

KG
11366
v. 805

Meridian Circle.

General Record.

Az

1879
May 5

Reinvestigation of the errors of the Micrometer screws
of Microscopes E, F, G, H, before the substitution of the
new Clark Microscopes. Plan of investigation same as
described on page 187d.

Microscope E

May 5	May 7	May 7	May 9	May 9	May 12	May 12	May 13	Mean	
"	"	"	"	"	"	"	"	"	"
40 7.74	6.06	6.36	6.58	6.64	6.66	6.62	6.10	6.59	58.86
41 6.94	5.20	4.86	5.50	5.08	5.62	5.58	4.80	5.45	58.54
42 5.52	3.52	3.36	3.94	3.46	4.44	4.30	3.40	3.99	58.47
43 4.30	1.86	1.62	2.66	1.94	2.90	2.58	1.80	2.46	58.74
44 2.64	0.62	0.82	1.28	1.02	1.64	1.22	0.47	1.20	58.69
45 0.66	59.76	59.74	59.72	59.66	0.24	0.26	59.10	54.89	
								29.330	
								58.66	

Microscope F

Correction for each 1".

May 7	May 7	May 9	May 9	May 12	May 12	May 13	Mean	
"	"	"	"	"	"	"	"	"
40 7.04	7.18	6.50	5.08	7.88	8.16	6.73	6.94	58.57
41 5.76	5.48	5.28	3.98	6.48	6.44	5.13	5.51	58.75
42 4.54	4.06	4.22	2.86	5.18	5.16	3.83	4.26	58.70
43 2.76	2.80	3.10	1.46	4.42	3.90	2.30	2.96	58.45
44 1.34	0.94	1.84	59.98	2.46	2.40	0.93	1.41	58.70
45 0.22	59.82	0.58	58.40	0.92	1.04	59.77	0.11	29.317
								58.64

Microscope G

May 7	May 7	May 7	May 7	May 9	May 9	May 12	May 12	May 12	May 12	Mean	
"	"	"	"	"	"	"	"	"	"	"	"
40 8.08	8.08	8.14	8.08	7.24	6.22	8.06	8.02	8.66	7.70	7.73	58.27
6.02	5.86	6.90	6.28	5.30	5.06	6.28	6.10	6.58	5.58	6.00	58.47
4.80	3.94	4.78	4.04	4.20	3.34	4.86	4.82	4.80	5.12	4.47	58.52
3.52	2.94	3.26	2.96	2.70	1.86	2.46	2.94	3.24	3.98	2.99	58.36
1.72	0.84	1.24	1.54	0.68	0.02	1.92	1.54	1.66	2.02	1.35	58.87
0.84	59.36	0.12	0.14	0.02	58.86	0.94	0.16	0.34	1.38	0.22	29.219
											58.47

Microscope H

May 7	May 7	May 7	May 7	May 9	May 9	May 12	May 12	May 13	Mean	
"	"	"	"	"	"	"	"	"	"	"
40 6.06	5.90	6.70	5.86	5.20	4.98	7.28	6.46	8.00	6.27	58.08
41 4.40	3.64	4.78	3.72	3.82	2.66	5.96	4.44	5.80	4.35	58.60
42 2.78	2.50	3.00	2.52	2.10	1.38	4.52	3.18	4.63	2.95	58.60
43 1.42	1.02	1.52	1.00	0.58	0.20	3.04	1.90	3.23	1.55	58.54
44 59.98	59.64	0.14	59.46	59.10	58.46	1.92	0.36	1.77	0.09	58.67
45 58.44	58.34	57.92	57.98	59.22	57.88	0.56	58.74	59.93	58.67	29.240
										58.48

4

1879

May 5

Recapitulation of errors of Micrometer Screw.

Microscope E.

Constant = 58.66

Computed value of each

1' from Plate II

Corr. E

1' " "

0-1 -16 -16

0-2 +12 -04

0-3 +17 +13

0-4 -12 +01

0-5 -03 -02

58.86

58.66

58.64

58.62

58.66

Obs^d

Values

58.86

58.64

58.47

58.74

58.69

Microscope F.

Constant = 58.64

Corr. E. Computed

value of each 1' from Pl. II

Obs^d

Values

0-1 +12 +12

0-2 +11 +01

0-3 +08 -07

0-4 +15 +08

0-5 -06 +02

58.69

58.64

58.62

58.60

58.64

58.57

58.75

58.70

58.45

58.70

Microscope G

Constant = 58.47

+26 +26

+01 +27

-6 +21

+8 +29

-59 -10

58.53

58.48

58.46

58.44

58.48

58.27

58.47

58.52

58.36

58.87

Microscope H

Constant = 58.48

+45 +45

-12 +33

-14 +19

-10 +09

-10 -01

58.53

58.48

58.46

58.44

58.48

58.08

58.60

58.60

58.54

58.58

May 5

Investigation of Periodic
E. P. G. H. for each 6"Errors of (old) Micrometers
Plate 2.

Microscope E. Const = 58.66

	(O)	(C)	Δ	Corr. E
40 1.14	5.72	~~5.79~~	+0.07	+0.03 +0.03
6.89	5.83	5.88	+0.05	+0.01 +0.04
12.72	5.52	5.86	+0.34	+0.30 +0.34
24.22	5.98	5.90	-0.08	-0.12 +0.22
30.12	5.90	5.88	-0.02	-0.06 +0.16
35.96	5.84	5.79	-0.05	-0.09 +0.07
41.82	5.86	5.85	-0.01	-0.05 +0.02
47.40	5.58	5.90	+0.32	+0.28 +0.30
53.61	6.21	5.88	-0.33	-0.37 -0.07
59.39	5.78	5.89	+0.11	+0.07 +0.00
			<u>7.89</u>	
			<u>49</u>	
			<u>7.40</u>	

Microscope F. Const = 58.64

	(O)	(C)	Δ	Corr. E
40 1.61	5.76	5.79	+0.03	+0.02 +0.02
7.37	6.13	5.89	-0.24	-0.25 -0.23
13.50	5.48	5.85	+0.37	+0.36 +0.13
18.98	6.19	5.90	-0.29	-0.30 -0.17
25.17	5.95	5.89	-0.06	-0.07 -0.24
31.12	6.03	5.78	-0.25	-0.26 -0.50
37.15	5.44	5.86	+0.44	+0.43 -0.07
42.89	5.81	5.89	+0.09	+0.08 +0.01
48.40	6.20	5.88	-0.32	-0.33 -0.32
54.60	5.56	5.89	+0.33	+0.32 +0.00
60.16			<u>7.26</u>	
			<u>1.16</u>	
			<u>+0.01</u>	

1879.
May 5

Investigation of Periodic Errors of (old) Micrometers & Cont.
 Microscope G.
 Constant = 5.847

	(0)	(C)	Δ corr. Σ		
40' 1.33	"	"	"	"	"
7.08	5.75	5.78	+03	-00	-00
13.40	6.32	5.86	-46	-49	-49
19.43	6.03	5.84	-19	-22	-71
24.73	5.30	5.89	+59	+55	-16
30.30	5.57	5.87	+30	+27	+11
35.85	5.55	5.77	+22	+18	+29
42.35	6.50	5.84	-66	-69	-40
48.43	6.08	5.88	-20	-23	-63
54.06	5.63	5.86	+23	+19	-14
59.37	5.31	5.87	+46	+43	+00
			+184		
			-152		
			+033		

Constant = 5.848

	(0)	(C)	Δ corr. Σ		
40' 1.07	"	"	"	"	"
6.46	5.39	5.78	+39	+37	+37
12.48	6.02	5.87	-15	-17	+20
18.26	5.78	5.85	+07	+04	+24
24.09	5.83	5.89	+06	+04	+28
30.00	5.91	5.86	-05	-07	+21
35.80	5.80	5.77	-03	-06	+15
41.89	6.09	5.84	-25	-27	-12
47.48	5.59	5.88	+29	+27	+15
53.53	6.05	5.87	-18	-21	-06
59.33	5.80	5.88	+08	+06	+00
			+89		
			-66		
			+23		

1879
May 5

W.A.R. obs.

N ^o 1 =	h	m	s	h	m
	2	42	6	3	52
2 =	5	8	"	5	10
3 =	9	41	"	10	45
4 =	10	48	"	12	40
5 =	12	41	"	13	35
6 =	20	47	"	22	19

May 6

W.A.R. obs.

N ^o 1 =	h	m	s	h	m
	2	44	"	4	14
2 =	9	12	"	11	38
3 =	11	40	"	13	34
4 =	20	57	"	22	11
5 =	22	56	"	0	41
6 =	0	50	"	2	20

879
May 7

W.A.R. obs.

N ^o 1 =	h m	to	h m
	2 23		4 17
2 =	9 32	"	11 22
3 =	11 28	"	13 39
4 =	0 44	"	1 22
5 =	1 37	"	3 5

Perhaps Microscope E was disturbed at 2 30 M.T. in some experiments with Mr George B Clark with reference to mounting the new microscopes. Look out for a change of Reg at this time.

After observing Polaris on A₁, A and A₂, set the collimation screw at 47.760 and 48.760 and observed A₂, 5

May 8 W.A.R. obs.

N ^o 1 =	h m	to	h m
	19 13		11 33
2 =	11 38	"	13 36
3 =	20 8	"	22 3
4 =	22 58	"	0 41
5 =	0 45	"	2 39

May 9

N ^o 1 =	2 46	"	4 6
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May 10 W.A.R. obs.

