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VOL. XXVI.—PART I.

THIRTEENTH REPORT OF THE SECTION

FOR THE OBSERVATION OF

MARS,

DEALING WITH THE APPARITION OF 1917–1918.

Director—Harold Thomson, F.R.A.S.

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SECTION FOR THE OBSERVATION OF MARS.

DIRECTOR.—HAROLD THOMSON, F.R.A.S.

REPORT OF THE SECTION, 1917–1918.

INTRODUCTION.

The apparition dealt with in this Memoir cannot be considered a very favourable one for observation, as Mars was in Aphelion on 1918 January 30, and at the date of Opposition, 1918 March 14, was about 62,000,000 miles from the Earth. In preparing this Memoir the Director has followed closely the admirable arrangement adopted for many years by Monsieur E. M. Antoniadi, whose retirement has been a great loss to the Section.

Phenomena.

Vernal Equinox of N. hemisphere Autumnal Equinox of S. hemisphere	1917 September 4.
Mars in W. Quadrature with Sun	1917 December 11.
Mars in Apparitional Perigee	1918 March 18.
Mars in Opposition to Sun	1918 March 14.
Diameter of Mars at Opposition (using Hartwig value of 4·68 seconds for semi-diameter)	14″·12.
Position angle of N. Pole at Opposition	22°·91.
Latitude of centre of disc at Opposition	+ 21°·63.
Summer Solstice in N. hemisphere Winter Solstice in S. hemisphere	1918 March 24.
Mars in E. Quadrature with Sun	1918 June 20.
Position of Mars at Opposition	R.A. = 11^h 44^m. Dec. = + 5° 53′
Heliocentric longitude of Mars at Opposition	173° 32′.
Heliocentric latitude of Mars at Opposition	1° 31′ 23″.

From the above data it will be seen that this apparition was similar to that of 1903, when Mars was in opposition on 1903 March 29.

The Members of the Section.

The following table gives the names of Members who have contributed notes or drawings, their localities, the sizes of instruments employed and the numbers of drawings sent in :—

Observer.	Locality.	Aperture of Instrument in Inches.	No. of Drawings sent to Association.
AINSLIE, M. A., Instructor-Comdr., R.N., F.R.A.S.	London	8½ and 9 Spec., 28 O.G.	22
ELLISON, Rev. W. F. A., F.R.A.S.	Fethard-on-Sea, Ireland.	5¼ O.G. 18 Spec.	4
CHURCH, Miss E. K.	Ashtead	9 Spec.	—
GALE, W. F., J.P., F.R.A.S.	Sydney, N.S.W.	8½ Spec.	—
GARDINER, E.	Sydney, N.S.W.	6 O.G.	10*
HOSKINS, G. H.	Sydney, N.S.W.	18 Spec.	—*
MCEWEN, H.	Glasgow	5 O.G.	17
OLSON, Dr. C. M., DD.S.	Forbes, N.S.W.	4½ O.G.	—
PHILLIPS, Rev. T. E. R., F.R.A.S.	Headley, Surrey	12¼ Spec. 8 O.G. 28 O.G.	29
STEAVENSON, Dr. W. H., F.R.A.S.	London and Four Marks.	8, 10, and 28 O.G.	8
SARGENT, F., F.R.A.S.	Bristol	10 Spec.	3
THOMSON, H., F.R.A.S.	Newcastle-on-Tyne	12½ Spec.	41
TRIPP, C. H.	Timaru, New Zealand.	—	—

* Mr. Gardiner's drawings represent Mars during the apparition of 1915–16, but were received too late to be included in the Memoir for that apparition.

Notes on Mr. Hoskins's observations of the occultation of the star Cape (1900), 1524, by Mars were forwarded by Mr. W. F. Gale, F.R.A.S. Mr. Arthur Burnet has kindly compiled the note on this phenomenon, which was predicted by him.

By the kindness of the Astronomer Royal three Members of the Section were allowed to observe Mars on several occasions with the 28-inch refractor, which enabled them to make comparisons between the appearance of the planet as seen with an instrument of this size and that seen with the smaller instruments usually employed.

The earliest observation of the planet was obtained by Mr. McEwen on 1917 October 28 and the latest by Rev. T. E. R. Phillips on 1918 June 15.

Observational and Telescopic Notes.

During the early part of the apparition most of the observers in Great Britain found definition very poor, but about the time of opposition conditions improved considerably. In Australia, Mr. W. F. Gale reported "good" to "very good" definition during the period covered by his notes—1918 January to April—but he states that the good nights were few in number. Mr. Tripp, in New Zealand, writes that he did not have "a good crisp view of Mars" once during the year, and that the planet always appeared to him more "blurred and misty than at previous oppositions."

On the whole, the Director is of the opinion that the seeing conditions were about equal to normal. Those who have the advantage of living in countries favoured by more clear skies than are usual in Great Britain sometimes express surprise that it should be possible to carry out here so much work on planetary details as has been done in the past. It seems probable, however, that conditions in this country are not so bad as some people suppose, as nights of the very finest definition are experienced by those who have observatories in suitable positions. The majority of our Members have little choice regarding the position of their observatories and no doubt some are placed in positions not the most favourable for good seeing conditions; but experience has shown that in some localities very good definition is frequently obtained.

It has already been mentioned that three of our Members, Ainslie, Phillips and Steavenson, were able to use the 28-inch refractor at the Royal Observatory, and as these observers also used refracting and reflecting telescopes of 8 inches upwards, their remarks with reference to the various instruments are worth recording.

Writing concerning the 28-inch refractor, Steavenson says:—"On April 22, seeing was 5–6 [on Professor Pickering's Scale] for about two hours. I saw very little more than I have seen with the 10-inch O.G. before, but what I saw was seen almost at once, instead of being built up laboriously by about an hour's steady gazing, and when seen was held steadily and certainly for minutes together. Otherwise the whole planet looked much as I have always seen it with 8-inch and 10-inch refractors. The 'canals' were broad and diffuse, though pretty straight and smooth on the whole. There was no question of any of them being merely the edges of faint half-tone shadings. It has been said that with increased aperture the planet looks more and more natural, but on this night I thought it was perhaps more *unnatural* looking than I had ever seen it. This effect was largely produced by the straightness and length of *Protonilus*, *Deuteronilus*, *Phison*, and *Euphrates*.

"*Orontes* and *Typhonius* were the only streaks which looked as if they were discontinuous."

On the occasions when Phillips and Ainslie used the 28-inch the definition, unfortunately, was very poor.

Phillips reports that in the existing conditions he was unable to see more than he had previously done with the 8-inch refractor and 12¼-inch reflector.

As regards the comparative merits of the refractor and reflector for planetary work, Phillips writes: "I am confirmed in the view that though the reflectors are unquestionably superior to the refractors on planets *on their night*, they are much more sensitive to adverse conditions. I have noticed this frequently and as a general working instrument the 8-inch refractor, despite its relatively small aperture and comparative deficiency in separating power, is to be preferred. I can often see *something* with this when the image in the reflector is all turmoil and confusion. Still, for the finer details and more delicate features I must wait for the nights that suit the 12¼-inch and 18-inch reflectors."

The experience of the Director coincides with that of Phillips on these points, but the reflector has many advantages in other directions. For the observation of colour it is unquestionably the most suitable instrument, and the ease and comfort with which it can be used for long periods without the observer assuming awkward and strained positions when objects are high in the sky go far to compensate for some of its disadvantages, and its comparative cheapness makes it pre-eminently the instrument for the amateur who requires considerable aperture at moderate cost.

The Director has found that even near a large town, such as Newcastle, the silver film will last for a considerable number of years provided the mirror is covered by a well-fitting cap when not in use. Care must be taken not to put on the cap if either the mirror or flat is dewed. Dew can sometimes be got rid of from the flat by placing the warm hand on the cell or near the flat.

The magnification employed by the observers was usually moderate. On his 5-inch refractor McEwen employed powers up to 180, Phillips seldom exceeded 300 on either telescope, Ellison used 230 on his 5¼-inch refractor and powers up to 360 on the 18-inch reflector. Steavenson employed 470 on the 28-inch refractor and 430 on the 10-inch at Mr. Worthington's Observatory at Four Marks. Ainslie used various powers from 200 to 400 on his 8½-inch and 9-inch reflectors and the Director seldom employed higher powers than 320 on the 12½-inch mirror. No general rule can be laid down regarding the most suitable powers for planetary observation, as observers differ considerably as regards their choice in this matter. The Director prefers to use the lowest power which will give sufficient magnification for the observation required; others, observing at the same instrument, prefer to employ the highest power which the conditions will allow. In the opinion of the Director there is little to be gained by the use of very high magnifying powers on Mars when searching for faint detail and it is seldom that powers up to 50 to the inch diameter of O.G. can be employed with satisfaction on this planet.

The Drawings.

The drawings sent in by McEwen, Steavenson and Gardiner were executed in colour. McEwen employed crayons, while Steavenson used pastels, and Gardiner's sketches, made during the 1915–16 apparition, were in water-colours. Phillips, Ainslie, Ellison and the Director usually made pencil sketches, but Phillips also used water-colours occasionally, and the Director, when desiring to make coloured drawings, used pastels, which he found very satisfactory and much easier to use than crayons or water-colours. The Director has always found it impossible to make satisfactory coloured sketches while actually observing at the telescope and in his case the coloured drawings made were only intended to give a general idea of the appearance of the colouring of the planet, and it seems to him that most observers will find pencil sketches the easiest and most satisfactory in the long run for depicting the details seen upon the disc. In making drawings of planetary surfaces the first essential is not to make an artistic and pleasing picture but rather to record as accurately as possible the form and position of all markings observed. If this can be done in an artistic manner so much the better, but accuracy should never be sacrificed to artistic effect. It may often occur that drawings which appear rough and crude yet contain much valuable information when executed by a careful observer who only records details of which he is certain. No one, therefore, need be discouraged from observing Mars by inability to draw in an artistic manner, but it is essential that the drawings should be reliable in respect of the details shown and every effort should be made to place markings in their correct relative positions and of the correct sizes. To many people this is not easy, even when making an ordinary pencil sketch, and the difficulty is greatly increased if a coloured drawing is attempted at the telescope, but every possible care should be exercised by the observer in order to obtain accuracy.

There is a difference of opinion regarding the advisability of consulting a chart of Mars while observing at the telescope. Probably in the case of able and experienced observers, not much harm is done by this procedure, but in the case of observers new to the planet, the Director is of the opinion that it is far better that all mental bias should be avoided and that the observer should not consult the charts while actually observing the planet. There have been many instances of observers with a thorough knowledge of the charts of Mars who have drawn and recorded markings on the planet with small instruments which during that apparition were totally invisible to the most experienced observers using more powerful appliances, and similarly, strong detail, quite easily seen, has been omitted when peculiar to the apparition in question. These errors are not deliberate on the part of the observer, but are the effect of an unconscious mental bias which is sufficient to influence the mind when endeavouring to see details on the disc. In recent years there has been a tendency among observers to concentrate

too much upon the discovery of faint canals, and it should be remembered that the more easily seen markings are just as important as the canals and may, in fact, provide more evidence than can the fainter details of the physical conditions of the planet. The drawings on Plates I.–VIII. have been reproduced direct from drawings kindly supplied for the purpose by the observers themselves and have not been copied by the Director for reproduction purposes.

In compiling the chart the Director has endeavoured to place the markings as nearly as possible in what may be termed the average position as deduced from the drawings sent to him. These positions will be found to differ in some cases from those on previous charts.

The Colours of the Disc.

Numerous notes regarding the colours visible on the planet were made by observers during the apparition. On the whole, those observers who used the larger reflecting telescopes agreed well with one another in their colour estimates, but the colours noted by those using refractors often differ considerably from those recorded by the users of the reflectors. There is no doubt that colours on planetary surfaces are much better seen in reflectors than in refractors, especially when the latter are of small dimensions.

Gale, in March, noted a "light *ruddy brown* tint" in the area between Syrtis and Thoth, while the whole disc exhibited a "rich ruddiness"; and on other occasions he speaks of a "rich copper tint." Steavenson writes that with the 28-inch refractor in April, he found the "general colour of the disc more *ruddy-orange* than in the 8-inch or 10-inch refractors, though not the clear *pink* shewn by a reflector. The *Sinus Sabœus* and *Mare Acidalium* seemed to be a very dark green, like distant pine trees." Later in the apparition he thought *M. Acidalium*, a "pale olive green" and the disc "pinkish orange."

McEwen saw many shades of ochre, sepia, raw umber and brown-yellow in the early part of the apparition when the disc was very small. In March he refers to the *delft-blue* colour of *Syrtis Major* and the *vandyke-brown* tint of *Casius*.

With regard to colour, Ainslie writes: "I hesitate to state any general conclusion, but my impression was that the 'red' portions of the disc were not really anything like red." In his estimation "*yellowish pink*" best described the colour of the disc, while *Mare Acidalium* and all the darker part of the N. hemisphere shewed no colour but a varying shade of *grey*. The *Maria* in the S. hemisphere, such as *Syrtis Major* as far north as *Nili Pons* were blue and occasionally he found *Syrtis Major* a "*pure blue* which ended abruptly at *Nili Pons*, giving place to grey." Ellison also speaks of *Syrtis Major* as "full *sky-blue*—a beautiful colour" and of the other *Maria* as "*grey-blue*." Phillips writes in 1918 March: "The most interesting point

in regard to colour is the contrast between the northern and southern markings. The latter are *greenish-blue* with the refractor and *bluish-grey* in the reflector. The N. markings—*e.g.*, *M. Acidalium*—appear to me *neutral tints* in both instruments."

In general, the Director's estimates of colour agreed with those of Phillips, using a similar instrument. On 1918 March 25, with the most perfect seeing experienced for many years, the contrast in colour between *Syrtis Major* and *Casius* was most marked, the former being *greenish blue* and the latter something between *raw umber* and *vandyke brown*, shading into a warm *grey* towards the south.

There are obvious difficulties in comparing observers' colour notes unless some form of colour scale is used by all observers, and in an endeavour to obtain uniformity of nomenclature colour scales were very kindly prepared by McEwen with crayons, which were distributed to the Members of the Section. These scales were used on a few favourable occasions by Phillips and the Director, but it was often found difficult to match the somewhat indefinite colours seen on the disc with those on the scale. There is no doubt, however, that the use of a scale of this kind, which was used many years ago for the colours of Jupiter's belts, helps to reduce discrepancies arising through the varying nomenclature adopted by the observer.

Colour change on the planet is certainly an important matter, so that anything which will tend to give an accurate picture of the changes, seasonal or otherwise, which take place is of distinct value. It is hoped, therefore, that this matter will receive further attention in the future.

The Canals.

The term "canals," as applied to the narrow dusky streaks observed on Mars, has now passed into such regular and world-wide use that there seems to be no reason to discontinue it. Whether the term is used for markings on the Moon, on Mars, or elsewhere, it now conveys to the mind of the astronomer a marking of a particular character, and although the word may imply artificiality to the non-astronomical reader, it is now fully understood that the use of the word "canal" does not necessarily imply belief in water-courses any more than the "seas" on the Moon suggest ships to the human observer.

The Director, therefore, sees no reason to abandon this term when dealing with the narrow markings seen on Mars. The term "canals" has been applied in the past to markings which differ widely amongst themselves, and probably it would have been better to confine this term to the narrower and fainter streaks seen on the disc, and employ some other term for such broad, dark markings as *Cerberus*, *Casius*, *Agathodæmon* and in recent years the great *Nepenthes-Thoth* curve.

The existence of such markings as these, and indeed of very many of the fainter and narrower canals, cannot be questioned. Many of them are quite conspicuous features even in telescopes of very moderate apertures, and they are well authenticated by the overwhelming testimony of the most experienced and skilful observers and of photography. The principal difference which still exists between observers of these canals is in regard to the form in which they are seen—whether as very narrow lines of geometrical pattern or as more hazy, broader markings of more natural appearance.

One of the most puzzling problems that the student of Mars has to face to-day is the explanation of the extraordinary differences which exist between observers in their delineation of the canals—differences which, in the Director's opinion, cannot possibly be ascribed entirely to differences in the seeing conditions, instrumental causes, or varying skill in the delineation of planetary detail. In other words, the differences seem to be due to the observers themselves, rather than their conditions or instruments, and it is noticeable that those who see hard narrow lines on Mars where others see soft hazy streaks, also seem to see rather similar details on other planets such as Jupiter. There is, perhaps, no subject in planetary observational work which has aroused such keen controversy as the correct delineation of the Martian "canals" and "oases." In the opinion of the Director it would be of the greatest interest and value in planetary research if one or two of our leading observers who have hitherto belonged to what, for want of a better name, may be called the anti-Lowellian School, could observe the planet at the Flagstaff Observatory itself.

If these observers found that they then saw the canals in a different form from that in which they had previously drawn them it would go far towards a settlement of this question in the minds of most of our observers.

PART II.

THE OBSERVATIONS.

The following abbreviations are used in this report:— Ω = areocentric longitude; ω = longitude of centre of disc; Φ = areocentric latitude; ϕ = latitude of centre of disc; N = North; S = South; E = Areographic East = p = preceding; W = Areographic West = f = following; C.M. = Central meridian of disc; η = heliocentric longitude of Mars.

All dates are in G.M.T.

SECTION I.

Sinus Sabæus and Mare Erythræum.

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

Hammonis Cornu.—Bright areas along the western border of *Syrtis Major* and *Deltoton Sinus* were frequently observed and may have modified the form of this promontory, which is variously shewn on the drawings of all observers. On 1918 January 3, Phillips shows the coast-line here rounded and similarly on March 12, but on March 20 and 21, *Hammonis Cornu* is shewn as a distinct sharp projection into the dark border of the *Mare*. On March 21, Steavenson also shows this feature similarly, while on April 22, though still pointed, the cape does not project into the *Mare*.

To the Director, this coast line was rounded on February 8 and 9 in bad seeing conditions, bordered by a white area and rounded on March 13, somewhat pointed on March 17 and 21, on which date there was a large white area bordering the W. coast of *Syrtis Major* which seemed to have decreased in size by March 23. On April 23 and 25, bright areas are shewn by Phillips along W. coast of the *Mare* and the coast-line was drawn well rounded.

On April 25, the Director drew the promontory more pointed but not encroaching upon the borders of the *Mare*. Ellison's drawings of March 31 also shew the promontory somewhat pointed in agreement with the other observers, and rounded on April 22. Ainslie shows the coast line smoothly curved on March 17, and agrees with the other observers in showing *Hammonis Cornu* more angular on March 22 and 23, while on April 25 the rounded form is again shewn, but on the following day he noted it as "more pointed than usual." On 1917 December 2 this region was white to McEwen and his sketch of the disc, which was then only about $6\frac{1}{2}$ secs. in diameter, shows this feature somewhat angular.

Observing with the 28-inch refractor at the Royal Observatory on April 22, Steavenson writes that he paid particular attention to the coast line of *Deltoton Sinus* and found no deep indentation to the S. of it.

Ainslie also remarked that *Hammonis Cornu* had a sharp point towards the end of the apparition and generally shewed a bright border which, on 1918 March 17, appeared to him light pink in colour.

It seems probable that the changes which occur in the appearance of the coast line in this neighbourhood are real and are due to white areas, frequently observed along the W. borders of the Maria in this region. (*See* Figs. 1–6, Plate I, and 1 and 2, Plate II.).

SINUS SABÆUS showed its usual form and had considerable intensity to most observers from 1918 January onwards. On January 3, Phillips found it "moderately dark" and on his drawing of March 12 it is drawn dark and well defined with its N. border sharp and clear cut. On April 25, Phillips noted that this marking was "very dark."

Using the 28-inch refractor on April 19, Steavenson found *Sinus Sabœus* "dusky neutral tint with a faint tinge of dark green, like foliage of distant pine trees," and on April 22 he saw the dark markings in this region a "greyish olive green or sage green."

Steavenson also remarked that the coast line from *Syrtis Major* to the *Forked Bay* was "very sharply defined and not fuzzy." His drawings of March 21 and April 22 show this marking dark and prominent, but the *Portus Sigeus* is not conspicuous.

Ellison in his sketch of April 22 shows *Sabœus* dark with clear cut borders both N. and S. and he also shows *Portus Sigeus* prominently. On this drawing the preceding end of S. Sabæus is shewn considerably wider than the following end.

So early as 1917 November 24, McEwen was able to make out this marking on the small disc as a "diffused brown yellow band" and on the following night he noted it as "a faint brown ochre band."

Ainslie shows *Sabœus* dark and broad throughout the apparition.

To the Director the strait had a similar appearance to that of the previous apparition. In March, the following portion towards *Furca* was much darker than the preceding portion.

The drawings of Phillips and Steavenson make the latitude of the N. edge of the strait at the position of *Portus Sigeus* about $-10°$ and the width was about $7°$ to $8°$. Ainslie shows it rather wider on March 17, and the N. edge at about $-5°$. (*See* Figs. 1–6, Plates I. and II.).

