REPORT ON MARS, NO. 43.

By WILLIAM H. PICKERING.

Drawings of the Apparition of 1926, Continued.

This opposition occurred on November 4, but the planet was nearest to the Earth on October 27, when its diameter was 20″.4, or about four-fifths of what it had been at the previous opposition. This was still unusually near, however, and favorable for investigation. The solar longitude ☉ was 326°.0, corresponding to M.D. January 49, but as the southern hemisphere was turned strongly towards us, latitude —19°.7 being central, we had to do chiefly with summer conditions on the planet. The vernal equinox which occurs at ☉ = 0°, M.D. March 1, did not arrive until February 1, 1927, when the planet's diameter was reduced to 8″.6. The southern hemisphere was therefore having its very hottest weather, and the northern its coldest, although we could not see the latter to much advantage. After September 10, when the solar longitude was 280°.3, and the planet's diameter 15″.7, it was nearer us than it had been in 1924 at the same season of its year. The average date of the drawings was October 30, or five days before opposition. In 1924 it was eleven days afterward. The difference is possibly in part due to the suggestion of the writer that early observations of the planet were likely to show more interesting changes than those made later in the planet's year. If the difference in the date is due to this cause, we trust that the various observers were not disappointed.

Our last Report was published in order to give early information of certain changes and shifts of the markings observed in 1928, for the benefit of other observers. It therefore appeared out of its chronological sequence. The present Report is really a continuation of No. **41**, and, as we have done on a previous similar occasion, the drawings of the various observers will be numbered in continuation of those given in the earlier Report, beginning with number 25, and will be discussed in connection with them. A third new observer, Mr. B. M. Peek, in addition to Messrs. M. A. Ellison and F. J. Hargreaves whose work has already been published, has sent in some very good drawings, showing many canals and a great many lakes. Owing to the otherwise regrettable delay in the appearance of this publication, we have been fortunate in securing five excellent drawings made by the well-known French observer, M. E. M. Antoniadi, taken from the December number of *L'Astronomie*. His work is available because he has now apparently adopted our plan of making drawings differing in longitude by 60°, and beginning with the longitude 0° for the central meridian. There is only one drawing which differs seriously, by 28°, from its required position. But one longitude, that for 240°, is omitted, presumably because he

PLATE XIX

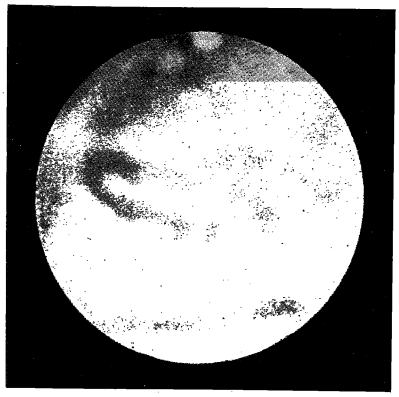

Fig. 25
Antoniadi 0° A

Fig. 26
Peek 5° A

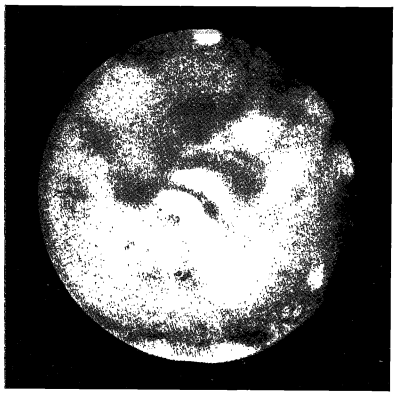

Fig. 29
Antoniadi 75° B

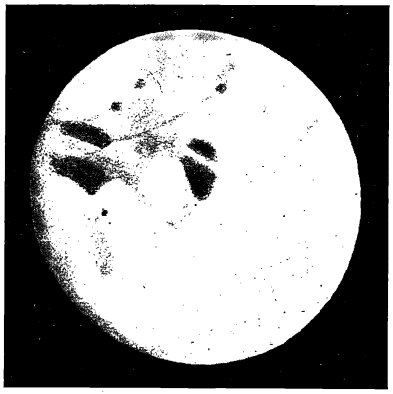

Fig. 30
Peek 82° B

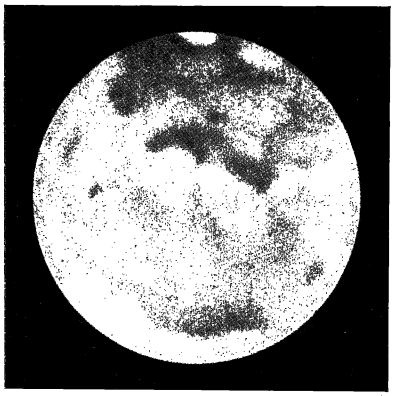

Fig 33
Antoniadi 148° C

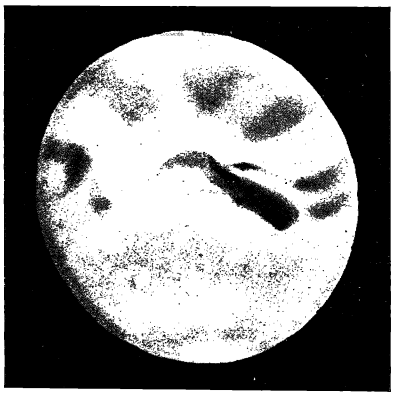

Fig. 34
Peek 136° C

DRAWINGS OF MARS IN 1926.

POPULAR ASTRONOMY, No. 370.

PLATE XX

Fig. 27
Attkins 343° **A**

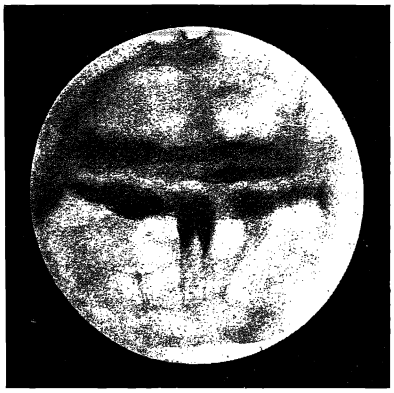

Fig. 28
Wilson 0° **A**

Fig. 31
Attkins 74° **B**

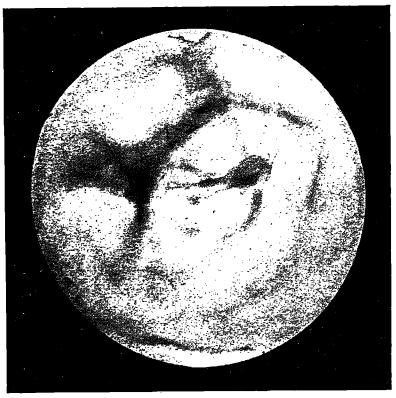

Fig. 32
Wilson 60° **B**

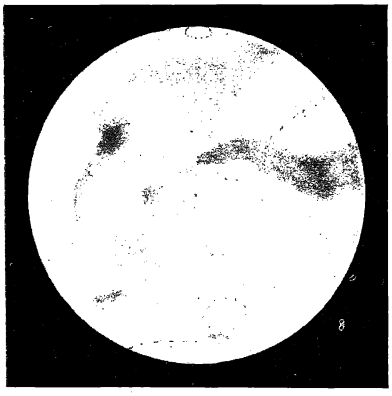

Fig. 35
Attkins 136° **C**

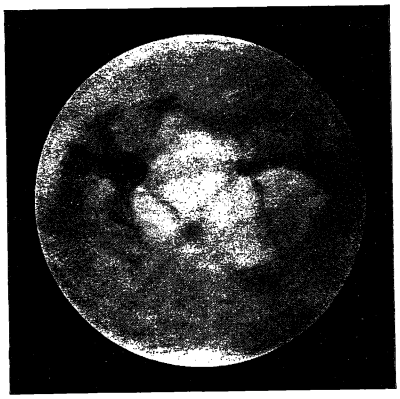

Fig. 36
Wilson 118° **C**

DRAWINGS OF MARS IN 1926.

could obtain no satisfactory drawing of it. He gives an interesting drawing in its place, but one not suitable for our work.

