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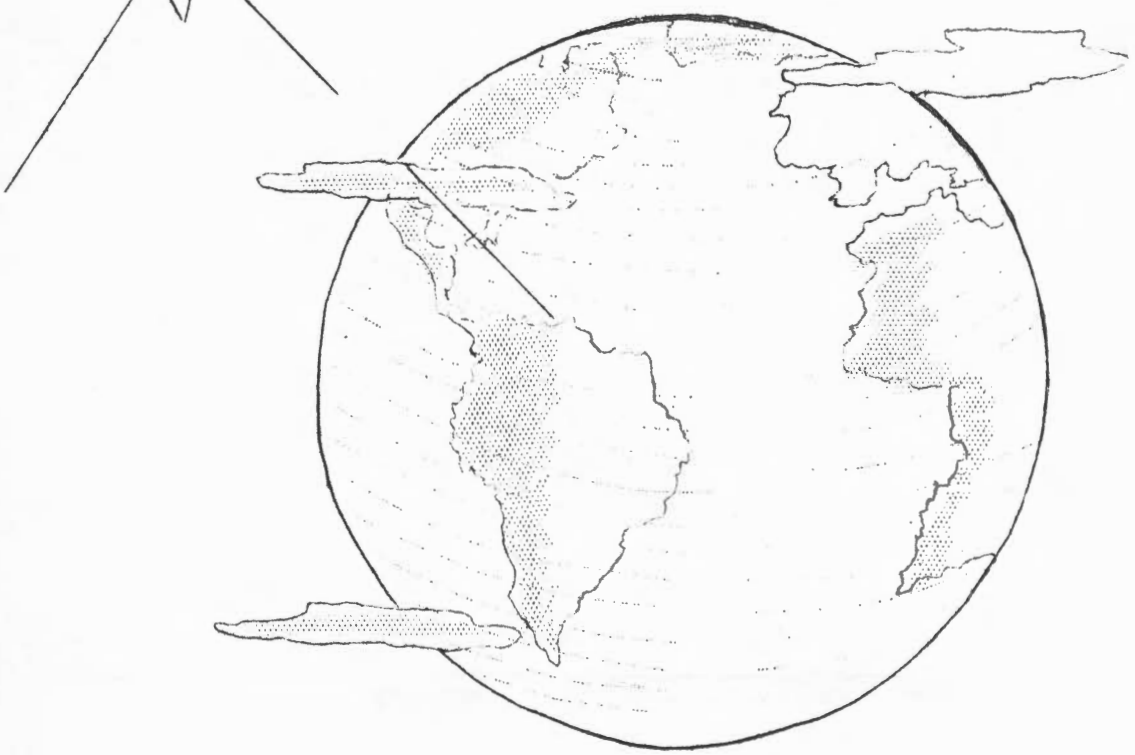

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VENUS OCCULTS A STAR

by Walter H. Haas

Occultations of stars by planets are fairly infrequent so that I was very interested to note a prediction of such an event in the January, 1948, issue of the Journal of the British Astronomical Association. The star affected was 36 Arietis, magnitude 6.5; and the event was to occur near 7:40 P.M., M.S.T., on March 19, 1948. The star would be hidden for five or six minutes at stations in the United States. In the Eastern States Venus would be too low at the time of the occultation for useful views, and near the West Coast the planet would be seen against a bright twilight sky. On March 19 there was to be illuminated 0.64 of the disc of Venus, with disappearance occurring at the dark limb and reappearance at the bright limb.

I called the approaching event to the attention of all members of the Association of Lunar and Planetary Observers likely to be able to watch it. It was pointed out that the occultation afforded an unusual opportunity for the direct observation of Venusian atmospheric effects. Observers were requested to look carefully for possible dimming and/or discoloring of the stellar image when close to the limb of the planet.

