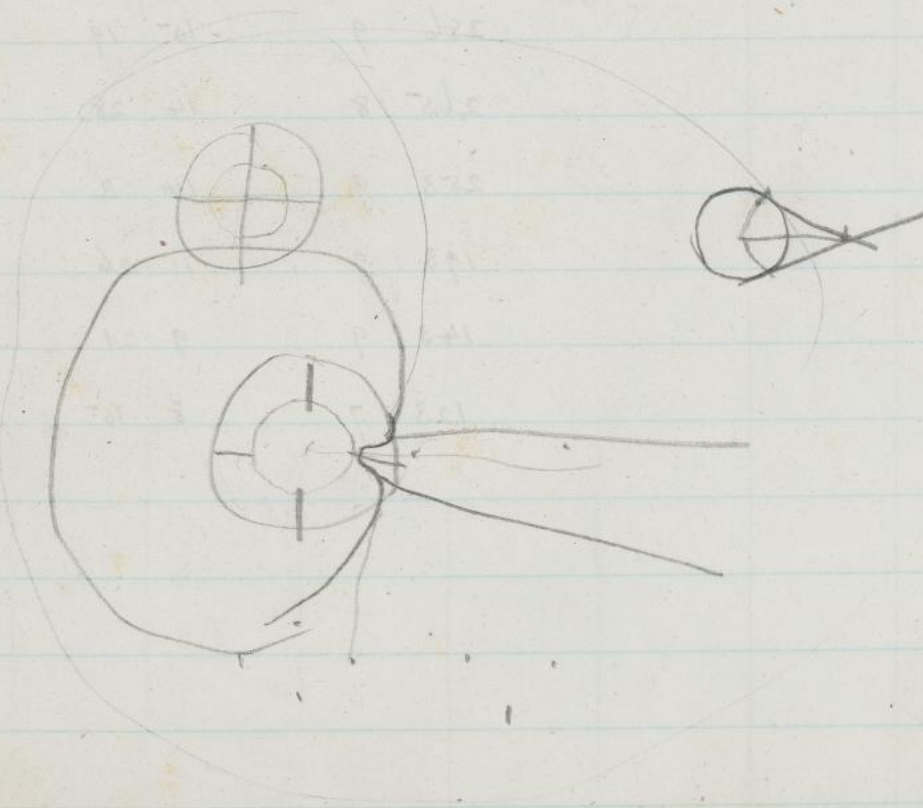


1877pae.proj. 4658

R 20 KG 11365.464.

Position of satellite assuming greatest elongation
to be $80''$ to have occurred on Sat. 18th, and the period to be
30 hours

Wednesday	$38''$ W
Thursday	$80''$ W
Friday	$38''$ W
Saturday	$64''$ E
Sunday	$64''$ E
Monday	$38''$ W
Tuesday	$80''$ W



Ephemeris of Mars.

Star Places

Aug. 22	23 ^h 22 ^m 4 ^s	-11° 2' 56"	585	9	23 29 39	-11 23
23	21 17	8 5	583	8	29 36	11 22
24	20 27	13 16	571	8	29 6	11 14
25	19 36	18 29	557	9	28 31	11 17
26	18 43	23 42	556	9	28 29	11 16
27	17 47	28 55	484	9	25 28	11 33
28	16 50	34 6	463	9	24 30	10 50
29	15 51	39 15	453	9	23 53	11 8
30	14 51	44 19	385	9	20 31	11 37
31	13 48	49 19	381	9	20 22	11 43
			365	9	19 24	11 50
			309	8	16 36	11 27
			286	9	15 19	11 32
			265	8	14 28	11 12
			253	9	14 3	11 29
			193	9	11 26	11 56
			143	9	9 21	11 43
			123	7	8 15	11 21

Places of Comparison Stars with reference to Mars.

	453(9) sf	571(8) sf	556-7(9) sf	463(9) nf	265(8) sp	583-5 ⁽⁸⁾⁽⁹⁾ sf	309(8) sp	253(9) sp	286(9) sp
Aug. 22	149 ^m 5'	7 2	11 6 ²⁵ 13 ¹⁴	2 26 13	7 36 9				
23	236 ^{sf} 0	7 49 6	7 ¹² 14 ⁸		6 49 4	8 ¹⁹ 22 ¹⁴ 15			
24	3 26 5	8 39 1	8 ² 4 ³ 4 ⁴	484(9) sf	5 59 1	9 ⁹ 12 ⁹ 10	3 51 14		
25	4 17 10	9 30 4	8 ⁵³ 55 ² 1	5 52 15	5 8 6	10 ⁰ 3 ⁴ 5	3 0 9	5 33 11	4 17 14
26	123(7) np	143(9) sp	9 46 ⁴⁸ 7 ⁶	6 45 10	4 15 12	148 ³⁵⁵⁽⁹⁾ 13	2 7 3	4 40 5	3 24 8
27	9 32 7	8 26 14		7 41 5	2 35 ³⁸¹⁽⁹⁾ 14	2 44 8	1 11 2	3 44 1	2 28 4
28	8 35 13	7 29 9	365(9) sf	8 38 1	3 32 9	3 41 3	0 14 7	2 47 5	1 31 2
29	193(9) sp	6 30 4	3 33 11	9 37 6	4 31 4	4 40 2	0 47 12	1 48 10	0 32 7
30	3 25 12	5 30 1	4 33 6		5 31 1	5 40 7		0 48 15	0 28 12
31	2 22 7	4 27 6	5 36 1		6 34 6	6 43 12			

5.2 Error + 29^s 3. Re 503
24.3

1st Guntach 22^h 28^m 35^s 7



RG-11365.464



Aug. 6. 1877

Aug. 6 1877.

x cent.

	Decl.	Magn.	Time by B. 236	
0	1.3	8	19 ^h 25 ^m 15. ^s 0	Star marked
	1.5	11	55.0	Supposed (78)
	3.4	7	27 8.6	Oetz. 20234
	1.6		56.2	Place of (78) Aug. 4
	0.1		28 40.2	Oetz. 20252

		1 31.6	
27° 38.9	Oetz. 20252-3	59 ^m 16.92	
27 26.1	20234	57 44.27	
12.8		1 34.65	
	3.3		
	<u>13.2</u>		

	1 ^m 51 ^s	
	<u>55^s</u>	28 40
2	46	2 46
25	55	<u>25 54</u>
25	55	
<u>28</u>	<u>41</u>	

Aug. 6 1877

Drawings of Mars. 20-30 m. lid time.

H. S.

E. G. P.



Dark line of
shadow of ring seen
in ball.

*

Aug. 11, 1877.

Oeltzen 20141 double; pr. component observed. It follows Oeltzen 20123 $1^m 43.7$ by stop-watch.

Oeltzen 20234 is red and follows Oeltzen 20141 $6^m 0.3$ by stop-watch.

Supposed (78) follows Oeltzen 20141 $31\frac{1}{2}$ by stop-watch.

Transits over 3 wires; star over a star over b (78) over a, star over c (78) over b & c.

Star	0.0	(78)	31.5	by stop-watch
	15.7		47.0	
	35.0		67.2	
	<hr/> 50.7		<hr/> 1215.7	
			50.7	
			<hr/> 95.0	
			31.7	

Started chronograph.

Rattle just before $19^h 7^m$
Transits on chronograph at $19^h 7^m$ by B. 236 over 3 wires
Moon " $19^h 8^m 9^s$ " "

These transits are of star & asteroid as above.

Position circle set 45° from previous position
Star over two upper sides of square, planet over two lower. Both observations of star precede those of planet. Disappearances only observed.
First set about $19^h 15^m$ by B. 236.

Second " $19^h 15^m \frac{3}{4}$ to $16^m \frac{3}{4}$ by B. 236.

Third " $19^h 16^m \frac{1}{4}$ " $17^m \frac{1}{4}$ " " "

Run failed.

Aug 11, 1877

Fresh start with coarser pen $19^h 27^m$.
 First set of transits ended about $19^h 32^m$.
 Second " " " ; first tap on planet too early.
 Third " " " ;
 Fourth
 Fifth.

~~The~~ E.C.P. obs. all preceding.

19 28.

A.S. obs.

5 transits as above. Where two taps occur together take the mean.

At about 20^h by Bond 236 the supposed asteroid was found to follow the preceding component of the double star 28.7 by the stop watch. The object observed is no doubt the asteroid, if E.C.P.'s observation refers to the same thing, of which there can be no reasonable doubt, as both observers looked at it together.

6 transits as above. In the last three the star was set near the middle of the square and the asteroid near the lower angle. Pen failed for most of this set. When two taps occur followed by two rattles, take second tap.

Fresh start $20^h 40^m$

5 or 6 transits as above, Take 2^d tap where 2 occur.
 Transits of the double star over which inclined from s p to n f; disappearance

Aug 11 1899

15

and reappearances. Some single taps are for transits on lines inclined the other way; reject these.

Transits of Oeltzen 20123 (supposed) & ~~Q~~ double star; disappearances & reappearances. In these last transits the square was set for observations of right ascension only.

Stopped pen at a little before $21^h 11^m$; but it had been running over the same track for a minute or so.

At $21^h 20^m$ by B. 236 (78) follows preceding component of double star 26^s by stopwatch. No doubt whatever of identification of asteroid.

Oeltzen 20123 (same star observed with chronograph above) precedes prec. component of double star $1^m 44^s$ by stopwatch. No doubt the double star is Oeltzen 20141.

Stopwatch runs for a minute in good agreement with chronometer B. 236.

Summary Reduction

Line	Diff	R.A.	Diff	Dec	1 st D. 1/2"
196	31.5	29.75	43.7	591.8	295.9 6' 22.0
33		28.85	44.7	605.3	302.6 15.3
34		29.75	44.7	605.3	302.6 15.3
36		29.40	44.0	595.8	297.9 20.0
37		29.35	44.1	597.1	298.5 18.4
49		28.20	45.4 48.8	620.1	310.0 7.9
50		28.20	42.7	579.2	289.6 28.3
52		28.50	44.4	601.2	300.6 17.3
53		28.65	43.3	586.3	293.1 24.8
55		28.85	43.9	594.5	297.2 20.7
20 29		27.70	43.8	593.1	296.5 21.4
47		26.75	42.7 40.7	579.2	289.6 28.3
48		26.90	43.4	587.6	293.8 24.1
50		26.50	44.0	595.8	297.9 20.0
51		26.35	44.3	599.9	300.0 17.9
52		27.15	43.9	594.5	297.2 20.7
53		26.90	43.8	593.1	296.5 21.4

Mean. 5

Time. 55	R.A.	Dec.			
11d 100	29.42	18.20	5	E.C.P.	11d 19 h 34m 32s
	28.48	19.80	5	A.S.	" 19
28 53	27.70	21.4	1	A.S.	" 20 28 53
49 44	26.91	22.1	6	A.S.	" 20 49 44

0.2 52

0.2 52

Time of transits p 14. E. L. S. M.

	Star		(78)		Σ	D	
1st	19h	30	59.7	31	14.7	2 6.5	7.1
		31	6.8	31	57.3	3 6.0	<u>36.6</u>
						59.5	43.7
2d.		32	21.8	32	35.4	50.7	7.1
			28.9	33	13.0	48.4	37.6
						57.7	44.7
3d.		34	1.4	34	16.4	9.9	7.1
			8.5	34	53.0	9.4	37.6
						59.5	44.7
4d.		35	37.4	35	52.0	22.0	7.2
			44.6	36	28.8 36	20.8	36.8
						58.8	44.0
5d.		36	52.7	37	9.0	56.4	7.0
		37	1.7	37	46.1	25.1	37.1
				45	19.7	58.7	44.1
				34	32.0		

A. S. M.

1st	48	19.5	32.0		
		26.7	49 10.6	46.2	7.2
		32.0	57.0	42.6	38.6
				56.4	45.8
2d.	49	57.0	10.8	0.9	6.9
	50	3.9	45.6 46.5	57.3	35.8
			47.4	56.4	42.7
3d.	51	28.0	41.6	3.3	7.3
		35.3	52 18.7	0.3	37.1
			52	57.0	44.4
4	52	48.7	53 3.0	44.7	7.3
		56.0	28.3 39.0	42.0	36.0
			39.8	57.3	43.3

		*	(78)	Σ	
50k	54	11.2	25.2	29.5	7.1
		18.3	55 2.0	27.2	36.8
				57.7	43.9
60k	20 28	22.1	33.6	49.9	5.7
		27.8	29 11.7	45.3	38.1
				55.4	43.8
46	54.6 56.6	47 33.0	2 24.2	39.0	
47	27.6	47 44.7	3 27.7	11.7	
			53.5	20.7	
48	6.6	48 43.0	44.4	31.2	
	37.8	48 55.2	38.2	12.2	
			53.8	43.4	
49	16.3	49 52.8	4.1	31.5	
	47.8	50 5.3	57.1	12.5	
			53.0	44.0	
50	29.2	51 4.8	29.8	31.4	
51	0.6	51 17.7	22.5	12.9	
			52.7	44.3	
50	35.3	52 12.0	42.1	39.5	
52	6.8	52 24.4	36.4	12.4	
			54.3	43.9	
52	44.4	53 20.9	0.3	31.5	
53	65.9	53 32.2	54.1	12.3	
			53.8	43.8	

$5^* 47.0$
 $116^* 47.0$
 $49^* 44.5$

527

reducta diff time 6 sec. $15 = 15 \times 8836$

1	1354	595.8	9478	13540
2	2708	9.5		541.6
3	4062	565.3		541.6
4	5416		5416	595.8
5	6770	5426	6770	54
6	8124	2708	1083	601.2
7	9478	948	62013	
8	10832	57716		5416
9	12186		6012	4062
			13	4
			5999	5463

677.9

410	990	6/1324	210
1820	19.8	22.1	42
	455		240
	26.910		48

453
52.6

48	32.0
49	10.6
50	10.8
50	406.5
51	41.6
52	18.7
53	3.0
53	39.0
54	25.2

Diff. Declin. of Component of Double Star.

