
REPORT ON MARS, No. 14.

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THE TWO VARIETIES OF CANALS.

As a result of the observations made at the last opposition, that of 1913-4, it is concluded that the dark areas on Mars, whether broad areas like the maria, or narrow ones like the canals, are of two distinct classes, those that are comparatively permanent, and those that are ephemeral. Soon after the northern polar snows began to melt, the cap was surrounded by a broad grey or brownish band, that, unlike the southern maria, never appeared green. It soon narrowed in places to a mere canal, bounding the cap on the south. This canal retreated towards the north with the snow, and as compared with many of the more southern features of the planet was distinctly ephemeral. The polar bays, of which there were four that year, all exhibited a similar shifting, but their deep blue color, at times, indicated water. All these shifting dark areas are believed to owe their darkness either to ground moistened by thawing, or to actual swamp. The darkness of the more permanent canals and green maria are thought to be due to vegetation.

To illustrate the difference between those two kinds of canals Table I has been prepared. The left hand side of the Table represents the best drawing made each day during the presentation of the planet preceding opposition, the other side the drawings of the presentation following, the two sides being arranged exactly alike. The first two columns give the date and longitude of the central meridian, the next the number of canals shown on each side of the meridian, the *P* indicating the preceding or eastern side. The last column indicates by a cross on which side of the meridian the polar band was most marked, as indicated either by its breadth or density, or both. When there is no choice between the two sides, the result is entered under the column headed *E*. The four polar marshes are not included in this estimate, each balancing off an equal length of canal, on the other side. Prior to opposition the limb is on the *F* side, after opposition on that of *P*. The subscripts ₁ and ₂ stand for limb and terminator.

With regard to the permanent canals, we find that in general both before and after opposition, six-tenths of them are found on the side of

TABLE I.
PERMANENT AND EPHEMERAL CANALS.

Before Date	"	Permanent		Ephemeral			After Date	"	Permanent		Ephemeral		
		P ₁	F ₁	P ₁	E	F ₁			P ₁	F ₁	P ₁	E	F ₁
Dec. 3	346	0	1		+		Jan. 6	351	1	0	+		
8	306	0	0	+			10	342	3	0	+		
10	273	4	1	+			12	338	2	2		+	
12	252	4	2	+			15	281	3	0	+		
13	237	3	3	+			17	284	5	0	+		
15	227	3	5		+		18	240	6	4	+		
16	192	2	4			+	20	222	7	5		+	
17	185	2	7		+		21	184	1	1		+	
18	177	0	6		+		27	163	0	1	+		
19	162	1	3		+		Feb. 1	158	1	4	+		
22	168	2	2	+			5	104	4	3		+	
23	172	2	5		+		7	75	3	1		+	
25	125	6	0		+		8	42	1	1	+		
29	155	1	2	+			10	50	0	2		+	
30	101	6	2		+								
31	64	5	5		+								
Jan. 4	5	1	2		+								
5	41	0	3		+								
Total		43	53	6	11	1			37	24	8	6	0
Per cent		45	55	33	61	6			61	39	57	43	0

the planet towards the limb. This side has slightly the greater area, and it is also rather better lighted. On the whole the preceding, that is the afternoon, side of the disk shows a slight excess of canals over the morning side, 80 to 77, but not more than might well be due to accident, on account of the small number of observations considered. For the ephemeral canals on the other hand, those that we have attributed to marshy conditions, we find that before opposition on 33 per cent of the dates they were most marked in the afternoon or preceding side, to only 6 per cent in the morning. After opposition, as the sun rose higher upon them, with the advance of the season, 57 per cent of the dates were most marked in the afternoon, and none at all in the morning. It therefore appears that the permanent canals are most marked on the limb side, and the ephemeral canals on the side when it is afternoon, regardless of limb or terminator. Indeed by watching the polar band, and estimating its breadth in a given longitude with regard to the breadth of the polar cap, we should actually be able to see the ground on Mars thaw out under the influence of our sun as the Martian day progresses. This has in fact been done here this past month on several occasions, a difference being noticeable in the course of two or three hours. This, and watching the fog clear and shift on the sunrise limb, brings before us rather vividly the meteorological conditions existing on our sister world.

