Memoirs

OF THE

British Astronomical Association.

VOL. VI. PART III.

REPORT OF THE SECTION

FOR THE OBSERVATION OF

MARS.

Director—E. M. Antoniadi.

LONDON:
PRINTED AND PUBLISHED FOR THE ASSOCIATION,
BY EYRE AND SPOTTISWOODE,
HER MAJESTY'S PRINTERS.

Price to Members Two Shillings. *Non-Members Three Shillings.*

PUBLISHED FEBRUARY 21, 1898.

Members of the Association receive one copy of this Report, post free, and if they require extra copies, can obtain them from the Assistant Secretary, Mr. T. F. Maunder, 26, Martin's Lane, Cannon Street, E.C., at Two Shillings each. The price to Non-Members is Three Shillings. Postage, One Penny.

Five Volumes of the Memoirs of the Association are now complete.

The prices of the different Reports published hitherto are as follows:—

	Extra Copies to Members.				Non-Members.			
			Post Free.				Post Free.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Vol. I.—Part I.—Lunar Section, 1891	0	6	0	6½	0	9	0	9½
II.—Meteoric Section, 1891	0	6	0	6½	0	9	0	9½
III.—Star Colour Section, 1891	0	6	0	6½	0	9	0	9½
IV.—Variable Star Section, 1891	0	6	0	6½	0	9	0	9½
V.—Jupiter Section, 1891	1	0	1	1	1	6	1	7
VI.—Solar Section, 1891	1	0	1	1	1	6	1	7
Vol. II.—Part I.—Saturn Section, 1892	1	0	1	1	1	6	1	7
II.—Lunar Section, 1892	1	0	1	1	1	6	1	7
III.—Solar Section, 1892	1	0	1	1	1	6	1	7
IV.—Star Colour Section, 1892	0	6	0	6½	0	9	0	9½
V.—Jupiter Section, 1892	1	0	1	1	1	6	1	7
VI.—Mars Section, 1892	1	0	1	1	1	6	1	7
Vol. III.—Part I.—Meteoric Section, 1893	0	6	0	6½	0	9	0	9½
II.—Variable Star Section, 1892–3	0	6	0	6½	0	9	0	9½
III.—Solar Section, 1893	1	0	1	1	1	6	1	7
IV.—Jupiter Section, 1893	1	0	1	1	1	6	1	7
V.—Lunar Section, 1893–5	1	0	1	1	1	6	1	7
Vol. IV.—Part I.—Meteoric Section, 1894	0	6	0	6½	0	9	0	9½
II.—Jupiter Section, 1894–5	1	0	1	1	1	6	1	7
III.—Solar Section, 1894	1	0	1	1	1	6	1	7
IV.—Mars Section, 1894	1	0	1	1	1	6	1	7
Vol. V.—Part I.—Meteoric Section, 1895	0	6	0	6½	0	9	0	9½
II.—Variable Star Section, 1894–6	0	6	0	6½	0	9	0	9½
III.—Jupiter Section, 1895	1	0	1	1	1	6	1	7
IV.—Solar Section, 1895	1	0	1	1	1	6	1	7
Vol. VI.—Part I.—Eclipse Expedition, 1896	1	0	1	1	1	6	1	7
II.—Meteoric Section, 1896	0	6	0	6½	0	9	0	9½
III.—Mars Section, 1896–7	2	0	2	1	3	0	3	1

JOURNALS.

Seven Volumes of the Journal of the Association are now complete:—

		Extra Copies to Members.				Non-Members.			
				Post Free.				Post Free.	
		s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Vol. I.—Session 1890–91.	The set (unbound)	10	0	10	6	15	0	15	6
Vol. II.—Session 1891–92.	,, ,,	10	0	10	6	15	0	15	6
Vol. III.—Session 1892–93.	,, ,,	10	0	10	6	15	0	15	6
Vol. IV.—Session 1893–94.	,, ,,	10	0	10	6	15	0	15	6
Vol. V.—Session 1894–95.	,, ,,	10	0	10	6	15	0	15	6
Vol. VI.—Session 1895–96.	,, ,,	10	0	10	6	15	0	15	6
Vol. VII.—Session 1896–97.	,, ,,	10	0	10	6	15	0	15	6

SECTION FOR THE OBSERVATION

OF

MARS.

DIRECTOR.—E. M. ANTONIADI.

REPORT OF THE SECTION, 1896.

PART I.

PROLEGOMENA.

1. The Apparition of 1896–1897.

Like that of 1894, this opposition of Mars was, on the whole, a very favourable one. It is true that the planet, which in 1892, approached the earth at the distance of 0·377, and in 1894 at 0·431, was at the distance 0·561 (52,041,000 miles), on December 4, 1896. But the great northern declination, and consequent high altitude to European astronomers, of Mars at opposition more than compensated for the reduced disk, which, even at maximum, scarcely attained 17″·12.

The planet passed in perihelion on 1896, June 12. The summer solstice of its southern hemisphere took place on July 10, and the vernal equinox of its northern hemisphere on December 25. The opposition (December 10), having occurred in heliocentric longitude 79° 45′, the latitude of the centre of the disk was negative in December, and Mars showed us slightly his south pole during the best part of the apparition. The combination, however, of the movements of the earth and Mars in their orbits gave rise to more than one change of sign in the latitude of the centre of the disk, which, starting on 1896, June 1, at — 24°, became positive by September 24, to attain its greatest positive value + 2°·8 on October 27. By November 24, the sign of the latitude was again negative, reaching its second maximum negative value — 7°·3 on 1897, January 15. But from March 14 to the end of the apparition the latitude was again positive. Thus the earth passed in 1896–1897, no less than three times through the plane of the Martian equator.

---

1 p. 6002.

2. The Work of the Section.

This is of a very high order, and constitutes a marked progress in our knowledge of the planet. Excepting Prof. Schiaparelli's wonderful powers, we might say that no single observer's efforts could ever attain the standard of truthfulness and accuracy arrived at by the aggregate result of the British Astronomical Association's band of Martian observers.

The weather in Europe, as we shall presently see, was anything but satisfactory during the autumn of 1896, and it is gratifying to find that so large a number of drawings have been sent in under such untoward circumstances.

The following are the names of the Members having joined the Section in 1896–1897.

Observer.	Locality.	Aperture of Instrument in Inches.	Drawings.
ANTONIADI, E. M.	Juvisy, *France*	$9\frac{3}{4}$ O.G. $6\frac{1}{2}$ Spec.	53
CLARK, J. E., B.A., B.Sc.	York	$4\frac{1}{2}$ O.G.	—
DAVIS, G. T.	Reading	$3\frac{3}{4}$ O.G.	[21] 14
DOBIE, HERBERT, M.D.	Chester	$10\frac{1}{4}$ Spec.	—
GALE, W. F., F.R.A.S.	Sydney, *New South Wales.*	5 O.G. 6·1 O.G.	3
GRIFFITHS, H. F.	Streatham, Surrey	$6\frac{1}{2}$ Spec.	[9] 4
HALL, W. J.	Nantwich, Cheshire	$4\frac{7}{8}$ Spec.	6
KEMPTHORNE, Rev. P. H., M.A., F.R.A.S.	Wellington College, Berkshire.	$12\frac{1}{2}$ Spec.	7
MAW, W. H., F.R.A.S.	Kensington, London Outwood, Surrey	6 O.G. 8 O.G.	[6] 5
MEARES, J. W., F.R.A.S.	Calcutta, *India*	$9\frac{1}{4}$ Spec.	15
MEE, ARTHUR, F.R.A.S.	Cardiff, Wales	$8\frac{1}{2}$ Spec.	[6] 2
MOLESWORTH, P. B., Capt. R.E.	Tricomali, *Ceylon*	$9\frac{1}{4}$ Spec.	[6] *4
MOREUX, ABBÉ TH.	Bourges, Juvisy } *France*	$4\frac{1}{4}$ O.G. $9\frac{3}{4}$ O.G.	[2] 1
OFFORD, J. M., F.R.M.S.	Ealing	$12\frac{1}{2}$ Spec.	8
PHILLIPS, Rev. TH. E. R.	Yeovil, Somerset	$9\frac{1}{2}$ Spec.	[32] 18
RHEDEN, J.	Trient, *Tyrol, Austria.*	5 O.G.	2
ROBERTS, C., F.R.A.S.	Aberdeen	$6\frac{1}{2}$ Spec.	[37] 21
TOWNSHEND, H. J.	Leeds	$9\frac{1}{2}$ Spec.	1
WILLIAMS, A. STANLEY, F.R.A.S.	Brighton	$6\frac{1}{2}$ Spec.	1

* Capt. Molesworth was enabled to take 174 drawings during the apparition. Six of these have been sent to the Association, while the whole set of admirable delineations was forwarded to the Director for inspection, and a summary of the notes accompanying them has been utilised in the present Report.

The original number of drawings to hand was 215. But as 50 of these were destroyed by fire at the Bourges Seminary, the

residence of Abbé Moreux, to whom the drawings were circulated, the final number was reduced to 165. The figures in brackets in the last column of the table give the original number of drawings forwarded to the Section by the respective Members.

A complete list of the drawings received is given in the following Table :—

ω and φ stand for the longitude and the latitude of the centre of the disk respectively, as always hereafter.

No.	Observer.	Date.	ω.	φ.
			°	°
1	Antoniadi	Jan. 5, 1897	0	− 7·0
2	Maw	Feb. 7, „	2	− 5·8
3	Meares	Dec. 21, 1896	5	− 5·2
4	*Maw*, Pl. 2, fig. 1	Jan. 1, 1897	22	− 6·7
5	Offord	Jan. 3, „	23	− 6·9
6	Phillips	Feb. 3, „	26	− 6·3
7	Phillips	Mar. 15, „	27	+ 0·3
8	Kempthorne	Jan. 3, „	30	− 6·9
9	Phillips	Feb. 9, „	31	− 5·6
10	Antoniadi	June 30, 1896	34	−19·3
11	Meares	Dec. 21, „	40	− 5·2
12	Antoniadi	Nov. 25, „	48	− 0·1
13	Antoniadi	June 27, „	49	−19·9
14	Kempthorne	Nov. 20, „	51	+ 0·8
15	Meares	Dec. 18, „	52	− 4·7
16	Antoniadi	Dec. 27, „	56	− 6·1
17	*Antoniadi*, Pl. 2, fig. 2	Jan. 31, 1897	62	− 6·6
18	Phillips	Feb. 3, „	62	− 6·3
19	Meares	Dec. 18, 1896	70	− 4·7
20	Meares	Dec. 15, „	81	− 4·2
21	Phillips	Jan. 27, 1897	83	− 6·9
22	Antoniadi	Jan. 31, „	83	− 6·6
23	Kempthorne	Oct. 8, 1896	90	+ 1·7
24	*Meares*, Pl. 2, fig. 3	Dec. 18, „	95	− 4·7
25	Antoniadi	June 23, „	96	−20·7
26	Antoniadi	Jan. 26, 1897	101	− 6·9
27	*Roberts*, Pl. 2, fig. 4	Nov. 13, 1896	103	+ 1·7
28	Antoniadi	May 17, „	115	−25±
29	Meares	Dec. 12, „	116	− 3·6
30	Antoniadi	Dec. 15, „	120	− 4·2
31	Antoniadi	Jan. 26, 1897	123	− 6·9
32	*Meares*, Pl. 2, fig. 5	Dec. 9, 1896	130	− 2·9
33	Antoniadi	Oct. 13, „	134	+ 2·2
34	Antoniadi	Nov. 7, „	147	+ 2·3
35	Antoniadi	Oct. 2, „	149	+ 1·1
36	Hall	Dec. 14, „	152	− 4·0
37	Antoniadi	Jan. 26, 1897	152	− 6·9
38	*Phillips*, Pl. 2, fig. 6	Jan. 27, „	156	− 6·9
39	Antoniadi	Nov. 10, 1896	158	+ 2·1
40	Meares	Dec. 8, „	160	− 2·7
41	Antoniadi	Oct. 2, „	164	+ 1·1
42	*A. S. Williams*, Pl. 3, fig. 7.	Aug. 29, „	167	− 5·3
43	Kempthorne	Nov. 9, „	167	+ 2·1
44	Antoniadi	Sept. 30, „	168	+ 0·8
45	Offord	Dec. 15, „	169	− 4·1
46	Antoniadi	Nov. 10, „	173	+ 2·1
47	Antoniadi	Jan. 22, 1897	178	− 7·2

No.	Observer.	Date.	ω	ϕ
			°	°
48	Phillips	Feb. 28, 1897	178	− 2·7
49	Antoniadi	Dec. 10, 1896	180	− 3·2
50	Davis	Nov. 4, „	183	+ 2·5
51	Davis	Dec. 12 „	186	− 3·6
52	Antoniadi	Nov. 10, „	188	+ 2·0
53	Mee	Dec. 15, „	188	− 4·1
54	Roberts	Oct. 6, „	190	+ 1·6
55	Roberts	Nov. 4, „	190	+ 2·5
56	Molesworth	Jan. 9, 1897	192	− 7·2
57	Meares	Dec. 3, 1896	196	− 1·7
58	Davis	Nov. 2, „	196	+ 2·6
59	Hall	Dec. 14, „	198	− 4·0
60	Kempthorne	Dec. 11, „	199	− 3·4
61	Antoniadi	Dec. 10, „	202	− 3·2
62	Roberts	Oct. 5, „	203	+ 1·4
63	*Griffiths*, Pl. 3, fig. 8	Dec. 11, „	203	− 3·3
64	Antoniadi	July 19, „	205	−15·0
65	Roberts	Nov. 7, „	205	+ 2·1
66	Roberts	Aug. 25, „	207	− 6·2
67	Davis	Dec. 11, „	207	− 3·3
68	Offord	Dec. 12, „	207	− 3·6
69	Antoniadi	June 12, „	215	−22·5
70	Davis	Oct. 31, „	215	+ 2·7
71	Roberts	July 18, „	217	−15·3
72	Maw	Jan. 17, 1897	217	− 7·3
73	Antoniadi	Dec. 10, 1896	219	− 3·2
74	Meares	Nov. 30, „	220	− 1·1
75	Roberts	Oct. 2, „	221	+ 1·0
76	Phillips	Dec. 11, „	221	− 3·4
77	Hall	Dec. 11, „	223	− 3·4
78	Roberts	Aug. 24, „	230	− 6·2
79	Maw	Jan. 15, 1897	231	− 7·3
80	Rheden	Dec. 8, 1896	232	− 2·7
81	*Offord*, Pl. 3, fig. 9	Dec. 11 „	233	− 3·4
82	Phillips	Feb. 22, 1897	233	− 3·7
83	Roberts	Nov. 7, 1896	235	+ 2·1
84	Griffiths	Dec. 7, „	239	− 2·4
85	Antoniadi	Nov. 4, „	240	+ 2·5
86	Davis	Feb. 22, 1897	240	− 3·7
87	Antoniadi	Jan. 8, „	241	− 7·1
88	Davis	Oct. 29, 1896	243	+ 2·8
89	Offord	Dec. 12, „	243	− 3·7
90	Phillips	Dec. 11, „	244	− 3·4
91	Davis	Oct. 28, „	246	+ 2·8
92	*Gale*, Pl. 3, fig. 10	Dec. 31, „	246	− 6·5
93	Offord	Dec. 11, „	247	− 3·4
94	Phillips	Feb. 17, 1897	247	− 4·5
95	Offord	Dec. 7, 1896	250	− 2·6
96	Kempthorne	Jan. 17, 1897	250	− 7·3
97	Antoniadi	Dec. 7, 1896	252	− 2·5
98	Antoniadi	Sept. 28, „	253	+ 0·5
99	Meares	Nov. 29, „	257	− 0·9
100	Roberts	July 12, „	258	−16·8
101	Roberts	Oct. 31, „	259	+ 2·7
102	Antoniadi	Oct. 30, „	260	+ 2·7
103	Davis	Oct. 26, „	262	+ 2·8
104	Antoniadi	Dec. 7, „	262	− 2·5
105	Phillips	Feb. 17, 1897	265	− 4·5
106	Antoniadi	Jan. 8, „	266	− 7·1
107	Antoniadi	Sept. 28, 1896	267	+ 0·5

