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OF THE
British Astronomical Association.

VOL. XXI.—PART IV.

# TWELFTH REPORT OF THE SECTION

FOR THE OBSERVATION OF

# MARS,

## DEALING WITH THE APPARITION OF 1915–1916.

*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, 1915–1916.*

## PART I.

## PROLEGOMENA.

### 1. The Apparition of 1915–1916.

This aphelic opposition occurred on 1916, February 10, when Mars passed at the distance of 0·675 (63,000,000 miles) from the Earth, as against 0·622 (58,000,000 miles) in January 1914. The high altitude of the planet in Europe atoned but slightly for the reduced disk.

*Phenomena.*

| | |
|---|---|
| Vernal Equinox of N. hemisphere - | 1915, October 17. |
| Autumnal Equinox of S. hemisphere | |
| Mars in W. Quadrature with the Sun | 1915, November 10. |
| Mars in Apparitional Perigee - | 1916, February 9. |
| Diameter of Mars in Apparitional Perigee - - - - - - | 14″·96. |
| Mars in Opposition with the Sun - | 1916, February 10. |
| Heliocentric longitude of Mars in Opposition - - - - | 140°. |
| Position of Mars in Opposition - | $\alpha = 9^h\ 36^m$. |
| | $\delta = +\ 19°\ 7'$. |
| Diameter of Mars in Opposition - | 14″·96. |
| Position angle of the N. pole of Mars in Opposition - - - - | 4°. |
| Latitude of the centre of the disk at Opposition - - - - | + 16°·1. |
| Mars in Aphelion - - - - | 1916, March 14. |
| Summer Solstice of N. hemisphere - | 1916, May 6. |
| Winter Solstice of S. hemisphere - | |
| Mars in E. Quadrature with the Sun | 1916, May 15. |

The positive latitude of the centre of the disk increased from + 12°·1 on 1915, October 1, to + 19°·7 on 1915, December 16; it then decreased to + 14°·2 on 1916, March 12; after which it again increased to the end of the apparition.

## 2. The Members of the Section and their Instruments.

The names of the Sectional Members in 1915–1916, their equipment, and drawings sent, were as follows :—

| Observer. | Locality. | Aperture of Instrument in Inches. | Drawings. |
|---|---|---|---|
| ANTONIADI, E. M., F.R.A.S. | Meudon, France | 8½ Spec. | 8 |
| ELLISON, REV. W. F. A. | Fethard-on-Sea, Ireland. | 5 O.G.<br>18 Spec. | 16 |
| MCEWEN, H. | Cambuslang, Scotland | 5 O.G. | 124 |
| PHILLIPS, REV. T. E. R., M.A., F.R.A.S. | Epsom | 8 O.G.<br>10 O.G.<br>12¼ Spec. | 17 |
| THOMSON, H., F.R.A.S. | Newcastle-on-Tyne | 12¼ Spec. | 10 |
| | | | 169 |

The observations cover a period of 8 months and 11 days, the extreme records, both due to the zeal of McEwen, being 1915, September 9, and 1916, May 20.

## 3. Observational Notes.

"I had quite a poor season with Mars," writes Phillips, "and saw very little detail of special interest." Also Thomson says: "I had not one really good night, and generally my seeing conditions were so bad that it was with difficulty that I could make out anything."

As in 1913–1914, the large refractor was not available for astronomical work of any kind in 1915–1916.

Ellison rightly remarks that he could not draw "the detail seen in the 18-in. Calver."

The darkness of *Sinus Sabæus*, *Syrtis Major*, and *Mare Acidalium* appeared very great to Ellison. "These areas," he writes, "often struck me as nearly, if not quite, as dark as the sky outside the planet's limb. In other words their albedo was nearly zero. This struck me at the time as clear proof that these are really areas of ocean, for nothing but deep water (or a deep layer of something transparent) could absorb sunlight so completely as to have practically no albedo."

## 4. The Colour of the Disk.

The relation between the yellowness of the planet and the faintness of the dusky areas has shown, in 1916, the following phenomena to the Director :—

| Date. | ω | Colour of Disk. | Intensity of Dark Spots. | Date. | ω | Colour of Disk. | Intensity of Dark Spots. |
|---|---|---|---|---|---|---|---|
| 1916. | ° | | | 1916. | ° | | |
| Feb. 5 | 112 | Yellowish | Moderate. | Mar. 8 | 199 | Ruddy | Faintish |
| „ 20 | 349 | do. | Faint to left. | „ 30 | 7 | Yellowish | do., |
| „ 24 | 322 | do. | Faintish. | „ 31 | 351 | do. ruddy. | A bit faintish. |
| Mar. 1 | 260 | Yellow | Faint. | April 3 | 327 | Yellowish | Darkish. |

No very striking cloudy formations were recorded during this apparition. Yet, as in 1913–1914 and previously, haze often whitened several districts.

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## 5. Secular Changes on the Surface of Mars.

In addition to the cases given in our Report for 1911–1912, pp. 117–118, the study of past drawings shows that the *Cerberus*, so conspicuous between 1783 and 1800, was either faint or invisible from at least 1830 to 1896. But, since 1898 it has often rivalled *Mare Cimmerium* in darkness.

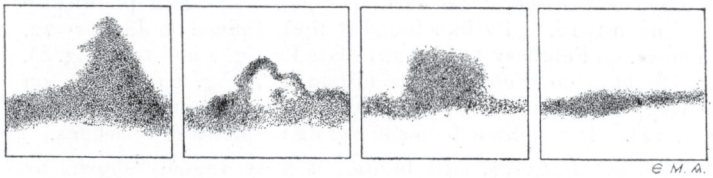


FIG. 1.—1840. Beer and Mædler. FIG. 2.—1856. W. de la Rue. FIG. 3.—1858. Secchi. FIG. 4.—1875. Holden.

Secular change to the S.W. of *Ismenius Lacus*.

Again, at least between 1830 and 1858, and perhaps also in 1873, the ochre yellow district of *Eden*, S.W. of *Ismenius Lacus*, was dusky (Figs. 1, 2, 3). Some 150,000 square miles of "desert" were affected by this modification. But, by 1875, the region here had assumed its ordinary appearance (Fig. 4).

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# PART II.

## THE OBSERVATIONS.

Abbreviations :—$\Omega$ = areocentric longitude ; $\Phi$ = areocentric latitude ; $\omega$ = longitude of the centre of the disk ; $\phi$ = latitude of the same ; N. = North ; S. = South ; E. = Areographic East = *p.* = preceding ; W. = Areographic West = *f.* = following ; C.M. = central meridian ; $\eta$ = heliocentric longitude of Mars. All dates are in G.C.M.T.

### SECTION I.

**Sinus Sabæus.**

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

*Hellespontus* was almost always indiscernible in 1915–1916 (Figs. 5 and 10). However its S. part, beyond $\Phi = -40^\circ$, was darkish to the Director on April 3 (Fig. 33).

*Noachis*, owing to the tilt of the axis, was not well displayed for observation. Yellow cloud must have been prevalent hereabout, as no Member caught the slightest trace of this "island" (Figs. 5–12) ; nor was it ever seen bright on the periphery during this apparition, which is surprising.

*Pandoræ Fretum*, so dark in 1909, was again practically invisible in 1916.* Phillips found it dimly defined on January 22, Thomson on February 19 and 20 (Plate I., Fig. 2 and text Fig. 6), the Director on February 20 (Plate II., Fig. 6), Ellison on February 21 (Plate I., Fig. 1), and the Director on February 24 (Fig. 32). It could not be made out at all on other occasions.

*Vulcani Pelagus*, still fainter, is very vaguely shown by Thomson on February 20 and by Ellison on February 21 (Plate I., Fig. 1).

*Deucalionis Regio*, shaded and narrow to all Members, had its usual shape (Plate II., Fig. 6). Owing to the invisibility of *Pandoræ Fretum*, it was badly outlined to S., where the slightly duskier shading of the whole district beyond yielded a contrasted, though faint, demarkation.

On March 30, the Director saw that the E. half of this "island," together with *Pandoræ Fretum* and *Noachis*, was hidden under a yellow cloud area (Fig. 12).

*Iani Fretum*, barely shaded by Phillips and Thomson, is drawn darker by McEwen and the Director, and very dark indeed by Ellison (Figs. 5 and 10, and Plate I., Fig. 1).

* An examination of the drawings of Mars made since 1783 has shown to the Director that *Pandoræ Fretum* is often dark between $\eta = 230^\circ$ and $10^\circ$, but very faint as a rule from $\eta = 30^\circ$ to $150^\circ$. Thus an exposure to a vertical Sun seems to interfere with its darkness.

*SINUS SABÆUS*, winding as usual, and narrowed by distance


FIG. 5.—The *Sinus Sabæus* region. 1916, February 23, $\omega = 345^{\circ} \pm$ (Ellison).

(Figs. 30, 31), was, according to the joint results of all Members, apparently very faint on November 11 (Fig. 11) and December 13; faint on January 12 and 13; dark on January 18; faintish on January 22 and February 19; rather faint to E., darkish to W., on February 20; very dark on February 21 (Plate I., Fig. 1); darkish on February 22; dark on February 23; faintish to E., darkish to W., on February 24; darkish on February 27 and March 1; faint to E. on March 3 (Plate II., Fig. 5); darkish on March 6, 30, 31, and April 1; faintish on April 2, 3, and 5; darkish on April 8; dark on May 10; faintish on May 13 and 16; and dark on May 18.