PORTUS SIGEUS is shewn on Ellison's drawing of April 22 as a very pronounced single indentation of the coast line. It was "always difficult" to Ainslie. It is indicated on Phillips's drawing of March 12 rather shallow and curved and in April it cannot

be distinguished on his drawings, nor is it shewn on those of Steavenson. Good observations of this region were somewhat scanty, but it appears that this feature was not conspicuous, at any rate after March. (*See* Figs. 3–6, Plate I., and 1 and 2, Plate II.).

DEUCALIONIS REGIO did not differ much from the appearance it had in 1915–16. The preceding end is shown pointed on March 21 and April 22 by Steavenson, whose coloured sketches show this region whitish on March 21 and somewhat ruddy on April 22, but with no grey shading except at the *f.* end, where it sweeps Northward and *Iani Fretum* crosses it.

Ellison's drawing of April 22 shows this region shaded.

Phillips depicts it whitish on January 3 and March 12, and very lightly shaded on April 23 and 25. To the Director it was usually fairly bright and on April 17 a special note to this effect was made.

On Ainslie's drawings the region seems to have had about the same intensity as the continent to the N. of *Sinus Sabæus*. Generally the observers' drawings agree well in showing the preceding end pointed and the area only very lightly shaded. (*See* Plates I. and II.).

HELLESPONTUS.—Steavenson noted that the N. portion of *Hellespontus* was conspicuous on April 22 (Plate II., fig. 2), and it seems to be indicated, although not very definitely, on the drawings of the Director on March 17, 21 and 23, while on April 25 it was noted as "easy" and it is also shewn by Ellison on April 22 (Plate 1, fig. 2). It cannot be certainly identified on the drawings of Ainslie and the majority of Phillips's drawings are not at a favourable longitude for this feature.

SINUS FURCOSUS was seen clearly double by Ainslie on two occasions only in April, but he states that his seeing conditions were usually poor.

The two prongs are shewn prominently on Ellison's drawing of April 22 and Steavenson on March 21 with the 10-inch O.G. at Four Marks and on April 22 with the 28-inch O.G. saw the Forked Bay very clearly, but he writes that on the latter date it was only at intervals that a definite fork could be made out.

The Forked Bay could not be resolved by Phillips on the small disc of January 5, but it was seen double by him on all occasions in March and April when favourably situated for observation. Gale reports that he could not definitely divide it on April 4, when it appeared to him as a "dark knot." Similarly on March 12, the Director found this marking very dark but could not be sure that the Forks were visible, possibly due to poor seeing which was prevalent during March, but on April 17 the forked appearance was clearly seen. On March 12, 13 and 17 the Director noted that this portion was much darker than the remainder of *Sinus Sabæus*. Few drawings are available with the Forked Bay on the C.M., but the drawings of Phillips and Steavenson agree in making the points of the "prongs" about 8° apart The *Hiddekel* prong, which was observed to be itself double in

1903 by Molesworth was not seen thus by any of our observers during this apparition. (*See* Plates I. and II.).

FASTIGIUM ARYN is shewn sharply pointed by Ellison on April 22. To Steavenson it appeared somewhat rounded and slightly shaded on March 21 and April 22, when he found it "rather difficult," while Phillips saw it pointed if somewhat diffused in outline on March 12 and April 23 and 25. On March 12 the Director found this promontory diffused and scarcely perceptible, but on April 17 his drawings show it similar to those of Phillips, its S. end being pointed. (*See* Plates I. and II.).

EDOM PROMONTORIUM was described by McEwen on 1917 November 25 as "bright white" but not so bright as N. Polar cap. Phillips shows it white on March 12, April 23 and April 25. To Steavenson on March 21 and April 22 it was not brighter than the adjoining land.

The Director found it bright on March 17, but on April 17 he noted that there was no pronounced white spot here. (*See* Plates I. and II.).

EDOM, EDEN, THYMIAMATA.—These regions showed no unusual feature during the apparition. To McEwen, 1917 November 24, they were "gold ochre" in colour, and they are shewn of a ruddy tint in Steavenson's coloured drawings of 1918 March 21 and April 22, on which a faint white area is indicated at the Southern border of *Thymiamata* to the N. of *Iani Fretum.* This lighter area is also indicated on Phillips's drawings of March 12, April 23 and 25, but no prominent whiteness was observed here during the apparition. (*See* Figs. 4 and 5, Plate I.).

AERIA.—This region was frequently seen white during the apparition, especially close to the following edge of *Syrtis Major.* Phillips noted that the coast of *Aeria* was "very bright" near the limb on March 17. His drawings of March 20 and 21 show no sign of whiteness here when near C.M. On March 23, when this region was near the *f.* limb, the whole district was covered with a white mass and it was shewn bright on April 23 and very bright on April 25 as *Syrtis Major* approached the *p.* limb and so it was seen by Gale on February 22. McEwen found it "bright white" on 1917 November 25, and on 1917 December 2 noted under $\omega = 292°$ that there was a white border along the *f.* coast line of Syrtis Major. On March 23 he found this region light ochre and rather bright. The drawings of Ainslie, Steavenson and the Director agree also in shewing this region bright when near the limb. Thus to the Director on March 12 the N. part of *Aeria* was "exceedingly bright" on the *p.* limb and on March 13 a large white area was observed covering the S. portion of the region and *Hammonis Cornu,* the longitude of C.M. being 332°. On March 17, $\omega = 300°$, this white area is shewn on the Director's drawing as a round white spot, $\lambda = 305°$, $\phi = +5°$, much smaller in area than on March 12 and the same whiteness is shewn on March 20, 21, 22, 23, and 25, on the last date the brightness of this region when on the *f.* limb was very

pronounced. That white " clouds " are common in this portion of the disc is evident from a study of our past records.

ARABIA.—Nothing unusual was noted in connection with this region beyond an occasional whiteness near the limb.

DIOSCURA.—Appeared very much the same as during the previous apparition. Phillips, on a coloured sketch dated March 21, shows it ruddy and not shaded. In general throughout the apparition this area is shown without appreciable shading, except on January 3, when it is shown shaded. In general this agrees with the Director's drawings, although to him in poor definition this area occasionally seemed darker than the region to the South of *Protonilus*, and Steavenson on his coloured sketches in March and April agrees in showing this area of the same general tone as the more southerly lands.

Ainslie's drawings agree generally with those of the Director, but in a few cases this region is shown slightly shaded and it appears thus on McEwen's sketch of March 22. The white spot numbered 16 on our 1903 chart was not observed by any Member during this apparition. (*See* Figs. 1–6, Plate I.).

CYDONIA was somewhat bright towards the *p.* edge of *M. Acidalium* to Phillips on January 3 under $\omega = 319°$. On March 12 the whole region *Dioscura-Cydonia* is shown on his sketches unshaded and without any pronounced white areas. On April 23 and 25, under $\omega = 348°$, a white spot was seen in this region preceding the edge of *M. Acidalium*, similar to those observed here in 1901, 1903 and other apparitions.* (*See* Figs. 4 and 5, Plate I.). The position of this white spot appears to have been about

$$\lambda = 5° \; \phi = +45°.$$

This spot is not shown on Steavenson's sketch of April 22 (Fig. 2, Plate II.) under $\omega = 325°$, nor did the Director see it when observing this region in March, nor on April 17. It is not seen on Ainslie's drawing of April 18, McEwen's of 1917 November 24, nor on Phillips's sketches in March and it thus appears that while this spot is of a recurrent nature it is not permanent. In 1903 this white spot was not shown by Phillips on May 4 and 7, but it appears on the drawings of May 12, 14 and 15.

The heliocentric longitude of Mars on 1918 April 23 was 191° and on 1903 May 12 it was 207°.

ORTYGIA.—A white spot was seen by Phillips on April 25 *p.* the coast line of *M. Acidalium* and precisely similar to a white spot seen here by him in 1903. (*See* Fig. 5, Plate I.).

SIRBONIS PALUS.—A dusky shading was suspected by the Director on 1918 March 17 approximately at $\lambda = 331° \; \phi = +10°$.

The canals *Orontes, Phison and Euphrates* were not seen at the time. On April 25 in rather poor seeing careful attention was paid to this region to determine the visibility of *Phison* and *Euphrates*, but, although glimpses of a network of broad streaks

* *See* Memoir, Vol. XVI., Part IV., p. 65.

was seen, no definite canals could be held certainly, but a dusky shading was suspected approximately in the position of the junction of *Phison* and *Euphrates* with *Typhonius-Orontes*, as shown on 1903 chart.

On March 21 Steavenson with the 10-inch O.G. clearly saw both *Phison* and *Euphrates* and with the 28-inch O.G. on April 22 these two canals and *Orontes* are shown as delicate lines, but no trace of *Sirbonis Lacus* is shown. (Fig. 6, Plate I.). Neither can this lake be confirmed from Phillips's drawings, who only doubtfully glimpsed *Euphrates* on April 25. Ainslie also does not show this lake and the weight of evidence therefore is against the visibility of this marking as a definite lake, but it has been indicated on the chart as an ill-defined shading.

ASTABORÆ FONS, ANUBIDIS FONS, ARETHUSA FONS.—None of these lakes is shown on any drawings available from our Members during the apparition. Steavenson observed this region with the 28-inch O.G. but shows no definite lakes here.

ISMENIUS LACUS.—Very few drawings of this district are available before or after the March and April presentations.

The lake does not appear on Phillips's drawing of 1918 January 3, but it was a conspicuous feature in March and April. Ainslie, Phillips, Steavenson, and the Director agree in showing *Ismenius Lacus* as a dark oval, some 8° to 10° long by 4° to 6° broad. It was usually shown broader than the canal *Protonilus*. Ellison, on the other hand, shows this lake as a well defined projection on the South side of the canal (*see* Fig. 2, Plate I.) and, writing in 1920 he states that he always sees this marking and *Coloë Palus* as " sharp little triangles as hard as bits of blue glass," with their vertices trailing away into indistinct lines which gradually lose themselves in the yellow region to the South. Phillips noted that this lake was " quite dark and definite " on March 12. To Gale it was " conspicuous " on April 4 and to the Director " large and dusky " on April 25. Two determinations of the position of this lake by Phillips make its longitude about 335·5° and the drawings of Ainslie and Steavenson agree in placing it within a degree of this position. (*See* Plates I. and II.).

DIRCE FONS.—With the possible exception of one drawing, this marking was not recorded by any Member of the Section in 1918.

IANI FRETUM.—Clearly seen by Ainslie, Phillips, Steavenson and the Director. Ainslie shows it very dark with an intensity equal to that of *Furca* and *Margaritifer Sinus* on his sketch of April 18, made, however, in poor seeing conditions. To the other three observers it was never so dark as the neighbouring *Maria*, though the Director noted it rather strongly shaded on March 12 and nearly as dark as *Margaritifer* on April 17. (*See* Figs. 2, 3, 5, and 6, Plate II.).

PANDORÆ FRETUM—Was distinctly difficult during this apparition. It does not appear on Phillips's drawing of January 3 when the disc was only 8 seconds in diameter, but it is well shown on his drawing of March 13, on which the preceding end is much

fainter than the following portion. At the April apparition this strait was very faintly indicated on Phillips's sketches. Steavenson indicates only the preceding and following portions of this marking on March 21 (Fig. 6, Plate I.) and on April 22 it was entirely invisible to him.

The Director found it invisible on March 17 and it was somewhat uncertainly glimpsed on March 21 and clearly seen on April 17. The following end is shown dark on Ainslie's sketch of April 18.

MINOR DETAIL.

ASOPUS?—On April 25 suspected by the Director as a dusky streak from *Astusapis Sinus* towards *Portus Sigeus.*

ARNON AND ANUBIS were not seen by any Member during this apparition, but a faint shading was noted by the Director on March 12 running in a S.E. direction from *Ismenius Lacus,* which may have been *Anubis.*

CALLIRRHOË—PIERIUS.—This canal was conspicuous throughout March and April. The preceding end of *Pierius* is shown some 4° to 5° broad and rather diffused by Steavenson in the longitude of *Copais Palus,* and narrowing down to a fine line near its junction with *Mare Acidalium.* (*See* Fig. 6, Plate I.). On April 22 he shows it diffused throughout its length and about 3° broad at longitude 325°, then on C.M., but fading out before reaching the border of *Acidalium.* (Fig. 2, Plate II.).

To Phillips and the Director *Callirrhoë* was usually very distinctly seen running into the *p.* border of *Acidalium.* It is shown by Phillips on March 9, 3½° broad and somewhat diffused, on March 12 somewhat faint and narrower, and on April 23 and 25 darker and well defined. To the Director on March 12 it was dark and broad and clearly seen to the border of *Acidalium.* On March 17 and April 25 *Pierius* was noted as "very easy" and it was shown about 4° broad.

Phillips and the Director show this prominent streak slightly curved to follow the parallel of latitude. Steavenson and Ainslie show it straight and Ainslie on March 17 shows it straight and narrow, while on March 23 he draws it broad and diffuse, on April 18 well defined and dark but not clearly reaching to *Acidalium,* on April 25 narrow and faint from 310° to the terminator. On April 4 Gale noted that this "faint streaklike marking" was widely separated from the N. *p.* angle of *Acidalium.* It appears that the slight differences between observers, in regard to *Callirrhoë-Pierius* are such that they can be accounted for by variable seeing conditions and the personal equation of the observers, rather than by any real change in the appearance of the canal from night to night. But it was pointed out by Lowell (*Annals Lowell Observatory,* Vol. 3) that in 1903 it was a characteristic of this canal that it faded away at its western end as also did *Deuteronilus* and that this behaviour is unlike that of the majority of the canals, which keep the same intensity throughout. It seems to the Director, however, that some distinction may well be drawn between the broad hazy canals of this type and the narrower and usually more uniform canals.

DEUTERONILUS—Is shown (Fig. 6, Plate I.) on March 21 by Steavenson narrow at its junction with *L. Ismenius* but wider and diffused towards *Niliacus Lacus.* With the 28-inch O.G., on April 22, he shows it more definite and entering the *p.* edge of Niliacus, where its width was about 3°. (Fig. 2, Plate II.) Phillips, Steavenson and the Director agree in showing this canal running into *Niliacus Lacus* and to them it was an easy object during March and April. Ainslie shows it narrow on March 17, broad on March 23 and April 18, when it did not reach the border of *Niliacus* on his sketch and on April 26 ($\omega = 325°$) it is not shown, but it was seen clearly by Phillips the previous night and it does not appear that any real change was indicated.

On April 4 Gale noted possible duplicity and he stated that it extended from the *Niliacus Lacus* to the preceding limb.

EUPHRATES is shown as a narrow line from *Ismenius Lacus* to *Portus Sigeus* by Steavenson on March 21 and April 22. It does not appear on Phillips's drawings of March 12, April 23 and 25, but on April 25 it was apparently glimpsed by him at times but not certainly. On the same date particular attention was paid to this region by the Director, who noted that, although faint detail could be glimpsed resembling a network of broad streaks in the neighbourhood of *Phison* and *Euphrates*, he could not be certain of any definite canal.

Ellison's drawing of April 22 (Fig. 2, Plate I.) shows a canal running a short distance from *Portus Sigeus* towards the North which faded away at about latitude + 10.

On March 17 Euphrates was depicted throughout its whole length by Ainslie, using his 8½-inch mirror, and again on April 25. The canal is shown 2° to 3° broad and single.

GEHON is not shown on Phillips's sketches of this region in March, but appears prominently on April 23 and 25 as a broad dusky streak about 4° wide from the Western prong of the Forked Bay to the S. *p.* corner of *Niliacus Lacus*. The intensity towards the North was much less than near the Forked Bay.

According to Phillips's sketches this canal did not extend N. of *Achillis Pons* as shown on the 1903 chart, but joined *Niliacus Lacus* as shown by Molesworth in the 1896 *Memoir*, page 75. On his drawing of March 21 Steavenson shows here a faint broad shading, some 8° wide, extending from the two prongs of the Forked Bay to the S. *p.* corner of *Niliacus Lacus* and there is no trace on his sketch of any canal running to the North of *Achillis Pons* into the *p.* corner of *Acidalium*. On April 22 with the 28-inch O.G. under $\omega = 325$ Steavenson drew this streak about half as wide as n March 5 proceeding from the following prong of the Forked Bay only, but he noted it as "very broad." Later on the same evening, under $\omega = 353°$, this ill-defined streak is shown only to its junction with *Deuteronilus* at about longitude 10°. (*See* Fig. 2, Plate II.).

Ainslie on April 18 shows a narrow canal from the following prong running into a lake on *Deuteronilus*, which may have been the *Dirce Fons* of 1915-16, although the Director is of the opinion that this lake was not seen in 1918. On April 26 Ainslie shows *Gehon* running into *Niliacus Lacus* as seen by Steavenson and Phillips, and it seems probable that the poor seeing on April 18 caused the canal to be wrongly placed as it was seen by no other observer in the position shown on that date, although it may be the *Is* of Lowell (1897 and 1900).

Ellison's sketch of April 22 shows Gehon for a few degrees only from the Furca. (Fig. 2, Plate I.).

HIDDEKEL is shown by Steavenson on his sketch of March 21 (Fig. 6, Plate I.) running as usual from the *p.* prong of the Forked Bay to *Lacus Ismenius*, but with the 28-inch O.G. on April 22 this canal is not shown, nor is it seen on Phillips's sketches during the apparition.

The Director noted that it was "suspected without looking for it" on March 17, and on April 17 he remarked that this canal ran into the *f.* end of *Ismenius* but it was not certain to which prong of the Forked Bay it went. The existence of the canal was quite plain on this date and it was frequently drawn by Ainslie and appears on his sketches of March 16, 17, and 23, April 25 and 26. Phillips shows a canal in this neighbourhood, but he makes it run to *Coloë Palus* instead of *Ismenius*, which is the course of *Sitacus* (*see* 1900 and 1903 *Memoirs*). We have here an example of one of those strange discrepancies between observers which are so difficult to explain.

ORONTES–TYPHONIUS was seen only by Steavenson when using the 28-inch O.G. on April 22, under $\omega = 353°$, when he noted that these canals "were the only streaks which looked as if they were discontinuous." (Fig. 2, Plate II.)

OXUS-TRITONILUS.—This curved canal running from the N. point of *Margaritifer Sinus* to *Ismenius Lacus* was clearly depicted by Steavenson, Phillips and the Director. The width of the canal in general was similar to that of Hiddekel, Phison and Euphrates. Steavenson speaks of these canals as "broad and diffuse, though pretty straight and smooth on the

whole. There was no question of their being merely the edges of faint half-tone shadings." These canals are not shown on Ainslie's drawing of April 18, referred to above in connection with *Gehon* and *Is.* These canals were seen by the Director at intervals on March 12 and very easily on April 17, but observations of this region near the C.M. were few.

PHISON is clearly shown by Ainslie on his drawings of March 17 and April 25 and 26. Steavenson drew it on March 21 and April 22 from *Portus Sigeus* to *Coloë Palus.* This canal was not certainly seen by the Director, but was suspected on April 25, on which date Phillips noted that it was quite distinct, but it is not recorded by him on any other date.

PROTONILUS.—Could be traced as far as *Ismenius Lacus* by McEwen on 1917 December 2, when the diameter of the disc was between 6 and 7 seconds of arc and throughout the apparition was a conspicuous marking. Phillips draws it as a broad hazy streak on January 3 and generally throughout the apparition it appeared broad and diffused to him. Ellison shows it strong and somewhat narrow on April 22. Steavenson shows it narrow on March 21 and rather broad and diffused on April 22. Ainslie's drawings also vary in regard to the width and intensity. To the Director, in general this canal appeared broad and diffuse, and on April 25 it was noted that its width was about 8° where it joined *Ismenius Lacus* and that its edges were not sharp but diffuse. Doubling of this canal was not recorded by any of our observers during this apparition. (*See* Plates I., II., and VIII.).

SITACUS is shown by Steavenson on April 22 running from the *p.* prong of the Forked Bay to the junction of *Astaboras* and *Phison.* (Fig. 2, Plate II). It also appears to be indicated on sketch by Ainslie on April 18 made in poor conditions, but there is some doubt regarding its identification. Phillips shows the canal on March 12 and April 25, running into *Coloë Palus* (Figs. 4–5, Plate I.).

(*Note.*—It should be noted that in Lowell's map *Coloë Palus* of the *B.A.A. Memoirs* is *Pseboas Lacus* and that his *Coloë Palus* is placed at the intersection of *Phison, Sitacus,* and *Astaboras.*

In Lowell's 1894 map the canal *Arabice* runs to the B.A.A. *Coloë Palus,* while *Sitacus* runs further south to the junction of *Phison* and *Astaboras.*

In Flammarion and Antoniadi's map *Pseboas Lacus* is placed about $\lambda = 296°, \phi = +33°$, while *Coloë Palus* is 6° or 7° further North).

The Director is of the opinion that Ainslie, Phillips, and Steavenson all saw the same canal here and it is thus recorded on the chart and called *Sitacus.*

SECTION II.

Margaritifer Sinus, Auroræ Sinus, and Mare Acidalium.

