REPORT ON MARS No. 27.

By WILLIAM H. PICKERING.

GENERAL INFORMATION AND INSTRUCTIONS.

This report will be devoted mainly to giving more or less technical information and suggestions to other observers, some of whom may be beginners. The apparition occurring this year is a notable one. Opposition occurs on August 23, but on account of the eccentricity of the Martian and terrestrial orbits the planet will be nearest to us August 22 12^h G. M. T. or at 7^h in the evening Eastern Standard Time. It will then be nearer to us than has been the case since before 1800, or than will again be the case until after the year 2000. The next nearest opposition occurred eighty years ago in 1845, when the planet was only slightly more remote. We shall this year approach it within 34,630,000 miles. A question of one or two million miles will however make no particular difference to astronomers, but the thing that really interests them is that the planet will stay near us for a very long interval, so that we can watch it through a very long portion of its year. In 1916 we passed Mars when it was near its aphelion, and on only one day in February did we get to within 62,680,000 miles of it. This year we shall be nearer than that from June 9 to November 1 inclusive, or for 146 days. During all this interval we shall be able to scan its surface to very great advantage.

Unfortunately for northern observers the planet will be pretty far south of the celestial equator, although not as far as at the last apparition. It will reach its farthest south this year on March 13, —23°.6. It will then advance steadily northward to —14°.7 on July 11, it will again turn south to —18°.4 on September 8, and then rapidly northward to —11°.9 on November 1, and to +2°.9 at the end of the year.

After June 21, for that portion of the Martian year following ☉ 203°.3, and corresponding on Mars to the middle of October, the planet will present a larger disk than it has at that same season for many years. We shall therefore see it during the interval of its late autumn and early winter particularly well. Its maximum diameter on August 22 will be 25″.1. It passes its autumnal equinox for its northern hemisphere, ☉ 180° according to the Ephemeris on May 13, and its winter solstice ☉ 270° on October 5. We shall consequently get a better view of the southern hemisphere of the planet than we have had for many years, the latitude of the center of the disk ranging from —16° to —21° for the five months, June 1 to November 1, when the planet is nearest to us.

In Report on Mars No. **15**, Popular Astronomy 1916, **24**, 236, we explained the proper use of the Ephemeris as published in the *Nautical Almanac.* Since Mars is to be so near us this summer, it is possible that a number of amateur astronomers may wish to observe it, who will not have access to that Report, and will not know the best way to record their observations. It has therefore seemed to me desirable to rewrite certain portions of it, with such changes as have been rendered necessary by alterations in the *Almanac,* and such revisions and improvements as have occurred to me in the meantime. For any really accurate work on Mars a copy of the *Almanac* is absolutely nceessary.

But before proceeding to consider the observations a few words may be said regarding the most desirable kind of instrumental equipment. For Planetary as distinguished from Sidereal astronomy, certain requirements are of importance. Our knowledge of Mars has now reached such a state of completeness, that only under exceptional circumstances can a telescope of less than 5 inches aperture be of much use. For the same amount of money, if less than a thousand dollars is available, better results can certainly be obtained with a reflector than with a refractor. On the other hand, however, a reflector is much the more troublesome of the two, on account of the necessity of occasionally silvering the mirror, and of its variations in shape due to changes in temperature. For larger instruments, we find in practice, that Mr. Phillips usually prefers an 8-inch Cooke refractor to a 12-inch Calver reflector. At the Lowell Observatory they prefer a 24-inch refractor by Clark, with an aperture reduced sometimes to as little as 12 inches, to a 40-inch reflector by the same maker. Heretofore Professor Douglass has used an 8-inch Clark refractor. This year he is to use a 40-inch Brashear reflector. It will be interesting to see which instrument in his hands gives the better results. A large aperture is particularly desirable for the study of color effects, on account of the greater brightness of the image. This applies chiefly to Mars and Jupiter however.