*PORTUS SIGEUS* appears as a single shallow notch in the drawings of Ellison, McEwen, Phillips, and the Director.

*SINUS FURCOSUS*, sombre as usual, could not be resolved by McEwen, in whose 5-in. it looked knobbish (Fig. 8). The prongs were difficult to Thomson (Fig. 6, and Plate I., Fig. 2), and to the Director (Plate II., Fig. 6, and text Figs. 9 and 12), and less so to Phillips (Plate I., Fig. 3, and text Fig. 7). But they were neatly separated in the large instrument of Ellison, on whose beautiful drawings they are quite sharp (Plate I., Fig. 1, and text Figs. 5 and 10); and they would have looked further apart were the planet to have been nearer to the Earth. The intensity of *Sinus Furcosus* underwent almost the same apparent changes as that of *Sinus Sabæus* above given; and it is very interesting to note that McEwen could scarcely make out the "Forked Bay" on November 11 (Fig. 11).

*FASTIGIUM ARYN* is free from the outstanding shade of inferior vision in the drawings of Ellison.

FIG. 6.—February 20, $\omega = 345°$. (Thomson.)


FIG. 7.—January 18, $\omega = 349°$. (Phillips.)

The *Sinus Sabæus* district in 1916.

*THYMIAMATA* was seen crossed by a whitish streak coming from *Chryse*, by McEwen on December 13.

*EDOM PROMONTORIUM* showed its usual form to Phillips (Fig. 7) and the Director (Plate II., Fig. 6, and text Figs. 9 and 12); but Ellison draws it less protruding (Plate I., Fig. 1, and text Figs. 5 and 10). It was bright, by contrast, to McEwen on April 1 and May 13.

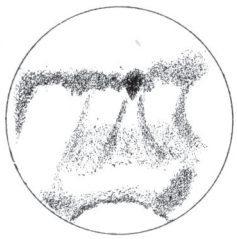

FIG. 8.—February 22, $\omega = 349°$. (McEwen.)

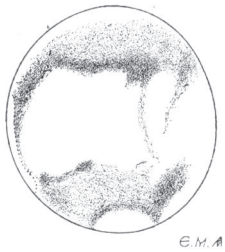


FIG. 9.—March 31, $\omega = 351°$. (The Director.)

The *Sinus Sabæus* region in 1916.

*EDOM* set whitish to Thomson on January 11 (Fig. 13), and looked white near C.M. to McEwen on May 10.

*AERIA* appeared whitish when setting to Thomson on January 11 (Fig. 13); bright to S., risen, to the Director on March 1 (Fig. 28); and bright white, to S. again, *f.* C.M., to McEwen on May 18 and 20.

*HAMMONIS CORNU*, blunted to Thomson, seemed more angular to Ellison, McEwen, Phillips, and the Director.

*ARABIA* set bright to Thomson on February 19 (Plate I., Fig. 2).

*EDEN*, shaded to McEwen, set bright to Thomson on January 11 (Fig. 13).


FIG. 10.—*Sinus Sabæus and Mare Acidalium*, 1916, February 21, $\omega = 351°$. (Ellison.)

*ISMENIUS LACUS*, occasionally conspicuous to McEwen (Fig. 11), was very dark and quite "easy" in Ellison's large telescope (Plate I., Fig. 1, and text Figs. 5 and 10), and also "very dark and prominent" to Thomson (Fig. 6). Nor was it difficult to Phillips (Figs. 30, 31) and the Director (Fig. 32). From the data of these observers, we infer that this "lake" was apparently dark on November 11 ; indiscernible on December 13 ; darkish on January 18 ; faint on January 22 ; faintish on February 20 ; very dark on February 21, 22, and 23 (Plate I., Fig. 1, and text Figs. 5 and 10) ; faintish on February 24, 27, March 1 and 3 ; unnoticed on March 30 ; darkish on March 31 ; faintish on April 1 and 2 ; darkish on April 3 ; and again faintish on April 5.

FIG. 11.—November 11, $\omega = 354°$. (McEwen.)

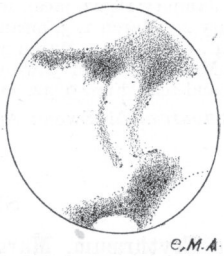


FIG. 12.—March 30, $\omega = 7°$. (The Director.)

The *Sinus Sabæus* region in 1915–1916.

*DIRCE FONS* was successfully descried by McEwen on November 11 (Fig. 11) and on February 20, and was "prominent" to him on the first date ; a most creditable result. It was "very dark" and "quite an easy object" in the large aperture of Ellison (Plate I., Fig. 1, and text Figs. 5 and 10).

*DIOSCURIA* looked shaded to McEwen, Thomson, and especially to the Director (Plate II., Fig. 6, and text Figs. 9, 32, and 33).

*CYDONIA* was also shaded to the same observers and to Phillips. On February 20, McEwen drew a small bright spot, 5° across, *p. Mare Acidalium.*

### MINOR DETAIL.

*ARNON.*—Ellison: February 21, seen to N. only, mean width 3°, narrow to S., broadening to N., intense (Fig. 10); 22, 23, to N. especially, mean width 2° (Fig. 5).—McEwen: January 18, to S., width 8°, faint.

*CALLIRRHOE.*—Ellison, McEwen, Phillips, Thomson, the Director: merged in polar shadings.

*DEUTERONILUS.*—Ellison: February 21, 22, 23, width 2°, darkish, not going beyond, or W. of, *Dirce Fons* (Plate I., Fig. 1, and text Figs. 5 and 10).—McEwen: November to May, width 5° to 9°, edge of shaded *Cydonia.*—Phillips: January 18, 22, February 27, March 1, 3, 31, to E. only, width 4°, faint.—Thomson: February 19, 20, width 4°, faintish.—The Director: February 20, 24, width 5°, edge of shaded *Cydonia.*

*EUPHRATES.*—McEwen: February 22, to S., width 10°, faint.

*GEHON.*—Ellison: February 21, straight, width 2°, running either towards *Dirce Fons*, though not attaining it, or W. of it (Plate I., Fig. 1); 22, 23, to S. only, width 1° (Fig. 5).—McEwen: January to May, width 5° to 14°, often edge of shaded *Eden.*—The Director: March 30, 31, convex to E.N.E., width 5°, faint (Figs. 9 and 12).

*HIDDEKEL.*—Ellison: January 22, to S. only, width 1° (Plate II., Fig. 4); February 21, 22, 23, to S. only, width 1° (Plate I., Fig. 1, and text Figs. 5 and 10).—McEwen: January to April, mean width 6°, edge of shaded *Eden.*—Phillips: January 22, to S.W. only, width 5°, faint and diffuse.

*ORONTES.*—McEwen: April 2, convex to N.W., edge of shade to N.

*PHISON.*—McEwen: January to April, width 4° to 15°.—Phillips: January 22, to N. only, width 10°, smudgy.—Thomson: March 3, to N.E., width 4°, exceedingly faint (Plate II., Fig. 5).—The Director: February 24, concave to S.E., width 6°, faint (Fig. 32).

*PIERIUS.*—Ellison, McEwen, Phillips, Thomson, the Director: merged in polar shadings.

*PROTONILUS.*—Ellison: January 22, width 2°, dark (Plate II., Fig. 4); February 21, 22, 23, width 2°, dark (Figs. 5 and 10).—McEwen: November 11, 20, January 18, 22, mean width 4½°, faintish.—Phillips: January 18, 22, February 27, March 1, 3, mean width 4°, faintish.—Thomson: February 20, width 4°, very plain; March 3, width 4°, darkish.—The Director: February 20, 24, March 31, April 3, width 4½°, edge of shaded *Dioscuria* (Plate II., Fig. 6, and text, Figs. 9, 32, 33).

*TYPHONIUS.*—McEwen: April 2, edge of shade to N.

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## SECTION II.

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

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

*ARGYRE I.*, according to the joint data of all Sectional Members, rose bright on November 11 (Fig. 11); set invisible on January 7; was not whitish near C.M. on January 11 and 12; looked bright on C.M. on January 13; rose very bright on January 18 (Fig. 7) and 22 perhaps; set unnoticed on February 13, 14, and 16 (Fig. 15); was invisible on C.M. on

February 17; looked whitish on C.M. on February 19 (Plate I., Fig. 2); rose invisible, but set bright, on February 20; rose unnoticed on February 21, 22, 23, 24, 27, and March 1; set invisible on March 27; was unnoticed on C.M. on March 28; rose invisible on March 30 and 31; appeared very bright on C.M. on March 31; rose whitish on April 1 and 5; and could not be made out, setting, on April 30, May 1, 3, and 10. Hence, as usual in aphelic apparitions, *Argyre* very frequently appeared as a bright marginal glare in 1915–1916.

*Mare Erythræum* looked very faint to all Members throughout the apparition.

*Pyrrhæ Regio*, generally indiscernible (Plate I., Figs. 1–3), was drawn as a lightening of *Mare Erythræum* by McEwen on December 13, January 12, February 13, and March 28. On December 13 it rose white; and, on April 2, a bright spot, 12° across, was seen by the same observer on the central part of the "island."

