

REPORT ON MARS, No. 21.**WILLIAM H. PICKERING***[Continued from page 79.]*

The writer makes it a point never to enter a canal or lake on his drawings that he cannot hold in steady vision, either as long as he cares to look at it, or, if the seeing is constantly fluctuating, at least as long as the good seeing lasts, whether that be for a minute, or for only a few seconds. Even supposing that a canal that we only glimpse is really there, it is not worth while recording it, because we cannot see it well enough to be sure of its curvature, direction, or position. If we draw it wrongly, then our observation throws doubt and discredit on the location determined by some other observer who has really seen it in a satisfactory manner.

The fact that a canal is drawn by an accepted observer ought to be sufficient guarantee that it was really there. The confirmation of others should be merely as to its visibility, curvature, etc. A canal that is only glimpsed should not be entered on the visibility scale at all. There are plenty of interesting and surprising phenomena constantly occurring on Mars that we can clearly see, without entering details that we can only glimpse, even if we think they are real. One reason that we find so many straight canals on certain maps of the planet that have been published in the past is that their authors entered everything they could glimpse, whether they really saw it clearly or not. Anything that one can only glimpse he naturally, and properly, enters either as a straight line, or as a circle.

Before leaving the question of the faintness of the canals that should be entered upon our drawings, the writer would again like to state that under no circumstances should a map be taken to the telescope, and canals and lakes that are found upon it hunted up on the planet. While this course of procedure would obviously add materially to the number of canals found, it is considered to be a distinctly objectionable method, for the several reasons given in Report No. 18, 2, *POPULAR ASTRONOMY* 1917, 25, 560. We don't want canals on our list that are found that way. The proper method of procedure is to leave all maps entirely out of one's mind, and enter on the drawing only those features that are clearly seen in the telescope.

The writer wishes to say here again what he said before, that there is no such thing as superlative eyesight, as has sometimes been claimed for particular individuals. There is of course bad eyesight, and good

eyesight, but between those who have really good eyesight there is very little to choose. With a little training in their work all persons with good eyesight see just about equally well (See Report No. 11, 10, *POPULAR ASTRONOMY* 1915, 23, 578).

Another point illustrated by Table III is that with a really first class observer, the difference between good and only moderate seeing does not make very much difference in the total number of canals detected. We know that the seeing in Arizona is good, and we know that the seeing in England is only moderate at the best, yet the difference between our second and fifth columns is not so very great. It is quite possible, however, that the fifty-ninth canal of the fifth column may be distinctly narrower than the fifty-first canal of the second. But besides good and moderate seeing there is also poor seeing, and there is no question but that with poor seeing, which is very prevalent at times in the north, no canals can be seen at all.

Considering now exclusively the work of the four observers in the first group, we find not only that they all saw about the same number of canals, but also that the canals that they did see were in general the same. Thus there were 33 canals that they all four recorded, or more than half of the whole number seen by any one of them. There were 15 that three of them saw, 18 seen by two, making 66 confirmed canals, and 25 seen only by one, 91 in all. None of them saw more than eight canals which one of the other three could not confirm. Indeed Phillips saw only two unconfirmed canals.

But because a canal is not confirmed, that does not show by any means that it does not exist. It must be remembered that this study is based on only a few selected drawings furnished by each observer. Many unconfirmed canals might be amply confirmed were all the drawings of all the observers consulted. Moreover, it is probable that some canals are very short lived, lasting only a few days,—possibly only a few hours. Therefore unless any two drawings are made at exactly the same time, it is quite possible that one may show a canal not found upon the other. Then too we must consider the possible difference in atmospheric conditions upon the planet when the drawings were made, such as small and invisible Martian clouds, as well as the varying seeing upon our own planet.

As a result of this investigation we find from Table III that the published drawings show 131 different canals, of which 83 were seen by at least two observers. In 1914 the total number seen was 80, confirmed by two observers 45. In 1916 total number 77, confirmed 54. Thus we find a steady increase each year in the number of confirmed canals, and we expect this number to reach its maximum for several years to come at the next apparition. Of the 29 canals taken from Lowell's

various maps, 8 were confirmed by two or more observers, and one was confirmed out of the 5 taken from the map of Jarry-Desloges. This would seem to imply that the additional canals, not shown upon our standard map, are in general either very faint, or else very transient phenomena.

