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REPORT ON MARS, NO. 41.

By WILLIAM H. PICKERING.

Drawings of the Apparition of 1926.

Of the fifteen sets of drawings sent to me since this apparition, I am publishing the two best complete sets, a combination of two others of exceptional excellence, both of which were incomplete, but which supplemented each other very nicely, and my own. All the larger reflectors gave results nearly equally good, and all were inferior to those given by the three refractors, but I finally decided to replace a more artistic set of drawings than mine, the former of which I had at first selected for this Report, because mine gave the details more definitely and the confirmed canals were rather more numerous. With regard to the instrumental equipment of the various observers, in addition to his 8-inch refractor, Mr. Phillips often used a 12-inch reflector for confirmatory purposes, and once used it exclusively. Mr. Ellison similarly occasionally used an 18-inch reflector, but in both cases the main reliance was placed on the refractor. Particular attention is called to the two drawings by Mr. Hargreaves made with a 6.5-inch reflector. He sent others which were very good indeed for an instrument of that size, but these two I think are worthy of especial mention.

My examination and marking of a drawing for excellence depends mainly on the number of canals and other fine detail shown upon it that are corroborated by other observers. I next subtract the number of canals shown that are not corroborated. This plan is not carried out with mathematical precision however, for if the set is a very good one, I assume that the observer saw clearly several unconfirmed canals, though not many, which were really there. On the other hand if the set is of a lower grade, and contains a good many well known canals that other observers did not see at all, I cut it pretty severely, on the theory that although these canals were undoubtedly thought to be seen, their actual existence is not assured, and it is believed in any case that they were not seen well enough to justify their insertion on the drawing. A certain weight is given to the general appearance of the drawings, as to whether the shapes of the larger details agree well with what is seen by others. Here again it is best not to be too precise, because changes sometimes occur even in the course of a month, and if two drawings are made a month apart, as is often the case, the difference in detail may perhaps be real. This can often be decided by means of other drawings made at about the same time. Again if the longitude of a drawing

PLATE XII

Fig. 1
Phillips 6° A

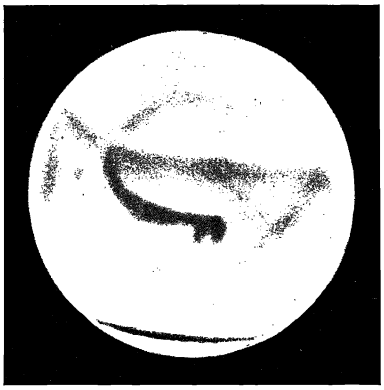

Fig. 2
Hargreaves 0° A

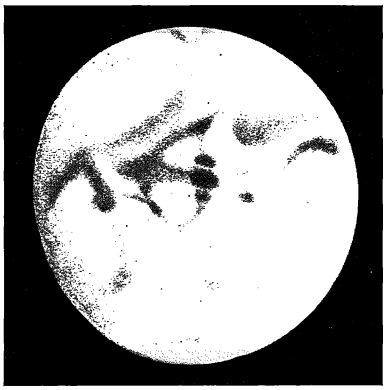

Fig. 5
Phillips 74° B

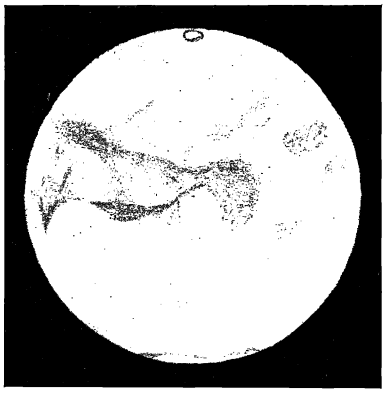

Fig. 6
Ellison 73° B

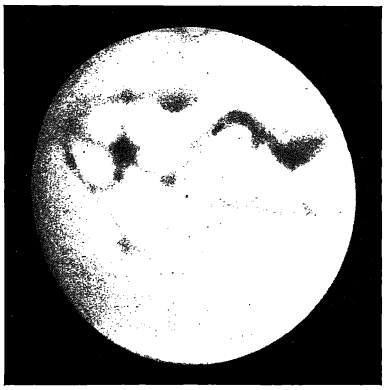

Fig. 9
Phillips 121° C

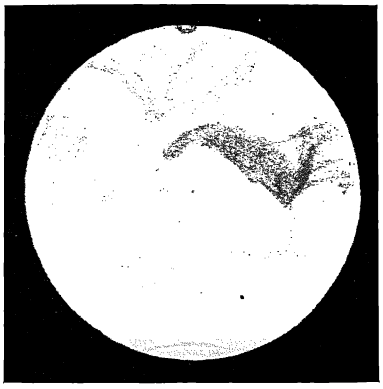

Fig. 10
Ellison 139° C

DRAWINGS OF MARS IN 1926.