Dis.	Reck.	Dis.	Reck.	Dis.	Dis.	Reck.
56 2.4	5.3	25.5	30.9	58.3	21.5	26.5
<u>3.3</u>	<u>6.3</u>	<u>26.4</u>	<u>31.9</u>	<u>59.2</u>	<u>22.0</u>	<u>27.5</u>
.9	1.0	.9	1.0	.9	.5	1.0
Dis.	Reck.	Dis.	Reck.	Dis.	Reck.	Dis.
51.0	54.0	14.2	19.4	0.5	3.7	12.8
<u>51.6</u>	<u>55.0</u>	<u>15.0</u>	<u>20.3</u>	<u>1.4</u>	<u>4.6</u>	<u>13.7</u>
.6	1.0	.8	.9	.9	.9	.9

Dis.	Dis.	Reck.
29.6	42.6	46.0
<u>30.6</u>	<u>43.5</u>	<u>47.0</u>
1.0	.9	1.0

Dis.	Reck.
.9	1.0
.9	1.0
.9	
5	1.0
.6	1.0
.8	.9
.9	.9
.9	1.0
1.0	1.0
.9	1.0
8.3	116.8
.83	.97

	Dist.	Res.	Star	A.C.	20123 20141	20141
A	21422.4	4.6	20123	36.3		
C	38.7	41.0	"	36.4		
A	5 2.0	4.0	20123	36.0	144.2	144.9
C	38.0	40.2	"	36.4	44.4	44.9
A	6 46.2	48.5	20141	36.2	44.5	45.0
	46.9	49.0	20141	36.0	44.4	45.0
C	7 22.4	24.6	"	36.1		
	22.9	25.2	"	36.2		
				1.6	36.20 = Lick Egan	

36.28 20123

.12 20141

Lick Egan = 36.20 s.

Diff R.A. 20123 & 20141 = 12 44.38 0

" " 20123 & 20141 = 12 44.95
.57

$$\begin{array}{r}
 3620 \\
 1444 \\
 \hline
 14650 \\
 5020 \\
 \hline
 14150 \\
 362 \\
 \hline
 50.9868
 \end{array}$$

Equivalent Diameter = 5

22

Aug. 14, 1897

$d^1 a^1$	$b^1 b^2$	$c^1 c^2$
a^3	b^3	c^3
$d^1 d^2$	$e^1 e^2$	$f^1 f^2$
a^3		
$g^1 g^2$	$h^1 h^2$	$i^1 i^2$
a^3	h^3	

W. L. L. L. L.

Observer.

Inst. Coast Survey Micrometer

Means

a^1	$ad^1 47$	7.27	47	7.29	7.28		a^1 to c^1
49	$ad^2 48$	0.20		0.80	0.50	0 93.22	± 4 99.34
	$be^1 54$	55.03		54.78	54.90	6 54.40	
	$be^2 55$	51.68		51.63	51.66	0 96.76	a^2 to c^2
	$ch^1 62$	6.74		6.50	6.62	6 54.96	15 03.62
	$ch^2 63$	3.86		4.38	4.12	0 97.50	

 a^3

50	$ad^1 47$	4.52	4.68	4.60		0 94.04	a^1 to c^1
	$ad^2 47$	98.56	98.72	98.64		6 54.34	15 00.26
	$be^1 54$	52.85	53.12	52.98		0 96.50	
	$be^2 55$	49.29	49.68	49.48		6 55.38	a^2 to c^2
	$ch^1 62$	4.85	4.87	4.86		0 97.14	15 03.36
	$ch^2 63$	1.92	2.08	2.00			

 d^1

56	$ad^1 47$	10.38	11.60	10.99		0 94.54	d^1 to f^1
	$ad^2 48$	5.50	5.56	5.53		6 54.55	15 01.02
	$be^1 54$	60.10	60.05	60.08		0 96.62	
	$be^2 55$	56.90	56.50	56.70		6 55.31	d^2 to f^2
	$cl^1 62$	12.20	11.82	12.01		0 94.57	15 01.05
	$cl^2 63$	6.58	6.58	6.58			

Aug 14, 1877

23

 d^3

Means

57	68.50	ag'	47	12.85	12.85	12.85	0	92.87	d' to f'
		ag ²	48	5.42	6.03	5.72	14	6.58	14 99.45
		ch'	62	11.98	12.62	12.30	0	94.40	d ² to f ²
		ch ²	63	6.29	7.10	6.70			15 0.98

 g^1

64	27.15	ag'	47	15.70	15.67	15.68	0	95.10	g' to h'
		ag ²	48	10.87	10.70	10.78	14	7.25	15 2.35
		ch'	62	18.02	18.04	18.03	0	93.05	g ² to h ²
		ch ²	63	11.02	11.14	11.08			15 0.30

 g^3

65	19.78		47	13.74	14.22	13.98	0	95.09	g' to h'
			48	9.06	9.08	9.07	14	7.47	15 2.56
			62	16.43	16.65	16.54	0	92.74	g ² to h ²
			63	9.10	9.45	9.28			15 0.21

 a^2

47	6.50	ac'	49	33.00	32.90	32.95	0	86.27	a ² to g ²
48	0.52	ac ²	50	19.30	19.15	19.22	5	86.43	14 93.35
		df'	56	5.85	5.45	5.65	1	63.31	a ³ to g ³
		df ²	57	68.92	69.00	68.96	6	57.34	15 01.00
		gh'	64	26.40	26.20	26.30	0	93.92	
		gh ²	65	20.00	20.45	20.22			

24

Aug 14, 1877

b

4 54.58

ac'	49	31.93	32.55	32.24		14 92.94
ac ²	50	17.90	18.43	18.16	0 85.92	
df'	56	7.05	6.93	6.99	5 88.83	
df ²	57	68.80	68.95	68.88	1 61.89	13 6 92.94
gh'	64	25.35	25.50	25.18	6 56.30	
gh ²	65	19.80	19.68	19.74	0 94.56	15 01.58

c

62 6.88

ac'	49	28.04	27.85	27.94		14 97.56
ac ²	50	18.22	18.55	18.38	0-90.44	
df'	56	15.55	15.30	15.42	5-97.04	
df ²	57	68.55	68.50	68.52	1 53.10	13 6 92.94
gh'	64	25.60	25.40	25.50	6 56.98	
gh ²	65	18.63	19.50	19.06	0 93.56	15 00.68

a' to e'

a² to e²

d' to f'

d² to f²

14.9934

15.0362

15.0102

15.0105

15.0026

15.0336

14.9945

15.0098

14.9980 =

15.0349

15.0024

15.0102

0.62492

0.62645

0.62510

0.625425

g' to h'

g² to h²a² to g²a³ to g³

15.0235

15.0030

14.9335

15.0100

15.0256

15.0021

14.9815

15.0036

15.0246

15.0026

14.9325

15.0068

0.626025

0.62511

0.62219

0.62528

b' to gh'

b³ to gh²

c' to h'

c³ to h³

14.9294

15.0158

14.9756

15.0068

0.62206

0.62566

0.62398

0.62528

Aug 14, 1877

25

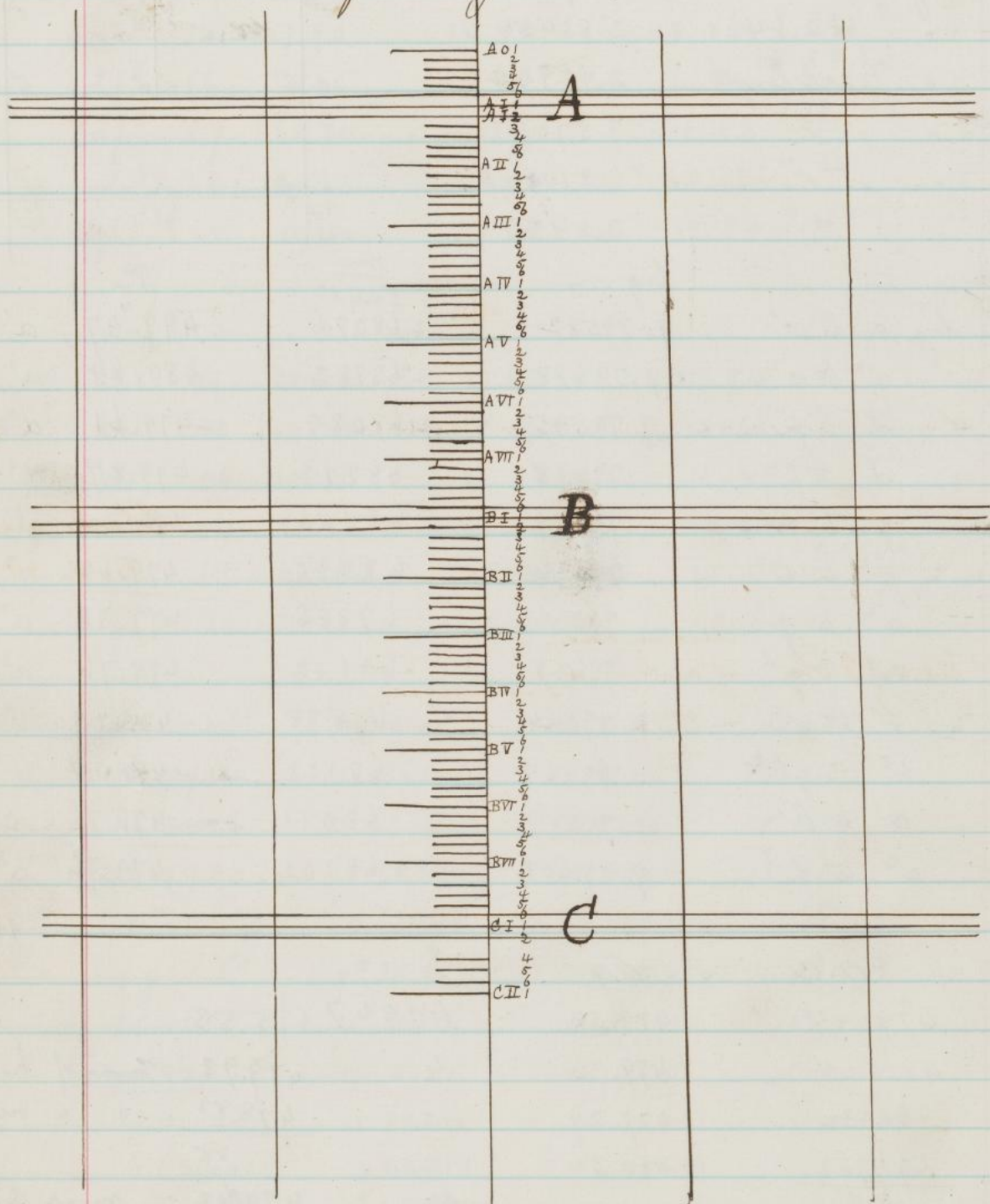
log 1^c in inches	9.59517
" 682.84	2.83432
" Focal length	2.42949
" $\frac{1}{F}$	7.57051
" $\sin 1''$	5.31443
" Σ	2.88494

$\frac{a'}{a^3}$	$\frac{b'}{b^3}$	$\frac{c'}{c^3}$
$\frac{d'}{d^3}$	$\frac{e'}{e^3}$	$\frac{f'}{f^3}$
$\frac{g'}{g^3}$	$\frac{h'}{h^3}$	$\frac{l'}{l^3}$

	log m	log $\frac{m}{F \sin 1''}$	R	
log $a' \text{ to } c'$	9.79582	2.68076	479.47	$a' \text{ to } c'$
$a^2 \text{ to } c^2$	9.79688	2.68182	480.64	$a^2 \text{ to } c^2$
$d' \text{ to } f'$	9.79595	2.68089	479.61	$d' \text{ to } f'$
$d^2 \text{ to } f^2$.79618	.68112	479.87	$d^2 \text{ to } f^2$
$g' \text{ to } h'$	79659	68153	480.32	$g' \text{ to } h'$
$g^2 \text{ to } h^2$	79596	68090	479.62	$g^2 \text{ to } h^2$
$a^2 \text{ to } g^2$	79392	67886	477.38	$a^2 \text{ to } g^2$
$a^3 \text{ to } g^3$	79608	68102	479.76	$a^3 \text{ to } g^3$
$b' \text{ to } h'$	79384	67878	477.29	$b' \text{ to } h'$
$b^3 \text{ to } h^3$	79634	68128	480.04	$b^3 \text{ to } h^3$
$c' \text{ to } l'$	79517	68011	478.76	$c' \text{ to } l'$
$c^3 \text{ to } l^3$	9.79608	2.68102	479.76	$c^3 \text{ to } l^3$

ac	ag		
479.47	477.38	479.47 6 5.53	
480.64	479.76	4	479.92 mean of horizon line
480.32	477.29		478.83 " " " "
479.62	480.04		85
480.01	478.76	6990	479.42 = mean line eq.
32.00	479.76		1414
	478.83		19176.8
	31.92		479.42
	61529.9		19176.8
	983		479.42
			677.9 = diag.
			27.57 Dec 2013
			27.52 2014
			27.36 2015

Explanation of Nomenclature used in the following record.



Notice that reading is towards the omitted line which would have been marked C I 3. This is the position in the telescope when the micrometer head is above the instrument.

Aug 17, 1877

27

Observations of Mars.

W. Upton.

Aug. 17.

cloudy until about 13^h. During occasional
clear intervals, the position of the micrometer
was taken.

Parallel 215.6

block used
Frod. 3437

Power 3

	Sid. t of obs.	Microm. Reading of coincidence	Star 541 Line employed
Mars A	22 47 32	- 15.6	B IV 1

* went below the
measured scale, i.
comparison impossible

C

			Star 619
23 8 20	43	3.3	B V 1
	42	96.6	
		98.8	
		99.9	
		97.5	

* not seen.

Aug. 17. (contin.)

Will. Obs.

Block Brd. 3451

Power 3	Time of obs.	Parallel	215.6	Micr. Reading of coincidence	Star 619	Reading of Star bissection	
Mars C	23 17 30	42	62.5	Line used	B V 1	58 95.7	* almost same
			60.5			42 61.2	8 as Mars
			60.5			16 34.5	
			61.3				
			60.8				
			61.9				
			61.2				
C	23 25 20	48	43.5		B VII 4	48 67.7	
			41.8			48 41.8	
			42.2			0 25.9	
			41.5				
			41.4				
			40.5				
			41.8				
C	23 34 15	56	10.9		B VII 2	58 75.0	
			11.7			56 11.1	
			11.2			2 63.9	
			10.5				
			10.9				
			11.5				
			11.1				

Aug. 17 (contin.)