No.	Observer.	Date.	ω	φ
			°	°
108	*Hall*, Pl. 3, fig. 11 -	Dec. 5, 1896 -	267	— 2·1
109	Antoniadi - -	Oct. 29, „ -	269	+ 2·7
110	Phillips - -	Jan. 15, 1897 -	269	— 7·3
111	Roberts - -	Oct. 27, 1896 -	270	+ 2·8
112	Phillips - -	Feb. 14, 1897 -	271	— 5·0
113	Antoniadi - -	July 12, 1896 -	272	—16·7
114	Roberts - -	Sept. 27, „ -	272	+ 0·4
115	Antoniadi - -	Oct. 30, „ -	275	+ 2·7
116	*Moreux*, Pl. 3, fig. 12	Oct. 30, „ -	275	+ 2·7
117	Antoniadi - -	Dec. 7, „ -	277	— 2·5
118	Antoniadi - -	Sept. 26, „ -	279	+ 0·2
119	Antoniadi - -	Sept. 26, „ -	279	+ 0·2
120	Molesworth -	Nov. 28, „ -	279	— 0·7
121	Griffiths - -	Feb. 16, 1897 -	279	— 4·7
122	Roberts - -	July 11, 1896 -	281	—17·0
123	Antoniadi - -	Sept. 17, „ -	284	— 1·3
124	*Mee*, Pl. 4, fig. 13 -	Dec. 3, „ -	285	— 1·7
125	Antoniadi - -	Dec. 8, „ -	285	— 2·8
126	Antoniadi - -	Dec. 8, „ -	285	— 2·8
127	Roberts - -	Oct. 31, „ -	286	+ 2·7
128	Phillips - -	Feb. 21, 1897 -	286	— 3·8
129	Gale - -	Dec. 24, 1896 -	288	— 5·7
130	Roberts - -	July 11, „ -	289	—17·0
131	Davis - -	Nov. 30, „ -	290	— 1·1
132	Phillips - -	Dec. 3, „ -	290	— 1·7
133	Antoniadi - -	July 10, „ -	292	—17·0
134	Offord - -	Nov. 30, „ -	296	— 1·1
135	Roberts - -	Aug. 16, „ -	297	— 8·2
136	Antoniadi - -	Sept. 17, „ -	298	— 1·3
137	*Davis*, Pl. 4, fig. 14 -	Oct. 22, „ -	301	+ 2·7
138	*Rheden*, Pl. 4, fig. 15	Dec. 2, „ -	302	— 1·5
139	Davis - -	Feb. 17, 1897 -	304	— 4·5
140	Gale - -	Dec. 26, 1896 -	306	— 6·0
141	Meares - -	Dec. 27, „ -	309	— 6·1
142	Davis - -	Oct. 21, „ -	310	+ 2·7
143	Maw - -	Nov. 29, „ -	310	— 0·9
144	Antoniadi - -	Jan. 5, 1897 -	310	— 7·0
145	Antoniadi - -	Oct. 23, 1896 -	312	+ 2·7
146	Griffiths -	Nov. 29, „ -	318	— 0·9
147	Hall - -	Nov. 29, „ -	318	— 0·9
148	Roberts - -	Sept. 22, „ -	319	— 0·4
149	Molesworth - -	Dec. 24, „ -	320	— 5·7
150	*Townshend*, Pl. 4, fig. 16	Nov. 30, „ -	322	— 1·1
151	Davis - -	Oct. 20, „ -	324	+ 2·6
152	Antoniadi - -	Oct. 23, „ -	327	+ 2·7
153	Phillips - -	Nov. 29, „ -	327	— 0·8
154	Hall - -	Nov. 29, „ -	330	— 0·8
155	Meares - -	Dec. 24, „ -	333	— 5·7
156	Roberts - -	July 5, „ -	335	—18·2
157	Antoniadi - -	Nov. 30, „ -	335	— 1·1
158	*Kempthorne*, Pl. 4, fig. 17	Nov. 29, „ -	338	— 0·9
159	Antoniadi - -	Jan. 5, 1897 -	339	— 7·0
160	Antoniadi - -	Oct. 23, 1896 -	342	+ 2·7
161	Phillips - -	Nov. 29, „ -	342	— 0·8
162	*Molesworth*, Pl. 4, fig. 18	Dec. 23, „ -	345	— 5·6
163	Roberts - -	Sept. 19, „ -	347	— 0·8
164	Antoniadi - -	Nov. 28, „ -	349	— 0·8
165	Meares - -	Dec. 28, „ -	349	— 6·3

The Section may be congratulated in having among its Members such past masters in the art of detecting and accurately delineating the details of the Martian surface as Capt. Molesworth and the Rev. T. E. R. Phillips. The areographic work of the former, based on 174 beautifully executed drawings, constitutes one of the best studies of the planet ever undertaken, and what is to be regretted is that our limited space does not allow us to do full justice to it here. We can only hope to see some day Capt. Molesworth himself embodying the results of his admirable investigation in a separate volume. Meantime the Rev. T. E. R. Phillips has taken the utmost possible advantage of the slightest break in the overcast skies of the British Isles, and the excellence of his work, made under such untoward circumstances, gives us an idea of what he could do in more favourable climes. The Section is further indebted to Mr. Meares for his truthfully refreshing pictures of Mars, and to the Rev. P. H. Kempthorne for his very accurate designs. Messrs. Maw, Mee, Moreux, Griffiths, Offord, Rheden, and Townshend also supplied valuable notes and drawings, while the modest apertures of Messrs. Davis and Hall did excellent work on the ruddy planet. On the other hand, it is to be regretted that we had not the full collaboration of that distinguished astronomer, Mr. A. Stanley Williams, and that the low northern altitude of Mars in the southern hemisphere did not allow our valued colleague, Mr. Walter F. Gale, to study the planet as he would like to have done.

Before concluding this short sketch of the work of the Section in 1896–97, the Director would like to express his sense of deep gratitude to Prof. G. V. Schiaparelli for his invaluable suggestions, criticisms, and descriptions of the most intricate phenomena presented by the planet; also to Mr. Percival Lowell for an account of his work in 1896, so kindly given. Short extracts from Mr. Lowell's letters accompany, in foot notes, the text of the observations for the benefit of the Section.

---

3. The Weather.

In Europe was, as a rule, very cloudy. Writing on January 14, Rev. T. E. R. Phillips says: "I have had a most disappointing "time, worse than I can ever remember, and it was in the vain "hope that the sky would clear that I delayed sending you my "drawings till now. Night after night, week after week, we "have had continuous, almost unbroken, sheets of cloud. So "utterly wretched has the weather been that a drawing of Mars "could only be made on *one* night out of the last *twenty-eight*, "though I have been on the look out on every possible "occasion."

Mr. Mee also found "the weather at Cardiff very unpro-"pitious."

Mr. Griffiths, however, remarks, that at Streatham "the "weather has not been very unfavourable. Most clear nights "gave good definition. The night of November 29 was superb "and without a tremor."

At Bourges, as at Juvisy, overcast skies prevailed, and there were certainly not seven cloudless nights a month, as a mean.

Most of these gave bad definition, and very often it was hopeless to attempt a sketch.

We have the same distressing meteorological record from Australia.

Fortunately for the Section, however, matters were different in India and Ceylon. Writing from Calcutta, Mr. Meares says: "Definition always good, so it was merely a question of different "degrees of fine definition and the planet's altitude."

A curious effect of passing clouds on definition was repeatedly observed at Trincomali, by Capt. Molesworth: "As the cloud "approaches within 15° or 20° of the planet, the latter, even on "a night of excellent definition begins to blur and 'boil' as "though the cloud was encircled with a dense layer of hot air "currents. This boiling comes on quite suddenly, and the "approach of a cloud can be at once foretold without taking "the eye from the eye-piece. During the actual passage of the "cloud, the image, when visible, is fairly steady, but the 'boiling' "is again noticed after the cloud has passed the planet, the "definition becoming sharp with great suddenness when the "planet is about 15° clear."

---

4. The Telescope.

The past apparition of Mars gave us some striking examples of the wonderful efficiency of the "Calver reflector" in the detection of delicate planetary details. The aperture that performed, as a whole, best, was the 9¼-in. The 10¼-in. and 12-in. were less fortunate, and so were apertures below 9 inches.

These facts should be borne in mind by planetary observers.

---

5. The Colours of the Disk.

The "continents" are described as "a very pale orange, and "very much that of a gas flame," by Griffiths.

The same observer gives a decided bluish tinge to the "seas." On January 15, Rev. Phillips wrote:—"The seas seemed of a "more decided bluish green than I have seen them before." And later:—"The colours [of the seas] have generally appeared "of a bluish green. *Syrtis Major* on February 16 was of a dark "'verdigris.' Its tone was decidedly deeper than in November." The Director finds the Martian seas of a steel grey colour invariably. Occasionally, the band round the N. polar cap assumed a bluish tinge. But this was never quite certain.*

The bright borders of some *Maria* have no objective existence. They are mere contrast phenomena, which one can perfectly reproduce on paper.

The colouring of the 18 drawings at the end of this Report was copied from Mr. Walter J. Hall's beautiful sketches.

---

* Mr. Lowell gives a beautiful sky blue colour to the seas when observing the planet in daylight. It will be remembered that Secchi singularly enough saw them almost black by day.

6. On the Observation of the Details of the Martian Surface.

A good 4-in. O.G. will give an exact idea of the Martian topography. But in order to hope for a view of the intricate canal system, an aperture of at least 6 inches is necessary. Here, however, the experience of observers varies, and what is "an obvious feature" to one observer in an unpretending 6½-in. reflector is invisible to another in the monster 36-in. Lick refractor. Everybody sees in his own way.

"My experience," says the Rev. T. E. R. Phillips, "of Martian "observations this winter (the first time I have ever used anything "more than my 3-in. refractor on this planet) has led me to "believe that Mars is not nearly so difficult an object as is "commonly supposed, and that many of the canals are easy, "quite as easy as the wisps often seen crossing the equatorial "zone of Jupiter. I consider that Mars bears high powers *with* "*advantage*, better, perhaps, than any other of the planets, "certainly better than Jupiter, as the intrinsic brightness of the "disk seems so much greater. I found that *as a general rule* "a power of 260 gave me the most perfect image of Mars, "though *splendid* views might be obtained with over 300 *in* "*good air*. But as regards Jupiter, I find that I can see no "more, or very little more, with these high powers than I can "with 185, which is the eye-piece I usually employ in scrutinising "the Jovian disk."

With a large aperture, the illumination of the field of view is a useful auxiliary, and this was tried with advantage to the definition by Mr. Maw and the Director. Yellow glasses give the same result. The planet is best seen behind light cirri or cirro strati, or even in fog.

---

7. The Canals.

Were seen by *all* the working Members of the Section invariably. Some details of their visibility will surely interest the Members of the Association.

"Generally speaking," says Capt. Molesworth, "the canals "seen during these observations do not present the hard line-like "appearance and angularity with which they are drawn by "Schiaparelli. This is probably due to the use of low powers, "the unsteadiness of my slow motions, and the want of a driving "clock. Some of them, such as *Gehon*, *Ambrosia*, *Læstrygon*, "and *Avernus* were certainly seen at times as well defined narrow "lines. But as a rule the canals appear slightly curved and of "appreciable breadth, the angles being generally rounded and "softened . . . The Maria are generally darker at the embou-"chure of a canal; the canal broadening slightly where it meets "the Mare; the latter curving round slightly to form a sort of "delta at the estuary. When seen double, the two components "appear usually as slightly darker edgings to a faint included "shade, the canal appearing, under any but the best definition, "merely as a shaded band."

Writing on December 12, the Rev. T. E. R. Phillips says: "Unless these so-called canals are of quite recent appearance, I "cannot understand how it is that so few of them were seen and "drawn before Schiaparelli called attention to them in 1877. I "do not think they could well be missed by a good observer, "with a good instrument, in the present day."

"With the planet so small," says Mr. Meares, "it would "hardly be expected that much detail would be visible, but I "was surprised to find that of the few canals seen, none appeared "as a sharp hard line as usually represented."

The Director's experience with M. Flammarion's excellent $9\frac{3}{4}$-in. equatoreal is that the canals are very difficult objects, visible only by rare glimpses, and had it not been for Prof. Schiaparelli's wonderful discoveries, and the fore-knowledge that "the canals are there," he would have missed three-quarters at least of those seen now. The final result would thus scarcely attain the value of Secchi's, Lockyer's, Dawes', or Green's capital drawings.

The Juvisy drawings fully corroborate Capt. Molesworth's and Mr. Meares' statements on the broadish and diffused appearance of the linear markings (which is a corollary of their indistinctness), for out of some 55 of these streaks seen in 1894 and 1896, only the *Læstrygon* was found, during both oppositions, as an exceedingly fine black line. In justice, however, to the unrivalled Milan drawings, it should not be forgotten that the imperfect seeing of a narrow black line gives the appearance of a more or less diffused dusky band.

* * * * * * * *

The total number of canals seen in 1896–97 by the Members of the Section is 106. Of these, 76 belong to Schiaparelli's maps, 12 to Lowell's, while 18 are either "new" or unidentifiable.

In the following three tables will be found the names of all the known canals seen, and the exact positions of the "new" ones. Duplicity is indicated by (*d*).

I. SCHIAPARELLI'S MAPS.

Æsacus.	*Boreas.*	*Galaxias.*
Æthiops.	*Callirrhoe.*	*Ganges* (*d*).
Agathodæmon (*d*).	*Ceraunius.*	*Gehon.*
Alcyonius.	*Cerberus* (*d*).	*Gigas* (*d*).
Alpheus.	*Chrysorrhoas* (*d*).	*Gorgon.*
Ambrosia.	*Cyclops* (*d*).	*Hades.*
Amenthes.	*Dardanus.*	*Herculis Columnæ.*
Antæus.	*Deuteronilus.*	*Hiddekel* (*d*?).
Anubis.	*Eosphoros.*	*Hyblæus.*
Araxes.	*Erebus* (*d*).	*Hydaspes.*
Ascanius.	*Eumenides-Orcus* (*d*).	*Hydraotes.*
Astaboras.	*Eunostos.*	*Iamuna* (*d*?).
Astapus.	*Euphrates* (*d*).	*Iaxartes.*
Astusapes.	*Euripus.*	*Indus* (*d*).
Avernus.	*Fortunæ.*	*Iordanis.*

Iris.	*Pactolus.*	*Sirenius.*
Issedon.	*Peneus.*	*Styx (d).*
Læstrygon.	*Phasis.*	*Tanais (d).*
Lethes.	*Phison (d?).*	*Tartarus.*
Nectar (d).	*Phlegethon.*	*Thoth.*
Nepenthes.	*Plutus.*	*Titan (d).*
Niloheras (d).	*Protonilus (d).*	*Triton.*
Nilus (d).	*Pyriphlegethon.*	*Typhonius (d).*
Orontes (d?).	*Scamander.*	*Uranius.*
Oxus (d).	*Simois.*	*Xanthus.*
		UNNAMED.

II. LOWELL'S MAP.

"*Asopus.*"	"*Dargamanes.*"	"*Hyscus.*"
"*Bætis.*"	"*Elison.*"	"*Neudrus.*"
"*Brontes (d).*"	"*Helisson.*"	"*Thyanis.*"
"*Daradax.*"	"*Hypsas.*"	"29 *Niloheras.*"

III. "NEW" OR UNIDENTIFIABLE CANALS.

Reference Letter.	Extent. From ω	From φ	To ω	To φ	Reference Letter.	Extent. From ω	From φ	To ω	To φ
	°	°	°	°		°	°	°	°
A	35	0	40	−12	**K**	260	+28	283	+28
B	59	− 6	80	+ 7	**L**	265	+40	282	+30
C	95	−29	103	−40	**M**	265	+ 3	273	− 3
D	144	+43	165	+15	**N**	273	− 3	278	+ 8
E	208	+33	214	+ 9	**O**	283	+30	294	+41
F	217	−40	217	−52	**P**	285	+38	289	+44
G	240	+40	243	+28	**Q***	306	− 1	318	−12
H	248	+42	258	+16	**R**	321	− 3	323	−10
I	258	− 3	279	+ 8	**S**	336	− 4	339	−40

* This might be identical with the canal forming *Pharos Insula*, although it does not run in the same direction as Rev. T. E. R. Phillips' and Schiaparelli's lines.

The names of the discoverers of the "new" canals are given further down, in the exposition of the observations. We say "*new*" because the novel character of some of these is open to discussion. In many cases we have to deal with (periodical?) reappearances of lines seen previously.

The following table gives the number of canals seen by the various observers.

Observer.	Canals.			
	Schiap.	Lowell.	"New."	Total.
Capt. Molesworth - -	71	8	15	94
Rev. T. E. R. Phillips -	58	3	2	63
Antoniadi - - -	42	1	3	46
Griffiths - - -	35	1	1	37
Meares - - -	19	0	1	20
Davis - - -	15	0	1	16
Rev. P. H. Kempthorne -	12	0	0	12
Stanley Williams* -	8	0	0	8
Mee - - -	7	0	0	7
Maw - - -	7	0	0	7
Rheden - - -	6	1	0	7
Offord - - -	7	0	0	7
Moreux - - -	5	0	1	6
Hall - - -	4	0	0	4
Townshend - - -	4	0	0	4
Gale† - - -	1	0	1	2

*The observations of Mr. Stanley Williams to hand extend only from August 10 to August 29, 1896. Their accuracy is marvellous, considering the smallness of the disk and the disadvantageous circumstances under which they were conducted.

† It is greatly to be regretted that the low altitude of the planet and the very unfavourable atmospheric conditions at Sydney did not allow this first-rate observer to study Mars in 1896–1897, as at the 1892 apparition.

