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OF THE
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FOURTEENTH REPORT OF THE SECTION

FOR THE OBSERVATION OF

M A R S,

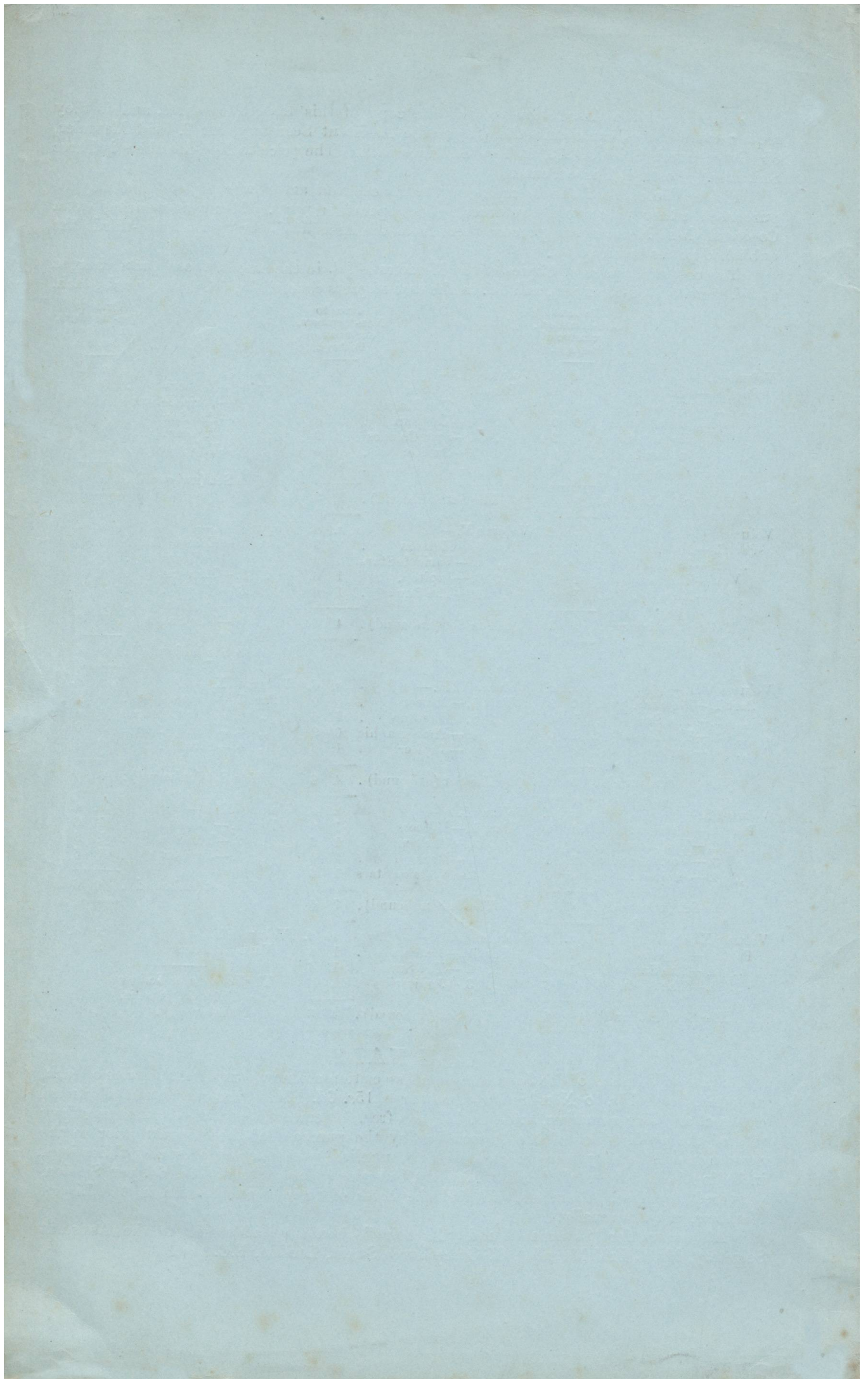
DEALING WITH THE APPARITION OF 1919-1920.

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Director—Harold Thomson, M.Sc., F.R.A.S.

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# SECTION FOR THE OBSERVATION OF MARS.

DIRECTOR.—HAROLD THOMSON, M.Sc., F.R.A.S.

REPORT OF THE SECTION, 1919–1920.

## INTRODUCTION.

The opposition which occurred on 1920 April 20 was not a favourable one for observers in Great Britain owing to the South Declination of the planet. The apparition resembled that of 1905, when opposition took place on May 8. The planet approached the Earth within about 54,200,000 miles on 1920 April 28.

### *Data.*

|                                              |                                              |
|----------------------------------------------|----------------------------------------------|
| Mars in W. Quadrature with Sun               | - 1920 January 13.                           |
| Mars in Apparitional Perigee                 | - - 1920 April 28.                           |
| Mars in Opposition to Sun                    | - - - 1920 April 20.                         |
| Diameter of Mars at Opposition               | - - 15".91.                                  |
| Position angle of N. Pole at Opposition      | 35°.64.                                      |
| Latitude of centre of disc at Opposition     | + 18°.92.                                    |
| Summer Solstice of N. Hemisphere             | - } 1920 February 8.                         |
| Winter Solstice of S. Hemisphere             |                                              |
| Position of Mars at Opposition               | - { R.A. = 13 <sup>h</sup> 58 <sup>m</sup> . |
|                                              | - { Dec. = S. 10° 26'.                       |
| Heliocentric longitude of Mars at Opposition | - } 210° 32'.                                |
| - - - - -                                    |                                              |
| Heliocentric latitude of Mars at Opposition  | - } N. 0° 35'.                               |
| - - - - -                                    |                                              |

The season on Mars at the date of opposition corresponded with July on Earth, so that the observations here recorded deal with summer in the N. hemisphere of the planet.

### The Members of the Section.

The following table gives the names of Members who have contributed notes or drawings, with particulars of their localities and instruments, and the number of drawings submitted :—

| Observer.                                    | Locality.                | Aperture of Instrument in Inches. | No. of Drawings. |
|----------------------------------------------|--------------------------|-----------------------------------|------------------|
| ATKINS, E. A. L., F.R.A.S.                   | Squirrel's Heath, Essex. | 8½ Spec.                          | 26               |
| BRINDLEY, T. - - -                           | Sydney, N. S. Wales      | 8½ Spec.                          | 5                |
| ELLISON, Rev. W. F. A., M.A., B.D., F.R.A.S. | Armagh, Ireland -        | 10 O.G.                           | 6                |
| McEWEN, HENRY - - -                          | Cambuslang - - -         | 5 O.G.                            | 59               |
| GALE, W. F., J.P., F.R.A.S.                  | Sydney, N. S. Wales      | 8½ Spec.<br>6 O.G.                | 7                |
| GARDINER, E. - - -                           | Haberfield, N. S. Wales. | 6 O.G.                            | —                |
| LARMAN, M. L. - - -                          | Southend-on-Sea -        | 6 O.G.                            | 6                |
| DU MARTHERAY, C. F. M. -                     | Brussels - - -           | 5·3 O.G.,<br>8½ Spec.             | 18 and chart.    |
| NANGLE, JAMES, O.B.E., F.R.A.S.              | Sydney, N. S. Wales      | Not stated                        | 4                |
| PHILLIPS, Rev. T. E. R., M.A., F.R.A.S.      | Headley, Surrey -        | 8 O.G. and<br>12¼ Spec.           | 8                |
| SHERLOCK, E. DENTON -                        | Manchester - - -         | 3 O.G.                            | 10               |
| STEAVENSON, Dr. W. H., F.R.A.S.              | Helwan, Egypt -          | 4 O.G.                            | 1                |
| THOMSON, HAROLD, M.Sc., F.R.A.S.             | Newcastle-on-Tyne        | 12½ Spec.                         | 9                |

### Notes.

As Mars was South of the Equator during the 1920 apparition, it is not surprising that observational notes from our home observers were not so plentiful as in 1918. The work of the Section also suffered from the absence of Dr. W. H. Steavenson abroad, and Instructor-Captain Ainslie was also unable to do any observational work, and the absence of a report from these two able observers was a great loss to the Section.

The Rev. T. E. R. Phillips also was unable to do so much as at the previous oppositions, and the situation of the Director's observatory was such that he was hardly able to observe the planet at all. Fortunately, Mr. Atkins, Mr. McEwen, M. du Martheray, and Mr. Gale from N. S. Wales, were able to send in good reports, and this Memoir is due very largely to their work. It will be understood that the difficulty of compiling a satisfactory Memoir from the somewhat scanty material available has been considerable, and that this has been increased by the inability of the Director himself to take his fair share in the observational work.

The seeing conditions in Great Britain during the apparition appear to have been fairly normal, but good seeing could hardly be expected when the planet was some ten degrees South of the Equator. Mr. Gale (who had the assistance of his son, Mr. A. W. W. Gale), writing from Sydney, N.S.W., says that previous to opposition definition was never high-class, but after opposition he had remarkably good definition, the month of May affording him the highest number of first-class nights he had known in that month.

Mr. Gale used a 6-inch Alvan Clark refractor and an 8½-inch With reflector mounted as an altazimuth, and it is interesting to read that he found, when the seeing was good, that he could see as much detail with the mirror despite its inferior mounting as with the clock-driven refractor, and sometimes with greater certainty. This agrees with the experience of Phillips and others that the refractor has the advantage when seeing is moderate, but that the reflector is excellent when the seeing conditions are really suitable. Mr. Gale used on a few occasions a wire-gauze screen in front of his telescope, and states that he sometimes used this device on Mars and believed that certain faint markings then showed to advantage in the reduced glare. The Director and Phillips have also used a screen on Mars and in some cases have found improved definition, but as a rule it was preferred to observe without the screen.

Mr. Larman, whom we are pleased to welcome as a new Member of the Section, reports that his seeing conditions were extremely poor throughout the opposition, and even the broader markings were very difficult. He could seldom use a higher power than 160 on his 6-inch refractor.

M. du Martheray's experience was similar, and Rev. W. F. A. Ellison reported that he had only one first-class night during the apparition, and on that night he could not see a marking of any kind on the disc! This was in Longitude 120°, which is well known as the most difficult part of the planet, but the invisibility of *Mare Sirenum* was unusual.

Mr. Denton Sherlock sends a series of drawings made with a 3-inch refractor. It is not to be expected that much detail could be seen with such a small aperture, but his drawings show the principal dark markings and some of the darker canals, and it should be an encouragement to other possessors of small telescopes to know that something can be done by a skilled and patient observer, even on so difficult a subject as Mars, with a 3-inch telescope—though, naturally, a study of the finer details requires a more powerful instrument.

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### Features of the Apparition.

Undoubtedly, the predominant phenomenon of the apparition was the prevalence of large white areas on the disc, which sometimes obscured such markings as the *Syrtis Major*. Thus, Ellison remarks upon the "great sheets of brilliant cloud which often drowned out the most conspicuous markings. On May 19

and 20, at 10 hrs. G.M.T. "the *Syrtis Major* was entirely concealed under such a sheet; only its extreme N. end projecting like a little black spike." This phenomenon was also noted by the Director and other observers and is well illustrated by photographs taken at the Lowell Observatory, copies of which were very kindly sent to the Director. A comparison of photographs taken in 1905 and 1920 shows that the white clouds were much more frequent in 1920 than in 1905, when the seasons on Mars were more or less similar. Gale calls attention to this feature of the apparition and says in his report:—"To me the most striking feature of the opposition has been the great amount of cloud visible on Mars. Most remarkable of all was the dissipation in the space of fourteen minutes of a great cloud which overspread a large area in the south-following portion of the disc." Gale's account of this phenomenon on 1920 May 5 reads as follows: "The Southern Polar arc has been increasingly visible since 9 hrs. 30 mins. (Sydney time), and has a broad, long tongue of light white cloud extending over *Thyle II* and *Ausonia*. After an interval of 14 minutes the planet was again examined, and I was amazed to note that the cloud had disappeared in the interval between 11 hrs. 0 min. and 11 hrs. 14 mins. *Mare Tyrrhenum* was partly covered, but is now (at 11 hrs. 14 mins.) free from cloud, although the marking appears slightly hazy. Definition is of the highest class and all the features recorded were seen also by my son, whose sight is keen and mind unprejudiced. *Deltoton Sinus*, *Crocea*, *Libya* and the North part of *Mare Tyrrhenum* are completely overlaid. The cloud turns north and overlies the eastern half of *Aeria*. These portions have been seen cloud-covered on several occasions, but do not seem to be subject to such rapid and remarkable clearing as seen in the case of the *Ausonia* cloud." On May 30 at 7 hrs. 40 mins. (Sydney time), when the longitude of the C.M. was about  $330^\circ$ , Gale noted that *Mare Acidalium* and *Lacus Niliacus* "were completely obscured by a light mass." At 8 hrs. 15 mins. *Mare Acidalium* was still cloud-covered, and at 8.40 the northern part of the *Mare* was "just now perceived," the southern part was still overlaid by bright white cloud. By 9 hrs. 15 mins. the brightness over *Mare Acidalium* was much reduced. It appeared to have cleared from the northward.

On the limb of the planet many white and sometimes very brilliant areas were recorded. Thus, McEwen, on May 7 and 8, saw brilliant white areas on the *p.* limb over *Syrtis Major* and *Libya* region which he found "astonishingly bright and much brighter than the Polar cap." Later in the evening McEwen recorded that this bright area was "creeping South." The brightness of some of these areas made them to appear to project beyond the limb.

Bright areas were also observed fairly regularly along the *f.* coastline of *Syrtis Major*, in *Elysium*, *Argyre* and *Tempe*; and Attkins writes: "Early in June the cloud over *Aurora Sinus* was very striking and interesting." Attkins also recorded a very large bright triangular area *p.* *Propontis* on May 29,

which extended almost half-way across the disc, and numerous other examples are recorded by various Members. The Director for convenience has called these white areas "clouds," although it seems quite probable that they are not clouds at all. The nature of this white material which occasionally obliterates some of the darker *maria* is not yet definitely proved, but it seems reasonable to conclude from its behaviour that it is either cloud, snow or hoar frost, or perhaps all three at different times. The study of the behaviour of these white areas is, therefore, of importance, especially when indications are found of rapid change in their appearance during the progress of the Martian day. When we see upon the planet white material at the Poles which looks like snow and behaves like snow; when we see areas in the early morning covered by white material which disappears, as hoar frost or light snow would disappear on Earth with the increasing warmth of midday; when we see other phenomena which have their parallel in the behaviour of clouds on Earth, it does not seem unreasonable to conclude that we have evidences of phenomena on Mars not unlike some of those which are well known to us here, and the further study of these phenomena cannot fail to throw some further light on many interesting questions regarding the planet.

While these white areas were undoubtedly the most prominent feature of the opposition, there were other interesting features which are dealt with in the text. One which calls for special mention, perhaps, was the great development of the bay on the following side of *Syrtis Major* where the canals *Astusapis* and *Astaboras* enter the *Mare*. This feature was so conspicuous that it caught the eye at once when observing this region of the planet, and it is very prominent also on the Lowell Observatory photographs for 1920. Yet this conspicuous change of outline was strangely missed by some of our observers who recorded much more difficult detail elsewhere, which illustrates one of the difficulties of compiling a Memoir such as this when the material is comparatively scanty, and insufficient, in some cases, to establish definitely which of the observers correctly delineated the markings when they differed. The photographs and work of other observers, however, definitely show that this bay was a real feature of the apparition.

## THE OBSERVATIONS.

The following abbreviations are used in this report :—

$\Omega = \lambda$  = areographic longitude ;

$\omega$  = longitude of centre of disc ;

$\Phi$  = areographic latitude ;

$\phi$  = latitude of centre of disc ;

N = North ; S = South ; E = *p* = preceding = areographic East ; W = *f* = following = areographic West.

C.M. = Central meridian of disc.

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### SECTION I.

#### Sinus Sabæus and Mare Erythræum.

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

*HAMMONIS CORNU*.—Nothing of particular interest was observed in connection with this promontory. On the majority of the drawings the coast line here is shown curved, but Atkins drew a somewhat pronounced angle on May 7, 9, 10 and 13, with a white area on the first three of these dates. On May 29 and 30, Gale shows an almost detached white projection into the *Mare*, and he remarked that the promontory was well-marked as a light encroachment into the dark area.

Brindley on April 24, and Nangle on May 28, show the coast-line curved here, but on June 16 and July 22 du Martheray shows the promontory very distinctly pointed, while on July 25 his drawing resembles Gale's of May 29.

Phillips's sketches of May 12 and 14 show some indication of the promontory, but it is not pronounced, and the appearance on his drawings resembles that of 1917-18.

On May 9 and 12 the Director drew *Hammonis Cornu* as a small rounded projection into the *Mare*.

Sherlock with his 3-inch O.G. shows a curved coastline, and McEwen's drawings are usually similar, but his sketch of May 15 shows an angle here. Ellison shows a somewhat obtuse angle here on May 12 and 14.

The Director concludes that the appearance of this feature was very similar to that of 1905 and 1917-18, but its appearance is undoubtedly affected by seeing conditions and the power of



the instrument employed. It also seems probable that actual changes take place in this neighbourhood. (See Figs. 1-6, Plate I.)

*SINUS SABÆUS*.—The drawings of Brindley, Gale, Sherlock, McEwen, Phillips and the Director in May show this marking about  $7^{\circ}$  or  $8^{\circ}$  wide, with the N. edge more clearly defined than the S. edge. Attkins, however, drew it abnormally broad, and Du Martheray's drawings in June and July show the shading extending to the edge of the bright Southern regions with no defined outline of *Deucalionis Regio*. On July 22 he noted that "*Sinus Sabæus* had its usual aspect," but his drawing indicates a very wide dark shading with no indication of *Deucalionis Regio* or *Pandoræ Fretum*. These are, however, indicated faintly on his general chart of markings seen during the apparition. No drawings are available for comparison with those of Du Martheray for July from which the apparent darkening of this region of the planet can be confirmed.

Nangle's drawing of May 28 shows the strait rather broad, with the S. edge ill-defined. *Pandoræ Fretum* and *Deucalionis Regio* are shown slightly shaded, from which it appears that all darkened late in the apparition into one shaded area or that on the small disc in July it was not possible to distinguish *Deucalionis Regio*.

On his sketch of May 9, Phillips shows the part of *Sinus Sabæus p. Furca* distinctly less dark than the remainder of the marking. This lighter area is absent on his drawing of May 12, but on this date a very bright area is shown on *Edom Promontorium*. It is possible that here we may have evidence of a movement Northwards of a bright cloud of some kind. (See Fig. 4, Plate I.)

To McEwen the colour of *Sinus Sabæus* was sepia on March 9 and May 7, 9, 10 and 12, but raw umber on April 7. To Attkins this marking was pale on May 9 and 10, but on June 13 he found it fairly dark, while Phillips shows it fairly dark on May 9 and 12. Gale noted it very dark and conspicuous on May 29, and darker than *Syrtis Major* on May 30. Sherlock also shows *Sabæus* very dark on May 13, and on June 19 he shows a white area obscuring a considerable portion of its length.

Phillips's sketch of May 12 places the N. edge of *Sabæus* in the position of *Portus Sigeus* at about Lat.  $-4^{\circ}$ . Gale's sketches place it further South, while Attkins in the main agrees with Phillips, and Du Martheray places it practically on the Equator. These differences appear to be accidental, and there is no conclusive evidence of any change of position to be gathered from the observations available in 1920. This marking appears to the Director to change its appearance very little from year to year, in marked contrast to the regions South of it such as *Pandoræ Fretum*, which varies greatly in its appearance and intensity. It may be interesting to speculate whether we have here evidence of some form of evergreen tropical vegetation which varies little with the Martian seasons.

