

KU11365.474

R 32

2







KG 11365.474





Ingress 1st and 2nd Contacts.

West Equatorial E. C. S. obs.

Aperture cms. Source Achromatic eyepiece
 Plate of glass ruled in squares in focus, sides not
 parallel to diurnal motion. Point of contact shown
 by diagonal of squares, independently of position
 of sun's limb. Light reduced by piece of
 light red glass and neutral tint wedge varied
 by hand. Time recorded on ~~Standard~~ Mean time Chronograph
 Band 440, by Miss R. H. Saunders.

	1st Contact			2nd Contact		
Observed.	10	29	19.5	10	32	10.5
Error of Chron.			44.8			44.8
Corrected times	10	28	34.7	10	31	25.7

From the length of the indentation at the observed
 1st contact it would appear that the depth of
 the indentation was ^{about} .35" which would correspond to
 a correction of - 5.4 s. to the observed time.

The second contact was late rather than early a line
 of light being seen around Mercury. It was however
 so narrow that no correction is deemed advisable.
 Limb very wavy. Edge of lens very wavy.

1878. May 6th 0Transit of Φ .

S. Waldo observed

15-inch Equatorial, Eye piece 1, with dark red shade.

Eye piece No 3. being too high in the condition of the clouds. Aperture cut down to inches.

As I feared the position angle might be in error I began to sweep the $\odot$'s disc in the expected position for. This sweeping had continued for several minutes before seeing at last the unmistakable indentation of Φ on the $\odot$'s limb. The two pistol shots were fired as

Chum. Band 503 agreed upon in close succession.

10^h 29^m 18^s.5 Time of the 1st pistol shot, at which time the $\odot$'s limb was well notched. In reaching over to the pistol and firing I may have consumed $\pm 3^s$ and I roughly estimate the time the notch had been formed at 10^s from its subsequent growth. But I have evidently lost the 1st contact, though I should estimate it at 10^h 29^m 5^s $\pm 14^s$.

An attempt was now made to measure the cusps, but I found it impossible to do so, the cusps being very poorly defined and nothing seemed tangible enough to call a lineable object.

B 503

10 29 56.5 Φ estimated semicircular.

After this phase a singular phenomenon presented itself which I am unable to explain. Just before 2nd contact a blur of black seemed to connect Φ with the $\odot$'s limb. It was not definite enough to say whether the $\odot$'s limb made angular or rounded cusps with Φ . I vainly thought of the "black drop" though a disbeliever in that phenomenon having any existence with good telescopes.

B 503

10 31 6 a glimmer of light began to show itself between

B.503 ♀ and the ☉ which became a certain thread at
 10^h 31^m 11^s.5

after this phase, ♀ continued wavy, sometimes reaching
B.503 out to the ☉'s limb until
 10^h 31^m 20^s.0 but

B.503 at
 10^h 31 41 ♀ was well in the disc, and a clear band say
 of 3" or 4" of light separated ♀ and the ☉'s limb.

The above times are by M.T. Box Chronometer "Bond 503"
 and are uncorrected for chronometer error.
 Chronometer times taken by Recorder, William Winlock.

First Contact.

Appearance of the Notch 10^h 29^m 18^s.5 by Bond 503.

Deduct for time in firing pistol 3^s for chron. Corr. 24^s.9 to 503. p. 124.
 — 33.0

1st Contact. H.C.O. m.t. = 10^h 28^m 45^s.5 which may be 15^s late.

Second Contact. (Phase "glimmer of light")

Appearance of the glimmer 10^h 31^m 9^s

Deduct for chron. Corr. to 503 24^s.9 p. 124

2nd Contact H.C.O. m.t. = 10^h 30^m 44^s.1 ± 2^s.

Measures of Φ from $\odot$'s limb. Apparatus including filar

Micrometer as described p. 22, 23.

L. Waldo Brown. W. W. Winkler Chronometer
and Recorder.

Movable web brought tangent to limb of $\odot$ at 1st Contact.

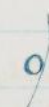
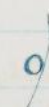
Eye piece 1. Definition poor.

Band 503			Micrometer, Mercury directed.
10 th	37 ^m	38 ^s	51.768
	38	53	52.345
	3	43.5	
	39	56.3	52.755
	40	17.5	53.130
	41	12.0	53.515
	41	39.8	53.743
	42	33.3	54.165
	43	9.3	54.328
	43	35.0	54.562
	44	24.0	54.775
	44	56.3	54.980
	45	59.7	55.205
	46	27.6	55.375
	47	58.0	55.645
	47	16.3	55.972
	47	44.0	56.105
10	48	31.3	56.288

10 50 Discontinued these measures to prepare to measure
the diameter of Φ . Definition poor.
For coincidences et sequens see p. 51, 52.

Ingress - Interior Contact.
 Portable 3ⁱⁿ equatorial. Power, Microm. VI.

With. obs.
 Bond 312

1 28 10.3 very small cusp. 
 15.2 tangent 
 27.0 clearly on the sun's disk 
 29 42.9 disks separated by 2.001^{in} as indicated by the
 inserted scale.

$2.001^{\text{in}} = 5.2''$ assuming focal length to be 40^{in} , which distance I would
 require $1^{\text{m}} 20^{\text{s}}$ to pass over. Taking the mean of the 1st and
 3^d readings for one determination we have

1	28	18.6	
		15.2	
		<u>22.9</u>	
1	28	18.9	= time by Bond 312
		+ 39.2	Corr. to Prod. 1327
		- 38.4	Corr. for Error of Prod. 1327
1	28	<u>19.7</u>	corrected sidereal time of interior contact
2	57	36.8	Sid. for mean noon
1	29	<u>17.1</u>	Sid. Interval
		- 14.6	
1	29	2.5	Mean "
10	30	<u>57.5</u>	Mean time of interior contact

Image of planet unsteady and poorly defined; observa-
 tions consequently not very reliable.

A rattle on chronograph key at 1 26 37 was made
 soon after the planet was first seen.

W. H. Pickering Abscure.
 Aperture $\approx$ 1 cm. Power.
 Telescope belonging to Mass. Inst. of Technology.
 Chromatic Band 332 (Said. time)

1st Contact			2nd Contact			3rd Contact			4th Contact		
Band $\frac{1}{6}$ long			Just Contact			Low Light?			Low Light. dark		
1h	21.2	45.0	1	24.5		1	24.16		1	24.31	
	4	30		4	30		4	30		4	30
1	26	15	1	28.35		1	28.46		1	29.1	
Red 1.9	2	37.8	7	2	37.8	9	2	37.8	9	2	37.8
10	28	52.8	10	31	12.8	10	31	23.8	10	31	38.8

A. G. Clark. Memo.
 Aperture Power.

Walt Grounds full.

1st Contact			2nd Contact		
10	28	53.5	10	31	33
		9			9
10	28	44.5	10	31	24

Egress. 3d and 4th Contacts.
 Sep 21. West Equatorial E.C.S. Observed.

Arrangements as at ingress except that Mr. Ender's records. Sun emerges from cloud.
 Sun emerges from cloud at 5h 59m 9.50 after 3d contact, interval between cusps then equals $\frac{2}{3}$ diameter of Mercury. At 6 0 50 enters cloud interval cusp $\approx .6$ diameter. At 6 1 22 again visible cusp .3 diam. At 6 1 26.5 Mercury off sun. No trace of it was visible after this although it was looked for carefully beyond the sun's limb until 6 4.

Appearance	Cusps. 6	Cusps. 6	Cusps. 3	4th Contact
Observed time	5 59 9.5	6 0 50	6 1 22	6 1 26.5
Error Chron.	44.8	44.8	44.8	44.8
Correct time.	5 58 24.7	6 0 5.2	6 0 37.2	6 0 41.7
Assumed Cor.	23.7	18.7	4.3	
	5 58 0.8	6 0 23.9	6 0 41.5	6 0 41.7

The last two times are alone entitled to confidence owing to the difficulty of ^{estimating} ~~measuring~~ a large interval between the cusps.

The edge of the lens was serrated at this time with indentations 2" or 3" deep rendering the recognition of the Mercury difficult.

15 inch. Equatorial. Observations of Egress. 3rd Contact.
S.W. & N.W.

10 inches aperture. Extremely light Sunshade with deeper
mrs available.

Row 503

at 5^h 30^m I went to the 15-inch to prepare for egress.
Eyepiece I adopted. A heavy bank of
clouds obscured $\odot$ until within a few
minutes of 3rd Contact. I prepared to measure
distances as before after 2nd Contact - but passing
clouds prevented.

5^h 57^m 9^s.5 $\odot$ just visible through clouds and near
3rd Contact.

5 58 10. Through the clouds I saw the limb of $\odot$
and $\odot$ in contact - with a glimmer of light
which the clouds prevent my seeing as
plainly as at 2nd Contact in the morning,
but at

5 58 30.5 the glimmer had vanished and there
was a bold connection between $\odot$ and
the $\odot$.

5 58 47.0 $\odot$ Estimated $\frac{1}{3}$ off the $\odot$'s disc

6 0 3.0 $\odot$ Sharp and semi-circular Estimated.
Third Contact. Phase "glimmer of light disappears".

Row 503. 5^h 58^m 16^s. deduct for Chron. Cor. p. 124. 24^s.3

3rd Contact 5^h 57^m 51^s.7 H.C. O. mt.