In this connection should be mentioned the canal work of Mr. C. Roberts, F.R.A.S. Mr. Roberts sent a chart of Mars embodying his results from July to November. Although his observations do not even extend to the opposition, he shows, nevertheless, 134 canals: 64 Schiaparelli's, 34 Lowell's, and 36 "new" or unidentifiable. These are truly astounding results for a 6½-inch altazimuth Herschelian reflector, where the head of the observer further absorbs considerable light. The Director has submitted Mr. Roberts' observations to a thorough examination, by comparing them first with the actual appearance of the planet, then with the Sectional work, and lastly with the existing charts. The result of this comparison would tend to leave the impression that Mr. Roberts has been probably mislead by some sort of illusion, arising from the use of a bad mirror. Under such circumstances it was thought safer to avoid introducing uncertain data in the general excellence of the Section's work, and not overcrowd our already crowded chart with the most dædalian canal network ever devised (Plate II., Fig. 4).

8. The Lakes.

"When a linear marking increases in breadth," says Prof. Schiaparelli, "a dark spot appears on its intersection with another "simple canal. These are the lakes observed by Gale and Lowell. "The spot may be visible even when the transversal canal is not "seen. Such a phenomenon is observable with great ease on the "two bands, always broad, of the *Ceraunius* . . . Occasionally, "a neatly doubled canal gives rise to *two* very small spots by its "intersections with a third simple canal, or to *four* spots by "its intersections with another double . . . In this case the "four dark spots form a parallelogram. It is useless to say that "under such circumstances, the observation is of considerable "difficulty."

The number of small lakes seen in 1896–97 by the Section is very considerable, and amounts to 26. Four of these belong to Schiaparelli's maps, 9 to Lowell's, while 13 are new or unidentifiable.

I. SCHIAPARELLI'S MAPS.

Coloe Palus.	*Lacus Ismenius.*
Dirce Fons.	*Sirbonis Palus.*

II. LOWELL'S LAKES.

"*Ammonium.*"	"*Ferentinæ Lucus.*"	"*Lucus Feronia.*"
"*Aquæ Appollinares.*"	"*Labeatis Lacus.*"	"*Lucus Maricæ.*"
"*Castalia Fons.*"	"*Lucrinus Lacus.*"	"*Utopia.*"

III. NEW LAKES.

Reference Letter.	Approximate Position.		Reference Letter.	Approximate Position.		Reference Letter.	Approximate Position.	
	ω	ϕ		ω	ϕ		ω	ϕ
	°	°		°	°		°	°
a	27	+ 38	*e*	102	− 12	*i*	187	+ 44
b	65	+ 48	*f*	104	− 14	*k*	210	+ 40
c	79	+ 8	*g*	140	− 8	*l*	214	− 59
d	84	− 24	*h*	152	− 9	*m*	296	+ 23

Lake n: $\omega = 314°$ $\phi = +12°$.

The new knots have been all discovered by Capt. Molesworth.

The number of lakes seen by each of the observers is as follows:—

Observer.	Schiaparelli's Maps.	Gale, 1892, and Lowell, 1894.	New Lakes.	Total.
Capt. Molesworth - -	3	8	13	24
Antoniadi - -	3	3	0	6
Rev. T. E. R. Phillips -	2	2	0	4
Griffiths - - -	2	1	0	3
Meares - - -	2	0	0	2

As a rule, the lakes are difficult objects, and require very satisfactory conditions to be seen.

9. The Bright Projections of the Terminator and Limb.

These were somewhat few and indistinct during the last apparition. They were seen by Capt. Molesworth, Rev. T. E. R. Phillips, Messrs. Maw, Griffiths, and Meares.

I.—*Projections on the Terminator.*

(1.) 1896, November 3.—"Apparent projection on S.W. terminator (*i.e.*, as looked at from earth). Either a mountain, or due to irradiation from a brilliant spot" (Phillips).

(2.) November 22.—Mr. Maw sees "a bright projection on terminator," towards $\omega = 305°$, $\phi = +60°$. Also "a bright spot was seen near the S. pole."

(3.) 1897, February 1.—"An intensely white spot appearing to project and distort the terminator. This would be approximately between *Noachis* and *Argyre*. This was, I think, a case of actual, not optical, projection, but the night was not a good one" (Molesworth). Position: $\omega = 25°$, $\phi = -50°$.

(4.) February 7.—Mr. Maw sees a bright projection on the terminator, towards $\omega = 75°$, $\phi = -35°$. This falls somewhere about *Thaumasia*.

II.—*Projections from the Limb.*

These are phenomena altogether without a parallel on the earth. Irradiation must certainly account for a great many of them.

(1.) 1896, November 24.—"An intensely white spot was seen on the limb, appearing to project and to distort the curve of the limb. Distortion probably optical, due to irradiation" (Molesworth). Position (*Baltia*): $\omega = 45°$, $\phi = +60°$.

(2.) 1897, February 4.—"A minute white spot projecting well beyond the limb . . . Another case, I think, of actual, not optical, projection, as the definition was very sharp" (Molesworth). Position (*Thyle II.*): $\omega = 220°$, $\phi = -7°$.

Mr. Griffiths supplies the following observations of a white spot on the limb :—

(3.) "February 16^d 7^h 18^m.—A prominence was seen on the "preceding limb close beneath *Mare Cimmerium* . . . Power "360, through haze, but excellent definition.

"February 17^d 7^h 54^m.—This prominence was again seen . . . "Power 260, air 2.

"February 18^d 8^h 32^m.—On the limb. I have no doubt of its "reality."

Mr. Meares writes that "white spots appeared occasionally to "stand out of the limb."

10. The Condensations of Aqueous Vapour in the Martian Atmosphere.

It is a well-known fact that the atmosphere of Mars is singularly destitute of cloud, as compared to our own. The apparition of 1896–1897, forms no exception to this rule, for the planet was generally seen with its customary, refreshing, serene appearance.

Occasionally, however, one could detect some incontestable cases of cloudy condensations. The observations of the Section establish a further analogy between Mars and the earth, namely, the natural tendency manifested by aqueous vapour to condense, in the form of haze, cloud, or fog, in the frigid zone rather than in the equinoxial regions of the planet. The polar fogs in 1896–1897 are dealt with at length in their respective Sections VII. and VIII. (p. 96 to 99). What we will do here is to give some examples of the *partial* condensations in the equatorial or temperate regions of Mars, from which it will be seen that this part of the planet's atmosphere can yield nothing beyond some vague dimmings in the visibility of the surface details.

Rev. T. E. R. Phillips writes under date January 16 :—

"[Last night], the definition on one part of the disk was very "good. The rest seemed to be somewhat dimmed, I thought by "clouds or mists in the Martian atmosphere . . . Nearly "all the canals round *Elysium* were invisible."

"On December 4," says Capt. Molesworth, " . . . there "appears to have been an extensive cloud formation covering the "region N. of *Trivium Charontis*, and blotting out the canals, "even *Styx*, completely."

Again, "on April 2," says the Captain, "the whole of the "region round *Herculis Columnæ* and *Sirenius* was invisible, "though the *Mare Sirenum* was distinct, probably due to local "cloud formation in the *Aonius Sinus* region."

The occasional invisibility of the canals detected by Schiaparelli could perhaps be explained by these same hazy condensations of aqueous vapour in the torrid zone of the planet.

PART II.

THE OBSERVATIONS.

Introductory.

In dealing with so large a number of drawings, Mr. Maunder's excellent programme of 1892 was followed in arbitrarily dividing the planet's surface into eight sections, of which six, having a mean breadth of 60° of longitude, extend from + 60° to — 60° of latitude, while the remaining two sections deal with the polar regions.

Section.	Breadth.	Limits of		Region.		Drawings.
		ω.	ϕ.	Schiaparelli's Maps.	Green's Map.	
I.	60°	310° to 10°	+60° to −60°	*Sinus Sabæus* -	Dawes' Forked Bay.	27
II.	45	10 „ 55	+60 „ −60	*Auroræ Sinus* -	De la Rue Ocean.	12
III.	65	55 „ 120	+60 „ −60	*Solis Lacus* -	Terby Sea -	15
IV.	60	120 „ 180	+60 „ −60	*Mare Sirenum* -	Maraldi Sea E.	19
V.	70	180 „ 250	+60 „ −60	*Mare Cimmerium*	Maraldi Sea W.	47
VI.	60	250 „ 310	+60 „ −60	*Syrtis Major* -	Kaiser Sea -	45
VII.	360	0 to 360	−60 „ −90	South Polar Region - -		165
VIII.	360	0 „ 360	+60 „ +90	North Polar Region - -		165

In the descriptions which follow, we have adopted Schiaparelli's charming areographical nomenclature. The dark areas have been systematically alluded to as seas, or anything signifying water. The yellow background is alluded to by names conveying the idea of land. As Mr. Maunder says, "the practice "has high sanction, is in general use, and appears decidedly "convenient." But the student should familiarise himself with the denominations of "dark" and "yellow material" for the Martian spots, which, if not enhancing very much his areographic knowledge, is doubtless more scientific, having at least the merit of sparing him the deceptions into which those eager at jumping into conclusions have fallen.

The conjecture of dividing the surface of the planet exclusively into land and water, according to the colour of its markings was a childish one, and must doubtless have been suggested by our school maps of geography, which, although conveying an exact idea of the configuration of our coasts, give the most fallacious views as to what the earth looks like from space. For the supporters of this theory scarcely saw that they thus deprived the planet of vegetation. And since there is water on Mars, the presence of vegetation attains a degree of probability approaching

to certainty. Were the dark areas of the planet to remain fixed or to change in tone partly with the seasons, we could thus reasonably infer the existence of seas and forests, or meadows, on our neighbour. But instability is the characteristic feature of the Martian markings, and the nature of these changes being inexplicable by the phenomena of vegetation, we are naturally driven to be somewhat sceptical on the value of existing theories.

SECTION I.

Sinus Sabæus and Mare Erythræum.

$\omega = 310°$ to $10°$; $\phi = +60°$ to $-60°$.

[The words *East* and *West* are invariably used in their areographic sense.]

HAMMONIS CORNU.—This remarkable promontory is shown with its usual outline by a large majority of the Members of the Section, and the drawings of Maw, Griffiths, Hall, Meares, Kempthorne (Plate IV., Fig. 17), Offord, Rheden (Plate IV., Fig. 15), and Antoniadi mutually confirm each other here. Stanley Williams speaks of it as "visible just clear of the terminator," August 14, 1896, and as "very conspicuous," August 15, with a disk of the planet of only 8″·7. The same marking was seen sharply pointed by Townshend (Plate IV., Fig. 16), but rounded by Davis (Plate IV., Fig. 14) and Gale, owing, perhaps, to imperfect seeing. Molesworth draws the cape (Plate IV., Fig. 18) as gradually merging, through one of Lowell's *pontes*, into a land north of *Hellas*, while Phillips shows it connected rather with *Iapygia*. Both these observers agree, however, in drawing a canal on the mainland, behind the cape, running from *Syrtis Major* to *Sinus Sabæus*, and forming Schiaparelli's *Pharos Insula* (1882).

SINUS SABÆUS AND XISUTHRI REGIO.—This strait was seen as a dark, grey, curved band, not unlike but broader than Mædler's ribbon of 1830. Such is the appearance given to it by Gale, Mee, Davis, Offord, Maw, Griffiths, Hall, Townshend, and Kempthorne (Plate IV., Fig. 17), while Meares and Rheden (Plate IV., Fig. 15) agree in reducing the breadth of the *Sinus* considerably. Under unfavourable conditions, Antoniadi's experience was a similar one, *Xisuthri Regio* becoming visible only with a sharp image. Stanley Williams, however, describes the *Sinus* "as a plain dark streak with *Xisuthrus*," as far back as August 10. *Xisuthri Regio* is very distinctly shown on Phillips drawings, while Molesworth cuts it at right angles to its length by the new canal S. prolonging *Euphrates*.

The bright coast N. of *Sinus Sabæus* is shown by Davis (Plate IV., Fig. 14), Rheden, Townshend (Plate IV., Fig. 16), Kempthorne (Plate IV., Fig. 17), Molesworth (Plate IV., Fig. 18), and Antoniadi. Such appearances are not due to cloud or fog,

or to snow-clad cliffs! being mere contrast phenomena. (*See ante*, p. 61.)

FASTIGIUM ARYN.—*Dawes' Forked Bay* was seen with its usual sombre appearance by most observers, and we might safely conclude that this region underwent no change since the 1894 apparition of the planet. The *Vertex of Aryn* is shown quite distinctly by Phillips and Meares, but shaded by Molesworth and Antoniadi. Such shading is very likely dependent on, or connected with, the gemination of one or the other of the canals ending here.

EDOM PROMONTORIUM.—This was seen very bright by Molesworth (Plate IV., Fig. 18), Kempthorne (Plate IV., Fig. 17), Phillips, and Meares. The latter describes it as "especially "conspicuous near the limb." Molesworth shows the whole of *Edom* whitish as far as *Euphrates* and *Orontes*, and says that "on "one occasion the *Sinus Sabæus* was seen to be notched by a "minute circular island jutting out from *Edom* into the *Sinus*, "S. of the estuary of *Hiddekel*, with apparently a narrow canal "separating it from *Edom*." The accompanying map (Fig. 1)

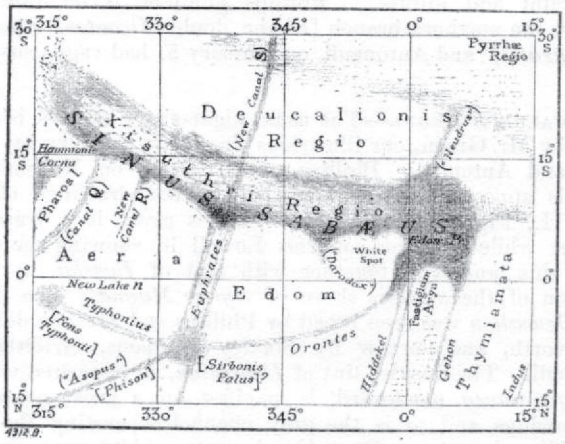


Fig. 1. The *Sinus Sabæus* region of Mars in 1896–97. (Capt. Molesworth.)*

of this region has been extracted from the Ceylon observer's chart of Mars, for the benefit of the Section. A short curved canal was seen limiting the whiteness of *Edom Prom.* on the mainland by Phillips, and the same marking was suspected by Molesworth, but such appearances might be phenomena of contrast, carrying us back to Mr. Maunder's theory (1882) that some of the canals might be due to differences of shade in neighbouring districts.

(*See* p. 74, Lowell's "*Daradax*.")

* In these reproductions of separate regions from our distinguished colleague's chart (Figs. 1, 2, 5, and 11), the names in brackets are additions to Schiaparelli's maps by Capt. Molesworth, while names in parentheses are notes, explanations, or identifications by the Director.

EDEN was found fainter than *Edom*, by Molesworth, but often snow white on limb. Both Molesworth and Antoniadi agree in showing the land between *Hiddekel* and *Gehon* as a "half tone."

AERIA is described as "very red; much the reddest part of "the planet," November 29, by Maw, but "pale yellow near the "central meridian," and "very white" on limb by Molesworth.

CYDONIA.—"There is a brilliant spot partly on the *Acidalium* "*Mare* in lat. 53° N. long. 20°, seen best near the limb," according to Meares, which is certainly the W. end of *Cydonia*, and not the probably illusory *Scheria Insula* of Schiaparelli. It will be remembered that *Cydonia* and *Tempe* were both snow (or fog) covered in 1864 and 1894.

ISMENIUS LACUS is shown as a slight shading, elongated from E. to W., by Molesworth, Griffiths, Meares and Antoniadi.

DIRCE FONS (1884) appears as an oval shading on Griffiths' map, but not in the position given by Schiaparelli.

SIRBONIS PALUS (1879) was seen throughout by Molesworth, but "faint and diffuse." Phillips glimpsed it on January 1, "where the northern branch [of the double *Orontes*] crosses the "*Euphrates*," and Antoniadi, on January 5, had vague suspicions of it.

DEUCALIONIS REGIO.—The usual cigar-shape of this island, as drawn by Mr. Green, our illustrious President, is shown by Molesworth and Antoniadi. Phillips saw it narrow on November 29, and this appearance is corroborated by the drawings of Maw (Plate II., Fig. 1) and Offord. Meares gives it a trapezoidal contour, while Griffiths confirms Lowell in showing the eastern end of this land, cut, together with that of *Pyrrha*, by a continuation of the western shore of *Syrtis Magna*. The channel S. of *Deucalion* was seen broad by Phillips and Meares, diffuse by Molesworth, and narrow by Stanley Williams, Griffiths, and Antoniadi. The duskier tint of *Deucalion*, as compared to *Edom* or *Thymiamata* northward, is manifest on a great majority of the drawings, and so is the grey channel separating the island from *Thymiamata*. *Deucalion* becomes white near the limb. With reference to the changes of this land, Molesworth could not find any evidence of them more than might be easily due to variations in position and definition. On November 18, however, he found *Deucalion* very inconspicuous, "with the exception of a white oval" facing the embouchure of the *Euphrates*. Two canals cross *Deucalion* at right angles to its length on Molesworth's chart (Fig. 1). The more westerly one corresponds to Lowell's "*Neudrus*," while the other, S, an extension of *Euphrates*, across *Sinus Sabæus* and *Xisuthrus*, was discovered by Molesworth. (*See* p. 74 and the preceding Fig. 1.)

