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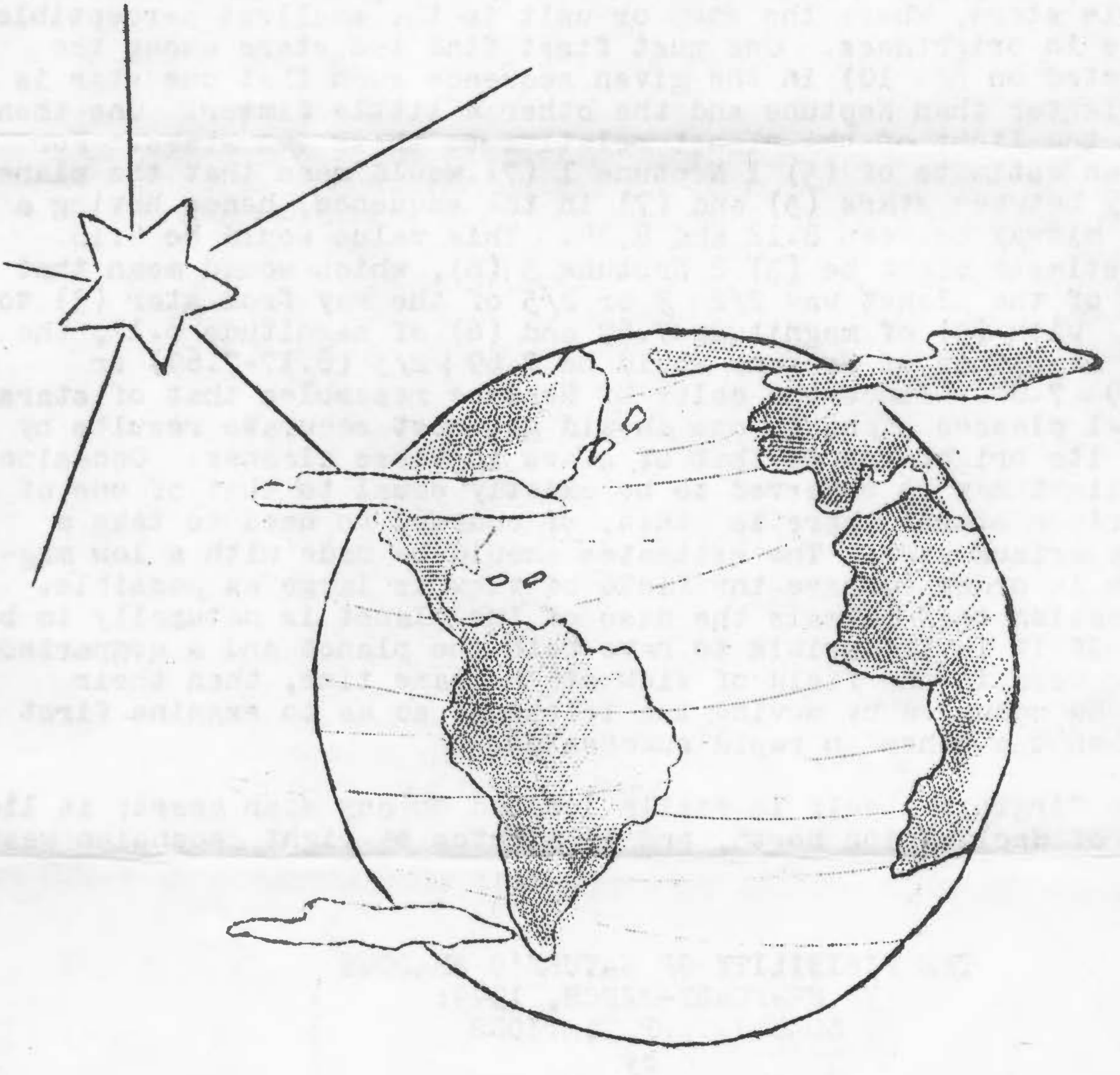
(Association of Lunar and Planetary Observers)



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NEPTUNE

For the chart of stars near Neptune on pg. 10 of this issue we are indebted to Mr. Carl P. Richards, 530 N. 19th St., Salem, Oregon, and to other persons at his place of employment. We thank Mr. Richards and his friends and hope that members of the Association of Lunar and Planetary Observers will use this chart to estimate the brightness of Neptune.

