ASSOCIATION OF LUNAR AND PLANETARY OBSERVERS

The Strolling Astronomer

VOLUME 7, NUMBER 1 JANUARY 1, 1953

In This Issue

THE STROLLING ASTRONOMER
1203 North Alameda Street
Las Cruces, New Mexico

THE

STROLLING ASTRONOMER

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1 Issue (in stock)......	$0.35
6 Months.............	1.75
1 Year...............	3.00
2 Years..............	5.00

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

ANNOUNCEMENTS

New Format. We hope you like your Strolling Astronomer in its new arrangement. The present booklet form is, we think, much more attractive than the old form. This booklet has been planned and designed by our publishers, the Stevens Agency, 202 S. Broadway, Albuquerque, New Mexico. The change is being made with this first issue of the new year - though we blush to think how old the year already is - since a number of our members bind The Strolling Astronomer year by year. Would you like to let us hear how you like our new layout?

Availability of 200-Inch Lunar and Planetary Photographs. Many of our readers have doubtless seen the lunar and planetary photographs taken with the 200-inch Hale Telescope on Palomar Mountain in recent issues of Time, Life, National Geographic Magazine, and other periodicals. The 200-inch photographs listed below may be purchased from the California Institute of Technology Bookstore, 1201 E. California St., Pasadena, Calif. They may be bought either as 8 by 10 inches photographs for 75 cents each or as 4 by 3-1/4 inches slides for $1.50 cents each. If ordering by mail, add 75 cents per order for postage and packing. Order by catalogue number only.

SP - 14. Moon, region of Clavius.
SP - 15. Moon, region of Copernicus.
SP - 16. Mars, in blue and red light.
SP - 17. Mars, two views in blue light.
SP - 18. Jupiter, in blue light.
SP - 19. Jupiter, in blue light.
SP - 20. Jupiter, in bluelight, showing large red spot.
SP - 21. Jupiter, in blue light, showing large red spot. Satellite Ganymede and shadow (above).
SP - 22. Jupiter, in red light. Satellite Ganymede and shadow (above).
SP - 23. Saturn, in blue light.

It goes without saying that these photographs are a worthwhile addition to any astronomical library. Although it has been stressed that the 200-inch will seldom be used on Solar System bodies, we hope that occasionally additional lunar and planetary photographs will be taken with it. It certainly has the potential ability to take photographs of our next-door neighbors surpassing all existing ones.

Acknowledgments. We express our thanks to Scientific American magazine and particularly to Mr. Albert Ingalls for the article on pp. 84-87 of their January, 1953 issue about Maedler's Square and its mysteries. Dr. J. C. Bartlett and others have discussed in the pages of The Strolling Astronomer the remarkable variations in the drawings and descriptions of this lunar region by different observers. We thank Mr. Ingalls for his kind mention of the A.L.P.O. in connection with this lunar riddle and heartily welcome our new members who first heard of us through the Scientific American article.

We also thank The Griffith Observer and Dr. Dinsmore Alter for using as the feature article in their January, 1953 issue a contribution from Walter H. Haas called "Some Long-Enduring Features in the South Temperate Zone of Jupiter." The article is an expansion of Mr. Elmer J. Reese's careful and meritorous study reported in the March, 1952 Strolling Astronomer. These long-lasting markings have remained present during the current 1952-53 apparition of Jupiter.

Get-Well Wishes. We have been sorry to learn of the recent serious illness of Mr. Harry Freeman with heart trouble. Mr. Freeman is a telescope-maker in Los Angeles and has long been very active as a leader of amateur astronomers on the West Coast. We join his many friends in wishing him a speedy recovery.

Personal. It is possible that the Editor will spend much of February and March at the Aberdeen Proving Ground, Maryland on a White Sands Proving Ground assignment. If so and if time permits, he would enjoy meeting astronomical friends and colleagues in that vicinity.

No further details are yet known.

IN MEMORIAM

We learned with deep sorrow of the recent deaths of two of our members, Judge Ben S. Beery of Los Angeles and Mr. Lee Hunsicker of Freeport, Illinois. Judge Beery was very active, we understand, in the Los Angeles Astronomical Society in its early days in the nineteen thirties. Its present size and growth show how well its founders built. The Editor greatly enjoyed corresponding with Judge Beery about common astronomical interests and talking with him, all too briefly, at the Convention of Western Amateurs at Berkeley in 1952. Mr. Hunsicker had just joined the A.L.P.O., and we regret knowing nothing about him. We extend our sympathies to the families of our departed colleagues.

THE OCCULTATION OF THE STAR SIGMA ARIETIS BY JUPITER ON NOVEMBER 20, 1952

by Walter H. Haas

On pp. 138-139 of the October, 1952 Strolling Astronomer we directed the attention of A.L.P.O. members to the rare event of an occultation of a naked-eye star by the planet Jupiter. The star, Sigma Arietis, is of stellar magnitude 5.5. Clear skies make it possible to observe the morning-hours occultation immersion at many places in the western half of the United States, though seeing conditions were poor as a whole. Other colleagues had clouds. Our praise and our sympathy must go to Mr. Clive Chapman, 11 Forth St., Woollahra, Sydney, Australia - our praise because he alerted a total of seven individuals and scientific institutions in Australia and New Zealand to the occultation and our sympathy because clouds prevented any observations at all in those countries! In this article we shall use Universal Time. We now summarize the work of the reporting observers:

J. T. Carle, Fresno, Calif. 8-inch refl., 135X, rather good seeing, rather poor transparency. Beginning constant observing at $10^h 20^m$, Mr. Carle found no change in the color or brightness of the star until about $10^h 44^m$, when it began to grow noticeably dimmer and to lose its bluish cast. Sigma appeared to touch the disc of Jupiter near $10^h 46^m$ and disappeared suddenly near $10^h 48^m 45^s$. "After this first disappearance there was an interval of about 10 seconds in which the star was completely invisible, after which it again appeared, apparently hanging on the edge of the disc for a second or two, disappeared and returned, popping in and out of view for about 15 seconds before finally disappearing completely." We shall refer again to this curious behavior.

S. Cawelti, Box 382, Occidental College, Los Angeles 41, Calif. 15-inch refl. seeing fair, transparency bad. The star grew red as it entered the atmosphere of Jupiter and later was apparently seen inside the limb of the planet.