But it is not only at the boundary of the snow that the ephemeral canals and swamps exist. Sometimes these canals lead away from the snow with a slightly southerly inclination. Again while the canal usually retreats with the snow, yet sometimes it is left behind and a fresh canal develops between it and the snow cap. Thus on December 10, 1913, the boundary canal was narrow and was clearly identified as Heliconius. On the 12th the snow had retreated somewhat to the north, and the canal was very broad and light blue in color. On the 13th it had again narrowed, and shifted towards the further retreating snow. On December 15 the snow had still further retreated, and the canal was now very narrow and clearly coincided with Pyramus. A month later on January 17 Heliconius was very faintly indicated, with Pyramus clearly marked to the north of it.

The Syrtis marsh is another example of an ephemeral dark area. The lakes and canals seen in the Protei region, described in Report No. 3 and figured in No. 8, are clearly examples of ephemeral markings, very different from the usual run of canals and lakes. That a lake or swamp 1000 miles in length, as shown in Report No. 8, Figure 22, should exist where nothing of the sort was seen four days previously, as shown in Figure 23, appears to us as little short of astounding. Similarly that the Protei lakes 200 and 300 miles in diameter should disappear in the course of a few days seems to us well nigh incredible. Clearly they must all have been very shallow bodies of water or mere marshes, and the surface of Mars in these regions must be very flat. If consisting of marshy land the marshes are not necessarily all at the same level, and might even be intersected by small ranges of hills, invisible to us. Nevertheless, such changes are certainly extraordinary and never occur upon either the Earth or Moon, the only other planetary bodies with those surfaces we are familiar. If due to the presence of water however, such changes are exactly what we should expect to find on Mars. Indeed had we known that the surface was so level, we might almost have predicted them.

The explanation is comparatively simple, and depends merely on the atmospheric pressure. On the Earth the pressure is so great that the boiling point of water is raised far above the mean temperature of the planet. Consequently evaporation and precipitation both take place slowly. On the moon the pressure is so low that the boiling point would be reduced to the melting point, and consequently water as such disappears entirely from the surface. Imagine now a planet with an intermediate atmospheric pressure. Let us suppose the boiling point reduced to the mean temperature of the planet. Steam would therefore rapidly condense to water at night, and the water would boil away by day into steam. Judged by appearances it would seem that on Mars

the boiling point is slightly but not far above the daylight temperature. Otherwise we should expect the marshy areas to be continually enveloped in cloud. This is not the case, although heavy clouds are often seen rising from them (Reports Nos. 3 and 4).

If the daylight temperature of Mars were $68^{\circ} F$ ($20^{\circ} C$), in order that water should exist on its surface, the pressure of its atmosphere would have to be at least five-eighths of an inch (17 mm). It is generally supposed to lie between one and three inches. Writers sometimes commiserate with the Martians for not having more water on their planet, but it would seem that they may perhaps thank their lucky stars that there is not more of it, else they might all be in danger of drowning! While it now appears improbable to us that the canals are devices for transporting water across the surface of the planet, it is possible that some of them may serve the opposite purpose, that of retaining the water as long as possible, so that all may not be carried at once to the other pole, by means of the regular aerial planetary circulation.

PERMANENT CHANGES OF SURFACE.

In Report No. 7 we showed by means of a series of drawings the gradual changes that had taken place in that region of the planet following the Syrtis during the past thirty-six years. What is in some ways a more striking and interesting change is exhibited by the drawings in Plate II. The first observer to represent the surface of Mars completely and accurately as we know it today was Sir J. N. Lockyer, in 1862. He employed an aperture of 6 inches. Other early observers show certain features, notably the Syrtis itself, which can be readily identified at the present time, but most of their drawings show little else that is now recognizable, and the drawings themselves are clearly of but little value.