Such estimates can be made by the step-method familiar to students of variable stars, where the step or unit is the smallest perceptible difference in brightness. One must first find two stars among the eight (listed on pg. 10) in the given sequence such that one star is a little brighter than Neptune and the other a little dimmer. One then estimates the light of the planet relative to these two stars. For example, an estimate of (5) 1 Neptune 1 (7) would mean that the planet was midway between stars (5) and (7) in the sequence, hence having a magnitude midway between 8.12 and 8.24. This value would be 8.18. Another estimate might be (3) 2 Neptune 3 (6), which would mean that the light of the planet was $2/2+3$ or $2/5$ of the way from star (3) to star (6). With (3) of magnitude 7.69 and (6) of magnitude 8.17, the resulting magnitude of Neptune would be $7.69 + 2/5\ (8.17-7.69)$ or $7.69 + 0.19 = 7.88$. Since the color of Neptune resembles that of stars of spectral classes A and B, one should get most accurate results by comparing its brightness to that of stars in these classes. Occasionally its light may be observed to be exactly equal to that of one of the comparison stars; there is then, of course, no need to take a second comparison star. The estimates should be made with a low magnification in order to have the field of view as large as possible. A magnification that reveals the disc of the planet is naturally to be avoided. If it is impossible to have both the planet and a comparison star being used in the field of view at the same time, then their light may be compared by moving the telescope so as to examine first one and then the other in rapid succession.

Theta Virginis itself is easily located on any star chart; it lies 6 degrees of declination north, and 15 minutes of right ascension west, of Spica.

THE VISIBILITY OF SATURN'S SHADOWS IN FEBRUARY-MARCH, 1949: SOME INTERPRETATIONS

by
Walter H. Haas
(Concluded from May issue)

There are doubtless many persons at least as able as the writer to interpret the foregoing data, but he would like to call attention to the following points:

1. A planetary feature of sufficient darkness (or brightness, presumably) can be seen when its breadth is considerably less than the limit of resolving power of the telescope used. The Dawes limit is 0".76 for a 6-inch, 0".65 for a 7-inch, and 0".46 for a 10-inch. Excepting Cragg's view of February 18, the shadow of the rings was last definitely seen on February 12, when its width was 0".08. It was invisible to several observers from February 15 to 18, when its width was 0".04 or less. The shadow of the ball last looked black on February 15, width about 0".12, and after opposition first looked black on February 26, width about 0".10. It did look darker and wider than the thin band on the unshadowed limb when much narrower still, being so observed as late as February 19 and as early as February 23. The width on those dates was only about 0".04. There can remain little doubt that a black band of breadth 0".1 is readily visible in 6- to 10-inch telescopes.

2. The breadth in the telescopic image of a planetary feature (as distinguished from the actual angular breadth) can be less than the limit of resolution of the telescope. During February the shadow of the ball, the Crape Band, Cassini's Division, and the shadow of Ring A all had widths below this limit for 6- and 7-inch telescopes. Therefore, if each had had a breadth equal to the Dawes limit, they would all have been equally wide with such apertures. But in actuality the different observers, most of them then lacking knowledge of the angular breadths of these features, made repeated intercomparisons of widths all below the Dawes limit. It is clear that such an application of simple diffraction theory is ruled out; the observed width of the globe's shadow, for example, must have been less than 0".76 in a 6-inch telescope. The writer thinks that this failure is easily explained. The simple theory relates to a star on a dark sky-background. But if this background were brightened so that there was less and less difference in intensity between star and background, the fainter outer parts of the spurious disc would become invisible; and the observed diameter of the disc would grow less. Features on planetary discs usually contrast far less with their backgrounds than does a star with the sky, and the lucky planetary observer will hence have a gain in resolving-power with these markings beyond what he could obtain with double stars. In much the same way, the spurious disc of a thirteenth magnitude star is far smaller than that of Sirius in, say, an 8-inch telescope; with the dim star one sees only the brightest central part of the spurious disc.