Thomas A. Cragg, Mount Wilson Observatory 6-inch refr. 350X, seeing fair, transparency very good. We learn from Mr. Cragg's very full report that the occultation was observed with the 60-inch and 100-inch reflectors on Mount Wilson, and we look forward to the publication of the results of their studies. At immersion the star entered the limb of Jupiter in the South South Temperate Zone between the South South Temperate Belt and the South South South Temperate Belt, a position confirmed by Haas. Emersion on the east limb was at or very close to the South South Temperate Belt. Immersion occurred at $10^h 48^m.3$; emersion, at $12^h 38^m.7$. It is not clear from Cragg's letter how these times were obtained. Each observed time is three to four minutes before the predicted time for Mount Wilson so that the Ephemeris right ascension of Jupiter was evidently slightly in error. Cragg is the only observer to mention emersion, all the others making no attempt to observe it because of the very low altitude of the planet.

With conditions good enough to show two diffraction rings around the star, Mr. Cragg detected no decrease in light before apparent tangency with the disc of Jupiter very close to $10^h 48^m$. He then glanced at a nearby clock for two seconds; and when he again looked at the star, it appeared to be much dimmer. Perhaps, however, this effect was really an irradiation illusion. At any rate Sigma was now dimming progressively, as was confirmed by comparing its light to that of Jupiter IV near the northwest limb of the planet; and it continued to do so until it disappeared in 10 to 15 seconds after Cragg's return to the eyepiece. He perceived no change in color. He is confident that the star was visible through the extreme edge of Jupiter just before its final extinction (compare to Cawelti).

Dan Davis, Jr., Box 536, Childress, Texas. 6-inch refl., poor seeing. The star was last definitely seen at $10^h 44^m 30^s$ and was last suspected near $10^h 46^m$.

Walter H. Haas, Las Cruces, N. M. 6-inch refl., 188X and 298X, bad seeing good transparency. In the unsteady air the star blurred so badly with the image of Jupiter that it was impossible to tell anything about dimming or discoloring. Immersion was near $10^h 45^m$, a time uncertain by several minutes.

R. R. Lee, 701 6 Ave., Boulder, Colo. Denver University 20-inch refr., 180X, fair seeing. Mr. Lee found the blue fringe of light around the planet in the large refractor a severe handicap and could not see the star after $10^h 45^m$. The Editor would suggest that a higher power should have been used, surely more than 9 to the inch of aperture.

Russell C. Maag, 816 1/2 S. Massachusetts, Sedalia, Missouri. 8-inch refl., 192X, rather good seeing, good transparency. Sigma Arietis preserved a silvery white color until $10^h 43^m$; it then became slightly reddish, the red cast growing deeper until the sudden disappearance (also sudden to Carle) at $10^h 44^m 15^s$. There was a loss in light of about 0.5 stellar magnitudes.

Frank Mayes, 402 S. Juanita Ave., Redondo Beach, Calif. and Fred Eiserling, 106 Diamond St., Redondo Beach, Calif. T. A. Cragg's 12-inch refl., Inglewood, Calif., about 100X. Immersion was observed near $10^h 48^m$. "As the star approached the limb, a slight quivering and reddening was seen. There was also a double flare of the star as it passed behind Jupiter. As the star disappeared, we saw it shining a little bit through Jupiter's atmosphere." Mayes and Eiserling thus appear to confirm that Sigma Arietis reappeared after it first vanished and that it was visible inside the limb of Jupiter.

Cecil Post, 621 S. Melendres, Las Cruces, N. M. 6-inch refl., 180X, bad seeing, excellent transparency. The observer estimates that the star began to be dimmed by the atmosphere of Jupiter at $10^h 44^m$. A little later, in a steadier moment, Sigma looked blue very close to the limb. Disappearance was recorded at $10^h 46^m 16^s$ but could have really occurred as much as 30 seconds later.

J. Russell Smith, Skyview Observatory, Eagle Pass, Texas. 16-inch refl., 100X, very bad seeing. Immersion was timed to occur at $10^h 43^m$.

J. A. Westphal, Box 1590, Tulsa, Oklahoma and G. Rose. 12.5-inch refl. near Tulsa, 246X, very bad seeing, rather poor transparency. Immersion was timed at $10^h 46^m$, with a probable error of 30 seconds. It was impossible to tell anything about dimming, reddening, and the like.

Readers will realize, of course, that the observed time of immersion varied a few minutes according to the geographical position of the observer and that the times of other events mentioned above also varied.

Perhaps the most obvious conclusion from these reports is that the occultation was difficult to observe with ordinary telescopes. Certainly it was more difficult to determine the true appearance of the star very close to the limb of Jupiter than one would expect from the ready visibility of the Galilean satellites in the same position. The difficulties of observing the star may have been due in large measure to the poor seeing; for Carle, Cragg, and Maag enjoyed adequate views of the phenomenon right up to occultation disappearance with only six- or eight-inch telescopes. Even so, at future occultations of stars by planets each observer should certainly attempt to use as large a telescope as he can. The Editor also recommends a fairly high magnification, certainly no less than 20 to the inch of aperture and preferably more than that. A high power will help by decreasing the brightness of the limb (or terminator) of a planet, while naturally the brightness of a star is unaffected.

The evidence is very strong that the star was dimmed by the atmosphere of Jupiter above the reflecting surface and is good that it was reddened. Carle, Cragg, Maag, and Post all found a decrease in brightness. Carle, Cawelti, Maag, Mayes, and Eiserling all remarked a reddening or a loss of the initial blue color, although Cragg could detect no change in color and Post found the star still blue very soon before disappearance. We might note that a reddening would not depend on the chemical composition of the atmosphere of Jupiter. The observers disagree very badly on the duration of these Jovian atmospheric effects. We have estimates of 15 seconds or less (Cragg), a minute and 15 seconds (Maag), 2 minutes and 16 seconds or somewhat more (Post), and fully 5 minutes (Carle)! It is impossibly to reach any conclusions from these numbers about the optically effective height of the Jovian atmosphere above the reflecting surface. It is easy to compute (from data in our October, 1952 issue) that at the distance of Jupiter the speed of the star in its relative path was about 580 miles per minute and that its height above the reflecting surface was about 430 miles one minute before it was occulted at that surface. In the strong gravitational field of Jupiter an atmosphere must decrease rapidly in density with increasing height and hence would be expected to be relatively shallow. Thus, Mr. Cragg's brief duration of dimming may be the most likely; his 15 seconds would mean that dimming began with the star about 100 miles above the reflecting surface.

