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SEVENTH REPORT OF THE SECTION

FOR THE OBSERVATION OF

MARS,

DEALING WITH THE APPARITION OF 1905.

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, 1905.

PART I.

PROLEGOMENA.

1. The Apparition of 1905.

The opposition with which we are now concerned, and which occurred on 1905, May 8, was a more favourable one than that of 1903. For, while Mars was at the distance of 0·638 (59,200,000 miles) on 1903, April 3, he approached us to within 0·537 (49,800,000 miles) on 1905, May 16. But the resulting increase in size of the disc, which reached 17″·3 a week after opposition, was counterbalanced, for European observers, by a low altitude of the planet above the horizon; and it is only fortunate that, under such circumstances, the Section has received full support from skilled observers in Australia and New Zealand.

Phenomena.

Summer Solstice of N. hemisphere Winter Solstice of S. hemisphere	1905, January 14.
Mars in W. Quadrature with the Sun	1905, January 26.
Mars in Opposition	1905, May 8.
Heliocentric longitude of Mars in Opposition	227° 32′.
Position of Mars in Opposition	$\alpha = 15^h\ 0^m$. $\delta = -16°\ 57'$.
Diameter of Mars in Opposition	17″·1.
Position angle of the N. end of the axis of Mars at Opposition	38°·8.

Latitude of the centre of the disc at Opposition	+ 14°·7.
Mars in apparitional Perigee	1905, May 16.
Diameter of Mars in apparitional Perigee	17″·3.
Autumnal Equinox of N. hemisphere / Vernal Equinox of S. hemisphere	1905, July 16.
Mars in E. Quadrature with the Sun	1905, August 26.
Passage of Mars through Perihelion	1905, November 8.

It was the N. pole that the planet presented to us throughout the observations.

2. The Members of the Section.

The following table gives the names of the Members who constituted the Mars Section in 1905, 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.	No. of Drawings sent.
ANTONIADI, E. M., F.R.A.S.	Paris	8½ Spec.	2
COBHAM, A. B.	Sydney, N.S.W., Australia.	8½ Spec.	1
GALE, W. F., J.P., F.R.A.S.	Newcastle, N.S.W., Australia.	6 O.G. / 8½ Spec.	0*
HIRST, G. D., F.R.A.S.	Sydney, N.S.W., Australia.	4¼ O.G.	4†
KILLIP, Rev. R., F.R.A.S.	Southport	5 O.G.	1
LEPPER, G. H.	Maritzburg, Natal, S. Africa.	3½ O.G.	15
PHILLIPS, Rev. T. E. R., M.A., F.R.A.S.	Croydon	9¼ Spec.	9
WARD, J. T.	Wanganui, New Zealand.	9½ O.G.	15
WRIGHT, H.	Sydney, N.S.W., Australia.	8½ Spec.	6
			53

* A fire in the residence of Mr. Gale has unfortunately destroyed a number of his papers, among which also the original drawings of the 1905 apparition of Mars.

† The drawings of Mr. Hirst are coloured, and represent the general appearance of the planet more faithfully than any others received during the apparition.

3. Observational and Telescopic Notes.

Lepper studied Mars from a height of 2,170 feet above sea-level, a fact which slightly compensated for the modesty of the aperture used.

Ward observed with a fine 9½-in. by Cooke, mounted on an English form of equatorial, with finder of 2½-in., and a battery of eye-pieces magnifying from 32 to 750. This instrument is further provided with a filar and position micrometer, and powers ranging from 100 to 1175. The dome of the observatory is 20 feet in diameter, and overlooks the town of Wanganui from a considerable height. The New Zealand observer modestly notes: "Considering our aperture, 9½ in., and that our "instrument is a 'Cooke,' we have not shown much fine detail; "but in all cases nothing but what could be held steadily has "been shown." On 1905, May 20, he found that "slight fog "at intervals improves seeing," while on other occasions "it was "felt that a small range of neutral-tinted screens to eye-piece "would have much improved definition at times when sky was "clear and image very brilliant, but unfortunately these were "not to be got at the time."

Hirst has tried such a screen to advantage: "I have found "a piece of very lightly smoked glass occasionally useful, when "held over the eye-piece, in bringing out details by modifying "the glare."

4. The Colours of the Disc.

Killip remarks: "The dark portions have seemed very "bluish to my eye, and the ruddy colour of the rest of the disc "most marked."

5. Haze and Cloud in the Atmosphere of Mars.

The veils of the atmosphere of the planet may be divided in two classes: (1) Haze, of an apparently yellow colour; and (2) Whitish clouds. The yellow veils, which were discovered in 1879 by Burton,* one of the most keen-sighted and skilful of Martian observers of all time, are very frequent in the tropical and temperate zones; while the whiter clouds are rather rare outside of the polar regions.

On 1905, April 30, "although the air was steady," says Hirst, "the seeing, as far as the planet was concerned, was not "good; even in the best moments a thin veil seemed as if drawn "across the disc, which rendered any satisfactory delineation a "matter of much patience." On May 15, the same observer noted "a slight diminution of the ruddy colour towards each "pole"; while in the second half of the apparition, Lepper remarked a fading in the intensity of the *Maria*. Also, *Auroræ Sinus* was faint from April 30 to June 20 at least. *Lunæ Lacus*, *Mare Acidalium*, *Thaumasia*, *Mare Sirenum*, *Mare Tyrrhenum*, *Mare Hadriacum*, *Hellas*, *Libya*, &c., all seem to have shown

* In his *Physical Observations of Mars, 1879–1880*, Burton wrote: "I "have more than once remarked that such a temporary veil was not brighter, "and, in one instance at least, was fainter, than the adjacent continent, "nearly of the same tint of orange, and many shades fainter than the snow "spots" (*Sc. Trans. of the Royal Dublin Society*, Vol. I., n.s., p. 156). It is thus obvious that this able astronomer has almost outstripped, by fully 25 years, Prof. W. H. Pickering's independent remark that the Martian clouds are pale yellow (*Ann. of Harvard Coll. Obs.*, Vol. LIII., No. viii., p. 155).

evidence of temporary obliteration. Such phenomena are readily accounted for by very thin and transparent haze, or even by sand dust raised from the Martian deserts.

A dull white spot was drawn by Hirst on N. *Thaumasia* on April 30, which is explicable by thin white haze.

A faint whitish shimmer was frequently seen on the S. limb by Killip, Phillips, and Wright; while a brighter patch of white cloud, or fog, covered the N. polar regions, according to the unanimous testimony of all the Members of the Section. Phillips has further observed this marking to expand from 20° to 47° in a space of 45 days, and to become even "intensely bright and "slightly bluish." And as the phenomenon was certainly not due to snow, the conclusion obtrudes itself upon us that cloud in the polar regions of Mars might occasionally appear so dense as almost to rival the lustre of the polar snows.

6. Streaks.

"I see no canals," says Hirst. "In fact, I have never seen "anything on this occasion, or in years past when using larger "apertures, that could by any stretch of the imagination be "made to support the wonderful observations of these marvels "made by other observers, unless the few streaks depicted "in my drawings may be taken as indications of them. If so, "the canal champions are welcome to them."

Phillips writes: "Those seen were comparatively few in "number, and almost all of them appeared as soft hazy lines "or streaks. No "canals" were seen really double, but the "*Nilokeras*, as at sundry previous apparitions, was apparently "composed of two separate streaks inclined to each other at a "small angle, and meeting at the *Lacus Lunæ*."

The Members of the Section saw 65 more or less streaky markings in 1905, of which two cannot be identified on the various charts of the planet.

The following table gives the number of streaks seen by each observer:—

Rev. T. E. R. Phillips	44
Ward	42
Lepper	21
Wright	18
The Director	14
Cobham	10
Hirst	8
Gale	3
Killip	2

The streaks drawn by Ward and Hirst are very smudgy and irregular, having a perfectly natural and pleasing appearance. Those of Wright and Cobham are more regular. As to the 21 markings of this class shown by Lepper, they are generally mere edges of half-tones.

Apart from the *Nilokeras*, no double "canals" were seen. Of the streaks recorded, 62 per cent. are more or less intensified edges of faint shadings, while one of them has been resolved into knots of unequal size.

PART II.

THE OBSERVATIONS.

Introductory.

As usual, we have followed in this Report Mr. Maunder's conventional division of the surface of the planet into eight sections, of which six, each having a mean breadth of 60° in longitude, extend from + 60° to — 60° of latitude, while the other two deal with the polar regions.

The following abbreviations are used in the discussion of the observations:—Ω = areocentric longitude, reckoned from *Fastigium Aryn* to the right; Φ = areocentric latitude; ω = longitude of the centre of the disc; ϕ = latitude of the centre of the disc; 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 planet.

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

Reference to the Chart at the end of the Report will render clearer the following analysis.

SECTION I.

Sinus Sabæus and Mare Erythræum.

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

Hammonis Cornu, the promontory to the S. of *Aeria*, is shown moderately pointed by Hirst, Phillips, and the Director, flattened and rounded by Lepper and Wright. Ward saw it sometimes slightly tapering, at others square, and on one occasion blunted (Fig. 1). Discrepancies like these are accounted for by air tremors and flitting visibility. Phillips further noted the "cape" to be connected with *Solis Pons* on July 12.

Sinus Sabæus presented its usual form in 1905. Its slightly winding course, reduced by the tilt of the axis, is particularly noticeable on the drawings of Ward and Phillips. But considerable disagreement is found between the various representations of the width of the "strait." Thus, while Phillips draws it very narrow, especially to E. (Plate III., 12), being supported here by Hirst and Wright, Lepper and the Director show it moderately broad, and Ward still wider. Such differences are due to personal equation. The narrowness of the *Sinus* to W., above *Edom*, is beautifully shown by Ward, and also, much more strongly, by Phillips (Plate III., 12). With reference to the darkness of the "strait," Phillips and the Director found it quite as intense as *Syrtis Major*, but Lepper, Ward, and Wright (Plate III., 11) show it slightly fainter.

