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THE

STROLLING ASTRONOMER

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ANNOUNCEMENTS

ERRORS IN AUGUST, 1953 ISSUE. In Table I on pg. 116 the latitude is intended to be both north and south. On pg. 116, right column, lines 25-28 read "he did not show the division in his drawing." On pg. 120, right column, line 32 read "smaller", not "small". On pg. 123, right column, line 24 read "both being faint".

ERRORS IN SEPTEMBER, 1953 ISSUE. On pg. 137, left column, line 3 read "magmatic", not "magnetic". On pg. 137, left column, line 48 read "true meaning", not "type meaning".

SEASON'S GREETINGS. Although it seems very probable that this issue will not reach our readers until after the holiday season at the end of the year, the staff of THE STROLLING ASTRONOMER wants to wish each and every one of you A MOST HAPPY NEW YEAR. May 1954 bring you bigger and better telescopes, clearer skies, and fine seeing!

ASTRONOMICAL LEAGUE BOOK SERVICE. The Astronomical League, an organization chiefly composed of amateur astronomy clubs in the United States, has recently initiated a special Book Service for its members. This service enables League members to receive a ten percent discount on any book about astronomy or an allied science published in the United States. The Book Service Chairman is Miss Grace C. Scholz, 110 Schuyler Road, Silver Spring, Maryland. Those wishing to use this service need merely send to this address the name of the book they want its author, the name of the publisher, the list price, the name of the League member society to which they belong, their name and address, and a check or money order made out to the Astronomical League Book Service for the list price less a ten percent discount. The publisher will mail the book directly to the person ordering it.

We were very glad to learn of the initiation of this service for American amateur astronomers and hope that many of our readers will take advantage of it.

SOME RECENT OBSERVATIONS OF JUPITER BY K. KOMODA

by Elmer J. Reese

Mr. Kazuyoshi Komoda of Japan recently submitted a comprehensive report on his observations of Jupiter from 1947 to 1952. His large notebook is beautifully illustrated by no fewer than 103 full-disc drawings of the Giant

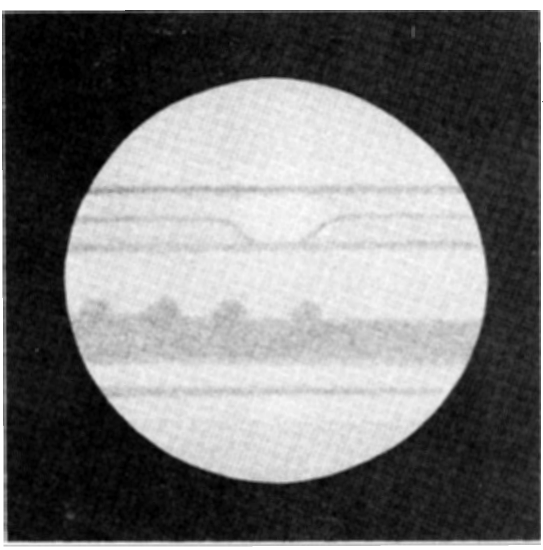

Figure 1. Jupiter. K. Komoda 6-in. refl. July 14, 1947 $13^h\ 10^m$, U.T. C.M.$_1$ = 199° C.M.$_2$ = 236°.

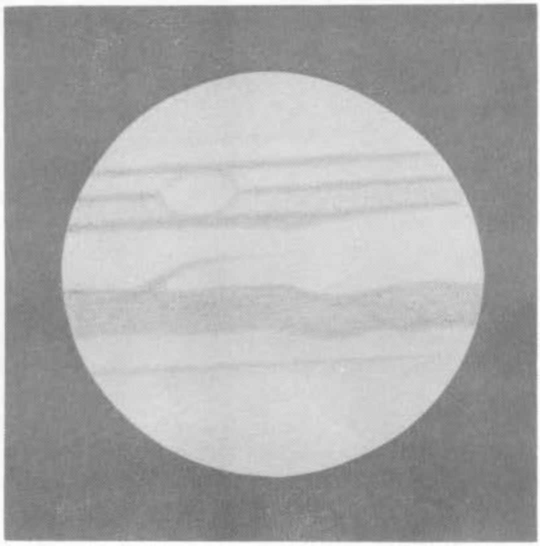

Figure 2.
Jupiter
K. Komoda
6-inch refl.
Aug. 13, 1948.
$11^h\ 15^m$, U.T.
C.M.$_1$ = 347°.
C.M.$_2$ = 243°.

Planet! A brief summary of his observations follows:

The Great Red Spot Region

The Red Spot was quite invisible in 1947; however, the Red Spot Hollow was clearly seen as a bright oval area in the South Tropical Zone. On July 14 Komoda found the Hollow a little brighter and whiter than the yellowish South Tropical Zone (Fig. 1).

In 1948 the Hollow was again visible as a prominent, bright oval, with dusky border, denting the south edge of the South Equatorial Belt to form the well-known bay in that belt (Fig. 2). On June 6 the color of the Hollow was described as very deep yellow. (Several other observers found the Hollow very dull and yellow-ochre during June of 1948). Mr. Komoda observed a very interesting disturbance in the South Equatorial Belt between the following end of the Hollow and longitude (II) 290°. The disturbance was most active in June and consisted of a number of whitish, cloud-like markings which were apparently obscuring parts of the South Equatorial Belt following the Hollow.