*PORTUS SIGEUS* is barely discernible on Phillips's drawings of May 9 and 12, nor can it be seen on Attkins's sketches in May. McEwen recorded its visibility on May 9 and 10, and on the latter date he estimated its longitude at  $327^{\circ}$ . It was, he says, darker than the rest of *Sabæus* and of sepia tint. On May 29 and 30, Gale draws it as a dark projection on the N. edge of *Sabæus*, with two narrow canals, *Phison* and *Euphrates*, running N. from it almost parallel to one another. On May 31 Gale says that *Portus Sigeus* was not clearly defined, but that the canals from it were sometimes seen as a broad, hazy blurr. This marking is strongly indicated on Du Martheray's drawing of July 22.

*DEUCALIONIS REGIO*.—Attkins's drawings in May show this region bright, with no dark boundary to the South, *Pandoræ Fretum* not being visible on his drawings in May, nor on those of Phillips, McEwen, Ellison and Larman. No light area connecting this region with *Thymiamata* could be seen by Attkins on June 13. Du Martheray's sketches of June 16 and July 22 show this region shaded.

*PANDORÆ FRETUM*.—As stated above, this marking was not shown on the May drawings, but on June 13 Attkins was pretty certain of it, and it appears to have been indicated on Brindley's drawing of April 24; but Gale reported on April 29 that there was no dark marking S. of *Deucalionis Regio*, *Pandoræ Fretum* being invisible and the S. limb quite featureless. Gale's drawings of May 29 and 30, however, show *Pandoræ Fretum* quite strongly, and it is confirmed on Nangle's coloured drawing of May 28. Du Martheray shows this region shaded in June.

*DAWES FORKED BAY OR SINUS FURCOSUS*.—Throughout the apparition Attkins shows this bay single, as does Nangle on May 28. Phillips shows it forked on May 9, but remarked that it was "not well split," and he found it somewhat indistinct and ill-defined on May 12, when near the *f.* limb. Brindley noted that the colour of *Furca* on April 24 was decidedly blue, but was unable to see the forks, although the image in his  $8\frac{1}{2}$ -inch reflector was clear and sharp. Gale could not see the fork on April 21, but on May 29 he states that both points were clearly shown, with the fork somewhat shaded; and again on May 30 he found it distinctly forked and the marking was dark and larger than his remembrance of it. The following night he found the marking "fuzzy, but the points appear to show through the haze." On this date the bay was much less dark than *Syrtis Major* or *Mare Acidaliæ*. Ellison shows the forks clearly on May 7 and 8.

Du Martheray's drawings show this feature somewhat indistinctly forked; and the Director, who had few good views of this region, also saw it usually indistinct and hazy in outline, and on May 9 he found it much fainter than *Margaritifera Sinus*.

To McEwen the whole bay was "very conspicuous" and of "rhomboidal shape" and sepia tint on April 8, when it is shown as a large, prominent, single marking on his drawing. On

May 7 McEwen thought it the darkest spot on the disc and estimated its longitude at  $357^{\circ}$ . On May 8 it appeared faint and small, and its longitude was estimated at  $0^{\circ}$ . On May 9, McEwen again found it conspicuous and of sepia tint; no forks are shown on his drawing. On May 10, McEwen saw this marking rectangular in shape, and it was again very dark on May 13 near the *f.* limb.

*FASTIGIUM ARYN* was clearly seen by Ellison on May 7 and 8, and by Phillips on May 9, and also by Gale on May 29 and 30; but, as will be gathered from the account given above of the Forked Bay, this feature, in general, was not well seen in 1920.

*EDOM PROMONTORIUM*.—McEwen shows a light area here on April 8, and it is shown very white by Phillips on May 12, although it was not so seen on May 9 by Phillips or the Director.

*EDOM*.—Light ochre to McEwen on April 8 and light orange to Attkins on May 7. There was nothing of special interest to record in connection with this region. McEwen shows the S. edge of this region where bordering *S. Sabæus* rather bright on May 12.

*EDEN*.—McEwen records the colour of this region as "brown yellow" on April 7, "burnt yellow" on April 8. Attkins calls it light orange on May 7.

*ARABIA*.—"Gold ochre" to McEwen on March 9 and April 7, and "burnt yellow" on April 8 and May 13. Attkins found it "light orange" on May 7.

A "very vivid" white area over this region was noted near the *p.* limb on May 4 by Attkins.

*AERIA*.—White areas were observed in this region, especially along the *f.* coastline of *Syrtis Major*, where such brightness is frequently visible. These white areas are plainly seen on the Lowell Observatory photographs. Sometimes they partially obscured the *Syrtis Major*. Gale's drawing of May 5 shows a remarkable instance of a white cloud on *Aeria* which extended Eastwards and obscured the S. portion of *Syrtis Major* (see Fig. 2, Plate VI.).

*DIOSCURA*.—Attkins in May shows this region no deeper in tint than *Arabia* and *Eden*. On June 13 he noted that this land was lightly shaded. Du Martheray shows the region N. of *Coloë Palus* and *Ismenius Lacus* shaded on his drawings of June 16, July 22 and 25.

*CYDONIA*.—Attkins on May 3 noted a contrast in the colour of *Cydonia*, which was shaded, with *Eden*, which was light-orange tint. A small white spot was seen by Attkins on May 3 preceding the coastline of *Mare Acidalium*. This spot does not appear on his drawing of May 7, nor on Phillips's drawings of May 4 or 9, but Gale's drawing of May 29 shows a white area along the greater part of the *p.* edge of *M. Acidalium*, and he noted on May 30 that the region N. of *Deuteronilus* was very bright.

A similar white area situated rather further N. was recorded here in 1918 and other apparitions. It does not appear to be a permanent feature, however.

Du Martheray reports that, on June 16 and July 22, *Cydonia* to the North of *Protonilus* and *Deuteronilus* was very dark and greenish, which showed up the whiteness of the Pole.

*THYMIAMATA*.—McEwen recorded the colour of this land as “burnt yellow” on May 4 and “pale gold ochre” on May 8, where it indented *Iani Fretum*. Du Martheray shows it shaded on his drawing of June 9, and Attkins’s coloured sketch of June 13 shows the area between *Indus* and *Gehon* distinctly more red and darker than the neighbouring *Eden*.

*ISMENIUS LACUS*.—This lake was again rather conspicuous. Du Martheray describes it as an oval spot, elongated and greenish. He places it on his chart in its usual position on the 40th parallel at  $\lambda = 330^\circ$ . From estimates of its transit over the C.M., Phillips places it at  $\lambda = 336^\circ.7$  on May 9 and  $338^\circ.2$  on May 12, and micrometer measures of its latitude gave  $40^\circ.3$  and  $42^\circ.4$  respectively. It appears that this marking has been stationary for some years, as Lowell found a constant longitude of  $336^\circ$  between 1894 and 1903. Ellison writes that to his eye *Ismenius Lacus* and *Coloë Palus* were “sharp little triangles as hard as bits of blue glass.” To most of the observers, however, this lake seems to have appeared as a somewhat hazy oval spot on the canal *Protonilus*. Both the lake and the canal can be seen readily on the Lowell Observatory photographs taken in April and May, 1920.

*IANI FRETUM*.—Observers differed in their delineation of this portion of the disc. Attkins usually showed *Sabæus Sinus*, *Furcosus* and *Margaritifer Sinus* as one continuous dark marking, with no indication of a lighter connection between *Deucalionis Regio* and *Thymiamata*. On May 3, however, a white area preceded *Margaritifer* and a somewhat similar appearance is shown on June 8 and 10, but on June 13 he could not see this brighter region. Phillips’s sketch of May 9 shows this neighbourhood very similar to its appearance in 1918, with *Deucalionis Regio* barely divided from *Thymiamata* by a slight shading. The Director noted on May 3 that the brighter land between *Furca* and *Margaritifer S.* was well seen and that it was *not* darkly shaded. Du Martheray also, on his chart, shows a lighter area here. Gale shows no light passage, nor do Ellison, Nangle or McEwen, but the Director is confident that this light bridge was present in the early part of May, though it certainly was not so bright as *Deucalionis Regio* or *Thymiamata*, and this is confirmed by drawings of other observers published elsewhere.

*ARETHUSA LACUS* was recorded doubtfully by McEwen on April 7, but on April 8 he could not see the lake, although *Arnon* and *Pierius* were distinct. It appeared to him as a “thickening” at the junction of *Arnon* with *Pierius* and *Callirrhoë* on May 10,

when he estimated its longitude at 339°. No other Member of the Section recorded this lake in 1920.

*HELLESPONTUS* was too far South to be well seen. Du Martheray states that it was very dark on July 25.

#### MINOR DETAIL.

*ASOPUS*.—Seen by Attkins on May 10, and the Director on May 12 saw a broad hazy shading here which, however, may have been a part of *Phison*.

*ARNON* is shown by McEwen on April 8 as a broad hazy streak, which he recorded as "distinct." He noted it again on May 10, when it was diffused and hazy. This canal was not seen by any other Member.

*ASTABORAS* is clearly shown by Gale, and is indicated on Phillips's sketch of May 12, and was also noted by McEwen.

*CALLIRHOË* was similar to its appearance in 1918. It is clearly shown by Phillips on May 9 and 12, when it apparently entered *Mare Acidalium*. The Director noted that it could not be seen on May 4, nor does it appear on his drawings of May 3 and 9 made under unfavourable seeing conditions. It is absent from Du Martheray's drawings and chart, but Attkins saw it plainly on May 3 and it is shown on his drawing of May 10 as a rather narrow canal. Gale noted it as "definite" on May 29, and it was again seen by Attkins on June 13. McEwen also shows it on April 8 and May 10, when it was visible from *Arethusa Lacus* to *Mare Acidalium*.

*DEUTERONILUS* was traced by McEwen on April 8 to its junction with *Gehon*. It is not shown on his drawings of May 3 and 4, but on May 8 it was seen from *Ismenius Lacus* to *Niliacus Lacus*, and it also appears on his sketches of May 9 and 10. On Phillips's drawings of May 9 and 12, the following end of this canal seemed to fade away, nor is its junction with *Niliacus Lacus* shown by Attkins on May 3, June 10 and 13.

Phillips shows this canal leading as usual to *Niliacus Lacus*, while apparently Attkins saw it running to the North of *Achillis Pons*.

Du Martheray records the canal as "thin and delicate and of green colour," and Nangle also shows it rather narrow but distinct on May 28.

*EUPHRATES* was seen by McEwen on April 8 as a diffused shading from *Ismenius Lacus* to *Sinus Sabæus*, and he noted it also on May 9 and 10. On the latter date it was faint and diffused. On May 12 McEwen writes: "*Phison* became more distinct and broad, with well-defined edges; it gave the impression of being lighter in the middle. *Euphrates* had the same appearance. *Astaboras* had not this appearance." Gale, on May 29, shows two parallel narrow canals from *Portus Sigeus* extending past the centre of the disc, which he calls *Phison* and *Euphrates*. The usual course of *Phison* is to *Coloë Palus*, so possibly these canals should be considered as a double *Euphrates*. Hamilton's drawings, published in *Lowell Observatory Bulletin*, No. 83, show both *Phison* and *Euphrates* narrow and double, resembling Gale's sketch in this respect.

Phillips, on May 12, shows this canal as a broad diffuse band extending N. only as far as the centre of the disc. (See Figs. 1-4, 6, Plate I.)

*GEHON* is shown on Attkins's drawings narrow but distinct, and running into the s. p. corner of *Niliacus Lacus*. McEwen, on April 8, traced it to its junction with *Deuteronilus*, and on May 7 he writes: "*Gehon* extended from *Baie du Méridien* by a convex curve to E. to *Lacus Niliacus*. No trace of *Siloë Fons*, and *Gehon* on its continuation was traced right down the E. side of *Niliacus*, perhaps joining it or *M. Acidalium*." On the following night he noted that it appeared to divide at the position of *Siloë Fons* into two, one branch going to *M. Acidalium* and the other straight N. On May 9 and 10 he saw it as a broad and very distinct band going straight from *Furca* to *Niliacus*

*Lacus*. On May 29 Gale, in very good seeing, saw the canal extending as far as *Deuteronilus* only. He draws it as a very narrow line.

Du Martheray found the canal to be feeble, but he shows *Indus* very strong and dark, entering the S. p. corner of *Niliacus Lacus*, and the possibility of some confusion between these canals under poor seeing conditions must be borne in mind.

*HIDDEKEL* appeared to McEwen as a narrow faint streak, about  $\frac{1}{2}$  sec. in width, on April 8, and of unequal intensity. He found it distinct on May 7 from *Furca* to *Ismenius Lacus*, and he also shows it on May 8, 9 and 10. Gale shows it as a fine line on his sketches of May 29 and 30, when it faded out before reaching *Ismenius Lacus*. It is also shown thus by Ellison on May 7. Du Martheray found it vague and greyish and reaching *Ismenius*. Phillips, on May 9 and 12, shows only the S. portion of the canal. It also appears to be indicated on Attkins's drawings of May 7 and 9 as a faint narrow line extending from *Ismenius* towards *Furca*. (See Figs. 1, 4, 5 and 6, Plate I.)

*ORONTES* appears to be indicated on Phillips's drawing of May 12 at least as far as *Sirbonis Palus*, which may be represented by a faint hazy patch on his sketch. McEwen, on May 7, noted a streak in this neighbourhood which he thought was either *Orontes* or *Sitacus*, probably the latter.

*OXUS-TRITONILUS*.—*Oxus* was noted by Gale on April 21 and May 27, when he noted that momentarily it appeared to join into *Deuteronilus*. It was again seen on May 28. It was doubtful to Attkins on May 3, but appears on his drawing of May 9 reaching *Ismenius Lacus*.

*PHISON* was distinct to McEwen on April 8 as a finely shaded line joining *Portus Sigeus* with *Coloë Palus*. Its breadth appeared to be about  $\frac{1}{4}$  of a second of arc, while *Euphrates* was about  $1\frac{1}{2}$  seconds.

On May 12 McEwen found this canal diffused but distinct where crossing *Arabia*, but its full length could not be traced to *Portus Sigeus* or *Coloë Palus*. Later the same evening *Phison* became more distinct, with well-defined edges, giving the impression of being lighter in the middle. On May 15, McEwen found the canal again visible for part only of its length. Du Martheray records it as very feeble and visible to its N. extremity, and it is thus shown on his sketch of June 23. Gale has a note on May 29 that *Phison* was seen from *Portus Sigeus* extending past the centre of the disc. He shows it nearly parallel to *Euphrates*, and it is possible, as suggested above under "*Euphrates*," that perhaps this canal should be considered as a double *Euphrates* rather than *Phison* and *Euphrates*.

*PROTONILUS*.—Du Martheray describes this canal as narrow and delicate, and of green colour. It is clearly seen on his drawings of June 16 and July 22, forming the border of a dark *Cydonia*. It also appears on his drawing of July 25, when it is described as fine and dark.

Earlier in the apparition it was plain to the Director on May 12, but not so dark as *Ismenius Lacus*. It is shown by McEwen on May 10 and 12, and Attkins records it on May 7. Gale notes that it was "perfectly shown" on May 29, and it is clearly depicted on Nangle's coloured drawing of May 28. (See Figs. 1-6, Plate I.)

*SITACUS*.—McEwen has the following note on May 7: "*Sitacus* or *Orontes*, the first more probable, darker than *Hiddekel*, was traced to *Euphrates*, which was not visible." Later the same evening he noted that *Sitacus* was distinct, and the same canal is shown on his sketch of May 8 at its junction with *Euphrates*.

*TYPHONIUS*.—Possibly seen by McEwen on May 10.

## SECTION II.

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

$$\Omega = 10^\circ \text{ to } 70^\circ; \Phi = +60^\circ \text{ to } -60^\circ.$$

*MARGARITIFER SINUS.*—There are very few satisfactory drawings available of this region. To Phillips and the Director, the *Mare* had its usual form on the few occasions in May when it could be examined. On June 7, 8 and 9, Du Martheray draws the *Mare* as a very prominent feature, which increased in size and darkness until on June 11 it had an enormous area, with *Indus* of great width and intensity. No drawings are available to compare with Du Martheray's for these dates, but Ellison on May 7 and 8 shows the *Mare* conspicuous but not so large as does Du Martheray. Sherlock was able to draw it and the canal *Indus* with his 3-inch O.G. on June 9. Phillips and the Director show this sea separated from *Sinus Furcosus* by *Iani Fretum*, but the other observers did not show it thus, except that it is so indicated on Du Martheray's chart.

McEwen found this *Mare* conspicuous on April 29 and May 3 and of neutral tint, and on the latter night he found no evidence of *Pyrrhæ Regio* indenting the coastline. McEwen's drawings of May 7 show the *Mare* distinctly fainter than *Sinus Furcosus*, and he describes it as a "rather dark marking—an elongated spot with longer axis slanting from S.S.W. to N.N.E." On the following night McEwen found it faint, but the darkest part of the whole dark area *Sinus Sabæus-Margaritifer Sinus*. His drawing of May 9 shows the *Mare*, under  $\omega = 357^\circ$ , when near the terminator, much fainter than *Sinus Furcosus*, and to the South of it he shows a large white area. It had, he says, the same tint as *Iani Fretum* and *Sinus Sabæus*. To the Director on the same date the *Mare* had its usual V-shaped form and was much darker than *Sinus Furcosus*, which could not be distinguished properly in the poor seeing conditions prevailing. The available data regarding the appearance of this *Mare* are very scanty, and, while it appears to have darkened in June, when Du Martheray drew it so very large, its appearance in May does not seem to have been much, if any, different from that of 1918 (see Figs. 1-6, Plate II.).

*EOS-PYRRHÆ REGIO.*—*Eos* was observed by Atkins on April 29 and is indicated on Phillips's sketch of May 4 and Gale's of May 20, when its E. and W. length appears to have been unusually great. Gale describes it as similar in appearance to *Deucalionis Regio*. Atkins, on May 3, shows a large white area here. *Eos* was also seen by the Director on May 3, but not very certainly. It was separated from *Chryse* by a faint and rather narrow shading. It is shown somewhat similarly by Phillips on May 4.

*AROMATUM PROMONTORIUM* was described by McEwen as distinct on April 29 and light ochre in colour, and it was also seen thus by Atkins on June 6.

*AURORÆ SINUS*.—The most interesting feature observed in connection with this part of the planet was recorded by Attkins on June 8, when he found only the N. and N.E. portions of *Auroræ Sinus* visible, the rest being covered by a brilliant white mass. The previous evening, June 7, Attkins had observed *Thaumasia* white, and on June 9 this portion of the disc had become a dull white, rather suggesting a transference of the white material from *Thaumasia* to *Auroræ Sinus*. By June 9 the brilliant white area had moved to the East over *Argyre* and *Pyrrhæ Regio*, and *Auroræ Sinus* still looked very pale, but was no longer very bright. By June 10, *Bosphorus Gemmatus* seemed darker, but *Auroræ Sinus* was still pale and the bright area had shrunk to less than one-quarter of its previous size. Du Martheray's drawings of June 8, 9 and 11 also show a very bright white area on the S. limb, but he does not show it so large as it appears on Attkins's drawing. Sherlock with only 3-inch O.G. apparently also saw this region bright on June 9. Very few notes or drawings are available concerning this portion of the disc, but the general appearance, colour and shape of *Auroræ Sinus* appear to have been normal. McEwen noted that it was invisible on February 19 in poor definition; on April 27 he found it much fainter than *M. Acidalium* and of warm sepia tint. On April 29 he found it dark, the tint being deepest at the *Ganges* exit, which on April 30 appeared pointed and dark. On May 3, McEwen recorded this marking with *Bosphorus Gemmatus* and *Margaritifera Sinus*, all dark and of neutral tint, and again the *Ganges* exit was the darkest part of the bay, and Gale found *Auroræ Sinus* dark and strongly marked on April 23 and May 20, and Attkins found it dark when rising on June 13.