YAONIS REGIO is shown vague and diffuse by Molesworth and Antoniadi.

NOACHIS.—On most of the drawings this island is seen as a confused patch of land together with *Argyre* and *Ogygis Regio*.

Phillips and Meares agree in showing its eastern end whitish, and on November 29 Maw found it more strongly marked than *Hellas*. Molesworth, who gives to it a large extension, and a lesser inclination to the equator than is represented on Schiaparelli's maps, saw it separated from *Argyre* by "a dark, well "defined strait." Like *Deucalion*, this land also increases in whiteness near the limb.

On February 1 a bright projection on the terminator was seen by Molesworth between *Noachis* and *Argyre* in $\omega = 25°$, $\phi = 50°$. (*See* p. 67.)

MARE ERYTHRÆUM.—All observers agree in the dusky tinge of this vast expanse of grey material. Molesworth describes it "of a distinct indigo blue, with the faintest tinge of green." The dark band extending from *Hammonis Cornu* to the S. polar cap is thus described by Molesworth: "It follows the trend of "*Hammonis Cornu*, and forms the southern boundary of the rift "extending from the latter towards *Hellas*. . . . Here it joins "the dark circle bounding *Hellas*, and extends upwards towards "the pole."

CANALS OF SECTION I.—(Seventeen in number).

(1.) Schiaparelli's maps:—

Euphrates	-	Seen by Molesworth (*double*), Antoniadi (*double*), Griffiths, Meares, Phillips (very broad), and Stanley Williams [the last observer saw the bay of *Euphrates* distinctly in August 1896].
Gehon	-	,, Maw, Molesworth, Phillips, and Antoniadi.
Hiddekel	-	,, Molesworth ("delicately *double* in December"), Antoniadi (*suspected double*),* Davis, Griffiths, Phillips, Townshend, Stanley Williams.
Iordanis	-	,, Griffiths, Molesworth, Phillips.
Orontes	-	,, Phillips (*suspected double*). ["There was "no doubt about the existence of the two "branches," January 1, Phillips.] Antoniadi (*suspected double*); Kempthorne, Molesworth, Stanley Williams ("dark towards *Sinus Sabæus*," August 14–15).
Oxus	-	,, Molesworth (*double* from *Indus* to *Gehon*); Griffiths, Phillips, Townshend?
Phison	-	,, Phillips (*double*), Townshend (*double*), Antoniadi (*double*); Griffiths, Kempthorne, Meares, Moreux, Stanley Williams.
Protonilus	-	,, Molesworth (*double*, broad and dark); Phillips, *double*; Griffiths, Hall, Kempthorne, Maw ("fairly broad." November 29), Townshend, Antoniadi.
Typhonius	-	,, Phillips (*double*); Antoniadi (*double*); Davis (glimpses); Griffiths, Molesworth.
Unnamed Canal forming Pharos Insula.		,, Phillips and Molesworth?

* The gemination of this canal is somewhat doubtful, for in November and December Prof. Schiaparelli found it "Tout à fait mince et filiforme et plus étroit que le Gehon."

(2.) Lowell's map:—

"*Asopus*" -	Seen by Phillips and Rheden.
"*Daradax*" -	„ Molesworth, Phillips. [The latter suggests that it is just possible that what he took to be a new canal was the N. boundary of the bright spot of *Edom Promontorium*, although it seemed too narrow and too clearly defined for this. *See* p. 71.]
"*Neudrus*" -	„ Molesworth.

(3.) New Canals:—

P	Detected by Phillips (uniting N. branch of *Protonilus* to *Nilosyrtis*) extending from $\omega = 285°$, $\phi = +38°$ to $\omega = 289°$, $\phi = -44°$
Q	„ Molesworth ("4") extending from $\omega = 306°$, $\phi = -1°$ to $\omega = 318°$, $\phi = -12°$.
R	„ Molesworth, extending from $\omega = 321°$, $\phi = -3°$ to $\omega = 323°$, $\phi = -10°$.
S	„ Molesworth ("15") [*Phison* produced over Deucalion], extending from $\omega = 336°$, $\phi = -4°$ to $\omega = 339°$, $\phi = -40°$.
NEW LAKE η -	Discovered by Molesworth ["Fons Typhonii" on the intersection of *Typhonius* with the eastern (invisible) component of Lowell's "*Asopus*," which Molesworth takes for *Phison*]. Position: $\omega = 314°$, $\phi = +12°$.

SECTION II.

Margaritifer Sinus, Auroræ Sinus, and Mare Acidalium.

$\omega = 10°$ to $55°$; $\phi = +60°$ to $-60°$.

MARGARITIFER SINUS.—This is a much paler marking than the sombre neighbouring *Forked Bay of Dawes*. All the Members of the Section agree on this point. The grand anomalous gemination of the *Indus* (*see* p. 77) detected by Molesworth gives to the bay some resemblance to the *Sinus Sabæus* (Fig. 2).

CHRYSE was seen very ruddy S. of *Mare Acidalium* by Maw, November 22.

AURORÆ SINUS.—The coast from the estuary of the *Indus* to that of the *Ganges* showed very nearly Schiaparelli's form in 1896-97, and *Aromatum Promontorium* had exactly the outline given to it by the Milan designs. On January 31 Antoniadi saw a dark area S. of this promontory, which is not confirmed by the other Members of the Section. *Auroræ Sinus* is of about the same depth of shade as the *Margaritifer Sinus* on all the drawings, but its surface is not so dull as that of the latter bay. Its colour was found "dark blue-grey, very "dark at estuary of *Ganges*" by Molesworth. Two dark spots were seen on the *Auroræ Sinus* on November 25 (Fig. 3) and December 27 by Antoniadi in the direction of the

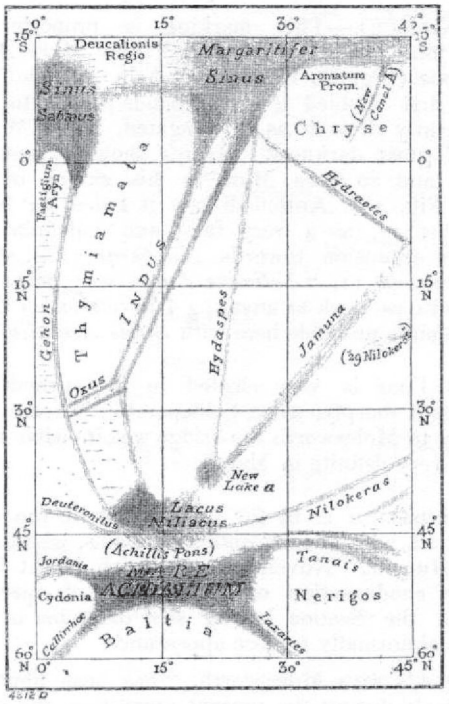


Fig. 2. The *Margaritifer* and *Acidalius Sinus* region of Mars (Capt. Molesworth).

Ganges produced. No support to these is given by the other drawings, but Molesworth shows an island in the embouchure of the *Ganges*, the dark material involving which N. and S. would, perhaps, under certain conditions, give rise to two duskier spots. The impression given by these spots, to use Mr. Lowell's areographic language, would be that of "oases in the vege-"tation region," lying on the *Ganges* produced, and on the same line as *Lunæ Lacus* and "*Lacus* "*Labeatis*."

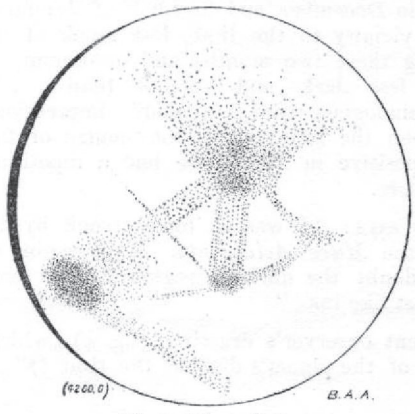


Fig 3. Mars 1896, Nov. 25^{d} 14^{h} 6^{m}, $\omega = 48°$. (Antoniadi.)

An intensely white minute circular spot was seen by Molesworth in *Auroræ Sinus* in December, "too far N. for "*Protei Regio*. In Jan-"uary it had disappeared, "and was not again "seen."

LACUS NILIACUS.—This marking is properly shown by Molesworth only, distinctly separated from *Mare Acidalium* by *Achillis Pons* (Fig. 2), but increased in latitude by some 7°. Griffiths at first doubled it in two bands parallel to the *Jamuna*, but subsequently drew it as an elongated, E. to W. trapezoidal marking, of great darkness. Meares shows it united to *Mare Acidalium*, and so does Maw in his sketch of January 1 (Plate II., Fig. 1). Antoniadi saw it twice, on November 25 and December 27, as a very faint and indefinite shading of considerable extension towards *Nilokeras* (Fig. 3). Phillips writes, December 11, "*Niliacus Lacus* very large and almost "black—quite as black as anything I have seen on the disk," but some confusion is probable here with *Sinus Acidalius*.

ACHILLIS PONS is very shaded in Molesworth's map, but Griffiths cuts it sharply, as on Schiaparelli's charts.

According to Molesworth the bridge was invisible in November, but became very definite in March.

MARE ACIDALIUM is by far the darkest of the dark areas of the planet, and, with the exception of Davis, who found it "less dark than *Auroræ*," November 18, which might be accounted for by hazy condensation or insufficiency of aperture, all the Members of the Section having sent diagrams of this region, dwell on its abnormally sombre appearance.

"This spot," says Molesworth, "has been abnormally dark, "almost black, during the present apparition, the dark tint ex- "tending in a lesser degree, over the *Lacus Niliacus*. Even in "December it was the darkest marking on the disk, darker than "*Sinus Sabæus*, and appearing to notch the polar snows." Moreux describes it as "very black," November 15; Maw, "very "dark, particularly east side," November 22; Antoniadi, "ink "black near terminator, just above fog of north polar region," November 25 (fig. 3). Owing to the increasing south latitude of the centre of the disk in December and first half of January, *Mare Acidalium*, by its vicinity to the limb, lost much of its November intensity during these two months, and on January 1 Maw found it "much less dark and smaller than . . . "November 22," while analogous were Antoniadi's impressions on January 31. But when the latitude of the centre of the disk became once more positive in March, we had a repetition of the November appearances.

On March 16, Phillips says: "I was at once struck by the "absolute blackness of the *Mare Acidalium*. This region of "Mars is beyond all doubt the darkest region I have ever seen on a planet, being just like ink!"

We subjoin this excellent observer's drawing (fig. 4), which, considering the smallness of the planet's disk at the time (7″·5), is worthy of admiration.

The real darkness of *Sinus Acidalius* was of course considerably greater than the apparent, for at its best presentation (October, $\phi = +2''{\cdot}8$) at least 40° separated it from the centre

of the disk. But as markings 40° from the central meridian lose fully $\frac{3}{8}$ of their central intensity from the blurring effect of the planet's atmosphere, we find that the real darkness of this *Mare*, whose apparent intensity was estimated at three times that of the *Sinus Sabæus*, would be four times greater than that of any other marking on the planet's surface.

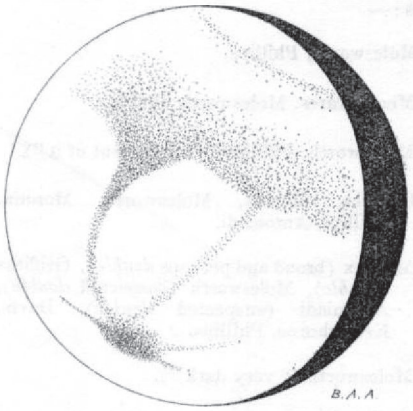


Fig. 4, Mars, 1897, March $15^d\ 7^h\ 30^m\ \omega = 27°$ (Phillips).

Now we should point out here that such abnormal blackness of a region towards the end of winter is scarcely compatible with a LEAFY changing vegetation theory, and that we should rather consider *Sinus Acidalius* as a great lake, a vast meadow, that is GRASSY vegetation, or possibly but not probably an evergreen cypress forest.

PYRRHÆ REGIO was seen by Davis and Griffiths; Phillips found it "quite distinct" in February, while Maw describes it as "faintly indicated." Molesworth's impression is that it is "very similar to *Deucalion*, but fainter, and less prominent. "Like *Deucalion*, it appears traversed by two canals [New S "and Lowell's '*Dargamanes*'] (*see* p. 78) . . . *Pyrrha* is "distinctly separated from *Chryse* by a strait well defined to "north and fading southwards." *Pyrrha* brightens when near the limb.

PROTEI REGIO is shown on the drawings of Griffiths, Meares, Phillips and Molesworth.

ARGYRE.—This is the brightening land near the limb *par excellence*. It is often so white as to be mistaken for a polar cap. The real form of this island is shown properly by Molesworth only, who describes it as a long "oval spot, with well "defined edges, white when near the central meridian, and "intensely white when on the limb. There is no evidence of the "separation between *Argyre* and the unnamed island east of "it, or of the bright circular island shown north of *Argyre* in "Schiaparelli's map." But here we are in 43° of south latitude, and the present apparition was in no way a favourable one for a thorough examination of these regions. No other Member of the Section shows *Argyre* distinctly separated either from *Noachis* or from *Ogygis Regio*, and the observations of Griffiths, Meares, and Antoniadi confirm each other on this point. When near the limb, this island became intensely white invariably. Proctor's hoar frost is the best explanation of this remarkable phenomenon.

CANALS OF SECTION II. (Nine in number).

(1) Schiaparelli's maps :—

Callirrhoe	Seen by	Molesworth, Phillips.
Deuteronilus	,,	Mee, Meares, Molesworth, Phillips.
Hydaspes	,	Molesworth, Phillips ("a fragment of it").
Hydraotes	,,	Griffiths, Meares, Molesworth, Moreux, Phillips, Antoniadi.
Iamuna	,,	Moreux (broad and perhaps *double*), Griffiths (*double*), Molesworth (suspected *double*), Antoniadi (suspected *double*), Davis, Kempthorne, Phillips.
Iaxartes	,,	Molesworth ("very dark").
Indus	,,	Molesworth (*double* as far as the *Oxus*, anomalous gemination), Antoniadi (broad), Davis, Griffiths, Kempthorne-Mee, Maw, Meares, Phillips. [According to Molesworth the *Indus* was very distinct and double in December as far as its junction to the *Oxus*. In January it was fainter, and this indistinctness increased in March and April. "In "this case there appears to be fair evi- "dence of change," for the progressive invisibility of this canal was not due to the skrinking of the disk, as meantime the *Hydaspes* was gaining in prominence.]

(2) Lowell's map :—

"*Dargamanes*"	Seen by	Molesworth.

(3) New canal :—

A	Detected by	Molesworth ("Jamuna II."), and extending from $\omega = 35°$, $\phi = 0°$ to $\omega = 40°$, $\phi = -12°$.

LAKES :—

(1) Lowell's Lake :—

"*Lucus Feronia*" [33].	Seen by	Griffiths.

(2) New Lake :—

a	Detected by	Molesworth ("H") Position : $\omega = 27°$, $\phi = +35°$. ["This appears to have been merged into *Niliacus Lacus*.]

SECTION III.

Solis Lacus.

$\omega = 55°$ to $120°$; $\phi = +60°$ to $-60°$.

LUNÆ LACUS was seen by five observers, namely, Griffiths, Phillips, Maw, Molesworth, and Antoniadi. The former shows it pretty extended and faint on his map; Phillips drew it rather small and dark in February and March, while Maw writes: "Only indicated by a very faint shading" (November 23). Molesworth found it "most insignificant" in November, darker in December, and "far larger and darker" from January to April. Antoniadi fully corroborates this statement as to the intensity of the *Lacus*, which, while pale and indistinct in November and December, was repeatedly glimpsed as weirdly ink-black on January 31 (Plate II., Fig. 2).