FURCA SINUS SABÆI, or "Dawes Forked Bay," was irresolvable to the $3\frac{1}{2}$-in. O.G. of Lepper, to the $4\frac{1}{2}$-in. of Hirst (Plate II., 1), and to the $8\frac{1}{2}$-in. reflector of Wright (Plate III., 11). Phillips makes the prongs 5° apart (Plate III., 12), Ward and the Director 9°. The best view of the "Forked Bay" was obtained by Ward, who found it "sharp and distinct," the "coast" line on *Edom* running parallel to the meridian. The New Zealand observer shows the fork very deeply indenting the "continent" to N.,* the *Hiddekel* prong sharply tapering, the

FIG. 1.—The *Sinus Sabæus*, as seen in New Zealand on 1905, May 9, by Ward.

Gehon prong rather blunted and shorter, while the head of the "bay" appeared square (Fig. 1). All Members of the Section agree in drawing *Furca* dark, and Lepper calls it "one of the "darkest portions of the planet." The superior darkness of the forked region over that of the "strait" is very accurately shown by Ward.

PORTUS SIGEUS was vaguely glimpsed as a single shallow indentation, by Ward, Wright (Plate III., 11), and the Director.

FASTIGIUM ARYN seemed "sharply and clearly defined on "one occasion only" to Phillips. It was vague to the Director, but always sharp on the fine drawings of Ward.

EDOM PROMONTORIUM appeared bright to Phillips and Ward. Here is the white spot 9 of our Chart.

EDOM was normally tinted in 1905.

EDEN presented nothing remarkable.

THYMIAMATA is drawn narrow to S., much narrower than the head of "Dawes Forked Bay," by Ward† (Fig. 1). The whole

* A similar view of *Sinus Sabæus* was depicted by Prof. Barnard with the 12-in. Lick in 1892 (Flammarion, *Mars*, Vol. II., p. 51).

† Schiaparelli saw the reverse, as shown by his drawings and charts; but in 1909, with the large telescope at Meudon, the Director found the "Forked Bay" much broader than S. *Thymiamata*, so that there can be no doubt whatever about the accuracy of Ward's delineation.

of the country here, as far as the *Gehon* and *Indus*, appeared shaded to Lepper.

AERIA seemed whitish to Phillips, and the contrasted brightening of its "coast" was obvious to Lepper.

ARABIA was observed to be dusky by Phillips.

DIOSCURIA is drawn shaded by Hirst, Lepper, Ward, Wright (Plate III., 11), and the Director (Fig. 2). The shading was uneven to Ward.

CYDONIA appears partially shaded on the sketches of Hirst (Plate II., 1) and Wright. Ward and the Director found it shaded to E. only. But Lepper shades it all over.

Phillips and the Director observed the white spot 1 of the Chart, on W. *Cydonia*, immediately *p* the *Mare Acidalium* (Fig. 2).

ISMENIUS LACUS was seen elongated E. to W., as usual, by Ward, Wright (Plate III., 11), and the Director. But there is a disagreement as to its size, Ward making it 20° long by 12° broad; Wright 16° by 12°; and the Director 12° by 8° (Fig. 2). The outline of the "lake" is irregular on Ward's sketches, and its intensity does not appear to have remained always the same in New Zealand. *Ismenius Lacus* seems to have been observed confusedly by Wright, but the Director found it fairly dark and oval on May 29.

The centre of this spot was at about $\Omega = 330°$ in 1905.

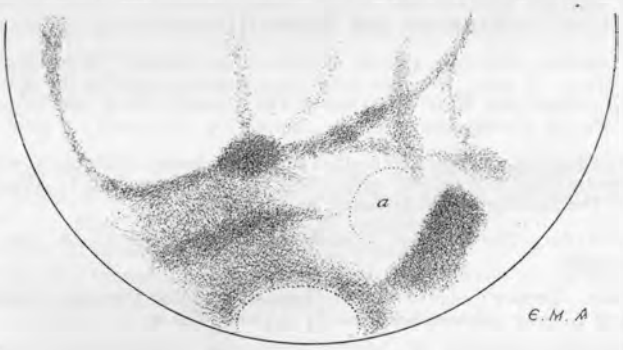

FIG. 2.—*Ismenius Lacus* and the surrounding country, on 1905, May $29^d\ 21^h\ 0^m$. (The Director.)

ARETHUSA LACUS can be recognised as a darker condensation of the *Cecropia* shadings, on a drawing taken by Ward on May 16.

DEUCALIONIS REGIO appears fairly large and wide on the delineations of Lepper and Phillips. Its breadth was moderate, according to the Director, small according to Wright. Ward, while supporting the Director here, further represents the "island" narrow to W. The well-known cigar shape was obvious to Lepper, Phillips, Ward, Wright (Plate III., 11), and

the Director. As to the bend to N.W., it is well shown by Ward (Fig. 1), who draws the "island" as a "peninsula" attached to the "continent." This is confirmed by Phillips (Plate III., 12). The Director shows a faint "channel" between *Deucalionis Regio* and *Thymiamata*, while Lepper saw a very broad separating streak here. The duskiness of *Deucalionis Regio* was noted by Lepper, Phillips, Wright (Plate III., 11), and the Director, Ward scarcely drawing any grey tinge on the "island."

A narrow "bridge," similar to the one observed by Major Molesworth in 1903,* was seen connecting *Deucalionis Regio* with the "continent" to N. by Ward, on April 4.

PANDORÆ FRETUM, that broad "channel," which Herschel discovered in 1783, and which is occasionally obliterated by cloud, was narrow and faintish to Lepper. But the superior optical means of Phillips (Plate III., 12), Ward (Fig. 1), Wright (Plate III., 11), and the Director, showed it as a wide, dark "strait."

NOACHIS appears dusky on Lepper's drawings, but Phillips found it bright on the limb.

HELLESPONTUS was dark, according to Phillips and Ward.

MARE ERYTHRÆUM (E.) was too foreshortened by perspective in order to reveal much detail.

STREAKS AND MINOR DETAIL.

CALLIRRHOE.—Phillips: 4° wide, dark, swelling to fully 7° at its estuary to W.—Ward: 5° wide, irregular, very faint, running more to the S.W.,† and not ending into *Mare Acidalium*.—The Director: only the E. part visible (Fig. 2), 3° wide, faint; seen by glimpses.

DEUTERONILUS.—Lepper: intensified edge of *Cydonia*.—Phillips: 3° wide, "dark and strong."—Ward: 6° wide, often seen not extending to *Niliacus Lacus*.—The Director: 3° wide, faint; only glimpsed.

EUPHRATES.—The Director: 3° wide, exceedingly faint; visible only by rare glimpses.

GEHON.—Lepper: edge of shaded *Thymiamata*.—The Director: 3° wide, convex to E., easy; almost held steadily at times (Fig. 2).

HIDDEKEL.—Phillips: 3° wide, "glimpsed once, as a faint, narrow, "dusky streak."—The Director: 2° wide, curved, convex to W., very faint, and seen by rare glimpses.

PHISON.—Phillips: "Appeared distinctly an edge of faint shading" to W.

PIERIUS.—Lepper: edge of shaded *Dioscuria*.—Phillips: 3° wide, dark.—Ward: confuse, irregular.—The Director: 3° wide, dark; almost held steadily by moments.

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* *Mars Report* for 1903, p. 67, Fig. 4.

† On Ward's drawing of May 9 both the *Deuteronilus* and *Callirrhoe* run more obliquely upwards, to S.W., as shown by Mr. Knobel in 1884, February (*Mem.* R.A.S., Vol. XLVIII., Plate V.).

PROTONILUS.—Lepper: intensified edge of shaded *Dioscuria.*—Phillips: 4° wide; "quite a dark streak. One of the strongest and most conspicuous "canals." — Ward: May 9, anomalously broad; "a long ribbon-like "marking"; 3° to E., 5° to W. On other occasions, less defined, and on May 15 disconnected from *Colœ Palus.*—Wright: 4° wide, intensified edge of shaded *Dioscuria.*—The Director: 3° wide, intensified border of the *Dioscuria* shadings.

TRITONILUS. — The Director: May 29, 4° wide, faintly knotted and irregular, running from *Ismenius Lacus* to *Margaritifer Sinus*, and convex to N.W. This view is similar to that of 1903,* but much less detailed, and fainter (Fig. 2).

XENIUS.—Ward: May 8, 8° wide, and dark (Fig. 7).

SECTION II.

Margaritifer Sinus, Auroræ Sinus, and Mare Acidalium.

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

MARGARITIFER SINUS appears sharply pointed on the drawings of all the Members having sketched this region, and, as usual, has a distinct N.E. trend. Yet the powerful instrument, and favourable S. latitude, of Ward, enabled him to see the "gulf" slightly bulging on the "continent" to N.W. (Fig. 1), exactly as drawn by Molesworth in 1903. The consensus of evidence is that this "bay" was, in 1905, slightly fainter than "Dawes Forked Bay," the darkest portion being, according to Phillips and Ward, the N. extremity (Plate III., 12, and Fig. 1).

HYDASPIS SINUS is admirably shown by Ward on his drawing of May 3 (Plate II., 2).

AROMATUM PROMONTORIUM was observed normally blunted by Hirst, Lepper, Phillips, Ward (Plate II., 2), and the Director. But on May 8, Ward found it somewhat pointed, with some minute irregularities about the "coast."

A white spot, 2 of our Chart, was observed by Phillips on the S. part of *Chryse*, as in 1903.

CHRYSE seemed generally bright to Phillips, although on July 2 he found it dusky on C.M.

AURORÆ SINUS showed its usual form in 1905. It would seem that this "gulf" was dark early in the apparition, that it faded much from the end of April to the greater part of June, and

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* Although the S.W. trend of *Protonilus* produced is recognisable on Galle's drawings, made in 1839 (Flammarion, *Mars*, Vol. I., p. 125), the *Tritonilus* seems to have been first properly represented by Prof. Holden with the 26-in. Washington equatorial on 1879, November 6 (Photographs of Prof. Holden's drawings, 1875-1888, kindly sent to the Director by Messrs. W. Wesley & Son, 28, Essex Street, Strand). See also *Mars Report* for 1903, p. 69.

that it resumed its usual darkness later. Subjoined are the records concerning this phenomenon :—

Date.	ω	Intensity of *Auroræ Sinus*.	Observer.
1905, April 30 -	75°	Very faint, fainter than *Ceraunius*.	Hirst (Plate II., 4).
,, May 3 -	52	Faint, "general markings "difficult."	Ward.
,, ,, 7 -	33	Faint - - - -	Hirst.
,, ,, 8 -	15	do. - - - -	Ward.
,, ,, 13 -	76	do. - - - -	Lepper.
,, June 20 -	71	do. - - - -	do. (Plate II., 3).
,, ,, 28 -	81	Fairly dark - - -	Phillips.
,, July 2 -	51	do. - - -	do.