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PLATE XIII

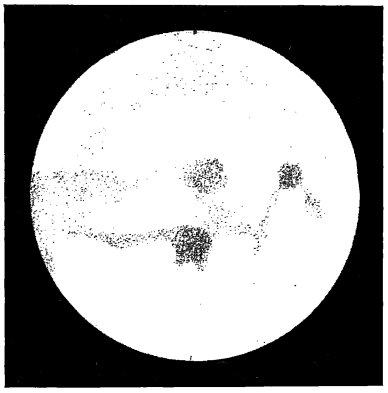

Fig. 3
Pickering 4° A

Fig. 4
Trumpler 3° A

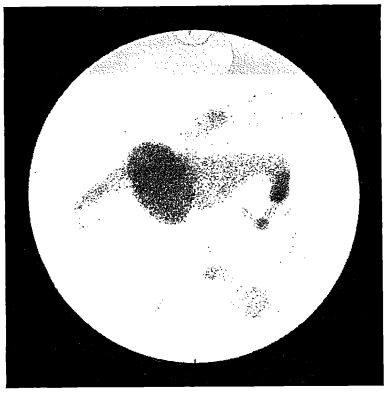

Fig. 7
Pickering 60° B

Fig. 8
Trumpler 55° B

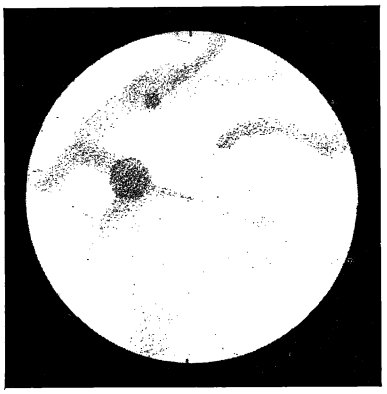

Fig. 11
Pickering 119° C

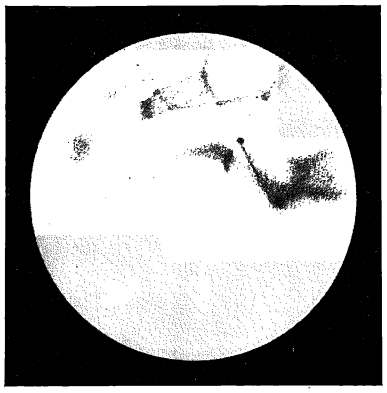

Fig. 12
Trumpler 136° C

DRAWINGS OF MARS IN 1926.

differs materially from the desired longitude, that counts against it. English observers are unavoidably somewhat at a disadvantage here, since so many of their nights are cloudy. On the other hand, American observers east of the Mississippi, and especially in the north, are at a hopeless disadvantage, because their seeing is so poor.

The precise time when each desired longitude will cross the central meridian of the disk should be carefully calculated before hand, as described in Report No. **27**, POPULAR ASTRONOMY 1924, **32**, 335, and the drawing begun as nearly as possible at about five minutes before that time. This will insure that the more striking details will be properly located. Earlier writers often recommended that the observer should never know beforehand when he drew the planet, what longitude was central. This would be absurd however now-a-days, when everyone at all familiar with Mars can tell at a glance what portion of its surface is on the meridian. If the details are not clear enough to show that, they are not worth drawing at all. Planetary astronomers are now far beyond that period of the investigation. If a drawing is a poor one in spite of great detail, and contains much imaginary material, or is in part drawn at the telescope from recollections of earlier drawings or maps, that fact is easily detected. Another point to be considered in the examination of the drawings is their conformation to what is now the accepted standard, as shown in the better drawings published in this Report. While a drawing may be accepted if its coarser and more conspicuous canals are put in their proper places, yet any drawing which represents such canals as narrow straight lines is at a distinct disadvantage. The almost universal opinion of the best modern observers is that that is not the way the canals appear when well seen. It merely indicates poor draughtsmanship. The bounding of a dark region by an extremely narrow canal, while it may possibly sometimes be objective, is in most cases believed to be simply a subjective phenomenon due to contrast, strongly influencing certain observers. The very narrow double canals which are an analogous feature are all ruled out as imaginary, and due also to contrast. Finally, although of less importance in a scientific investigation, an observer should be willing to spend enough time on his work to furnish a properly finished drawing, with smooth darkened surfaces, and not send in a rough sketch for publication.