4th Contact.

Rms 503.

6^h 0^m 10^s.0 $\delta \frac{6}{10}$ after O's disc.6^h 0^m 22^s.8 $\delta \frac{8}{10}$ " " " "6^h 0^m 36^s.1 $\delta \frac{9}{10}$ " " " "6^h 1^m 2^s.2 4th Contact - perhaps 3^s late.

Definition and Condition of observations much better than in the Morning. Sink of the O boiling, but I could see the edges of the "teeth" clearly. I was impressed with the fact that after 3^d contact δ seemed trying to get into an elongated  shape, which after the planet was $\frac{1}{3}$

The instant after 4th Contact δ was absolutely invisible, though I tried hard to see it, putting the O out of the field, taking shades off etc.

Mr. William Winkler deserves to be especially remembered through this day's observations for his assiduous attention to making the observations made by me a success.

Seonard also.

Fourth Contact. Phase - final disappearance of δ .Rms 503 6^h 1^m 2^s.2 deduct for diam. Cor. p. 124. 24^s.34th Contact 6^h 0^m 37^s.9

Ch. H. Pickering - Brewer.

J. F. Mc C. recorded three times noted two only recorded.

1st Obs. Internal Contact (?)

2d " Planet halting off

3d " Last Contact very doubtful.

Obs Times noted (a) probably Internal Contact
(b) Last Contact.

	a	b
Observed Time	9 53 22	9 55 24
Error		
Corrected Time		
Corrected to Mean Time		
Corrected Mean Time		

Measures for Coincidence (Continued from p. 24) . 15-inch Equator.

Band 503.

Eypiece No 3. Aperture inches*

10th 55^m (about)

Tang. I

Tan II

48.998

49.068

49.008

49.122

49.008

49.078

49.024

49.090

49.030

49.082

* Diaphragm marked .5

Double distance Measures.

Band 503

Micron.

11th 2^m 40^s

50.215

2.425

3 32

47.790

11 4 15

50.280

2.537

4 40

47.743

2.481 Diam = 12.16

These measures are not entitled to any confidence from the very poor definition of Φ . Clouds as usual.

L.M.Oh.

M.M. Record as before.

Measure in the afternoon, 3 P.M. at equinox.

Achromatic eyepiece - Aperture 10 inches - Hilger wedge.
Definition continues miserable.

Band 503

3 ^h	26 ^m	30	51.410	2.065
	28	30	53.475	
			<u>104.885</u>	

31	53.390	2.180
33	51.210	
	<u>164.600</u>	

33	53.408	2.130
34	51.278	
	<u>104.686</u>	

36	53.353	2.060
37	51.293	
	<u>104.646</u>	

38	53.428	2.191
38	51.237	
	<u>164.666</u>	

3 ^h	40	53.536	2.363
	41	51.173	
			<u>989</u>
			2.165

$\therefore$ value of diameter = 10".61

Measure of the diameter of ϕ with the $5\frac{1}{4}$ in equatorial in the
 n. ring. Small filar micrometer fitted on
 by S.W. Eyepiece with equiv. focus inches
 fitted to micrometer. Double distances.

Equatorial Diameters.

Band 503		micrometer	
4 ^h	33 ^m	107.685 9.618	1.067
	35	10.632 9.516	1.116
	37	9.516 10.711	1.195
	39	10.721 9.538	1.183
	39	9.594 10.725	1.131
	40	9.594 10.697	1.103
	41	9.600 10.672	1.072
			867
			1.124
1124 x 22918 = 25.76		Diam = 12.88	

Polar Diameter as before -

Rnd 503.

Microm.

4th 52^m

9.580

1.025

10.605

53

9.573

1.099

10.672

54

9.596

1.127

10.723

55

9.549

1.181

10.730

56

9.598

1.127

10.725

559

1.1118

The value in this column see p. 121.

Mr. A. R. finds from these obs. diam = $\frac{13'' 59}{12.82}$
 $1.1118 \times 22.918 = 25.4707$ Diam = 12.74

Measure of diameter by G. G. P.

3 54 53.521 2.386
51.135

53.516 2.409
51.107

53.388 2.144
51.240

53.408 2.300
51.108

53.526 2.457
51.067

4 0 $\overline{2.3392} = \underline{\underline{11.46}}$

During these measures the apparent diameter of Mercury was at times reduced one third to one half.

Observations for diameter by transits over inclined and vertical lines.

W. A. R. and W. E. Skewis.

Description of Plates.

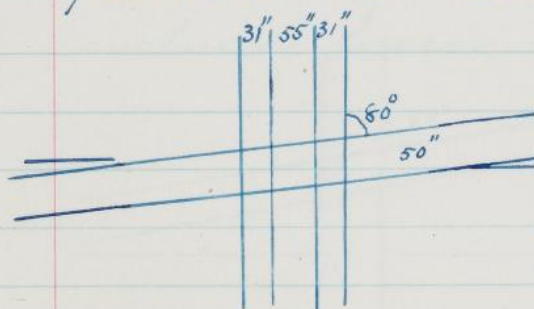
Plate I consists of 10 parallel lines ruled at a distance of 22" from each other.



Assuming focal length of object glass to be 268.84ⁱⁿ, the interval 22" = 0.02867ⁱⁿ. This was the

quantity adopted in ruling. Transits made on June 5 and 14 to determine equatorial interval (recorded in R 11 7p 168, 172) give $1.4685 = 22''.03$

v. Note p. 61. Plate II consists of 4 vertical lines crossed by two parallel lines inclined at an angle of 10°.



The distances of the two inclined lines is 0.06517ⁱⁿ = 50"; of the vertical lines 0.04040ⁱⁿ, 0.07168ⁱⁿ, and 0.04040ⁱⁿ, which equal 31", 55" and 31" respectively.

It has been considered unnecessary to verify these distances by determining the interval from transits.

The readings of the screw head of Prof. Rogers' ruling machine are here given for reference.

Plate I

rev.	div.
0	00.00
0	68.37
1	37.07
2	6.40
2	74.92
3	43.44
4	12.74
4	81.47
5	49.87
6	19.09

Plate II

Vertical lines		Inclined lines	
rev.	div.	rev.	div.
0	00.00	0	00.00
0	96.95	1	55.80
2	68.55		
3	65.46		

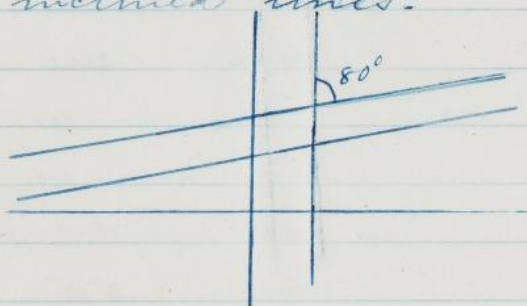
Observations for diameter of Mercury over inclined and vertical lines

With Plate I. The zero of position was determined by allowing Mercury to transit the field along one of the lines, and the desired inclination obtained by means of the micrometer scale attached to the instrument.

With Plate II. The plate was set by means of the ~~same~~ horizontal line, and was not moved from that position during the series of observations.

Note. By mistake the dimensions of a plate have been given ^{as Plate II} above which was ruled as given but which was not used in the observations.

Plate II consisted of two vertical and two inclined lines.



The values ^{used} ~~ruled~~ in ruling the plate have not been preserved; but the linear distance between the vertical lines determined by Prof. Rogers' microscope is 0.71366. v. R 11, 192.

Morning.1st Series.

Plate II KAR.

Colored glass held in hand - neutral tint.
Telescope not well balanced.

2 ^d	Inclined.		Mean.	Vertical.		
	I	II		I	II	
19 ^m	8.2	18.6		19 ^m	6.77	12.77
	12.3	22.9			7.41	13.42
	4.1	4.3	4.20		.64	.65
						Mean.
19	37.8	48.5		19	37.82	43.67
	41.7	52.2			38.55	44.38
	4.1	3.9	3.90		.73	.71
						.72
20	49.5	59.4		20	41.05	47.05
	53.5	3.4			41.73	47.77
	4.0	4.0	4.00		.68	.72
						.70
21	15.7	26.3		21	13.77	19.92
	19.3	29.5			14.52	20.62
	3.6	3.2	3.40		.75	.70
						.73
22	20.0	29.6		22	18.48	24.40
	24.1	33.5			19.15	25.05
	4.1	3.9	4.00		.67	.65
						.66
22	46.6	56.1		22	45.00	51.00
	50.0	0.3			45.80	51.68
	3.4	4.2	3.80		.80	.68
						.74

	Inclined			Vertical			MAR
	I	II		I	II		
23 ^m	19.1 ^p	29.2 ^p		17.72 ^p	24.05 ^p		
	22.3	33.4		18.46	24.68	Mean	
	2.2	4.2	3.70	.74	.63	0.69	
23	50.6	0.2		48.83	54.83 ⁹³		
	54.4	4.1		49.57	55.61		
	3.8	3.9	3.15	.74	.68	.71	
24	20.6	30.7		18.66	24.57		
	23.8	34.5		19.43	25.43		
	3.2	3.8	3.50	.77	.86	.81	

New Series.

Colored glass fastened to eyepiece with wax. Telescope
balanced better.