By July, 1949 the aspect of this remarkable region had changed completely (Fig. 3). The Hollow was no longer prominent, but in its place was the famous Red Spot - a dusky ellipse some twenty degrees long in contact with the north edge of the South Temperate Belt. For some unknown reason, the interior of the Red Spot is usually brighter than the outer edge-such was the case in July, 1949. The south component of the South Equatorial Belt, which was extremely dark, vanished very abruptly near each end of the Red Spot instead of being visibly deflected around the north end of the Spot. Such an aspect is quite unusual. However, Jupiter is full of surprises and the Red Spot did not remain visible very long. By October 24 it had faded away and in its place was the Hollow - a yellowish-white oval surrounded by a dark border.

The Hollow remained prominent in 1950 while the Spot, itself, was quite invisible (Figs. 4 and 5). On July 7 Mr. Komoda noted that the interior of the Hollow was about as bright as the South Tropical Zone while its outer edge was very dark. The color of the interior was described as yellow-white on September 4, October 8, and November 4.

When Mr. Komoda next observed the Red Spot region, on September 20, 1951, he found that the Hollow and the south component of the South Equatorial Belt had faded away while the dusky Red Spot was once again a

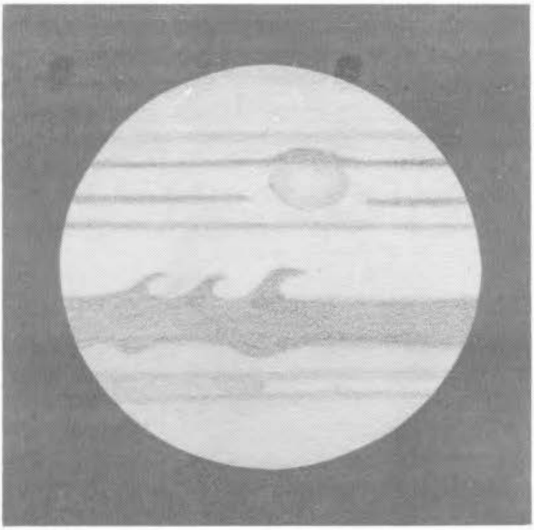

Figure 3.
Jupiter.
K. Komoda.
6-inch refl.
July 21, 1949.
$14^h\ 10^m$, U.T.
C.M.$_1$ = 60°.
C.M.$_2$ = 227°.

fairly prominent feature. The Spot presented a dusky ellipse, darker at the edges than in the center. A fine, narrow belt was seen extending from the following end of the Spot (Fig. 6). The following entry was made on October 16: "The Red Spot is in contact with the South Temperate Belt but separated from the north component of the South Equatorial Belt. The shape is that of an oval and the color is pale orange. The center of the Spot is pale while the edge is darker." The Red Spot was darker and redder on December 9 than on October 31.

The Red Spot's Drift in Longitude

Mr. Komoda's observations of the Red Spot region reveal a gradual, though somewhat irregular, drift towards increasing longitude (II) from 1947 to 1952. After examining his transit records, we might adopt 230° as the longitude of the center of the Red Spot region on June 8, 1947; and 270° as the center of this region on October 29, 1952. Thus the longitude of the Spot increased 40° in 1,970 days. This corresponds to a rotation period of $9^h\ 55^m\ 41.^s5$.

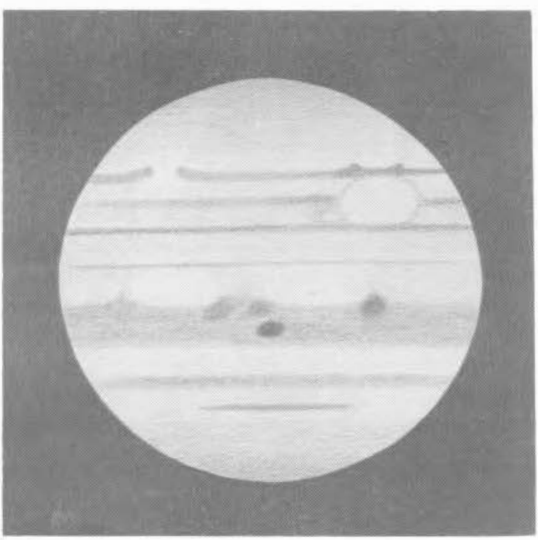

Figure 4.
Jupiter.
K. Komoda.
8-inch refl.
July 7, 1950.
$19^h\ 40^m$, U.T.
C.M.$_1$ = 204°.
C.M.$_2$ = 210°.

Small, Bright Cloud in the S. Temperate Belt

Our Japanese colleague closely followed the bright spot in the South Temperate Belt which we know as the Epstein-Both Disturbance (Strolling Astronomer, Vol. 6, p. 66; Vol. 6, p. 117). Mr. Komoda first observed this little cloud-like marking on August 8, 1951, at longitude (II) 53°. His last observation of the cloud was on November 3, 1951 at 344°. An examination of all his transits indicate that the center of the cloud was at longitude (II) 8° at opposition on Oct. 3, 1951 and had a mean rotation period of $9^h\ 55^m\ 8^s$.

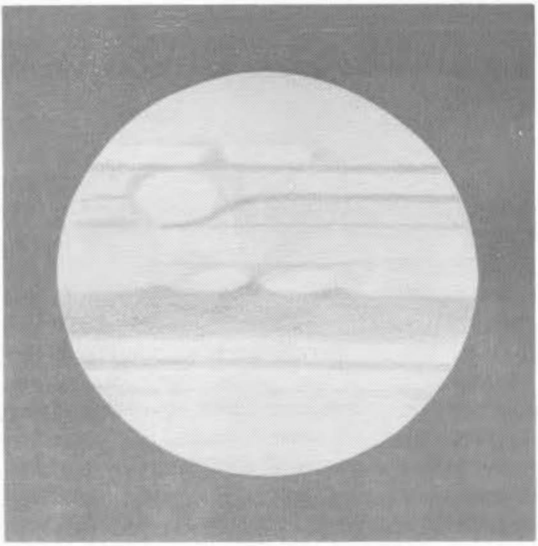

Figure 5.
Jupiter.
K. Komoda.
8-inch refl.
Nov. 4, 1950.
$10^h\ 20^m$, U.T.
$C.M._1 = 98°$
$C.M._2 = 271°$.