There are two features shown by Lockyer however that at once strike the modern observer as peculiar. If we examine his drawing, Figure 3, and compare it with Schiaparelli's map in our first Report, we shall recognize without difficulty Sabaeus on the extreme left and Solis Lacus on the right. South of Solis we shall recognize Tithonius, and note where it is joined to Aurorae, but what is that singular marking which fills the place now held by Juventae Fons? For convenience we will call it *X* and shall refer to it by that name hereafter. Starting now from Sabaeus and proceeding towards the center of the disk we first reach Margaritifer, and soon after its twin feature, another unrecognizable marking, which we will call *Y*. It will be noticed that while Lockyer does not show the point of Aryn, he does show Sigaeus

PLATE II

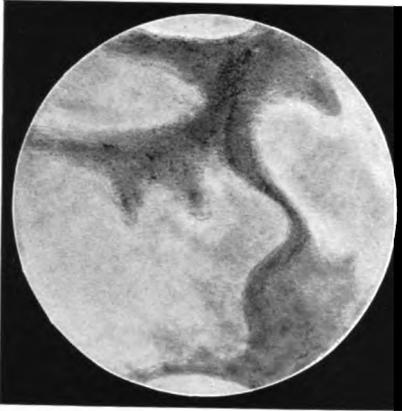


FIG. 1.
Secchi
1858 June 5, 9^h40^m

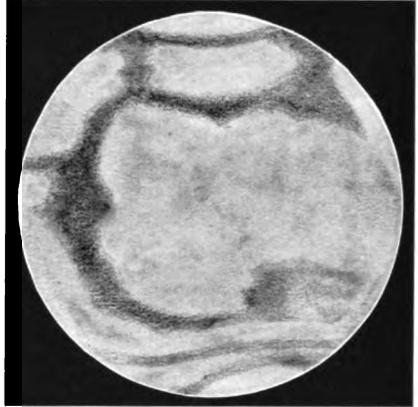


FIG. 2.
Secchi
1858 June 10, 9^h00^m



FIG. 3.
Lockyer
1862 Sept. 23, 12^h55^m



FIG. 4.
Kaiser
1864 Dec. 18, 10^h00^m

DRAWINGS OF MARS

Portus, the little bay where Phison and Euphrates join Sabaeus, also Daradax, the bay lying between it and the forked bay of Sabaeus. These are both very minute details, often not visible at the present day. They indicate the general accuracy of his drawing, and our surprise is the greater at the presence of the large unfamiliar markings *X* and *Y*.

Figure 4 is by Kaiser, drawn two years later. Aperture 7 inches. *X* does not appear on his drawing and the region looks much as it does at the present day (see Report No. 8, Figures 5 to 8) but *Y* is clearly shown, and equals Margaritifer in size. Sabaeus appears at the extreme left.

Figure 5 is by Dawes. Aperture 8 inches. He had a keen eye, and discovered the point of Aryn within the forked bay, which was formerly named after him. His sense of proportion was not good however, and he brings the bay much too near to Solis Lacus. He does not show *X*, but *Y* is even more prominent than in the previous drawings.

In Figure 6 Green, who was an artist by profession, and who necessarily had an excellent idea of proportion, represents this region very much as did Lockyer and Kaiser. He used a reflector of 13 inches aperture. Sabaeus is on the extreme left, and Solis on the right. He shows *X* quite as clearly as did Lockyer, although of a somewhat different shape, but of *Y* there is no sign whatever. That part of the drawing might have been made yesterday.

The drawing by Schiaparelli shown in Figure 7 aperture 18 inches, differs from our modern drawings only in the fact that the promontory to the right of Margaritifer extends much farther south than it does at present, or in Kaiser's or Green's drawings. There is no trace of either *X* or *Y*,—except as canals.

If we turn back to Secchi's drawing made in 1858, aperture 9.5 inches, Figure 2 is readily recognized with the Syrtis on the left, the forked bay of Sabaeus on the right and Sigaeus Portus, longitude 335° on the central meridian. Compare with Report No. 8, Figure 4. In Figure 1 computation shows that longitude 35° must therefore have been central much as in Figure 3, and it is clear that the three bays indicated must be Margaritifer, *Y* and *X*, the latter connecting, through Ganges with Acidalium, much as Aurorae did in 1913-4. Compare with Report No. 8, Figure 9. Secchi's representation of *X* is more like that of Green than it is like that of Lockyer, but it is clear that the same object was seen by all three.