N ^o 1 =	10 14	"	12 31
2 =	12 31	"	13 44
3 =	24		

1879
May 11

W. A. R. obs.

$$N^{\circ}1 = \begin{matrix} h & m \\ 0 & 29 \end{matrix} \text{ to } \begin{matrix} h & m \\ 2 & 32 \end{matrix}$$

Removed Microscope E. in order to experiment with the new microscopes. Replaced it at 6^h PM. The reading after replacement is about 18" different from before.

May 12

W. A. R. obs.

$$N^{\circ}1 = \begin{matrix} h & m \\ 3 & 7 \end{matrix} \text{ to } \begin{matrix} h & m \\ 3 & 43 \end{matrix}$$

$$2 = \begin{matrix} h & m \\ 11 & 45 \end{matrix} \text{ " } \begin{matrix} h & m \\ 13 & 38 \end{matrix}$$

May 13

W. A. R. obs.

$$N^{\circ}1 = \begin{matrix} h & m \\ 3 & 3 \end{matrix} \text{ to } \begin{matrix} h & m \\ 4 & 40 \end{matrix}$$

$$2 = \begin{matrix} h & m \\ 10 & 40 \end{matrix} \text{ " } \begin{matrix} h & m \\ 11 & 53 \end{matrix}$$

$$3 = \begin{matrix} h & m \\ 11 & 59 \end{matrix} \text{ " } \begin{matrix} h & m \\ 13 & 41 \end{matrix}$$

May 14

W. A. R. obs.

$$N^{\circ}1 = \begin{matrix} h & m \\ 3 & 0 \end{matrix} \text{ " } \begin{matrix} h & m \\ 3 & 31 \end{matrix}$$

$$2 = \begin{matrix} h & m \\ 10 & 12 \end{matrix} \text{ " } \begin{matrix} h & m \\ 12 & 23 \end{matrix}$$

$$3 = \begin{matrix} h & m \\ 12 & 27 \end{matrix} \text{ " } \begin{matrix} h & m \\ 13 & 59 \end{matrix}$$

L₂₁

Took Microscope E out of its bearing at 4^h PM for experiments with new microscopes. Replaced it at 10^h 0^m S.T.

May 15

W. A. R. obs.

$$N^{\circ}1 = \begin{matrix} h & m \\ 3 & 3 \end{matrix} \text{ to } \begin{matrix} h & m \\ 3 & 36 \end{matrix}$$

May 23

Investigation of the ruled plates which are to be substituted for the metal comb in the new microscopes E & F & G & H.

The following measures were made with Mrs Rogers comparator, using the same part of the screw for each space. The zero of the four plates ruled is 4 revo-

lutions of the Rogers screw away from the zero marked on the of the engine. The measures are in the order 1 2 3 4 5.

Measures of Micrometer Plate No. 1.

Series I

	Div. Compa-	Corr.	Σ
100.00	99.92 = 99.960	+0.35	+0.35
100.10	.12 = 100.110	-.115	-.080
99.98	.00 = 99.990	+0.05	-.075
99.95	.95 = 99.950	+0.045	-.030
99.92	.90 = 99.910	+0.085	+0.055
100.13	.15 = 100.140	-.145	-.090
100.00	.00 = 100.000	-.005	-.095
99.95	.98 = 99.965	+0.030	-.065
100.12	.10 = 100.110	-.115	-.180
99.86	.90 = 99.880	+0.115	-.065
99.98	.99 = 99.985	+0.010	-.055
99.98	.95 = 99.965	+0.030	-.025
100.12	.13 = 100.125	-.130	-.155
99.87	.94 = 99.955	+0.040	-.115
99.86	.90 = 99.880	+0.15	+0.000
	99.995		

6" Bands

Div.	Corr.	Σ
41.3	41.4	41.35 + .20 +.20
41.7	41.7	41.70 -.15 +.05
41.7	41.3	41.50 +.05 +.10
41.3	41.7	41.50 +.05 +.15
41.2	41.2	41.20 +.35 +.50
41.6	41.5	41.55 +.00 +.50
41.5	41.8	41.65 -.10 +.40
41.7	41.7	41.70 -.15 +.25
41.5	41.8	41.65 -.10 +.15
41.7	41.8	41.75 -.20 -.05
		5.55
		41.535

1' Plate No. 1

Series II 6

Space	Series II.	Series	Mean
	Division	Comparison	
	Corr.	Σ	Σ
1	100.05 - .05 - .05	+0.04	+0.00
2	100.07 - .07 - .12	-.08	-.10
3	100.00 + .00 - .12	-.07	-.10
4	99.86 + .14 + .02	-.03	+0.00
5	99.99 + .01 + .03	+0.06	+0.04
6	100.03 - .03 + .00	-.09	-.04
7	100.05 - .05 - .05	-.09	-.07
8	99.96 + .04 - .01	-.06	-.03
9	100.01 + .01 - .02	-.18	-.10
10	100.03 - .03 - .05	-.06	-.05
11	100.08 - .08 - .13	-.05	-.09
12	100.01 - .01 - .14	-.02	-.08
13	99.98 + .02 - .12	-.15	-.13
14	99.91 + .09 - .03	-.11	-.07
15	100.00 + .00	+0.00	
	150.003		
	100.002		

$$1 \text{ Division} = \frac{1}{7995} \text{ in}$$

Plate No. 2.

1' Spaces			6" Spaces		
Division	Comparat.	Corr. Σ	Division	Comparat.	Corr. Σ
Series I			Series II		
1	100.02	-.01 -.01	100.02	-.01 -.01	-.01
2	100.09	-.08 -.09	100.12	-.11 -.12	-.10
3	100.00	+.01 -.08	99.96	+.06 -.06	-.07
4	99.89	+.12 +.04	99.94	+.07 +.01	+.02
5	100.06	-.04 +.00	100.08	-.07 -.06	-.03
6	100.01	+.00 +.00	100.08	-.06 -.12	-.06
7	99.99	+.02 +.02	100.01	+.00 -.12	-.05
8	100.02	-.01 +.01	99.93	+.08 -.04	-.01
9	100.12	-.11 -.10	100.09	-.07 -.11	-.10
10	100.05	-.04 -.14	100.00	+.01 -.10	-.12
11	100.01	+.00 -.14	100.06	-.05 -.15	-.14
12	99.95	+.06 -.08	99.93	+.09 -.06	-.07
13	100.03	-.02 -.10	100.02	-.01 -.07	-.08
14	99.90	+.11 +.01	99.92	+.09 +.02	+.02
15	100.07	-.06 -.05	100.08	-.06 -.04	-.04
	1500.21		1500.24		
	100.014		100.016		

Plate No. 3.

1' Spaces			6" Spaces		
Division	Comparat.	Corr. Σ	Division	Comparat.	Corr. Σ
Series I			Series II		
1	99.95	+.04 +.04	99.95	+.04 +.04	+.04
2	100.12	-.13 -.09	100.08	-.09 -.05	-.07
3	99.98	+.01 -.08	99.96	+.04 -.01	-.04
4	99.92	+.08 +.00	99.90	+.09 +.08	+.04
5	100.05	-.06 -.06	100.09	-.10 -.02	-.04
6	100.11	-.12 -.18	100.09	-.09 -.11	-.14
7	99.93	+.06 -.12	99.95	+.04 -.07	-.09
8	99.87	+.13 +.01	99.91	+.08 +.01	+.01
9	100.17	-.18 -.17	100.15	-.15 -.14	-.15
10	99.92	+.07 -.10	99.95	+.04 -.10	-.10
11	100.01	-.02 -.12	100.01	-.02 -.12	-.12
12	99.95	+.05 -.07	99.98	+.02 -.10	-.09
13	100.08	-.09 -.16	100.08	-.09 -.19	-.17
14	99.87	+.12 -.04	99.87	+.12 -.07	-.06
15	99.96	+.04 +.00	99.96	+.04 -.03	-.02
	1499.89		1499.93		
	99.993		99.995		

1879
May 23

Plate No 4.

1' Spaces

Series I.

Series II.

6" Spaces

	Division Comparat.	Corr.	Σ
1	99.95	+05	+05
2	100.17	-.16	-.11
3	100.00	+00	-.11
4	99.98	+03	-.08
5	100.03	-.03	-.11
6	100.02	-.01	-.12
7	99.97	+03	-.09
8	99.98	+03	-.06
9	100.06	-.06	-.12
10	99.99	+02	-.10
11	99.93	+07	-.03
12	99.95	+06	+03
13	100.04	-.04	-.01
14	99.99	+02	+01
15	100.01	-.01	+00
150007			
100,005			

	Division Comparat.	Corr.	Σ	Mean Σ
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	Division Comparat.	Corr.	Σ
41.30		+025	+025
41.70		-.15	+010
41.50		+005	+015
41.30		+025	+040
41.50		+005	+045
41.50		+005	+050
41.70		-.15	+035
41.80		-.25	+010
41.40		+015	+025
41.80		-.25	+000
530			
41.55			

Recapitulation.

1' Spaces

Plates I II III IV.