*MARE ACIDALIUM* was again one of the most conspicuous markings on the disc. It was well shown by Sherlock with his small telescope. Attkins shows it perhaps rather wider than usual, and frequently remarked upon its size and darkness.

On Phillips's sketch of May 4 it extends over about  $30^\circ$  in longitude at its widest part. Ellison, Gale, Attkins, Phillips, Du Martheray and the Director agree in showing it separated from *Niliacus Lacus* by *Achillis Pons*, but on June 13 Attkins found this bridge doubtful, and McEwen noted on April 30 that *Achillis Pons* was invisible. Gale saw the *Mare* on April 16 stippled with darker spots and crossed by two white and clear bridges (*Achillis Pons* and *Thera?*). Gale also comments on the "steel blue" colour of the *Mare* in the reflector, and states that the tint was so marked as to attract attention. Gale recorded a number of white clouds in this neighbourhood. His drawing of May 27 shows a large white area in the centre of the *Mare*, and on May 29 under  $\omega = 337^\circ$  he saw the *Mare* partly covered by a white mass which disappeared as it approached the C.M. The following night, at approximately the same longitude, he found *Acidalium* and *Niliacus Lacus* "completely obscured," and the N. part of *Acidalium* was not seen until the C.M. was at  $344^\circ$ . Half an hour later the white area had cleared



away from the N. end of the *Mare*. McEwen also has an interesting note to the effect that on May 10 he noticed "some bright spots in *Mare Acidalium* flashing at the terminator." Attkins calls attention to a long, triangular-shaped, white area on June 1, which covered part of *Acidalium* near the *p.* limb and extended nearly to the C.M. at  $117^\circ$ . This white area was seen on several nights.

Du Martheray's drawing of this *Mare* on June 9 shows it unevenly shaded, with a dark area near its S. *p* corner, and a somewhat similar appearance is shown on July 14, when a lighter area is indicated in the centre of the *Mare*. The colour recorded for this sea varies. To McEwen it was usually sepia, sometimes mixed with blue; to Gale steel blue, and on May 20 the N. end was bluer than the S. end. Du Martheray calls the colour green. Ellison remarks that *Mare Acidalium* appeared to him softer in its outlines than some of the other *Maria*, whose boundaries were hard and definite. In general, there appears to have been little, if any, change in the appearance of this sea since 1918.

*NILIACUS LACUS* appeared as usual, separated from *M. Acidalium* by *Achillis Pons*. McEwen, however, does not show this bridge in April and May, and on May 3 states that it could not be seen although steadily looked for. Attkins, on the same evening, noted that *Achillis Pons* was "most plain."

*NILOKERAS* is shown by Phillips as a broad, hazy, curved shading, without well-defined edges from *Niliacus Lacus* to *Lunæ Lacus*, and so it appeared to Gale and the Director. Ellison and Attkins show it rather narrower and better defined. Du Martheray describes it as wide and grey and broader towards *M. Acidalium*. Gale noted that this curved shading was double in May, and Attkins's drawings of June 6 and 8 show two widely-separated canals, the S. one entering *Niliacus Lacus* and the N. one curved and joining the *f.* coastline of *M. Acidalium* at about  $+45^\circ$ . This N. canal was not shown on Attkins's drawings in April and May, and it appears to have been obliterated by white cloud on June 10 (see Figs. 3 and 4, Plate III.).

On his sketch of April 29, McEwen shows *Nilokeras* rather narrow and well-defined, extending beyond *Lacus Lunæ* as *Uranus* to the position of *Ascræus Lacus*. McEwen also recorded *Dardanus* further to the N., which he says was easily seen on April 30 and traced to a confused smudge in the position of *Ceraunius* on May 3 (see Figs. 4 and 5, Plate II., and Fig. 2, Plate III.).

*LUNÆ LACUS*.—According to the drawings of Attkins, this lake appears to have varied in its appearance. On April 29 he draws it as a dark round spot about  $10^\circ$  in diameter and very conspicuous. On June 6 he shows a very large, dark area here about  $22^\circ$  in diameter. This dark patch seems to have decreased on June 8 and 9 to less than half its size on June 6. It is very prominent on his drawing of June 10 under  $\omega = 34^\circ$ , in strong contrast to the whiteness of *Tempe* to the N. of it. Attkins reports that on June 6 the large circular dark area here had a

darker spot in its centre, which he could not see on the following night, when the general appearance was the same as on June 6 (see Fig. 4, Plate III.). Attkins remarks that he had never previously seen this lake of such a size, and that the eye was attracted to it at once owing to its immense size. He also remarked that none of the canals, *Nilokeras*, *Ganges* or *Chrysorhoas*, could be traced within the border of the shaded area. Phillips also remarked upon the darkness and prominence of this lake on June 2 and 6, and to him its outline was hazy. Du Martheray described it as diffuse, very extensive and dark in July, and also greenish in colour. Earlier in the apparition, on April 17, McEwen found this lake faint and diffused, brown-yellow in colour, and on April 20 he records it as a "diffused smudge." Sherlock also draws this lake very dark and prominent near the *p.* limb on June 4.

Attkins's interesting observations of June 6, 7, 8 and 9 certainly appear to provide evidence of a rapid change in the appearance of the dark shading in this neighbourhood.

*ACHILLIS FONNS AND JUVENTÆ FONNS.*—Du Martheray indicates *Juventæ Fons* on his chart, but there is no detailed record of its observation in his notes, and neither of these interesting lakes was observed by any of the other Members in 1920.

*TEMPE.*—Bright areas were frequent in this region during the apparition, but this brightness was apparently not constant. On April 27 McEwen found the colour of this region light ochre to the N. and terra-cotta to the S., and on April 29 and 30 he draws the N. part next to *Tanais* white and states that the colour to the S. gradually turned to vermilion. In May McEwen does not show any marked whiteness in *Tempe*, but Attkins records it brilliantly white when rising on May 3. Attkins, on April 29, draws a brilliant white spot at the *f.* end of *Achillis Pons*, when the rest of *Tempe* appeared to him bright red or orange. The Director also drew a brilliant area here on May 3 which appears to be the same as spot No. 3 on the chart for 1905.

Gale, on May 20, noted *Tempe* "distinctly bright and whitish" and "very white" on May 28. Attkins's drawings in June also show the white area near the S. *f.* coast of *M. Acidalium*, and Phillips shows a white area on the following side of *Tempe* on June 2. Du Martheray also records this region as "very white." On May 29 Gale recorded a bright intrusion into the N. *f.* edge of *M. Acidalium*, when he saw the following coast of the *Mare* overlaid by a bright white mass which appeared to be the preceding portion of an extensive light area over *Tempe*.

*ARGYRE*, as usual, was frequently seen very bright on the limb.

*CHRYSE* was light-red orange to Attkins on May 2, the colour being "very striking." It rose white to him on May 10, and

on June 8 he noted it as "light brown" or "dingy yellow," which, he says, was most beautifully visible on several nights and very striking in twilight, half an hour or so after sunset. To Du Martheray, on June 8, the colour was dark salmon, very accentuated at the centre of the disc. McEwen found the colour light and gold ochre on April 29 and he also saw a vermilion tint here the same evening, and on April 29 and 30 and May 3 he saw "burnt yellow" and "terra-cotta" tints in this region and on *Xanthe* the W. portion of *Chryse*.

#### MINOR DETAIL.

*DARDANUS*.—As mentioned above, this canal was recorded by McEwen only.

*GANGES* was distinctly seen by McEwen on April 27, 29 and 30 with soft edges. It was not seen on May 3. Attkins shows it narrow and well-defined on June 6, 8 and 9. Du Martheray states that it was very wide and of a dark salmon colour. To him it appeared double on July 14, when he shows the *f.* component much darker than the *p.* one. Du Martheray mentions in his report that there appeared to be knots on the *f.* side of this canal, and queries whether one of these may have been *Juventæ Fons*. The Director thinks this improbable, as when *Juventæ Fons* is seen it is usually very black and, although often difficult, it is unmistakable when seen. *Ganges* appears to be shown near the *p.* limb on Sherlock's drawing of June 4 with only 3-inches aperture.

*HYDASPES*.—Visible as a grey filament to Du Martheray on June 11, especially at its two extremities. To the S. he draws *Hydaspis Sinus* very prominently on June 11. McEwen also recorded this canal on May 3, 4, 7 and 8, and Attkins on May 7.

*ISSEDON*.—Seen by McEwen on April 29 and 30. It is also shown on Du Martheray's chart as far as *Lacus Labætis*.

*INDUS* was very dark and wide and olive green to Du Martheray, who applies this name on his chart to the whole of the streak from the N. end of *Margaritifera Sinus* to *Niliacus Lacus*. Attkins shows this streak on his drawing of June 9 running to the S. *p.* point of *M. Acidalium* and not to *Niliacus Lacus*. It is not shown on Gale's drawing of May 27. McEwen remarked on May 3 that he could not see *Indus* clearly, a confused shading extending N. was all that could be seen of it. On May 7 he found the canal "very distinct" when approaching the C.M., *Indus* being darker than *Hydaspes*. On May 8 it was again seen, but faint and diffused until near the C.M., when it became more prominent. It is well shown on Attkins's drawing of May 3, and was suspected by Sherlock on June 9.

*JAMUNA*.—Scarcely visible to Du Martheray, and at most a difference of tone between two regions. It is shown on Attkins's drawing of April 29, May 3, June 6, 7 and 8, and on McEwen's of April 30 and May 3.

*LABÆTIS LACUS* is indicated on Du Martheray's drawing of July 14, and he notes that it was feeble and uncertain and grey in colour.

It could not be seen by McEwen on April 29.

*TANAIS* is shown rather as the boundary of a shaded *Baltia* than a canal. It appeared as a raw umber shading to McEwen on February 19 and dark-green to Du Martheray on May 31. Attkins's drawing of June 6 shows it about 10° wide as a prolongation of the N. end of *Acidalium*. Phillips's drawing of June 2 shows this marking forming, with *Clarius* and *Eurotas*, a broad, fairly well-defined band.

## SECTION III.

**Solis Lacus.**

$$\Omega = 70^\circ \text{ to } 120^\circ; \Phi = +60^\circ \text{ to } -60^\circ.$$

This and the following section are well known to be the most difficult on the planet, especially when the S. Pole is turned away from the Earth, as the markings in the N. are usually very faint. Thus, Ellison reports that, on the only good night he had during the apparition, under  $\omega = 120^\circ$  he could see no detail of any sort. Other observers were more fortunate, but all found this region difficult, and on account of the faintness of the markings there are considerable discrepancies between observers with regard to certain features, and the Director in consequence is uncertain in some cases regarding the identification of markings recorded.

*THAUMASIA* was seen very bright on the limb by McEwen in 1919 December and 1920 February. On April 29 he considered it light ochre in colour—almost white and slightly darker at its W. end—an appearance, however, which did not persist throughout the evening. Attkins shows the whole area very white on June 1.

*SOLIS LACUS*.—No trace of this lake could be seen by McEwen on February 19, April 29 and 30. On June 2, Phillips noted it “very dark against the S. snow,” and on the previous night Attkins saw it faintly as a “dark smudge” on a white *Thaumasia*.

*TITHONIUS LACUS* was perhaps seen by McEwen on the small disc on 1919 December 7, and on February 19 he reported that it was faintly visible, and again on April 27. On April 29 he found it faint on C.M. with diffused outline and tint pale raw umber. It was easy to Attkins on April 29, and it is also shown on the Director’s drawing of this date, and on Phillips’s of April 23 and June 2, as an elongated widening of the canal *Agathodæmon*. It does not appear on Attkins’s drawing of June 1, but was “strongly marked” on June 6 in good seeing, and it was also recorded by Du Martheray on June 9.

*ASCRAEUS LACUS* could not be seen by McEwen on April 27, but on April 29 he remarks that *Ceraunius*, which had been broad and conspicuous when half-way between the limb and C.M., faded out and became invisible on C.M., and that *Ascræus Lacus*, which had not been visible, became “somewhat conspicuous and so well-defined as to enable its position to be placed as shown on the drawing.” The position of this lake on McEwen’s drawing is approximately  $\lambda = 87^\circ \phi = +20^\circ$ . On his drawing of May 29 under  $\omega = 141^\circ$ , Attkins shows a diffused lake at the *p.* end of a long curved shading, which appears to have been approximately in the position of *Ascræus Lacus* as shown in our previous charts (see Fig. 2, Plate IV.).

Du Martheray records it on his chart near the position indicated by McEwen in latitude about  $+25^\circ$  or  $15^\circ$  further N. than shown on 1903 chart (see Plate VII.).

*MAREOTIS LACUS*.—There is very little information available regarding this lake. On Phillips's drawings of April 23 and June 2, faint diffused shadings are seen approximately in the position of this lake, and on June 1, under  $\omega = 117^\circ$ , Attkins shows a pronounced lake approximately at  $\lambda = 105^\circ \phi = +33^\circ$ , which the Director has considered to be *Mareotis*. Attkins describes this lake as an indefinite shading, difficult to hold, almost at the limit of vision and looking like a round spot.

*MÆOTIS PALUS*, conspicuous to McEwen on April 29 as an enlargement on the dark shading bordering on the N. Polar snows, but not recorded by any other observer.

*THARSIS*.—A white area is shown on Phillips's drawing of June 2, approximately at  $\lambda = 108^\circ \phi = +8^\circ$ . A similar white area was recorded near this place in 1918 and in other previous apparitions.

*CERAUNIUS* was seen by McEwen as a faint grey marking so early in the apparition as February 19, and on April 27 he was able to trace it as far South as the position of *Ascræus Lacus* and considered its colour faint raw umber. On April 29 he found it broad and conspicuous under  $\omega = 72^\circ$ , but when it reached the C.M. it was invisible, although *Ascræus Lacus* then became visible at its S. end. This is an interesting observation, and difficult to explain unless there was some obscuration by Martian cloud in the interval. On April 27, Attkins shows this marking outlined by two streaks forming an elongated ellipse, but it was only doubtfully seen. It also appears to be indicated on Attkins's sketch of May 29.

Du Martheray, on his drawing of June 9 and on his chart, shows this marking as a fairly dark and well-defined shading of great width, and he described it as pale and reddish on July 14. In the form seen in recent apparitions, this marking cannot be classed as a "canal."

#### MINOR DETAIL.

*AGATHODÆMON* is described by Attkins as wide and "smudgy" on April 29, and is shown thus on McEwen's drawing of the same date tapering to its junction with *Auroræ Sinus*. It was not abnormally wide to the Director on the same date. Attkins shows it narrow with no sign of *Tithonius Lacus* on June 1, when *Thaumasia* to the South of it was very bright.

*ASCURIS LACUS*.—Seen only by McEwen on February 19 on the W. end of *Tanais*.

*ARAXES*.—Attkins noted, on June 1, "*Tithonius-Araxes* easily held, joining *Sirens' Bay* to *Auroræ Sinus*."

*CHRYSORRHOAS*.—Seen by McEwen on February 19, and in April it is clearly shown by Attkins on April 29 and June 6. On the former date Attkins describes it as "wide and smudgy." It is shown by Phillips on June 2. Du Martheray states that it was seen near *Lacus Lunæ*, and that it was faint and wide.

*FORTUNA*.—Recorded only by McEwen, who states that it was easily seen on April 30.

*NILUS* was broad, vague and greenish to Du Martheray. Attkins shows it very definite and somewhat narrow on June 6, 7 and 8.

*URANIUS* was noted by McEwen on April 29 and also appears on Phillips's drawing of June 2 as a hazy faint streak from *Lacus Lunæ* to a dark patch on *Amazonis*.

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## SECTION IV.

### Mare Sirenum.

$$\Omega = 120^\circ \text{ to } 180^\circ; \Phi = -60^\circ \text{ to } +60^\circ.$$

The markings in this Section, like those in the previous one are usually difficult when the N. Pole is turned towards the Earth, and 1920 was no exception to the rule. As a result, there are comparatively few observations of this part of the planet, and divergences between observers make the task of identification in some cases very difficult.

*MARE SIRENUM*.—To McEwen this *Mare* appeared as a faint shading between the light regions *Phæthontis-Electris* and *Memnonia* on January 8. On February 4 the *Maria Sirenum*, *Cimmerium* and *Tyrrhenum* all appeared to him as a sepia band extending across the disc, and when on the terminator the dark *Sirenum* appeared to indent it.

On April 17, McEwen found *Mare Sirenum* the darkest feature on the disc, but on April 21, under  $\omega = 151^\circ$ , he could see no trace of it, the whole of the S. region at the time being of light ochre tint.

The “*Beak of the Sirens*” is shown dark and sharply pointed by Attkins on June 1, and it is shown rather indistinctly on Phillips's drawing of June 2 near the terminator. The *Mare* is shown dark on Du Martheray's drawings of May 25 and 28, but in his general description of the apparition he says that it was feeble and greyish (see Figs. 5 and 6, Plate III.).

*TITANUM SINUS* is described as “distinct” by McEwen on April 17, and is so shown on Du Martheray's chart.

*ASCANIA PALUS*.—Gale reported that this marking was distinctly visible on June 16. McEwen's drawings of April 17 and 21 show a lake not far from the position of *Ascania Palus* of the 1903 Chart, but further East. He identifies this marking on his sketch of April 21 as *Biblis Fons*. This lake, however, on Lowell's maps, is situated at about  $+9^\circ$ , and is much nearer the Equator than that shown by McEwen. It is possible that the marking shown by McEwen may be the *Trichonis Lacus* of 1903, as it is situated on the canal *Sirenius* on his drawing.

On his sketch of May 22, Phillips shows a shaded area preceding *Propontis* by some  $50^\circ$ . It is possible that this is the same marking as seen by McEwen, though the positions are not the same. Steavenson, on his sketch of April 18, shows a

curved dark marking preceding *Propontis* which may have been composed of *Ascania Palus* with *Euxinus Lacus* and *Castorius Lacus*, but with the small amount of data available the identification of these markings is very uncertain.

*NODUS GORDII* is described by Du Martheray as shaded. It is shown on his chart at the junction of *Pyriphlegethon* with *Ulysses*, the latter canal running from the lake called *Ascræus* in Section III. to the *Beak of the Sirens*. (This canal is called *Sirenius* on Du Martheray's chart.)

It may also be indicated on Attkins's drawing of May 29, but the identification is very doubtful, as a slight error in drawing would make it better represent *Ascræus Lacus*, although Attkins himself thought it *Nodus Gordii*.

*AMAZONIS*.—Terra-cotta in colour to McEwen on April 21, when he was able to make out the bordering canals *Orcus-Eumenides* and *Pyriphlegethon*. A white spot was recorded by Attkins here near the limb on April 29. Attkins's drawing, May 29, shows here a curved dark shading, terminating in the lake mentioned above, which may have been *Nodus Gordii* or *Ascræus Lacus*. This region is shown shaded by Phillips on June 2, with no well-defined border.

*AMMONIUM LACUS*.—McEwen remarked on April 17 that this lake did not appear at the junction of *Titan* and *Orcus*; but on April 21, in good seeing, he noted it on *Eumenides-Orcus*. Attkins also shows a lake here on May 22.

*MEMNONIA*.—Frequently recorded bright white by McEwen.

*ARCADIA*.—A well-marked white area of tapering form was shown over this region by Attkins on his sketches of May 29 and June 1. This white area extended from the limb, where it subtended an angle of about  $15^\circ$ , to the C.M. at about  $117^\circ$ . The centre line of this area was between  $+45^\circ$  and  $+50^\circ$  in latitude. Attkins reports that this bright area on the Eastern part of the disc was seen on several nights gradually lengthening as the longitude of the C.M. decreased each evening.