Lepper adds : "One of the most remarkable features noticed " was the fading of *Auroræ Sinus* and *Maria* to the S. These " *Maria* were quite sufficiently dark to be visible early in the " season, but they afterwards faded so much that it was only " with great difficulty that the coast lines could be seen." And " the faintness of the *Maria* was especially noticeable when " these regions were E. of the C.M."

LUNÆ LACUS was seen by Lepper on June 20 (Plate II., 3), and by Phillips on June 28 and July 2, the latter observer describing it as "dark and easy, but somewhat diffuse." Inasmuch as an observer like Ward missed it on May 3 and 8, we deem it probable that it was veiled by cloud at the time.*

OXIA appears to have been very faintly shaded, according to the Director.

NILIACUS LACUS could not be "seen separately" by Lepper (Plate II., 3), Hirst, and Ward. Phillips found it "not very " distinct," and "very soft and diffuse to S.," except perhaps on May 29 ; the Director drawing it much fainter than *Mare Acidalium* (Fig. 2).

ACHILLIS PONS appeared confuse to Phillips (Fig. 3), but easier to the Director (Fig. 2).

ACIDALIUM MARE had a roughly triangular, bell-like form, to Hirst (Plate II., 1), and this view receives some support from Ward on May 3 (Plate II., 2) and 8. To Wright and Lepper (Plate II., 3) it seemed pear-shaped, the narrow end to N.†

* Such obliterations of *Lunæ Lacus* are of very frequent occurrence, especially in perihelic oppositions, when the solar rays reach the country hereabout under great obliquity. Thus it was that neither Prof. Barnard, nor Prof. Schæberle, nor Prof. Hussey, nor Prof. Campbell at Lick in 1892, nor the Director at Meudon in 1909, could see any traces of it (*Publ. of the Astr. Soc. of the Pacific*, Vol. V., No. 30; Flammarion, *Mars*, Vol. II., p. 52 ; and *Journal* B.A.A., Vol. XX., p. 80, Plate, Fig. 3).

† As delineated by Burton in 1871 (Dr. Terby, *Aréographie*, Plate III., Fig. 30). See also *Mars Report*, 1900–1901, Plate III., Fig. 3.

But Phillips and the Director rather incline towards a rectangular, or trapezoidal, form (Figs. 2 and 3). Ward gives to this "sea" large dimensions (Plate II., 2), his drawing of May 8 showing it as a huge bell over the polar whiteness (Fig. 7).

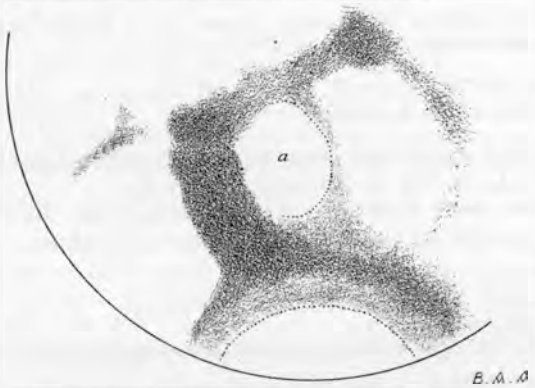

FIG. 3.—The *Mare Acidalium* region on 1905, July 2, according to Phillips.

The intensity of *Mare Acidalium* was not very great in 1905, rather less than in 1903.* To Hirst, under $\omega = 33°$, it seemed fainter than *Furca*, although *Mare Acidalium* was on the C.M. and "Dawes Forked Bay" more than midway between C.M. and *p* limb, and further removed from the centre by the tilt of the axis (Plate II., 1). Lepper describes it "very dark, though it "appeared to fade as the season progressed." Phillips calls it "the most prominent" of "the dark regions in the N. hemi-"sphere." Wright draws it fairly dark. To both Ward and the Director *Mare Acidalium* appeared fainter than the "Forked Bay." The darkness was not uniform. On July 2, Phillips found the *Mare* dark "especially . . . in its N. portion"—a statement confirmed by Ward (Plate II., 2). Near the limb Wright and the Director saw the S. end darker. Ward further found the *f* edge more intense than the *p*, while on May 8 the New Zealand observer drew the *Mare* very irregularly shaded, and crossed obliquely by a dark streak, from N.E. to S.W. (Fig. 7). A fine sight indeed.

The apparent fading of this "sea" with the progress of the season, to which Lepper called attention, may be due either to seasonal change,† or to obliteration by haze.

TEMPE showed nothing abnormal beyond the ordinary white spot, 3 of our Chart,‡ which Phillips saw *f* the *Mare Acidalium*

* *Acidalium Mare* "has been much fainter of late [1905] than the deep "tone it presented in 1903" (Denning, *The Observatory*, 1905, p. 324). This "sea" was also faint during the similar apparition of 1890.

† *Mars Report* for 1900–1901, p. 104. At the time when that *Report* was written, the great part played by cloud could not be properly realised. What clouds can do on Mars we learned from the wonderful and unprecedented disappearance of the dark markings in 1909.

‡ This spot was drawn by Burton in 1871 (Dr. Terby, *Aréographie*, Plate III., Fig. 30).

(Fig. 3, spot *a*). Traces of this marking are also found on Ward's drawings of May 3 and 8.

Eos appeared to touch *Aromatum Promontorium*, according to Phillips's observation of July 2.

Pyrrhæ Regio is vaguely shown as a dusky region by Lepper and Phillips.

Mare Erythræum (W.) was still viewed too obliquely in 1905 to present much detail.

Argyre is drawn very white on S. limb by Hirst on April 30 (Plate II., 4), and by the Director on May 29.

Whitish cloud seems to have obliterated the *Mare* W. of *Argyre*, on June 28 and July 2, according to Phillips.

Streaks and Minor Detail.

Ganges.—Phillips : 6° "broad and diffuse, but fairly strong."

Iamuna.—Phillips : 3° wide, very faint, "seen on June 28."

Indus.—Lepper : edge of shaded *Thymiamata ;* also glimpsed "as a "faint streak."—Phillips : 3° wide, convex to E., and not extending as far as *Lacus Niliacus* on July 2.—The Director : 4° wide, convex to E., and merging into *Lacus Niliacus.*

Nilokeras.—One of the most conspicuous streaks. Lepper : "as a broad "but faint streak."—Phillips : "anomalously double, as at some previous "apparitions," 3° wide bands, 5° apart to W., 12° to E. This on June 28 ; but on July 2, smudgy (Fig. 3).—Ward : anomalously double on May 8 ; S. band 3° wide, N. 5° ; interval of 11° to W., 16° to E.—Wright : most broad and diffuse.

Tanais.—Phillips : 6° wide, dark.—Ward : mere edge of shaded *Baltia.*

SECTION III.

Solis Lacus.

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

Thaumasia could not be seen all along its S. outline, probably owing to haze. It was very white to Lepper, white to Phillips, and, perhaps, further brightening with the obliquity of the illumination about the limb, according to Phillips and Ward.

A bright spot, 4 of our Chart, certainly due to cloud, was observed by Hirst in the N. part of *Thaumasia* on April 30.

Solis Lacus was "throughout extremely faint," says Lepper ; it "was only seen with any degree of certainty on May 13." Phillips draws it small, foreshortened, and oval, adding that it was "clearly seen, and fairly dark" (Plate II., 5). Wright's impressions were similar.

Tithonius Lacus was "possibly glimpsed once or twice" by Lepper. Phillips says it was "well seen, but decidedly less "dark than *Solis Lacus.*" On May 9, Ward found it diffuse,

and narrow on limb; Wright, on June 8, in a similar position, depicts it broad, dark, and diffuse.

AUREA CHERSO is marked, though not as a peninsula, on Phillips's drawing of June 28.

AONIUS SINUS appears partly as a small dark smudge on a sketch taken by Phillips, on June 23* (Plate II., 5).

PHŒNICIS LACUS was "soft and hazy, but not difficult" to Phillips, who elongates it E. to W., on June 20, 21, and 23 (Plate II., 5). Wright draws it confuse on *Agathodæmon*.†

DÆDALIA seemed bright to Phillips and Ward.

THARSIS appeared shaded on the W. side to Ward. Its brightening on limb is well represented by Phillips and Ward.

A bright spot, 5 of the Chart, was observed by Phillips here, in $\Omega = 90°$, $\Phi = +10°$, corresponding almost exactly in position with spot 8 of 1903, seen by the same observer.

OPHIR showed nothing abnormal in 1905.

ASCRÆUS LACUS appears as a very large swelling of *Ceraunius* on Phillips's drawing of June 23 (Plate II., 5).

MAREOTIS LACUS is described as a "rather large, ill-defined "spot on *Ceraunius*," by Phillips.

MÆOTIS PALUS is confuse on the delineations of Phillips and Ward.

STREAKS AND MINOR DETAIL.

AGATHODÆMON.—Phillips: 3° wide, "broad, and fairly strong."—Ward: May 9, edge of shade to N., on limb.—Wright: confuse with *Tithonius Lacus*.

ARAXES.—Phillips: 3° wide, faint.—Ward: concave to S.E., edge of shade to N.W.—Wright: broad and smudgy.

CERAUNIUS.—Hirst: April 30, most broad and diffuse.—Phillips: 4° wide, "broad and soft."—Ward: very confuse.

CHARADRUS.—Ward: edge of shading to S.

CHRYSORRHOAS.—Phillips: 3° wide, a "soft and hazy line."

CLARIUS.—Phillips: edge of shade to S.

FORTUNA.—Ward: May 9, near *p* limb, edge of shading to W.

IRIS.—Phillips: 6° wide, convex to W., diffuse.

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* That cloud on Mars had something to do with the disappearance of this "gulf" ever since 1894 (*Mars Reports* for 1894, 1896, 1898–1899, 1900–1901, and 1903) there can be no doubt whatever, since the Director saw this marking very dark and with great detail, at Meudon, in 1909.