6" Spaces

	I	II	III	IV	Mean	corr. Index of Refining Bureau. <i>Index of refining Bureau</i>	Index settings of Refining Bureau.	Corr. Setting.	Original Setting.	Corr. Setting.	Corr. Setting.	
1	+01	-.01	+04	+05	+02	+06	29.738	29.744	9.828	-2.44	-2.4	9.804
2	-.08	-.09	-.09	-.11	-.09	-.27	60.195	60.168	12.778	-.23 +00	-.23	12.75
3	-.07	-.08	-.08	-.11	-.09	-.27	90.132	90.105	15.748	-.22 +00	-.22	15.72
4	-.10	+04	+00	-.08	-.04	-.12	19.691	19.679	18.733	-.21 +09	-.12	18.72
5	-.11	+00	-.06	-.11	-.07	-.21	-50.010	49.989	21.723	-.20 +15	-.05	21.72
6	-.14	+00	-.18	-.12	-.11	-.33	80.272	80.239	24.703	-.19 +30	+11	24.71
7	-.15	+02	-.12	-.09	-.08	-.24	9.828	9.804	27.715	-.18 +33	+15	27.73
8	-.11	+01	+01	-.06	-.04	-.12	39.868	39.856	30.747	-.16 +24	+08	30.75
9	-.16	-.10	+17	-.12	-.14	-.42	70.312	70.270	33.782	-.15 +15	+00	33.78
10	-.10	-.14	-.10	-.10	-.11	-.33	-99.994	99.961	36.818	-.14 +12	-.02	36.82
11	-.13	-.14	-.12	+03	-.11	-.33	29.799	29.766	39.868	-.12 +00	-.12	39.86
12	-.12	-.08	-.07	+03	-.06	-.18	60.232	60.214				
13	-.11	-.10	-.16	-.01	-.10	-.30	90.182	90.152				
14	-.08	+01	-.04	+01	-.03	-.09	19.744	19.735				
15	+00	+00	+00	+00	+00	+00	50.050	50.050				

	6" Spaces					+ 41.5	Corr. Setting
1	+0.20	-.02	-.21	+0.25	+0.5	+0.00	+0.00
2	+0.05	+0.11	-.17	+0.10	+0.2	+0.00	+0.00
3	+0.10	+0.24	+0.02	+0.15	+0.13	+0.03	+0.09
4	+0.15	+0.17	+0.06	+0.40	+0.19	+0.05	+0.15
5	+0.50	+0.40	+0.30	+0.45	+0.41	+0.10	+0.30
6	+0.50	+0.43	+0.34	+0.50	+0.44	+0.11	+0.33
7	+0.40	+0.16	+0.43	+0.35	+0.34	+0.08	+0.24
8	+0.25	+0.29	+0.21	+0.10	+0.21	+0.05	+0.15
9	+0.15	+0.17	+0.15	+0.25	+0.16	+0.04	+0.12
10	-.05	+0.00	-.06	+0.00	+0.02	+0.00	+0.00

1879
May 24

Measures of Plate No. 5. This plate was ruled by applying the corrections derived from the measures of the Plates 1, 2, 3, & 4.

18 Spaces Plate 5.
Division
Comparat. Corr $\pm$

1	105.038	-.010	-.010	-.01
2	.010	+.018	+.008	+.00
3	.012	+.016	+.024	+.01
4	.022	+.006	+.030	+.02
5	.018	+.010	+.040	+.02
6	.040	-.012	+.028	+.02
7	.022	+.006	+.034	+.02
8	.090	-.062	-.028	-.02
9	.028	+.000	-.028	-.02
10	.006	+.022	+.006	+.00
11	.040	-.012	-.018	-.01
12	.046	-.018	-.036	-.02
13	.028	+.000	-.036	-.02
14	.010	+.018	-.018	-.01
15	.022	+.006		+.00
	100.028			

$$1 \text{ div} = .5998''$$

6" Spaces
With Eye Piece Micrometer

		II.	
1	41.7	41.60	41.5
2	41.6	41.60	41.6
3	41.6	41.63	41.7
4	41.8	41.60	41.5
5	41.5	41.53	41.6
6	41.7	41.60	41.6
7	41.5	41.50	41.5
8	41.5	41.53	41.5
9	41.6	41.53	41.5
10	41.5	41.50	41.5
		562	
		41.562	

6" Spaces

II	I+II	Z	Σ ''
41.50	41.550	-.003	-.003
41.57	41.580	-.033	-.036
41.53	41.580	-.033	-.069
41.53	41.560	-.013	-.082
41.47	41.500	+.047	-.035
41.63	41.610	-.063	-.098
41.40	41.450	+.097	-.001
41.57	41.550	-.003	-.004
41.57	41.550	-.003	-.007
41.57	41.541	+.007	+.000
534	41.547		
41.534			

$$41.55 \text{ div} = 6.0''$$

$$1 \text{ div} = .14444''$$

1879

May 28

Substituted the new Clark Microscope for the old ones furnished with the instrument. These differ from the old ones mainly in the following respects:—

(a) The screws which have a pitch of 50 in. have been made with great care so as to be nearly free from error depending on one revolution, thus avoiding the necessity of the laborious operation of applying corrections to each fraction of a revolution at which they are made. From the recapitulation on Page 111. of the *Figure & Record* it appears that the mean maximum error depending on one revolution is only 0.04.

(b) Instead of the metal comb and the spider-line micrometer of the old microscopes there is a fixed glass plate having 15 spaces = 15', while the middle space is again subdivided into 10 equal parts giving 6". The screw carries a glass plate on which are ruled two parallel lines separated by an interval of ten divisions of the Rogers screw. The wings of the two plates (being face to face) have nearly the same focus.

The errors of the 1' spaces of the fixed plates will be found on Page 97 of the *Figure & Book*.

The error of the screws for each successive revolution are to be found by setting the moveable (double) wire on each line of the glass plate and comparing with the measured spaces with the known values of the spaces of the glass plate.

(c) All the microscopes have two eyepieces so arranged that either can be used at will. No 1 magnifies 57 diameters and No 2 magnifies 87 diameters. No 1 is used to read the divisions and No 2 to make the accurate dissection.

The order of observation will be as follows:—

- First setting of telescope
J.F.M. reads with No 1.
Second setting of telescope
- (1) J.F.M. reads with No 1.
 - (2) W.R.R. reads with No 1.
 - (3) W.R.R. reads with No 2.
 - 4 J.F.M. reads with No 2.

1879.
May 28

Investigation of periodic errors of new (Clark) Micrometer screws.

Method of Investigation.

Plate No 5 whose errors will be found on Page 107 (Exposure & Record Book) was inserted in the moveable slide of the new Micrometer and the frame was then adjusted under a half inch objector on the large Comparator.

The following measures were then made:-

Recapitulation

Div.	No 1	No 2	No 3	No 4	Mean
0	+ .00	+ .00	+ .00	+ .00	+ .000
1	+ .03	+ .03	+ .03	+ .04	+ .03
2	+ .03	+ .03	+ .01	+ .02	+ .02
3	- .01	+ .00	+ .01	+ .01	+ .00
4	+ .02	- .01	+ .03	- .03	- .01
5	+ .03	+ .00	- .06	- .06	- .02
6	+ .05	- .03	- .11	- .06	- .04
7	+ .04	- .01	- .08	- .05	- .03
8	+ .03	- .01	- .08	- .08	- .03
9	+ .03	- .01	- .03	- .01	- .01
10	+ .00	+ .00	+ .00	+ .00	+ .00

Accumulated Corrections.

$$\begin{aligned}\text{Since } 100 \text{ div.} &= 60'' \\ 1 \text{ div.} &= 6''.00 \\ .01 \text{ div.} &= .06''\end{aligned}$$

Mean Correction
Σ for Mean of the
from Microscopy

Div.

Div.	"
0	+ 0.00
1	+ .03
2	+ .02
3	+ .00
4	- .01
5	- .02
6	- .04
7	- .03
8	- .03
9	- .01
10	+ .00

Correction from
measure of Standard Plate.

Δ	"
	+ 0.00
	+ .00
	- .01
	- .01
	+ .00
	- .01
	+ .00
	+ .00
	+ .00
	+ .00
	+ .00

1879
May 28

Readings of new Micrometer for the minutes of the fixed glass scale corresponding to the minute notches of the old Micrometers.

Measures on the first of the double lines nearest the screw.

	Micrometers	E	Comp.	H	G	A
0'	0'	49.74	50.03	49.16	49.42	50.08
1	1	50.72	50.59	49.34	50.14	49.96
2	2	51.42	50.74	48.52	49.54	49.44
3	3	51.28	51.05	48.84	50.28	51.28
4	4	50.70	50.59	48.66	50.76	50.10
5	5	50.18	50.30	48.24	50.42	50.54

May 29 W A Robs.

No 1 =	h	m	to	h	m
	41	45		5	22
2 =	12	6	"	13	35
3 =	13	40	"	14	48
4 =	22	33	"	23	58
5 =	0	49	"	2	25

May 30 W A Robs.

No 1 =	4	15	"	5	20
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May 31 W A Robs.

No 1 =	12	11	"	1	41
2 =	14	18	"	14	47
3 =	0	12	"	1	24

1879 W A Robs.

June 1

No 1 =	4	28	"	5	22
2 =	11	30	"	13	57
3 =	22	32	"	0	42
4 =	1	44	"	3	3

1879
June 4

Glass Index

Microscopes	E.	F.	G.	H.
0'	50.00	49.44	49.28	50.66
1	50.36	49.80	50.10	50.36
2	49.96	49.68	49.82	50.12
3	50.12	49.40	50.04	51.14
4	50.46	49.16	50.08	50.84
5	50.38	49.10	49.72	51.04

Recapitulation of 'i' readings on glass scale.

E		F		G		H	
May 28	June 1	May 28	June 1	May 28	June 1	May 28	June 1
60.98	60.36	60.56	60.36	60.18	60.82	60.72	59.70
60.70	59.60	60.15	59.88	59.18	59.72	59.40	59.76
59.86	60.16	60.31	59.72	60.32	60.22	60.74	60.02
59.42	60.34	59.54	59.76	59.82	60.04	60.48	59.70
59.48	59.92	59.71	59.94	59.58	59.64	59.66	60.20

June 4

WAK obs.