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

MARGARITIFER SINUS is shown in its usual form by Phillips, Steavenson and the Director, but few drawings are available. Ainslie did not obtain a view of this region in good conditions, while McEwen was only able to observe this portion of the disc in November 1917, when the apparent diameter of the planet was very small. On April 19 Steavenson examined this ***Mare*** with the 28-inch refractor and found the colour to be " neutral tint with a faint tinge of dark green like the foliage of distant pine-trees " and three days later with the same instrument the colour was noted as " pale olive green."

Phillips writes that on March 11 there was an interesting contrast in the colour of the N. and S. markings. The S. markings appeared to him greenish blue in the refractor and bluish grey in the reflector, while the N. *Maria,* such as *Acidalium,* appeared neutral tint in both telescopes. To Gale, Phillips,

Steavenson and the Director *Margaritifer Sinus* was usually less dark than *Furca*.

OXIA PALUS was seen only by Phillips, who found it "easy" on March 9. It also appears on his sketch of March 12 (Fig. 4, Plate I.), but it is not shown on his drawings of this region in April. That it was visible in April is shown, however, by some of the drawings published by Professor W. H. Pickering in *Popular Astronomy*, Vol. XXVII.

EOS-PYRRHÆ REGIO.—A bright pointed projection from *Aromatum Promontorium* in the position of *Eos* is shown indenting the *Mare* by Phillips on March 8 and on the following day this bright area seems to have extended and formed the *Pyrrhæ Regio*.

On March 12 the Director noted that *Pyrrhæ Regio* ran into *Aromatum Prom.* and that no dark bridge could be seen dividing *Eos* from the land to the N. of it as shown on the 1903 chart.

On April 17 this dark bridge was uncertainly suspected by the Director, who noted that the lighter area did not extend so far to the East as during the March apparition.

AURORÆ SINUS was seen dark by Phillips and the Director on January 1 and is shown very dark and uniformly shaded by Phillips on January 30, the colour being a mixture of green and blue in the refractor and blue in the reflector.

About March 1 a large white area was visible in this neighbourhood and on that date Phillips found that the region *Auroræ Sinus–Solis Lacus* was partially veiled and appeared much less dark than at the previous presentation. On March 1 under $\omega = 121°$ this large white area extended from $\lambda = 110°$, $\phi = +10°$ to the preceding limb, where it subtended an angle of about 30°, its southern limit being approximately at $-20°$. On March 4, under $\omega = 66°$, Ellison showed *Auroræ Sinus* very dark. Phillips on March 5, under $\omega = 78°$, found it still partially veiled and faint, but *Ganges* was visible preceded by a large white area in *Chryse* which, if the remains of the bright area seen on March 1, had moved eastwards and northwards and was beginning to disappear.

By March 8, *Auroræ Sinus* had resumed its normal appearance to Phillips, who found its colour bluish grey in the reflector and greenish blue in the refractor.

Phillips's drawing of March 9 (Fig. 3, Plate II.) shows considerable detail in this *Mare*. *Protei Regio* appears as a lightly shaded bridge across the Mare emerging just north of *Nectar*. To the south of this bright bridge were two dusky condensations or streaks which were probably the *Dargamanes* and *Garrhuenus* of the 1901 chart (*see Memoirs*, Vol. XI., part III., page 102). A hazy condensation to the North of *Protei Regio* is also indicated on Phillips's drawing. A dark condensation has been noted here frequently by Lowell and also by Antoniadi and others (*See* 1901 *Memoir* and chart, where it is marked β.)

LUNÆ LACUS is shown by Ellison, Phillips and the Director as a large hazy shading at the junction of *Ganges* and *Nilokeras* without any well-defined border or central condensation (*see*

Fig. 6, Plate II.; Fig. 3, Plate III.). It appeared hazy and diffuse to Phillips on January 1, and on January 30 he describes it as "easy but soft and diffuse," and on March 9 he recorded that there was "no definite spot at present visible in the position of *Lacus Lunæ*" and this region had much the same appearance during the April presentation. On April 8 the Director noted that "the broad dusky shading forming *Nilokeras* was somewhat darker in the position of *Lacus Lunæ* but there was no well-defined marking here—just a dark smudge."

Ainslie's drawing of April 12 shows a strong dark, somewhat diffuse condensation in this position, slightly elongated in an E. and W. direction, about 10° long by 8° broad. The observations of this region are scanty, but observers in the main agree in showing *Lacus Lunæ* as large and diffuse without any well-marked lake at its centre.

ACHILLIS FONS.—Seen only by Phillips on March 9 when "it came out clearly once or twice." His sketch (Fig. 3, Plate III.) shows it as a well-defined spot on the N. edge of the large curved shading designated *Nilokeras* on our charts. It is shown joined to the S.W. corner of *Acidalium* by a well-defined canal.

JUVENTÆ FONS.—This difficult lake was also only seen by Phillips, though carefully looked for by the Director. Phillips writes that on March 9, greatly to his surprise when looking for *Ganges*, this little dark spot persistently appeared at intervals, together with the canal *Bœtis* connecting it with *Auroræ Sinus*. This was the only occasion on which this lake was seen by one of our observers during the apparition. (*See* Fig. 3, Plate III.).

NILIACUS LACUS is shown generally throughout the apparition paler than *Mare Acidalium* but is clearly shown on the drawings available from January to the end of April. The borders of this marking are shown somewhat diffuse by Steavenson, Phillips and the Director in contrast with the clear cut outline of *Mare Acidalium*.

Gale noted on April 4 that *Niliacus* was clearly separated from *Acidalium* and so it was seen by most of the observers, who also agree generally that it was much fainter than *Acidalium*. Ellison, however, on March 4 shows it nearly of the same intensity as the *Mare* and projecting towards the West.

It is not shown on McEwen's drawing of 1917 November 24, made under conditions which were not very good, when the diameter of the disc was also very small. On 1917 November 25 McEwen remarked that *Acidalium* was "clearly visible rather more than half-way from the limb to C.M., but no trace of *Niliacus* could be seen, but the intervals of steady image were too short to be sure about this."

ACHILLIS PONS suspected, but uncertainly, by Phillips on the small disc of January 1, on which night the Director thought it was certainly visible. It was clearly seen by Phillips on January 30 and during the remainder of the apparition was shown on his drawings and on those of Steavenson and the Direc-

tor. Ainslie shows this bridge on April 12, but did not see it on April 18, when the seeing was poor. Ellison's drawing of March 4 (Fig. 2, Plate III.) appears to indicate the following portion only and the Director noted on April 17 that it was faint and difficult to see under rather poor seeing conditions.

Gale recorded its appearance on April 4 and there appears to be no doubt that the bridge was visible during the apparition whenever seeing conditions were good.

MARE ACIDALIUM was probably the darkest and most conspicuous marking on the disc during the period under review, although Ainslie thought that this *Mare* was never so black as he remembered it in former years, such as 1903. Ainslie considered the colour a varying shade of grey; Steavenson, a "dusky neutral tint with a faint tinge of dark green" on April 19 with the 28-inch O.G., and "pale olive green" on April 22 with the same instrument.

On the small disc of 1917 November 24, McEwen found *Acidalium* "by far the most conspicuous feature on the disc," but on the following night it was faint when approaching the C.M. On this night McEwen found that details on the disc appeared to be veiled, although fairly well defined.

To Phillips and the Director *Mare Acidalium* was very dark and prominent on the small disc of 1918 January 1, and so it usually appeared throughout the apparition. Phillips found the colour "neutral tint" on January 30 and March 8, and on the latter date recorded that the *Mare* was "unevenly shaded but the mottlings difficult to locate." The Director on March 7 and 12 noted that the N. end of *Acidalium* was much darker than the S. end, and the colour was neutral tint. On April 8 the colour appeared to him bluish grey and on April 17 the shading was not uniform, darkest towards the North, but no definite lakes or canals could be detected within the border of the *Mare*.

Phillips's sketches are somewhat at variance with those of the Director as he shows the S. end of the *Mare* rather darker than the N. and the intensity fading in the region of *Baltia* between latitude +60° and +70°. The general form of *Acidalium* as depicted on Phillips's drawings was very similar to that shown by him in 1903, when *Baltia* and *Acidalium* combined to form one dark curved area. (*See M.N.*, Vol. LXIV., No. 1), and so it is shown by most of our observers during the apparition. Steavenson records on April 22 that the Mare was faint north of the latitude of *Callirrhoë*, although the preceding edge reached nearly to the Polar Cap—which, doubtless, was the canal *Iaxartes*, also recorded by Phillips. (*See* Fig. 5, Plate II., and Fig. 3, Plate III.).

NILOKERAS is represented on the drawings of Phillips, Ellison and the Director as a broad shaded area sweeping in a curve from *Lacus Niliacus* to the position of *Lacus Lunæ*. It is frequently described by Phillips as "very diffuse and smudgy."

While examining this marking on March 9 Phillips clearly detected *Achillis Fons*, which was joined to the S. *f.* corner of

Acidalium by a well defined streak or intensification of the broad *Nilokeras* shading. (*See* Fig. 3, Plate III.) Phillips's sketch of this date shows some indication of a lighter area in this shading dividing it unevenly into Nilokeras I. and II., but in general the drawings do not show two separate components in this marking, but the Director noted on March 12 that the N. edge was accentuated almost into a separate streak, and Gale reported that on March 29 *Nilokeras* curved in a "faint *double* marking towards the *f.* side of the disc."

TEMPE was frequently seen bright both near the limb and on the C.M., especially near the *f.* edge of *Acidalium*, where the appearance of a white area is very common. Gale speaks of this region on March 29 as a "rich copper colour with indefinite shadings."

ARGYRE.—On 1917 November 24 McEwen observed an intensely brilliant white spot on the S. limb, which he identifies as Argyre I. He states that the brilliancy of this spot was sufficient to make it appear to project beyond the limb under unsteady atmospheric conditions. This region was also seen bright by McEwen on 1917 November 25 and by Phillips on 1918 January 30, March 7 and 9, and April 14.

MINOR DETAIL.

DARDANUS.—On April 4, Gale noted an "extension from *Niliacus* in the position of Dardanus." This canal is not shewn on any of the drawings available for comparison. The Director suspected a long narrow *bright* area in about the position of this canal on January 1, but the disc was then too small for very accurate observation. No sketch is available showing this canal, and it has been omitted from the chart in consequence.

GANGES.—This canal, which was invisible to Phillips and the Director in 1916, was seen by the former on January 30, and appears on his sketches during February and March as a broad, hazy streak, and so it also appeared to the Director on April 8 and 17. Ainslie shows it dark and well-defined on April 12, and Ellison similarly earlier in the apparition on March 4 (*see* Figs. 1, 2, 3 and 4, Plate III.).

JAMUNA.—The N. portion of this canal appears on Phillips's sketch of January 30, but it was not traced to its junction with *Aurorœ Sinus*. On March 8 it is shewn throughout its whole course, but on March 9 Phillips remarked that he did not think it extended as far as *Aurorœ Sinus* (*see* Fig. 5, Plate II.). Suspected towards its S. end by the Director on April 17 it was not clearly seen by him during the apparition.

HYDASPES.—A faint shading, extending S. from *Acidalium*, about 15° west of the position of *Indus*, was noted by McEwen on 1917 November 24, which possibly may have been *Hydaspes*, although this canal has been usually faint and difficult, and it seems improbable that it can have been sufficiently dark to be seen on the small disc at that date.

Ainslie shows a narrow canal here on April 18, but no other observer recorded it during the apparition.

INDUS.—Invisible to McEwen on the small disc of 1917 November 24, it does not appear on Phillips's drawings during the apparition, unless it is incorporated in the N. end of *Gehon*, which he shows running into *Lacus Niliacus*. It was seen by Steavenson on April 22 with the 28-inch O.G.

TANAIS does not seem to have been always distinguishable from the general shading of *Baltia-Nerigos*. Its *f.* portion, where it sweeps southwards at *Ceraunius*, is shewn on Phillips's drawings of January 30. His

drawings in March show this marking at its *p.* end rather faint and terminating before its junction with *Acidalium.* On April 8, the Director recorded that *Tanais-Eurotas* and *Eridanus* were seen clearly as two separate broad streaks with a lighter, but still shaded, area between them. Ainslie's drawing of April 12 is similar to that of the Director on April 8. On April 17 the Director noted that *Tanais* appeared very similar to the form given it on the 1905 chart.

SECTION III.

Solis Lacus.

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

This and the following Section are undoubtedly the most difficult on the planet. There are a number of faint markings between latitudes 0° and + 40° which are extremely difficult to define clearly, and it is not surprising that observers sometimes differ considerably in their representations of this portion of the planet's surface.

An interesting feature of this region was the extraordinary brilliancy of three white spots observed in February and April by Phillips, Steavenson and the Director.

The approximate positions of these white areas was

(*a*) $\lambda = 110°$; $\phi = +8°$
(*b*) $\lambda = 113°$; $\phi = +40°$
(*c*) $\lambda = 140°$; $\phi = +18°$

The brightness of these spots was remarkable especially, perhaps, at the end of February, when the Director noted that they brightened perceptibly as they approached the limb. White areas have been observed frequently in these regions of the planet. Probably the most famous example is Schiaparelli's *Nix Olympica.* Lowell's position for this spot in 1903 was $\lambda = 131°$; $\phi = +21°$. Making some allowance for possible errors in our drawings and their measurements, it is possible that spot " c " was *Nix Olympica,* while spot " b," in the middle of *Arcadia,* seems to correspond with a similar bright spot seen by Lowell in this neighbourhood in 1903 in longitude 107°, latitude + 41°. The area " a " is probably identical with that numbered 9 on our 1903 chart.

Phillips notes that he saw similar white areas here in 1903 and 1905. On April 8 the Director noted a bright spot on the *p.* limb, approximately in the position of spot No. 8 on the 1903 chart. Whether these bright spots are due to snow, cloud or hoar frost on Mars, we cannot say with any certainty, but it is of the utmost importance that they should be observed with the greatest care, as they may provide an important clue to a solution of many problems in connection with Martian climatology.

THAUMASIA.—The tilt of the planet's axis made observation of this well-known region somewhat difficult, its southern boundary being scarcely, if at all, discernible. On several

nights, however, during the apparition, Phillips had good views of *Solis Lacus* and the region to the N. of it bounded by *Agathodæmon* and its associated canals. McEwen, on 1917 November 24, noted the colour of this region as "light ochre with splashes of white, which brightened this part of the limb," the longitude of C.M. at the time being 21°, and it was again noted as "light ochre" on December 21. This area appeared "partly veiled" to Phillips on March 1, and *Solis Lacus* was invisible to him, and on March 5 the pallor still remained, but Solis Lacus was visible, although difficult. Phillips's drawings of March 8 and 9 show a normal appearance here. On April 8 the Director saw a white area to the west of Solis Lacus (*see* 1913–14 *Memoir*, page 69) and Phillips's drawing, made three days previously, appears to indicate a whiteness extending over the *f.* portion of *Thaumasia*.

SOLIS LACUS was too close to the S. limb for favourable observation, but it was clearly seen on frequent occasions. It does not appear to have shewn any unusual features during the apparition. Phillips found it quite distinct on January 30 (*see* Fig. 1, Plate III.). On March 1 it was veiled by the cloud which partially obscured *Aurorœ Sinus* and could not be detected, but on March 5 it was again faintly visible and by March 8 the cloudiness had disappeared and the lake with the canal *Nectar* were clearly seen. At the next presentation, in April, the lake was clearly seen by Phillips on April 8 and by the Director, who noted, however, that it was faint and seemed to be partially veiled. As stated above, there was a white spot in about $\lambda = 108°$ following the lake on this date.

NECTARIS FONS.—No definite lake was observed here, but Phillips shows a dark condensation or streak on his drawing of March 9, which has been mentioned above as probably the same as the marking called *Garrhuenus* on the 1901 chart (*see* Fig. 3, Plate III.).

TITHONIUS LACUS.—On the small disc of 1917 December 21 this lake appeared "distinct" to McEwen, though diffused. It was elongated E. and W. According to his estimate the W. end of the lake was at $\lambda = 104°$. McEwen also states that the lake was "darker than *Ceraunius* and *Fortuna*." On the drawings of Phillips and the Director this lake had its usual elongated form. Phillips found it easy on January 30 and it is strongly shewn as a broadening of the canal *Agathodœmon* in March and April. The Director found it broad and rather faint on April 8. Ellison shows it rather small and dark on March 4. Ainslie shows a broad diffused wedge-shaped shading here under $\omega = 70°$ on April 12, which consisted of *Agathodœmon* and *Tithonius Lacus*, the combined streak being separated from the coast-line of *Aurorœ Sinus* by a bright bridge. If this could be identified with Schiaparelli's *Aurea Chersonesus* of 1877 and 1879, it would be an interesting observation. This bright bridge is not shewn by any other member and it may

have been a very temporary phenomenon (*see* 1901, *Memoir*, page 107).

PHŒNICIS LACUS is not shewn as a definite lake on the drawings of Phillips or the Director, and few other drawings are available of this region. A dark band or wide canal was seen here by the Director on April 8, but no definite lake could be made out.

ASCRÆUS LACUS was not visible to McEwen on 1917 December 21, nor to the Director on the much larger disc of April 8. Neither does it appear on Phillips's drawings of January 30 or March 5. There is, however, some confusion regarding this lake. On the 1903 chart this lake was in latitude +9°; in Flammarion and Antoniadi's standard chart it is shewn at about + 17°. In 1915 it was shewn on the chart at about + 22°. To the Director, on April 8, a large dusky shaded band covered the area of *Amazonis* from longitude 100° to 160° and latitude + 10° to + 40° approximately. The outlines were indefinite.

MAREOTIS LACUS.—It seems that there was some confusion between this and the preceding marking on the part of some of the observers. Measurements of Phillips's drawings show a large hazy spot formed by the junction of *Ceraunius*, *Nilus* and *Charadrus* at about lat. + 35° in the position of *Mareotis Lacus*, as shewn on the 1903 chart, and the Director has assumed that this is the same marking seen here in 1903. Phillips found it "easy but soft and diffuse" on January 30, and draws it thus throughout the apparition. The Director showed no definite lake here on April 8, the whole dusky shading being faint and diffused. All the markings in this neighbourhood were difficult and their identification from previous charts is by no means certain.

CERAUNIUS.—McEwen on 1917 December 21 noted that the E. edge of this marking was visible when he could see no trace of the W. edge, and he found that the E. edge "continued S. meeting *Fortuna* in about the position of the invisible *Ascræus*." Later the same day, under $\omega = 116°$, the W. edge was also seen but the E. edge was the harder. Phillips noted that *Ceraunius* was "more definite" than *Nilus* on January 30, and he shows it faint towards the north in February and March, but darker and more clearly defined on April 5 under $\omega = 139°$. On Phillips's drawings the edges of this marking were generally indefinite and ill-defined during the greater part of the apparition. To the Director, this marking was fairly well-defined on April 8 towards the North, but broad and diffused towards the centre of the disc, in the position of *Lacus Mareotis* (Fig. 2, Plate IV.). Ainslie shows it dark on April 12 and a white bridge crossing it N. of *Lacus Mareotis*.

TRICHONIS LACUS.—No definite lake is shewn by any observer in the position of this marking. Phillips shows the

junction of *Sirenius* and *Charadrus* here forming a prominent bend in the shaded streak, but no dark condensation at the junction.

MINOR DETAIL.

AGATHODÆMON showed no special features and was seen in its normal form throughout the apparition, except that Ainslie shows a bright bridge on April 12 separating this canal from *Aurorœ Sinus*. The canal itself, on Ainslie's sketch, appears as a broad wedge-shaped marking.

CHRYSORRHOAS was not recorded on any of the available drawings.

FORTUNA, recorded only by McEwen on 1917 December 21, but the Director noted on April 8 that there seemed to be a dusky streak running South from *Mareotis Lacus* which might be *Iris* or *Fortuna*.

NECTAR appears in its usual form on Phillips's drawings when not obliterated by white cloud.

NILUS is shewn broad and diffuse by Phillips and possibly broadly double on March 9. This shaded streak was faint on Phillips's sketch of January 30, but dark and nearly 10° wide on his drawings of March 9 and April 8. Ellison's drawing of March 4 and Ainslie's of April 12 shew *Nilus* very strongly marked and broadening into a large diffuse shading in the position of *Mareotis Lacus*.

ARAXES is strongly shewn on the Director's drawing of April 8, but a drawing by Phillips on the same date does not confirm the darkness of this canal.

SECTION IV.

Mare Sirenum.

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

MARE SIRENUM could not be seen by McEwen on the small disc of 1916 December 16, when he noted a gold ochre tint in this neighbourhood.

The *Mare* is shown dark by Phillips on February 24, 25, 27 and April 1, but its *p.* end seems to have been partially covered by the white cloud which early in April covered Thaumasia.

The Director's drawings of February 27 (Fig. 2, Plate V.) also shew this *Mare* dark, and it is shewn fairly so on April 2, 3 and 8; but a note states that on April 2, in unsteady seeing, the markings here were difficult to make out Steavenson shews it fairly dark and well defined on its N. edge on February 25 (Fig. 4, Plate IV.), and Ainslie also shows it dark on May 10.

