Memoirs
OF THE
British Astronomical Association.

VOL. XX.—PART II.

NINTH REPORT OF THE SECTION

FOR THE OBSERVATION OF

MARS,

DEALING WITH THE APPARITION OF 1909.

WITH ONE HUNDRED ILLUSTRATIONS.

"The perfectly 'natural' appearance of the planet, and the total absence of straight lines . . . . seem to me significant."—GEORGE E. HALE.

Director—E. M. Antoniadi, F.R.A.S.

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SECTION FOR THE OBSERVATION

OF

MARS.

DIRECTOR.—E. M. ANTONIADI, F.R.A.S.

REPORT OF THE SECTION, 1909.

PART I.

PROLEGOMENA.

1. The Apparition of 1909.

This memorable perihelic opposition occurred on 1909 September 24, and was the most favourable one of our time. Although Mars was, on 1909, September 18, at the distance of 0·389 (36,000,000 miles), and had not approached the Earth as near as in 1813, 1830, 1845, 1877, and 1892, yet his considerable altitude above the horizon largely compensated, to European observers, for the small difference in diameter of his disk.

The opposition took place 32 days after the date of August 23, when the Earth passes at its minimum distance from the orbit of Mars.

Phenomena.

Autumnal Equinox of N. hemisphere Vernal Equinox of S. hemisphere	1909, April 21.
Mars in W. Quadrature with the Sun	1909, May 13.
Mars in Perihelion	1909, August 13.
Winter Solstice of N. hemisphere Summer Solstice of S. hemisphere	1909, September 14.
Mars in Apparitional Perigee	1909, September 18.
Diameter of Mars in Apparitional Perigee	24″·0.
Mars in Opposition with the Sun	1909, September 24.
Heliocentric longitude of Mars in Opposition	0° 43′.
Position of Mars in Opposition	$\alpha = 0^h\ 10^m$. $\delta = -4^\circ\ 13'$.

Diameter of Mars in Opposition -	23″·9.
Position angle of the N. pole of Mars in Opposition - - - - -	334°·0.
Latitude of the centre of the disk at Opposition - - - - -	− 20°·4.
Mars in E. Quadrature with the Sun	1910, January 18.

The negative latitude of the centre of the disk varied from − 21°·1 on 1909, June 1, to − 21°·8 on June 20; it then decreased to 19°·4 on August 28; again increased to − 24°·7 on December 6; after which it diminished to the end of the apparition.

2. The Members of the Section and their Instruments.

The following table gives the names of the Members who constituted the Mars Section in 1909, the aperture of their telescopes, as well as the number of drawings forwarded by each to the Association :—

Observer.	Locality.	Aperture of Instrument in Inches.	Drawings.
ANTONIADI, E. M., F.R.A.S.	Juvisy, France -	8½ Spec.	67
		9¾ O.G.	
	Meudon, France -	32¾ O.G.	
BACKHOUSE, T. W., F.R.A.S.	Sunderland - -	4¼ O.G.	29
CRAIG, REV. S. R., B.A., LL.B., F.R.A.S.	Londonderry, Ireland.	4½ O.G.	4
DOBBIE, A. W. - - -	Adelaide, S. Australia.	18 Spec.	5
GIVIN, R. D., M.D., L.R.C.P., M.R.C.S.	Sydney, N.S.W., Australia.	3⅝ O.G.	29
HAWKS, E. - - - -	Leeds - - -	12 Spec.	2
		18 Spec.	
HOSKINS, G. H. - - -	Burwood. N.S.W., Australia.	12 Spec.	2
KILLIP, REV. R., F.R.A.S. -	Southport - -	5 O.G.	5
NANGLE, J., F.I.A., F.R.A.S.	Sydney, N.S.W., Australia.	6¼ O.G.	14
O'HARA, C. - - - -	Derrylin, Ireland -	6½ Spec.	11
PHILLIPS, REV. T. E. R., M.A., F.R.A.S.	Ashtead - -	12¼ Spec.	20
SHORT, J. - - - - -	Sydney, N.S.W., Australia.	7 O.G.	20
		11½ O.G.	
STRACHAN. W. - - -	Bournemouth -	10 Spec.	—
WARD, J. T. - - -	Wanganui, New Zealand.	9½ O.G.	—
WILLIAMS, A. S., F.R.A.S. -	Hove (W. Brighton)	6½ Spec.	1
WRIGHT, H. - - -	Sydney, N.S.W., Australia.	4¾ O.G.	2
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The observations cover a period of 5 months and 18 days, the first record being that of O'Hara, on 1909, July 14, the last one by Backhouse, on December 31.

* * * *

Great loss was sustained by the Section since 1909 by the death of Dr. Givin and the Rev. R. Killip. The work of the former with a $3\frac{5}{8}$-in. will remain the best ever made with such an instrument.

3. Optical and Telescopic Notes.

MUSCÆ VOLITANTES.—In the course of his observations, the Director was hampered by the presence, in his eyes, of *muscæ volitantes* (Fig. 1). These were particularly troublesome

FIG. 1.—Muscæ volitantes.

at first, passing frequently across the planet. Yet, with some experience, the eye was trained to avoid their noxious agency; and, by an instinctive muscular movement, it managed to alter their course whenever they threatened to transit the disk of Mars.

SUBJECTIVE QUIVERS OF THE OPTICAL IMAGE.—From a series of experiments made in 1903 the Director concluded that the undulations of planetary disks are not exclusively of atmospheric origin, and that they are also due sometimes to the imperfection of the eye.

SLIDING SHED FOR A REFLECTOR.—A convenient form of such a structure is shown in Figs. 2 and 3, and may be found

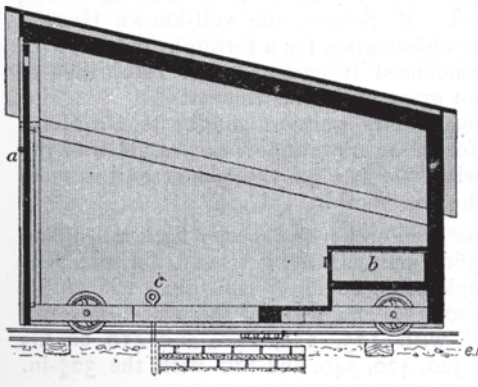

FIG. 2.—Longitudinal section.

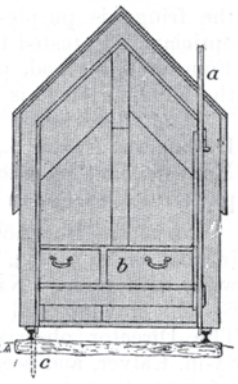

FIG. 3.—Front view.

Movable Shed for protecting a Reflecting Telescope.
a = Door; *b* = Drawers; *c* = Clamping Bar.

useful by amateurs. This was devised by the Director for his $8\frac{1}{2}$-in. Calver, and did not cost more than 8*l*. No originality is,

naturally, claimed for it; and the form given was merely dictated by necessity. The shed rolls on wheels. The length, 33 feet, of the rails enables the telescope to remain at such a distance from the structure as to receive none of the waves of heat emitted by the latter. A contrivance of this kind is superior to a dome, or any other arrangement, for the isolated body of the reflector, exposed to the sky, cools down very rapidly, especially if a draught be produced in the tube by opening the door of the mirror for a quarter of an hour before starting work.

OBSERVATIONAL SPECTACLES.—While observing, it is disadvantageous to keep the eye which does no work open, and troublesome to keep it closed. Hence the advantage of the

FIG. 4.—Observing Spectacles.

old spectacles, in the use of which the inactive eye remains open against a black glass, while the other looks in front of the eye-piece through an empty elliptical frame (*a* of Fig. 4).

THE MEUDON REFRACTOR.—The ground on which the base of the dome stands is 533 feet above sea-level. The inner diameter of the cupola measures 60·7 feet, and its crown rises some 83 feet above the floor.

The aperture of the object-glass by the Brothers Henry is 32·7 inches, and the focal length 52·5 feet. The eye-pieces magnify 200, 320, 470, 540, and 810 diameters, the focussing with the last-named power being sensible to a displacement of the eye-piece of one-fiftieth of an inch. On pushing the eye end in, a bluish-violet ring fringes the image; on drawing it out, the fringe is purple-red. M. Schaer, the well-known Geneva optician, who tested the object-glass for a fortnight in 1909 with Foucault's method, pronounced it perfect. The refulgence of the Martian image is not great in this instrument.

The Association tenders its warmest thanks to Dr. Henri Deslandres, A.R.A.S., for the hearty support he has given to the Mars Section by allowing the use on the planet of the most powerful telescope in the Old World.

POWER.—Backhouse used on his 4½-in. very high magnifiers indeed, of 247, 253, 360, and, usually, 370, and did excellent work with them. Nangle could not apply more than 160 on his 6¼-in. Hawks used 200, 350, and 450 on the 18-in. mirror.* The Director observed with 175, 230, 290, and 410 on his 8½-in. Calver, and used 320, 470, 540, and 810 with the 32¾-in. refractor.

When the dark areas of the planet were exceedingly faint, early in August 1909, it was only with low powers that they could be suspected at all. At Meudon, the eye-piece of 320

* For further notes on the observational methods and appliances of the Section in 1909, *see* Journal, B.A.A., Vol. XX., pp. 469–473.

usually employed showed steadily faint half-tones never suspected before; 470 and 540, although yielding fine views of the outlines of the *maria*, were already too much for the delicate shadings; while, with 810, it was possible to catch good glimpses of the form of some minute "bays," or of the irregularities in the edges of the snows.

Hence the beginner should note that—

I. *A comparatively low power will show to best advantage the intensities of the dusky areas, and will bring out well the faint half-tones;* and that

II. *High powers, which do not show faint shadings, are useful in revealing detail in the outlines of the dark spots and in those of the polar caps.*

The variable intensity of the *maria* should always be estimated with the same low power. If an eye-piece of 200 be used on Mars at opposition and one of 350 later, as a compensation for the reduced disk, the erroneous conclusion of a "seasonal fading" of the dark spots at the end of the apparition should be avoided. Yet mistakes like these are frequent.

THE ADVANTAGES OF LARGE OVER SMALL TELESCOPES.—After an experience ranging over thirty years with refractors of $2\frac{1}{3}$, 3, $4\frac{1}{4}$, 6, $8\frac{3}{4}$, $9\frac{1}{2}$, $9\frac{3}{4}$, $10\frac{1}{4}$, $32\frac{3}{4}$, and $49\frac{1}{2}$-in., and with reflectors of $6\frac{1}{2}$, $8\frac{1}{2}$, $12\frac{1}{2}$, $20\frac{1}{2}$, and 40-in., the Director, like Prof. Barnard, Prof. Hale, and others, has no doubt that large telescopes are superior to small ones. Observation and theory concur in proving that, owing to reduced diffraction and superior light-grasp, the greater aperture beats the smaller one.

Experiments in this line were made at Meudon in 1911 on Mars, Jupiter, and Saturn, with the $32\frac{3}{4}$-in. and the $8\frac{1}{2}$-in. Calver. Under good seeing, the superiority of the former instrument over the latter was simply overwhelming; while even under horrid definition, as shown by Alvan Clark, nothing could be glimpsed in the small glass which would not be quite plain in the great one.*

The advantages, on the planets, of large over small apertures are the following:—

I. *The resolution of single spots into more or less irregular components;*
II. *The detection of new small spots;*
III. *The detection of irregularities in the outline of apparently regular markings;*
IV. *The increase in size of dark areas, in accordance with the formula of Dawes* $\left(S = \frac{4''\cdot 56}{\alpha}\right)$, *and the increased breadth and plainness of a real dark line, like Cassini's division in Saturn's ring;*
V. *The gain of contrast of the image; hence the superior intensity of the various markings;*

* *See* Journal, B.A.A., Vol. XX., p. 79, and Vol. XXI., pp. 105–106.

VI. *The detection of checkered structures there where small instruments show only uniform tints;*

VII. *The detection of faint half-tones, inaccessible to ordinary appliances;*

VIII. *The clearer perception of colour, and the detection of new tints;* and

IX. *The ready perception of slight defects of the image, such as minute atmospheric tremors, rendered invisible by diffraction in smaller telescopes, or colour due to atmospheric dispersion at an altitude of* 30° *above the horizon.*

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4. Atmospheric Definition.

SCALE OF SEEING.—A scale of I. to V. was used by the Director, I. corresponding to perfect seeing, without a quiver; II. to slight undulations, with moments of calm lasting several seconds; III. to moderate seeing, with larger air tremors; IV. to poor definition, with constant troublesome undulations; and V. to a very bad image, scarcely allowing to take a rough sketch.

Such a scale, on Mars, is necessarily relative, not absolute, as subordinated to the size of the disk. Thus, definition estimated at III. on a disk of 24″ would be about V. on one of 4″.

THE BEST NIGHTS.—The most advantageous evenings, at Meudon, were invariably foggy, without wind. Cirrus yielded much less favourable results. The worst nights were those of great transparency and twinkling, when stars could be seen down to the horizon.

ATMOSPHERIC CONDITIONS AT MEUDON.—No special advantages are claimed for these. That locality, situated 533 feet above sea-level, is simply an ordinary observing station, certainly inferior to Flagstaff, whose altitude is 7,250 feet. But in what consists this inferiority? Inasmuch as Mars was seen repeatedly at Meudon through the $32\frac{3}{4}$-in. without a quiver, and as similar results were obtained, with smaller instruments, all over the Earth, we conclude that *any* locality *will* yield sometimes spells of calm seeing. Hence the superiority of Flagstaff over an ordinary station is reduced (*a*) to a greater transparency of air, which can be no very marked advantage on the planets, since admirable views of these bodies are obtained in the smoke of great cities; and (*b*) to a greater proportion of good nights. But as the aperture at Meudon is $2\frac{1}{2}$ times larger than at Flagstaff, Mars was defined in 1909 from the great French observatory exactly as if he were $2\frac{1}{2}$ times nearer the Earth than in Arizona; and odds like these have proved decisive.*

Yet, when speaking of the definition at Flagstaff, it is necessary to remark that the photographic image there transcends the visual one.

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* *See* p. 33.

On 1909, September 20, the wonderfully steady image lasted exceptionally several hours. More frequently the good view was preceded by a period of slight rippling of the disk, very detrimental to the detection of fine detail. The undulations would then cease *suddenly*, when the perfectly calm image of Mars revealed a host of bewildering irregularities, all held steadily, and standing out with a boldness and definiteness defying description.

After a hot day, the table-land at Meudon is covered with masses of air greatly differing in temperature. And another curious feature of the definition there is that it gets impaired as the night advances.

DIFFERENT MODES OF SEEING AN OBJECT.—The phenomena revealed by the $32\frac{3}{4}$-in. necessitate the following classification :—

A *glimpse* of an object does not last more than 0·3 second ;
A *short view* of an object lasts from 0·3 to 1 second ; and
An object *held steadily* is one whose visibility continues for 1 second and above.

5. The Satellites of Mars.

The two minute orbs attending the planet were repeatedly seen at Meudon. Fig. 5 gives the configuration of the Martian system on a clear night. These companions move about very

FIG. 5.—Mars and his two Satellites, on 1909, September $25^d\ 22^h\ 40^m$ G.C.M.T. (The Director.)

quickly. Phobos, the nearest, is much brighter than Deimos. They both seem to shine with a bluish light ; probably a contrast effect with the ruddy colour of their primary.

6. The Limb of Mars.

At the beginning of the observations with the $32\frac{3}{4}$-in., the limb appeared duskier than the central regions of the planet,

" as if the atmosphere of Mars, like that of the major planets, " exerted some absorption on the rays reflected from its " surface ";* and the photographs taken by Prof. Hale and Prof. Barnard confirm this impression. Hence the white limb is an effect of contrast.

7. The Dark Polar Band.

The dusky belt apparently surrounding the polar snow caps was never photographed; and as its form disobeys perspective, it must also be a contrast effect.†

8. Change on the Surface of Mars.

Apart from the great variations due to cloud, it is impossible at present to affirm or deny the question of objective change in the outlines of the dark areas.

But the Director is sure that a great many small details of the surface show a remarkable stability, recalling to memory the invariable character of the markings on our Moon.

9. Martian Detail.

Ward writes: "Our 9½ Cooke does very good work, but " I have worked a 14-in. reflector, and get finer results on the " planets with this. With a power of 600 on one evening " during last opposition it revealed a wealth of detail, but being " no draughtsman I felt it useless to attempt a sketch."

At the first glance cast through the 32¾-in. on 1909, September 20, the Director thought he was dreaming and scanning Mars from his outer satellite. The planet revealed a prodigious and bewildering amount of sharp or diffused natural, irregular, detail, all held steadily; and it was at once obvious that the geometrical network of single and double canals discovered by Schiaparelli was a gross illusion.

Such detail could not be drawn; hence only its coarser markings were recorded in the note-book.

A characteristic feature of the Meudon delineations is that they show Mars quite different from what was recorded by Schiaparelli between 1877 and 1890, or from what was ever drawn by any other observer, past or present. And, although the Director was certain of the accuracy of his drawings, yet it was gratifying to him to receive, more than two months after the publication of his work, the impersonal confirmation of photography. In fact, Prof. Hale, who had secured at the time, with the 60-in. reflector, the finest negatives ever made of Mars, wrote to the Director that the delineations in question were "in excellent agreement" with the Mount Wilson photographs,

* M.N., R.A.S., June 1911, p. 715. This idea was subsequently adopted by M. Flammarion, who, however, forgot the source of his inspiration (Bull. S.A.F., November 1912, p. 509).

† A.N., No. 4358, 4376, 4427, 4472.

which, like those of Dr. Lowell, thus also showed the planet with the peculiar appearance recorded in the $32\frac{3}{4}$-in. refractor.*

Again, the comparison of these drawings with those of Dr. Lowell, and with the Flagstaff glass positives, leads to the conclusion that the beautiful photographs of Dr. Lowell disprove his drawings, while confirming those of the Director at Meudon (Figs. 6, 7, and 8).† A fact so startling betrays the dangers of pressing too closely the argument of "seeing."

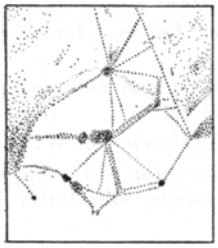

FIG. 6.—Sept. 17. Drawing by Dr. Lowell.

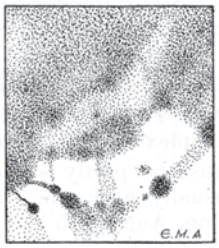

FIG. 7.—Oct. 6 and 11. Drawing by the Director.

FIG. 8.—Oct. 18. From a Flagstaff photograph.

Solis Lacus in 1909.

The number of new objects discovered in 1909 on Mars by the Director with the $32\frac{3}{4}$-in. amounts to 102.

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10. The Colours of the Disk.

POLAR SNOWS AND WHITE CLOUDS.—The former are usually brilliant white, the latter dull white in the majority of cases.

"CONTINENTAL" REGIONS. — The soil of Mars shows generally an ochre colour. Some parts are of a lighter tinge. The yellow hue seems temporary and due to yellow cloud.

SOUTHERN "ISLANDS."—Generally, the "islands" S. of the tropical dark spots are of a more or less pronounced ruddy colour. In August 1909, *Hellas* was fiery red.

DARK AREAS.—The dusky spots are grey‡ with an indigo tinge, and show traces of green in some parts.

Promethei Sinus was blue to the Director, in the $8\frac{1}{2}$-in., on 1909, August 15. Killip calls attention to the "very conspicuous colouring" of *Syrtis Major*, whose "bluish portions" were "most striking."

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* *See* Journal, B.A.A., Vol. XX., p. 376, April 1910.

† This argument completely refutes the ideas expressed by Mr. Gheury in Journal, B.A.A., Vol. XX., p. 385, since photography has confirmed the drawings which he criticised, while controverting those which he was supporting.

‡ Prof. A. E. Douglass informed the Director in 1910 that, in the 60-in. reflector on Mount Wilson, the *maria* appeared to him "a neutral grey, with perhaps some slight tinges of green."

The colours of the dark areas in the $32\frac{3}{4}$-in. were the following :—

Blackish indigo grey : *Juventæ Fons*, *Agathodæmon* to E., with its "lakes," *Phœnicis Lacus*.

Indigo grey : *Syrtis Major* from *Œnotria* to N. and N.E., *Sinus Sabæus*, *Sinus Furcosus*.

Blue grey : *Mare Cimmerium* on 1909, September 25.

Greenish indigo grey : *Sinus Margaritifer*, *Mare Erythræum*, *Auroræ Sinus*, *Bosporus Gemmatus*, *Solis Lacus*, *Aonius Sinus*, *Mare Sirenum*, *Mare Tyrrhenum*.

Meadow green : Region to S. of *Syrtis Major* and *Deltoton Sinus ;* also some parts of *Mare Erythræum* to W.

Dingy brown : A complex spot in *Mare Erythræum* to W.

The green tinge must be partly subjective ; for while the $8\frac{1}{2}$-in. Calver shows usually grey the dark areas, the latter looked green in it on 1909, August 16 and 22.

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11. Cloud on Mars, and the Great Pallor of the Dusky Areas at the beginning of the Apparition.

In the early part of the observations, an unprecedented paleness rendered almost invisible the dark spots of the planet, while the disk, instead of being ochre, presented a characteristic lemon tinge.*

"As soon as work was commenced" [1909, July 23], says Hawks, "it was noticed that the markings on the surface of the "planet were extremely faint, and the colouring of the disk in "general appeared of a much paler tint than usual. That "ruddy glow, which so characterises the 'fiery planet,' seemed "to have entirely disappeared, its place being taken by a "pronounced yellow tint. Even to the naked eye this change "of colour was apparent to a certain extent, for the planet "shone in the heavens with a lustre more akin to that of "Jupiter than what we generally expect Mars to present. "Later on in the apparition the colour of the markings them-"selves seemed to gain some of its original strength, while the "yellow tints of the 'deserts' seemed to change from a light "yellow to an orange colour."

Givin saw no markings on August 14 ; there were faint indefinite shadings on August 21 ; while the dark spots seemed "washed-out" on September 14.

From August 18 to September 2, Nangle noted "the "extraordinary faintness of the markings," the details acquiring their ordinary intensity on October 16. He adds that "the "chief tone of colour was yellow, whilst the markings appeared "of a greenish tint. Only very occasionally did some of the "continental areas show a reddish orange tinge."

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* This pale yellow colour was first pointed out by the Director (B.S.A.F., 1909, Sept., p. 387).

On October 27, Backhouse found the "seas very dark and striking."

On November 6, Killip still noted the disk to be "of a decidedly yellowish tint."

Careful records of the general colour of Mars and of the mean intensity of the *maria* were obtained by the Director :—

Date.	ω	Colour of Disk.	Intensity of Dark Spots.	Date.	ω	Colour of Disk.	Intensity of Dark Spots.
1909.	°			1909.	°		
Aug. 12	305	Pale lemon	Exceedingly faint.	Aug. 31	90	Ruddy	Darkish.
,, 12	320	do.	do.	Sept. 2	83	Yellowish	Faintish.
,, 12	335	do.	do.	,, 3	134	Ruddy	Darkish.
,, 12	349	do.	do.	,, 3	70	do.	do.
,, 12	4	do.	do.	,, 5	56	do.	do.
,, 14	263	Lemon	do.	,, 6	87	do.	Faint.
,, 15	277	do.	Very faint.	,, 14	332	do.	Dark.
,, 15	314	do.	do.	,, 16	308	do.	do.
,, 15	325	do.	do.	,, 19	280	Ruddy, yellowish.	Faintish.
,, 15	336	do.	do.	,, 20	306	do.	do.
,, 15	254	Lemon yellow	do.	,, 20	354	Yellow	do.
,, 16	290	do.	do.	,, 20	279	Ruddy, yellowish.	do.
,, 22	182	Yellow	Faint.	,, 20	301	do.	do.
,, 23	204	Yellow, ruddier.	do.	,, 25	217	Ruddy	do.
,, 23	226	Golden yellow	do.	,, 25	251	do.	do.
,, 23	241	Yellow	do.	Oct. 6	121	Ruddy, yellowish.	Dark.
,, 23	255	do.	do.	,, 11	76	Yellowish	Faintish.
,, 23	173	Ruddy	Dark.	,, 14	41	Ruddy	Darkish.
,, 24	195	Less ruddy	Faintish.	,, 16	31	Ruddy, yellow	do.
,, 24	210	Yellow	do.	,, 19	349	Ruddy	Dark.
,, 24	229	do.	do.	,, 21	346	do.	Darkish.
,, 25	148	Ruddy	Darkish.	,, 22	293	Ruddy, yellow	do.
,, 26	184	Ruddy to left; yellow to right.	Dark to left; faint to right.	,, 23	320	do.	do.
,, 26	206	Yellowish	Faintish.	Nov. 1	194	Ruddy	do.
,, 27	151	Ruddy	Darkish.	,, 4	210	do.	Dark.
,, 28	120	do.	do.	,, 5	197	Ruddy, yellow	Darkish.
,, 29	150	do.	do.	,, 6	199	do.	do.
,, 29	172	do.	do.	,, 7	145	Ruddy	do.
,, 29	194	Ruddy, yellow	do.	,, 9	160	do.	Dark.
,, 29	111	Ruddy	do.	,, 27	346	do.	do.