Interest in this project was apparently large, and I thank all who attempted to obtain data. Most, unhappily, could report only cloudy skies; and some had the vexing experience of seeing Venus vanish under clouds just before immersion. Conditions were too poor to allow the desired observations for J.W. Tisdale at Levy, Arkansas, and for R. Lee and W. Albrecht at the Milwaukee Astronomical Society Observatory and were probably still worse farther east (planet lower). An aperture of 3 1/2 inches is evidently too small for this project, for it did not reveal the star at all to R.C. Maag on a dark sky at Lawrence, Kansas. The following persons were able to see the star close to the dark limb and to attempt the desired observations.

Observer	Station	Telescope
T.R. Cave, Jr.	Long Beach, Calif.	8-inch reflector
P.F. Froeschner	St. Louis, Mo.	10-inch reflector
W.H. Haas	Albuquerque, N.M.	6-inch reflector
H.M. Johnson	Des Moines, Iowa	8-inch refractor
D. Monger	Lawrence, Kansas	6-inch refractor
E.K. White	Kimberley, B.C., Canada	7-inch reflector

Cave had rather poor seeing and some haze. Employing 240X, he first suspected a dimming of the star 26 seconds before the dark limb disappearance. He observed the color of the star both before disappearance and 15 minutes after reappearance, when it was yellow-white. He found the star to redden measurably as it dimmed and called it reddish-yellow four seconds before disappearance.

Froeschner saw neither dimming nor discoloring but emphasizes that his seeing was bad. Like all the others, he was unable to observe the bright limb reappearance, first seeing 36 Arietis when already far from the limb of Venus.

Haas used 188X in poor seeing and a clear sky. To quote from his notebook: "I had an impression that the star was dimmed, presumably by the planet's atmosphere, for some seconds before it disappeared. No refraction-caused discoloration was observed. Even the dimming is uncertain and must be given no serious attention unless confirmed...."

Johnson had fair conditions, the image being pleasing under 120X. He reports: "No discoloring effects were seen at any time. The immersion impressed me as being nearly instantaneous, though surely not quite so. That is, not like a lunar occultation, but neither gradual over several seconds. I should say gradual over a few tenths (of a) second at most."

Monger used 135X with both seeing and transparency very good. (Can such things be?). The star dimmed for about 20 seconds before immersion, he reports; and a reddish hue was observed for about five seconds. "This reddish hue was not very pronouncedbut just tinted the color of the star."

White had poor seeing and a clear sky; he employed 250X. "I thought the star dimmed slightly about one second before it disappeared and that the star's color changed from yellow to greyish," he writes. Since passage through a denser medium, here a planetary atmosphere, should redden light, it may be that color was merely harder to see in a dimmer object.

To interpret these observations, one needs to know the perpendicular distance h of the star from the limb of Venus, measured in a plane perpendicular to the line of sight at Venus. If the orbital velocity of the planet in this plane is V, this value is also the velocity of the star in its relative path-relative to the assumedly stationary planet. Its distance on this path from the point of contact with the planet is VT, if T is the interval between a given time and that of immersion or emersion. We further take R as the radius of the planet and A as the acute angle between the relative path and the planetary radius drawn to the point of contact. One then has for finding h at time T the formula:

$(R + h)^2 = R^2 + V^2T^2 + 2RVT \cos A$ by the Law of Cosines of plane trigonometry. If one selects R as the unit of distance, one has:

$h^2 + 2h = V^2T^2 + 2VT \cos A$. Since h is small in practice, one may use:

$h = V^2 T^2/2 + VT \cos A$

It is not difficult to find V, and A is quickly determined if position-angles are available. For Cave 26 seconds before immersion and for Monger 20 seconds before immersion the computed h is 350 and 310 miles respectively. My interpretation is that they saw during most of these intervals, not real dimming, but an effect of the increasing brightness of the sky closer to Venus. For certain other intervals before immersion mentioned above, one has:

Observer	T	h
Cave	4 s	52 miles
Haas	4 (some)	57
Johnson	0.2 (at most a few tenths)	3
Monger	5	77
White	1	16

It appears pointless to take a mean of these values. The significant thing is that four observers out of six found a dimming and that a fifth suspected one. Also, two of them found a reddening. Venusian atmospheric effects appear demonstrated.