TABLE IV.

PROPORTION OF THE CANALS VISIBLE TO THE DIFFERENT OBSERVERS.

| Vis. | Pl. | Pk. | W. | D. | Mg. | Misc. | Total |
|-------|------|------|------|------|------|-------|-------|
| 6 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 25 |
| 5 | .85 | .77 | .85 | .92 | .85 | .77 | 13 |
| 4 | .83 | .75 | .67 | .58 | .75 | .42 | 12 |
| 3 | .27 | .45 | .64 | .64 | .82 | .18 | 11 |
| 2 | .09 | .36 | .32 | .36 | .73 | .14 | 22 |
| 1 | .04 | .04 | .04 | .06 | .79 | .02 | 48 |
| Total | 53 | 59 | 60 | 62 | 108 | 46 | 131 |

In Table IV the arrangement is similar to that in Table III, except that instead of giving the total number of canals seen by each observer, it gives the proportion of the total number recorded. These total numbers are given in the last column of Table IV, and are taken directly from Table III. As we descend the columns to fainter and fainter canals, the proportion of the total number seen by each observer should gradually decrease, falling off sharply when he approaches his limit, and this we find in general to be the case. We notice by the last column that as the canals grow fainter, they first decrease, and then later increase in numbers. This was noticed also at the last apparition.

MAGNIFICATION. ARYN.

The question of magnification is a very important one in planetary research, and three general results of observation may be laid down in this place. (a) As long as we can retain a reasonably distinct image, the more we magnify the more accurately can we measure and draw the various planetary details. Difficult canals are of two kinds, those that are extremely narrow and sharp, and those that are broad but lacking in contrast. (b) Within reasonable limits difficult narrow canals are equally well seen with either high or low powers. (c) For the broad canals and large lakes lacking in contrast, a low power is desirable,—provided that they are really there. The real question, however, often is, "Are they there?" If they are not, then the user of the high power, although correct in omitting them, appears at a disadvantage as compared to the user of the low power, since he apparently has not been able to detect them.

To take one concrete instance from among several, the canal Boreosyrtris joining Casius to Nilosyrtris was clearly seen in 1916 by Wilson and Douglass, but not by Phillips or the writer (Report No. 17, figures 21, 22, 23, and 24). This past year Wilson still saw it vaguely, but the others did not. What they saw was a broad well defined area, very dark, but not shaped in the least like a canal. On the other hand Maggini saw it as a narrow curved streak, exactly as it is drawn on the standard map (Report No. 15), and not at all as it appeared to the others. He used a low power,—only 318. Wilson used magnifications of 211 and 360; the other observers used various powers from 400 to 660 (see Table I). The users of the low powers were of course credited with the canal, but—was it really there?

This question of what we shall call a canal, and what not, is sometimes a very difficult one, notably in region C. Should the use of the term depend on the shape of the object only, or should we also fix a limiting breadth? For instance in Figure 10 the broad band stretching westerly from Tithonius along latitude -10° , in longitude 115° , has been identified as the canal Eumenides. This is doubtless correct, but what should be done with the still broader parallel band, somewhat farther to the north, and stretching two-thirds way across the disk. It fills practically all the space between Gigas and Acheron. Should it be called a canal, and if so which, or both? In Figure 12 the same band of the same width is shown, but only on the eastern half of the disk. In Figure 9 it is also shown, but within it a narrower darker band appears. In Figure 30 only the narrower band is visible. In Figure 11 a double canal similarly placed, but lying in latitude $+32^\circ$ and $+37^\circ$, has been identified as Acheron and Phlegethon, while in Figure 29 an inclined double canal in latitude $+15^\circ$ and $+22^\circ$ has been called Gigas.

These drawings illustrate a typical doubtful case of identification. Is it possible that they are all representations of the same canal? In Figures 10 and 12 high powers of 350, 450, 430, and 660 were employed, in the other four lower powers of 330, 211, 440, 318, and 300. Was it really a broad uniform band as the high powers indicated, or was it of variegated structure with duplications of narrow canals, located in different places and extended in different azimuths, as shown by the lower powers?