Du Martheray also shows a tapering white area crossing *Arcadia* on May 28, but on his sketch it is extended even further to the West than shown by Attkins (see Fig. 6, Plate III.).

*PROPONTIS* is described and drawn by Du Martheray as a pale diffused marking in May. Phillips, on May 22, shows two dark markings here which may have been *Propontis I. and II.*, but as the latitude of the N. marking is about  $+63^\circ$  on the drawing, it is more probable that the N. marking was *Arsenius Lacus*.

On his drawing of May 24, under  $\omega = 193^\circ$ , Attkins shows three dark spots which seem to correspond best with *Castorius Lacus*, *Arsenius Lacus* and *Hyperboreus Lacus*, but Attkins remarks that all markings at the time were very faint except *Trivium Charontis*, and it is possible that they are slightly misplaced on his drawing and that one of them was *Propontis*. The S. spot Attkins thought most probably *Arsenius Lacus*.

There is the same difficulty in identifying the dark spots shown on Attkins's drawings of May 26 and 29, and the Director concludes that they represented *Propontis*, *Castorius* and *Arsenius*.

The only drawing we have from Steavenson during this apparition is of this region. It was made with the 4-inch Cooke refractor at the Helwan Observatory under moderate seeing conditions on April 18. It appears to show *Propontis I.* in latitude  $+41^{\circ}$   $\lambda = 182^{\circ}$ , forming the S. end of a shading some  $10^{\circ}$  in width of a form similar to that noted by the Director in 1918 (see 1917-18 *Memoir*, Fig. 3, Plate V.). No sign of *Herculis Pons* is visible.

Gale, on June 16, has the following note: "*Propontis I.* and *II.* appear connected by a broad faint band which originates in the extensive dark marking to the North. *Euxinus Lacus* and *Ascania Palus* were distinctly visible, the latter with broad faint extension near to the middle of the disc, doubtless *Erebus*." Unfortunately, Gale has sent no sketch illustrating his observations of this night.

McEwen described *Propontis* as a "dusky smudge" on April 17, and on April 21, though diffused, it was the darkest spot on the disc ( $\omega = 139^{\circ}$ ), and of deep raw umber colour. On April 25, under  $\omega = 202^{\circ}$ , McEwen reported *Propontis II.* as "large but not dark," with *Hades* and *Boreas* joining it (see Figs. 3-6, Plate IV.).

*ARSENIUS LACUS*.—Some remarks have been made already in the previous paragraphs regarding the identification of this lake. There is some possibility of *Propontis II.* being confused with *Arsenius*, but it seems probable that *Propontis I. and II.* were seen as one in this apparition, and that the N. dark marking shown by Phillips and Attkins was *Arsenius Lacus* (see Figs. 5-6, Plate IV.).

*EUXINUS LACUS and CASTORIUS LACUS*.—Phillips's sketch of April 19 shows a dark marking preceding *Propontis*, which is also shown in Steavenson's drawing of April 18, which appears to have been composed of *Euxinus* and *Castorius*, together with their neighbouring faint shadings. Gale also shows a shading of this kind here on May 4. On June 16, Gale states that the above two lakes were distinctly visible, but no drawing is available (see Fig. 4, Plate IV.).

*ATLANTIS* is clearly shown on Phillips's drawing of April 19. It was not seen by Attkins in May. McEwen noted that the inlet to *Atlantis* was distinct on April 16, but his drawing does not show this land dividing *M. Sirenum* from *M. Cimmerium*, nor is it definitely seen on his drawing of May 23.

#### MINOR DETAIL.

*ARTYNIA FONS*.—Brindley states that this shading (see Chart for 1905) was very clear on May 16, and his drawing represents it as a projection Southwards from the general shading in this neighbourhood, much as shown on the 1905 Chart. This is probably the same marking as seen by McEwen and called by him *Sirenius*.



*ACHERON*.—Possibly seen by Steavenson on April 18.

*EUMENIDES-ORCUS*.—Recorded by McEwen on April 17 and 21; it is also shown by Attkins on May 29 running almost along parallel of latitude  $+ 10^{\circ}$ . Gale also noted it on June 16.

*ERIDANUS* appears to be shown on Steavenson's drawing of April 18 and probably on Phillips's drawing of May 22, but as a rule it is not distinguished from the general shading of this neighbourhood and from *Eurotas*.

*EUROTAS* appears on Steavenson's drawing of April 18 as a rather faint shading to the S. of a similar streak, which appears to have been *Eridanus*. Du Martheray, on May 31, shows the whole of this region shaded to the border of the N. P. cap, and he remarks that the region of *Tanaïs* was an accentuated Prussian blue. Phillips shows this marking on June 2 as a broad streak forming a continuous band with *Tanaïs* and *Clarius*.

*MARICÆ LACUS*.—Recorded only by McEwen on the *Eumenides* on April 21.

*PYRIPHLEGETHON*.—Rather narrow to McEwen on April 21. Du Martheray shows it extending to *Nodus Gordii*.

*PHLEGETHON*.—A broad curved streak is shown by Attkins on June 1, which seems to have been formed partly by this canal and partly by the *Brontes* shading of the 1900-1 apparition.

*TITAN*.—Recorded by McEwen on April 17 and on April 21, on which date it faded out before reaching *Mare Sirenum*, which itself was invisible at the time. This canal is also shown by Attkins in May.

*TRICHONIS LACUS*.—Attkins's drawing of June 1 shows a lake at approximately  $\lambda = 127^{\circ} \varphi = + 30$ , which may have been *Trichonis* of the 1903 chart, but this identification is very doubtful owing to want of confirmatory data.

*SIRENIUS* is shown by McEwen on April 21 running S. from the Polar band and crossing *Eumenides* and *Pyriphlegethon*. He remarks that whereas on the globe the longitude of its intersection with the latter canal was  $127^{\circ}$ , its longitude appeared to be  $139^{\circ}$ . It will be noted that McEwen shows this canal as a continuous line from the border of the Polar cap Southwards, as shown on Antoniadi's standard chart in *Memoirs*, Vol. XI., Part III.

## SECTION V.

### Mare Cimmerium, Elysium and Trivium Charontis.

$$\Omega = 180^{\circ} \text{ to } 250^{\circ}; \Phi = -60^{\circ} \text{ to } +60^{\circ}.$$

*MARE CIMMERIUM*.—McEwen noted in April that the W. end of this sea was darker than the E. end, and it was also darker than *Mare Sirenum*. He found the colour to be sepia on February 4 and April 16. Attkins, on April 16, under  $\omega = 189^{\circ}$ , found the *Mare* very faint, but on May 19 he noted it "dark" and "fairly dark" on May 21 and 22; but on May 24 he reports that all markings were very faint. It is, however, shown dark by Ellison on this date, and it was clearly seen by Sherlock in May with only 3-inches aperture. Brindley drew it very faint on May 9.

Attkins's drawing of this neighbourhood on May 19 does not show *Cyclopus Sinus*, but he reported that both *Læstrygonum Sinus* and *Cyclopus Sinus* were well marked on May 21, and McEwen on May 23 also stated that the former bay was

conspicuous and of a darker shade of neutral tint than the *Mare*. The form of this bay to McEwen was triangular with its base on *Mare Cimmerium*. Ellison draws *Cyclopus Sinus* very prominently on May 19, but not so prominently on the following day. Gale also noted *Læstrygonum Sinus* on May 4.

Du Martheray remarks upon the very dark green colour of *Mare Cimmerium* on May 21, when it was in marked contrast to the brilliancy of the lands to the South, and in his general report on the colours of the seas he calls this sea "blackish."

Gardiner found it dark-green in May.

*HESPERIA* is shown on McEwen's drawings of April 16, but not completely severing the *Maria*. There was on this date a white area covering part of *Libya* and *Hesperia*. The Director was unable to see *Hesperia* on May 19, and it is not shown on Phillips's drawing of May 22, but seems to be indicated on Nangle's sketch of June 5. Attkins could not see it on May 19, but Gale states that it was plainly seen on May 4, although to him also it had been invisible on March 26. On May 4, Gale has the following note: "*Hesperia* is plainly seen dividing *Mare Tyrrhenum* from *Mare Cimmerium*. There is also a dark marking parallel with *Cimmerium*, like an extension of *Mare Tyrrhenum* and as widely separated as *Hesperia*." (See Figs. 2 and 6, Plate V., Figs. 1-6, Plate VI.)

Du Martheray indicates the N. portion of *Hesperia*, but on his drawings also this land does not traverse the *Maria*. Attkins reports that he did not see *Hesperia* with certainty during the apparition, but thought he saw it on May 14 under poor seeing conditions.

*MARE TYRRHENUM* (E) is shown fairly dark on most of the drawings. As mentioned above, Gale saw it continued to the S. of *Mare Cimmerium*.

*ERIDANIA* and *ELECTRIS* were frequently seen bright. Thus, McEwen found *Eridania* very bright white and brighter than the Polar cap on February 4, when *Electris* was also bright. On May 23 he noted these regions as very light ochre tint and almost white. Attkins, on May 19, recorded *Eridania* white at S. limb like a large Polar cap, and so also it appeared to him on May 21 and 22.

*ZEPHYRIA*, *ÆOLIS*, *ÆTHIOPIS*.—Nothing worthy of special remark was recorded in connection with these regions. *Æthiopsis* is described by Du Martheray as greyish, and it was seen to rise white occasionally by Attkins. Phillips shows it somewhat shaded on his sketch of May 22.

*ELYSIUM* is shown somewhat pentagonal on McEwen's drawing of April 16 under  $\omega = 217^\circ$ . Earlier the same evening McEwen noted, under  $\omega = 210^\circ$ , that *Elysium* was not circular, although the E. side at junction of *Cerberus* with *Styx* was rounded. The E. and W. diameter of *Elysium* on McEwen's drawing is rather more than one-third of the diameter of the disc; Gale, on March 29, states that "the diameter of the dark

markings enclosing *Elysium* was about one-quarter of the disc and of *Elysium* proper one-fifth of the disc. According to transit observations made by Phillips and the Director on May 22, the diameter of *Elysium* was about  $26^{\circ} \cdot 3$ , which is smaller than it is usually shown on the drawings and charts. McEwen has the following note on the shape of *Elysium* on May 23, on which date his drawing shows much detail in this neighbourhood: "*Styx*, *Chaos* and *Hyblæus* gave a rounded outline, while *Cerberus* and *Eunostos* gave straight edges with rounded junctions at *Trivium Charontis*, *Lacus Lucrinus* and *Hephæstus*. A broad diffused band crossed *Elysium* in a N. and S. direction (*Galaxias?*)."  
Gale shows *Elysium* roughly circular on May 4, as does Ellison. Gardiner, on the other hand, thought it square with blunted angles. Phillips shows it somewhat rounded, but not very regular in shape. The preceding part of this land was frequently seen very white, and this is well-shown on the drawings of Atkins and McEwen. Du Martheray on May 21 noted, however, that *Elysium* was hardly distinguished from the rest of the disc, and Gale's drawing of May 5 shows no white area within the borders. Phillips's drawing of May 22 shows the whole area bright. There is no doubt that this region is subject to considerable change in this respect.

*PAMBOTIS LACUS (LUCRINUS LACUS)*.—This lake was not visible to McEwen on April 16, but is shown dark on his drawings of May 23, when he estimated the longitude of its E. edge at  $219^{\circ}$ . Ellison's drawings of May 19 and 20 show a gap between the canals *Cerberus* and *Eunostos* approximately in the position of this lake, which was thus possibly obscured on these dates by cloud or haze. Atkins does not show the lake, but it is perhaps indicated on Phillips's drawing of May 22 as a slight darkening in the *Cerberus* shading.

*CERBERUS*.—This marking was again one of the most conspicuous of the dark markings on the disc. It was seen by McEwen so early in the apparition as February 4, when *Trivium Charontis* was somewhat distinct. *Cerberus* was usually shown well defined with sharp borders by Atkins. McEwen found it "distinct with diffuse edges and of raw umber tint" on April 16. Gale remarked on May 4 that *Cerberus* was very dark and broad, and on May 7 he thought its width was greater than hitherto. On June 11, Gale thought that, while *Cerberus* and *Styx* were still dark, they were less pronounced than at the previous presentation.

Du Martheray records this marking as green or Prussian blue at the terminator, dark and unequally shaded and double. This doubling, however, is not apparent on those of his sketches which are available for examination.

There does not appear to have been any change of importance in the appearance of this marking since the previous apparition.

*TRIVIUM CHARONTIS* appears on most of the drawings simply as a part of the general dark marking forming *Cerberus* and

*Styx*. It is interesting to note, however, that McEwen shows it clearly darker than the rest of *Cerberus* on May 23 and of pronounced triangular form (see Fig. 1, Plate V.). This appearance was not pronounced on his earlier drawings of April 16, and on February 4 he recorded its outlines as shaded. On May 24, Attkins also shows this marking darker than the rest of *Cerberus*, and he describes it as triangular with its base to N.E., which agrees with McEwen's description of the previous day and also Ellison's note, who writes regarding this marking that to him it did not look "fuzzy but extremely sharp and definite, of a dark-blue colour like that of *Syrtis Major* and shaped like a wild hyacinth flower, with a long soft-outlined streak trailing away from each lip, while *Cerberus* formed the stem." Phillips remarked that he could not see *Trivium Charontis* as a separate spot distinct from the general *Cerberus* shading, but in March Gale noted that it sometimes appeared as two dark knots lying N. and S. These two condensations, however, were not visible to him in May. Brindley shows this marking very blue on his coloured drawing of May 9, and Gardiner noted it dark-green on May 4.

*SITHONIUS LACUS*.—A conspicuous dark spot projecting from the N. P. cap was seen by McEwen on February 4 in about the position of this lake, which, he says, must have been very extended. McEwen again recorded it on May 23, when its tint was sepia and *Gyndes* connected it with *Propontis II*. It is shown on his drawing as an extended marking and not as a round lake. The lake is probably shown on Attkins's drawing of May 19.

*STYMPHALIUS LACUS* is recorded by McEwen on May 23 as distinct. Attkins shows a lake on his drawing of May 19, which was possibly this, but the identification is not certain. McEwen estimated the longitude of this lake on May 23 at  $219^{\circ}$ , which is about half-way between the positions of *Stymphalius* and *Sithonius*, as shown on the standard chart, and there may thus be some confusion between the two.

*PHLEGRA*.—To Attkins, on April 16, *Phlegra* was deep orange-red in colour, contrasting strongly with *Amazonia* and *Zephyria*, which were yellowish. On May 26, Attkins shows a greyish shading here, with a white area in its centre between *Erebus* and *Styx*. McEwen recorded a brown-yellow tint in *Phlegra* on May 23, and to him it was very dark on that date. Phillips on May 22, and Steavenson on April 18, show it perhaps lighter than usual, and Du Martheray shows this region clear of shading on May 21, but shaded on May 24, 25 and 28.

*CEBRENIA* is shown shaded by Du Martheray in May, and although shown much darker than *Elysium* by Phillips on May 22, no well-defined borders were drawn. To Attkins, on May 19 and 21, this region seemed faintly shaded.

*GYNDES* is recorded by McEwen connecting *Sithonius Lacus* with *Propontis II*. on May 23, and also appears on Phillips's sketch of the previous night. Gale and Attkins show a broad

shaded area extending from the N. end of *Casius* to *Propontis*, which, however, did not appear as a canal on their drawings.

*HECATES LACUS*.—Seen by McEwen on May 23 as a darkening at the junction of *Styx* and *Chaos*. It is not shown on Phillips's drawing of May 22, nor on Attkins's of May 19, but he shows it on May 24. The Director could not see it on May 19 or 22. (See Fig. 1, Plate V.)

*MORPHEOS LACUS* was seen by Attkins on May 19 as a round dark spot. McEwen, on May 23, also saw a darkening at the junction of *Hyblæus* and *Chaos*, but he drew no definite lake, nor did Phillips on May 22. The Director also noted a local darkening in the canal in the position of this lake.

#### MINOR DETAIL.

*ÆTHIOPS*.—McEwen, on April 16, draws this canal from *Cimmerius Lacus* to the p. end of *Hephæstus*, where it merged into *Eunostos* as shown on the standard chart in the 1900-1 *Memoir*. It is possibly shown on Ellison's drawing of May 10.

On March 29, Gale writes: "The conspicuous canal connecting the *Mare Cimmerium* with the N. end of *Eunostos*, seen well last night, is again a very definite marking. It does not seem to coincide in position with *Cyclops* or other canal known to me." No sketch is available for this date, but possibly this may describe *Æthiops*.

*ADAMAS*.—On April 16, McEwen drew a canal from *Cimmerius Lacus* to the W. end of *Hephæstus*, which he called *Triton*. The Director, however, is not sure that this may not have been *Adamas*. On May 5, Gale has a note: "*Adamas* is clearly visible as a broad faint connection between *Thoth* and *Eunostos*," but the Director is not clear whether this is the canal called *Æthiops* above or if it should be considered as *Eunostos II.* or *Hephæstus*, as no sketch is available.

*ÆSACUS*.—Seen by McEwen as a continuation of *Styx* on May 23. Its N. part only was seen by the Director on May 22. Possibly the identification should be *Myrmidon*.

*ANIAN*.—Broad and somewhat faint but with well-defined edges to McEwen on May 23.

*BOREAS* appears on Gale's drawings of May 4 and 12, and also on McEwen's of May 23. Gale remarks that this canal clearly connected the N. end of *Styx* with *Propontis*. On May 9 it appeared at times to be double to Gale.

*CHAOS*.—Sharp at E. end and diffused at W. end to McEwen on February 4. It was, perhaps, the faintest of the canals surrounding *Elysium*.

*CYCLOPS*.—On some of the drawings it is difficult to decide whether the canal drawn should be identified as *Cyclops* or *Cerberus II.* Du Martheray described *Cyclops* as "fugitive and broad," and on his chart he does not show *Cerberus II.*, and *Cyclops* is drawn running almost along the 210° meridian. Gale writes that he did not think that the true *Cyclops* was visible to him during the opposition, but the Director is inclined to think that the canals shown by Gale and Du Martheray are identical and that it is better to consider it as *Cyclops*. McEwen, on May 23, under  $\omega = 202^\circ$ , noted *Cyclops* as the edge of a darker shading of gold ochre tint, but his drawing of the same evening, under  $\omega = 212^\circ$ , appears to show *Cerberus II.*, and he noted that the continuation of *Cerberus* to the *Mare* was distinct.

Phillips, on May 22, shows a broad distinct canal from the position of *Pambotis Lacus* to *Mare Cimmerium* at about  $\lambda = 241^\circ$ , which seems to agree more closely with the position of *Cerberus II.* than *Cyclops*.

Ellison's drawings of May 19 and 20 show a canal running to a prominent bay in *Mare Cimmerium*, from which on May 20 a further canal emerged with a more Westerly course which may have been the canal mentioned by Gale.

Attkins reports that *Cyclops* was distinct on May 19 and 22, and his sketch of May 21 appears to show *Cerberus II.*, but not *Cyclops*. It appears from the small amount of data available that both *Cyclops* and *Cerberus II.* were seen at different times by two or three of the observers.

*CERBERUS II.*—See above under *Cyclops*.

*DIS.*—Ellison, on May 24, noted a canal which he described as "very hard and dark like a line drawn with a pen" from the N. lip of *Trivium Charontis* running due N. until lost in the dusky mass surrounding the Pole." Ellison remarks that this canal was too meridional for either *Styx* or *Hades*, and the Director has recorded it as *Dis*, a name given by Lowell to a canal in this position.