The seven apparitions since 1913, when these Reports began, carry the planet around through its entire orbit, and we have now therefore seen it at every season of the Martian year. When my next Report appears it will be found that Professor Douglass and I have each furnished drawings in all six longitudes of the planet for the seven apparitions. Mr. Phillips and Mr. Wilson have each sent in similar sets of drawings for five apparitions, but no other observer has furnished them for more than three. Through 1922 Douglass observed five apparitions with an 8-inch refractor belonging to the Harvard Ob-

servatory, which was loaned him by my brother, and by means of it recorded more confirmed canals than any other observer. After my brother's death Harvard required the refractor returned, in order that it might be loaned for variable star work. Douglass succeeded, however, in replacing it with a 36-inch reflector by a manufacturer of the first class, so that his observations were not interrupted. This was most fortunate, but I regret to say that for Martian work that instrument appears to be distinctly inferior to the little refractor, so that Douglass' drawings are not now, what they used to be, as determined by the number of confirmed canals seen.

After my retirement for age in 1924, Harvard permitted me to keep their 11-inch Clark refractor here for another six months, in order to complete my observations for the sixth apparition, but it was impossible to keep, or hire it for two years longer, so as to enable me to complete my series of observations for the planet's year. An effort to buy it at a fair price was also unsuccessful. I consequently purchased a 12.5-inch reflector by one of the world's leading manufacturers, but as in the case of Douglass, I find that my present drawings are not at all of the quality that they were formerly, and we neither of us now can see more than the average amount of detail, as compared with observers favorably situated elsewhere. In short, the definition of my telescope has not at this past apparition proved itself good enough to enable me to take advantage of the excellent seeing that is found in a tropical latitude.

As a result of a thermometric investigation, which will be described in a future paper, on the definition of reflectors, I have found that by encasing the upper end of the telescope in wood, and placing a thin wood-fiber tube inside of it, reaching down as far as the supports of the flat, so as to keep that end as warm as possible, I obtained improved definition. A wire netting having a one-quarter inch mesh placed over the opening further improved the seeing. It also gave an illuminated field on which the web in the eye-piece was visible. If an index is attached to the netting, and the tube graduated to 360°, the position of the spectra shown forms a convenient method of measuring position angles, which is sufficiently accurate for many purposes. Reducing the aperture from 12.5 to 10 inches, nearly always gave improved results. A magnification of 340 was used on all the best nights, but a lower power is best for Martian clouds, and other coarse but faint detail. A 6-inch electric fan sending a current of air through the window near the mirror, and up through the tube, was later found to give greatly improved results. Unfortunately this was not tried until after the apparition was over.

As far as can be judged ,all the more favorably situated observers using reflectors large or small, saw about the same amount of detail at the last apparition. While there was not a great deal of difference between them, exceptionally favorable conditions or a poor night was occasionally shown. There seemed to be a fixed limit of definition placed

on these reflectors of whatever size, above six inches, which none of them could pass. I hope, however, by means of the electric fan to raise this limit somewhat at the coming apparition. The same thing seems to be true of refractors of a size above 10 inches, but their limit of definition is at present distinctly higher than that of the reflectors. An exception to this rule appears to be necessary in the case of the 100-inch reflector on Mt. Wilson. This instrument is furnished with an open-work tube, and a study of well known lunar detail, which I had an opportunity to make with it, and which I hope to describe later, leads me to believe that with favorable seeing it should give results quite comparable to those of the best refractors.

It is I think regrettable that not a single observer should have been able to draw the planet through the seven apparitions with the same instrument. This would have made statistical studies of the canals and lakes throughout the planet's year possible, as the drawings would then have been properly comparable. The same is true of other studies, such as the seasonal changes of cloud, haze, and vegetation. Another reason why I regret that Douglass's and my observations are not now up to our former standard is because in 1924, when it first became possible to compare Hamilton's and my observations with those made with the Lick 36-inch refractor, they were found to be comparable, and we were thus able to confirm many of Dr. Trumpler's canals and other of his fine detail, which otherwise, since no one else could see them, would have had to be classed as "unconfirmed." It is to be hoped that before the next apparition of 1931 arrives some observer with keen eyesight, and favorably located, will have secured a moderate sized refractor, of 12-inch aperture or over, and thus be able to confirm and supplement the detail seen at Mt. Hamilton. Private information implies that this may even be done this year in Japan. In the meantime the two other observers who used refractors, and whose results are recorded here, have evidently done good work in this direction. The various canals and lakes seen by all of these observers will be identified later.