26	12.0	20.9		10.66	16.82		
	15.0	25.8		11.43	17.97		Reject.
27	10.6	20.6		11.85	17.90		
	14.0	23.9		12.49	18.48 ⁵		
	9.4	3.3	3.35	.64	.68	.66	
29	42.0	52.1		44.46	50.50		
	46.1	56.1		44.90	51.05		
	4.1	4.0	4.05	.44	.55	.50	

	Inclined-			Vertical-			M.A.R.
	I	II		I	II		
30 ^m	11.9	22.6		20.00	25.95		Man.
	16.1	27.0		20.71	26.50		
	4.2	4.4	4.30	.71	.55	0.63	
32	43.0	53.9		49.00	55.16		
	47.0	57.8		49.63	55.74		
	4.0	3.9	3.95	.13	.58	.61	
33	23.7	34.1		29.00	35.23		
	27.9	38.5		29.90	35.82		
	4.2	4.4	4.30	.90	.59	.74	
33	50.1	2.0					
	54.2	3.9	reject				
	4.1						
35	6.1	16.7		11.50	17.50		
34	10.2	20.7		12.05	18.05		
	4.1	4.0	4.05	.56	.56	.56	
35	27.7	38.1		32.76	39.08		
	31.9	42.0		33.50	39.74		
	4.2	3.9	4.05	.74	.63	.69	
35	51.3	1.8		56.34	—		
	55.3	6.0		57.00	—		
	4.0	4.2	4.10	.66			

W.R.

		Inclined		Vertical			
		I	II	I	II		
36 ^{hr}		11.6	22.0	16.78	22.90		
		16.0	25.9	17.62	23.42		
		4.4	3.9	3.95	.84	.62	.88
36		35.6	45.6	40.05	46.10		
		39.1	50.0	40.68	46.65		
		3.8	4.4	3.95	.63	.55	.59
36		57.3	7.8	37 ^m 2.18	8.27		
		1.2	11.3	2.78	8.70		
		3.9	3.5	3.70	.60	.43	.52
37		21.6	31.4	25.86	32.00		
		25.0	35.7	26.48	32.60		
		8.4	4.3	3.85	.62	.60	.61
37		48.0	57.8	52.20	58.50		
		51.5	1.7	52.83	59.05		
		3.5	3.9	3.70	.63	.55	.59
38		13.0	22.9	17.30	23.40		
		16.7	27.3	17.88	24.00		
		3.7	4.4	4.05	.58	.60	.59
38		13.0	22.8	17.30			
		16.8	27.3	17.82			

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	Inclined -			Vertical -			W.A.R.
	I	II		I	II		
39 ^m	30.3	40.9 ~~33.8~~		36.78 ^s	42.90 ^s		
	33.8	44.7		37.40	43.47		Mean
	3.5	8.8	8.65	.62	.57		.60
39	51.7	3.0		58.95	4.87		
	56.3	6.6		59.50	5.40		
	4.6	8.6	4.10	.58	.53		.54
40	27.6	38.1		33.73	39.81		
	31.8	41.4		34.32	40.37		
	4.2	3.3	3.75	.59	.56		.58
40	56.3	7.0		28.0 ^s	8.68		
	11.1	11.3		3.33	9.33		
	3.8	4.3	4.05	.53	.65		.59
41	21.5	32.0		27.56	33.58		
	26.0	35.9		28.21	34.18		
	4.5	3.9	4.20	.65	.60		.63
41	42.8	52.9		48.10	54.28		
	46.7	56.8		48.73	54.90		
	3.9	3.9	3.90	.63	.62		.63
42	5.1	15.2		10.50	16.64		
	8.7	18.8		11.21	17.15		
	3.6	3.6	3.60	.71	.57		.61

Inclined.			Vertical.		
I	II		F	II	
42 ^m	46.0	47.4	51.41	57.53	
	56.5	0.3	52.10	58.22	Mean
34	38	3.60	.69	.69	0.69
9.7	19.6		14.68	20.78	
13.6	23.7		15.48	21.50	
3.9	4.1	400	.80	.72	.76

Mean values of horizontal diameters by transits

First Series	Second Series	Third Series	Final mean.
0.65	0.66	0.62	
.72	.50	.52	
.70	.63	.44	
.73	.61	.55	"
.66	.74	.57	10.68
.74	.55	.59	9.27
.69	.69	.61	8.95
.71	.68	.58	9.63"
.81	.59	.66	log 9.63 = 0.98363
0.712	.52	.72	
"	.61	.54	
10.68 log 1.02857	.59 log 0.95182	.71	"
log 9.98117	.59 log 9.98117	.597 = 8.95	#
1.00974	.60 0.93299		
* Not reduced to the equator	.54	.85	log 9.63 = 0.98363
10.73	.58		" cos 16.45 = 9.98117
	.59		log D = .96480
log 9.27 = 0.96709	.63		D = 9.22"
log 9.98117	.63		
0.99826	.61		
8.88"	.68		
	.76		
	.518 = 9.27*		

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Afternoon.

Plate II.

Inclined

Vertical

W.R.

I II Mean

I II

Mean

58.3 5.1

58.61 4.55

2.1 12.0

59.12 5.27

3.8 3.9 3.85

.51 .42

0.63

12 29.29 39.6

29.50 35.46

32.6 43.5

30.00 36.00

3.4 3.9 3.65

.60 .54

.52

13 10.2 21.1

16.32 ~~12.33~~

14.0 25.1

16.78 22.74

3.8 4.0 3.90

.46 .41

.44

13 37.1 47.0

42.13 48.00

40.6 51.1

42.62 48.60

3.5 4.1 3.80

.48 .60

.55

13 59.4 9.7

4.37 10.4³

3.0 14.0

4.93 ~~16.02~~

3.6 4.3 3.80

.56 .59

.57

14 23.8 34.0

28.83 34.75

27.7 38.1

29.43 35.52

3.9 4.1 4.00

.60 .58

.59

14 48.2 58.6

53.00 59.20

52.4 1.6

53.73 59.78

4.3 3.0 3.60

.73 .58

.66

Inclined-

Vertical-

W.A.R.

15^m

I II
 57.0 7.1
 1.1 10.7
 4.1 3.6 8.15

I II
 1.53 7.70
 2.18 8.21
 .65 .51 0.58

16

24.1 34.4
 27.6 38.1
 3.5 3.7 3.60

⁴⁰
~~29.50~~ 35.29
 29.95 36.05
 .55 .76 .66

16

51.1 1.0
 54.4 4.6
 3.3 3.6 3.45

56.15 2.10
 56.85 2.83
 .70 .73 .72

17

^{20.5}
 10.8 ~~13.6~~
 13.6 23.8
 2.8 3.3 3.05

15.06 20.12
 15.63 20.63
 .57 .51 .54

17

38.4 48.4
 41.5 51.7
 3.1 3.3 3.20

43.38 49.50
 44.18 ¹³
~~50.63~~
 .80 .63 .71

23

8.0 18.0
 11.7

reject

Perseus Lacertis from inclined line, First Series, Plate.
Collection of results from preceding pages.

Series I Series II Series III
 Morning Afternoon.

Time of transit
 Limb I to limb II Time of transit
 Limb I to II Time of transit
 Limb I to II

4.50

3.35

3.45

3.90

4.05

3.65

3.40

4.20

3.90

4.00

3.95

3.70

3.80

4.20

3.80

3.70

4.05 3.96

4.00

3.85

4.10

3.60

3.50

3.95

3.85

3.49

3.95

3.60

3.70

3.45

3.85

3.05

3.70

3.20

4.05

3.65

3.65

4.10 3.85

3.75

4.05

4.20

3.90

3.60

3.60

4.00

3.91

Log D D
 Log 3.79 0.57864 .97557 9.75
 Log 3.91 .59218 .98911 9.75
 Log 3.65 .56229 .95922 9.10

9.103

Log 15 1.17609
 Log sin 10° 9.23867
 Log cos 10° 9.98117
 Log Quot. 3.9693

Plate I.

Zero of Position $289^{\circ} 26'$

WAR

1st SetReading $294^{\circ} 26'$

Series -

Interval

	1	2	3	4	5	6	7	8	9	
3 ^l 24 ^m	22.3	34.4	51.9	Means						12.1 14.6
	27.7	42.3	59.3							17.5 17.0
	5.4	7.9	7.4	1.5						14.1
				6.90						
25	31.7	48.2	2							16.5
	39.2	54.9								15.6
	7.6	6.7		7.15						
26	36.3	53.6								17.3
	44.4	1.7								17.3
	8.1	8.1		8.10						
27	11.8	28.7								16.9
	19.8	37.9								17.1
	8.0	8.2		8.10						
27	51.5	8.3								16.8
	59.7	16.8								17.1
	8.2	8.5		8.85						
28	31.2	46.6								15.4
	38.0	54.9								16.9
	6.8	8.3		7.55						
										11.25 11.56

	1	2	3		W.A.R.
29 ^m	^s 7.7	^s 24.7	Means		17.0
	15.3	32.1			16.8
	7.6	7.4	7.50	^s 6.90	
				7.15	
29	55.8	13.0		8.10	17.2
	2.0	19.6		8.10	17.6
	6.2	6.6	6.40	8.35	
				7.55	
30	³ 46.7	52.8		7.50	16.1
	43.1	0.3		6.40	17.2
	6.4	7.5	6.95	6.85	
				7.25	
31	13.7	30.0		7.50	16.3
	20.5	37.7		6.85	17.2
	6.8	7.7	7.25	$\log 7.38$	
				$\log \sin 5^\circ$	
31	51.6	8.2		$\log \cos 16^\circ 45'$	16.6
	58.2	16.6		$\log 15$	18.4
	6.6	8.4	7.50	$\log D$	
				D	
32	33.4	49.4			16.0
	37.4	57.1			17.7
	6.0	7.7	6.85		
					$\begin{array}{r} 99 \\ 1052 \\ 1125 \\ \hline 13 \overline{) 2117} \end{array}$
					$\begin{array}{r} 1049 \\ 1156 \\ \hline 2205 \end{array}$
					$\begin{array}{r} 228 \\ 16.75 \\ \hline I = 16.62 \end{array}$

W.A.R.