TITHONIUS LACUS is shown with its normal appearance by Meares' artistic drawings; also by Phillips and Griffiths, who show it as a mere broadening of *Agathodæmon*. Molesworth saw the lake split in two (fig. 5) by the doubled *Agathodæmon* (December 22). "Compared with *Lacus Solis*," says this distinguished observer, "it appeared small early in December,

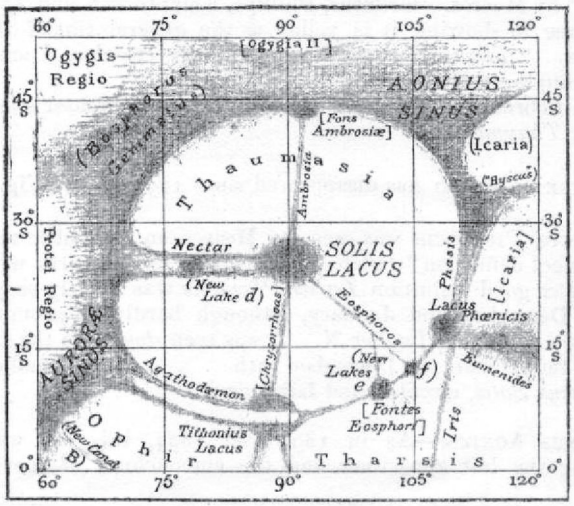


Fig. 5. The *Solis Lacus* region of Mars, after Capt. Molesworth.

" but quite as dark when near limb; only slightly smaller and " quite as dark when on central meridian."

SOLIS LACUS.—This remarkable formation was faint in 1896–1897, probably much fainter than in 1894. It was invisible in a 4¼ O.G. to Moreux, November 15, very faint to Antoniadi, who never saw it properly of late, and faint to Davis, Griffiths, and Phillips. Meares and Kempthorne agree in showing it a shade darker. In the admirable drawing by Meares (Plate II., Fig. 3), *Solis Lacus* appears elongated from E.-N.-E. to W.-S.-W., while its intensity is comparable to that of the *Auroræ Sinus* near the limb. We extract the following notes on *Solis Lacus* from Molesworth's invaluable Memoir:—"The latter . . . is " almost circular (perhaps slightly elongated E. and W.), with " a darker spot* where *Nectar* meets it. This spot was very " visible in December, so much so as to give the *Lacus Solis* a " pear shape. It was not well seen later. The colour of the " lake was dark blue grey in December and January, very distinct " even near the limb, the extent of the lake being about 4^{c}—7^{c}. " In February the lake was much fainter and more difficult to " see, being practically invisible when at all near the limb. In " April . . . it was very faint. The fading of the *Solis Lacus* " was accompanied by a progressive darkening of *Thaumasia*, " rendering the latter dull, ill-defined, and inconspicuous."

Of the five canals seen radiating from the lake, four have been seen by Molesworth, two by Meares, and one by Griffiths and Phillips. (*See* end of this Section, pp. 82, 83).

THAUMASIA is described as "very brilliant, especially near the limb," by Meares. Griffiths, Phillips, Kempthorne, and Antoniadi all agree in showing it as yellow as the general tint of the continents. "*Thaumasia* appears practically circular, Lacus Solis " occupying the centre" (Molesworth).

On February 7, Maw saw a projection on terminator somewhere about *Thaumasia*.

AUREA CHERSO has disappeared since 1894. (*See* Fig. 6.)

LACUS PHŒNICIS was seen by Meares on December 18 under " perfect definition" (Plate II., Fig. 3). Molesworth writes:— " Under good definition *Lacus Phœnicis* was a fairly easy object " in December and January, although hardly as prominent as " *Fons Eosphori*† further N. It was seen *double* in the direction " of the *Phasis* on December 12th . . . It is smaller than " *Lacus Solis*, circular, and fairly dark."

SINUS AONIUS.—As in 1892 and 1894, this bay was faint during the last apparition, and the embouchure of the *Phasis*,

* Possibly a combination of "*Palicorum Lacus*" and "*Nessonis Lacus*" of Lowell.

† *See* "Now Lakes," *e* and *f*, p. 83.

which becomes occasionally very dark,* was also very indistinct in 1896–97. On December 12, under good definition, Meares saw the eastern end of *Mare Sirenum* merging into the *Aonic Gulf*. *Icaria* was non-existent, and *Herculis Columnæ*, instead of having a breadth of some 3°, was widened to 18°! Phillips could never see this bay properly in November. On November 12 he says :—"The *Aonius Sinus* should have been on the meridian "when I was at work last night, but not a trace of it could be "seen." Analogous phenomena were seen by Antoniadi; on December 15, the *Sinus* was *very* faint, but the contour of *Icaria*, from $\omega = 120°$ upwards, was as sharply cut as by a razor. On January 26, however, with perfect seeing, not the slightest trace of the *Aonius Sinus* could be found. The statement is at variance with Griffiths' dark representation of this region as on the existing maps of the planet. Molesworth writes: "I have had considerable difficulty in defining this portion well, "and the results are rather discordant . . . From a consideration "of all the drawings, it would appear that in December either "*Aonius Sinus* or *Sirenius* was practically invisible." The same observer finds a "very blue tinge" to *Aonius Sinus*.

THARSIS was seen dark by Moreux, November 15.

---

* A careful examination of the drawings of this region during the last 70 years leads to the suspicion of the occurrence of periodical changes. Generally speaking, we may say that the recent appearances of *Sinus Aonius* are in some way, normal to this marking, and that the deep extension of this gulf into *Dædalia* in 1877 and 1879 was an exceptional phenomenon.

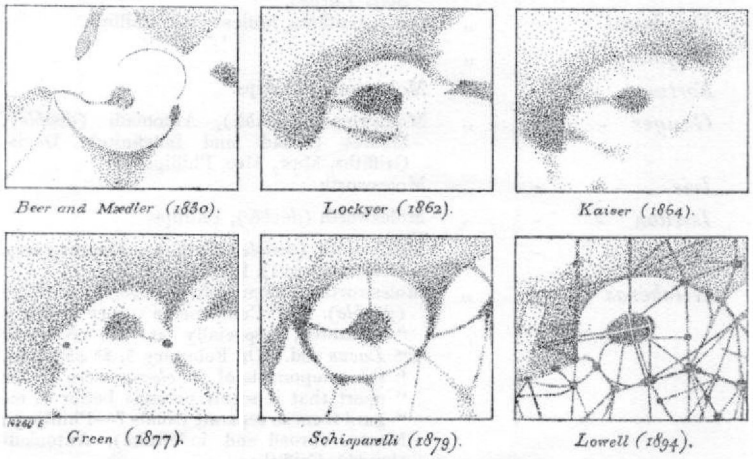


Fig. 6. The historica. appearances of the *Solis Lacus* region on Mars.

We append a diagram of the various views of the *Aonic Gulf* by the best observers. It is obvious that in 1830, 1862, 1864, and 1894 the outline of the bay was sensibly the same, while the 1877–79 change (darkening of the embouchure of the *Phasis*) is manifest. An imperfect view of Lowell's chart would be an exact copy of Kaiser's beautiful drawing.

OGYGIS REGIO is shown one with *Argyre* and *Noachis* by Griffiths, Meares, and Antoniadi. On December 5, Maw writes: "Only the faintest indication of *Ogygia*." It is described as "far fainter and less prominent than *Argyre*" by Molesworth, who adds: "Early in December it appeared to consist of two "distinct white masses; the first rather indefinite in the position "of Schiaparelli's *Ogygia*, separated from *Argyre* by an ill-"defined strait, and from 'Ogygia II.' by a distinct broad "strait; the second ('Ogygia II.') S. of *Thaumasia*, "showing a circular outline, convex to the latter ('Ogygia II.' "is far brighter than *Ogygia*)." [*See* the Chart and Fig. 5. 'Ogygia II.' is identical with Proctor's (1888) 'Mist Land.']

CANALS OF SECTION III.—(Twenty-two in number).

(1.) Schiaparelli's maps:—

Agathodæmon	-	Seen by Molesworth (*double*), Antoniadi (broad and indefinite), Griffiths, Meares, Moreux, Phillips. [Molesworth saw frequently a curious knotted appearance to this canal].
Ambrosia	-	,, Molesworth.
Araxes	- -	,, Phillips (Molesworth ?).
Ceraunius	-	,, Antoniadi (broad, dusky, indefinite), Meares (W. component only), Molesworth, Phillips. [Molesworth notes that, singularly enough, "*Ceraunius* was easier seen near the edge "than on the central meridian."]
Chrysorrhoas	-	,, Phillips (*double*), Antoniadi (broad), (Griffiths, Meares, Molesworth (prolonged to *Solis Lacus*),
Dardanus	-	,, Davis, Griffiths, Molesworth, Phillips.
Eosphoros?	-	,, Molesworth.
Fortunæ	- -	,, Molesworth, Phillips.
Ganges	- -	,, Molesworth (*double*), Antoniadi (*double*), Meares (broad and indefinite), Davis, Griffiths, Maw, Mee, Phillips.
Iris	- -	,, Molesworth.
Issedon	- -	,, Molesworth (*double*), Phillips.
Nectar	- -	,, Molesworth (*double*), Griffiths, Meares (very distinct always), Phillips.
Nilokeras	-	,, Molesworth (anomalously *double*), Phillips (*double*). ["Components very widely "separated, especially at the *Niliacus* "*Lacus* end. On February 3, $8^h\ 45^m$ P.M., "the components of *Nilokeras* were so far "apart that it seems perhaps better to re-"gard them as separate canals"—Phillips]; Meares (broad and indefinite), Antoniadi (broad), Griffiths.
Nilus	- -	,, Molesworth (*double*), Meares, Phillips, Antoniadi.
Phasis	- -	,, Molesworth (broad), Griffiths, Meares, Antoniadi.
Tanais	- -	,, Phillips (*double*), Molesworth (*doubtfully double*), Griffiths, Meares.
Uranius	- -	,, Molesworth.

(2.) Lowell's map :—

"*Bætis*" -	Seen by Griffiths [but having its embouchure close to the *Jamuna* and *Ganges*].
"*Hypsas*" -	„ Molesworth (a fragment only).
"*Nilokeras*, 29"	„ Molesworth. [This is a new canal, discovered by Mr. Lowell in 1894, but wrongly identified with *Nilokeras*.]

(3.) New canals :—

B - -	Detected by Molesworth ("Agathodæmon II."), extending from $\omega = 59°$, $\phi = -6°$, to $\omega = 80°$, $\phi = +7°$.
C - -	„ Meares, W. of *Ambrosia*, extending from $\omega = 95°$, $\phi = -29°$ to $\omega = 103$ $\phi = -40°$. [This canal was discovered by Burton in 1879. *See* "Second Report of Mars Section," by Mr. Cammell, 1894, p. 62, Mr. Stanley Williams' Report.]

LAKES :—

(1.) Lowell's :—

"*Lacus Labeatis*."	Seen by Molesworth.

(2.) New lakes :—

b - -	Detected by Molesworth ("Tanais Lacus.") Position : $\omega = 65°$, $\phi = +48$.
c - -	„ Molesworth, on the intersection of his "*Agathodæmon II.*" with *Chrysorrhoas*. Position : $\omega - 79°$, $\phi = +8°$.
d - -	„ Molesworth, on *Nectar*, midway between *Solis Lacus* and its embouchure. [Some canal must cross *Nectar* at this point. Position : $\omega = 84°$, $\phi = -24°$. "Several other minute "dark knots suspected in *Nectar*."]
e and *f* -	„ Molesworth ("Fontes Eosphori") between *Tithonius Lacus* and *Phœnicis Lacus*. Position of *e* : $\omega = 102°$, $\phi = -12°$; of *f* : $\omega = 104°$; $\phi = -14°$. [Molesworth further notes that "*Agathodæmon* was seen "knotted on several occasions "between *Lacus Tithonius* and "*Phœnicis*."]

SECTION IV.

Mare Sirenum.

$\omega = 120^\circ$ to 180°; $\phi = +60^\circ$ to -60°.

ICARIA.—We have already mentioned (p. 81) the remarkable observation of Meares, who on December 12 saw *Mare Sirenum* merging into the *Aonius Sinus*, thus entailing a six-fold broadening of *Herculis Columnæ*. Subjoined is Meares' drawing (Fig. 7). "This effect," says Mr. Maunder, "has often "been represented, and "particularly in 1892. "The difficulty of ex- "plaining it arises from "the fact that one ob- "server will show "*Icaria* in its proper "form and place, but a "little while before or "after another observer "fails to see it at all."* We should not forget here that this region of Mars is exceeding difficult to represent properly, owing to the characteristic faintness of the markings, and that we are more exposed to illusion here than elsewhere.† Griffiths, Molesworth, and Antoniadi mutually support each other in showing practically no change in *Icaria*.

Fig. 7. Mars, 1896, December 12, $4^h\ 17^m$. $\omega = 116$. (Meares).

MARE SIRENUM.—All the Members of the Section agree in showing this marking with its usual appearance. Its colour is described as "deep indigo blue-grey, darkest near *Titanum Sinus*," by Molesworth. Griffiths, Phillips (Plate II., Fig. 6), and Molesworth give it the Schiaparelli form, while Antoniadi, as in 1894, rather corroborates Lowell here. *Sinus Titanum* is well drawn by Kempthorne, but is feebly indicated by Hall, Mee, and Offord; Stanley Williams saw it beautifully on August 29 (Plate III., Fig. 7) with a disk of only $9''{\cdot}40$. Meares shows a dark line crossing the mare obliquely from N.W. to S.E. (Plate II., Fig. 5), seen on December 9, "definition exquisite."

---

* "Knowledge," March 1895, p. 58.

† Analogous observations were noted by Lohse in 1879 and Antoniadi in 1892 (*vide* First Report of the Mars Section, by Mr. E. Walter Maunder, 1892 apparition, p. 19).

The island of *Sirenia*, detected by Stanley Williams in 1892, is shown by Griffiths and Molesworth. This is possibly a contrast phenomenon with no objective existence.

ATLANTIS was suspected by Stanley Williams as far back as August 29. It was invisible to Meares as a bright streak, although glimpsed as a lighter spot between *Maria Sirenum* and *Cimmerium*. Griffiths, Molesworth, Phillips, and Antoniadi all show it distinctly, though somewhat shaded and ill-defined.

NODUS GORDII is one of the most intricate regions of the planet, and occasionally, under instantaneous glimpses, one sees the whole of *Amazonis* as far as *Dædalia* covered with the most inextricable of canal networks, defying any attempt at representation on paper. At least such was Antoniadi's experience in 1894, and during the last apparition of Mars. The *Knot* itself is shown as a faint shading by Molesworth and Phillips. The former found it darkening in April. No name could have been more appropriate to this marking.

MEMNONIA was found "very bright yellowish white, especially where it borders the *Mare Sirenum*," by Molesworth.

AMAZONIS "duller than *Memnonia* in colour, but sometimes shows white on limb." (Molesworth.)

PHÆTHONTIS becomes brilliant in the vicinity of the terminator or limb. It was white to Antoniadi when rising on October 13, and white again to Molesworth when setting on the limb on January 9.

On November 3 Phillips saw an "apparent projection on S.W. "terminator. Either a mountain or due to irradiation from a "brilliant spot." This might be an observation of brilliant *Phæthontis*.

THYLE Islands were seen repeatedly brilliant on the limb by Phillips.

PROPONTIS was found large and dark in the beginning of November by Phillips, and these appearances were confirmed during the December presentation. Griffiths speaks of "the "blackness of the *Propontis* and other lakes near the northern "pole," and further shows it doubled E. to W. in two roundish spots on his map. Meares saw it surrounded by "a bright ring" when near the limb. Molesworth shows nothing at this place, but gives a dark spot at the meeting point of *Titan* and *Erebus*, and an extensive marking at + 60° of latitude which he calls "Palus Titanum," while Kempthorne draws *Propontis* as very dark. *Propontis* was, strangely enough, almost missed by Antoniadi. Some remarkable changes (cloud?) must have taken place here.

CANALS OF SECTION IV.—(Seventeen in number).

(1.) Schiaparelli's Charts :—

Eumenides-Orcus,	Seen by	Griffiths (*double*), Molesworth (*double*), Phillips (*double*; broad and shaded only towards *Trivium Charontis*), Antoniadi (*double*; broad and indefinite westwards);* Stanley Williams (broad), Davis, Hall, Kempthorne, Mee, Meares, Offord. ["Both "*Eumenides* and *Orcus* were seen distinctly "double during the greater part of the "apparition, *Eumenides* being much knotted "and *Orcus* banded, especially near *Trivium* "*Charontis*." . . . "As regards the "position of these lakes, with reference "to the components of the double canals, I "cannot speak with certainty. They "always appear to me as slightly darker "nuclei with a faint surrounding shade, ". . . their outline being often very in-"definite, and appearing to extend beyond "the breadth of the double canal."—Molesworth]
Erebus - -	„	Molesworth (*double*); Antoniadi (broad), Griffiths, Phillips.
Gigas - -	„	Molesworth (*double*), Griffiths, Offord, Phillips (extending E.), Antoniadi.
Gorgon -	„	Griffiths, Molesworth, Phillips.
Herculis Columnæ.	„	Griffiths, Molesworth, Antoniadi.
Phlegethon -	„	Molesworth, Phillips, Antoniadi.
Plutus - -	„	Molesworth.
Pyriphlegethon	„	Antoniadi (broad); Davis, Griffiths, Kempthorne, Molesworth, Phillips.
Simois - -	„	Molesworth, Phillips.
Sirenius -	„	Griffiths, Molesworth, Phillips, Antoniadi.
Titan -	„	Molesworth (*double*), Phillips (*double*), Antoniadi (*double*);† Griffith, Offord, Stanley Williams.