We give below the exact timings known to us, expressed as Universal Time on March 20, 1948

Observer	Station	Time of Disappearance
T.R. Cave, Jr.	Long Beach, Calif.	$2^h\ 40^m\ 34^s$
D. Monger	Lawrence, Kansas	2 39 56
E.K. White	Kimberley, B.C., Canada	2 39 3 ± 1^s

longer read the time from a pocket watch checked both before and after the occultation with Naval Observatory time signals. Probably Cave and White used the same procedure, though they do not give explicit details.

It is interesting to compare our results and ones found at an occultation of Eta Geminorum by Venus on July 26, 1910, and given in Astronomische Nachrichten, Volume 185, No. 4435, pgs. 303-8, 1910. Especially interesting observations were made at Juvisy with three different telescopes, apertures 4 inches to 9 inches, by F. Baldet, F. Quénisset, and E.M. Antoniadi. To translate here and later: "But the emersion occurred under more favorable conditions so that we were able to confirm, independently and very clearly, that Eta Geminorum (then of magnitude 3 1/2) did not reappear suddenly, as with lunar occultations. In fact, there was at first a barely perceptible luminescense; then the very faint star seemed to detach itself from the dark edge of the planet. It rapidly increased in brightness and in 1 1/2 to 2 seconds after the first sensation of luminescense had regained its initial brightness. Besides this increase of luminosity at the moment of emersion, we noticed that Eta Geminorum continued to gain slowly and slightly in intensity according to its distance from Venus.....There was no appreciable change in the color of the star."

"The slow variation in the brightness of Eta Geminorum is naturally due to contrast. As to the much more rapid change in intensity at the moment of emersion, it cannot be explained by the apparent diameter of the star. It would be necessary, in fact, to impute to it a value of 0 ".1, which disagrees with our knowledge of stellar diameters."

"The hypothesis which appears to us the most probable for explaining the variation in brightness is that the light of the star was absorbed in traversing the atmosphere of Venus. In our observation this variation, which lasted from 1 1/2 to 2 seconds, corresponds to a motion of the planet of 0".8 to 0".11. We hence deduce that the height of the atmosphere of the Venus which produced this absorption is 80 to 110 kilometers."

At the same occultation F. Sy at Algiers with a 13-inch telescope noted that " the reappearance seemed to occur progressively." For Kasan, Engelhardt Sternwarte, where the sun was 18 degrees high in a very clear sky, W. Baranow commented:"At emersion the star was notably fainter than after some seconds." The aperture was 12-inches. At the Koenigsberg Observatory the phenomenon was watched with a 13-inch refractor. H. Battermann reports of the emersion: "Sudden, somewhat indistinct because eye fatigued from waiting. Suspected a weak point of light five seconds previously (to given time of emersion), perhaps illusion." No possible atmospheric effects were recorded at Madrid (conditions bad) or at Strassburg. All of the observers found it comparatively difficult to see the star at the bright limb immersion.

In conclusion I should like to offer these suggestions:

1. Careful observation of future occultations of stars by planets may be very much worthwhile watching.

2. On such occasions it should be instructive for some large observatory to carry out precise photoelectric measures of the brightness of the star near the limb of the planet.

3. Someone having access to extensive library facilities might profitably examine the literature on occultations of stars by planets for references to possible planetary atmospheric effects. Such reports may be fairly numerous, though scattered, since timings on such occultations in the past were often attempted.

DETAIL IN THE RINGS OF SATURN

by Walter H. Haas

During May the planet Saturn should still be high enough in the early evening to allow some fairly good views. With the Saturnicentric latitude of the earth near -16°, the rings will be fairly well opened. When the planet is again observable next autumn, the rings will have closed considerably; and it will be some years before they are again opened as widely as now - by which time Saturn will be in southern declination.

Everyone knows of Cassini's Division in the rings; but actually this feature is easy for small telescopes of good quality, and many other details in the rings have been recorded by members of the A.L.P.O. using average apertures. We shall commence at the inner edge of the rings.

