

157 (Revised) Proj. 1405

KG  
11365  
339

08

Observations for Time & Occultations.  
Harvard College Observatory.  
June 12 1870 — Jan. 27 1871



KG-113651 339



July 20 21

Wire intervals Meridian Circle

			Log.	Sum of distances from D of	
G <sub>1</sub>	+12 442	1.09989		wires in tally C	34.676
G <sub>2</sub>	9 887	.99506		Mean of the four	8.669
3	7 462	.87286		Sum of distances from D of	
4	4 885	.68886		wires in tally E	34.591
E <sub>1</sub>	4 272	.69653		Mean of the four	8.648
2	7 467	.87315		Mean of C, D, E, between C & D:	
3	9 766	.98972		reduction to D	$\frac{.085}{9} = .0094$
4	12 386	1.09283			

July 21<sup>st</sup> 1870

value of one revolution of  
Right Ascension screw  
from Polaris

5 measures over a single wire  
from 22<sup>r</sup> to 17<sup>r</sup> give  $1^r = 1.239$

3 from E & W collimators

3 measures of 10<sup>r</sup> over three wires  
from 13<sup>r</sup> to 40<sup>r</sup> give  $1^r = 1.240$

Meridian Circle Illumination W.  
c negative when mean of micrometric  
readings of pointings on N. & S. collimators  
exceeds reading at which wire stood during  
observations.

Meridian Circle level. Value of  
1 division estimated from some  
experiments of W. A. Rogers at 0."8







KG 11365.339

Date

Observer

Illumin'n

Star

Mag.

 $\delta$ 

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $r$ 

T

a

 $\Delta T$

Date	1870 June 12			
Observer	E. P. A.			
Illumin'n	E.			
Star	$\alpha$ Virginis	$\delta$ Virginis	$\eta$ Urs. Maj.	
Mag.				
$\delta$	$10^{\circ} 29' S$	$0^{\circ} 4'$	$49^{\circ} 58'$	
Wire	a			
"	b			
"	c			
"	1	13 18 29.0	13 28 12.8	13 42 29.0
"	2	33.0	16.6	34.6
"	3	36.5	20.0	40.4
"	4	40.3	23.7	46.0
"	5	43.8	27.3	51.4
"	d			
"	e			
"	f			
Sum	182.6	100.4	201.4	
Mean	13 18 36.52	13 28 20.08	13 42 40.28	
Red'n to				
m				
n. (tan. $\delta$ - tan $\phi$ )	- .28	- .24	+ .07	
c. sec. $\delta$	+ .25	+ .25	+ .39	
r				
T - b sec $\phi$	13 18 36.49	13 28 20.09	13 42 40.64	
a	13 18 21.88	13 28 51.26	13 42 26.15	
$\Delta T + b \sec \phi$	- 14.61	14.83	14.49	

c assumed +.25      n estimated +.26

$\Delta T + bsec \phi$  (6 stars) - 14.68

bsec  $\phi$  by observation + .81

Clock fast (at 13<sup>h</sup> 58<sup>m</sup>) 15<sup>s</sup> 49



Date	1870 June 12			
Observer	E. P. A.			
Illumin'n	E.			
Star	$\alpha$ Bootis	$\delta$ Bootis	$\alpha^2$ Librae	
Mag.				
$\delta$	$19^\circ 52'$	$52^\circ 27'$	$15^\circ 30' \phi$	
Wire	a			
"	b			
"	c			
"	1	14 9 52.0	14 20 50.0	14 43 50.1
"	2	55.9	56.0	53.9
"	3	59.7	21 1.7	57.7
"	4	10 3.7	7.9	44 1.4
"	5	7.3	13.9	5.0
"	d			
"	e			
"	f			
Sum	298.6	9.5	288.1	
Mean	14 9 59.72	14 21 1.90	14 44 57.62	
Red'n to				
m				
n ( $\tan. \delta - \tan \phi$ )	-.14	+.10	-.31	
c. sec. $\delta$	+.27	+.41	+.26	
$\tau$				
T - $b \sec \phi$	14 9 59.85	14 21 2.41	14 44 57.57	
a	14 9 45.09	14 20 47.71	14 43 42.89	
$\Delta T + b \sec \phi$	- 14.76	14.70	14.68	