The fact that shadows less than 0".2 wide did not usually look black is due, of course, to diffraction. It is surprising, however, that in good seeing shadows scarcely more than 0".1 wide can appear black in 6- and 7-inch telescopes. We should theoretically expect that below a certain limit evidently less than the Dawes limit the diminishing width of a shadow would produce decreasing observed darkness, but would not affect observed width. Hare found precisely this effect with the shadow of A from February 1 to 12.

3. Shadows look much too wide relative to less black features when both are very thin. On February 6, for example, Hare made the shadow of A about as wide as the Crape Band; actually, the Band was between two and three times as wide as the shadow (see table above). We should note, however, that the observed relative width of two features when both are narrower than the Dawes limit does not depend upon apparent relative darkness only. The apparently darker feature is sometimes the wider, sometimes the narrower. Can we more generally assert that the observed angular width of a feature (distinguished from true width again) increases as the amount of contrast between it and its background increases?

4. There is little reason to doubt that the dark band beside the unshadowed limb is an illusion caused by the difference in brightness between the ball and the rings. Penumbral shadow is ruled out as an explanation, for the width of such shadow can be computed to be at most 0".03. Therefore, penumbral shadow can have been visible only from February 20 to February 23--if indeed visible at all with such extreme thinness. We hence must suppose that the dark limb band is a contrast-effect. This contrast-band showed very different aspects to different observers (compare Johnson and Haas on February 23, or White on March 2 and Johnson on March 3) and, for that matter, to the same observer on different dates (compare Haas on February 17 and 18). There is even lacking convincing evidence that the band grows more inconspicuous as the quality of the view improves. If such was true for Johnson on February 23, the spurious band was yet seen easily by both Reese and White in at least two splendid views of the planet. In brief, our data fail to show how the appearance of the band depends upon such things as aperture, seeing, transparency, etc. Its behavior is instead apparently capricious. It would appear that a very basic problem in planetary studies may be difficult of solution: how can one decide whether a given feature between two regions of different intensity is a contrast-caused illusion or actual?

A curious white spot often seen on the rings beside the shadow of the ball and presumably a contrast-effect has been described by H. M. Johnson (Journal of the British Astronomical Association, Vol. 51, pg. 309, 1941). The writer has told how two white spots, one on each limb, are sometimes observed, especially within 10 days of an opposition (Popular Astronomy, Vol. 55, pg. 476, 1947). Possibly the one on the side where shadow is lacking is a secondary contrast-effect, due to contrast between the rings and the dark limb band there. The 1949 near-opposition period produced few observations of the white spot(s), perhaps because of the narrowness of the ring-arms. Only Reese and Haas ever caught glimpses of them. Past studies have shown the visibility of these spots to be about as unpredictable as that of the dark limb band.

It should be evident that knowledge of the appearance of narrow features of known width has many applications in lunar and planetary astronomy. One thinks of the canals of Mars at once. The writer hence recommends future studies of the Saturnian shadows. He would also suggest that much might be learned through the study of an artificial disc on which spots, lines, humps, etc. of known (angular) size simulate planetary detail. Interested readers might like to refer to W. H. Pickering's studies of such an artificial disc; his report may be found in Chapter IV of Volume 32, Part 2 of Harvard Annals, 1900.

Postscript. Since our May issue went to press, we have learned of a few additional observations of the Saturnian shadows last February by Oberndorfer in Germany with a 4-inch reflector at 160x and by J. C. Bartlett in Baltimore, Maryland, with a 3.5-inch reflector at 100x. These observations little affect the foregoing discussion, but readers might like to know of them anyhow. Here are observations of the shadow of the ball on the rings:

February 7. (U. T. date here and later.) Oberndorfer could still see this shadow.

February 9. Bartlett in poor definition found nearly equal black shadow-effects on both limbs. The one on the right limb seemed a trifle wider.

February 13. With excellent definition Bartlett saw identical shadow-effects on both sides of the ball.

February 24. In good definition no trace of a dark band was seen on the left limb; but there was definite and black shadow on the right limb, according to Bartlett. Subsequent to this date he watched the true shadow on the right (east) limb grow to a black wedge while there was no spurious shadow on the left limb.

Bartlett made these observations of the shadow of Ring A just north of the projected rings:

February 2. A narrow black border of A was seen with poor definition.

February 9. The shadow was seen as a thin, black line in bad definition.