We thus find *X* shown on three of these early drawings, and *Y* on four of them, in fact on all four of the earliest ones, drawn prior to 1865. Considering the general accuracy of these drawings even in minute details, we can hardly doubt that large dark areas on the planet have therefore really permanently disappeared in the past fifty

years. This it will be noted is quite a different matter from the extensive temporary changes that are now generally recognized as occurring upon the planet. In general the length of both *X* and *Y* may be taken at 500 miles. To adopt a terrestrial analogy it is much as if the group of the New England States had been converted into a permanent desert, or as if the same thing had happened to England and Scotland. These drawings are all taken from Flammarion I, 138, 139, 153, 177, 186, 278 and 475.

It is not easy to determine the exact date at which the *X* and *Y* markings disappeared from Mars. This is because the drawings made between 1864 and 1877 are of inferior quality to those that preceded and followed them, perhaps owing in part to the greater distance of the planet at opposition. According to Burton in 1871 the *Y* was still there. According to Green in 1873 its existence is doubtful, while Terby indicates plainly that it was not visible. In October 1877 Dreyer shows it on a drawing, while Green as we have already seen clearly indicates that in September it had disappeared. If we neglect Dreyer's drawing, it disappeared between 1871 and 1873. The evidence regarding the *X* is unsatisfactory. As we have seen, its location is now marked more or less by *Juventae Fons*. According to Schiaparelli the longitude of *Juventae* in 1877 was 61° , in 1888 it was 64° . In 1879 Lohse made it 68° . According to drawings by Professor Douglass, Mr. Slipher and the writer in 1914 (Report No. 8) its longitude was 52° , 68° , and 52° . We have here a total range of 16° , but since on Mr. Slipher's drawing *Juventae* is nearer the limb than on the others, we may accord his drawing half weight, and obtain a mean value of 55° . This compared with the mean of the three earlier values 64° , gives a range of 9° or over 300 miles! Clearly the longitude of this marking should be investigated.

The last drawing, Figure 8, is from an unpublished sketch made by Professor Douglass while at Arequipa in 1892. It is of interest as showing how the promontory to the right of *Margaritifera*, which Schiaparelli showed extending so far to the south, changed back to its present abbreviated form. It was not by a gradual shortening, as we might have naturally expected, but instead, a dark band stretched straight across it from east to west, cutting off the tip. This band was very dark and conspicuous, and is shown on a number of Professor Douglass' drawings, as well as on several others made at the same time by the writer. The region to the south of it later darkened. As far as known this band has never since been seen in the dark and distinct form that it had during that opposition.

Another striking fact which these earlier drawings impress upon us is the general tendency on Mars to duplication, and also to the produc-

PLATE III



FIG. 5.
Dawes
1864 Nov. 14, 12^h00^m



FIG. 6.
Green
1877 Sept. 1, 13^h10^m



FIG. 7.
Schiaparelli
1890 June 9.



FIG. 8.
Douglass
1892 Aug. 15, 10^h40^m

DRAWINGS OF MARS

tion of triangular bays. The latest instance of this occurred at the last opposition, when Propontis and Castorius suddenly appeared side by side and just alike (Report No. 4, Figure 1). The forked bay of Sabaeus is another instance, and now we have Margaritifer, and its twin *Y*. On the earth the only well marked triangular bays or straits are the Gulf of California, the Straits of Malacca, and the northern end of the sea of Japan. That six such bays should have been seen on Mars, grouped in three pairs, indicates that there must be some connection between the components. Since the *Y* has long since disappeared, it seems that it is not necessary that the connection should be maintained.

That Propontis and Castorius exactly coincided in position with the canals Hades and Erigone on Antoniadi's map (Flammarion II), leads us to surmise that the frequently recorded duplication of the canals may also be a genuine phenomenon. The difficulty that the writer has always felt regarding it, however, has been that those who saw it, either saw too much, or else other observers saw too little. We have seen by Report No. 11 that one felt uncertain of the separation of two parallel lines with the naked eye when the angular distance between them was reduced to $69''$. Schiaparelli discovered the duplication of the canals with an aperture of 8 inches, and it is claimed to have been seen with 6. If the diameter of the pupil of the eye is assumed under ordinary conditions in a well lighted room to be one-eighth of an inch, as for instance when the above recorded separation of the parallel lines was suspected, the separation of the canals when observed with these small apertures should range from at least $1''$ to $1''.33$. That such obvious separations should not be readily detected with larger apertures, working even under rather unfavorable atmospheric conditions, seems incredible. On account of the lateness of the development of the detail on Mars this season, the assumed duplication will hardly reach its maximum before opposition, so that this year should be extremely favorable for its detection, if it really exists.