*Eos* is faintly shown by Thomson on February 19 (Fig. 16).

*Margaritifer Sinus* seems to have been deformed by yellow clouds, cutting off its N. point to Thomson on January 11 (Fig. 13) and 13, and to Phillips on January 18 (Fig. 7); an appearance which had ceased by the February presentation. Ellison does not show the "bay" as a deep notch (Plate I., Fig. 1, and text Figs. 5 and 10). According to the joint Sectional results, this "gulf" was seemingly unnoticed on October 31; was faint on November 4; very faint on November 11 and December 13; faint and distorted, as above, on January 11; very faint on January 12; faint and distorted on January 13; faint and deformed on January 18; faint on February 13; darkish on February 16 and 17; faintish on February 19 and 20; very dark on February 21 (Fig. 10, and Plate I., Fig. 1); faintish on February 22; dark on February 23 (Fig. 5); faintish on February 27, March 27, 28, 30, 31; darkish on April 1, 2, and 5; unnoticed on May 3; and again dark on May 10.

*Aromatum Promontorium* looked blunted to all.

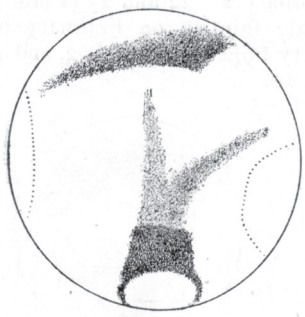

FIG. 13.—January 11, $\omega = 36°$. (Thomson.)

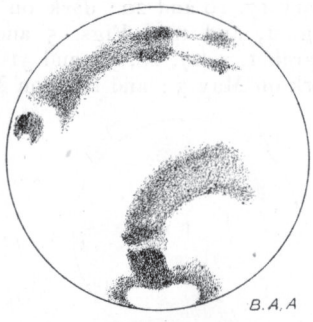


FIG. 14.—February 19, $\omega = 45°$. (Phillips.)

The *Margaritifer Sinus*, *Auroræ Sinus* and *Mare Acidalium* in 1916.

*AURORÆ SINUS* was normally outlined. According to McEwen, Phillips, Thomson, and the Director, it was exceedingly faint, or invisible, on October 31 and November 2 ; faintish on November 4 and 11 ; whitish apparently, risen, on December 13 ; exceedingly faint on January 7 ; darkish on January 11 ; faint on January 12, 13, February 11 and 13 ; darkish on February 14, 16, and 17 ; faintish in the middle, with curious dark spots to N. and S., on February 19 and 20 (Figs. 14 and 17) ; darkish on February 21 (Plate I., Fig. 1) ; very faint indeed on March 22 ; darkish *p.* C.M., but whitish setting, on March 23 (Fig. 19) ; faintish on March 27 ; darkish on March 28 ; faintish on March 31 ; dark on April 1 and 2 ; very faint on April 30 ; invisible on May 1 ; faint on May 3 ; and dark on May 10.

*CHRYSE* rose partly brightish to the Director on February 24 (Fig. 32), and to McEwen on May 10 and 13.

*XANTHE* seems to have been covered with yellow cloud in mid-February, for Phillips, Thomson, and the Director could then detect no trace of the *Ganges* or *Jamuna* under good conditions. On February 19, Phillips found the "markings in neighbourhood of *Ganges* quite invisible" (Fig. 14). A whitish streak was drawn here on February 19 by Thomson (Plate I., Fig. 2) ; whereas McEwen saw *Xanthe*, occasionally dusky, and further rising bright on February 20, and setting bright on March 23 (Fig. 19).

*LUNÆ LACUS* appeared invariably faint and diffuse to McEwen, Phillips, Thomson, and the Director, and does not seem to have been obliterated by the yellow cloud S. of it during the observations.

*NILIACUS LACUS*, seen by all Members, was variously represented by them. Confused to McEwen (Fig. 15, and Plate I., Fig. 4) and the Director (Fig. 12), it looked small and roughly oval, under good definition, to Phillips (Plate I., Fig. 3) and Thomson (Plate I., Fig. 2), and trapezoidal to Ellison (Figs. 5 and 10, and Plate I., Fig. 1). From the results of these observers, we conclude that this "lake" was apparently darkish on October 31 ; almost invisible on November 11, December 13, and January 7 ; faintish on January 11, 12, 13, 18, 22, and February 13 ; darkish on February 14 and 16 ; faintish on February 17, 19 and 20 ; dark on February 21, 22 and 23 (Plate I., Fig. 1, and text Figs. 5 and 10) ; faintish on February 27, March 1, 3, 27, 28, 30, and 31 ; very faint on April 1, 2, and 5 ; dark on May 3 ; and faint on May 10.

FIG. 15.—February 16, $\omega = 51°$. (McEwen.)


FIG. 16.—February 19, $\omega = 52°$. (Thomson.)

The *Mare Acidalium*, in 1916.

*ACHILLIS PONS* could not be made out by Ellison, McEwen, and the Director. Thomson saw it ochre on February 19 (Plate I., Fig. 2). Phillips found it "shaded" and "not sharply defined this apparition," and drew it slanting N.E. to S.W. on March 31 (Plate I., Fig. 3).

*MARE ACIDALIUM* vied in intensity with *Sinus Furcosus*, and was "the darkest object on the planet" to Ellison. Irregularly polygonal to this observer (Plate I., Fig. 1, and text Figs. 5 and 10), and to the Director (Plate II., Fig. 6, and text Figs. 9 and 12), it looked trapezoidal or bell-shaped to Thomson (Plate I., Fig. 2, and text Figs. 6, 13, and 16), and revealed to Phillips the form drawn by Molesworth in 1903 (Plate I., Fig. 3). The outline adopted on our Chart, Plate III., is a combination of Ellison's data with those of the other Members, due allowance being naturally made for the distortion resulting from Mercator's projection. The colour of *Mare Acidalium* was "grey" to Thomson on January 13. According to the Sectional results, this "sea" was apparently faintish on September 27 and 28; "conspicuous" on October 1; darkish on October 31; faintish on November 11; exceedingly faint on December 13 and January 7; dark on January 11; faintish on January 12 and 13; dark on January 18; darkish on January 22; very faint on February 13; darkish on February 14 and 16; faintish on February 17; dark on February 19 and 20; very dark on February 21, 22, and 23; faintish on February 27; darkish on March 1; faintish on March 3, 27, 28, and 30; darkish on March 31; faintish on April 1, 2, and 5; and dark on May 1 and 3.

*ACHILLIS FONS*, detected by Molesworth in 1903, was well drawn by McEwen on January 13, and was also seen by Phillips on March 31 (Plate I., Fig. 3).

*TEMPE* showed a large whitish spot to Thomson, *f. Mare Acidalium*, on February 19 (Plate I., Fig. 2). To McEwen it was very bright on C.M. on September 29; bright *p.* C.M. on October 31; and whitish to W., on C.M., on November 2 and 4; and to E., on C.M., on November 11. Phillips found it very bright risen on January 22. Thomson saw *Tempe* "very bright" risen on January 13; bright risen, but normal on C.M., on February 19; and bright risen on February 20. It was further whitish risen to the Director on March 30 (Fig. 12). This "land" seemed curiously shaded to McEwen on May 10.

## MINOR DETAIL.

*GANGES.*—McEwen: February 13, width 12°, faint; 14, invisible; 16, narrow to S., mean width 5°, faint; 17, width, 14°; edge of shaded *Xanthe;* 19, width 10°, darkish; 20, width 15°, faint; 21, width 12°, faint; March 27, width 13°; 28, width 8°, faint.—Phillips: February 16, 19, 20, March 31, invisible, the observer speaking of the "disappearance of the *Ganges*" (Plate I., Fig. 3, and text Figs. 14, 17, and 18).—Thomson: January 11, 13, February 19, March 23, "not seen" (Plate I., Fig. 2, and text Figs. 13 and 16).

Undoubtedly, the *Ganges* was exceedingly faint in 1916.

*HYDASPES.*—McEwen : October to April, width 8° to 12°, straight and diffuse.

*HYDRAOTES.*—McEwen : February 19, 20, width 7°, faint.

*INDUS.*—Ellison : February 21, almost straight, width 3°, faintish (Plate I., Fig. 1, and text Fig. 10) ; 22, 23, to S. only, width 1° (Fig. 5).—McEwen: February to April, generally convex to E., mean with 10°, diffused.—The Director : February 20, March 30, convex to E., width 5°, faint (Plate II., Fig. 6, and text Fig. 12).

*JAMUNA.*—McEwen : November to March, width 4° to 12°, sometimes edge of shaded *Xanthe*.—Thomson : January 11, width 8°, very faint.

*NILOKERAS I.*—Ellison : February 21, width 13°, smudgy (Plate I., Fig. 1). —McEwen : September to May, width 7° to 15°, amorphous, and edge, on February 17, of shaded *Xanthe*.—Phillips : February 16, width 18°, smudgy ; 19, convex to S.E., do., dark ; 20, convex to S.E., width 14°, conspicuous ; March 31, convex to S.E., width 12°, smudgy (Plate I., Fig. 3).—Thomson : January 11, February 13, 19, concave to N.W., broadest to N.E., mean width 10°, faintish ; March 23, smudgy (Plate I., Fig. 5).—The Director : February 20, width 8°, easy, diffuse.