† The reason for the criticism in *Mars Report* for 1903, p. 75, note 3, is that *Phœnicis Lacus*, which the great Dawes could never see with 8 inches, could not be dark, definite, and even ruddy (!) in a 4¼-in. Small telescopes do not show red tints in the dusky spots of Mars, and this fact constitutes an unanswerable confutation of the observation in question.

NECTAR.—Phillips: 4° wide, diffuse.

NILUS.—Hirst: April 30, most faint, broad, and diffused.—Phillips: 5° wide, "very broad and diffuse, on the one occasion it was observed."

SECTION IV.

Mare Sirenum.

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

ICARIA was seen dusky by Ward as far as *Hyscus* on April 25—a very important observation.*

PHAETHONTIS appeared bright on limb to Phillips and Ward.

MARE SIRENUM is shown in its ordinary form by Phillips and Wright. Inadequacy of aperture did not enable Lepper to see the N.E. branch of this "sea." Ward drew the *Mare* bulging on the "continent" to the S.E. of *Titanum Sinus* (Plate II., 6). Lepper found it "pale at first, but afterwards "[it] became more conspicuous." We see here an effect of haze. Phillips thought it "dimmed by atmospheric absorption," consequent on the tilt of the axis. It was dark on May 9 to Ward.

SIRENUM SINUS, sharp to Phillips, seemed broad to Ward and Wright.

GIGANTUM SINUS, the "bay" discovered here by Burton in 1879,† is delineated as the just-mentioned bulging by Ward (Plate II., 6).

TITANUM SINUS is faintly indicated by Phillips, but most satisfactorily by Ward.

ATLANTIS appeared to Ward as a dull irregular lightening to the W. of *Mare Sirenum* (Plate II., 6).

MEMNONIA, bright to Ward, was further noted as whitening about the limb by Cobham and Wright.

AMAZONIS is intensely shaded on the drawings of Phillips, and less so on those of Ward.

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* The shading of *Icaria* was indicated by Prof. Barnard in a drawing taken with the 36-in. Lick refractor on 1894, September 2 (*The Astrophysical Journal*, Vol. XVII., Plate facing p. 249); and it was a most striking feature to the Director in 1909 with the 32·7-in. Meudon equatorial (*Journal* B.A.A., Vol. XX., Plate of p. 80, Fig. 2). This must be a permanent appearance of the region in question, but brightening occasionally by the interposition of cloud.

† Writing on 1879, November 13, Burton says: "Trouvelot Bay . . . " was on this night seen to terminate in a double point" (*Scient. Tr. of the R. Dublin Society*, Vol. I., n.s., p. 159, and Plate VII., Fig. 16). This was confirmed at Meudon in 1909 (*Journal* B.A.A., Vol. XX., Plate of p. 80, Fig. 2).

ARCADIA, bright to Ward generally, and dusky to S., according to Wright, is further shown to whiten near the limb by Cobham and Wright.*

NODUS GORDII is described by Phillips as a "rather large "dusky spot at junction of *Pyriphlegethon* and *Gigas*." This corresponds to the S. end of the *Nodus* in $\Omega = 132°, \Phi = +10°$.

PHRYGIUS LACUS appears as a "dusky spot at junction of "*Gigas* and *Eumenides*," according to Phillips.

AMMONIUM was not observed by any of our Members in 1905.

ASCANIA PALUS can be seen as a large swelling at the junction of *Pyriphlegethon* and *Acheron-Erebus* on the drawing of Phillips of June 21.

ARTYNIA FONS is dark and tapering to S.† on Ward's drawing of April 25.

PROPONTIS I. is faintly shown by Cobham (Plate III., 7). Lepper saw it occasionally as a darker condensation of the *Titania* shadings. Phillips describes it as a "very large dark "spot. Not seen sharply defined, except to N. Very soft "and diffuse to S." (Plate II., 5). Ward and Wright draw it confuse in the shades. Gale writes that on May 27 "a very "dark marking in high N. latitude and in longitude about 180° "to 200° formed the most striking feature of the disc. What "appeared most strange was its sudden conspicuousness and "the fact that I could not again see it when it should have "been on the disc, although near the limb."

HERCULIS PONS is faintly indicated by Cobham, Phillips, and Wright.

PROPONTIS II. appears vaguely on the sketches of Cobham (Plate III., 7) and Wright.‡

TITANIA was admirably shown in its tapering form by Lepper and Ward (Plate III., 6). It is more confuse on the drawings of Cobham, Phillips, and Wright. On May 28, Ward saw it as dark as *Mare Sirenum*.

STREAKS AND MINOR DETAIL.

ACHERON.—Ward: irregular edge of shade to S.

DAMASTES.—Ward: edge of shaded *Titania*.

EUMENIDES.—Phillips: 3° wide, "somewhat vague."—Ward: edge of shade to N.

EUROTAS.—Phillips: 3° wide to W., 8° to E., faint and diffuse.—Ward: edge of shaded *Titania*.

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* This whitening was also noticed by M. Quénisset in 1905.

† This spot was also somewhat pointed to Molesworth in 1903 (*Mars Report* for that year, Chart, Plate I.).

‡ The duplicity of *Propontis* is well shown on M. Quénisset's drawings of this apparition.

FEVOS.—Ward : edge of shaded *Titania*.

GIGAS.—Phillips : 4° wide, very soft and diffuse.—Ward : 10° wide, irregular, dark, though diffused, and not extending as far to S.W. as *Mare Sirenum*.*

HYSCUS.—Ward : edge of shaded *Icaria*.

PYRIPHLEGETHON.—Phillips : "very broad, diffuse, and irregular streak."

TITAN.—Phillips : 5° wide to N., fading off into a point to S. "Not seen "S. of centre of disc."—Ward : to N. only, edge of shaded *Titania*.

NEW STREAK.

HYPANIS.—Named by the Director, and seen by Ward as an irregular streak, 12° wide almost.—Wright also saw this marking with a breadth of 4°.

SECTION V.

Mare Cimmerium, Elysium, and Trivium Charontis.

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

MARE CIMMERIUM is shown in its ordinary cigar form by Cobham, Killip, Wright, and the Director. On June 13, $\omega = 212°$, Phillips could not see it detached from *Mare Tyrrhenum*—an observation countenanced by Hirst and Lepper. Ward represents it broad above the *Cyclops* estuary, bulging over the same, slightly pointed at the upper end of *Hesperia*, and tapering to W. (Fig. 4). This is the shape it had to Lockyer on 1862, October 11.† As to the intensity of the *Mare*, it was moderate to Cobham (Plate III., 7), Killip

FIG. 4.—*Mare Cimmerium*, *Hesperia*, *Pambotis Lacus*, and *Trivium Charontis*, as drawn by Ward on 1905, May 24.

* A similar broad and irregular view of the *Gigas* was drawn by Dawes in 1864 (*M.N.* R.A.S., 1865, first view of Mars, 1864, November 3) ; and there can be no doubt that the delineations of Dawes and Ward give a truer appearance of the *Gigas* than the linear representations of Schiaparelli.

† *Memoirs* R.A.S., Vol. XXXII., Plate III., Figs. 1 and 2.

(Plate III., 10), Wright, and the Director (Plate III., 9). It appeared fairly dark to Hirst, Lepper, and Phillips. Ward shows it rather fainter than *Mare Sirenum*. Phillips adds that it was "perceptibly darker along its N. border"—a probable effect of contrast.

CIMMERIA INSULA, that long, subjective production of contrast, was seen by nobody in 1905.

LÆSTRYGONUM SINUS is indicated as a slight bulging by Cobham (Plate III., 7), Ward, and Wright.

CYCLOPUM SINUS is drawn as a larger bulging of the *Mare* by Ward (Fig. 4).

TRITONIS SINUS, a name now given to the W. end of *Mare Cimmerium*, is well drawn pointed by Ward (Fig. 4).*

HESPERIA is shown bright and narrow by Ward on April 14 (Plate III., 8) and May 24 (Fig. 4), broader and dusky by the Director on June 7 (Plate III., 9). Wright seems to represent it, but completely severed from the "continent" by a dark "channel." It was invisible to Lepper and to Hirst, and also to Phillips on June 13, when "*Mare Cimmerium* was observed " only as a dusky region connected with the *Syrtis Minor* " without any trace of *Hesperia*."

TYRRHENUM MARE (E.) was quite as dark as *Mare Cimmerium*, according to Hirst, Lepper, Ward, Wright, and the Director (Plate III., 9).

ELECTRIS can be seen bright near the limb on the drawings of Phillips and Ward.

ERIDANIA is delineated bright on the limb by Cobham, Phillips, Ward, and Wright.

ZEPHYRIA was described by Killip on June 10 as "a very " brilliant strip of white on the *p* limb." It was also bright to Ward.

ÆOLIS showed nothing abnormal in 1905.

ÆTHIOPIS seemed to be whitish to Lepper.

ELYSIUM appeared oval-pentagonal to Lepper and to Phillips, small, round, or elongated E. to W., to Cobham (Plate III., 7), Ward, and Wright. Cobham, Lepper, Phillips, Ward, and Wright all agree in showing it brighter than the surrounding deserts; and on April 14, Ward found it "brilliantly white" on C.M. (Plate III., 8).

As in past apparitions, a white spot, 6 of the Chart, was seen *f Trivium Charontis* by Phillips and Ward.

* This tapering appearance is a step towards the recognition of the true form of *Mare Cimmerium* to W., where it ends in a very sharp, slightly curved point. The true configuration of the *f* end was discovered by Dr. Cerulli with his 15½-in. Cooke in 1896 (*Marte nel 1896-1897*, Plate II., Fig. 1), and it was fully confirmed by the Director with the 32·7-in. Meudon telescope in 1909 (*Journal* B.A.A., Vol. XX., p. 80 Plate, Fig. 1).

PAMBOTIS LACUS, which came into prominence in 1903, was well observed by Gale, Phillips (Fig. 5), and Ward (Fig. 4). Phillips defines it as "large and rather diffuse," only a little inferior to *Trivium Charontis*.