An exhaustive account of the phenomenon may be given thus, according to the data of the Director (*see* Plate I., Figs. 1 to 9) :

1909, August 12.—E. half of *Hellas* invisible; *Mare Hadriacum* invisible to E.; *Syrtis Major* and *Mare Tyrrhenum* exceedingly faint and almost invisible; *Sinus Sabæus* very faint indeed to W., slightly greyer to E.; *Deltoton Sinus* and *Barathrum*, although faint, are the duskiest spots on the disk.

August 14.—*Promethei Sinus* conspicuous; *Mare Cimmerium* very faint; *Syrtis Major*, *Mare Tyrrhenum*, and *Mare Hadriacum* are very faint, though a shade more intense than on the 12th.

August 15.—Same view as on the 14th, *Promethei Sinus* conspicuous; *Syrtis Parva* darkish; *Deltoton Sinus*, *Barathrum*, and *Sinus Sabæus* along the coast of *Aeria*, with *Portus Sigeus*, constitute the most conspicuous markings, and they are all faint; *Sinus Sabæus* very faint to W.; *Pandoræ Fretum* very faint; *Syrtis Major* again exceedingly faint.

August 16.—*Syrtis Major*, *Mare Tyrrhenum*, *Mare Hadriacum*, and *Sinus Sabæus* very faint; *Deltoton Sinus* and *Barathrum* less so.

August 22.—*Mare Cimmerium* faint, *Mare Sirenum* dark.

August 23.—*Mare Cimmerium* faint with *Mare Tyrrhenum*; *Mare Hadriacum* faint; *Syrtis Major* practically invisible; *Promethei Sinus* darkish; *Mare Sirenum* dark; *Memnonia* ruddy, detailed.

August 24.—*Mare Chronium* darkish at midnight, invisible 2^h later; *Mare Sirenum* dark; *Mare Cimmerium* and *Mare Tyrrhenum* a bit duskier than on the 23rd; *Trivium Charontis* exceedingly faint in yellow region.

August 25.—*Mare Sirenum* dark; *Palinuri Fretum* and *Lacus Ascræus* conspicuous; *Memnonia* ruddy, detailed.

August 26.—*Mare Chronium* dusky; *Mare Sirenum* dark; *Mare Cimmerium* still less faint than on the 24th; to the N. of *Mare Sirenum*, the soil is ruddy and detailed; to the N. of *Mare Cimmerium* the soil is yellow without details; *Trivium Charontis* invisible.

August 27.—*Mare Sirenum* dark; *Memnonia* ruddy and detailed.

August 28.—*Mare Sirenum* dark; *Solis Lacus* darkish; *Aonius Sinus* faint.

August 29.—*Mare Sirenum* dark; *Mare Cimmerium* less so, but still more intense than on the 26th; *Aonius Sinus*, *Mare Chronium* conspicuous; *Solis Lacus* faint; *Phœnicis Lacus* very dark; *Lacus Ascræus* dusky; *Trivium Charontis* very faint.

August 31.—*Auroræ Sinus* dusky; *Mare Sirenum* dark; *Solis Lacus* and *Aonius Sinus* faint; *Phœnicis Lacus* and *Ascræus Lacus* conspicuous.

September 2.—*Aonius Sinus* and *Solis Lacus* very faint; *Lacus Ascræus* and *Mare Sirenum* dark.

September 3, 2^h.—*Solis Lacus* utterly invisible; *Mare Sirenum* dark, with *Lacus Ascræus* and *Palinuri Fretum*.—22^h 15^m: *Auroræ Sinus*, *Lacus Ascræus*, and *Mare Sirenum* darkish; *Solis Lacus* very faint. *Juventæ Fons* black.

September 5.—*Auroræ Sinus* and *Solis Lacus* faintish; *Juventæ Fons* invisible.

September 6.—Same view as on the 5th.

September 14.—The dark areas are recovering their usual intensity. *Sabæus Sinus*; *Pandoræ Fretum*, *Barathrum*, and *Deltoton Sinus* are dark. *Aeria* and *Edom* appear ruddy.

September 16.—Same view as on the 14th. *Mare Hadriacum* dusky.

September 19.—*Syrtis Major* perhaps faint; *Mare Tyrrhenum*, *Sinus Sabæus*, *Mare Hadriacum*, &c., normally dark.

September 20.—Same view as on the 19th; *Margaritifer Sinus* faint.

Here the pallor may be considered as virtually finished. The most noteworthy local fadings seen subsequently are the following:

September 25.—*Trivium Charontis* very faint.

October 6.—*Phœnicis Lacus* black; *Lacus Ascræus* very faint to-night; *Solis Lacus* faintish.

October 11.—*Phœnicis Lacus* very faint; *Lacus Ascræus* invisible; *Solis Lacus* faintish; *Tithonius Lacus* faint to W.

November 1.—*Trivium Charontis* invisible.

November 4.—*Trivium Charontis* conspicuous.

November 5.—*Trivium Charontis* faintish.

November 6.—Same view as on the 5th.

It is noteworthy that, throughout the apparition, the greater part of the N. hemisphere was yellow.

From the foregoing observations we gather that, generally, and apart from local obliterations—

A ruddy appearance of Mars corresponds to a maximum darkness of his dusky areas, and to a neater perception of his details; and

A yellow appearance coincides with a lesser intensity of the dark areas and a lesser visibility of the details.

The pallor was obviously due to cloud of a yellow colour, less ochre than the "continental" regions of the planet. As Mars receives more heat from the Sun at perihelion than at aphelion, in the ratio of 1·5 to 1, the movements in his atmosphere must be more pronounced in the former case than in the latter; and the planet appears to be more yellow in perihelic than in aphelic apparitions.

A brass-coloured veil covered *Hellas* on 1909, September 20. On the same date, *Deucalionis Regio* was whitish-grey, not ruddy, as if there were grey clouds on Mars.

The phenomena presented by white clouds on Mars in 1909 were not very marked. Yet *Eridania* was invariably of a bright roseate colour, whitening under oblique view.

A large projection, "almost as bright as the S. polar snow," was seen by Nangle on October 29, towards $\Omega = 195^\circ$ and $\Phi = -45^\circ$, agreeing in position with *Eridania*.

It would seem that the yellow clouds are more frequent, more sluggish, and more lasting than the great white formations occasionally observed on the planet.

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12. Impossibility of the Linear "Canal" Network of Schiaparelli as an Objective Reality on the Planet.

EXPLANATION OF THE "CANAL" IMPRESSION.—It is certain that painstaking observers are liable to catch glimpses, on Mars, of narrow, straight lines. Our Sectional data since 1892 establish that several observers saw these phenomena. In 1909, Hawks noted many linear markings, but he remarked that "the "nearer Mars gets to the Earth, these lines seem to get more "and more diffuse." Nangle, however, records that "none of "the beautiful network of fine lines shown in Schiaparelli's and "Lowell's maps were even so much as suspected, in spite of the "most careful scrutiny."

The question of the so-called "canals" was attacked by the Director with the great telescope in an open mind. Inured for years to the fleeting visibility of straight lines on Mars with the ordinary appliances he was using, it was impossible for him to distrust the Milan observations. But the difficulty of reconciling the "canal" phenomena with logic prompted him to doubt their reality. Now, glimpses of fine lines were had when the image was flaring in the $32\frac{3}{4}$-in. (Fig. 9); never when it was calm; while definition without quivers has revealed a very complex natural structure of the so-called "continental" regions of the planet.

FIG. 9.—The *Titan* and *Brontes*, glimpsed as straight lines under awful seeing, on 1909, November 9. (The Director, $32\frac{3}{4}$-in. in O.G.)

Some forty irregular markings were held steadily at Meudon in the positions of some of Schiaparelli's or Lowell's linear "canals"; and they showed such a diversity of appearance

that it was deemed necessary to divide them into the ten following classes* :—

(1) Dark, irregular, narrow lines.—*Agathodæmon* (Figs. 10–11†), *Bætis* (Figs. 12–13).

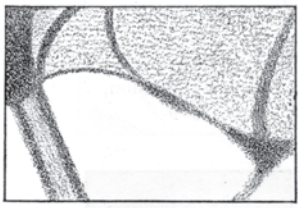

FIG. 10.—Schiaparelli, 1890.

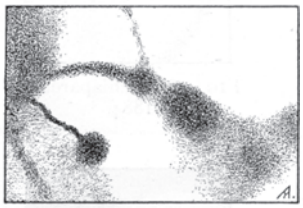

FIG. 11.—Meudon, 1909.

Agathodæmon.

FIG. 12.—Schiaparelli, 1882.

FIG. 13.—Meudon, 1909.

Bætis.

(2) More or less narrow, irregular streaks.—*Cyclops*, *Nia*, *Oxus*.

(3) Knotted, irregular bands.—*Astapus* (Figs. 14–15), *Borbyses*, *Cerberus*, *Euripus*, *Nectar* (Figs. 16–17), *Notus*, *Oeroe* (Figs. 18-19).

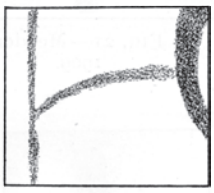

FIG. 14.—Schiaparelli, 1884.

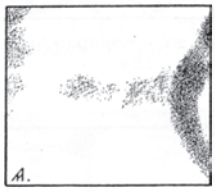

FIG. 15.—Meudon, 1909.

Astapus.

* *See* also Comptes Rendus de l'Académie des Sciences, 1909, Vol. II., p. 838.

† For the sake of comparison, the Director's view of each streak is attended with some previously observed linear appearance of the same marking.

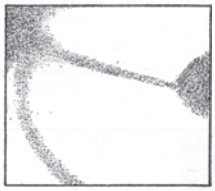

FIG. 16.—Schiaparelli, 1884.

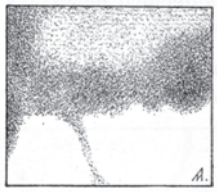

FIG. 17.—Meudon, 1909.

Nectar.

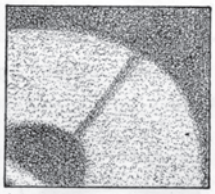

FIG. 18.—Schiaparelli, 1890.

FIG. 19.—Meudon, 1909.

Oeroe.

(4) Broad, curved, or winding irregular bands.—*Araxes* (Figs. 20–21), *Chrysorrhoas* (Figs. 22–23), *Indus*, *Labotas*, *Nilosyrtis*, *Protonilus*, *Simois* (Figs. 24–25), and *Tithonius* (Figs. 26–27).

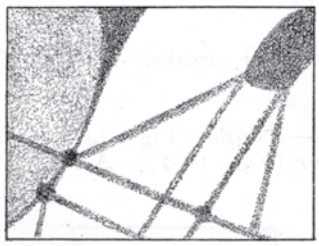

FIG. 20.—Schiaparelli, 1890.

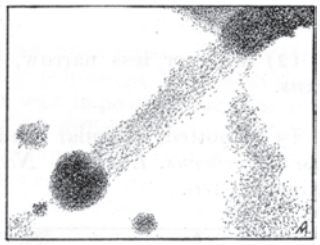

FIG. 21.—Meudon, 1909.

Araxes.

FIG. 22.—Schiaparelli, 1879.

FIG. 23.—Meudon, 1909.

Chrysorrhoas.

FIG. 24.—Schiaparelli, 1879.

FIG. 25.—Meudon, 1909.

Simois.

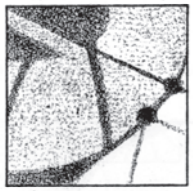

FIG. 26.—Schiaparelli, 1890.

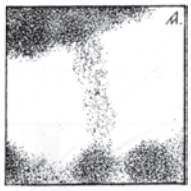

FIG. 27.—Meudon, 1909.

Tithonius.

(5) Broad and diffused, complex shadings.—*Alpheus*, N., *Fortuna*, *Lethes*, *Thoth*.

(6) Diffused, irregular markings, which are narrow near some "inlet" of the *maria*, and then widen out into the "continental" regions.—*Gorgon* (Figs. 28-29-30), *Sirenius*, *Titan*.

FIG. 28.—Schiaparelli, 1879.

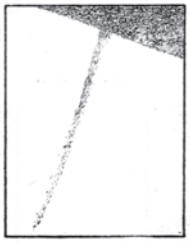

FIG. 29.—Schiaparelli, 1884.

FIG. 30.—Meudon, 1909.

Gorgon.

(7) Series of more or less disconnected irregular knots and filaments.—*Antæus* and *Læstrygon* (Figs. 31–32).

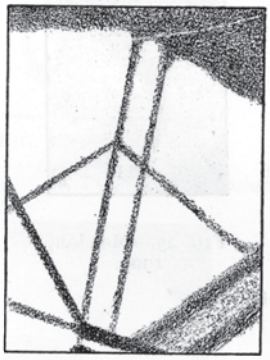

FIG. 31.—Schiaparelli, 1884.

FIG. 32.—Meudon, 1909.

Læstrygon and *Antæus.*

(8) Series of detached knots of various sizes.—*Triton* (Figs. 33–34).

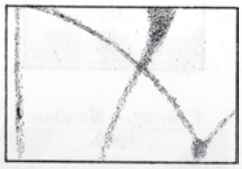

FIG. 33.—Schiaparelli, 1879.

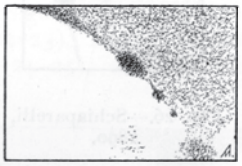

FIG. 34.—Meudon, 1909.

Triton.

(9) Isolated, irregular "lakes."—*Ambrosia* (Figs. 35-36), *Eosphoros* (Figs. 37–38), *Hyria Lacus* (Figs. 45–46-47).

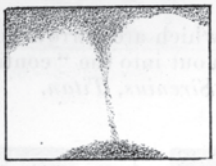

FIG. 35.—Schiaparelli, 1884.

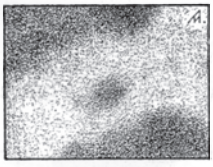

FIG. 36.—Meudon, 1909.

Ambrosia.

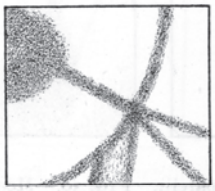

FIG. 37.—Schiaparelli, 1884.

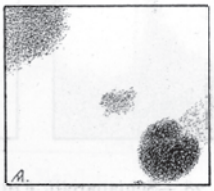

FIG. 38.—Meudon, 1909.

Eosphoros.

(10) More or less jagged edges of faint half-tones.—*Ganges* (Figs. 39–40), *Hydraotes*, *Hyscus* (Figs. 41–42), *Nepenthes* S., *Scamander*, *Tartarus* (Figs. 43–44), *Xanthus*.

FIG. 39.—Schiaparelli, 1884.

FIG. 40.—Meudon, 1909.

Ganges.

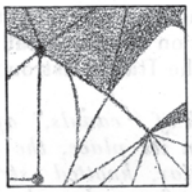

FIG. 41.—Lowell, 1894.

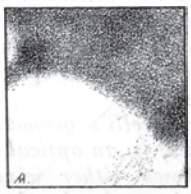

FIG. 42.—Meudon, 1909.

Hyscus.

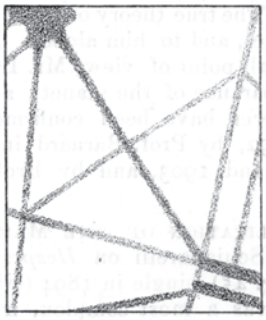

FIG. 43.—Schiaparelli, 1884.

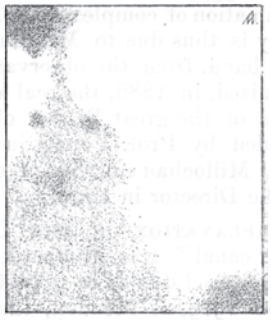

FIG. 44.—Meudon, 1909.

Tartarus.

The fact that the greater part of the N. hemisphere of Mars was veiled by yellow cloud, combined with overcast skies and frequent bad seeing in France, did not enable a more fruitful inquiry into the question.

Now, if we consider—

(*a*) That Mars was defined in 1909 with the Meudon $32\frac{3}{4}$-in. as if he were from four to sixteen times nearer the Earth than in Schiaparelli's modest $8\frac{1}{2}$-in. refractor;

(*b*) That all the irregularities of the above markings were held quite steadily in the large telescope while the straight lines were only glimpsed at Milan ;

(*c*) That these irregular markings obey rigorously the laws of perspective, while this is too frequently not the case with the lines ;

(*d*) That a real, narrow, dark, planetary line, like Cassini's division in front of Saturn, is naturally, owing to reduced diffraction, much broader and far more conspicuous in a large telescope than in a small one ; and

(*e*) That minute irregular detail, utterly beyond the reach of Schiaparelli's instruments, and confirmed by photography, was held steadily in the $32\frac{3}{4}$-in. when no trace of lines could be seen at all,

We reach the conclusion, which leaves no room for doubt, that the natural appearances revealed by the great French telescope give a much more truthful representation of the details on the planet than the rude spider's webs of the Italian astronomer.

Hence

Schiaparelli's geometrical network of "canals," appearing by flashes, is an optical illusion. In its place, the globe of Mars shows either winding, irregular, knotted streaks, or broader irregular bands, or groups of complex shadings, or isolated dusky spots, or jagged edges of half-tones.

In accordance, therefore, with Mr. Maunder's theory of 1894–1895,* the lines, which are glimpsed severally, are merely a summation of complex details. The true theory of the "canal" fallacy is thus due to Mr. Maunder, and to him alone. On the other hand, from the observational point of view, Mr. Denning recognised, in 1886, the real appearance of the planet ; and the results of the great Bristol observer have been confirmed and extended by Prof. Young in 1892, by Prof. Barnard in 1894, by M. Millochau in 1899, 1901, and 1903, and by Prof. Hale and the Director in 1909.

EXPLANATION OF THE DUPLICATION OF THE MARKINGS. —A "canal" was glimpsed by Schiaparelli on *Hesperia*, and this appeared double in 1890 (Fig. 45), single in 1894 (Fig. 46). But, in 1909, at Meudon, there was a most complex, irregular "lake" in this position (Fig. 47). Also, the *Læstrygon*, which was

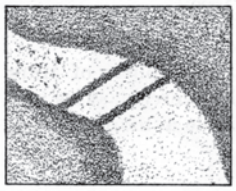

FIG. 45.—Schiaparelli, 1890.

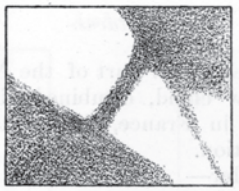

FIG. 46.—Schiaparelli, 1894.

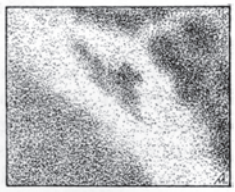

FIG. 47.—Meudon, 1909.

Various views of *Hyria Lacus*, illustrating the illusive character of the single and double "canals" of Schiaparelli.

* Knowledge, 1894, p. 250 ; 1895, p. 58.

glimpsed sometimes single, sometimes double (Fig. 31) by Schiaparelli, appeared as a series of irregular shadings in the $32\frac{3}{4}$-in. (Fig. 32), while broad streaks seemed particularly liable to present at Milan this phenomenon of "gemination." Hence

The doubling "canals" and "lakes" of Schiaparelli, which are also seen by glimpses, are the products of a kindred optical illusion, which may flash over any complex marking, but, preferably, along the edges of a broad, irregular streak.

And thus the scepticism regarding the objectivity of the geometrical network, manifested since 1879 by Mr. Maunder, Mr. Green, Capt. Noble, and, subsequently, by Mr. Holmes, M. Bigourdan, and others, has triumphed over the wonders associated with canals and their doublings.

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PART II.

THE OBSERVATIONS.

The following abbreviations are used in the discussion of the data supplied by the Members of the Section :—Ω = areocentric longitude, reckoned from *Fastigium Aryn* to the right ; Φ = areocentric latitude ; ω = longitude of the centre of the disk ; ϕ = latitude of the centre of the disk ; N. = North ; S. = South ; E. = Areographic East (West, or left, for the observer) ; W. = Areographic West (East, or right, for the observer) ; *p.* = preceding ; *f.* = following ; C.M. = central meridian of the disk.

The dates are invariably given in G.C.M.T.

The estimates of intensity of the dusky areas are based on the Director's observations since 1888 ; and a mark considered as showing a normal intensity is one appearing as dark as ever since 1888.

The dimensions of the minor details are given in equatorial degrees of the planet.

A merely conventional use is made of the names implying land and water, although the black spots may be unfrozen lakes. Our object is to sharpen our powers to the accurate perception and delineation of the phenomena presented by Mars. Speculation as to their exact nature is beyond the bounds of Science.

Reference to the Chart (Plate V.) at the end of the Report will render clearer the following analysis.

SECTION I.

Sinus Sabæus.

$\Omega = 310^\circ$ to 10° ; $\Phi = -60^\circ$ to $+60^\circ$.

HELLESPONTUS showed its ordinary form in 1909, stretching to the S. pole, but was not a conspicuous marking.* Yellow cloud covered it almost constantly, although the veil was never thick enough to obliterate the "channel" entirely. The great pallor in the early part of the apparition seems, however, to have affected *Hellespontus* to a lesser degree than most of the surrounding dark areas (Plate I., Figs. 1 and 2). But on September 16 and 20, when the other markings had almost recovered their normal intensity, this broad streak was invisible ; and it was only at the October presentation of this region that *Hellespontus* regained to some extent anything like its ordinary appearance. From the joint results of Backhouse, Craig, Dobbie, Givin, Hawks, Killip, Nangle, O'Hara, Phillips, Short, and

* The American photographs of 1909 support this view.

the Director we glean that *Hellespontus* was very faint from August 12 to 16, and on September 2, 4, and 5; that it was darkish on September 13; invisible on September 14; more or less faint on September 15; invisible on September 16; faint from September 17 to 19; invisible on September 20; very faint on September 23; faint on September 29, October 2, 4, 6; darker on October 9; almost normally intense on October 19; faint from October 21 to 25, and on October 27, 29, and 30; rather dark on November 16; faint on November 27; and invisible on November 29 and December 31.

NOACHIS was drawn correctly by Backhouse, Craig, Givin, Nangle, and O'Hara. Phillips shows it more pointed to N.E. To the Director the outlines of this "island" were always diffused, both in the $8\frac{1}{2}$-in. Calver and in the $32\frac{3}{4}$-in.; but definition was never good when the object was examined with the large instrument. *Noachis* was very red at Meudon on October 14, 16, 19, 21, and 23, and it appeared cut obliquely by the streak *Hyllus* on the last of these dates.*

Curiously enough, this "land" was never seen brightening near the periphery in 1909.

PANDORÆ FRETUM, which remained virtually invisible in 1907, was one of the very conspicuous markings of the 1909 apparition. It is drawn broad by Backhouse, Craig, Dobbie, Givin, Hoskins, Nangle, O'Hara, Phillips, and the Director; all these observers agreeing to represent it as rising to S.W. above *Sinus Furcosus*.† The "strait" suffered considerably from the pallor in August, being very faint, according to the data of Backhouse, Craig, Dobbie, Givin, Hoskins, Killip, Nangle, O'Hara, Phillips, Short, and the Director, on August 12 (Plate I., Fig. 2), 14, 15, and 16, but dark on September 2 and after. It appeared particularly intense on September 16, October 6, and November 27. However, the darkness was perhaps always slightly inferior to that of *Sinus Sabæus*.