His drawings are instructive because made with the largest refractor in the eastern hemisphere, and are perhaps the best secured at this apparition in continental Europe, certainly the best I have seen. They would be very important indeed, if his seeing were good enough to take advantage of the large size of his aperture. Such, however, is not the case, but his skill as an artist and observer is such that the drawings give an excellent idea of how the planet looks when the seeing is fair, but not really first class. Indeed they closely resemble some by the late M. Trouvelot made at Harvard many years ago with the 15-inch refractor, and published in the *Harvard Annals* at that time. The seeing at Harvard was less favorable, however. M. Antoniadi gives the quality of his seeing only relatively and by description, but not on the Standard Scale. On one date, however, it must have been fairly good, because on that drawing are shown as many as 20 canals that are confirmed by other observers. Throughout the world the seeing improves as we approach the tropics, and get farther and farther away from the anticyclones of the temperate zones. Thus in our southern states the seeing is much better than it is in the north, and better still as we go west, and get still farther away from the anticyclone tracks. We should expect the same to be true in Europe, and undoubtedly the seeing is better in Italy than in more northern countries. A curious exception to this rule, however, occurs in the case of the British Isles, and it is surprising that there, when they do get clear skies, the seeing appears to be appreciably better than it is in central France. Undoubtedly the moisture of their climate is largely responsible for this, giving small hourly changes of temperature. This is statistically the case in Jamaica, where our very best seeing occurs, as noted elsewhere, on our very wettest nights. Our Ceylon correspondent, Dr. F. O'B. Ellison, informed me in 1924 that it was probable that his drawings in 1926 would be very materially interfered with by the coming monsoon. This unfortunately has proved to be only too true, two of his six drawings, however, are good, and one of them, which is of about the same quality as those taken from *L'Astronomie,* has been inserted to fill the vacant space in M. Antoniadi's series.

During this apparition it may be noted that low magnifications were used as a rule, although Dr. Trumpler on three occasions used 520, and one other observer used 500. The lowest power used was 175 with a 6.5-inch aperture. The magnification that should be employed depends of course on the character of the detail, but also somewhat on the size of the planet. When the latter was very remote I have used even as high as 600 with an 11-inch aperture, but 55 diameters to the inch requires very good seeing indeed, as well as a good instrument.

DESCRIPTION OF THE DRAWINGS.

The designations, names, addresses, and equipment of the observers are as follows:

Ad. M. E. M. Antoniadi, L'Observatoire Astronomique, Meudon, France. 32.7-inch refractor by the MM. Henry.

Pe. B. M. Peek, F.R.A.S., Gorse Cliff School, Herne, Kent, England, since removed to Sohan, Silhill Hall Rd., Solihull, Birmingham. 12.2-inch reflector by Linscott. Magnifications 225, 300. Seeing 2 to 8.

Ak. E. A. L. Attkins, F.R.A.S., 2 Outred Villas, Squirrel's Heath, Romford, Essex, England. 8.5-inch reflector by Dall. Magnifications 480 and 330. Seeing on the Standard Scale 5 to 10.

W. L. J. Wilson, Esq., Box 62, Franklin, Kentucky, U. S. A. The drawings were made at Nashville, Tennessee. 11-inch reflector, without clock, made by himself. Magnification 350. Seeing on the Standard Scale 7 and 8.

D. Professor A. E. Douglass, University of Arizona, Tucson, Arizona, U. S. A. 36-inch reflector by Brashear, but used with an aperture of 13 inches. Magnification 225. Seeing on the Standard Scale 5 to 9.

E. Dr. F. O'B. Ellison, Colombo, Ceylon. 12-inch reflector. Mirror by the Rev. W. F. A. Ellison, mounting by himself. Magnifications 275 and 500. Seeing on Standard Scale 6 to 8.

N. K. Nakamura, Esq., Astronomical Observatory, Imperial University, Kyoto, Japan. 12.8-inch reflector by Calver. Magnifications 222 and 405. Seeing on the Standard Scale 7 to 13.

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.** In Table I is given a statement of the main facts relating to the various drawings. This 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 Greenwich Civil 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.	Obs.	Aper.	Magn.	Seeing	1926	Reg.	Long. °	ΔLong. °	Lat. °	Diam. ″	☉ °	M.D
25	Ad	32.7			Nov. 15.7	A	0.7	0	—18	19.1	319.2	Jan. 37
26	Pe	12.2	300	5	Nov. 25.0	A	5	+ 5	—20	17.6	324.9	Jan. 47
27	Ak	8.5	480	10	Nov. 22.9	A	343	—17	—19	17.9	323.7	Jan. 45
28	W	11.	350	8	Oct. 21.9	A	0	0	—14	20.3	305.6	Jan. 14
29	Ad	32.7			Dec. 15.7	B	75	+15	—20	14.3	335.6	Feb. 10
30	Pe	12.2	300	8	Oct. 7.0	B	82	+22	—13	19.1	296.7	Dec. 54
31	Ak	8.5	480	5	Nov. 14.9	B	74	+14	—18	19.1	319.2	Jan. 37
32	W	11.	350	8	Oct. 20.2	B	60	0	—20	20.2	304.4	Jan. 12
33	Ad	32.7			Nov. 1.8	C	148	+28	—16	20.3	311.2	Jan. 23
34	Pe	12.2	300	5, 6	Oct. 3.0	C	136	+16	—12	18.6	294.3	Dec. 50
35	Ak	8.5	480	8	Nov. 10.0	C	136	+16	—18	19.7	316.5	Jan. 32
36	W	11.	350	8	Nov. 17.1	C	118	— 2	—19	18.8	320.4	Jan. 39
37	Ad	32.7			Dec. 6.7	D	178	— 2	—20	15.7	330.8	Feb. 1
38	Pe	12.2	300	6, 7	Nov. 2.0	D	199	+19	—16	20.3	311.9	Jan. 24
39	Ak	8.5	330	7	Nov. 1.9	D	190	+10	—16	20.3	311.9	Jan. 24
40	W	11.	350	8	Nov. 12.2	D	181	+ 1	—18	19.6	317.5	Jan. 34
41	E_2	12	275, 500	6, 8	Nov. 26.7	E	237	— 3	—20	17.3	325.4	Jan. 48
42	Pe	12.2	225	2, 4	Oct. 26.9	E	237	— 3	—15	20.4	308.4	Jan. 19
43	Ak	8.5	480	8	Dec. 4.9	E	255	+15	—20	16.0	330.3	Feb. 1
44	W	11.	350	7	Nov. 6.2	E	244	+ 4	—17	20.0	314.2	Jan. 28
45	Ad	32.7			Oct. 19.9	F	292	— 8	—14	19.8	303.7	Jan. 11
46	Pe	12.2	300	4, 6	Oct. 21.9	F	284	—16	—14	20.3	305.5	Jan. 14
47	Ak	8.5	330	6, 7	Oct. 20.9	F	276	—24	—14	20.3	304.9	Jan. 13
48	W	11.	350	8	Nov. 1.2	F	300	0	—16	20.3	311.4	Jan. 24
49	D	13.	225	7, 8	Oct. 26.2	A	347	—13	—15	20.4	307.9	Jan. 18
50	N	12.8	222	8, 9	Nov. 8.6	A	3	+ 3	—17	19.9	315.3	Jan. 30
51	D	13.	225	8, 9	Oct. 18.2	B	61	+ 1	—14	20.1	303.2	Jan. 10
52	N	12.8	222, 405	11,13	Nov. 2.8	B	57	— 3	—16	20.3	311.9	Jan. 24
53	D	13.	225	8, 9	Oct. 12.2	C	114	— 6	—13	19.6	299.7	Jan. 4
54	N	12.8	222, 315	9, 12	Oct. 25.7	C	124	+ 4	—15	20.4	307.3	Jan. 17
55	D	13.	225	5, 6	Oct. 12.4	D	167	—13	—13	19.6	299.8	Jan. 4
56	N	12.8	222	8, 10	Oct. 19.6	D	178	— 2	—14	20.2	303.8	Jan. 11
57	D	13.	225	7	Nov. 2.1	E	236	— 4	—16	20.3	312.0	Jan. 25
58	N	12.8	222, 315	8, 9	Oct. 10.5	E	238	— 2	—13	19.4	298.5	Jan. 2
59	D	13.	225	8, 9	Nov. 1.2	F	287	—13	—16	20.3	311.4	Jan. 24
60	N	12.8	222	7, 9	Nov. 9.4	F	302	+ 2	—17	19.8	315.9	Jan. 31