W. U.

Time of Obs.	Coincidence	Line used	Star bisecton
Powers Tel. 23 58 10	56.78.1	B VII 2	60 2.8
	80.3		56 79.7
	79.5		3 23.1
	77.8		
	80.6		
	81.7		
	79.7		

Wris very
faint with
this power.
Illumination
as strong as
possible

0 6 42	58 61.8	B VII 4	60 6.5
	65.6		58 64.1
	66.2		1 42.4
	63.2		
	64.3		
	63.7		
	64.1		

0 15 25	58 61.9	B VII 4	60 26.4
	61.5		58 63.2
	66.2		1 63.2
	63.5		
	62.5		
	63.6		
	63.2		

Aug. 17, 1877 This date known to be Aug. 18.
 Search for Hall's satellite of Mars.
 At ~~22~~ $22^h 20^m$ sid. time small star s.p.
 Mars seen by A. Searle when Mars is
 behind the ring in ring mic. eye-piece
 No. 4 (power 373). Estimated position
 angle 260° , estimated distance ^{from limb} 40"
 of Mars, supposing Mars to be 25" across.

At $22^h 35^m$ sid. time E. C. P. sees
 an object; distance from nearest point of
 Mars 2.8 times diameter of Mars;
 position s.p. about 240° .

At $22^h 40^m$ sid. time W. Upton estimated
 position of object s.p. Mars 250° , distance
 twice the breadth of the ring or a little more
 than twice the diameter of the planet from the
~~nearest point~~ nearest point on the limb,
 say 60".

All these estimates independent.

Will. attempted to get a transit but
 fog came on before 23^h sid. time.

Approx. position of Star $23^h 24^m 47^s$ $\delta - *$
 $-10^\circ 43' 26''$ $+ 4.45''$

Star 463 s.p. Mars $20^\circ, 7'$ is near by.

$- 24''$

Aug 19, 1877

31

Copy of Telegrams.

(1) To Alvan Clark & Sons.

Discovered by Prof. Hall. Look for satellites of Mars tonight from 11 to 3. Distance from twenty to ninety seconds; period twenty nine hours. Telegraph result immediately; send word to Harvard Obs.

(Received Aug. 18 P.M.)

John Rodgers.
Asst. U.S.N. Obs.

(2) Washington, D.C. Aug. 19, 1877.

Two satellites of Mars by Hall at Washington; first - elongation west August 18, eleven hours Washington. Distance 80 seconds, period 30 hours.

Distance of second - 50 seconds.

Joseph Henry.

Calculations for Aug. 19.

Star seen last night, if not a satellite should be found $4^{\circ} 33''$ north of Mars, following it 34° .

Aug. 19, 1877, 11^h mean time.

Diameter of ring in eye-piece used last night found approximately from a star near the equator to be ~~6~~ 6'. This is the inside diameter. Hence, Mars being set at the south point of the ring the star should cross about $\frac{2}{3}$ to $\frac{3}{4}$ of ~~the~~

Aug 19 1877

Aug 19th 1877 Examination of Mars for transit

Transit of \star		near equator	for diameter of ring		
		outer	inner		
2	40.0	48.9	27.9	36.7	0.4
3	0.8	14.4	48.8	30	26.6
	20.8	25.5	20.9	26.3	26.3
	2625 15	393.75			
	20.85 x 15	312.75			
	5.4				

2.7

135

40

43.5

width of ring by Vernier 2.6 2.7 2.9 2.8

2.6

2.7

2.8

2.9

2.6 = clear

Continued from last page.

The ring's diameter lower down, 34^s
 later, has looked for in this position for
 50^s after transit of Mars both by E.C.P.
 & A.S. without success. Moonlight pretty
 bright however.

Mars being behind ring, E.C.P.
 noticed dark and light rays proceeding
 from it as from the sun. Pos. angle 250° to
 290°

Aug 19, 1877

33

After long looking about $11\frac{1}{2}$ mean time, H. P. could see nothing about Mars that looked like a satellite, but saw a faint star about $4'$ from Mars n. p.: pos. angle say 310° .
E. C. P. also saw this star.

Observed transits of this object were indicated with placing Mars on parallel with observed at same time transits of 463

De.
 19.6
 * 33.4
 13.8
 time by

time by stop watch 13.7
 Diff obs. by watch 4 m.
 22h 7m. A.S. obs.

22h 45.8 8.0
 58. ± 11.3
 12.2 8.3

Stop watch 13.6

56.1

Stop watch $28.0 - 13.6 = 14.4$ s

10.4
 143.5

22h 14m 34.8
 14 47.6
 12.8

$40.3 - 28.0 = 12.3$

137.5

13.6

14.35

12.55

Aug 19, 1877

Aug. 19

E.C.P. ~~to H~~ ¹² ~~14~~ 6 ¹² ~~14~~ 6

above diameter

$$\begin{array}{r}
 22h \quad 87.8 \quad 126 \\
 33(?) \quad 26.2 \quad 40.5 \\
 \hline
 14.3
 \end{array}$$

$$\begin{array}{r}
 22h \quad 34(?) \quad 18.5 \quad 38-46.5 \quad \delta = 7.6 \\
 32.0 \quad 38-59. \quad 12.6 \\
 \hline
 13.5 \quad 12.5 \quad 5.0
 \end{array}$$

~~Object faint.~~
 U. U. sh.

$$\begin{array}{r}
 16.9 \quad 8.4 \quad 50m \quad 33.1 \quad 8.4 \\
 31.0 \quad 12.6 \quad 46.1 \quad 12.9 \\
 \hline
 14.1 \quad 4.2 \quad 13.0 \quad 4.5
 \end{array}$$

$$\begin{array}{r}
 51 \quad 37.8 \quad 8.4 \quad 52 \quad 48.2 \quad 8.3 \\
 51 \quad 51.3 \quad 13.1 \quad 53 \quad 0.8 \quad 13.3 \\
 \hline
 13.5 \quad 4.7 \quad 12.6 \quad 5.1
 \end{array}$$

$$\begin{array}{r}
 53 \quad 50.7 \quad 8.3 \quad 14.1 \\
 54 \quad 3.8 \quad 13.2 \\
 \hline
 13.1 \quad 4.9
 \end{array}$$

Aug. 19, 1877

35

Aug. 19 Summary.

a.s. 1375
13.6
1435

4.0

3.3

z.c.p.

12.55 13.6

14.3

13.5

3.6

4.8

—

W.U

12.5 13.4

14.1

13.0.

13.5

12.6

13.1 13.35.0 4.9

4.2

4.5

4.7

5.1

4.9 4.7

36

Aug 19, 1877

Power 2 - Clock 3451 Fod.

Aug. 19 -

Parallel 213.8

W.L. Oho.

Time.		Star position		Coincidence		* H63 Line used
Mar B	23 35 38	66 76.5	67 6.2	6.2	VI 5	
		67 5.2		3.3		
		0 28.7		6.5		
				4.6		
				5.15		
	39 37	66 93.5	67 6.9	6.9	VI 5	
		67 8.3		7.8		
		0 14.8		10.0		
				8.4		
				8.28		
	44 27	67 36.7	67 41.5	41.5	VI 5	
		41.1		41.4		
		0 4.4		41.5		
				40.0		
				41.1		
	49 2	67 61.2	68 51.5	51.5	VI 6	
		68 52.0		52.2		
		0 90.8		52.4		
				51.8		
				51.98		
	53 24	67 68.8	68 56.6	56.6	VI 6	
		56.9		56.2		
		0 88.1		57.8		
				56.9		
				56.88		

Aug. 19	Star	Time	* 423 Coincidence	Line used	Possible that
Mars B	89 92.5	0-1-58	90 11.0	B III 2	this is not
	90 10.48		9.5		* 423, a
	0 17.0		10.5		fainter * f. by
			<u>10.9</u>		about 10.5
			10.48		
	90 35.7	0-15 10	90 35.7 51.6	B III 2	Mars
	90 50.9		49.8		disc very
	0 15.2		50.7		poorly de-
			<u>51.5</u>		fined.
			50.9		
			Becomes foggy at 14 h		

Continued search for satellites until 15^h 30^m
could see at intervals the star observed earlier
but no others nearer the planet. Air full of fog.

Aug 21, 1877

Aug. 21

Distances between ruled lines of scale, measured
with stage micrometer in W.A.R.'s microscope

W.L. Oth-

192.8	192.0 ✓	193.8	192.8
194.2	193.0 ✓	192.8	* 194.0
192.5	* 193.0 ✓	194.0	194.0
193.0	192.0 ✓	193.8	192.5
break	193.5 ✓	* 192.8	193.8
** 192.5 ✓	192.8 ✓	194.0	194.8
** 193.0 ✓	192.0 ✓	194.0	** 192.0
** 192.5 ✓	193.5 ✓	193.0	** 193.0
192.0 ✓	* 192.8 ✓	193.8	** 194.0
193.5 ✓	192.5 ✓	194.0	193.8
193.0 ✓	193.0 192.5	* 193.5	192.8
192.0 ✓	192.8 ✓	192.8	194.0
* 193.0 ✓	192.0 ✓	194.0	193.5
193.8 ✓	192.0 ✓	193.2	
192.5 ✓	* 193.0 ✓	192.8	
192.8 ✓	192.5 ✓	194.0	
193.5 ✓	192.0 ✓	* 194.0	
192.5 ✓	193.0 ✓	192.5	
* 192.5 ✓	193.0 ✓	193.8	
194.0	** 191.8 ✓	193.8	
193.0 194.0	** 191.8 ✓	193.8	
193.0 193.0	** 192.5	193.0	
191.5 ✓	** 192.5	193.2	
193.0 593.5	** 191.5	* 194.0	
193.0 593.5	192.5	193.5	
* 192.0 ✓	194.0	192.8	
193.0 ✓	193.0	194.5	
193.0 ✓	193.5	193.8	
192.5 ✓	194.0		

Aug 21, 1877

39

Aug. 21

It became partially clear about 12^h 45^m.
 Tried for upwards of half an hour to obtain
 comparisons of Mars with star No. 423 but was
 unsuccessful, it becoming entirely cloudy.

W.U.

Aug 22d. Satellite of Mars observed by
 W. A. N. G. Clark. W. U. and E. C. P.
 at 11.50 E. C. P. was so about following at dist 20"
 G. C. estimates distance as $\frac{2}{3}$ diameter of the
 planet.

12.30 W. U. estimates dist at .5 at 22h³⁵ at 22h³⁵
 1.30° = true angle

22 40 E. C. P. estimates distance at 10" pos. ang. 30°

Unsuccessful attempts were made to obtain
 transits.

Aug. 22, 1877

W.L. Obs.
block 3451 Ford.

Power	A	time	Star	Star time	Star	453	Coincidence	Line used	Pos. Circ
Mars	C	23 43 30		75.586		76.192		B IV 2	215.8
				76.192		184			
				0.606		194			
						196			
						76.192			
		49 15		75.695		76.127		B IV 2	
				76.126		123			
				0.431		127			
						129			
						76.126			
		55 0		75.618		75.931		B IV 2	
				75.936		939			
				0.318		949			
						923			
						75.936			
		59 38		75.779		76.730		B IV 3	
				76.734		723			
				0.955		741			
						741			
						76.734			
		0 5 10		75.820		75.925		B IV 2	
				75.930		928			Disk not ^{alt} defined
				0.110		942			
						923			
						75.930			

Aug. 22, 1897

Will. Obs. 41
Block 3451 Ford.

time	coincidence	556 Star time	571 Star time	Line used
Mars C 0 23 0	0.5868	9.894	19.512	A I 4
	.576	0.587	0.587	
	.585	9.307	9.925	
	.600			
	0.589			

0 32 15	6.600	7.153	19.614	A II 4
	598	6.599	6.599	
	614	0.554	13.015	
	583			
	6.599			

		Line used	556 Star time	571 Star time	Line used
0 42 0	6.605	A II 4	7.575	20.148	A IV 6
	593		6.601	20.591	585
	605		0.974	0.443	600
	602				574
	6.601				20.591

Planet and stars having become very much blurred, observation here ended - at 14^h 40^m M.T.

424
 Aug. 23/1877
Friday

Aug. 23, 1877. Luman eclipse.

Moon rose partly eclipsed ^{when first seen} and in haze & patches of cloud.

In Bowditch comet-seeke the whole limb of the moon could first be seen at 18^h 35^m 23^s, time of South Clock. Observer A. S. Clouds hindered observation, but the obscuration ^{of the limb} seemed due to the earth's shadow, not to the clouds, during the few minutes preceding the time above stated.

Eleven minutes later there was no perceptible penumbra in view.

clouds prevented observation of Mars

Aug. 24 Observed Mars during clear intervals from 10^h to 12^h but could not see any satellite. Moon almost in conjunction with the planet and about 15° north.

Aug 24, 1877
 583
~~586~~

43

	time	coincidence line	Star time
Mars d	22 44 20	9.637	AVI 4
		646	10.093
		654	<u>9.648</u>
		658	0.445
		655	
		639	
		<u>9.648</u>	

22 58 5	9.582	AVI 4	—
	585		forgot to record
	585		
	<u>583</u>		
	9.584		

453

Mars B.	23 22 20	lost	—
	23 30 10	lost	clouds

Abandoned work at 13^h 15^m

Aug 27, 1877

Aug. 27,

Satellites of Mars

	For. 3451	t	Dist	Ang	Dist	Ang
Rogers, Mt						
Searle, it			40 ^{from center}	255	40	255
Uplm, W	21	15	^{from limb} 60	245	20"	250
Pickering, E. b.						

R observed transit dist 1.75 ^(?)

Searle A $21^{\circ} 45^m$ - dist $45''$ from center 230°
 Satellite certainly farther south and probably farther off

E. b. P. obs. photometer

Satellite invisible; Certainly fainter than

156.1 very bright

159.6 — " —

167.8 — " —

159.5 — " —

166.1 — " —

252
 158.6
 167.0
 8.6

11.3

Aug 27, 1877

45

Aug. 27

Satellite not seen. Artificial star reduced
nearly to brightness of satellite as recollected.

A.S. Obs. photometer.

157.5	165.6
158.4	165.2
158.5	165.3
158.1	166.3
157.9	167.0
158.08	165.88
	8.08
	7.80
3.90	

E. C. P. Obs.

Satellite seen at interval,
[245.2 rej.] but the
measures are as before.

