall
66.45	3 30	May 5, 1955	Pale violet tint in east half of floor; violet band at base, east side of central peak
68.24	2 02	Oct. 19, 1964	Strong blue tint, east half of floor; blue-violet glare, base E. side central peak
68.46	3 53	June 23, 1964	Absent
68.48	3 33	Nov. 16, 1956	Floor; bright bluish tint E. of central peak; blue-gray W. of central peak
69.91	3 20	Nov. 7, 1965	Absent
70.49	0 45	Nov. 9, 1954	Absent
70.52	4 48	June 11, 1957	Floor; uniform bluish radiance
72.58	0 51	Mar. 27, 1964	Absent
72.73	4 39	July 14, 1954	EWBS; violet glare
72.73	5 33	June 30, 1958	Absent
73.23	4 40	Apr. 6, 1955	Absent
75.15	4 26	June 22, 1956	Absent

Table I. (Continued)

Colongitude	Universal Time	U.T. Date	Remarks
75°67	4^h55^m	June 23, 1964	Blue-violet glare, N.E. rim; strong violet tinge in nimbus
77.59	1 22	Oct. 11, 1954	Absent
77.60	5 40	July 11, 1957	Pale violet radiance in crater and on plateau, m
79.10	5 30	June 29, 1950	Strong bluish glare; E., S.E. wall
79.42	4 57	Oct. 11, 1954	Violet tint on floor, east wall and central peak; intermittent
79.61	6 05	July 30, 1958	Absent
79.79	4 04	July 4, 1955	Absent
80.19	0 46	Jan. 8, 1955	Strong violet glare whole length of E. rim; brightest S.E. and around EWBS
81.13	1 18	Jan. 27, 1956	Violet glare whole length of E. wall and around EWBS; violet tint in VA
82.17	4 54	Aug. 22, 1964	Absent
83.48	4 23	Sept. 10, 1965	Absent
84.40	2 33	Mar. 24, 1959	Strong blue and blue-violet glares; E. wall, EWBS, SWBS; intermittent display
84.41	6 10	June 3, 1966	Nimbus only; violet hue
85.04	5 50	July 1, 1958	Absent
85.31	1 59	Mar. 28, 1964	Blue-violet glare, E. wall and N. wall; EWBS; violet tinge in nimbus
85.83	5 42	July 29, 1950	Absent
85.60	4 55	Mar. 24, 1959	Same as 84°40 above
86.50	4 22	May 26, 1964	Strong blue-violet glare, E. wall and EWBS; strong violet tinge in nimbus
86.83	4 50	Aug. 3, 1955	Plateau, m, only; pale violet tint
89.83	1 32	Oct. 12, 1954	Pale violet radiance; S. wall, S.E., E., N.E. walls; central peak
90.22	5 20	Apr. 4, 1954	Absent
90.23	6 07	Oct. 10, 1965	Pale violet radiance; whole of W. interior; dark violet, nimbus; pale violet on plateau, m
90.46	0 40	Oct. 31, 1955	Bright blue-violet glare, E., N.E. rim; dark violet hue in nimbus; pale violet radiance over m
91.16	4 09	Oct. 12, 1954	Strong violet tint E. half of floor; very faint W. half of floor and W. wall. Dark violet in nimbus; pale violet on m.
91.63	4 25	Aug. 28, 1950	Intense blue-violet glare; EWBS, E., N.E. rim
92.33	7 05	July 31, 1958	Absent
92.59	4 50	Oct. 31, 1955	Intense blue-violet glare, E., N.E. rim. Dark violet in nimbus; pale violet on m.
93.06	4 17	Oct. 25, 1964	Nimbus only; dark violet hue
93.87	2 33	Jan. 28, 1956	Pale violet radiance; E., N.E. rim
94.29	4 45	Aug. 23, 1964	Absent
95.28	3 38	Sept. 10, 1965	Absent
95.44	1 10	Feb. 7, 1966	Nimbus only; intense, dark violet hue
96.77	6 28	May 4, 1958	Blue-violet glare S. side of EWBS; dark violet in nimbus; pale violet on m
96.83	4 48	Nov. 11, 1954	E. wall? Uncertain
97.57	6 29	July 2, 1958	Strong violet glare whole length of E. wall, involving EWBS; dark violet nimbus
97.59	5 35	July 16, 1954	Whole interior of strong violet tint; violet tint in nimbus and VA
98.01	5 24	Mar. 25, 1959	Intense blue-violet glare on whole length of E. rim and on EWBS; dark violet hue in nimbus
98.31	0 45	Oct. 20, 1956	Bright blue-violet glare on EWBS, E., N.E. rim. Dark violet in nimbus.
99.56	3 03	Sept. 22, 1964	Bright blue-violet glare; EWBS and N.E. rim. Dark violet in nimbus.
99.67	5 42	Oct. 2, 1955	Violet glare, E., N.E. rim. Over EWBS resembled a violet mist. Crater itself was hazy; could not get sharp focus.