(2.) Lowell's map :—

"*Brontes?*" -	Seen by	Antoniadi (*double*).‡
"*Elison?*" -	„	Phillips.
"*Hyscus*" -	„	Molesworth.
"*Thyanis*" -	„	Molesworth.

* Mr. Lowell did not see "any doubling of the *Orcus*. It was," he says, under date January 16, "in poor seeing, confused, which was, I think, an "effect of the ouses, for in better glimpses I have seen these as if strung on "it, not enclosed." This statement is further confirmed by his letter of March 5. "You will be interested to learn that yesterday I chanced to have "a good glimpse of the *Eumenides*, and that it showed perfectly single." We cannot but take this evidence as conclusive. Wrong focussing plays an important *rôle* in the gemination of the Martian canals (*see* note on *Hiddekel*, p. 73, and the end of the Report).

† "The doubling of the Titan . . . has always seemed to me not to be "a true doubling, but the accidental parallelism of the *Titan* and *Evenus*." —Lowell, January 16.

‡ "The same (accidental parallelism) is true of the *Brontes* and the "*Erinæus*."—Lowell.

(3.) New Canal :—

D	Detected by Molesworth ("61"); extending from $\omega = 144°$, $\phi = +43°$ to $\omega = 165°$, $\phi = +15°$.

LAKES :

(1.) Lowell's map :—

"*Ammonium*"	Seen by Molesworth and Phillips ("rather large"), and glimpsed by Antoniadi.
"*Utopia*"	„ Molesworth, and glimpsed by Antoniadi.
"*Lucus Maricæ.*"	„ Molesworth, and glimpsed by Antoniadi. [It will be remembered that these three lakes on *Eumenides-Orcus* were discovered in 1892 by our valued colleague, Mr. Walter Gale of Sydney, N.S.W.]
"*Castalia Fons*"	„ Molesworth.
"*Ferentinæ Lucus.*"	„ Molesworth.

(2.) New lakes :—

g	Detected by Molesworth, on intersection of *Eumenides* and *Gorgon*, and distinct from Lowell's "*Nodus Gordii.*" Position: $\omega = 142°$; $\phi = -8°$.
h	„ Molesworth, S. of "138 *Lucus Maricæ.*" Position: $\omega = 152°$; $\phi = -9°$.

SECTION V.

Mare Cimmerium, Elysium, and Trivium Charontis.

$\omega = 180°$ to $250°$; $\phi = +60°$ to $-60°$.

MARE CIMMERIUM. — This extensive dark area "of a faint "blue-grey, the blue tint being very pronounced when the "definition is sharpest," according to Molesworth, appears to have undergone considerable changes during the last apparition, and the observations of Phillips and Molesworth certainly point to such a conclusion. Writing on January 14, Phillips says : "At "the beginning of November it appeared much less dark in the "centre as shown in Schiaparelli's chart. A month later I "found its aspect materially changed, and in a drawing made on "December 11 . . . there are shown two very dark patches, one "at that portion of the sea which "receives the canal *Læstrygon*, and "the other at the 'following' end. "The intermediate space is much "less dark, and a bright promontory "appeared projecting into the sea "immediately following the mouth "of *Læstrygon*. On the night of "the 14th (fig. 8), I saw a small "canal bounding this promontory on "the north, and connecting the "mouth of *Læstrygon* with that of

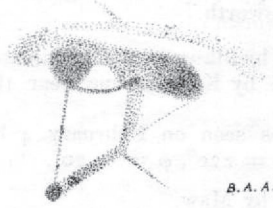


Fig. 8. Mare Cimmerium, 1896, Dec. 14 (Phillips).

" the *Cyclops*. Possibly the apparent promontory was only a " patch of cloud, and the canal only the north boundary of the " *Mare Cimmerium* showing just outside the cloud's edge." Molesworth found the " *Cimmerium Mare* . . . very dark between " *Æolis* and *Æthiopia* and *Cimmeria*," and confirms the two dark spots of Phillips. Antoniadi saw the following spot as far back as June 12, and adds another dark spot somewhere about the embouchure of the *Cyclops*. Some interesting details on *Cimmeria Insula* are given by Molesworth :—" There is no doubt " of the existence of this island. Under good definition it was " always well seen, and even when the seeing was poor, its " presence was indicated by a distinct lightening of the centre " of the *Mare*. Under very good definition *Cimmeria* was seen " divided by faint longitudinal canals* into three, as figured on " the chart . . . There seems [to exist] a strong analogy between " *Hesperia*, *Cimmeria*, and *Atlantis*," for the former reached its maximum distinctness on January 7, *Cimmeria* on January 9 and 15, and *Atlantis* on January 11, " which appears to suggest " a curious connexion." " About January 26," says Griffiths, " the whole of this region was very faint indeed. On No- " vember 4 a bright fluting was visible extending along its " length." Plate III., fig. 8, gives one of Griffiths' best drawings of this region. *Cimmeria Insula* was also seen by Meares, Davis, Gale, Hall, Kempthorne, Maw, Mee, Offord, and Rheden, all show the *Mare* with its true outline. Kempthorne shows the bay of the *Læstrygon* very marked, while Antoniadi saw bright contrast borders north of the *Mare* on October 2.

HESPERIA presented exactly Schiaparelli's, not Lowell's, outline, fading southwards, and was a strikingly easy feature throughout the apparition. All Members having sent drawings of this region show it beautifully, and its form is substantially the same as drawn by Davis, Gale, Griffiths, Hall, Kempthorne, Maw, Meares, Offord, (Plate III., fig. 9), Phillips, Rheden, and Antoniadi. A remnant of the canal *Xanthus*, which, according to Schiaparelli, crossed *Hesperia* in 1894, was seen by the last-named observer on January 8.

MARE TYRRHENUM.—According to the observation of Meares, Phillips, Hall, Kempthorne, Maw, Molesworth, and Antoniadi, this sea was slightly fainter than *Mare Cimmerium*. Griffiths, however, shows it darker on his map.

MARE CHRONIUM was seen by Stanley Williams in August, and later on by Phillips, Meares, and Molesworth.

ELECTRIS AND ERIDANIA were seen brilliant on the terminator by Antoniadi on July 12, 1896, and by Kempthorne near the limb on November 9.

A white projection on the limb was seen on February 4 by Molesworth about *Thyle* (?), towards $\omega = 220°$, $\phi = -70°$.

ZEPHYRIA is described as " ruddy " by Maw.

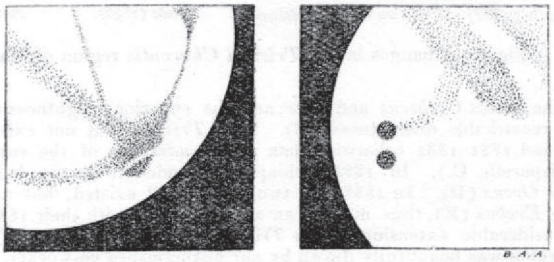
---

* One of these is Lowell's " *Helisson*."

HEPHÆSTUS is shown as a faint shading on drawings by Hall, Meares, Molesworth, Offord, Phillips, and Antoniadi. It "does not appear to touch *Hyblæus*" (Meares). The position of this spot, according to Meares, was $\omega = 262°$, $\varphi = +30°$, thus giving it a north-easterly extension.

ELYSIUM.—This decidedly white pentagonal area is perhaps the most interesting of the "continental" regions of the planet, standing as it does in noble relief from its sombre surroundings, so appropriately christened by Schiaparelli with the well known series of infernal names. All Members of the Section possessing adequate optical means agree in showing not only the superior whiteness of *Elysium*, but also the intensely brilliant spot at its preceding end, towards *Trivium Charontis* (marked X on the map). The drawings of Griffiths, Maw, Meares, Mee, Molesworth, and Antoniadi all show these appearances, while Maw, speaking of the eastern spot, says that "its brightness stood out "from its surroundings just as Aristarchus does on the Moon."

TRIVIUM CHARONTIS is the metropolitan "lake" or "oasis" of Mars, as Tycho is the metropolitan walled plain on the Moon. No less than seven canals radiate from this intensely dark spot, rendered occasionally ink-black by superior (?) definition. The sombre character of the *Trivium* is shown on all those of the admirable series of 174 beautiful drawings of Molesworth relating to this region, from October to April, and on all Phillips' views from November to March inclusively. On the other hand, Griffiths, Davis, Kempthorne, Meares, Gale (Plate III., fig. 10), Mee, Hall, and Maw also agree in dwelling on the remarkable intensity of this marking. A prelude of what was going to be observed later was seen by Griffiths on November 6, when he drew the *Trivium* broken up in two irregular masses of dark material near the limb (Fig. 9, A. *See also* Plate III., fig. 8). Four days later Antoniadi, while engaged in a survey of



A.—1896, Nov. 6 (Griffiths). B.—1897, Jan. 8 (Antoniadi).

Fig. 9. Appearances of *Trivium Charontis* in 1896–1897.

the lakes discovered in 1892 by Gale on *Eumenides-Orcus*, was strikingly surprised to see, during one moment of wonderfully sharp definition, the *Trivium Charontis* composed of two circular

black spots (Fig. 10, H)*, the line uniting which was, roughly, north to south, or perhaps at right angles to the direction of the *Orcus*. The same phenomena were seen in December, although the two spots were somewhat less obvious and confuse. But on January 8 with $\omega = 241°$, and a consequent distance to the centre of the disk of 0·656 they reappeared with their usual November distinctness, and, in spite of foreshortening, were seen quite round. This instructive observation shows that under their geometrically circular and illusory outline, the two dark spots concealed most intricate forms, and that the appearances of figs. 9, B, and 10, H, should be considered as nothing more than barbarous representations of a detail too minutely complex to be accessible to our means. And as much might perhaps be said of the existing maps of the planet, and the apparently geometrical division of its surface.

* We append in fig. 10 the successive appearances of the *Trivium Charontis* during the last one hundred years. Herschel missed this marking in 1777, 1779, and 1781. Its discoverer is Schrœter (*vide* Flammarion's *La Planète Mars*, p. 75, fig 44 [65]), who at the same time detected the canals *Cerberus* and *Cyclops*, as shown in fig. 10, A. In 1839, Galle found this spot very extended, and of great darkness, having shown at the same

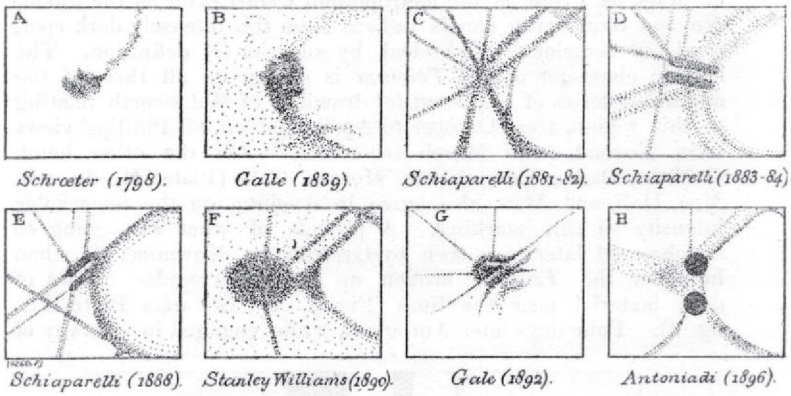


Fig. 10. Changes in the *Trivium Charontis* region of Mars.

time the canals *Cerberus* and *Styx*, and the superior brightness of *Elysium*, with remarkable distinctness (B). The *Trivium* did not exist almost in 1879 and 1881–1882 otherwise than as a *rendezvous* of the various canals (Schiaparelli, C.). In 1884, Schiaparelli divided it in two bands parallel to the *Orcus* (D). In 1888 the two bands still existed, but now directed to the *Erebus* (E), thus making an angle of 45° ± with their 1884 direction. A considerable extension of the *Trivium* occurred in 1890 (F). In 1892 this region was beautifully drawn by our distinguished co-worker, Mr. Walter Gale. The structure of the marking was a somewhat complex one at the time; but a gemination of its material towards the *Erebus* was still apparent (G). Lastly, we have the curious 1896 appearances (H), corroborated by Prof. Schiaparelli himself.

Such phenomena would readily upset all our theories and put a bridle to our imagination were we not enabled to console ourselves with the illusory character of gemination, and by the very great probability that the real changes are incomparably simpler and less bizarre than the preceding diagrams would tend to show.

CANALS OF SECTION V. (Twenty-two in number).

(1.) Schiaparelli's maps :—

Æsacus	Seen by Molesworth.
Æthiops	„ Davis, Molesworth, Phillips, Rheden, Antoniadi.
Antæus	„ Davis, Molesworth, Phillips, Rheden, Antoniadi.
Ascanius	„ Molesworth.
Avernus	„ Molesworth, Phillips, Stanley Williams (glimpsed as a shading, August 29).
Boreas	„ Gale, Griffiths, Mee ? Molesworth.
Cerberus	„ Griffiths (*double*), Kempthorne (*double*), Molesworth (*double*), Antoniadi (*double*); Davis, Hall, Mee, Maw, Meares, Offord, Phillips, Rheden. ["The most consistently visible canal."—Molesworth.]
Cyclops	„ Molesworth (*double*), Antoniadi (*double*), Griffiths, Phillips, Rheden.
Eunostos	„ Antoniadi (broad); Griffiths, Meares, Molesworth, Offord, Phillips.
Galaxias	„ Molesworth (*susp. double*) ? Phillips.
Hades	„ Phillips ("quite broad and dark"), Griffiths, Kempthorne, Molesworth.
Hyblæus	„ Antoniadi (broad); Griffiths, Meares ("very distinct"), Molesworth, Offord, Phillips.
Læstrygon	„ Kempthorne, Molesworth, Phillips, Stanley Williams, Antoniadi.
Pactolus	„ Maw, Molesworth, Phillips, Antoniadi.
Scamander	„ Molesworth.
Styx	„ Molesworth (*double*), Phillips (*double*), Antoniadi (broad and dark); Davis, Griffiths, Kempthorne, Mee, Meares.
Tartarus	„ Davis, Griffiths, Hall, Maw, Molesworth, Phillips, Antoniadi.
Triton	„ Molesworth, Antoniadi. ["Not seen in November, *Hesperia* opening direct into *Libya*. December, January, February, distinct, with a right-angle bend, faint and difficult to see in March."—Molesworth.]
Xanthus	„ Molesworth.

(2.) Lowell's map :—

"*Hellisson*"	Seen by Molesworth. (Not shown on map owing to overcrowding.)

(3.) New canals :—

E	Detected by Molesworth ("Hyblæus II.") extending from $\omega = 208°$, $\phi = +33°$ to $\omega = 214°$, $\phi = +9°$.
F	„ Molesworth ("Scamander II."), extending from $\omega = 217°$, $\phi = -40°$ to $\omega = 217°$, $\phi = -52°$.

LAKES.

(1.) Lowell's lakes :—

"*Aquæ Apollinares.*"	Seen by Molesworth and Phillips (who says: "*Tarentarus* seemed swollen into a lake-like aspect where it crosses the *Avernus*").
"*Lucrinus Lacus.*"	Seen double or triple by Molesworth on junction of *Cyclops* and *Cerberus*. [This lake is shown by Stanley Williams in 1890, Fig. 10, F.]

(2.) New lakes :—

i	Detected by Molesworth ("Fons Borealis") on intersection of *Hades* and *Boreas*.	Position: $\omega = 187°$, $\phi = +44°$.
k	" Molesworth ("Æsaci Fons") on intersection of *Styx* and *Boreas*.	Position: $\omega = 210°$, $\phi = +60°$.
l	" Molesworth ("Stygia Palus.")	Position: $\omega = 214°$. $\phi = -59°$.

SECTION VI.

Syrtis Major.

$\omega = 250°$ to $310°$; $\phi = +60°$ to $-60°$.

SYRTIS PARVA is usually a faintish marking, and it is thus shown by Phillips, Hall (Plate III. Fig. 11), Davis, Meares, Moreux (Plate III., Fig. 12), Molesworth, Griffiths, and Antoniadi. On January 17, however, Kempthorne found it as dark as the Syrtis Major near the terminator.

LIBYA.—This remarkable land was of a brilliant yellow hue during the last apparition, as shown on Lowell's 1894 map. Griffiths, Mee (Plate IV., Fig. 13), Meares, Phillips, and Antoniadi support Lowell's outline of this region, while Molesworth (Fig. 11), Offord, and Rheden (Plate IV., Fig. 15), divide *Libya* in two masses of land by a deep gulf on the south side. On October 30, Moreux found the south-west curve of *Libya* exceedingly white; while Davis and Hall show this spot as a sharp promontory. (*See* the beautiful picture of Plate III., Fig. 11.) Bright contrast borders were seen to *Libya* by Antoniadi on July 10, 1896.

Fig. 11. *Libya* in 1896–1897.
(Capt. Molesworth.)