OBSERVATIONS IN DECEMBER.

Early in December the deserts were very red, and on the 6th and 10th they were painted to match 14 on the scale. By December 14 they were orange and matched 12. On December 17 and 19 they were still more yellow, with scarcely any cloud visible at the limb. Their color must nearly have reached 11. The next night the disk was seen at a glance to be much redder again, with much cloud on the limb, and also scattered in small areas over the disk. The reading on the color scale was found to be 14. December 25 the color was reduced to 12.5. It thus appears that while the bands that later develop into canals are still broad, and while the main features, such as the bays of Sabaeus and

Margaritifer, are still in the process of forming, the atmosphere of Mars is generally in a pretty hazy condition. It is only when the atmosphere clears that the individual clouds become distinctly visible. While the scale is particularly adapted to the determination of the general color of the desert regions, and their variation from night to night, in order to determine the colors of the individual markings, such as the maria, and the blue and brown spots, another method must be employed. This consists in actually drawing and coloring the disk, and viewing the result through a black mask by a properly colored light. When this has been done, it is found that the maria are not in general really green by white light as our vegetation is, but only grey. That is they match plain pencil shading. On the other hand however, they are decidedly green compared with the desert regions. We therefore conclude that the vegetation is not continuous as with us, but occurs in spots on the red soil, the red and green uniting to produce on our eyes the effect of grey. The northern maria, which we have hitherto described as grey, it now appears have a brownish tint, doubtless that of moistened soil. Observations were secured upon the following dates:—

December 4, ω 173°, M. D. March 46. Owing to previous unfavorable terrestrial atmospheric conditions at this Martian longitude, this was our first view this year of the twin bays of Proponitis and Castorius. They were now united into one broad and nearly uniform band, extending from the polar cap to Charontis.

December 6, ω 153° and 190°, M. D. March 48. The individual canals leading from the two bays to Charontis were now just visible, and quite distinct, but the bays themselves were still combined into one. Titanum was distinguishable, but not yet very marked in shape. Definition good, but very little detail.

December 7, ω 174°, M. D. March 49. A cloud 700 miles in length following Charontis was noted within 30° of the central meridian. Earlier it also followed the western canal connecting Charontis with the polar band. The breadth of this band, where preceding Proponitis, in longitude 140°, was recorded as follows, in terms of the breadth of the polar cap, showing its gradual broadening as the Martian day progressed. The

TABLE II.
BREADTH OF THE POLAR BAND.

G. M. T.	ω	M. L. T.	Breadth	Miles
^h 20.7	145°	^h 2.6	0.6	300
21.0	150	2.9	0.7	350
22.6	172	4.5	0.8	400
22.8	175	4.7	0.9	450
23.0	178	4.9	1.2	600

third column of the table gives the Martian local solar time for longitude 140° . The rapid increase in breadth towards the end of the observation was in large part due to the proximity of the terminator, which caused the whole region to darken. The four earlier observations are believed to be fairly accurate. The latitude was $+55^\circ$.

December 8. The longitude and latitude of the south preceding corner of Castorius were determined, by the method described in Report No. 13 at the time of transitting the central meridian, at $135^\circ.6$ and $+43^\circ$.

December 10, $\omega 118^\circ$, M. D. March 52. The longitude and latitude of this point were redetermined. Result $137^\circ.5$ and $+43^\circ$. It will be interesting to see if the longitude increases as the season advances. The latitude was certainly greater than $+39^\circ$. It was at first thought that the twin polar bays had begun to separate, but it was concluded later that the effect was only due to a cloud stretching across the dark region. Phoenicis Lacus was faintly seen for the first time this year.