OUR PRESENT MAPS OF MARS.

The largest part of the work in the preparation of this Report by far lay in the identification of the various canals and lakes. On the sixty different drawings it was found that there were 847 identifications of 189 canals, and 318 identifications of 110 lakes. The difficulty of this work was enormously increased by the lack of any suitable map of the region observed. Such a map must show not only the canals and lakes themselves, but must also furnish short legible names by means of which they may be described. With so many canals as appeared in 1926 it was obviously impossible to continue the use of Flammarion's and Antoniadi's map, published in Flammarion's *Mars II* and in Report No. **15**. This map contains 120 canals in all, and of these only 58 were drawn by the twelve observers in 1926,—all the others were different. We must, therefore, go back to Lowell's maps for our identifications, but

there are several objections to their form of publication, or to their use for general purposes. In the first place there are half a dozen of them scattered through his three massive volumes of *Annals,* and there is no one map of the southern hemisphere showing even all the chief canals. Again they are reproduced by the half-tone process, and are too faint. A photographic copy of any one of them would be quite illegible. Finally many of his canals were not seen at all this year, and many more were seen which he never recorded. As a result, if, as is thought may be the case, many of the fainter canals are merely shower tracks, then these properly speaking will never be seen again, although other showers may occur in nearly the same places. Fortunately a Danish lady, some years ago, Miss Brun by name, very kindly presented me with a large globe which she herself had painted, showing very distinctly all of Lowell's canals. This globe was based on unpublished photographs of drawings upon a globe made by Lowell himself, and has been of the greatest assistance in the work of identification, and has enabled me to avoid searching through all his maps, and photographs, and perhaps of not finding the proper canal after all. Of other maps that of Jarry-Desloges is clear, but shows only his own canals, and the names in many cases are different from those to which we are accustomed. Trumpler's recent map shows also only those canals seen by himself, and gives very few names. Obviously a new map brought up to date, showing all the canals that have appeared recently on Mars, and omitting all those that have not been seen for years, and may perhaps never be seen again, is badly needed. It is hoped to supply such a map in one of our forthcoming Reports, but until it appears those of my readers who have not access to all the maps above specified will have to accept the names here given without any indication, other than the letters from **A** to **F**, of the location of many of the corresponding canals.

Identification of the Canals and Lakes.

It should be recognized that an identification is not merely a matter of recording what marking on a given map most nearly resembles a marking in a drawing. Suppose that we have two drawings and both differ from the map, and still more from one another. How much difference shall we allow before we conclude that the drawings represent different objects? Take for example the canal Peneus in the following side of Hellas, which both Schiaparelli and Lowell represent on their maps as straight, and running nearly east and west. Phillips draws a canal in about the same place, Report No. **41**, Figure 21, strongly concave to the north, while if it were really straight it should appear concave to the south. Trumpler draws a straight canal, Figure 24, pointing towards the edge of the polar cap and in the photograph of his original drawing perhaps connecting with it. Are they the same canal, and is it a case of confirmation, or are they two separate unconfirmed canals counting against both observers? Nakamura, Figure 60, on this point partly confirms Phillips. Again in the same drawings Trumpler draws the

marking Rha, southeast of Hellas and near the limb, as a well-defined canal. Phillips draws what is evidently the same marking as a broadened area which we should never think of calling a canal. If we credit Trumpler, as seems natural, it seems as if we should credit Phillips also. But how about Douglass' still broader area extending farther both east and west than Hellas, but excepting for its width resembling Trumpler's? He has of course always seen the canals wider than other observers, but should he be ruled out in this concrete case? He appears to me to have drawn the canals in general narrower this year than heretofore.

Trumpler like Schiaparelli and Lowell draws them very narrow, but he at least generally makes some difference in their breadth, which the other two, with a few exceptions, did not. In 1924 with the Harvard 11-inch I drew them of about the same width as he did in regions **A, B,** and **F,** but wider in **D** and **E.** My seeing when the latter drawing was made was poor, which probably accounts for the difference in that case. Trumpler furnished no drawing of region **C.** In 1926 with my 12-inch reflector, only in the case of **E** did I draw them nearly as narrow as he. In that case my seeing was good, and his rather unusually poor. The difference in the two years was obviously due in my case to the inferior defining power of a reflector as compared with a refractor. Nevertheless by the use of the electric fan, driving the warm air out of my tube, I am hoping to get some narrow canals at future apparitions. My impression is that, if Trumpler and I were to look at Mars under favorable weather conditions with either the 11-inch refractor or the 36-inch, the canals would appear to us with either instrument of about the same width, as was the case when we were using different instruments in 1924. Since, moreover, we both drew the canals of all degrees of width, I believe that the widths shown were really nearly correct. Some were as fine as they could be drawn, but whether these were really too wide or too narrow we have at present no certain means of judging. With poor seeing a dark line drawn on paper appears rather narrower than it really is. Moreover since the canals are not black on white, but presumably gray on yellow, this would also tend to make them appear narrower than they really are. On a 2-inch drawing of Mars the width of a pencil line ranges from 20 to 30 miles. Measures of some of the better drawings made in 1924, when the planet was near us, indicate that, since some of the canals were narrower than it was possible to draw them even on a 3-inch disk, the widths of the narrowest were less than 10, and possibly in some cases as narrow as 5 miles.

Since as we know even prominent canals sometimes shift their location on the planet, and since, moreover, Martian clouds or heavy precipitation will sometimes entirely conceal a region from one observer, and a few days later reveal it to another, unless allowance is made for these facts, identification may occasionally become very difficult. To illustrate this latter point, all of the canals in Aurorae shown in my drawing, Figure 7, and drawn on November 27, diameter of the planet

17".3 (see Report No. **41**) were masked and blotted out by a dense precipitation, doubtless of water, darkening the whole region. No one else drew this area as late as that, but Attkins' drawing, Figure 31, and Ellison's Figure 6, dated November 15 and 16 respectively, show nothing of the kind. December 28 dense clouds covered the region, and it was nearly as bright as the deserts, but by January 2, 1927,these had cleared away, and the precipitation had again appeared in all directions, completely covering even Thaumasia, no canals, and not even Solis being visible, although the central meridian was 60°, central latitude —19°.7, and diameter of the planet 11".7. A similar darkening of Libya has been recorded by many observers.