No 1 =	12	35	to	14	45
2 =	14	47	"	15	30
3 =	0	44	"	1	56
4 =	1	59	"	2	30

WAK and ECP found that with the $\frac{1}{2}$ Eyepiece of the new Microscope of the Meridian Circle the magnifying power is 57 diameters and with the .04ⁱⁿ Eyepiece that it is 87 diameters.

849

June 5

W A R obs.

$$N^o 1 = \begin{matrix} h & m \\ 4 & 48 \end{matrix} \text{ to } \begin{matrix} h & m \\ 6 & 20 \end{matrix}$$

$$2 = \begin{matrix} h & m \\ 12 & 43 \end{matrix} \text{ " } \begin{matrix} h & m \\ 14 & 39 \end{matrix}$$

W A R begins an investigation of the errors of the East Meridian Circle. Professor Pickering begins a similar independent investigation.

1899
June 5

Investigation of the relation between the two halves of the Meridian Circle, the order of reading being from the Zenith (division 180°) southwards to the Nadir.

The mean of the readings the four microscopes define the vertical line passing through the centre of the Circle. If ϕ falls exactly on an even degree and the Equator-point correction equals zero this line is situated in a plane which passes through the line of Collimation of the telescope (when this line is vertical) and the centre of the graduated circle.

In this discussion it will be assumed that the fixed line A B is in this plane when the telescope points to the

zenith. When the telescope is directed to any point South of the zenith, the line of collimation has moved away from the fixed line AB by an angle equal to the difference between the mean of readings by the Microscopes for the two positions plus or minus the error of this part of the graduated arc.

If only two Microscopes are read we can give the fixed line of reference AB the same definition as before by adding 45° to the mean of the readings.

It is to be noted that it is not necessary that the four Microscopes should be situated exactly 90° apart. It is only necessary that after the reading of AB has been found, this reading shall be a constant during the time occupied in making a given series of observations.

The order of observation is as follows:-

(a) The telescope is directed towards the zenith and set for Microscope $E = 45^\circ 0' 0''$ nearly. The line AB will then be situated in a vertical plane passing through division 180° and the line of collimation of the telescope for this particular pointing.

(b) The glass plates attached to the opposite circle are then set as nearly as possible 180° apart. If by examination they are found to be exactly 180° apart we have only to compare the mean of the four microscopes E, F, G, H for the two halves of revolution in order to ascertain the relation between these halves.

(c) If the glass plates are not set exactly 180° apart the order of proceedings is as follows:-

(1) Telescope set for $E = 45^\circ 0' 0''$

(2) Microscope A set for coincidence with the new line of plate (H)

1879

June 5

- (3) The position of the new line on plate (C) is measured with microscope C.
- (4) Microscopes E, F, G, & H, are then read.
- (5) The telescope is revolved 180° from South to North and a coincidence is made with Micrometer A by mechanical adjustment.
- (6) The reading of the new line of the glass plate is made.
- (7) The difference between the readings of C for the two positions will be twice the error of subdivision with the equal parts expressed in divisions of index of screw.
- (8) Microscopes E, F, G, & H are again read.

22

1879

June 7

W.S.R. obs.

N ^o 1 =	h	m	s	h	m
	0	42		2	24
2 =	1	5	"	5	58

Discovered with the new high eyepiece of the new micrometer that the lines of the circle have the following defects

- (a) Many of the short divisions taper off sharply at the end of the cut thus:— Care must be taken to set at a little distance from the end.
- (b) Many of the long divisions have an offset amounting to as much as 1.3 just before the end of the short divisions, thus:— Care must be taken to set along the line ab.

June 8

W.S.R. obs.

N ^o 1 =	h	m	s	h	m
	1	5		5	58
2 =	11	53	"	14	
3 =	14	7	"	15	18
4 =	22	56	"	0	57
5 =	0	58	"	2	58

Got the value of 1 revolution of the collimator screw from observations of Polaris on A₁, for revolution 46.73, 47, 73. 48, 73. Reject the last revolution as the screw will not work to 48.73 rev. without crowding.

June 9

W.S.R. obs.

N ^o 1 =	h	m	s	h	m
	4	50		5	48
2 =	4	49	"	16	00

1879
June 9

Investigating of the four quarters of the East Circle.
Let the glass plates 90° apart nearly. Microscope C has been revolved 180° since the previous entry in order to make the increasing reading correspond to an increasing south zenith distance.

In the following measures the telescope is moved from the Zenith-North to N.C. Nadir, S.C. and zenith again. For an increasing reading in this direction the reading of Micrometer C diminishes.

Hence when C ~~reads less~~ for telescope at ~~zenith~~ S.C. than for telescope at Z the telescope has made more than one fourth of a revolution.

Order from the zenith South.

June 10

Thermometers removed from the window of the East Circle room to the West Transit room North-East window.

Change made at 3^h ST.

Oiled pivot- cleaned friction rollers with kerosene
Took off the rubber caps from the east to prevent spring of the telescope.

Error of circle page 21 A_2 .

June 12

W. A. R. Obs.

$$N^o 1 = 0^h 39^m \text{ to } 1.41$$

June 13

W. A. R. Obs.

$$N^o 1 = 5^h 19^m \text{ to } 6^h 39^m$$

24

1879

June 16

W.A.R. obs.

No 1 =

2 =

Put the cover on North Collimation

Adjusted Microscope H for illumination at 2^h 5^m.Error of circle Page 40 A₂. Recapitulation of Results
Page 42 A₂.

June 17

W.A.R. obs.

No 1 = 3^h 22^m to 7^h 22^m

2 = 12 41 " 14 56

3 = 14 58 " 15 59

4 = 0 46 " 1 41

5 = 1 43 " 2 9

6 = 2 20 " 4 6

Error of circle p. 52 A₂.

June 18

W.A.R. obs.

No 1 = 12 17 " 14 34

2 = 14 37 " 15 49

3 = 0 54 " 1 50

4 = 2 9 " 3 23

Error of circle p 60 A₂.

June 19

W.A.R. obs.

No 1 = 5 34 " 5 57

2 = 12 32 " 14 46

3 = 14 48 " 15 46

4 = 23 52 " 1 39

5 = 1 43 " 3 22

Error of circle p 63 A₂.

1879 W.A.R. obs.
June 20

$N^{\circ}1 = \begin{matrix} h & m \\ 5 & 45 \end{matrix} \begin{matrix} h & m \\ 6 & 34 \end{matrix}$
 $2 = 12 \ 17 \quad " \quad 13 \ 21$

June 21 W.A.R. obs.

$N^{\circ}1 = 13 \ 20 \quad " \quad 15 \ 46$
 $2 = 15 \ 50 \quad " \quad 16 \ 13$
 $3 = 0 \ 20 \quad " \quad 2 \ 20$

June 22 W.A.R. obs.

$N^{\circ}1 = 5 \ 38 \quad " \quad 6 \ 44$
 $2 = 13 \ 14 \quad " \quad 15 \ 19$
 $3 = 15 \ 21 \quad " \quad 15 \ 47$
 $4 = 0 \ 57 \quad " \quad 1 \ 59$
 $5 = 2 \ 49 \quad " \quad 3 \ 37$

June 23 Made the attempt to read Microscope A for 100 pointing within 15 minutes.

W.A.R. did not see the head of the screw during the entire operation. Mr Frank Waldo doing the reading and Mr Epton the recording.

The time of 100 settings was 13 10, but fully one half of this time was occupied in reading. The micrometer read nearly 39.0 div. The actual readings ranged as follows:-

No of cases	Reading	"
1	38.7	60.9
22	38.8	193.6
20	38.9	178.0
30	39.0	370.0
12	39.1	108.2
5	39.2	46.0
2	39.3	18.6
2	39.4	18.8
		38.94

Probable error of single reading = $\frac{8453}{100} = 84.53$

28

1879

June 23

W.A.R. obs.

N ^o 1 =	5	56	to	7	12
2 =	12	32	"	14	59
3 =	15	5	"	16	10
4 =	0	43	"	3	—
5 =	3	6	"	5	35

Error of Circle p. 66 A₂Recapitulation of results p. 68 to 89 A₂

June 24

W.A.R. obs.

N ^o 1 =	5	14	to	6	53
2 =	12	48	"	15	2
3 =	15	5	"	16	42
4 =	2	12	"	3	41

Found it feasible to use only the high-power eyepieces on microscope L.G. H. From this date the high power will be kept in position permanently. The order of reading between J. F. M. and myself will be the same as before.

June 25

W.A.R. obs.

N ^o 1 =	6	3	to	7	32
2 =	13	1	"	15	4
3 =	15	18	"	16	30
4 =	0	54	"	2	8

June 26

W.A.R. obs.

N ^o 1 =	6	6	"	7	25
2 =	12	52	"	15	16
3 =	15	18	"	16	46
4 =	23	46	"	2	6
5 =	2	49	"	4	34

1849
June 30

W.A.R. obs.

N ^o 1=	6	20	to	7	43
2=	12	45	"	15	7
3=	15	10	"	17	17
4=	0	54	"	3	20
5=	3	29	"	6	57

July 1

N ^o 1=	6	34	to	7	41
2=	12	49	"	15	22
3=	15	25	"	17	18
4=	0	53	"	3	3
5=	3	23	"	5	21

July 2

N ^o 1=	5	47	"	7	43
2=	12	50	"	14	58
3=	15	3	"	17	23
4=	17	29	"	17	36
5=	0	56	"	2	55

July 3

N ^o 1=	6	37	"	7	43
2=	13	28	"	15	25
3=	15	29	"	16	34
4=	0	52	"	2	58

After the observations of July 3. and before the same
July 4. Mounted the high-power microscopes designated
A and B.