An equatorial mounting and satisfactory driving clock would be considered indispensable by most observers, yet Mr. Wilson has secured excellent drawings in the past without a clock. It would, however, be hopeless to attempt measurements without it. For lunar work provision should be made to slow its rate appreciably, and some arrangement of gears, without using a screw, should be employed to provide for motion in declination. In moist climates a wooden dew cap extending a short distance down the tube of the telescope must be provided. With apertures of over 10 inches a cat's eye diaphragm, which can be manipulated from the eye-end, should be placed over the objective, to regulate the aperture in accordance with the quality of the seeing. Finely divided circles are of no use in Planetary astronomy, but a rough graduation to degrees will occasionally be found convenient. A position circle at the eye-end is necessary for accurate work.

For low latitudes a total reflection prism should be used for all work, and the observer must gradually accustom himself to seeing everything right for left. The best seeing always occurs near the zenith, and without the prism this part of the sky is entirely eliminated from observation. Moreover the trouble from the flying specks within the eye is much reduced if we look horizontally instead of upwards. A filar micrometer is of course necessary for some investigations. For the study of the finest detail, there is no question but that a negative eye-piece is superior to a positive one. This is chiefly because, with the latter, dust and irregularities of surface on the field lens interfere with the view. A Tolles' single lens eye-piece is better than either for showing faint contrasts in difficult detail, and should certainly be employed for this work. It also has a larger field. It has the disadvantage, however, that since its focus lies within the glass itself we cannot employ a reticule with it.

For small apertures a magnification of 40 or even 50 diameters per inch of aperture may be employed, if the seeing is good enough. I have myself used a power of 660 on our 11-inch refractor to advantage, when the disk of the planet was small. This was merely for drawing out lines however. In a search for fine detail, or faint contrasts, a magnification of 430 or even 330 was preferred. Most observers with large instruments confine themselves chiefly to powers of 400 to 450. We are provided this year with Tolles' eye-pieces of 300, 400, and 600 magnification, to be used in accordance with the object and the character of the seeing.

Considering that the instrument equipment is already provided, we will now consider what preparation should be made for our planetary studies. In making drawings of Mars it is very desirable before any attempt at sketching the details is made to have a disk properly outlined on paper, the gibbous shape being correctly shown, and the positions of the poles marked. Some observers are in the habit of making all their drawings of the planet, from the beginning of the apparition to the end, of exactly the same size. This has the serious disadvantage that at the beginning and end the scale of the drawing is much too large, while at opposition it is too small to show properly all that can be seen. Much the better plan is to draw on a fixed scale, of let us say either 3 millimeters, or a tenth of an inch, to one second of arc. The only disadvantage of this plan is that if we wish to copy certain of our drawings of the planet made near opposition, so that they shall all be of the same size, it is a little more troublesome to do so. This difficulty is insignificant however, and we have used this plan successfully here since 1912. On account of the excellent seeing that we enjoy, we have adopted a scale of 4 mm. to the second, but in most localities 3 mm. will be large enough. The larger the drawing, the longer it takes to finish it, which is a distinct disadvantage in the case of a rapidly rotating planet. It is the custom of the writer to enter all his draw-

ings on the right hand pages of a record book devoted exclusively to this planet, since it is then more convenient to compare them with one another. We record the date at the top of each page, and of each figure, and beneath the latter the time of beginning and ending the drawing of the outlines, also the time of finishing the shading, the magnification, the quality of the seeing on the Standard Scale, and the aperture when a change from that usually employed occurs. Then follow the computed results, which we shall next describe, and which are entered in ink.

In order to explain more clearly how the disk should be drawn, we will give an example of what we believe to be the best method of procedure. Let us suppose that we wish to make some drawings of the planet at the end of June. Since we may have cloudy weather on any particular night, and the planet changes its size and shape very slowly,
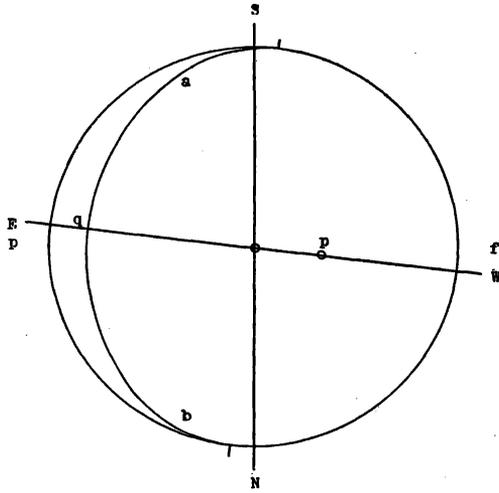