Cawelti, Mayes, and Eiserling appear to have seen the star inside the limb of Jupiter; and Cragg is confident that he witnessed this aspect. One may be properly suspicious that such an appearance is real, for stars have been similarly seen inside the limb of the very solid moon! If real at this occultation, and not just an optical illusion, we must interpret the effect to mean that Jupiter is still translucent a little below the reflecting surface. However, the suddenness of the disappearance to Carle and Maag would suggest that the planet becomes rapidly opaque at a definite and sharply defined level. Maag's estimate of a decrease in brightness by 0.5 stellar magnitudes would mean that 37 percent of the light of the star was absorbed as its rays approached tangency to the reflecting surface.

The most unexpected result was doubtless the successive disappearances and reappearances of the star remarked by Carle, Mayes, and Eiserling. Carle saw a number of these; the others, two. Among the remaining observers, who saw no such final "flares", probably only Cragg and Maag had views adequate to reveal them. We must apparently interpret these effects to mean that adjacent strata of the Jovian atmosphere differ very greatly in transparency. This matter must be of considerable interest to students of planetary atmospheres, and future occultations of stars by Jupiter should be watched very closely for such appearances.

PECULIAR OPTICAL PHENOMENA ASSOCIATED WITH THE TRANSITS AND OCCULTATIONS OF THE FOUR LARGE SATELLITES OF JUPITER.

by James C. Bartlett, Jr.

On the evening of June 26th, in the year 1828, the celebrated Piazzi Smyth sat down to the telescope, applied his practiced eye to the ocular, and began a survey of Jupiter. At about the same time a certain Mr. Maclear, 12 miles from Bedford, was similarly engaged; while yet another observer, a Mr. Pearson, 35 miles from Bedford, was also examining the planet. And this is what all three of them independently observed: A transit of J II was in progress. Whether the beginning of transit was observed we are not told by Webb, from whom the above particulars were taken; but after the satellite had "fairly entered on Jupiter" it was subsequently found outside the limb 12 or 13 minutes later "where it remained visible for at least 4^m, and then suddenly vanished."[1]

"Where and what could have been the cause?" asked the good Vicar of Hardwick. An adequate answer was certainly not without its difficulties. Had the time interval been much less, say seconds rather than minutes, one might have supposed that the satellite had been optically projected onto the disc before the time of actual ingress; as stars appear occasionally to be projected onto the moon.[2] But the long time interval would certainly rule out any such explanation, or indeed any rational explanation. Was a hitherto unnoticed star close to the limb of the planet later mistaken for Jupiter II? Then why should it suddenly vanish? Well, if Jupiter were moving towards the star it is barely possible that an occultation had been unwittingly witnessed, and that this event had been confused with the earlier ingress of the true satellite. This point could be settled by looking up the right ascension and declination of Jupiter for June 26, 1828; by finding the motion of the planet, whether retrograde or direct; and finally by plotting on a good star atlas to see what stars of magnitudes comparable to Jupiter II might have suffered a Jovian occultation.

But other anomalous satellite phenomena are not susceptible to such a simple test. For instance, transit shadows have occasionally been seen in duplicate, and at times of peculiar shapes; and Cassini once was unable to find the shadow of J I when it was on the disc and should have been visible.[3]

It is the purpose of this paper to discuss another class of peculiar phenomena, certainly wholly optical in origin; relating to apparent distortions in the shapes of the satellites and in the limb of Jupiter when a transit or an occultation is imminent. Apparent abnormalities in the shapes of the satellites during transit have been reported by such observers as Barnard[4] and Innes;[5] but observations of apparent distortions in satellite discs when near ingress, or shortly after egress, may be original so far as is known to the writer. However, distortion in the Jovian limb on the close approach of a satellite was noticed by Webb.[6]

Fortunately such phenomena are accessible to observers with small means, and so afford an interesting and more or less virgin field for amateur investigators. The writer's observations, described below, were all made with a 3.5-inch Newtonian at only 100X. Of course, individual differences in visual acuity, in seeing ability, and in instrumental quality, will modify the diameter of the smallest effective aperture for any given observer; but in general an aperture of from 3 to 4 inches charged with 100X to 200X should be sufficient.

In the year 1949, the writer made a small study of distortion phenomena and we may begin with a transit egress of J III observed August 20th, 1949, by U.T. date. At approximately $3^h\ 22^m$, U. T., the disc of III was about half off the limb; and in this position the satellite presented the appearance of a perfectly round and brilliant white disc. At 3^h 28^m, with J III just clear of the planet, the disc of the satellite was observed to be strangely flattened into a long ellipse whose major axis lay tangent to the limb of the planet. At 3^h 35^m, the satellite maintaining its elliptical appearance, I noticed that the limb of Jupiter also appeared flattened on the arc of the limb directly opposite the satellite.

At 3^h 40^m, J III had almost returned to its normal appearance, though it now appeared to be slightly elliptical the other way; which means that the major axis of the ellipse was now normal to the limb of the planet. At 3^h 46^m the disc of III was sensibly round, and at the same time the affected portion of the Jovian limb was found to be restored to normal.

August 22nd, 1949, an occultation of J II took place under the following circumstances: At 3^h 18^m the satellite was in apparent contact with the planet's limb, at which time the disc of J II appeared to be flattened into a long ellipse whose major axis was tangent to the limb of Jupiter. At 3^h 21^m J II was apparently dichotomized; but at least twice between 3^h 18^m and 3^h 25^m it appeared to be projected onto the disc. At 3^h 25^m it was still visible as a slight protuberance on the limb. No distortion of the planet's limb was noticed.