In the actual process of identification, when difficulties arise, it is often best to begin with the lakes shown, and after we have settled on their names, the names of the neighboring canals will become obvious. Thus in the case of Figures 5 and 7 the canals at first would not identify at all. The two most northerly lakes in the former are Lunae and Ascraeus, and we might naturally suppose that the same was true in the latter. The large northern lake in Figure 7 is Ascraeus, which has grown appreciably in size in the seven weeks since the earlier drawing was made. The other lake, however, is not Lunae, but Nilacus, connecting with Margaritifer by means of Indus. Lunae is shown above and between the two. It is drawn nearly in line between Ascraeus and Aurorae. In Figure 5 it is drawn well to one side. Both drawings are somewhat out of proportion in this respect, something about half-way between the two being correct. Having settled that, we find that the little lake north of Solis in Figure 7 is Pynx, which, however, seems to have increased its longitude by about 3°, or 130 miles if Lowell's location was correct, or else on the other hand is a new and more recent formation. The canal Catarractus joining it to Solis was not there in 1924, although observed many years previously by Lowell, who named it. Pynx had not developed at all when Phillips' drawing was made, but he shows three others Maesia, 118, and Phoenix not shown in Figure 7. Several of the canals in the latter drawing do not appear in that of Phillips. The surface of the planet in fact had changed materially between the two dates, and in that sense the drawings are not comparable, but the canals which fail to identify with one another in the drawings all show clearly when properly identified on the little 8-inch globe. This illustration is given as an example of a rather unusually troublesome identification, yet one which when correctly solved came out in a very satisfactory manner. In most cases, however, where all the drawings are made at about the same time, or when the planet is changing slowly, as at the time of the solstices, identifications are comparatively direct and easy.

The identification of all of the canals in each of the sixty drawings is given in Table II. The third and following columns are headed by the designations of the various observers, and each contains the letter or letters indicating the regions in which the canals are found. These let-

PLATE XXI

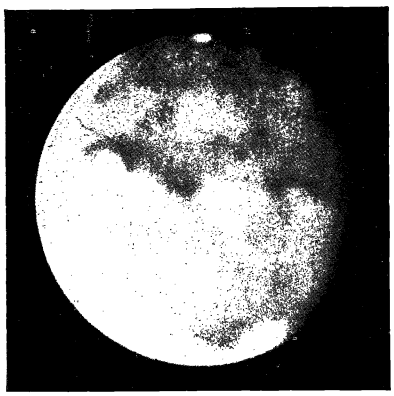

Fig. 37
Antoniadi 178° **D**

Fig. 38
Peek 199° **D**

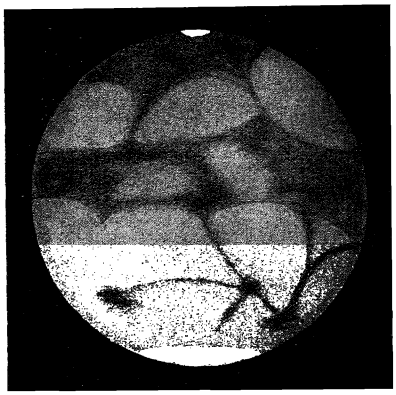

Fig. 41
Ellison$_2$ 237° **E**

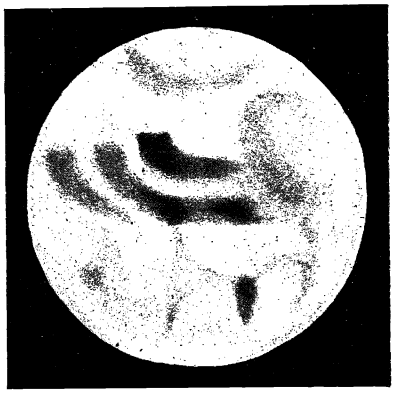

Fig. 42
Peek 237° **E**

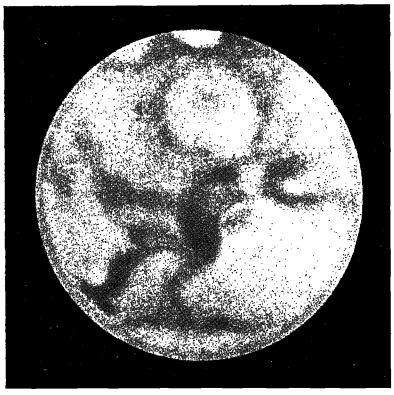

Fig. 45
Antoniadi 292° **F**

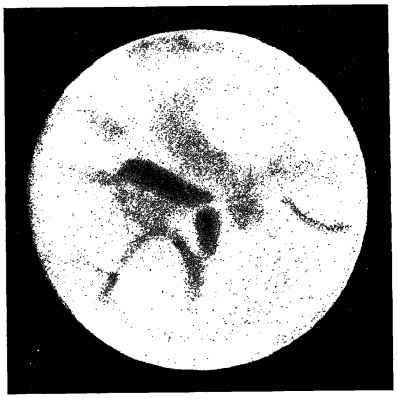

Fig. 46
Peek 284° **F**

DRAWINGS OF MARS IN 1926.

POPULAR ASTRONOMY, No. 370.

PLATE XXII

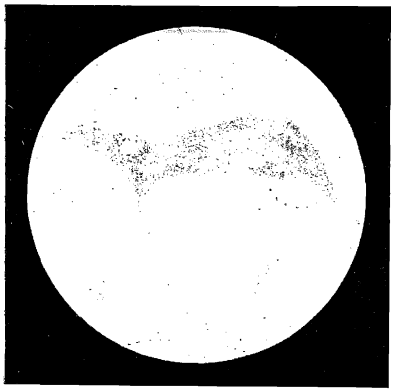

Fig. 39
Attkins 190° **D**

Fig. 40
Wilson 181° **D**

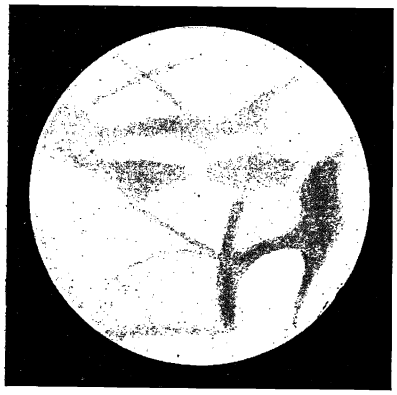

Fig. 43
Attkins 255° **E**

Fig. 44
Wilson 244° **E**

Fig. 47
Attkins 276° **F**

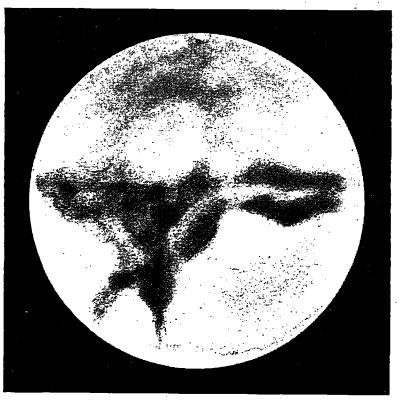

Fig. 48
Wilson 300° **F**

DRAWINGS OF MARS IN 1926.

ters are given in Table I, and also under the drawings themselves. In the last column is given the number of observers who saw each canal, thus indicating its relative visibility. Where the work of two observers supplements one another, as in the case of Ellison$_3$ and Hargreaves, if both saw the same canal, it counts as only one. Lowell recorded many canals by number which were never named. These numbers are given after the named canals, but numbers 13, 14, and 15 refer to Report No. **35**, Figure 50. Finally certain canals not found on any previous map are indicated by capital letters.