Date	1870	June 14		
Observer		E. P. A.		
Illumin'n		E.		
Star		$\alpha$ Virginis	$\zeta$ Virginis	$\eta$ Urs. Maj.
Mag.				
$\delta$		$10^{\circ} 29' S.$	$0^{\circ} 41'$	$49^{\circ} 58'$
Wire	a			
"	b			
"	c			
"	1	13 18 29.0	13 28 12.6	13 42 28.8
"	2	32.7	16.2	34.6
"	3	36.4	19.8	40.0
"	4	40.1	23.6	45.7
"	5	43.8	27.0	51.5
"	d			
"	e			
"	f			
Sum		182.0	99.2	200.6
Mean		13 18 36.40	13 28 19.84	13 42 40.12
Red'n to				
m				
$n(\tan. \delta - \tan. \phi)$		- .28	- .24	+ .07
c. sec. $\delta$		+ .25	+ .25	+ .39
$\tau$				
T - bsec $\phi$		13 18 36.37	13 28 19.85	13 42 40.58
a		13 18 21.86	13 28 5.24	13 42 26.12
$\Delta T + bsec \phi$		- 14.51	14.61	14.46

Constants assumed as on June 12  
 Clock fast (at 13<sup>h</sup> 30<sup>m</sup>) 15<sup>s</sup>.34



Date	1870	June 15			
Observer		E. P. A.			
Illumin'n		E.			
Star		$\eta$ Urs. Maj.	$\eta$ Bootis	$\alpha$ Draconis	
Mag.					
$\delta$		$49^{\circ} 58'$	$19^{\circ} 3'$	$65^{\circ} 0'$	
Wire	a				
"	b				
"	c				
"	1	13 42 28.9	13 48 37.6	14 0 50.6	
"	2	34.8	41.4	0 59.1	
"	3	40.1	45.3	1 7.6	
"	4	45.9	49.0	16.0	
"	5	51.4	52.9	24.6	
"	d				
"	e				
"	f				
Sum		201.1	226.2	37.9	
Mean		13 42 40.22	13 48 45.24	14 1 7.58	
Red'n to					
m					
n ( $\tan. \delta - \tan \varphi$ )		+ .10	- .20	+ .43	
c. sec. $\delta$		+ .39	+ .26	+ .49	
$\tau$					
T - $b \sec \varphi$		13 42 40.71	13 48 45.30	14 1 8.50	
a		13 42 26.10	13 48 30.78	14 0 53.87	
$\Delta T + b \sec \varphi$		- 14.61	14.52	14.63	

Date	1870 June 15			
Observer	E.P.A.			
Illumin'n	E.			
Star	$\alpha$ Bootis	$\gamma$ Bootis	$\epsilon$ Bootis	
Mag.				
$\delta$	$19^\circ 52'$	$52^\circ 27'$	$27^\circ 38'$	
Wire	a			
"	b			
"	c			
"	1	14 9 54.8	14 20 49.9	14 39 26.2
"	2	55.8	55.9	30.3
"	3	59.6	21 1.8	34.3
"	4	10 3.6	7.8	38.7
"	5	7.2	13.6	42.7
"	d			
"	e			
"	f			
Sum	298.0	9.0	172.2	
Mean	14 9 59.60	14 21 1.80	14 39 34.44	
Red'n to				
m				
n (tan. $\delta$ - tan $\phi$ )	- .19	+ .14	- .14	
c. sec. $\delta$	+ .27	+ .41	+ .28	
$\tau$				
T - bsec $\phi$	14 9 59.68	14 21 2.35	14 39 34.58	
a	14 9 45.07	14 20 47.66	14 39 19.92	
$\Delta T + bsec \phi$	- 14.61	14.69	14.66	

$c'$  assumed + .25  
 n from  $\alpha$  Draconis &  $\alpha^2$  Librae + .35

$\Delta T + bsec \phi$  from 7 other stars - 14.65  
 bsec  $\phi$  assumed + .85

Clock fast (at  $14^h 24^m$ ) + 5.50



Date	1870	June 15		
Observer	E. P. A.			
Illumin'n	E.			
Star	$\alpha^2$ Librae	$\beta$ Bootis	$\beta$ Librae	
Mag.	15° 30' S.	40° 54'	8° 54' S.	
Wire	a			
"	b			
"	c			
"	1	14 43 50.0	14 57 9.3	15 10 9.8
"	2	54.0	14.0	13.6
"	3	57.7	18.8	17.1
"	4	44 1.5	23.7	20.7
"	5	5.2	28.6	24.6
"	d			
"	e			
"	f			
Sum		288.4	94.4	85.8
Mean		14 43 57.68	14 57 18.88	15 10 17.16
Red'n to				
m				
n (tan. $\delta$ - tan $\phi$ )		-.42	-.02	-.37
c. sec. $\delta$		+.26	+.33	+.25
r				
T - bsec $\phi$		14 43 57.52	14 57 19.19	15 10 17.04
a		14 43 42.89	14 57 4.44	15 10 2.36
$\Delta T + t_{sec \phi}$		- 14.63	14.75	14.68

Date 1870 June 18  
 Observer E. P. A.  
 Illumin'n E.