Table I. (Continued)

Colongitude	Universal Time	U.T. Date	Remarks
100°18	1^h47^m	Oct. 11, 1965	Whole crater, exclusive of southern area, pale violet; dark violet in nimbus; pale violet on plateau, m
100.72	2 44	Dec. 12, 1954	Strong violet glare, E. rim, changing to brown (see text).
101.91	6 24	Mar. 17, 1957	Strong violet glare; EWBS and whole length of E. wall. Dark violet in nimbus; pale violet on plateau, m
102.23	2 00	Oct. 13, 1954	Bright blue-violet glare, E. rim; pale violet radiance within crater and around SWBS. Dark violet in nimbus; pale violet on plateau, m.
103.26	7 03	Apr. 5, 1958	Absent
103.88	5 15	Oct. 13, 1954	Scarcely perceptible violet radiance within crater; wall bands look faint
103.96	3 18	Nov. 1, 1955	Pale violet tint; EWBS, E., N.E. rim, dark violet hue in nimbus.
104.78	2 12	Oct. 22, 1964	Blue-violet glare; EWBS, E., N.E. wall. Dark violet hue in nimbus.
105.83	5 24	June 26, 1964	Dark violet in nimbus; pale violet on m. Absent from crater.
106.25	4 22	Aug. 24, 1964	Bright blue-violet; EWBS, E., N.E. wall
106.69	1 58	Oct. 10, 1957	Absent
107.29	3 20	Sept. 12, 1965	Absent
107.90	2 42	Nov. 12, 1954	Blue-violet glare; EWBS and whole length of E. wall. Suspected violet tint in VA; certain on m.
109.12	5 07	Nov. 12, 1954	Greatly faded since 2^h42^m
109.77	4 50	July 31, 1950	Violet glare; E., N.E. rim
109.84	1 57	Nov. 21, 1964	Bright blue-violet glare; N.E., N., and N.W. rims.
110.07	7 06	July 3, 1958	Bright blue-violet glare; E., N.E. rim. Dark violet, nimbus; pale violet, m.
110.55	7 05	July 17, 1954	Pale violet tint on surface N.E. of crater; no color elsewhere
111.43	4 55	Oct. 4, 1955	Pale violet tint; EWBS and whole length of E. rim; dark violet in nimbus.
111.13	7 27	Sept. 1, 1958	Whole crater filled with pale violet radiance, especially bright on walls. Pale violet in VA and on m.
111.53	5 38	May 28, 1964	Blue-violet glare; E., N.E. wall. Dark violet hue in nimbus.
111.95	3 30	Sept. 23, 1964	Blue-violet flare; EWBS, E., N.E., N., N.W. wall.
112.62	2 20	Oct. 12, 1965	Nimbus only; dark violet hue.
114.06	6 43	Mar. 18, 1957	Strong violet glare; EWBS, E. wall. Very strong violet hue in nimbus.
114.79	2 49	Oct. 14, 1954	Absent
116.24	5 39	Oct. 14, 1954	Absent
116.28	6 15	Aug. 2, 1958	Strong violet glare; EWBS, N.E. wall. Dark violet, nimbus. Strong violet, m.
118.22	5 48	June 27, 1964	Bright blue-violet; EWBS, E., N.E. rim. Dark violet in nimbus.
118.75	4 58	Aug. 25, 1964	Same as 118°22
119.50	3 15	Oct. 11, 1957	Same as 118°22
124.51	5 03	July 27, 1964	Absent
125.60	7 42	June 26, 1956	Intense blue-violet glare on EWBS. Dark violet in nimbus.
126.63	3 02	Oct. 13, 1965	Pale, blue-violet tint on EWBS and whole length of E. wall; pale violet radiance in crater, exclusive of southern region. Dark violet, nimbus.
130.02	4 02	Oct. 24, 1964	Blue-violet glare; EWBS, E., N.E. rim. Dark violet hue in nimbus.

Table I. (Continued)