Lest an erroneous impression should be produced on those unfamiliar with the planet, it should be stated at once that in the above instance the writer has purposely selected a most difficult example, on the most difficult of the six selected regions of the planet,—region C. This region is difficult, and was so in 1914 and 1916, because it shows extremely little contrast, so little in fact that at first sight no detail at

all can be seen upon it, save Acidalium Mare in the north, and possibly Solis Lacus and Tithonius in the south. In the other five regions with reasonably good seeing the detail stands out as clearly as it does on most of the drawings, but in region C, if we did not greatly exaggerate the contrast that we actually find, our drawings would be merely blank paper. Indeed this region might almost be taken from another planet, so unlike it is to the other five.

On the Moon it has been found that, with a magnification of 4, certain straight, narrow, dark, canal-like lines are visible, which with a magnification of 12 or greater entirely disappear, or rather, more correctly speaking, present to us then a very different appearance (Report No. 6). It is possible that something analogous to this structure is to be found on this contrastless face of Mars. At the next apparition the planet will be appreciably nearer to us at this same season of its year, and it is suggested in studying this particular face of the planet, that extremely low powers in addition to the high ones should be used by all the observers, powers such as 200 and 300 for instance. By this means it is possible that some of these radical divergencies of appearance can be assimilated.

It must not be supposed, however, that this now seemingly lifeless, contrastless region of the planet is always a desert waste, and that our standard map representing it as seamed with narrow canals, traversing it in all directions, is hopelessly inaccurate and misleading. This region certainly does convey the impression of a desert waste, or at least of a very uninteresting area, during that portion of the year when the moisture is flowing southerly from the northern polar cap, but when conditions are reversed, and the flow is from the south, innumerable short narrow canals appear, much more numerous than the map indicates, and fully as narrow. This statement is based on drawings made by Professor Douglass and the writer, under very favourable atmospheric conditions, with a 13-inch refractor at Arequipa, Peru, in 1892. An entirely different map is needed for this face of the planet between the September equinox and the December solstice from what would have been suitable at the last three apparitions.

But it is not only in region C that marked differences have been detected. The Elysium canals were very much narrower, fainter, and straighter, in 1892, while the Syrtis Minor and Lacus Phoenicis were then conspicuous objects. The point of Aryn scarcely visible, or seen only with difficulty of late years, was a most conspicuous feature at that time, while the canal system to the north of Sabaeus on the contrary was much more difficult of detection. Most of the drawings of

region A show Aryn strongly marked this year. Only two notes were received by the writer on the subject. One was from Professor Douglass, who says: "I looked many times to make sure of its visibility. When the seeing was 7 or 8 I could only see it occasionally, but at 8 or 9 on the scale I have used I could see it most of the time, or at least I seem to be confident that I did." The other note from Mr. Wilson says: "I have found Aryn rather difficult. There seems to be considerable shading across it, and only at very good moments could the prongs be seen separately." The writer did not succeed in seeing it at all this year, and indicates that fact in his drawings. In 1916 he suspected it towards the end of the apparition, but never has it been at all comparable of late years to its striking appearance in 1892, when it was fully as marked as in any of the drawings made this past year.

COMPARISON OF THE PAST THREE APPARITIONS.

Comparing the past year's work with that of the previous apparitions, as described in Reports No. 8 and 17, we notice that the present drawings were made appreciably later in the Martian Calendar year. The earlier observations were all taken between $\odot 5^{\circ}.5$ and $26^{\circ}.1$, corresponding on the revised Calendar to between the Martian dates of March 12 and 54. In 1916 the drawings were made between $\odot 44^{\circ}.2$ and $66^{\circ}.7$, corresponding to the dates of April 37 and May 31. By Table I the present set of drawings were made between $\odot 80^{\circ}.3$ and $106^{\circ}.1$, corresponding to the Martian dates of June 6 and July 6, rather more than one quarter of the year being thus completely covered by the three apparitions. As a result, on comparing the three sets of drawings, we notice that between each set the northern snow cap has appreciably diminished in size. It has turned also more directly towards us. The summer solstice occurred, with $\odot 90^{\circ}.0$, on the Martian date June 27, which for us was March 24, 1918. In 1914 the central latitude lay between $+2^{\circ}$ and $+9^{\circ}$, in 1916 between $+14^{\circ}$ and $+18^{\circ}$, and this year between $+21^{\circ}.5$ and $+22^{\circ}.8$. The maximum size of the planet in three years was $15''.0$, $13''.9$, and $14''.1$; it was therefore still extremely remote, even when nearest us. At an August opposition it appears almost twice as large.