BARATHRUM is the name given to a dark spot occasionally visible in the *mare* immediately E. of *Deucalionis Regio*.‡ During the great pallor, on August 12–16, the Director noticed that it was, with *Deltoton Sinus*, a little less veiled than all the surrounding regions (Plate I., Figs. 1, 3, and 4); but in September, when the yellow material had cleared off, there remained nothing abnormal here. Yet, on October 9, Nangle still showed *Barathrum* very dark and conspicuous.

DEUCALIONIS REGIO appeared narrow and shaded in 1909, according to Backhouse, Craig, Givin, Hoskins, Nangle, O'Hara, and the Director; and these peculiarities are confirmed by the

* The American photographs of 1909 represent *Noachis* brighter than *Deucalionis Regio*.

† To this peculiarity the Director's attention was called by M. Quénisset. M. Crouzel also noticed it at Toulouse with the 15-in. Henry equatorial. Prof. Hale's photograph of November 3 shows clearly this S.-W. trend (Plate I., Fig. A).

‡ As on Kaiser's chart of 1862–1864.

photographs (Plate I., Fig. A). But Phillips drew it broader and invariably bright. Bad seeing at Meudon did not enable the Director to detect irregularities of outline here.* It curved to N.W. almost at right angles to join *Thymiamata*, and the

FIG. 48.—The *Sinus Sabæus* region of Mars. 1909, September 17, $\omega = 323°$. (Backhouse.)

E. end, *Scylla et Charybdis*, was fairly tapering. On September 20, in the 32-in., *Deucalionis Regio* appeared certainly ashy grey, not red; a very unusual and remarkable phenomenon; but, on October 19, 21, 23, and on November 27, it was very red indeed.

This "island" was never seen as a marginal glimmer in 1909.

SINUS SABÆUS presented its usual winding form in 1909. The data of Backhouse, Givin, Hoskins, Nangle, O'Hara, Phillips, and the Director agree on this point. On September 20, two small, shallow notches of the "coast" were detected with the $8\frac{1}{2}$-in. reflector, and these were confirmed on the same date with the $32\frac{3}{4}$-in. (Fig. 49). The "strait" was rendered

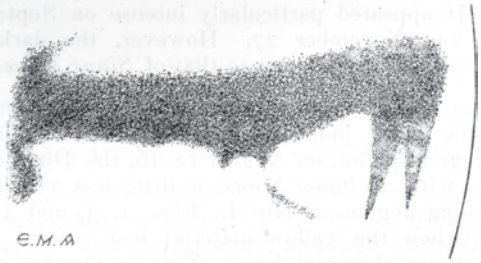

FIG. 49.—*Sinus Sabæus*. 1909, September 20, $\omega = 301°$. (The Director, $32\frac{3}{4}$-in.)

exceedingly faint and ghost-like by the pallor in August. From the combined results of Backhouse, Craig, Dobbie, Givin, Hoskins, Hawks, Killip, Nangle, O'Hara, Phillips, Short, and the Director, *Sinus Sabæus* was exceedingly faint, or almost invisible, on August 12 (Plate I., Fig. 2), 15, and 16, when,

* But, on September 14, M. Idrac, observing with the $32\frac{3}{4}$-in., found *Deucalionis Regio* "cut by a large number of capes and gulfs with sharp "outlines." This is a most important result.

however, its N.E. edge was a bit darker as far as *Portus Sigeus* (Plate I., Fig. 3); it appeared dusky on September 2, 4, 5, 8; dark on September 11 and 13; very dark on September 14 (Plate I., Fig. 9), 16–19; darker to E. than to W. on September 20 (Fig. 49); dark on September 21; fainter on September 23, 24, 29, 30; faintish on October 1 and 2; dark on October 5–6, 8–10, 14; very dark on October 16, 18, 19; dark on October 21–25, 27, 29, 30; fainter on November 6, 10, 16, 26; dark on November 27 and 29; and faint on December 31. On October 20, Hawks found it "by far the darkest marking on the disc." In the $32\frac{3}{4}$-in., the colour of *Sinus Sabæus* was bluish grey, never greenish, in 1909.

Portus Sigeus was recognised as an indentation of the "coast" by Backhouse, Craig, Givin, Hawks, Nangle (Plate III., Fig. 6), O'Hara, and Phillips. It looked distinctly and objectively double* to the Director in the $32\frac{3}{4}$-in. (Fig. 49), and traces of this duplex character were glimpsed by Phillips on October 25. This part of *Sinus Sabæus*, although faint in August, seems to have suffered less from the pallor than most other marks in these regions.

Sinus Furcosus showed no abnormal features in 1909. Its double structure was suspected by Givin with $3\frac{5}{8}$-in. (Plate II., Fig. 1), and was recognised by Craig with $4\frac{1}{2}$-in., as well as by Hoskins, Nangle, Phillips, and the Director. The "Forked Bay" is admirably drawn by Hoskins (Plate II., Fig. 2), and was always seen in a boiling image at Meudon. However, on September 20, the prongs were sharp in the large telescope, but it was difficult to make out much detail at 60° from C.M. (Fig. 49). The "bay" was large in the $32\frac{3}{4}$-in., owing to reduced diffraction,† and it looked fairly extended to S.W. On October 19, during moments of bad seeing, the *Sinus* was glimpsed bridged by a whitish streak running from *Fastigium Aryn* to S. The intensity of the "bay" underwent almost exactly the same changes as that of *Sinus Sabæus* already described, the marking looking very pale in August and dark in September and after.

Fastigium Aryn is drawn bright by Craig, Hoskins, Nangle, Phillips, and the Director, and its occasional shaded appearance may be a result of bad telescopic or atmospheric definition.

M. Flammarion concludes that a change would have occurred in *Sinus Furcosus* between 1830 and 1909 (B.S.A.F., December 1913, pp. 505–507); but he overlooks the most elementary laws of optics, and his ideas do not deserve serious consideration.

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* This double structure was discovered by Green in 1877 (Mem., R.A.S., Vol. XLIV., Plate II., Fig. 12), and may be recognised on a photograph taken on 1909, September 24, by Prof. Barnard.

† It is also large on Prof. Hale's photograph of November 3 (Plate I., Fig. A). Increased diffraction causes the "bay" to appear smaller in aphelic apparitions, when *Deucalionis Regio*, *Thymiamata*, and *Edom* encroach upon it considerably (*see* Schiaparelli's drawings of 1884).

THYMIAMATA looked narrower to S. than *Sinus Furcosus* at Meudon, owing to reduced diffraction and to the nearness of the planet.

It was bright near the terminator to Hawks on October 20.

EDOM PROMONTORIUM rises considerably to S. on the drawings of Nangle, Phillips, and the Director. As the "channel" is contracted here, bad seeing in the large telescope gave momentary impressions that *Edom* was united to *Deucalionis Regio*. It appeared bright to Phillips on October 24 ; probably a contrast effect.

EDOM underwent some remarkable changes of colour in the $32\frac{3}{4}$-in. Very red on September 16 in the $8\frac{1}{2}$-in. Calver, it was yellow at Meudon on September 20 ; yellow again on October 19, it became fiery red on October 21, and once more yellowed on October 23.

AERIA also showed similar phenomena. On September 17, O'Hara was struck with its "very ruddy" colour. Yellowish on August 12 to the Director, it was very red near C.M. on September 16, yellow on September 20 and October 19, fiery red on October 21, and golden yellow on October 23.

Aeria was seen whitish on limb with the $8\frac{1}{2}$-in. reflector, on August 15 and 23.

HAMMONIS CORNU was depicted blunted on almost all the drawings ; but Phillips shows it projecting deeply into the *mare*, as united to *Incurva Insula*, of which hereafter. With the large telescope and splendid seeing, the Director saw *Hammonis Cornu* completely detached from *Incurva Insula*, and shaped somewhat like the beak of a parrot (Plate III., Fig. 3).

ARABIA was yellow in 1909.

EDEN was also yellow throughout the apparition.

It looked bright near the limb to Nangle, on September 2.

SIRBONIS PALUS is described by Stanley Williams on October 24 as "one of the irregularities of *Typhonius-Orontes*." On September 20, October 19, 21, and November 27, the *Palus* was glimpsed as a faint shading in the large telescope.

SEMIRAMIDIS LACUS was observed at Meudon as a shading 2° across, on *Euphrates*, on October 19, 21, and November 27.

ARETHUSA FONS appeared during gleams of calm in the $32\frac{3}{4}$-in. as a rather faint knot, 3° in diameter, on November 27.

SILOE FONS was seen with the large instrument as an oval shading, measuring a maximum of 4°, on October 19. On the following day, it was "an easy object" to Hawks.

ISMENIUS LACUS was rendered invisible by yellow cloud throughout the greater part of the apparition; but, on November 27, it flashed forth at Meudon as an oval dusky spot (Fig. 50).

FIG. 50.—*Ismenius Lacus* and surrounding country.
1909, November 27, $\omega = 346°$. (The Director, $32\frac{3}{4}$-in.)

MINOR DETAIL.

ANUBIS.—Craig: September 15, 2° wide, faint.—The Director: August 15, September 20, glimpsed by flashes of $\frac{1}{4}$ second as a faint streak, 2° wide (Plate III., Fig. 3).

EUPHRATES.—Hawks: "Double . . . . . appeared filled with dusky "matter which faded away to invisibility towards the North."—Phillips: September 14, 18, October 24, 25, 29, mean breadth 7°, darkish, visible to S. especially. On October 25, "double in Mr. G. T. Newbegin's 9-in. "refractor."—The Director: August 12, 15, September 20, glimpsed, broad, very faint, perhaps doublish, with the $8\frac{1}{2}$-in. Calver; September 20, in $32\frac{3}{4}$-in., apparently W. component only visible by glimpses, but doubtful; October 19, 21, 23, and November 27, glimpsed broad, diffused, faint at Meudon, with tendency to appear doublish by flashes under poor seeing. This marking was always seen under bad conditions with the great instrument.*

GEHON.—Killip: October 18, 3° wide.—Phillips: September 14, straight, 4° wide: October 19, convex to E., 4° wide.—The Director: August 12, glimpsed, 3° wide, exceedingly faint; 15, edge of shade to E.; September 20, suspected doublish by glimpses; October 16, at Meudon, visible to S. only, diffuse; 19, glimpsed convex to N.N.E., 3° wide, faint.

HIDDEKEL.—The Director: August 12, glimpsed narrow, 2°, and extremely faint; 15, edge of shade to W.; September 20, 2° wide, glimpsed very faint; October 19, November 27, with the $32\frac{3}{4}$-in., $2\frac{1}{2}$° wide, glimpsed curved, convex to N.W., very faint.†

HYLLUS.—O'Hara: September 17, 5° wide, dark.—The Director: October 21, suspected; 23, width 3°, runs S. to N. on *Noachis;* November 27, width 3°, runs S.S.E. to N.N.W. The streak was well seen with the $32\frac{3}{4}$-in. during a rapid view of $\frac{3}{4}$ second, and was not merely glimpsed.

LABOTAS.—The Director: September 20, detected by a glimpse in the $8\frac{1}{2}$-in. Calver, and held steadily with the $32\frac{3}{4}$-in. for some 3 seconds, when it appeared curved, $2\frac{1}{2}$° wide in its broadest part, and dark; October 19, glimpsed badly; November 27, curved, 3° wide, diffused. The streak runs out to N.W. from the W. prong of *Portus Sigeus.*

NEUDRUS.—Hawks: October 20, thread-like, 1° wide.—O'Hara: September 23, width 18°, a faint shading.—The Director: September 20, with $8\frac{1}{2}$-in., seen as a faint shading on *Deucalionis Regio;* November 27, with $32\frac{3}{4}$-in., 6° wide, diffused, and faint.

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* More fortunate than the Director, M. Idrac, using the $32\frac{3}{4}$-in. on September 17, under fine seeing, solved the enigma of the *Euphrates*, which was glimpsed as "a dark band, large and diffused, of irregular intensity "and breadth, appearing continuous." As M. Idrac was then a beginner in arcography and ignored even the existence of the *Euphrates*, his observation acquires great importance.

† With the wonderful 5-foot Ritchey mirror, Prof. Hale saw "the two "'canals' which reach out from the extremities of *Sabæus Sinus* resolved "into minute curved and twisted filaments"; and they were broad and not straight (letter to the Director, dated 1910, January 3).

ORONTES.—Phillips: September 14, curved, 4° wide; 18, do. (Plate III., Fig. 5); October 24, 25, 2° wide, very faint; 29, 4° wide, darkish.—Stanley Williams: October 24, "full of small irregularities," continuity doubtful.—The Director: August 12, 15, 16, September 20, glimpsed 3° wide, exceedingly faint; at Meudon, October 16, 19, 21, 23, November 27, glimpsed convex to N.W., 2½° wide, faint; edge of shade to N., on October 19.

PHISON.—Craig: September 15, to S. only, 3° wide.—Hawks: October 25, 2° wide, running more to N.E. than usual.—Phillips: September 18, 8° wide, very faint; 23, 10° wide, very faint; October 25, 4° wide, faint; October 29, 5° wide, faint.—The Director: August 12, 16, broad and exceedingly faint; September 20, invisible in 32¾-in., but illusive glimpses of duplex appearance;* October 19, 21, 23, 6° wide, exceedingly faint, glimpsed vaguely doublish, under bad definition.

POROS.—Phillips: September 23, 2° wide; October 29, 1° wide, faint.—The Director: September 20, glimpsed illusively double under bad seeing.

PROTONILUS.—The Director: September 20, held steadily with the great telescope for many seconds, as a dark line, 1½° wide apparently, but greatly foreshortened by the tilt of the axis of Mars; October 23, conspicuous, glimpsed, 4° wide.

TYPHONIUS.—Hawks: October 25, double, faint.—Phillips: September 18, 4° wide, faint; October 24 and 25, 2° wide, very faint; 29, 3° wide, faint.—Stanley Williams, October 24, "full of small irregularities . . . . . "I suspected that it widened out in opening on the *Syrtis*"; doubtful continuity.—The Director: August 12, 15, 16, glimpsed 3° wide, darkish, hence not affected by pallor (Plate I., Figs. 1 and 3); September 20, 2° wide, faintish; with the 32¾-in., it was invisible on September 20, through Martian cloud; October 19, edge of shade to N.: 21, 23, November 27, glimpsed 3° wide, faint.

SECTION II.

Mare Erythræum, Margaritifer Sinus, Auroræ Sinus, and Mare Acidalium.

$\Omega = 10°$ to $70°$; $\Phi = -60°$ to $+60°$.

ARGYRE appeared united to *Noachis* to all the members of the Section. Yellow cloud veiled it almost constantly in 1909; but, on October 16, the cloud cleared off, and this "island" showed in the great telescope a fiery red colour near the C.M. At that time, the surrounding *mare* was dark, and the separation from *Noachis* complete. But poor seeing, without a fraction of a second of calm, rendered impossible any attempt to determine the shape of this "land" or to detect any irregularities of outline. *Argyre* seemed roundish in the 32¾-in., with diffused borders. *Charitum Promontorium* and *Horarum Promontorium* were scarcely indicated.

The occasions on which *Argyre* brightened near the periphery were few in 1909. To Backhouse it looked bright on limb, on November 20, while to the Director it was whitish after sunrise on August 15, and brightish near the terminator on October 19, 21, and 23.

* M. Idrac saw the Phison by glimpses with the 32¾-in., like the *Euphrates*, as already described in foregoing note.

ARGYROPOROS, suspected by Craig, was seen twice with the 32¾-in., on October 16 and 19. This is the name now given to the "channel" separating *Argyre* from *Noachis*.

OGYGIS REGIO was observed very confusedly by the Director in October, and looked scarcely brighter than the *mare*.

PHLEGRÆI CAMPI is the name given by the Director to the most remarkable spot ever detected by him on Mars. On October 11, he recorded the following impressions in his observing book :—"For some 2 or 3 seconds, a curious *brown* spot was "held steadily, apparently to the N.W. of *Argyre*. It was "elongated E. to W., had very irregular borders, and its struc- "ture was veined and knotted, while its intensity was very "uneven. A wonderful and unexpected sight!" The exact location of the marking was impossible to obtain, for so startling was the apparition, that the whole effort of the observer was forthwith concentrated on its physical appearance, which was well secured by description, though not by delineation. It might have been situated to the S.W. of *Argyre*, where a large *brown* spot was quite conspicuous with the 32¾-in. in 1911. It measured in 1909 some 8° in length and some 4° in breadth; and its unique brown colour jarred on the greenish expanses of the *Mare Erythræum*.

The Director is confident that when Mars will present again his S. pole, the great American telescopes, if directed on the planet, will not fail to confirm the existence of a brown spot to the right of *Argyre*.

MARE ERYTHRÆUM appears less dark than the great "bays" to the N. of it on all the drawings showing this region. The 32¾-in. revealed a checkered structure here, and the presence of darker greenish knots* of irregular form under *Argyre* (Plate II., Fig. 3). The colour of the *mare* was distinctly greenish at Meudon. From the joint data of Backhouse, Craig, Dobbie, Givin, Hoskins, Killip, Nangle, O'Hara, Phillips, Short, and the Director, it follows that this "sea" looked as a whole very faint on August 12 and 15 and September 2; faint on September 5 and 8; rather dark on September 13 and 14; faint on September 16, 17, and 20; dark and normal on September 30, October 1, 2, 4, and 5; faintish on October 6 and 9; normally intense on October 11, 14, 16, 18, 19, 21; rather faint on October 23, 24, November 1, 6, 19, 20, 22, 23, 25, 26, 27, and 29; and normally dark on December 21 and 31. Hence *Mare Erythræum* also partook of the pallor in August.

PROTEI REGIO was very inconspicuous in 1909, and was vaguely glimpsed by the Director at Meudon with the 32¾-in. on October 14 and 16 under bad seeing.† It does not seem to stand fine definition.

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* One of these was photographed by Prof. Barnard on 1909, September 24.

† *Protei Regio* was observed sometimes united to *Thaumasia* by a light streak (Burton, 1879, Sci. Trans. of the Royal Dublin Society, Vol. I., n.s., Plate VI., Fig. 6).

PYRRHÆ REGIO is recognisable on O'Hara's drawing of September 13 (Fig. 51). Phillips depicts it as united to *Chryse* on October 19, and as a lightening of the *mare* on November 19. Under very poor definition, on October 14 and 16, the $32\frac{3}{4}$-in. showed it also as a lightening, curving down to *Eos* on the N.

FIG. 51.—The *Margaritifer Sinus* region of Mars.
1909, September 13, $\omega = 25°$. (O'Hara.)

Eos seems faintly indicated in Nangle's drawing of October 6. On October 19, Phillips observed it united to *Aromatum Promontorium* and *Pyrrhæ Regio*. Stanley Williams wrote on October 17: "What struck me most in the short glimpse I had, "was the 'curious island' which you saw on October 11, off "*Aromatum Promontorium*. This island, marked *a* in the "diagram, ... was quite bright, but obviously *very* "*irregular*, both in outline and in brightness. And there was "in addition a fainter extension *b*, extending a long distance to "the south. It may have been separated from *a* by a narrow "channel" (Fig. 52). The Director first detected this "island" with the $32\frac{3}{4}$-in. on October 11, when he was struck by the presence, off *Aromatum Promontorium*, of an irregular, oval

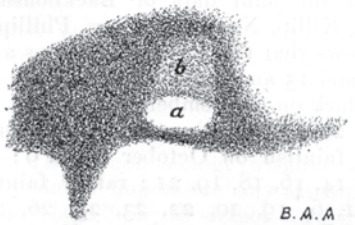

FIG. 52.—*Eos*. 1909, October 17. (A. Stanley Williams.)

marking (Plate II., Fig. 3), quite as bright as *Chryse*. Its N. "coast" was very winding and sharp, and it was dimly defined to S., where it merged into the dusky colour of *Pyrrhæ Regio*. It was held steadily for quite a minute. But, on October 14 and 16, it was confused.*

* Lockyer in 1862, Schæberle and Barnard in 1892, drew this "island" vaguely. It was well seen by M. Crouzel in 1909, when it was photographed by Prof. Barnard, on the day of opposition, and by Prof. Hale on November 3 (Plate I., Fig. A). Traces of it are also found on Dr. Lowell's glass positives of September 23. It is dusky on all the photographs.

AURORÆ FRETUM is the name now given to the "channel" between *Eos* and the "continent." It is drawn by Nangle. With the $32\frac{3}{4}$-in., it was sharply defined along the sinuous outline of *Eos*, but diffused to N.

MARGARITIFER SINUS looked more or less V-shaped, and stretching to N.N.E., to Craig, Dobbie, Givin, Hoskins, Killip, Nangle, O'Hara (Fig. 51), Phillips, and the Director. It was always seen near C.M. under tremendous flare with the $32\frac{3}{4}$-in., so that nothing new could be discovered in its structure.* Yet its colour appeared greenish. From the results of Backhouse, Craig, Dobbie, Givin, Hawks, Hoskins, Killip, Nangle, O'Hara, Phillips, Short, and the Director, it appears that *Margaritifer Sinus* was very faint on August 12 and 15; faint on September 5; faintish on September 8; normally dark on September 13, 14, 16; faint on September 20; normal on September 29, 30, October 1, 2, 4, 5, 6; faint on October 10; normal on October 11, 14, 16, 18, 19, 21; faint on October 23, 24; rather faint on November 19, 20, 22, 23; darker on November 25; and faint on November 26 and 29. *Margaritifer Sinus* was less affected by the pallor than *Sinus Sabæus*.

IANI FRETUM was drawn line-like by Hawks on October 20, but broader by O'Hara and Phillips. To the Director it appeared just a shade duskier than *Deucalionis Regio*.

AROMATUM PROMONTORIUM is rounded on all the drawings showing it.

On November 19, Phillips found it bright near the limb.

AURORÆ SINUS seemed almost regularly concave to Backhouse, Givin, Hawks, Hoskins, Nangle, O'Hara, Phillips, and the Director. Under fairly good definition at Meudon, its edges looked diffused, not sharp. Its darkness, which was considerable, did not extend far to S.; while its colour was greenish in the large telescope. The observations of Backhouse, Craig, Dobbie, Givin, Hoskins, Killip, Nangle, O'Hara, Phillips, Short, Wright, and the Director represent this "bay" faint on August 19; rather dark on August 31 and September 1; very faint on September 2; rather faint on September 3, 5, 6, 8; rather dark on September 13, 16; rather faint on September 24, 29, 30, October 1; dark on October 2 and 4; rather dark on October 6, 11, 12, 14, 16, 18, 19, and November 2; very faint on November 4 and 6; about normal on November 19, 20, 22, 23, 25, and 26; rather faint on December 6; and very dark on December 21. The fading between September 1 and 2 is unquestionable.

CHRYSE was yellowish in 1909.

XANTHE is the name now given to the W. part of *Chryse*, whose colour is reddish-brown, according to Dr. Bœddicker.

* M. Baldet saw it blunted to N. from the Pic du Midi, an appearance confirmed on Prof. Hale's photograph of November 3 (Plate I., Fig. A).

This country appeared slightly shaded, and yellowish, not brown, in 1909,

HYDRÆ PALUS is the name given by the Director to a small, irregular "lake," detected by him at Meudon, some distance to the N. of *Aromatum Promontorium*. On October 11, this marking was held steadily for some 6 seconds, and it was glimpsed 3 days later.

JUVENTÆ FONS was observed by Stanley Williams, on October 17, "blackish and quite evident." The marking was glimpsed at Juvisy with the 8½-inch Calver on September 3, as "a small black circle," 3° across. On October 6, at Meudon, it was held quite steadily as a large ellipse near the limb, and its colour was a blackish indigo grey. Five days later, it was fainter and round, nearly 5° across, near C.M., with an indigo tinge. On October 14, it was confuse in bad seeing. Reduced diffraction in the 32¾-in. showed *Juventæ Fons* much larger than in the 8½-in., while it was often blotted out by cloud (p. 37).