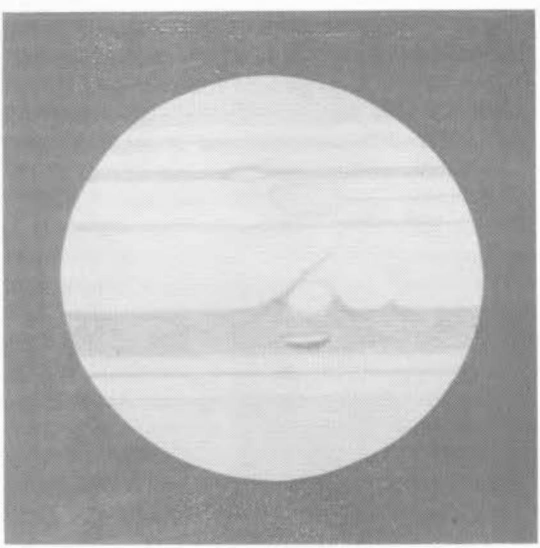

Figure 6.
Jupiter.
K. Komoda.
8-inch refl.
Oct. 16, 1951.
$15^h\ 44^m$, U.T.
$C.M._1 = 173°$.
$C.M._2 = 225°$.

Average Color of the Belts and Zones

	1947	1948	1949	1950	1951
STB				cool gray	cool gray
SEBs	red-brown	russet		red-brown	
SEBn	red-brown	russet		red-brown	
NEB		gray		red-brown	red-brown
NTB				red-brown	
STrZ	yellowish		yellowish	white	
EZ	yellow		dull	dull	
NTrZ			yellowish	yellowish	

Order of Decreasing Darkness of the Belts

Belt	1947	1948	1949	1950	1951
STB	2	3	2	2	2
SEBs	3	(1	4	5	5
SEBn	3	(	3	4	3
NEB	1	2	1	1	1
NTB	5	4	5	3	4

During 1948 the South Equatorial Belt was usually the darkest and most conspicuous belt on Jupiter except in longitudes near the Red Spot Hollow where the interior of the belt was much lighter than in longitudes more distant from the Hollow. In most longitudes the North Equatorial Belt was the second most conspicuous belt; however, in longitudes near the Hollow, this belt retained its distinction of being the most prominent belt on the planet.

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THE SOLAR TRANSIT OF MERCURY ON NOVEMBER 14, 1953.

We have received a number of observations of the transits of Mercury across the sun on November 14, 1953 from A.L.P.O. members and should here like to put on record these reports, even though we strongly suspect that not all work done has been reported as yet. On the whole, weather conditions were unfavorable in the United States; and a number of colleagues have reported that their plans were frustrated by cloudy skies. We here summarize the available observations.

J. Russell Smith. Eagle Pass, Texas. 8-inch reflector used at 4.5 inches with a solar wedge and a dark glass. Sky clear and seeing poor. Mr. Smith timed the third contact (internal tangency) to occur at $18^h 7^m 46^s$ U.T., and estimates that he may be in error several seconds in either direction.

Black River Astronomical Society Observers. We here extract from the Bulletin of the Black River Astronomical Society, Volume IV, Number 1. Contacts were timed (U.T.) as follows:

P. Smith: First Contact, $15^h 37^m 1^s$. Third Contact, $18^h 8^m 8^s$. Fourth Contact, $18^h 11^m 20^s$.
K. Walko: Second Contact, $15^h 40^m 8^s$. Third Contact, $18^h 7^m 52^s$.
G. Diedrich: Second Contact, $15^h 40^m 31^s$. Third Contact, $18^h 7^m 49^s$. Fourth Contact, $18^h 11^m 13^s$.
J. Rick: Third Contact, $18^h 8^m 20^s$.
A. Goldstein: Fourth Contact, $18^h 11^m 12^s$.

Dr. Smith observed with a 4-inch refractor at 100X in Lorain, Ohio. Mr. Walko employed an 8-inch reflector at 120X in Maple Heights, Ohio. All other observers were in Elyria, Ohio. Clear skies and steady seeing favored the observations.

Ralph N. Buckstaff. Oshkosh, Wisconsin. First seen when half upon the sun's disc, Mercury was watched throughout the transit. The last time given is $18^h\ 10^m\ 50.^s6$, U.T.; but it is not certain that this time is that of a contact.

Donald Rosenfield. Adler Planetarium, Chicago. 10-inch F:4 reflector with an unaluminized mirror. Observation communicated by Robert G. Johnsson. Latitude 41°51' 58."3 North. Longitude 87°36' 24."1 West. (Of course, the exact geographic position of the observer must be known since the observed times of contacts vary with the position of the observer on the earth's surface.) Third contact was timed at $18^h\ 8^m\ 20^s$, U.T., using 188X. Fourth contact was timed at $18^h\ 11^m\ 21^s$, using only 32X.

Observers at Claude Carpenter's Private Observatory. Near Romeland, Calif. Observations communicated by Chalmers Myers. Six telescopes were set up, including Mr. Myers' 10-inch reflector and several 6-inch and 4-inch refractors. Clouds concealed the ingress of Mercury into the sun, but a fair view was had of the egress. Third contact was recorded at $18^h\ 8^m\ 12^s$ by everyone except Mr. Clarke Harris, who secured $18^h\ 12^m\ 14^s$ (third contact or fourth contact?). Mr. Harris was projecting the sun's disc upon a fine grade of paper.