*EUNOSTOS* is well shown by Du Martheray, its S. portion forming a border of *Elysium* and extended to *Lacus Nubis*. Phillips draws it similarly on May 22. McEwen, on May 23, noted that this canal was the faintest of those forming the borders of *Elysium*. Gale found it "conspicuous" on April 29 near the *p.* limb.

*EREBUS* was about the same intensity as *Styx* to McEwen on April 16, when he saw it broad and diffused and traced it to the position of *Ascania Palus*.

*HADES* is shown broad and conspicuous by Phillips on May 22, by Attkins as an edge of the shading on May 22 and rather strongly on May 24. McEwen also shows it on May 23, and Ellison draws it as a narrow line on May 24.

*HYBLEUS.*—McEwen writes on April 16: "*Hyblæus* diffused, harder on side next *Elysium*; it joined *Hephæstus* in a mass of diffusion." This border of *Elysium* appears on all the observers' drawings of this region.

*HEPHÆSTUS* was drawn as a diffused shading by McEwen on April 16 with its S. edge fairly distinct. Gale, on May 5, shows a narrow canal approximately in this position which, however, may have been *Eunostos*. Gale had also recorded this marking on April 28 near the limb. Phillips's drawing of May 22 shows a canal here similar to the *Hephæstus* of the 1903 chart and the *Eunostos* of the 1913-14 chart. (See Fig. 2, Plate VI.)

*LÆSTRYGNON.*—Seen repeatedly by McEwen in good moments on April 16 and also on May 23, when it was distinct, narrow and dark. It is described as large, grey and diffuse by Du Martheray on May 24. Gale could see no trace of it on May 4, but reported *Læstrygonum Sinus* fairly prominent.

*MYRMIDON* appears to be shewn on Attkins's drawing of May 19, but may be confused with *Æsacus*.

*ORCUS* appears on Attkins's drawings of April 16 and May 24, and also on those of McEwen of May 23. Phillips shows it very broad on April 19.

*PACTOLUS.*—This canal is shown by Attkins on May 19 and 21, running from *Lacus Nubis* to the position of *Pambotis Lacus*.

*STYX* was clearly seen by most of the observers forming part of the border of *Elysium*. Attkins described it as "smudgy" on April 16 and "faint" on May 24 and 26.

*STYGLIA PALUS* was "plain" to Attkins on May 22 as a small dark spot; it was also seen by him on May 24.

*TRITON.*—McEwen reported on April 16 a canal which he called *Triton* running from *Cimmerium Lacus* to the W. end of *Hephæstus*. The Director, however, has called this canal *Adamas* above.

## SECTION VI.

**Syrtis Major.**

$$\Omega = 250^{\circ} \text{ to } 310^{\circ}; \Phi = +60^{\circ} \text{ to } -60^{\circ}.$$

*MARE TYRRHENUM* (W.) is described as olive green and mottled by Du Martheray. To McEwen, on March 9, this sea had a distinct raw umber tint, this tint being deepest at the terminator, where its darkness caused the appearance of an indentation. On April 9, McEwen called the colour "faint neutral tint." This *Mare* was clearly seen by Sherlock with his 3-inch O.G. in May, which is some indication that its intensity at that time was considerable. Larman drew it about the same darkness as *Sinus Sabæus* on May 12 and 14. Phillips drew it ill-defined on May 14, with no definite border to the S., but on May 22 he shows it with more definite outlines. Atkins found it "pale" on May 13. Du Martheray noted three darker areas in the *Mare* on June 23, when he shows the area of the *Mare* very large and extending far to the South over *Ausonia*. (See Fig. 3, Plate VI.)

*SYRTIS MINOR* was not a conspicuous feature on the drawings of Phillips or the Director, but Phillips, and also Du Martheray, show a darkening of the *Mare* where *Amenthes* entered. Ellison shows *Syrtis Minor* as a very conspicuous pointed bay, and Atkins also shows it strongly accentuated on May 19. Earlier in the apparition, on April 16, it had been "very distinct" to McEwen. It does not appear on Larman's drawings of May 12 and 14. Nangle shows it strongly pointed on June 5. (See Figs. 5 and 6, Plate V., Figs. 3, 4 and 5, Plate VI.)

*AUSONIA*.—All this region is shown very white by Atkins on May 19, with a well-defined N. border. Phillips, on May 14 and 22, shows this region slightly shaded to the N., with no determinate boundary. McEwen noted on February 4, that *Ausonia* was very white and brighter than the N. P. cap. He also saw it white on March 9, and Gale on April 29 saw a bright area extending S. over part of *M. Tyrrhenum* and *Ausonia*, but stated that the S. part of the disc S. of *M. Tyrrhenum* was not specially bright and showed no detail.

Du Martheray's drawing of June 23 extends the shading of the *Maria* here very far South, and there is only a faint indication of *Ausonia* on his sketch at this date. (See Fig. 3, Plate VI.)

*MARE HADRIACUM*.—Gale, on April 29, writes: "Immediately S. of the bright patch over the f. end of *M. Tyrrhenum* there is a dark disconnected marking with an extension following to about the C.M. It would appear to be part of *Hadriacum Mare* and *Pandoræ Fretum*." Du Martheray shows this sea dark on his drawing of June 23.

*HELLAS*.—The majority of the observers saw no well-defined boundaries to this region during the apparition. This land

was frequently seen bright. Later in the apparition, on June 23, Du Martheray saw *Hellas* with well-defined borders to the North.

*LIBYA*.—The drawings of Phillips, Attkins and the Director show little change in the appearance of this region since 1918. On their drawings it is shown broad in latitude and rounded at the *f.* end. In June, Du Martheray shows it narrow and pointed. Gale shows this neighbourhood covered with white cloud on May 4 and 5, and it was also seen thus by Attkins on several occasions. Gale describes *Libya* as “very extensive” on March 26, and on April 29 he found it bright with the brightness extending S. and overlying part of *Mare Tyrrhenum* and *Ausonia*. An account of a large white area which lay over *Libya* and *Ausonia* on May 5, and of its rapid disappearance as recorded by Gale, is given elsewhere in this *Memoir*. On May 15, McEwen noted *S. Libya* “very light or rather bright but not white.” This bright part, he says, “extended right into *S. Syrtis Major* almost if not to the other side.” His representation resembles somewhat that of Du Martheray on June 23. The Director’s drawing of May 12 and Phillips’s of May 14 show the coastline clearly and the area considerably shaded, as it was so frequently seen in 1918. This region of the planet appears to be subject to considerable variations in its appearance owing to the occasional presence of white cloud, especially when near the limb. On May 13 the Director noted a faint light bridge across the *Syrtis* opposite *Libya*. (See Figs. 3–6, Plate VI.)

*SYRTIS MAJOR*.—The most remarkable feature in connection with this *Mare* during the apparition was the great prominence of *Astusapis Sinus* on its following coastline. This feature was striking even to casual observation, and it comes out very plainly on the Lowell Observatory photographs. Ellison remarks that it was conspicuous whenever *Syrtis Major* was seen and it is prominent on the drawings of Phillips, Attkins, Gale, Du Martheray, and the Director. It was, however, seldom shewn by McEwen, who comments upon the sharp outline of the following coastline of *Syrtis Major* as compared with the ill-defined preceding border. Thus, on May 13 McEwen records that the West side of *Syrtis* was hard and distinct as usual, while the East side was very diffused and difficult to define; and on May 15 he noted that the East side was very irregular, parts of the coastline being diffused and other parts hard in contrast to the hard outline of the West side, which in general he shows of a deeper tint than the East side. To McEwen the colour of *Syrtis Major* was light grey on 1919 December 25, pale neutral tint on March 7, pale blue on April 7 and 8, delft blue on West and sepia on East on May 13 and 15. On the last date he notes that the West side of *Syrtis* approaching the C.M. was dark and straight almost N. and S., with a slight turn to the W. at *S. Aeria*. This differs widely from Phillips’s drawing of the previous night (compare Fig. 4 with Fig. 6, Plate VI.). Nangle draws the N. end of *Syrtis* broad and blunted,



and does not show *Nilosyrtis* on June 5. Larman, on May 19, shows a large white area separating the N. from the S. portion of this sea. Du Martheray, on June 23, draws *Syrtis* very broad and dark with a hard well-defined *p.* edge, which omits entirely the *Nepenthes Thoth* curve.\* Unfortunately, there are no other drawings of this region of the planet at so late a date in the apparition, and no previous drawings are available by Du Martheray, so that it is not possible to determine from the evidence available whether the *Nepenthes Thoth* curve disappeared in June or whether it had been overlooked by Du Martheray, who considered this *Mare* dark-green, chestnut-leaf green and Prussian blue in colour. To Du Martheray, *Syrtis Major* was the darkest of the *Maria*. Gale noted, on April 29, that the colour of this sea was "steel blue." Attkins found it usually grey and Phillips greenish blue on May 14. (See Figs. 2-6, Plate VI. and Plate VII.)

*LUNÆ PONS.*—Attkins noted, on May 13, that this feature was "well seen." The Director could not see it on the previous night, and it is not shown on Phillips's drawing of May 14. Possibly this was an example of white cloud of short duration. Attkins's drawing on May 13 represents this white area more closely resembling the *Crocea* of the 1911-12 chart than *Lunæ Pons*. Sherlock also, on May 13, shows a light area in the dark *Mare* in this neighbourhood.

*ÆNOTRIA* is shown by Attkins on his drawing of May 13. It is not shown by McEwen on his sketches of May 12, 13 and 15, nor by Phillips on May 14, nor by the Director on May 12, on which night, however, he saw a very bright area in *Aeria*, bordering on the *f.* coastline of *Syrtis Major*, and Attkins remarks that this feature seemed to be formed by a projection from a bright cloud on *Aeria*. On May 13, the Director suspected in poor definition a faint bright bridge across the *Syrtis*, which may have been the same as seen by Attkins; and Sherlock's drawing of May 13, with only 3-inches aperture, also appears to confirm Attkins's drawing. It would appear that this brighter area on the *Syrtis* must have been of brief duration.

*SOLIS PONS.*—McEwen notes that this was "probably visible" on May 15.

*MÆRIS LACUS.*—McEwen's sketches of May 15 show this lake as a large dark shading on the *Nepenthes*. No separate lake was visible to Phillips, Attkins or the Director on the great *Nepenthes-Thoth* curve, but there was a darkening of this streak where it entered the border of *Syrtis Major*. Gale has a note on April 29: "*Lacus Mæris* was dark and formed the broad connection with *Thoth-Nepenthes*," and he states that he could not distinguish the lake separately. (See Fig. 4, Plate VI.)

*ISIDIS REGIO.*—We have no record during this apparition of any bright spots in this region such as were seen in 1918, but

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\* On a later drawing sent by M. du Martheray, of this date, the *Nepenthes Thoth* is shown.

the region was occasionally seen bright when near the limb. McEwen's drawing of May 15 shows this region rather dark when on C.M., and it is dusky on Phillips's drawings of May 14 and 22. Attkins noted it bright orange in colour on May 13 and brilliantly white on May 19 when rising.

*NEITH REGIO.*—McEwen mentions, on May 15, that it was "difficult to make out the patches and streaks" on this region, which is shown dusky by Du Martheray on June 23 and July 29.

*CASIUS.*—Like *Cerberus*, although classed as a canal, this marking in recent apparitions has resembled rather the *Maria* than the canals. The name *Casius* is here applied as in 1918 to the whole of the dark wedge-shaped formation which was again a very conspicuous feature of the planet. The general appearance of this marking was very similar to that of 1918, but Du Martheray on June 23, in addition to *Lacus Nubis*, shows two condensations on the following edge of the "wedge" similar to those observed by Antoniadi and Molesworth in 1903. (See *Memoirs*, Vol. XVI, Part IV, page 90.)

Du Martheray's drawing of June 23 indicates an increased intensity at the edges of this marking which may be considered as the canals *Alcyonis* and *Casius* proper, but this appearance was not recorded by any of our other observers.

Gale remarks upon the broadness and darkness of *Casius* in March and April, but it is interesting to note that it does not appear on McEwen's sketch of March 7 under  $\omega = 263^\circ$ , nor on that of March 9 under  $\omega = 243^\circ$ , but definition was poor on both occasions, and it may have been missed in consequence. Nor is it seen on his drawing of April 9, under  $\omega = 291^\circ$ , but it is strongly shown on his sketch of May 15 under  $\omega = 286^\circ$ . From this it would appear that, although some observers recorded *Casius* as broad and dark in March and April, its intensity probably increased in May. Du Martheray refers to this marking as grey, greenish and dark, with three knots as mentioned above. F. W. Gale found its N. portion broad and dark on March 28, and A. W. W. Gale broad and faint on April 28, while on the following night F. W. Gale considered it "very dark, forming part of a very extensive dark area." (See Figs. 1-6, Plate VI.)

*NUBIS LACUS* is shown as a strong dark spot some  $10^\circ$  in diameter by Attkins on May 13 and 19, and by Du Martheray in June and July. Phillips also shows this lake on May 14 and 22, and the Director found it prominent and dark on May 19. From the data available, it appears that this lake was more pronounced than in 1918. (See Figs. 1-6, Plate VI.)

*NILI PONS* is not shown on Phillips's drawings of May 14 and 22, nor does it appear on the drawings of Gale, Attkins or Du Martheray when the *Syrtis* was near C.M. The Director failed to see it on May 12, and it is absent from Ellison's sketch of May 14. McEwen remarks on May 15 that *Nilosyrtis* was not traced to *Coloë Palus*, and his drawings of this date show a large gap at the N. end of the *Syrtis* which, however, hardly

resembled the *Nili Pons* of 1918 as depicted by Phillips. (See Figs. 2-6, Plate VI.)

*NILOSYRTIS* is shown strongly convex to the E. by Phillips on May 14 and 22, very much as drawn by him in 1918. Du Martheray does not show such a pronounced bend on June 23, and on his drawing it appears convex to the W., under  $\omega = 287^\circ$ . Earlier the same evening, under  $\omega = 268^\circ$ , he shows it double. Attkins, on May 13, shows *Nilosyrtis* similarly to Phillips. Gale on May 5, and the Director on May 12, show it curved, but not to the same extent as Phillips. Ellison, on May 14, shows it straight and meridional.

The Director concludes that this canal had much the same appearance as in 1918, and that the above-mentioned differences between observers do not indicate any real change in the canal itself. (See Figs. 2-6, Plate VI.)

*UTOPIA* is darkly shaded on most of the drawings available.

*MEROË INSULA*.—Light orange in colour to Attkins on April 17.

*COLOË PALUS* was conspicuous to McEwen on April 8, and was drawn by Phillips on May 14 as a large ill-defined oval spot. (See Fig. 6, Plate VI.)

Gale found it dark on May 5, and the Director drew it as a prominent feature of the shading here, but not as a separate marking on May 12. Du Martheray found it very dark on June 16.

*BOREOSYRTIS* is shown on Du Martheray's chart without a well-defined border to the N. To him the colour was grey. Phillips shows it in the form of a wide hazy canal joining *Coloë Palus* to the shaded area to the N. in the neighbourhood of *COPAIS PALUS*. McEwen noted it as a broad shading on April 18, but not in canal form. Attkins describes and draws *Boreosyrtis* on May 9 as a triangular shading. (See Figs. 5 and 6, Plate VI., Figs. 1 and 3, Plate I.)

*COPAIS PALUS*.—Gale states on May 4 that this marking was very dark and apparently joined *Casius*. It was usually shown merged into the general shading of this part of the disc and is indicated as a darkening of the shading by Attkins on May 13 and by Phillips on May 14. McEwen places this marking further to the S.E. on the "wedge of *Casius*," and on May 15 remarked upon its raw umber tint.

#### MINOR DETAIL.

*AMENTHES*.—Du Martheray shows a broad canal from *Lacus Nubis* to *Syrtis Minor*, which he identifies with *Amenthes*. Phillips, on his drawing of May 22, also shows a broad canal near this place, but not running direct to *Lacus Nubis*. On the other hand, Du Martheray omits from most of his drawings in June and July that part of the *Nepenthes-Thoth* curve from *Lacus Nubis* to *Lacus Mæris*, which was so conspicuous

to other observers in April and May. With one exception, we have only Du Martheray's drawings available for June and July, and none of his previous to June, so it is not possible to be certain of any change here. Attkins, on May 19, shows *Amenthes* running straight from *Lacus Nubis* to *Syrtis Minor*, and he also shows the *Nepenthes-Thoth* at the same time. Ellison's drawing of the same date also shows *Amenthes*. Gale, on April 29, speaks of a broad branch of *Nepenthes* which swept south to *Syrtis Minor*, and on May 1 he reported that this canal was very plain. It was also seen by the Director on May 22 as the border of a white area overlying *Syrtis Major*, very much as shown by Ellison on May 19. McEwen, earlier in the apparition on March 9, noted faint traces of *Amenthes* leaving *Syrtis Minor*. Nangle, on June 5, also shows this canal. (See Figs. 1 and 3, Plate VI.)

*ASTUSAPES* appears on the drawings of Attkins, Phillips and the Director in May.

*ASTABORAS*.—This canal appears on Gale's drawings of May 5, 29 and 30. Phillips's drawing of May 14 shows only the *p.* end of this canal, where it entered the prominent *Astusapis Sinus*. The Director could not see it on May 12, but it appears to have been seen by Attkins on the following night.

*ASTAPUS* appears on McEwen's drawings of May 15 and was noted as "distinct when well past C.M." It was not recorded by any of our other observers, but Gale on May 5 noted a faint canal from about latitude  $+20^\circ$  on *Thoth* to latitude  $+23^\circ$  on *Nilosyrtis*, which may have been the same canal as seen by McEwen.

*NEPENTHES-THOTH*.—This great curved canal was again conspicuous to Phillips, Attkins, Gale and the Director in May. McEwen shows it on his drawings of May 15 very broad with *Lacus Mæris* separated from *Syrtis Major* by a narrow light bridge. He also shows a gap in the curve at about the position of *Triton Lacus*, near the place where the Director suspected a similar gap on one or two occasions in 1912. Unfortunately, there is very little available information regarding this marking before May. It is not definitely shown on McEwen's sketches of March 9 and April 9 when the *p.* border of *Syrtis Major* was drawn ill-defined, and it is entirely absent from Du Martheray's chart and drawings of June and July. Can it be that this marking—so strong and conspicuous in May—was invisible in April and disappeared in June and July? It does not seem probable that this was the case, as it is shown strongly on Hamilton's drawings of April 23 and 28 (see *Lowell Observatory Bulletin* No. 831), and Gale saw it on June 4 and remarked that it was "very conspicuous but its tint was slightly less dark than last month."

*NASAMON*.—Recorded by McEwen on May 15, and also appears on Du Martheray's drawing of June 23, but it seems doubtful whether the canal seen should not be identified with *Asclepius*.

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## SECTION VII.

### The South Polar Regions.

$$\Omega = 0^\circ \text{ to } 360^\circ. \quad \Phi = -60^\circ \text{ to } -90^\circ.$$

Owing to the tilt of the planet's axis away from the Earth, no detail observations of the South Polar cap were possible. The S. limb was usually seen whitish and often bright areas were noted, especially by Gale. Phillips remarked on May 19 that the S. limb was "astonishingly bright." Nothing so bright had been seen by him here previously during the apparition.

## SECTION VIII.

## The North Polar Regions.

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

Considerable attention was devoted to the appearance of the North Polar cap and its neighbourhood by McEwen, Attkins, Phillips and Gale. An interesting feature of this region of the planet was a white area which resembled the Polar cap and might easily have been mistaken for it. Thus, on May 22, the Director, under  $\omega = 202^\circ$ , has the following note: "Following the N.P. cap there is a very bright area, brighter than the cap itself," and later the same evening this area was noted as "very brilliant and easily mistaken for the N.P. cap." There was a very dark spot between this area and the N.P. cap, which by contrast appeared quite black. Phillips remarks that on the previous night a very large white area surrounded the Polar cap, which could not be distinguished from it; but on May 22 he found the cap very small and not very bright, the white spot referred to above being brighter than the cap. Phillips noted on this date that *Olympia* was not seen.