FIG. 1.

we will select some time such as Greenwich midnight on July 1, and compute our disk for that instant. This computation is entered in ink on the margin of the record book. Consulting the *American Ephemeris* for 1924, p. 629, we find that the apparent diameter of the planet will be 17".56 or 52.68 millimeters upon our adopted scale. If we prefer tenths of an inch the diameter will be 1.76 inches. We will now draw a circle of this diameter, and a vertical line passing through its center to indicate the south and north poles of the planet. Again consulting the Ephemeris we find that $q = 1".59 = 4.77$ mm., $Q = 252°.1$, and $P = 349°.0$. Then in order to locate the phase axis we have $Q + 90° - P = -6°.9$. Lay off this angle by means of a protractor from the north pole, towards the east or preceding side, since it is a minus quantity, as shown in Figure 1. On Mars east is defined as on the earth, and corresponds to west on the moon, or in the sky. A diameter

through this point will be the phase diameter, and a perpendicular to it the phase equator EW. From the eastern end of this latter before opposition, or from the western end afterwards, lay off the distance $q = 4.77$ mm.

While we cannot draw an ellipse with dividers, yet if the excentricity is not very great, as in the case of Mars, we can approximate to it sufficiently nearly for any drawings we may have occasion to make. The maximum possible ratio of q to the diameter d for Mars is 0.15.

TABLE I.

FACTOR FOR DRAWING ELLIPSES.

q/d	Factor	q/d	Factor	q/d	Factor
0.00	1.000	0.05	1.08	0.10	1.17
.01	1.015	.06	1.10	.11	1.19
.02	1.03	.07	1.115	.12	1.215
.03	1.05	.08	1.13	.13	1.24
.04	1.065	.09	1.15	.14	1.265
				.15	1.30

In Table I is given the factor by which we must multiply the radius of the planet, in order to obtain what we may call the phase radius, the radius with which we can draw the middle two-thirds of the terminator. The remaining one-sixth near each phase pole we must finish by hand. This however is easily done since we have the original circle of the disk to guide us. Returning to our drawing of July 1 we find that the ratio of q/d equals 0.09, and by the table the corresponding factor is 1.15. Multiplying our semi-diameter 26.34 mm. by this factor we obtain 30.3 mm. From the point q, Figure 1, lay off this distance qp on the phase diameter, and with p as a center draw the middle section ab of the arc of the terminator. Finish by hand or with a celluloid curve. The maximum deviation between the circular arc drawn by this method and the true elliptical curve is 0.015 of the radius, and lies at about 40° from the phase equator, the radius of the circular arc being a little too short at this point. This method is quicker, and distinctly more accurate than the well-known method of drawing an oval by means of circular arcs. When the ratio q/d does not exceed 0.05 we may draw the whole terminator with a radius equal to that of the planet. The maximum deviation from the ellipse, however, will then be larger, reaching 0.03 of the radius between phase latitudes 60° and 70°.

The phase drawing is now complete, but when a continuous series of drawings is being made, it is a good plan to copy in the snow cap from one of the previous drawings before beginning to work. This is particularly true of the northern snow cap when it is small, and changes but little from night to night. This saves time at the telescope, and if the drawing is incorrect, it is a simple matter to change it. The method employed in making drawings is described in full in Report No. 9, and need not therefore be repeated here. The writer has a few extra copies of this report which he can furnish to those who

would really like to make use of it, and cannot otherwise see it. In order to locate the planet's axis on the drawing with accuracy, a position circle is necessary. We first let the planet trail, and set the thread parallel to its motion. Then we read the circle, and add $90° + P$ as given in the Ephemeris. This gives the azimuth of the axis. Without a position circle we may orient roughly by the north polar cap direct, when this is visible.