In Table V are entered the names of all the canals that reached visibility 6 in 1914 and 1918, and all those that reached 5 and 6 in 1916. Since there were but three observers included in 1914, each one counts as two in reckoning the visibility. Of the canals recorded, there were 21 in 1914, 22 in 1916, and 25 in 1918. In a few cases the former identifications have been slightly changed, in order to make the results more strictly comparable for the three years. A number of changes

of visibility will be noted, however; 14 canals have increased since 1914, 8 have diminished, while 14 were of the same visibility at the first and last apparitions. In the case of Cephissus, it was invisible in

TABLE V.
COMPARISON OF THE CHIEF CANALS SEEN IN 1914, 1916, and 1918.

| Canal | 1914 | 1916 | 1918 | Canal | 1914 | 1916 | 1918 |
|--------------|------|------|------|-------------|------|------|------|
| Astaboras | 0 | 0 | 6 | Hades | 4 | 5 | 6 |
| Boreas | 6 | 1 | 2 | Hyblaeus | 6 | 5 | 6 |
| Boreosyrtris | 6 | 5 | 2 | Indus | 4 | 5 | 5 |
| Brontes | 4 | 6 | 5 | Nectar | 6 | 4 | 5 |
| Callirrhoe | 6 | 1 | 6 | Nepenthes | 6 | 5 | 6 |
| Casius | 6 | 6 | 6 | Nilokeras | 6 | 6 | 6 |
| Cephissus | 0 | 0 | 6 | Nilosyrtris | 6 | 6 | 6 |
| Ceraunius | 6 | 6 | 5 | Nilus | 2 | 3 | 6 |
| Cerberus | 6 | 6 | 6 | Ophir | 6 | 4 | 6 |
| Chaos | 4 | 2 | 6 | Oxus | 2 | 3 | 6 |
| Cyclops | 2 | 6 | 6 | Pandora | 6 | 5 | 4 |
| Daemon | 6 | 3 | 5 | Protonilus | 4 | 6 | 6 |
| Deuteronilus | 6 | 6 | 6 | Sitacus | 4 | 5 | 6 |
| Erebus | 4 | 3 | 6 | Styx | 6 | 6 | 6 |
| Eunostos | 6 | 6 | 6 | Tartarus | 6 | 2 | 1 |
| Euphrates | 4 | 5 | 6 | Thoth | 6 | 6 | 6 |
| Gehon | 4 | 4 | 6 | Tithonius | 6 | 0 | 0 |
| Gigas | 6 | 5 | 6 | Triton | 4 | 5 | 4 |

the two earlier years, simply because it was hidden under the snow cap. Pandora and Tartarus are so far south that they were rather difficult the past year. The majority have probably increased in visibility since 1914, but the most notable cases are Astaboras, Cyclops, Nilus, and Oxus. The most noticeable decreases occurred in Boreas, Boreosyrtris, and Tithonius. In 1914 the place of Cyclops was taken in part by Achelous (L), a canal beside it. Tithonius in that year was probably a survival from the southern inundations. Omitting these, the more striking increases occurred in the vicinity of latitude $+30^\circ$, the more striking decreases along latitude $+45^\circ$. It is to be expected that at the next apparition the drying up of the more northern marshes will be still more pronounced.

THE LAKES OF MARS.

In Table VI is given a list of the various lakes identified this past year upon the planet. Ismenius was the only one seen by all six observers. Solis was seen by five. Ellison's telescope was too small, and probably his seeing too poor, to show an object so near the southern limb. The two smaller telescopes in 1916 also missed it. Only five saw Nuba. A portion of its outline is clearly shown in Figure 22,

but since it did not appear any darker than the large dark region to the west of it, identification was not admitted. Of the remaining

TABLE VI.
LAKES IDENTIFIED IN THE DRAWINGS.