As in our Reports pertaining to the six previous apparitions, the drawings are arranged in the order of the longitudes of the stations from which they were obtained, beginning with the European ones. All the drawings in the same horizontal row represent approximately the same Martian longitude. In the vertical columns the longitudes are intended to differ by 60°, beginning with longitude 0°. Thus six views of the planet are shown by each observer, covering the whole visible surface. These six regions are indicated by the letters **A**, **B**, **C**, **D**, **E**, and **F**. The names of the observers, their location, equipment, etc., are as follows:

Ph Rev. T. E. R. Phillips, Epsom, England. 8-inch refractor by Cooke and 12.2-inch reflector by Calver. Magnifications 211, 282, and 350. Seeing on the Standard Scale ranging from 5 to 9. (For a 7-inch refractor 11 is perfect, and for an 8-inch it is nearly the same).

H F. J. Hargreaves, Esq., Kingswood, Surrey, England. 6.5-inch reflector, maker unknown. Magnification 320. Seeing not recorded.

E_3 M. A. Ellison, Esq., Armagh, Ireland. 10-inch refractor by Grubb. Magnifications 275 and 400. Seeing not recorded. (The Ellison family appears to be devoted to Mars. This is the third member of it whose drawings I have published, hence the subscript).

Pk Professor W. H. Pickering, Mandeville, Jamaica, B. W. I. 12.5-inch reflector by Calver. Aperture actually used, 10-inch. Magnification 340. Seeing on the Standard Scale ranging from 7 to 10.

T Dr. Trumpler, Mt. Hamilton, California, U. S. A. 36-inch refractor by Clark. Magnifications 270, 350, and 520. Seeing 2, 3, and 4 on a local scale of 5.

In Table I is given a statement of the main facts relating to the various drawings. The Table is arranged as in previous Reports, the successive columns giving the number of the figure, the designation of the observer, the aperture of his instrument, the magnifications employed, the seeing on the Standard Scale, which is described in Report No. **9**, the date of the drawing in Universal Time, the region depicted, the longitude of the central meridian, its deviation from the desired standard, the latitude of the center of the disk, the angular diameter of the planet, the longitude of the Sun as seen from Mars, as described in the *Ephemeris,* and the corresponding Martian Date taken from Report No. **10**.

TABLE I.

FUNDAMENTAL DATA OF THE FIGURES.

Fig.	Ob.	Apr.	Mag.	S.	1926	R.	Long.	ΔLong.	Lat.	Diam.	☉	M. D.
							°	°	°	″	°	
1	Ph	12.2	282	8, 9	Oct. 19.1	A	6	+ 6	—14.0	20.2	303.8	Jan. 11
2	H	6.5	320	—	Nov. 25.0	A	0	0	—19.5	17.6	324.9	Jan. 47
3	Pk	10	340	10	Oct. 24.2	A	4	+ 4	—14.8	20.4	306.7	Jan. 16
4	T	36	350	3	Oct. 26.3	A	3	+ 3	—15.1	20.4	307.9	Jan. 18
5	Ph	8	211	7	Oct. 6.9	B	74	+14	—12.6	19.1	296.7	Dec. 54
6	E_3	10	275	—	Nov. 16.0	B	73	+13	—18.5	19.0	319.9	Jan. 38
7	Pk	10	340	8	Nov. 27.2	B	60	0	—19.7	17.3	326.0	Jan. 49
8	T	36	350, 520	2, 4	Oct. 23.3	B	55	— 5	—14.5	20.3	306.1	Jan. 15
9	Ph	8, 12.2	211, 219	8	Oct. 1.9	C	121	+ 1	—12.4	18.4	293.7	Dec. 49
10	E_3	10	275	—	Nov. 5.9	C	139	+19	—17.0	20.0	314.2	Jan. 28
11	Pk	10	340	7	Nov. 17.1	C	119	— 1	—18.6	18.8	320.4	Jan. 39
12	T	36	350	3, 4	Oct. 17.4	C	136	+16	—13.8	20.4	302.6	Jan. 9
13	Ph	8	211	5	Sept. 25.0	D	194	+14	—12.3	17.6	289.5	Dec. 42
14	H	6.5	175	—	Dec. 11.9	D	175	— 5	—20.4	14.8	334.1	Feb. 7
15	Pk	10	340	10	Nov. 11.1	D	182	+ 2	—17.8	19.6	317.0	Jan. 33
16	T	36	350, 520	2, 4	Nov. 16.2	D	162	—18	—18.5	18.9	319.9	Jan. 38
17	Ph	8, 12.2	211, 282	8, 9	Oct. 26.9	E	242	+ 2	—15.2	20.4	308.5	Jan. 19
18	E_3	10	275	—	Oct. 30.0	E	230	—10	—15.8	20.4	310.2	Jan. 22
19	Pk	10	340	10	Nov. 4.1	E	242	+ 2	—16.6	20.2	313.1	Jan. 26
20	T	36	270, 350	2, 3	Nov. 10.3	E	233	— 7	—17.6	19.6	316.5	Jan. 32
21	Ph	8, 12.2	211, 282	7, 8	Oct. 19.9	F	287	—13	—14.2	20.2	304.4	Jan. 12
22	E_3	10	270, 400	—	Oct. 21.0	F	302	+ 2	—14.3	20.2	305.0	Jan. 13
23	Pk	10	340	8, 10	Oct. 27.1	F	299	— 1	—15.3	20.4	308.5	Jan. 19
24	T	36	270, 520	4	Nov. 2.2	F	290	—10	—16.3	20.2	312.0	Jan. 25