247.4	255.0
248.5	254.9
248.9	254.8
245.9	255.1
249.0	255.0
248.8	254.96
248.08	48.08
	1.88
3.44	

U U obs.

96.8	62.5
78.7	67.5
76.7	65.0
78.2	66.8
75.6	69.0
76.1	68.1
33.3	36.6
76.6	67.28
67.28	
9.38	
4.69	

Aug 28, 1877

Aug. 28.

Planet (112) 17 30 49 -25 18

Comparison Stars

Q. Arg. S.	16776	(7)	17	19	22	-25	48	19	}
	16777	(6.7)	17	19	22	25	48	16	
	16810	(9)	17	20	44	25	5	31	
	16817	(7.8)	17	21	6	25	22	43	
	16818	(6.7)	17	21	6	25	22	45	

	17047	(9)	17	33	0	25	32	10	}
	17048	(8.9)	17	33	1	25	32	11	
	17205	(8.9)	17	40	11	25	7	37	}
	17206	(9)	17	40	11	25	7	35	

Bright Stars for Position of Sat.

~~Aug 28th 16784 (4) 17 19 30 29 43 27~~
~~Aug 30th 17 20 50 29 40 27~~

(112)	30th.	17	32	10	-25°	14'
Sept	2d		35	31	-25°	9
	3d		36	32	25	8
	4		37	34	25	6
	5		38	35	25	5
	6th		39	36	25	4
	7th					
	8					
	9					
	10					
	11	45	6	24	56	

Aug. 28 1877

47

Aug 28th 1877.
Measurement of Actinon

18h 28 time by watch.

26° 12.5 Civil Ready.

23 11.8

3° 0.7

Dec
Subtr add to Declination

18	28	0
17	33	18
<hr/>		
	54	42
12	54	30

Time transit 16818 to find diameter of fil
9.5 1 34 85 seconds = about 75^{sec} on equator
on 18

A. S. Oto
W. Ric-

Same series reads 107° 30'
hd. watch

16817x	19	6	33	2' S of cent.	
*	12	55.5		1' N of cent	10 m.
*	14	42.5		2' N " "	10 m
PL2	16	8.5		2-3' N " "	12 m
PL2	17	30		6' N " "	"
	17	46.5		8' N " "	"
	18	0		2' S " "	12
	18	13.8		2' N " "	"
	18	56.5		8' N " "	10 m

These transits were taken with the smooth side of the notched bar, set on an hour circle. The reading, 107° 30' above seems to refer to the setting for the notched bar on a parallel of declination; in that case, the reading during the observations was 17° 30', as I think I remember it was; and the inclination afterwards given to the bar (see next page) was 7° 55', the reading being 125° 25'. (Noted by A. S., Aug. 31, 1877.)

Aug. 28, 1877

Frod. 3451

Supp. Pl 19 37 31.5 5' N of centre 12+
 38 26.0 3' N of " a little fainter 12-
 17047 Not seen.

~~Telescope~~ Telescope set farther south, to take in 17047.

16817 19 41 26.0 1' S of centre 7m
 * 47 48.0 2' N " " 9.10 m
 * 49 35.0 3' N " " 10 or less
 Pl? * 52 0.5 3' N " " 12 less
 * 52 23 5' N " " 13
 17047 * 53 22.5 9' S " " 9
 53 48.8 9' N 9.10

Pl? * 20 1 58.5 17047 not seen

~~Pl? *~~ 20 7 29.0
 Pl? * 20 9 54.5
 17047 11 16.2

Stop Watch

Pl? * 0^m 0^s 0

17047 1 13.3

25° 25' reading of position circle; transits over smooth side of notched bar as before.

Pl? * 0^m 0^s 0
 1 13.8

Could not incline wires any more and get transits of both.

This was probably not (112) but some star (A.S. Sept. 5, 1877).

Hears at 9^h ¹³/₄ mean time. Obs. A.S.



Aug 28, 1877

19

U. U. of ~~space~~ satellite has 2 diam
 distant point angle 270° almost exactly.
 2d point angle 245° 8" from last ~~doubtful~~
 confirmed

U. A. R. observed pt. brightness of satellite

204.2 200.0

206.2 2

204.6 7

204.6 207.4

204.6

20.3 27.0

$$A \text{ and } B \text{ are } = (ap + q - ar)$$

$$p \text{ and } q \text{ are } = ar \text{ and } ar$$

$$r \text{ and } p \text{ are } = q \text{ and } q$$

$$[(ap + q - ar) - ar] = ar$$

$$ar - (ar + ar - ar) =$$

$$ar - (ar + ar) =$$



Aug 29, 1877

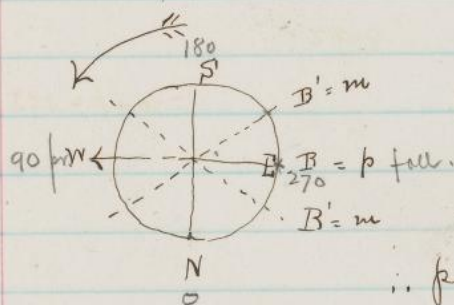
1877 - Aug 29.

S. W. obs.

Mars. Telescope W.

Obj. Eyep. = 399 dia.

Position Microm. with the glass plate ruled by
Mr. A. Rogers.



$(m - p + 90) = \text{angle from N}$

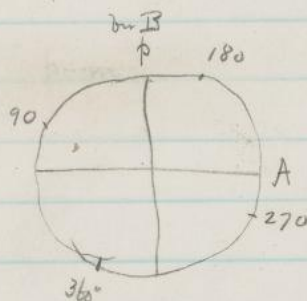
where $m = \text{micrometer reading}$

and $p = \text{position of zero reading} + 90$

$\therefore \text{position angle} = \{360 - (m - p + 90)\}$

$$= (360 - 90 + p) - m$$

$$= (270 + p) - m.$$



For tel. W. & Microm. at A, set the reading of the Ver B = p
when the star remains bisected along the transverse wire.

Evidently then the m_B will read $p + 90$ when the microm. head
is turned toward 270° & 360° to the zero of position.

Putting $m = \text{the reading on star}$ we have

for Tel. W. Microm. head W. $p + 90 - m$, when the Microm. at
reading on the secondary is greater than when on the
primary.

Aug 29 1877

53

1877. Aug ~~29~~ ^{28^d} ~~14^h~~ ^{13^h} (28^h 13^m)

S. W. obs.

observed satellite of Mars as follows:

	3451			Microm		vernier	
Corr to	H ^h 47 ^m	10 ^s		60.363 8.530	B	139.7	(25 ^h 25 ^m 8.5 ^s) not much more than an estimate.
Cham. 3451	23	54	20	60.280 8.447	B	147.5	250.7
= - 20 ^s	+2	0	50	60.535 8.702	B	144.5	253.7 close approx.
	0	5	10	60.525 8.682	B	146.8	251.4
	25	0		60.75? 8.92	B	145.3	252.9 close approx.
270 + p = 398.2							

Zero of position B = 128°.2 at 12^h 27^m S.D.
 Satellite is S. p. Mars P. ang $\frac{360}{107} \pm$
 253°

Center of Mars reads 51.833 (Microm.)
 51.833

Achromatic eye piece - Mars circled behind the field diaphragm. Definition good, but marred by glass plates (S. W. thinks) in the micrometer.

Bisections difficult and clock work either not adjusted to Mars motion or running poorly.

Discontinued owing to poor definition at 2.30 am
 S. W.

Aug 29, 1877

55

1877. Aug 29^d. 15^h

S. W. obs.

Satellite of Mars.

3451	1 ^h	17 ^m	30 ^s	56. 56. ^r	645	4.888	121.2	275.3
Corr = - 20 ^s		30	45		57.333	5.576	121.5	275.0
		34	15	(57.?)	57.109	5.352	125.5	271.0
		38	0		57.232	5.475	123.2	273.3
		45	0		57.557	5.800	120.7	275.8
		54	0		57.573	5.816	127.4	269.1
		59	15		57.628	5.871	126.3	270.2

at 2^h 23^m $126^{\circ}.5 = B$ for zero of pos.

270 + p

396.5

51.775

2^h 30^m

51.740

51.757

172

51.757

for coincidence

Satellite almost exactly preceding, and is fainter than last night perhaps because nearer its primary.

Definition good at middle of observations but poor at beginning and end. The clock work runs irregularly and through that cause and a considerable dead motion in R.A. the greatest chance of error lies in the uncertainty of regarding Mars as bisected even in its few seconds absence from the field while the satellite is bisected.

The polar spot and the contrasting greenish ^{blue} & reddish tints are well marked in the 15^m and in the finder as well.

No other point of light seen in the neighborhood which the observer suspects to be a satellite.

Apparatus same as last night. Discontinued at 4.10 a.m.

S. W.

Aug 30, 1877

Aug. 30, 1877. Mount. (112)

Hour Circle set at ^h13-^m2. Chronometer ^h18-^m37
Chronometer ^h18-^m38-^{sec}12

RA	17	33	40
	18	38	12
	1	4	32
	1	<u>32</u>	
			22325

Obs on 16818 Dec $28^{\circ} 22'$

18h 55m	18 52.5
17 21	
1 34	
2	

~~11h 31m 28s~~

(112) R.A. = 17 32 10 25 17
 corrected = 17 31 51 25 18
 correction already applied?

16776 Hare's Argo 1h 46m
 19h 42 57.8
 17 19 22.
 1 50 35
 4
 not the star

Aug 30, 1877

57

How Angle 1h 5^m 2

$$\begin{array}{r}
 RA \quad 17 \quad 19 \quad 22 \\
 \quad \quad 1 \quad 52 \\
 \hline
 19 \quad 11 \quad 22 \\
 19 \quad 11 \quad 53
 \end{array}$$

$$\begin{array}{r}
 19 \quad 17^m \quad 56 \\
 \quad \quad 1 \quad 22 \\
 \hline
 19 \quad 48 \\
 \quad \quad 1 \quad 45
 \end{array}$$

$$\begin{array}{r}
 1677.6 \\
 1677.6817 \\
 \hline
 1677.6817
 \end{array}$$

$$\begin{array}{r}
 19 \quad 28 \quad 13.8 \\
 19 \quad 29 \quad 34.1 \\
 \quad \quad 1 \quad 20.3
 \end{array}$$

transit of ? (112)
 * 17047
 Diff RA
 too dist.

$$\begin{array}{r}
 19 \quad 32 \quad 3.8 \\
 32 \quad 45.4 \\
 \hline
 41.6
 \end{array}$$

rather

$$\begin{array}{r}
 33 \quad 7.6 \\
 33 \quad 23.2 \\
 34 \quad 5.0 \\
 \hline
 41.8 \\
 57.4
 \end{array}$$

Aug 30, 1877

Width of field

$$\begin{array}{r} 19 \quad 35 \quad 30.6 \\ 19 \quad 36 \quad 16.7 \\ \hline 46 \end{array}$$

92 = dia. field

$$cat = .9026 \times .90 = .81.2345$$

Cur * on left hand side of (22) at 16.31 ^{apert}
at 19 h 40 m

$$\begin{array}{r} 81.23 \\ 15 \\ \hline 4061.5 \\ 81.23 \\ \hline 1218.4 \end{array}$$

20' 18" = diam. field

$$\begin{array}{r} 19 \quad 46 \quad 38 \quad 17047 \\ 46 \quad 31.3 \\ \hline 27.5 \end{array}$$

Comparison by * @ following 17047. 27.4 s and
19' 20' 20" h. full as bright as long as
than 17047.

$$\begin{array}{r} 46 \quad 48.0 \\ 15.3 \\ \hline 27.3 \end{array}$$

Cur * will be dominated by @ 1st of two
small stars by (B) instead by c

Aug 30, 1877

59

* (2) 1 5-2

	b	c	a
inclined line 53	29.0	53.49.7	55 3.8
vertical	49.4	54.4 5.4	55 10.1

$$\begin{array}{r} a-b \quad 16.0 \\ a-c \quad 1^m \quad 20.7 \\ \quad \quad \quad 4.7 \end{array}$$

repeated

b inclined 56 48.4 b vert. 14.2 a inclined 5-8 24.5

c inclined 57 9 7 c vert. 30.0 a vert. --- 40.1

$$\begin{array}{r} a-b \quad 20.3 \\ a-c \quad 1 \quad 25.9 \\ \quad \quad \quad 10.7 \end{array}$$

repeated as last time

59	40.7	0	6.3	1	18.8
60	1.7	0	22.3	1	31.6

$$\begin{array}{r} a-b \quad 20.5 \\ a-c \quad 1 \quad 25.3 \\ \quad \quad \quad 9.4 \end{array}$$

541	54.4	2	19.7	3	29.5
2	14.3	2	35.3	3	44.8

$$\begin{array}{r} a-b \quad 21.0 \\ a-c \quad 1 \quad 25.1 \\ \quad \quad \quad 9.5 \end{array}$$

5	5.0	29.0 ±	6	40.2
	25.7 ±	46.0		55.2

$$\begin{array}{r} a-b \quad 24.9 \\ a-c \quad 1 \quad 9.2 \end{array}$$

Mean of last 4

$$\begin{array}{r} a-b \quad 1 \quad 25.30 \\ a-c \quad 1 \quad 9.55 \end{array}$$

18 Aug 30, 1877

Repeated E. C. P. obs.

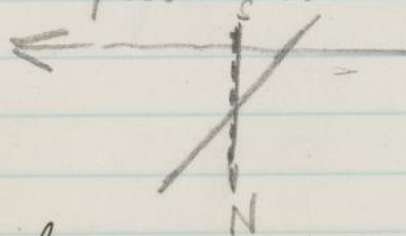
Ind. 20 ^h 12 ^m 36 ^s .0	12 ^m 57 ^s .0	14 ^m 00 ^s .6	a-b 1 ^m 24 ^s .2
Vert. 13 ^m 3 ^s .0	13 ^m 17.5	14 27.2	a-c 1 9.7
19 ^m 24.6	19 ^m 45.0	21 ^m 0.0	a-b 1 ^m 24 ^s .3
19 ^m 50.2	20 ^m 5.4	21 ^m 14.5	a-c 1 9.1
21 ^m 52.8	22 ^m 13.7	23 ^m 28.0	a-b 1 ^m 26 ^s .0
22 ^m 18.0	22 ^m 34.3	23 ^m 44.0	a-c 1 ^m 9.7

Mean of 1st two 1^m 24^s.25
1 9.40

During the preceding measures the notched bar was vertical (or coincident with an hour circle) the position circle being set to the readings 210° & 30°.