Star  $\alpha$  Bootis  $\delta$  Bootis  $\epsilon$  Bootis  
 Mag.  $19^{\circ} 52'$   $52^{\circ} 27'$   $27^{\circ} 38'$   
 $\delta$

Wire a  
 " b  
 " c  
 " 1  
 " 2  
 " 3  
 " 4  
 " 5  
 " d  
 " e  
 " f

14 9 52.2 14 20 50.2 14 39 26.7  
 " 56.1 56.4 30.8  
 " 10 0.2 21 2.5 34.8  
 " 4.0 8.2 38.8  
 " 7.7 14.0 42.9

Sum 0.2 11.3 174.0  
 Mean 14 10 0.04 14 21 2.26 14 39 34.80

Red'n to

m  
 $n(\tan. \delta - \tan \varphi)$  - .15 + .11 - .11  
 $c. \sec. \delta$  + .27 + .41 + .28

r

T - bsec  $\varphi$  14 10 0.16 14 21 2.78 14 39 34.97  
 a 14 9 45.04 14 20 47.60 14 39 19.90  
 $\Delta T + bsec \varphi$  - 15.12 15.18 15.07

$c'$  assumed +.25  
 $n$  from  $\delta$  Bootis &  $\delta$  Librae +.27  
 $\Delta T + bsec \varphi$  from 4 other stars - 15.15  
 $bsec \varphi$  assumed + .90  
 Clock fast (at 14<sup>h</sup> 44<sup>m</sup>) 16.05



Date	1870 June 18			
Observer	E. P. A.			
Illumin'n	E.			
Star	$\alpha^2$ Librae	$\beta$ Bootis	$\beta$ Librae	
Mag.				
$\delta$	$15^\circ 30' S.$	$40^\circ 54'$	$8^\circ 54' S.$	
Wire	a			
"	b			
"	c			
"	1	14 43 50.8	14 57 9.8	15 10 10.4
"	2	54.4	14.5	14.0
"	3	58.0	19.2	17.6
"	4	44 1.8	24.0	21.2
"	5	5.6	28.8	24.9
"	d			
"	e			
"	f			
Sum	290.6	96.3	88.1	
Mean	14 43 58.12	14 57 19.26	15 10 17.62	
Red'n to				
m				
$n(\tan. \delta - \tan \varphi)$	-.32	-.01	-.29	
c. sec. $\delta$	+1.26	+1.33	+1.25	
$\tau$				
T - $b \sec \varphi$	14 43 58.06	14 57 19.58	15 10 17.58	
a	14 43 42.88	14 57 4.41	15 10 2.35	
$\Delta T + b \sec \varphi$	- 15.18	15.17	15.23	

Date	1870	June 21						
Observer		A S				A S		
Illumin'n		6						
Star		$\beta$ Bootis	48	H Cephei	16	$\beta$ Deliae		
Mag.								
$\delta$								
Wire	a							
"	b							
"	c							
"	1	h m s	14 57 10.9	15 3 39.5	15 10 11.5			
"	2		15.7	55.7	15.1			
"	3		20.6	4 12.5	18.9			
"	4		25.3	28.0	22.5			
"	5		30.1	44.9	26.1			
"	d							
"	e							
"	f							
Sum			102.6	50.6	94.1			
Mean			14 57 20.52	15 4 12.12	15 10 18.82			
Red'n to								
m								
n, tan. $\delta$			-0.5	-0.2	-5.33	-1.87	-107	-37
c, sec. $\delta$			1.32	+3.3	-4.53	-1.13	1.01	+25
$\tau$								
T			<del>16.72</del>					
a			14 57 4.38	3 3 52.65	15 10 2.34			
$\Delta T$			16.72	16.47	16.36			

$c'$  assumed +.25  
n +.35

$\Delta T + \text{hsec} = -16.47$   
 $\text{hsec} = + 9.5$  observed  
 Clock fast at 15<sup>h</sup> 15<sup>m</sup> 17<sup>s</sup> 42



June 21

EPCA

Illumin'n

$\mu'$  Bootis & Bar Bar  $\in$  Serpens

Mag.