Colongitude	Universal Time	U.T. Date	Remarks
130°58	4^h16^m	Aug. 26, 1964	Same as 130°02
130.84	4 57	Jan. 12, 1955	Same as 130°02 except no color in nimbus
130.88	6 44	June 28, 1964	Blue-violet glare; EWBS, E., N.E., N., N.W. walls
131.25	5 43	July 26, 1956	Absent
131.37	2 40	Oct. 12, 1957	Bright blue-violet glare; EWBS, E., N.E., N., N.W. walls. Dark violet, nimbus.
134.89	3 29	Nov. 23, 1964	Strong blue-violet glare; N., N.E., N.W. walls. Dark violet, nimbus.
135.16	3 44	Oct. 5, 1955	Intensely bright blue-violet glare; EWBS, E., N. E. wall
136.53	4 43	July 28, 1964	Blue-violet glare; EWBS. Dark violet in nimbus; pale violet on m.
136.59	4 05	Sept. 25, 1964	Same as 136°53 but absent on m.
136.61	7 31	May 30, 1964	Bright blue-violet glare; EWBS, E., N.E. walls. Dark violet, nimbus.
137.41	3 15	Oct. 14, 1965	Absent.
142.47	4 37	Oct. 25, 1964	Blue-violet glare; EWBS, E., N.E. wall. Faint violet tinge in nimbus.
142.95	4 37	Aug. 27, 1964	Blue-violet glare; EWBS, E., N.E. wall. Dark violet, nimbus; pale violet, m.
143.39	7 19	June 29, 1964	Suspected on EWBS, but too faint to be certain
144.04	4 00	Oct. 13, 1957	Weak violet glare; whole length of E. wall.
147.73	4 50	Nov. 24, 1964	Blue-violet glare, N. rim. Dark violet in nimbus; pale violet in VA
148.93	5 35	June 28, 1956	Intense blue-violet glare, EWBS. Dark violet, nimbus. Pale violet, VA and m.
149.28	5 07	Sept. 26, 1964	Moderately intense; EWBS. Dark violet, nimbus.
149.30	5 50	July 29, 1964	Nimbus only; dark violet hue
154.13	4 52	Sept. 7, 1955	Strong blue-violet glare; E., N.E. rim; also east base of central peak. Dark violet, nimbus.
154.50	4 22	Oct. 26, 1964	Nimbus only; dark violet hue
154.94	6 00	June 20, 1964	Nimbus only; dark violet hue
155.16	4 40	Aug. 28, 1964	Faint blue-violet radiance, EWBS. Dark violet hue in nimbus.
155.62	5 40	July 28, 1956	Vivid blue-violet glare on central peak, band across eastern floor to EWBS; on EWBS, and E., N.E. wall.
156.47	7 20	July 28, 1956	Absent (see July 28 above)
156.19	3 41	Sept. 16, 1965	Absent
157.28	5 45	Oct. 15, 1957	Strong blue-violet glare, whole length of E. wall.
161.26	4 48	Sept. 27, 1964	Absent
161.43	6 10	June 29, 1956	Faint, blue-violet tint; EWBS
165.34	6 45	Aug. 6, 1955	Absent
165.46	6 47	Oct. 18, 1954	Strong blue-violet glare; EWBS, E. wall and on central peak.
166.01	5 50	Nov. 6, 1955	Strong blue-violet glare, E., N.E. wall. Dark violet hue in nimbus.
166.18	4 32	Sept. 8, 1955	Strong bluish glare on E., N.E. wall, on S. edge of EWBS, and bordering both edges of the bright floor band, passing around westward of central peak. Dark violet tint in nimbus.
173.53	5 28	July 31, 1964	Pale blue tint; N.E., N., N.W. walls and floor.
174.03	6 55	June 30, 1956	Vivid blue-violet glare; EWBS, E., N.E. wall.
180.04	7 21	July 2, 1964	Absent
180.06	6 45	Oct. 28, 1964	Absent
181.77	6 00	Oct. 16, 1957	Faint blue-gray tint; N., N.W., W. floor and walls
182.43	6 58	Aug. 18, 1957	Pale blue tint on all walls; floor dazzling white
195.73	5 56	Aug. 7, 1950	Absent

Table I. (Continued)

Colongitude	Universal Time	U.T. Date	Remarks
196°.11	7^h19^m	July 24, 1954	Crater filled with pale violet light. See text.
208.84	7 35	Aug. 8, 1950	Absent
208.95	8 18	July 25, 1954	Absent

BOOK REVIEWS

The American Ephemeris and Nautical Almanac For the Year 1967, issued by the Nautical Almanac Office, U. S. Naval Observatory. Available from the Superintendent of Documents, U. S. Printing Office, Washington, D.C. 1965, $3.75. Issued in England by H. M. Nautical Almanac Office under the title The Astronomical Ephemeris.

Reviewed by William O. Roberts

In the year 1767 the Astronomer Royal, Nevil Maskelyne, introduced The Nautical Almanac and Astronomical Ephemeris in England. It appears indicative of the spirit of the times that in the following year James Cook was placed in command of the barque "Endeavour" for the famous voyage to Tahiti to observe the transit of Venus. Two hundred years later, astronomers and navigators continue to use the current versions of this annual in their everyday work; and for this reason, perhaps, it seldom receives more than perfunctory notice in book-review columns.

Within its five-hundred-odd pages is to be found an imposing collection of data which deal principally with the major objects of the Solar System and their constantly changing aspects. The sun and the moon, the major planets and their satellites, and the principal minor planets have their positions set down in tabular form, often for each day of the year. Apparent diameters of the planets, stellar magnitudes, and defects of illumination are often given. An observer of Jupiter would be able to refer to the central meridian longitude for 0 hours in Systems I and II for each day. Twenty-eight pages are devoted to Jupiter's satellites alone. Amateurs who have attempted to carry on observations of the phenomena and brightness changes of the four principal satellites of Jupiter will certainly appreciate this feature.

The lunar observer, to take another case, is also generously provided for. Among the data published are: hourly positions of the moon throughout the year, time of occurrence of each phase of each lunation, dates of apogee and perigee, eclipse schedules, both solar and lunar, libration and nutation angles, and percentage of illumination of the disk. There is a calendar and a diary of astronomical phenomena for the year in the front of the book. At the other end one will find numerous conversion tables and formulae as well as a generous explanation supplement to aid the user of the tables. There is even a list of the principal observatories throughout the world.

In spite of the fact that both Greenwich and the U. S. Naval Observatory have programs going upon comets and occultations, there is no comet information given; and occultations of planets and only bright stars are merely listed. This omission is deliberate, and the reader is referred to Sky and Telescope for occultations material for North American stations. Meteor shower predictions are omitted. On the other hand, there is a catalogue of approximately 1100 stars brighter than 5th magnitude with their positions, magnitudes, and spectral types.

It appears pretty obvious that this almanac is designed to accommodate the navigator and the astronomer working with material that will directly improve the navigator's ability to find his position at sea or in the sky, quickly and accurately. It happens, however, that this material is in large part the kind of stuff that is of great interest to systematic lunar and planetary observers, whether they be amateur or professional. It is a reference with which every serious amateur ought to be familiar.

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1967 Celestial Calendar and Handbook, authored and published by Chas. F. Johnson, Jr., 48 Roberts Street, Watertown, Conn. Price $1.00. 32 pages.