February 13. Shadow was barely visible as a hairline on the north edge of Ring A. This observation is now the last one known to us of the dwindling shadow of Ring A, except for Cragg's puzzling view on February 18.

OBSERVATIONS AND COMMENTS

Note. All dates and times in this publication are by Universal Time, unless the contrary is stated.

E. Pfannenschmidt writes that Dr. Ruegemer in Germany has been making extensive observations of the brightness of Uranus with only Zeiss binoculars. The method, of course, is to compare it to neighboring stars. In this fashion Dr. Ruegemer has found that a period of variation in light of 10 3/4 hours "seems sure" (with occasional 35-minute irregular changes). This 10 3/4-hrs. period presumably results from the rotation of Uranus. The editor thinks it rather surprising that such an effect should be found at the present time when a pole of rotation of Uranus is near the center of the disc. He would suggest that the equatorial regions of the planet must differ substantially in brightness in different longitudes, for features at high latitudes would not be carried off (or on) the disc by the rotation. Perhaps some readers would like to imitate Dr. Ruegemer's studies next winter; the simplest optical equipment is sufficient.

All students of Uranus able to read the German language should study Mr. Pfannenschmidt's article about the planet on pp. 88 and 89 of the April, 1949, issue of <u>Sternenwelt</u>. An accompanying plate of 8 drawings by various observers in the years 1936-49 should be especially interesting. On March 2, 1949, Pfannenschmidt in a letter wrote about Uranus as follows: "The vertical white band and/or central section on the disc as well as the horizontal dark stripe crossing it have been seen here by approximately eight observers [from December, 1948, to February, 1949] . It is interesting to compare the drawings with those made by [members of] the A. L. P. O......It seems to me that the features compare well with each other. The band (as Ruegemer especially notes) could easily also be seen as a central area with the size of the disc as small as it is. All in all, I personally think the observers have more or less seen the same objects on the disc during the period in question, namely: a disc with a central [white] area exhibiting dark borders towards the limb and occasional extra bright areas on the limb looking somewhat like cusps."

It may be interesting to inquire about the angular dimensions of features on Uranus. During 1949 the angular diameter of the planet will have varied from 3".4 to 3".8. Since Uranus is not observed near conjunction, we may adopt 3".7 as an average angular diameter; and this value will also serve well enough for other recent years. Rough measures of the drawings in <u>Sternenwelt</u> mentioned above, which drawings were made with apertures of from 4 to 10 inches, give that dark bands were drawn with widths as little as 1/20 the diameter of Uranus, or only 0".2. Now it may and should be argued that such measurements ought to be limited to <u>original</u> drawings, not published copies. The editor hence made some measurements of a few of his own original drawings with a 6-inch reflector during the 1948-9 apparition; the width of the markings ranged from about 0".2 to about 0".5. One is thus, it appears, obliged to suppose either that observers show the markings very much too small or that the widths of features in the telescopic image of the planet are below the Dawes limit of resolution. We scarcely see how the former can be the complete explanation, for the Dawes limit is 1".1 for a 4-inch and 0".8 for a 6-inch so that markings seen with such apertures would have to cover a fair portion of the whole disc if as wide as the Dawes limit. We should prefer to think that the <u>observed</u> spurious discs of features on Uranus are smaller than the spurious discs of stars seen on a dark sky because of a smaller amount of contrast with their background. This result may be generally true of lunar and planetary detail.

In a supplement to R. Rigollet's Documentation des Observateurs, no. 4, 1949, we read of an important observation of Uranus by Professor Armellini. Here is the editor's translation of Monsieur Rigollet's published translation:

"On February 23 Dr. Gabriella Armellini with the aid of the Steinheil equatorial at the Astronomical Observatory of Rome (Monte Mario), aperture 395 mm. [about 16 inches] , focal length 5.24 meters [about 17 feet] , using a magnification of 650, observed on the disc of Uranus two small white spots near the equator of the planet. The weather was very fine and calm, and the planet was near the meridian. The two spots were in addition seen by Madame Armellini on the nights of February 24 and 25, but they were too small for micrometric measures."

As Monsieur Rigollet has already suggested, we appear here to have a significant Uranian analogue of the outstanding white areas occasionally observed in the Equatorial Zone of Saturn.