It is interesting to record that these two white areas at the N. Pole were indicated on Sherlock's drawing of May 22 with only a 3-inch telescope. Certainly they are not shown quite in the form in which they were seen by Phillips and the Director with much more powerful instruments, but as one cap with an indentation in its S. edge, but it was undoubtedly the same phenomenon which is recorded and is a tribute to the keen observational powers of Sherlock.

With only two drawings available showing this separate white area, which was then some way from the C.M., it is difficult to measure its position accurately, but it appears to have been approximately in longitude  $300^\circ$  to  $320^\circ$  on the N. part of *Cecropia*. The black spot mentioned above was very prominent on May 22, and may have been of short duration, but no information is available concerning it except on that date.

On May 4 Gale shows a detached bright area which was probably *Olympia* (see 1906 *Memoir*, page 97). Gale's note reads: "There is a detached white patch about one-third of the size of the Polar cap and separated from it by half its diameter. The interspace is faint yellow tint, and the area preceding just N. of *Propontis* and *Euxinus Lacus* is distinctly of ruddy hue."

*HYPERBOREUS LACUS*.—This lake appears as a dark enlargement of the dark band round the Polar cap on the drawings of Phillips and Gale in May. This dark border to the N. Polar cap is shown strongly by Phillips and Gale in May. McEwen noted on April 27 that this lake was seen projecting into the "brown-yellow margin round the N. P. cap."

*BALTIA*.—The S. part of this marking was shaded and formed a continuation of *Mare Acidalium*. The N. edge of this shaded area was not usually well-defined, and on Phillips's drawing of May 4 lay at about  $+70^\circ$  in latitude. To the N. of this, Phillips shows *Abalos* bright, bordered on the N. by the dark band round the N.P. cap.

Gale, on May 19 and 27, shows the shading of *M. Acidalium* extending to the edge of the N.P. cap, but it is bridged by a narrow white band at about latitude  $65^\circ$ . McEwen shows a similar aspect on April 30; and on May 12, under  $\omega = 301^\circ$ , when *M. Acidalium* was near the f. limb, Phillips shows a brilliant white spot separating *M. Acidalium* from *Hyperboreus Lacus*. (See Figs. 4, 5 and 6, Plate II., and Figs. 1-4, Plate III.)

*CADMUS*.—Recorded by Gale on May 29.

*KISON*.—Recorded by Gale on May 29.

#### THE NORTHERN SNOWS.

The size of the N. Polar cap shows considerable variation on the drawings of the different observers. Generally, it may be said that the smaller the telescope, the larger the cap is shown.

In the 1918 *Memoir* a table was given comparing the diameter of the Polar cap as measured on drawings and by the micrometer. This table showed very considerable variations between observers' drawings, and the same is found in 1920. In these circumstances, the true history of the changes in the diameter of the Polar cap can only be deduced from a series of regular observations by one or more observers, as observations by one observer cannot necessarily be used to fill gaps left by another. The Director has not considered it necessary to compile a similar table for this year in view of the comparatively small amount of data available; but a record is given below of the various notes upon the appearance of the N. Polar cap, and a few measures made by Phillips with a micrometer are recorded.

| Date.       | Observer. | Remarks.                                                                                                                                                                          |
|-------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1919 Dec. 7 | McEwen    | N.P.C. seen for first time. Tried hard to see it previously. Dull white, but margined by dark border, probably <i>Tanaïs</i> .                                                    |
| " " 25      | "         | N.P.C. appears larger than on 7th. Tint dull white and bordered by faint sepia band about $\cdot 7''$ broad, which, although faint, was the most conspicuous feature on the disc. |
| 1920 Jan. 8 | "         | N.P.C. large and dull white. Not so bright as S. limb (Martian date, 53 May). Cap well defined. The surrounding border distinct.                                                  |
| " Feb. 4    | "         | N.P.C. dull white and rather extended. Outlined by diffused raw umber band.                                                                                                       |
| " " 19      | "         | N.P.C. small, touching N. limb.                                                                                                                                                   |
| " Mar. 7    | "         | N.P. region dull white, with confused outline of small cap.                                                                                                                       |

| Date.       | Observer.     | Remarks.                                                                                                                                                                                             |
|-------------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1920 Mar. 9 | McEwen        | Dull white with shaded border.                                                                                                                                                                       |
| " " 28      | Gale          | N.P.C. bright and edged with narrow dark ring.                                                                                                                                                       |
| " Apr. 2    | "             | N.P.C. small and brilliant.                                                                                                                                                                          |
| " " 7       | "             | N.P.C. edged with dark fringe.                                                                                                                                                                       |
| " " 7       | McEwen        | N.P.C. light ochre with white centre at Pole. The white part showed no boundary.                                                                                                                     |
| " " 8       | "             | Dull white or very light grey with brighter centre.                                                                                                                                                  |
| " " 9       | "             | Cap light ochre brightening to white at Pole.                                                                                                                                                        |
| " " 13      | Phillips      | In unsteady seeing no Polar cap visible, only brighter areas near N. and S. limbs.                                                                                                                   |
| " " 16      | Gale          | N.P.C. small and inconspicuous.                                                                                                                                                                      |
| " " 16      | McEwen        | N.P.C. white with extremely faint border.                                                                                                                                                            |
| " " 16      | Attkins       | N.P.C. uncertain.                                                                                                                                                                                    |
| " " 19      | Phillips      | I do not think the white area at the N. Pole is the Polar cap itself.                                                                                                                                |
| " " 21      | Gale          | N.P.C. small and bright with a smaller white space following on the disc.                                                                                                                            |
| " " 23      | Attkins       | N.P.C. brilliant and small ( $\omega = 118^\circ$ ).                                                                                                                                                 |
| " " 23      | Phillips      | This is the first time the N.P.C. has been measurable. The mist or cloud has, in part, cleared away and revealed a well defined spot, but I am not sure now that it is the snow itself that is seen. |
| " " 23      | Gale          | N.P.C. well-defined and brilliant.                                                                                                                                                                   |
| " " 24      | Brindley      | N. Pole clear.                                                                                                                                                                                       |
| " " 27      | McEwen        | N.P.C. white and fairly well-defined. It appears to be extending. Margin brown-yellow. <i>Hyperboreus Lacus</i> seen projecting into this margin.                                                    |
| " " 28      | A. W. W. Gale | N.P.C. small and semi-elliptical.                                                                                                                                                                    |
| " " 29      | Attkins       | N.P.C. small and bright.                                                                                                                                                                             |
| " " 29      | McEwen        | Bright white and contracted.                                                                                                                                                                         |
| " " 29      | Gale          | Dull and inconspicuous.                                                                                                                                                                              |
| " " 29      | Phillips      | Very dark spot <i>p.</i> N.P. cap.                                                                                                                                                                   |
| " " 30      | McEwen        | N.P.C. white.                                                                                                                                                                                        |
| " May 1     | Gale          | N.P.C. dull and fuzzy.                                                                                                                                                                               |
| " " 3       | Attkins       | N.P.C. small and bright, the Polar band faint.                                                                                                                                                       |
| " " 3       | McEwen        | N.P.C. white with warm sepia diffused band bordering it.                                                                                                                                             |
| " " 4       | Attkins       | N.P.C. small and bright.                                                                                                                                                                             |
| " " 4       | McEwen        | N.P.C. inclined to be bright white and tended to project beyond limb.                                                                                                                                |
| " " 4       | Gale          | N.P.C. small and bright.                                                                                                                                                                             |
| " " 4       | Phillips      | N.P.C. seems clear and bright and larger in better moments. It is surrounded by a very dark line, especially N. of <i>Mare Acidalium</i> .                                                           |
| " " 5       | Brindley      | N.P.C. getting clearer.                                                                                                                                                                              |
| " " 5       | Gale          | N.P.C. small and fuzzy in outline. Later the same evening Gale noted that "the N. <i>p.</i> side of the cap was now sharply defined and there was a dark line on <i>f.</i> side."                    |
| " " 7       | Sherlock      | N.P.C. a round white patch.                                                                                                                                                                          |
| " " 7       | McEwen        | N.P.C. bright white with fairly distinct border.                                                                                                                                                     |
| " " 8       | "             | N.P.C. bright white with well-defined border.                                                                                                                                                        |
| " " 9       | Gale          | A white area <i>f.</i> N.P. cap is clearly visible and a bright spot precedes the Pole.                                                                                                              |

| Date.      | Observer.    | Remarks.                                                                                                                                                                                                                     |
|------------|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1920 May 9 | McEwen       | N.P.C. white. Since beginning observation it appears to be decreasing as the planet rotates; not certain of this, however. ( $\omega = 357^\circ$ ) N.P.C. white and distinct.                                               |
| " " 9      | Phillips     | N.P.C. looked decidedly smaller again, and this is supported by the micrometer measure.                                                                                                                                      |
| " " 9      | Attkins      | N.P.C. slightly larger than of late.                                                                                                                                                                                         |
| " " 10     | "            | N.P.C. brilliant. Band faint.                                                                                                                                                                                                |
| " " 10     | McEwen       | N.P.C. distinct but not bright white. Later rather bright with distinct border.                                                                                                                                              |
| " " 10     | Gale         | N.P.C. fuzzy and surrounded by whitish haze.                                                                                                                                                                                 |
| " " 12     | McEwen       | White with distinct border. Small and difficult to see.                                                                                                                                                                      |
| " " 12     | Gale         | N.P.C. is larger and less definite in outline than recently. A bright patch on limb N. <i>p.</i> is as bright but less in size than the cap.                                                                                 |
| " " 13     | Attkins      | N.P.C. brilliant. Band faint but plain.                                                                                                                                                                                      |
| " " 14     | Gale         | N.P.C. dull but extensive.                                                                                                                                                                                                   |
| " " 15     | McEwen       | N.P.C. bright white.                                                                                                                                                                                                         |
| " " 16     | Gale         | N.P.C. dull and ill-defined.                                                                                                                                                                                                 |
| " " 17     | "            | N.P.C. small and brilliant. Strongly contrasted with last night's appearance.                                                                                                                                                |
| " " 18     | "            | Small and very bright and edged, as always seen this apparition, with a narrow dark band which is denser on <i>f.</i> side.                                                                                                  |
| " " 19     | Attkins      | N.P.C. brilliant and seemed extended on <i>p.</i> side.                                                                                                                                                                      |
| " " 20     | Gale         | N.P.C. elliptical outline and brilliant.                                                                                                                                                                                     |
| " " 21     | Phillips     | There is now a very large white area surrounding the N.P. cap. The cap itself could not be distinguished from this.                                                                                                          |
| " " 21     | Attkins      | N.P. band dark and cap seems extended on <i>p.</i> side ( $\omega = 213^\circ$ ).                                                                                                                                            |
| " " 21     | Du Martheray | Outline indefinite and not very bright.                                                                                                                                                                                      |
| " " 22     | Attkins      | N.P.C. seems to have whitish extension at <i>p.</i> side ( $\omega = 220^\circ \pm$ ).                                                                                                                                       |
| " " 22     | Phillips     | The white area in N. Polar regions noted last night has disappeared! The N.P.C. very small and not very bright. There is a dark spot <i>f.</i> the cap separating it from a white spot which appeared brighter than the cap. |
| " " 23     | McEwen       | N.P.C. small and bright in an extended white (dull) area which is liable to be confused with the actual cap.                                                                                                                 |
| " " 28     | Du Martheray | N.P. shines more brightly this evening.                                                                                                                                                                                      |
| " " 29     | Attkins      | N.P.C. small but bright. The band is darkest at N. edge.                                                                                                                                                                     |
| " " 21     | Gale         | N.P.C. dull and diffuse.                                                                                                                                                                                                     |
| " June 1   | Attkins      | Polar band dark on <i>f.</i> side and fairly dark altogether. The cap is small and bright.                                                                                                                                   |
| " " 2      | Phillips     | N.P.C. very small. Region round N. Pole heavily shaded.                                                                                                                                                                      |
| " " 4      | Gale         | N.P.C. larger and more diffuse than a week ago.                                                                                                                                                                              |
| " " 6      | Attkins      | N.P.C. not visible, but there is a large indefinite whiteness N. of the shading <i>M. Acidalium-Ceraunius</i> .                                                                                                              |
| " " 9      | Du Martheray | N.P.C. smaller but clear and now shines brightly.                                                                                                                                                                            |



| Date.        | Observer.    | Remarks.                                                                                         |
|--------------|--------------|--------------------------------------------------------------------------------------------------|
| 1920 June 11 | Gale         | N.P.C. faint and diffuse.                                                                        |
| " " 11       | Du Martheray | N.P.C. very clear and rounded                                                                    |
| " " 16       | Gale         | N.P.C. on limb small and ill-defined.                                                            |
| " " 16       | Du Martheray | N.P.C. bright white.                                                                             |
| " July 19    | "            | N.P.C. more extended and less brilliant.<br>The variations due probably to the presence of fogs. |

## MEASURES OF NORTH POLAR CAP.

The only measures of the N. P. cap available this apparition are those of Phillips. These are given below and are *not* corrected by the factor 1.3, by which Phillips found it necessary to multiply his results. (See *B.A.A. Journal*, Vol. XXIX., pp. 221-2.)

| Date.         | Observer. | Measured Diameter. | Remarks.                               |
|---------------|-----------|--------------------|----------------------------------------|
| 1920 April 23 | Phillips  | 5°.3               | Not sure that the snow itself is seen. |
| " " 29        | "         | 5°.2               | Seeing poor.                           |
| " May 3       | "         | 6°.7               | "                                      |
| " " 4         | "         | 8°.5               | Cap looks clear and bright and larger. |
| " " 9         | "         | 6°.3               | Cap looked smaller again.              |
| " " 12        | "         | 6°.7               |                                        |
| " " 14        | "         | 6°.7               |                                        |
| " June 2      | "         | 6°.3               |                                        |

The above measures cover a period equivalent to the end of July and August on Mars.

## POSITION OF MARKINGS.

The positions of a few markings were estimated or measured principally by Phillips and McEwen. These are given below:—

| Marking.                 | Observer. | Date.    | $\lambda$ | $\phi$  | Remarks.                                   |
|--------------------------|-----------|----------|-----------|---------|--------------------------------------------|
|                          |           | 1920.    |           |         |                                            |
| <i>Mare Acidalium</i>    | McEwen    | May 7    | 5°        | —       | <i>p.</i> edge.                            |
| "                        | "         | " 8      | 7°        | —       | "                                          |
| "                        | "         | " 3      | 22.3°     | —       | Centre.                                    |
| <i>Auroræ Sinus</i> -    | "         | " 3      | 55°       | —       | "                                          |
| <i>Propontis</i> - -     | Phillips  | April 19 | 181°.9    | —       | —                                          |
| " - -                    | "         | " 21     | 180°.5    | + 43°.1 | —                                          |
| <i>Trivium Charontis</i> | "         | " 19     | 195°.3    | —       | —                                          |
| "                        | "         | " 21     | 196°.6    | + 17.1  | —                                          |
| "                        | Thomson   | May 22   | 198°.3    | —       | <i>p.</i> edge.                            |
| <i>Læstrygon Sinus</i>   | Phillips  | April 21 | 197°.2    | —       | —                                          |
| <i>Elysium p.</i> -      | "         | May 22   | 200°.5    | —       | <i>p.</i> side.                            |
| " <i>p.</i> -            | Thomson   | "        | 201°.2    | —       | —                                          |
| " <i>f.</i> {            | Phillips  | }        | 226°.8    | —       | Mean of 2 observations,<br><i>f.</i> side. |
| " <i>f.</i> {            | Thomson   |          |           |         |                                            |

| Marking.              | Observer. | Date.  | $\lambda$ | $\phi$ | Remarks.                                 |
|-----------------------|-----------|--------|-----------|--------|------------------------------------------|
|                       |           | 1920.  |           |        |                                          |
| <i>Lacus Pambotis</i> | McEwen    | May 23 | 219°      | —      | p. side of lake.                         |
| <i>Lacus Nubis</i>    | Phillips  | " 19   | 257°·7    | —      | —                                        |
| <i>Coloë Palus</i>    | McEwen    | " 15   | 290°      | —      | —                                        |
| <i>Portus Sigeus</i>  | "         | " 9    | 329°      | —      | —                                        |
| "                     | "         | " 10   | 327°      | —      | Slightly p.<br>C.M.                      |
| "                     | "         | " 12   | 330°      | —      | —                                        |
| "                     | "         | " 15   | 327°      | —      | —                                        |
| <i>Ismenius Lacus</i> | Phillips  | " 9    | 336°·7    | +40°·3 | —                                        |
| "                     | "         | " 12   | 338°·2    | +42°·4 | —                                        |
| <i>Arethusa Lacus</i> | McEwen    | " 10   | 339°      | —      | —                                        |
| <i>Fastygium Aryn</i> | Phillips  | " 9    | 357°      | —      | Agrees with<br>previous ap-<br>parition. |
| "                     | McEwen    | " 7    | 357°      | —      | —                                        |
| "                     | "         | " 8    | 0°        | —      | —                                        |
| "                     | "         | " 9    | 357°      | —      | —                                        |

#### CHARACTERISTICS OF THE 1920 APPARITION.

The following were among the most striking features of the apparition:—

- (1) The large white areas which occasionally obscured or partially obscured some of the *Maria*, and especially *Syrtis Major*.
- (2) The frequent appearance of very bright areas along the limb or terminator.
- (3) The great prominence of *Astusapis Sinus* on the f. coastline of *Syrtis Major*.
- (4) The continued strength of the great *Nepenthes-Thoth* curve.

#### CONCLUSION.

In bringing this *Memoir* to a conclusion, the Director desires to express his thanks to those who have contributed to it. The apparition was a difficult one for observers in Great Britain, and consequently the material available for discussion was not so complete as usual, making it difficult where observers differed to arrive at conclusions regarding some of the fainter markings. The addition of two or three capable and experienced observers, especially if situated in the S. hemisphere, would be of great assistance in making our work on the planet more complete.

The Association, and the Mars Section in particular, are greatly indebted to the Royal Society for the grant of money which has enabled this Report to be published.

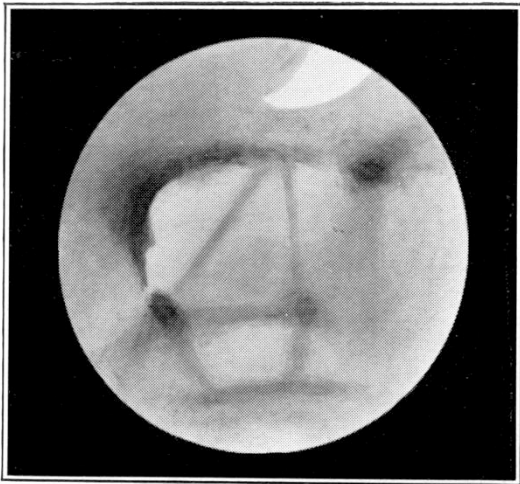


FIG. 1.—H. McEWEN.  
5-in. O.G. 1920 April 8.  
 $\omega = 310^\circ, \varphi = +17^\circ.5$ .