CANDOR is the name here given to the whitish band fringing the *Ganges* to W.,* and which was quite conspicuous at Meudon on October 11 (Plate II., Fig. 3). Undoubtedly, the surface is of a lighter colour here.

LUNÆ LACUS was a very difficult and rare object in 1909. Givin detected it with 38⅝-in. only, on November 2. Phillips gave it some 9° in diameter on October 19 and November 19, when it was drawn very dark. The Director glimpsed it with the 8½-in. on September 2, 3, and 5, as a small diffused spot; but, on the following day, it was invisible under first-class definition. No trace whatever of *Lunæ Lacus* could be had in the great telescope on October 6 and 11, certainly owing to yellow cloud on Mars.

OXIA PALUS could be only vaguely glimpsed at Meudon on October 14 and 16, under great flickering of the image.†

NILIACUS LACUS was very faint in 1909, owing to yellow cloud. It is shown by Givin, O'Hara, and the Director. On October 14 and 16, it was very elongated from E. to W., and faint at Meudon. The "lake," according to the joint results of Backhouse, Craig, Dobbie, Givin, Hawks, Hoskins, Killip, Nangle, O'Hara, Phillips, Short, and the Director, was invisible on September 8; faint on September 13 (Fig. 51); invisible on September 14, 16, 29, 30, October 1; faint on October 4; invisible on October 6; faint on October 14 and 16; invisible on October 18, 19, November 20, 22, 23, 25, and 26.

ACHILLIS PONS is recognisable on Givin's drawing of November 6.

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* This marking was discovered by Holden on 1877, October 9, with the 26-in. Washington refractor, and was seen subsequently by Schiaparelli in 1882, and by Prof. Barnard in 1892.

† Seen detached from *Margaritifer Sinus* by MM. Baldet and Crouzel. Prof. Hale's photograph of November 3 confirms this (Plate I., Fig. A).

MARE ACIDALIUM looks a shade darker than *Niliacus Lacus* on Givin's sketch of November 6.

MINOR DETAIL.

BÆTIS.—The Director: October 11, held steadily for 3 seconds at least, as a narrow, sinuous, black line,* not lying in the same direction as the *Ganges*, but more to E.; width 1° (Fig. 13); October 14, confuse.

GANGES.—Craig: September 16, to S. only, 3° wide.—Givin: November 2. 2° wide.—Hawks: "Easily seen double, interior being filled with a "light shading."—Phillips: September 8, width 9°, dark; October 11, 19, do.; November 19, width 6°, very dark.—The Director: August 31, 7° wide, easy; September 2, 3, 5, 6, do., faint with 8½-in.; October 6, in 32¾-in., a dark streak, curved by perspective near the limb; October 11, in 32¾-in., merely the W. edge of a faint shading† extending to E. as far as the *Jamuna*, and held quite steadily (Fig. 40); a secondary, shorter streak seemed to run, by flashes, some 8° E., parallel with the W. edge: a gemination under bad seeing; October 14 and 16, W. edge of half tone.

DARDANUS.—Givin: November 6, 3° wide, faint.—The Director: October 14, 4° wide, to E. only, very faint.

HYDRAOTES.—The Director: October 14, 16, exceedingly faint edge of shade to N.E.

INDUS.—Givin: November 6, straight, 2° wide.—Killip: October 18, 3° wide, faint.—Phillips: September 14, convex to E., 3° wide, faint; October 19, do., very faint.—Stanley Williams: October 17, "the *Indus* "was dark and well defined."—The Director: August 12, 3° wide, curved, dark, hence not involved in the pallor; 15, do.; September 20, visible to S. only, 3° wide; October 14, 16, 19, curved, convex to E., irregular, 4° wide, darkish, under bad seeing.

JAMUNA.—The Director: September 3, broad and diffused, faint streak; October 11, S.E. edge of faint half tone extending as far as the W. edge of *Ganges*; glimpsed doubtfully doublish, under bad seeing; October 14 and 16, edge of shade to N.W.

NILOKERAS.—Phillips: October 19, width 7°, very faint.

OXUS.—Phillips: October 19, 2° wide, faint.—The Director: October 16, width 3°, very faint.

SECTION III.

Solis Lacus.

$\Omega = 70°$ to $120°$; $\Phi = -60°$ to $+60°$.

BOSPORUS GEMMATUS presented nothing abnormal to most Members of the Section in 1909, and looked decidedly greenish grey at Meudon. Its intensity was but slight in the early observations, but it was greatly enhanced later. The data of Backhouse, Craig, Dobbie, Givin, Hawks, Nangle, O'Hara, Phillips, and the Director show the "strait" to have appeared very faint on August 19; faint on August 31, September 1, 2, 5, 6, 8, 13, 16, 24, and October 1; normally dark on October 6;

* M. Crouzel also saw this streak very dark.
† It was thus photographed also by Dr. Lowell on September 23.

faintish on October 11, 12; normal or faintish on October 14 and 16; faint on October 19; rather faint on November 2, 6, 19, 20, 22, 23, 25, 26, and December 6; and normal on December 21.

On November 19, Phillips saw *Bosporos Gemmatus* interrupted in $\Phi = -45^\circ \pm$ by a cloud mass (Fig. 53).

PHRIXI REGIO is the name here given to a faint half-tone detected by the Director with the $32\frac{3}{4}$-in. on October 11, immediately to the S.E. of *Thaumasia* (Plate II., Fig. 3).* Possibly a yellow cloud mass.

DEPRESSIO PONTICA is the name now given to a considerable dusky marking held steadily at Meudon, on October 6, to the S. of *Thaumasia*. Dark on the N. side, it faded off into *Mare Australe* (Fig. 55).† Phillips saw this spot on October 11.

FIG. 53.—*Bosporos Gemmatus*. 1909, November 19, $\omega = 64^\circ$. (Phillips.)

DELPHINI PORTUS, *CANCRI PORTUS*, and *BATHYS PORTUS* are names now given in this Report to three very dark dots detected at Meudon on October 6, on the S. "coast" of *Thaumasia* (Fig. 55).‡ At the first glance cast on that evening in the $32\frac{3}{4}$-in., the Director was struck by the extraordinary appearance of these markings, which looked like three perfectly sharp and round black spots, like the shadows of Jupiter's satellites in transit! Their roundness was the more deceitful as it defied perspective near the limb. A few moments later they no longer seemed black, but dark indigo grey, and their borders became diffused, concealing a natural irregular structure. On October 11, these "inlets" were still there, but evidently obliterated by yellow dust.

* This detail was confirmed by M. Crouzel, and seems to be recognisable on Dr. Lowell's beautiful photograph of September 23.

† *Depressio Pontica* is traceable on Dr. Lowell's photograph of October 18 (Fig. 8).

‡ These spots were also seen by M. Crouzel.

AONIUS SINUS is variously represented by the Members. On October 6, Backhouse very truthfully showed it merging into the duskiness of *Icaria* (Fig. 57); Craig gave it a more Schiaparellian form (Fig. 60); to Givin it always looked inconspicuous and confuse; Hawks drew it like Lowell (Plate II., Fig. 4); O'Hara, like Backhouse (Fig. 58); Phillips, like Schiaparelli (Fig. 56). The Director confirms Backhouse and O'Hara here, and their mode of representation is countenanced by photography (Fig. 8). The *Sinus* was of a distinct greenish tinge. From the joint data of Backhouse, Craig, Givin, Hawks, O'Hara, Phillips, Short, Wright, and the Director, it follows that the *Sinus* looked faint on July 14, August 25, 27, 28, 29, 31; exceedingly faint on September 2, 3, and 6; darkish on September 14; faintish on September 22, 23, 24, and October 4; rather dark on October 6; faintish on October 8, 11, and 12; very faint on November 4; darkish on November 7 and 9; faintish on November 14, December 6, 20, and 24. Like the great majority of the dusky markings, *Sinus Aonius* also suffered from the great pallor.

DEPRESSIONES AONIÆ, a new name, was given by the Director to a series of irregular dark spots which he held steadily on October 6 in the greenish-grey expanse of *Aonius Sinus*. These appeared in the $32\frac{3}{4}$-in. to be of various sizes and intensities. The largest was to N.W., but this was not so dark as the one to its S.E. Those more to the S. were obviously much smaller (Fig. 55).

CHRYSOKERAS is another new name, given to a curious brightish "peninsula" seen by the Director to jut out S.W. of the apex of *Thaumasia* (Fig. 55). This marking was held quite steadily at Meudon, and it glistened in the surrounding *mare*, although being fainter than *Thaumasia*. It was broader to N.E. than to S.W., where it ended in a "cape," now termed *Bosporium Promontorium*. Another, but less satisfactory, view of *Chrysokeras* was had on October 11.*

The streak was seen like a glimmer on the terminator on October 16.

THAUMASIA has the usual circular or oval outline given to it by small telescopes, on the drawings of Givin, Hawks (Plate II., Fig. 4), and Phillips, as well as on those taken by the Director with the $8\frac{1}{2}$-in. Calver. But this regularity broke down into a very complex form at Meudon, on October 6 and 11. Firstly, the three dark spots on its edge, above described, were notching its outline; then the part between *Delphini Portus* and *Cancri Portus* was bulging outwards, while the "coast" along *Depressio Pontica* was concave; here the "land" ended in a "promontory," *Heræum Promontorium*, the S. end of *Thaumasia*,† beyond which the "coast" ran to N.N.W. into

* *Chrysokeras* was discovered by Prof. Barnard and Prof. Hussey in 1892, and was admirably photographed by Dr. Lowell on 1909, October 18 (Fig. 8).

† So also on Dr. Lowell's photograph of October 18.

Bathys Portus; and, from this point to *Mare Sirenum*, the slightly bulging outline trended from E.S.E. to W.N.W. On October 11, the form of this "land" was compared to the head of some fabulous animal,* and the whole S. district, from *Nectar* to *Oeroe*, seemed more or less shaded to Phillips and to the Director (Fig. 55, and Plate II., Fig. 3).

A lemon whitish spot was seen with the $32\frac{3}{4}$-in., on October 11, towards the E. part of *Thaumasia*, in $\Omega = 111°$, $\Phi = -25°$. Cloud?

AUREA CHERSO could be seen at Meudon owing to the fact that the "coast" to the N. of *Nectar* was more protruding than to the S., and also on account of the visibility of the streak now termed *Nia* (Plate II., Fig. 3).

NECTARIS FONS was held steadily with the $32\frac{3}{4}$-in. as a condensation on *Nectar*.†

AMBROSIÆ LACUS is a small, dusky, irregular, isolated spot, lying on one-third of the distance between *Solis Lacus* and the S.E. "coast" of *Thaumasia*. This was held steadily for a few seconds at Meudon, on October 6, and was never seen again.

EOSPHORI LACUS is another kindred irregular marking, but of larger size. It was also held steadily with the $32\frac{3}{4}$-in.‡

SOLIS LACUS, generally dark and conspicuous in 1907, was faint in 1909,§ much fainter than *Mare Sirenum*. Increased diffraction in Givin's small refractor reduced it to an oval spot,

FIG. 54.—Mars. 1909, November 2, $\omega = 96°$.
(Dr. Givin.)

6° long, E. to W., by 4° broad (Fig. 54). Hawks made it 10° long, 5° wide, ∞-shaped, and hence doublish (Plate II., Fig. 4). To O'Hara it appeared as an amorphous smudge. Phillips depicted it as being 16° long and 7° broad, elongated E.N.E. to W.S.W. Stanley Williams notes that, on October 8, "it seemed

* In 1877, Green also compared it to "the head of an animal," adding that, under superior optical conditions, "the hard lines would then be found to be indented and broken, and the crudities of form disappear as truth advanced" (Mem., R.A.S., Vol. XLIV., p. 13).

† This spot was also seen by M. Crouzel.

‡ Dr. Lowell first discovered this marking at a previous apparition.

§ Green found *Solis Lacus* "very dark" in 1877, but it seems that its E. part was veiled at the time.

" quite faint, probably owing to the presence of light markings " in its interior ? " At Meudon, the great " lake " had a length of 21° and a breadth of 11 ; it was pear-shaped,* the narrow end to E.N.E., the broad one to W.S.W. The Director was enabled, on October 6 and 11 (Fig. 55, and Plate II., Fig. 3), to notice a great variety of shadings in *Solis Lacus*, the more conspicuous of which have been secured in the drawings. There was first a dark spot, 3° across, now called *Lucis Portus*, near its N.E. end ; above this, an irregular, much fainter spot was visible, and the same was to be seen to the E. of *Lucis Portus;* then the " lake " showed a lighter interior ; while a very large faintish marking lay to S.W., and a smaller one to W. (Fig. 55). All these details were held steadily, and the colour of *Solis Lacus* was decidedly greenish. Considerable variations were noted in the intensity of the " inland sea." Thus the combined results of Backhouse, Givin, Hawks, Hoskins, Nangle, O'Hara, Phillips, Wright, and the Director, show *Solis Lacus* to have been faint on July 14 ; very faint on August 19 ; faint on August 28, 31, September 1 ; very faint indeed on September 2 ; invisible on September 3 (Plate I., Fig. 7) ; very faint on September 5 ; faint on September 6 (Plate I., Fig. 8), 8 ; invisible on September 22 ; faint on September 24, October 4, 6 ; very faint on October 8 ; faint on October 11, 12, 14, 16, November 2, 4 ; invisible on November 6 ; rather faint on November 7, 9, 14, 19, 20, 22, 23 ; and faintish on December 6, 20, 21, and 24. It is certain that the " lake," which, like the other markings, was affected by the pallor in August, was almost blotted out on September 2 and 3, but to reappear faint afterwards.

DÆDALIA did not present any remarkable phenomena ; but, after being ruddy on October 6, it was yellow on October 11.

TITHONIUS LACUS was observed by Givin, Hawks, and Phillips under the form it shows in ordinary appliances. The drawings of these Members, combined with those of O'Hara and the Director, show this marking to have been invisible on July 14 and August 28 ; faint on August 31 and September 1 ; practically invisible, and certainly veiled on September 2 and 3 ; faint on September 5, 6, and 8 ; invisible on September 22 ; faint on September 24, October 4 ; very dark to E., faint to W., on October 6 and 11 ; faint on October 12, 14, 16, November 2 and 6 ; invisible on November 7 and 14 ; faintish on November 19 ; and invisible perhaps on December 6.†

The great separating power of the 32¾-in. enabled the Director, on October 6 and 11, under steady seeing, to resolve *Tithonius Lacus* into a nest of seven distinct dusky markings, all held steadily (Fig. 55) :—

CETI LACUS, the E. knot, looked like a small, 2° wide, roundish black spot on *Agathodæmon*. This may be a deep water basin.

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* As on Dr. Lowell's fine photograph of 1909, October 18.

† *Tithonius Lacus* was almost invisible in 1877.

MELAS LACUS appeared like a beautiful, large, black, oval knob, standing out boldly in the great telescope. It lay more to N.W., and measured 6° by 4°.* Possibly another real, deep, unfrozen lake.

HEBES LACUS, roundish and faintish, formed the "inlet" of *Chrysorrhoas*. Diameter: $3\frac{1}{2}°$.

IUS LACUS, smaller and faintish, was situated due W. of *Melas Lacus*. Diameter: $2\frac{1}{2}°$.

NOCTIS LACUS is more to W., and measures 5° across. It was faint at the time.

ECHUS LACUS, $3\frac{1}{2}°$ in diameter, is situated to the N. of the preceding, and

CORVI LACUS, to the N.E. of *Phœnicis Lacus*, did not measure more than 1° across.

The impression of the observer was that the two E. "lakes" of this group were quite free from cloud on October 6, and that the W. ones were partly obliterated by yellow dust. On October 11, the E. ones were also somewhat veiled, while those to the W. were still more heavily effaced.

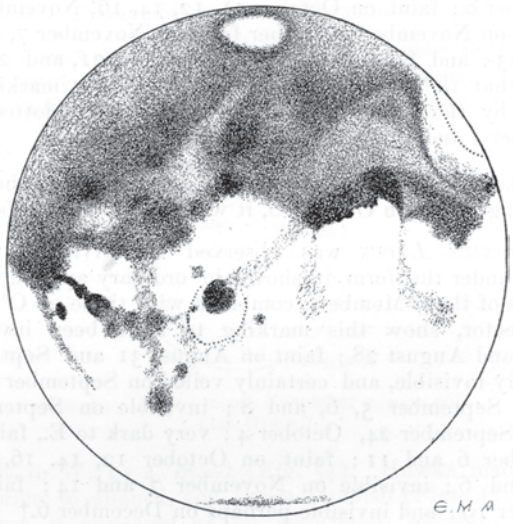

FIG. 55.—Mars. 1909, October 6, $\omega = 121°$. (The Director.)

PHŒNICIS LACUS, possibly a large body of deep, unfrozen water, presented phenomena of the most remarkable character during this apparition. It was seen only by Hawks, Phillips, and the Director, as considerable aperture is necessary to show it; and its intensity varied from blackness to invisibility.†

* Seen by Major Eddie in 1907.

† In 1892, Prof. Barnard called attention to the variable visibility of this spot.

Hawks wrote to the Director: "Your note about *Lacus* "*Phœnicis* appearing 'annoying' to the eye I can heartily con- "firm" (Plate II., Fig. 4), and "the faintness of this spot on "another date was also recorded here." To this observer, the "lake" had a breadth of 3°, to Phillips 4°, to the Director 5° with the $8\frac{1}{2}$-in., 7° with the $32\frac{3}{4}$-in. on account of the much less nugatory effect of diffraction in the great objective. On October 6, at Meudon, *Phœnicis Lacus* looked, for a second, heart-shaped; and its indigo black colour was so intense as to render it the darkest mark ever seen on Mars, riveting the attention of the observer almost to the exclusion of the other spots. From the combined results of the three amateurs mentioned above, it follows that *Phœnicis Lacus* was invisible on August 28; rather faint at 0^h, dark at 22^h, on August 29; rather dark on August 31 and September 1; quite invisible on September 2, 3 (Plate I., Fig. 7), and 6; black on October 6; exceedingly faint on October 11; black on October 12; faint on November 6; and invisible on November 7 and 9. All these partial or total obliterations through yellow cloud are certain. Of course, a small black spot like *Phœnicis Lacus* is more liable to total veilings by cloud than a large dark area.

A whitish irregular spot was seen at Meudon round the N. part of *Phœnicis Lacus* on October 6. It may be due to white cloud, or, preferably, as in the case of *Candor*, to a lighter tint of the surface here.*

OTI LACUS, discovered by Dobbie, in 1907, was observed at Meudon, on October 6, as a dusky spot, 3° across.

ASCRÆUS LACUS also underwent variations of intensity. With the $8\frac{1}{2}$-in. Calver, it looked quite dark and extended (7° across) on August 25, 29, 31, and September 2; and on September 3 and 5 it was faint. In the $32\frac{3}{4}$-in., it was irregular, had a diameter of 6°, and was very faint, on October 6.

PAVONIS LACUS is the name now given to a small shading, 2° in diameter, seen at Meudon on October 6 to the S.W. of the preceding.

OPHIR was generally yellow in 1909.

THARSIS seemed distinctly yellow, especially on October 6 and 11.

On November 9, it was whitish on the limb at Meudon, while a "light yellow area" seen by Wright near the periphery on October 25 corresponded to this region (Plate II., Fig. 6).

ARCADIA, like all other N. "lands," was veiled by yellow material in 1909.

Nangle on September 24, and Killip on October 6, found *Arcadia* bright on limb.

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* *Lacus Phœnicis* was "surrounded with light" also in 1877, according to Green (Mem., R.A.S., Vol. XLIV., p. 14 of reprint).

MINOR DETAIL.

AGATHODÆMON.—Givin: November 2, width 2° (Fig. 54).—Hawks: October 12, 2° wide, "a thin streak."—Phillips, September 8, 6° wide, faint; October 11, do., dark; November 29, 4° wide, faint.—The Director: August 29, 31, September 3, 5, 6, 2° wide, faint in 8½-in. Calver; October 6, a short, curved black streak, held steadily for many seconds in the 32¾-in.; convex to S.S.W., it merged into the blackish "lakes" to N.W. (Fig. 11); October 11, same view, but marking fainter; October 14, 16, confuse.* This may be a real, deep water channel.

AMBROSIA.—Phillips: October 6, 8° wide, faint; October 11, 6° wide, dark.—The Director: October 6, no "canal" here at all, but a small isolated "lake," held steadily in the large instrument (p. 42, Fig. 36).

CHRYSORRHOAS.—Phillips: September 8, October 11, width 5½°, faint; November 19, 5° wide, straight, conspicuous.—The Director: August 31, with 8½-in., glimpsed 3° wide, convex to N.W., faint; October 11, with 32¾-in., 4° wide to S., 1° only to N.W., curved, convex to N.W., angular (Fig. 23), irregular, and knotted, very faint, seen steadily through transparent yellow dust.

EOSPHOROS.—The Director: October 6, no "canal" here at all, but only an irregular "lake," held steadily (Fig. 38 and p. 60).

FORTUNA.—The Director: September 6, glimpsed 4° wide, faint, with 8½-in.; October 6, 11, glimpsed 5° wide to S., narrowing to N., diffused, irregular, faint.

IRIS.—The Director: September 3, 5, glimpsed 3° wide, very faint.

NECTAR.—Givin: November 2, 4° wide, faint.—Hawks: "double"; October 12, 3° wide, dark (Plate II., Fig. 4).—Phillips: September 8, October 11, November 29, 3° wide, darkish, edge of half-tone to S.—The Director: September 3, 5, 6, with 8½-in., 3½° wide, diffused, held steadily; October 6, 11, with 32¾-in., 4½° wide, irregular, knotted, greenish, held steadily for many minutes at a time (Fig. 17);† October 14, 16, 4° wide, confuse, intermittently visible.

NIA.—This is the name given to the streak running between *Agathodæmon* and *Nectar*. The Director: October 11, width 1°, irregular, faint grey, held steadily in 32¾-in. for some 2 seconds.

NILUS.—The Director: September 2, 3, breadth 4°, faint, diffused, in 8½-in. Calver mirror.

OERoE.—Hawks: "double."—Phillips: September 1, 5° wide, dark; October 6, 11, 3° wide, faint, edge of shade to S.E.—The Director: September 6, seen steadily with 8½-in., 3° wide, conspicuous, edge of shade to S.E.; October 6 and 11, 4½° wide, knotted, irregular, greenish, held quite steadily in 32¾-in. (Fig. 19). This is Dr. Lowell's *Bathys.*‡

PHASIS.—Hawks: October 12, 2° wide, faint.—The Director: August 29, glimpsed 2° wide, exceedingly faint and doubtful.

TITHONIUS.—Hawks: October 12, 3° wide, dark.—Phillips: 5° wide, darkish.—The Director: September 6, with 8½-in. mirror, 3° wide, glimpsed; October 6, 11, with large telescope, 5½° broad, undulating, faint, held quite steadily (Fig. 27).§

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* *Agathodæmon* was successfully photographed by Dr. Lowell on 1909, September 23.

† The great breadth of *Nectar* in 1909 was first pointed out by M. Quénisset. The streak was photographed by Dr. Lowell on October 18 (Fig. 8).

‡ Photographed by Dr. Lowell on October 18 (Fig. 8).

§ Photographed by Dr. Lowell on October 18 (Fig. 8).

SECTION IV.

Mare Sirenum.

$\Omega = 120°$ to $180°$; $\Phi = -60°$ to $+60°$.

PALINURI FRETUM seems to have been but little affected by the pallor. On August 25 and September 3 (Plate I., Fig. 7), the Director was surprised to detect here, with the $8\frac{1}{2}$-in. Calver, a considerable dusky spot; and this was confirmed in the $32\frac{3}{4}$-in. on October 6 and November 9.

ICARIA appeared distinctly shaded as far as *Hyscus* to Backhouse (Fig. 57), Hawks, O'Hara (Fig. 58), Short, and the Director (Fig. 55). But Phillips, like Schiaparelli, always saw it bright (Fig. 56). The shading, which was invariably conspicuous in the $8\frac{1}{2}$-in., was particularly dark on October 6 in the great telescope; and as the photographs show this district also shaded,* there can be no doubt as to this appearance.