*NILOKERAS II.*—Phillips : February 19, convex to S.E., width 5°, faint (Fig. 14) ; 20, "narrow 'canal' from *Mare Acidalium* steadily seen," convex to S.E., width 4°, faintish ; March 31, seen clearly to issue from *Mare Acidalium* and pass through *Achillis Fons*, concave to N.W., knotted darkish (Plate I., Fig. 3).—Thomson : February 19, a "hazy" shading (Fig. 16).

*OXUS.*—Ellison : February 21, edge of shade E. of the *Indus* (Fig. 10). —McEwen : February 19, 20, 22, generally convex to N.W., width 4° to 8°, faint.

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## SECTION III.

### Solis Lacus.

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

*BOSPOROS GEMMATUS* was faint in 1916 (Plate I., Fig. 4) ; but on March 23 Thomson drew it darkish (Plate I., Fig. 5).

*AONIUS SINUS* remained invisible throughout the apparition.

*THAUMASIA* was consequently outlined to E. and S.E. only. It rose white to McEwen on September 28 and January 12.

*AUREA CHERSONESUS* looked fairly protruding to McEwen (Plate I., Fig. 4) ; to Phillips on February 16, 19, and 20 (Fig. 14, 17, 18) ; and to Thomson on March 23 (Plate I., Fig. 5).

*SOLIS LACUS*, roundish, when rarely visible, to McEwen (Plate I., Fig. 4), was oval to Phillips (Figs. 14 and 17) and to Thomson (Fig. 16, and Plate I., Fig. 5). From the joint delineations of McEwen, Phillips, Thomson, and the Director, it results that this great "lake" was apparently unnoticed on October 31 ; faintish on November 2 ; unnoticed again on January 2 ; very faint on January 7 ; invisible on February 5 ; faint on February 9 ; unnoticed on February 11 ; faint on February 13 ; darkish on February 16 ; unnoticed on February 17 ; darkish on February 19 and 20 ; faintish on March 22 ; darkish on March 23 ; unnoticed on March 27, April 28, 30, May 1 and 3.

*DÆDALIA* set whitish to Thomson on February 7, and looked whitish on C.M. to McEwen on April 28.

*TITHONIUS LACUS* comes out triangular on the drawings of Phillips (Fig. 17 and 18) and roughly elliptical on those of Thomson (Plate I., Fig. 5, and text Fig. 16). The data of the observers of *Solis Lacus* showed that this "lake" was seemingly faintish on October 31; unnoticed on January 2; exceedingly faint on January 7; invisible on February 5; faint on February 9, 11, 13, and 14; darkish on February 16, 17, 19, and 20; unnoticed on March 22; darkish on March 23 and 27; and unnoticed on May 1 and 3.

*PHŒNICIS LACUS* was doubtfully drawn by McEwen on February 13 and 16, and probably by Thomson on March 23 (Plate I., Fig. 5).

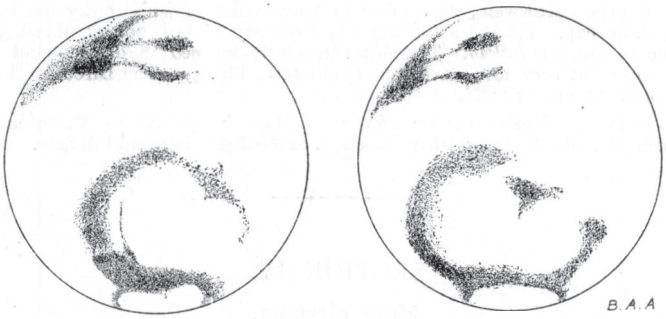


FIG. 17.—February 20, $\omega = 74°$. FIG. 18.—February 20, $\omega = 101°$.
The *Solis Lacus* region in 1916 (Phillips).

*OPHIR* showed nothing abnormal.

*THARSIS* rose bright to McEwen on September 29; set "very bright" to Thomson on February 7, and to Phillips on February 8 (Plate I., Fig. 6); was whitish *p.* C.M. to McEwen on April 26 and 30; and bright to him on C.M. on May 1.

*ASCRÆUS LACUS* was often drawn as a faint smudge by McEwen, and once also by Thomson, on March 23 (Plate I., Fig. 5).

*MAREOTIS LACUS*, N. of the preceding, was clearly, though faintly, depicted by Phillips on February 20 and March 31 (Figs. 17 and 18, and Plate I., Fig. 3).

*MÆOTIS PALUS*, vaguely indicated by McEwen on January 2 is shown faint by Phillips on February 20 (Fig. 18).

## MINOR DETAIL.

*AGATHODÆMON.*—McEwen: October to February, convex to N., width 4° to 10°.—Phillips: February 19, 20, convex to N.E., angular, wavy, width 4°, faintish.—Thomson: February 19, wavy, convex to N.E., mean width 4°; March 23, do., width 5°, drawn intense.

*CERAUNIUS.*—McEwen : September to May, broader to N. than S., mean width 10°, drawn fairly intense usually.—Phillips : February 20, width 6°, exceedingly faint.—Thomson : March 23, mean width 15°, smudgy (Plate I., Fig. 5).

*CHRYSORRHOAS.*—McEwen : February 13, May 3, convex to N.W., width 7°.

*CLARIUS.*—McEwen : September to May, edge of shade round N. snow cap.—Phillips : February 16, 19, 20, March 31, edge of shaded *Nerigos.*—Thomson : March 23, merged in polar shading, but 15° wide, and dark (Plate I., Fig. 5).

*IRIS.*—McEwen : February 13, width 3°, faint.—Thomson : March 23, mean width 5°, faintish.

*NECTAR.*—Phillips : February 19, width 5°, faintish. — Thomson : February 19, March 23, with 3°, darkish.

*NILUS.*—McEwen : November to February, with 4° to 15°, but mean width 8°, smudgy, faint.—Phillips : March 31, width 10°, faint.

*PHLEGETHON.*—McEwen : April 28, width 15°, very faint.

*TANAIS.*—McEwen : September to May, coincides with dusky band of N. snow cap.—Phillips : January 28, February 16, 19, 20, 27, March 31, edge of shaded *Baltia.*—Thomson : generally merged in dusky band of N. cap ; but very dark on March 23 (Plate I., Fig. 5).—The Director : lost in subjective polar band.

*URANIUS.*—McEwen : September to May, width 4½° to 8°, faint.—Thomson : March 23, width 7°, smudgy, exceedingly faint and diffuse.

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## SECTION IV.

### Mare Sirenum.

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

*ICARIA* is too far S. for observation under such a latitude of the centre of the disk as we had in 1916. Yet it never glimmered on the limb.

*PHAETHONTIS* rose very bright to McEwen on September 21 and October 31 ; was white risen to Phillips on February 8 (Plate I., Fig. 6), and to McEwen on April 28.

*MARE SIRENUM* seemed normally shaped, but owing to distance and to the inclination of the axis, it showed only its two terminal "bays," *Sirenum Sinus* and *Titanum Sinus* (Fig. 20). From the drawings of McEwen, Phillips, Thomson and the Director, we conclude that this "sea" was apparently faint on October 22 and 31 ; unnoticed on January 2 ; darkish on February 2, 4 and 5 ; faintish on February 6, 7, and 8 ; darkish on February 9 ; unnoticed on February 11 ; darkish on March 8 ; faint on March 18 ; dark to E. on March 23 ; faintish on April 26 ; and darkish on April 28.

*ATLANTIS* was drawn by McEwen on February 2 and by Phillips on February 9 (Fig. 20).

*MEMNONIA* rose whitish to McEwen on September 27, October 31, and March 23.

*NODUS GORDII* comes out as a faint smudge on McEwen's drawings of November 2 and February 11.

*AMAZONIS* looked shaded to McEwen and Thomson. It was

FIG. 19.—March 23, $\omega = 124°$. (McEwen.)

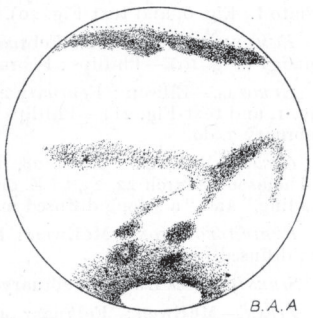


FIG. 20.—February 9, $\omega = 175°$. (Phillips.)

The *Titania* region in 1916.

bright *f.* C.M. on September 21, and rose bright on February 16 (Plate I., Fig. 4) to McEwen ; was whitish to N.E., setting, to the Director on March 8 (Fig. 24) ; and again bright risen to McEwen on May 1.

*ARCADIA*, shaded to Thomson, was white to E. to McEwen on November 2 ; rose bright to Thomson on January 11 (Fig. 13) and 13 ; set white to McEwen and Thomson on February 2 (Fig. 22) ; set whitish to E., with *Diacria*, to Thomson on February 7 ; and to Thomson and Phillips on February 8 (Plate I., Fig. 6).

*TITANIA* is shown shaded by Ellison, McEwen, Phillips, and Thomson, having sometimes the appearance of a long dusky triangle stretching S. (Fig. 18, and Plate II., Fig. 1).