The Crape Ring, or Ring C, has been given much attention in this periodical in recent months. The frequent textbook statements about its being extremely hard to see are nonsense. The dark Crape projection against the ball is obvious; and the ring at the ansae is easy for a 4-inch telescope under good conditions or at least was up to May, 1947. At its outer edge the Crape Ring is separated from Ring B by a black gap, which we call the Fifth Division, "discovered" by E.K. White in 1943 and since confirmed by several others. This gap has also been seen by P. Lowell several decades ago and by the Pic du Midi workers more recently. It is perhaps easiest to observe when Saturn is pale, on a dawn or twilight sky.

The middle ring, or Ring B, is definitely brighter than the outer ring and frequently is unmistakably the brightest portion of the whole Saturnian system. It is most brilliant of all in its outermost third, or even outermost sixth. The brightness perhaps diminishes inward by steps rather than progressively, but even the inner edge of Ring B is brighter than most or all of Ring A (outer ring).

Near the inner edge of Ring B is a concentric shading in the rings, which we call the Third Division. T.Cragg and T.R. Cave have split in into two thin streaks, an aspect which others should look for when the view is excellent. Most observers see the Third as somewhat broader than Cassini's and as dusky. In other words, it is not a gap like Cassini's but only a concentric shading. Some of those who have observed the Third Division with 6- to 12-inch telescopes in 1942 - 8 are F.R. Vaughn, R. Barker, E.J. Reese, E.K. White, T.R. Hake, and W.H. Haas.

A so-called Fourth Division outside the middle of Ring B is a delicate object and requires further study.

The easiest feature in Ring A is Encke's Division, and a dozen or more of us have seen it. Whatever may have been true in the past, Enche's is certainly now visible enough in ordinary-sized instruments of good quality. The observers agree rather well that it lies a little outside the middle of Ring A and that it is narrower and less dark than Cassini's Division. Like other gaps, concentric shadings, and brighter annuli in the rings, Encke's is naturally most conspicuous near the ansae.

Several of us have also observed in Ring A a thin and comparatively brilliant annulus adjacent to Cassini's. Apart from this annulus, the ring is somewhat brighter outside of Encke's than inside it. Possible details close to the outer edge of Ring A are uncertain and demand further study.

We have found little evidence of changes in the features described above during the period of our studies. An exception to this statement is that we have obtained strong evidence of variations in the brightness of Rings A and B (and C?) as a whole. One might here mention the recent dimness of Ring B compared to the Equatorial Zone of the globe, as described elsewhere in this issue. Some evidence bearing on fluctuations in Ring A is presented in "Observations of Saturn, 1943-46", Popular Astronomy, Volume 55, pg. 476, 1947.

We invite our readers to look this month for the objects described above. We shall be interested to hear what they see. Perhaps they may even conclude, as Dr. A.F. Alexander has apparently done since directing the Saturn Section of the British Astronomical Association, that the supposed sameness of which Saturn is often accused results largely from lack of careful and frequent observing.

PLANETARY NEWS

Contributors of observations during the last month include A. F. Alexander (for himself and B. Burrell and F.H. Thornton), J.C. Bartlett, T.R. Cave, J.P. Dow, E.L. Forsyth, P.F. Froeschner, E.E. Hare, H.M. Johnson, (Miss) A.I. Hoth, R.R. LaPelle, R. Missert, D.R. Monger, A.W. Mount, E. Pfannenschmidt (for himself and the "Schwaebische Sternwarte Stuttgart" observers), O.C. Ranck, E.J. Reese, C.S. Slemaker, and E.K. White. We are pleased by this interest in lunar and planetary affairs and hope that it will keep increasing.

An important observation of Saturn has been received from a new subscriber, R.R. LaPelle of Longmeadow, Mass. At 10:00 P.M., E.S.T., on February 18, 1948 (3^h on February 19, U.T.) he saw with his six-inch reflector a triangular dark spot on the globe between the dark belts. Two observers verified its presence on February 18, but Mr. La Pelle writes that he had never seen it before and has not done so since. The spot was "clear and unmistakable - about as dark as the belts on the ball." A drawing suggests that the triangular spot lay in the wide South Temperate Zone. It may have been on the central meridian near 10:30 P.M., E.S.T.; and the period of rotation was presumably 10/1/4 to 10 3/4 hours. The view of Saturn was good enough to show Cassini's Division sharp and black near the ansae.