2^d set.

Reading 299° 26'

	1	2	3	4	5	6	
34 ^m	27.1 ^s	35.4 ^s	44.2 ^s	53.4 ^s	Means		26.3
	30.4	39.4	48.1	56.1			25.7
	3.3	4.0	3.9	2.7	3.45		
35	28.1	36.4	45.6	54.5			26.4
	32.2	40.7	49.1	58.5			26.3
	4.1	4.3	3.5	4.0	3.98		
36	17.2	26.5	34.4	43.3			26.1
	21.0	29.5	38.0	47.1			26.1
	3.8	3.0	3.6	3.8	3.55		
37	6.1	14.1	23.4	31.9			25.8
	9.3	18.1	27.1	35.6			26.3
	3.2	3.0	3.7	3.7	3.65		
37	50.3	59.2	7.6	16.3			26.0
	53.3	3.1	11.2	19.6			26.3
	3.6	3.9	3.6	3.3	3.45		
38	38.1	47.2	55.7	4.0			25.9
	42.0	51.2	59.2	7.8			25.8
	3.9	4.0	3.5	3.8	3.80		
39	23.1	31.5	40.2	49 46.2			26.1
	27.2	35.6	43.9	53.3 #			26.1
	4.1	4.1	3.7	4.1	4.00		
							18 26 18 26

	1	2	3	4	5	W.A.R.
40	^s 7.6	^s 16.4	^s 24.1	^s 33.2	Mean.	25.6
	11.1	19.6	28.4	37.4		26.3
	3.5	3.2	4.3	4.2	3.80	

40	57.3	0.1	7.8	16.4		25.4
	54.3	3.4	11.6	20.0		25.7
	3.3	3.3	3.8	3.6	3.50	

41	38.7	46.9	58.6	4.1		25.4
	42.2	50.3	59.3	8.0		25.8
	3.5	3.4	3.7	3.9	3.62	

42	22.4	30.2	39.3	47.7		25.3
	25.7	34.5	42.6	^s 51.6		25.9
	3.3	4.3	3.3	3.9	3.70	

3.48

3.98

3.55

3.65

3.45

3.60

4.00

3.80

3.50

3.62

3.70

3.68

1017 1037

1826 1826

11)2843 12863

3)25.85 26.03

8.62 8.68

I = 8.65

Log 3.68 0.56585

Log 3.80 3.9693

Log D .96278

D 9.18

M.H.R.

3d set.								
Reading							304° 26'	
	1	2	3	4	5	6	7	
43 ^m	32.6 ^s	37.9 ^s	43.8 ^s	47.5 ^s	55.6	1.4	Means	28.8
	35.0	40.3	46.3	52.0	57.5	4.1		29.1
	2.4	2.4	2.5	2.5	1.9	2.7	2.40	
44	22.5	28.2	34.5	39.7	46.3	51.8		29.3
	25.4	31.0	36.6	42.3	48.3	54.5		29.1
	2.9	2.8	2.1	2.6	2.0	2.8	2.52	
45	8.3	14.1	20.1	25.9	32.0	38.0		29.7
	11.0	16.5	22.3	28.3	34.6	40.3		29.3
	2.7	2.4	2.2	2.4	2.6	2.3	2.43	
45	5 ⁴ 52.0	0.0	5.3	11.3	17.3	22.6		28.6
	56.5	2.0	7.3	14.0	19.9	25.6		29.1
	2.8	2.0	2.0	2.7	2.6	2.0	2.47	
46	37.4	43.5	49.9	54.9	0.6	6.6		29.2
	40.0	45.7	52.0	57.6	3.2	9.4		29.4
	2.6	2.2	2.1	2.7	2.6	2.8	2.50	
47	20.7 (?)	26.0	32.0	38.1	43.7	49.2		23.2
	22.4	28.7	34.4	40.4	46.2	51.6		22.9
		2.7	2.4	2.3	2.5	2.4	2.46	
48	1.5	8.3	14.0	19.8	25.3	31.5		30.0 22.2
	4.5	10.7	16.1	22.2	28.0	33.6		29.1 22.9
	3.0	2.4	2.1	2.4	2.7	2.1	2.45	

1988 1980

	1	2	3	4	5	6	7	
48	47.3	53.1	58.9	4.6	10.9	16.3		29.0
	49.7	55.5	1.3	7.2	13.6	18.6		28.9
	2.4	2.4	2.4	2.6	2.7	2.3	2.47	
49	30.4	56.1	41.5	47.2	53.2	58.8		28.4
	32.4	38.7	44.0	49.6	55.5	1.7		29.3
	2.0	2.6	2.5	2.4	2.3	2.9	2.45	
50	41.4	47.4	~~52.9~~ 53.9	58.8	6.0	—		23.6
	43.7	50.0	55.6	1.7	7.5	—		23.8
	2.3	2.6	2.7	2.9	2.5		2.60	
								810 820
								1988 1980

$$\begin{array}{r}
 2.40 \\
 2.52 \\
 2.43 \\
 2.47 \\
 2.50 \\
 2.46 \\
 2.45 \\
 2.47 \\
 2.60 \\
 \hline
 2.48 \times 78 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 \log 2.467^{78} \quad 410 \\
 \log \sin 18^\circ \quad 392X \\
 \log \cos 16.45^\circ \quad 9.98117 \\
 \log 10 \quad 1.17619 \\
 \log D \quad 436 \\
 \quad \quad 9.6272 \\
 \quad \quad D \quad 9.47 \\
 \quad \quad \quad 21
 \end{array}$$

40t set

Reading — 309° 26'

	1	2	3	4	5	6	7	8	
52	18.3	22.7	27.3	31.5	36.4	40.7	45.5	Means.	27.2
	20.6	25.1	29.4	33.6	38.1	42.5	47.1		26.5
	2.3	2.4	2.1	2.1	1.7	1.8	1.6	2.00	

53	23.9	28.3	32.6	37.0	41.6	45.8	50.5		26.6
	25.7	30.1	34.5	38.9	43.4	47.7	52.5		26.8
	1.8	1.8	1.9	1.9	1.8	1.9	2.0	1.87	

Reversed telescope.

58	23.8	28.0	32.3	37.1	41.6	46.3	50.6		26.8
	26.1	30.1	~~34.7~~ 35.2	39.1	43.4	48.1	52.7		26.6
	2.3	2.1	2.4	2.0	1.8	1.8	2.1	2.07	

59	1.1	5.2	9.6	14.2	18.7	23.4	28.0		26.9
	2.9	7.3	11.8	16.1	20.8	25.6	30.0		27.1
	1.8	2.1	2.2	1.9	2.1	2.2	2.0	2.04	

59	42.2	46.5	50.9	55.3	59.9	4.9	9.0		26.8
	44.1	48.3	53.0	57.3	2.2	6.4	11.2		27.1
	1.9	1.8	2.1	2.0	2.3	1.5	2.2	1.97	

0	26.0	29.9	34.4	38.8	43.3	48.0	52.5		26.5
	27.8	32.1	36.4	41.1	45.4	49.8	54.4		26.6
	1.8	2.2	2.0	2.3	2.1	1.8	1.9	2.01	

1	4.8	9.5	13.8	18.4	23.4	27.5	32.0		27.2
	7.0	11.3	15.9	20.5	25.1	29.6	34.3		27.3
	2.2	1.8	2.1	2.1	1.7	2.1	2.3	2.04	

1880 1880

W.A.R.

	1	2	3	4	5	6	7		
4 ^h 1 ^m	49.4	53.4	58.0	2.4	7.2	11.5	16.1	26.7	
	51.2	55.5	0.1	4.3	9.2	13.5	18.0	26.8	
	1.8	2.1	2.1	1.9	2.0	2.0	1.9	1.97	
2	49.6	53.7	58.2	2.4	6.9	11.4	16.2	26.6	
	51.6	56.0	59.9	4.5	9.1	13.5	18.2	26.6	
	2.0	2.3	1.8	2.1	2.2	2.1	2.0	2.06	
3	25.5(3)	30.2	34.2	39.1	43.5	48.0	52.9	27.4	
	27.9	32.1	36.2	41.1	45.6	50.0	54.6	26.7	
	2.4	1.9	2.0	2.0	2.1	2.0	1.8	2.01	
battled	4	6.7	11.2	15.6	20.0	24.6	29.1	33.3	26.6
by clouds		8.7	12.8	17.4	22.0	26.3	30.6	35.2	26.5
		2.0	1.6	1.8	2.0	1.7	1.5	1.9	1.79
clouds	4	51.0	55.4	0.2	4.3	9.0	13.3	18.1	27.1
		52.8	57.3	1.7	6.1	10.6	15.3	19.6	26.8
		1.8	1.9	1.5	1.8	1.6	2.0	1.5	1.77
5	30.1	reject			1.79				1344 1334
	32.0				1.73				1880 1880
					2.00				12 3224 3214
					1.87				6 2686 2678
					2.07				448 446
					2.04				I = 4.47
					1.97				log 1.964
					2.01				log 2.004
					2.04				log 2.07
					1.97				log 1.964
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					1.97				log 1.964
					2.01				log 2.004
					2.04				log 2.07
					1.97				log 1.964
					2.01				log 2.004
					2.04				log 2.07
					1.97				log 1.964
					2.01				log 2.004
					2.04				log 2.07
			</						

Plate I.