A star ran on the notched bar when the reading was 120°, previous to the observations. The notched bar, during the observations, was set so that the disappearances, which were observed, took place on the smooth side of the bar. The angle between the two bars is 45°, about.

The field was as follows: stars in southern part of field.

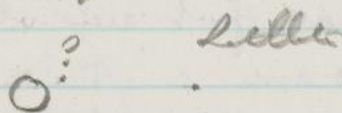


The objects observed seem to have been stars. See page 66.

Aug 30 1897

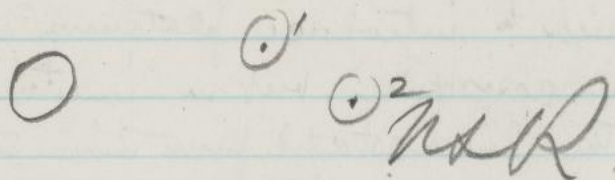
61

Satellites of Mars.



* E.C.P.

E.C.P.



At $21^h 12^m$ by F. 3451
 E.C.P. observes inner satellite $\frac{4}{10}$
 distance of outer one; pos. angle
 nearly the same.

W.A.R. says pos. angle of inner sat.
 about 5° more than that of outer;
 distance of inner sat. from limb
 about $\frac{2}{3}$ diam. of planet.

E.C.P. observes satellite 2



The Seagram observes 2nd sat. 1 $270^\circ 12''$

Aug 30. 1877

Aug 30. 1877.

App. same as last night. S. W. obs.
about 12.30^{min.} a black spot seen which was not
visible about 7.30 am. — The greenish tints well
marked in contrast to the reddish tints below (in the
field). Clock work adjusted from time to time
by altering length of clock pendulum.

Tried to introduce platinum wires with Buffs
Beegs assistance, but in inserting the lines in the
wg the lines started from thin solder and could not
be used. Used lines in glass as usual.

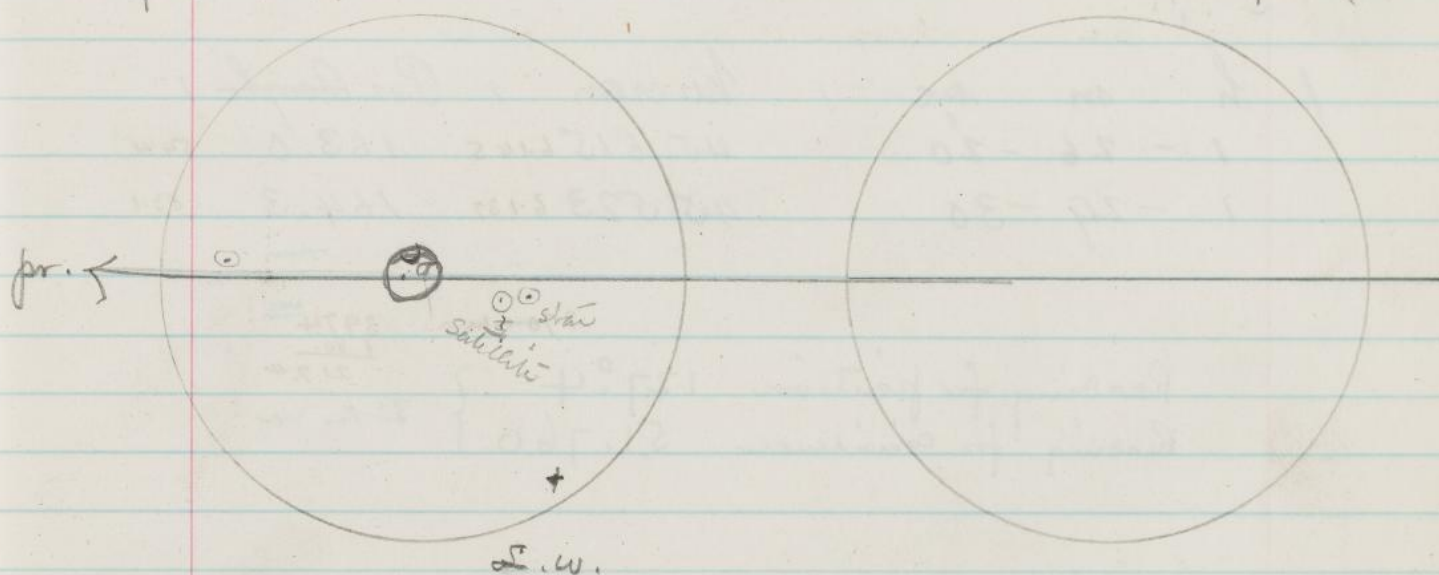
Definition good at intervals and the satellite more
difficult to measure than last night.

Aug 30, 1877

63

Aug 30. 1877.

S.W. obs. E.C.P. & T.S. Squarm & cnsn



Chron. 3451			Main	Pos Angles to center of star		
Cm = -20 ^s Reject	23	52	400	43.440	8.220 154.5	52.9 only doubtful
		56	30	47.295	4.465 156.2	61.891
	0	10	40	44.870	6.890 157.9	59.5
		14	45	44.288	7.472 157.9	± 2° 59.5
		17	5	44.278	7.482 154.4	wright 4 against 63.0
		20	50	44.257	7.503 157.5	59.9
		24	0	44.297	7.463 158.7	58.7 and possibly good
		27	50	44.145	7.615 157.2	60.2
oh.	37	50	50	44.217	7.543 157.4	60.0
oh.	50	55	55	44.665	7.095 158.7	58.7
oh.	57	40	40	45.025	6.735 160.5	56.9
1h.	1	10	10	45.170	6.590 161.3	56.1
1h.	4	25	25	44.923	6.837 161.3	56.1
1h.	11	10	10	44.945	6.815 161.5	55.9
1h.	15	35	35	45.110	6.650 163.4	54.0
1h.	18	30	30	45.120	6.640 164.4	53.0
1h.	21	25	25	45.202	6.558 161.7	55.7

64

Aug 30, 1877

1877. Aug 30.

h	m	sec	microm	Pos. Angle
1	- 26	- 20	45.615 6.145	163.0 54.4
1	- 29	- 30	45.523 6.137	164.3 53.1

$270 + m = \frac{397.4}{1.80.}$
 $\frac{217.4}{3 \text{ A. m.}}$
 Reading for position $127^{\circ}.4$
 Reading for coincidence 51.760

Sept. 2, 1877

Sept 2d 1877 (18)
54 0 Ready of line column

	b	c	a
Dist 0	25 ⁺ 23.3	38.2	26 47.4

a-b	1	24.1	} ∴ Object observed Aug 30th was a star.
a-c	1	9.2	

Cut star 19 30 10.2
~~30 50.2~~

A lead #	30	52.7	3' north.	9 ⁺
	31	33.8		
	31	42.0	low.	8.5
	31	58.7	25.2	
	32	21.4	47.9	all about is right declin.
	32	33.9	60.4	

r	35	18.8	40	23.9
		27.4	36.8	7.9
		43.8	53.7	24.8
	36	7.4	17.5	48.6
		20.5	30.4	61.5

36	46.8	55	85
	55.3	85	86
37	12.2	25.4	85
	35.2	48.4	79
	48.6	61.8	15
			8.4
			25.1
			48.4
			61.5

Sept. 2, 1877

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0	17.5	0.0	35.6	
8.4	55	8.3	44.8	9.2
25.7		25.2 lat.	1.6	26.0
48.4		48.4	24.3	48.7
61.6	56	61.4	37.9	62.3

actinoid not found.

70

Sept. 2d. 1877.

$$15/456 \text{ (3)} \quad 26^m \quad 26/456 \text{ (18)}$$

$$456/15 \begin{array}{r} 133 \\ 1368 \\ \hline 1820 \end{array} \quad \begin{array}{r} 186 \\ 182 \\ \hline 4 \end{array}$$

$$15/800 \text{ (53)} \quad \begin{array}{r} 75 \\ 01 \end{array}$$

A.S.B.

11^h 30^m

B.B.P.

12 15



* prob. star.

Cir
Sun 3451
= - 25²

Chron.	Microm.	Pos.	Obs.
23h 10m 40s	60.168 ^{8.41} + 59	134.4 263.0	S.W. preceding satellite
18 40	59.984 ^{8.22}	135.1 262.3	" "
33 50	59.210 ^{7.45}	137.6 259.8	Sw
46 0	? clouds	142.5 254.9	Sw
57 50	59.245 ^{7.49} dmt	? ?	S.W.
0 6 50	clouds	141.8 255.6	a. clouds for
22 30	59.162 ^{7.40}	clouds	a. clouds
[31 30	60.524 ^{8.76}	cloudy]	S.W.

Assume that reading for position is 129°.4

" " " " " " 51.76

Owing to clouds the reading for position is assumed same as last observation - though the micrometer has been removed in the interval.

$$\begin{array}{r} 290 \\ 129.4 \\ \hline 399.4 \end{array}$$

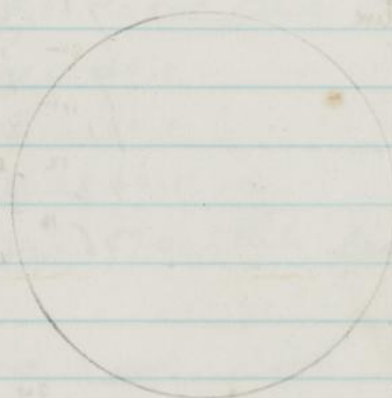
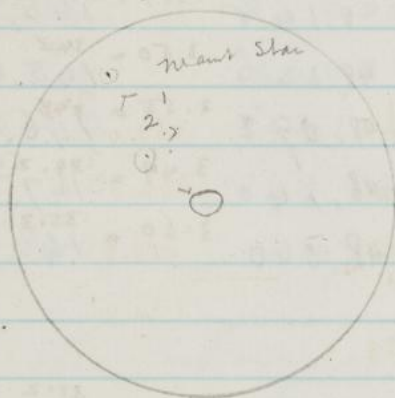
Note May 20, 1880. In the present reduction, the observations by Mr. Clark on this page are omitted and the last observation (60.524) is inserted in brackets.

Sept. 3, 1877

71

Sept 3rd 13^h

1.30 PM Examined Mars carefully but no object near or bright enough to be a satellite. Definition bad - a slight haze in the Sky.



S.M.

72

Sept. 4, 1877

Inner Sat.

Sept. 4, 1877. 12.0 Sun, excellent.
 Moon in full behind green glass

Cor. to Chron 3451

- - 35°

Parallax zero of Position
 = 128.4

270.0
 398.4
 180.
 218.4

true s.t.
58m 45.

11 59 20

12 3 5

5 05

7 35

9 10

11 40

13 20

15 40

Position Obs
 48.19 3.45 = 33.8 144.2 74.2 S.W.

48.220 3.42 = 33.5 144.2 74.2

48.092 3.55 = 34.8 144.3 74.1

8.148 3.49 = 34.2 145.3 73.1

48.136 3.50 = 34.3 145.6 72.8

48.092 2.55 = 34.8 146.4 72.0

48.148 3.49 = 34.2 147.3 71.1

48.040 3.60 = 35.3 148.9 69.5

34 30
 35 5

36 55
 37 30

42

42 15
 42 50

43 25
 44 0

44 55
 45 30

45 05
 46 40

50 55
 51 30

48.458 3.18 = 31.2 151.3 67.1 E.C.P

150.6 67.8 E.C.P

(Lays time)

48.363 3.28 32.1 153.6 64.8 S.W.

48.420 3.22 31.6 154.7 63.9 S.W.

48.434 3.21 31.5 156.8 61.6

48.518 3.12 30.6 157.0 61.4

48.695 2.94 28.8 156.7 61.7

Note May 22, 1880. No correction such as is given in the pencil note below was apparently applied to the observation made at 44m and it seems somewhat doubtful whether the observer meant that the position angle, or the reading of the position circle, should be increased.

+ Position angle should be increased 1° not because of error in reading but because position was estimated incorrectly.

Sept. 4, 1877

73

Microm. Head West, Satt West in field.

Antic Latitude.

[Note May 17, 1880. The first time
should be 1 31 55 if the
chronometer is fast 35°.]



	Time.	Microm. Ang.	Obs.	Remarks.
1 ^W	31 25	53.64	60.3	microm. not nearly
1	32 30	43.92 9.72 = 158.6	60.3	as good as then of
				the inner latitude.
	34 40	43.72 57.91 = 158.5	59.5	Difficult
Take zero of	38 37	43.60 58.03 = 157.8	60.5	Latitude barely visible
Pos. = 128° 3	41 40	44.02 27.62 = 157.5	60.8	
+ 40	43 42	44.120 7.52 = 157.2	60.1	
27.3	46 45	43.860 7.78 = 157.2	60.1	
1 ^W	49 48	43.93 57.70 = 157.5	59.6	Latitude seen only by glancing

All the above observations made with No 2
plan Microm. Eyepiece.

Coincidences and Zero of Position with Achromatic
Eyepiece.

Coincid	2nd view	3rd view
51.645	50.642	52.650
.640	50.643	52.635
.648	50.6425	85
.640		52.6425
.649	Assume Coincidence 50.64	
51.6444		

{ Zero of position by stars of 8-9 mag. was Mark at 2h 32
2° following at 2h 05m. 128° 19'

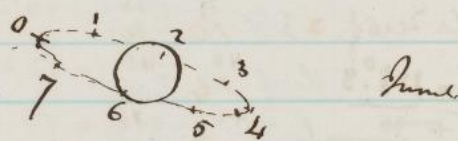
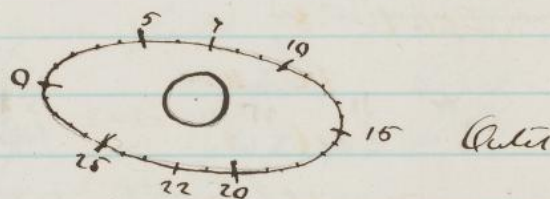
2 08 128° 18'

{ Definitive has become very bad 2 20
Zero of position is misleading 128° 26' only good 2 23
128° 21' 2 29

Elongation of Mars Outer Satellite.