ATLANTIS seen with difficulty by Phillips and the Director (Figs. 1 and 2, Plate V.) on February 27, it was invisible to the Dirctor in poor seeing on April 2. Phillips glimpsed it on April 1, when he found it shaded and difficult. It does not appear on Steavenson's sketch of February 25.

MEMNONIA was seen bright by McEwen on 1917 November 10, especially when near the limb. His sketch of this date shows a bright streak extending over *Memnonia* and *Zephyria* and a similar appearance was noted on December 16 under $\omega = 153°$, when this white band was very bright—brighter than the Polar Cap. The latitude of the bright streak was about $-10°$ and it extended from the limb to a little past the C.M.

TITANUM SINUS is clearly shewn by Phillips on February 27 and April 1 and on the latter date traces of the canal *Tartarus* were seen at its junction with the bay. This bay is strongly shewn on the Director's drawings of February 27, April 2, 3 and 8.

PHÆTHONTIS and ELECTRIS were frequently seen very bright on the limb.

AMAZONIS and ARCADIA.—These regions contained a number of faint shadings, which were very difficult to locate or draw accurately. From the comparatively few drawings available it appears that the markings can be best identified with the system comprising *Trichonis Lacus*, *Gorgon*, *Sirenius*, *Nodus Gordii*, *Phlegethon*, *Pyriphlegethon*, *Eumenides* and possibly part of *Gigas*.

A brilliant white spot, $\lambda = 140°$, $\phi = +18°$, has been mentioned elsewhere under Section III.

Amazonis appeared greyish to McEwen in 1917 November.

NODUS GORDII.—The Director has identified this marking with a darkening in the dusky streak *Sirenius Eumenides*, where a prominent bend is shewn on Phillips's drawing of April 5. (*See* Fig. 3, Plate IV.).

The position of this marking was approximately $\lambda = 118°$, $\phi = +4°$.

AMMONIUM LACUS.—No definite lake was seen here by any of our observers.

MEDUSÆ FONS-AQUÆ APOLLINARES (*See* 1909 *Memoir*, page 68).—The Director detected a streak on April 2 approximately in the position of these markings as shewn in the 1909 chart and a similar streak appears to be indicated on Phillips's sketch of the previous night. The streak appeared to the Director to be continued along the parallel of latitude towards the S.W. end of *Cerberus* and he noted that if it was really the *Eumenides-Orcus* it did *not* run into the *Trivium Charontis*. (*See* Figs. 3 and 4, Plate V.).

Ainslie on March 31 shows a dusky streak running approximately along the parallel $-10°$ toward *Pambotis Lacus*.

This canal has been called *Marne* by Professor W. H. Pickering in his Report on Mars No. 21 (*Pop. Ast.*, Vol. XXVII.).

EUXINUS LACUS—ASCANIA PALUS.—A broad ill defined shading preceding *Propontis* by 20° or 30° is shown on the drawings of Phillips, Steavenson and the Director. The position of this shading agreed approximately with that given to *Euxinus Lacus* and *Ascania Palus* on the 1915 chart and was, no doubt, the same marking. In the Interim Report *B.A.A. Journal*, Vol. XXIX., page 48, this marking was called *Artynia-Titania?* As measured on Phillips's drawing of April 5 at latitude $+55°$ the longitude of the centre of this shading was about 135° and at latitude $+30°$ it was about 159°. Phillips's drawings of February 25 and February 27 show two condensations in this shading, which may be identified with *Ascania Palus* and *Euxinus Lacus*

of the 1915 chart. The Director's sketches of February 27, April 2 and 3 are somewhat similar to those of Steavenson, who on February 25 shows the shading about 12° wide and extending nearly to latitude +15°. Although well seen by the above observers this marking was somewhat difficult and there seemed to the Director to be a wealth of faint detail in this neighbourhood which was just beyond the reach of clear seeing. (*See* Figs. 3 and 4, Plate IV.; Figs. 2, 3, 4, Plate V.).

EREBUS is shewn on Phillips's drawing of February 27, rather broad and dark from *Ascania Palus* to about halfway to *Trivium Charontis*, when it faded out; on the Director's drawing of the same date a faint broad shading extended southwards from Ascania Palus, but followed the course of *Brontes* or *Titan* (1913–14 *Memoir*) rather than *Erebus*, which is indicated on Steavenson's drawing of February 25, only near its junction with *Trivium Charontis*. (*See* Fig. 6, Plate V.).

PROPONTIS I. and II.—These markings are variously shewn by Phillips, Steavenson, Ainslie and the Director. Phillips shows them separated by *Herculis Pons* on all his sketches in February, March and April, whenever seeing conditions were good. On February 24, however, he remarked that *Propontis* was surprisingly indefinite, although *Cerberus* was dark. Steavenson on February 25 and the Director on February 27 show *Herculis Pons*, but the latter was unable to see it on subsequent dates when he depicted *Propontis* somewhat resembling the "*Wedge of Casius.*" (*See also* Professor Douglas's drawings Nos. 15 and 16 in Professor Pickering's report on Mars No. 21, *P. A.*, Vol. XXVII.). Phillips's estimates of the longitude of these markings are given later in this *Memoir*.

Ainslie's drawings of March 31 and April 5 show these shadings somewhat indefinitely merged into a large triangular marking in the region *Cebrenia* and on May 9 his sketch apparently indicates two separate markings. On the small disc of 1917 December 21, McEwen was able to detect *Propontis* as a thickening of the band around the N. Polar cap.

CHARADRUS is shown by Phillips and the Director as a broad hazy shading without well defined edges and about 10° wide.

MINOR DETAIL.

EUMENIDES-ORCUS.—This canal was not well seen by Members during this apparition. *Orcus*, or possibly *Tartarus*, is shown by Phillips on March 26 under $\omega = 215°$, near its junction with *Trivium Charontis* and similarly by McEwen on March 24. It does not certainly appear on the drawings of Ainslie, Ellison, Steavenson or the Director.

ACHERON AND *PHLEGETHON.*—A shaded streak, identified by McEwen with these canals, was seen by him on the small disc of 1917 November 10 to have ragged edges and to be pale sepia in colour, and again on December 16. The identification of the markings seen in this neighbourhood is somewhat doubtful.

The Director has called the dark shading leading westwards from *Lacus Mareotis*, *Charadrus*, as on the 1903 chart, and it is possible that this is the marking referred to by McEwen.

EUROTAS can hardly be said to have appeared as a definite canal, the markings in this neighbourhood being broad and hazy on Phillips's drawings, who alone had much success in this region. The Director's drawings in April show *Tanais-Eurotas* as a broad streak quite separate from *Eridanus*.

TITAN appears to be indicated on Ainslie's drawing of March 31.

TARTARUS.—Phillips noted a trace of this canal on April 1 and it is possibly the same marking as seen by Ainslie the previous night and called *Titan* above; but see below.

TITANUM SINUS appears rather pointed to the N. on the drawings of Phillips, Ainslie, and the Director. It is shown rounded on Steavenson's sketch of February 25. In Professor Douglas's drawing of March 4, given in Professor Pickering's Report, No. 21, referred to above, the canals *Gigas*, *Titan* and *Tartarus* are shown emanating from this bay.

SECTION V.

Mare Cimmerium, Elysium and Trivium Charontis.

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

MARE CIMMERIUM presented no very special features in 1918. The following end is shown pointed by Phillips on March 23 (Fig. 2, Plate VI.), when *Hesperia* was clearly visible, and so it appeared to Steavenson on the previous night (Fig. 2, Plate VII.).

Læstrygonum Sinus and *Cyclopum Sinus* are clearly shown on Steavenson's drawing of March 22 and on Phillips's of February 17 and March 26, and Ellison showed *Cyclopum Sinus* very prominently on March 21 and 23.

McEwen noted the colour of this sea as "faint raw amber" on 1917 October 30, with a shaded border on *Æolis* and *Æthiopis*, both of which were "golden ochre."

On March 22, McEwen considered *M. Cimmerium* "defined but faint," and its colour a neutral tint. He shows the following point somewhat rounded and noted that, although no distinct spot appeared, *Cimmerius* was darker than *Cimmerium*. On Ainslie's sketches this *Mare* is shown dark but less so than *Syrtis Major*, which is in agreement with the drawings of Phillips and the Director. On May 2 Ainslie noted the great contrast in the colour of *Cimmerium* and *Syrtis Major*, which were light blue, and that of the shaded area of *Utopia*, which was dark grey.

ERIDANIA-ELECTRIS.—These regions were observed very bright on the limb by Phillips on March 22, 23 and 25, but it does not appear that this brightness was conspicuous at the February apparition, when, however, there were few drawings made.

ÆOLIS.—A bright spot was observed by Phillips on *f*. limb adjacent to the S. edge of *Cerberus* on February 25 and 27 under $\omega = 149°$ and $168°$. This spot was also seen by the Director on February 27. This bright spot does not appear on Phillips's drawing of April 5 under $\omega = 172°$ and it was, no doubt, of a transient nature.

HESPERIA.—Phillips's drawings of February 16 and 17 (Fig. 5, Plates VI. and VII.) show no trace of *Hesperia*, nor does Steavenson's sketch of February 16. The Director did not see this region under good conditions until March 17, when he failed to see *Hesperia*, which, however, was then nearing the terminator. Ellison's drawing of March 21 appears to show *Hesperia* running parallel to the N. boundary of *M. Cimmerium*, but it did not enter *Æthiopis*, from which it was separated by the heavily shaded *Mare*. (*See* Fig. 6, Plate VII.).

On the following night, using the 10-inch O.G. at Four Marks, Steavenson shows *Hesperia* clearly, in its usual form, and this is confirmed by Phillips on March 23, Fig. 2, Plate VII., and Fig. 2, Plate VI. It is always absent on Ainslie's drawings.

The Director suspected it rather uncertainly on March 23, and on March 25 the region was closely examined, but he was unable to satisfy himself that this land was visible.

Steavenson wrote in April: "I have certainly seen *Hesperia* quite distinctly this apparition, but it requires pretty good seeing and at best it is not so conspicuous as some drawings show it—in fact I think my own show it too boldly." On March 24 McEwen noted that *Hesperia* was clearly seen, separating *M. Cimmerium* from *Tyrrhenum*.

There is thus some conflict of testimony regarding this feature, but it may be taken that *Hesperia* was, at any rate, not easily seen during March and was apparently invisible in February.

ZEPHYRIA.—A bright streak crossing this region and *Memnonia* was observed by McEwen on 1917 November 10 and December 16.

ÆTHIOPIS.—This region presented no special features. It is shown reddish on Steavenson's coloured drawings and McEwen saw "gold ochre" tints here in 1917 October.

The region was bright to Ainslie on May 2 under $\omega = 256°$.

ELYSIUM was seen "distinctly white" by Phillips on February 16, and throughout the apparition his drawings show it much brighter than the surrounding lands. His coloured sketch of March 27 shows *Elysium* brilliantly white, in strong contrast to the reddish colour of the neighbouring land. Phillips's drawings show the whole area within the boundary canals white and not merely a white patch following *Trivium Charontis*. Steavenson shows *Elysium* moderately bright on February 16 under $\omega = 243°$ and very white on February 25 under $\omega = 182°$ and he also noted it whitish near the C.M. His drawings agree with those of Phillips in showing the whole area white on these dates and on March 25. On February 27 the Director noted a white spot to the South when near the *f.* limb similar to that seen in 1916 (*see* Fig. 2, Plate V.), and on March 23, 25 and 27 he found only the preceding portion of *Elysium* very bright as shown on the 1903 chart, and the same whiteness was observed on April 2 and 3, and May 4. On May 4 the size of the white area was much smaller than earlier in the apparition and it was noted that "generally the area of *Elysium* was *not* brighter than the

rest of the disc." On May 8 the Director noted that there was a faint bright patch visible but the *whole* area was not bright. Gale noted on March 8 that *Elysium* was " pentagonal and clearly enclosed, except on the N. side. It was brighter than the rest of the surface and whitish."

McEwen found it bright on 1917 December 9 and on March 24 he noted the interior of *Elysium* " brown yellow, lightening to gold ochre and then white to East." Later the same evening he found *Elysium*, in good seeing, to be " venetian red, deepest at its W. side and lightest—almost white—at E. side."

Ainslie reports that on the limb its brightness was sometimes equal to the N. Polar cap. He noted it bright on May 2 and on May 9 he states that the *p.* side was much brighter than the following side and on May 10 he found it very bright near the terminator.

Ellison also, on March 21, found *Elysium* " very conspicuous near *p.* limb, bright white, nearly as bright as N. Polar snow."

To Ellison, Phillips, Steavenson and the Director, the form of *Elysium* was roughly circular. Ainslie and McEwen show it rather pentagonal, but McEwen noted its circular shape on March 24. With reference to the enclosing canals, Steavenson writes " The canals round *Elysium* were all seen with certainty, but never at any moment as *thin* lines. All canals seemed to me diffuse streaks. I have no doubt of their objectivity, as they were seen best when seeing was good, but whether their ultimate structure is simple or more complex, I could not say. I can only say that there is something of a streaky and dusky nature in their positions. Sometimes they do not look *quite* smooth or continuous as if there were something just ' wrong ' with them. But to say *where* they are irregular is as hard as to draw the suspicions of irregularity which one gets sometimes in the faint belts of Saturn."

TRIVIUM CHARONTIS appears on most of the drawings available merely as a part of *Cerberus*.

Ellison, Phillips, Steavenson and the Director show no condensation in the form of a lake here. Ainslie, however, on March 31 detected a condensation which was again seen by him on May 2 and 9.

Phillips remarked on February 16 and 27 that this was " scarcely a definite spot on *Cerberus*," and in very fine seeing on March 25 the Director could see no definite lake and the corner of *Trivium* seemed to be of the same shade and intensity as the rest of the *Cerberus*.

CERBERUS.—This broad and conspicuous marking was again a very prominent feature of the disc. It seems to the Director a misnomer to call this great streak a " canal " as it more closely approaches the *Maria* in appearance.

It is shown rather dark on the drawings of Ainslie, Phillips, Steavenson, and the Director, and moderately so by Ellison and McEwen. It is drawn well defined by the majority of the observers. Phillips does not show it on his sketch of the small

disc of 1917 December 5. It was diffused to McEwen on March 24, but broad and distinct. The width of the marking appears to have been about 7° or 8°, tapering slightly towards the S.W. On March 26 Phillips suspected duplicity, but noted that possibly this was an illusion, but the impression was gained at the best moments (*See* Fig. 1, Plate VI.). The Director thought the colour slightly greenish in the reflector on April 3, and on May 8 he found the canal nearly as dark as *M. Cimmerium.*

PAMBOTIS LACUS (Lowell's *Lacus Lucrinus*).—This lake does not appear on Phillips's drawings of February 16 and 17, but is strongly shown on his sketches of March 23 and 26 (*see* Fig. 2, Plate VI.). Steavenson, Ellison and the Director did not detect this lake at all. It was recorded by McEwen on the small disc of 1917 December 9 and again on 1918 March 23, when he noted it as faint.

Ainslie's drawings of March 31, April 27, May 2 and 9, all show this lake, but it is absent from his drawings of March 23, 24 and 27.

HECATES LACUS.—Appears on Ainslie's sketch of May 2, but was not recorded by any other observer (Fig. 1, Plate VII.).

MORPHEOS LACUS does not appear on Ainslie's drawings, except on May 2, when it is strongly shown with a canal (apparently *Marsyas*) proceeding westwards from it. It is perhaps faintly indicated on Steavenson's beautiful sketch of March 22 (Fig. 2, Plate VII.), when he shows the two canals *Marsyas* and *Anian* meeting at this spot. This lake is absent from Phillips's drawings of February 16 and 17, but is very clearly shown on those of March 23 and 26; but he does not show the canal *Marsyas.* This lake also seems to be indicated on McEwen's drawing of March 24. The lake was not seen by the Director and is not shown on Ellison's drawings.

SINTIUS LACUS appears only on Ainslie's drawing of May 2, as a definite lake on *Eunostos* (Fig. 1, Plate VII.).

SITHONIUS LACUS is strongly shown by Phillips on his drawings of March 23 and 26 (Fig. 1 and 2, Plate VI.) as a round spot some 8° in diameter on the border of the *Gyndes* shading. It does not appear on the February drawings of Phillips or Steavenson, but the latter shows it as a slight projection on the S. edge of *Gyndes* on March 22, on which date McEwen has the following note; "*Sithonius* or *Copais Palus* faint but distinct, forming a neutral tint border to the N. Polar cap."

PHLEGRA is shewn lightly shaded between *Hades* and *Styx* by Phillips in February, but this shading was not conspicuous, and is entirely absent from Steavenson's drawings of February 16 and 25 and March 22. The Director shows it slightly shaded on February 27 and April 2. Ainslie shows this region and part of *Cebrenia* shaded on March 31. On the whole it appears that there was no striking darkness of this region in 1918.

CEBRENIA is shown strongly reddish on Steavenson's coloured sketches, bordered on the North by *Gyndes.* Ainslie shows this

region shaded between the positions of *Hades* and *Myrmidon* (1903 chart).

GYNDES I. AND II. appear as a broad shading with a well defined S. edge, and diffuse and indeterminate boundary towards the North on the drawings of Phillips and the Director during March. Steavenson's sketch of February 25 appears to indicate *Gyndes* I. only, with some ill-defined reddish shading between it and the edge of the N. P. cap. This shading is strongly shown on McEwen's sketch of March 24 of a yellowish brown colour. Ainslie's drawings of March 23 and 27 and April 27 point to the visibility of *Gyndes* I. and II. as separate streaks.

MINOR DETAIL.

ADAMAS.—McEwen on 1917 December 9 observed a "distinct, though shaded line from *Casius* to the W. end of *Cimmerium*," which may have been the canal *Adamas*. This canal was not confirmed by any other observer.

ANIAN.—McEwen on 1917 December 9 observed a projection from the North Polar cap band extending to the N. side of *Elysium* in the position of this canal, which appears on Phillips's drawing of March 23 and 26, and is shown about 5° wide (Figs. 1 and 2, Plate VI.). It was not seen by Phillips during the February presentation. McEwen's drawing of March 24 shows a broad diffuse shading here, extending over some 15° of longitude. On the other hand, Steavenson on March 22 shows this canal as a very fine line when observing with a power of 430 on the 10-inch O.G. at Four Marks. (Fig. 2, Plate VII.).

ANTÆUS appears only on Steavenson's drawing of March 22 as a very fine and delicate canal from *Pambotis Lacus* to *Læstrygon Sinus* (*see* Fig. 2, Plate VII.).

BOREAS is possibly indicated on Ainslie's drawing of May 2 as a broad shading entering *Hecates Lacus*. It is also shown on Steavenson's drawings of February 25 (*see* Figs. 6, Plate V., and Fig. 1, Plate VII.).

CHAOS.—Broader than *Cerberus* to McEwen on March 24, but not so distinct. To the Director, Phillips and Steavenson it was rather less wide than *Cerberus* and, although clearly seen in February, March and April, it was not so dark as that canal. On all drawings it is shown as a definite marking and not merely as an edge to *Elysium*.

CYCLOPS was rather conspicuous throughout the apparition. Phillips shows it on February 16 and 17 as a broad streak little less in width than *Cerberus* but not so dark, and similarly at the March presentation. The Director was doubtful occasionally whether this canal should be considered as *Cyclops* or *Cerberus II.*; but is of the opinion that the canal most frequently seen was *Cyclops*.

Steavenson shows two canals diverging from *Pambotis Lacus* on March 22.

EUNOSTOS.—McEwen reports that this canal was clearly seen on 1917 December 9 forming the *f.* border of *Elysium*; on March 24 it seemed to him not to be continuous but broken, and it did not enter *Lacus Pambotis*. The drawings of Phillips on March 23 and 26 do not show any discontinuity, nor was anything abnormal observed here by Steavenson, Ainslie or the Director on March 22, 23, and 25. Ellison's sketch of March 24 shows the boundaries of *Elysium* unbroken. Ainslie's drawing of the same date, made in poor seeing, seems to indicate a discontinuity which may have been identical with that noted by McEwen. According to the charts of Schiaparelli, Lowell, Flammarion and Antoniadi, the name *Eunostos* is given not only to the curved S.W. boundary of *Elysium* but also to the canal running into *Lacus Nubis*. This portion of the canal may be confused with *Pactolus*, as Lowell has pointed out, and it is sometimes difficult to decide which canal is indicated. It is also called *Hephæstus* on 1903 chart.

Steavenson's drawings of February 16 and March 22 show a canal in the position of *Eunostos*, so does Ellison on March 23, and the Director on March 25 and May 4. Phillips shows a canal here on February 16, but on February 17 he noted that he could see no connection between *L. Nubis* and *Elysium*. In his sketches of the March presentation he shows a strong canal from *L. Nubis* to the border of *Elysium* which he calls *Hephœstus*, following the 1903 chart.

The Director has called the canal leading to *Nubis Lacus* in 1918 *Hephœstus*.