PHAETHONTIS, bright to Phillips, was also shaded according to O'Hara and the Director, the shading being quite plain on the photographs also.† The "coast" here does not run parallel to *Mare Sirenum*, but more to S. On October 6, this "land" was yellowish grey.

Phaethontis was seen to brighten near the periphery in 1909 by the Director, on August 31, September 2 and 3.

DRYADIS PALUS is the name given by the Director to a diffused dusky spot seen by him on *Phaethontis* on October 6 with the $32\frac{3}{4}$-in. A faint, irregular curved streak seemed to emerge out of it to S.E. and N.W.

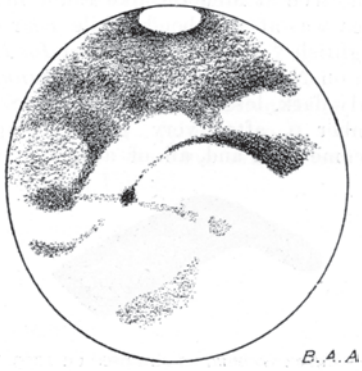

FIG. 56.—The *Mare Sirenum* region. 1909, September 1, $\omega = 123°$. (Phillips.)

MARE SIRENUM was one of the most interesting markings during the apparition. Its shape is drawn diversely by the Members, part of whom follow Schiaparelli, while others give it

* Dr. Lowell's glass positives of October 18 (Fig. 8).
† *Ibid.*

a broad beak to E. In the former group, we find Craig, Hawks (Plate II., Fig. 4), and Phillips (Fig. 56); in the latter, Backhouse (Fig. 57), Givin, Killip, Nangle, O'Hara (Fig. 58), Wright, and the Director (Fig. 55). Photography shows the beak even broader than drawn by any Member.* A detailed view of the outline of *Mare Sirenum* was obtained at Meudon on October 6, under good seeing. While the S. outline then appeared diffused, a very complex structure was held steadily to N. The "coast" of *Memnonia* was very much serrated from the E. end to the bend, where a bright, hooked "promontory" was quite conspicuous. From this point, a rough circular arc

FIG. 57.—October 8, $\omega = 134°$. (Backhouse.)

FIG. 58.—November 14, $\omega = 140°$. (O'Hara.)

The *Mare Sirenum* region in 1909.

led to *Gorgonum Sinus;* and before reaching *Titanum Sinus*, there was the shallow "bay" of *Gigantum Sinus*. Meantime a very uneven intensity characterised the *mare*. Thus Wright shows it darkest at the bend, while Craig (Fig. 60), Nangle, and O'Hara (Fig. 61) agree in depicting a lighter region in its centre. These impressions are confirmed by the Director, who, on October 6, noticed at Meudon, like Eddie in 1907, that by far the darkest area was at the bend, while near *Gorgonum Sinus* there was a brightish "island" now called *Ios Insula*, and which was seen again on November 5 and 9. *Titanum Sinus* did not look particularly dark, less so than *Sirenum Sinus*.

On November 9, after very good seeing, the image in the $32\frac{3}{4}$-in. became bad, and, all of a sudden, the irregularities

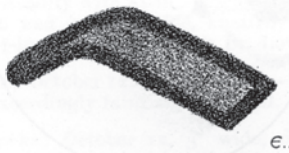

FIG. 59.—*Mare Sirenum*, as glimpsed on 1909, November 9, for $\frac{1}{3}$ of a second. (The Director.)

disappeared, when the tired eye had the fleeting impression shown on Fig. 59. This fact demonstrates the illusive character of Schiaparelli's "sea-girding canals."

* Dr. Lowell's fine photograph of October 18 (Plate I., Fig. C).

As a whole, *Mare Sirenum* was a very sombre marking in 1909,* and, during the pallor, it far surpassed in darkness all the dusky regions of the planet (Plate I., Fig. 5). But, later in the

FIG. 60.—September, $\omega = 150° \pm$. (Craig.)

FIG. 61.—October 8, $\omega = 165°$. (O'Hara.)

The *Mare Sirenum* region in 1909.

apparition, it faded. Its colour in the great refractor was a greenish indigo grey on October 6, less green perhaps than *Solis Lacus*. From the joint results of Backhouse, Craig, Dobbie, Givin, Hawks, Hoskins, Killip, Nangle, O'Hara, Phillips, Short, and the Director, it seems that *Mare Sirenum* looked very dark and deformed by yellow cloud on July 14 ; dark on August 12, 22–29, 31, September 1, 2, 3, 6, 14, 15, 19 ; faintish on September 20, 21, 22, 23 ; rather dark on September 24 ; dark on September 25, 26, 28, October 4, 5 ; very dark on October 6 ; rather dark on October 8 ; very dark on October 11, 12, 18 ; dark on October 20, 23, 24 ; faintish on October 25, 26, 30, November 1 ; dark on November 2, 4, 5 ; faintish on November 6, 7, 8, 9 ; dark to E. on November 14 ; rather dark on November 29 and December 1 ; very dark on December 8 ; faint on December 20 ; and rather dark on December 31. The most striking phenomenon was the deformation of *Mare Sirenum* seen by O'Hara on July 14 (Plate II., Fig. 5), when cloud covered its outlines, and made the spot look oval. Some partial veilings were further noted : by the Director on September 3, when the *mare* was dark to W., faintish to E. ; and by Wright on October 25, when the marking was faint except about *Titanum Sinus* (Plate II., Fig. 6).

SIRENUM SINUS, sharp to Craig, Hawks, and Phillips, was broad and rounded to Backhouse, Givin, Killip, Nangle, O'Hara, Stanley Williams, Wright, and the Director.†

GORGONUM SINUS comes out V-shaped on the drawings of Nangle, Phillips, and the Director. It was tapering in the $32\frac{3}{4}$-in., and looked faint owing to the vicinity of *Ios Insula*.

GIGANTUM SINUS was held steadily in the great telescope as a hump.

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* "Darker than I had previously observed anything on Mars' surface" (Lockyer, 1862, Mem., R.A.S., Vol. XXXII., p. 190).

† It was also broad to M. Crouzel.

TITANUM SINUS appeared generally dark and V-shaped to Backhouse, Craig, Dobbie, Givin, Hawks, Hoskins, Killip, Nangle, O'Hara, Phillips, Wright (Plate II., Fig. 6), and the Director.

ATLANTIS, a largely subjective marking,* was depicted brightish and straight by Givin, Hawks, Nangle, and Phillips. It was always either dimly defined or invisible to the Director. Yet, as the objective streak *Simois* does not join *Mare Sirenum*, passing to W., there is between the two spots a slightly lighter space.

MEMNONIA appeared brightish to the S. of *Titanum Sinus* to the Director. On September 19, Givin saw it bright under the E. beak, while on November 6, Phillips noticed a round whitish spot to the N.W. of *Titanum Sinus*.

Memnonia was observed bright on the limb by the Director on September 3 and on November 1 and 4.

NODUS GORDII looked as an elongated shading to Phillips on October 6. It was smaller to the Director in the $8\frac{1}{2}$-in. late in August; but the great telescope revealed nothing else here, on October 6, than a dimly-defined smudge.

TATTA LACUS is drawn on October 12 by Hawks as a 2° broad knot. To Phillips, on September 1 and November 6, it was 7° across and faint. The Director glimpsed it with the $8\frac{1}{2}$-in. on August 23, 27, 29, and September 3 when its diameter was 5°. On October 6, at Meudon, this region was covered with yellow cloud, blotting out the details.

LUCUS MARICÆ was seen with the $32\frac{3}{4}$-in. on November 6 and 9. It was some 3° across, and looked very faint and diffused. Only a rapid view of it was had at the time.

AMMONIUM had a breadth of 2° to Hawks on October 12. Phillips gave it 8° from E. to W. on August 28 and October 4. This "lake," like its neighbours, was conspicuous in the $8\frac{1}{2}$-in. on August 23, 25, 27, 29, and September 3, when the "land" here was ochre; but on November 6 and 9, the region to the N. of *Mare Sirenum* being yellow, *Ammonium* was scarcely accessible to the $32\frac{3}{4}$-in. as a 4° knot of extreme faintness.

MEDUSÆ FONS is the name now given by the Director to a small knot, $2\frac{1}{2}$° across, which he detected at Meudon near *Titanum Sinus*. Short views of it were had on November 5 and 9, and it was engaged in the *Titan* shadings.

AQUÆ APOLLINARES, likewise engaged in the same half-tones, appeared to the Director with the $32\frac{3}{4}$-in. as a 3° wide, roundish knot, on November 5, 6, and 9.

AMAZONIS, shaded on the drawings of Backhouse, Givin, Hoskins, Wright, and the Director, comes off bright on those of

* No trace of *Atlantis* could be found by M. Baldet from the Pic du Midi, either visually or photographically.

Craig, Dobbie, Hawks, Nangle, O'Hara, and Phillips. At Meudon, the half-tone was seen to extend in November quite as far as *Tartarus* and *Trivium Charontis*. Yellow cloud veiled it early in November; but, on November 9, the cloud cleared off, and the 32¾-in. unravelled, for 12 consecutive seconds, a most complex structure here, when *Amazonis* appeared covered with a prodigious quantity of irregular details and undulating grey filaments.*

MINOR DETAIL.

ARAXES.—Craig: September, 3° wide.—Hawks: October 12, width 1°, darkish.—Phillips: September 1, October 4, 3° wide, faint; October 6, 5° wide, faint; October 11, 3° wide, darkish; November 6, 2° wide, faint.—The Director: August 29, September 6, glimpsed 3° wide, diffused, faint in 8½-in. Calver; October 6, 6° wide, wavy, held steadily, very faint in 32¾-in. (Fig. 21); October 11, exceedingly faint, yellow cloud; November 9, 5° wide, faint.†

EUMENIDES.—Hawks: October 12, 1° wide.—Phillips: August 28, September 1, October 4, 6, 11, November 6, 8, breadth 4°, faint.—The Director: August 23, 25, 26, 27, 29, September 3, 4° wide, edge of shaded *Amazonis*.

GIGAS.—Craig: September, 3° wide, convex to N.W.—The Director: August 23 (Plate I., Fig. 5), 27, September 3, wavy, 4° wide, diffused. Never seen with the large instrument.

GORGON.—Givin: November 29, 3° wide, very faint.—Phillips: August 28, October 4, 6, November 6, 5° wide, sometimes convex to E.—The Director: August 23, 29, 3° broad, wavy, diffused; in the large telescope, on October 6, the *Gorgon* was held steadily for 3 seconds as a narrow, sinuous, half-tone to S., expanding irregularly to N. An interesting sight indeed (Fig. 30); November 5, 6, 9, more smudgy.

HERCULIS COLUMNÆ.—Phillips: August 28, 10° wide, faint; September 1, 10° wide, dark; October 4, 9° wide, faint; October 6, 11, 8° wide, faint.—The Director: August 29, barely indicated; October 6, November 5, 6, 9, no trace whatever at Meudon.

HYSCUS.—Backhouse: October 8, edge of *Icaria* shading.—O'Hara: November 14, N.E. edge of *Icaria* shading.—Short: September 23, 24, edge of *Icaria* shading.—The Director: August 25, October 6, November 7, 9, edge of *Icaria* shading (Fig. 42).

PYRIPHLEGETHON.—The Director: August 29, diffused edge of shaded *Amazonis*; November 9, 5° wide, visible to N.W. only.

SIMOIS.—Nangle: September 10, 15, October 16, 3° wide, faint.—Phillips: November 6, 3° wide, faint.—The Director: August 26, 29, convex to E., 4° wide, diffused; October 6, with the 32¾-in., *Simois* was held steadily for several seconds, and stood out with a boldness and definiteness defying description; convex to W., it was narrow to N., widening out gradually like a trumpet into a vast "inlet" on *Mare Chronium*, and its appearance was that of an irregular, curved, dark band (Fig. 25); November 4, 5, 6, 9, convex to E., diffused.

SIRENIUS.—Craig: September, 3° wide, trending to N.N.W.—Givin: December 1, 5° wide, diffused.—Phillips: October 11, November 6, convex to S., faint.—The Director: August 25, 28, 29, September 3, 6, curved, amorphous, widely diffused; October 6, November 9, narrowish to S. in 32¾-in., and broadening out into a vast shading to N.N.W., exceedingly faint.

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* *See* Journal, B.A.A., Vol. XX., p. 137.

† *Araxes* was photographed by Dr. Lowell on 1909, October 18.

TITAN.—Givin : October 23, November 29, December 1, some 3° wide.—Phillips, August 28, 7° wide and faint ; October 4, 3° wide, faintish ; November 6, 8, to S. only, 4½° broad ; December 8, 4° wide, faint.—The Director : August 22, 23, 24, 25, 26, 27, 29, September 3, with 8½-in., seems, as usual, to emerge from *Titanum Sinus*, 4° wide, conspicuous ; September 25, do., at Meudon, bad seeing ; November 4, 5, 6, 7, 9, held steadily in 32¾-in. as reaching out of the N.W. front of *Mare Sirenum*, and not out of *Titanum Sinus ;* 3½° wide, irregular, undulating, to S., swells out into a vast shading to N., whose S.W. limit is the *Tartarus*.

A *new streak* was drawn with a breadth of 7° by Phillips on October 4, prolonging *Gorgon* over *Phaethontis*.

SECTION V.

Mare Cimmerium, Elysium, and Trivium Charontis.

$\Omega = 180°$ to $250°$; $\Phi = -60°$ to $+60°$.

MARE CHRONIUM looks more or less streaky on the drawings of Backhouse, Craig, Dobbie, Givin, Hoskins, Killip, O'Hara, Phillips, and Wright (Plate II., Fig. 6). Such was also its appearance to the Director with the 8½-in. ; but, at Meudon, the outline was less regular, owing to a narrow passage in $\Omega = 160°$, and to the broad, deep "inlet" of *Simois*. Its tint was uneven. The intensity of *Mare Chronium* was considerable at times, although undergoing changes of a marked character. Thus it was dusky on August 14–15, according to the Director ; invisible on August 22 ; faintish on August 23 ; and darkish on August 24, 25, 26, 27, and 29, September 25, November 1, 4, 5, 6, and 9.

TIPHYS FRETUM had a breadth of some 6° to the Director at Meudon.

ELECTRIS is not shaded on the drawings supplied by Backhouse, Craig, Dobbie, Givin, Hawks, Hoskins, Killip, Phillips, Short, and Wright, while Nangle, O'Hara, and the Director agree in representing it dusky. It was invariably greyish near C.M. to the last-named observer, both in the 8½-in. and in the 32¾-in.

On October 4, Phillips drew a small oval white spot in the N.E. part of this "land."

Electris was bright on the periphery on August 28, 29, and September 3.

ERIDANIA, curiously enough, did not present any features of interest to most Members. However, the Director must dissent from them on this point, as from August to November, and in the 8½-in. as well as in the 32¾-in., *Eridania* always appeared to him of a bright rose colour near the C.M., being much brighter than the adjoining regions (Plate I., Fig. 6). This peculiarity was striking at the first glance cast in the telescope. As to the shape of this "land," it was roughly pentagonal, elongated E. to W., with a blunted angle on *Mare Cimmerium*. Definition being never good at Meudon when this marking was near the

C.M., its borders always appeared diffused in the great instrument.

Phillips drew a whitish spot on *Eridania* near the terminator on December 8. The Director saw this "land" bright on the limb on August 23, 24, 27, 29, October 22 and 23, and bright on the terminator on October 6, 11, November 7 and 9. Wright on October 25 (Plate II., Fig. 6) and Nangle on October 29 (Fig. 62), drew *Eridania* as a bright projection on the terminator.

FIG. 62.—*Eridania*, seen as a bright projection.
1909, October 29, $\omega = 130° \pm$. (Nangle.)

MARE CIMMERIUM appeared cigar-shaped to Backhouse (Fig. 63), Givin, Phillips, and the Director with $8\frac{1}{2}$-in. It is squarish to W. on the drawings of Hoskins (Fig. 64), Nangle,

FIG. 63.—September 28, $\omega = 216°$.
(Backhouse.)

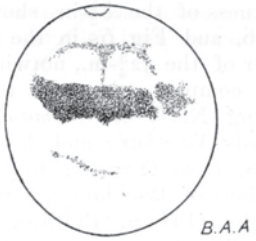

FIG. 64.—August 12, $\omega = 207°$.
(Hoskins.)

The *Mare Cimmerium* region in 1909.

and O'Hara. Some irregularities of outline towards its W. end were already glimpsed at Juvisy in August; and, on September 20, this part of the *Mare*, called *Tritonis Sinus*, was held steadily with the $32\frac{3}{4}$-in., and looked very tapering* and slightly curving to N.W. Meantime two "bays," those of the *Cyclops* and *Cerberus*, were visible more to E. (Plate III., Fig. 1). On September 25, under fluttering seeing, the "inlets" of *Læstrygon* and *Scamander* were very conspicuous at Meudon, while a group of yellowish "islands," still further E., was a new and striking feature of the 1909 apparition. The colour of *Mare Cimmerium*, grey with the $8\frac{1}{2}$-in., was greenish grey in the large telescope on September 20, when partly veiled by yellow dust; but, on September 25, the surrounding regions being very ruddy, the *Mare* was of a lovely cobalt blue grey. As to the general intensity of *Mare Cimmerium*, it was always inferior to that of

* It is thus shown on Prof. Hale's wonderful photograph of 1909, October 5 (Plate I., Fig. B).

Mare Sirenum, and particularly so in the early part of the apparition (Fig. 65). The shading was by no means uniform.

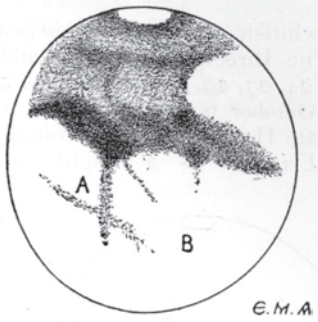

FIG. 65.—Mars. 1909, August 26, $\omega = 184°$. The region marked A was ruddy and detailed, that marked B was yellow and without details. (The Director.)

There was first a dark irregular spot due S. of the "yellowish "islands" above mentioned; then *Scamandri Sinus* and *Læstrygonum Sinus* formed two other dark condensations (which the weakness of the $8\frac{1}{2}$-in. showed as two round nuclei (Plate I., Fig. 6, and Fig. 65 in the text), while the superior separating power of the $32\frac{3}{4}$-in., notwithstanding bad seeing, resolved into more complex triangular forms); then another very irregular shading N.W. of *Scamandri Sinus;* a slight intensification towards *Xanthus;* and, lastly, a darkness along the "coast" of *Æolis*, from $\Omega = 212°$ to *Cyclopum Sinus*. According to the drawings of Backhouse, Craig, Dobbie, Givin, Hoskins, Killip, Nangle, O'Hara, Phillips, Short, Wright, and the Director, *Mare Cimmerium* appeared faint on August 12; exceedingly faint on August 14 and 15; faint on August 22; a bit darker on August 23, 24, and 25; still a little duskier on August 26, 27, 28, and 29; darkish on September 10; faintish on September 12, 14; rather darker on September 15 and 18; faintish on September 19, 20, 21, 22, 23, 24, 25; darkish on September 26, 28, October 4, 5, 6, 8, 14, 16, 18, 20, 21, 22, 23, 24, 25, 26, 30; faintish on November 1; rather dark on November 4, 5, 6, 7, 8, 9, 29, December 1; very dark (?) on December 6 and 7; and faintish on December 8. Greatly affected by the August pallor, *Mare Cimmerium* subsequently regained to some extent its normal intensity; but it was never dark.

SYMPLEGADES INSULÆ is the name given by the Director to a group of irregular half-tones detected by him on September 25 at Meudon in *Mare Cimmerium*, near the coast of *Zephyria*. Definition was V at the time, but Mars subtended $23''{\cdot}8$, and for some $\frac{1}{6}$ of a second, now and then, about five good gleams could be secured. These "islands" were yellow, though duskier than *Zephyria*, and they had a very complex and irregular structure which could not be drawn. The group was divided

chiefly into three unequal, jagged parts, and its existence was confirmed on November 4, 5, 6, and 9.*

SCAMANDRI SINUS, or the "bay" on *Mare Cimmerium* of the homonymous streak, is shown triangular and darkish by Givin, Phillips, and the Director.

LÆSTRYGONUM SINUS, the easiest of the "estuaries" of *Mare Cimmerium*, is drawn triangular and darkish by Craig, Givin, Hoskins, Phillips, and the Director.

CYCLOPUM SINUS was depicted by Givin, Nangle, and Phillips. At Meudon, on September 20, it was held steadily as a considerable V-shaped "inlet" (Plate III., Fig. 3).†

CERBERI SINUS was detected by the Director with the 32¾-in. on September 20, and was held steadily. It had almost exactly the same V-shaped appearance and the same size as the foregoing, from which it was separated by an arched "coast." (Plate III., Fig. 3).‡

TRITONIS SINUS is the W. tapering end of *Mare Cimmerium*. It was remarkably sharp in the large telescope and apparently free from lateral irregularities. But foreshortening must have rendered these invisible near the limb on September 20.

HESPERIA, more or less normal in shape on the drawings of Backhouse, Craig, Nangle, O'Hara, and the Director with the 8½-in., is shown narrow by Hoskins and Phillips, and very narrow indeed by Givin. With the 32¾-in., on September 20, it was possible to discover a more complex outline to the "peninsula," which was broad in the middle and rather narrow to N.W. Most Members, like Backhouse, Craig, Hoskins, Nangle, O'Hara, and the Director, agree in representing *Hesperia* shaded;§ but Phillips drew it bright.

The Director suspects that this "land" is perhaps more conspicuous under oblique view than on the C.M.

HYRIA LACUS is the name now given to a very large and complex "lake" detected at Meudon on *Hesperia*.‖ On September 22, O'Hara drew here a broad streak, 6° wide, uniting *Mare Cimmerium* to *Mare Tyrrhenum*. It is on this marking

* A vague indication of *Symplegades Insulæ* can be found on Green's delineations of 1877, and on Burton's of 1879 ("Noble Cape," in Sci. Trans. R. Dublin Soc., Vol. I. (n.s.), Plate VII., Nos. 16, 17, and 20). Schæberle seems to have seen them in 1892.

† *Cyclopum Sinus* was photographed by Prof. Hale on 1909, October 5 (Plate I., Fig. B).

‡ *Cerberi Sinus* was also photographed by Prof. Hale on 1909, October 5.

§ It is also strongly shaded on the 1909 photographs of Prof. Hale (Plate I., Fig. B) and Prof. Barnard.

‖ The existence of this marking was also confirmed by photography. It comes out as a "lake" on the photographs of 1909 by Prof. Hale (Plate I., Fig. B) and Prof. Barnard. Schiaparelli saw it as a "canal" (*see* p. 44, Figs. 45–46).

that the first glance cast in the $32\frac{3}{4}$-in. by the Director on September 20, fell. Definition was then perfectly calm, and it was a great surprise to see such a huge "lake" on *Hesperia*, never recorded before (Fig. 47). The spot was divided in two unequal and very irregular dark masses, and showed a great amount of detail held steadily for many minutes, which no artist could ever think of drawing.

ZEPHYRIA was bright on C.M. to the Director on August 23, but intense ochre on September 25. On November 6 and 8, Phillips drew here a bright spot, some 10° across.

Zephyria was observed to be whitish near the limb on August 28 and 29 by the Director.

ÆOLIS, bright ruddy near the C.M. on September 25, and shaded N. of *Antæus*, appeared whitish near the limb on August 29 to the Director.

ÆTHIOPIS, veiled by yellow cloud on September 20 to the Director, showed two whitish spots of unequal size to Nangle on September 10.

PAMBOTIS LACUS, so conspicuous in 1907, was almost an insignificant marking in 1909. Givin caught traces of it on October 16 and 18. Phillips gave it 5° on September 26 and on November 4. On September 25, it was invisible at Meudon; but on November 4, 5, and 6, it looked roughly circular, 4° across, and moderately dark.