The puzzling thing is that La Pelle's spot apparently escaped all other observers, who were looking at Saturn fairly often last February. Was it, then, very transient? That such may be so is suggested by the fact that in 1942 J. Metzger (Philadelphia, Penna.) and R.Barker (Chestnut, Herts., England) each drew a prominent dark object on the globe and that each of these objects was reported only that once. Is Saturn subject to violent, large-scale eruptions from time to time? The matter is important enough that we request all readers to review their records on Saturn near last February 18 and to report to us. Epecially valuable will be observations coincident with La Pelle's or only a small integral number of Saturnian rotations away. Negative data are here quite as significant as positive ones for tracing the history of the prominent spot.

W.H. Haas thinks that the following central meridian transits with his 6-inch reflector all refer to the same feature, which was on the south edge of the main belt (the S.E.B.). The longitude A depends upon an arbitrary zero meridian (a Saturnian Greenwich) and an assumed rotation of 10 hours, 14 minutes. The proposed identification rests in part on the observer's impression that he was viewing the same object, and on the lack of similar objects near it. If this identification is correct, a rather remarkable accelerating motion is indicated; the period of

rotation was near $10^h\ 14^m$ on March 20 and near $10^h\ 9^m$ on April 6. It is important that we receive any additional observations of this column. They are potentially very valuable for studying the Saturnian rotation.

Date	Mark	U.T. Central	Long.(A)
1948, March,20	base dark column	$6^h\ 12^m$	30°
March 23	base thin dark column	5 47	26
March 27	base thin dark column	1 46	22
March 28	base large dark column	8 14	13
April 1	base large dark column	3 36	347
April 4	base large dark column	2 41	328
April 6	base large dark column	5 38	322

The two items above should emphasize the importance of keeping careful written records of observations. One cannot possibly know at the time what future importance an observation may assume.

Ring C of Saturn and its projection continue to receive attention. We summarize recent reports on the width of the C projection at the central meridian, where the unit is the width of Cassini's at the ansae. Seven estimates by R. Missert with an 6-inch reflector from February 5 to March 21 give an average value of 0.8. E.J. Reese on April 4 estimated 1.2 with his splendid 6-inch reflector and excellent seeing. A.W. Mount's recent views with an 8-inch reflector give 0.8. D.R. Monger in a 6-inch reflector estimated 1.5 on April 7 and 1.4 on April 8. E.E. Hare gets 1.0 or 1.1 with a 7-inch reflector. W.H. Haas with a 6-inch reflector obtained 1.0 as the average of five estimates from March 27 to April 19. F.H. Thornton got 1 1/8 in March with an 18-inch reflector. The observers agree about the extreme darkness of the Crape Projection during the last month. Mount calls it "very definitely darker than some months ago"; and several others find it almost as black as the shadow of the ball. Reese observed on April 4 what several others have looked for in vain.: the C projection was darker adjacent to Ring B than along its south edge. This difference is caused by the shadow of Ring B. Missert on March 21 and Haas from late March to late April found Ring C off the ball to extend in about 2/5 of the way from the inner edge of Ring B to the globe. Haas thinks Ring C at the ansae probably fainter and more difficult to see than in 1939-47. What do others find?

The doubled South Equatorial Belt and the South Polar Belt continue to be the most prominent dark belts on Saturn. The S.P.B. has definitely been abnormally intense during the last month and is comparable to the S.E.B. components. Haas from late March to late April repeatedly found the north component the darker, and Monger on April 8 described the S.E.B. as fading off indefinitely at its south edge. The Equatorial Band has been distinct enough to Hare and Haas during the better views; the former calls it " a little lumpy." The South Temperate Belt and the North Temperate Belt are still more difficult; the N.T.B., in fact, is seldom seen now and is much weaker than last autumn. Monger on April 7 and 8 drew the Equatorial Zone duskier in its north half than in its south half.