Granicus is shown as a broad dark shading by Phillips, Ainslie, Steavenson, and the Director.

Hephæstus. (*See* under *Eunostos* above).

Lystrægon is not shown on any of the available drawings.

Marsyas is shown by Steavenson, March 22, and probably by Ainslie, on May 2.

Styx formed part of the well defined boundary of *Elysium*. It is shown dark on most of the drawings.

SECTION VI.

Syrtis Major.

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

Mare Tyrrhenum was clearly seen by McEwen on the small disc of 1917 December 9, when he considered its colour "raw umber." On March 22, McEwen calls the colour of this Mare "delft blue" and he then found it "defined but faint," and on March 24 he considered it a neutral tint and not so dark as *Syrtis Major*. To Steavenson this sea appeared "brownish grey" in the reflector in February. Phillips shows it a bluish grey on his coloured drawings, resembling the tint of *Syrtis Major* and so it usually appeared to the Director in the 12½-inch reflector. All observers agree in showing the *Mare* without a well-defined border towards the South on *Ausonia*, but its Northern coast-line was usually clearly defined. According to Phillips's drawings this Mare was considerably fainter than *Syrtis Major* in February, but darkened later in the apparition and this is borne out by Steavenson's drawings. Ellison also shows the *Mare* very dark in March. Ainslie, however, on March 22 shows the *Mare* much less dark than *Syrtis Major*. No observer was able to record the patchy appearance of this sea noted by M. Antoniadi in 1909 and by Molesworth in 1903.

Syrtis Minor does not appear as a distinct marking on the drawings of Ainslie, Phillips, Steavenson, or the Director, it being merged into the general outline of the *Mare* on their sketches. Ellison, however, shows a very dark strong projection of the *Mare* northward, approximately in the position of this feature on his sketch of March 21 (Fig. 6, Plate VII.). This was not seen by either Phillips or the Director on this date, but their sketches show a strong canal crossing *Libya* here. McEwen mentions that he saw this marking distinctly on March 22, and on March 24 he draws it as a very prominent pointed projection of the *Mare* and noted that "it was dark, with *Amenthes Thoth* appearing as distinct brown yellow band going to *Boreosyrtis*."

McEwen's representation of this region of the planet in March differs widely from that of Phillips, Steavenson, and the Director. To these observers *Amenthes* was invisible at this time. Ainslie shows a broad dark shading rather similar to that of McEwen on March 20, but on March 21, 22 and 23 he shows the usual *Nepenthes-Thoth* curve, as does Ellison on March 21.

HELLAS was too far South to be well observed. Phillips noted on January 6 that it shone with an intense lustre like a Polar cap, and on April 26 he says: "*Hellas* exceedingly bright to-night. I think there must have been a recent snowfall." *Hellas* was very bright to the Director on March 22, and bright on limb on March 23. On April 25 a very bright spot, like a Polar cap, was noted here. A similar appearance was noted by McEwen on 1917 October 30 and December 2. Steavenson also found it "very white" on April 22 when near the *p.* limb.

LUNÆ PONS was not observed during this apparition.

ŒNOTRIA is clearly shown on Steavenson's drawings of March 22 and April 22 and is faintly seen on Phillips's drawings of March 12, 20, and 21. On March 17 the Director failed to find any trace of *Œnotria* but there was a bright spot near the *f.* border of *Syrtis Major*, nor could it be seen on March 20. A bright continuation of *Libya* across the *Syrtis* was suspected on March 21; but for further observations of this appearance *see* below under "*Libya.*"

LIBYA is very clearly shown on the drawings of Phillips, Steavenson, Ainslie, Ellison, and the Director, and McEwen's sketch of March 23 shows what was in the Director's opinion *Libya*, although identified by McEwen himself as *Ausonia*.

The form in which *Libya* is depicted by the observers varies slightly. Steavenson shows it broad (in latitude) with rather a square W. end. (Fig. 2, Plate VII.). Phillips and the Director show it broad and usually rounded to the west (Figs. 4 and 5, Plate VIII.). Ainslie in general shows it rather narrow and pointed at the following end and so does Ellison.

Phillips and the Director agree in showing this area usually shaded and Steavenson shows it slightly so. The Director noted that in bad definition it could not always be seen and under these conditions the *p.* coast-line of *Syrtis Major* seemed to extend from *Osiridis Prom.* to the position of *Syrtis Minor*, exactly as drawn and described by McEwen when observing the small disc of 1917 October 28 (*see* Fig. 2, Plate VIII.). A special note of this was made by the Director on March 18, when it was recorded that the *p.* edge of *Syrtis* appeared as described above but that this was not the true form of this coast-line but was due to the fact that the true outline of *Libya* (which was shaded) and the Nepenthes-Thoth became confused in the poor seeing and appeared as a curved continuous coast-line. The drawings suggest that *Libya* ran further than usual towards the West and this was especially noted by Phillips in February.

On February 7 Phillips noted that *Libya* appeared to be bounded on the *p.* side by a dusky streak which may be identified

with *Triton* or possibly the *Pallas* of 1903, and on March 20, 21 and 23 it is shown heavily shaded. This shaded appearance of *Libya* was very conspicuous to the Director on March 17, 21, 22, 23, 25 and April 25, with the dark canal forming the E. boundary of the shading. Steavenson's drawing of March 22 shows this canal double from the point of *Mare Cimmerium* on a course which identifies it with *Triton* rather than the 1903 *Pallas*.

On March 15 Phillips noted a "curious appearance of *Syrtis Major*. The N. portion seems completely severed by cloud." The Mare was nearing the *p.* limb at the time and Phillips's sketch shows a bright bridge extending from *Libya* across the *Syrtis*. This could not be seen the following night in poor definition and it was very doubtful on March 17, but later in the evening on this date, when *Syrtis* was approaching the *p.* limb, the bright bridge again seemed to be complete. On March 21 Phillips noted that *Libya* was heavily shaded ($\omega = 290°$) with a relatively light area adjacent on the *Syrtis* (*i.e.* following *Libya*). "I think," he wrote, "it is the combined effect of these two regions as they approach the limb which causes the appearance noted on March 15. (Fig. 4, Plate VIII.). Similar appearances have been recorded previously. (*See*, for example, *Mars Memoir*, 1903, page 87).

On March 23, under $\omega = 245°$, when *Syrtis Major* was near the *f.* limb, Phillips noted that the N. portion was completely severed from the rest by a light area, and on March 21 Ellison wrote: "Libya extends nearly across the Syrtis, sometimes suspected extension right across."

Writing concerning his observations with the 28-inch O.G. at Greenwich on April 22, Steavenson says: "I could not see *Œnotria* at first, but as *Syrtis* came near the *p.* limb it became visible, as did *Crocea*, in continuation of *Libya*. These two—*Crocea* and *Œnotria*—made a sort of paler stripe extending almost across *Syrtis Major*."

This bright bridge across *Syrtis Major* was not seen by the Director on March 17 under $\omega = 320°$, nor on March 20, but on March 21 an extension of *Libya* in the form of a rather narrow bright line was suspected, but could not be confirmed. On March 25, under $\omega = 240°$, it was thought that a bright bridge extended across the *Syrtis*. On this date a very brilliant white spot preceded the dark shading on *Libya* (Fig. 3, Plate VI.). This spot was also seen by Phillips on March 23, but it does not appear on his sketch of March 21, nor is it shewn during the February presentation. Gale also has a note that on March 8 *Libya* extended as a light marking South-west across *Œnotria*.

Syrtis Major was throughout the apparition one of the most conspicuous markings on the disc. Most of the observers agree in showing the N. end darker than the S. portion, at any rate when well on the disc. Phillips's sketch of January 3, under $\omega = 319°$, shows, perhaps, the reverse, but this may be due to proximity to the limb.

For early observations of this *Mare*, in 1917, we depend entirely upon the early morning work of McEwen. On October

28 he noted that the preceding border of the *Syrtis* ran from *Osiridis Promontorium* and Syrtis Minor, and that this side was hazy and not clear-cut like the W. side. A precisely similar appearance was noted by the Director when observing under poor definition in March, when observation was much easier on the larger disc and it does not appear probable that there was any real change in the form of the *p.* border of *Syrtis* between this date and February, when the form of the coast-line and of Nepenthes-Thoth was clearly seen to be similar to that of the preceding apparition. At this time McEwen found the colour of the *Syrtis* to be sepia, and on October 30 it seemed hazy to him and very diffused on E. side crossing Libya. On December 2, McEwen found the *Syrtis* " faint and difficult to see and exhibiting a mixture of brown-ochre and raw umber tints, with light patches here and there. The western side of *Deltoton Sinus* and round it into *Sabœus Sinus* was much darker—it was like a narrow border to the W. side of the Syrtis." On this date, also, McEwen calls attention to the darkness of *Coloë Palus*, which was " almost black."

Protonilus and *Boreosyrtis*, he says, were not so dark, but conspicuous and *Syrtis* by comparison was quite faint. Comparing this observation with his own of subsequent dates Professor W. H. Pickering traces a movement Southwards of the dark area which he calls the " flooding of the marshes " (*see P.A.*, XXVI., No. 255). McEwen's sketch at this early date, when the disc was only about 7 seconds of arc diameter, appears to show indications of *Nepenthes-Thoth* in the form of two faint projections from the *p.* coast-line, but he states that the image was too small and definition not good enough to see exactly the appearance of details on *Libya*. McEwen's next drawing of this region was on 1917 December 8, $\omega = 238°$, when the *Syrtis* was not far enough on the small disc to be well seen. This drawing is interesting, as it appears to show a very strong canal in the position of *Amenthes*, together with *Adamas*, and a bright spot is shewn at the S.W. end of *Hesperia*. The *Amenthes* does not appear on the drawings of any other Member in February, March or April, but Ainslie shows it very strongly on May 2.

It is unfortunate that there is not more evidence available regarding *Amenthes*, and it seems possible that under the difficult conditions the prominent *Nepenthes-Thoth* curve may have been confused with it. If this is not so, then a considerable change took place here between December and February. On January 3, Phillips found *Syrtis Major* nearing the terminator, faint and indistinct; but when next seen, on February 16, it was very dark, with the *Nepenthes-Thoth* curve very conspicuous and so it remained during the apparition. Phillips's early sketches of *Syrtis Major* give it the form shewn in Lowell's 1903 chart, but later in the apparition there was an increase in the prominence of *Astusapis Sinus*, though this bay did not become so conspicuous as in the 1920 apparition. This bay was noted by Phillips and Steavenson on February 16, and it

was easy to them and to the Director in March and April. Ainslie and Ellison also show this bay occasionally.

On March 15, Phillips noted a bright bridge across the *Mare*, similar to that shewn by Gale in 1903 *Memoir*, page 87.

The same appearance was seen on March 17, in both cases when the *Syrtis* was approaching the limb, the bright bridge not being seen when near the C.M.

Steavenson carefully observed the *Syrtis* with a 28-inch O.G. at Greenwich on April 22, and noted that near the *p.* limb *Crocea* and *Œnotria* became visible, making a paler stripe almost across the *Mare*.

On February 9 the Director noted a large white area cutting across the N. portion of *Syrtis Major* when near the C.M., in about the position of *Nili Pons*. This whiteness was fully 10° wide and extended over about 40° in longitude.

The colour of the *Syrtis* was usually " bluish grey " or sometimes " greenish " to Phillips. Steavenson considered it " blue-green " on February 16 with the reflector and " emerald green " on March 21 with the 10-inch O.G. On April 27, with the 28-inch O.G., he thought the whole *Mare* a " pale olive or sage green."

To the Director the colour was neutral tint on March 17 and 18, bluish grey on March 21, dark greenish on March 22, bluish-green on March 23, and greenish-blue on March 25. On the last date the seeing conditions were magnificent and the contrast in the colour of *Syrtis Major* and *Casius*, which was of a brownish tinge, was most marked. On April 25 the colour in the reflector was a greyish-green resembling the shade of some kinds of fir-trees. Ainslie remarked in March that the *Syrtis* was much the darkest marking on the disc, but on May 2, when near the *f.* terminator, he found it very faint and its colour light blue. Sargent, in common with most of the other observers, draws the N. end much darker than the S. end, and on March 22 shows *Libya* apparently crossing the *Mare* from E. to W.

With regard to the outlines of the *Maria* generally, Ellison writes : " In moments of best seeing the outlines are *not* diffused but hard and irregular, like coast-lines on a map."

Mœris Lacus was merged in the great *Nepenthes-Thoth* curve to most of the observers. Steavenson's sketch of March 22 (Fig. 2, Plate VII.) appears to indicate a darker shading on the S. edge of the canal. Gale remarked, on March 8, that while *Thoth* was visible to about latitude + 10°, *Nepenthes* and *Lacus Mœris* were absent. Ellison, perhaps, indicates *L. Mœris* on his sketch of March 21 as a widening of the canal, and he noted that it was " visibly darker than the rest of the streak " (Fig. 6, Plate VII.). No definite lake or intensification of the shading is seen on the drawings of Ainslie, Phillips or the Director, and it is certain that this lake had not the prominent appearance recorded in 1903.

Isidis Regio was " gold ochre " to McEwen on 1917 October 28, and is shewn somewhat dark by him on March 23, with a

lighter area north of the position of *Lacus Mœris*. Phillips shows this region uniform in shade up to March 22, and his coloured sketch of March 21 shows it reddish, but on March 23 (Fig. 2, Plate VI.) he noted a bright spot in a position similar to that shewn on our 1911–12 chart and there called *Nix Atlantica* (*see Memoirs*, Vol. XX., page 162). On the same night Phillips noted a bright area preceding *Libya* approximately in longitude 255°.

NIX ATLANTICA.—Steavenson's sketch of March 22 also appears to indicate this white spot faintly, and on March 16 Phillips noted a bright spot here which he thought was "too large to be *Nix Atlantica*." On the following day he thought this spot had moved a little further South, and it was not seen by him on March 20 or 21, but it was clearly seen again on March 22.

This spot escaped the notice of the Director, but on March 25 he suspected, but could not definitely confirm, a bright "bridge" across the dark *Nepenthes*, to the south of the position of this spot.

A white spot further North is shewn by Ainslie at about lat. + 25° on March 20.

The appearance of this white area appears, therefore, to have been transitory and of brief duration.

NUBIS LACUS is shewn on the drawings of Phillips as a distinct enlargement of the S. end of *Casius* in March, but earlier in the apparition it is not prominent. On February 16 Phillips remarked that he frequently had impressions of this lake. It is well shewn on his sketch of March 23 (Fig. 2, Plate VI.), when he estimated its longitude at 256·7°.

Ellison's sketch of March 21 shows this lake distinctly. In very good seeing on March 25 the Director drew a very definite lake here (Fig. 3, Plate VI.), but in general this marking did not appear to differ much in intensity from that of *Casius*, and this is confirmed by Ainslie's drawings. It thus appears that this lake was not nearly so conspicuous as in 1916.

CASIUS.—This name is applied here to the whole of the dark wedge-shaped marking which was so conspicuous during the apparition. The drawings of the observers are in good general agreement regarding the appearance of this marking, which had a similar form to that of the previous apparition. On March 25 the Director examined this region of the planet under the best conditions he had ever experienced on Mars, and noted that there was a very striking contrast in the colours of *Casius* and *Syrtis Major*.

The former was not uniform in colour, as its N. portion was the darker. The colour was considered to be a tint between raw umber and vandyke-brown, shading into a warm grey towards the South, while the *Syrtis* looked greenish-blue.

This contrast in colour is well shewn on tinted sketches by Phillips on March 21 and 22, and by McEwen on March 23. The latter called the colour of *Casius* vandyke brown.

While it cannot be definitely said that the two canals *Casius* and *Alcyonis*, shewn on the 1903 chart, were clearly seen by any observer, Steavenson indicates an increased intensity in the shading at the *f.* edge of the dark area, and Ainslie's drawing of April 27 seems to show both these canals.

NILI PONS was usually seen by Phillips and the Director, but Steavenson found it doubtful or difficult, and he wrote in April: "The case of *Nili Pons* is interesting. I missed it altogether with the 10-inch O.G. at Four Marks, although I think I actually looked for it. Phillips sees it clearly—in fact he shews it on his drawings as a very conspicuous feature; you (the Director) also see it clearly," and he suggests that his failure at that time to see this marking may have been due to the fact that, at that time he was somewhat out of practice at planetary work, not having been able to observe regularly. On April 22, with the 28-inch O.G. at Greenwich, he was able to glimpse the bridge.

Ellison's drawing of March 21 does not show *Nili Pons*, but it seems to be indicated on Sargent's sketch of March 22, and it is conspicuous on Phillips's of March 20 and 21, and less so on March 23, and at that time it was also plain to the Director. McEwen does not show it on March 23. Ainslie's sketches are rather indeterminate on this matter, and he has no special note regarding it. It may well be that the appearance of this bridge varies with the Martian hour.

UTOPIA was darkly shaded and merged into the "*Wedge of Casius.*" The S. boundary is shewn well defined by Phillips, Steavenson and the Director, but the Northern edge was not so clearly marked. Steavenson's sketch of March 22 appears to show a portion of *Heliconius* forming the N. border of this shading (Fig. 2, Plate VII.).

MEROË INSULA.—Nothing of much note was recorded here. Phillips, on March 21, noted a bright region following *Nili Pons*, and the Director drew a similar white area on March 23, but rather further South. McEwen also noted a light area here on March 22.

NILO SYRTIS.—Observers differ somewhat in the way they draw this marking, but Ainslie, Phillips, Ellison and Steavenson agree in showing it strongly curved and convex to the East, especially after the date of opposition. The Director showed it more meridional in its S. portion, but is inclined to agree that the sketches of Steavenson and Phillips give a more accurate representation of this feature than his own, and the Lowell Observatory drawings and photographs confirm rather the appearance shewn on Phillips's and Steavenson's sketches. McEwen was unable to see *Nilo Syrtis* on the small disc of 1917 October 28, but on December 2 it is clearly shewn, and he noted that it became much lighter and narrower at N. lat. $+30°$.

COLOË PALUS was "large and dark" to McEwen on 1917 December 2 with its centre "almost black"; round about it the colour was sepia. McEwen on this date estimated the longitude

at " 8° greater than shown on Flammarion's globe, being 303°·7 and the latitude about + 43°." On March 23 McEwen found it " large and prominent " and raw umber in colour. This marking is not shown as a lake on the drawings of Steavenson and Ainslie, but as a part of a large dark shading continuous with *Casius*. Phillips and the Director show it as a large hazy dark spot on the *Nilo Syrtis* and joined to the remainder of the shaded area is this region. (Figs. 4 and 5, Plate VIII.). No particular colour could be detected by the Director on March 17, when this marking was carefully examined with the reflector.

On April 22 Ellison draws *Coloë Palus* small, well defined and dark, and describes it and *Ismenius Lacus* as looking like " sharp little triangles as hard as bits of blue glass." (Fig. 2, Plate I.).

MINOR DETAIL.

ADAMAS.—McEwen noted on December 9 a long distinct, though shaded line from *Casius* to the West end of *M. Cimmerium*, which seems to have been in the position of *Adamas*. Ainslie also on April 27 shows a narrow curved line in this neighbourhood, but no other observer recorded this canal during the apparition.

AMENTHES is not shown by Phillips, Steavenson, or the Director. One or two Members show occasionally a canal in this position, but omit *Nepenthes-Thoth*, and it seems very doubtful whether this canal was really visible during the apparition.

BOREOSYRTIS is merged into the general shading in this district on the majority of the drawings; it is shown more distinctly by Phillips, but it had not the appearance of a canal but rather that of a broad shading with indefinite edges.

HELIOCONIUS is shown by Steavenson as a broad dark band on *Utopia*, on March 22. On Phillips's drawing it is shown more completely merged into the general shading, and the Director also failed to distinguish it from the general background of the shaded *Utopia*.

TRITON (*or PALLAS*?).—Steavenson's sketch of March 22 shows a double canal from the *f.* point of *Mare Cimmerium*, and Phillips's drawing of February 17 shows a single canal in about the same position. The Director's sketches show a clearly marked border concave to the East to the shaded *Libya*, but no well-defined canal. There is some doubt whether this canal or border of the *Libya* shading should be called *Triton* or *Pallas*, as its position was difficult to determine accurately, especially as *Hesperia* was usually invisible. The Director noted that the curvature of the *p.* border of the shading on *Libya* was concave to the N.E., and not convex as *Pallas* is shown on the 1903 chart.

SECTION VII.

The South Polar Region.

$\Phi = -60°$ to $-90°$.

Owing to the tilt of the planet's axis this region of the planet could not be observed. Occasional bright areas were noticed by most of the observers on the Southern limb.

SECTION VIII.

The North Polar Regions.

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

BALTIA appears dark and formed part of *Mare Acidalium* on the drawings of Phillips and the Director, its extension westwards forming a broad canal-like marking probably including *Eridanus* and *Tanais*, although there are indications of *Tanais* as a separate marking on the drawings of Phillips and the Director, who on several occasions drew two dark bands here, separated by a lighter zone, and these also appear on Ainslie's drawing of April 12.