| No. | Lakes | Pl. | Pk. | W. | D. | Mg. | Misc. | Obs. |
|-----|----------------|-----|-----|----|----|-----|-------|------|
| 1 | Acidalius (L) | | | | AB | AB | A | 3 |
| 2 | Aenarium (L) | | | | | A | | 1 |
| 3 | Alcyonia (L) | | | C | | | | 1 |
| 4 | Ammonium | | | | | D | | 1 |
| 5 | Anonum (L) | B | | | | A | | 2 |
| 6 | Arethusa | | A | A | | AF | A | 4 |
| 7 | Arsenius (L) | | D | | | C | | 2 |
| 8 | Ascraeus | | B | | | C | | 2 |
| 9 | Auri (L) | B | | | B | BC | | 3 |
| 10 | Biblis (L) | | | | | C | | 1 |
| 11 | Caloe | AEF | | | | F | F | 3 |
| 12 | Castorius | D | D | | D | | | 3 |
| 13 | Casuentus (L) | | | | | F | | 1 |
| 14 | Charontis | | | DE | D | DE | | 3 |
| 15 | Copais | | | | | F | | 1 |
| 16 | Cyane (L) | | | | | C | | 1 |
| 17 | Cyclopus (L) | | | D | | E | | 2 |
| 18 | Fortunae (L) | | | | | C | | 1 |
| 19 | Gordii (L) | | | | | C | | 1 |
| 20 | Hecates | | | | | D | | 1 |
| 21 | Hesperidum (L) | | | | | E | | 1 |
| 22 | Hyperboreas | A | B | B | AB | AF | | 5 |
| 23 | Ismenius | AF | AF | A | AF | AF | AF | 6 |
| 24 | Juventae | | B | | | | | 1 |
| 25 | Lunae | | | B | | BC | M | 3 |
| 26 | Memphidis (JD) | | | | | F | | 1 |
| 27 | Messies (L) | | | C | B | BC | B | 4 |
| 28 | Moeris | | | | | EF | | 1 |
| 29 | Moreh (L) | D | D | D | | D | | 4 |
| 30 | Morpheus (JD) | E | | | | D | | 2 |
| 31 | Niliacus | AB | | | | AB | | 2 |
| 32 | Nilus (L) | | | | | EF | | 1 |
| 33 | Nuba | EF | | EF | F | EF | F | 5 |
| 34 | Oxia | B | AB | | AB | B | | 4 |
| 35 | Palladius (L) | | | | | A | | 1 |
| 36 | Pambotis | E | | E | | DE | | 3 |
| 37 | Panopis (L) | | | C | | | | 1 |
| 38 | Phoenicis | | | C | | CD | | 2 |
| 39 | Primus (L) | | | | | D | | 1 |
| 40 | Propontis | D | D | D | D | CD | | 5 |
| 41 | Propontis II | D | | | | D | | 2 |
| 42 | Pyrea (L) | | | | | A | | 1 |
| 43 | Rubiginis (L) | | | | | B | | 1 |
| 44 | Semnon (L) | | | | | C | | 1 |
| 45 | Siloe | | | A | | AF | | 2 |
| 46 | Sirbonis | | | | | F | | 1 |
| 47 | Sithonius | E | | | | E | | 2 |
| 48 | Solis | B | BC | B | BC | C | | 5 |
| 49 | Stymphalus | | | | | D | | 1 |
| 50 | Titanis (L) | | | | | E | | 1 |
| 51 | Triton | | | | | E | | 1 |
| 52 | Ulysses (L) | | | | | B | | 1 |

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important lakes Hyperboreas and Propontis were missed by the miscellaneous observers. Tables VII and VIII are arranged precisely like Tables III and IV, and the same remarks apply to them.

Considering now only the four observers in the first group, there were four lakes seen by all of them, namely Hyperboreas, Ismenius, Propontis, and Solis. Four more lakes were seen by three of them, and six additional lakes by two of them, making in all 14 that were confirmed, and fifteen that were seen by only one observer. No observer saw more than six unconfirmed lakes, and Douglass had only one that was not confirmed by one of the others.

TABLE VII.

THE NUMBER OF LAKES RECORDED.

| Vis. | Pl. | Pk. | W. | D. | Mg. | Misc. | Total |
|--------------|-----------|-----------|-----------|-----------|-----------|----------|-----------|
| 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 5 | 4 | 3 | 4 | 4 | 4 | 1 | 4 |
| 4 | 2 | 3 | 3 | 2 | 4 | 2 | 4 |
| 3 | 4 | 1 | 3 | 4 | 6 | 3 | 7 |
| 2 | 5 | 2 | 3 | 0 | 10 | 0 | 10 |
| 1 | 0 | 1 | 2 | 0 | 67 | 0 | 70 |
| Total | 16 | 11 | 16 | 11 | 92 | 7 | 96 |
| Confirmed | 16 | 10 | 14 | 11 | 25 | 7 | 26 |