What is perhaps the first observation of Venus since its superior conjunction on April 16 was obtained by C. B. Stephenson at 16^h on May 10 with a 6-inch refractor and powers of 90x to 200x. At that time 99.4 percent of the disc was illuminated, and the planet was only about 7 degrees from the sun. With fair seeing and good transparency Stephenson was uncertain of the position of the phase-cusps, nor could he distinguish the limb from the terminator. The surface looked uniformly blank most of the time in this "very good view", a result confirmed by W. Lorenz.

On pp. 2 and 3 of our January, 1949, issue there is briefly described J. C. Bartlett's theory of vertical oscillations of the Red Spot Hollow on Jupiter. Dr. Bartlett recently wrote that such a theory is not original with him but that instead B. M.Peek previously postulated variations in the level at which the Hollow floats to explain the small variations in its rotational velocity. Peek had further found that whenever the Spot became conspicuously dark, the rotation-period lengthened. The editor doubts that such a correlation has been maintained since 1936; for example, the rotation-period of the Hollow between the 1938 and 1939 oppositions was perhaps at that time the longest sustained one ever determined for the mark, though the Spot was invisible in 1938 and very faint early in 1939. It is proper to remark that Dr. Bartlett's theory was devised to account for rapid changes in the brightness of the Hollow (occurring within a matter of a few weeks or even days). Vertical oscillations causing such variations in brightness might well also cause changes in rotation-period.

Known observers of Jupiter from March to May are T. Cragg, W. H. Haas, E. E. Hare, L. T. Johnson, E. J. Reese, and J. W. Tisdale. In spite of the planet's declination of -20° or -21° some fairly pleasing views have been obtained.

By the method of visual central meridian transits Reese has obtained these longitudes (II) for the Red Spot Hollow from March 24 to May 9: preceding end 220° (5 transits), center 234° (6 transits), and following end 248° (8 transits). From March 31 to May 18 Haas secured by the same method: prec. end 215° (5 transits), center 228° (6 transits), fol. end 243° (6 transits). There is apparently a sizeable systematic difference between the two observers; Reese's values are close to what he and several others found in the summer of 1948. The Hollow presented the familiar appearance of a large oval area depressing the south edge of the South Equatorial Belt. It has been growing dimmer. We thus find that when the Hollow was near the central meridian it was described by Haas as "definitely brighter than the South Tropical Zone" on April 7, as equal to this Zone on April 12 and as "somewhat dimmer" than this Zone on both sides of it on May 14. Moreover, L. T. Johnson found the Hollow "dusky" on May 14, though not on May 9. A dark column across the South Tropical Zone at the fol shoulder of the Hollow had been prominent in 1948 and was still notabl in February and March, 1949; it had become narrow and inconspicuous by April and May. The South Equatorial Belt South, or at least a south component of a belt in low southern latitudes, was very intense on both sides of the Hollow. On March 24 and 29 and April 3 Reese found the Hollow to be "extremely bright and white" in its north prec. portion. Haas drew it brighter near its prec. end than elsewhere on May 18.

We have these longitudes (II) for an object thought to be the Red Spot:

Observer	Date	Prec. End	Center	Fol. End
Reese	March 24	223°		
Reese	May 9	221	237°	251°
Haas	May 18	225(?)		240(?)

The work of Haas may give some indication that the Spot has been growing darker recently. On April 22 he noted "suggestions of a faint Red Spot inside the Hollow." On May 14 he mentioned "indications of dusky matter in the south part of the Hollow"; and on May 18, with conditions no better than four days before, he drew what certainly looks like the Red Spot of the past.

In March the North Equatorial Belt and the South Equatorial Belt were the most conspicuous belts on the planet and were about equal to each other. In poor views the S. E. B. appeared to have a darker south edge. Better views showed that the S. E. B. consisted of two components. The south one was straight, continuous, and very dark; the north one was far more disturbed, and its north edge was very irregular. During April and May the N. E. B. continued prominent; when the seeing was briefly fairly good for Haas at $9^h 54^m$ on May 14, he found its edges to be much darker than its interior. The south component of the S. E. B. meanwhile remained very dark and ranked second in conspicuousness. The north component, however, steadily faded. Haas found it less conspicuous than the South Temperate Belt on April 7, slightly weaker than even the North Temperate Belt on