79

Zero of position 305.54
1st Set

W.U.

Reading 315.54. Power III, too high, image unsteady
Lines

	1	2	3	4	5	6	Mean Δ	Mean Int.
$\frac{h}{2}$ m								
55	40.3	50.4						
	44.3	54.6						
A	4.0	4.2					4.10	

Int. 10.1
10.3

Zero of position 270.10
Reading 280.10 Power II

10.10 10.30
10.20 (2)

59	36.7	45.6	55.1	4.2				
	40.7	50.3	59.2	9.3				
	4.0	4.7	4.1	4.1		4.22		
	8.9	9.5	9.1					
	9.6	8.9	10.1				9.17	9.53

0	25.5	34.9	44.7	53.1				
	30.5	39.6	48.9	57.7				
	5.0	4.7	4.2	4.6		4.62		
	9.4	9.8	8.4					
	9.1	9.3	8.8				9.53	9.07

1	44.2	53.7	2.5					
	49.1	58.1	7.4					
	4.9	4.4	4.9		4.73			
	9.5	8.8						
	9.0	9.3					9.15	9.15

2	36.9	45.8	54.9	4.5				
	40.7	50.1	59.9	8.8				
	3.8	4.3	5.0	4.3	4.35			
	8.9	9.1	9.6					
	9.4	9.8	8.9				9.20	9.37

4.48(5) 9.26(11) 9.28(11)
9.27 (22)

2nd Set
Reading 285.10

W.L.

	1	2	3	4	5	6		
3	55.0	1.0	7.1	13.2	19.1	25.2		
	58.0	2.9	10.2	16.2	22.3	29.0		
	3.0	1.9	3.1	3.0	3.1	3.8	2.98	
	6.0	6.1	6.1	5.9	6.1			
	4.9	7.3	6.0	6.1	6.7		6.04	6.20
4	43.7	49.4	56.0	1.6	8.1	14.1		
	46.7	52.8	58.7	5.0	11.4	17.3		
	3.0	3.4	2.7	3.4	3.3	3.2	3.17	
	5.7	6.6	5.6	6.5	6.0			
	6.1	5.9	6.3	6.4	5.9		6.08	6.12
5	27.0	32.9	39.0	45.2	51.2	58.1		
	29.2	35.8	42.0	48.0	54.4	60.5		
	2.2	2.9	3.0	2.8	3.2	2.4	2.75	
	5.9	6.1	6.2	6.0	6.9			
	6.6	6.2	6.0	6.4	6.1		6.22	6.26
6	13.5	19.6	26.0	32.0	37.9	43.8		
	16.0	22.2	28.8	34.5	40.8	46.7		
	2.5	2.6	2.8	2.5	2.9	2.9	2.70	
	6.1	6.4	6.0	5.9	5.9			
	6.2	6.6	5.7	6.3	5.9			

3rd Set

Reading 275.10

7	33.5	52.8						
	43.6	4.2						
	10.1	11.4				10.75		
	19.3							
	20.6					19.80	20.60	
8	12.6	32.9						
	21.8	42.7						
	9.2	9.8				9.50		
	20.3							
	20.9					20.30	20.90	

zero of position 270.50

10.12(4) 19.80(2) 20.75(2)
20.28(4)

4th Set.

Full.

Zero of position 271.4
Reading 281.4

	1	2	3	4	5	6	7
14			17.0	25.2	34.3	42.2	51.1
			20.8	29.2	37.7	45.6	55.5
			3.8	4.0	3.4	3.4	4.4
			8.2	9.1	7.9	8.9	
			8.4	8.5	7.9	8.9	
							3.80
							8.52
							8.42

15	8.2	16.0	25.0	33.2	42.7	
	11.8	21.0	29.1	38.0	46.0	
	~~3.6~~	5.0	4.1	4.8	3.3	4.16
	7.8	9.0	8.2	9.5		
	~~9.2~~	~~8.1~~	~~8.9~~	~~8.0~~		

	8.62	8.55
3.98(10)	8.57(8)	8.48(8)
	8.52	(16)

Plate II.

No. 11.

Zero of position 155.5

Reading 155.5

Inclined

Vertical.

	I	II		I	II
4 48	56.5	6.5			
	0.2	11.2			
	3.7	4.7	4.20		
	10.0				
	11.0		10.00	11.00	
49	32.6	43.3			
	37.2	47.4			
	4.6	4.1	4.35		
	10.7				
	10.2		10.70	10.20	
49	56.7	6.5		1.7	7.7
	0.7	11.4		2.5	8.6
	4.0	4.9	4.45	0.8	1.1
	9.8				0.95
	10.7		9.80	10.70	
50	26.5	35.9		30.6	36.4
	29.5	40.2		31.0	37.1
	3.0	4.3	3.65	0.4	0.7
	9.4				0.55
	10.7		9.40	10.70	
50	50.3	0.9		54.9	0.5
	54.2	4.9		55.4	1.3
	3.9	4.0	3.95	0.5	0.8
	10.6				0.65
	10.7				
			10.60	10.70	
			4.12(10)	10.10(5)	10.66(5)
			10.38(10)		
					0.72

Not reduced as observer abandoned measuring with this plate.

Plate I.

Zero of position 85.02

1st Set.

W.U.

Reading 90.02

	1	2	3	4	5	
$\frac{h}{5}$				15.5		
$\frac{m}{0}$				22.4		
				6.9		<u>6.90</u> ref.
2			30.3	48.0		
			39.0	58.2		
			8.7	10.2	9.45	
			17.7			
			19.2			17.70 19.20
3			15.7	34.6		
			26.0	45.4		
			10.3	10.8	10.55	
			18.9			
			19.4			18.90 19.40
4			8.4	25.8		
			17.2	35.6		
			8.8	9.8	9.30	
			17.4			
			18.4			17.40 18.40
						9.77(6) 18.00(3) 19.00(3)
						18.50(6)

2nd Pet
Reading 95.02

m.u.

	1	2	3	4	5	6			
5			22.5	31.1	40.5	49.0			
			27.2	35.8	44.7	53.7			
			4.7	4.7	4.2	4.7	4.56		
			8.6	9.4	8.5				
			8.6	8.9	9.0		8.83	8.83	
6			26.7	35.7	44.8	53.4			
			31.4	40.0	48.8	58.4			
			4.7	4.3	4.0	5.0	4.50		
			9.0	9.1	8.6				
			8.6	8.8	9.6		8.90	9.00	
7			11.6		29.2	38.0			
			16.1		33.0	43.0			
			4.5		3.8	5.0	4.43		
			17.6		8.8				
			16.9		10.0		8.80	8.97	
8			1.3	9.7	18.6	27.7			
			5.8	14.1	23.6	32.0			
			4.5	4.4	5.0	4.3	4.55		
			8.4	8.9	9.1				
			8.3	9.5	8.4		8.80	8.73	
8			52.1	1.3	10.0	18.6			
			56.1	5.3	14.0	22.5			
			4.0	4.0	4.0	3.9	3.98		
			9.2	8.7	8.6				
			9.2	8.7	8.5		8.83	8.80	
9			52.9	1.6					
			57.4	5.8					
			4.5	4.2			4.35		
			8.7						
			8.4				8.70	8.40	
11				50.6		8.6			
				55.3		12.2			
				4.7		3.6	4.15		
				18.0					
				16.9					

9.00 8.40
4.36/23 8.84/16 8.74/16

3rd Set

W.L.

Reading 100.02

	1	2	3	4	5	6	7	8	
13		8.8	15.1	21.0	27.3	33.1	38.8		
		11.5	17.5	23.8	30.0	35.8	41.6		
		2.7	2.4	2.8	2.7	2.7	2.8		2.68
		6.3	5.9	6.3	5.8	5.7			
		6.0	6.3	6.2	5.8	5.8			6.20 6.02
13		52.5	59.0		10.5		22.5		
		55.6	1.3		13.2		25.3		
		3.1	2.3		2.7		2.8		2.72
		6.5		11.5		12.0			
		5.7		11.9		12.1			6.00 5.94
14		41.2	46.5		58.2	4.9			
		43.4	49.4		1.1	6.6			
		2.2	2.9		2.9	1.7			2.42
		5.3		11.7		6.7			
		6.0		11.7	4 th Set	5.5			
									5.92 5.80
									2.61(14) 6.04(11) 5.92(11)
									5.98 (22)
									Reading 105.02
15		50.8	53.6						
		53.0	57.9						
		2.2	2.3						2.25
		4.8							
		4.9							4.80 4.90
16		32.0		41.8	46.2	50.5	55.0	59.6	
		35.0		43.9	48.6	52.7	57.3	1.9	
		3.0		2.1	2.4	2.2	2.3	2.3	2.38
		9.8		4.4	4.3	4.5	4.6		
		8.9		4.7	4.1	4.6	4.6		4.60 4.48
7		12.0		21.3	25.9	30.1	34.7	39.0	
		14.1		23.2	28.0	32.4	36.7	41.2	
		2.1		1.9	2.1	2.3	2.0	2.2	2.10
		9.3		4.6	4.2	4.6	4.3		
		9.1		4.8	4.4	4.3	4.5		
									50
									4.50
									2.24(14) 4.63(11) 4.63(11)
									4.63 (22)

Reduction of observations.