It might be mentioned that the Carpenter Observatory has an 18-inch reflector, surely one of the largest amateur instruments in the country doing regularly scheduled work.

Observers at the Laws Observatory of the University of Missouri. Columbia, Missouri. Latitude 38° 56' 13."4 North. Longitude $6^h\ 9^m\ 18.^s76$ West. Report communicated by John W. Reed. The sky was very clear; but the seeing was very poor, especially at third contact. There were three observers: Dr. R. D. Levee, the Director of the Laws Observatory, with a 7.5-inch refractor and a projected image of the sun 16 inches in diameter; Mr. John W. Reed with a 4.2-inch refractor at 60X and a direct view of the sun through a dark green filter; and Mr. Willet Beavers with a 2.1-inch refractor at 70X and a direct view through a dark clear filter. Mr. William Reid and Mr. John McComb helped as timekeepers and auxiliary observers. Considerable care was taken in the timing of the contacts; and it is thought that the error in the timepieces and the error in reading them together amount to one second or less, being certainly much smaller than the error in the observations themselves in such poor seeing. First contact was completely lost because of the considerable "boiling" of the solar limb. For second contact Dr. Levee secured $15^h\ 40^m\ 24.^s0$, U.T.; Mr. Reed $15^h\ 40^m\ 17.^s4$; and Mr. Beavers, $15^h\ 40^m\ 15.^s9$. For third contact Dr. Levee obtained $18^h\ 7^m\ 51.^s5$; Mr. Reed, $18^h\ 8^m\ 11.^s2$; and Mr. Beavers, $18^h\ 8^m\ 10.^s4$. Dr. Levee suspected that his time was too early and states that the magnification on the 7.5-inch refractor was too great for the very poor seeing. For fourth contact Levee secured $18^h\ 11^m\ 29.^s4$, and Reed got $18^h\ 10^m\ 38^s$. (Is it possible that Reed's time should actually be $18^h\ 11^m\ 38^s$? The Ephemeris value for Columbia is $18^h\ 12^m.0$.)

No unusual appearances were noted on the disc of Mercury between second and third contacts (refer to The Strolling Astronomer, Vol. 7, No. 8, pg. 122, 1953).

Robert G. Johnsson and Joseph Anderer. Adler Planetarium, Chicago, Illinois. These observers performed an interesting experiment. Each equipped himself with a 3.5-inch unaluminized Skyscope reflector, and each used it at 60X with a neutral density filter. However, the one filter was much denser than the other. Mr. Johnsson summarized their objectives and results in a letter dated Nov. 16, 1953: "We had suspected that the 'black drop effect' at second contact would last longer in the telescope using the low density filter. And we had also suspected that the telescope equipped with the low density filter would be the first to see the effect at third contact. It has been noticed by almost everyone at some time or the other that if one holds his hand out at arm's length and slowly closes his forefinger and thumb together, just before the forefinger and the thumb meet a projection appears to connect the two. It can readily be seen that holding your finger toward a light source of high intensity increased the 'projection effect', and the connection between the thumb and forefinger becomes visible when the two are farther apart than when the hand is held toward a less intense background. It should follow, therefore, if the 'black drop effect' of the transit is similar to the 'projection effect' demonstrated by the use of thumb and forefinger, that a reduction in the intensity of the solar disk should have some effect on the 'black drop effect'. As stated at the beginning of the paragraph we had suspected that the 'black drop effect' at second contact would be visible longer in the telescope with the low intensity filter. This did not take place. There was, however, considerable wind which caused vibration in the telescopes at this contact; and although both Mr. Anderer and myself feel that the 'black drop effect' definitely lasted longer in the high density telescope, we could be wrong considering the circumstances under which this contact was observed. The observation made at third contact, which we consider accurate, resulted as we had expected with the low density telescope seeing the 'black drop effect' first [by about 5 seconds] ."

To the Editor the results do not seem entirely conclusive because of the contradiction at second contact. The experiment should be well worth repeating at future transits of Mercury - and perhaps our youngest members can try them on Venus also at her solar transits in 2004 and 2012.

Persons desiring to compare the observed times of the contacts given above with the predicted times at the various reporting stations can do so in a rough way by using the predicted times for many different places in the United States listed on pages 365 and 366 of the 1953 American Ephemeris and Nautical Almanac. If a reporting station is not listed, take the times for the nearest listed place; or do an interpolation among adjacent listed places with the aid of a map of this country. The Ephemeris times are given to the nearest tenth of a minute only.

[As we go to press, we have learned of a number of previously unknown observations of the transit of Mercury across the sun on November 14, 1953. Therefore, there will be a second paper on this unusual and interesting astronomical event.]

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FOR THE BEGINNER: SOME SUGGESTIONS FOR OBSERVING JUPITER.

There is perhaps no more fascinating object than the Giant Planet to study with a small telescope. Mars is apt to be a disappointment to an ordinary instrument, and the ringed Saturn often seems to show a sameness from week to week; but the ever-changing dark belts and bright zones of Jupiter and the always-varying positions of the four bright satellites are a pageant well worth watching in even a 3-or 4-inch telescope. With larger and larger instruments the opportunities for serious study are more and more multiplied.