Reviewed by J. Russell Smith

Here's another annual Celestial Calendar and Handbook. This 1967 edition has an eyecatching photo of Jupiter on the front cover while a useful drawing (key map) showing Jupiter's belts and zones is found on the back cover. One principal feature of the booklet is the calendar page for each month. This lists, on the various dates, important and interesting astronomical events. On March 13, 1967, one finds that Uranus is at opposition at 11^h, Eastern Standard Time, and Venus is 1° N. of the moon at 16^h, E.S.T. On the back of each calendar page one finds charts for Jupiter's satellites; these have been reprinted by permission of the Nautical Almanac Office, Washington, D.C.

The booklet gives useful information on the planets, eclipses, the "Big Four" asteroids, the principal meteor showers, variable stars, clusters, galaxies, nebulae, and physical data for the sun, moon, and planets. If one is interested in finding Uranus, Neptune, Juno, or Vesta, the book contains finding charts to assist him. Altogether, this work is well done; and it will make a useful reference to have on the astronomical shelf.

A new item added to the 1967 edition is a handy order blank to use in ordering the 1968 edition.

THE REMARKABLE 1966 LEONID METEOR SHOWER

It is already well known to most of our readers that an extraordinary Leonid meteor shower occurred during the morning hours of November 17, 1966. Indeed, Dennis Milon unqualifiedly speaks of it as "the greatest meteor shower in recorded history" and estimates the peak rate at about twice that for the famous 1833 Leonid shower. A small number of reports have been received, although the A.L.P.O. has never had any meteor section. A few photographs have also arrived, and a portion of meteor photographs secured by New Mexico State University Observatory staff members illustrate this article. We thank all contributors.

By far the most complete account is that of Dennis Milon, who reported for a team of 13 observers on Kitt Peak in southern Arizona. The others were Mike Barrett, Roger Duewel, Steven Jay, Earle Kapchuk, Gregory Lazear, Lee McDonald, David McLean, Alvin Post, Don Pearson, Jack Sulentic, Lyle Supp, and Daniel Vukobratovich. The team had disappointing results on November 16, with only about 9 Leonids per hour. Meteors were also few on November 18. Nor were results spectacular during the first hour of group observing on November 17, the rate being 33 Leonids per hour from 8^h30^m to 9^h30^m, U.T. Observers found it hard to keep up with counting meteors and estimating their stellar magnitudes as the rate increased greatly during the second hour. Perhaps we can do no better than to quote part of Mr. Milon's report.

"But it was getting impossible to write down magnitude estimates as the meteors came faster and faster. Looking up and down and writing as fast as we could, we fell behind the Leonids; and there were yells of 'I can't do it...There are just too many!' So we stopped estimating magnitudes and started making counts per minute. The count was about 30 per minute at 11^h10^m, U.T. when a -8 or so fireball exploded.

"The sky literally began to rain shooting stars. Everywhere we turned we saw them. We excitedly figured hourly rates from our counts and wondered how they would compare with the great showers of the past. It was obvious to us that this type of shower would terrify the ignorant, not to mention effects upon astrologers!

"By 11^h30^m there were several hundred per minute. At 11^h45^m, U.T. the meteors were so intense that we guessed how many were seen by a sweep of the head in one second. The fantastic rate of about 40 per second was reached at 11^h54^m. It was indeed difficult to gauge such a rate, but this value is the consensus of observers. Our graph defines the time of maximum very well even without the peak estimates since the easily made counts below 100 per minute are symmetrical with the observed peak."

The graph mentioned is Figure 23. The observers estimated the average magnitude at 1.5 or 2.0. Many of the brighter meteors left trains lasting for several minutes. The Kitt Peak team took photographs with both black-and-white and color film. The highest photographic rate was 43 Leonids on a 43-second exposure by Dave McLean.

Mr. Milon continues: "The rate was over 100 per minute for an hour, from about 11^h30^m to 12^h30^m. It was over 1000 per minute for 40 minutes, 11^h35^m to 12^h15^m. The peak of perhaps 2400 per minute was centered at 11^h55^m, U.T... ..By 12^h40^m the shower was back down to 30 per minute. We continued to see Leonids in the brightening dawn sky until a colorful Arizona sunrise closed out our observing."