The most conspicuous change that occurred in 1926 as compared with the apparition of 1924 was the broadening and darkening of Pandora,

as shown in Figures 1, 2, 3, and 4. It was also dark in 1922. It has thus appeared dark in Martian September and January, but faint in 1924 in November as well as at all other apparitions. On account of the uniformity of the temperature in different latitudes, and the mildness of the Martian climate, as compared to that of the Earth, vegetation in general usually begins to develop at about the time of the equinoxes. In 1892 Pandora was dark in Martian October and November. I am inclined to believe therefore that the faintness of Pandora in 1924 was due merely to cloudiness in the Martian atmosphere, but that at the four other apparitions when it was faint, the faintness was due to lack of water, and other wintry conditions. The most extensive change observed was in the canal system and maria between longitudes 200° and 290°, that is, between Charontis and the Syrtis, including the canals surrounding Elysium. A smaller area of marked change is about Thaumasia, already described in Reports Nos. **35**, **37**, and **39**. In the lower longitudes indicated by the letters **A**, **B**, and **C** under the drawings, there seems to have been a darkening and broadening of the desert canals in the northern hemisphere. Indeed, throughout this hemisphere various changes more or less conspicuous occurred.

Observer's Remarks.

Mr. Hargreaves states that on October 23 and 26 the prominent canal Cerberus was invisible, but that by October 31 it had reappeared and "remained on view throughout the rest of the apparition." Dr. Trumpler states that two brilliant white spots do not stand out sufficiently brightly on his drawings. One is Thule 2, to the right of the polar cap in Figure 16, which was nearly as bright as the cap itself. The other was a brilliant white spot covering most of Libya in Figure 24. This was clearly seen in Jamaica, and is shown in Figure 23 of the same square-cornered shape. Phillips and Ellison, respectively, in England and Ireland saw it quite differently, Nepenthes being much more pointed towards the south. The interval which had elapsed between Figures 22 and 23 was only six days.

Mr. Phillips points out a number of interesting changes noted upon the planet, in several instances evidently due to clouds, which seem to have been very prevalent over the southern hemisphere during Martian January. His obsrvations showing striking changes in Thaumasia have already been described and partly illustrated in Report No. **39**. His drawing of the same region made one month later is shown in Figure 5. The curious triple appearance of the Solis is doubtless due to two clouds, one of which is faintly indicated in Figure 8, also drawn in October, while its meridional extension, unknown previous to this apparition, is confirmed in all the other figures of regions **B** and **C**. Among Mr. Phillips' earlier observations was a cloudlike extension from the terminator on September 4, independently confirmed by Mr. B. M. Peek, some of whose drawings will be shown in a later Report. Numer-

ous clouds over the Syrtis region were seen on October 26, which are well shown in Figure 21. The shapes and location of some of these areas are of interest. The one over Ausonia gradually changed from a rounded to a square marking in Figure 23. Twelve days elapsed between Figures 22 and 24. If the clouds southwest of Euxinus were visible during all that time, they certainly were not recorded by me in Figure 23.