TABLE II.

CANALS IDENTIFIED IN THE DRAWINGS.

No.	Canal	Ph.	E$_3$.	H.	Pk.	T.	Ad.	E$_2$.	Pe.	Ak.	W.	D.	N.Ob.
1	Abas			D		CD			CD				3
2	Achates	EF	F		EF	E	EF	E		E	E	EF	F	9
3	Acheron						D							1
4	Adamus	E			E								E	3
5	Aegyptus									A				1
6	Aesculapius			D		D					D	D		4
7	Aethiops		E			E			E		E	E	E	6
8	Agathodaemon	BC	BC		BC	B	B			B	C	BC	BC	9
9	Alpheus					F								1
10	Ambrosia	BC				B					BC	C		4
11	Amenthes	E				F				EF		EF	F	5
12	Anubis		F			F	F							3
13	Arabice									A	A			2
14	Araxes	BC	BC		C	C	BC		BC	C	BC	CD	C	10
15	Arges		C		D					D	D			4
16	Arius						F							1
17	Asopus					F	F							2
18	Astaborus											AF		1
19	Astapus					F	F		F	F		F		5
20	Australe	B			B	B						B		4
21	Avernus		E										D	2
22	Axon									C	D	D		3
23	Baetis					B				B	B	B	B	5
24	Balyra	BC				CD	B		D	C	C			6
25	Bathys										BC			1
26	Bradanus	AB	B	A	AB	AB			AB			AB	B	7
27	Brontes			D							D		C	3
28	Caicus				C	B	B					B		4
29	Calydon				BC					C	C			3
30	Cantabras	A									A		A	3
31	Casuentus								E					1
32	Catarractus	BC	B		BC	BC	B		BC	BC	BC	BC	BC	10
33	Cenion					CD			D				C	3
34	Centritis				F							EF		2
35	Cerberus			D		D				D	D	D	DE	6
36	Cestrus	B	B		A	AB					B	B	B	7
37	Chronium	D	C	D	D	CD	CD			D	C	CD	CD	9
38	Chrysorrhoas				C	B	B				B	B		5
39	Cimbus								D			D	D	3
40	Clitumnus					B	B			B				3
41	Clymene	EF	E			F	F				E	F		6
42	Cocytus						F							1
43	Coptos					C								1
44	Cyclops		E		E	E					E	E	E	6
45	Cyrus				C	B								2

TABLE II.—CONTINUED.

CANALS IDENTIFIED IN THE DRAWINGS.

No.	Canal	Ph.	E_3.	H.	Pk.	T.	Ad.	E_2.	Pe.	Ak.	W.	D.	N.Ob.	
46	Dargamanes										B			1
47	Dargidus	E			F					F	F			4
48	Djihoun	A		A		A			A	A		A	A	7
49	Dosaron		F			F								2
50	Draco	BC										C		2
51	Drahonus					C								1
52	Dyras										F	F		2
53	Eosphoros	BC	BC		C	C			BC	BC	C	C	C	9
54	Erannoboas						A							1
55	Erebus	D			E									2
56	Escol					C								1
57	Eumenides	BC		D	CD					D		D	D	6
58	Euphrates		F							A			A	3
59	Euripas	F			EF		F			F				4
60	Fortuna				BC					C				2
61	Ganges	B	B		B				B		B	B	B	7
62	Garrhuanus		B	A		AB			A		A	AB	B	6
63	Gelbes									D	D			2
64	Gehon	A								A			A	3
65	Gigas				BCD							CD		2
66	Glaucus	C				C	B			B	B	C	BC	7
67	Glesus		E			E					E	E		4
68	Gorgon												C	1
69	Helisson		E			E		E	E			EF		5
70	Helorus								B				B	2
71	Hephaestus												E	1
72	Hiddekel		F									A		2
73	Hyblaeus		E										E	2
74	Hypsa				D			E			D	F	E	5
75	Hyscus					D					D	C	C	4
76	Indus		B		B	A				B	A		B	6
77	Iris											C		1
78	Jala								A					1
79	Jamuna					AB			B	B	B			4
80	Jatrus		C				C							2
81	Kanah	A		A	A	AB	A		A	A		AB	B	9
82	Kedron											C		1
83	Labotas					A				A	A		A	4
84	Laestrigon	DE			E	D	D			D	DE	E	DE	8
85	Laus					E								1
86	Leontes		E			E					E			3
87	Lethes				F							E		2
88	Libicum					F							E	2
89	Malva			D		CD							D	3
90	Nar	E								E				2
91	Nectar	BC	B		BC	B	B		B	BC	BC	BC	BC	10
92	Nepenthes	EF	EF		EF	EF	F	E	EF	EF	EF	EF	EF	10
93	Neudros			A		A					A	AB	A	5
94	Nilokeras					B				B				2
95	Nilosyrtis	F	F		F	F	F				F	F	F	8
96	Nilotis	F	F		F	F	F				F	F	F	8
97	Nus	DEF	EF		E	EF	F	E	EF	E	E	EF	E	10
98	Oescus		E			DE					D			3
99	Orcus					E				D	E		D	4
100	Orontes	A							A	A	A			4
101	Orosines		F								EF	F		3
102	Orpheus	C							C					2
103	Oxus						A				A			2

TABLE II.—CONTINUED.

CANALS IDENTIFIED IN THE DRAWINGS.

No.	Canal	Ph.	E_3.	H.	Pk.	T.	Ad.	E_2.	Pe.	Ak.	W.	D.	N.Ob.
104	Pactolus	DE	E		DE	E		E	D	E		E	8
105	Peneus	F											2
106	Phasis	C	C			C						BC	5
107	Phison	A		A		F			A	A		F	7
108	Phryxus						B						1
109	Pingus				B				C	C	C	B	5
110	Plutus				D						CD	C	3
111	Psychrus										D		2
112	Pyretus					EF				F	E		3
113	Rha	EF	EF		E	EF	F		F	E		F	8
114	Rhesus						F						1
115	Saeprus						F			F	F		3
116	Sambus	AF	F	A	F	AF			A	A	A	AF	9
117	Saus	C	C		CD	CD							4
118	Scamander				E		D			E		D	4
119	Sindus									D			1
120	Sirenius		C									C	2
121	Stachir											D	1
122	Steropes						D				CD	D	4
123	Styx	DE	E		DE	D				D		DE	6
124	Tartarus	CD			D	D	C				D		5
125	Thermodon				D								1
126	Thoth	EF	EF		EF	EF	F	E	EF	EF	E	EF	10
127	Triton					EF	F	E	EF		EF	F	5
128	Typhonius	AF		A					AF	A			4
129	Uranius				B								1
130	Vitis						B				C	C	3
131	Xanthus	E			E	E				E		E	6
132	13											B	1
133	14	BC				B			B			B	5
134	15										B		1
135	531		B						B			B	3
136	534	A		A	A					A		A	5
137	537					B						B	2
138	540	B											1
139	543					A							1
140	547	BC	B		BC	B			BC		B	BC	7
141	563					A							1
142	565					B							1
143	569					C							1
144	581					C							1
145	583		C		C	CD						C	4
146	585											D	1
147	594					D							1
148	602	C	C				C						3
149	609									E			1
150	611		C			C	C				E	DE	5
151	619					D							1
152	624	E	E	D	D	E		E				F	6
153	628		E			E					E		3
154	639					E					EF	E	3
155	640		E								E		2
156	642					EF					F		2
157	644					E	F						2
158	647					F							1
159	649	EF	EF			F			F		F		5
160	651	E	EF			EF	F			EF		F	6
161	655		F			F							2

TABLE II.—CONTINUED.