Sept. $p = 250^{\circ}$ $\epsilon = 70^{\circ}$

1	7.8	1	22.9
2	14.1	3	5.2
3	20.3	4	11.4
5	2.5	5	17.6
6	8.7	6	23.8
7	14.9	8	6.0
8	21.1	9	12.2
10	3.4	10	18.5
11	9.6	12	0.7
12	15.9	13	7.0
13	22.2	14	13.3
15	4.4	15	19.5
16	10.6	17	1.7
17	16.9	18	8.0
18	23.2	19	14.3
20	5.4	21	20.5
21	11.7	22	2.8
22	17.9	23	9.0
23	24.1		
24	0.1		
25	6		



Aug 31. $\epsilon = 70^{\circ}$

1	6.2
2	7.8
3	1.6
4	19.4
5	13.2
6	15.2
7	2.8
8	9.0
9	14.3
10	20.5
11	2.8
12	9.0
13	14.3
14	20.5
15	2.8
16	9.0
17	14.3
18	20.5
19	2.8
20	9.0
21	14.3
22	20.5
23	2.8
24	9.0
25	14.3
26	20.5
27	2.8
28	9.0
29	14.3
30	20.5

Sept. $\epsilon = 70^{\circ}$

1	6.3
2	12.5
3	18.6
4	7.1
5	13.2
6	19.3
7	2.9

30.2

2	6.2
3	12.4
4	18.6
5	7.1
6	13.2
7	19.3
8	2.9
9	9.0
10	15.1
11	21.2
12	2.7
13	8.8
14	14.9
15	21.0
16	2.6
17	8.7
18	14.8
19	20.9
20	2.5
21	8.6
22	14.7
23	20.8
24	2.4
25	8.5
26	14.6
27	20.7
28	2.3
29	8.4
30	14.5

$$29^{\circ} 8' = (\epsilon. \text{ to } 70^{\circ})$$

Elongations of Mars from Earth.

Sept: 1 8 E

12 W

16 E

2 11 W

15

3 10 W

14

4 9 W

13

5 8 W

12

6 11

15 W

7 10

14 W

8 9

13 W

9 8

12 W

10 11 W

15

11 10 W

14

12 9 W

13

13 8 W

12

14 11

15 W

15^d 10

16 14 W

16 9

16 13 W

17 8

17 12 W

18 7

18 11 W

19 6

19 10 W

20 13

20 17 W

21 12

21 16 W

22 11

22 15 W

23 10

23 14 W

24 13 W

25 12 W

26 11 W

Sept. 9 1877

Sept 9th 1877.

Some satellite close to planet

O L 13-

Mercur B 79.6 Very difficult & uncertain
Seeing excellent.

S. M. obs -

S. M. Rec

Telescope West - Mercur. Sypher No 2 - Mars behind
neutral tint (?) glass and both satellites easily seen
at first with Mars well defined.

The above observation all which was made owing to
a difficulty in getting Mars defined all around, and have the
satellite directed away from the glass edge which is rough.

Began tonight by getting angles of position with the group
of threads used in directing Mars in distance measure.

Call this middle group B

Call the numerous threads to this (and to all the small lines) A.

First illumination until 2^h 35^m S.T. Then none thereafter.

Sept. 9, 1877. Telescope Work. Vernier B always read.

77

m.t. 12^h 45^m

Ammon 30^m 18 $\rho = 90 + \rho - m$.

Satt. n.f. (outer one)

Chum 3451

Vern. B. (^{Group}B) Microm. head.

outer Satt. 0^h 39^m 45^s

55^o. 2 72.63 IV $\frac{90}{27.83}$

44 0

55^o. 3 72.53 N $90 + \rho = 127.83$

47 50

55. 3 72.53 W

49 0

55. 4 72.43 W

0 50 0

55. 3 72.53 W

51.76
42.89
8.87
8.61

1 7 30

{ 145^o 12' } 42.890 $2.782 = 76.8$

15 50

{ Group B } 43.152 $71.520 = 73.7$

20 50

43.295 $71.377 = 72.5$

31 20

43.030 $71.842 = 75.0$

1 34 20

43.183 $71.789 = 73.4$

Zero of position by Mars

37^o 50'

N } T₁ W.

at 1^h 56^m st = 2^h 14^m 38^m m.t.

Reversed the Micrometer.

2 10 0

240.5 (Group B) S 67.33

13 45

240.2 S 67.62

15 30

240.5 S 67.33

59.654
51.672
7.982
1.22
7803
59.435
51.672
8.163
163
80.0

2 25 20

59.835 E $8.163 = 89.8$

28 45

59.654 E $78.982 = 88.1$

33 10

59.235 E $78.568 = 84.0$

Inner Satt. visited with wire A and position read in $\frac{3}{17} \frac{2}{5} \frac{4}{5}$ 59.575

No illumination.

Inner Satt. 2 42 45

141.0 ($\frac{26}{11}$) 47.083 W $2.549 = 35.4$

44 45

140.7 ($\frac{11}{13}$) 47.205 W $2.467 = 35.4$

Reversed the telescope.

69
3288
43.8
38.9

Note May 19, 1880. Chronometer correction seems by Mr. Waldo's thesis to be about -50^s.

78 Telescope East. Sept 9 1897.
 Sept. 9. 1897.

$\begin{array}{r} 260 \\ 308^{\circ} 0 \\ 668^{\circ} 0 \\ \hline 325^{\circ} 7 \end{array}$

Inner Satt. $3^h 1^m 40^s$ $325^{\circ} 7$ 72.3 48.108 71.672 44.4
 Inner Satt. { Cried get vis further measure - though had a final glimpse at 4.10 AM (m.t.) when Mars was about 10° above him.

Outer Satt. $3^h 12^m$ 335° 63 Est $1'$ from Mars \odot

Inner Satt. 3 17 327 71 Little more than estimate

Zero of position by Mars $\begin{array}{r} 270 \\ 308^{\circ} 0'7 \\ 578 \\ \hline \end{array}$ } Tel E.
 $3^h 28^m$ s.t. = $16^h 10^m$ m.t.

m.t. $16^h 35^m$ Bar = 30.19 Thu 59.5

Coincidence $17^h 30^m$ (m.t.) Microm. eyepiece No 4.

$\begin{array}{r} [50] [49] 681 \\ .665 \\ .665 \\ \hline 49.670 \\ \text{Coincidence at } [50].672 \\ 51.672 \end{array}$ $\begin{array}{r} 51 [50].664 \\ .673 \\ .680 \\ 50.672 \end{array}$ $\begin{array}{r} 52 [51].673 \\ .680 \\ .668 \\ 51.674 \end{array}$

Sept 10. 1877. Telescope East

S. W. obs.

12^h m. sky almost overcast, but Mars visible through the clouds.

12.^h 30^m Mars seen through a slight bank of clouds.

13^h " pretty well seen through slight halo; 20^m lost owing to the sidereal focus having been disturbed and not replaced.

13^h 30^m Eyepiece No 2 - Mars behind ruby glass. After twenty five minutes steady gazing nothing certainly seen about Mars, though object suspected 70" f. Seen through halo - and limb defined but little detail of his disc.

14^h Mars just visible through the clouds with little hope of a bearing away before morning.

Sept. 12, 1877. $8^h 10^m$ mean time.
 Bright meteor from γ through α Cassiopeiae.
 Bright as Capella. No train.

1877 Sept 12^d 13^h 0^m

outer Satellite easily seen about 25" fall. σ .

All efforts to secure measures failed however owing

1. To the observer not being able to make the clock run long enough at a time to get a measure, and
2. To the recurrence of clouds at intervals of a very few minutes.

Tried to measure pos. & dist. without clock work but could not.

— Satellite is now (13^h 5^m) invisible owing to the haze which covers the S & N portions of the Sky.

Sept. 13, 1877

81

1877

Sept 13^d

S. Tr. vls.

st. 23^h 45^m

Both satellites faintly visible. Eyepce No. 2.

0 10^m

observer can no longer see inner sat.

outer Satellite.Ver 13₂12^h 20^m 15^s

171.5 Est 45° — uncertain.

0 40

Ball of clock pendulum falls without running 6^m before observer had lengthened the pendulum until the nut was in only half way - and still the clock gains in the stars motion.0 50^m

179°

Est 57°

an estimate made by putting edge of glass to coincide with movable wire and setting this edge as nearly as may be perpendicular to the line joining the planets @ and sat.

1^h 10^m

- occasional glimpses as though "something was there" about 10° greater pos. angle than last estimate. I should think 40" distant but the "glimpse" is so difficult that it may be as much as 60"

1^h 20^m

- The observer cannot get even a "glimpse" after continued gazing.

1^h

30

definition poor.

1^h40^m

Nothing seen - and ♂ is now getting so low that the observer has no hopes of seeing the satellites.

2^h 3^m s.t.
= 14^h 30^m m.#Reading for pos. in ♂
" coincidence

126°.7 [42]

51.68

$$\begin{array}{r} 126.7 \\ 90 \\ \hline 216.7 \\ 171.5 \\ \hline 45. \end{array}$$

Sept. 14 1877

877. Sept. 14.

Inserted silk threads in diaphragm but neither they, nor human hairs would give satisfaction after insertion in the micrometer.

Removed the lines in glass previously used in observing Mars and put in the spider lines instead for measuring of Mars satellites.

Inserted in cups No 2 & 3 pieces of nearly plane glass with ground edges: then smoked the glass to the desired density.

The following measures are more than usually discrepant owing to an inequality in the running of the clock which causes the telescope to swing backwards & forwards after the object is fairly bisected.

Both satellites following β !

Mars bisected in all the following observations by a single web.

1877 Sept. 14.

S. W. obs.

Tel. W. Microm. Super No 2.

Sky hazy and definition of planet bad and yet at moments showing surprising detail. Inner Sat. certainly as bright as the outer one. Cor. to 3451 = $-1^m.0$

Inner Sat.

	3451.	Cor. 3451.	Rev ^m 13.	180°	Microm.	Dist.
21	56 15	55.2	139.3	256.0-75	46.38	3.63 ref. bad 35.6
	59 10	58.2	141.6	253.7	46.54	3.47 34.1
22	1 25	0.4	141.5	253.8	46.53	3.48 34.1
	2 55	1.9	142.7	252.6	46.53	3.48 34.1
	4 30	3.5	141.7	253.6	46.49	3.52 34.5
	6 25	5.4	143.3	252.0	46.49	3.52 34.5
	10 25	9.4	142.3	253.0	46.55	3.46 34.0
	12 40	11.7	145.0	250.3	46.62	3.39 33.2
	15 40	14.7	144.6	250.7	46.61	3.40 33.3
	17 30	16.5	147.8	247.5	46.59	3.42 ref. imp 33.59
	19 10	18.2	146.2	249.1	46.78	3.23 31.7
	22 10	21.2	148.5	246.8	46.47	3.54 34.7
	24 30	23.5	147.0	248.3	46.54	3.47 34.0
	42 0	41.0	154.1	241.2	46.85	3.16 31.0
	44 30	43.5	153.0	242.3	46.87	3.14 30.8
	48 0	47.0	157.5	237.8	46.99	3.02 29.6
23	5 15	4.2	159.5	235.8	47.56	2.45 24.0
	7 30	6.5	161.2	234.1	47.44	2.57 25.2
	10 45	9.7	163.3	232.0	47.60	2.44 24.6
	13 10	12.2	169.0	226.3	47.79	2.22 diffinet - 23.8
	15 35	14.6	170.7	224.6	47.62	2.39 23.4
	19 40	18.7	171.8	223.5	47.85	2.26 22.2

877. Sept. 14.

Made a trial of angle method of measuring dist. of sat. and angle - but observer's opinion is that the difficulty of marking net tangent to σ behind the colour glass, prevents the results from approaching in accuracy the results obtained in the usual manner.

- Bright wire illumination unusually good tonight.

1877 - Sept 14.

S. W. obs.

Outer Sat. Definition good. Satellite distinct.
Wire illumination. Closest running better.

3451		Corr 3451.		New B. 270° + 180°		270° + 180°		7 1/2"	
0 ^h	0 ^m	20 ^s	23 ^h 59 ^m 30 ^s	134.7	260.6	41.868	8.12	79.4	
2	30	1.5		134.8	260.5	41.64	8.37	82.0	
4	30	3.5		134.5	260.8	41.79	8.22	80.6	
5	45	4.8		135.2	260.1	41.79	8.22	80.6	
7	15	6.2		134.3	261.0	41.73	8.28	81.1	
9	30	8.5		135.8	259.5	41.44	(comp. faint.)	84.0	
11	30	10.5		134.7	260.6	41.60	8.41	82.4	
16	10	15.2		134.7	260.6	41.70	8.31	81.4	
17	50	16.8		136.8	258.5	41.68	8.33	81.6	
19	40	18.7		136.2	259.1	41.72	8.29	81.2	
21	35	20.6		137.2	258.1	41.54	(s. faint)	83.0	
24	45	23.8		137.0	258.3	41.57	8.44	82.7	
26	15	25.2		136.7	258.6	41.47	8.54	83.7	
28	45	27.7		136.8	258.5	41.54	8.47	83.1	
31	0	30.0		137.3	258.6	41.45	8.56	83.9	
33	10	32.2		136.7	258.6	41.67	8.34	81.7	
36	—	35		127.3	258.1	41.50	8.41	82.4	
41	50	40.8		139.7	255.6	41.52	8.49	83.2	
43	40	42.7		136.4	258.9	41.60	8.41	82.4	
45	0	44.0		138.0	257.3	41.45	(comp. faint)	83.9	
47	0	46.0		138.0	257.3	41.70	8.31	81.4	
49	0	48.0		138.8	256.5	41.47	8.54	83.7	
0	51	50.2		138.4	256.9	41.51	(8.50")	83.3	

Definition becoming poor again.

1899. Sept. 14.

2 m. obs.

 $1^h 0^m$

Actu. Sy. per - from 400.

50.011

.008

.008

 $50.009 = 50^{\circ}.01$ $p = 125^{\circ} 20'$

270

 $270^{\circ} + p = 395^{\circ} 20'$ $= 395^{\circ}.3$

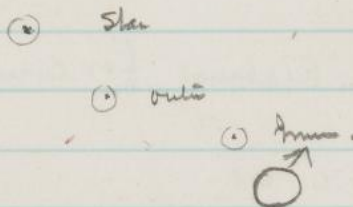
} Readings for coincidence

} Zero of position found by taking the last of a series of successive approx. directions of the polar spot of Mars.