6

Wire a

b

C

1

2

44 3

44 4

44 5

" d

" e

" f

Sum

Mean

Red'n to

m

 $n. \tan. \delta$ c. sec.  $\delta$ 

5

T

a

 $\Delta T$

Date 1870 June 24

Observer A. S.

Illumin'n E.

Star  $\pi$  Capricorni  $\epsilon$  Delphini Cy. 3241

Mag.

 $\delta$  $18^{\circ} 38' S.$  $10^{\circ} 52'$  $72^{\circ} 5'$ 

Wire

a

"

b

"

c

"

1

20 20 4.00

20 27

11.6

20

30

28.9

"

2

8.0

15.2

40.8

"

3

11.8

18.8

30 52.2

"

4

15.6

22.6

31 4.2

"

5

19.3

26.3

15.6

"

d

"

e

"

f

Sum

Mean

20 20 11.74

20 27

18.90

20 30

52.34

Red'n to

m

n. (tan.  $\delta - \tan \varphi$ )

- .54

- .31

+ .94

c. sec.  $\delta$ 

+ .26

+ .25

+ .81

 $\tau$  $T - b \sec \varphi$ 

20 20 11.46

20 27

18.84

20 30

54.09

a

20 19 54.39

20 27

1.74

20 30

37.02

 $\Delta T + b \sec \varphi$ 

- 17.07

17.40

17.07

c' assumed + .25

n from  $\pi$  Capr. & Cy. 3241 + .43 $\Delta T + b \sec \varphi = -17.08$  $b \sec \varphi = + .92$  observedClock fast (at 20<sup>h</sup> 26<sup>m</sup>)

-18.00



Date	1870	June 28				
Observer		E. P. A.				
Illumin'n		E.				
Star		$\beta$ Bootis	$\beta$ Librae	$\mu'$ Bootis		
Mag.		4.0° 54'	8° 54' S.	37° 50'		
$\delta$						
Wire	a					
"	b					
"	c					
"	1	14 57 13.4	15 10 14.0	15 19 45.8		
"	2	18.4	17.8	50.1		
"	3	22.8	21.3	54.9		
"	4	27.7	25.0	59.5		
"	5	32.7	28.6	20 4.0		
"	d					
"	e					
"	f					
Sum		115.0	106.7	274.3		
Mean		14 57 23.00	15 10 21.34	15 19 54.86		
Red'n to						
m						
n. (tan. $\delta$ - tan $\phi$ )		-.02	-.40	-.05		
c. sec. $\delta$		+.33	+.25	+.32		
r						
T - bsec $\phi$		14 57 23.31	15 10 21.19	15 19 55.13		
a		14 57 4.28	15 10 2.32	15 19 36.27		
$\Delta T + bsec \phi$		19.03	18.87	18.86		

Date	1870 June 28						
Observer	E. P. A.						
Illumin'n	E.						
Star	$\gamma^2$ Urs. Min.	$\alpha$ Cor. Bor.	$\alpha$ Serpenti				
Mag.	72° 18'	27° 4'	6° 50'				
$\delta$							
Wire	a						
"	b						
"	c						
"	1	15 20 53.0	15 29 23.0	15 38 5.2			
"	2	21 5.2	27.3	8.8			
"	3	17.1	31.4	12.4			
"	4	29.2	35.6	16.0			
"	5	41.0	39.5	19.7			
"	d						
"	e						
"	f						
Sum		85.5	156.8	62.1			
Mean		15 21 17.10	15 29 31.36	15 38 12.42			
Red'n to							
m							
n ( $\tan. \delta - \tan \phi$ )		+ .82	- .15	- .28			
c. sec. $\delta$		+ .82	+ .28	+ .25			
$\tau$							
T - bsec $\phi$	15 21 18.74	15 29 31.49	15 38 12.39				
a	15 20 59.81	15 29 12.52	15 37 53.44				
$\Delta T + bsec \phi$	- 18.93	18.97	18.95				

$c'$  assumed +.25  
 $n$  from  $\gamma^2$  Urs. Min. &  $\beta'$  Scorpii +.37  
 $\Delta T + bsec \phi$  from 7 remaining stars -18.92  
 $bsec \phi$  by level reading June 29 at 2<sup>h</sup> mean time +1.00  
 Clock fast at 15<sup>h</sup> 28<sup>m</sup> 19.92