May 2, and distinctly inferior to the N. T. B. on May 18. L. T. Johnson found ti to rank sixth in conspicuousness on May 14, when he saw eight belts. This north component was probably both faint and thin in mid-May. The South Temperate Belt usually came third in conspicuousness; the North Temperate Belt, fourth. The S. T. B. was composed of two close components, at least at times. The Equatorial Band was usually seen only with difficulty; it lay near the north edge of the S. E. B. in March and April and nearer the middle of the Equatorial Zone in May. In May some fairly dark sections were seen in it. Other belts have been observed even less frequently. A North North Temperate Belt has been seen a little north of the N. T. B. and was probably stronger in mid-May than before. On the other side of the N. T. B. and in the North Tropical Zone a nameless belt was remarked by Hare on March 20 and by Haas on May 14. Hare described it as "very diffused" and "lumpy"; Haas thought it fairly dark but very thin. Haas has sometimes suspected a thin belt in the South Tropical Zone near the Red Spot Hollow (the S. E. B. s?). A belt south of the S. T. B. has been remarked by Johnson and Hare; perhaps two belts are involved, even three. Cragg's view on April 22 suggested to him three far southern belts in the shaded South Polar Region.

Haas, largely confirmed by Johnson, has found the South Tropical Zone much brighter than any other zone. (However, this zone looked dusky preceding the R. S. H. to Johnson on May 14). The North Tropical Zone ranked second in brightness with these exceptions only: Cragg on April 22 at C. M. (II) 314° made it "definitely the brightest zone on the planet." The S. Tr. Z. and the N. Tr. Z. may have been equally bright for Johnson on May 9 at C. M. (II) 240° . The South Temperate Zone and the North Temperate Zone have often been dim; it is perhaps at least partly for this reason that many views of the planet have shown each polar shading reaching all the way to the nearer Temperate Belt. Reese near the first of April saw the N. Te. Z. "as a narrow bright yellow zone between 1/3 and 1/2 as wide as the N. Tr. Z." Reese then observed no S. Te. Z., which may well have grown brighter (or wider?) later; for this zone was apparently fairly bright to Cragg on April 22. Moreover, Haas first saw the S. Te. Z. on April 21 and noted it on a number of subsequent dates; and Hare observed it on May 3. The tone of the Equatorial Zone in recent months has been dim to dull, and sometimes even dusky. We here are thinking of the zone outside of some bright, sometimes even brilliant, areas at the south edge of the N. E. B. Near the first of April Reese found the E. Z. very dull at times. It was probably more dusky, on the average, in May than earlier in the year; Tisdale, Johnson, and Haas all commented on duskiness that month. With fairly good conditions (seven belts visible) on May 23 and C. M. (I) 340°, Haas found the portion of the E. Z. not near either limb to be darker than either of the large, dusky polar shadings. The zone was similarly dull in 1938, when a dark yellow or orange hue pervaded it.

The statement on pg. 7 of our May issue that E. E. Hare observed the satellite Mimas of Saturn with a 7-inch telescope is incorrect. Mr. Hare described in correspondence certain satellite-positions taken from the Ephemeris; the editor mistakenly assumed that Hare spoke of objects which he had seen. A few readers have written of being unable to see satellite Tethys or its shadow in transit across the ball of Saturn, where they may well be extremely difficult objects.

TWO INVITATIONS

We urge all our readers able to do so to plan to attend the Western Convention of Amateur Astronomers to be held in Los Angeles on August 22, 23, and 24. The "Western" of the title is not intended to be exclusive; everyone able to be there will be welcome. Professor G. B. Blair suggested some months ago that such a meeting be held; the response was spendid, and various members of the host organization, the Los Angeles Astronomical Society, are working very hard to make the coming gathering a success. It is hoped that this meeting may become an annual event for Western amateurs.

The three-day program includes several sessions for papers. Everyone who wishes to is urged to prepare a paper; Mr. T. R. Cave says: "Many amateurs, I fear, may feel that they have nothing new to discuss or present in a paper, even a very short one. However, nearly every amateur astronomer and telescope maker that I've had the pleasure of visiting has at least a few tricks which are original with him and which would be very helpful to some other amateur if he but saw or heard about them. So as I see it, nearly everyone can present a paper of some sort or other, which will be interesting and helpful to others." It is planned to arrange the different sessions for papers according to subject-matter, e.g., observing, telescope making, etc.