No trace of *Nix Atlantica* (1877–1882) was seen by any of the Members of the Section.

MŒRIS LACUS was non-existent in 1896–1897, having gradually glided down into the invading shores of the *Major Syrtis*.* Its place is indicated by a simple fairly dark bay, of the Hour-glass Sea, by Phillips, Meares, Offord, Moreux, Molesworth, Griffiths, Mee, Rheden, and Antoniadi.

ISIDIS REGIO was found whitish at the September and October presentations by Antoniadi; also by Molesworth in November and December, especially near the limb.

SYRTIS MAJOR.—This, the first marking ever detected by man on Mars, showed but little change since the 1894 apparition, excepting, indeed, the complete disappearance of *Lake Mœris* in its sombre background Lowell's map is very accurate here, and the form he gives to the *Syrtis* has been corroborated by a large majority of the Members of the Section, amid whom should be mentioned Phillips, Offord, Meares, Moreux, Griffiths, Mee, Rheden (Plate IV., Fig. 15), and Antoniadi. Molesworth gives it a more decided V-shape (Plate IV., Fig. 18), and is followed here by Davis (Plate IV., Fig. 14), Hall, Gale, Maw, Townshend (Plate IV., Fig. 16), and Kempthorne (Plate IV., Fig. 17). The superior darkness of the *Mare* towards *Nilosyrtis* is shown by Gale, Phillips, Moreux, Molesworth, Mee, Davis, Maw,

---

* We subjoin, in Fig. 12, which we owe to the kindness of the Editor of "Knowledge," a comparative view of the gradual invasion of the dark material from the *Syrtis Major* over *Libya* and *Isidis Regio*. *Lake Mœris*, which in 1862 and 1864, was situated midway between the two *Syrtes*, was engulphed by the *Greater Syrtis* in 1896. A comparison of the drawings, however, of this region by the ablest observers will make it apparent that it was owing not only to the invasion of the *Syrtis* that *Lacus Mœris* disappeared, but also to the gradual approach of the lake towards the Kaiser Sea. The strong argument in favour of this interpretation is that during the last 35 years the breadth of Libya did not undergo the considerable diminution required by the fixity of *Lake Mœris*.

Differences of level in an unstable surface seems the most plausible explanation to such appearances (p. 101).

Fig. 12. Changes in the *Libya* region of Mars (1864–1897), assuming that *Lake Mœris* has remained fixed in the meantime.

Townshend, Kempthorne, and Antoniadi. Under very imperfect seeing the *Syrtis* assumed to the last named observer a grotesque triangular appearance, exactly as seen by Maraldi in 1719. Molesworth found "that the northern end was seen broadened "out into an exceedingly dark diamond-shaped spot," while Townshend saw a distinct gemination here (Plate IV., Fig. 16). On January 15, Phillips found the *Syrtis Magna* "quite severed "from the *Nilosyrtis*, just above the *Astapus*," and asks if this might not be a dense cloud bank crossing the *Syrtis* at this point.

The surface of the *Syrtis Major* was seen sprinkled with dusky spots by Kempthorne on November 29, and by Antoniadi on December 7. Molesworth found a "distinct greenish blue tinge" to the Hourglass Sea.

NILOSYRTIS was seen by Hall, Phillips, Moreux, Molesworth Griffiths, Mee, Davis, Offord, Rheden, Meares, Maw, and Antoniadi.

COLOE PALUS (1879) is shown by Phillips, Molesworth, Meares, and Antoniadi.

BOREOSYRTIS is depicted on drawings by Hall, Davis, Phillips (swollen into a lake-like aspect), Gale, Kempthorne, Mearcs, Molesworth, Griffiths, Mee, Offord, and Antoniadi. Traces of gemination of the *Boreosyrtis* are shown by Phillips.

NEITH REGIO.—Phillips writes concerning a very bright area seen here on January 16. It is described as "comparable to "the spot at the N. pole." The whole of this region, down to the N. cap, was seen faintly shaded by Moreux on October 30. *Utopia* was seen dark by Phillips.

A projection on the terminator was observed by Maw on November 22, in $\omega = 305°$, $\phi = +60°$.

ŒNOTRIA is described as "just indicated" by Maw, November 29, and projecting from the W. shore of *Syrtis Major* by Davis. Molesworth speaks of it as "a dull lightening" of the *Syrtis*. On September 17 Antoniadi found it abnormally visible, reminding the 1879 designs of Schiaparelli; but this brightness was short lived, for the island had assumed its usual appearance by September 26. On November 29 it was again an obvious feature to Griffiths; also on February 21 to Phillips.

IAPYGIA is vaguely shown by Molesworth only.

THE "PONTES" OF LOWELL are well drawn by Molesworth, but uniting a land N. of Hellas rather than *Hellas* itself to *Libya* and *Hammonis Cornu* respectively. Griffiths and Rheden also agree in showing both of them. But only the preceding "bridge" was seen by Meares on November 29, by Antoniadi on December 7, and by Davis on February 17, the latter with a disk of only 9″·4—a very creditable achievement indeed for the modest aperture used.*

* "Lunæ Pons has been there all the opposition and Mœris not."—Lowell, January 16.

AUSONIA was seen brilliant on the limb by Maw, Kempthorne, and Antoniadi.

EURIPUS is shown by Molesworth only.

MARE HADRIACUM has a "distinct greenish blue tinge," according to Molesworth.

HELLAS was seen white near the limb or terminator by Davis, Kempthorne, Molesworth, Griffiths, Meares, Phillips, and Antoniadi. Only its inferior half could be well defined. In spite of its rather unpropitious position in 1896, Molesworth saw both the arms of the "cross," with a lake at their meeting point.

A brilliant "star-like scintillating point (marked Y on the map) was seen on *Hellas* by Offord, on December 11, bringing to mind the white specks seen by Schiaparelli in 1881–1882 on each of the four quadrants of this island.

CANALS OF SECTION VI. (Nineteen in number).

(1.) Schiaparelli's Chart :—

Amenthes	Seen by	Antoniadi (broad); Davis, Griffiths, Kempthorne, Molesworth, Moreux, Offord, Phillips ("easier towards end of apparition"), Rheden.
Alcyonius	„	Molesworth, Phillips, Rheden.
Alpheus	„	Molesworth.
Anubis?	„	Molesworth.
Astaboras	„	Molesworth, Phillips, Antoniadi.
Astapus?	„	Molesworth, Phillips.
Astusapes	„	Molesworth, Phillips, Antoniadi. (S. embouchure only.)
Lethes	„	Davis, Molesworth, Phillips, Antoniadi.
Nepenthes?	„	Molesworth, Phillips, Antoniadi?
Peneus	„	Molesworth.
Thoth	„	Phillips, Antoniadi.

(2.) New Canals :—

G	Detected by	Molesworth ("Lethes II.") extending from $\omega = 240°$, $\phi = +40°$ to $\omega = 243°$, $\phi = +28°$. [This might be a simple continuation of *Æthiops*.]
H	„	Molesworth ("Amenthes II.") extending from $\omega = 248°$, $\phi = +42°$ to $\omega = 258°$, $\phi = +16°$.
I	„	Molesworth and Antoniadi, extending from *Lacus Mœris* to *Syrtis Parva*, from $\omega = 258°$, $\phi = -3°$ to $\omega = 279°$, $\phi = +8°$. [This is a return of the canal seen by Mr. Stanley Williams in 1890.]
K	„	Antoniadi (between *Syrtis Major* and *Hephæstus* extending from $\omega = 260$, $\phi = +28°$ to $\omega = 283°$, $\phi = +28°$.

L	**Detected independently by Antoniadi (1896, Sept. 17), Davis, Gale, Griffiths, Molesworth, Moreux, Phillips, and extending from $\omega = 265°$, $\phi = +40°$ to $\omega = 282°$, $\phi = +30°$. [This canal is, perhaps, a *periodical* return of the one seen by Herschel in 1781, Schrœter in 1785, 1798, and 1800, Franzenau and Dawes in 1864, Niesten in 1881, Burton and Bœddicker in 1882. Mr. Lowell rediscovered it in 1894.**
M	,, Molesworth ("95"), extending from $\omega = 265°$, $\phi = +3°$ to $\omega = 273°$, $\phi = -3°$.
N	,, Molesworth ("94"), extending from $\omega = 273°$, $\phi = -3°$ to $\omega = 278°$, $\phi = +8°$.
O	,, Molesworth ("Nilosyrtis II."), extending from $\omega = 283°$, $\phi = +30°$ to $\omega = 294°$, $\phi = +41°$. [This would cut *Meroe Insula* in two.]

NEW LAKE :—

m	Detected by Molesworth on intersection of *Astaboras* and Lowell's "*Asopus*." Position : $\omega = 296°$, $\phi = +28°$.

SECTION VII.

The South Polar Region.

$\omega = 0°$ to $360°$; $\phi = -60°$ to $-90°$.

From the beginning of the apparition to the end of August the S. polar cap underwent a very marked diminution, as will be apparent on an inspection of the following figures :—

Date.	ω.	Areocentric Arc of Cap.	Observer.	Date.	ω.	Areocentric Arc of Cap.	Observer.
1896.	°	°		1896.	°	°	
May 17 -	115 ±	51		July 10 -	292	30	
June 12 -	215	40		,, 12 -	272	32	Antoniadi.
,, 23 -	96	34	Antoniadi.	,, 19 -	205	28	
,, 27 -	49	31		Aug. 29 -	167	7	Stanley Williams.
,, 30 -	34	34					

No Member of the Section saw this cap with certainty after Stanley Williams' last observation on August 29. It was at first bounded by a dark bluish grey band, which gradually lost its intensity with the diminution of the snow-covered area.

The disappearance of the polar cap was followed by the occasional apparition in these regions of dull white mysterious glimmers, not always to be accounted for by the passage across the central meridian of regions whitening with the obliquity of

the visual ray,* although the two phenomena are probably produced by the same cause. These spots assumed every degree of intensity between great transparency (and consequent indistinctness) and a whiteness comparable to that of *Hellas* on the limb. Their aspect was very characteristic, and they could under no circumstances whatever be mistaken for the polar cap itself.

A complete record of such appearances is given in the following table:—

Date.	ω.	Areocentric Arc of White Spot.	Observer.	"Changing" Island on Central Meridian.
1896.				
Sept. 17 -	284°	40° ±	Antoniadi -	
„ 26 -	279	40 ±	Do. -	
Nov. 29 -	257	40 ±	Meares -	*Thyle II.*
„ 29 -	327	25 ±	Phillips -	*Novissima Thyle.*
„ 30 -	290	25 ±	Davis -	
1897.				
Jan. 22 -	178	48 ±	Antoniadi -	*Thyle.*
„ 26 -	101	45 ±	Do. -	
„ 26 -	123	45 ±	Do. -	
„ 31 -	62	40 ±	Do. -	*Argyre II.*
Feb. 3 -	62	35 ±	Phillips -	*Argyre II.*, "very brilliant."
Mar. 15 -	27	40 ±	Do. -	

Evidently the whitenesses of November 29, January 22 and 31, and February 3, could be attributed to the brightening lands, but there was nothing on the central meridian on September 17 and 26, November 30, January 26, and March 15. We have then to deal here with phenomena connected with the polar regions themselves. Their natural explanation is that of partial condensations of aqueous vapour in the Martian atmosphere producing *haze*.

SECTION VIII.

The North Polar Region.

$\omega = 0^\circ$ to 360°; $\phi = +60^\circ$ to $+90^\circ$.

Owing to the great obliquity of the solar rays, the N. polar cap underwent but little change in 1896 to 1897. It was not a very obvious feature, nor was it always there. Hence, taking into account the conflicting nature of the observations, a comparative table of the dimensions of this cap, based on the drawings of the Members of the Section, would be of little use here. We will,

* It would perhaps not be an overbold assumption to consider the diurnal variability of such lands (*Argyre*, *Hellas*, &c.) as due to *radiation fogs*. The cloudless and rarefied atmosphere of Mars must be eminently favourable to both solar and Martian radiation. Cold air flowing down into a warm damp atmospheric stratum would cause the formation of such fogs in the evening, while the heat from the rising sun would bring about their disappearance by allowing the air to retake all the moisture which has been condensed out of it.

then, confine ourselves to a few remarks with reference to the appearances of these snows.

The cap was first detected by Stanley Williams, on August 29, 1896 (*see* Plate III., Fig. 7). It was a difficult object in September, but became decidedly distinct subsequently until the end of the apparition. "Early in February," says Molesworth, "dark marshes appear to have begun to form on the boundary of "the polar snows. The cap appears to have reached a minimum "about March 18, the surrounding marshes having increased in "extent and darkness. In April the cap appears to have increased "again slightly (probably owing to its being turned more towards "the earth), but the marshes continued to darken, rivalling the "*Mare Cimmerium* and southern part of *Syrtis Major* in "darkness."

From the conduct of the hyperborean dusky spots, Molesworth gathers that "the darker markings are in some way related to "water action, or vegetation dependent on water."

An intensely white spot, apparently projecting beyond the limb, was seen by Meares, on December 9, towards $\omega = 200^\circ \pm$, $\phi = +65^\circ$.

During the latter half of November, and the beginning of December, the N. polar regions of Mars presented a remarkable and almost unique appearance, the whole of the frigid zone being covered by a dull white material, much brighter than the hazy phenomena of the other pole, but decidedly fainter than the general brilliance of the snows. The polar cap itself was lost in the whiteness, which at maximum presented a uniform tint, extending at the same time over a radius of 35 areocentric degrees.

The following table gives a complete account of the phenomenon as seen by the Members of the Section :—

Date.	ω	Areocentric Arc of Spot.	Observer.	Date.	ω	Areocentric Arc of Spot.	Observer.
1896.	°	°		1896.	°	°	
Nov. 9	167	25	Kempthorne.	Nov. 29	257	60	Meares.
„ 10	173	20	Antoniadi.	„ 29	310	75	Maw.
„ 18	336, 76	56	Molesworth.	„ 29	318	Missed	Griffiths.
„ 18	65	Missed	Griffiths.	„ 29	327, 342	40	Phillips.
„ 20	346, 2	60	Molesworth.	„ 29	338	20±	Kempthorne.
„ 20	50	Missed	Griffiths.	„ 30	220	80	Meares.
„ 21	325, 339	60	Molesworth.	„ 30	296	38	Offord.
„ 24	307, 322	65	Molesworth.	„ 30	322	60	Townshend.
„ 25	48	65	Antoniadi.	„ 30	335	40	Antoniadi.
„ 26	264, 291	60	Molesworth.	Dec. 3	196	70	Meares.
„ 28	254, 279	70	Molesworth.	„ 3	285	50±	Mee.
„ 28	349	45	Antoniadi.	„ 3	290	35	Phillips.
				„ 4	190	40	Molesworth.
				„ 6	146	35	Molesworth.

Analogous appearances, but of a much less decided character, were seen by Meares throughout the month of December.

Three explanations of the phenomenon present themselves naturally to the mind: (1) a vast snowfall; (2) the formation of hoar frost; (3) a condensation of the water vapour of the Martian atmosphere in the form of cloud or fog. The snow theory is open to more than one objection. The strongest of these are (1) the incontestable *dull white* colour of the phenomenon, as compared to the brilliancy of the polar snows themselves; (2) the absence of the dark band characteristic of the melting of the Martian snows during the decreasing phase; (3) the extraordinary rapidity (10 days) of the melting of such a vast area of snow, with an almost horizontal sun; and (4), last but not least, the impossibility to satisfactorily account for the faint December glimmers, which repeated, but in a very reduced scale, the remarkable phenomena seen in November. The hoar frost interpretation is a very satisfactory one. The cloud or fog explanation is also good and scarcely open to discussion, for all the preceding objections to the snow theory become the characteristic features of cloudy condensations of aqueous vapour.

Until the contrary is demonstrated, therefore, we may consider the white appearances of the north polar regions of Mars in November 1896 as produced by *hoar frost*, *cloud*, or *fog*.

"Similar phenomena," says Prof. Schiaparelli, "were visible "round the north pole in 1879 and 1881–1882. They are "probably produced by the same cause which renders so often "brilliant *Thyle I.* and *II.*, *Argyre I.* and *II.* in the other "hemisphere."

PART III.

CONCLUSION.

Chart of Mars in 1896–1897.

Our Plate I. is a combination of the results given in the 165 drawings supplied by the Members of the Section. The process of combination was an arduous one, and the only way to avoid constantly contradictory representations of the same markings was the creation of a system of weights attached to each observation. Notwithstanding, however, the difficulty, and the somewhat arbitrary character of the task, the Director is firmly convinced that the Chart of the Section is a very fair and truthful representation of the appearance of the planet during the last apparition.

The chief changes from preceding years were:—

(1.) The gemination in two round spots of *Trivium Charontis;*

(2.) The disappearance of *Lake Mœris* in the Kaiser Sea;

(3.) The reappearance of the great periodical canal **L** between *Nilosyrtis* and *Boreosyrtis*.