TRIVIUM CHARONTIS is crescent-shaped on the drawings of Cobham (Plate III., 7), Hirst, and Wright, round on those of Lepper, and elongated, E. to W., according to Phillips and Ward (Figs. 5 and 4). The Director saw it only once confusedly,

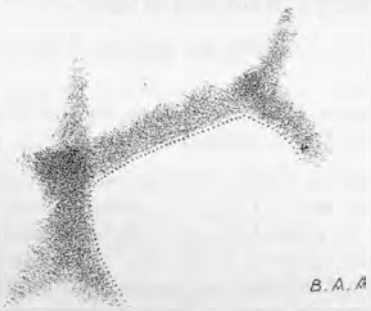

FIG. 5.—*Trivium Charontis* and *Pambotis Lacus* on 1905, June 13, after Phillips.

under bad definition, near the *p* limb (Plate III., 9). Phillips says of it: "Quite one of the most conspicuous of the 'lakes.'" Gale noted "a very great change in the appearance of *Trivium* "*Charontis* on June 27 and 29, and July 4, local time, as com- "pared with May 27. On the earlier date two round dark "patches, with intervening shading, were clearly seen (the W. "one was too close to be *Pambotis Lacus*, which was also "faintly indicated, and the general direction in which they lay "was N.E. and S.W. At the end of June and beginning of "July the *Cerberus* and *Styx* were broad and definite, and only "slightly more marked at their junction, presenting the appear- "ance usually delineated."

MORPHEOS LACUS is faintly shown by Ward on April 14 (Plate III., 8).

PHLEGRA, as usual, is dusky on the drawings of Lepper, Phillips, and Ward.

CEBRENIA also appears shaded on the representations of Lepper and Ward.

ÆTHERIA too was slightly shaded, according to Lepper and Ward, the last of whom saw it bright on the terminator on May 28 (Plate II., 6).

STREAKS AND MINOR DETAIL.

ÆSACUS.—Cobham: convex to W., 2° wide, faint.—Wright: do.

ALCYONIUS.—Cobham: 3° wide, intensified edge of shaded *Utopia*.—Hirst: edge of shaded *Utopia*.—Lepper: do.—Ward: do.—Wright: 3° wide, intensified edge of shaded *Utopia*.

AVERNUS.—Ward : 9° wide in part, irregular, diffuse (Plate II., 6).

BOREAS.—Phillips : 3° wide, very faint and diffused.—Ward : edge of *Phlegra* shading.

CERBERUS.—Cobham : 3° wide, dark.—Gale : end of June, beginning of July, "broad and definite."—Hirst : 3° wide, diffused.—Lepper : 3° wide, edge of bright *Elysium*, dark on April 29.—Phillips : 7° wide, "broad and "dark, but not as sharply defined as usual," and sharper towards *Elysium*, part of whose edge it forms (Fig. 5).—Ward : 7° wide, irregular, diffuse, dark edge of bright *Elysium*.—Wright, 3° wide, dark.

CHAOS.—Cobham : 2° wide, extremely faint.—Lepper : edge of bright *Elysium*.—Phillips : 7° wide, "well seen bounding *Elysium* to N.," and edge of bright *Elysium*.—Ward : 8° wide, edge of bright *Elysium*.—Wright : 2° wide, extremely faint.

CYCLOPS.—Phillips : 4° wide, "hazy and ill-defined."

EREBUS.—Phillips : 3° wide, "very soft and somewhat narrow, but well "seen on a few occasions ;" edge of shade to N.W.

EUNOSTOS.—Cobham : 2° wide, faintish.—Lepper : edge of bright *Elysium*.—Phillips : 6° wide, diffuse, "well seen," edge of bright *Elysium*.—Ward : very faint, edge of bright *Elysium*.—Wright : 2° wide, faintish.

GRANICUS.—Cobham : edge of shaded *Titania*, very faint.—Phillips : 7° wide to S.E., 4° to N.W., fairly dark.—Ward : edge of shaded *Titania*.—Wright : edge of shaded *Titania*, very faint.

GYNDES I.—Cobham : edge of shade to N.—Phillips : 3° wide, "well "seen, but less dark than in 1903."—Ward : 3° wide, edge of shaded region.—Wright : edge of shade to N.

HADES.—Cobham : 3° wide, irregular, dark, edge of shade to W.—Lepper : edge of shaded *Phlegra*.—Phillips : 10° wide, diffuse, "vague. All "the region about here is slightly shaded." Edge of shading to W.—Ward : edge of shaded *Phlegra*.—Wright : 3° wide, irregular, dark ; edge of shade to W.

HEPHÆSTUS.—Ward : 8° wide, irregular, diffuse.

HYBLÆUS.—Cobham : 2° wide, very faint.—Lepper : edge of bright *Elysium*.—Phillips : 7° wide, "rather faint," edge of bright *Elysium*.—Ward : edge of bright *Elysium*, faint.—Wright : 2° wide, very faint.

LÆSTRYGON.—Phillips : 7° wide to N., and sharply narrowing to S., faint.

ORCUS.—Lepper : glimpsed "as E. projection of *Trivium Charontis*."—Phillips : 3° wide to S.E., 6° to N.W., "hazy and difficult" ; edge of shade to N.E.—Ward : edge of shade to N.

STYX.—Cobham : 3° wide, faint, edge of shade to E.—Gale : end of June and beginning of July, "broad and indefinite."—Hirst : 5° wide, irregular, darkish.—Lepper : edge of shade to *Elysium*.—Phillips : 7° wide, "sharply "defined on its W. side," edge of bright *Elysium*.—Ward : 9° wide, dark edge of bright *Elysium*.—Wright : 3° wide, faint, edge of shade to E.

TRITON.—Hirst : N. edge of shaded *Hesperia*.—Killip : do.—Lepper : do.—Phillips : do.—Wright : do.

NEW STREAK.

CYDARIS.—Name given by the Director to a streak seen by Gale to run "from the junction of *Chaos* and *Hyblæus* N.E. to *Stymphalius Lacus*."

SECTION VI.

Syrtis Major.

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

MARE TYRRHENUM (W.) had its normal form and intensity to most Members of the Section. But on May 24, Wright drew it as if it were partly obliterated by a cloud.

SYRTIS PARVA, faintly indicated by Lepper, is pointed and normally dark on the sketches of Hirst, Phillips, Ward, Wright, and the Director (Plate III., 9).

AUSONIA, confuse, was seen bright near the limb by Killip and Ward.

HADRIACUM MARE, "fairly dark" generally to Lepper, "appeared very faint, as if veiled by a thin fog" on May 28, to the same observer. It was always faintish to Hirst, Phillips, Ward, and Wright; but the Director found it normally intense on June 7 (Plate III., 9).

HELLAS was generally noticed as a bright shimmer on the limb by Phillips, Ward, and the Director (Plate III., 9). On May 15 it was, however, nearly as ruddy as *Aeria* to Hirst, under $\omega = 330^\circ$, whilst Lepper described it sometimes as "rather "dusky." The evidence of Martian haze makes itself felt here also.

LUNÆ PONS is recognisable as a 9° wide band, fading off to S.W., on the drawing of July 12 of Phillips. Wright also shows it as an 8° wide, diffuse band, but only on May 24.

SOLIS PONS was drawn by Phillips on July 12, as a 9° wide band, fading to S.E.

IAPYGIA was vaguely glimpsed by Lepper.

ŒNOTRIA seems to be represented on Wright's drawing of May 24.

SYRTIS MAJOR appeared widely open to S. in 1905, wider perhaps than it ever was, and rounded to N.* It displayed almost Lowell's form to all Members not using very modest instruments. Its E. border presents the well-known "bight" near *Mœris Lacus*, on the delineations of Hirst, Phillips, Ward, and Wright; the "bay" in question being shallower in outline, according to Wright, more pronounced on Hirst's and Phillips's sketches, and deepest on those of Ward (Fig. 6 and Plate III., 8). The W. "coast" is straight on the drawing taken by Phillips on July 12, and on Hirst's beautiful picture of May 15. It was slightly concave to N.W., after Wright, and the Director. But Ward draws this boundary as bulging inwards, towards *Œnotria*, outwards, or on *Aeria*, further S., and there can be no doubt

* This remarkable breadth was very striking to M. Quénisset, using a $4\frac{1}{4}$-in.—a very creditable achievement indeed.

whatever that on this point, as on so many others, our New Zealand colleague is right. The *f* outline of the great "sea" was "very hard," or well defined to Ward, more so than the *p*,

FIG. 6.—*Syrtis Major* and adjoining country, as seen on 1905, May 15, by Ward.

which is in harmony with the observations made in 1903 by Attkins and Molesworth.*

As to the N. point of the *Syrtis*, it looked rather sharp to Hirst, Phillips, and Lepper, but doublish † to Ward on May 15 (Fig. 6), together with a distinct bulging to N.W.,‡ supported by Wright (Plate III., 11).

The intensity of *Syrtis Major* in 1905 was great, and all Members agree in depicting the marking in question very dark indeed. It might have been the darkest of all Martian spots at the time. But, as usual, the shading did not display everywhere the same degree of intensity, being deepest at the point, according to Phillips, Ward, Wright, and the Director (Plate III., 9)—a probable effect of contrast. Further S., lighter regions were detected by Wright, and these seem to be faintly countenanced by Ward.

Under $\omega = 260°$, on June 10, the risen *Syrtis* was invisible to Killip (Plate III., 10).

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* *Mars Report* for 1903, p. 86.

† *Mars Report* for 1896, p. 94, and for 1903, p. 85.

‡ As seen by Molesworth in 1896, 1898, 1901, and 1903 (see *Reports* for these various apparitions).

On the drawing by Wright of May 16, and on that of Hirst of May 22, there seems to exist some indication of an equatorial belt of haze, as observed by Kibbler in 1901,* and Gale in 1903 †; but the synchronous views of Ward scarcely justify such a conclusion.

DELTOTON SINUS is admirably depicted as bulging out into *Aeria* by Ward (Fig. 6).

MŒRIS LACUS appeared as a "gulf" of *Syrtis Major*, according to Hirst, Phillips, Ward (Plate III., 8, and Fig. 6), and Wright. On April 14, May 16 and 20, Ward drew it as a sharply tapering "bay."