On October 30 a white cloud was seen by Mr. Phillips over Hellas, where a previous one had been noted here in 1924, and confirmed by Dr. Van Biesbroeck. It is described at some length in Report No. **34**. November 2 an unusually brilliant limb cloud covering the Syrtis was also noted. This was seen here upon the same date, and later by Dr. Trumpler. When these clouds disappear they are nearly always replaced by a "gray mistiness" as Mr. Phillips expresses it. We may interpret this that as having deposited their moisture as rain, and having disappeared, the land which they had concealed now presents due to the moistening, a darker color than before, such as is seen in some of the wider canals. He notes that Cerberus, which had previously been hidden, reappeared upon October 31. This date is the same as that given above by Mr. Hargreaves. Ellison shows it, however, in his drawing of October 30. On the other hand, my drawing, Figure 19 made on November 4, agrees with that of Phillips made on October 26. There appears thus to be an alternation in the appearance of the canals in this instance. On December 2 Phillips states that the Syrtis region was still found to be cloudy, Nepenthes and Thoth being almost completely concealed, but the canal Amenthes had now appeared as a straight meridional line. On December 4 he says "the peak of Mare Hadriacum is seen curiously bent over toward the west." It appeared indeed like a canal of rapidly diminishing width following the course of Peneus. See all the drawings of Region **F**. He states also that Nepenthes now runs nearly "straight out from Syrtis, not strongly curved as before." This is shown clearly in Figures 23 and 24, and would imply an increased velocity of the wind, on the theory that these broad curved canals are due to storm tracks in a general planetary circulation. On December 19 he noted "a general pallor affecting all the markings of the disk," presumably due to a universal haze affecting the whole planet. On December 22 I recorded "all detail except Sirenum difficult and extremely faint."

What May Be Expected at the Coming Apparition.

The opposition of 1928 falls on December 21, but the planet is nearest the Earth six days earlier, when its diameter reaches 16″.0. This is less than two-thirds of what it was at the nearest recent opposition in 1924. However it will not appear to us to be so large again even as 16″ before the year 1937. Opposition this year occurs at solar longitude 1°, or almost exactly at the vernal equinox of the planet, which we have dated

on our planetary calendar as Martian Date March 1. Both hemispheres north and south will therefore be equally well seen. The planet's declination will be +26°.6, which is almost as far north as it ever reaches. On November 8 while the apparent size of the planet is increasing, the solar longitude will be 339°.4 and its diameter 13″.3. In 1926 while its apparent diameter was decreasing, its solar longitude and its diameter were the same. Therefore before November 8 at the same season of its year, the planet was nearer us in 1926, but after November 8 it will be nearer us, and we should therefore see it better in 1928.

All of my drawings made in December and January of 1926 between solar longitudes 330° and 0° show unusual, but coarse detail. This is due in part to very cloudy weather on Mars, but also to extensive temporary darkening of its northern hemisphere. Similar observations were made here at the same Martian season during October and November of 1913. This would seem to imply rainstorms in that hemisphere on Mars, in short a planetary rainy season. Any observations for or against that view made at the coming apparition should be of interest. It is likely for this reason to be a particularly poor time this year to look for canals, although next year after opposition they should begin to appear. On the other hand those who begin observing as early as the middle of October, when the planet has already attained a diameter of 11″, should have an opportunity to watch the birth of the three great marshes or tundra surrounding the northern polar cap. This will be an easy and an interesting observation. The largest of these marshes, Acidalium, is comparable in size, although smaller, than the great marsh occupying the western end of Siberia, which covers about half a million square miles, and becomes liquid at the time of the melting of our own polar cap. Similar extensive marshes form at the same time in the northern portions of the American continent. The chief distributing canals from the Martian tundra leading to the northern maria, when they do form, should be large and conspicuous. It is most important that their radii of curvature should be carefully and accurately drawn, since they give us a measure of the velocity of the winds in the upper atmosphere of the planet, see Report No. **19**.

A great variety of color visible on Mars should be a feature of this apparition. Besides the customary yellow, orange, white, and gray, we should also see conspicuous areas of light and dark green, light and dark blue, and brown. These latter colors are readily studied by the light of an electric lamp, which should be held at a distance from the paper so that the latter shall appear about as bright as the polar snow-cap, or if that is not visible, the brighter clouds. A black paper mask containing a round hole of the proposed size of the drawing of the planet may be used to advantage in making colored sketches. In order to study the yellow and orange it is necessary to place two or three sheets of very light blue glass in front of the lamp, and the latter should be of at least 20 watts, in order to illumine the paper to equality with the