In order to obtain readily comparable drawings of the planet, it is desirable that an effort should be made to secure them when certain fixed longitudes are on the central meridian. Twelve longitudes 30° apart have been selected beginning with $\lambda = 0°$. At the close of each apparition the alternate ones 0°, 60°, 120°, etc. are published. In order to determine at what time the drawings should be made in order

TABLE II.

TIMES OF TRANSIT FOR SELECTED MERIDIANS.

Merid.	Hour	Merid.	Hour	Merid.	Hour
°	h m	°	h m	°	h m
30	2 03.1	150	10 15.6	270	18 28.0
60	4 06.2	180	12 18.7	300	20 31.1
90	6 09.4	210	14 21.8	330	22 34.2
120	8 12.5	240	16 24.9	360	24 37.4

to have these meridians central we shall make use of Table II. This table is based on the supposition that the same point transits the central meridian of the planet on successive nights after an interval of 37.4 minutes. Owing to the relative orbital motions of Mars and the earth this quantity is liable to slight fluctuations, but the table gives average results which are near enough for all ordinary purposes. Let us suppose that we wish to know at what time longitude 240° will transit on July 1. From the table we find that the hour corresponding to longitude 240° is $16^h 24^m.9$. Turning to the Ephemeris we find in the next to last column on page 629 the number $2^h 50^m.4$. Adding these and subtracting 5^h, if we use Eastern Standard Time, we learn that longitude 240° will transit the central meridian of the disk at $14^h 15^m.3$ E. S. T. In case our result had exceeded 24^h, as it is liable to do for the higher longitudes, we should have had to take the hour from the previous day in the Ephemeris, and subtract 24^h from our final result.

Before we begin our observations for the year we always compute a private ephemeris for our station, a portion of which is shown, as follows:

July 1 210°	July 4 180°
h m	h m
9 21.8	7 18.7
2 50.4	4 45.9
12 12.2	12 04.6

The successive lines give the dates, the longitudes of the central meridians desired, the corresponding hours, taken from Table II less 5^h cor-

rection for Eastern Standard Time, the hours for the dates taken from
the *Almanac,* and the corresponding hours at which the drawings
should be made. The interval between the times taken from the
Almanac is 73^h 55^m.5. Dividing this by 36 gives us the interval
2^h 03^m.2 required by the planet to revolve 30°. Adding this to 12^h
04^m.6 gives us 14^h 07^m.8, the time that longitude 210° would reach
the central meridian on July 4, which we might of course have com-
puted directly. The difference between this last time and 12^h 12^m.2
divided by 3 gives us 38^m.5, which shows us how much later the same
meridian transits on successive days. This figure differs by several
minutes in different parts of the apparition. We are now prepared to
construct our private ephemeris, of which it will only be necessary here
to give four dates. The intermediate dates in the columns are obtained
by simply adding the 38^m.5. The successive hours on the same night
are obtained by adding the 2^h 03^m.2.

July	E. S. T.	Long.	E. S. T.	Long.	E. S. T.	Long.
	h m	°	h m	°	h m	°
1 Tuesday	12 12.2	210	14 15.4	240	16 18.6	270
2 Wednesday	" 50.7	"	" 53.9	"	" 57.1	"
3 Thursday	13 29.2	"	15 32.4	"	17 35.6	"
4 Friday	12 04.6	180	14 07.8	210	16 11.0	240

We will suppose that having now obtained our drawing, which will
not in general have been secured at exactly the required time, we wish
to know the longitude of its central meridian. The question immediate-
ly arises at what time should we say that the drawing had been made.
Heretofore it has been the general custom to take the mean of the
times when the insertion of the details was begun and finished, and be-
fore the shading was begun, and call this the time for which the central
meridian should be computed. Another suggestion is that the proper
time is that at which the drawing is begun. Since the planet rotates at
the rate of 1° in 4 minutes, and a drawing may sometimes require as
much as 20 minutes or more to construct all the details, the question

TABLE III.

MULTIPLICATION TABLE FOR r.