SCORPII PALUS is the name given by the Director to a considerable "lake," discovered on November 5 with the large telescope, to the S. of *Cerberus I.* It was held steadily, was moderately dark, and appeared extremely jagged and irregular in outline. If this marking is permanent, how did it elude detection so long?

Stanley Williams believes that the existence of *Scorpii Palus* may help to bring about the duplication of the *Cerberus*.

TRIVIUM CHARONTIS never looked dark in 1909. While in 1892 it was an easy object with $4\frac{1}{4}$-in. to the Director, it escaped the attention of the great majority of our Members during this apparition. On October 4 and November 6, Phillips drew it as a faint shading, 7° across. At Meudon, it was distinctly elongated E. to W., measuring some 10° by 6°. From the joint Sectional data, it results that *Trivium Charontis* was invisible on August 12, 22, and 23; that it was exceedingly faint and ghost-like on August 24; invisible on August 26 (Fig. 65), 27, and 28; exceedingly faint on August 29; invisible on September 10, 14, 15, 24, and perhaps 25; very faint on September 26; invisible on September 28, October 6, 8, 11, 14, 16, 18, 20, 21, 23, 25, 26, 30, and November 1; faint on November 4, 5, 6, and 8; and again invisible on December 6, 7, and 8. We infer with certainty that *Trivium Charontis* was blotted out to invisibility by the pallor of August, and that it subsequently appeared very faint. Yellow cloud kept it more or less veiled throughout the apparition.

CASTALIA FONS was glimpsed by the Director with the 8½-in. on August 25 and never after.

ELYSIUM looked almost invariably lost in the yellow veil covering the N. regions in 1909; a very characteristic feature of the 1909 opposition!

It was bright near the limb* to the Director on August 29, to Nangle on September 24, and to Phillips on October 29.

PHLEGRA was yellow in 1909.

ÆTHERIA was also yellow. On September 15, Nangle saw a whitish spot here.

Ætheria was bright on the limb to Phillips on October 29.

MINOR DETAIL.

ÆTHIOPS.—The Director: August 15, 2° wide, exceedingly faint, glimpsed to S. only.

ANTÆUS.—Phillips: September 26, November 4, 8,† 3° wide, faint.—The Director: November 4, at Meudon, 4° wide, diffuse, isolated between *Læstrygon* and *Pambotis Lacus;* November 5, held quite steadily with the 32¾-in. for several seconds between *Læstrygon* and *Pambotis Lacus;* very irregular, from 2° to 4° wide, composed of two filaments near *Læstrygon*, and of two very complex and irregular dusky spots further to N.W., and not reaching *Pambotis Lacus* (Fig. 32). The district to N.E. of *Antæus* was slightly shaded on this date.

CERBERUS I.—Phillips: September 26, width 6°, dark, edge of half-tone in *Æolis;* October 4 and November 8, 7° wide, darkish.—The Director: August 22, 23, invisible, blotted out by pallor; August 24, 26, incredibly faint and ghost-like, a weird sight indeed! August 29, 4° wide, faint; September 25, with 32¾-in., diffused, 5° wide, image = V; November 4-6, 4° wide, knotted, diffused. Never seen under first-class conditions. The veiling of this marking by yellow cloud early in the apparition is unquestionable.

CERBERUS II.—Nangle: September 15, 3° wide, straight, disobeying perspective.—The Director: September 25 and November 5, with the large instrument, glimpsed 2° wide, very faint, not running parallel to *Cyclops*, but converging with it towards *Pambotis Lacus*.

CYCLOPS.—Craig: September 24, 3° wide, faint.—Givin: October 16, 3° wide, winding.—Nangle: September 10, 15, October 16, 2° wide, darkish.—Phillips: September 26, November 4, 8, convex to E., 4° wide, darkish; edge of shade to E. on September 26.—The Director: August 14, 23, 24, 26, exceedingly faint and ghost-like, seen by rapid views; August 29, 3½° wide, faint; September 25, seen by short views, November 4, 5, 6, some 3° wide, faint, perhaps knotted with 32¾-in.

EUNOSTOS.—Phillips: September 26, 3° wide, faint.—The Director: September 25, glimpsed once with large telescope, 3° wide and faint.

HADES.—Phillips: November 26, width 10°, a faint marking.

LÆSTRYGON.—Craig: September, width 3°, faint.—The Director: August 22, invisible, veiled; August 23, 24, 26, glimpsed to S. only,

* Prof. Hale's photograph of October 5 also shows it slightly bright near the limb (Plate I., Fig. B).

† On all these three dates, Phillips drew *Antæus* as running into *Læstrygonum Sinus*.

2° wide, exceedingly faint and ghost-like ; August 29, 3° wide, glimpsed all along, faint ; September 25, 3° wide, diffused, in a flaring image during a very clear night and a display of the aurora borealis ; yet the power of the great telescope made itself felt, now and then, by glimpses, when the streak, which, as a whole, is remarkably straight, appeared resolved into distinct irregular dots of various sizes, and curved filaments, which was most tantalising to the draughtsman ; November 4, 5, 6, fairly straight, 3° wide, composed of more or less detached winding. filamentary shadings (Fig. 32) ; more confuse on November 6.

On August 29, in the 8½-in. Calver, *Læstrygon*, *Cerberus I.*, and *Cyclops*, with the included "coast" of *Mare Cimmerium*, flashed forth now and then simultaneously, forming a trapezium.

LETHES.—Craig : September, breadth 3°.—The Director : August 14, 15, 3° wide, very faint ; September 25, smudgy and amorphous in the 32¾-in.

ORCUS.—Givin : October 23, 5° wide.—Hawks : September and October, "very dark" and "of great density."—Hoskins : August 12, 6° wide, irregular, faint. — Phillips : August 28, September 26, November 6, December 8, 5° wide, faintish.—The Director : August 23, S. edge of shaded *Amazonis*.

SCAMANDER. — Givin : October 23 and 24, 3° wide, faint. — Nangle : September 10, 3° wide.—Phillips : October 4, November 8, December 8, 4° wide, faint.—The Director : August 23, 24, 26, 29, 4° wide, concave to W., edge of bright *Eridania ;* November 4, 5, 6, 7, 4½° wide, concave to W., edge of bright *Eridania*.

STYX.—Phillips : September 26, 3° wide, faint.

TARTARUS.—The Director : August 23 and 26, glimpsed as a 2° narrow, faint streak, with the small instrument ; November 5 and 6, a revelation in the 32¾-in., when, instead of the linear marking of Schiaparelli, there was here a steadily-seen jagged edge of the half-tone to N. of *Mare Sirenum* (Fig. 44).

XANTHUS.—Givin : October 18 and 23, 3½° wide.—Nangle : September 10, 15° wide ; 15, 10° wide, faint ; October 16, 4° wide.—O'Hara : September 22, 5° wide, dark ; December 8, 12° wide.—Phillips : September 26, November 8, 4° broad, faintish.—The Director : August 22, 23, 24, 26, 29, 5° wide, edge of bright *Eridania ;* September 25, November 4, 5, 6, 4° wide, edge of shade to W., or of bright *Eridania* to E., with 32¾-in.

A *new streak* was drawn by Phillips on September 26 between *Sinus Cyclopum* and *Ammonium*, convex to S.S.E., edge of shade to N.

SECTION VI.

Mare Tyrrhenum and Syrtis Major.

$\Omega = 250°$ to $310°$; $\Phi = -60°$ to $+60°$.

PROMETHEI SINUS usually presented a darkish tint in 1909. On August 15, it looked blue to the Director in the 8½-in. reflector, while 8 days later, it was not a conspicuous marking near the C.M., appearing even brightish at sunset near the terminator, probably on account of thin white cloud.

CHERSONESUS, fairly well seen at Juvisy with 8½-in., was barely more detailed in the 32¾-in. at Meudon, under perfect conditions, on September 20. Undoubtedly this is no failure of the large instrument, for, on the last-mentioned date, a dingy,

brownish veil covered all these regions as far as *Mare Hadriacum* and *Hellas*, if not up to *Hellespontus*.

AUSONIA was fairly well drawn by Backhouse on October 27 and 30. It is more confuse on the other delineations; but the "land" is difficult to define. With the $32\frac{3}{4}$-in. the Director could never detect a sharp outline to *S. Ausonia;* but *N. Ausonia* was better defined. *Circæum Promontorium* looked, however, very obtuse and inconspicuous, although this was not the case with the "cape" to N.W., opposite *Œnotria*. *S. Ausonia*, although much duskier than *Eridania*, was still brighter than *N. Ausonia*.* The colour of these "lands," on September 20, was a dingy, brownish yellow; on October 23, a fiery red.

Ausonia was whitish on the limb to the Director, when rising, dusky later, near the C.M., on August 23 and 24. On August 26 it was again bright near the limb; so also on September 25; and it brightened while nearing the terminator on November 6.

PERÆA is the name given by the Director to a curious, elongated "land" bordering *Ausonia* to S.W., and running almost concentrically with *Mare Hadriacum* and the N.E. "coast" of *Hellas*.† This marking was detected under grand definition on September 20 at Meudon, and was held quite steadily for minutes at a time. It was very winding and irregular in outline; its colour was also a dingy, brownish yellow, and it was separated from *Ausonia* by a knotted, irregular streak, now christened *Borbyses*. Dim views of this marking were had later, on September 25 and October 23.

HADRIACUM MARE is correctly drawn by Backhouse (Plate III., Fig. 4), Craig, Givin, Hawks, Killip, Nangle, O'Hara, Phillips, and Short (Plate III., Fig. 2). At Meudon, it looked extended to the E. of *Hellas*, narrow, further to N.E., and very narrow between *Hellas* and *Chersonesus*. On September 20, it was not grey, but brownish yellow, like the adjoining "lands." A dark spot was seen by the Director with the $8\frac{1}{2}$-in. on September 19, and with the $32\frac{3}{4}$-in. on September 20, due S. of *Hellas*.‡ This was also seen by O'Hara on December 7. According to the joint results of Backhouse, Craig, Dobbie, Givin, Killip, Nangle, O'Hara, Phillips, Short, and the Director, *Mare Hadriacum* was totally invisible to E., and exceedingly faint to N.W. on August 12; very faint on August 14; a bit more intense on August 15; still very faint on August 16 (Plate I., Fig. 4), 23, and 24; darker on September 2; rather faint on September 4, 5, 9, 11, 12, 13; rather dark on September 15, 16, 17, 18, 19; faintish

* This was confirmed by Prof. Hale's photograph of 1909, October 5 (Plate I., Fig. B).

† The existence of *Peræa* was also confirmed by Prof. Hale's photograph of October 5.

‡ This spot was subsequently photographed by Prof. Hale (Plate I., Fig. B).

on September 20, 21, 22, 23 ; darker on September 24 and 25 ; dark on October 6, 9 ; faintish on October 11, 14, 16, 18, 20, 21, 22, 23 ; normal on October 25, 27 ; faintish on October 29, 30 ; normally dark on October 31 ; faint on November 4, 10, 16 ; normal and dark on November 27 ; and dark to S. on December 7. Hence *Mare Hadriacum* was obliterated almost to invisibility early in the apparition.

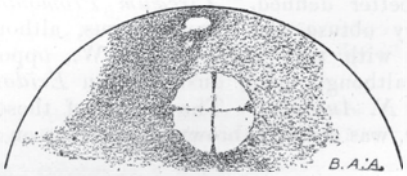

FIG. 66.—*Hellas*. 1909, October 25, $\omega = 280°$. (Hawks.)

HELLAS, roundish in the small telescopes of Backhouse, Craig, Givin, Killip, and Short, assumed a more oval form in the larger appliances of Dobbie, Hawks (Fig. 66), Nangle, O'Hara, Phillips, and the Director. At Meudon, on September 20, under superb definition, the outline of this "island" appeared somewhat pointed to the S., at the part now called *Malea Promontorium*, while a shallow "bay" was held steadily on its N.N.E. "coast" (Plate III., Fig. 3). This was named *Portus Bucoleontis* by the Director. On each side of the "bay" there were two lobes, the one to N.W. being the larger.* However, the outline of *Hellas* was quite sharp in the large instrument, only to N.,† for it diffused into the surrounding *maria* to E., to W., and to S. On the same date, the central "lake" discovered on *Hellas* by Stanley Williams in 1892 was visible, although being exceedingly faint. O'Hara gave it 3° across on September 22. With the kind permission of the discoverer, this "lake" was named *Zea Lacus* by the Director. The brightness of *Hellas* was not uniform, but greatest at the N.W. lobe.‡ Its colour was a "light lemon" to Hawks on October 25, while it appeared ruddy to Killip on October 30, and "very ruddy" to O'Hara on September 17. The Director found *Hellas* ruddy on August 12 ; very red on August 14, 15, 16 ; pale on August 23 ; red on September 14 and 16 ; very red on September 19 ; brownish, very curious, on September 20, 25 ; yellowish on October 19 ; and again very red on October 22 and 23.

Like *Noachis*, *Hellas* did not brighten much under oblique view in 1909, and, especially at the time of the pallor, when indeed it would often rise and set without assuming any white tinge. Backhouse saw *Hellas* setting bright on November 26. The Director's data establish that this "land" was not bright

* The existence of *Portus Bucoleontis* with the lateral lobes was confirmed photographically by Prof. Hale on 1909, October 5 (Plate I., Fig. B).

† The lower half of *Hellas* was already recognised by Huygens in 1659.

‡ As pointed out by M. Quénisset.

when setting on August 12 and 15; that it was whitish when risen on August 15, 23, and 24; ruddy near sunset on September 14, and after sunrise on September 25; and yellow near sunset on October 19 and 21.

Observation shows that the S. "islands" assume their maximum marginal brightening in winter, under an oblique Sun. Hence, if, as seems probable, the brightening is due to more or less transparent cloud,* then cold would favour the condensation of the white clouds of Mars, while heat seems to further the formation of the yellow dust clouds.

YAONIS FRETUM is the name now given to the narrow "channel" separating *Hellas* from *Yaonis Regio.* O'Hara drew it dusky on September 17 and 22, Phillips fainter on September 18, 23, and October 29. It was rather easy with the $8\frac{1}{2}$-in. on August 12, 14, and 15, and it was quite dark and conspicuous, broadening to S., at Meudon on September 20.

YAONIS REGIO, roundish to O'Hara, looked oval and dusky in the $8\frac{1}{2}$-in. at Juvisy. With the $32\frac{3}{4}$-in., it was seen tapering to N.E., and with a sharply-defined, undulating "coast" to N., after which it diffused off into *Hellespontus.* Its colour on September 20 was a dingy brownish yellow.

MARE TYRRHENUM presented its usual form to most Members. At Meudon, it was better defined to N. than to S. Its intensity, which seems uniform in ordinary appliances, was broken up by the superior separating power of the $32\frac{3}{4}$-in., on September 20, and under perfect definition, into at least 16 very dark and irregular knots of various sizes, all held steadily for several seconds (Plate III., Fig. 3).† This was a remarkable and unexpected sight indeed; and it took some time to ascertain that the view was not illusive, a suspicion which the boldness and definiteness with which the spots stood out from the dusky background of the *mare* proved to be unfounded. There was also a lightening of the dark material across *Mare Tyrrhenum*, between *Hyria Lacus* and *Euripus.* This knotted structure of *Mare Tyrrhenum* constitutes detail of a very delicate order; and, probably, no aperture under 30 inches would define it, while even then, an experienced observer, with a trained eye and perfect seeing, would be necessary to glimpse it. The colour of this "sea" was a dark olive greenish grey on September 20. From the observations of Backhouse, Craig, Dobbie, Givin, Hawks, Killip, Nangle, O'Hara, Phillips, Short, and the Director, it appears that *Mare Tyrrhenum* was invisible on

* *See* Mars Report for 1907, p. 69.

† Commenting on these knots, Prof. Hale wrote to the Director on 1910, January 3: "I do not remember that my visual observations showed "so regular a distribution of the darkest markings appearing in your "drawing of September 20th. Have you purposely adopted a somewhat "conventional mode of representing them, on account of the impossibility "of recording the excessively complex details visible at the telescope?" The explanation to this is that the knots were drawn as they appeared; but that there was no higher power than 320 available at the time. High magnifiers would certainly have revealed more irregularity here.

August 12 ; very faint indeed on August 14, especially to E. ; very faint on August 15, 16, 23, and 24 ; faint on August 26 ; rather faint on August 29, September 4 and 5 ; darker on September 9 ; faintish on September 10, 11, 12, 13, 14 ; rather dark on September 15 ; very faint on September 16 ; rather dark on September 17 and 18 ; very dark, especially to E., on September 19 ; very dark indeed on September 20, 21 ; very dark at ends, lighter in middle, on September 22 ; dark on September 23, 24 ; very dark on September 25, 26, 28, October 6, 9 ; rather dark on October 11, 14, 16, 18, 20, 21 ; dark on October 22, 23, 25, 27, 29, 30 ; faintish on November 1 ; darker on November 4, 5, 6, 8, 9 ; and very dark on December 7. We conclude from these records that *Mare Tyrrhenum* was very much obliterated by the pallor, and that it had recovered its normal intensity, which is great, by September 20.

SYRTIS PARVA, pointed on the drawings of Craig and O'Hara, is less marked on those of Givin, Hawks, Killip, Nangle, and Phillips. The curve was moderately deep at Meudon, where the "bay" was seen occupied by one of the dark knots of *Mare Tyrrhenum*. *Syrtis Parva* was also very faint during the pallor, but less so than *Mare Tyrrhenum*, for on August 14, 15, and 16, it formed the darkest part of the latter.

IAPYGIA, a confused marking, could be detected at Meudon merely as a brighter irregular green patch in the intensely green expanses seen on September 20 to the N. of *Hellas*. This "land" loses when best seen.

STRONGYLE INSULA is the name now given to a roundish grey spot held steadily on September 20 with the $32\frac{3}{4}$-in. to the E. of *Deucalionis Regio* and *Barathrum* (Plate III., Fig. 3).

ŒNOTRIA was seen united to *Aeria* by Phillips. Fairly conspicuous on September 19 in the $8\frac{1}{2}$-in., it became confuse in the $32\frac{3}{4}$-in., although there still was a lightening of the *mare* running S.E. out of *Nymphæum Promontorium*.

INCURVA INSULA is the name given by the Director to a curved "island," shaped into a meniscus, and discovered at Meudon between *Hammonis Cornu* and *Nymphæum Promontorium*.* On September 20, under perfect seeing, the "island" appeared white, sharply defined, and irregularly jagged, especially to N.W., where it was concave, and was held steadily for many minutes, contrasting with the lawn-green colour of the country around (Plate III., Fig. 3).

Midway between *Iapygia*, *Strongyle*, *Œnotria*, and *Incurva Insula*, there was a dark irregular spot on the lighter ground of the green districts to the S. of *Syrtis Major*, where a great

* Eight days later, Prof. Barnard confirmed the existence of this "island" by photographing it. Traces of it seem to have been caught by Green in 1877, which shows how stable some at least of the minute details are on the planet.

many minute white dots were visible in the 32¾-in. on September 20.*

DELTOTON SINUS is recognisable as a shallow "bight" of *Aeria* on the drawings of Backhouse, Craig, Dobbie, Givin, Phillips, and the Director with 8½-in. But on September 20, the large telescope unravelled a greater general concavity here, and immediately resolved *Deltoton Sinus* into three sharply-defined minor "bays," held steadily, with arched outlines (Plate III., Fig. 3).† The dark area here was greenish grey, not meadow green, as to S.E., and seemed much mottled.

NYMPHÆUM PROMONTORIUM is a new name given by the Director to a sharp "cape" seen by him with the 8½-in. on September 19, to the N.E. of *Deltoton Sinus*, and running into *Œnotria*. On the following day, at Meudon, the "promontory" was still more remarkable, and it must be a permanent feature. Traces of it were caught by Givin.‡

SYRTIS MAJOR did not show Lowell's form in 1909, and it no longer bulged to the E., as observed from 1894 to 1907. It was distinctly V-shaped to Backhouse, Craig, Dobbie (Fig. 67), Givin, Hawks, Killip (Fig. 68), Nangle, O'Hara, Phillips, Short,

FIG. 67.—November 16, $\omega = 290°$. (Dobbie.)

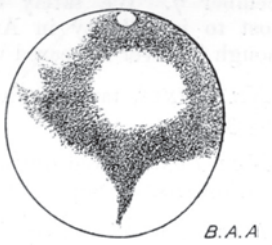

FIG. 68.—October 30, $\omega = 295°$. (Killip.)

The *Syrtis Major* region in 1909.

and generally to the Director with 8½-in. Hawks justly remarks: "I could not make out the well-known 'swelling' on "the W. side of the *Syrtis*." On September 19, the Director noticed, with the small instrument, that *Syrtis Major* had the form given to it by Dawes in 1864.§ On the following day, at Meudon, this general impression was confirmed. Concave to E., the great "sea" was somewhat lobed to N., the W. "coast" showing *Nymphæum Promontorium* as jutting into *Œnotria*, while the collective view of the triple "bay" corresponded to the notch seen by Dawes to the N.E. of *Hammonis Cornu*. But the intensity of *Syrtis Major*, which was fairly uniform

* This spot was photographed by Prof. Hale on October 5.

† The existence of this triple "bay" was confirmed a fortnight later by the wonderful photograph of Prof. Hale (Plate I., Fig. B).

‡ Prof. Hale's photograph just mentioned shows *Nymphæum Promontorium* exactly as drawn at Meudon.

§ A.N., No. 4359.

along *Libya*, as far N. as the entrance to *Lacus Mœris*, ended at this point, where a "shoal," now called *Arena*, was held steadily for minutes in the great telescope. This half-tone "bridged" the *Syrtis* towards its N. extremity, and measured some 5° in breadth as a mean. Beyond this, the dusky area took a N.E. direction, with wavy outlines; while a second "bridge," *Nili Pons*, marked the bottom of *Nili Sinus*, or the N. end of *Syrtis Major*.* From *Mare Tyrrhenum* to *Arena*, and as far to S.W. as *Œnotria*, the colour was a fine indigo blue on September 20; S. of this, we had the mottled meadow-green expanses, sprinkled with the white specks. *Syrtis Major* was very heavily obliterated by the pallor. The drawings of Backhouse, Craig, Dobbie, Givin, Hawks, Hoskins, Killip, Nangle, O'Hara, Phillips, Short, and the Director, show the *Syrtis* almost invisible and ghost-like to N. and E., very faint to S., on August 12; a bit duskier to N. on August 14; exceedingly faint on August 15; still a shade duskier to N. on August 16; very faint on August 23; faint on September 2, 4, 5; darkish on September 9; faintish on September 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25; darker on October 6, 9, 11, 14, 16, 18, 21, 22; still darker on October 23, 25, 27; faintish on October 29, 30, November 10, 16, 27, and December 7. We safely conclude that *Syrtis Major*, veiled almost to invisibility in August, increased in intensity later, although it never appeared with its true darkness in 1909.

Nili Sinus, tapering in the small telescopes, was rounded in the 32¾-in.

Nili Pons looked like a faint lightening at the beginning of the *Nilosyrtis*, on September 20, at Meudon.

Libya showed an irregular arched outline to most Members, and was shaded, according to Backhouse (Plate III., Fig. 4), Dobbie, O'Hara, Phillips, and the Director. In the 32¾-in., the shading was very heavy,† and ended to N. at the *Nepenthes*.

Libya appeared to the Director as a glimmer, when setting on November 27.

Mœris Lacus presented abnormal dimensions in 1909. Craig, on September 15, made it some 15° long and 4° wide; a capital result for the aperture used. Givin indicates it as a minute notch on the "coast"; Hawks as a small "inlet"; Nangle as a "bay." Phillips gave it a length of 10° and a breadth of 3°, on September 18 and 23. During the pallor, on August 14, the Director noted that *Syrtis Major* seemed occasionally "to extend as far as *Syrtis Minor*"; a fact accounted for by the size of this "lake" and the shading of *Libya*, which the 8½-in. could not well define under the circumstances. On

* All these details, which cannot be seen on the Flagstaff drawings of 1909, are conspicuous on Prof. Hale's photograph of October 5 (Plate I., Fig. B).