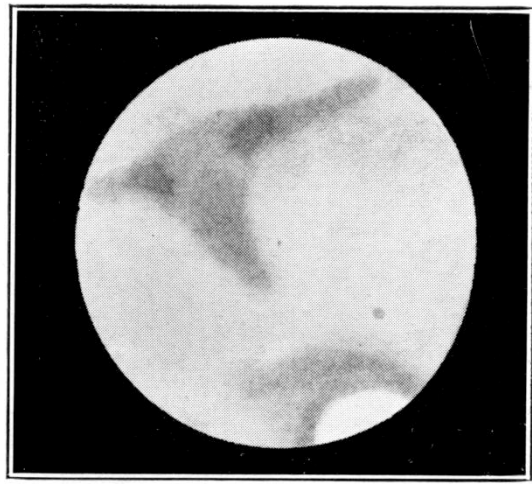


FIG. 2.—E. D. SHERLOCK.  
3-in. O.G. 1920 May 13.  
 $\omega = 312^\circ, \varphi = +22^\circ$ .

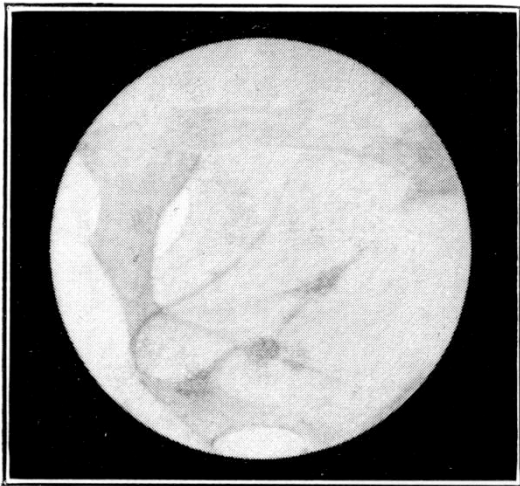


FIG. 3.—E. A. L. ATKINS.  
 $8\frac{1}{2}$ -in. Spec. 1920 May 10.  
 $\omega = 314^\circ, \varphi = +21^\circ.5$ .

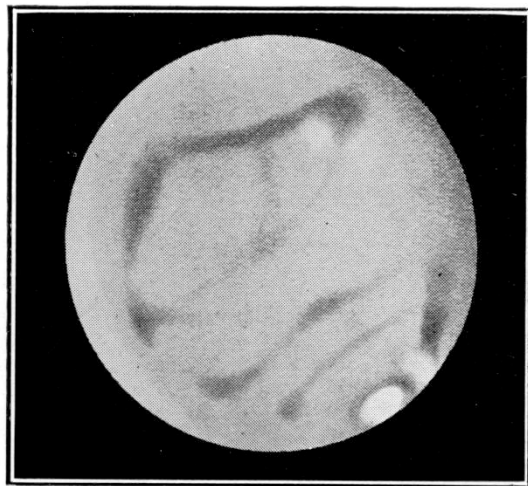


FIG. 4.—T. E. R. PHILLIPS.  
8-in. O.G. 1920 May 12.  
 $\omega = 331^\circ, \varphi = +21^\circ.5$ .

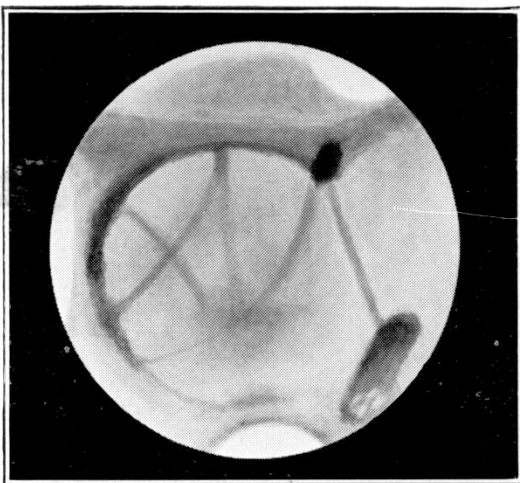


FIG. 5.—H. McEWEN.  
5-in. O.G. 1920 May 10.  
 $\omega = 339^\circ, \varphi = +21^\circ.5$ .

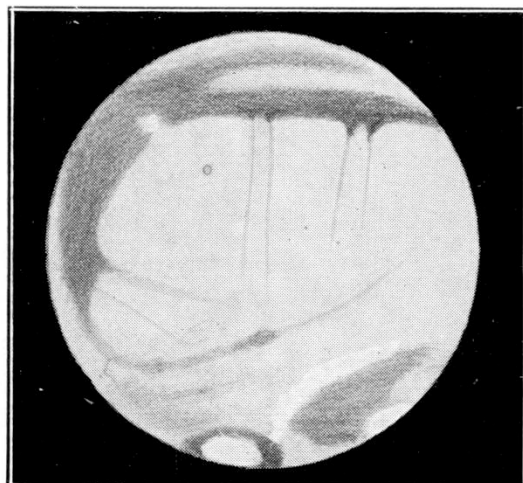


FIG. 6.—W. F. GALE.  
 $8\frac{1}{2}$ -in. Spec. 1920 May 29.  
 $\omega = 342^\circ, \varphi = +23^\circ$ .

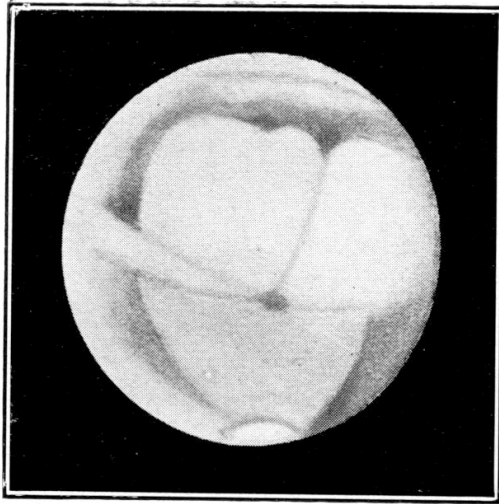


FIG. 1.—J. NANGLE.  
1920 May 28.  
 $\omega = 352^\circ, \varphi = +22^\circ.5$ .



FIG. 2.—W. F. A. ELLISON.  
10-in. O.G. 1920 May 7.  
 $\omega = 356^\circ, \varphi = +21^\circ$ .

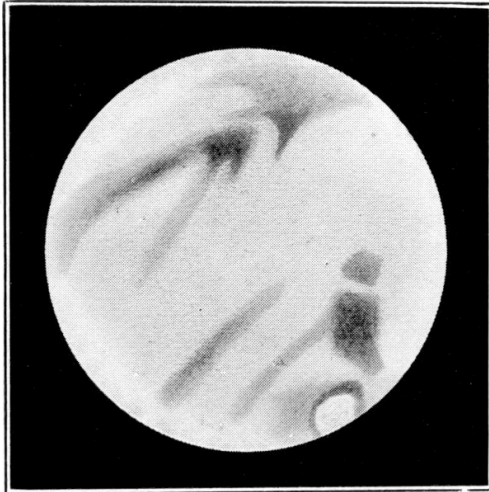


FIG. 3.—T. E. R. PHILLIPS.  
5-in. O.G. 1920 May 9.  
 $\omega = 0^\circ, \varphi = +21^\circ.5$ .

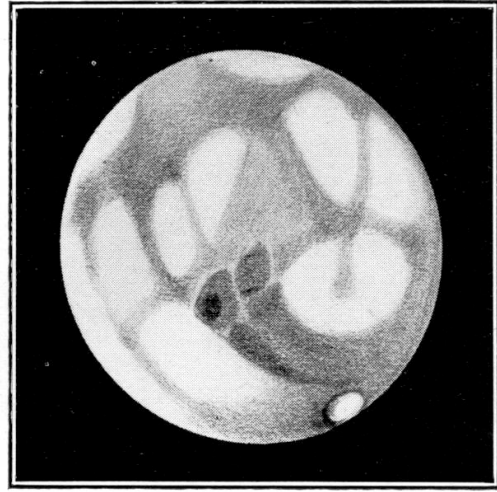


FIG. 4.—C. F. M. DU MARTHERAY.  
5.3-in. O.G. and 8½-in. Spec.  
1920 June 9.  
 $\omega = 38^\circ, \varphi = +23^\circ$ .

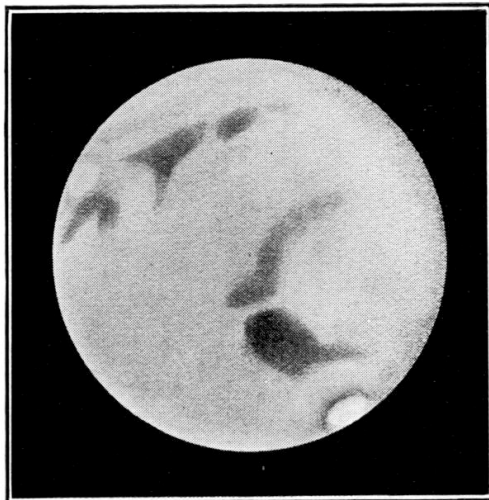


FIG. 5.—T. E. R. PHILLIPS.  
8-in. O.G. 1920 May 4.  
 $\omega = 44^\circ, \varphi = +21^\circ$ .

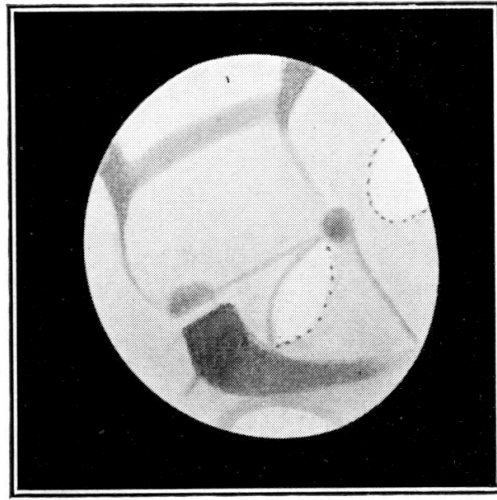


FIG. 6.—E. A. L. ATKINS.  
8½-in. Spec. 1920 June 9.  
 $\omega = 51^\circ, \varphi = +23^\circ$ .

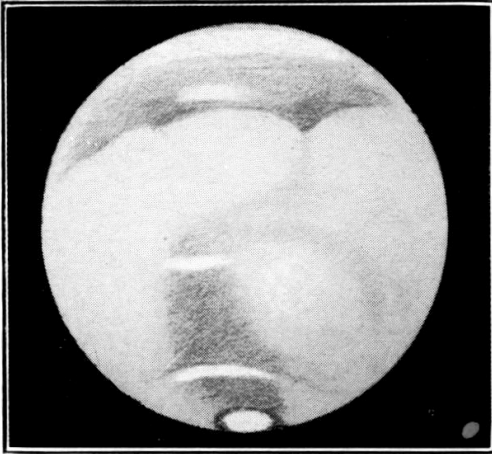


FIG. 1.—W. F. GALE.  
8½-in. Spec. 1920 May 19.  
 $\omega = 57^\circ, \varphi = +22^\circ$ .

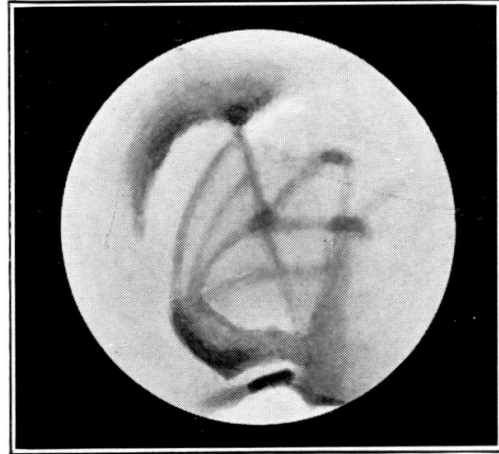


FIG. 2.—H. McEWEN.  
5-in. O.G. 1920 April 30.  
 $\omega = 64^\circ, \varphi = +20^\circ$ .

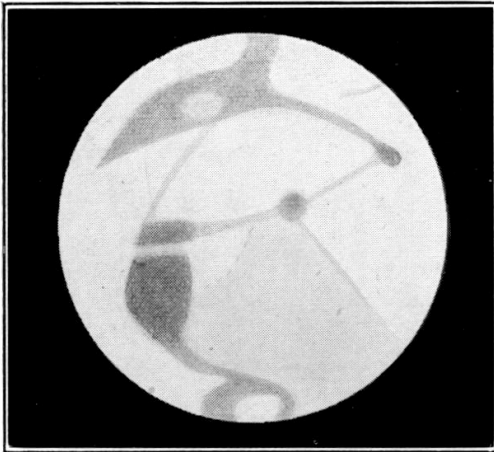


FIG. 3.—E. A. L. ATKINS.  
8½-in. Spec. 1920 April 29.  
 $\omega = 65^\circ, \varphi = +20^\circ$ .



FIG. 4.—E. A. L. ATKINS.  
8½-in. Spec. 1920 June 6.  
 $\omega = 71^\circ, \varphi = +23^\circ$ .

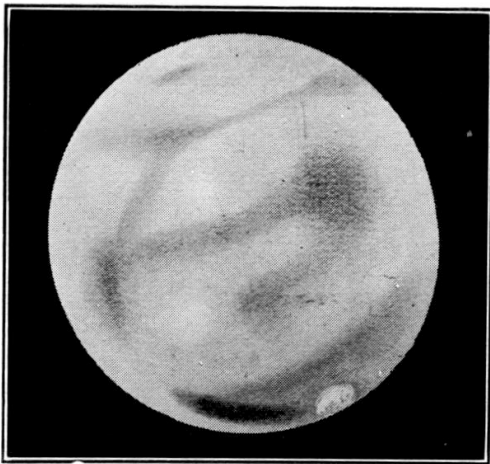


FIG. 5.—T. E. R. PHILLIPS.  
8-in. O.G. 1920 June 2.  
 $\omega = 115^\circ, \varphi = +23^\circ$ .

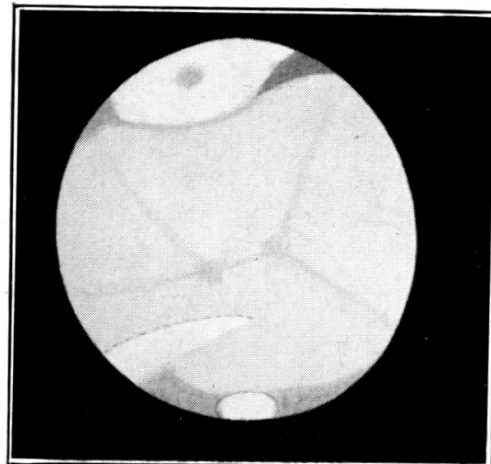


FIG. 6.—E. A. L. ATKINS.  
8½-in. Spec. 1920 June 1.  
 $\omega = 117^\circ, \varphi = +23^\circ$ .

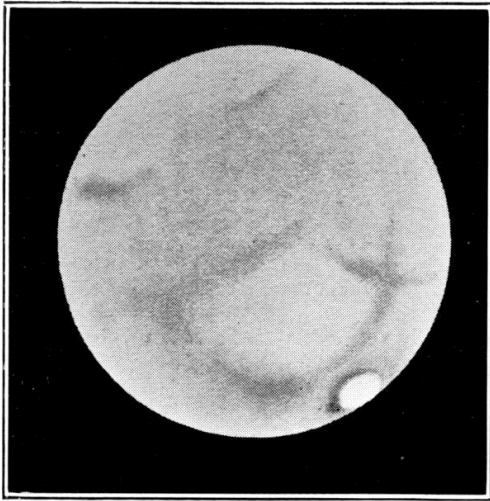


FIG. 1.—T. E. R. PHILLIPS.  
8-in. O.G. 1920 April 23.  
 $\omega = 130^\circ, \varphi = +19^\circ$ .

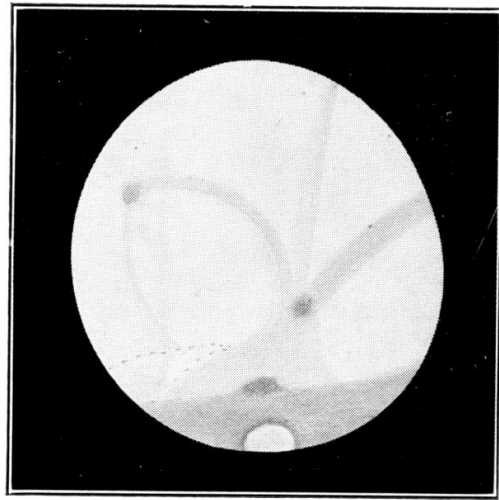


FIG. 2.—E. A. L. ATKINS.  
 $8\frac{1}{2}$ -in. Spec. 1920 May 29.  
 $\omega = 141^\circ, \varphi = +23^\circ$ .

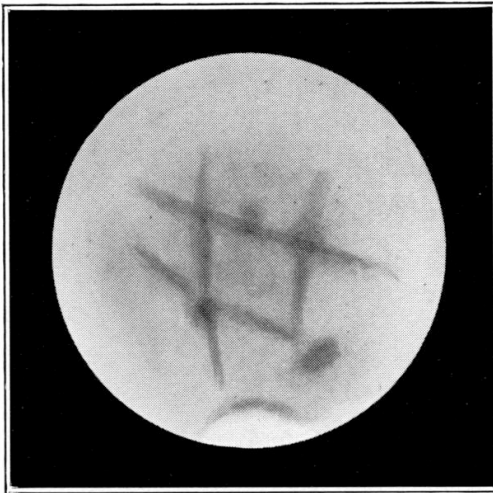


FIG. 3.—H. McEWEN.  
5-in. O.G. 1920 April 21.  
 $\omega = 151^\circ, \varphi = +19^\circ$ .

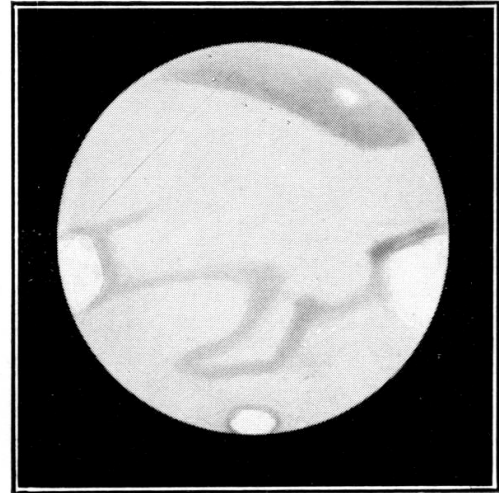


FIG. 4.—W. H. STEAVENSON.  
4-in. O.G. 1920 April 18.  
 $\omega = 161^\circ, \varphi = +18^\circ.5$ .

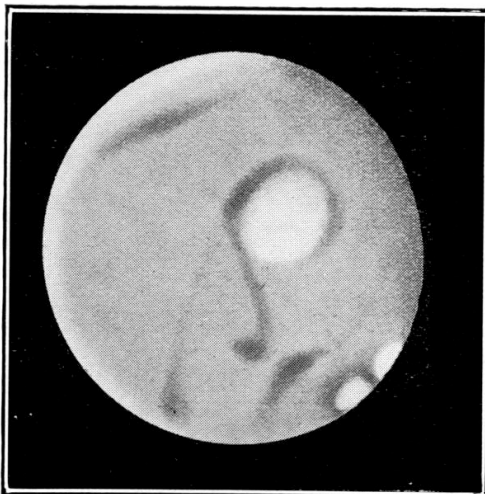


FIG. 5.—T. E. R. PHILLIPS.  
8-in. O.G. 1920 May 22.  
 $\omega = 185^\circ, \varphi = +22^\circ.5$ .