*ASCANIA PALUS* is recognisable as an oval shading on Phillips's drawings of February 8 and 9 (Plate I., Fig. 6, and text Fig. 20).

*EUXINUS LACUS*, apparently sketched by McEwen on January 2, was well seen by Phillips on February 8 and 9 (Plate I., Fig. 6, and text Fig. 20).

Hence these two objects were there, as in 1913–1914.

*PROPONTIS I.*, oval to Phillips on January 2 and February 9 (Figs. 23 and 20), and roundish on March 18, looked more confused to McEwen (Fig. 26), Thomson, and the Director (Fig. 24). The combined data of these observers show that this "lake" was seemingly faint on December 26 ; darkish on January 2 ; very faint on February 2 ; darkish on February 4, 7, and 9 ; unnoticed on February 11 ; and faintish on March 8 and 18.

*PROPONTIS II.* can be seen only on Phillips's drawings of January 2 (Fig. 23) and February 9 (Fig. 20).

### MINOR DETAIL.

*BRONTES.*—Ellison : February 2, to N. only, E.S.E. edge of shaded *Titania* (Plate II., Fig. 1, and text Fig. 21).—Phillips : February 20, do. (Fig. 18).

*EREBUS.*—Phillips : February 8, 9, March 18, width 6°, faintish, diffused (Plate I., Fig. 6, and text Fig. 20).

*EUMENIDES.*—McEwen : February 6, 11, 13, March 23, width 10° to 12°, smudgy (Fig. 19).—Phillips : February 9, March 18, width 10°, diffused.

*EUROTAS.*—Ellison : February 2, S.E. edge of shaded *Titania* (Plate II., Fig. 1, and text Fig. 21).—Phillips : January 2, February 9. do.—Thomson : February 7, do.

*GIGAS.*—McEwen : April 28, to N.E. only, width 15°, very faint : —Thomson : March 22, 23, to E. only, width 12°, smudgy, "a broad dusky shading," and "a strong diffused marking."

*PYRIPHLEGETHON.*—McEwen : February 4, 6, 9, 11, 13, 16, width 4° to 12°, diffused.

*SIRENIUS.*—McEwen : February 9, to N. only, width 8°.

*TITAN.*—McEwen : February 4, 11, April 28 ; chiefly to N., mean width 7°, faint.—Thomson : to N. only, width 5°, faint.

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## SECTION V.

### Mare Cimmerium, Elysium, and Trivium Charontis.

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

*ELECTRIS* rose bright to Phillips on February 8, and set bright to him on February 9 (Fig. 20) ; it further set bright to the Director on March 8 (Fig. 24), and to Phillips on March 18.

*ERIDANIA* rose whitish to Phillips on February 9 (Fig. 20) and March 18.

*MARE CIMMERIUM* looked cigar-shaped to N.W., at *Tritonis Sinus*, to the Director (Fig. 28) and seemed more tapering to Phillips (Plate II., Fig. 2). It was fairly broad (Plate II., Fig. 1), and *Læstrygonum Sinus* could be made out by Ellison (Plate II., Fig. 1, and text Fig. 21), Phillips (Plate II., Fig. 2). and Thomson (Fig. 22). Indeed, the latter seems to have caught *Symplegades Insulæ* also (Fig. 22). The joint results of all Members of the Section show that *Mare Cimmerium* was seemingly faint on October 22 ; faint to W. on November 20 ; unnoticed on December 26 (Fig. 26) ; normal to E. on January 2 ; darkish on January 28 and 31 ; very faint to W. on February 1 ; faintish, save to E., on February 2 ; darkish on February 4 ; faintish to W. on February 6 ; faintish to E. on February 7 ; darkish to E. on February 9 ; unnoticed on February 11 ; faintish to W. on March 1, 3, 4, and 6 ; faintish on March 8 and 18 ; faint on April 15 ; and darkish to E. on April 28.

*HESPERIA* comes out shaded on the drawings of McEwen, Phillips, Thomson, and of the Director.

*ZEPHYRIA* was bright to S. to McEwen on February 4 and 6.

*ÆOLIS* was brightish near *Mare Cimmerium* to McEwen on February 2, 4, and 6, and set whitish to the Director on March 1 (Fig. 28).

*ÆTHIOPIS* presented a whitish spot, 15° across, to Thomson, W. of the *Cyclops*, on January 2 (Fig. 25). This is probably identical with the kindred object seen hereabout by Gledhill in 1871, Burton in 1882, Eddie in 1907, the Director in 1911, and Phillips in 1914. Hence the marking seems permanent.

FIG. 21.—February 2, $\omega = 179°$. (Ellison.)

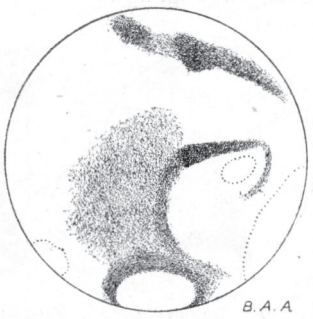


FIG. 22.—February 2, $\omega = 186°$. (Thomson.)

*Mare Cimmerium* and *Trivium Charontis* in 1916.

*PAMBOTIS LACUS* is shown as a swelling of the convergent streaks hereabout, by Ellison on February 2.

*TRIVIUM CHARONTIS* usually appeared as merely the broadest end of the *Cerberus* (Plate II., Fig. 1, and text Fig. 22). However, Thomson on January 2 saw it darker than that streak (Fig. 25), whereas the Director found it isolated on March 1 (Fig. 28). It was not conspicuous in 1916. The combined data of all Members show that this "lake" was probably faintish on October 22; very faint on December 26 (Fig. 26) and January 2; faintish on January 28, 31, February 1, 2, and 4; darkish on February 6 and 7; very faint on February 9 and 11; darkish on March 1; faintish on March 4; faint on March 8 and 18; and very faint on April 15.

*ELYSIUM* was exceptionally ill-defined to N. in 1916; and, through the faintness of the skirting streaks, except the *Cerberus*, it was badly limited, save to S.E. As usual, its form was roughly pentagonal. According to our joint data, *Elysium* rose bright on October 22; set unnoticed on November 20; looked yellow on December 26 and January 2; set yellow on January 22; was yellow on January 28, 31, and February 1; rose yellow,

and remained so, on C.M., on February 2; appeared yellow *f.* C.M. on February 4; rose white, and turned yellow, on C.M., on February 6; rose yellow on February 7 and 8; was yellow on February 9; rose bright on February 11; was yellow on March 1; set yellow on March 2, 3, 4, and 6; was yellow on C.M. on March 8 and 18; set brightish on April 9 and 15; and set yellow on May 20. On October 15, McEwen found brightest the W. end of *Elysium*; on January 2, Thomson, and on February 2, McEwen, saw brighter the E. angle (Fig. 25). Lastly, on February 2, Thomson noticed a bright spot to S. (Fig. 22).

*HECATES LACUS* was vaguely drawn by Phillips on January 2 (Fig. 23).

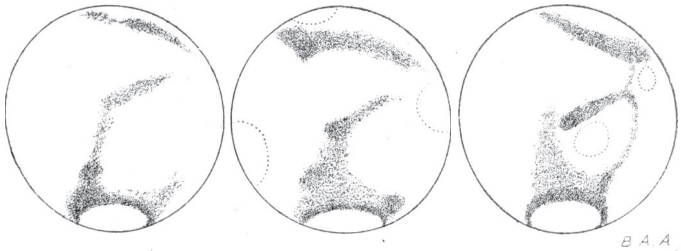


FIG. 23.—January 2, $\omega = 191°$. (Phillips.)

FIG. 24.—March 8, $\omega = 199°$. (The Director.)

FIG. 25.—January 2, $\omega = 202°$. (Thomson).

The *Mare Cimmerium* and *Trivium Charontis* regions in 1916.

*PHLEGRA* appeared shaded to McEwen, Phillips, Thomson, and the Director.

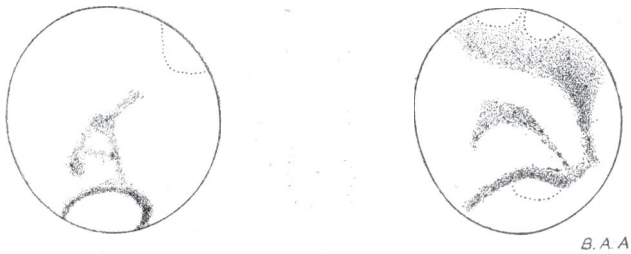


FIG. 26.—December 26, $\omega = 215°$.

FIG. 27.—November 20, $\omega = 257°$.

The *Trivium Charontis* and *Syrtis Major* districts in 1915 (McEwen).

*CEBRENIA* was also shaded to the same.

*ÆTHERIA* looked similarly dusky, and seemed brightish on C.M. to McEwen on November 20, rising whitish to Thomson on February 2 and 7.

## MINOR DETAIL.

*ÆSACUS.*—McEwen : February 2, width 11°.

*ANIAN.*—McEwen : February 2, running N.N.W., width 15°.—Thomson : January 2, width 8°, a dark edge of shaded *Cebrenia* (Fig. 25).