LIBYA was round to Lepper, Wright, and to the Director, but containing the *Abyssinia* lobe,‡ according to Hirst, Phillips, and Ward (Plate III., 8, and Fig. 6). All Members concur in drawing it bright—a probable effect of haze, for the Director thinks it likely that this country is always shaded in reality. The occasional equatorial cloud bank over the *Syrtis* must sometimes extend over *Libya* also.

ISIDIS REGIO, duskier than *Aeria*, to Lepper, looked bright to Phillips.

NILI PONS was seen by Lepper on April 24, and by Wright on May 17 (Plate III., 11). Phillips writes that *Syrtis Major* was "perhaps severed from the *Nilosyrtis* by a white bridge," adding that he could not quite satisfy himself "that the severance "was complete and not merely an irradiation effect."

Phillips further saw two white spots, 7 and 8 of our Chart, on either side of *Nili Pons* on July 12.

MEROE displayed nothing worth noting in 1905.

COLOE PALUS, smudgy to Wright, is described by Phillips as a "conspicuous swelling on *Nilokeras*." To Ward it was very dark, trapezoidal, and elongated along a meridian of the planet (Fig. 6).

NEITH REGIO appears shaded on the sketches of Lepper, Phillips, Ward, and Wright (Plate III., 11).

NUBIS LACUS is described "as a darker patch forming the "extremity of the *Casius*," by Lepper. The Director found it dark and distinct on June 7 (Plate III., 9).

COPAIS PALUS was seen by Lepper "as a condensation "in the dusky regions N. of the *Syrtis*." It is confuse on the views of Phillips, Ward (Fig. 6), and of the Director (Plate III., 9).

UTOPIA is heavily shaded on the drawings of all Members having studied this region. The evidence of Hirst, Lepper,

* *Mars Report* for 1901, p. 124.
† *Mars Report* for 1903, pp. 87–88.
‡ *Mars Report* for 1896, p. 92.

Phillips, Ward (Fig. 6), Wright, and of the Director is unanimous on this point, and all agree again in representing the shaded area to be triangular (Plate III., 8 and 9).* Phillips found it, however, less shaded perhaps that in 1903, adding that at the last-named apparition "two large dark spots † were observed "in the region N. of the *Casius*, but this portion of the disc "was rarely seen at all in 1905, and the two spots were not "recovered." The shading appeared uneven to Ward (Fig. 6).

STREAKS AND MINOR DETAIL.

AMENTHES.—The Director : 3° wide, faint and diffuse.

ASCLEPIUS.—Lepper : edge of shade to W.—Wright : do.—The Director : 5° wide, soft and diffuse.

BOREOSYRTIS.—Lepper : edge of shaded *Neith Regio*.—Phillips : 6° wide, convex to W., "dark and conspicuous."—Ward : confuse, edge of shaded *Neith Regio*.

CASIUS.—Hirst : edge of *Utopia* shadings.—Lepper : "a dusky com- "densation between *Utopia* and *Neith*."—Phillips : 7° wide to N.W., 1° to S.E., "dark and strong, but not canaliform."—Ward : 3° wide, intensified edge of *Utopia* shades.—Wright : 4° wide, intensified edge of *Utopia* shading.—The Director : complex, knotted, intensified edge of shades about *Utopia ;* the knotted structure flitting in and out of sight under bad seeing (Plate III., 9).

NILOSYRTIS.—Hirst : 4° wide.—Lepper : edge of shaded *Neith Regio*.—Phillips : 4° wide, curved. "One of the best-defined canals ; strong, dark, "and curved. It appeared separated from the tip of *Syrtis Major* by a "bright 'bridge.'"—Ward : generally, 3° wide to S., 5° to N.W., irregular. "The fine marking starting out of the *Syrtis M[ajor]* at N. appears to begin "*not* at extreme N. point, but a little S.E. of it. This well seen at times." An excellent and important observation. *Nilosyrtis* was partly shown in New Zealand as an edge to the *Utopia* shadings (Fig. 6).—Wright : 3° wide, curved, beginning somewhat N.E. of the point, which confirms Ward's note. —The Director : 3° wide, curved.

SECTION VII.

The South Polar Region.

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

On June 10, Killip saw a small bright spot on the S. limb, almost like a polar cap (Plate III., 10). Phillips writes that "the region at and close to the S. limb was particularly bright "at times, and shone with an intense steely blue light, especially "when *Noachis*, *Phaethontis*, *Electris*, *Eridania*, *Thaumasia*, "and *Hellas* were on the meridian. It is quite possible that "this intense brightness was really due to the extension N. of "the S. polar cap."

A dull white spot of indefinite boundaries appears about the S. limb on the drawings of May 16 and 17 of Wright.

Cloudy or hazy condensations seem probable here.

* *Mars Report* for 1903, p. 89.
† *Ibid.*, Plate IV., 3.

SECTION VIII.

The North Polar Region.

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

The smaller tilt of the axis in 1905, as compared with that of 1903 ($+14°{\cdot}7$, instead of $+22°{\cdot}5$), and the fact that large masses of cloud were frequently hiding the surface in high latitudes, did not enable our Members to study the N. polar regions of Mars in 1905 as satisfactorily as they did at the previous apparition of the planet.

ORTYGIA was bright to Phillips.

THERA appeared to Ward on May 8 and 9 to sever completely *Mare Acidalium* from the N. shadings.* Hence *Thera* was a "bridge" at the time (Fig. 7). Something like this was already seen by Gale in 1903.†

FIG. 7.—Remarkable appearance of *Mare Acidalium* and country to North, after the observations made on 1905, May 8, by Ward.

ACIDALIA PALUS is the name now given by the Director to a lenticular dark shading seen by Ward to the N. of *Thera*, on May 8 (Fig. 7) and 9.

BALTIA is shaded by Ward (Plate II., 2).

NERIGOS is also shaded by Ward (Plate II., 2).

ABALOS too appears shaded on Ward's drawings.

LACUS HYPERBOREUS was hidden by the polar cloud masses in 1905.

IERNE is shaded by Ward.

DEUCALIDONIUS LACUS was veiled by cloud so as to be utterly invisible.

SCANDIA appeared bright on limb to Wright on May 27.

* Mr. Knobel saw repeatedly in 1873 "a light band" between *Mare Acidalium* and the N. pole (*M.N.* R.A.S., Vol. XXXIII., p. 476); but this marking was invisible to him in 1884 (*Mem.* R.A.S., Vol. XLVIII., p. 277).

† *Mars Report* for 1903, p. 92, Fig. 15.

ARSENIUS LACUS could not be seen by any Member of the Section.

PANCHAIA is shaded on the sketches of Cobham (Plate III., 7), Ward, and Wright.

UCHRONIA is also shaded by Ward and Wright.

CECROPIA too is dusky on the drawings of Killip, Ward, and the Director (Plate III., 9).

STREAKS AND MINOR DETAIL.

CEPHISSUS.—Phillips : $4\frac{1}{2}^\circ$ wide, "faint soft smudge."—Ward : 5° wide, faint, diffuse, traces of it only.

CHOASPES.—Ward : 7° wide, dark, irregular.

GYNDES II.—Phillips : 5° wide, diffuse.—Ward : edge of shades to S.

HELICONIUS.—Lepper : edge of *Utopia* shadings.—Phillips : 4° wide, dark.—Ward : do.

IAXARTES.—Lepper : indicated.—Ward : seen only on May 3, as the darker edge of *Mare Acidalium ;* invisible on May 8 and 9.

PYRAMUS.—Killip : June 10, diffuse (Plate III., 10).

THE CLOUD AREA OF THE NORTH POLE.

No polar snow cap was ever seen about the N. pole in 1905, the opposition having occurred almost four months after the summer solstice of the N. hemisphere of the planet. The snows were replaced by the dull white glimmers of clouds, whose variable extent and intensity formed perhaps the most striking feature of the apparition.

Lepper rightly remarks that "on some of the drawings a "white patch of considerable extent may be seen in the polar "regions," but that "this does not represent the polar [snow] "cap."

Nor could the Director see any true cap over the N. pole in 1905. Here there always was to him a dull white spot of fair size, centered on the pole.

The observations of the great cloud mass by Phillips are of unusual interest. He says : "There was a diffuse dusky marking "in about latitude $+ 65^\circ$ bounding the N. polar regions, and the "whole of the district N. of this was whitish, though not "uniformly so. At first, however, there scarcely seemed to be "any definite polar cap visible, or, at any rate, there was "certainly no sharply defined belt enclosing it, such as is so "conspicuous a feature when the 'snow' is melting. On the "whole, I thought it probable that, when the observations "commenced, the new cap had not yet formed, but that the pole "and surrounding region were shrouded in mist or fog. This "region was intensely bright and slightly bluish, just like the "region at the S. limb, but I am not quite sure that the cap "itself was ever seen altogether clear of fog or cloud. The "intensely white area alluded to seemed to expand from a "diameter of somewhat less than 30° in June to nearly 50° in "July, the increase taking place rather suddenly either at the "end of the former or the beginning of the latter month."

Figs. 8, 9, 10, and 11 show the increase in size of the N. polar white material as seen by Phillips from May 29 to July 12.

FIG. 8.—May 29, $\omega = 350°$.

FIG. 9.—June 21, $\omega = 157°$.

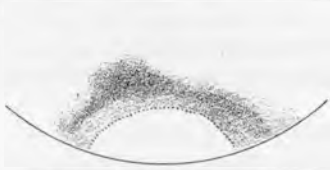

FIG. 10.—July 2, $\omega = 51°$.

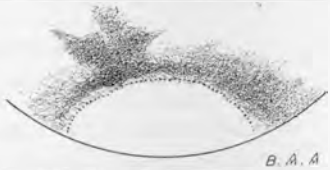

FIG. 11.—July 12, $\omega = 307°$.

White Cloud, spreading in 1905 over the N. Polar Regions of Mars, after Phillips.