ABALOS.—Between the N. border of *M. Acidalium* and the N. Polar cap a light area is shown by Ainslie, Ellison, Phillips and the Director, bordered to the South by *Eridanus* and to the North by the dark border of the Polar cap. Phillips's sketches of this region closely resemble his of the same region in 1903. As this light region was to the North of Eridanus it does not appear to have been identical with *Thera*, of 1903 and 1905, which was further South. (*See Memoirs*, Vol. XVII., Part II., page 58).

THERA (?).—On April 8 only when *Mare Acidalium* was approaching the *p.* limb the Director drew an indentation into the *Mare*, near the position of *Thera*, as shown on the 1903 chart.

HYPERBOREUS LACUS was well seen by Phillips, Ainslie, and the Director. Phillips noted on March 1 that the lake "seemed to be partly uncovered by the melting snow," and from this date onward his sketches of this region show it with increasing prominence, but rather as a dark border to the Polar cap than a definite lake.

On March 12 he draws it prominently and noted that it was "large and dark," and on April 8 it was "very dark" and so it was shown during April. It was "very dark" to the Director on March 12 and April 17, and extensive dark marking was drawn in this neighbourhood resembling the *Acidalia Palus* of 1905. Gale noted on March 29 that the Polar cap was "edged by a dark marking which is clearly separated from *Mare Acidalium*."

DEUCALIDONIUS LACUS.—On April 8, the longitude of C.M. being 130°, the Director noted "a curiously persistent impression that there was a very dark line or spot on the following edge of the N. Polar cap and that this spot separated from the Polar cap a white area of about the same size as the cap, but not so bright. This white area was possibly the same as that seen by Phillips on April 5.

WHITE AREAS.—A large white area whose centre was about at $\lambda = 290°$ was observed by Phillips on March 21 (Fig. 4, Plate VIII.). This area was, perhaps, indicated on his sketch of March 20, also. The Southern boundary reached $+70°$ and it extended over about 60° in longitude. A similar white area was also drawn (Fig. 2, Plate VI.) on March 23, with its centre at about 245°, which may have been the same as *Olympia* of 1903,

or possibly the same area as seen on March 21 with some change of position. On this night Phillips thought the Polar cap had increased in diameter—a suspicion which was confirmed by micrometer measurement.

This bright area was seen by Phillips on April 1 and confirmed with the 28-inch O.G. at Greenwich on April 5, and it was also observed by him on April 26, and by Ainslie on May 2 and 9. On May 12 Phillips noted that the N. Polar cap seemed to have increased to a striking extent, but careful scrutiny showed this to be an illusion, arising from the proximity on its *f.* side of the adjoining white area in about longitude 220°. This appears to have been the *Olympia* of 1903 in very similar form. (*See* 1903 *Memoir*, page 97). This is probably the detached patch noted by Ainslie on May 9 on the *f.* side of the N. Polar cap, which later appeared to him as if it were a part of the cap itself, divided from the remainder by a dark rift. A similar appearance was noted by Ainslie on May 10 in both instances when using the 28-inch O.G.

McEwen's sketch of March 22 shows a misty white area somewhat similar to that seen by Phillips on the following night. *See* also Phillips's drawing of March 26, Fig. 1, Plate VI., where a large white area is shown in about $\lambda = 215°$.

MINOR DETAIL.

IAXARTES appears first on a drawing by Phillips on March 9. It was not seen the previous night, although seeing was good. On March 12 it was faintly indicated as a hazy streak and it appears again very strongly on his drawing of April 25, but is not shown on a drawing made two nights previously.

ERIDANUS is shown on the Director's drawings in April both preceding and following *Mare Acidalium*, and on April 8 a special note was made that the canals *Tanais*, *Eurotas* and *Eridanus* were seen separated by a lighter but shaded area. Phillips's sketches of March 8 and 9 show the canal *p.* the N. point of *Acidalium*. Following *Mare Acidalium* the region of *Baltia* took the form of a long tapering dark streak in which *Eridanus* was usually merged, but *Tanais* can be seen faintly on his sketch of March 8 and 9 separate from this darker shading.

THE NORTHERN SNOWS.

The true Polar cap was not always visible during the apparition —or at least the appearance sometimes seen was rather that of white mist obscuring the outlines of the cap.

As the behaviour of the Polar caps is of considerable interest and importance the notes of the observers are given below rather fully:—

Date.	Observer,	Remarks.
1917 Oct. 28	McEwen	North Polar Cup, white; it extended with shaded border to N. lat. 45° in long. 280°.
„ „ 30	„	Border of cap diffused. Cap white.
„ Nov. 10	„	Cap clearly seen in steady air. It was dull greyish-white, with bright spots. Edge, estimated at 45° N. lat., was ragged and part of it light ochre, while other part dull and greyish white.

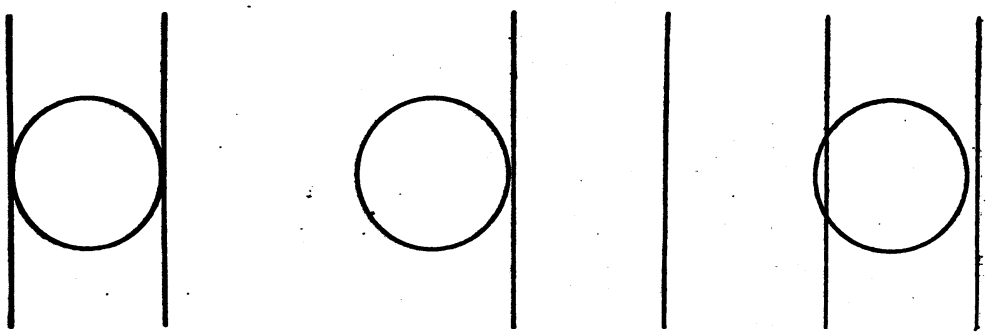
Date.	Observer.	Remarks.
1917 Nov. 24	McEwen	N. Polar cap white, with clear-cut edges. Border estimated at + 55° in λ = 20°.
,, ,, 25	,,	Edge of cap estimated at + 55° at λ = 353°, and + 58° at λ = 7°.
,, Dec. 2	,,	Edge of cap +45° to + 53° in λ = 290° to 300°.
,, ,, 5	Phillips	Cap large and bright.
,, ,, 9	McEwen	Cap white, with brown yellow margin.
,, ,, 16	,,	Cap not white but screened, as if with thin light-ochre veil.
,, ,, 21	,,	N. Polar cap visibly reduced. Estimated its border at N. lat. 62° in long. 90°. Border, faint vandyke brown.
1918 Jan. 1	Thomson	Cap edge estimated at + 66° in long. 44°.
,, ,, 5	Gale	N. Polar cap fairly large and edged by a broad dark marking, which extends towards centre of disc.
,, Feb. 16	Phillips	N. Polar cap distinctly larger than usual and dull white, with less well-defined edge. "I believe this region to be covered by cloud and that the snow itself is invisible."
,, ,, 18	,,	A dull white area about the N. Pole. Cloud or fog? Diameter 17·7°.
,, ,, 24	,,	"A lot of the fog seems to have cleared away, but still doubtful whether the snow is visible."
,, ,, 25	,,	"Polar cap not uniformly bright to-night. There is no doubt about the clearing of the mist, and I believe the snow to be now partly visible."
,, ,, 26	Thomson	Definition bad. There seems to be no dark ring round cap.
,, ,, 27	,,	No dark border to cap.
,, ,, 28	Phillips	*Hyperboreus Lacus* detected.
,, Mar. 1	,,	*Hyperboreus Lacus* partly uncovered by melting snow.
,, ,, 8	Gale	N. Polar cap very bright.
,, ,, 12	Thomson	*Hyperboreus Lacus* seen as a small dark marking.
,, ,, 17	Phillips	Polar cap quite small and apparently without a dark border in longitude presented to view (± 350°).
,, ,, 21	,,	No remarks, but a distinct dark border is shewn on drawing. White area observed at λ = 290°.
,, ,, 21	Thomson	No well-defined edges to cap, but seeing poor. Suspected a very small and bright cap in the haze.
,, ,, 22	,,	Seeing too poor to see definite cap, but was inclined to think that, with better seeing, the cap would have appeared clearly defined.
,, ,, 22	McEwen	Cap dull grayish-white, with a brighter portion near limb, under ω = 268°.
,, ,, 23	,,	Cap covered with ochre-tinted mist, with a bright area in position of *Ierne*. On this night, Phillips, Ainslie and the Director show the cap small, but clearly defined.
,, ,, 24	,,	Cap very dull, not white but light grey.
,, ,, 24	Phillips	Cap measured and found to be about $5\frac{1}{2}°$ diameter

Date.	Observer.	Remarks.
1918 Mar. 25	Thomson	N.P. cap very small. I do not think it exceeds $\frac{1}{20}$ of diameter of disc. In good seeing, it seemed that a distinct cap could be seen and not a hazy area. I think there was no dark ring, but of this I am not very sure.
„ „ 29	Gale	N.P. cap bright and edged by a dark marking, which is clearly separated from *M. Acidalium*. This did not appear to be the case three nights ago, in poor seeing.
„ „ 31	„	N.P. cap more completely fringed by a dark edging.
„ Apr. 1	Phillips	A light area seen near cap, but not so white as the snow.
„ „ 3	Thomson	N.P. cap small, with well-defined edges and not hazy. Could see no dark border.
„ „ 4	Gale	N.P. cap small and diffuse and no dark border.
„ „ 8	Thomson	N.P. cap small and distinct, with dark spot following (*Deucalidonius L.*).
„ „ 14	Phillips	N.P. cap rather larger than of late.
„ „ 17	Thomson	N.P. cap very bright and distinct.
„ „ 26	Phillips	Bright area N. of *Boreosyrtis* as on March 21.
„ May 8	„	White area seen on April 1 and 5 seemed larger and whiter.
„ „ 10	Ainslie	N.P. cap has a very dark margin.
„ „ 11	Phillips	N.P. cap seems to have increased perceptibly, more so than the measures suggest.
„ „ 11	Thomson	Cap large and diffuse but seeing poor.
„ „ 12	Phillips	Cap seemed strikingly increased as if by fresh fall of snow, but careful observation showed this to be illusive, due to a white area at about $\lambda = 220°$.
„ „ 15	„	Cap looks much larger to-night.

MEASURES OF NORTH POLAR CAP.

A considerable number of micrometer measures of the N. P. cap were made by Phillips during the apparition and a few by other Members.

Phillips investigated the results obtained with three different methods of measurement on lunar craters (*a*) with the webs placed on the edges of the crater, (*b*) with the webs both outside the crater at an interval estimated to be equal to the diameter of the crater, (*c*) with one web crossing the crater and the other outside it. These three methods are illustrated below:—



(*a*) (*b*) (*c*)

His conclusions were published on pages 221–2, Vol. XXIX. of the *Journal*. For measuring the major axis of the Polar cap *when small*, method (*b*) seems to be the most satisfactory, and by this method on lunar craters Phillips found that in his case the result obtained should be multiplied by a factor 1·3, to give the result which seemed to be most nearly correct. This factor was about the same as that found many years ago by Professor Pickering in his experiments with illuminated holes in artificial discs. (*See Harvard Annals*, 32).

Phillips and the Director used method (*b*) for ascertaining the diameter of the cap. McEwen measured the latitude of the S. edge of the cap. Method (*b*) is not applicable, except when the Polar regions are turned towards the Earth so that the whole of the cap can be seen.

Table I. gives the measures of the Polar cap, and also the diameter of the cap as deduced from measures of the observer's drawings. The diameters of the cap are based on the assumption that the diameter of the planet's disc was as given on pages 180–182 of the *Nautical Almanac* for 1918. (It has been pointed out elsewhere that these diameters differ from those given on pages 533–5 in the same volume).

An inspection of Table I. shows that the diameters of the cap as measured on drawings are usually considerably greater than those obtained from micrometer measures, and that there are considerable discordances between observers as, perhaps, might be expected considering the range of instruments employed. It appears, however, that there is very fair agreement in the micrometer measurements of Phillips and the Director considering the difficulty of making some of the measurements. Comparing Phillips's micrometer measurements with measurements of his drawings we find that the ratio

$$\frac{\text{Drawing diameter}}{\text{Measured diameter}} = 2\cdot1 \text{ on the average for 12 nights}$$

when both measures and drawings were made. This does not take into account the factor 1·3 by which Phillips himself considers that his micrometer measures should be multiplied and this multiplication has not been applied to the figures given in Table I.

TABLE I.

DIAMETER OF NORTH POLAR CAP.

Date.	Observer.	Diameter.		Remarks
		From Measure.	From Drawing.	
1917.				
Nov. 17	McEwen	90°	—	
„ 24	„	70°	—	
„ 25	„	73°·3	—	Mean of 3 observations.

Date.	Observer.	Diameter.		Remarks.
		From Measure.	From Drawing.	
1917.				
Dec. 2	McEwen	82°	—	
,, 5	Phillips	—	48°	
,, 9	McEwen	60°	—	
1918.				
Jan. 1	Phillips	15°·9	—	
,, 1	Thomson	20°·4	—	
,, 2	Phillips	19°·5	37°·3	
,, 3	,,	19°·9	—	
,, 27	,,	15°·0	—	
,, 30	,,	9°·4	31°	"Measures too small" (T.E.R.P.).
,, 30	Ainslie	—	23°	From estimation.
Feb. 6	Phillips	9°·2	—	
,, 16	Steavenson	—	25°·1	
,, 16	Phillips	—	33°	
,, 17	,,	—	33°	
,, 18	,,	17°·7	—	"Dull white Cloud or fog."
,, 24	,,	—	29°	
,, 25	,,	—	25°	
,, 25	Steavenson	—	25°·1	
,, 27	Phillips	7°·8	18°	
,, 27	Thomson	—	20°·2	
Mar. 1	Phillips	7°·0	16°	
,, 4	Ellison	—	9°·2	
,, 5	Phillips	—	15°	
,, 8	,,	7°·5	15°	
,, 9	,,	6°·7	15°	
,, 10	Ainslie	—	20°·5	
,, 12	Phillips	—	15°	
,, 12	Thomson	12°·4	13°·6	
,, 15	Phillips	5°·2	—	
,, 16	Ainslie	—	20°·5	
,, 17	Phillips	6°·1	—	
,, 17	Ainslie	—	17°·8	
,, 17	Thomson	—	12°·3	
,, 20	Phillips	5°·5	12°	
,, 20	Ainslie	—	18°·3	
,, 21	Phillips	5°·5	10°	
,, 21	Thomson	7°·1	11°·0	
,, 21	Steavenson	—	10°·0	
,, 21	Ainslie	—	14°·8	
,, 21	Ellison	—	11°·5	
,, 22	Thomson	—	11°·0	
,, 22	Sargent	—	25°·1	
,, 22	Ainslie	—	15°·5	
,, 23	Phillips	6°·9	13°·6	
,, 23	Ellison	—	9°·2	
,, 23	Ainslie	—	14°·6	
,, 23	Thomson	—	9°·5	
,, 24	Phillips	5°·5	—	
,, 24	Ainslie	—	11°·7	
,, 24	Ellison	—	9°·2	
,, 25	Thomson	—	8°·8	
,, 26	Phillips	6°·4	10°·7	
,, 27	Ainslie	—	13°·7	
,, 31	,,	—	13°·7	

Date.	Observer.	Diameter.		Remarks.
		From Measure.	From Drawing.	
1918.				
Apr. 1	Phillips	—	12°·0	
„ 2	„	5°·4	—	
„ 2	Thomson	—	11°·0	
„ 3	„	—	8°·6	
„ 5	Phillips	—	10°·5	
„ 5	Ainslie	—	14°·8	
„ 6	Phillips	4°·7	—	
„ 8	Thomson	5°·1	11°·5	
„ 8	Phillips	—	9°·2	
„ 12	„	5°·7	—	
„ 12	Ainslie	—	16°·7	
„ 14	Ellison	—	6°·9	
„ 17	Thomson	6°·5	11°·5	
„ 18	Phillips	6°·1	—	
„ 18	Ainslie	—	11°·1	
„ 22	Steavenson	—	8°·9	
„ 22	Phillips	6°·0	—	
„ 22	Ellison	—	9°·2	
„ 23	Phillips	5°·9	10°·3	
„ 25	„	5°·6	9°·5	
„ 25	Thomson	—	6°·9	
„ 25	Ainslie	—	14°·8	
„ 26	Phillips	5°·5	—	
„ 26	Ainslie	—	13°·7	
„ 27	„	—	14°·6	
May 2	„	—	16°·5	
„ 8	Phillips	5°·5	—	
„ 9	Ainslie	—	16°·5	
„ 10	„	7°·6	14°·4	
„ 11	Phillips	6°·6	—	
„ 12	„	6°·2	—	
„ 15	„	8°·4	—	‘Looks much larger to-night.’ (T.E.R.P.).
„ 16	„	7°·8	—	
„ 17	„	8°·3	—	
„ 21	„	7°·7	—	
„ 27	„	9°·0	—	
„ 31	„	11°·4	—	
June 8	„	10°·3	—	
„ 15	„	9°·9	—	

From a study of the above table it appears that Phillips's measures indicate a steady increase in the diameter of the N. Polar cap during May, commencing about 50 days after the Summer Solstice of the N. Hemisphere, or when the heliocentric longitude of the planet was about 200°. According to the excellent table of phenomena of the Martian year published by M. Antoniadi in the *Memoir* for 1911–12, the N. Polar cap should continue to decrease long after this date. (Compare curves of the melting of Polar snows given in 1903 *Memoir*, where no indication of any systematic increase in diameter is shown up to 100 days after the Solstice).

LONGITUDES OF MARKINGS.

The longitudes of points on the disk determined by estimates of the time of transit over the Central Meridian are given below in Table II. :—

TABLE II.

Marking.	Observer.	Date.	λ	Remarks.
		1918.		
Fastigium Aryn -	Phillips	March 11	355°·4	Mean=356°·95.
	,,	,, 12	357°·2	
	,,	,, 15	357°·5	
	,,	,, 17	357°·2	
	,,	April 23	357°·3	
	,,	,, 25	357°·1	
F. prong of Furca -	Thomson	March 12	1°·0	
Iani Fretum (centre)	Thomson	March 12	9°·5	
Mare Acidalium -				
(Centre) - -	Thomson	March 9	33°·4	Mean 32°·9.
	Phillips	April 18	33°·8	
	,,	,, 22	32°·0	
N.P. end - -	Thomson	March 9	22°·0	
Point δ (1903 chart)	,,	April 17	30°·7	"Estimate probably late."
Auroræ Sinus -	Phillips	March 7	59°·3	Mean 57°·15.
	,,	,, 8	55°·0	Poor definition.
Solis Lacus - -	Phillips	March 8	80°·6	
Propontis I. - -	Phillips	April 2	173°·5	Mean 176°·6.
	,,	May 12	179°·7	
Trivium Charontis -	Phillips	Feb. 27	193°·6	
	,,	May 8	198°·7	
	,,	,, 9	199°·6	
	Thomson	Feb. 27	192°·4	
		1918.		
Lacus Nubis - -	Phillips	March 24	256°·7	
Syrtis Major.—				
Position of *Lacus Mœris* - -	Thomson	March 23	279°·3	*Mœris* not visible.
Centre of *Syrtis* -	,,	Feb. 9	λ is slightly less than 291° (past C.M. at time of observation).	
,, - -	Phillips	March 20	289°·6	Mean 289·3.
,, - -	,,	,, 21	291°·1	
,, - -	,,	,, 23	287°·4	
N. point - -	Thomson	,, 17	289°·5	
,, - -	,,	,, 21	299°·4	Noted as probably late.
,, - -	,,	,, 23	288°·6	

Marking.	Observer.	Date.	λ	Remarks.
		1917.		
Coloë Palus - -	McEwen	Dec. 2	303°·7	Lat. = + 43°.
		1918.		
	Phillips	March 20	300°·4	
	,,	,, 21	299°·5	
	,,	,, 22	299°·2	
		1918		
Hammonis Cornu -	Thomson	Feb. 8	298°·4	Seeing bad and observation unreliable.
	Phillips	March 20	315°·1	} Mean 314°·6
	,,	,, 21	313°·2	
	,,	,, 22	315°·5	
Ismenius Lacus -	Phillips	March 20	334°·9	} Mean 335°·5.
	,,	April 26	336°·1	

MICROMETER MEASURES OF DIAMETER OF PLANET.

An umber of measures of the planet's diameter, made by Phillips are given below, with the figures given in *N.A.*, pages 180–2 and 533–5, for comparison. The smaller of the diameters given in *N.A.* is based upon Hartwig's value of 4·68 seconds for the semi-diameter at unit distance and the larger on Pierce's value of 5·05 seconds. Phillips's measures were made with the 8-inch refractor and no doubt some allowance must be made for irradiation, but the results obtained appear to support the large value for the planet's diameter.

TABLE III.

DIAMETER OF DISC.