In recent weeks the Equatorial Zone has been clearly brighter than Ring B, a condition not formerly regularly present by any means. Reese writes that on February 7, 1948, Ring B was to him 1 1/2 units the brighter (scale of 10 units for Saturnian intensities). From February 18 to 29 the two were equal. From March 3 to April 9 he found Ring B duller than the E.Z. by 1 to 2 1/2 units. Haas first commented on the unusual dimness of Ring B on March 13 and called it dimmer than the E.Z. in all views but two from then up to April 20 (last observation). The amount of the difference was 1/2 to 2 units to him. It appears evident that Ring B has dimmed or that the E.Z. has brightened — or both. Decreasing differences in brightness between the ring and other parts of the globe rather strongly indicate that the ring has dimmed. Moreover,

E.K. White wrote on March 13 that "recent good views" made Ring B in its outer portions dimmer than the E.Z. and in its central portions only equal to the ball north of the rings - hence certainly relatively less bright than "normal".

Mars will be too distant for much good work with small telescopes during May, the diameter diminishing from 8."5 on May 1 to 6"9 on May 31. During this period the tilt of the north pole toward the earth will increase from 19° to 22°. Quantity D will be 92° on May 1 and 105° on May 31, the season thus corresponding to our last of June and start of July. The polar caps will bear watching, and it is possible that the north cap may reform before long.

The north cap is still small, sharply outlined and very brilliant. E.E. Hare writes that measures of his original drawings give an angular diameter of 22° on March 21 and 26, gradually decreasing to 18° on April 20. Perhaps, then, the rate of melting of the snow cap is decreasing. The summer solstice of the northern hemisphere (D 90°)falls on April 26. The north polar band is still intense. E. Pfannenschmidt and his colleagues agree that it was very dark in February and March. As late as April 20 the south polar cap was still usually diffuse, rather small, and comparatively dim, but extremely variable - evidently still atmospheric.

Notes on Martian colors betray some of the inevitable inconsistences. Attractive colored drawings by J.P. Dow with a 9-inch refractor on February 21 and 28 show the deserts orange and the maria, both southern and northern, dark green. Dow emphasizes, though, that to him the colors are usually dingy and are only at intervals clear and distinct. Drawings by La Pelle with a 6-inch reflector show the deserts red and the maria blue. Missert with a 6-inch reflector in January-March found the southern and equatorial maria greenish. The north polar band and the large northern features (Acidalium, etc.) varied from gray to greenish. Reese with a 6-inch reflector on March 22 found the huge Wedge of Casius "decidedly chocolate-brown" while Syrtis Major was "very dark and blue". In mid-April Ceraunius and vicinity looked decidedly brown to Hare in his 7-inch reflector. Pfannenschmidt wrote on March 10: "Colors of the maria differ from green to greenish gray or slate color or bluish gray. Sometimes I have observed some northern details to accept a sort of reddish-brown color."

Reese writes of two suspected terminator cloud projections: one a small white spot near the north cap on March 18 at C.M. 339° and the other a bright spot near the equator on April 4 at C.M. 205°. Reese pertinently asks how one is to know whether a projection is real or merely an effect of irradiation. Certainly it is often difficult to decide. The editor would opine that one should not consider a projection to exist unless the jutting-out effect is greater than with other equally bright areas at the edge of Mars under similar conditions of observations.

Missert on March 10 in deep twolight at C.M. 8° saw a pronounced flattening on the sunrise terminator at the southern maria. One is reminded of T. Cragg's similar observation on January 18 (in March issue). Missert opines that the effect was optical, not due to a difference in elevation. Since dark maria so very seldom cause a visible deformation of the edge of the disc, the editor wonders whether instead Marian clouds or haze may be involved.