We must first learn something of the names of the belts and zones. Let us imagine the planet as it appears when on the meridian in middle northern latitudes and when it is viewed in a simply inverting telescope. Then south is at the top, and west is at the left - and, strangely, north is at the bottom and east at the right. The belts, being parallel to the equator, run east and west; and the obvious polar flattening will further help us to orient the image of Jupiter. No one can tell in advance precisely what the pattern of belts and zones will be; but we shall venture a word description, which should be good enough for identification purposes, from the aspect in recent years. The bright space across the middle of the disc is the Equatorial Zone, and a faint and narrow belt often present near its middle is the Equatorial Band. The prominent belt a little north of the center of the disc is the North Equatorial Belt. The bright space to its north is the North Tropical Zone. Going north, we then find in order the North Temperate Belt, the North Temperate Zone, the North North Temperate Belt, the North North Temperate Zone, the North North North Temperate Belt, etc. However, the belts and zones north of the North Temperate Belt vary in appearance; and identification is sometimes difficult. Finally we come to the North Polar Region, a large shaded region at the bottom of the disc. On the south side of the Equatorial Zone and a little above the center of the disc is the South Equatorial Belt. It is usually composed of two components, the South Equatorial Belt South and the South Equatorial Belt North; and the intervening bright space is called, rather cumbrously, the South Equatorial Belt Zone. To the south of the South Equatorial Belt South is the bright South Tropical Zone, in which the famous Red Spot lies. Going farther south, we encounter in order the South Temperate Belt, the South Temperate Zone, the South South Temperate Belt, the South South Temperate Zone, the South South South Temperate Belt, etc. The South Temperate Belt is usually conspicuous and lies about midway between the center of the disc and the south limb. Just as in the northern hemisphere, the appearance of the belts and zones in higher latitudes than the South Temperate Belt is variable enough that identification is sometimes uncertain. A shaded South Polar Region covers the top of the planet.

Drawings of the full disc of Jupiter have definite value in the study of the planet, but it is necessary that they be made quickly. The planet rotates on its axis in slightly less than 10 hours and will not stand still for the best of astronomical artists. Ten minutes is the longest that can be allowed for making a drawing of Jupiter. Otherwise, the markings have been shifted so much by the rotation that positions on the drawings are worthless. Of course, the general precepts about lunar and planetary drawings given in The Strolling Astronomer, Volume 7, No. 6, pp. 87-88, 1953 apply to drawings of the Giant Planet. In addition to full-disc drawings, sectional drawings showing some belt or zone of special interest and drawings of individual features like the Red Spot are of value.

However, the most valuable work that the ordinary amateur can do on Jupiter is the making of central meridian transits, which allow computations of longitudes and hence of rotation-periods. Merely estimating visually when a given marking is midway between the east and the west limbs is accurate enough. The time of the transit, that is, the time when the marking is on the central meridian and midway between the two limbs, is recorded to the nearest minute only. This time is entered in the notebook along with a brief description of the marking. The observer attempts, of course, to catch all the features that cross the central meridian while he is at the telescope. If he can observe a particular marking a second time, it becomes possible to determine its rotation-period. If the marking can be kept under observation for a month, a rotation-period accurate to within a few seconds can be determined. It should be pointed out that most Jovian spots are not sufficiently individualized to be quickly and certainly recognized; but if the observer will secure as many transits as he can, the tricky problem of deciding which ones relate to the same spots may be left to our Jupiter Recorder.

It is not actually necessary for the observer to report anything but the times of his transits to the Recorder; however, his enjoyment of the work may increase if he goes a little further. The first step is to compute the longitude of the spot from the time of the transit, and here the American Ephemeris and Nautical Almanac for the current year is an essential. The computation is described in The Strolling Astronomer, Volume 7, No. 7, pp. 96-98, 1953. Jupiter does not rotate as a whole, and it has been found convenient to use two Systems for expressing longitude. System I is employed for low-latitude markings, from the south edge of the North Equatorial Belt to the north edge of the South Equatorial Belt inclusive. System II is employed for the rest of the planet. However, very few markings move exactly in either System I or System II; and different spots at the same latitude may differ in their rotation-rates. After the longitudes have been computed, the observations are plotted on a graph in the proper System, longitude being plotted against date. Drift-lines joining observations of the same markings are then drawn, and here a considerable amount of judgement is often necessary. The slopes of the different drift-lines, often expressed as the amount of change in longitude in 30 days, give us the rotation-periods of the different spots watched. Some Jovian spots have variable rotation-periods so that the drift-lines become drift-curves. The colors of the belts and zones make Jupiter a lovely spectacle, especially with larger apertures of 10 inches and more. Regular observations of these colors are of value but must be made under conditions as nearly standardized as possible for a given series of estimates of color - the same telescope, the same eyepiece, the same color filters if any are used, etc. Hazy or foggy skies and the morning and evening twilight must be avoided because of their effect on observations of color. Beginners, and even some who are no longer beginners, can very profitably study Dr. Bartlett's article called "The Filter" in The Strolling Astronomer, Volume 7, No. 4, pp. 53-56, 1953.

The intensities of the different belts and zones may also be recorded on some kind of numerical scale. It is very difficult to find fixed values on such a scale; but one possibility is to call shadows of satellites zero, most of the belts two to four (according to how dark they are), most of the zones five or six (according to how bright they are), and the very brightest markings which ever appear ten. With some practice such a scale is easier to use than one might think, and the scale is preferable to vague words like "fairly bright" or "very dark".

Another study is the estimating of the relative conspicuousnesses of the belts, or zones for that matter. Here conspicuousness is defined as a combined effect of intensity and width. (A narrow and intensely dark belt and a wide but a very light one might be equal in conspicuousness.) The relative conspicuousness of the belts (or zones) is obtained by noting the order in which they become visible as the eyepiece is brought into sharp focus from a position at which the globe of Jupiter is quite featureless. These estimates of conspicuousness have less physical meaning than those of intensity; but they are much easier to make with accuracy, especially in small telescopes, and are far less influenced by differences in seeing, transparency, aperture, and the like. A very thin and very dark belt will look too wide and too light in a telescope too small to resolve such a belt properly.