The Convention will meet at the Griffith Planetarium on the evening of Monday, August 22, and will visit the Mount Wilson Observatory on August 24. An exhibit of telescopes, photographs, drawings, etc. is planned for the evening of August 23 and will be the more interesting as the more persons participate in it. Those attending are urged to bring along their portable telescopes, which will be used on the Observing Night at Mount Wilson. Moreover, there is to be "a contest for telescopes with several awards in the different classes." Tentative plans call for Professor Blair of the University of Nevada, Professor Pruett of the University of Oregon, and some member of the Mount Wilson staff to address the convention on subjects of special interest to amateurs. Those wishing additional information should write the Program Chairman, T. R. Cave, Los Angeles Astronomical Society, Box 9841, Los Feliz Station, Los Angeles 27, Calif.

Here is a rare chance to meet your astronomical friends both within and without the A. L. P. O. Let's do our part to make this meeting a success! One of our leading observers is coming all the way from British Columbia, and the editor expects to be there.

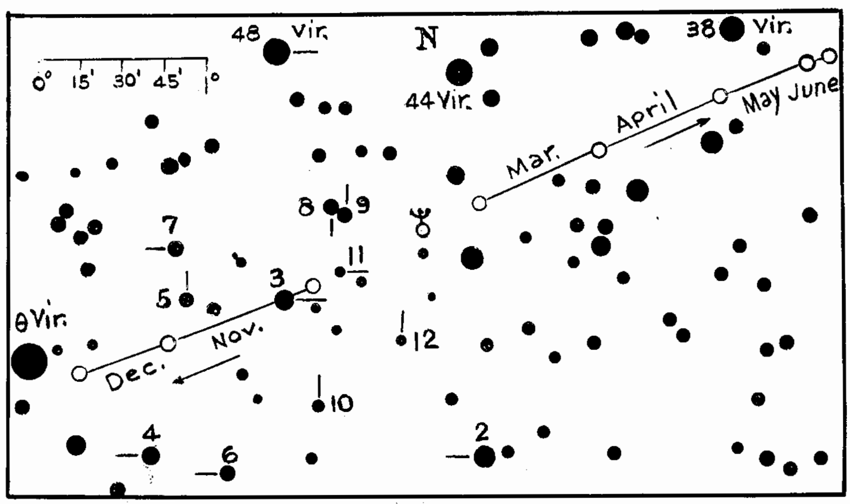
Mr. Bernard Lewis, Public Relations Office, Empire State Building, New York, New York has kindly invited all members of the Association of Lunar and Planetary Observers living in the New York City area to watch the next eclipse of the moon from the Empire State Observatory. This eclipse will occur on the evening of October 6, 1949 (E.S.T. date). We hope that our subscribers in and near New York will avail themselves of the fine opportunity here presented and will contact Mr. Lewis.

Why Not Observe Neptune?

The following article called "Neptune" and the accompanying chart were originally published in Documentation des Observateurs (in English Observers' Pamphlet). The pamphlet is published by Monsieur R. Rigollet at the National Center for Scientific Research in Paris. The following translation from the French is by the editor:

"Observations of the magnitude of Neptune are just as desirable as those of Uranus (refer to Documentation des Observateurs, no. 3, 1949). It is one's duty to profit from the present position of this distant planet near the field of the photovisual sequence of the Leander McCormick Observatory no. -5° 28, which it will, moreover, travel through at the end of this year and next. This sequence is easy to construct, being adjacent to the star Theta Virginis, which it precedes by a degree of right ascension. Here is a list of comparison stars for Neptune (refer to the map) with photovisual magnitudes and spectra:

1	7.11	FO	5	8.12	FO
2	7.31	A2	6	8.17	KO
3	7.69	KO	7	8.24	KO
4	8.09	A5	8	8.70	A5



"Avail yourself of good opera glasses or a telescope with a large field of view. Observations may be made in the evening up to July and can be resumed next winter. Estimates repeated during the night should eventually give a value for the effect of the rotation of Neptune, the duration of which is still controversial."

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S T A F F

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