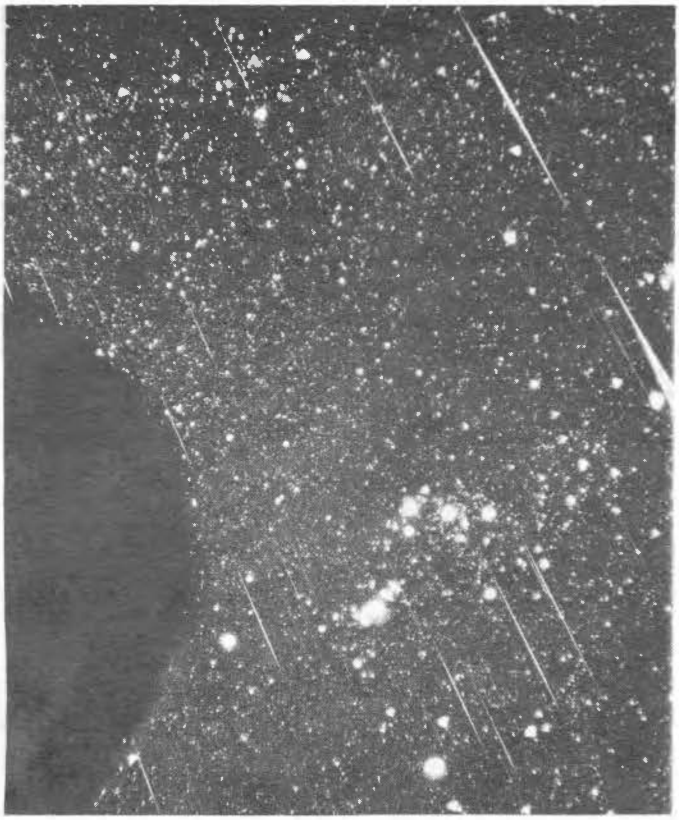

Figure 19. Photograph of the Leonid meteors by Scott Murrell at New Mexico State University Observatory on November 17, 1966 at about 4:45 A.M., M.S.T., 11^h45^m, U.T. Region shown is in Orion; note the belt and sword. The dark shadow on the left margin is the telescope tube. The camera, a Miranda with 50-mm. Fl.9 lens, was mounted on the 12-inch telescope tracking at the sidereal rate. Tri-X film, 10 minute exposure.

Figure 20. Photograph of the Leonids by Scott Murrell at New Mexico State University Observatory on November 17, 1966 near 5:00 A.M., M.S.T. (12^h0^m, U.T.) The region is the Sickle in Leo, including the radiant. The three bright stars at the upper right are Zeta Leonis (left), Gamma (center), and Eta. The radiant, where the meteor trails shown would converge, was probably just above Gamma and to the right of Zeta. The bright streak on the left edge is said to be the Pageos satellite.

Figure 21. Photograph of the Leonids by Tom Kirby and Tom Pope of New Mexico State University Observatory. 11^h31^m–$11^h 43^m$ on November 17, 1966, U.T. 12 minutes at F2.8. 35-mm. wide-angle lens. Tri-X film. Camera stationary so that stars trailed.

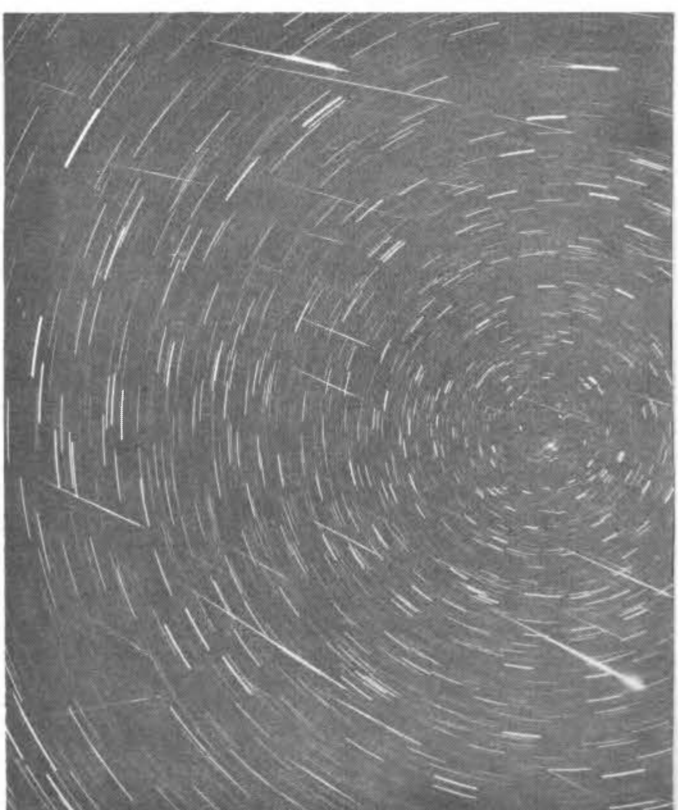

Figure 22. Photograph of the Leonids by Tom Kirby and Tom Pope. $11^h 58^m$–12^h23^m, U.T. 25 minutes at F4.0. Other data as on Figure 21.