Sept. 16 1877

1877. Sept. 16.

Both satellites visible ($12^h 20^m$ m.t.) thus



Tried No. 4 spec. with micro. glass to see whether inner sat. could be better observed through diffraction fringes at edge of ϕ thin glass: but the power is evidently too high for both satellites are only faintly visible - too faint to measure.

Used spec. No 2 much better.

1877 Sept. 16.

♂ Satellite.

L. W. obs.

Til Σ , Cyper No 2. Mass well defined with No 4 & ash. sup. pce but it seems to the observer that 400 is much too high a power for so faint ^{planetary} obj. as either of the satellites.

Cm to 3451 = -1^m.Inner Sat. 3451

Ver B

Micron r "

0	39	30	0 ^h 38 ^m .4	155.3	60.7 ^{+180°}	53.00	2.98	29.2
0	44	0	42.9	154.5	61.5	52.62	2.62	25.5
0	56	0	54.9	154.7	61.3	52.58	2.56	25.0

The difficulty of making brictions is painful - in the observer's opinion a rare opportunity for an exact series of measures on the inner sat. is lost owing to the miserable behavior of the driving clock.

1	4	45	1 ^h 3.6	158.2	57.8	52.46	2.44	23.9
1	26	0	24 ^m .9	174.7	41.3(?)	52.72	2.70	26.5

* This last a measurement of a point which observer only suspects to be the sat: the sat. is lost. The clock is gaining fast.

Outer Sat.

1	35	50	1 ^h 34 ^m .7	150.5	65.5 ^{+180°}	57.60	7.58	74.3
1	43	0	1 ^h 41.9	150.5	65.5	57.07	7.05	69.1
1	45	0	1 43.9	151.8	64.2	57.23	7.21	70.7
1	47	30	1 46.4	152.3	63.7	57.15	7.13	69.9
1	54	45	1 53.6	152.3	63.7	57.20	7.18	70.4
2	1	15	2 0.1	151.4	64.6	56.96	6.94	68.0
2	5	0	2 3.9	153.7	62.3	56.92	6.90	67.6
2	8	30	2 7.4	154.9	61.1	56.77	6.75	66.2
2	10	10	2 9.1	154.0	62.0	56.96	6.94	68.0
2	22	40	2 21.6	151.3	64.7	56.50	6.48	63.5

* adjusted clock - kept under pendulum as far as possible and before rising weight. goes better.

1877. Sept. 18.

I

II

June Sat.Sept. 14^d23^h^m

9.7

23.6

22^h^m

1.9

34.1

17.2

21.8

3.5

34.5

14.8

23.4

5.4

34.5

36.7

8.8

.08

14^d23^h^m

12.2

= 22.9

34.4

14

22^h^m

10.7

22^h^m

8.6

$$\frac{22.9}{24.4} = \cos. \text{ ang. in time to be subtracted from I to give II.}$$

1.35984

1.53656

9.82328 = cos 3^h 13^m.05assume true of planet $\delta = 7^h 38.5^m$

$$\therefore 24^h : 7^h 38.5^m :: 3^h 13.05^m : x$$
Log 7^h.64 = 0.8831" 3^h.22 = 0.5079

ac. 24 = 8.6198

0.0108 = 1.025

= 1^h 1.5^m

$$\therefore \text{June Satellite W. elong. at } 14^d 22^h 11^m \text{ s.t.}$$

$$\text{W. elong. at } 14^d 7^h 46^m \text{ m.t.}$$

Corr. s.t. to m.t.

$$\text{W. elong. } 14^d 7^h 45^m \text{ H.C. out.}$$

$$= 14^d 7^h 21^m \text{ m.t.}$$
(See page 96
94
90)

1877 Sept. 16.

 δ satellite.

S. W. vls.

Outer Satellite.

	3451		Ver B.		Microm.
^h 2	^m 26	^s 30	^h 25 ^m 4	154.0 62.0 +80.	56.56 6.44" 64.1
2	29	0	2 27 ^m 9	156.5 59.5	56.58 6.56" 64.3
2	33	—	Lost —	clouds coming up from W & S. W.	

Note Oct. 21, 1881. In the Astr. Nachr. the position angle for the set of 3 observations at the time 2^h 25^m (last observation by 1.89 and first two above) is printed 241.3 instead of 242.1, which seems to be required and is used in the present reduction.

Readings for Coincidence

$$2^h 37^m = 14^h 50^m \text{ m.t.}$$

John. Syce (400)

$$\begin{array}{r} 50.028 \\ .020 \\ .018 \\ \hline 50.020 \\ \hline 50.022 \end{array}$$

sky overcast at 3 hrs. — and observe unable to obtain zero of position. A very sudden change for in 7^m the whole sky seems to be cleared.

Note — 4.30 AM — Clear away about 3.30 again but 8 too low and observe has other duties.

Sept. 16th 20^h Geo. Clark comes up and fixes the clock so that apparently it can now be regulated, and will run.

Sept 17th 8^h observed zero of position m(t) 125° 57' = ver B.

$$\begin{array}{r} 90^\circ: 270^\circ + 296^\circ \\ + 18^\circ \\ \hline 215^\circ 57' = 216.0 \end{array}$$

$$\begin{array}{r} 396 \\ 150 \\ \hline 246 \\ 180 \\ \hline 66 \end{array}$$

1877 Sept. 18

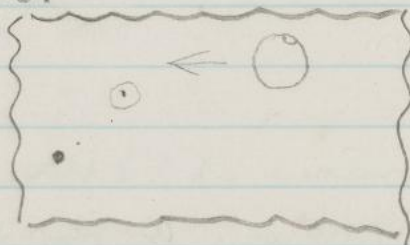
S. M. obs.

Satellite very faint owing to proximity of moon to \odot .
 sufficiently visible with moon rays falling in object
 glass - faintly visible with moon rays screened by
 edge of slit.

Satellite not visible behind the wires - and unable
 to estimate its position when near $+$ \therefore the
 position & distance are separately observed.

Wire illumination.

clock running a trifle slow - but better than previously.
 Rained pendulum 1 rev.



Sept. 18th 8^h

The

1897 Sept. 18. Tel. N. power No 2. at 11^h 40^m definition medium - and one sat. visible n.f. ♂. Searched carefully for No 2 but not visible. Telescope screened from direct rays of moon by keeping just behind edge of slit.

Outer Satellite. $\text{Cor. } 63451 = -1.2^m$

Chrom. 3451	W	m	s	m	Var 13	° -180	Microm	r
	0	4	0	3	157.6	239.1		
	0	8	0	7			43.21	6.82 66.8
	0	11		10	158.2	238.5		
	0	17		16			43.36	6.67 65.4
	0	26		25	159.7	237.0		
	0	35		34			43.50	6.53 64.0
	0	46		45	160.7	236.0		
		49		48			43.83	6.20 60.8
*	1	0		59	164.7	232.0		
1	13			12	Sort.			

Definition worse than a commonly poor winter night at end of obs.

Brilliant aurora.

lang R	lang. I	
50.003	50.057	} Readings for coincidence
.003	.053	
.005	.050	
50.004	50.653	
	.004	
	50.029	

1^h 26^m s.i. (= 13^h 30^m w.e.t.) Zero of position

$$\begin{array}{r} 216^{\circ} 43' - 90^{\circ} \\ 90 \\ \hline 126 \quad 43' \end{array}$$

* power M. No 2 = 401 from this time through the evening.

$$\begin{array}{r} 126.7 \\ 270 \\ \hline 270 + \beta = 396.7 \end{array}$$

Looked for inner Sat. several times in course of the above obs. but not found.

The previous angles computed up to and including this date not all be accepted 1897.
2.22.

Inner Sat.

(Cont. from p. 90)

Ephem. of Inner Sat ♂.

$$\therefore \text{N. elong} = \text{Sept } 14^{\text{d}} 7^{\text{h}} 45^{\text{m}} =$$

$$\text{W. elong. } 24) 0.7 \text{ L}$$

$$\begin{array}{r} \text{Wash. int.} \\ 14 \quad 21 \\ 20 \quad 44 \\ 19 \quad 21 \\ 18 \quad 21 \\ 17 \quad 21 \\ 16 \quad 21 \\ 15 \quad 21 \\ 14 \quad 21 \\ 13 \quad 21 \\ 12 \quad 21 \\ 11 \quad 21 \\ 10 \quad 21 \\ 9 \quad 21 \\ 8 \quad 21 \\ 7 \quad 21 \\ 6 \quad 21 \\ 5 \quad 21 \\ 4 \quad 21 \\ 3 \quad 21 \\ 2 \quad 21 \\ 1 \quad 21 \end{array}$$

obs.

$$\therefore 25^{\text{d}} 0.35$$

$$\begin{array}{r} 1.3979 \\ 9.5038 \\ \hline 1.8941 \end{array}$$

$$7^{\text{h}} = .292$$

$$\begin{array}{r} .027 \\ 0.319 \end{array}$$

$$1.8941 = 78.36 \therefore \text{the whole no. } 78 \text{ r.}$$

$$\text{Log } 25.035 = \begin{array}{r} 1.3979 \\ 1.8921 \\ \hline 0.5058 \end{array}$$

$$= 0.3205 = 7^{\text{h}} 41.6^{\text{m}}$$

$$= 2917 = 7^{\text{h}}$$

$$.0288$$

$$0.284$$

$$.0004$$

$$= 42^{\text{m}}$$

$$\therefore \text{Time rev} = 7^{\text{h}} 42^{\text{m}}$$

$$\text{Sept. } 14^{\text{d}} 7^{\text{h}} 45^{\text{m}} = \text{N. elong.}$$

$$14^{\text{d}} 15^{\text{h}} 27^{\text{m}} = \text{N. elong.}$$

$$15 \quad 14 \quad 33 \quad \text{N. elong.}$$

$$16 \quad 13 \quad 39 \quad \text{N. elong.}$$

$$17 \quad 12 \quad 45 \quad \text{N. elong.}$$

$$18 \quad 11 \quad 51 \quad \text{N. elong.}$$

$$19 \quad 10 \quad 57 \quad \text{N. elong.}$$

$$20 \quad 10 \quad 3 \quad \text{N. elong.}$$

$$21 \quad 9 \quad 9 \quad \text{N. elong.}$$

$$22 \quad 8 \quad 15 \quad \text{N. elong.}$$

$$23 \quad 7 \quad 21 \quad \text{N. elong.}$$

$$23 \quad 15 \quad 3 \quad \text{N. elong.}$$

$$24 \quad 14 \quad 9 \quad \text{N. elong.}$$

$$25 \quad 13 \quad 15 \quad \text{N. elong.}$$

$$26 \quad 12 \quad 21 \quad \text{N. elong.}$$

26^d 12^h 21^m

n elong.

27^d 11^h 29^m

n elong.

28 10 33

n

29 9 39

n

30 8 45

n

30^d 8^h 45^m

14 7 45

16^d 1^h 00^m

24

64

321

76) 3840 (5065

380

400

400

400

400

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Aug 44^d 7^h 3

20 13.4

23^d 14.923^d 17.9
$$= .7083$$

$$\underline{.0375}$$

$$23.7458$$

$$\underline{0.3182}$$
13^h.0 = 13^h.47^h 38^m.5 = .0048
$$2916$$

$$\underline{.0266}$$

$$= 0.3182$$

$$1.3755$$

$$\underline{9.5027}$$

$$1.8728 = 74.61$$

$$1.3755$$

$$\underline{1.4722}$$

$$9.5033 = 0.3186$$

$$\underline{2916}$$

$$0.270 = 7^h 39^m.0$$

or with 5 places.

$$1.37558$$

$$\underline{9.86953}$$

$$.50605$$

$$\underline{9.87216}$$

$$9.50342 = .31873$$

$$\underline{2916} = 7^h$$

$$.0271$$

$$\underline{270} = 39^m$$

$$.0001 = 0.2$$
7^h 39^m.2

3 revs

22^h 57.6 m.t. = 3 rev.

55.2

15^h 18.4

∴ 3 revs of the inner Sat. occupy

$$\text{Answer W. elong. of outer sat.} = \text{Sept. } 10^d 10^h 14^m 14^s \text{ (s.t.)}$$

Computation of ~
Ephemeris of Inner Sat. ♂.

S.W.

Temp. 90. W. elong. is at. $14^d 22^h 3^m 6^s$ H.C. (s.t.).

RA mean ☉

$$14^d 10^h 28^m 5^s = H.$$

$$14^d 10^h 26^m 8^s = m.t.$$

.4166
.0021

$$\begin{array}{r} .6666 \\ .0250 \\ \hline .6916 \end{array}$$

$$49^d 16^h 44^m 4187 = \text{Sept. } 14^d 10^h 23^m 7^s$$

$$= \text{Sept. } 14^d 10^h 3^m 1^s = \text{wash. m.t.}$$

$$\therefore \text{Interval} = 29^d 7271$$

$$\text{Aug } 19^d 16^h 6^s$$

$$\left\{ \begin{array}{l} \log 9583 = 1.98150 \\ \log 73^h = 9.98150 \end{array} \right\} \log = 1.47315$$

$$\log 73^h = 9.98150$$

$$1.49165 \quad 31.02 \quad 93 \text{ revs.}$$

$$\begin{array}{r} \text{Sept. } 14^d 10^h 3^m 1^s = 45^d 4187 \\ \text{Aug } 20^d 13^h \quad 20 \cdot 5416 \\ \hline 24 \cdot 8771 \end{array}$$

$$\therefore \text{Time rev} = 7^h 39^m 5^s$$

$$\log 24.8771 = 1.3958$$

$$7.9815$$

$$1.3958$$

$$1.4143 = 25.96$$

$$\log 78 \quad 1.8921$$

$$= \frac{26}{3}$$

$$9.5037 = 3189$$

$$78$$

$$291.6 = 7^h$$

$$0.273 \quad 0.270 = 39^m 5^s$$

$$0.003$$

Inner Sat. E. Elongation

97

Sept. 10^d 10^h 3^m

Inner Sat. = ~~10^d 10^h 3^m~~

11 9 3

12 8 0

13 7 0

14 6 0

15 5 0

16 4 0

17 3 0

18 2 0

19 1 0

20 0 0

20 23 0

21 22 0

22 21 0

23 20 0

24 19 0

25 18 0

26 17 0

27 16 0

28 15 0

29 14 0

30 13 0

Oct

1 12 0

2 11 0

3 10 0

4 9 0

5 8

6 7

7 6

7 13 40

8 12 40

Sept. 21 1877

877.