Date.	Phillips's Measure.	Secs.	*N.A.* pp. 180–2	*N.A.* pp. 533–5
1918.				
March 15	Polar Diameter - -	15″·39	} 14·14	15·24
	Equatorial Diameter -	15 ·52		
,, 17	Equatorial Diameter -	15 ·26	14·14	15·26
May 15	Polar Diameter -	10 ·68	10·0	10·83
,, 16	Polar Diameter - -	10 ·2	9·94	10·75

CHARACTERISTICS OF THE 1918 APPARITION.

Some of the most striking features of the apparition were the following :—

(1) The three brilliant white spots in the *Amazonis-Arcadia* region;

(2) The continued prominence of the great *Nepenthes-Thoth* curve;
(3) The darkness of *Lacus Hyperboreus* as in 1903;
(4) The definite dark area of *Casius*, which in no way resembled a canal but should rather be classed with the *Maria*;
(5) The bright bridge occasionally seen crossing *Syrtis Major*;
(6) The prominence of *Lacus Ismenius*;
(7) The darkness of *Mare Acidalium*;
(8) The appearance of *Juventæ Fons* and *Achillis Fons*;
(9) The indefinite appearance of *Lacus Lunæ*;
(10) The shading of *Libya*;
(11) The appearance of large white areas occasionally blotting out such markings as *Syrtis Major* when near the limb;
(12) The apparent veiling in March of large areas near *Auroræ Sinus* and the rapid dispersion of the obscuring material;
(13) The detached white mass N. of *Boreosyrtis* whose centre was $\pm$ 290°, and the similar area at $\pm$ 220°;
(14) The faintness of *Hesperia*;
(15) The darkness of *Cerberus* and *Propontis*;
(16) The conspicuous appearance of *Protonilus* and *Deuteronilus*.

Note on the Occultation of the star Cape (1900) 1524 by Mars 1918 April 11.

By ARTHUR BURNET, F.R.A.S.

The prediction of the phenomenon was sent to the observatories at Melbourne and Perth, and also to the New South Wales Branch of the B.A.A. Dr. Baldwin kindly circulated the prediction to most of the observatories and astronomical associations in Australia and New Zealand.

The original prediction indicated that the occultation would be visible throughout Australia, but was based on the *N.A.* place of Mars, and the Cape Catalogue (1900) place of the star, uncorrected for proper motion or any later catalogue. Ross corrections to the apparent place of Mars, together with the slight error in the assumed position of the star, will probably account for the difference between prediction and observation.

The following accounts of observations are compiled from various sources.

Dr. Baldwin reports as follows:—

"At Melbourne we had a clear sky most of the time but with occasional thin haze about the predicted time. I was observing with the 8-inch refractor, magnification

190. Here there was no occultation; for a time no division could be seen between Mars and the star, which even at its closest showed like a flame coming out of the limb of Mars. The observation was interfered with a good deal by varying atmospheric conditions, so that there was no certainty of any variation of light other than that arising from this cause. The passage of the star was very close to the limb of Mars and can be fairly spoken of as grazing it."

Mr. H. B. Curlewis, of the Perth Observatory, describes his observations as follows :—

"The first disappearance of the star occurred at $8^h\ 0^m$ and reappearance at $8^h\ 3^m$ Thus it will be seen that it only just escaped being a graze. Evidently the star must have a proper motion in R.A. and Dec., the former causing it to disappear beforehand and the latter causing a shift southward almost enough to bring it clear of the planet. The dimming of the star's magnitude as the atmosphere of Mars covered it was quite perceptible. It was very difficult to say really when the star quite disappeared, for its track was almost tangential to the edge of the planet, and it may really have disappeared a minute earlier and re-appeared before $8^h\ 3^m$; it was, however, certainly visible, then hanging on to the planet's limb. At $8^h\ 4^m$ it was clear of the edge and almost at its full magnitude. The diminution of brightness amounted to at least two magnitudes."

Mr. G. H. Hoskins, observing at Beecroft, 17 miles west from Sydney, gives the following description of the phenomenon, the instrument used being a reflector of 18-inch aperture, power 270 :

"At $9^h\ 48^m$ there was a break in the clouds enabling me to see the star apparently touching the limb of the planet. There were no signs of distortion at the moment, the star being sharp and clear. From this time until $9^h\ 57^m$ I was able to keep the star constantly in view. At $9^h\ 53^m$ the star dimmed to about half its former lustre and I found myself unable to focus it. It appeared woolly, rather like a star which had been magnified too much on a bad night, and more like a luminous smudge with perhaps a green tint to it. Owing to the effect of refraction its light was projected on to the south polar cap of the planet. The light of the star almost disappeared, but I was still able to see it until $9^h\ 57^m$, when the clouds again drifted over the planet and utterly obscured the view. I did not see it again until $10^h\ 2^m$, the star being then 2″ or 3″ away from the planet, sharp and clear as when I first saw it."

Dr. W. E. Macfarlane, who observed at Irvingbank, North Queensland, using a 7-inch Cooke refractor, apparently did not notice any gradual diminution of the light of the star, but the occultation was more nearly central there, and he estimated the duration as being about 20 minutes.

Dr. C. Moreton Olson, observing at Forbes, N.S.W., makes the following report:—

> "The occultation of the star was atmospheric throughout. Immersion into the planet's atmosphere began gradually at 9·50 p.m. and terminated sharply on emersion at 10 p.m., Standard State time, Thursday, April 11, 1918. Clear transparent night, conditions for seeing being most favourable; the planet almost on the meridian. The star, of a pale yellowish orange hue, approached the planet apparently radially at an angle of about 245° s.p., skirting tangentially the gibbous limb of the planet, cutting off as it were a section of its atmospheric envelope. In no stage of this atmospheric occultation was the star lost sight of. Its colour paled down gradually from brilliancy to a very faint salmon tint; at the same time its disc enhanced in size and softened down to a blurred woolly image as though over-magnified, or as a small object would appear out of focus. There is no doubt of the depth of the atmosphere surrounding Mars, for the apparent vertical zenith drop of the star at emersion was evidenced in a rapid recovery of brilliance, whereas in the immersion, with the planet's rotation, the refraction process was incipiently gradual."

Published August 1924.

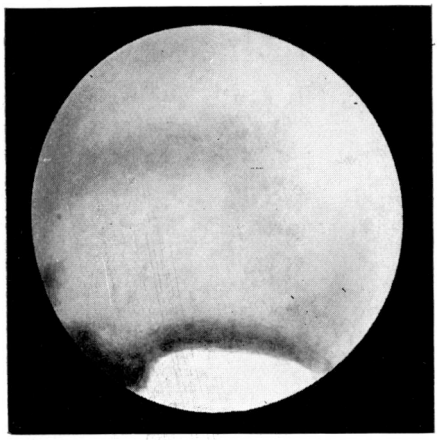


FIG. 1.—H. McEWEN. 5-in. O.G.
1917 November 25. $\omega = 341^\circ, \varphi = +22^\circ{\cdot}7$.

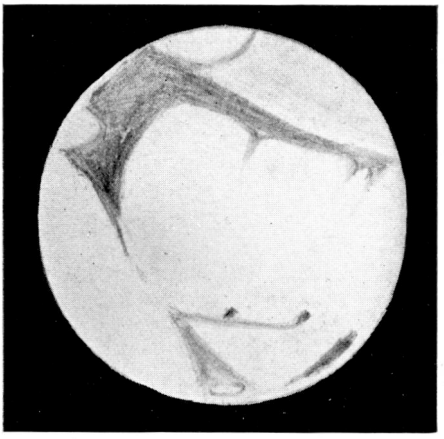


FIG. 2.—W. F. A. ELLISON. 10-in. Spec.
1918 April 22. $\omega = 332^\circ, \varphi = +22^\circ{\cdot}5$.

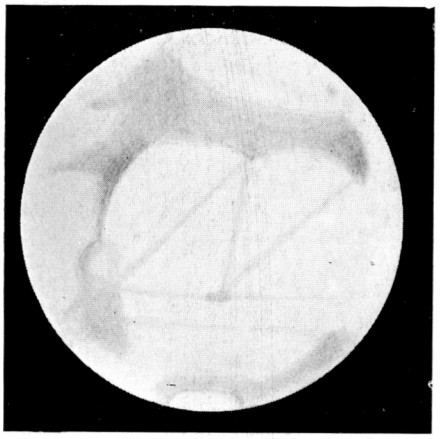


FIG. 3.—M. A. AINSLIE. $8\frac{1}{2}$-in. Spec.
1918 March 17. $\omega = 328^\circ, \varphi = +21^\circ{\cdot}6$.

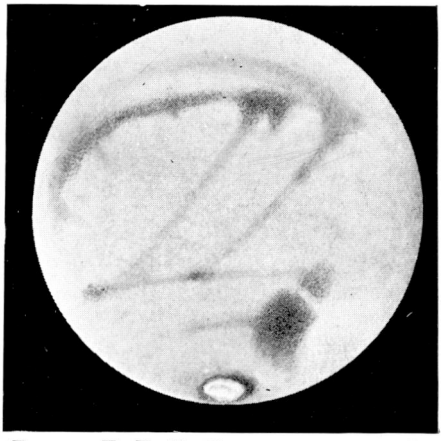


FIG. 4.—T. E. R. PHILLIPS. 8-in. O.G.
1918 March 12. $\omega = 349^\circ, \varphi = +21^\circ{\cdot}6$.

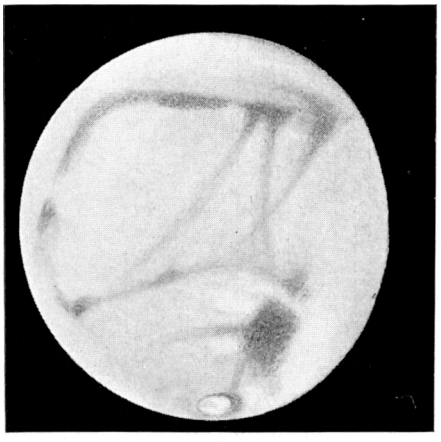


FIG. 5.—T. E. R. PHILLIPS. 8-in. O.G.
1918 April 25. $\omega = 348^\circ, \varphi = +22^\circ{\cdot}6$.

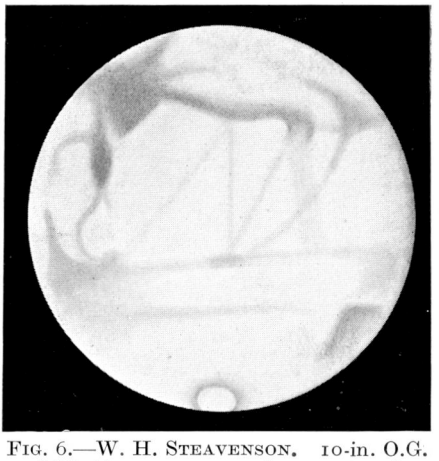


FIG. 6.—W. H. STEAVENSON. 10-in. O.G.
1918 March 21. $\omega = 333^\circ, \varphi = +21^\circ{\cdot}7$.

FIG. 1.—M. A. AINSLIE. 8½-in. Spec.
1918 April 25. $\omega = 317°$, $\varphi = +22°{\cdot}6$.

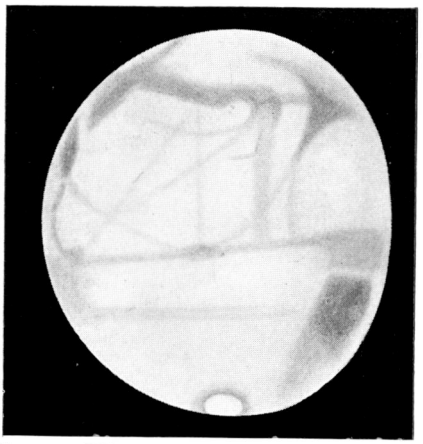


FIG. 2.—W. H. STEAVENSON. 28-in. O.G.
1918 April 22. $\omega = 353°$, $\varphi = +22°{\cdot}6$.

FIG. 3.—H. THOMSON. 12½-in. Spec.
1918 March 12. $\omega = 10°{\cdot}7$, $\varphi = +21°{\cdot}6$.

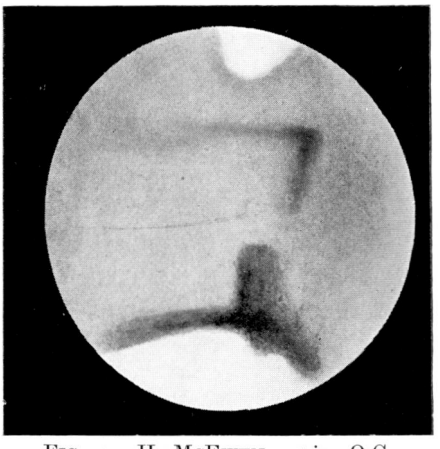


FIG. 4.—H. MCEWEN. 5-in. O.G.
1917 November 24. $\omega = 21°$, $\varphi = +22°{\cdot}7$.

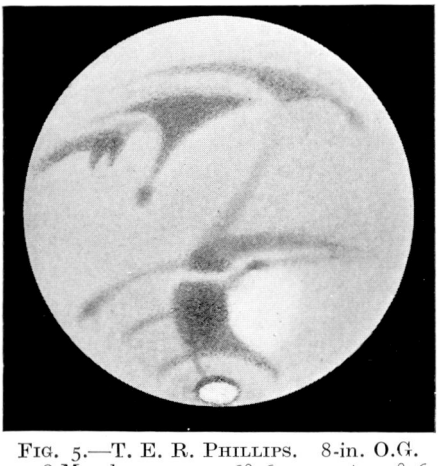


FIG. 5.—T. E. R. PHILLIPS. 8-in. O.G.
1918 March 9. $\omega = 36°{\cdot}6$, $\varphi = +21°{\cdot}6$.

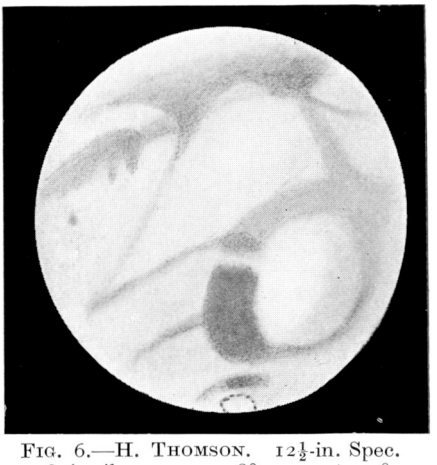


FIG. 6.—H. THOMSON. 12½-in. Spec.
1918 April 17. $\omega = 38°$, $\varphi = +22°{\cdot}3$.

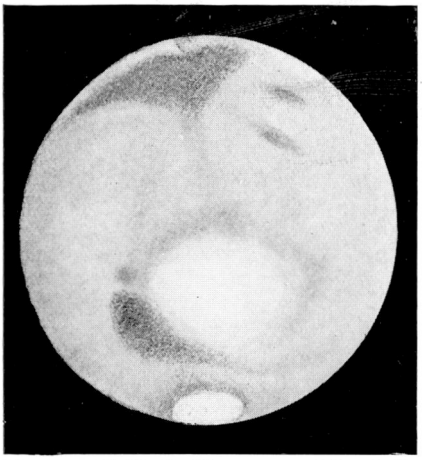


FIG. 1.—T. E. R. PHILLIPS. 8-in. O.G.
1918 January 30. $\omega = 66°{\cdot}1, \varphi = +21°{\cdot}9.$

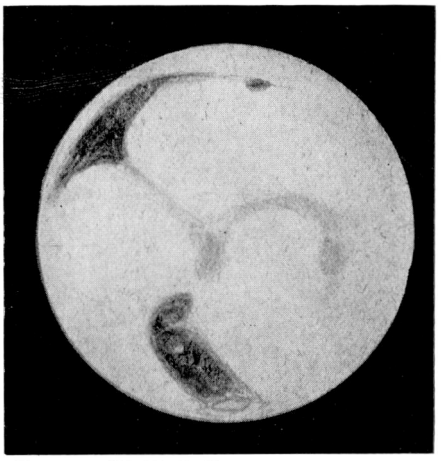


FIG. 2.—W. F. A. ELLISON $5\frac{1}{4}$-in. O.G.
1918 March 4. $\omega = 66°, \varphi = +21°{\cdot}5.$

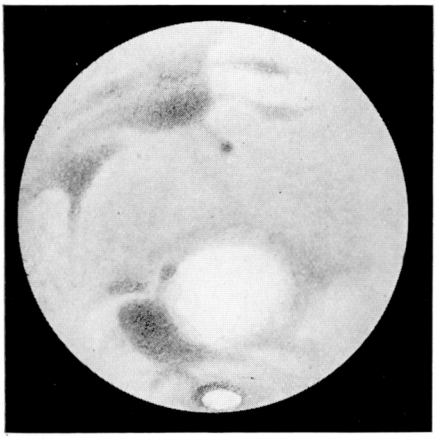


FIG. 3.—T. E. R. PHILLIPS. 8-in. O.G.
1918 March 9. $\omega = 65°{\cdot}8, \varphi = +21°{\cdot}6.$

FIG. 4.—M. A. AINSLIE. 9-in. Spec.
1918 April 12. $\omega = 79°, \varphi = +22°{\cdot}2.$

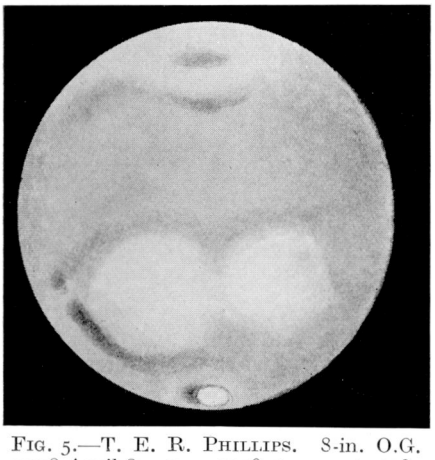


FIG. 5.—T. E. R. PHILLIPS. 8-in. O.G.
1918 April 8. $\omega = 105°{\cdot}5, \varphi = +22°.$

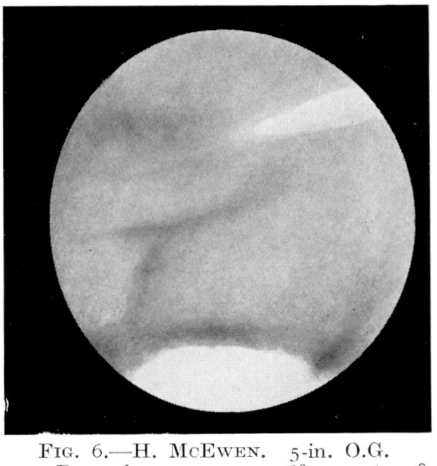


FIG. 6.—H. MCEWEN. 5-in. O.G.
1917 December 21. $\omega = 116°, \varphi = +23°$

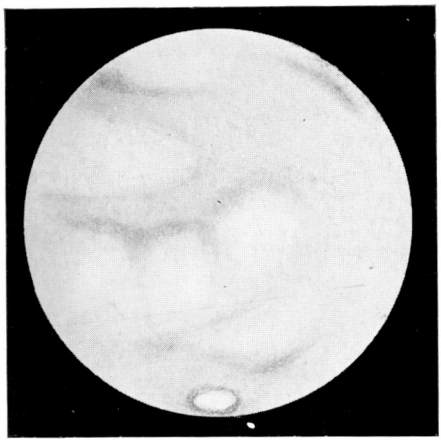


FIG. 1.—T. E. R. PHILLIPS. 8-in. O.G.
1918 March 1. $\omega = 121°$, $\varphi = +21°{\cdot}5$.

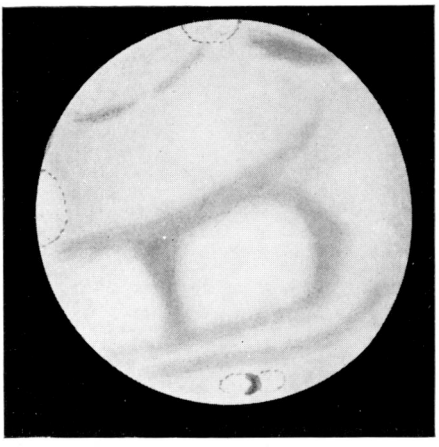


FIG. 2.—H. THOMSON. 12½-in. Spec.
1918 April 8. $\omega = 130°$, $\varphi = +22°$.

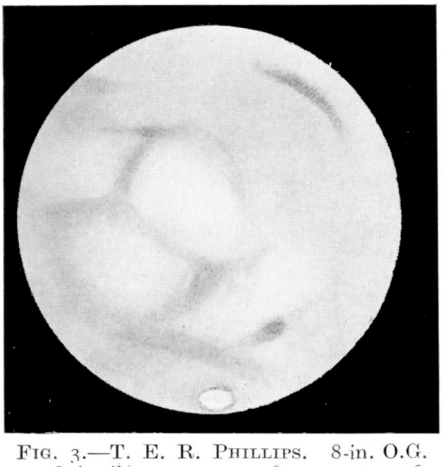


FIG. 3.—T. E. R. PHILLIPS. 8-in. O.G.
1918 April 5. $\omega = 139°$, $\varphi = +22°$.