*CERBERUS I.*—Ellison : January 31, width 4°, dark ; February 2, width 8° to N.E., 4° to S.W., mean width 6°, dark (Plate II., Fig. 1, and text Fig. 21).—McEwen : October 15, edge of bright *Elysium ;* 22, width 10°, dark, do. ; December 26, width 8° ; January 28, width 10° ; February 2, width 8° ; 4, 11, width 10°. - Phillips : January 2, width 12°, faintish ; February 6, width 10°, dark ; 9, width 10°, faint ; March 4, mean width 10°, dark ; 18, width 8°, faintish.—Thomson : January 2, width 10° to N.E., 6° to S.W., darkish ; February 2, width 9° to N.E., 5° to S.W., very dark ; 7, do., dark ; March 3, do., darkish.—The Director : March 1, invisible ; 8, width 10° to N.E., 8° to S.W., dark (Fig. 24.)

*CERBERUS II.*—Ellison : February 2, mean width 3°, darkish (Fig. 21).

*CHAOS.*—Ellison : February 2, invisible.—McEwen : February 2, width 9° ; 4, edge of bright *Elysium.*—Phillips : February 1, 6, 9, March 4, 18, exceedingly faint and diffused edge of shaded *Cebrenia ;* almost invisible. —Thomson : January 2, February 2, edge of shaded *Cebrenia.*—The Director : March 1, 8, invisible.

*CYCLOPS.*—Ellison : January 31, width 3°, darkish.—McEwen : January 28, width 4°.—Phillips : February 1, 6, March 4, running N.E. to S.W., width 8°, faintish (Plate II., Fig. 2).—Thomson : January 2, March 3, width 4°, faintish.—The Director : March 1, 8, invisible.

*EUNOSTOS I.* (skirting *Elysium*).—Ellison : January 31, February 2, convex to S.W., width 2°, darkish (Plate II., Fig. 1, and text Fig. 21).—McEwen : October 15, November 20, width 8°, edge of brightish *Elysium ;* January 28, width 8°.—Phillips : February 1, 6, 9, March 4, convex to S.W., width 6°, faint—Thomson : January 2, February 2, March 3, convex to S.W., width 6°, faintish, save on January 2 (Fig. 25).—The Director : March 1 and 8, invisible.

*EUNOSTOS II.* (*Elysium* to *Nubis Lacus*).—Ellison : January 31, February 2, chiefly to S.E., mean width 2°, darkish.—Phillips : February 1, March 4, width 4°, exceedingly faint.—Thomson : March 3, to N.W. only, width 3°, very faint.

*GRANICUS.*—Phillips : January 2, edge of shade to N.E.—Thomson : February 7, do.

*GYNDES.*—Ellison : January 31, February 2, edge of shade to N.

*HADES.*—Ellison : February 2, mean width 3°, dark (Plate II., Fig. 1, and text Fig. 21).—McEwen : December 26, February 2, 4, 6, 11, width 5° to 12°, occasionally edge of shaded *Phlegra.*—Phillips : January 2, mean width 10°, dark ; February 9, March 18, width 10°, faint.—Thomson : January 2, edge of shaded *Phlegra ;* February 7, width 5°, darkish.—The Director : March 8, invisible otherwise than edge of *Phlegra* (Fig. 24).

*HEPHÆSTUS.*—McEwen : November 20, January 28, March 2, roundish, large, faint (Fig. 27).

*HYBLÆUS.*—Ellison : February 2, convex to W.N.W., width 2°, faintish (Plate II., Fig. 1, and text Fig. 21).—McEwen : October 15, November 20 edge of bright *Elysium.*—Phillips : February 1, 6, 9, March 4, exceedingly faint edge of shaded *Ætheria.*—Thomson : January 2, convex to N.W., width 6°, darkish.—The Director : March 1 and 8, invisible.

*LÆSTRYGON.*—McEwen : February 4, width 5°, faint.

*ORCUS.*—McEwen: October to February, width 4° to 12°, once seen knotted, edge of shaded *Amazonis.*—Phillips: January 2, February 9, March 18, width 10°, very faint and diffuse.

*STYX.*—Ellison: January 31, mean width 2°, dark.—McEwen: October to February, width 8° to 12°, edge of shaded *Phlegra.*—Phillips: February 1, 6, edge of shaded *Phlegra;* 9, March 4, invisible.—Thomson: January 2, February 2, convex to N.E., width 6°, edge of shaded *Phlegra.*—The Director: March 8, edge of shaded *Phlegra* (Fig. 24).

*TARTARUS.*—Thomson: February 2, to N.W. only, edge of shade to N.E.

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## SECTION VI.

### Mare Tyrrhenum and Syrtis Major.

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

*CHERSONESUS* set bright to Thomson on March 3 (Plate II., Fig. 5).

*AUSONIA*, shaded to McEwen, Phillips, Thomson, and to the Director, rose very bright on October 15 and December 26 to McEwen (Fig. 26).

*HADRIACUM MARE* was invariably faint in 1916.

*HELLAS*, whose lower half only could be scrutinised to advantage, was repeatedly seen as a marginal glimmer. According to the drawings of all Members, it rose whitish on September 9, October 15 and November 20 (Fig. 27); remained whitish on C.M. on November 20; was yellow on C.M., and set yellow on January 22; rose yellow on February 1; rose unnoticed on February 6; set yellow on February 24; rose unnoticed and was yellow on C.M., on March 1; was yellow *f.* C.M. on March 2; yellow on C.M. and at sunset, save to S.W., on March 3 (Plate II., Fig. 5); rose yellow on March 4; was yellow on C.M. on March 6; set yellow, or invisible, on March 31; set bright on April 3 (Fig. 33); was yellow *p.* C.M. on April 8; looked whitish on C.M. on April 9; set yellow on May 16; transited the C.M. yellow on May 18; and was very bright on C.M. on May 20.

*MARE TYRRHENUM* was distinctly faint, and its shape looked usual, though with diffused borders (Plate II., Figs. 2 and 3). From the joint Sectional data, we infer that this "sea" was exceedingly faint on November 20; faint on January 22; darkish on January 28 and 31; very faint on February 1; faintish on February 6, 24, March 1 and 2; very faint to W. on March 3; faint on March 4 (Fig. 29) and 6; darkish on April 3; very faint on April 8, 9, and 15; darkish on May 18; and faintish on May 20.

*SYRTIS PARVA* is barely indicated as a faint indentation by Phillips, Thomson, and the Director.

*ŒNOTRIA* was drawn by Phillips on January 22 and Thomson on March 3 as a lightening of *Syrtis Major* (Fig. 31).

*DELTOTON SINUS* comes out as a very shallow concavity on Phillips's drawing of March 1 and on those of the Director.

*NYMPHÆUM PROMONTORIUM* is slightly protuberant on the drawings of Thomson and the Director.

*SYRTIS MAJOR* had practically the form of 1913–1914. V-shaped to McEwen (Fig. 27), it revealed the "bight" towards *Lacus Mœris* to Phillips (Plate II., Fig. 2 and text Figs. 29, 30, and 31), Thomson (Plate II., Figs. 3 and 5), but scarcely so to the Director (Figs. 28, 32, 33), and was very broad to S. to Ellison (Plate II., Fig. 4). It looked "unevenly shaded" to Thomson on March 2 and 3. Generally it was darkest to N. The Sectional results establish that *Syrtis Major* was apparently very

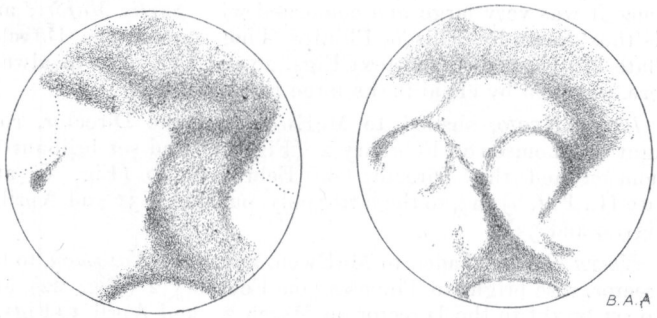


FIG. 28.—March 1, $\omega = 260°$. (The Director.)

FIG. 29.—March 4, $\omega = 267°$. (Phillips.)

The *Syrtis Major* and its surroundings in 1916.

faint on November 20; indiscernible on December 13; darkish on January 18; faintish on January 22 and February 1; darkish on February 6; faintish on February 24 and March 1; faint on March 2; very faint to E., dark to N.W., on March 3; dark to N. on March 4; faintish, save to N.W., on March 6; dark on March 31 and April 3; very faint, save to W., on April 8; dark, especially to W., on April 9; faintish on May 13; very faint on May 16; darkish on May 18; and faintish on May 20.

*NILI PONS* was drawn by Thomson only on March 3 (Plate II., Fig. 3).

FIG. 30.—March 3, $\omega = 309°$.

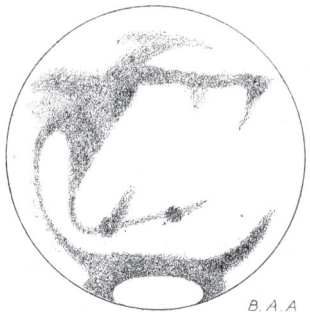


FIG. 31.—January 22, $\omega = 315°$.

*Syrtis Major* in 1916 (Phillips).