Date	1870 June 28		
Observer	E. P. A.		
Illumin'n	E.		
Star	$\epsilon$ Serpentis $\epsilon$ Cor. Bor. $\beta'$ Scorpii		
Mag.			
$\delta$	$4^{\circ} 52'$	$27^{\circ} 16'$	$19^{\circ} 27' S.$
Wire	a		
"	b		
"	c		
"	1	15 44 33.5	15 52 24.6 15 58 6.1
"	2	37.1	28.8 9.9
"	3	40.8	32.7 13.8
"	4	44.4	36.9 17.6
"	5	48.0	40.8 21.5
"	d		
"	e		
"	f		
Sum	203.8	163.8	68.9
Mean	15 44 40.76	15 52 32.76	15 58 13.78
Red'n to			
m			
n. $(\tan. \delta - \tan. \varphi)$	- .31	- .15	- .47
c. sec. $\delta$	+ .25	+ .28	+ .26
$\tau$			
$T - b \sec \varphi$	15 44 40.70	15 52 32.89	15 58 13.57
a	15 44 21.79	15 52 14.01	15 57 54.63
$\Delta T + b \sec \varphi$	- 18.91	18.88	18.94

Date 1870 June 29  
 Observer E. P. A.  
 Illumin'n E.

Star  $\beta$  Bootis  $\beta$  Librae  $\mu$  Bootis  
 Mag.  $40^{\circ} 54'$   $8^{\circ} 54' \phi$   $37^{\circ} 50'$   
 $\delta$

Wire a  
 " b  
 " c  
 " 1  
 " 2  
 " 3  
 " 4  
 " 5  
 " d  
 " e  
 " f

14	57	14.1	15	10	14.3	15	19	16.1
		18.8			18.0			50.7
		23.8			21.8			55.2
		28.6			25.4		20	0.0
		32.9			29.0			4.4

Sum  $118.2$   
 Mean  $14\ 57\ 23.64\ 15\ 10\ 21.70\ 15\ 19\ 55.28$

Red'n to

m  
 $n(\tan. \delta - \tan \phi)$   $-.01$   $-.31$   $-.04$   
 c. sec.  $\delta$   $+.33$   $+.23$   $+.32$

r

T - bsec  $\phi$   $14\ 57\ 23.96\ 15\ 10\ 21.64\ 15\ 19\ 55.56$   
 a  $14\ 57\ 4.27\ 15\ 10\ 2.31\ 15\ 19\ 36.26$   
 $\Delta T + bsec \phi$   $- 19.69$   $19.33$   $19.30$

C' assumed  $+.25$   
 n from Gr. 2320 } 9 cam.  $+.29$

$\Delta T + bsec \phi$  from 4 other stars  $- 19.48$   
 bsec  $\phi$  by reading level at 2<sup>h</sup> meantime  $+ 1.00$   
 Clock fast (at  $15^h 26^m$ )  $20.48$



Date 1870 June 29  
 Observer E. P. A.  
 Illumin'n

Star  $\gamma$  2320  $\epsilon$  Herculis  $\gamma$  Camelopard.  
 Mag.  $66^{\circ} 9'$   $46^{\circ} 38'$   $66^{\circ} 7'$   
 $\delta$

Wire a  
 " b  
 " c  
 " 1  
 " 2  
 " 3  
 " 4  
 " 5  
 " d  
 " e  
 " f

16	6	0.2	16	16	0.5	16	41	10.0
		9.8			5.8			18.9
		19.6			10.9			28.0
		29.6			16.2			36.2
		39.0			21.6			46.0

Sum  
 Mean

16	6	98.2	16	16	55.0	16	41	139.1
		19.64			11.00			27.82

Red'n to

m

n. (tan.  $\delta$  - tan  $\varphi$ )

c. sec.  $\delta$

+ .46  
 + .67

+ .04  
 + .36

- .92  
 - .62

r

T - bsec  $\varphi$  16 6 20.77 16 16 11.40 16 41 26.28  
 a 16 6 1.16 16 15 51.78 41 41 6.67  
 $\Delta T + bsec \varphi$  - 19.61 19.62 19.61

Date	1870	July 5		
Observer		E. P. A.		
Illumin'n		E.		
Star		Gr. 2320	$\delta$ Ophiuchi	$\pi$ Herculis
Mag.		68° 9'	3° 21' S.	46° 38'
$\delta$				
Wire	a			
"	b			
"	c			
"	1	16 6 2.2	16 7 48.9	16 16 3.3
"	2	12.8	52.6	8.6
"	3	22.0	56.3	13.9
"	4	31.7	59.8	19.1
"	5	41.6	8 3.4	24.3
"	d			
"	e			
"	f			
Sum		110.3	281.0	69.2
Mean		16 6 22.06	16 7 56.20	16 16 73.84
Red'n to				
m				
n (tan. $\delta$ - tan $\varphi$ )		+ .79	- .48	+ .07
c. sec. $\delta$		+ .67	+ .25	+ .36
r				
T - bsec $\varphi$		16 6 23.52	16 7 55.97	16 16 14.27
a		16 6 0.96	16 7 33.71	16 15 51.11
$\Delta T + bsec \varphi$		- 22.56	22.26	22.56