Observers having a filar micrometer can make measures of the longitudes of markings not on the central meridian and can also measure the latitudes of the different belts (or north and south edges of wide belts). Far too little work has been done on such belt-latitudes. Probably not many of our readers have access to filar micrometers on telescopes in professional observatories, but we invite attention to the filar micrometer built by Carroll and Bohannon, La Crescenta, California and advertised on our back outside cover. Of course, such a device is of great use in lunar and planetary astronomy in general, not just in the study of Jupiter. We plan to carry a short article on the filar micrometer and some of its lunar and planetary applications in the very near future.

The four large satellites of Jupiter are also of interest. Central meridian transits of these satellites and their shadows may be observed in order to study the random and systematic errors in central meridian transits of the surface features. The phenomena of the satellites, their ingresses and egresses when they transit the face of Jupiter, their occultations behind their primary, and their eclipse disappearance and reappearances may be very carefully timed, say to the nearest tenth of a minute. It has been found in recent years that the observed times of these events are in curious and systematic disagreement with the computed times in the Ephemeris. Some good observers have reported rapid changes in the color and brightness of the different satellites. Such changes would appear to demand some atmosphere for these bodies, and this matter derives added interest from the fact that the largest satellite of Saturn (Titan) is known to have an atmosphere. Estimates of the relative brightnesses of these four satellites may be easily made with very small telescopes, and it will be convenient to use Ganymede (Jupiter III) as a standard. On a given night the estimates may be repeated at intervals of an hour, more or less.

A fascinating if difficult study is that of detail on the discs of these four large moons. Although some markings have been seen in only 6-inch telescopes (and very rarely even smaller ones), it is much better to have at least 10 inches of aperture for such work. High powers of 300X and more are needed. Good seeing, rather say excellent seeing, is also most desirable. Jupiter III is the easiest of these bodies to see detail on, and Jupiter II is the most difficult.

We hope that we have said enough to indicate that Jupiter is a very suitable object for the amateur observer to watch.

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IS THERE A NATURAL BRIDGE ON THE MOON ?

On July 30, 1953 the late John J. O'Neill, the Science Editor of the New York Herald Tribune, sent the Editor an observation of a most remarkable structure on the moon, a natural bridge on the east shore of the Mare Crisium. (Of course, one scarcely thinks of artificial bridges on the moon!) Partly because confirmation of such an observation appeared important, the Editor did not at once publish the report from Mr. O'Neill. Doubts of the reality of the lunar bridge were raised by a copy of a letter from Dr. Dinsmore Alter, the Director of the Griffith Observatory in Los Angeles, to Mr. O'Neill on September 29, 1953. Dr. Alter stated that visual and photographic examinations with the Griffith 12-inch refractor had quite failed to show the bridge. Nevertheless, the bridge was observed in England, according to Associated Press releases in American newspapers in late Dec. 1953. Since so extraordinary a lunar structure must be of considerable interest, we shall here pass on to our readers the available evidence and invite them to look for the lunar bridge. We begin with the paper and drawing submitted by Mr. O'Neill.

GIGANTIC NATURAL BRIDGE FOUND ON THE MOON

by John J. O'Neill

A gigantic natural bridge has been found on the moon at the east central edge of Mare Crisium, in the rim of its surrounding walls, at latitude 14° 50' North and longitude 48° West. It can be seen when the moon is about 18 days old and the terminator is about 1° west of the bridge. The position of the terminator is the critical factor as the bridge will be seen only when the sun's rays are almost horizontal. On Figure 7 the top of the ridge is seen and the illuminated area on the shadow side of the ridge caused by the sun shining through the hollow wall. The bridge was found July 29, 1953, at $6^h\ 30^m$, U.T., when the moon in its northerly course was approaching the equator, -3° 20' declination, and in right ascension, $22^h\ 55^m$. It was observed 1 hour and 50 minutes until clouds interfered.

When the same area was observed 24 hours earlier the structure appeared as two separated, disconnected promontories as the region is shown on the photographic reproduction of the Wilkins map, Section XII at the point 6.2 centimeters from the right and 2.7 centimeters from the top margin. [These dimensions refer to the reduced size of the map published in this periodical and now issued as a booklet.]

The bridge extends in a north-south direction and judging from the positions of the shadows cast by its lower supports it has the amazing span of about 12 miles from pediment to pediment. This is established by visual comparison of the area lighted by the rays coming through the hole with the floor of the crater Proclus which has a diameter of about 18 miles. More reliable estimates are desirable. The height of the span could not be determined from this observation as the shadow of the upper part of the span was cast out in space beyond the terminator. If the observation had been started a few hours earlier the shadow of the top of the bridge might have been detected.

Observations on the bridge were made with a 4-inch refractor, F:15. There was a slight haze but transparency was high and seeing was excellent. Lunagraphic features were unusually still. The bridge was not noticed during an exploratory period when a 55X eyepiece was used. When the 90X eyepiece was used the structure attracted attention. The details were beautifully sharp and features stood out in sharp contrast.