CANALS IDENTIFIED IN THE DRAWINGS.

No.	Canal	Ph.	E_3.	H.	Pk.	T.	Ad.	E_2.	Pe.	Ak.	W.	D.	N.	Ob.
162	663	F			F	F	F		F			F		6
163	664					F					F	F		3
164	666	F	F			F	F		F					5
165	667				F	F								2
166	670		F		F	F	F		F	F	F	F	F	9
167	671	F	F			F					F			4
168	674						F							1
169	690									A				1
170	704	C	C		C					C	C	C		6
171	A	E	E		E	E		E	E		E	E		8
172	B										A	A		2
173	C	AB	B		A	A	AB		A	A	AB	AB	B	10
174	D					A								1
175	E			D										1
176	F			A							A	A	A	4
177	G	A				A								2
178	H					CD								1
179	I					A								1
180	J								E		E			2
181	K					CD								1
182	L					D								1
183	M					C								1
184	N					D								1
185	O	E	E		E	E		E	DE	E	E	EF	E	10
186	P		E			F	F							3
187	Q										D			1
188	R		E		E			E		EF		F		5
189	S					F								1

Information regarding the number of canals recorded by each observer is contained in Table III. In this table it was found necessary to combine the work of Ellison[3] and Hargreaves, the latter having furnished two of the six drawings forming the set. A similar combination

TABLE III.

THE NUMBER OF CANALS RECORDED.

Obs.	Ph	E_3H	Pk	T	AdE_2	Pe	Ak	W	D	N	Total
10	8	8	8	8	8	8	8	8	8	8	8
9	6	7	7	7	5	4	7	6	7	7	7
8	6	5	6	6	6	3	3	4	6	3	6
7	7	6	4	6	1	5	3	4	7	6	7
6	9	11	8	12	5	4	8	8	11	8	14
5	7	8	6	13	9	7	6	9	12	7	16
4	8	8	8	13	3	3	9	13	10	6	21
3	4	12	3	12	6	4	7	14	7	9	26
2	6	8	7	11	4	3	5	9	8	7	34
1	1	1	2	21	7	2	4	4	6	2	50
Totals	62	74	59	109	54	43	60	79	82	63	189
Confirmed	61	73	57	88	47	41	56	75	76	61	139
Order	5	4	7	1	9	10	8	3	2	6	...
Aperture	8,12	10	10	36	33	12	8.5	11	13	13	...
L or M	L, M	L	M	L	L	M	M	M	M	M	...

Obs.	Ph	E_3	H	Pk	T	Ad	E_2	Pe	Ak	W	D	N
Percent	2	0	5	3	19	15	0	5	7	5	7	3

is made of the work of Antoniadi and Ellison$_2$, the latter having furnished one of the drawings. In the first column the canals are divided into groups according to their visibility as determined by the number of observers who recorded them. Thus all of the 10 sets of drawings show eight of the canals. Each one of these eight canals may therefore be described as being of visibility 10. The last column gives the total number of canals in each of the ten groups. As has been noticed in other years these numbers first diminish and then rapidly increase. To make the contents of the table a little clearer, we see for example by the fifth column that the fourth set of drawings which was furnished by Trumpler shows 12 canals in group 6, the total number contained in that group being 14. Douglass was the only observer who drew all of the 28 most readily visible canals, contained in the first four groups. Trumpler won by only one over him in the first six groups, and by only 12 in the whole confirmed series, which is rather striking when we have to compare a 36-inch lens with a mirror stopped down to 13 inches. Douglass uses an open tube. This probably could not be done with the Lick telescope, but it might be possible to get rid of the cold air currents within the tube by means of an electric fan or blower. There can be but little doubt that the air at the upper end of the tube is colder and denser than that near the bottom. That could at least be tried by thermometers. With my 10-foot tube the difference when I am not using the fan is from 1° to 2° Fahrenheit.

Following the ten groups the horizontal line of numbers marked Totals gives the total number of canals seen by each observer. Subtracting from these the numbers in the line above gives the total number of Confirmed canals by which we judge the set. Thus of Trumpler's 109 canals only 88 were confirmed by one or more of the other observers. Since he saw 17 per cent more confirmed canals than any one else, many of his 21 unconfirmed canals were doubtless real, and would have been confirmed had some other observer seen the planet equally well. If we had had the 11-inch Harvard refractor in Jamaica, with which Hamilton saw the same number of confirmed canals as Trumpler in 1924, doubtless many of his 21 unconfirmed canals would have been recorded as confirmed here. This refractor was returned to Harvard University at their request in 1925. The ten sets are ranked in the order of their confirmed canals in the next line. When two observers have the same number, as Phillips and Nakamura, preference is given to the observer having the smaller number of unconfirmed canals. The next two lines give the apertures of the telescopes employed,and a letter to indicate whether the instrument was furnished with a lens or a mirror. In the last two lines each of the twelve observers has a separate column, and the percentage of unconfirmed canals in his drawings is given. This percentage, except in the case of Trumpler perhaps, gives an idea of how indistinct a marking as seen in his telescope the observer would be willing to accept, and record as a genuine canal. It also indicates how far he was straining to record all the canals he could possibly

see. In general the smaller the percentage, the more reliable the observations will be of any unusual marking that he may record. Too much weight must not be given to these figures, however. Thus Douglass specializes on canals in the dark regions, which many observers find rather difficult to see. Peek records only two unconfirmed canals and Hargreaves only one. These numbers are obviously too small to give a reliable indication of the value of their work. Even four unconfirmed canals out of sixty or eighty is by no means a bad result, but merely suggests that care should be taken to draw only that which is certainly seen. In this connection it may be remarked that the only observers every one of whose canals was confirmed were the two Ellisons. Finally it must be remarked that the fact that a canal is not confirmed does not prove that it did not exist when drawn, for it is quite possible that no other observer was looking at the planet under favorable conditions when that particular canal was visible.

In Table IV the arrangement is similar to that in Table III, except that instead of giving the total number of canals seen by each observer, it gives the proportion of the total number recorded. These total numbers are given in the last column, and are taken directly from Table

TABLE IV.

PROPORTION OF THE CANALS VISIBLE TO THE DIFFERENT OBSERVERS.

Obs.	Ph	E_3H	Pk	T	AdE_2	Pe	Ak	W	D	N	Total
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	8
9	.86	1.00	1.00	1.00	.71	.57	1.00	.86	1.00	1.00	7
8	1.00	.83	1.00	1.00	1.00	.50	.50	.67	1.00	.50	6
7	1.00	.86	.57	.86	.14	.71	.43	.57	1.00	.86	7
6	.64	.79	.57	.86	.36	.29	.57	.57	.79	.57	14
5	.44	.50	.38	.81	.56	.44	.38	.56	.75	.44	16
4	.38	.38	.38	.62	.14	.14	.43	.62	.48	.29	21
3	.15	.46	.12	.46	.23	.15	.27	.54	.27	.35	26
2	.18	.24	.21	.32	.12	.09	.15	.27	.24	.21	34
1	.02	.02	.04	.42	.14	.04	.08	.08	.12	.04	50
Confirmed	.44	.52	.41	.63	.34	.29	.40	.54	.55	.44	1.00

III. The ideal observation would show the fractional proportions decreasing continuously. The last horizontal line of the table shows the proportion of confirmed canals that each observer contributed to the final result. It is deduced from the row of Table III marked Confirmed. The three remaining tables which pertain to the lakes are arranged exactly like their predecessors. Those designations indicated by numerals are given by the writer. A comparison of the last lines of Tables III and VI is instructive as indicating the characteristics of the work of some of the observers. Thus Phillips and $Ellison_3$, while extremely cautious about putting down what appeared to them to be doubtful canals, appear to have been less so with regard to the lakes, and to have put too much faith in fleeting impressions of this character. Hargreaves' drawings being merely supplementary to those of Ellison, and but two in number, showed only 8 lakes. One of these was unconfirmed, but

this obviously gives us and him no reliable information regarding his work. Trumpler again leads in unconfirmed percentage, but this time his confirmed lakes exceed in numbers very little those seen by Antoniadi, Phillips, and Wilson. In fact these observers may all four be

TABLE V.