	°		°		°
1	14.62	4	58.48	7	102.34
2	29.24	5	73.10	8	116.96
3	43.86	6	87.72	9	131.58

is evidently one of some importance. It is likely that the rule would
vary somewhat for different individuals, but if the plan of drawing
suggested in Report No. 9 is followed, it is probable that the last sug-
gested time is the best one to adopt. The matter will be further dis-
cussed in another report. In case we use Eastern Standard Time,
Greenwich midnight occurs at 7 P. M. We must then multiply the
number of hours and tenths that has elapsed since then by 14°.62, the
average number of degrees that Mars revolves in one hour as seen

from the earth. This we may most readily do by means of Table III. Add to this the number given under Central Meridian in the Ephemeris, and we have the required longitude. This computation we will also enter on the margin of the page. Under each drawing we should enter in ink the longitude of its central meridian, underscored, the solar longitude $\odot$ corresponding to the time at which the drawing was made, and which for Greenwich midnight of July 1 is given in the Ephemeris as 209°.35, the Martian Date corresponding to this number, taken from Report No. 10, the diameter of the disk in seconds, and the declinations of the Earth and Sun $D_{\oplus}$ and $D_{\odot}$, as seen from the planet, all taken from the Ephemeris.

Besides the larger drawings, we find it often useful near the time of opposition to have a series of smaller disks, some two inches in diameter, with the phase laid off approximately upon them. These we use when the conditions are unfavorable, or when we wish to depict some special feature only. We sometimes wish to know how distant the planet is from the earth in miles. This is readily obtained in miles by multiplying the Light-Time given in the second column of the Ephemeris by 11,180,000, which is the distance traversed by light in one minute of time. To find the distance in kilometers multiply by 18,000,-000. In order to determine the local Martian Apparent Time at which any event occurs upon the planet, such as the disappearance of a canal under a cloud, we correct the longitude of the Central Meridian by the number given in the column $A_{\odot} - A_{\oplus}$, both taken from the Ephemeris. Correct for the time of observation. This gives us the longitude on the planet at which noon is occurring at the given time. The difference between this result and the longitude of the canal, or other marking, gives us the number of hours that the event occurred before or after Apparent Noon. We sometimes may wish to describe the darkness of a given area on the planet. For this purpose a scale of ten parts has been employed, where 1 represents a very phenomenal darkness, such as might occasionally be found in the northern portion of the Syrtis, 3 the usual darkness of the maria, 7 the usual brightness of the desert areas, 8 and 9 the brightness of clouds along the limb, and 10 the brightness of the polar caps when they shine, as they occasionally do, with an intense white glare. These numbers may be placed directly on the drawings, and would then be of assistance should copies of them be desired for reproduction.

We are now aware that the position of the axis of Mars hitherto adopted in the *Almanac* is in error by nearly 3°, as is shown in Report No. 26. Further evidence on this matter will be furnished in our next report. Until the Ephemeris can be changed to meet the new conditions, we shall publish curves and formulae which will enable each observer to correct it, so as to give him accurate results to apply to his own observations of latitude and longitude. We are thus following the precedent we formerly set in a small way with regard to the angu-

lar diameter of the planet, prior to the time when the Ephemeris could be changed to agree with the better determination.

PUBLICATION OF DRAWINGS.

An invitation is hereby extended to all observers, whether heretofore members of the International Society of Observers of Mars, or not, to forward any drawings of the planet that they may secure this year and wish to have published, to the writer, in Mandeville, Jamaica, B. W. I. If their drawings are inferior to the least satisfactory of those published in Report No. 25, POPULAR ASTRONOMY 1923, **31**, **213**, it would be hardly worth while to send them. Care should be taken to draw only those features of which one is perfectly certain. A mere momentary glimpse of a lake or canal is no evidence at all that it really exists. We draw here only those canals that we can hold steadily and surely, and give no weight whatever to a canal that we simply imagine that we see. We hold it equally objectionable to take a map of Mars to the telescope, and look for known canals on the planet to enter on our drawings. The canals vary from year to year, some appearing one year and some another. Also they may change their shapes and azimuths upon the disk. Therefore a canal drawn under the influence of a map may entirely misrepresent what really exists on the planet. A drawing to be of any use whatever should contain only the observer's own impressions.