December 14, at $\omega 72^\circ$ Solis Lacus was near the central meridian. It had clearly developed, but the seeing was too poor to draw it satisfactorily.

December 16, $\omega 64^\circ$, M. D. April 2. The rounding off of the following end of the polar cap towards the limb was distinctly seen for the first time, although the cap still appeared tangent to the limb. A minute cloud was suspected following the Acidalius marsh, and past the central meridian. That is it had lasted well into the Martian afternoon. Solis Lacus could not be distinguished.

December 17, $\omega 83^\circ$, M. D. April 3. The snow cap had materially increased in size. Tithonius and Solis had now both developed.

December 19, $\omega 66^\circ$, M. D. April 5. A very brilliant white area was seen on the southern terminator, just preceding Thaumasia. It appeared whiter and fully as bright as the northern cap. Its latitude was in the vicinity of -40° . It seems at first rather early for snow in the southern hemisphere, until we look at the calendar and find that it was 61 days after the equinox in their long winter season. Since it was seen just before their sunset, it does not seem likely to have been hoar frost, but as it was not found again the next night, it must have been a very thin layer of snow.

December 20, $\omega 33^\circ$, M. D. April 6. The striking change in color of the disk due to the clearing away of the Martian clouds has already been described. The Acidalius marsh was found to have largely increased in size, its meridional length was now 1000 miles, in place of 600 as on the previous night, and its breadth 800 instead of 600. It was darkest towards the snow, and its color was bluish black. The conspicuous canal Hydraotes visible the previous night had disap-

peared and its place was covered by a white cloud, although it was now as late as two in the afternoon by Martian time in that longitude. Three drawings were made of the snow cap, measuring 16, 15, and 14 millimeters in length. The first and last were obviously too large and too small, indicating that we should expect an accuracy of about one millimeter, or $0''.25$, that being the scale on which all our drawings are now made.

December 25, ω 353° , M. D. April 11. The color of the deserts had again assumed an orange tint, indicating that the clearing off observed December 20 was but temporary. Although the Acidalium marsh was distinctly blue, there was no trace of polarization that could be detected. This is unusual, since the blue color and polarization usually go together. The snow cap which had somewhat diminished December 23 had again increased in size. The bay of Sabaeus had begun to develop, although there was no trace of Aryn as yet. Seeing 7. This date is 24 days later than any of the drawings showing Aryn published in Report No. 8. The region which should later develop into the Strait of Sabaeus had narrowed appreciably since our last previous view of it November 19, but the southern boundary was not sharply defined as yet. There was no trace of Margaritifer, although five days earlier a slight projection in that place had been recognized. The broad straight band connecting Acidalium with the Bay of Sabaeus appeared much as it did in November. Except Deuteronilus and Callirrhoe previously recorded, no canals were visible.

It will be recalled that in Report No. 12, on October 23, M.D. March 5, mention is made of the first appearance and formation of the Syrtis marsh this Martian year. On November 19 to 27, M. D. March 32 to 40, it was well seen, but it then appeared not much darker than the surrounding region, and only of moderate size. On December 26, M. D. April 12. At ω 300° the straight band connecting the Syrtis with the polar cap was clearly seen, and it was recorded that the Syrtis might be a little darker at the tip, but certainly there was no extensive marsh there at that time. Seeing 5. With this quality of seeing magnification 330 was clearly preferable to 660. A report has just been received from Professor Douglass of the Associated Observers, who observed it on the nights of November 26 and December 2. He states that the Syrtis seemed to show pretty black in its northern part in a limited area, especially on the second morning, but it did not show at all until within 30° of the central meridian,—“as if emerging from a morning fog.” His drawings show a comparatively small dark region about 300 miles in diameter. Neither observer had hitherto detected any blue color in it, and it is doubtful if it contained much water up to

December 26. Professor Douglass' observation corroborates the view that there is still much fog in the Martian atmosphere.