These have been dealt with *in extenso* in the preceding analysis.

Considerations on the Physical Condition of Mars.

Much confusion is prevailing owing to the very great number of hypotheses put forward in order to account for the Martian phenomena, and the bewildered student of areography loses his way in the maze of conjecture. After the exclusive division of the planet's surface into desert land and water came the classical inundations, flooding in a few days countries bigger than the British Isles,* then vegetation explained everything, and last but not least, artificiality resulting from local intelligence, crowned the whole.

Some effort then to see things in this chaos with some sort of simplicity would not be out of place here.

And first with reference to the ruddy colour of Mars. Sir John Herschel's suggestion, that the "ochrey" tint of the continents is due to the Martian soil, is a very satisfactory one. Mr. Lowell is also right in considering these regions as deserts, for their colour is very much that of yellow sand, and our Sahara, if not too much dimmed by our dazzling white atmosphere, would show a similar colour viewed from Venus.

We cannot admit, with Lambert, a ruddy vegetation. This is manifestly incredible. For the idea of change is not separable from that of vegetation, and every one knows that if there is anything invariable on Mars it is doubtless its standard Martial colour.

The "half shades" are probably not shoals doomed to periodical inundations, but very likely lands covered with scanty *grassy* vegetation. This would account for their changing appearance.

The whitenings near the limb of such lands are due either to ingenious Proctor's explanation of hoar frost or to our radiation fogs (p. 97). Both theories are quite satisfactory, as the calm rarefied air of the Martian atmosphere is eminently favourable to nocturnal radiation and attendant phenomena. Owing, however, to the characteristic sluggishness of circulation in the Martian atmosphere, so capitally pointed out by Mr. Maunder, we rather incline towards the hoar frost theory, dew being one of the simplest modes of precipitation.

The dark areas possibly represent both vegetation and water. Vegetation where seasonal changes are recorded; water where general invariability of tint is the predominant feature.

The vegetation theory accounts for many a change, but not for all the changes actually observed, and it cannot tell us, for instance, how *Mœris Lacus* gradually slipped into the *Syrtis Major*, nor why the once beautiful peninsula of *Aurea Cherso* has silently

* The promoters of the "inundations resulting from the melting of the polar snows theory" scarcely perceived that, were the *Mare* about the pole to have some depth, the passage of water from the solid to the liquid state with a corresponding decrease of volume would entail not inundations coming from the pole, but a diametrically opposed uprush of water from the equator to the polar regions.

vanished in the sombre *Auroræ Sinus*. Some other agency seems at work here, and the low mean density of Mars might account for such phenomena. The density of water being taken as unity, we have 3·91 for the density of Mars and 5·5 for that of the earth. With our mean density of 5·5 we enjoy a somewhat relative stability in our "rising" and "sinking" lands. Absolute instability would, on the other hand, be the characteristic feature of a planet whose density would approach that of water (Saturn and Jupiter). Mars is thus in an intermediate position between our imperfect stability and the complete instability reached at density equal unity.

Further support is given to this view by the latest investigations in cosmogony. According to M. Du Ligondès, the great authority on this subject, Mars would be one of the youngest worlds of our system in planetary evolution. "The variation of density "with depth," he adds, "is much less sensible for Mars than for "the earth. This conclusion is fully confirmed by the last obser- "vations which Mr. Lowell has published on the subject of the "polar flattening of Mars. This flattening is relatively much "greater than that of the earth." Applying to Mars Roche's formula

$$\delta = \delta_0 \left(1 - \frac{4}{5} R^2\right)$$

(where δ is the density of the layer of radius R), M. Du Ligondès finds for the polar flattening of Mars the value of $\frac{1}{212}$,* sensibly different from Mr. Lowell's $\frac{1}{190}$. This latter value agrees with the formula

$$\delta = \delta_0 \left(1 - \frac{1}{2} R^2\right)$$

for which the increase of density from the surface to the centre, instead of being 1 to 5 as in the case of the earth, is reduced to 2. The mean density of Mars being 3·91, the density would be only

5·6 in the centre,

2·8 at the surface of Mars.

"This last value," concludes M. Du Ligondès, "is almost that "of the rocks constituting the earth's crust. Owing, however, "to the low gravity on the surface and everywhere in the "interior of the planet Mars, the rocks, although relatively "dense, have doubtless a loose structure, which renders them at "the same time unresisting, permeable to water, and easily "deformable."

* It will be remembered that during the exceedingly favourable nodal opposition of 1879, Prof. Young found $\frac{1}{212}$ for the polar flattening.

Indistinct Vision and Gemination.

The Director wishes to emphasize his strong scepticism on any idea of reality attached to Martian gemination.

M. De Boë was certainly right in attributing the doubling of the linear markings to the secondary images formed in the eye under imperfect vision. Quite recently, the Director has been successful in reproducing on artificial Mars disks with single canals examined telescopically at 220 feet distance, *all* the phenomena of gemination. *Canals were split in two with included shade, while others remained single, and lakes separated in bands and round spots.* For this a focussing difference of $\frac{1}{200}$ in. was sufficient.

The absolute identity of these artificial doublings with those of Mars is so striking that we are immediately driven to inquire whether the two phenomena are not manifestations of one and the same cause, and whether the doctrine of chances would rather incline towards the interpretation of gemination by a perfectly allowable focussing error than towards the credence that the canals are suddenly jumping by magical scissiparity at distances of 300, 400, and 500 miles.

We can perfectly believe in the doubling of lines and knots under imperfect vision, since we have the overwhelming evidence before our eyes, while we could defy our imagination to account for a sudden disappearance of the Thames, giving rise to the formation of two variably distant bands, uniting Bristol to Brighton and Birmingham to Ipswich, each bearing its black knot—London, and leaving the intermediate country in a state of confused shading.

Gemination made a Sphinx-world of Mars. Without gemination, this planet stands no longer beyond our intellectual grasp. In fact, M. Daubrée has shown that contraction of a planet's crust would give rise to mountain ridges, while expansion of the nucleus would crack the crust mostly along the paths of great circles, very much in the manner of the Martian canal system.

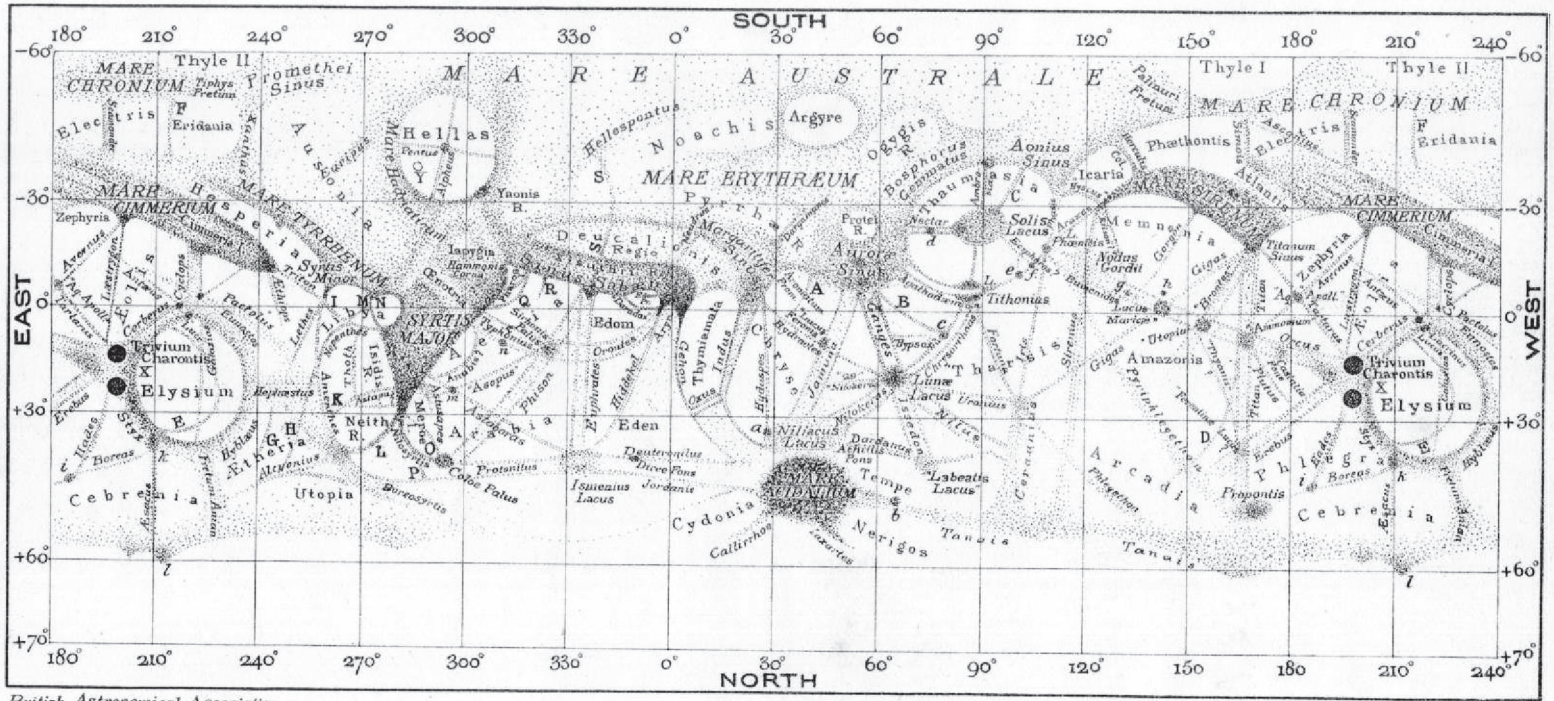
Nor would Mars, covered with expansion cracks, be a unique world in our system. For if we are obliged to explain our mountain ranges by contraction, it is to the reverse process that we should have recourse when trying to offer a satisfactory interpretation of the rays of Tycho and other walled plains on our satellite.

* * * * *

In concluding the present Report, the Director would like to express his hearty thanks to the gentlemen who worked with such perseverance and skill under such disheartening circumstances, and to congratulate them on the success which crowned their efforts in increasing our knowledge of the most fascinating of planets.

E. M. ANTONIADI,
Director of the Section.

Juvisy (S.-et-O.),
January, 1898.



British Astronomical Association. *E. M. Antoniadi del.*

CHART OF MARS

on Mercator's projection

PREPARED FROM OBSERVATIONS OF THE SECTION IN 1896

Memoirs

OF THE

British Astronomical Association.

VOL. VI. PART III.

REPORT OF THE SECTION

FOR THE OBSERVATION OF

MARS.

PLATES.

Director—E. M. Antoniadi.

LONDON:
PRINTED AND PUBLISHED FOR THE ASSOCIATION,
BY EYRE AND SPOTTISWOODE,
HER MAJESTY'S PRINTERS.

Fig.1. W. H. Maw. 8in O.G.
1897. Jan. 1d 10h 5m ω=22° φ=−6°7

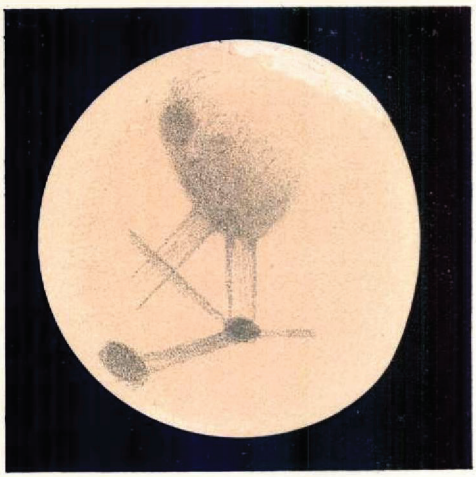


Fig.2. E. M. Antoniadi. 9½in O.G.
1897 Jan. 31d 6h 51m ω=62° φ=−6°6.

Fig.3. J.W. Meares. 9¼in Spec.
1896. Dec. 18d 6h 27m ω=95° φ=−4°7.

Fig.4. C. Roberts. 6½in Spec.
1896. Nov 13d 10h 30m ω=103° φ=−1°7.

Fig.5. J. W. Meares. 9¼in Spec.
1896. Dec 9d 3h 27m ω=130° φ=−2°9.

Fig.6. Th. E. R. Phillips. 9½in Spec.
1897. Jan. 27d 10h 45m ω=156° φ=−6°9.

Fig.7. A. Stanley Williams. $6\frac{1}{2}^{in}$ Spec;
1896. Aug. 29.^{d} 15.^{h} 30.^{m} ω=167° ϕ=-5°3.

Fig.8. H.F. Griffiths. 6^{in} Spec;
1896. Dec. 11.^{d} 9.^{h} 4.^{m} ω=203° ϕ=-3°3.

Fig.9. J.M. Offord. $12\frac{1}{2}^{in}$ Spec;
1896. Dec. 11.^{d} 11.^{h} 45.^{m} ω=233° ϕ=-3°3.

Fig.10. Walter Gale. 5^{in} O.G;
1896. Dec. 31.^{d} 0.^{h} 5.^{m} ω=246° ϕ=-6°5

Fig.11. W.J. Hall. $4\frac{7}{8}^{in}$ Spec;
1896. Dec. 5.^{d} 10.^{h} 80.^{m} ω=267° ϕ=-2°1

Fig.12. Abbé Th. Moreux $9\frac{3}{4}^{in}$ O.G:
1896. Oct. 30.^{d} 13.^{h} 36.^{m} ω=275° ϕ=+2°7

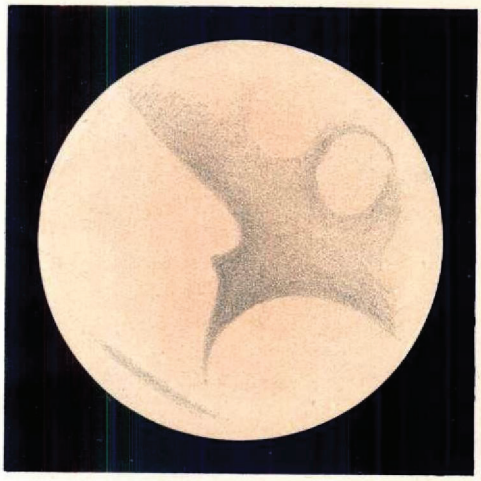


Fig.13. Arthur Mee. $8\frac{1}{2}^{in}$ Spec;
1896. Dec. $3^{d}10^{h}30^{m}$ ± $\omega=285°$ $\phi=-1°7$

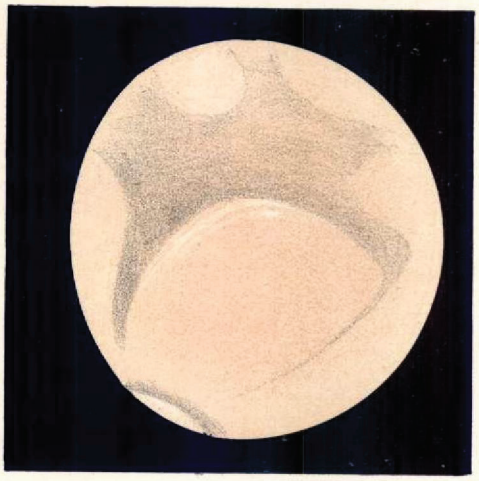


Fig.14. G.T.Davis. $3\frac{3}{4}^{in}$ O.G;
1896. Oct. $22^{d}10^{h}25^{m}$ $\omega=301°$ $\phi=+2°7$.

Fig.15 Joseph Rheden. $5\frac{1}{4}^{in}$ O.G;
1896, Dec. $2^{d}11^{h}5^{m}$ $\omega=309°$ $\phi=-1°5$.

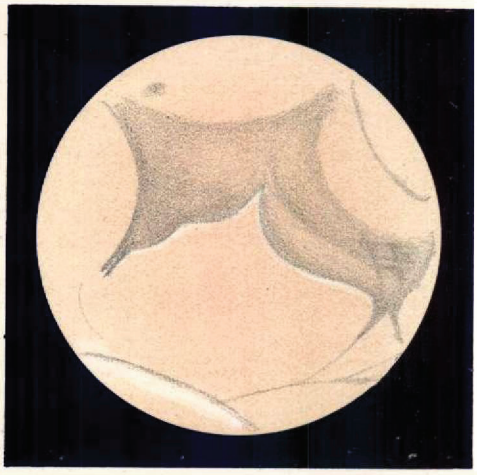


Fig.16 H.J. Townshend $9\frac{1}{2}^{in}$ Spec;
1896. Nov. $30^{d}11^{h}15^{m}$ $\omega=322°$ $\phi=-1°1$

Fig.17. P.H.Kempthorne. $12\frac{1}{2}^{in}$ Spec;
1896. Nov. $29.^{d}11^{h}45^{m}$ $\omega=338°$ $\phi=-0°9$.

Fig.18 P.B.Molesworth. $9\frac{1}{4}^{in}$ Spec;
1896 Dec. $23^{d}2^{h}5^{m}$ $\omega=345°$ $\phi=-5°6$.