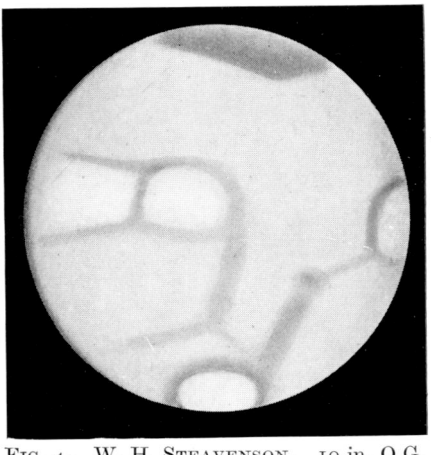


FIG. 4.—W. H. STEAVENSON. 10-in. O.G.
1918 February 25. $\omega = 144°$, $\varphi = +21°{\cdot}5$.

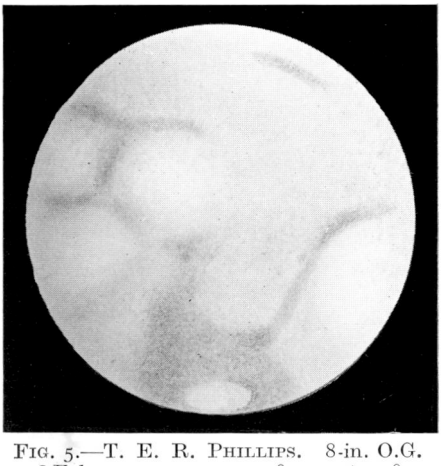


FIG. 5.—T. E. R. PHILLIPS. 8-in. O.G.
1918 February 25. $\omega = 149°$, $\varphi = +21°{\cdot}5$.

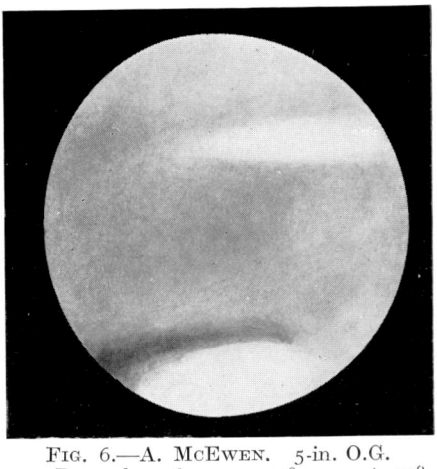


FIG. 6.—A. MCEWEN. 5-in. O.G.
1917 December 16. $\omega = 153°$, $\varphi = +23°$.

FIG. 1.—T. E. R. PHILLIPS. 8-in. O.G.
1918 February 27. $\omega = 157°{\cdot}8, \varphi = +21°{\cdot}5$.

FIG. 2.—H. THOMSON. 8-in. O.G.
1918 February 27. $\omega = 170°, \varphi = +21°{\cdot}5$.

FIG. 3.—H. THOMSON. 12½-in. Spec.
1918 April 2. $\omega = 166°, \varphi = +21°{\cdot}9$.

FIG. 4.—T. E. R. PHILLIPS. 8-in. O.G.
1918 April 1. $\omega = 181°{\cdot}6, \varphi = +21°{\cdot}9$.

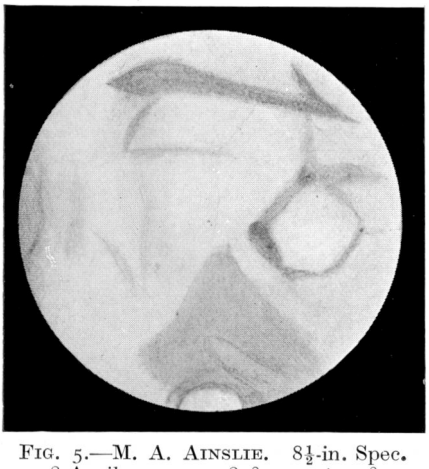


FIG. 5.—M. A. AINSLIE. 8½-in. Spec.
1918 April 1. $\omega = 189°, \varphi = +21°{\cdot}9$.

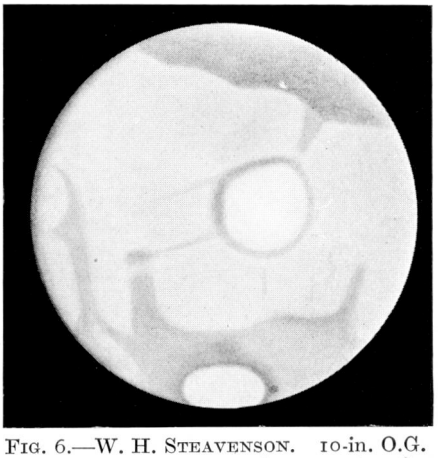


FIG. 6.—W. H. STEAVENSON. 10-in. O.G.
1918 February 25. $\omega = 190°{\cdot}2, \varphi = +21°{\cdot}9$.

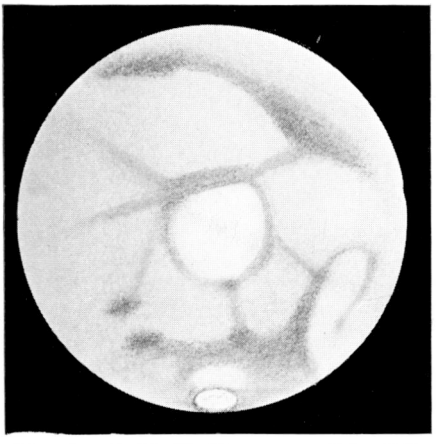


FIG. 1.—T. E. R. PHILLIPS. 8-in. O.G.
1918 March 26. $\omega = 215°$, $\varphi = +\ 21°{\cdot}8$.

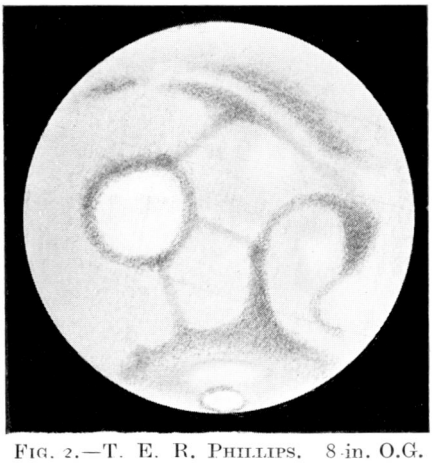


FIG. 2.—T. E. R. PHILLIPS. 8-in. O.G.
1918 March 23. $\omega = 245°{\cdot}6$, $\varphi = +\ 21°{\cdot}8$.

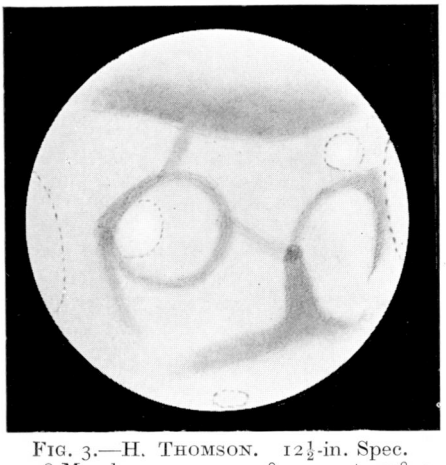


FIG. 3.—H. THOMSON. 12½-in. Spec.
1918 March 25. $\omega = 232°$, $\varphi = +\ 21°{\cdot}7$.

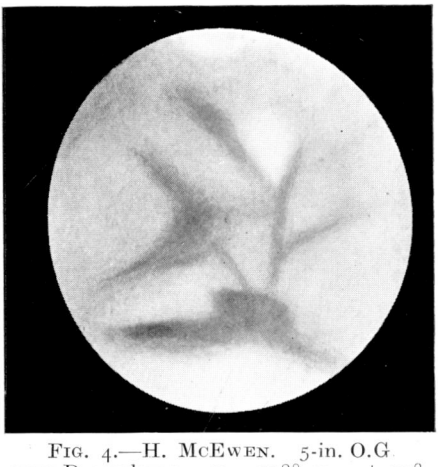


FIG. 4.—H. MCEWEN. 5-in. O.G.
1917 December 9. $\omega = 238°$, $\varphi = +\ 23°$.

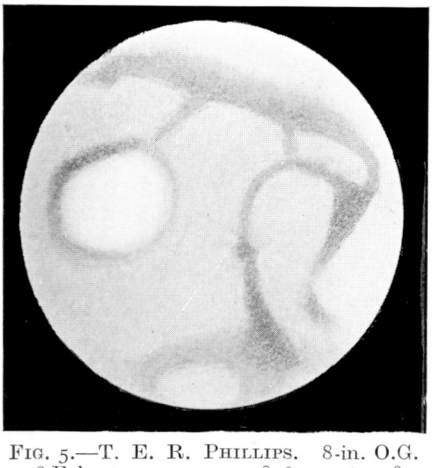


FIG. 5.—T. E. R. PHILLIPS. 8-in. O.G.
1918 February 17. $\omega = 241°{\cdot}6$, $\varphi = +\ 21°{\cdot}5$.

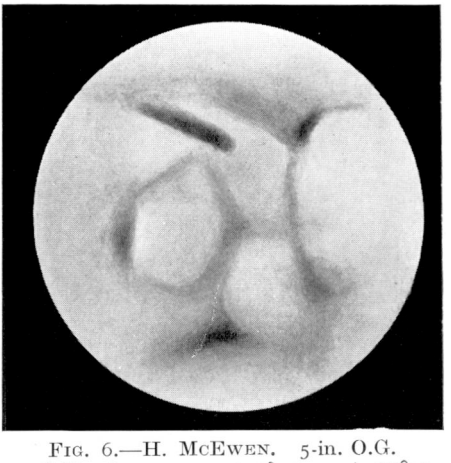


FIG. 6.—H. MCEWEN. 5-in. O.G.
1918 March 24. $\omega = 241°$, $\varphi = +\ 21°{\cdot}7$.

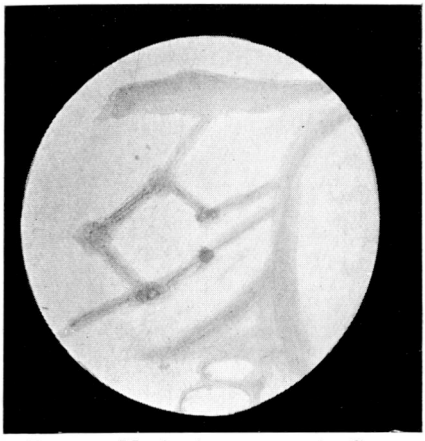


FIG. 1.—M. A. AINSLIE. 9-in. Spec.
1918 May 2. $\omega = 242°$, $\varphi = +23°$.

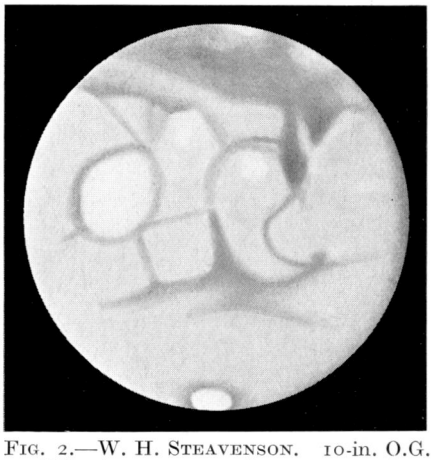


FIG. 2.—W. H. STEAVENSON. 10-in. O.G.
1918 March 22. $\omega = 254°{\cdot}5$, $\varphi = +21°{\cdot}7$.

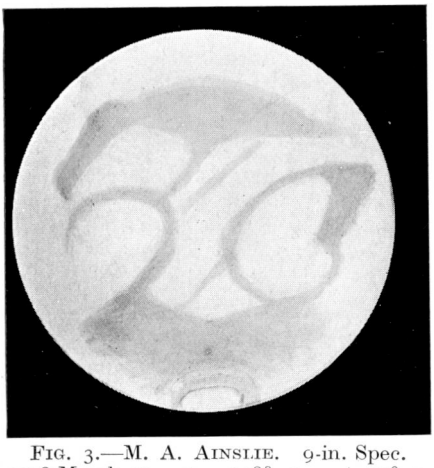


FIG. 3.—M. A. AINSLIE. 9-in. Spec.
1918 March 23. $\omega = 258°$, $\varphi = +21°{\cdot}7$.

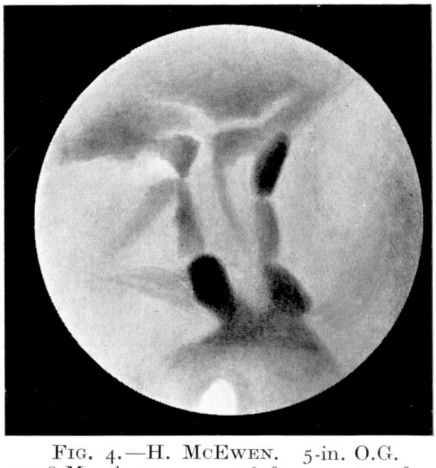


FIG. 4.—H. MCEWEN. 5-in. O.G.
1918 March 23. $\omega = 264°$, $\varphi = +21°{\cdot}7$.

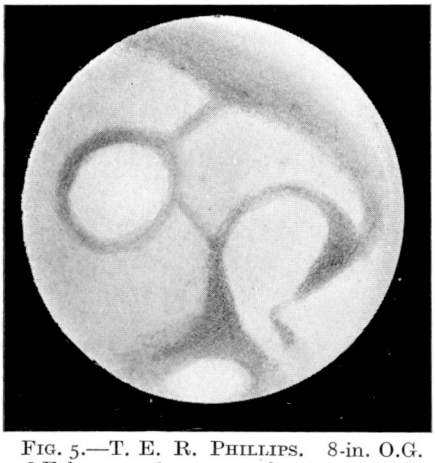


FIG. 5.—T. E. R. PHILLIPS. 8-in. O.G.
1918 February 16. $\omega = 250°{\cdot}5$, $\varphi = +21°{\cdot}5$.

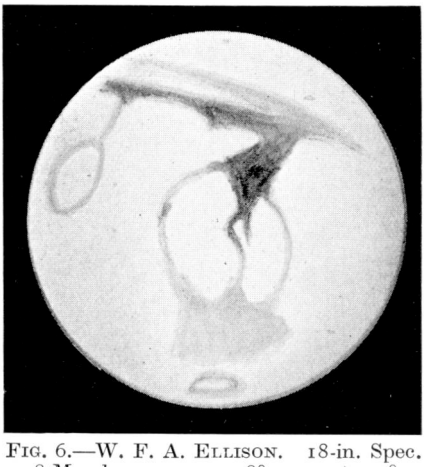


FIG. 6.—W. F. A. ELLISON. 18-in. Spec.
1918 March 21. $\omega = 278°$, $\varphi = +21°{\cdot}7$.

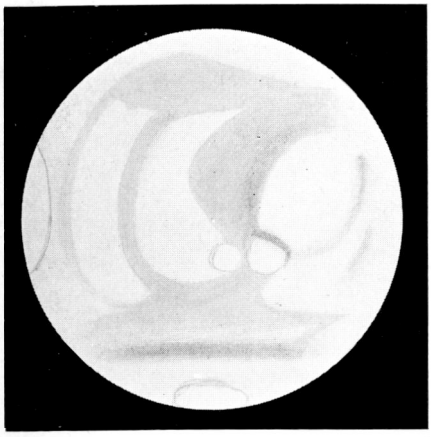


FIG. 1.—M. A. AINSLIE. 9-in. Spec.
1918 March 20. $\omega = 283°$, $\varphi = +21°{\cdot}7$.

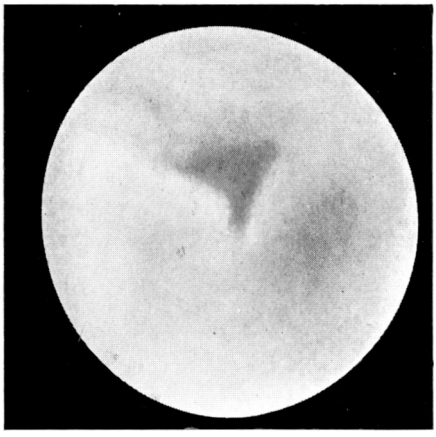


FIG. 2.—H. MCEWEN. 5-in. O.G.
1917 October 28. $\omega = 284°$, $\varphi = +20°{\cdot}7$.

FIG. 3.—H. MCEWEN. 5-in. O.G.
1917 December 2. $\omega = 292°$, $\varphi = +23°$.

FIG. 4.—T. E. R. PHILLIPS. 8-in. O.G.
1918 March 21. $\omega = 290°{\cdot}4$, $\varphi = +21°{\cdot}7$.

FIG. 5.—H. THOMSON. 12½-in. Spec.
1918 March 17. $\omega = 300°{\cdot}5$, $\varphi = +21°{\cdot}7$.

FIG. 6.—M. A. AINSLIE. 9-in. Spec.
1918 April 26. $\omega = 320°$, $\varphi = +22°{\cdot}7$.

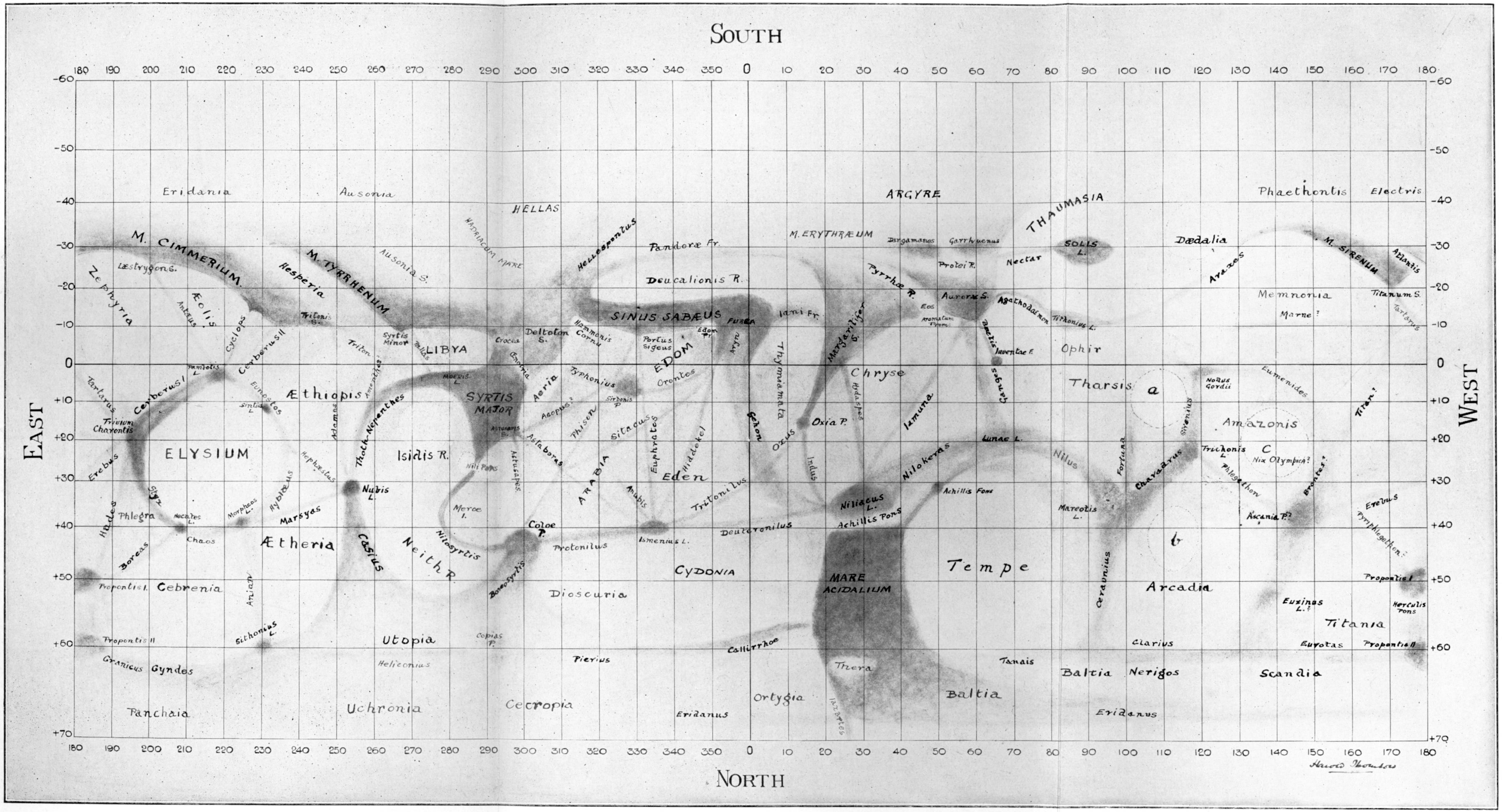


CHART OF MARS, ON MERCATOR'S PROJECTION.

PREPARED FROM OBSERVATIONS OF THE SECTION IN 1917–1918.

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