Since this was the first time that a ridge connecting the two promontories was noticed first attention was given to establishing the reality of this feature. It was necessary to eliminate optical illusions and other possible

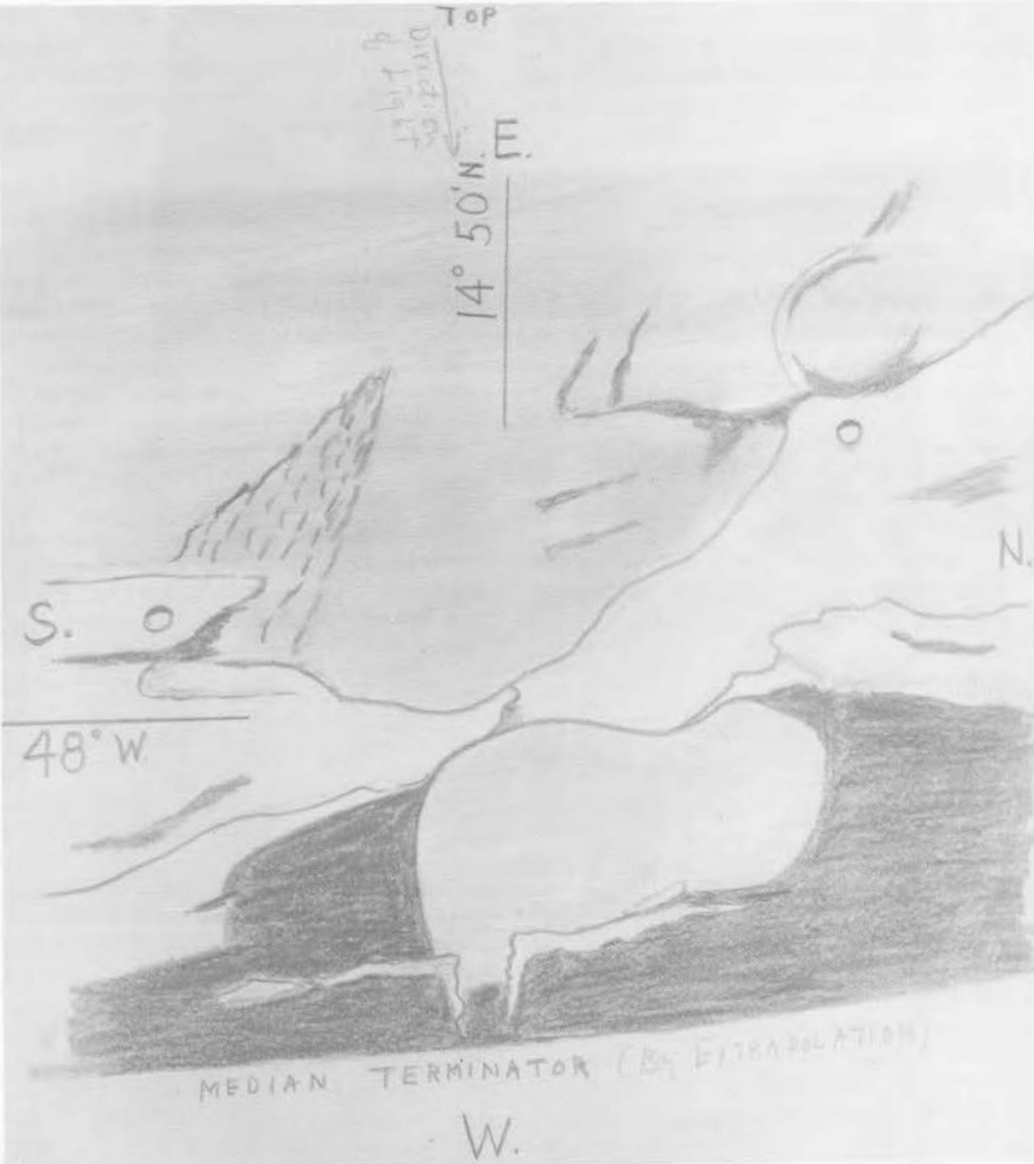

Figure 7. Natural Bridge on the Moon discovered by John J. O'Neill, July 29, 1953, $6^h\ 30^m$, U.T. 4-inch refractor. 90X. Colongitude 127.°2.

explanations. The seeing was so sharp and steady at 90X that there was no doubt as to the reality of the features seen. This was confirmed at 125X and 250X.

There will be relatively few hours in each lunation during which this feature can be seen.......

The colongitude of Mr. O'Neill's discovery observation was 127.°2, about three days after full moon. Some readers may note that a feature at longitude 48° W. is not on the sunset terminator until colongitude 132°, but the depression of the Mare Crisium below the general surface level of the moon explains the extreme nearness to the terminator at 127.°2. The longitude of the center of the moon was 0.°6 W. at the time of O'Neill's observation so that the lunar libration in longitude had almost its mean value. The bridge is on the sunrise terminator at colongitude 312° and would perhaps be best seen in morning solar lighting at 313°.

Readers might like to check Section XII of the Wilkins map and to note there the two separate promontories, which O'Neill's bridge connects. It is indeed surprising that so curious a structure in this part of the moon should have been so long unknown. This region has not been neglected by selenographers. On pg. 216 of his Moon Goodacre says: "Near the centre of the E. border [of Mare Crisium] is a narrow pass between lofty mountains. This pass has a crater on either side, and leads into a ruined ring, P. None of the maps show the true nature of this object." The last sentence implies that Goodacre gave much personal attention to the "pass", which O'Neill saw spanned by a "bridge".

We now come to the negative results of Dr. Alter and quote his letter to Mr. O'Neill on September 29, 1953: "At the request of Dr. Humason of the Mount Wilson and Palomar Observatories, I asked our observer, Mr. Paul Roques, to examine the area of your drawing at the proper phase, 18 days. We have a 12-inch Zeiss refractor. Mr. Roques examined the area both visually and photographically. I am enclosing a copy of the photograph which he made. From his report and the photograph, it seems certain that there is merely a gap in the ridges which bound the eastern part of Mare Crisium.