† The shading is confirmed by the 1909 photographs of Prof. Hale and Prof. Barnard.

September 19, the Calver mirror showed *Lacus Mœris* 14° long and 7° wide.* On the following day, the separating power of the $32\frac{3}{4}$-in. revealed here a huge oval marking, 18° long and 8° broad.† The borders of the "lake" were somewhat jagged, while near its northern "shores," a dusky "peninsula" and a dusky "island" were held steadily for a few seconds. Confuse views of *Mœris Lacus* were subsequently had at Meudon on October 22 and 23.

Judging from some drawings of Lockyer, Green, and Burton, and from the 1909 appearances, we deem it probable that *Lacus Mœris* is a very large marking, whose form, size, and intensity are often affected by yellow cloud.

Libycæ Paludes is the name now given to three small dark "lakes" on *Triton*, E. of *Mœris Lacus*, of which the one to S.E. was the larger, as seen with the $32\frac{3}{4}$-in.

Tritonis Lacus, on September 20, at Meudon, seemed to be a very faint and diffused smudge.

Isidis Regio was yellow and veiled on September 20.

Nix Atlantica was detected by Phillips on September 23 as a whitish spot, 9° across, to the N. of *Mœris Lacus*. An

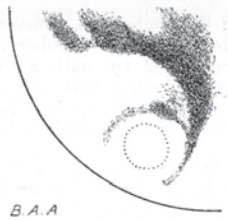

FIG. 69.—*Nix Atlantica*. 1909, September 23. (Phillips.)

excellent observation. Yellow cloud hereabout on September 20 did not enable the Director to see this interesting spot, which is obviously a permanent marking on *Isidis Regio*‡ (Fig. 69).

Neith Regio was veiled by yellow cloud.

Meroe Insula was also veiled in 1909.

Coloe Palus, seen by Phillips on October 29, was held steadily in the $32\frac{3}{4}$-in., on September 20, as an oval dusky spot. Foreshortening and a rippling image forbade the detection of irregularities in its outline.

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* A.N., No. 4,359.

† The great size of *Mœris Lacus* in 1909 was thoroughly confirmed by the photographs of Prof. Hale (Plate I., Fig. B), Prof. Barnard, Dr. Lowell, and M. Baldet.

‡ *Nix Atlantica* is recognisable on Prof. Hale's photograph of October 5.

MINOR DETAIL.

ALPHEUS.—Craig: September 25, 3° wide.—Hawks: October 25, 1° wide.—O'Hara: September 22, 3° wide.—The Director: August 16, glimpsed 2° wide, very faint and doubtful; September 16, edge of shade to E., N. end only; September 20, with 32¾-in., a rapid view was had of a succession of exceedingly faint and diffused spots.

AMENTHES.—Hawks: October 25, "appeared double."—The Director: August 14, 15, 16, 23, glimpsed amorphous, exceedingly faint and diffused; September 20, with the large instrument, under perfect seeing, it was noted that there existed nothing here to countenance the visibility of a streak.

ASTAPUS.—O'Hara: September 22, 4° wide, faint.—The Director: September 20, held steadily for some 5 seconds in the 32¾-in., 2½° wide, as a mean, composed of two more or less disconnected irregular dusky spots (Fig. 15).

ASTUSAPES.—Phillips: October 29, 6° wide, faint.—The Director: August 15, 16, glimpsed 2° narrow, faint.

BORBYSES.—The Director: September 20, held steadily in 32¾-in. as a very irregular and curved knotted band, whose breadth varied from 2° to 4°; September 25, October 23, confuse. This streak separates *Ausonia* from *Peræa*,* and was discovered with the 32¾-in.

EURIPUS.—O'Hara: September 22, 4° wide, dusky.—The Director: September 19, with 8½-in., 3° broad, conspicuous; September 20, 25, 4° wide, irregular, edge of shaded *N. Ausonia*, with large instrument.

NEPENTHES.—Phillips: September 18, convex to S., 5° wide, faint; September 23, 3° wide, do. (Fig. 69); October 29, faint edge to shaded *Libya*.—The Director: September 19, with 8½-in., curved, convex to S., W. end glimpsed only, edge of shaded *Libya*; September 20, mere edge of shaded *Libya*, impossible to trace it further N.E. than *Tritonis Lacus*, owing to yellow cloud blotting out all details near the limb.

NILOSYRTIS.—Hawks: October 25, convex to N.E., 2° wide.—Phillips: October 29, convex to N.E., 3° wide, faint.—The Director: August 14, glimpsed 3° wide, darkish in pallor; September 19, glimpsed convex to N.E., faint; September 20, 5° wide to S.W., very faint; October 22, 23, convex to E., faint. We conclude that *Nilosyrtis* was always veiled by yellow material in 1909.

PALLAS.—Phillips: October 29, edge of *Libya* shading.—The Director: September 19, edge of *Libya* shading, illusive.

PENEUS.—Hawks: October 25, 1° wide (Fig. 66), completing, with *Alpheus*, the cross.—O'Hara: September 22, 2° wide.—Phillips: October 29, 4° wide, faint, not extending to W. "coast."—The Director: September 20, glimpsed 3° wide, only when seeing became boiling with the 32¾-in.

THOTH.—The Director: September 20, as a succession of a few very faint and diffused knots.

TRITON.—The Director: September 20, seen as the edge of the *Hesperia* and *Libya* shading, where lie the knots called *Libycæ Paludes* (Fig. 34).

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* The existence of *Borbyses* was confirmed by Prof. Hale's beautiful photograph of 1909, October 5 (Plate I., Fig. B).

SECTION VII.

The South Polar Region.

$\Omega = 0°$ to $360°$; $\Phi = -60°$ to $-90°$.

In order to follow this description, the reader should consult our S. polar map (Plate IV.).

MARE AUSTRALE is shown grey by all the Members, and darker, by contrast, near the polar snows. On August 12, a faint dusky streak was glimpsed by the Director with the $9\frac{3}{4}$-in. O.G. to run from the snow-cap to *Hellas*, tangentially to its *f.* "coast." On August 15, this mark was noted again, together with another streak running from the cap to the *p.* "coast." On August 23, the last-named object was still there. On September 19 and 20, both were glimpsed again with the small telescope. But the $32\frac{3}{4}$-in. not only never confirmed these markings, but even never showed any detached irregularities capable of giving rise to streaky impressions here.

ARGYRE II. was not seen.

THYLE INSULÆ appeared confused, dusky, and united, to almost all the Members, through the invisibility of *Ulyxis Fretum*.

THYLE I., usually shaded and oval to the Director with $8\frac{1}{2}$-in., presented a dark "bight" to N.W. in that instrument on August 23, which was confirmed with the large telescope on November 5, when a marked "cape," *Ultimum Promontorium*, was seen to S.W. (Plate III., Fig. 1). The "island" was very dusky on November 4, 5, 6, and 7.

ULYXIS FRETUM was recognised by the Director with the $8\frac{1}{2}$-in. on August 23 and 29. On the former date, it swelled into the N.W. "coast" of *Thyle I.* Invisible on November 4 in the $32\frac{3}{4}$-in., it was held steadily on the following day, when it appeared broad on *Mare Chronium*, narrow to S., and with the dark "bay" discovered with the Calver reflector in August (Plate III., Fig. 1). The "strait" was less detailed on November 6 and 9.

THYLE II., confuse on the drawings of Craig and Phillips, was seen detached from *Thyle I.* with the $8\frac{1}{2}$-in. on August 23 and 29, and seemed oval and dusky. At Meudon, on November 5, this "island" was also irregular in outline, being somewhat pointed to E., and having a small dark "gulf," now named *Noti Sinus* to N.E. From this "inlet," a curved streak, *Notus*, convex to W., ran southwards. *Noti Sinus* and *Notus* were again seen on the three following evenings. Like *Thyle I.*, this "land" was heavily shaded in the large telescope on September 25, November 1, 4, 5, 6, and 7.

*Depressiones Hellespontic*æ were drawn as a single dusky mark by Dobbie, Hoskins, Nangle, Phillips, and the Director with the $8\frac{1}{2}$-in.; but on October 14, the $32\frac{3}{4}$-in. resolved this spot into two parts, notwithstanding a great flickering of the image (Fig. 70). This region was never seriously veiled in 1909, and constituted always a conspicuous marking.

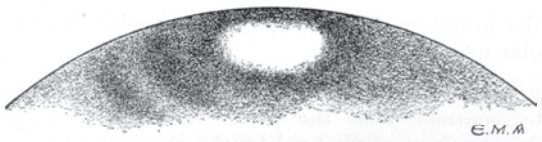


FIG. 70.—*Depressiones Hellespontic*æ. 1909, October 14, $\omega = 41°$. (The Director, $32\frac{3}{4}$-in.)

THE SOUTH POLAR SNOW CAP.

THE DARK POLAR BAND round the snow cap was seen by the majority of the Members of the Section, and disobeyed perspective, being a contrast effect with the bright area of the snows.

EXCENTRICITY OF THE CAP.—As usual, the mass of snow lay excentrically to the pole in 1909. The measures of the Director would place the centre of the cap towards $\Omega = 55°$, $\Phi = -84°$. When *Mare Cimmerium* was on the disc, the cap was very narrow on the C.M.; but with *Chryse* on the C.M., it attained its maximum breadth.

IRREGULAR OUTLINE OF THE SNOWS.—This was a frequent phenomenon under good conditions, as may be seen on Figs. 71, 72, Plate II., Fig. 3, Plate III., Fig. 3, &c.

THE DETACHED SNOW MASS *Novissima Thyle* AND *Magna Depressio* WITH *Rima Australis*.—On August 15, the Director found that the power of 410 of his $8\frac{1}{2}$-in. Calver mirror showed the snow cap bulging on the C.M. under $\omega = 306°$. The definition improving, the protruding part of the snows then appeared neatly detached from the main snow mass, and separated from it by a dusky rift. The isolated part was roughly oval, broader to E. than W., and measured some 10° in length and 5° in breadth. A broad V-shaped "bay," of considerable darkness, ended the rift on the *p.* side. Two hours later, rotation

FIG. 71.—*Novissima Thyle*, separated from the S. Snow Cap, on 1909, August $15^d\ 2^h\ 0^m$. (The Director, $8\frac{1}{2}$-in.)

foreshortened and broadened the dark separating streak, whose visibility became striking. The same phenomena were recorded

on August 16 at Juvisy, and by Phillips on August 17. The detached mass was again seen with the 8½-in. on August 23, but it was no longer conspicuous, looking small and pale, while the rift had broadened into a channel.

The Director's drawings place the centre of the detached white spot towards $\Omega = 308^{\circ} \pm$, $\Phi = -79^{\circ} \pm$, which agrees roughly with the position of Schiaparelli's *Novissima Thyle*, with which the marking was first identified by M. Jonckheere.

As similar appearances were recorded in the past,* and as the detached mass was first seen on 1909, August 8,† we draw the following inference :—

The separation of Novissima Thyle *from the S. snow cap is a regular seasonal phenomenon in the melting of these snows, and begins to be visible at least* 37 *days before the summer solstice of the S. hemisphere of the planet.*

The N. pole of Mars shows kindred appearances, as the Sectional data have established that *Olympia* detaches itself from the N. cap about a fortnight after the summer solstice of the N. hemisphere.‡

The rift separating *Novissima Thyle* from the S. snows is now termed *Rima australis*. And the triangular "bay" to the S.E. of *Novissima Thyle*, here called *Magna Depressio*, seems dentical with the isolated dusky spot often seen in the S. cap at a less advanced stage of the melting of the snows.

RIMA ANGUSTA is the name given by the Director to a narrow, sinuous, dark streak, which he saw furrowing the S. cap, with the reflector, under power 410, on September 6 (Fig. 72).

FIG. 72.—Rift and unequal brightness of the S. Snow Cap, on 1909, September 6, $\omega = 80^{\circ}$. (The Director, 8½-in.)

DIFFERENCES OF ALBEDO IN THE SNOWS.—The above drawing further shows that, on September 6, the greater part of the cap was dull, except towards $\Omega = 100^{\circ}$, where there was a bright, bulging mass. Also, on September 20, the snows, in the 32¾-inch, looked slightly greyish, save towards the bulging part, in $\Omega = 260^{\circ}$ (Plate III., Fig. 3). "Your observations of the "South Polar snow cap," remarks Stanley Williams in his letter of September 8 to the Director, "are also most interesting "[Fig. 72]. The duller portion would thus be due to the

* Schroeter in 1798, Mitchel in 1845, Green in 1877, whose "Mitchel Mountains" are certainly *Novissima Thyle*, Barnard, Keeler, Campbell, and Schaeberle in 1892, and again Barnard, Campbell, and Lowell in 1894, all saw this "land" more or less detached from the snow cap.

† A.N., No. 4348.

‡ Mars Report for 1903, Mem., B.A.A., Vol. XVI., pp. 97–98.

" presence of cloud or haze over the snow, or does it mean that " the snow sheet here had so far melted as to be more or less " discontinuous? If there were numerous bare patches—too " small to be separately seen, except in the case of the *sinuous* " rift—the effect of these would presumably be to cause the " surface as a whole to appear less bright?"

HAZE ON OR ABOUT THE SNOW CAP.—The cap appeared dull to Backhouse on September 8, October 8 and 24; dull and large to the Director in the $32\frac{3}{4}$-inch on November 27 (Fig. 73); and to Givin on November 29, December 1 and 6.

FIG. 73.—Dimness of the S. polar Snows, and dull white patch, to the left, on 1909, November 27, $\omega = 346°$. (The Director.)

On November 4, Wright saw a "very white spot about 25° from S. pole. Spot as white as polar cap, but did not appear as a protuberance. This spot was also seen by Mr. W. J. Macdonnell."

On November 27, the large telescope revealed a dull white cloud area in $\Omega = 286°$, $\Phi = -72°$ (Fig. 73).

DIMINUTION IN AREA OF THE S. CAP.—From 27° on July 14, the areocentric arc subtended by the snow cap dwindled to 10° by November 19, as shown in Fig. 74.

After December 4, the cap itself remained invisible to O'Hara, Phillips, and Backhouse.

Considering that Mars is much nearer to the Sun at the summer solstice of his S. hemisphere than at the summer solstice of his N. hemisphere, the melting of the S. snow cap must go on more quickly than that of the N. one.

Of course, clouds floating over the polar snow fields must partly check solar radiation and retard the melting of the cap beyond.

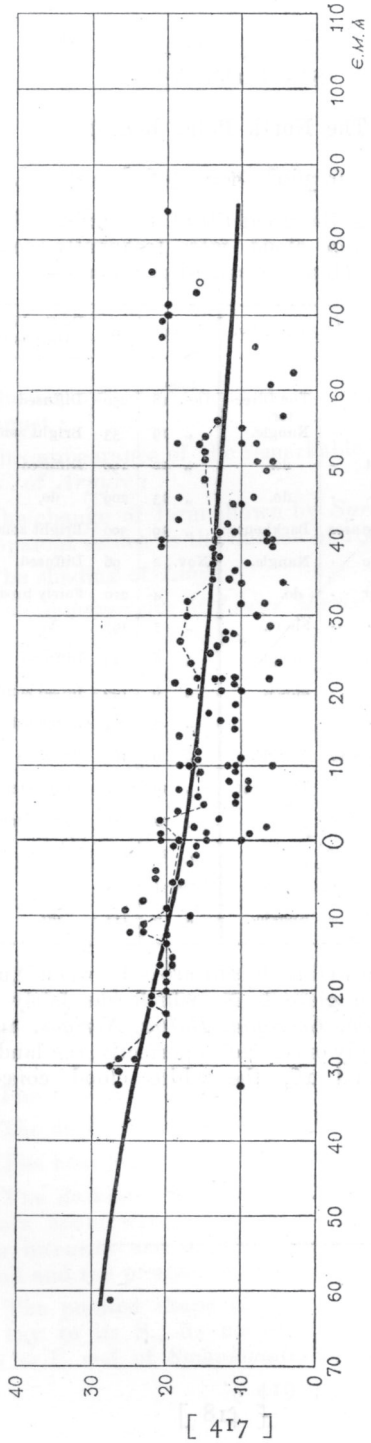


FIG. 74.—Diagram illustrating the diminution in the area of the S. polar Cap in 1909.
The ordinates correspond to the number of days preceding and following the summer solstice of the S. hemisphere of Mars; the abscissæ to the areocentric arc subtended by the snows.

SECTION VIII.

The North Polar Region.

$\Omega = 0°$ to $360°$; $\Phi = +60°$ to $+90°$.

Notwithstanding the great tilt of the axis, dull white areas, probably due to white cloud, were frequently seen by various Members in 1909. Here is a record of them :—

Date.	ω	Particulars of the Glare.	Observer.	Date.	ω	Particulars of the Glare.	Observer.
1909.	°			1909.	°		
Aug. 12	305	Bright arc -	The Director.	Oct. 18	250	Diffused -	Short.
„ 19	103	do. -	Nangle.	„ 19	33	Bright zone -	Phillips.
Sept. 2	330	Small spot -	do.	„ 20	190	Diffused -	Short.
„ 5	310	Larger - -	do.	„ 23	209	do. -	Givin.
„ 8	36	Very large area	Backhouse.	„ 29	300	Bright zone -	Phillips.
„ 9	270	Bright arc -	Nangle.	Nov. 2	96	Diffused -	Givin.
„ 10	230	Lenticular -	do.	„ 4	210	Fairly broad -	The Director.
„ 13	280	Diffused - -	Short.	„ 5	197	do. -	do.
„ 15	190	Lenticular -	Nangle.	„ 6	43	Diffused -	Givin.
„ 20	150	Diffused - -	Short.	„ 6	199	Broad zone -	The Director.
„ 22	140	do. - -	do.	„ 8	204	Extended -	Phillips.
„ 24	170	Very extensive arc.	Nangle.	„ 9	160	Broad - -	The Director.
„ 25	251	White arc -	The Director.	„ 19	64	Very extended	Phillips.
Oct. 6	121	do. -	do.	„ 27	346	Fairly broad -	The Director.
„ 14	41	Bright patch -	do.	„ 29	172	Diffused -	Givin.
„ 16	31	do. -	do.	Dec. 1	171	do. -	do.
„ 16	230	Small spot -	Nangle.	„ 6	111	do. -	do.

The N. limb showed no bright areas between August 20 and September 1. The glare to N., which was fairly frequent on *Panchaia*, *Uchronia*, *Cecropia*, *Baltia*, *Nerigos*, and *Scandia*, was seen to cover only once, and imperfectly, the land of *Ortygia*. On October 14 and 16, the white cloud concealed *Mare Acidalium*.

PART III.

CHARACTERISTICS OF THE 1909 APPARITION.

A summary of the most striking features of the opposition may be given as follows :—

(1) The unprecedented phenomenon of the practical invisibility of the majority of the dark spots in August, and the subsequent gradual recovery of their more or less normal intensity ;

(2) The separation of *Novissima Thyle* from the S. polar cap in August ;

(3) The appearance of the remarkable brown spot *Phlegræi Campi*, W. of *Argyre ;*

(4) The change of form shown by *Syrtis Major* since 1907, and its apparent return to the outline of 1864 ;

(5) The shading of *Libya ;*

(6) The immense size of *Lacus Mœris ;*

(7) The protrusion of *Nymphæum Promontorium ;*

(8) The triple structure of *Deltoton Sinus ;*

(9) The mottled shading of *Mare Tyrrhenum ;*

(10) The darkness of *Pandoræ Fretum*, as contrasted with its invisibility in 1907 ;

(11) The pallor and mottled shading of *Solis Lacus ;*

(12) The irregular form, pointed to S., of *Thaumasia ;*

(13) The detection of *Chrysokeras ;*

(14) The complex structure of *Tithonius Lacus ;*

(15) The great darkness, on one occasion, of *Agathodæmon*, together with *Ceti Lacus* and *Melas Lacus ;*

(16) The large and blackish appearance of *Juventæ Fons ;*

(17) The three dark spots on the S. "coast" of *Thaumasia ;*

(18) The blackness, on one occasion, of *Phœnicis Lacus ;*

(19) The darkness and mottled appearance of *Aonius Sinus ;*

(20) The heavy shading of *Icaria ;*

(21) The darkness of *Mare Sirenum* in August, when the other dark spots were exceedingly faint or invisible, and its irregular intensity and outline, together with the broadness of its E. end and the presence of *Gigantum Sinus ;*

(22) The pointed shape of *Mare Cimmerium* to N.W., the double bay to its S., its uneven intensity, and the presence, towards its E. end, of *Symplegades Insulæ ;*

(23) The existence of the large, complex *Hyria Lacus*, on *Hesperia*;

(24) The bright rose colour of *Eridania*;

(25) The practical invisibility of *Lunæ Lacus*;

(26) The invisibility of *Elysium*;

(27) The faintness of *Trivium Charontis*;

(28) The visibility of *Eos*;

(29) The constant visibility of *Candor*;

(30) The visibility of *Phrixi Regio*;

(31) The visibility of *Peræa*;

(32) The visibility of *Portus Bucoleontis* on *Hellas*;

(33) The complex nature of *Depressio Hellespontica*;

(34) The visibility of *Incurva Insula*;

(35) The visibility of the half-tone *Arena*;

(36) The darkness of *Promethei Sinus*;

(37) The irregular outline of *Yaonis Regio*;

(38) The irregular outlines of *Thyle Insulæ*;

(39) The faint brightening of *Hellas* and *Argyre* near the limb or terminator; and

(40) The visibility of *Nix Atlantica*.

Such were these observations of the 1909 apparition, and such the conclusions to which we have been led by their discussion. It is our next duty to carry into the northern hemisphere of the planet the enquiry thus begun with powerful appliances in the southern; and to unravel the true configuration of the complex, irregular markings with which Nature has variegated that part also of the Martian surface.

Our study of the south hemisphere has yielded results beyond our most sanguine expectations. The alleged existence of a geometrical network of canals on Mars has received a lasting and unanswerable confutation. New markings and new colours have been revealed by the large telescope. The dark areas have shown mottlings and indentations never suspected before. And as the great majority of our data have been confirmed by the impersonal evidence of photography, they are now to be considered as permanently acquired to Science.

Paris, 74, Rue Jouffroy,
1915, July 21.

E. M. ANTONIADI,
Director of the Section.

Published 4th September 1915.

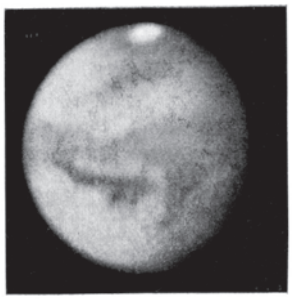


FIG. A.—November 3.
(Prof. HALE.)

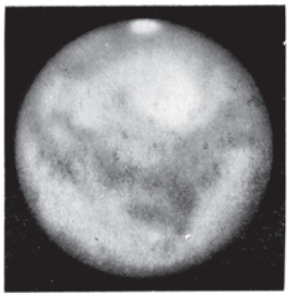


FIG. B.—October 5.
(Prof. HALE.)

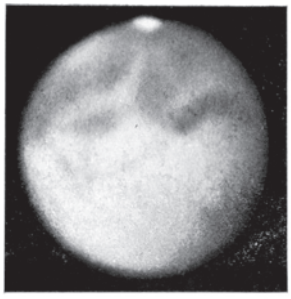


FIG. C.—October 18.
(Prof. LOWELL.)

DRAWINGS FROM PHOTOGRAPHS OF MARS IN 1909.

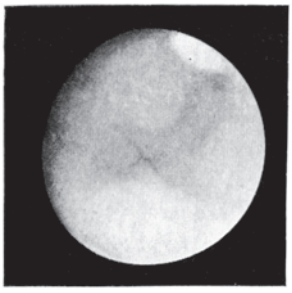


FIG. 1.—August 12, ω = 305°.

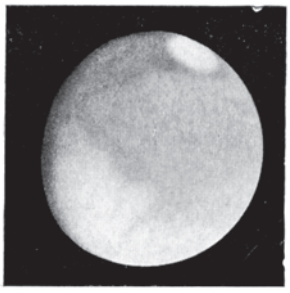


FIG. 2.—August 12, ω = 4°.