E. Pfannenschmidt with only a 2-inch refractor has been able to record such features as Acidalium, Ceraunius, Syrtis Major, Sirenum, and Nilosyrtis canal - very creditable results with such a small aperture. A set of Mars drawings by several observers with an 8-inch refractor at Stuttgart, Germany, shows much detail. The region enclosed by Nepenthes, Nilosyrtis, Casius, and the north polar band was extremely bright to E. Meyer there on March 10, compatibly with some views on this continent. D. Rielheimer at Stuttgart saw the Libya gap in Syrtis Major very well

on that date; it has also been observed by Hare, Haas, and Dow. Meyer's drawing shows several canals apparently composed of chains of minute spots. He did not draw Hesperia at C.M. 262°, perhaps further evidence of its duskiness this year (nor did Rielheimer at C.M. 267°). The Stuttgart observers have seen a number of dusky areas and slight differences of tone in the northern and equatorial deserts; one dusky area is triangular, with its apex at Aryn and a fan-like widening toward the north. A.F. Alexander has seen Trivium Charontis as a pair of tiny spots with a 5-inch refractor. Has anyone else done so?

A remarkable observation of Jupiter by E.J. Reese on March 25 showed a long bright band near longitude (II) 258° extending all the way from the south edge of the North Equatorial Belt to the South Temperate Zone! The two components of the South Equatorial Belt and the (single) South Temperate Belt were faint where the bright band crossed them, as though it lay above them; and the fainter Equatorial Band was quite invisible through it. This bright streak was conspicuous and certainly was a very unusual Jovian feature. E.E. Hare observed later on March 25; the region was close to the limb for him to get a good view of the streak, but he did note "a blotted out portion of the S.E.B." in the proper position.

We greatly desire additional observations of this amazing object. Please examine your notebooks for data on Jupiter near March 25. Reese saw nothing of the band when studying the same region on March 20. After March 25, he was unable to observe until April 4; the band had then completely disappeared, unless a very faint band following longitude (II) 258° was a faded remnant. Haas saw no sign of the brilliant band on March 22 and perceived nothing of it when he next saw its region near the central meridian on April 4. On March 28 he looked in vain for its possible projecting or irradiating on the limb of Jupiter, an observation suggested by Reese. Was the band, then, extremely transient? Does it represent a violent eruption on Jupiter? Might transiency be inevitable because of its lying across regions which rotate, some in System I and some in System II, that is slower by five minutes? And have similar bands ever been observed in the past?

Reese remarks that a conservative explanation of the band would be that it was due to a chance alignment of bright areas in the belts and zones. In so far as this alignment depends only upon the differing rotations of Systems I and II, it will be restored near May 11. He informs us that the region of the band will be well placed at 3:25 A.M., E.S.T., on May 10. A study of Jupiter at that time appears very desirable.

Venus will be excellently placed on May evenings, being high in the sky early in the month. By June first the crescent will be getting thin, and observers might look for the curious lighting of the dark hemisphere with the methods M.B.B. Heath suggested in our April issue. J.C. Bartlett writes that he once saw this curious phosphorence with an 8-inch refractor. He suggests that it may be a greatly augmented version of our light of the night sky (very little of which comes from the stars) and wonders whether this light, noctilucent clouds, etc. might not be far more pronounced on a planet closer to the sun. Dr. Bartlett reports that he has found a red filter very helpful in observing Venus. Others might try such a filter. He urges that members of A.L.P.O. look for irregularities (humps, hollows, etc.) along the terminator. If any are seen and watched closely, they might just possibly tell something about the Venusian rotation.

Some data about the shape of the terminator near the recent dichotomy are on hand. Bartlett on April 11 noted slight concavity. Monger on April 8 found very slight convexity, but judging was difficult. Hare found the terminator slightly

convex on April 7, straight on April 10, and concave on April 16. Miss A.I. Hoth, using a 7-inch reflector, drew the terminator definitely concave on April 18. With rather poor views, Haas called the terminator "nearly straight" from March 31 to April 6 and first recorded concavity on April 11. We might tentatively adopt April 9 as the date of observed dichotomy. Geometric dichotomy, the time when the sun-Venus-earth angle was 90°, did not arrive until April 16. The difference is presumably caused by the planet's atmosphere.

Mercury will be visible in the evening sky during much of this month, perhaps most conspicuously from May 15 to 20. Readers might like to see for how many consecutive evenings they can observe the Elusive Planet. Your neighbor's trees and lights will not help!

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S T A F F

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