At the transit of October 9th, 1949, at 23^h 44^m, when almost at first contact, J I was found to be also elongated into a narrow ellipse whose major axis lay tangent to the limb of Jupiter. At 23^h 47^m J I was half on the limb and shining very brightly (a common effect of the limb darkening). Though it was still apparently elliptical, the eccentricity of the ellipse had been much reduced. By 23^h 50^m the satellite appeared sensibly round. No corresponding distortions in the limb of the planet were observed.

One of the strange facts of such distortion phenomena is that they do not invariably occur, as the following examples will illustrate:

On October 2nd, 1949, at 0^h 21^m, J I was observed within 20 minutes of occultation; but no distortion was apparent either in the disc of the satellite or in the limb of the planet. A close juxtaposition of J I with the Jovian limb was also observed August 2nd, 1951, at 6^h 13^m, only 6 minutes after occultation reappearance. At this time, as on October 2nd., 1949, no abnormalities were recorded. Finally we may consider the transit of J II, September 27th, 1951. The satellite was observed at 4^h 37^m when very close to the limb of Jupiter, without any distortion appearing in either. Transit ingress was also observed without any unusual phenomena. Perhaps this is the most difficult thing to understand in any study of distortion phenomena, why they are not constant for constant conditions; for we must suppose that there is some factor predetermined by the conditions which gives rise to the observed optical effects.

Here we enter upon highly speculative ground; but it seems possible that the mind must be preconditioned in some manner in order for the factor to produce the illusion of physical distortion. If the mind be not so preconditioned, then we may suppose that the illusion would not occur, though the factor responsible for it might be present. However, this is merely a more or less plausible guess; since it is difficult to understand the nature of the hypothetical preconditioning, or why it should occasionally be wanting. All that can be said with certainty is that distortion phenomena arise partly from physical and partly from psychoogical factors.

The apparent physical factors are, of course, susceptible to measurement and have been investigated by the writer. For instance, it can be shown experimentally that two circles whose radii are as 6 is to 1.25 will produce a black drop effect when the distance between their respective limbs is 0.03 of the greater radius; and when the distance to the eye is 42.08 times the length of the greater radius. But there are no distortions in the adjacent limbs of the respective circles.

However such distortions are observed when a circle and an ellipse are juxtaposed. Experiment shows that given an ellipse of 0.09 eccentricity with a major axis which is to the diameter of the circle as 6 is to 1.25; and given a separation which is equal to 0.03 of the length of the major axis of the ellipse; and given a distance to the eye which is equal to 58.01 times the length of the major axis of the ellipse; then the circle will appear elliptical with its major axis tangent to the circumference of the ellipse at the point of nearest contact. The circumference-arc of the ellipse will also appear flattened at this point. It may be assumed that distortion effects will be intensified as the distance to the eye is greater, and/or the eccentricity of the ellipse is larger.

The above relations are purely empirical, and no physiological or psychological reason is known for them. It may also be supposed that the same relations and optical effects would not necessarily hold true for another observer, and hence two observers examining the same set of factors might not obtain the same phenomena. It may be noticed too that the major axis of the ellipse of Jupiter, which corresponds to its equatorial diameter, bears to the diameter of its largest satellite a relation very much greater than 6 is to 1.25. At best, therefore, the above relations can be regarded merely as clues to the probable cause of distortion phenomena affecting Jupiter and a satellite in very close proximity. But it would seem probable that the principal factor producing distortion phenomena in Jovian transits or occultations is the juxtaposition of a markedly oblate spheroid to a sensible sphere of very much smaller diameter.

A secondary factor, not investigated experimentally by the writer, is the possible influence of the Jovian belts. The juxtaposition of more or less straight, dark lines to a small, bright sphere may influence the appearance of the latter in such a way as to reduce it to a spurious ellipse whose major axis would, in this circumstance, probably lie normal to the limb of the planet.

We may thus suspect two factors involved in the production of distortion phenomena: A factor of optical confusion of adjacent circumferential arcs of different curvature, which presumably would produce in the satellite a spurious ellipse whose major axis would lie <u>tangent</u> to the limb of the planet; and a factor of optical extension whereby the major axis of the elliptical planet is transferred to the spherical satellite, causing the latter to appear as a smaller ellipse whose major axis would lie <u>normal</u> to the limb of the planet.

Brief mention may also be made of an entirely different phenomenon, occasionally noted during transit, which may be a borderline case between apparent and real effects. In some instances a purely optical cause may be suspected, but in others something more seems indicated. I refer to the fact that the satellite shadows do not always appear entirely black. It is true that almost all textbooks deny this; but no close student of the planet would accept such denials. The literature contains too many observations contra by reputable observers, and I have occasionally noted satellite shadows which were palpably gray when they should have been quite black.

Such appearances do not necessarily imply the incandescence of Jupiter, as some of the older observers supposed.[7] Penumbral effects, especially in J III and J IV, may often be suspected, and in the case of the closer satellites, I and II, the limb darkening of the planet undoubtedly plays a part in any such effects observed immediately after shadow ingress. As the shadow moves out from the duller limb region to brighter portions of the disc, it will naturally seem to become darker because the contrast is greater. Ipso facto, the mind may interpret this to mean that the shadow was formerly lighter and therefore not black but gray. Such an explanation, however, would not apply to observations of the shadows when far from the limbs; nor would it apply to the colors sometimes noticed in the shadows, an example of which is given by Webb.[8]

BAILLY

Charted:

Sept. 5, 1950 · Colong 192°.6
Sel. long −3°, lat −6°.7
S=4 T=5 200X daylight

Oct. 5, 1950 · Col 198°.6
Sel long −5°.8, lat −6°.1
S=5−7 T=4 300X twilight

with slight changes on
Oct. 25, 1951 · Col 212°.6

12-inch Reflector

Edwin E. Hare
Owensboro, Kentucky.