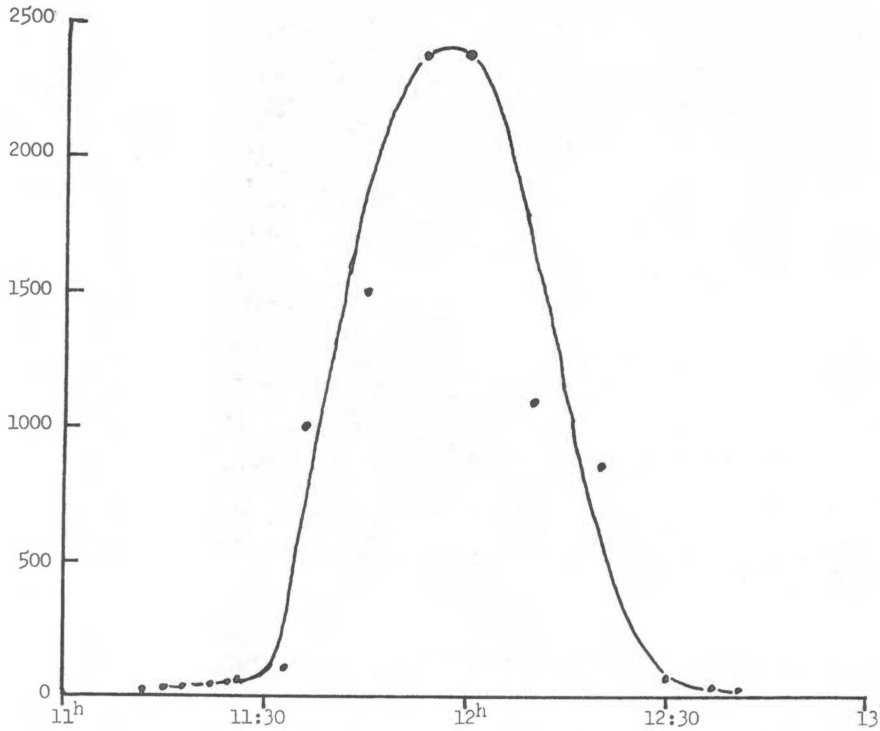

Figure 23. Meteor counts during the Leonid shower of November 17, 1966. The rate per <u>minute</u> for a single visual observer is plotted against time. The rate is derived from visual estimates of the number of Leonids per minute and per second by the Kitt Peak team of observers. Graph contributed by Dennis Milon.

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Rates reported for November 17, 1966 by a few observers follow. All are hourly rates for a single visual observer, adjusted from shorter time intervals when necessary.

Observer(s)	Interval (U.T.)	Station	Rate/Hr.
José Olivarez	about 8^h	Edinburg, Texas	8
Douglas Smith	8^h0^m-9^h0^m	Vinton, Virginia	73
Unnamed	10^h10^m-10^h40^m	Vinton, Virginia	222
Melvin E. Helms	10^h45^m-11^h0^m	Mill Creek, Oklahoma	484
Ken Thomson & others	about 11^h	Houston, Texas	10,000
Melvin E. Helms	11^h15^m-11^h30^m	Mill Creek, Oklahoma	1,372
José Olivarez	11^h15^m-11^h45^m	Edinburg, Texas	8,000
Melvin E. Helms*	11^h46^m-12^h1^m	Mill Creek, Oklahoma	112
Melvin E. Helms*	12^h1^m-12^h16^m	Mill Creek, Oklahoma	52

*Meteors counted only within a circular area about 9 degrees in diameter and centered near radiant in Leo.

The greatly higher rates for the Kitt Peak team than for the observers tabulated above (rates per minute are multiplied by 60 to get rates per hour) can perhaps be explained by very clear skies on Kitt Peak and by the effect of morning twilight farther east.

Mr. Helms estimated from observed paths that the radiant lay near 10 hrs., 5 mins.

right ascension and +19°5 declination. Perhaps some energetic reader would like to determine the radiant by extending the meteor trails shown on Figure 20 backward to their point of intersection.

ANNOUNCEMENTS

Sustaining Members and Sponsors. As of December 17, 1966, we have in these special classes of membership:

Sponsors - William O. Roberts, David P. Barcroft, Grace A. Fox, Philip and Virginia Glaser, John E. Westfall, Joel W. Goodman, the National Amateur Astronomers, Inc., James Q. Gant, Jr., Ken Thomson, Kenneth J. Delano, Richard E. Wend, and Phillip W. Budine.

Sustaining Members - Sky Publishing Corporation, Charles F. Capen, Craig L. Johnson, Geoffrey Gaherty, Jr., Dale P. Cruikshank, Charles L. Ricker, James W. Young, Alan McClure, Elmer J. Reese, George E. Wedge, Carl A. Anderson, Gordon D. Hall, Michael McCants, William K. Hartmann, Ralph Scott, A. W. Mount, Charles B. Owens, Joseph P. Vitous, Jimmy George Snyder, John E. Wilder, Clark R. Chapman, A. K. Parizek, B. Traucki, Emil P. Uhor, Charles H. Giffen, Frederick W. Jaeger, Klaus R. Brasch, P. K. Sartory, Nicholas Waitkus, Patrick S. McIntosh, Lyle T. Johnson, and the Chicago Astronomical Society.

Sustaining Members pay dues of $10 per year; Sponsors, $25 per year. The surplus above the regular rate is used to support the work and activities of the A.L.P.O. The assistance thus given has been extremely valuable to the Association.

New Assistant Mars Recorder. At Mars Recorder Brasch's request, a new Assistant Recorder has been appointed to succeed Mr. Wend, who has become the Jupiter Recorder. The Assistant Mars Recorder is now:

Kenneth T. Chalk
3489 Grey Avenue
Montreal 28, Quebec, Canada

It is planned that Mr. Chalk should handle the routine correspondence of the Mars Section and should assist in the reducing of A.L.P.O. Mars observations. Since he and Mr. Brasch live near each other and are well acquainted, it is expected that they can work together efficiently and effectively. We express our appreciation to Mr. Chalk for accepting this post and to Mr. Wend for his past services as Assistant Mars Recorder.

New Address for Lunar Recorder Westfall. The address of Mr. John E. Westfall is now:

1530 Kanawha St., Apt. 110
Adelphi, Maryland 20783

Mr. Westfall is the informal head of our Lunar Section and is also in charge of the A.L.P.O. Lunar Photograph Library, whose existence is still apparently unknown to some of our members.

Correction to Vol. 19, Nos. 11-12 of The Strolling Astronomer. Mr. William E. Shawcross of Sky and Telescope has pointed out that the reference "Pictures from the Moon", as given just below the caption of Figure 9 on pg. 193 of the issue cited, should have been credited to Mr. Raymond N. Watts, Jr. - not to that exceedingly prolific feature writer "Anon".

A.L.P.O. 1967 Convention. We remind our readers that our next Convention will be with the Western Amateur Astronomers at Long Beach, California in late August, 1967. More details will appear in future issues.