Plate I.

The equatorial interval of (10 line) Plate I is found to be
by transits recorded in R 11 pp. 168, 172, 173

$$1^s.4685 \quad \log = 0.16688$$

The observations give the interval of time of both
limbs between the wires taken. Hence



$$\sin \text{ of angle of incli.} = \frac{1.4685}{\text{observed interval}}$$

The interval of time between the transits of the two
limbs over the same wire, multiplied by the sine
of the angle of inclination will be the observed
diameter in time. This must be multiplied by
 $15 \cos \delta$ to reduce to arc. at equator

δ of Mercury	$16^\circ 48'.4$	—	$16^\circ 41'.7$
$\cos \delta$	.957		.958
			.9575
$15 \cos \delta$			14.362
$\log 15 \cos \delta$			1.15721

Interval between wires is designated I
 " of " the two limbs on same wire I'
 Angle of inclination $\angle$

Observations by W. U.

<u>Morning.</u>	log I	log I'	log I''	log Diam.	Diam.	No. of obs.	Notes
			1st Set. 7.79				
	1.00860	9.15828	9.77106	0.92827	8.48	2	Power too high.
		0.61278					abandoned.
	0.96708	9.19980	9.85108	1.00829	10.19	15	
		0.65128					
			2d Set. 7.80				
	0.78817	9.37871	9.84111	0.99832	9.96	24	
		0.46240					
			3d Set. 7.80				
	1.30707	8.85981	9.86499	1.02220	10.52	4	
		1.00578					
			4th Set. 7.81				
	0.93044	9.23644	9.83632	0.99353	9.85	10	
		0.59988					

Observations by W. U.

Afternoon. $\log I$ $\log \sin \alpha$ $\log I \sin \alpha$ $\log \text{Diam.}$ Diam. No. of Obs. Notes.

" I'

1st Set. $\gamma. 83$

1.26717 ✓ 8.89971 9.88960 1.05648 11.39 6

0.98989
~~9.89160~~

2d Set. $\gamma. 84$

0.94399 ✓ 9.22289 9.86238 1.02926 10.70 23

0.63949

3d Set. $\gamma. 85$

0.77670 9.39018 9.80682 9.97370 9.41 14

0.41664

4th Set. $\gamma. 85$

0.66558 ✓ 9.50130 9.85155 0.01843 10.43 14

0.35025

Summary.

Diam.	No. obs.	Inclini.			
10.19	15	9° 7'	152.85	458. ⁵ ~~8~~ 5	45
9.96	24	13 50	239.04	478.08	48
10.52	4	4 9	42.08	168.32	16
9.85	10	9 56	98.50	295.50	30
11.39	6	4 33	68.34	273.36	24
10.70	23	9 37	246.10	738.30	69
9.41	14	14 13	131.74	263. ⁴ ~~3~~ 4	28
10.43	14	18 30	146.02	146.02	14
	<u>110</u>		<u>1124 67</u>	<u>2821.57</u>	<u>274</u>

Mean by weights without regard
to inclination —

10."22

Mean by weights, giving to inclinations
20°, 15°, 10°, 5°, the weights 1, 2, 3, 4, —
10."30

Diameter of Mercury by W. A. R.

Collection of results.

Horizontal diameter by transits

First Series

Second Series

Third Series

9.45
10.23
9.75
8.58
9.10
8.57

Means.

9.23

Vertical diameter from transit over inclined lines.

First Series

Second Series

Third Series

9.45

9.75

9.10

9.43

Plate II

Vertical diameter from transit over lines with inclination
varying from 5° to 20°

$i = 5^\circ$

$i = 10$

$i = 15$

$i = 20$

9.18²⁴

9.18

9.17²¹

9.15⁶⁵

9.14

9.32

Plate I

Reduction of W.A.R.'s observations plate I by method given on p. 86

	log I	log μ " I'	log I' μ	log Diam.	Diam.	No. of Obs.
$\alpha = 5^\circ 4'$	1.22063	8.94625 0.86806	9.81431	0.97152	9.37	25
$\alpha = 9^\circ 46'$	0.93702	9.22986 0.56585	9.79571	0.95292	8.97	44
$\alpha = 14^\circ 35'$	0.76567	9.40121 0.39410	9.79531	0.95252	8.96	58
$\alpha = 19^\circ 11'$	0.65031	9.51657 0.29314	9.80971	0.96692	9.27	84

Mean by weights without regard
to inclination — $9''.13$

Mean by weights giving to inclinations
 $20^\circ, 15^\circ, 10^\circ, 5^\circ$, the weights 1, 2, 3, 4
 $9''.12$

9.37	$\times 25$	23425	$\times 4$	93700	100
8.97	$\times 44$	39468	$\times 3$	118404	132
8.96	$\times 58$	51968	$\times 2$	103936	116
9.27	$\times 84$	77868	$\times 1$	77868	84
		211	192729	393908	432

Continued from p. 53.

L. N. Observer.

Mean value 1 rev. at foot of scale used as determined by S. W.

$$1 \text{ rev} = 0^{\text{in}}.009992$$

$$= 0^{\text{in}}.0100$$

(Mem. S. W. See Micros. Rec.)

$$\text{Focal length } 5\frac{1}{4} \text{ in. Equatorial} = 90^{\text{in}}$$

$$\therefore \text{Sin. val. 1 rev} = \frac{1}{9000}$$

$$\begin{array}{r} 6.04595 \\ 4.68557 \\ \hline \end{array}$$

$$\therefore 1 \text{ rev} = 22''.918$$

$$1.36018$$

Mem. by L. N.

I have, for another purpose, a discussion of the eccentricity of this screw, which as I remember I without referring to my notes amounts to as much as $0.005 = 0''.1$ but the observations will not probably be of sufficient value for publication, and I have not thought it worth while to copy out the discussion of this screw.

2nd Mem. upon consulting my mem. (Micros. Rec. p. 43 S. W.) I find the eccentricity of the head to be

$$\text{Between } 0'' - 25'' = 0.0 \text{ of the head}$$

$$25 - 50 = +0.6 \quad \text{i.e. the interval is too great.}$$

$$50 - 75 = 0.1$$

$$75 - 100 = -0.6$$

Tworham 1327. Sidereal Standard Clock. L.M.O.

May 5^h.44 Sun fast 38^s 14, obs. m. A.R. } S.W. & m.u. compute
 6^h.35 " " 38.91 " " " }
 ∴ daily rate = +0^s.84
 Rate 0^s.1 = 0.08

Run 394 Mean Time Standard.

5^h.20 May 5^h.20 Apr. 1327.

Run 394.

7	25	46.01 = 4	31	0.0
7	25	-37.93	20	43.33
2	53	8.08		
4	31	40.28		
	0	27.80		
		44.47		
				+16.67

5^h.83

5 ^h .83 22	51	19.1 = 19	55	0.0
22	50	-38.50		
2	53	40.60		
19	52	40.28		
	3	0.32		
		16.10		
				+44.22
				+15.78

6^h.27

6 ^h .27 9	24	33.0 = 6	25	30.0
9	23	-38.84		
2	57	54.16		
6	26	36.83		
		17.33		
		3.28		
				+14.05
				+15.95

6^h.96

6 ^h .96 24 ^h	0	29.0 = 8	59	0.0
23	59	-39.42		
2	57	47.58		
21	2	36.83		
	3	10.75		
		26.76		
		44.00		
				+44.00
				+16.00

Ptoosham 3451Buc. Ct. Chum.

L.W. ob

May 5^d.85

$$\begin{array}{rcl}
 & 3451 & \text{Pr. 1327} \\
 23^h & 35^m & 42^s.5 = 23^h & 35^m & 11^s.0 \\
 & & & & - 38.52 \\
 & 34 & 32.48 & 34 & 32.48 \\
 + & 1^m & 10^s.02 & &
 \end{array}$$

+1^m 10^s.02May 6^d.48

Rond 394

$$\begin{array}{rcl}
 14 & 5 & 21.0 = 11^h & 5^m & 0^s.0 \\
 & & & & - 15.97 \\
 & 4 & 10.06 & 11 & 4 & 44.03 \\
 & & & & 1 & 49.20 \\
 & & & 2 & 59 & 36.83 \\
 & & & 14 & 4 & 10.06
 \end{array}$$

+1^m 10^s.94May 7^d.08

Pr. 1327

$$\begin{array}{rcl}
 5 & 0 & 56.50 = 5^h & 0^m & 25^s.0 \\
 & & & & - 39.52 \\
 59 & 45.48 & 4 & 59 & 45.48 \\
 1 & 11.02 & & &
 \end{array}$$

+1^m 11^s.02

$$\begin{array}{rcl}
 \therefore \text{Error } 5^d.94 & = & +1^m \ 10^s.10 \\
 6^d.25 & = & +1^m \ 10^s.75
 \end{array}$$

Brnd 503.