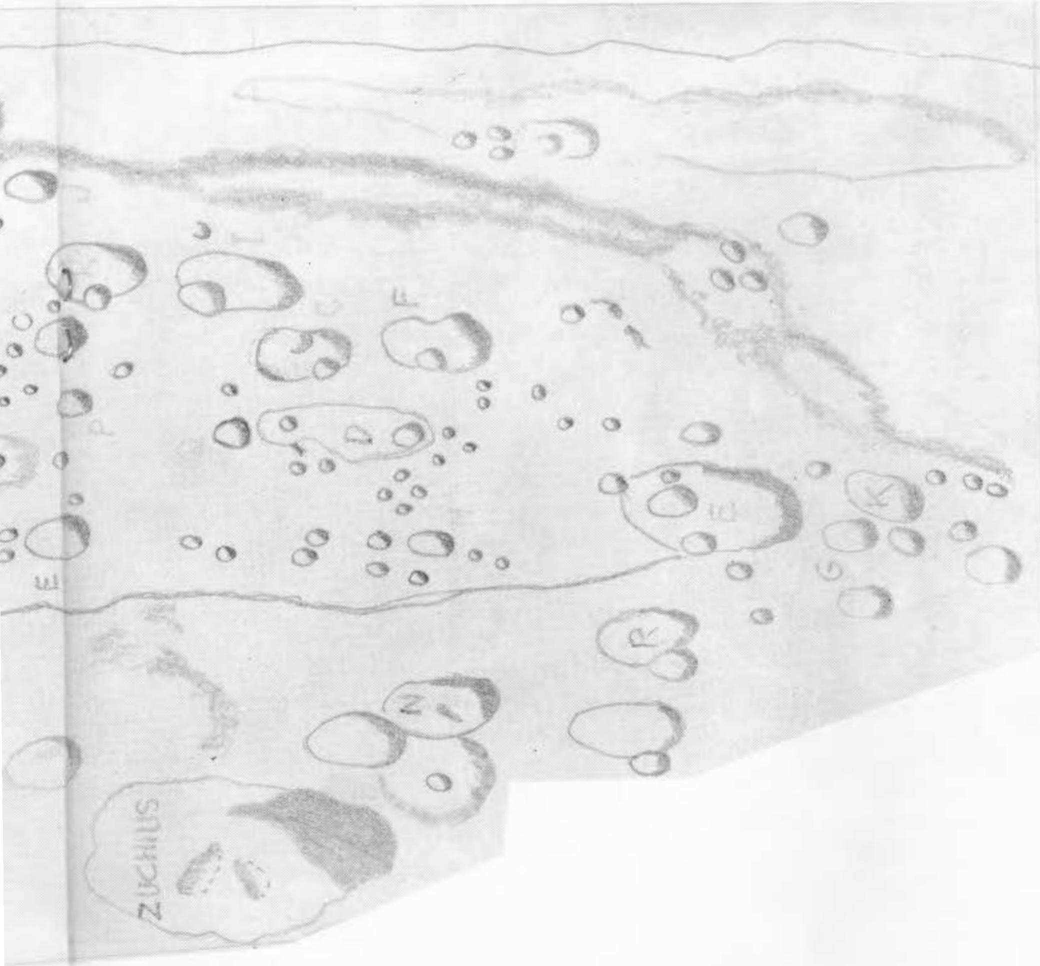

FIG. № 2

It is not wholly beyond the possibilities that in rare instances an actual phosphorescence of the Jovian cloud surface may be involved, at least locally. Phosphorescence is here taken in its modern sense to mean delayed emission resulting from the fall of previously excited electrons into orbits of lower energy with consequent emission of photons.

Are there phosphors in the Jovian clouds? At first blush it would not seem likely. And yet if the dark belts of Jupiter are to be considered clouds, then they must be composed of dark-colored crystals, microcrystals, or at least of very finely divided particles. At any rate the material of the belts must be in solid phase, though the belts themselves would consist of discrete units as the rings of Saturn consist of separate meteroids. This follows from the fact that belts composed of liquid droplets, as in ordinary aqueous clouds, would appear brilliant rather than dark, since we view them from outside and aabove. If the bright zones are also to be interpreted as clouds it is not precluded that the material may also be in solid phase, though less intensely colored and therefore probably of different substance.

There are admitted difficulties in any theory of local phosphorescence; yet it is often difficult to escape the suggestion of an analogous phenomenon, i.e. fluorescence. Local white spots are occasionally seen on the bright zones which are so much brighter than their background that they seem almost to glow. Newcomb was struck by this fact and remarked that "On the whole, there is a small probability that the brighter spots of this planet are from time to time slightly self-luminous."[9]

If these spots are indeed fluorescent they may also be phosphorescent. Fluorescence differs from phosphorescence by occurring only in the presence of the exciting radiation, while phosphorescence continues after the exciting radiation has been withdrawn. Actually the two processes are virtually identical; for the phosphor glows by virtue of interior excitation derived from energy stored in "trapped" electrons previously excited by exterior radiation. In both fluorescent and phosphorescent materials, therefore, photon emission results from excitation; or, as Leverenz has put it: "Fluorescence, then, is a limiting case of phosphorescence.."[10]

Supposing local Jovian areas of phosphorescence two facts would seem clear: (a) Total emission from the phosphorescent area would not significantly, if at all, affect the albedo of the planet within ranges detectable by present means; (b) but it would prevent a shadow thrown upon such an area from appearing absolutely black. Since an absolutely black shadow implies the absolute absence of light, the presence of even a feeble emission of photons should be detectable by the eye as a difference in depth or tone of the shadow.

REFERENCES

1. T. W. Webb; Celestial Objects for Common Telescopes: 1917; Longmans Green and Co., London; p. 203.
2. Ibid; p. 98
3. Ibid; p. 203
4. F. R. Moulton, An Introduction to Astronomy; 1922; Macmillan, N.Y.; p. 290.
5. T. W. Webb; Celestial Objects for Common Telescopes; 1917; Longmans, Green and Co. London; footnote, p. 194.
6. Ibid; p. 182
7. Simon Newcomb; Popular Astronomy; 1878; Harper and Brothers, N.Y. p.342
8. T. W. Webb; Celestial Objects for Common Telescopes; 1917; Longmans, Green and Co., London; footnote, p.180
9. Simon Newcomb; Popular Astronomy; 1876; Harper and Brothers, N.Y.; p. 343
10 H. W. Leverenz: Luminescent Solids (Phosphors); Science, 109, 184, 1949.

FOOTNOTE BY EDITOR. Jupiter II, the brightest per unit of surface area of the large satellites, is almost exactly the same tone as the central portions of Jupiter, being very difficult to see against them. Therefore, any Jovian spots for brighter than the general surface must have a much higher albedo than J II; and perhaps we shall have to resort to phosphorescence or fluorescence to explain them. Of course, more evidence is needed.