*LIBYA* appeared shaded to all Members. It rose bright to McEwen on October 15 and February 2; set brilliant to Thomson (Fig. 6) and to the Director on February 20 (Plate II., Fig. 6); rose white to the Director on March 8 (Fig. 24); set bright to him on March 31 (Fig. 9); and further set bright to McEwen on May 18.

*MŒRIS LACUS* had the 1911-1912 and 1913–1914 appearance. Hence it was very large and connected with *Syrtis Major*; and it is thus drawn by Ellison, Phillips, Thomson and the Director (Plate II., Figs. 2–5, and text Figs. 28 and 33). It was always there, unveiled by cloud in the large instruments.

*ISIDIS REGIO*, shaded to McEwen and the Director, rose bright to Thomson on February 2 (Fig. 22), and set brilliant to Thomson and the Director on February 20 (Fig. 6, and Plate II., Fig. 6) and, to the latter only, on March 31 and April 3 (Figs. 9 and 33).

*NEITH REGIO*, shaded to McEwen, and N. of *Nasamon*, to the Director, rose bright to Thomson on February 2 (Fig. 22) and also set bright to the Director on March 31 and April 3 (Figs. 9 and 33).

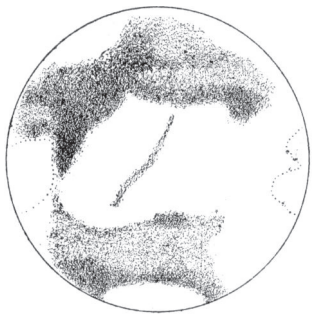

FIG. 32.—February 24, $\omega = 322°$.


FIG. 33.—April 3, $\omega = 327°$.

*Syrtis Major* in 1916 (the Director).

*NUBIS LACUS* was very probably less dark than in 1913–1914. According to the drawings of McEwen, Phillips, Thomson, and the Director, it was seemingly faintish on November 20 and February 1 ; dark on February 6 (Plate II., Fig. 2) ; and faintish on March 1 (Fig. 28), 3 and 4 (Fig. 29).

*MEROE* showed nothing unusual in 1916.

*COLOE PALUS* looked " very dark and quite easy . . . in the 18-in." of Ellison (Plate II., Fig. 4). From the joint data of all Members we conclude that this " lake " was seemingly dark on January 22 ; faintish on March 1 ; darkish on March 3 (Fig. 30), 31, and April 3.

*UTOPIA* is more or less heavily shaded by all the Sectional observers.

## MINOR DETAIL.

*AMENTHES.*—McEwen : March 2, 6, April 9, width 3° to 13°, faint.

*ASTUSAPES.*—McEwen : January 22, curved, width 5°,

*BOREOSYRTIS.*—Ellison : January 22, convex to N.W., width 2°, dark (Plate II., Fig. 4).—Phillips : February 1, March 3, convex to N.W., width 7°, dark, but confused in " marshes " (Fig. 30).

*CADMUS.*—Ellison : January 22, February 22, 23, convex to N.E., width 2° (Plate II., Fig. 4, and text Fig. 5).—Thomson : February 20, March 3, edge of shade tc E.

*CASIUS.*—Ellison : February 2, edge of dark *Utopia* (Plate II., Fig. 1, and text Fig. 21).– McEwen : November to April, width 6° to 15°, dusky edge of *Utopia*.—Phillips : January 22, February 1, 6, March 1, 3, 4, very dark edge of *Utopia* shades (Plate II., Fig. 2, and text Figs. 29, 30, 31).—Thomson : March 3, width 5°, very dark edge of *Utopia* shade (Plate II., Figs. 3 and 5).—The Director : March 1, edge of dark *Utopia* (Fig. 28).

*HELICONIUS.*—Ellison : February 2, edge of shaded *Uchronia.*—Phillips : February 1, 6, March 4, slanting down to N.E., width 8°, edge of shaded *Uchronia.*

*LETHES.*—McEwen : January 28, March 2, width 10°, faint.

*NASAMON.*—The Director : February 24, April 3, edge of shade in N. *Neith* (Figs. 32 and 33).

*NEPENTHES–THOTH.*—Phillips : January 22, February 1, 6, March 3, 4, convex to S.E., mean width 5°, conspicuous, dark, especially to S. (Plate II., Fig. 2, and text Figs. 29, 30, 31).—Thomson : March 3, convex to S.E., mean width 4°, dark ; " much as during previous apparition " (Plate II., Figs. 3 and 5).—The Director : March 1, April 3, convex to S.E., width 6°, conspicuous, darkish edge of shaded *Isidis Regio* (Fig. 28).

Hence this stripe remained, in 1916, quite as conspicuous as in 1913–1914 and in 1911–12. An interesting and lasting change !

*NILOSYRTIS.*—Ellison : January 22, admirably seen, angular, width 8° to S., 2° to W., darkish (Plate II., Fig. 4).—McEwen : November to May, convex to N.E., width 5° to 8°, dusky, sometimes edge of shade in *Neith Regio.*—Phillips : January 22, February 1, 6, March 1, 3, 4, convex to N.E., width 5°, darkish.—Thomson : March 3, convex to N.E., angular, width 4°, dark, edge of shaded *Neith Regio* (Plate II., Figs. 3 and 5).—The Director : February 24, March 1, 31, convex to N.E., width 6°, darkish, edge of shaded *Neith Regio.*

*RHÆSUS.*—Thomson : March 3, double, 2° wide bands, 7° apart (Plate II., Fig. 3).

*THOTH II.* (Section N. of *Nubis Lacus*).—Ellison : January 31, February 2, E. edge of *Utopia* darkness.—Phillips : February 1, 6, March 1, 3, 4, do.—Thomson : March 3, do.—The Director : March 1, do.

*TRITON.*—Ellison : January 31, February 2, mean width, 5°, darkish (Plate II., Fig. 1, and text Fig. 21).

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## SECTION VII.

### The South Polar Region.

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

*MARE AUSTRALE* was barely shaded. On March 3, Thomson saw a bright spot N. of *Novissima Thyle*, extending to *Hellas* (Plate II., Fig. 5) ; on November 4, McEwen descried a white patch on the full limb, S.E. of *Thaumasia* ; and, on March 3, Thomson saw another bright object near the S. limb, in about $\Omega = 260°$ (Plate II., Fig. 5).

*THYLE II.* looked very bright setting to the Director on March 1 (Fig. 28).

#### THE SOUTH POLAR WHITISHNESSES.

According to the joint sectional data, these presented the following phenomena :—

There was a "very white" area of 60° in the S. polar region on September 9 ; nothing on September 21 ; a "bright area" of 45° on September 27 ; a dull whitishness on September 28 and 29 ; nothing on October 1, 5, and 22 ; a dull whitishness of 60° on October 31 ; nothing on November 2, 4, and 11 ; a whitishness of 30° on November 20 ; nothing on December 13 and 26 ; a whitishness of 50° on January 2 ; nothing on January 7, 11, 12, and 13 ; a faint whitishness of 40° on January 18 ; nothing on January 22, 28, 31, February 1, 2, 4, and 5 ; a bright area of 40° on February 6 ; nothing on February 7 ; a whitishness of 60° on February 8 ; one of 70° on February 9 ; nothing on February 11, 13, and 14 ; a whitishness of 70° on February 16 ; nothing on February 17 ; a whitishness of 70° on February 19 ; nothing on February 20, 21, 22, 23, and 24 ; a faint whitishness of 60° on February 27 ; nothing on March 1 and 2 ; a whiteness of 35° on March 3 ; one of 30° on March 4 ; nothing on March 6, 8, 18, and 22 ; a whitishness of 60° on March 23 ; nothing on March 27, 28, and 30 ; a whitishness of 60° on March 31 ; one of 80° on April 1 ; nothing on April 2, 3, 5, 8, 9, 15, 26, and 28 ; a whitishness of 60° on April 30 ; nothing on May 1, 3, and 10 ; a bright whiteness of 20° on May 13 ; and nothing on May 16, 18, and 20.

Thus haze in the S. polar zone was neither frequent nor thick in 1915–1916.

## SECTION VIII.

### The North Polar Region.

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

*ORTYGIA* looked shaded to Phillips and the Director (Plate I., Fig. 3, and text Figs. 9 and 12).

*BALTIA* is very heavily shaded by Phillips (Plate I., Fig. 3, and text Figs. 17 and 18).

*ABALOS* is also strongly shaded by Phillips and not shown disconnected from the preceding half-tone.

*NERIGOS*, united to *Baltia* and *Abalos*, comes out also very dusky in the said drawings of Phillips.

*IERNE* was lost in the greyish polar band.

*LACUS HYPERBOREUS* is recognisable on Phillips's delineation of March 31 (Plate I., Fig. 3) as a very dark condensation skirting the N. snows towards $\Omega = 55^\circ$. Yet the cap was still too large in order to show this black "lake" to advantage.

*SCANDIA* is shaded by Ellison, Phillips, and the Director.

*DIACRIA* is shown dusky by Ellison, Phillips, and Thomson (Plate II., Fig. 1, and text Figs. 20, 21 and 22). It set whitish, together with the N. part of *Arcadia*, on February 7 to Thomson and on the morrow to Thomson and Phillips (Plate I., Fig. 6).

*PANCHAIA* is shaded by all Members.

*UCHRONIA* also appeared generally shaded.