$c'$  assumed + .25  
 $n$  from Gr. 2320 &  $\varphi$  Carr. + .50  
 $\Delta T + bsec \varphi$  from 4 other stars - 22.40  
 $bsec \varphi$  by level readings } + 1.02  
 July 5 1870 23<sup>h</sup>  $\frac{3}{4}$   
 Clock fast at 16<sup>h</sup> 24<sup>m</sup> 23<sup>s</sup>.42.



Date	1870	July 5		
Observer	E. P. A.			
Illumin'n	E.			
Star	$\zeta$ Ophiuchi	$\gamma$ Herculis	$\gamma$ Camelop.	
Mag.	10° 18' S.	39° 10'	66° 7'	
$\delta$				
Wire	a			
"	b			
"	c			
"	1	16 30 17.0	16 38 41.0	16 41 13.8
"	2	20.9	45.9	22.6
"	3	24.5	50.5	31.8
"	4	28.1	55.1	40.7
"	5	31.8	59.8	49.9
"	d			
"	e			
"	f			
Sum	122.3	252.3	158.8	
Mean	16 30 24.46	16 38 50.46	16 41 31.76	
Red'n to				
m				
n. ( $\tan. \delta - \tan \varphi$ )	- .54	- .05	- 1.59	
c. sec. $\delta$	+ .25	+ .32	- .62	
r				
T - bsec $\varphi$	16 30 24.17	16 38 50.73	16 41 29.55	
a	16 30 1.92	16 38 28.20	4 41 6.96	
$\Delta T$ f bsec $\varphi$	- 22.25	22.53	22.59	

Date 1870 July 9

Observer

E. P. A.

Illumin'n

E.

Star

 $\alpha$  Serpenti $\epsilon$  Serpenti $\epsilon$  Cor. Bor.

Mag.

 $\delta$  $6^{\circ} 50'$  $4^{\circ} 52'$  $27^{\circ} 15'$ 

Wire

a

"

b

"

c

" 1

15 38 10.6 15 44 38.9 15 52 30.0

" 2

14.1 42.5 34.0

" 3

17.8 46.2 38.1

" 4

21.6 49.9 42.2

" 5

25.1 53.4 46.3

" d

" e

" f

Sum

Mean

$$\begin{array}{ccc} 89.2 & 230.9 & 190.6 \\ 15\ 38\ 17.84 & 15\ 44\ 46.18 & 15\ 52\ 38.12 \end{array}$$

Red'n to

m

n. (tan.  $\delta$  - tan  $\phi$ )c. sec.  $\delta$ - .36  
+ .32- .38  
+ .32- .18  
+ .35 $\tau$ T - b sec  $\phi$  15 38 17.80 15 44 46.12 15 52 38.29

a

15 37 53.38 15 44 21.73 15 52 13.91

 $\Delta T + b \sec \phi$  - 24.42 24.39 24.38
$$\begin{array}{l} c = +.316 \text{ Illumination East} \\ n = +.455 \\ \Delta T + b \sec \phi = -24.38 \end{array} \left. \vphantom{\begin{array}{l} c \\ n \\ \Delta T + b \sec \phi \end{array}} \right\} \text{by Cauchy's method}$$

From level readings  $b \sec \phi = \begin{cases} +1.01 \text{ Illumination East} \\ +1.05 \text{ " West} \end{cases}$

Clock fast (at  $16^h 34^m$ ) 25.41



Date	1870	July 9			
Observer		E. P. N.			
Illumin'n		E.			W.
Star		$\beta$ Scorpii	$\delta$ Ophiuchi	$\delta$ Ophiuchi	
Mag.		19° 27' S.	3° 21' S.	10° 18' S.	
$\delta$					
Wire	a				
"	b				
"	c				
"	1	15 58 11.6	16 7 51.0	16 30 19.7	
"	2	15.4	54.7	23.2	
"	3	19.1	58.2	27.0	
"	4	23.0	8 1.8	30.7	
"	5	26.8	5.4	34.5	
"	d				
"	e				
"	f				
Sum		95.9	291.1	135.1	
Mean		15 58 19.18	16 7 58.22	16 30 27.02	
Red'n to					
m					
n. (tan. $\delta$ - tan $\phi$ )		-.57	-.144	-.50	
c. sec. $\delta$		+.33	+.32	-.32	
r					
T - bsec $\phi$		15 58 18.94	16 7 58.10	16 30 26.20	
a		15 57 54.58	16 7 33.69	16 30 1.91	
$\Delta T + bsec \phi$		- 24.36	24.41	24.29	