The dim white N. polar patch showed in 1905 the varying size given in the following table, in which the column d concerns the areocentric arc subtended by the cloudy area :—

Date.	ω	d	Observer.	Date.	ω	d	Observer.
1905.	°	°		1905.	°	°	
April 4 -	114	26	Lepper.	May 22	350	29	Lepper.
,, 4	329	33	Ward.		0	27	
	354	33			10	31	
,, 5 -	316	34	do.	,, 24 -	213	20	Ward.
,, 7 -	279	35	do.	,, 24 -	255	11	Wright.
,, 14 -	221	33	do.	,, 25 -	189	15	Ward.
,, 21 -	287	9	Lepper.	,, 26 -	329	22	Lepper.
,, 24 -	283	10	do.	,, 27 -	203	18	Cobham.
,, 25 -	137	26	Ward.	,, 27 -	203	18	Wright.
,, 26 -	250	8	Lepper.	,, 28 -	163	16	Ward.
,, 28 -	229	23	do.	,, 28 -	306	7	Lepper.
,, 29 -	221	22	do.	,, 29 -	346	23	The Director.
,, 30 -	75	30±	Hirst.	,, 29 -	350	19	Phillips.
May 1 -	203	26	Lepper.	June 7 -	255	26	The Director.
,, 3 -	52	29	Ward.	,, 8 -	107	11	Wright.
,, 7 -	33	30±	Hirst.	,, 10 -	260	20	Killip.
,, 8 -	15	29	Ward.	,, 13 -	212	21	Phillips.
,, 9 -	352	27	do.	,, 16 -	170	31	Lepper.
,, 13 -	76	—	Lepper.	,, 20 -	71	—	do.
,, 15 -	307	26	Ward.	,, 20 -	163	42	Phillips.
,, 15 -	330	30±	Hirst.	,, 21 -	157	31	do.
,, 16 -	285	26	Ward.	,, 23 -	135	33	do.
,, 16 -	304	18	Wright.	,, 28 -	81	45	do.
,, 17 -	321	17	do.	July 2 -	51	36	do.
,, 18 -	312	12	do.	,, 9 -	331	44	do.
,, 20 -	241	27	Ward.	,, 12 -	307	47	do.
,, 22 -	254	30±	Hirst.				

Fig. 12 gives a graphic illustration of the modifications in size of the cloud cap ; the ordinates corresponding to the dates, the abscissæ to the areocentric arc subtended by the white area.

The fact that the N. hemisphere of the planet, during the 1905 apparition, was in the Martian months of July, August,

and September, coupled with the well-known extreme diminution, if not total disappearance, of the polar snows after the summer solstice, cannot countenance the assumption that a snow-cap, 1,750 miles across, could ever form in full summer over the N. pole of Mars. It is, therefore, more logical to infer that the phenomenon would be due to clouds assuming, perhaps, their maximum thickness in the cold air of the polar regions.*

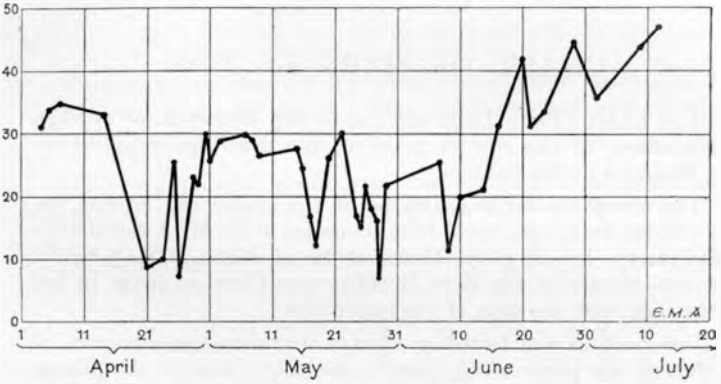

FIG. 12.—Curve showing the fluctuations in the diameter of the whitish material at the N. pole of Mars in 1905.

Yet, in this connection, it is important not to lose sight of the effect of perspective, since a thin cloud area, which would be fairly transparent at the equator, might apparently become an opaque white mass at the poles, through the foreshortening in which we see the frigid zones of the planet.†

It was noticed by Molesworth in the last Report that the N. polar snow cap melted in 1903 more quickly than in 1899 and in 1901.‡ The Director believes that such irregularities are also to be accounted for by cloud. For, while a clear sky over the pole in spring and summer would favour the melting and evaporation of the cap, the presence of cloud over the snows would check in some measure solar radiation, and consequently retard the diminution in area of the ice fields.

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* See also *Mars Reports*, for 1896, pp. 98–99; for 1899, p. 102; for 1901, p. 130; and 1903, pp. 98–99.

During the kindred apparition of 1873, Burton, Green, Lohse, Schmidt, and Trouvelot, all saw occasional dull swellings of the N. polar cap (Flammarion, *Mars*, Vol. I., p. 127 and pp. 210–227). A dull white area of considerable size was also seen at times in 1875 by Prof. Holden, observing with the 26-in. equatorial of Washington. In the analogous opposition of 1890, Mr. A. Stanley Williams found the N. cap very small, scarcely subtending 9° from April 25 to June 7; but on May 24 a dull white patch, 21° across, masked the true cap. In 1903, Prof. Barnard, discussing his 1894 work, wrote: "On several occasions a portion of the outline of the "[S.] polar cap was lost by a dusky obscuring medium which would "eventually clear away and the outlines would then again become distinct. "There seemed to be good reason for believing this temporary obscuration "to be of the nature of clouds" (*Astroph. Journal*, Vol. XVII., p. 254).

† Similarly, a thin cloud area would have its whiteness increased near the limb—a fact which plausibly explains the phenomenon of the lands which whiten with the obliquity.

‡ *Mars Report* for 1903, p. 95.

PART III.

CHART OF MARS IN 1905.

The Chart (Plate I.) at the end of this Report is, as usual, a combination of the results given in the drawings supplied by the Members of the Section.

The areographical co-ordinates of the centre of the disc, on the various drawings, have been computed from Mr. Crommelin's "Ephemeris for Physical Observations of Mars, 1904-5-6" *; and the transit of the Zero Meridian was found to occur in fair agreement with the data of the ephemeris.

Inasmuch as the lettering always introduces an element of confusion, the Director, in drawing the 1905 Chart of the planet, deemed it preferable to write the names of the various regions in thread-like characters, which is certainly an improvement over the past maps of the Section.

The lists of streaks and white spots are as follows :—

I.—STREAKY MARKINGS.

Acheron.	*Damastes.*	*Iamuna.*
Æsacus.	*Deuteronilus.*	*Iaxartes.*
Agathodæmon.	*Erebus.*	*Indus.*
Alcyonius.	*Eumenides.*	*Iris.*
Amenthes.	*Eunostos.*	*Læstrygon.*
Araxes.	*Euphrates.*	*Nectar.*
Asclepius.	*Eurotas.*	*Nilokeras (d).*
Avernus.	*Fevos.*	*Nilosyrtis.*
Boreas.	*Fortuna.*	*Nilus.*
Boreosyrtis.	*Ganges.*	*Orcus.*
Callirrhoe.	*Gehon.*	*Phison.*
Casius.	*Gigas.*	*Pierius.*
Cephissus.	*Granicus.*	*Protonilus.*
Ceraunius.	*Gyndes I.*	*Pyramus.*
Cerberus.	*Gyndes II.*	*Pyriphlegethon.*
Chaos.	*Hades.*	*Styx.*
Charadrus.	*Heliconius.*	*Tanais.*
Choaspes.	*Hephæstus.*	*Titan.*
Chrysorrhoas.	*Hiddekel.*	*Triton.*
Clarius.	*Hyblæus.*	*Tritonilus.*
Cyclops.	*Hyscus.*	*Xenius.*

* *M.N.* R.A.S., Vol. LXIV., pp. 506-521.

NEW STREAKS, NAMED BY THE DIRECTOR.

Hypanis.—From $\Omega = 115^\circ$, $\Phi = +54^\circ$, to $\Omega = 140^\circ$, $\Phi = +40^\circ$; seen by Ward and Wright.

Cydaris.—From $\Omega = 210^\circ$, $\Phi = +50^\circ$, to $\Omega = 225^\circ$, $= +38^\circ$; seen by Gale.

This makes a total of 65 streaks and allied markings, as already mentioned on p. 38. The *Nilokeras* was seen double, while the *Casius* was resolved into knots.

II.—THE LANDS WHITENING WITH THE OBLIQUITY are indicated by the symbol (*b*) on the Chart.

III.—WHITE SPOTS.—The following 9 bright spots were seen in the tropical and temperate regions of the planet:—

No.	Length.	Position. Ω	Position. Φ	Observer.	No.	Length.	Position. Ω	Position. Φ	Observer.
1	16°	8°	+ 44°	Phillips. The Director.	6	18°	205°	+ 18°	Phillips. Ward.
2	15	46	− 7	Phillips.	7	7	283	+ 21	Phillips.
3	22	52	+ 46	do.	8	8	291	+ 24	do.
4	15	92	− 17	Hirst.	9	12	352	− 3	Phillips. Ward.
5	17	92	+ 9	Phillips.					

The dimensions of these spots are given, as usual, in equatorial degrees.

CHARACTERISTICS OF THE 1905 APPARITION.