In Table IX a comparison is made of the lakes visible at the three apparitions. It is arranged exactly like Table V, except that it contains every lake that was seen by as many as two observers at either apparition. The number confirmed in 1914 was 7; in 1916 it was 12, and in 1918 it reached, as we have seen, 26. The Table contains 32 lakes, of which 6 diminished between 1914 and 1918, 22 increased in visibility and 4 remained unchanged. The three which most notably diminished were Ambrosia, Bathys, and Juventae. The first two are located in the extreme south, and could hardly have been seen had they developed this past year. Of the six that conspicuously increased, Hyperboreas

TABLE VIII.

PROPORTION OF THE LAKES VISIBLE TO THE DIFFERENT OBSERVERS.

| Vis. | Pl. | Pk. | W. | D. | Mg. | Misc. | Total |
|--------------|-----------|-----------|-----------|-----------|-----------|----------|-----------|
| 6 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1 |
| 5 | 1.00 | .75 | 1.00 | 1.00 | 1.00 | .25 | 4 |
| 4 | .50 | .75 | .75 | .50 | 1.00 | .50 | 4 |
| 3 | .57 | .14 | .43 | .57 | .86 | .43 | 7 |
| 2 | .50 | .20 | .30 | .00 | 1.00 | .00 | 10 |
| 1 | .00 | .01 | .03 | .00 | .96 | .00 | 70 |
| Total | 16 | 11 | 16 | 11 | 92 | 7 | 96 |

was covered by the snow cap in 1914 and 1916. The others, Arethusa, Castorius, Moreh, Oxia, and Pambotis ranged in latitude from $+60^\circ$ for Arethusa, to the equator for Pambotis, and they clearly increased

TABLE IX.

COMPARISON OF THE CHIEF LAKES SEEN IN 1914, 1916, AND 1918.

| Lake | 1914 | 1916 | 1918 | Lake | 1914 | 1916 | 1918 |
|---------------|------|------|------|---------------|------|------|------|
| Acidalius (L) | 2 | 1 | 3 | Lunae | | 5 | 3 |
| Ambrosia (L) | 4 | | | Messeis (L) | 2 | 3 | 4 |
| Anonum (L) | 2 | | 2 | Moreh (L) | 2 | | 4 |
| Arethusa | | 1 | 4 | Morpheos (JD) | | 1 | 2 |
| Arsenius (L) | | | 2 | Niliacus | 2 | 4 | 2 |
| Ascraeus | | 1 | 2 | Nuba | 4 | 4 | 5 |
| Auri (L) | 4 | | 3 | Orontes (JD) | | 2 | |
| Bathys (L) | 4 | | | Oxia | | 1 | 4 |
| Caloe | 2 | 3 | 3 | Pambotis | | 1 | 3 |
| Castorius | | 1 | 3 | Phoenicis | | 1 | 2 |
| Charontis | 4 | 4 | 3 | Propontis | 2 | 1 | 5 |
| Cyclopum (L) | | 1 | 2 | Propontis II | | 1 | 2 |
| Hecates | | 2 | 1 | Siloe | | 2 | 2 |
| Hyperboreas | | | 5 | Sithonius | | | 2 |
| Ismenius | 2 | 5 | 6 | Solis | 6 | 4 | 5 |
| Juventae | 4 | | 1 | Triviae (L) | | 2 | |

in visibility on account of the general precipitation. Probably at the next apparition the more southerly ones will have begun to diminish again. On the whole their development seems to follow, rather than precede that of the canals, so that still more may be expected to be visible in 1920.

TABLE X.

THE DOUBLE CANALS.

| Canal | W. | D. | Mg. | Canal | W. | D. | Mg. |
|--------------|----|----|-----|-------------|----|----|-----|
| Acheron | C | | | Gehon | | | A |
| Aesacus | E | | | Gigas | | | C |
| Alander | C | | | Hiddekel | | | A |
| Astaboras | | 1 | | Iris | C | | |
| Boreas | | | D | Jamuna | | | AB |
| Casius | F | | | Jordanis | | | A |
| Ceraunius | C | | | Nilosyrtris | F | | |
| Cerberus | E | | DE | Phison | | 1 | A |
| Cydnus | | | A | Phlegethon | C | | |
| Daemon | C | | | Protonilus | 1 | | |
| Deuteronilus | 1 | | | Pyramus | | | E |
| Draco | C | | | Sitacus | | | F |
| Erebus | | | D | Styx | E | | |
| Euphrates | 1 | 1 | | Thoth I | F | | |
| Eurotas | | | C | Thoth II | | | F |
| Fortuna | | | C | Ulysses | | | C |
| Ganges | | | B | Uranius | | | C |

THE DOUBLE CANALS.