A is set 15° from E towards F and B at 45° from E
towards F.

A and B being 30° apart will furnish the measures of

1879

July 3.

12 aliquot parts of a revolution. E and H will furnish measures of 24 aliquot parts of a revolution and will also correct the distance from $E = 45^\circ$ to $E = 60^\circ$ with the 12 aliquot parts of a revolution.
Adjusted E. F. G. & H. anew.

July 4

$$N^o 1 = \begin{array}{cc} h & m \\ 6 & 21 \end{array} \text{ to } \begin{array}{cc} h & m \\ 6 & 59 \end{array}$$

July 5

W.A.R. obs.

$$N^o 1 = \begin{array}{cc} 12 & 54 \end{array} \text{ " } \begin{array}{cc} 15 & 19 \\ 2 = & 3 \quad 5 \end{array}$$

Gave up on account of bad seeing.

July 6

W.A.R. obs.

$$N^o 1 = \begin{array}{cc} 6 & 50 \end{array} \text{ to } \begin{array}{cc} 8 & 7 \\ 2 = & 12 \quad 51 \end{array} \text{ " } \begin{array}{cc} 15 & 16 \\ 3 = & 15 \quad 20 \end{array} \text{ " } \begin{array}{cc} 15 & 54 \\ 4 = & 0 \quad 58 \end{array} \text{ " } \begin{array}{cc} 2 & 30 \end{array}$$

After the observations of July 6, adjusted E. F. G. & H. anew.

July 8

W.A.R. obs.

$$N^o 1 = \begin{array}{cc} & \end{array} \text{ to } \begin{array}{cc} 14 & 14 \\ 2 = & 16 \quad 18 \end{array} \text{ " } \begin{array}{cc} 17 & 17 \\ 3 = & & 3 \quad 17 \\ 4 = & 3 \quad 23 \end{array} \text{ " }$$

Error of circle p. 91 Δ_2

July 9

W.A.R. obs.

$$N^o 1 = \begin{array}{cc} 6 & 56 \end{array} \text{ " } \begin{array}{cc} 7 & 42 \\ 2 = & 12 \quad 43 \end{array} \text{ " } \begin{array}{cc} 15 & 10 \end{array}$$

1879
July 10

$N^{\circ}1 =$

4 m

2 =

3 =

4 =

353

Error of Circle p. 107 A_2
Recapitulation p. 115 &c.
WARR goes on his vacation.

Aug. 11 Collimation wires out of focus.

use 47.007

Error of Screw p. 131 A_2

Aug 10 Errors of Circle p. 128 A_2
New scheme of observation.

1879
Aug. 12

W.A.R. returns from his vacation.

No 1 =	35-4	^{h m} 5 35 to	^{h m} 7 56
2 =	355	8 58 "	10 14
3 =	356	16 42 "	19 9
4 =	357	4 16 "	5 9

Error of circle p 143 A_2 . Recapitulation p. 161 A_2 Made the following changes in the instrument before observation of $\odot$ on Aug. (12).

- (a) Mr Black put large milled heads on the micrometer screws.
- (b) Mr Black put a cap on eyepiece of telescope, and fitted a cap for holding colored wedge.
- (c) Mr Black fitted to the movable microscope A , a slow motion for focusing on the divisions of the circle.
- (d) Took out tail-piece and cleaned glass plate.
- (e) Set Microscopes E. F. G. H so that F. G. H shall read a little more than E for every position of the circle.
- (f) Set the vertical hinge in the vertical plane as near as the adjustment will allow. Clamped very firm after adjustment. The inclination will now differ slightly from $50^\circ 0'$.

Aug. 13 W.A.R. obs.

No 1 =	558	^{h m} 9 23 to	^{h m} 10 34
2 =	359	16 48 "	19 5
3 =	360	19 11 "	19 33

34

1879

Aug. 22

W.A.R. obs.

N ^o 1 = 376	^h 9	^m 44	^s 10	^h 10	^m 53
2 = 377	13	8	"	15	9

Error of circle p. 14 A₃.

Aug. 23

W.A.R. obs.

N ^o 1 = 378	^h 17	^m 18	^s 19	^h 19	^m 33
2 = 379	19	37	"	20	15
3 = 380	4	16	"	6	20

Aug. 24

W.A.R. obs.

N ^o 1 = 381	^h 9	^m 4	^s 10	^h 10	^m 58
2 = 382	18	36	"	20	0
3 = 383	0	58	"	3	3
4 = 384			"	6	10

Sept. 4

W.A.R. obs.

N ^o 1 = 385	^h	^m	^s	^h 10	^m 17
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Let 4.9-5 Before beginning observations of this date, set microscopes D and B at 45° from E and G.

Adjusted C, F, G & H anew both for focus and for pointing on the North Collimator.

N ^o 1 = 386	^h 10	^m 55	^s 11	^h 11	^m 36
2 = 387	12	38	"	15	5
3 = 388	15	10	"	16	29

Errors of circle p. 18 A₃.

After observation of 9^h 21^m readjusted G for parallelism of wires.

1879
Sept. 6 W.A.R. obs.

$N^o 1 = 389$	h	m	s	h	m
	12	51	0	13	46
$2 = 390$	17	54	"	20	11
$3 = 391$	0	47	"	12	5

Sept. 7 W.A.R. obs.

$N^o 1 = 392$	11	0	"	11	58
$2 = 393$	15	52	"	17	38

Sept. 8 W.A.R. obs.

$N^o 1 = 394$	10	56	"	12	9
$2 = 395$	13	8	"	15	33
$3 = 396$	15	44	"	17	53
$4 = 397$	17	59	"	20	18
$5 = 398$				3	35
$6 = 399$	3	46	"	4	5

Errors of Circle p. 24 Δ_3 .

Sept. 9 W.A.R. obs.

$N^o 1 = 400$	10	53	"	12	4
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Errors of Circle p. 30 Δ_3 .

Sept. 10 W.A.R. obs.

$N^o 1 = 404$	11	8	"	12	37
$2 = 405$	12	47	"	13	38
$3 = 406$	4	28	"	6	22
$4 = 407$	7	17	"		

Seeing very bad indeed.
Errors of Circle p. 32 Δ_3 .

36

1879

Sept. 11

W.A.R. obs.

N ^o 1 = 408	h m	h m
	11 9 to	12 31
2 = 409		16.33
3 = 410	4 43 "	6 23
4 = 411	7 18 "	9 13

Error of circle p. 34 A₃.

In adjusting microscope B. at 9^h 23^m ST it is probable that the position of the other microscopes was disturbed.

Sept. 12

W.A.R. obs.

N ^o 1 = 412	11 18 to	13 39
2 = 413	"	16 29

Error of circle p. 38 A₃.

Sept. 14

W.A.R. obs.

N ^o 1 = 414	"	3 18
2 = 415	3 24 "	5 44
3 = 416	"	7 52

Sept. 15

W.A.R. obs.

N ^o 1 = 417	"	13 40
2 = 418	14 59 "	15 50

Error of circle p. 48 A₃.

Sept. 16

W.A.R. obs.

N ^o 1 = 419	5 59 "	6 43
2 = 420	6 47 "	8 56

Error of circle p. 50 A₃.

1879
Sept. 17 WAK obs.

N^o1 = 421 $\frac{h}{w}$ 12.27^m
 2 = 422 12 51 " 14 16
 3 = 423 18 27 " 20 0
 4 = 424 7 16
 5 = 425 7 26 " 7 41

Error of circle p. 58 A₃.

Sept. 18 WAK obs.

N^o1 = 426 11 37 " 13 54

Error of circle p. 68 A₃.

Sept. 19 WAK obs.

N^o1 = 427 11 33 " 13 53
 2 = 428 14 9 " 16 15
 3 = 429 16 20 " 17 39

Errors of circle p. 70 A₃.

Sept. 20 WAK obs.

N^o1 = 430 19 22 " 20 21
 2 = 431 5 7 " 7 20

Sept. 21 WAK obs.

N^o1 = 432 12 0 " 13 57

Sept. 22 Errors of circle p. 78 A₃.
 Value of 1 div. of screws p. 98 A₃.

The discussion of the Circle observations are found in "B, Investigation of Circle".

38

1879
Sept. 23

W A R Obs.

N ^o 1 = 433	12 8	"	13 10
2 = 434	17 20	"	19 33
3 = 435	19 37	"	20 22
4 = 436		"	2 10

Sept. 24 W A R Obs.

N ^o 1 = 437	11 59	"	13 25
2 = 438		"	7 24
3 = 439		"	8 22
4 = 440		"	11 35

Sept. 25 W A R Obs.

N ^o 1 = 441	12 6	"	13 35
2 = 442			
3 = 443	19 14	"	20 12
4 = 444	5 29	"	
5 = 445		"	11 16

Sept. 26 W A R Obs.

N ^o 1 = 446	12 7	"	13 36
2 = 447		"	16 38
3 = 448	16 59	"	18 42

Sept. 27 W A R Obs.

N ^o 1 = 449		"	20 26
2 = 450	6 27	"	7 48

Sept. 28 W A R Obs.

N ^o 1 = 451	12 27	"	13 29
2 = 452	9 46	"	10 18

1849

W A R obs.