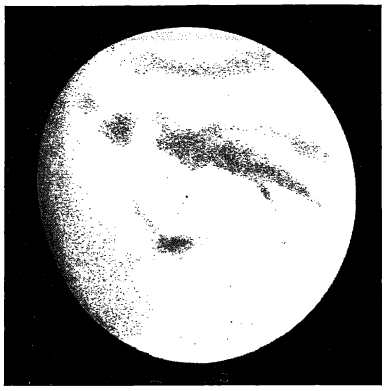

Fig. 13
Phillips 194° D

Fig. 14
Hargreaves 175° D

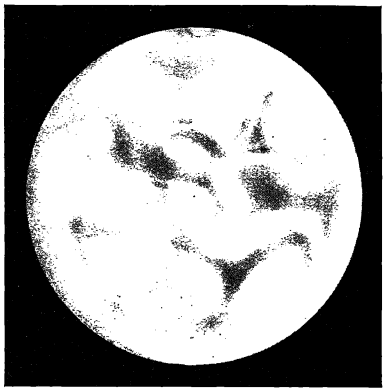

Fig. 17
Phillips 242° E

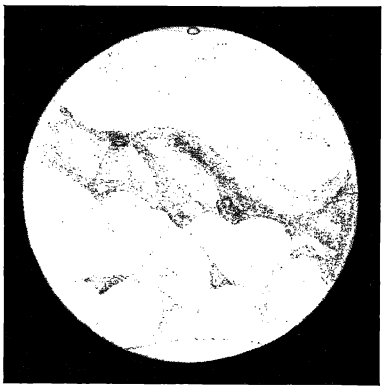

Fig. 18
Ellison 230° E

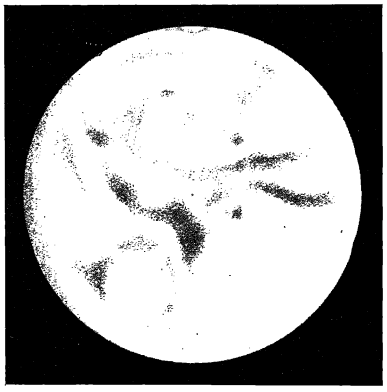

Fig. 21
Phillips 287° F

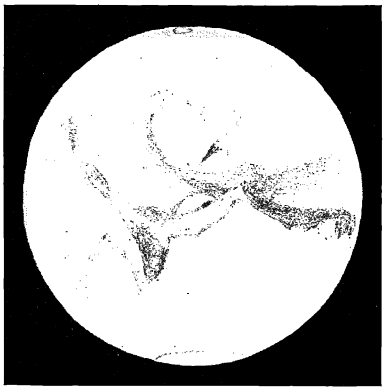

Fig. 22
Ellison 302° F

DRAWINGS OF MARS IN 1926.

Popular Astronomy No. 358.

PLATE XV

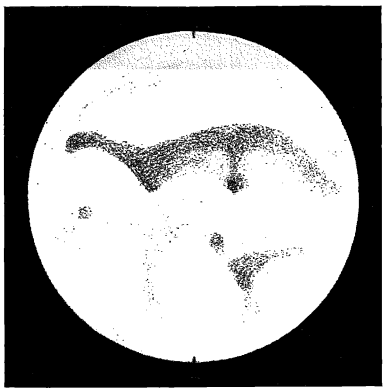

Fig. 15
Pickering 182° **D**

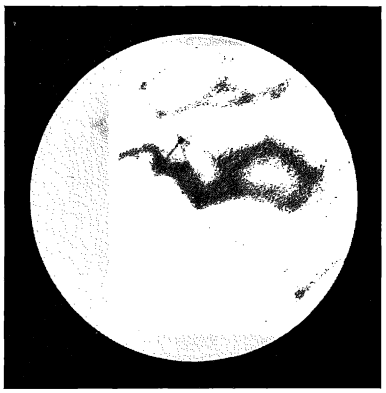

Fig. 16
Trumpler 162° **D**

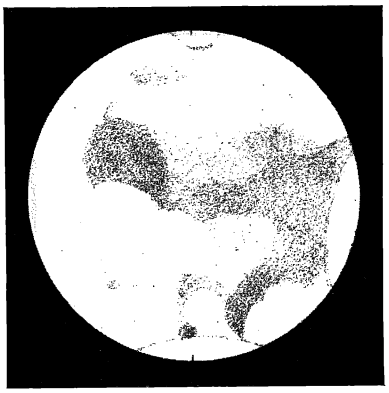

Fig. 19
Pickering 242° **E**

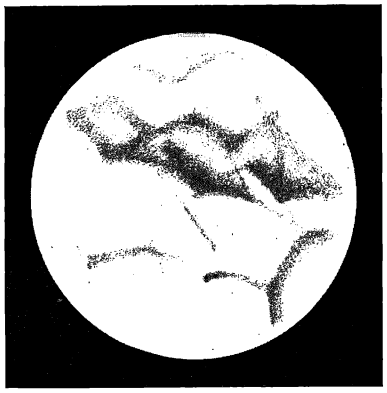

Fig. 20
Trumpler 233° **E**

Fig. 23
Pickering 299° **F**

Fig. 24
Trumpler 290° **F**

DRAWINGS OF MARS IN 1926.

polar cap. In case the snow itself is visible, the number of pieces of glass should be so chosen that the paper shall match the snow cap. Yellow ochre is the best ground color, but orange or yellow must be added for the center. The region north of Sabaeus is markedly redder than other portions of the disk. Colored crayons are preferable to water colors. Colored sketches should never be sent for publication.