In the first column of Table X are given the names of all the canals that were recorded as double at the past apparition, 34 in all. The three following columns indicate the corresponding drawings for each of the three observers who were successful in seeing them. The "1" indicates that the duplication is not shown in any of the drawings, but was described in a letter to the writer.

By consulting the map we shall see that the duplications lie in all azimuths, and occur in canals of all degrees of visibility. Wilson saw 16 duplications in 60 canals, or 27 per cent. Douglass saw 3 duplications in 62 canals, or 5 per cent, Maggini saw 18 duplications in 108 canals, or 17 per cent. The late Dr. Lowell used to claim that about 25 per cent of the canals could be doubled by a good observer (Lowell Bulletin No. 15).

Wilson and Maggini, the two most successful observers, recorded 49 canals in common. Of these Wilson succeeded in doubling 11, and Maggini 9. If the phenomenon observed was a real characteristic of these canals, we should expect that 4 or 5 of them at least would be seen double by both observers. In point of fact they only agree upon one canal, Cerberus, and that was one of the least obvious of Wilson's 11. The remaining 18 canals are considered to be double by one observer, and single by the other. Now suppose that we put the names of these 49 canals in each of two separate bags, and give them to the observers. Let Wilson be allowed to draw 11 names from his bag, and Maggini 9 from his. It would then be an even chance that they would have drawn the names of as many as two canals in common. On the planet they only secured one, or less even than chance should have given them. Douglass agreed with Wilson that Euphrates was double, he agreed with Maggini on the duplication of Phison, he found Astaboras double, which neither of the others admitted, but he detected no evidence whatever of duplication in the case of Cerberus.

It would appear that these three observers have made a very valuable contribution to our knowledge of the double canals. The writer did not look for the duplication himself this past year, because he was convinced that it was merely a subjective phenomenon, dependent in the case of the distinct canals on contrast with a bright background, and in the others on varying refraction due to wave motion in our own atmosphere, quite similar to that which produced the well known shadow bands at the time of a total solar eclipse. For experimental evidence on this last matter, see *Harvard Annals* 18 95-98. Dr. Lowell was a very successful observer of the phenomenon, and since he found the sharply curved Nepenthes double among other canals, it is quite

possible that some of the many fine lines that he detected in Saturn's rings, and which have not been seen by other observers, nor found when Saturn recently transited a star, may have been due to this same cause.

The phenomenon has more of physiological than of astronomical interest, but it should be well seen at this next apparition, and for those wishing to observe it, we cannot perhaps do better than quote two paragraphs from a letter lately received from Mr. Wilson. "The more widely separated double canals I have held steadily under good seeing, (8 and 9 on the standard scale). However, the Euphrates, as I think I have identified it, appears double on the drawings made when the best seeing prevailed (9 and 10). I caught it only in about one or two glimpses a minute." "The phenomenon of the more fine doubles lasts but an instant as double, and I am not sure that some illusion is not prevalent, at least as far as my vision is concerned. The Protonilus Deuteronilus was always seen double during my 1918 observations, when the seeing was as good as 8, though in spots there seemed to be an intermediate shading." These paragraphs may be compared with the writer's description of the doubling of Thoth Nepenthes in 1914, and of Protonilus Deuteronilus as he saw it in 1916 (Reports No. 5 and 16).

Mandeville, Jamaica, B. W. I.

Nov. 8, 1918.

THE MILKY WAY.

(*Bertha Ten Eyck James, our youngest contrib.*)

When the stars like jewels were cut and set
 In the arch of chameleon sky,
 Up from the floods of sunrise
 A lady came wandering by.

She dipped her fingers in star dust,
 They were rosy with the day,
 And trailed them across the heavens:
 Men called it the Milky Way.

From the "Linotype Column" Chicago Tribune.