Owing in part to unfavorable atmospheric conditions, and in part to circumstances over which the writer had no control, it was impossible to secure any observations on the last five days of the month. As soon as the telescope was again turned on the planet, January 1, it was at once noted that the Syrtis marsh was strongly developed, of large size and very blue, especially on the preceding side. The southern border was indistinct, but it was evident that a considerable change had occurred since our last observation. Its length and breadth on its southern border were both about 1200 miles. It is to be hoped that the planet has been under observation elsewhere during these five days, and that some one of the Associated Observers will be able to give a detailed account of just what happened, and especially of when the blue color made its first appearance. Three observations and a colored sketch have been sent by Mr. L. J. Wilson, S. P. A. The latter, made upon December 5, ω 135° , shows the Propontis Castorius region as slightly developed and of a bluish color. There is a small cloud on the southern terminator. Extensive color observations have been received from Mr. McEwen made on the nights of October 14, 21, and 30. The second indicated a darkening to the west of the Propontis region, at the edge of the polar cap, near longitude 200° . He also noted a bright area (presumably a cloud) following Charontis. The usual cloud following the Acidalium marsh was recorded in the last observation. He also recorded Tithonius, Ascræus, Lunæ, and Phœnices lakes. Ceraunius was recognized, and suspected of duplicity.

A very interesting private letter has just been received from M. Jarry Desloges, which unfortunately I am not permitted to quote. A few statements of general interest may be culled from it however. He says that although he possesses a telescope of 20 inches aperture, he considers that for planetary work it is useless to use apertures exceeding 13 inches, nor does he favor higher magnifications than 500. He states that excellent atmospheric conditions are found at Setif in northern Africa in the winter time. The altitude is 3600 feet, and two years ago they had 60 inches of snow there for over a month. This statement is of particular interest, since at nearly all the chief observatories of the world, north and south of the equator, the weather is unfavorable during the northern winter months. He carried a large telescope into the desert some 200 miles from the coast but found the conditions there distinctly inferior to those at Setif. This fully confirms our experience in Jamaica, that our best seeing comes on damp nights. He does not agree with the writer and some others that Elysium appeared rounded at the last opposition. An observation by the writer

made early in January indicates a considerable change in size in Elysium, and it is hoped that others will devote especial attention to this marking this year. Those sending colored sketches to the writer should mention the source of light they employ, and also mention if they took the precaution to have the image of the planet and the drawing of the same brightness.

Table III contains the usual data of the month's drawings.

TABLE III.
DATA OF THE DRAWINGS.

No.	1915	☉	M. D.	Long.	Lat.	Sun	Diam.	Seeing
31	Dec. 4	22.4 ^o	Mar. 46	173 ^o	+20 ^o	+9 ^o	9.0	6
32	" 6	23.3	" 48	153	"	"	9.1	8
33	" "	"	" "	190	"	"	"	8
34	" 7	23.8	" 49	153	"	"	9.2	7
35	" "	"	" "	174	"	"	"	6
36	" 10	25.2	" 52	118	"	10	9.5	12
37	" 16	27.9	Apr. 2	64	"	11	10.0	7
38	" 17	28.4	" 3	83	"	"	10.1	7, 6
39	" 19	29.3	" 5	66	"	12	10.3	8, 7
40	" 20	29.8	" 6	33	"	"	10.4	9
41	" 25	31.9	" 11	353	"	"	10.9	7, 6

The following canals and lakes were seen:—

- Dec. 4 D Cerberus. Lakes: Charontis.
 Dec. 6 D Cerberus, Hades, Erigone (Antoniadi). Lakes: Charontis.
 Dec. 7 D Cerberus, Hades, Erigone (A), Titan. Lakes: Charontis.
 Dec. 10 C Phlegethon, Acheron, Pyriphlegethon (?) Lakes: Phoenicis.
 Dec. 16 B Nilokeras, Chrysorrhoas, Hydraotes, Jamuna, Ceraunius. Lakes: Lunae, Tithonius.
 Dec. 17 B Ceraunius, Nectar. Lakes: Lunae, Tithonius, Solis.
 Dec. 19 B Nilokeras, Hydraotes, Chrysorrhoas, Araxes, Nectar. Lakes: Lunae, Tithonius, Solis.
 Dec. 20 B Nilokeras, Chrysorrhoas.
 Dec. 25 A Deuteronilus, Callirrhoe.