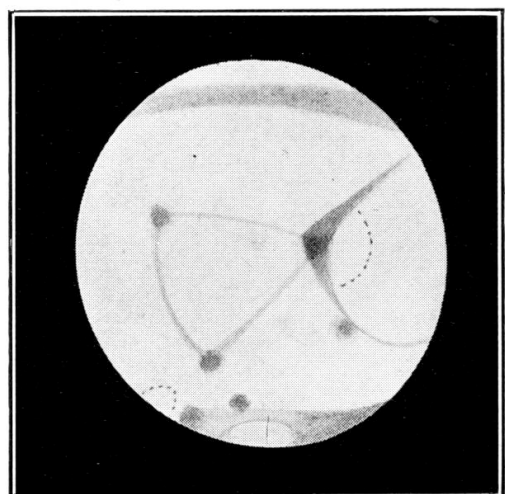


FIG. 6.—E. A. L. ATKINS.  
 $8\frac{1}{2}$ -in. Spec. 1920 May 24.  
 $\omega = 193^\circ, \varphi = +22^\circ.5$ .

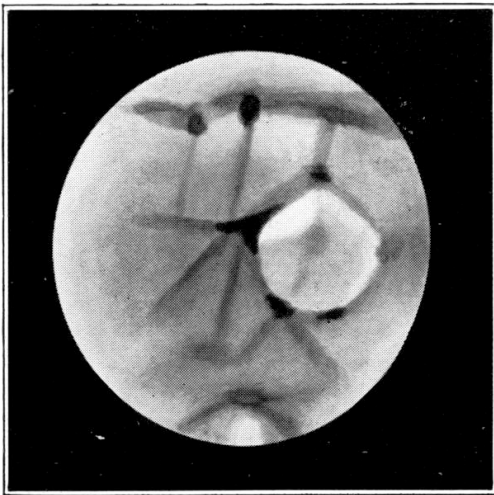


FIG. 1.—H. McEWEN.  
5-in. O.G. 1920 May 23.  
 $\omega = 202^\circ, \varphi = +22^\circ.5$ .

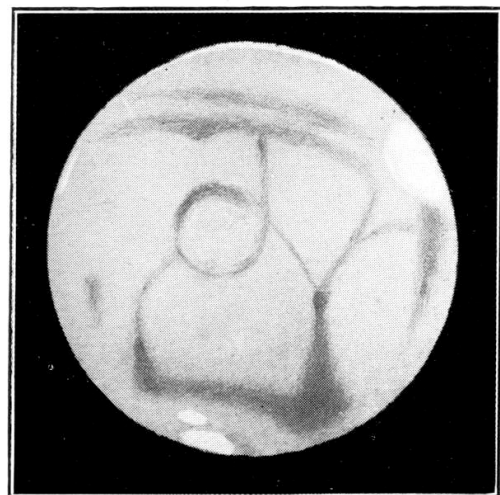


FIG. 2.—W. F. GALE.  
 $8\frac{1}{2}$ -in. Spec. 1920 May 4.  
 $\omega = 224^\circ, \varphi = +21^\circ$ .

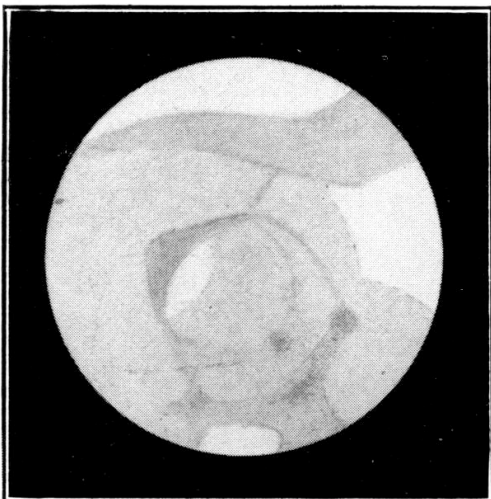


FIG. 3.—E. A. L. ATKINS.  
 $8\frac{1}{2}$ -in. Spec. 1920 May 19.  
 $\omega = 231^\circ, \varphi = +22^\circ$ .

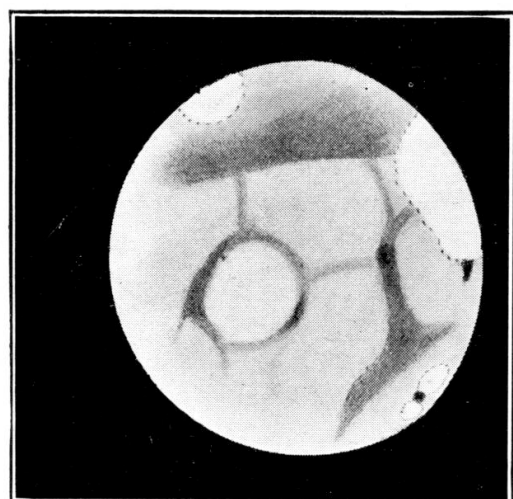


FIG. 4.—H. THOMSON.  
 $12\frac{1}{2}$ -in. Spec. 1920 May 22.  
 $\omega = 233^\circ, \varphi = +22^\circ.5$ .

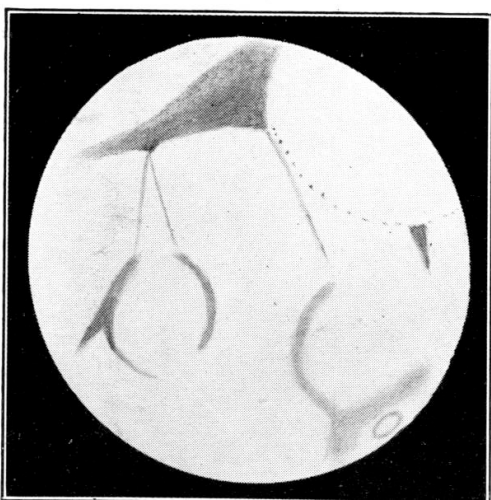


FIG. 5.—W. F. A. ELLISON.  
10-in. O.G. 1920 May 20.  
 $\omega = 240^\circ, \varphi = +22^\circ.5$ .

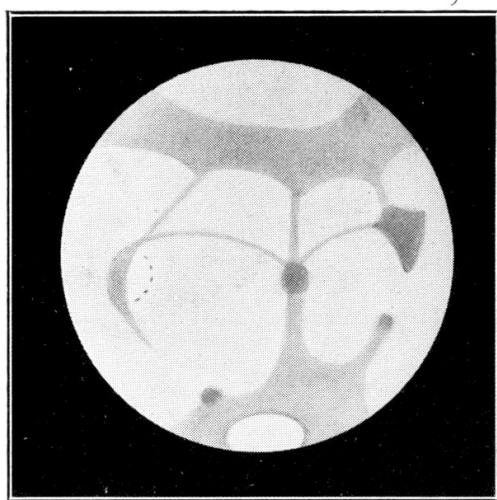


FIG. 6.—E. A. L. ATKINS.  
 $8\frac{1}{2}$ -in. Spec. 1920 May 19.  
 $\omega = 248^\circ, \varphi = +22^\circ$ .

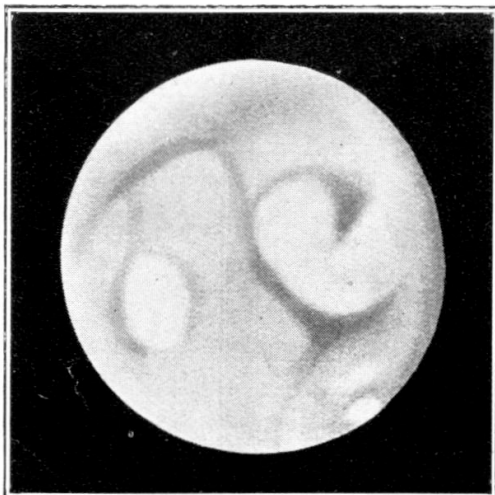


FIG. 1.—T. E. R. PHILLIPS.  
8-in. O.G. 1920 May 22.  
 $\omega = 257^\circ, \varphi = +22^\circ.5$ .

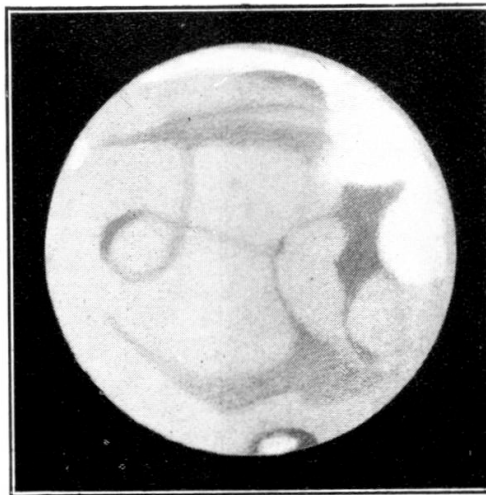


FIG. 2.—W. F. GALE.  
8½-in. Spec. 1920 May 5.  
 $\omega = 261^\circ, \varphi = +21^\circ$ .

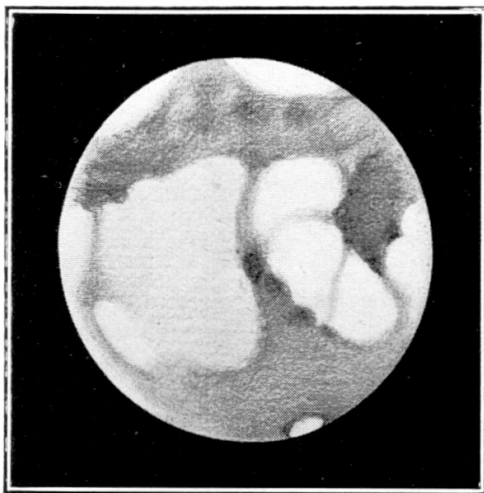


FIG. 3.—C. F. M. DU MARTHÉRAY.  
5·3-in. O.G. and 8½-in. Spec.  
1920 June 23.  
 $\omega = 268^\circ, \varphi = +23^\circ$ .

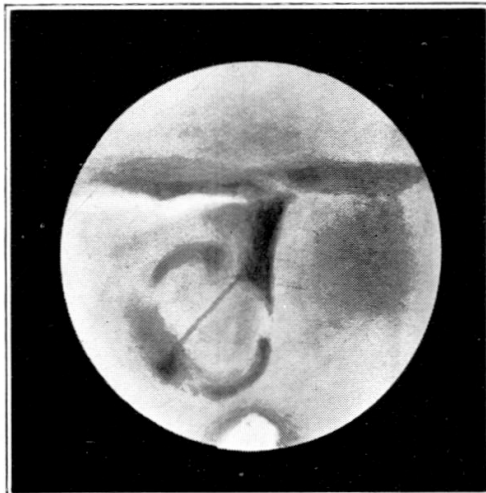


FIG. 4.—H. McEWEN.  
5-in. O.G. 1920 May 15.  
 $\omega = 286^\circ, \varphi = +22^\circ$ .

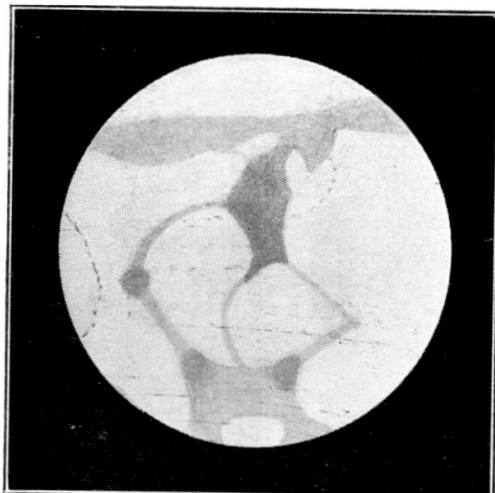


FIG. 5.—E. A. L. ATKINS.  
8½-in. Spec. 1920 May 13.  
 $\omega = 288^\circ, \varphi = +21^\circ.5$ .

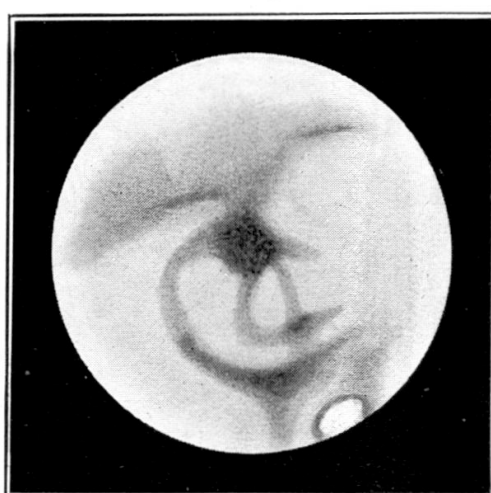
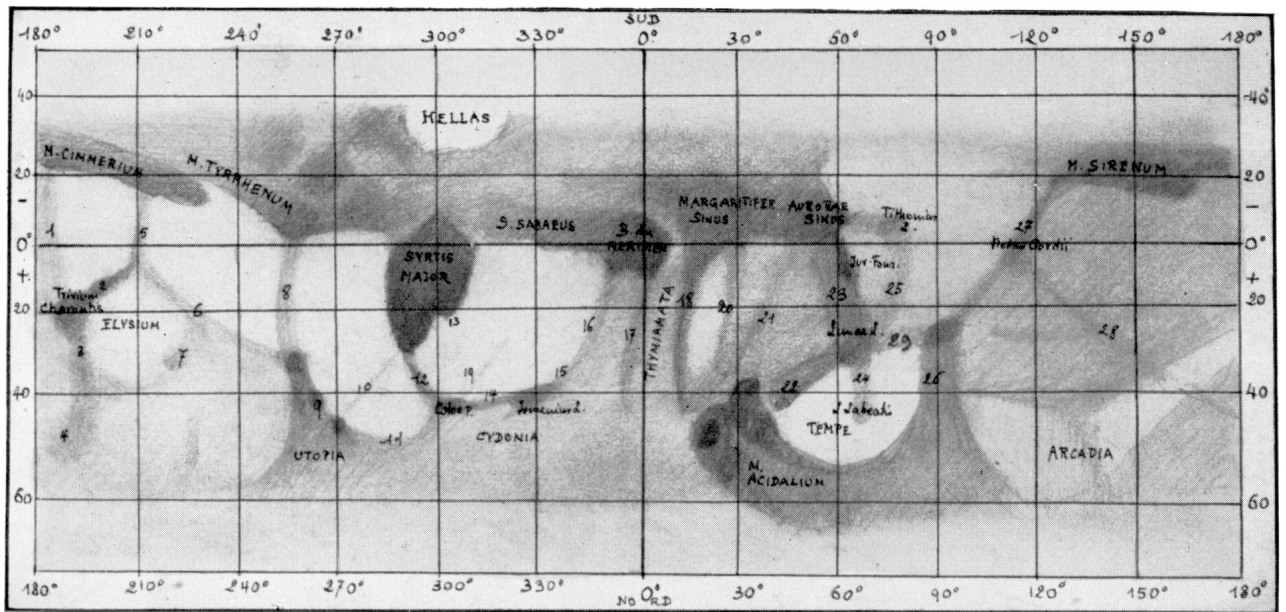


FIG. 6.—T. E. R. PHILLIPS.  
8-in. O.G. 1920 May 14.  
 $\omega = 290^\circ, \varphi = +22^\circ$ .

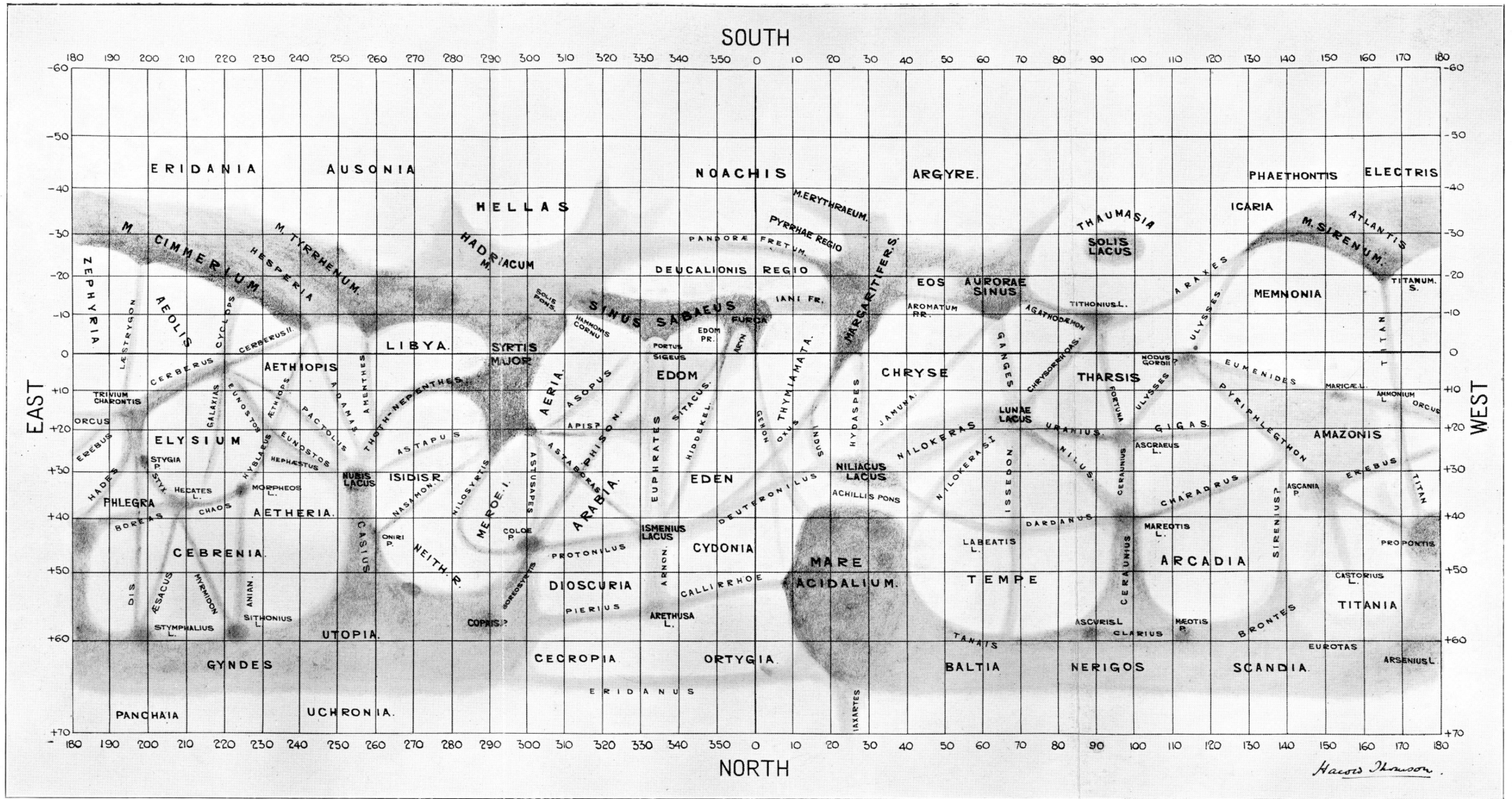


CHART OF MARS. By M. DU MARTHERAY.  
Showing details observed by him during 1920.



1. Lastrygon; 2. Cerberus; 3. Styx; 4. Propontis; 5. Cyclops; 6. Eunostos; 7. Elysia Palus (?); 8. Amenthes-Thoth; 9. Casius; 10. Nasamon (?); 11. Boreosyrtis; 12. Nilosyrtis; 13. Astaboras; 14. Protonilus; 15. Deuteronilus; 16. Hiddekel; 17. Gehon; 18. Indus; 19. Phison; 20. Hydaspes; 21. Jamuna; 22. Nilokeras; 23. Ganges; 24. Isedon; 25. Chrysorrohas; 26. Geraunius; 27. Sirenius; 28. Pyriphlegethon.

(The identifications of canals are those given by M. du Martheray.)



### CHART OF MARS, ON MERCATOR'S PROJECTION.

PREPARED FROM OBSERVATIONS OF THE SECTION 1919-1920.

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