Note Dec. 15, 1880.  
 Clock fast July 13 at 16<sup>h</sup> 31<sup>m</sup>

" " 9 " 16 34

Gain in 4 days

" " 2 "

" " 5 hours

27.75

25.41

2.34

1.17

.24

Disappearance of  $\delta$  Sagittarii recorded in note-book of A. Searle;  
 E. Equat. chron. A 424 21<sup>h</sup> 41<sup>m</sup> 46.0; reduction to S. Clark +13.23; time by S. Clark 21<sup>h</sup> 41<sup>m</sup> 59.2

Date	1870 July 9		
Observer	E. P. A.		
Illumin'n	N.		
Star	$\kappa$ Ophiuchi	$\delta$ Herulis	$\epsilon$ Urs. Min.
Mag.			
$\delta$	$9^{\circ} 35'$	$38^{\circ} 46'$	$82^{\circ} 15'$
Wire	a		
"	b		
"	c		
"	1	16 51 50.3	16 57 6.4 16 58 59.2
"	2	54.0	10.7 59 26.5
"	3	57.6	15.0 54.0
"	4	52 1.3	19.2 17 0 19.7
"	5	4.9	23.8 47.3
"	d		
"	e		
"	f		
Sum	288.1	75.1	266.7
Mean	16 51 57.62	16 57 15.02	16 59 53.54
-Red'n to			
m			
n. (tan. $\delta$ - tan $\phi$ )	- .34	- .11	+ 2.93
c. sec. $\delta$	- .32	- .38	- 2.34
$\tau$			
T - bsecq	16 51 56.96	16 57 14.53	16 59 53.93
a	16 51 32.63	16 56 50.08	16 59 29.61
$\Delta T + bsecq$	- 24.33	24.45	24.32



Date	1870 July 9			
Observer	E. P. A.			
Illumin'n	W.			
Star	$\alpha$ Hercules	$\beta$ Draconis	$\alpha$ Ophiuchi	
Mag.				
$\delta$	$14^{\circ} 33'$	$52^{\circ} 24'$	$12^{\circ} 40'$	
Wire	a			
"	b			
"	c			
"	1	17 9 2.4	17 27 44.8	17 29 13.4
"	2	6.2	50.6	17.1
"	3	10.0	56.8	20.9
"	4	13.8	28 2.6	24.6
"	5	17.6	8.8	28.2
"	d			
"	e			
"	f			
Sum	50.0	283.6	104.2	
Mean	17 9 10.00	17 27 56.72	17 29 20.84	
Red'n to				
m				
n. (tan. $\delta$ - tan $\phi$ )	-.30	+.18	-.31	
c. sec. $\delta$	-.33	-.57	-.32	
$\tau$				
T - bsec $\phi$	17 9 9.37	17 27 56.40	17 29 20.21	
a	17 8' 44.99	17 27 31.98	17 28 55.85	
$\Delta T$ + bsec $\phi$	- 24.38	24.42	24.36	

Date 1870 July 13

Observer E. P. A.

Illumin'n W.

Star

Mag.

 $\delta$  $\tau$  Herculis $\alpha$  Scorpii  $\eta$  Draconis $46^{\circ} 38'$  $26^{\circ} 8' S.$  $61^{\circ} 49'$ 

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

16	16	8.4	16	21	47.8	16	22	27.6
		13.5			51.9			35.2
		18.8			56.0			43.2
		24.0	22		0.0			50.6
		29.2			41.0			58.4

Sum

Mean

16	16	93.9	16	21	279.7	16	22	215.0
16	16	18.78	16	21	55.94	16	22	43.00

Red'n to

m

 $n (\tan. \delta - \tan \varphi)$ c. sec.  $\delta$ + .07  
- .47- .67  
- .36+ .46  
- .68 $\tau$ T - bsec  $\varphi$ 

16	16	18.38	16	21	54.91	16	22	42.78
----	----	-------	----	----	-------	----	----	-------

a

16	15	51.59	16	21	28.34	16	22	16.22
----	----	-------	----	----	-------	----	----	-------