A summary of the most striking features of the opposition we have been considering may be given as follows :—

(1) The great breadth of *Syrtis Major* and its blunted form to N.;

(2) The invisibility of *Lacus Mœris* otherwise than as a "gulf" of *Syrtis Major;*

(3) The visibility of *Abyssinia* to the S.W. of *Libya;*

(4) The comparative faintness, remarkable appearance, and "bridge" to the N. of *Mare Acidalium;*

(5) The confirmation of the existence of *Gigantum Sinus*, discovered by Burton in 1879;

(6) The darkness and tapering form of *Titania*, as seen by the Section in 1903;

(7) The visibility of *Pambotis Lacus;*

(8) The frequent evidence of haze, obliterating the intensity of the dark areas; and last, but not least:

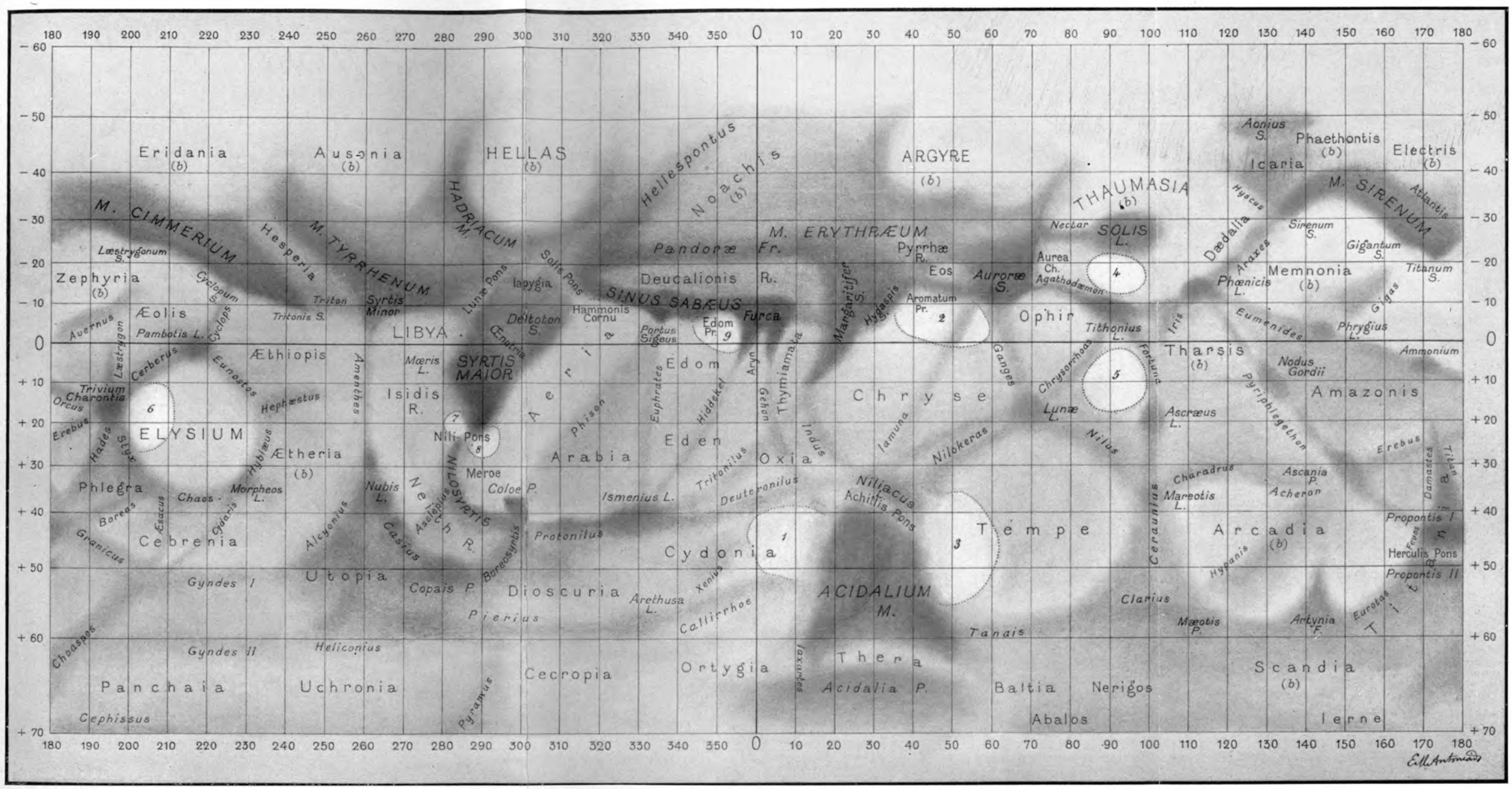
(9) The formation of a vast cloud area, 1,750 miles in diameter, over the N. polar regions of the planet.

E. M. ANTONIADI,
Director of the Section.

74 Rue Jouffroy,
Paris, 1910, October 22.

Published 21st December 1910.

SOUTH



NORTH

EAST

WEST

CHART OF MARS ON MERCATOR'S PROJECTION.

Prepared from the Observations of the Section in 1905.

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

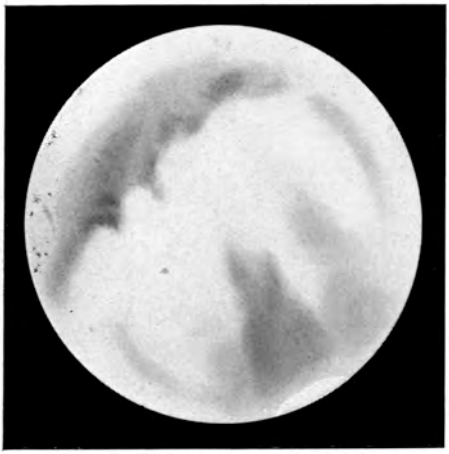


FIG. 1.—G. D. HIRST. $4\frac{1}{4}$-in. O.G.
1905, May 7. $\omega = 33^\circ$. $\phi = +14^\circ{\cdot}5$.

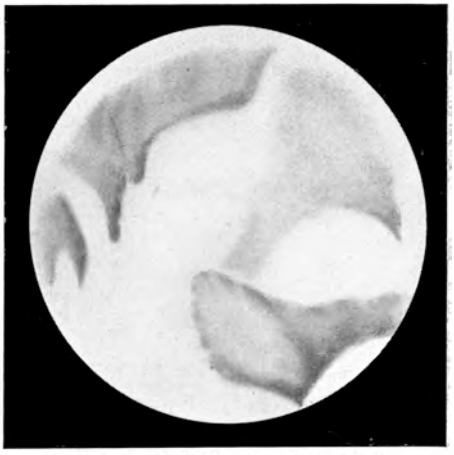


FIG. 2.—J. T. WARD. $9\frac{1}{2}$-in. O.G.
1905, May 3. $\omega = 52^\circ$. $\phi = +13^\circ{\cdot}8$.

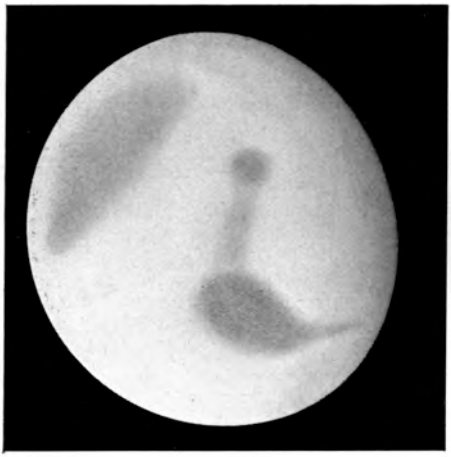


FIG. 3.—G. H. LEPPER. $3\frac{1}{2}$-in. O.G.
1905, June 20. $\omega = 55^\circ$. $\phi = +19^\circ{\cdot}6$.

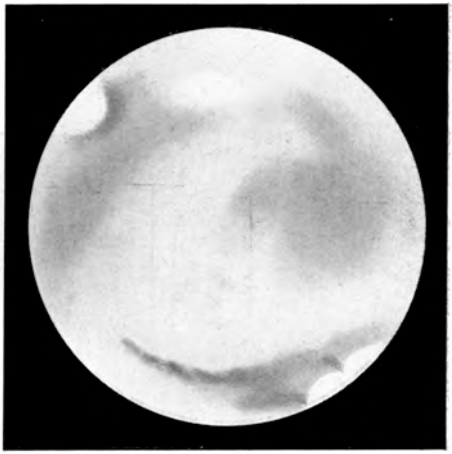


FIG. 4.—G. D. HIRST. $4\frac{1}{4}$-in. O.G.
1905, April 30. $\omega = 75^\circ$. $\phi = +13^\circ{\cdot}3$.

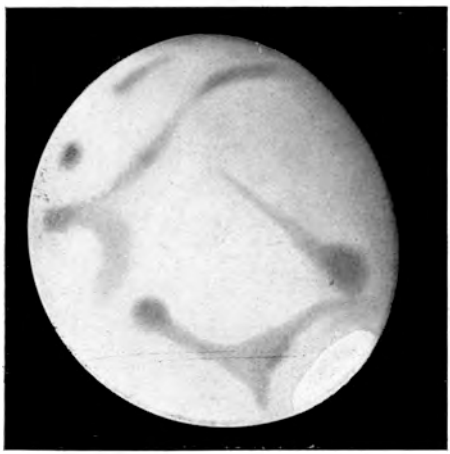


FIG. 5.—T. E. R. PHILLIPS. $9\frac{1}{4}$-in. spec.
1905, June 23. $\omega = 135^\circ$. $\phi = +19^\circ{\cdot}6$.

FIG. 6.—J. T. WARD. $9\frac{1}{2}$-in. O.G.
1905, May 28. $\omega = 163^\circ$. $\phi = +18^\circ{\cdot}0$.

FIG. 7.—A. B. COBHAM. 8½-in. spec.
1905, May 27. $\omega = 203°$. $= +17°{\cdot}9$.

FIG. 8.—J. T. WARD. 9½-in. O.G.
1905, April 14. $\omega = 221°$. $\phi = +11°{\cdot}2$.

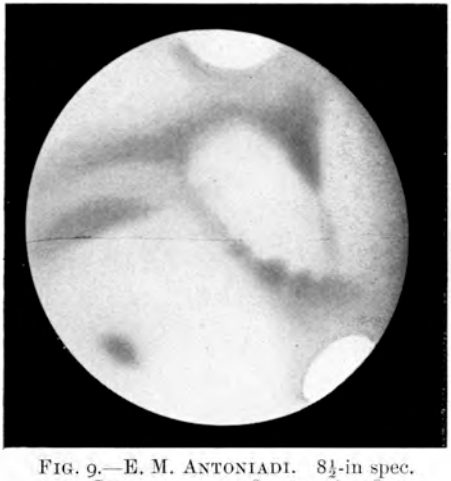


FIG. 9.—E. M. ANTONIADI. 8½-in spec.
1905, June 7. $\omega = 255°$. $\phi = +19°{\cdot}0$.

FIG. 10.—R. KILLIP. 5-in. O.G.
1905, June 10. $\omega = 260°$. $\phi = +19°{\cdot}2$.

FIG. 11.—H. WRIGHT. 8½-in. spec.
1905, May 17. $\omega^1 = 321°$. $\phi = +16°{\cdot}2$.

FIG. 12.—T. E. R. PHILLIPS. 9¼-in. spec.
1905, May 29. $\omega = 350°$. $\phi = +18°{\cdot}1$.