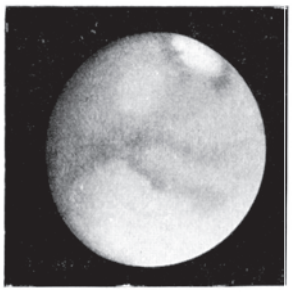


FIG. 3.—August 15, ω = 314°.

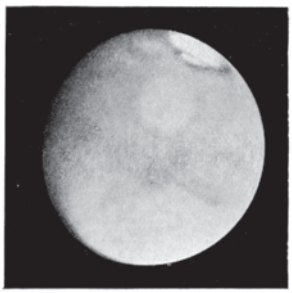


FIG. 4.—August 16, ω = 290°.

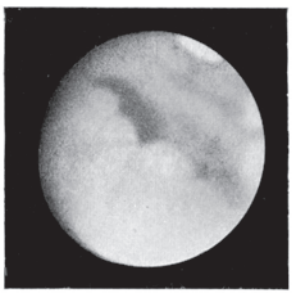


FIG. 5.—August 23, ω = 173°.

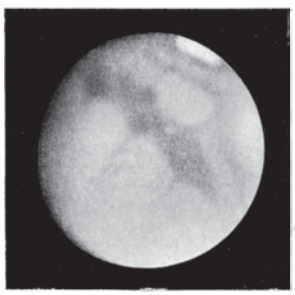


FIG. 6.—August 24, ω = 210°.

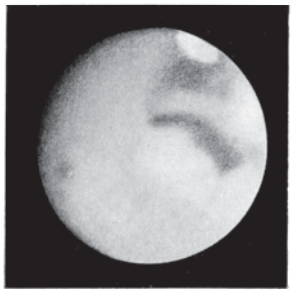


FIG. 7.—September 3, ω = 134°.

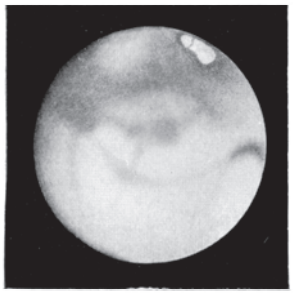


FIG. 8.—September 6, ω = 87°.

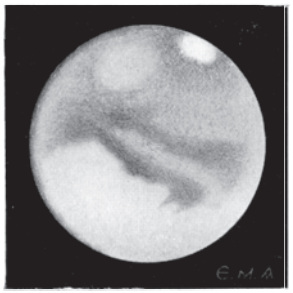


FIG. 9.—September 14, ω = 332°.

DRAWINGS ILLUSTRATING THE PALLOR OF THE MARIA IN AUGUST 1909, AND THE GRADUAL RECOVERY OF THEIR INTENSITY, ACCORDING TO THE DIRECTOR'S OBSERVATIONS WITH THE 8½-IN. REFLECTOR.

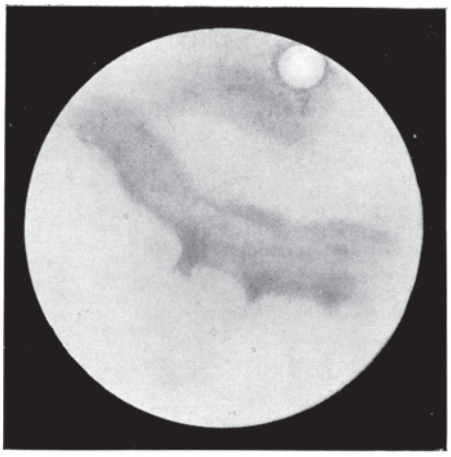


FIG. 1.—R. D. GIVIN. 3·6-in. O.G.
1909, October 2. $\omega = 6°$, $\phi = -21°{\cdot}0$.

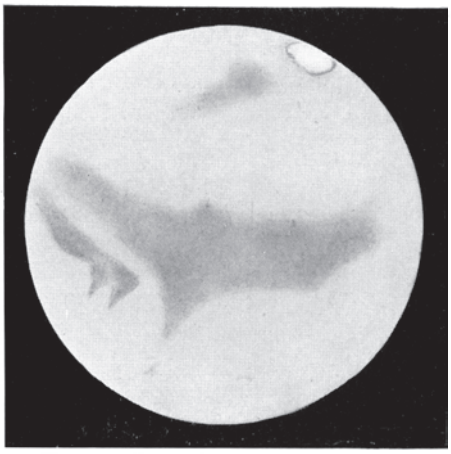


FIG. 2.—G. H. HOSKINS. 12-in. Spec.
1909, September 30. $\omega = 39°$, $\phi = -20°{\cdot}9$.

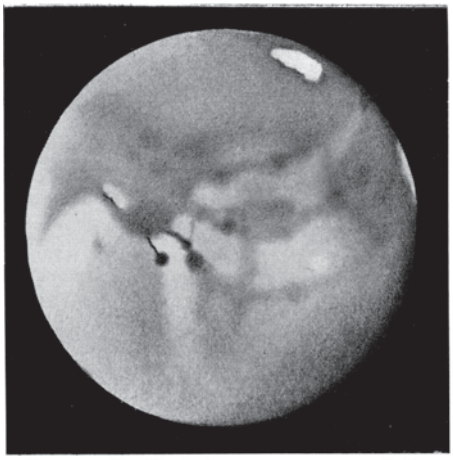


FIG. 3.—E. M. ANTONIADI. $32\frac{1}{4}$-in. O.G.
1909, October 11. $\omega = 76°$, $\phi = -21°{\cdot}9$.

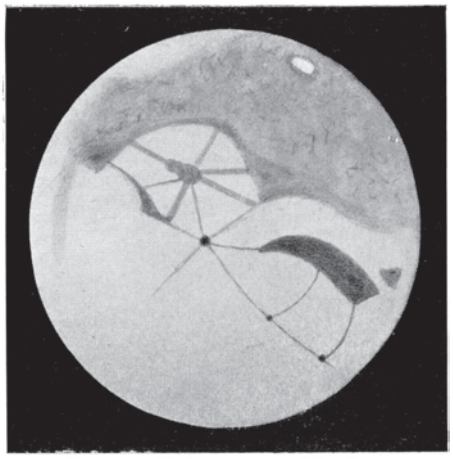


FIG. 4.—E. HAWKS. 18-in. Spec.
1909, October 12. $\omega = 120°$, $\phi = -21°{\cdot}8$.

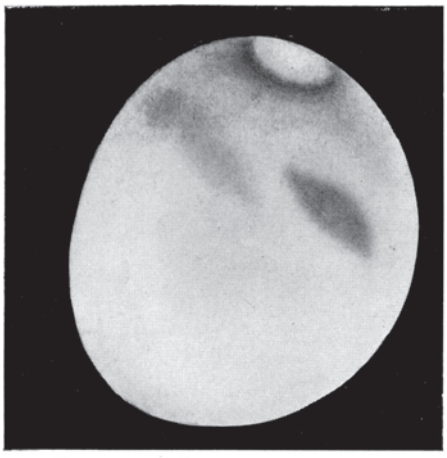


FIG. 5.—C. O'HARA. $6\frac{1}{2}$-in. Spec.
1909, July 14. $\omega = 120°$, $\phi = -21°{\cdot}3$.

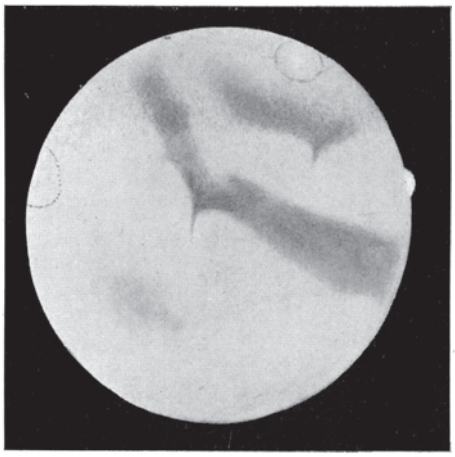


FIG. 6.—H. WRIGHT. $4\frac{1}{4}$-in. O.G.
1909, October 25. $\omega = 173°$, $\phi = -22°{\cdot}9$.

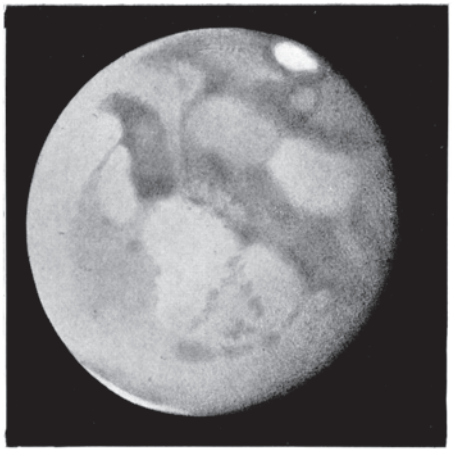


FIG. 1.—E. M. ANTONIADI. $32\frac{3}{4}$-in. O.G.
1909, November 5. $\omega = 197^{\circ}$, $\phi = -23^{\circ}\cdot6$.

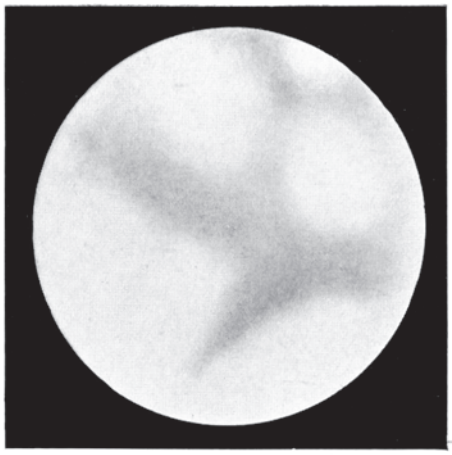


FIG. 2.—J. SHORT. 7-in. O.G.
1909, September 11. $\omega = 275^{\circ}$, $\phi = -19^{\circ}\cdot7$.

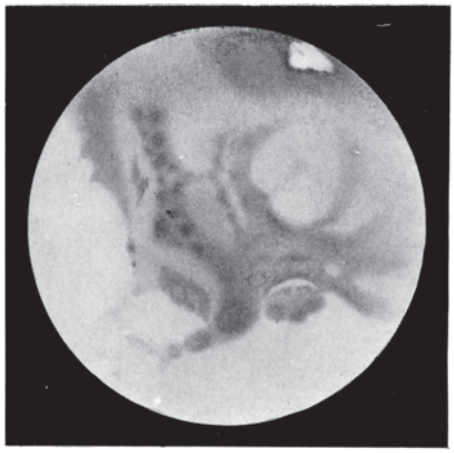


FIG. 3.—E. M. ANTONIADI. $32\frac{3}{4}$-in. O.G.
1909, September 20. $\omega = 279^{\circ}$, $\phi = -20^{\circ}\cdot2$.

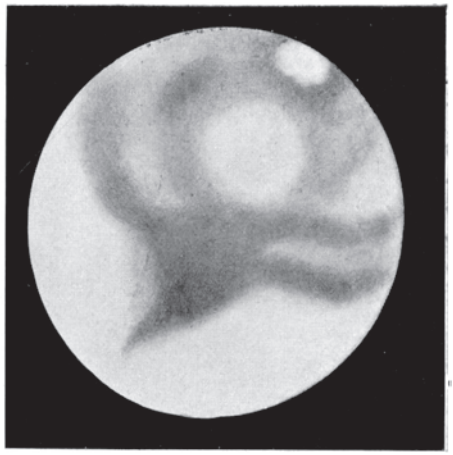


FIG. 4.—T. W. BACKHOUSE. $4\frac{1}{4}$-in. O.G.
1909, October 27. $\omega = 305^{\circ}$. $\phi = -23^{\circ}\cdot0$.

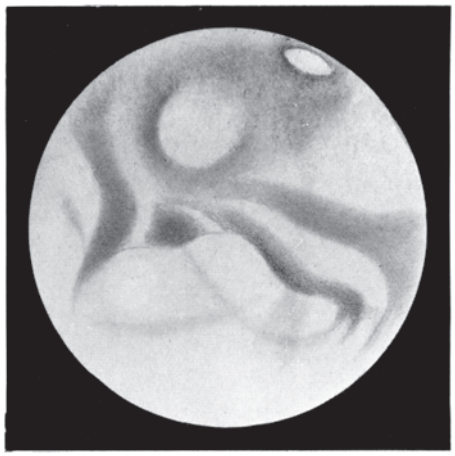


FIG. 5.—T. E. R. PHILLIPS. $12\frac{1}{4}$-in. Spec.
1909, September 18. $\omega = 310^{\circ}$, $\phi = -20^{\circ}\cdot0$.

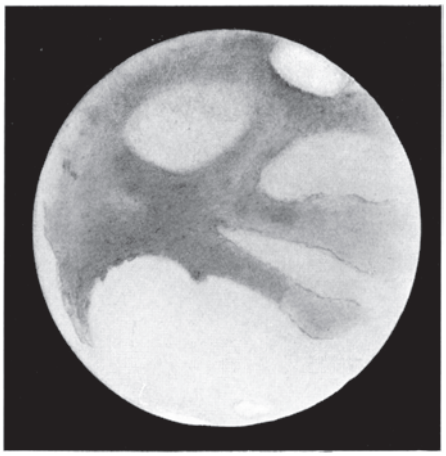
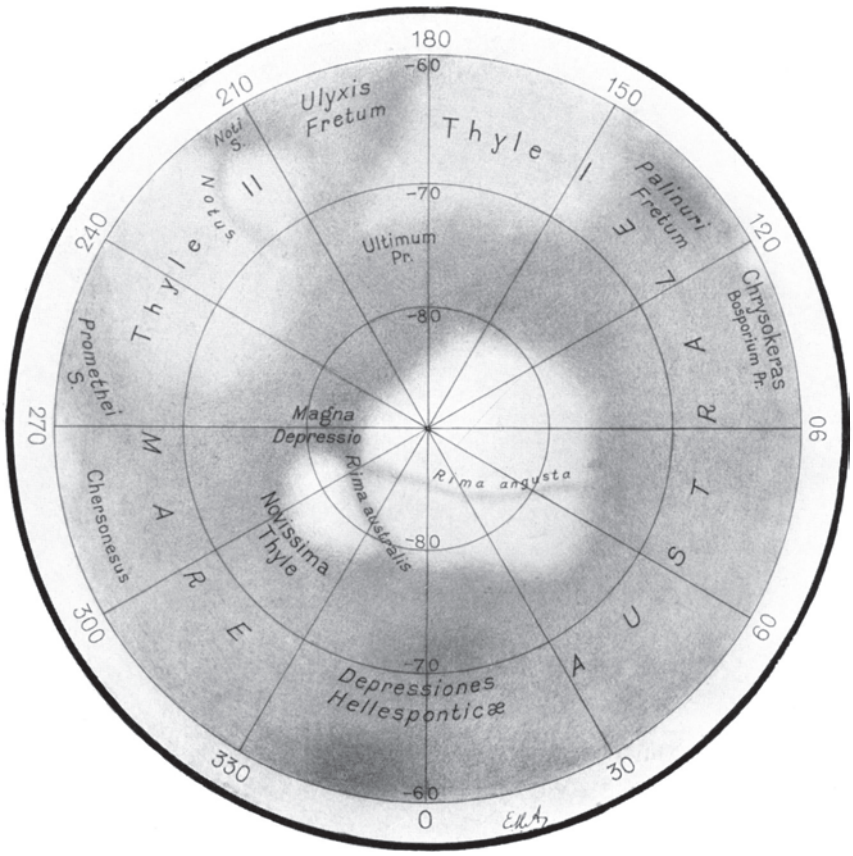


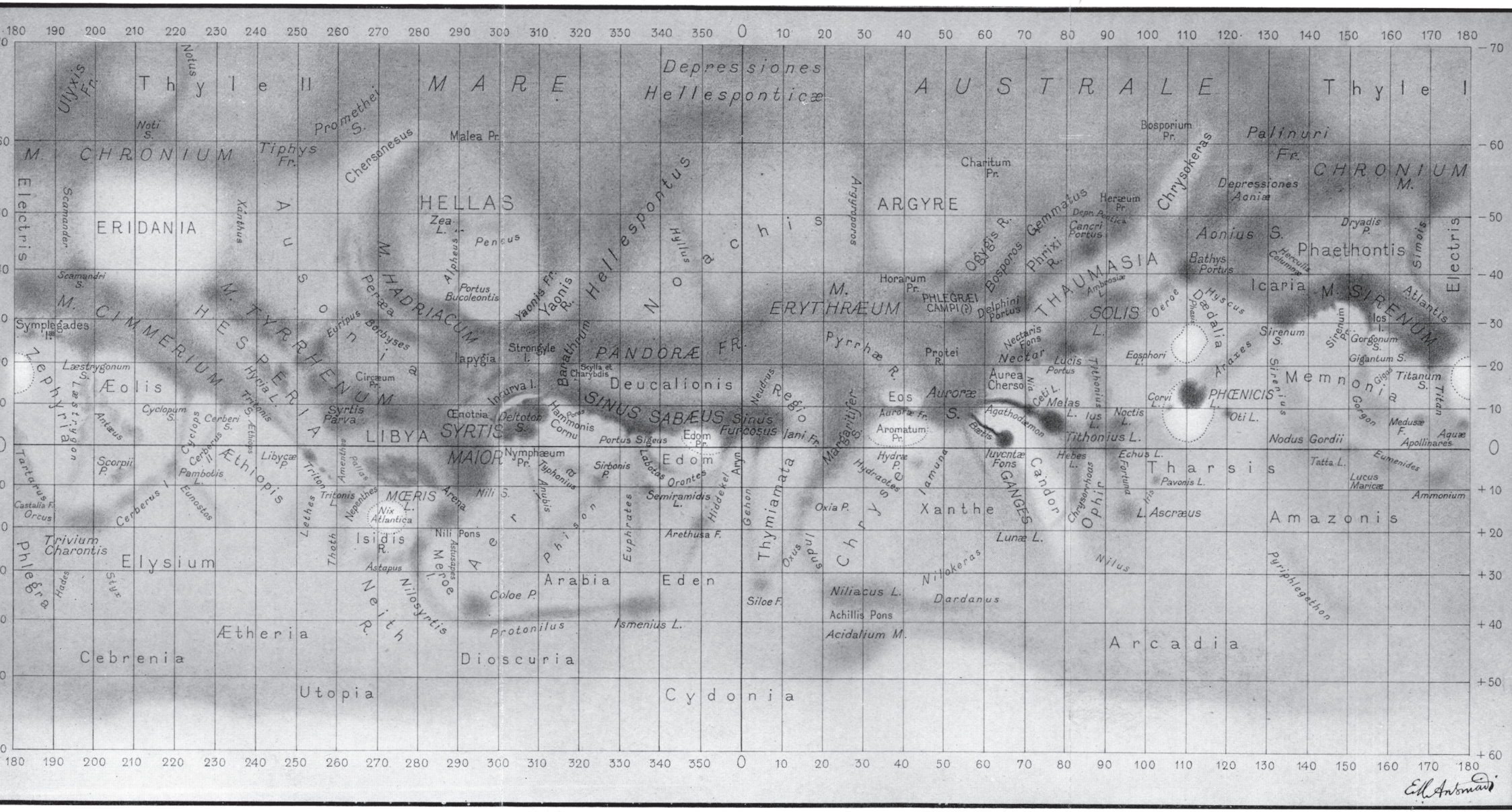
FIG. 6.—J. NANGLE. $6\frac{1}{4}$-in. O.G.
1909, September 2. $\omega = 320^{\circ}$, $\phi = -19^{\circ}\cdot5$.

Plate IV.



A Stereographic Projection of the South Polar Regions of Mars in 1909.

After the Observations of the Section.

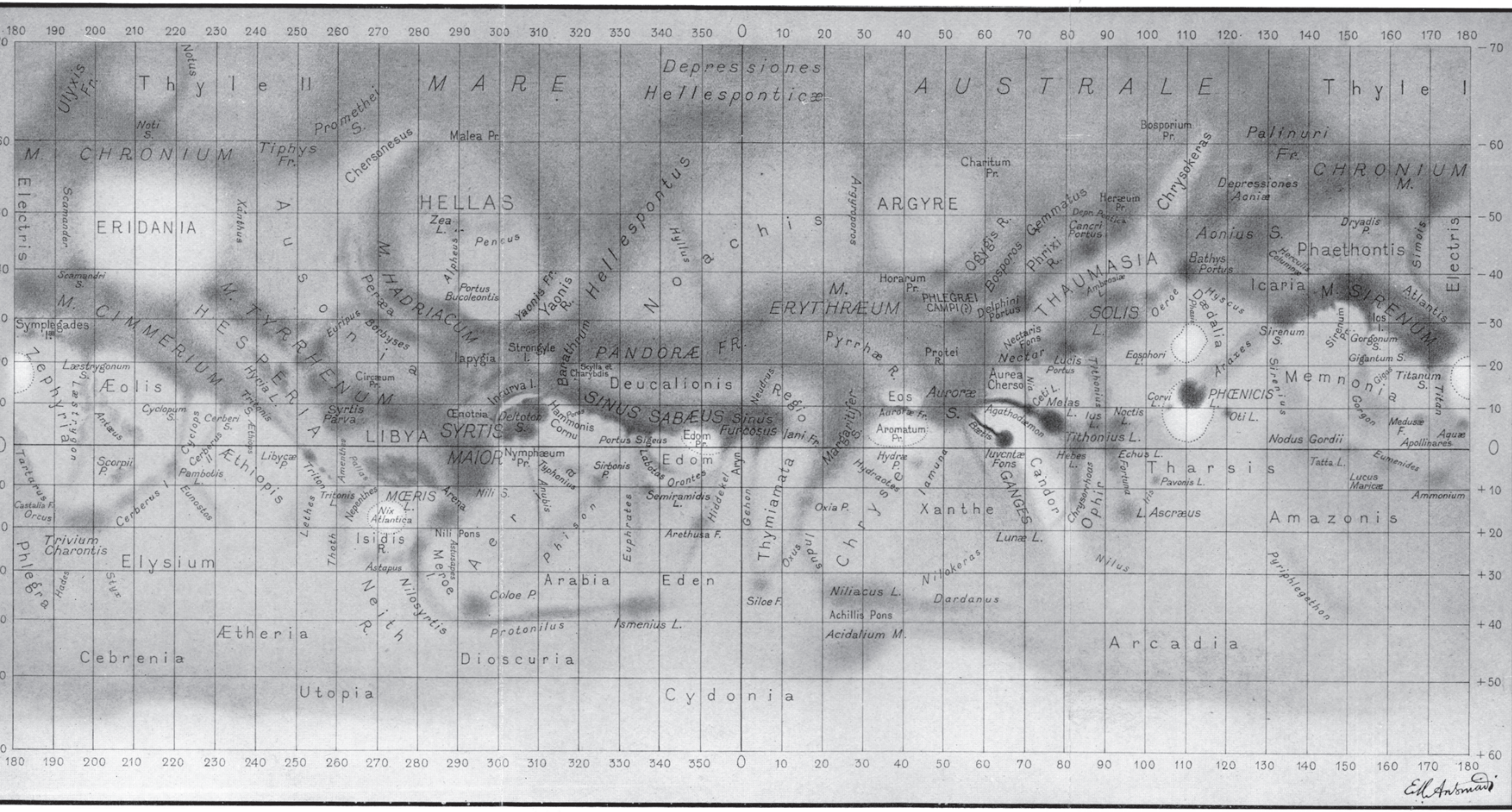


NORTH.

CHART OF MARS ON MERCATOR'S PROJECTION.

PREPARED FROM THE OBSERVATIONS OF THE SECTION IN 1909.

[Abbreviations.—M. = *Mare*; S. = *Sinus*; Fr. = *Fretum*; L. = *Lacus*; P. = *Palus*; F. = *Fons*; R. = *Regio*; Pr. = *Promontorium*



NORTH.

CHART OF MARS ON MERCATOR'S PROJECTION.

PREPARED FROM THE OBSERVATIONS OF THE SECTION IN 1909.

[Abbreviations.—M. = *Mare*; S. = *Sinus*; Fr. = *Fretum*; L. = *Lacus*; P. = *Palus*; F. = *Fons*; R. = *Regio*; Pr. = *Promontorium*