Martian clouds are usually yellow to yellowish white, on account of the dense atmosphere through which they are seen, and when they are near the center of the disk they are sometimes hardly distinguishable in color from the snow itself. On the other hand when superposed on the deserts, which is their usual location, and along the limb, it is often impossible to distinguish them from the deserts themselves. This causes one of the chief difficulties in the study of the surface changes on Mars. Therefore when the clouds are occasionally projected on the dark areas of vegetation, especial attention should be directed to their changing shapes and location, if these vary from night to night, in order to give us some idea of the direction and velocity of the winds on Mars. When the terminator is brighter than the center this indicates cloud. It appears that clouds are more readily detected by photography than by visual observation, but this requires an instrument driven by clockwork, in order to be successful.

Judged by our observations made at a similar season in 1913, light greens should begin to appear in the northern polar regions between ⊙ 300° and 330°, or in Martian January and early February, when the moisture reaches there from the southern pole. These northern polar greens are much lighter and more brilliant, though perhaps less conspicuous, than those of the southern maria, which also appears before the northern vernal equinox. These latter were seen first in Cimmerium and Sirenum and soon after to the south of Furca and Margaritifer. The difference in color of these two greens is like that existing between our grassy plains and the woods and bushes growing in other places. The northern polar greens are soon covered, however, by the polar snow cap, whose almost bluish whiteness and brilliancy is very striking. The difference in color between the snow and the whitish yellow clouds is usually appreciably more marked than that between the clouds and some of the yellow deserts. The difference in color between the northern and southern maria at this season is quite marked. The greens appear in both the autumn and springtime. The southern polar cap is now composed of yellow cloud, while the northern is pure white snow. Immediately north of the three great marshes which bound the northern cap snow soon turns light bluish. A dense haze covering the whole planet is sometimes seen, lasting for days or even weeks at a time.

Acidalium will soon turn bluish gray near the snow, and later the whole marsh will take on a very striking deep blue color. The greens of the maria soon become very pronounced. The two dark marshes, Boreosyrtis and Propontis, presently begin to turn blue, but never as

markedly so as Acidalium. Cerberus, which is in latitude just to the north of the equator, remains brown. In 1913 and 1915 Propontis was widely and obviously doubled and lengthened, its southern end moving slowly towards the west, thus changing its position angle on the planet. See Report No. 4. After ⊙ 10°, Martian Date March 21, the greens of the maria were thought to be less marked, possibly due to haze. By ⊙ 17°, Sabaeus had turned to a clear chocolate brown, of the color of freshly upturned soil. Clouds were seen rising from, and following the three northern marshes. Euxinus was a dark gray, neither green nor brown. The maria preceding and following it were greenish, but not markedly so. By ⊙ 20°.4 the greens of the maria were again strongly marked. At ⊙ 22°.7 March 47, Euxinus turned a conspicuous dark blue, and changed the location of its preceding border. The changes in color and extent of this marking are at certain seasons quite frequent, although the blue is of short duration, and should be watched for at all stations and carefully drawn, since the cause is unknown, although believed to be due like the greens to vegetation. A change of boundary towards the south is also sometimes quite rapid. The canal Thoth was recorded as brownish.

At ⊙ 29°.6, M. D. April 6, Lunae was also brown, the southern pole was recorded as dark greenish gray, and darker than the terminator, which was darker than the center of the disk. White clouds were recorded, which were not at all yellow. By ⊙ 32°.8 the maria had turned light green and the torrid regions were covered by a light general shading. A few days later the greens were no longer conspicuous. Broad faint bands crossed the northern deserts. The dark boundary to the melting snow had partly disappeared. At ⊙ 34°.6, Sabaeus was still a clear brown, Acidalium blue, followed by a conspicuous cloud, there was no pronounced green, and the south pole was very dark. Four days later Euxinus had vanished, and the Syrtis had at last turned green, M. D. April 20. Since the Syrtis is in the northern torrid zone, this was its spring. On M. D. April 38, Cerberus was still brown and Propontis had vanished. The last record was made on Martian Date May 43, diameter of the planet 5″.9. The maria were still recorded as green, but on account of the planet's distance the record is somewhat uncertain. At the next apparition in 1915, ⊙ 12°.0, M. D. March 25, the Acidalium marsh showed clear evidences of polarization, indicating thereby a free liquid surface, doubtless water. This only shows at rare intervals, presumably when the marsh is sufficiently full of water.

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