As mentioned in previous Reports, each observer is expected to send in six drawings, but a smaller number will be accepted. These drawings should be made with the central meridian coinciding as closely as possible with longitudes 0°, 60°, 120°, 180°, 240°, and 300°. It is recommended that the drawings be made between the middle of July and the first of October, but those made earlier or later will not be ruled out. Sufficient information should be given with each drawing to enable the writer to fill out a table like Table I of Report No. 25. This should include a statement whether the instrument employed was a reflector or a refractor, its aperture, and the magnification employed, the quality of the seeing on the Standard Scale, the date of the drawing, the hour, the kind of time used, or a reduction to Greenwich, and the computed longitude of the central meridian.

The publication of the drawings made at the apparition of 1922 has been seriously delayed by the fact, that although most of the observers sent in their drawings very promptly, yet one or two of the most prominent ones delayed forwarding them to me until this past winter, since which time I have been so fully occupied with other matters, that it has been quite impossible to make the comparisons necessary to decide which drawings to publish, and which ones to omit. This comparison is a rather laborious process, involving the identification and study of all the canals shown upon each drawing. It is expected to publish the drawings some time this year, but it is hoped that observ-

ers will be more considerate in future, since the delay of a few promi-
nent ones enforces the delay of the publication of the work of all the
others.

Suggested Observations.

It is now suggested that the most important work that can be done
on Mars at the coming apparition, besides making frequent drawings
of detail, is for those who possess filar micrometers to make as many
determinations as possible of the latitudes of the thirteen points
described in Report No. 26. The main object of these measures is not
so much to confirm the new position of the axis, although they will
serve for that purpose, as it is to determine the nature of the shifts in
location of these markings,—how far they are seasonal, and how far
irregular, in the nature of a week to week shift in position. There is
no question now but that the shifts occur, and that their extent is small,
hardly exceeding the width of a wide canal, and it is for this reason
that independent observations are necessary to confirm and measure
them.

The micrometer is particularly adapted to this work, since while its
systematic deviations for fine planetary detail are large, its accidental
deviations are small, as compared with drawings. We do not care so
much what is the true latitude of the point under consideration, as we
do to know the extent of its shift in latitude. If a micrometer is not
available, or even if it is, a determination of the latitude by means of
drawings made as described in Report No. 22, under Shifting Surface
Detail, is very desirable. Drawings made in the manner there described
give much more accurate determinations of latitude than drawings
made in the usual manner. Determinations of longitude may be as
accurate as those of latitude, but that question is not yet settled, and
it is certain that if made by means of transits of the central meridian,
they require more time to secure them. Observations of latitude made
at stations remote from Europe and America, such as Japan and
Australia would be particularly valuable. The writer will be glad to
publish any such determinations as are made.

The particular object in studying these small shifts of position is to
throw whatever light we can on the nature of the lakes, canals, and
other markings on the planet. It seems unlikely that a canal shifting
its location through let us say 150 miles can owe its origin to vegetation
growing along the sides of an irrigating ditch or covered aqueduct.
Ditches can hardly move, although parallel ditches suitable for double
canals might be constructed. That however complicates the problem,
which already seems rather improbable, with its necessary gigantic
pumping engines. If the canals are shower tracks, we should expect
them to shift about irregularly, but why do they shift so little? The
great problem of Mars is undoubtedly the explanation of the canals
and lakes, and anything that we can do to help elucidate that problem
is clearly of the first importance.

Another fact bearing on this question which it would be of interest to observe, especially about opposition, is whether the canals are most marked before or after passing the central meridian. If before, that would imply that they are developed at night perhaps by passing showers, if after, that implies that they are developed by day, the sun perhaps causing a thawing of the ground. They shift and change so rapidly in some cases, that it may well be questioned if they are any of them due to vegetation. At past apparitions at least two reliable observers have thought they perceived flashes of light coming from certain areas on the planet. These flashes were probably optical illusions due to eye strain. Nevertheless should any observer feel reasonably sure that he had seen something of the sort, he must not hesitate to communicate it, and if it should be confirmed by one or two other observers, seeing it at the same time in the same part of the planet, the matter would then become of some general interest.