Sept. 21st 9^h. outer satellite δ visible about $80''$ following, by moving the telescope slightly w by side vision - direct vision does not give its position with enough accuracy to justify measures being attempted.

10^h 45^m outer Sat. seems to be 'in the same position as at 9^h but it is not so distinct that I can be sure of seeing it at all. The moon is full and about $10 \text{ or } 12^\circ$ following δ .

S.M.

Ur

Sept. 23, 1877

99

1877. Sept. 23^d 10^h 45^m ♂ has outer sat. near elongation on following side. Tell. Nr. Observer S. W.

Reading for zero of pos. in Mars, two transverse wires to form segments. Microm. head below. Eye piece No 3.

p 215° 18' at 11^h 10^m m.t.
 $1.80 + p = \frac{180}{395.30}$ 90 + p - m for ~~prec.~~ ^{fall.} p - m - 90 for following }
 $\therefore (180 + p - m)$ = p - 90 - m.

Outer Sat. Eye pie No 2. Wire illumination p-90 = 125
 3451 Ver B. Microm.
 23^h 39^m m = 145° 2 70° 1 70° 1 41.73

Sat. extremely faint and the above no more than a careful estimate. Set the 2 transverse wires about 10" apart and then with the Sat. between them, after attending to stoppage of clock & removing small weight -

23 52 237° 5 ^{67.8} ~~77.8~~ sat. not certainly seen. This observation quite doubtful, should not be used unless confirmed. Clouds and haze have completely obscured ♂ Sat. at 23^h 55^m cut off all illumination, and estimate by measuring against Mars. ☉

24 3 238.0 ^{67.3} ~~77.3~~ pretty sure this time the Sat. is there.

0 5 238.7 ^{66.6} ~~76.6~~
 0 7 238.8 ^{66.5} ~~76.5~~
 0 11 237.7 ^{67.6} ~~77.6~~ very difficult.

Inner Sat.

At 0^h 20^m after some search noticed a faint point preceding Mars about 20 to 25" which I think is the inner Sat. Too faint to trust for distance - and between two wires about 15" apart

0 25 224° ^{191.3} ~~261.3~~

0 34 229° ^{196.3} ~~266.3~~ And I think that I saw the Sat. at all in this measure.

Note May 19, 1880. In Mr. Waldo's thesis, there seems to be a chronometer correction of -1^m for the measuring of Decimus, but not for those of Phobos. In the present reduction, this correction is applied to all the times.

1877 Sept. 23^d

Using zero of position^m following page. $\begin{array}{r} 215.55 \\ 270 \\ \hline 485.55 = p-90-m \end{array}$

3451

h m
0 38

Ver B

Microm

232°

^{253.6} I feel almost certain there is something about this position angle: it may be some very faint object, but it seems to move with the planet. It cannot be seen by direct vision, or at least with the greatest difficulty.

0 47

230°

²⁵⁶ I feel almost certain that I saw the satellite distinctly moved as a point of light for 3° just previous to this record.

0 51

231°

²⁵⁵ Think also I saw it. Est. dist = dia. moves from preceding time.

1 10

238°

²⁴⁸ Clock troublesome. Must run out. Cannot see sat. or any thing else with mic set for distance measures. Turned back to outer Sat. n. f.

Outer Sat.

Double mic

No ill.

1^h 13^m

243.3

^{62.3} Sat. faint but a good observation. { Oblique vision. }
♂ well defined.

1 17

^{240.8} 60.8

64.8

1 19

^{241.3} 61.3

64.3

1 23

^{240.8} 60.8

66.8

1 25

²⁴³ 63.

a ^{6.3} light out for distance completely Obscures the Sat.

1 36

148 ? 248 ?

42.50 must be about the reading for distance.

1 48

Do not see either of the Sat. The moon which

Sept. 23, 1877.

Has been hidden more or less by light clouds is now shining brightly. I cannot tell whether the satellites are lost on that account or not. Mars crossed the meridian about $10^h 40^m$ m.t. and it is now $13^h 40^m$ m.t. The observer thinks any higher power is worse than No. 2 for picking up the sats. when they are so very faint. The ease with which they have been seen tonight has been very variable. Once twice the outer sat. has shown quite distinctly for a second or so. But usually very difficult.

$1^h 57^m$ the faintest glimpse had of the outer one, away from the microm. wire.

♂ seems to him a neighbor hood of small stars and I am not sure the object observed was the 2^d sat. (the inner one)

Reading for position $215^\circ 33'$ on Mars, both wires -
Microm head South. (below). = $215^\circ 55'$

49.994	50.070	Bright wire - Eye pc No 2.
.994	.050	
.998	.050	

14^h m.t.

Note May 19, 1880. The correction required by the chronometer seems to be about -50^s by the copy of the record in Mer. Waldo's thesis, but the figures there cannot all be correct. The correction -50^s is assumed, in the present reduction, for Sept. 25, 1877.

Sept. 24, 1877

105

1877 Sept. 24.

S. M. obs.

Through the eyepiece of the photometer saw what I supposed to be satellite to δ^1 — on placing the microm. telescope saw two stars one say $90''$ and $30''$ and another about same dist. and 31° , but neither of these could be the sat. Saw no trace of anything else, and as I had no means of knowing pos & dist of Mars with photometer as I do not know whether I saw the Sats at all or not.

Sept. 25 Mars beaut. defined. Tel. W. Per. angle est. between transverse wires
Vernier 13 Microm. head below Mic.

S. M. obs. A. S. Records. Chron. 7.3451

Outer satellite 23^h 47^m 15^s

48 30

e

49 45

50 30

52 0

53 5

57 30

~~Est.~~

Inner satellite ~~20~~ 0^h 2^m 0^s Estimated reading 242° for inner satellite

Outer satellite 0 5 10

9 5

11 47

252.9 231.9

255.7 229.1

254.3 230.5

∴ Outer Sat. } Estimated distance 1.7 diameters from pos. limb
preceding } All these measures were made without
illumination & with difficulty.
Satellite rarely seen more than
1 second at a time.

0 15 15

254.3 230.5

This last bisection good.

Sept. 24, 1877

F. 3451

Vernier B

Outer scale

h 21^m 45^s

253.7

231.1

23 55

252.2 doublet 232.6

24 40

255.5

229.3

Pos. zero

0^h 38^m214^o 18'

Sept. 26, 1877

Eyepiece No 2 Telescope rr.

107

1877 Sept. 26. ♂ moderately well defined. Outside Sat. visible. Seems at first as though distance could be measured - but it proved to be just beyond the limit of visibility with any illumination which would show the wires. Angle of position measured between two

lines:	3457	0413		
23 ^h	26 ^m	216.3	268.2	2½ dia from edge E.
	30	218.3	266.2	
	31.5	217.7	266.8	
	33	217.7	266.8	
	34	219.3	265.2	
	36	218.3	266.2	
	38	218.3	266.2	
	40.5	218.7	265.8	
	42	218.3	266.2	
23	45	217.3	267.2	

24^h 0 Lost in the moonlight.

○ very faint

○ ? ∴ mlu Sat precedes.

○
out to Sat.

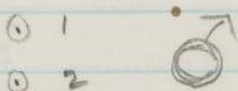
For zero of position - $214^{\circ} 33' = 214.55$ [7. of sun]
 $\frac{270.00}{484.55}$
 $270 + p' = 484.55$

Note May 19, 1880. Correction of chronometer probably as Sept. 25 (see p. 104). Correction used in present reduction - 1^m when the time is given only to minutes, - 0.8 when the half minute is given.

Sept 30, 1877

1877 Sept 30.

23^h 15^m s.t. both A.S. and S.W. are quite positive there are two faint points following preceding Mars thus:



say $2\frac{1}{2}$ diameters apart. No 1 being the brighter of the two, but no 2 being the first which S.W. saw.

Unable to measure dist. w. pos. of 2.

Unable to measure 1 with either dark or light lines - So.

put edge of glass near movable wire thus



a. b. movable wire

g glass

and directed means for

position with horizontal wire (par. to axis of screw) and read edge of glass for distance. Of course therefore only rough.

There is a very singular "glare" with a sharp edge about Mars which I think must seriously interfere with seeing δ sat. - it is sharply defined and I think comes from 1. A slight fogging of the obj. glass

or 2. Some diaphragm is wiring in the tube - In either case for faint objects near a primary it would be better to have it removed.

(possibly the crown lens is reversed in its cell?)
(probably the "ghost" of Mars spread out.)

1877 Sept. 30

S.W.

Tel. Nr. Eye piece No 2.
Outer Satellite.

Chrom 3451.		Pos.	Microm.		
23 ^h	55 ^m	149.8	245.5	56.83	6.80 66.6
0	4	151.3	244.0	56.30	6.27 61.4
0	7	153.7	241.6	56.00	5.97 58.5
0	10	153.7	241.6	56.18	6.15 60.3
0	12	152.0	243.3	56.60	6.57 64.6 ⁴
0	16	153.5	241.8	56.37	6.34 62.1 71.9
0	19	154.8	240.5	56.32	6.29 61.6
0	22	155.7	239.6	56.53	6.50 63.7
0	26	155.7	239.6	56.09	6.06 59.4
0	28	154.5	242.8	56.30	6.27 61.4
0	31	155.6	239.7	56.48	6.45 63.2
0	40	No longer distinctly visible.			

Coincidence 50.029
56.029 [Lower 400.]

Zero of position. $125^{\circ} 16' = p$
 $\underline{270}$
 $395^{\circ} 16' = 395^{\circ} 27' = 270 + p.$

Note May 19, 1880. No correction for clock error appears to have been applied in Max Wald's thesis. Perhaps the chronometer had been set back. No correction used in present reduction.

Oct. 5, 1877

111

1877. Oct 5th Friday.

L. Tr. obs.

Tel. Tr. Eypine No. 2.

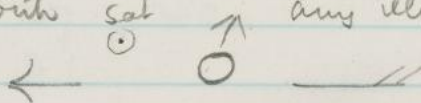
Definition very poor.

Main outer Satellite.

Seen with difficulty

and not visible with sat

any illumination.



3451	Ver 13		
23 ^w 52 ^m	235.3	249.6	
53	235.3	249.6	very faint
55	234.5	250.4	
56	233.7	251.2	
57	232.7	252.2	
58	234.7	250.2	
24 ^w 59 ^m	235.7	249.2	
0 ^m	235.0	249.9	
1	233.5	251.4	
2	233.7	251.2	
2.5	235.8	249.1	
3.5	235.0	249.9	
4	235.5	249.1	
5	235.5	249.4	seeing very bad
6.5	236.4	248.5	

The sat. is very faint, and about 2 dia. s.p.

Preceding (and all) measures made by placing Main & Sat between two pair. lines - microm head = 50.834

Note May 19, 1880. See note of this date p. 109.

1877 Oct. 5. Friday

S. n. ob.

$$\begin{array}{r} 0 \quad 27 \quad 40 \\ 3 \end{array}$$

236.2 248.7

236.0 248.9

0 37

No longer visible

Reading for zero of position $224^{\circ} 55'$
214

at 45 m

214

+ 90

304⁰.9

+ 1 pe

$$+ \quad 484.9$$

Star pr. Saturn for E.C.P. (* Star)
(wrong star) Jupiter.

Reading for pos. = $224^{\circ} 10'$

11 " Zero = $\frac{214}{90} \frac{55}{15} (= \text{Equalizer})$

9° 15

Transits

✱

5.

Interval

1^h 3^m 39^s.7

4^m 10.6^s

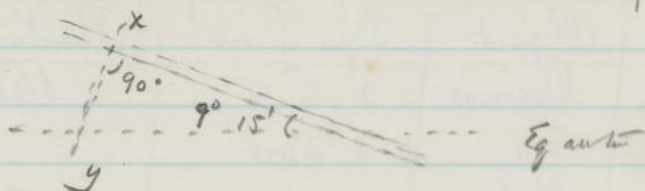
30.9

4^{hr} 44.5

5^m 14.7

30.2

acrob(x, y)



1877. Dates of measures of Orion Sat. of Mars.

			N.G.C. mt.	Trans.	E. mt.	Trans. obs.
August	28 ^d	0 ^h - 10 ^m .5 =	13.4	18.1	250° 85"	
	29 ^d	1.5 - 10.5	13.4	18.1	70 85 (10.5)	
	30	1 - 10.6	13.3	18.0	70 85 (10.5)	
Sept.	2	0 - 10.8	13.1	17.8	260 86	
	4	1.5 - 10.9	13.0	17.7	75° 85"	
	9	2 - 11.3	12.6	17.3	72 84	
	13	1 - 11.5	12.4	17.1	50° 80" 86 71 (10.7)	
	14	0.5 - 11.6	12.3	17.0	86 71 (10.7)	
	16	2.0 - 11.7	12.2	16.9	247 79	
	18	0.5 - 11.8	12.1	16.8	67	
	23	1.0 - 12.2	11.7	16.4		
	25	0. - 12.3	11.6	16.3	268	
	26	0.3 - 12.4	11.5	16.2	33 4	
	30	0. - 12.6	11.3	16.0	250	
	5	0 - 12.9	11.0	15.7	200	

Note May 20, 1880. The measures by Mr. Clark (p. 70) and by Prof. Pickering (p. 72) are not included in the tables of the present reduction, but are to be inserted separately. They are as follows:

Date	Object	Sid. Time	Position Circle	Micrometer	Obs.
Sept. 2	Deimos	0 6.4	141.8		C.
" "	"	0 22.1		59.162	C.
Sept. 4	Phobos	0 34.5	151.3	48.458	P.
" "	"	0 36.9	150.6		P.

There is also a distance on p. 85 deduced from two measures of angle (73.3 on p. 85, but apparently 76.5 with the semicircular 13.08 from the Am. Eph.)

1877. Date of Measure of inner Sat.

Sept.

4th 0^h (70° 32")

9 2.5

13 22.5

16 0.5 (261° 32.6)

23 0.5

25 0

1875-1885