Sept. 29

No 1 = 453	h m	h m
	12 15	13 56
2 = 454		20 29
3 = 455		2 9
4 = 456		9 50
5 = 457		10 19

Sept. 30

W A R obs.

No 1 = 458	h m	h m
	12 20	13 24
2 = 459	16 20	17 17
3 = 460	18 12	18 59
4 = 461	7 27	7 52
5 = 462	9 48	10 30

1

Recapitulation of 1' Readings on glass & collimation.

E May 28 June 1

60.98	60.36
60.70	59.60
59.86	60.16
59.42	60.34
59.48	59.92

G May 28 June 1

60.18	60.82
59.18	59.72
60.32	60.22
59.82	60.04
59.58	59.64

60.56	60.36
60.15	59.88
60.13	59.72
59.54	59.76
59.71	59.94

60.72	59.70
59.40	59.76
60.74	60.02
60.48	59.70
59.66	60.20

Oct 1

W A R obs.

No 1 = 463	h m	h m
	12 25	13 40
2 = 464	16 6	16 55
3 = 465	16 58	17 48
4 = 466	7 6	8 6
5 = 467	9 36	10 18

40

1879 W.A.R. obs.

Oct. 2

No 1 = 468 ^{h m} 12 26 to ^{h m} 13 39

2 = 469 15 3 " 17 17

3 = 470 17 21 " 19 10

Oct. 3 W.A.R. obs.

No 1 = 471 12 33 " 13 38

Oct. 4 W.A.R. obs.

No 1 = 472 14 25 J.F.M. obs.

2 = 473 19 1 20 54 W.A.R. "

3 = 474 21 2 22 10 " "

4 = 475 6 40 8 18 " " Oc.

Sent Grodsham Chronometer No 3451 to Bond & Son for cleaning and lengthening the break.

Oct. 5 W.A.R. obs.

No 1 = 476 12 36 to 14 19

2 = 477 17 17 19 11

Oct. 7 W.A.R. obs.

No 1 = 478 12 49 " 14 47

2 = 479 16 15 " 17 58

3 = 480 18 2 " 19 22

4 = 481 20 22 " 22 11

5 = 482 7 37

6 = 483 7 43 " 9 47

7 = 484 9 51 "

~~8~~

1879
Oct 7-8 W.A.R. obs.

No 1 = 485	h m	h m
	14 42	
2 = 486		17 37
3 = 487	18 46	19 37
4 = 488	9 30 "	10 46

Oct. 12 W.A.R. obs.

No 1 = 489	19 11	h m	20 47
2 = 490	20 52	"	22 9
3 = 491			11 26

Oct. 12-13 W.A.R. obs.

No 1 = 492	11 14	h m	
2 = 493			14 42
3 = 494	19 36	"	21 58
4 = 495	22 1	"	22 17
5 = 496	6 14	"	8 7
6 = 497			11 31

Oct. 13-14 W.A.R. obs.

No 1 = 498			18 53
2 = 499			19 26
3 = 500			22 22
4 = 501			8 13
5 = 502	8 56	"	11 47

Oct 14-15 W.A.R. obs.

No 1 = 503	12 56	"	14 15
2 = 504	17 52	"	20 52
3 = 505	20 56	"	23 10
4 = 506	23 57	"	0 57
5 = 507	1 2	"	1 34

42

1879 W.A.R. obs.
Oct. 15-16

No 1 = 508 ^{h m} 13 0 ^{h m} to 14 49

Oct. 18 W.A.R. obs.

No 1 = 509 19 58 " 21 42

Toddham Chronometer No 3451 returned from Bond & Son after cleaning and lengthening the beat.

Oct. 19 W.A.R. obs.

No 1 = 510 to 18 51

2 = 511 19 57 " 21 57

3 = 512 22 9 " 0 17

4 = 513 0 55 " 1 31

5 = 514 9 29

Oct. 19-20 W.A.R. obs.

No 1 = 515 12 59 " 14 50

2 = 516 15 25 " 15 52

3 = 517 21 3 " 22 17

4 = 518 9 56 "

5 = 519 " 10 22

6 = 520 10 25 " 13 30

Oct. 20-21 W.A.R. obs.

No 1 = 521 13 35 " 15 42

2 = 522 20 1

Set Chronometer 3851 38^s fast.

Oct. 22 W.A.R. obs.

No 1 = 523 11 53 " 13 46

D.

1879 W.A.R. obs.

Oct. 23

 $N^{\circ}1 = 5241$

20	51	2	4	2
----	----	---	---	---

 $2 = 525$

			11	34
--	--	--	----	----

 $3 = 526$

11	37	"	13	41
----	----	---	----	----

Oct. 24 J.F.M. obs. Polaris

 $N^{\circ}1 = 526$

12	41	"	15	2
----	----	---	----	---

Oct. 25 W.A.R. obs.

 $N^{\circ}1 = 527$

19	25	"	20	24
----	----	---	----	----

 $2 = 528$

23	53	"	1	32
----	----	---	---	----

 $3 = 529$

			11	48
--	--	--	----	----

Oct. 25-26 W.A.R. obs.

 $N^{\circ}1 = 530$

12	46	"	15	3
----	----	---	----	---

 $2 = 531$

15	9	"	15	48
----	---	---	----	----

 $3 = 532$

21	8	"	23	8
----	---	---	----	---

 $4 = 533$

23	58	"	1	27
----	----	---	---	----

 $5 = 534$

		"	10	25
--	--	---	----	----

 $6 = 536$

Oct. 26-27 W.A.R. obs.

 $N^{\circ}1 = 536$

12	56	"		
----	----	---	--	--

 $2 = 537$

21	49	"	23	48
----	----	---	----	----

 $3 = 538$

23	3	"	1	14
----	---	---	---	----

Oct. 28 W.A.R. obs.

 $N^{\circ}1 = 539$

12	11	"	13	27
----	----	---	----	----

46

1879
Oct 28.29 WSR Obs.

No 1 = 540 13 34 6 15 48
 2 = 541 20 56 " 23 6
 3 = 542 23 59 " 1 29 (2)
 4 = 543 10 31 " 11 34
 5 = 544 11 42 " 13 56

Oct. 29-30 WSR Obs.

No 1 = 545 14 0 " 15 45
 2 = 546 21 23 "
 3 = 547 0 19 " 1 26
 4 = 548 " 11 53

Oct 30.31 WSR Obs.

No 1 = 549 12 56 " 14 46

Nov 4 JFM obs. Polaris

No 1 = 550 12 45 "
 2 = 551 19 32 " 21 38
 3 = 552 " 1 39

Nov 6-7 WSR Obs.

No 1 = 553 13 6 " 15 24

Nov 7-8 WSR Obs.

No 1 = 554 " 15 37

Nov. 9 WSR Obs.

No 1 = 555 10 1 " 11 23
 2 = 556

1879 W.A.R. obs.
Nov. 9-10

N ^o 1 = 557	13 50	^{h m} 26	^{h m}
2 = 558	20 12	"	22 9
3 = 559		"	1 24
4 = 560	9 23	"	10 45

Nov. 10-11 W.A.R. obs.

N ^o 1 = 561	13 11	"	15 13
------------------------	-------	---	-------

Nov. 11-12 W.A.R. obs.

N ^o 1 = 562	13 43	"	15 27
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Nov. 15 W.A.R. obs.

N ^o 1 = 563	21 20	"	23 3
2 = 564	9 56	"	11 38
3 = 565	13 42	"	15 34

Nov. 16 W.A.R. obs.

N ^o 1 = 566	21 12	"	
2 = 567	23 57	"	1 26
3 = 568	11 43	"	13 53

Nov. 16-17 W.A.R. obs.

N ^o 1 = 569		"	16 11
2 = 570	22 29	"	0 34
3 = 571	0 39	"	1 43

Nov. 21 J.F.M. obs. Polaris

N ^o 1 = 572			15 25
------------------------	--	--	-------

48

1879

Nov. 23

J & M obs Polaris

No 1 = 573

h m s 4 31

Nov. 23.24

W & R obs.

No 1 = 574 15 57 $\frac{1}{2}$ 17 27

2 = 575 21 20 " 23 37

3 = 576 23 41 " 1 24

4 = 577 9 17 " 11 10

Nov. 25

W & R obs.

No 1 = 578 21 40 $\frac{1}{2}$ 22 38

2 = 579 22 43 " 1 31

3 = 580 12 4 " 14 2

4 = 581 16 15

Nov. 26

W & R obs.

No 1 = 582

0 13

2 = 583 0 13 1 30

Nov. 27

W & R obs.

No 1 = 584

16 20

Nov. 29

W & R obs.

No 1 = 585

1 46

2 = 586 11 28 " 13 27

3 = 587 " 16 42

Nov. 30

W & R obs.

No 1 = 588 21 35 "

2 = 589 0 2 " 1 43

3 = 590 10 14 "

4 = 491 0 12 " 13 58

1879
Dec 1 W.A.R. obs.

No 1 = 592 $\begin{matrix} h & m \\ 16 & 22 \end{matrix}$ to $\begin{matrix} h & m \\ 17 & 55 \end{matrix}$
2 = 593 3 41
3 = 594 14 11 "

Dec 1-2 W.A.R. obs.

No 1 = 595 $\begin{matrix} h & m \\ 16 & 26 \end{matrix}$ " $\begin{matrix} h & m \\ 17 & 14 \end{matrix}$
2 = 596 12 44

Dec 2-3 W.A.R. obs.