*COPAIS PALUS* was easy to the Director on February 24 (Fig. 32).

*CECROPIA* comes out also shaded in the records of Phillips, Thomson, and of the Director.

#### MINOR DETAIL.

*IAXARTES.*—Phillips: March 31, edge of shaded *Baltia*.

*KISON.*—Ellison: February 21, trending to N.W., where it broadens, mean width 5°, dark (Plate I., Fig. 1).

#### THE NORTH POLAR SNOW CAP

The N. snows were very seldom brilliant, and often dull white, in 1915–1916. Hence, as a rule, they were certainly covered with whitish cloud. As during the last apparition, they were again seen occasionally notched by *Mare Acidalium*. The outline of the cap was often irregular (Figs. 14, 17, 30, 34,

and 36); and brighter spots were seen in the white area by McEwen on November 20 (Fig. 27), February 17, March 23 and 28 (Fig. 35), and by Phillips on March 3, when the "*p.* end of polar cap" was "much brighter than *f.* end." On March 22 and May 20, McEwen found the cap yellowish, whereas on April 1 (Fig. 36) and 2 it was white to left, yellowish to right.

The N. snows diminished as follows :—

| Date. | Size of N. Cap and other Phenomena. | Observer. |
|---|---|---|
| 1915. | | |
| Sept. 9 | No cap seen | ME. |
| „ 21 | do. | „ |
| „ 27 | Cap subtends 65° ± and is "bright." | „ |
| „ 28 | 60°, "brilliant" | „ |
| „ 29 | 55°, "bright" | „ |
| Oct. 1 | 60° | „ |
| „ 15 | 55°, "diffuse" | „ |
| „ 22 | 80°, "very bright" | „ |
| „ 31 | 60°, "not bright" | „ |
| Nov. 2 | 60°, "white" | „ |
| „ 4 | 80°, "dull" | „ |
| „ 11 | 80°, "bright" | „ |
| „ 20 | 75°, "very bright" | „ |
| Dec. 13 | 70° do. | „ |
| „ 26 | 50° do. | „ |
| 1916. | | |
| Jan. 2 | 39°, "dull" | „ |
| „ 2 | 36° | Ph. |
| „ 2 | 40° | Th. |
| „ 7 | 50°, "dull" | ME. |
| „ 11 | 32°, "very brilliant" | Th. |
| „ 12 | 58°, "dull white" | ME. |
| „ 13 | 50°, "white" | „ |
| „ 13 | 38° | Th. |
| „ 18 | 47°, "bright" | ME. |
| „ 18 | 39° | Ph. |
| „ 22 | 42°, "white" | ME |
| „ 22 | 40° | Ph. |
| „ 22 | 34° | E. |
| „ 28 | 40°, "white" | ME. |
| „ 31 | 38° | E. |
| Feb. 1 | 36° | Ph. |
| „ 2 | 47°, "not bright" | ME. |
| „ 2 | 33° | Th. |
| „ 2 | 36° | E. |
| „ 4 | 46° | ME. |
| „ 5 | 38° | A. |
| „ 6 | 46° | ME. |
| „ 6 | 34° | Ph. |
| „ 7 | 34° | Th. |
| „ 8 | 32° | Ph. |
| „ 9 | 41°, "dull" | ME. |
| „ 9 | 33° | Ph. |
| „ 11 | 46°, "white" | ME. |
| „ 13 | 50°, "faint" | „ |
| „ 14 | 55° | „ |
| „ 16 | 46°, "somewhat faint" | „ |
| „ 16 | 31° | Ph. |
| „ 17 | 47°, "white," bright spots in it. | ME. |
| „ 19 | 46°, "bright white" | „ |

| Date. | Size of N. Cap and other Phenomena. | Observer. |
|---|---|---|
| 1916. | | |
| Feb. 19 | 32° | Ph. |
| „ 19 | 33° | Th. |
| „ 20 | 38° | ME. |
| „ 20 | 29° | Th. |
| „ 20 | 34° | Ph. |
| „ 20 | 38° | A. |
| „ 21 | 40°, "bright white" | ME. |
| „ 21 | 21° | E. |
| „ 22 | 21° | „ |
| „ 22 | 45° | ME. |
| „ 23 | 20° | E. |
| „ 24 | 43° | A. |
| „ 27 | 34° | Ph. |
| Mar. 1 | 33° | „ |
| „ 1 | 40° | A. |
| „ 2 | 38°, "rather bright" | ME. |
| „ 3 | 42°, "dull" | „ |
| „ 3 | 36° | Th. |
| „ 3 | 37° | Ph. |
| „ 4 | 36° | „ |
| „ 6 | 38°, "white" | ME. |
| „ 8 | 40° | A. |
| „ 18 | 33° | Ph. |
| „ 22 | 54°, "yellowish," with a white spot. | ME. |
| „ 23 | 30° | Th. |
| „ 23 | 45°, "dull," white spot in it | ME. |
| „ 27 | 55° do. | „ |
| „ 28 | 55°, bright spot in Cap | „ |
| „ 30 | 26° | A. |
| „ 31 | 23° | Ph. |
| „ 31 | 32° | A. |
| Apr. 1 | 50°, white to left, yellow to right. | ME. |
| „ 2 | 50°, do. do. | „ |
| „ 3 | 33° | A. |
| „ 5 | 60°, dull to left, yellow to right. | ME. |
| „ 8 | 55°, "dull" | „ |
| „ 9 | 55°, "dull white" | „ |
| „ 15 | 25°, "difficult" | „ |
| „ 26 | 32°, "white" | „ |
| „ 28 | 39°, "greyish" | „ |
| „ 30 | 39°, "white" | „ |
| May 1 | 50° | „ |
| „ 3 | 55°, "white" | „ |
| „ 10 | 35°, "rather bright white" | „ |
| „ 13 | 48°, "white" | „ |
| „ 16 | 31°, "bright" | „ |
| „ 18 | 38°, "white" | „ |
| „ 20 | 35°, "light ochre" | „ |

Comparing these data with the unsmoothed mean of 1856–1914, we find that they show an almost normal, or slightly accelerated, diminution of the N. snow cap (Fig. 37). Now, solar activity was normal in January and February 1916. considerably greater after. The observations of Ellison point to

a very rapid wane; those of Phillips and Thomson to a slightly accelerated one, those of the Director to a retarded shrinkage;


FIG. 34.—November 2, $\omega = 100°$. FIG. 35.—March 28, $\omega = 41°$. FIG. 36.—April 1, $\omega = 17°$.
Views of the N. Polar Cap in 1915–1916. (McEwen.)

while the apparent size of the cap in such an aphelic apparition was greatly increased by diffraction and irradiation in the small refractor of McEwen.

The normal here used embodies the results of the 1913–1914 apparition, with their high values for the size of the cap, whereas the normal utilised in the last Report stopped at 1912. In the light of that curve, the diminution of the snow cap in 1916

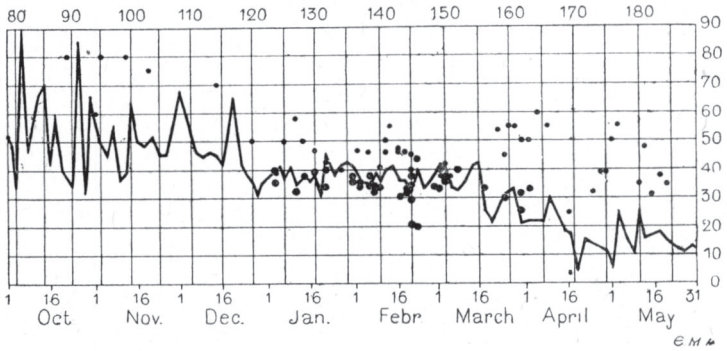


FIG. 37.—Size of the N. Polar Cap in 1915–1916, and its deviation from the normal of 70 years.

would be slightly retarded, instead of being slightly accelerated, as in the case of the complete up-to-date mean adopted in the above diagram.

## CHARACTERISTICS OF THE 1915–1916 APPARITION.

These were :—

(1) The persistent conspicuousness of the *Nepenthes-Thoth*;
(2) The great dimensions of *Lacus Mœris*;
(3) The faintness of *Mare Tyrrhenum*;
(4) The great faintness of *Pandoræ Fretum*;
(5) The invisibility of *Hellespontus*;
(6) The invisibility of *Aonius Sinus*;
(7) The extreme faintness or invisibility of the *Ganges*;
(8) The visibility of *Titania*, *Euxinus Lacus*, *Ascania Palus*, and *Propontis II.*;
(9) The faintishness of *Solis Lacus*;

(10) The faintness of *Trivium Charontis;*
(11) The dimness of *Elysium* to W., and especially to N.;
(12) The conspicuousness of *Cerberus;*
(13) The protrusion of *Aurea Chersonesus;*
(14) The darkness of *Mare Acidalium*, which seemed, as a rule, slightly superior to that of *Sinus Furcosus;*
(15) The shading of *Libya;*
(16) The darkness of *Utopia;*
(17) The visibility of *Dirce Fons;*
(18) The persistent visibility, since 1871, of a whitish spot on S. *Æthiopis*, suggesting that it is a permanent feature of the superficies.

Paris, 74, Rue Jouffroy,
1918, June 20.

E. M. ANTONIADI,
Director of the Section.

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