A.L.P.O. Paper Session with League. According to a vote during the business meeting held as part of the 1966 A.L.P.O. Convention at Tucson, we have accepted the invitation of the Astronomical League to give a paper session during the League's next National Convention. This meeting will be held at Washington, D.C. over the interval June 30-July 4, 1967. The National Capitol Amateurs will be the host society. Through the interest of Father Francis J. Heyden, S.J., the facilities at Georgetown University are being made available for the Convention. Early information about the Convention may be obtained by writing to the General Chairman, Mr. G. R. (Bob) Wright, 202 Piping Rock Drive, Silver Spring, Maryland 20904. On Friday evening, June 30, there will be an informal gathering in Copley Lounge at the University, and the Georgetown Observatory will be open for inspection and observing.

Mr. John E. Westfall has agreed to take charge of an A.L.P.O. exhibit, in which he will include many Ranger, Surveyor, and Orbiter close-up lunar photographs and other professional space research lunar findings. A.L.P.O. members are invited to attend this Convention at Washington, and those wishing to contribute to the program of our paper session should write to the Editor at an early date.

Surveyor I Lunar Surface Photographs. The National Space Science Data Center has announced the availability of the complete set of Surveyor I lunar television photographs, more than 10,000 television pictures of the lunar surface for the period from June 2 to lunar sunset on June 14, 1966 and several hundred additional photographs after the beginning of the second lunar day (July 12 and 13). Ancillary data available to the user include mosaics of the first and second lunar day, tabular printouts of television identification data, glossy prints of about 25 digitally processed photographs, and plots of Surveyor I touchdown strain gage information. Reproductions from 70-mm. film transparencies can be provided. A special catalog of all Surveyor I photographs will be available from the Data Center in the coming months. All inquiries should be addressed to:

National Space Science Data Center
Goddard Space Flight Center
Code 601
Greenbelt, Maryland 20771
Telephone: Area Code 301 982-6695

New Zip Code for A.L.P.O. Address. In an administrative change the zip code of the University Park Postoffice has been made the same as that of the city of Las Cruces. Our address has thus become: Box AZ, University Park, New Mexico 88001.

LUNAR AND PLANETARY PROSPECTS: JANUARY-FEBRUARY, 1967

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

Mercury. This planet will be at superior conjunction on January 18, at greatest elongation east on February 16, and at inferior conjunction on March 4. This February apparition will be the most favorable evening apparition of the year for observers in the northern hemisphere. The planet will be at perihelion on February 16, the day of greatest elongation (18° from the sun). On pages 7-8 of this issue Reverend Hodgson, the new A.L.P.O. Mercury Recorder, outlines programs for observing Mercury, in which readers are urged to participate. It is surely disappointing that there has still been no serious A.L.P.O. effort at an optical reinvestigation of the rotation of Mercury since the 59-day radar period was announced in 1965. For this purpose, intensive observation is absolutely essential; one should try to observe Mercury on as many dates as possible during the two or three weeks of favorable presentation.

Venus. This planet will be an increasingly prominent object in the evening sky during the first two months of the year. The value of K, the illuminated portion of the disk, will decrease from 0.98 on January 1 to 0.90 on March 1. The angular diameter of Venus will increase from 10"2 on January 1 to 11"5 on March 1. Rather high powers should be used to observe the notoriously brilliant disk. Readers will find guidelines for observing in Mr. Cruikshank's last Venus Report in this journal, Vol. 19, Nos. 7-8 and 9-10. Determinations of precisely how the observed phase compares with geometry and observations of the bright cusp-caps and bordering dark cusp-bands are recommended.

Mars. Certain data about this planet follow.

Date	Diameter	Tilt	Phase-Angle	Heliocentric Longitude
1967, Jan. 1	6"6	+22°	36°	158°
Jan. 16	7.4	+21	36	165
Jan. 31	8.4	+19	35	171
Feb. 15	9.6	+18	33	178
Mar. 2	11.2	+18	28	184

In February the planet will be getting close enough to justify regular observing with ordinary apertures. The summer solstice (heliocentric longitude 178°) of the northern hemisphere falls on February 16, 1967. Near that date one may expect to find a brilliant if small northern surface cap and a large and variable atmospheric cap on the south limb. The tilt of the axis of Mars will strongly favor the visibility of northern features. At 0 hrs., Universal Time, the central meridian of longitude is 4° on January 1, 69° on February 1, and 168° on March 1. The hourly rate of rotation is about 14°6 of longitude.

Persons not already familiar with observing Mars should read Mr. Wend's preliminary note on the 1967 apparition on pages 5-6 of this issue and Mr. Brasch's 1964-5 Mars Report on pages 12-18.

Jupiter. The Giant Planet will be at opposition on January 20, 1967, when its equatorial angular diameter will be 46."1 and its declination will be +21°. It will hence be very favorably placed in the sky during the early months of 1967 for northern hemisphere observers. Nevertheless, winter apparitions of Jupiter are usually poorly covered; A.L.P.O. members able to observe either regularly or occasionally will be making a needed contribution to the work of the Jupiter Section. Novice observers and those wishing to learn more about fruitful amateur programs on Jupiter would find our A.L.P.O. Jupiter Handbook very helpful. It can be ordered from the Editor for the price of 50¢.