MISCELLANEOUS PHENOMENA.

Last year's small northern polar cap probably disappeared in March, ⊙ 150°, the middle of the Martian August. It was not seen here, but the northern snow storms should have begun before that. The climatic conditions on Mars are so irregular, and vary so greatly from year to year, that a variation in the solar longitude ⊙, amounting to 20° or even more, is not at all unusual. This would correspond to about forty terrestrial days. Snow was seen in March stretching along the northern limb, but since the northern pole was turned away from us, and the planet was remote, diameter only 7″, little of interest was detected there. The snow may be visible as a long narrow band until June or July. Considerable irregularity should develop in May and June, affecting the northern detail, notably Acidalium. If not too near the limb, marked hourly changes may also be detected. Many cloud projections were seen upon the snow between ⊙ 178° and 211° in 1922, and should be looked for this year. The corresponding terrestrial dates are May 9 and July 4. The southern pole has been enveloped in cloud, but is expected to clear in April, early Martian September. The polar cap will begin to grow smaller in June, the end of Martian September, but will probably remain visible throughout the year when favorably situated for observation.

During April and May white clouds may conceal some of the dark portions of the disk, such as the Syrtis and Protei regions. The green color of the southern maria has already been detected, and will continue visible until opposition, the middle of the Martian November. For a study of the Martian colors the best artificial light to employ is a tungsten lamp of 20 to 40 watts, shining through a sufficient number of pieces of light blue glass, so that the illumined white paper, seen through a hole in blackened cardboard placed upon it, shall appear of both the same brilliancy and color as the polar snow cap. This test can

of course only be applied when the polar cap is quite free from the yellowish clouds which conceal it during the winter season. The narrowest canals should be seen at the end of May, the end of the Martian September. This is perhaps the most promising time to detect their duplication, if it really exists, although at the end of August the angular diameter of the planet is twice as great. In 1892 the darkest portion of the Syrtis exhibited a very striking transformation in shape, size, and color at ⊙ 214°. This was in connection with a marked development of Pandora, a canal connecting it at that time with the southern polar cap, and was followed immediately by a very extensive cloud formation, concealing much of the surrounding region. It occurred following a decided decrease in the size of the southern polar cap. The corresponding date this year will be July 9. There is no reason to expect a repetition of the occurrence on that date this year however, but the Syrtis should be carefully watched whenever visible, during June and July, especially in Japan and Australia, at times when it will be invisible to the more numerous American and European observers.

An interesting change in the location of the northern boundary of the southern maria between the Syrtis and Elysium will take place this year. In ⊙ 150°, Martian August, the northern boundary will be at Libya, latitude —6°. As the apparition progresses Libya and Aethiopis will gradually darken, as was first noticed by Perrotin over forty years ago. A new northern boundary will now be seen at Nepenthes, in latitude +15°. Both boundaries will be clearly visible for several months. and then the southern one will fade out, in early Martian November, and only the northern one will be left. The change should take place between terrestrial June and October.

In 1922 on July 4 the Furca at ⊙ 185° presented its usual appearance for the previous four apparitions, which is I believe to the normal eye that of a solid dark quadrilateral at the end of Sabaeus, Aryn being invisible. The next night it had lengthened in longitude by about 200 miles, and was therefore very carefully drawn. The night following it was if anything shorter than usual, but Aryn had now appeared as a short notch. Cloudy weather followed, but July 9 the notch was deeper and unquestionable, although by no means as distinct as during the apparition of 1892. It was seen even better in August, but by September the notch had disappeared. If the same sequence of events should occur this year, Aryn will appear the latter part of May.

It is expected that Amenthes will again become visible this year, and Nepenthes disappear. Observers should be careful to distinquish Amenthes from Triton. Amenthes begins on the western side of Hesperia, while Triton begins on the eastern. The northern part of Amenthes coincides very closely, if it is not identical with Thoth. The former was first suspected in 1922 at ⊙ 154°, and was clearly seen at ⊙ 173° and at 193°. These longitudes correspond in the present year