THE MOON'S EAST LIMB

by H. Percy Wilkins, F.R.A.S.

The portion of the lunar surface contained within the limits of the accompaning Figure 1, although full of interesting detail, has not been thoroughly explored with the result that numerous objects still await detection with adequate telescopic aid. This region extends from the center of Grimaldi through the southern portion

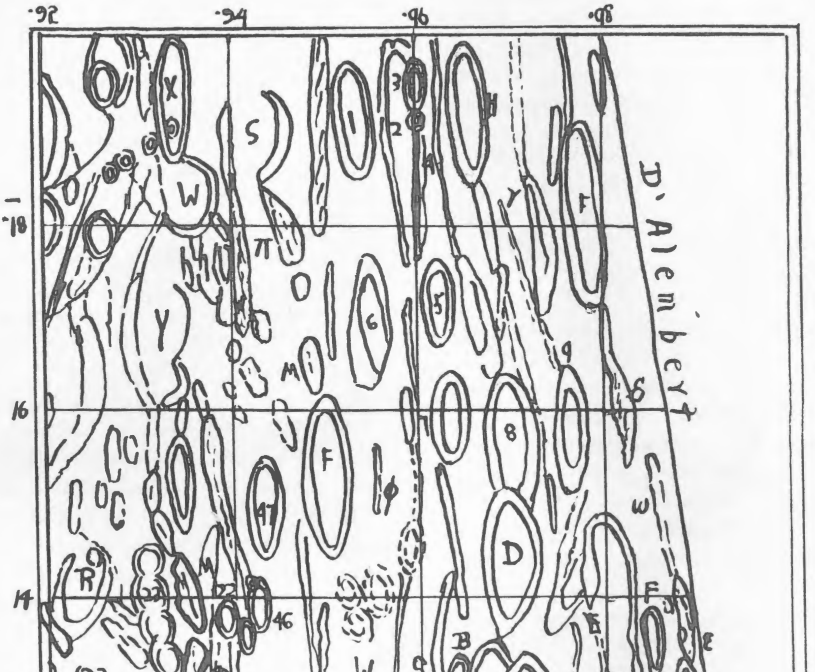

FIG. 1. The Moon's East Limb : H. Percy Wilkins, F.R.A.S.

of Riccioli to the limb and southwards almost to the northern glacis of Rocca. The chart is copied from Section XIX of the writer's 300-inch lunar map, Third Edition, but with details added as the result of the most recent observations.

East of Riccioli, and close to the limb in mean libration, is the large, well-formed ring Lowe, containing a central ridge on which is a minute craterlet and a crater, 2, on the north. Immediately to the east of Lowe are some small craters followed, beyond a mountain ridge, by a deep crater Bolton, with a central peak. Beyond Bolton rise the giant peaks of the D'Alembert Mountains; but since both are on the averted hemisphere, they cannot be shown on a mean libration map. The region from Xi 14 [?] across the equator and into the Northern Hemisphere as far as Olbers has been mapped by P.A. Moore and R. Baum in Memoirs B.A.A., 36,3; but their investigation did not extend farther south.

West of Lowe is a dark area known as Mare Hiemis, at the southern end of which is the ring Harris, named after a chartered electrical engineer of Great Britian. Its comparatively low walls are continuous except on the north; and it overlaps an ancient ring A, beyond which is the small crater Harris B and then the obscure formations S, W, and Z, counting in order to the east wall of Grimaldi. South of Harris are several shallow rings, of which D and F are the most prominent. West of F is the long mountain Gamma (γ), while on the north is the great ridge Delta (δ). Between these and the D'Alembert Mountains are numerous objects not mapped, for we still await accurate observations. This area is, then eminently suitable for amateur study with moderate apertures. Of the numerous mountain peaks visible in profile on the limb from time to time the great peak Epsilon (ϵ) rises over 20,000 feet, and there are others hardly less lofty farther south.

Just to the north of Harris is the bright mountain mass Beta (β) and, to the northwest, the isolated mountains M 1 and M2 and the delicate craterlet ~~12~~ on the east

13

rim of the shallow depression W. The positions of all the objects mentioned may be obtained from the accompanying chart, Figure 1, those of Grimaldi A and H being Xi-942, Eta-093 and Xi-944, Eta-083 respectively in rectangular coordinates. [Xi and Eta are measured in a plane tangent to the moon at the center of the disc at mean libration. Xi is measured along the equator, positive to the west; Eta is measured along the zero meridian of longitude, positive to the north. The unit for both Xi and Eta is one-one thousandth of the moon's radius in this plane.-Editor.]

The most important formations on the southern portion of the chart are the craters H, X, and 1. From the northwest of X a crater-row probably extends into a cleft while farther east is the ridge Pi (π) of considerable but, as yet, unmeasured altitude.

In the region covered by the chart we have the extensive ring Lowe, the crater Harris overlapping an old ring, numerous less marked enclosures, lofty mountain ridges, at least one cleft, and a considable greatly foreshortened area still quite unknown. The entire region, however, requires careful study under favorable libratory conditions. The limits of our present knowledge may be realized from a study of the Special Libratory Map Sections [published in The Strolling Astronomer for July, 1950], the blank spaces on which the author hopes will shortly be filled in by the intensive study of this region which it is hoped this article will stimulate.

OBSERVATIONS AND COMMENTS

Figure 2 is a chart of the giant lunar walled plain Bailly prepared by E. E. Hare, 1621 Payne Ave., Owensboro, Kentucky, from both visual and photographic observations with his 12-inch reflector. Details are given on Figure 2; it will be noticed that Mr. Hare's views were under evening solar illumination.

The letters used on Hare's chart are partly his own notation. This chart of Bailly may be compared to Section XXII of the Wilkins map and to Mr. K. W. Abineri's drawing published as Figure 4 on pg. 137 of our October, 1952 issue. If the differences among the three observers seem large, it should be remembered that Bailly is very close to the southeast limb. Mr. Hare has been remarkably successful in recording craters, probably overlooking other types of lunar features in Bailly shown by Wilkins and Abineri. Hare's combining of visual and photographic methods for charting the lunar surface must be highly recommended to all equipped serious observers. The photographs will naturally supply the main features and the needed key positions.