Assistant Jupiter Recorder Paul Mackal urges that the South Tropical Zone be closely observed for a possible new South Tropical Streak Disturbance. On October 6, 1966 at $10^h 30^m$, U.T., $C.M._2 = 221°$, Mr. Mackal found both components of the South Equatorial Belt greatly displaced toward the South Temperate Belt for about ten degrees of longitude. Mr. Douglas Smith observed a rather similar appearance on March 3, 1966 near longitude 18° (System II). The famous Red Spot region, centered near 30° in System II, has been very active during the 1966-7 apparition so far and hence deserves special study.

Saturn. The 1966 edgewise presentation of the rings has now ended, and both the earth and the sun will be on the south side of the plane of the rings for about 15 years. Saturn will be in the evening sky in January and February but will be increasingly poorly placed as it approaches its conjunction of March 23. The rings will widen as the Saturnicentric latitude of the earth increases numerically: -0°.3 on January 1, -1°.6 on February 1, and -3°.1 on March 1. The Saturnicentric latitude of the sun will increase numerically from -3°.0 on January 1 to -3°.9 on March 1. The shadow of the rings will hence be black and prominent a little north of the projected rings. The satellites of Saturn can still be observed with unusual ease because of the relative dimness of the obliquely lit rings. Other observations of Saturn can be based upon the report on the 1964-5 apparition by Messrs. Cragg and Bornhurst, Str. A., Vol. 19, Nos. 5-6, pp. 98-104. Numerical intensity estimates of ring and ball detail with color filters of known transmissions (e.g., Wratten Filters) are particularly recommended.

Uranus and Neptune. The paths of these distant planets among the stars are published in various places, e.g., pages 30 and 31 of the R.A.S.C. Observer's Handbook 1967. We give positions below:

Object	Right Ascension	Declination
Uranus, Jan. 1	$11^h\ 40^m\ 46^s$	+2° 56'
Uranus, Feb. 1	11 39 2	+3 8
Uranus, Mar. 1	11 35 19	+3 33
Neptune, Jan. 15	15 27 49	-17 5
Neptune, Feb. 15	15 29 37	-17 10
Beta Leonis (Denebola)	11 47 23	+14 45
Delta Scorpii	15 58 23	-22 32

The star positions supplied will allow members with circles on their telescopes to make differential settings. Uranus will be moving toward its opposition on March 13, 1967. Neptune will be more poorly placed in the morning sky and will not reach opposition until May 14. Mr. Abbey has agreed to describe a suitable Uranus project for A.L.P.O. members in the next issue. Meanwhile, observations of satellite brightnesses and of any objective ball detail are recommended. Observers having access to telescopes with filar micrometers might try to measure the oblateness of Uranus while the earth is still near the planet's equatorial plane.

Moon. Although Lunar Recorder Delano has not updated the list of observable lunar domes on pg. 215 of our preceding issue, readers may still use much of this list by recognizing that two synodic periods of the moon are very nearly 59 days. Thus the dome -931-071 (on the floor of Grimaldi) which was well placed on Nov. 25/26, 1966 (local civil time dates) is well placed again on Jan. 23/24, 1967. Readers can similarly update data on other domes. Mr. Delano wishes observers to realize, however, that domes must often be observed over such a brief interval of favorably oblique lighting that conditions may vary significantly for observers in different parts of the United States. For example, a dome ideally lit one evening for an observer in New England may be under too high a solar illumination for best viewing by the time that an observer in California can watch the moon later that evening.

Those wishing to study "lunar transient phenomena" should reread Charles Ricker's article in Str. A., Vol. 19, Nos. 9-10, pp. 167-169. The Aristarchus region will be illuminated from Jan. 22 to Feb. 6 and from Feb. 21 to March 7 (U.T. dates). Alphonsus will be in sunlight from Jan. 18 to Feb. 2 and from Feb. 17 to March 4. The moon will be at perigee on Jan. 28 and Feb. 25; at apogee, on Jan. 16 and Feb. 13.

OBSERVATIONS AND COMMENTS

The drawing here shown as Figure 24 was made when the earth was near its maximum angular elevation above the unilluminated side of the rings. The eastern arm of the rings was seen in its full length, but the slightly fainter western arm was only partially visible. Mr. Olivarez estimated the total stellar magnitude of the eastern arm at 12.0; it was fainter

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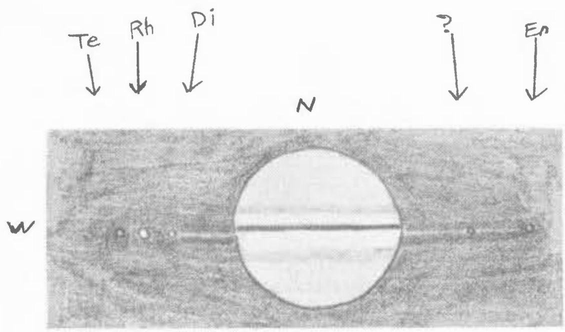

Figure 24. Drawing of Saturn by José Olivarez on November 24, 1966 at 2^h3^m, U.T. Pan American College 17-inch refl., 168X. Seeing 4, transparency 5. North at top, west at left. Four satellites and a spot on the east arm of the rings are indicated with arrows. Saturnicentric latitude of earth 0°26 N. Saturnicentric latitude of sun 2°41 S. Note shadow of rings north of the rings.

*****

than satellite Enceladus, which was assumed to be 11.8. The observer estimated decreasing brightness as follows: Titan (well east of planet, not drawn in Figure 24), Rhea, Tethys, Dione, Enceladus, apparent condensation on east arm of rings.

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STAFF