Mean Time

R.M.V.

May 5^d.2.

Brnd 503

Brnd 394

4 ^h	33 ^m	8.0	=	4	33	0.0
						-16.67
	32	43.33		32	43.33	

+ 24.567

May 5^d.97 Brnd 503

Fr. 1327

11 ^h	14	5.0	=
23			
23	17	16.5	

2	11	48.0	
	19 ^h	0.0	
		-38.62	
26	15	21.38	
2	53	40.28	
23	20	41.10	
	3	49.66	
	16	51.64	+ 24.86

May 6^d.26 Brnd 503

Fr. 1327.

6 ^h	20 ^m	51.0	=
21		31.0	=

9 ^h	19 ^m	45.0	
	20	25.0	
		-38.84	
9	19	46.16	
2	57	36.83	
6	22	9.33	
		2.60	
6	21	6.73	+ 24.27

5^d.94 = +24.856^d.25 = +24.27

Band 440 .

Meanline

A.M. obs.

May 5^d.2

Band 440

Band 394

$$\begin{array}{rcl}
 4 & 42 & 28.0 \\
 & & = \\
 & & 4 \quad 42 \quad 0.0 \\
 & & \quad -16.67 \\
 & & 41 \quad 43.33 \\
 & & + 44.67^s
 \end{array}$$

May 7^d.8

B1 440

Ar. 1327 .

$$\begin{array}{rcl}
 1^h & 56^m & 1.5 \\
 & & = \\
 2 & 2 & 14.5 \\
 & & = \\
 & & 4^h \quad 59^m \quad 48.0 \\
 & & 5 \quad 4 \quad 2.0 \\
 & & \quad -39.52 \\
 & & 5 \quad 3 \quad 22.48 \\
 & & 3 \quad 1 \quad 33.39 \\
 & & 2 \quad 1 \quad 49.09 \\
 & & \quad 19.95 \\
 & & 2 \quad 1 \quad 29.14 \\
 & & + 45.36
 \end{array}$$

$$\begin{array}{rcl}
 & & \text{in } 1.9 \quad +0.69 \\
 & & = +0.035
 \end{array}$$

$$5^d.94 = +44.92^s$$

$$6^d.25 = +45.08$$

Bnd 332.

Sid. Time.

X. Tr. obs.

May 5^d. 2 * checked below.

Bnd 332
 7^h 30^m 52.^s5

=

Prod 1327
 7^h 36^m 0.^s0
 7 35 - 37.93
 22.07

- 4^m 29.^s57

1.95

May 7^d. 8

332

4 48 21.0 =
 49 3.0 =
 49 40.0 =

Th. 1327

4 58 35.0
 54 17.0
 54 54.0
 54 - 39.52
 14.48

- 4^m 34.^s48

19 | 4.91
 2.60
 .) = 0.26
 83

May 5^d. 2 * Check Companion.

Bnd 394

7 28 40.0 =

4 39 0.0

- 16.67

4 38 43.33
 0 45.77

2 53 40.28
 7 33 9.38

- 4^m 29.385^d. 94 = - 4^m 31.^s526^d. 25 = - 4 32.32

block comparisons to check the errors
adopted for May 5.9

W. U. obs.

1327				Thursday PM May 9.2			
7	38	35	=	7	33	13.7	Bord 332
7	40			4	30		
~~4~~	~~30~~	10	=	~~7~~	~~3~~	3.1	440
7	41	30		4	30	56.3	503
7	~~42~~	40		7	43	11.6	Bord 3451

332 Sid.			1327 Error +41.4			3451 Sid.			
440 Mean			503 Mean						
7	38	35	7	40	10	7	41	30	Prod. Reading.
		-41.4			-41.4			-41.4	Corr.
7	37	53.6	7	39	28.6	7	40	48.6	True Sid t.
~~3~~	~~9~~	~~26.5~~	~~3~~	~~9~~	~~30.4~~	~~3~~	~~9~~	~~30.4~~	Sid t. mean norm.
			4	30	2.1	4	31	22.1	Sid Int.
					44.2			44.5	Corr.
			4	29	17.9	4	30	37.6	Mean Int.
7	33	13.7	4	30	3.1	4	30	56.3	Chrom. reading
- 4	39.9		+	45.2		+	18.7		Mean time
+	7.3		-	.7		+	5.0		Chrom error
- 4	32.6		+	44.5		+	23.7		Corr. for rate
						+	1	9.0	to May 5.9
									Error May 5.9

May 7.0 Error of 332		May 9.2		Δ Daily rate	
4	35.1	-4	39.9	-4.8	-2.2
440	+ 44.8	+	45.2	+ 0.4	+ 0.2
503	+ 22.0	+	18.7	- 3.3	- 1.5
3451	+ 1 10.4	+	13.0	+ 2.6	+ 1.2

These values are not to be used as accurate determinations of errors on May 5.9. They simply show that no large mistakes are made in the errors then adopted.

1878.

Meridian Transit $\odot$ and $\odot$ May 5th 99.S. Walcott

Russian Transit in the Meridian. Eyepiece 99 diameters.
 Bar. Cel. Chem. Prossham 3451. Autochronograph.

Observations for level (applicable only to the Meridian Transits.)

	w	e
Circle e	15.8	13.7
	14.8	13.0
	15.0	13.0

	w	e
Circle w	16.2	11.8
	16.5	11.5
	16.5	11.2

VI	I	II	III	IV	V
2 ^h	53 ^m 15.9	55 ^m 38.1	05.4	22.6	...
	19.7	41.9	4.1	,	...
	23.2	45.5	7.6	29.7	...
	26.6	49.1	11.5	33.18	...
	30.8	53.0	15.1	37.7	...

♀ (mean of μ^{pr} & foll. limbs).

		<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>	<u>V</u>
2^{h}	54	48. ⁵ 1	9. ⁵ 7	32. ⁵ 2	53. ⁵ 8	16. ⁵ 5
		51.4	13.5	35.8	58.0	20.2
		54.9	17.2	39.4	61.5	24.0
		58.6	20.8	43.0	65.4	27.4
		62.3	24.6	46.5	69.0	31.2

10	<u>III</u>	<u>IV</u>	<u>V</u>
		56 ^m 34.4	57 ^{5.5}
		39.0	60.4
		42.7	64.9
		46.2	68.4
		50.1	72.8

After this set had been completed the instrument was turned in a zenith by the azimuth screw adjustment, and again the transit of ♀ and the ☉ was noted on the Chronograph as follows; -

Extra Meridian Transit, ♀ and the ☉

8^h 18^m 57^s May 6^d.0

			I	II	III	IV	V	Sub, Ob.
☉	2 ^h	57	52.7	14.8	37.3	59.2		
			56.4	18.6	41.0	63.3		
			59.9	22.4	44.8	66.6		
			63.7	26.2	48.3	70.5		
			67.2	29.9	52.0	74.3		

♀	2	59	22.2	44.3	60 ^m 6.6	28.6	51.3
			25.9	48.2	10.3	32.3	55.0
			29.6	51.8	14.2	36.2	58.8
			33.2	55.5	17.5	39.8	62.1
			37.0	59.3	21.4	43.7	65.3

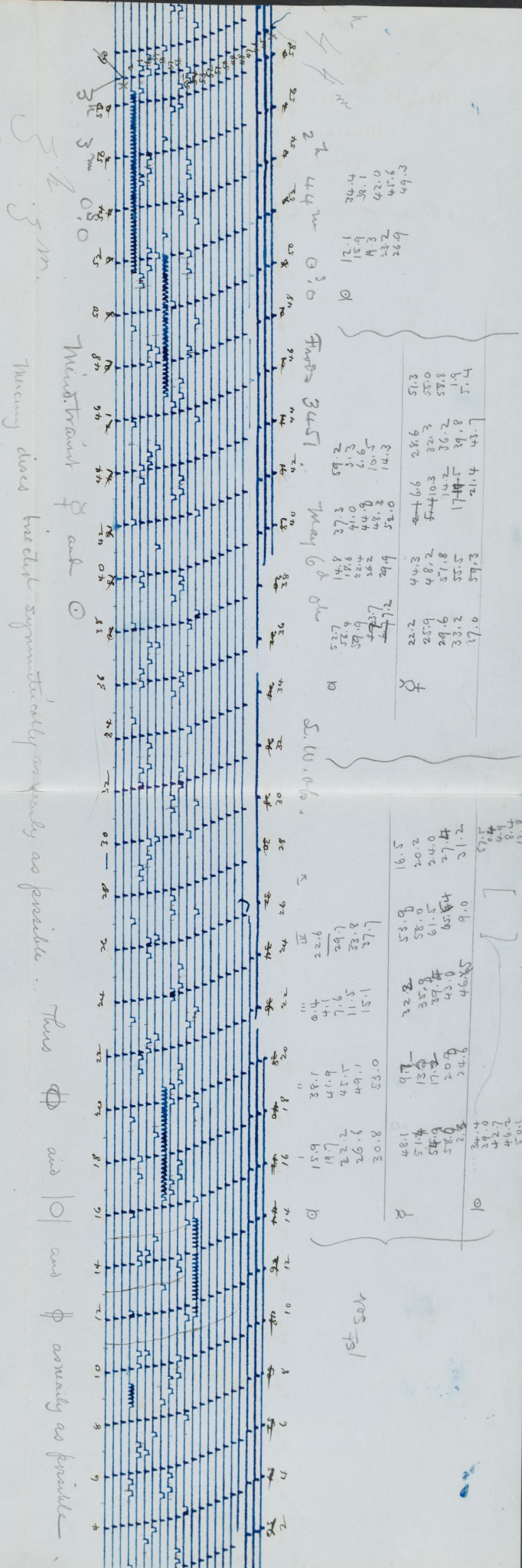
☉						61 ^m 12.1	34.4
						15.9	38.1
						19.3	42.0
						23.2	45.6
						26.9	49.3

May 6th 1878.