No 1 = 597 17 13
2 = 598

From 16.^h to 17.^h cleaned Circle and Microscopes
Adjusted illumination of microscopes.
Removed Microscope A & fitted to East Circle.
Placed 15° arc in position.
Oiled pivots.

Dec 3. Measures of Curvature of 15° arc. Measures of 10 successive
Start at North end. spaces at intervals of 20 divisions.
10 division interval

18.7
18.7 - .10
2.8 - 59
36.0 - 26.8
58.0 - 38.0
58.0 - 0.0
40.0 - 18.
9.0 - 31.
9.0 - 0.0
56.5 - 2.5
42.0 - 14.5
31.0 - 11.0
20.0 - 11.0
18.0 - 2.0
20.0 + 2.0

ℓ	Δ_1	Δ_2
6 46.8	68.6	
5 38.2	68.6	-7.5
4 37.1	61.1	-34.2
4 10.2	26.9	+4.6
3 38.7	31.5	-18.6
3 25.8	-12.9	-15.5
3 28.4	-2.6	

$$1 \text{ div} = \frac{1}{4}''$$

Since Δ_2 is nearly constant the curvature must be very small.

50

1879

Dec 3-4

HAR Obs.

No 1 = 599	^h 16	^m 38	^s 6	^h 17	^m 43
2 = 600	0	13	"	2	14
3 = 601	2	23	"	4	1
4 = 602					

Put on glass cases at 17^h
adjusted microscopes on North Collimator.

Dec 4-5

HAR Obs.

No 1 = 603			"	17	46
------------	--	--	---	----	----

Dec 6

HAR Obs.

No 1 = 604			"	13	58
------------	--	--	---	----	----

Dec 6-7

HAR Obs.

No 1 = 605			"	17	35
2 = 606	22	25	"	0	35
3 = 607	0	47	"	3	3
4 = 608			"	3	55

Dec 8

HAR Obs.

No 1 = 609	12	15	"	13	22
------------	----	----	---	----	----

Dec 8-9

HAR Obs.

No 1 = 610			"	17	56
2 = 611	0	0	"	1	55
3 = 612	1	58	"	2	14

1879
Dec 11-12 W.A.R. obs.

No 1 = 613 17 7 to 17 32
Dec 11 2 = 614 23 46 " 0 34 J.M. obs.
" 12 3 = 615 0 38 " 1 50 " "
" 12 4 = 616 " 13 41 " "

Dec 15 W.A.R. obs.

No 1 = 617 0 19 " 2 28
2 = 618 2 35 " 3 57
3 = 619 12 45? "
4 = 620 12 57 "
5 = 621 16 28

Dec 15-16 W.A.R. obs.

No 1 = 622 17 41 " 18 52
2 = 623 " 2 50

Dec 16-17 W.A.R. obs.

No 1 = 624 17 32 " 18 4
2 = 625 0 57 " 2 8
3 = 626 3 5 " 3 52
4 = 627 11 49 " 14 5
5 = 628 " 15 40

Dec 17-18 W.A.R. obs.

No 1 = 629 17 42 " 18 7
2 = 630 0 15 " 2 33
3 = 631 2 38 4 4

Sent -
Brought Goddham Chronometer 3451 to Bond & Sons to be
fixed. Received back same day.

52

1879

Dec 20

WAR obs.

 $N^{\circ}1 = 632 \quad \overset{h}{11} \overset{m}{52} \overset{s}{6} \quad \overset{h}{13} \overset{m}{58}$

Dec 20-21

WAR obs.

 $N^{\circ}1 = 633 \quad 17 \ 55 \ \text{to} \ 18 \ 30$
 $2 = 634 \quad 1 \ 33 \ \text{"} \quad 1 \ 55$

Dec. 23

JFM obs.

 $N^{\circ}1 = 635 \quad 0 \ 51 \ \text{"} \quad 2 \ 17$

Dec 25

JFM obs.

 $N^{\circ}1 = 636 \quad 12 \ 55 \ \text{"} \quad 13 \ 51$
 $2 = 637$
 $16 \ 19 \overset{34,51}{\text{Comparison}} \overset{7}{5}$

Dec. 25-26

WAR obs

 $N^{\circ}1 = 638 \quad 18 \ 5 \ \text{to}$
 $2 = 639 \quad 23 \ 51 \ \text{"} \quad 1 \ 37 \ \text{JFM obs.}$

Dec 27

JFM obs.

 $N^{\circ}1 = 640 \quad 0 \ 48 \ \text{"} \quad 2 \ 6$

Dec 28-29

WAR obs.

 $N^{\circ}1 = 641 \quad 18 \ 22 \ \text{"} \quad 18 \ 43$
 $2 = 642 \quad 0 \ \text{"} \quad 3 \ 11$
 $3 = 643 \quad 3 \ 17 \ \text{"} \quad 4 \ 1$

Dec 30

JFM obs.

 $N^{\circ}1 = 644 \quad 1 \ 53 \ \text{"} \quad 2 \ 42$

Dec 31

WAR obs.

 $N^{\circ}1 = 645 \quad 12 \ 13 \ \text{"} \quad 13 \ 59$

1880 JF M obs.
Jan. 1 WAK obs.

N^o 1 = 646 ^{h m} 3 2 to 3 2
2 = 647 3 9 " 3 52

Jan 2 WAK obs.

N^o 1 = 648 18 45 " 19 11

Feb. 29 Returned to the Observatory after a successful trip to London and Paris for the purpose of obtaining a copy of the English Yard and the French Metre, having left Cambridge Jan. 6. 1880.

Upon my return learned that my Assistant Joseph F. McCormock died of hemorrhage and blood-poison at half-past two o'clock in the afternoon of Feb. 4.

I wish here to record my sense of the great loss I have sustained. I bear cheerful testimony both to his great ability as a circle-reader and to his faithfulness in the discharge of his duties. The labor incurred in making the observations for the past year has been very considerable, involving constant attendance at very irregular hours both during the day and the night. With very rare exceptions he has been ready at every call. When the observations of this year are published they will bear conclusive testimony to his great ability as a circle-reader. I doubt if he has an equal in this respect, certainly he had no superior.

W. S. Rogers.

1880

Feb. 29

Before commencing the observations for the year 1880, made the following changes:-

- 1) During my absence the South Clock has been removed to the Howard Clock pier in the cellar-clock room. As the clock was found to have a gaining rate of about 3^s per day, it was thought better to reduce the rate. At my request Mr Edmunds made this reduction during the time between the morning of Feb. 28 and the afternoon of Feb. 29. The pendulum bob was lowered 10 div. of a revolution. This produced a change of $.27^s$ in the hourly rate.

Three ten-gramme weights ($3 \times 10 = 30$ grammes) added increased the hourly rate nearly 0.5^s .

But one five-gramme and two two-gramme weights ($5 + 2 + 2 = 9$ grammes) only increased it 0.07^s .

The fact that the centre of gravity of a large weight is farther above its base than is the case with a small weight, would partly account for this discrepancy, but probably a variation in the rate of the chronometer with which it was compared will account also for part of it.

Pendulum left at 3 A.M. Mar. 1, 1880 (Civil Time) with the following weights:-

One five-gramme brass weight.	5
Two two-gramme brass weights	4
One lead weight of nearly two grammes	2
One one-gramme brass weight	1
Total about twelve grammes.	12

1880

Feb. 29

(2) A new mounting of the North collimator has been made in order to allow of the mounting of a long focus collimator objective below the objective of the North collimator.

The marble caps of the South collimator pier having been removed four upright rods were inserted in the brick pier, and the plate forming the bearing of the collimator tube was fastened firmly to it.

The long collimator has a focus of 26 feet. The object-glass is set below the object-glass of the North collimator and an opening is made through the other pier and the walls of the building.

The dimensions of the pier on which the tube carrying the cross-hair is placed are as follows.

Dimensions at bottom

Dimensions at top.

Distance from bottom to top.

Focal distance of object-glass = $215.31 \text{ ft.} - 9.27 = 206.04$

(3) Adjusted the illuminating of all the microscopes, and adjusted the microscopes so that they read nearly the same when the telescope is pointed on the North collimator.

(4) Oiled the pivots.

(5) Examined the verticality of the transit. wire and found it unchanged.

Inasmuch as it has been found physically impossible for one observer to carry on the regular system of observations and at the same time to make the requisite number of observations for the investigation of the differential

1879

Feb 29

refraction in a systematic way when a large and miscellaneous list of stars is selected, the observations of this class will during the present year be limited to a few stars. An attempt will be made to obtain an equal number of observations at each culmination.

It has been found to be impracticable to limit the observations to stars which follow the sun in declination and at the same time obtain an equal number at opposite seasons of the year. Hence during the present year the working list will follow the order of right-ascension. The object to be gained in making the observations differential with respect to the sun will be secured in the reductions.

Adjusted for focus of collimators.

Adjusted for inclination of collimator wires.

Examined the verticality of the transit threads & found it unchanged.

Setting for collimation before commencing adjustment:-

46.653

Setting after adjustment

NC

SC

46.710

46.702

700

706

713

710

704

707

702

714

29

39

46.7058

46.7078

Mean = 46.706 - Set at 46.706

1880
Feb 29-Mar. 1

Began observations for absolute position for the
year 1880.