LAKES IDENTIFIED IN THE DRAWINGS.

Lake	Ph.	E_3.	H.	Pk.	T.	Ad.	E_2.	Pe.	Ak.	W.	D.	N.Ob.
Apollinaris	C		D	D						D		4
Auri	B							A		B		3
Ascraeus	B			B					C			3
Acube		E				D				D		3
Bandusia						C				CD		2
Charontis	DE	E	D	DE	DE	CD	E	DE	D	DE	E	D 10
Cranon					D	D		D				3
Cyclopium	E											1
Cynia	E									E		2
Casuentus					F						F	2
Deltodon	F				F	F			F			4
Dirce						A						1
Drepsa					C			CD				2
Dium	E				D			D				3
Eleon						D				D		2
Ferentini									C			1
Gomer	E	E								E		E 4
Gordii				D								1
Hesperidum										F		F 2
Immortalis										E		1
Isos	C											1
Juturna									A	A		2
Juventae					B	B		B		B	B	B 6
Lunae	B			B	B	B		B				5
Lucrinus		E										D 2
Margaritifer	A				AB			A				A 4
Maesia	BC				B	B				B		B 5
Maricae										D		1
Messeis											B	1
Moeris	EF							F		EF		EF 4
Niliacus				B	A				AB	B		4
Nilus	F											1
Nitriae									CD			1
Nuba	E					F						2
Phoenix	BC	BC				BC		C	C	C	B	BC 8
Pudnu					C	C						2
Pseboas						F						1
Pnups					F							1
Regina					AF	F						2
Sirbonis						F			A			2
Triton	EF						E	F	F	E	E	E 7
Utopia			D							D		2
Zur					F							1
2										B		1
3	BC			C	BC			B		BC	C	BC 7
7										BC		BC 2
8	B				B	B		B				4
101	AF				F	F					F	4
102	A								B			2
103	A			A				A				B 4
104	A					A		B				3
105	BC				B	B				BC	B	B 6

TABLE V.—CONTINUED.

LAKES IDENTIFIED IN THE DRAWINGS.

Lake	Ph.	E_3.	H.	Pk.	T.	Ad.	E_2.	Pe.	Ak.	W.	D.	N.Ob.	
106	A			B	B			B					4
107					A								1
108					AB								1
109	A				A								2
110						A			A	A		A	4
111				B	B	B				BC		B	5
112					A	A							2
113				A		A							2
114												C	1
115					B								1
116						B							1
117	C			B				B		C			4
118	BC			B								B	3
119						B							1
120										B			1
121	C					C				C		C	4
122					CD	CD		C					3
123					CD	C		C					3
124	CD				CD	C					C		4
125					D	C							2
126					CD	C							2
127					CD			C					2
128												C	1
129			D	D	D	D		D	D	D		D	8
130			D							D			2
131			D							D			2
132			D										1
133					D								1
134	E			E									2
135					D								1
136						D							1
137	F									F			2
138	DE	E		E	E		E			E		E	7
139										F			1
140	E				E	E				F			4
141	EF				F	F							3
142										E			1
143	E												1
144	EF					F							2
145					CD	CD							2
146		E											1
147	F												1
148					E								1
149	F												1
150	A	F	A		F								4
151		F											1
152					F							F	2
153					F								1
154					F								1
155					F								1
156					F					F			2
157					F						F		2
158					F								1
159												A	1
160						F				F			2
161						F							1
162										F			1
163					B					A			2

TABLE VI.

THE NUMBER OF LAKES RECORDED.

Obs.	Ph	E_3H	Pk	T	AdE_2	Pe	Ak	W	D	N	Total
10	1	1	1	1	1	1	1	1	1	1	1
9	..	..	..	..	..	..	..	..	..	..	0
8	1	2	1	1	2	2	2	2	1	2	2
7	3	1	2	2	2	2	1	3	2	3	3
6	1	0	0	2	2	1	0	2	2	2	2
5	2	0	2	3	3	1	0	2	0	2	3
4	13	2	5	8	7	6	3	8	2	6	15
3	7	2	2	6	6	6	1	2	0	1	11
2	7	4	2	14	13	2	3	13	2	4	32
1	6	3	1	12	6	0	2	7	1	3	41
Totals	41	15	16	49	42	21	13	40	11	24	110
Confirmed	35	12	15	37	36	21	11	33	10	21	69
Order	3	8	7	1	2	5	9	4	10	6	...
Aperture	8, 12	10	10	36	33	12	8.5	11	13	13	...
L or M	L, M	L	M	L	L	M	M	M	M	M	...

Obs.	Ph	E_3	H	Pk	T	Ad	E_2	Pe	Ak	W	D	N
Percent	15	22	12	6	24	15	0	0	15	18	9	12

TABLE VII.

PROPORTION OF THE LAKES VISIBLE TO THE DIFFERENT OBSERVERS.

Obs.	Ph	E_3H	Pk	T	AdE_2	Pe	Ak	W	D	N	Total
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1
9	...	...	...	...	...	...	...	...	...	...	0
8	.50	1.00	.50	.50	1.00	1.00	1.00	1.00	.50	1.00	2
7	1.00	.33	.67	.67	.67	.67	.33	1.00	.67	1.00	3
6	.50	.00	.00	1.00	1.00	.50	.00	1.00	1.00	1.00	2
5	.67	.00	.67	1.00	1.00	.33	.00	.67	.00	.67	3
4	.87	.13	.33	.53	.47	.40	.20	.53	.13	.40	15
3	.64	.18	.18	.27	.27	.27	.09	.18	.00	.09	11
2	.22	.12	.06	.44	.41	.06	.09	.41	.06	.12	32
1	.15	.07	.02	.29	.15	.00	.05	.17	.02	.07	41
Confirmed	.51	.17	.22	.54	.52	.30	.16	.48	.14	.30	1.00

properly placed in one group. Since one-quarter of Trumpler's lakes are unconfirmed by others, it looks as if he were straining too much to exceed in numbers.

Antoniadi's is a very singular case. In our Report No. **35** (POPULAR ASTRONOMY, 1926, **34**, 289) we found that he could see very few confirmed canals compared to other observers, much fewer for example than Wilson, who used an 11-inch reflector against Antoniadi's 33-inch refractor. The few that Antoniadi did see were all confirmed, but he missed four canals that were seen by 4, 5, 6, and 7 other observers out of the 8 whose drawings were considered. With regard to the lakes he saw 23 in the region under discussion at that time, while no other observer saw more than 14. But 13 of these latter were confirmed by other observers, and only 12 of Antoniadi's. Hamilton, who secured this result, used the 11-inch Harvard refractor. Antoniadi's caution with regard to the canals was certainly not shown with regard to the lakes. This year he lost his former caution with regard to the canals

also, as we see by the lower line of Table III, and even then made no better showing than before, since with the aid of $Ellison_2$, who contributed one drawing out of the six, and saw 12 confirmed canals, Antoniadi and Ellison combined saw only 47 that were confirmed, and seven of these were contributed by Ellison alone. On the other hand, Attkins with an 8.5-inch reflector saw 56 canals that were confirmed by other observers. Probably if Antoniadi had cut his aperture down to 12 or 15 inches, as was done by Lowell, by Douglass, and by Jarry-Desloges, he would have seen more canals. With the lakes, however, this year he did very much better. Indeed I think he may fairly be said to head the list, for although Trumpler saw one more that was confirmed, yet he saw 12 unconfirmed lakes while Antoniadi saw only 6. Nearly all of the observers saw a larger proportion of unconfirmed lakes than they did of unconfirmed canals, which points the moral that more caution is needed when recording what we believe to be a lake. The chief sinners, those having 15 or more per cent of unconfirmed lakes, were in general those who saw the largest number, and who, I believe, strained too much in order to lead.