Meridian Transit of γ .

Preceding readings.

Russian Transit
S. W. Brewer.



Toward No 1.

No. 2.

Photographs of the transit of Mercury
1878, May 5 and 6,
taken at Harvard College Observatory.

This work was undertaken mainly at the request of the U. S. Naval Observatory, by which the apparatus (heliostat, lens, and plate-frame, with engineer's level and small subsidiary apparatus) was furnished for the occasion. The plate-frame was mounted on the western sandstone pillar in the shed built for photographic work in 1872, and brick piers were built, one for the heliostat and lens, and one for the Portable Transit Instrument of the Observatory, by which the errors of position of the photographic telescope were determined.

The occasion was taken to obtain some photographs of the transit to be preserved at Harvard College Observatory. These were taken on dry plates furnished and developed by Mr. William Hudson, of Hingham, who was present on the day of the transit. The number of these plates exposed during the transit was fourteen. Of these, Nos. 1, 5, and 14, show no trace of Mercury; the rest, marked 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, by scratches in the varnish, and also labelled, are kept in a box marked "Photographs of the transit of Mercury, 1878".

The number of dry plates exposed and sent to Washington for development was 43. Their numbers in the series of plates prepared at Washington

are 73 to 115 inclusive. The report sent to Washington with regard to these plates will be found in the letter-book of the Observatory, containing copies of the letters written 1875-1878, pages 598 to 610 inclusive; see also a previous letter, pages 578, 579. The details of the work need not therefore be repeated here. The original record of the exposures of the plates is in book R 45, pages 12 to 17 inclusive. Pages 11, 18, 19^{and 20} of that book have notes of the observations made by Mr. Waldo to determine the errors of the photographic telescope.

For convenience, the times of exposure of the photographs are given in tabular form below. The column headed "Arm of plumb-line" shows when the silver plumb-line, hanging between the ruled plate and the sensitive plate, was turned 180° by means of the small brass arm to which its upper end was secured. The column headed "Duration of exposure" gives a general indication of the rapidity with which the slide was moved (in all cases, by hand merely). As the sky at first was wholly overcast, the "short" and "long" exposures of the photographs taken early in the transit were respectively somewhat longer than the "very short" and "rather long" exposures of many subsequent photographs, taken when the sun was more visible among broken clouds. The exposures of the Washington plates were made in accordance with instructions received from the U. S. Naval Observatory. The column of corrections for the chronometer F. 3451, (in circuit with the chronograph), from the face of

which the times for moving the slide were taken and recorded during the observations, is derived from data furnished by Mr. Waldo, as follows:

May 5^d 94. East of Cambridge sidereal time 1^m 10^s 10
 6.25. " " " " " 1 10.75.

The table on this page gives the time and manner of exposing the eleven photographs of the transit obtained for Harvard College Observatory (see page 141); the corresponding record for the photographs obtained for the U. S. Naval Observatory will be given on the next page.

Photographs taken for Harvard College Observatory.

No. of plate	Arm of plumb-line	Duration of exposure	Time of exposure		Correction required by chronometer	Cambridge sidereal time of exposure
			By face of chronometer	By chronographic record		
2	Probably east*	Short	1 ^h 39 ^m 10 ^s	1 ^h 39 ^m 10.1 ^s	— 1 ^m 10.1 ^s	1 ^h 38 ^m 0.0 ^s
3	" "	Medium	41 0	40 59.7		39 49.6
4	" "	Long	43 55	43 55.0		42 44.9
6†	West	Medium	4 45 45	4 45 45.3	— 1 10.3	4 44 35.0
7	"	Rather long	48 45	48 45.3		47 35.0
8	"	Short	6 17 23		— 1 10.5	6 16 12.5†
9	"	Short	19 5			17 54.5†
10	"	Short	46 20	6 46 20.1		45 9.6
11	"	Short	48 28	48 28.1		47 17.6
12	"	Very short	51 50	51 50.1		50 39.6
13	East	Short	7 30 30	7 30 30.1	— 1 10.6	7 29 19.5

* Nos. 2, 3, and 4 were exposed before any of the Washington plates, the first of which were taken with the arm of the plumb-line east, so that it may be presumed to have been east previously.

† No. 5, like Nos. 1 and 14, showed nothing of Mercury. In the case of No. 5 the lines on the ruled plate may possibly have concealed Mercury.

‡ The chronographic record was probably identical with that from the face of the chronometer in Nos. 8 and 9; but the fact was not recorded. The chronograph sheets were sent to Washington with other records.

Photographs taken for the U. S. Naval Observatory.

No. of plate	Arm of plumb-line	Duration of exposure	Time of exposure		Correction required by chronometer	Cambridge sidereal time of exposure	
			By face of chronometer	By chronographic record			
			<i>h m s</i>	<i>h m s</i>	<i>m s</i>	<i>h m s</i>	
73	East	Short	1 52 10	1 52 10.2	— 1 10.1	1 51 0.1	
74	"	Medium	55 30	55 30.3		54 20.2	
75	"	Long	58 5	58 5.2		56 55.1	
76	West	Short	2 4 40	2 4 40.2		2 3 30.1	
77	"	Medium	7 10	7 10.2		6 0.1	
78	"	Long	9 25	9 25.3		8 15.2	
79	East	Short	13 35	13 35.2		12 25.1	
80	"	Medium	16 0			14 50.1*	
81	"	Long	18 10	18 10.3		17 0.2	
82	West	Short	22 20	22 20.2		21 10.1	
83	"	Medium	25 5	25 5.3		23 55.2	
84	"	Long	27 25	27 25.3		26 15.2	
85	East	Short	3 19 40	19 40.2	— 1 10.2	3 18 30.0	
86	"	Medium	24 45	23 45.2		22 35.0†	
87	"	Long	26 10	26 10.3		25 0.1	
88	West	Short	29 30	29 30.2		28 20.0	
89	"	Medium	32 55	32 55.3		31 45.1	
90	"	Long	36 10			35 0.1*	
91	East	Short	39 25	39 25.2		38 15.0	
92	"	Medium	42 0	42 0.2		40 50.0	
93	"	Long	44 15	44 15.3		43 5.1	
94	West	Short	47 45	47 45.2		46 35.0	
95	"	Medium	49 35	49 35.3	— 1 10.3	48 25.0	
96	"	Long	51 20	51 20.3		50 10.0	
97	"	Very short	6 24 45	6 24 45.1	— 1 10.5	6 23 34.6	
98	"	Medium	27 30	27 30.2		26 19.7	
99	"	Rather long	29 25	29 25.2		28 14.7	
100	East	Very short	31 20	31 20.1		30 9.6	
101	"	Medium	37 0	37 0.2		35 49.7	
102	"	Rather long	38 50	38 50.2		37 39.7	
103	West	Short	42 10	42 10.2		40 59.7	
104	"	Medium	43 35	43 35.1		42 24.6	
105	"	Rather long	45 5	45 5.1		43 54.6	
106	East	Very short	53 55	53 55.0		52 44.5	
107	"	Medium	55 35	55 35.1		54 24.6	
108	"	Rather long	57 25	57 25.2		56 14.7	
109	"	Very short	7 22 40	7 22 40.0	— 1 10.6	7 21 29.4	
110	"	Medium	26 10	26 10.2		24 59.6	
111	"	Rather long	28 45	28 45.2		27 34.6	
112	West	Very short	32 0	31 59.7		30 49.1	
113	"	Medium	42 5	42 5.1		40 54.5*	
114	"	Rather long	53 15			52 4.6*	
115	East	Short	8 15 35	8 15 35.1		8 14 24.5	

* The chronograph failed to record the exposures of Nos. 80, 90, and 114. The Cambridge sidereal times of these exposures are derived from the record taken from the face of the chronometer, allowing for the probable difference between this and the chronographic record.

† Exposure of No. 86 evidently entered 1^m too late in record taken from face of chronometer.

The observations just described were made by the following persons:

Arthur Searle made and recorded the exposures, and directed the preparations for the photographic work.

Sidney Wetmore and Herbert H. Eustis assisted in getting the heliostat and its clock into adjustment, and managed the heliostat and chronograph during the photographic work.

William Hudson placed the fourteen plates taken for Harvard College Observatory in the plate-frame, and developed them after exposure.

The lens, plate-frame, and plumb-line were set in position under the direction of Leonard Waldo, who also made the measurements required to determine the exact position of this apparatus before and after the photographic work.

1872pbae, no. 1, 475w