Working list same as for 1879 - nearly.

$$\begin{array}{r} \text{No 1} = 1 \text{ } ^{h} 19 \text{ } ^{m} 3 \text{ } ^{s} 6 \text{ } ^{s} 20 \text{ } ^{m} 13 \\ 2 = 2 \text{ } 22 \text{ } 18 \text{ } " \text{ } 22 \text{ } 55 \end{array}$$

Mar. 1 W.A.R. obs.

$$\text{No 1} = 3$$

$$\begin{array}{r} 2 = 4 \text{ } 4 \text{ } 12 \text{ } " \text{ } 7 \text{ } 6 \\ 3 = 5 \text{ } 13 \text{ } 5 \text{ } " \text{ } 14 \text{ } 15 \\ 4 = 6 \text{ } 17 \text{ } 9 \text{ } " \text{ } 19 \text{ } 16 \\ 5 = 7 \text{ } 19 \text{ } 31 \text{ } " \text{ } 23 \text{ } 2 \end{array}$$

Mar. 2 W.A.R. obs.

$$\begin{array}{r} \text{No 1} = 8 \text{ } 0 \text{ } 48 \text{ } " \text{ } 1 \text{ } 16 \\ 2 = 9 \text{ } 4 \text{ } 27 \text{ } " \text{ } 6 \text{ } 45 \\ 3 = 10 \text{ } 16 \text{ } 28 \text{ } " \text{ } 16 \text{ } 41 \\ 4 = 11 \text{ } 17 \text{ } 10 \text{ } " \text{ } 19 \text{ } 7 \end{array}$$

Mar. 3 W.A.R. obs.

$$\begin{array}{r} \text{No 1} = 12 \text{ } 19 \text{ } 31 \text{ } " \text{ } 23 \text{ } 3 \\ 2 = 13 \text{ } 16 \text{ } 49 \text{ } " \text{ } 17 \text{ } 54 \end{array}$$

Mar. 4 W.A.R. obs.

$$\begin{array}{r} \text{No 1} = 14 \text{ } " \text{ } 1 \text{ } 10 \\ 2 = 15 \text{ } 6 \text{ } 38 \text{ } " \text{ } 8 \text{ } 7 \end{array}$$

Mar. 6 W.A.R. obs.

$$\text{No 1} = 16 \text{ } 16 \text{ } 34 \text{ } \text{---} \text{ } 17 \text{ } 34$$

1880

Mar. 8

W. S. R. obs.

No 1 = 17	h	m	s	h	m	s
				23	27	
2 = 18			"	1	35	
3 = 19	5	0	"	6	21	
4 = 20	6	51	"			
5 = 21	-	-		2	14	

Mar. 8 William C. Winlock having been engaged to take the place of J. F. Mc Cormick deceased, as Circle-Reader began work this day. At present his readings will not be used.

Mar. 9

Provisional investigation of Transit Reticule
for Meridian Circle.
Measures with ^{Regent's} Microscope Comparator.
Eyepiece No 3.

No div.	corr.	Σ	No div.	corr.	Σ
67.65	-.94		67.75	-.904	
66.15	+.56		66.20	+.51	
65.50	+1.21		65.65	+1.06	
66.10	+0.61		66.30	+.41	
67.80	-1.09		68.20	-1.49	
67.85	-1.14		67.35	-.64	
66.10	+.61		66.30	+.41	
65.75	+.96		65.85	+.86	
66.55	+.16		66.40	+.31	
67.80	-1.09		67.85	-1.10	
67.50	-.79				
66.15	+.56				
65.70	+1.01				
66.40	+.31				
67.70	-.99				
67.65	-.94				
66.30	+.41				
65.55	+1.16				
66.20	+.51				
67.55	-.84				
67.50	-.79				
66.30	+.41				
65.80	+.91				
66.45	+.26				
67.60	-.89				
67.75	-1.04				
66.35	+.36				
65.95	+.76				
66.10	+.61				
67.90	-1.19				

1880

Mar. 10

Corrections adopted for setting of Rogers' screw
to free it from periodic errors.

Rev.	No. dia. Screwhead.	Rev.	No. dia. Screwhead.	Rev.	No. dia. Screwhead.	Rev.	No. dia. Screwhead.
0		300	300.14	600	600.14	900	900.14
10	9.82	10	309.97	10	609.98	10	909.96
20	19.70	20	319.90	20	619.87	20	919.92
30	29.78	30	329.95	30	629.86	30	929.92
40	39.89	40	340.09	40	639.98	40	940.02
50	50.06	50	350.21	50	650.10	50	950.16
60	60.23	60	360.33	60	660.27	60	960.30
70	70.31	70	370.39	70	670.38	70	970.40
80	80.28	80	380.43	80	680.40	80	980.35
90	90.16	90	390.29	90	690.31	90	990.22
100	100.03	400	400.15	700	700.17	1000	1000.06
10	109.94	10	409.99	10	710.02	10	1009.93
20	119.80	20	420.93	20	719.90	20	1019.81
30	129.83	30	430.00	30	729.93	30	1029.84
40	139.89	40	440.11	40	740.10	40	1039.93
50	150.07	50	450.23	50	750.23	50	1050.07
60	160.23	60	460.38	60	760.35	60	1060.22
70	170.34	70	470.47	70	770.45	70	1070.31
80	180.37	80	480.50	80	780.43	80	1080.33
90	190.26	90	490.35	90	790.30	90	1090.17
200	200.09	500	500.15	800	800.10	1100	1099.98
10	209.93	10	509.17	10	809.93	10	1109.81
20	219.90	20	519.86	20	819.81	20	1119.68
30	229.92	30	529.89	30	829.83	30	1129.75
40	240.05	40	540.01	40	839.97	40	1139.86
50	250.19	50	550.18	50	850.10	50	1150.02
60	260.35	60	560.32	60	860.25	60	1160.14
70	270.39	70	570.44	70	870.35	70	1170.25
80	280.40	80	580.44	80	880.37	80	1180.26
90	290.33	90	590.32	90	890.25	90	1190.13
						1200	1200.00

60

1879

Mar. 10

Summed correction for each 5 divisions of
Rogers' Screw.

Div.	Corr.	Reading	Div.	Corr.	Div. Corr.
0	0	0	0	-0	51 + 3
5	-9	4.91	1	-2	52 + 5
10	-16	9.84	2	-4	53 + 6
15	-21	14.79	3	-6	54 + 8
20	-25	19.75	4	-8	55 + 10
25	-25	24.75	5	-9	56 + 11
30	-23	29.77	6	-10	57 + 13
35	-18	34.82	7	-12	58 + 14
40	-13	39.87	8	-13	59 + 15
45	-5	44.95	9	-15	60 + 16
50	+2	50.02	10	-16	61 + 17
55	+10	55.10	11	-17	62 + 18
60	+16	60.16	12	-18	63 + 19
65	+22	65.22	13	-19	64 + 21
70	+25	70.25	14	-20	65 + 22
75	+25	75.25	15	-21	66 + 23
80	+24	80.24	16	-22	67 + 24
85	+20	85.20	17	-23	68 + 24
90	+14	90.14	18	-24	69 + 25
95	+8	95.08	19	-24	70 + 25
1.00	-0	100.00	20	-25	71 + 25
			21	-25	72 + 25
			22	-25	73 + 25
			23	-25	74 + 25
			24	-25	75 + 25
			25	-25	76 + 25
			26	-25	77 + 25
			27	-24	78 + 25
			28	-24	79 + 25
			29	-24	80 + 24
			30	-23	81 + 23
			31	-22	82 + 22
			32	-21	83 + 21
			33	-20	84 + 20
			34	-19	85 + 20
			35	-18	86 + 19
			36	-17	87 + 18
			37	-16	88 + 17
			38	-15	89 + 16
			39	-14	90 + 14
			40	-13	91 + 13
			41	-11	92 + 12
			42	-10	93 + 10
			43	-8	94 + 9
			44	-6	95 + 8
			45	-5	96 + 7
			46	-3	97 + 5
			47	-1	98 + 4
			48	+0	99 + 2
			49	+1	100 + 0
			50	+2	

1899⁸⁰ WAK obs.
Mar. 10

$N^{\circ}1 = 22$ $23^{\text{h}} 44^{\text{m}} 4^{\text{s}}$ $1^{\text{h}} 29^{\text{m}}$
 $2 = 23$ $9^{\text{h}} 14^{\text{m}}$ " $11^{\text{h}} 19^{\text{m}}$
 $3 = 24$ $11^{\text{h}} 23^{\text{m}}$ " $13^{\text{h}} 28^{\text{m}}$

Mar. 11 WAK obs.

$N^{\circ}1 = 25$ $19^{\text{h}} 49^{\text{m}}$ " $20^{\text{h}} 25^{\text{m}}$
 $2 = 26$ $23^{\text{h}} 19^{\text{m}}$ " $23^{\text{h}} 15^{\text{m}}$

A direct line has been run from the Van Walsh Clock to 1327.

The Waltham clock, which will have the designation W.C. was recorded for the first time on Sheet $N^{\circ}2$. An arrangement is yet to be made by which the W.C. and Chro. 3451 can be recorded on the Chronograph at the same time.

Measures of 2³ Provisional plate.

Div		A	Σ	Corr. Screw head
0			+147	+4
40	133.20	+147	+364	+11
80	2.13	+217	+1411	+12
20	3.30	+047	+588	+18
60	4.17	-		
	5.45	-103		
40	6.45	+117		
80	7.23	-153		
20	8.50	+217		
60	9.13	+77		
00	10.27	-323		
40	11.67	+77		
80	12.27	+117		
20	13.23	+77		
60	14.27	-63		
	15.41	-73		
40	16.42	+47		
80	17.30	-283		
20	18.63	+177		
60	19.17	+177		
00	20.73	-383		
	69.41			
	133 347			

1879phae.proj.1809R