With regard now to the facility with which different observers are able to see canals and lakes, let us take the two extreme cases of Antoniadi and Douglass. Turning to Tables III and VI, we find by the line marked Order that for canals Douglass ranks 2, and Antoniadi 9. For lakes their positions are reversed, Antoniadi ranking 2, and Douglass 10. In the unconfirmed percentages Douglass makes much the better showing, for canals 7 to Antoniadi's 15, and for lakes 9 to again Antoniadi's 15. My impression is that Douglass does not look persistently enough for the lakes. There is no question, however, but that Antoniadi has looked hard enough this year for the canals, with so large a percentage as 15 that were unconfirmed. There are three possible reasons for his failing to detect what to other observers are comparatively so easy. It is either the fault of his eye, of his telescope, or of his seeing. When he was a young man he even doubled the canals with Schiaparelli. This might lead us to believe that his eyesight was now at fault, and possibly astigmatic. On the other hand his fellow observer M. Baldet, presumably a younger man, seems to have seen just about what Antoniadi did. If it is the fault of the seeing, or due to excessive air currents in the telescope, it is surprising that he should have succeeded in doing so well with the lakes. His explanation in 1924 was that the canals he could not see were not there (see Report No. **35**) and he unfortunately criticized severely not only Schiaparelli, but also Lowell and Trumpler for seeing them. Peek and Attkins are two other observers, living not far apart, but whose capacities for seeing canals and lakes are rather unequal. By Tables III and VI we find that the former saw 41 confirmed canals to Attkins' 56, but that he saw 21 confirmed lakes to Attkins' 11. He had a somewhat larger mirror.

PLATE XXIII

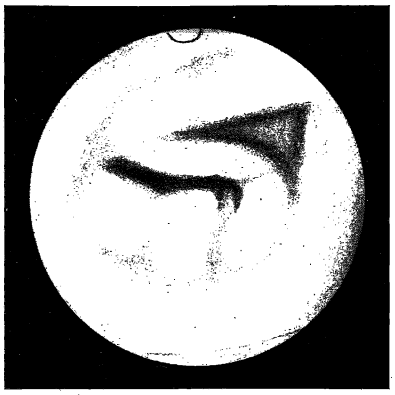

Fig. 49
Douglass 347° A

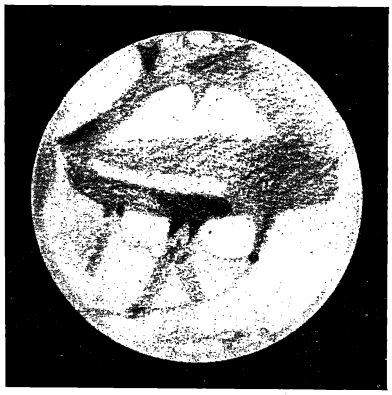

Fig. 50
Nakamura 3° A

Fig. 51
Douglass 61° B

Fig. 52
Nakamura 57° B

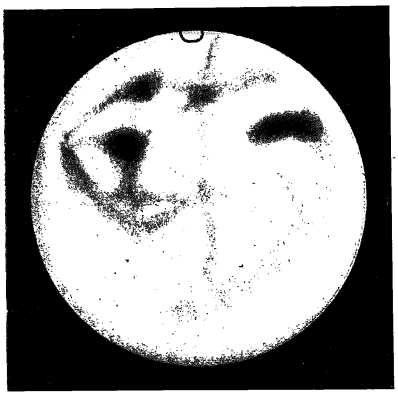

Fig. 53
Douglass 114° C

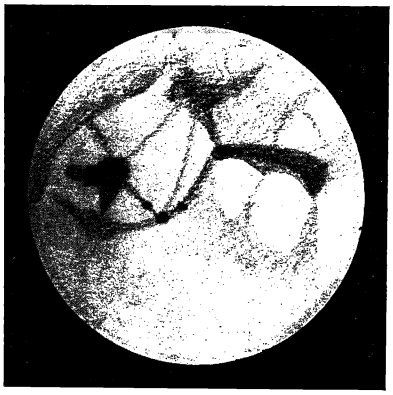

Fig. 54
Nakamura 124° C

DRAWINGS OF MARS IN 1926.

POPULAR ASTRONOMY, No. 370.

PLATE XXIV

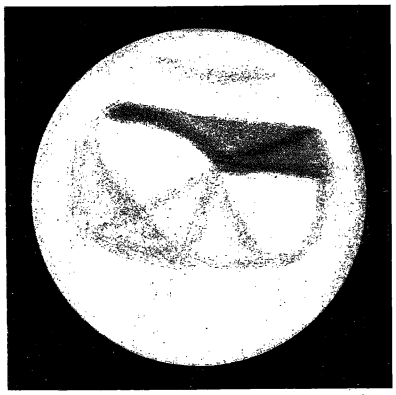

Fig. 55
Douglass 167° D

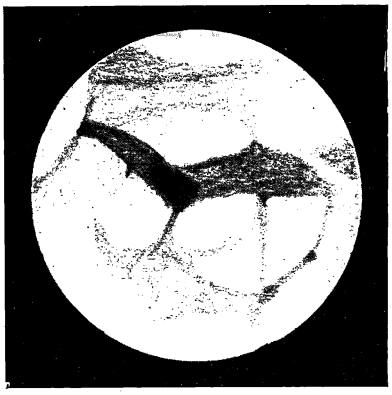

Fig. 56
Nakamura 178° D

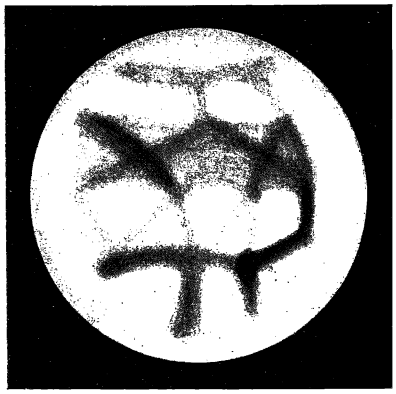

Fig. 57
Douglass 236° E

Fig. 58
Nakamura 238° E

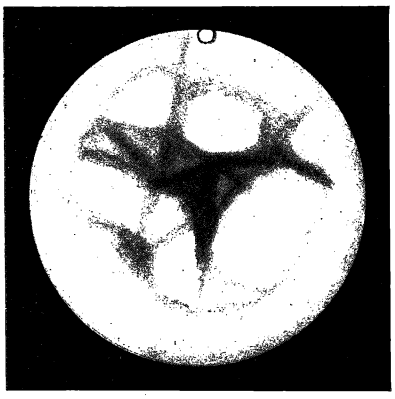

Fig. 59
Douglass 287° F

Fig. 60
Nakamura 302° F

DRAWINGS OF MARS IN 1926.