The lunar walled plain Plato continues to be a favorite object with A.L.P.O. lunarians. In August-October, 1952 we received observations from C. Rex Bohannon (16.5-inch refl.), J. T. Carle (8-inch refl.), T. A. Cragg (Mount Wilson Observatory 6-inch refr.), L. Dove (1.5-inch refr.), A. P. Lenham (2.5-inch refr.), and D. Strayhorn (3.75-inch refr.). Drawings by Bohannon and Strayhorn are reproduced as Figures 3 and 4 respectively. The arrow on Figures 4 points to a suspected light spot. We shall use here the temporary nomenclature for Plato proposed by E. J. Reese and given by Figure 1 on pg. 5 of our January, 1952 issue. The best view was enjoyed by Carle

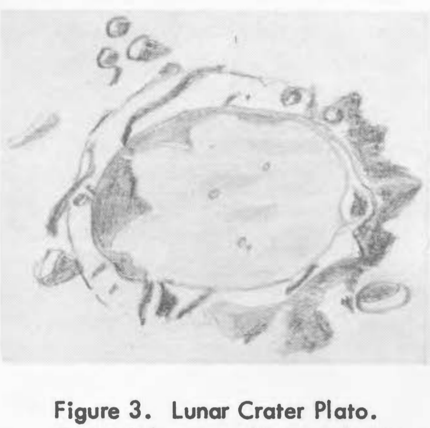

Figure 3. Lunar Crater Plato.
C. R. Bohannon. 16.5-inch refl. 250X.
Sept. 28, 1952. $4^h 0^m$, U.T.
Colong. = 21°.3

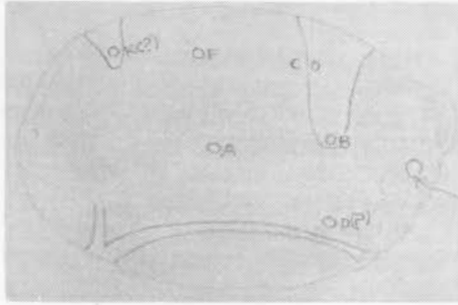

Figure 4. Plato. D.R. Strayhorn
3.75-inch refr. 85X-150X.
Oct. 1, 1952. $23^h 58^m$, U.T.
Colongitude = 68°.0

on October 29 at colongitude 40°.3; he distinctly perceived crescentic shadows in the central craterlet A, the east central craterlet B (often seen as a spot only), and the western ~~half~~ of the twin craterlets D. On October 3 Carle Found A, the twins D, and the southeast craterlet C to be clearly and continuously visible. All that is very praiseworthy performance, for an 8-inch telescope; indeed, it is creditable even to resolve the twins D with this aperture. Bohannon on September 28 saw A, C, D, and some darker shadings on the floor at colongitude 21°.3 (Figure 3). His drawing may be compared with one under similar lighting by J. T. Carle on February 5, 1952 at 21°.9 published as Figure 2 on pg. 61 of our May, 1952 issue. Although observing under lower lighting, Bohannon saw little or nothing of the oval dark area a little southeast of the center of the floor so prominent to Carle on February 5! Near colongitude 27° on October 28 Cragg perceived A and the twins D; yet in views of comparable quality in the past he had found the floor blank of detail at similar lighting. On October 27 Dove watched the sunrise in Plato near colongitude 14°, the seeing being good. He was surprised at how much detail he could see with only a 1.5-inch refractor at 30X. A very dark streak crossed the floor from east to west (the shadow of a west wall peak?), and there was a bright patch near both the southeast and the northeast walls. There was thus a resemblance to T.E. Howe's chart, Figure 14 on pg. 22 of the February, 1952 Strolling Astronomer. A lightening of the shadow over the east half of the floor suggested lunar mists to Dove - a proposal beset with difficulties but also supported by some names famous in lunar study during the last 80 years. On Strayhorn's six drawings one identified as spots the craterlets A, B, C, D as a single spot, probably F, and possibly one or two others, as well as several bright streaks and brighter areas of the floor - good results for the small aperture. Lenham has engaged upon an intensive study of the conspicuousness and intensities, of various spots, streaks, and shadings on the floor of Plato.

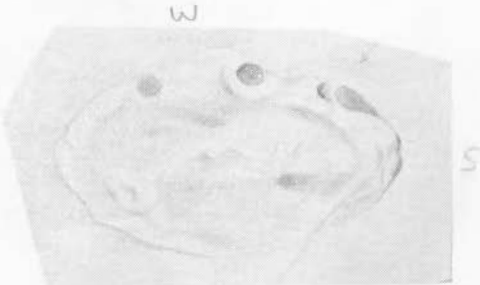

Figure 5. Lunar Crater Atlas.
T. Osawa. 6-inch refl. 230X.
Feb. 2, 1952. 11^h 20^m, U.T.
Colongitude = $348^o.6$

(Not in customary astron. orientation)

Figure 5 is a drawing of the lunar crater Atlas by Toshihiko Osawa of Osaka, Japan. It may be compared to a drawing by the same observer on August 9, 1951 at colongitude $352^o.2$, Figure 5 on pg. 1 of the November, 1951 Strolling Astronomer. For the student of apparent lunar changes Atlas is chiefly of interest because of the two prominent dark areas on the floor under high lighting, the one near the south wall and the other in the northwest quadrant of the floor. These are not yet outstanding at the lighting of Osawa's drawings. The arrow on Figure 5 in this issue points to a shading in which Osawa remarked a ruddy, brownish tint, present from 9^h 45^m to at least 11^h 20^m

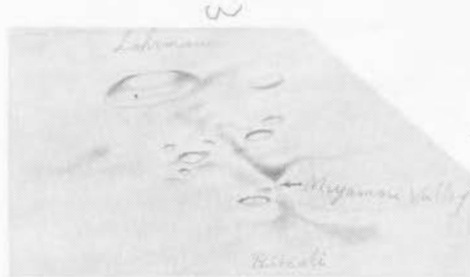

Figure 6. Miyamori's Valley and Vicinity
T. Osawa. 6-inch refl. 230X.
Oct. 2, 1952. 14^h 30^m, U.T.
Colongitude = $75^o.4$

(Not in customary astron. orientation)

on February 2, 1952. Since observations of definite colors on the moon are rather rare, we urge our readers to search for this ruddy hue near Atlas.