"I have examined a large transparency of one of the Lick Observatory photographs made at this same phase and find that it confirms Mr. Roques' conclusions."

The Griffith Observatory photograph taken by Mr. Roques was on September 26, 1953 at $5^h 49^m$, U.T. and thus at colongitude 127.°2, exactly the same lighting as when O'Neill found the bridge. On September 26 the center of the moon was at longitude 5.°9 W.; and this large western libration must favor determining the true topographic nature of the object, or so it would seem. The Griffith photograph is reproduced as Figure 8. Our reproduction may fail to do justice to the original, but it should at least indicate the position of this lunar bridge under discussion. This position is at the intersection of the two arrows, the one near the right margin and the other near the bottom margin, on Figure 8.

The negative results with the Griffith 12-inch might be thought to end the matter, for the larger telescope must have had the better view. Now, however, we come to the English observations reported in the press. No direct information on these is at present available. But if we may depend on the press, Dr. H. P. Wilkins confirmed the existence of the bridge on August 26, 1953; and Mr. Patrick Moore spotted the odd structure in September. Dr. Wilkins in a radio talk on December 21, 1953 described the bridge as about 20 miles long and a mile high and having one huge arc two miles across. He said that the bridge looks very artificial. He suggested that it might have been formed when a meteorite crashed through a cooling layer of molten lava, leaving a vast arch. Wilkins chiefly employs a 15-inch reflector; Moore, a 12-inch reflector.

Some of our readers might like to look for this bridge near either colongitude 313° (morning lighting) or 127° (evening lighting). We list the necessary times by Universal Time in coming months:

	$313°$	$127°$
February, 1954	$6^d\ 20^h$	$21^d\ 4^h$
March	$8^d\ 10^h$	$22^d\ 17^h$
April	$6^d\ 23^h$	$21^d\ 6^h$
May	$6^d\ 11^h$	$20^d\ 18^h$
June	$4^d\ 23^h$	$19^d\ 5^h$

Of course, observations can and should be made for several hours on either side of the times given. In the United States the best opportunities will be very soon after sunset on April 6, local civil time date, and soon before midnight by local civil time on Feb. 20, April 20, and June 18.

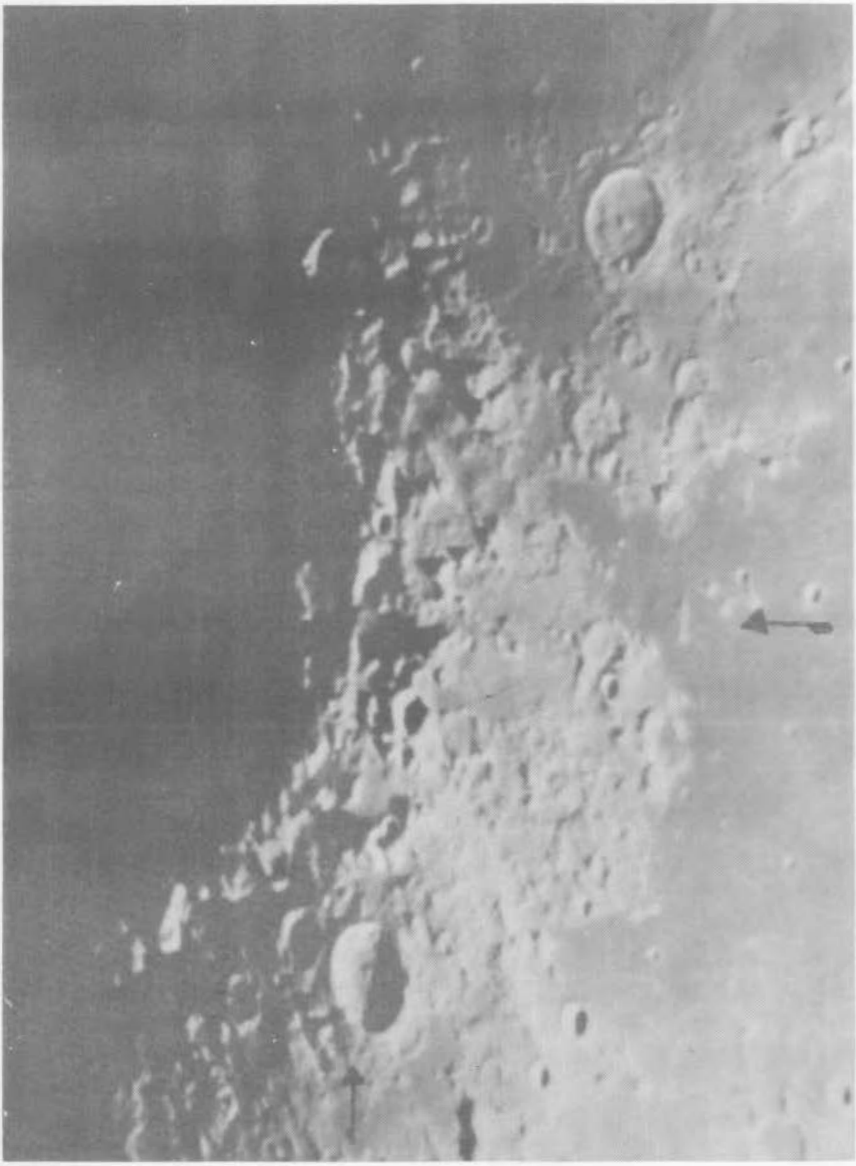

Figure 8. Photograph of O'Neill's Lunar Natural Bridge and Vicinity with Griffith Observatory 12-inch refractor. September 26, 1953, $5^h\ 49^m$, U. T. Colongitude $127°.2$. The Position of the Bridge is at the Intersection of the Arrows.