Figure 6 may be profitably examined in connection with the discussion of Miyamore's Valley on pg. 179 of our December, 1952 issue. There is perhaps a hint on Figure 6 of K. W. Abineri's pit at the west end of the broader eastern branch of the Valley. However, nothing is shown of P.A. Moore's mountain spur just south of the western part of the Valley, this spur apparently being detectable only under extremely low lighting.

Figure 7. Chart of Moretus in 1949 by A. P. Lenham. 3-1/4-inch refr.

Figure 7 is a general chart of the lunar crater Moretus by A.P. Lenham. Moretus lies southwest of Clavius on Section XXIII of the Wilkins map and hence near the moon's south pole. The conical central peak is one of the finest objects of its class on the moon.

Maedler's Square, now lunar formation Bartlett, has been discussed at some length in this periodical, most recently by Dr. Bartlett himself in the September, 1952 issue. Sever A.L.P.O. members continue to submit drawings of this region. Recent ones have been contributed by I. Courtright, T. Osawa, and D. R. Strayhorn. Mr. Courtright's drawing was on October 27, 1952 at 1^h 38^m, U.T., colongitude 13°.5., with a 12.5-inch reflector at 120X and 240X. His observation is described rather fully in Planetary Observers' Bulletin, Vol. 2, No. 10, pp. 81-82, 1952. There is in the text an unfortunate interchange of east and west as lunar directions, and the time of the drawing is there given wrongly. But more important, Mr. Courtright drew the classic four-walled Square of Maedler and Neison! The most obvious explanation would be that the very low lighting combined with his comparatively large aperture enabled him to see very low southeast and southwest walls beyond the grasp of smaller instruments of others in our group. In fact, the southeast wall was bordered by its own shadow, showing it clearly to be a ridge. This ridge is identical with the straight bright streak running southwest from the south wall of Fontenelle (shown, for example, on Figure 4 on pg. 5 of our July, 1951 issue) and passes east of the large mountain-mass southwest of Fontenelle. The southwest wall looked like some kind of rounded ridge to Courtright. Two days later, on October 29, 1952 at colongitude 37°.3 Donald Strayhorn made a drawing with a 3-3/4-inch refractor at 85X. Using the notation of Figure 1 on pg. 122 of the September, 1952 Strolling Astronomer, he saw plainly Barcroft's Cross and (probably) Maedler's Cross. He also recorded two gray crosses inside the enclosure Birmingham which seem to resemble the several crosses in Bartlett although outside the region usually drawn by our observers. Mr. Osawa's drawing was on August 3, 1952 at 61°.5 with a 6-inch reflector at 230X. The lighting was, of course, too high to see topographical features well, but Osawa did record a surprising number of small craterlets with narrow shadows on their west inner walls.

R.M. Adams drew the lunar crater Conon with a 3-inch refractor and a 10-inch reflector on October 29, 1952 at colongitude 38°.6 and on November 28 at 43°.6. We shall use here for convenience the notation of Reese's key chart, Figure 1 on pg. 83 of the June, 1952 Strolling Astronomer. The October 29 drawing shows only Wall Band A and Craterlet K 2 near the foot of the south wall. The November 28 drawing shows an apparent central peak, with no other detail on the floor; and on November 27 this "peak" was even more conspicuous. Mr. Elmer Reese, however, suggests that the apparent peak is really Bright Area O near the center of Conon. At any rate Reese himself drew Conon on November 28 at 42°.8 and saw O clearly in the northwest portion of the floor, though no bright area was seen ab the center. Fault B was the most conspicuous dark streak on the floor to Reese on this date and was noticeably fainter where it passed between Bright Areas O and I. Obscured? Mr. Reese remarks that Streak S no longer appears as definite to him as it did in 1948. Conon too hos its riddles- why not add it to your list of lunar objects to be observed and drawn?

In April, 1952 H. P. Wilkins and P. A. Moore of the British Astronomical Association had the rare privilege of observing the moon with the Meudon Observatory 33-inch refractor. Many of their results we have already described. We should now like to finish reporting the results kindly communicated to us by Mr. Wilkins. The chief interest of the two observers was in lunar topography, especially features too difficult for ordinary telescopes.

Birt and Straight Wall. 1952, April 3. Near 22^h, U.T. The object on the wall of A, which intrudes upon Birt, is a craterlet and was distinctly seen as such. The well-known cleft to the east of Birt begins and ends in two craterlets. On the north, where it cuts through a low dome or round hill, there is parallel to this an exceedingly minute cleft ending in 3 excessively minute pits. Not previously recorded. There is a ruined ring in contact with Birt and A and a little smaller than Birt. Drawing made.

Cassini A. April 3. Near 23^h, U.T. This crater lies within Cassini. On its floor and northwest of the center is a crater, very shallow and white, within which is a minute central pit, so small as to be only just within the capacity of this giant telescope. Not previously known. Also, on the east side, a minute hillock and terrace. Drawing made.

Sirsalis and A. 1952, April 7. Near $21^h 30^m$, U.T. A minute craterlet on crest of southwest wall of Sirsalis. From north wall of Sirsalis a delicate crater-pit chain runs south and curves southeast, with a craterlet midway. A has a minute craterlet on inner northeast slope. A now named Bertaud in honor of French observer who operated telescope for us. Drawing made.

Pythagoras. 1952, April 8. The central mountain has a minute central pit. Drawing

Kraft. April 8. A craterlet-chain at foot of inner east slope and two craterlets just below the east rim, also a minute hill on south end of floor. Drawing.

General. Between Copernicus and Stadius there are hundreds of ridges and craterlet and crater-pit chains radiating from Copernicus. Gassendi was full of detail; the principal clefts and craterlets were noted. The floor of Sven Hedin was covered with detail. A crater was seen on the summit of the central and largest ridge on the floor. Grimaldi B, on the north part of the floor of Grimaldi, shows a deflection from the normal type and traces of terracing on the east. Grimaldi B has been named Saheki.

Mr. Wilkins has added the detail discovered at Meudon to his map of the moon.