 $\Delta T + bsec \varphi$ 

- 26.79

26.57

26.56

c' assumed - .32

 $n$  from  $\alpha$  Scorpii &  $\eta$  Draconis

+ .48

 $\Delta T + bsec \varphi$  from 6 stars

- 26.69

bsec  $\varphi$  by level readings

+ 1.06

Clock fast (at 16<sup>h</sup> 31<sup>m</sup>)

27.75



Date	1870	July 13		
Observer	E. P. A.			
Illumin'n	W.			
Star	$\zeta$ Ophiuchi $\gamma$ Hercules $\delta$ Hercules			
Mag.	10° 18' S. 39° 10' 33° 46'			
$\delta$				
Wire	a			
"	b			
"	c			
"	1	16 30 28.9	16 38 45.8	16 57 8.8
"	2	25.8	50.7	13.0
"	3	29.6	56.2	17.4
"	4	33.0	59.9	21.8
"	5	36.8	39 4.7	26.1
"	d			
"	e			
"	f			
Sum		147.1	276.3	87.1
Mean		16 30 29.42	16 38 55.26	16 57 17.42
Red'n to				
m				
n (tan. $\delta$ - tan $\phi$ )		-.53	-.05	-.12
c. sec. $\delta$		-.33	-.41	-.38
$\tau$				
T - bsec $\phi$		16 30 28.56	16 38 54.80	16 57 16.92
a		16 30 1.90	16 38 28.12	16 56 50.05
$\Delta T + bsec \phi$		- 26.66	26.68	26.87

Date	1870 July 20									
Observer	E. D. A.									
Illumin'n	East									
Star	$\beta$ Leonis      Polaris $\alpha$ Virgin									
Mag.										
$\delta$										
Wire	a									
"	b									
"	c	11	42	44.10	13			13	18	40.20
				46.95						42.70
"	1			49.26						45.22
"	2			51.70						47.75
"	3			53.00		11	50.7			52.70
"	4	43		2.10						57.70
"	5			4.95				19		0.00
				7.28						2.70
"	d			10.16						5.40
"	e									
"	f									
Sum				<sup>24</sup> 273.41				<sup>18</sup> 294.37		
Mean		11	42	57.05	13	11	50.70	13	18	52.71
Red'n to										
m										
n. tan. $\delta$		274		-46.847				-185		
c. sec. $\delta$		1037		-41.559				+1017		
T										
a		11	42	28.62	1	11	38.60	13	18	21.49
$\Delta T$										



Date

Observer

Illumin'n

W A R

Star

Mag.

$\delta$

$\gamma$  Urs Maj.  $\gamma$  Boötis w Boötis

Wire

a

"

b

"

c

"

1

"

2

"

3

"

4

"

5

"

d

"

e

"

f

13	42	37.40	13	48	48.55	15	19	51.30
		41.40			51.35			54.40
		45.25			53.90			57.41
		49.10			56.40	20		0.50
		56.80	49		1.60			7.00
43		4.36			6.90			13.15
		8.30			9.55			16.40
		12.00			12.20			19.42
		16.10			14.80			22.70

Sum

Mean

		24			24			
		270.71			255.25			242.28
13	42	56.75	13	49	1.69	15	20	6.92

Red'n to

m

n. tan.  $\delta$

c. sec.  $\delta$

1	190		3	45
1	554		1	058

r

T

a

13	42	26.32	13	48	30.39	15	19	35.95
----	----	-------	----	----	-------	----	----	-------

$\Delta T$





Date																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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Date 1870 July 21

Observer E. P. O. A.

Illumin'n 8

Star

Mag.

 $\delta$  $\alpha$  Serpentes  $\zeta$  Urs. Min.  $\beta'$  Scorpii  
6° 50'

Wire

a

b

c

1

2

3

4

5

d

e

f

15	37	47.4	15	46	17.2	
	38	<u>4.4</u>		47	18.3	
		12.5		48	18.7	
		15.0			30.9	
		17.5			43.0	
		20.4			55.0	
		24.9	49	49.2	95	58
		30.0		43.3		26.5
		32.6		55.7		34.4
		35.0	50	7.3		34.0
		<u>37.5</u>		20.1		36.6
		49.9	51	20.2		39.2
			52	21.0		52.5
	39	02.3				59
						6.5

Sum

Mean

		225.0		29	3.2		1677
15	38	25.60	15	49	19.24	15	58
							33.54

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$ 

101	4.89	106
+12	4.78	-35

 $r$ 

T

a

15	37	53.28	15	48	47.53	15	57	54.49
----	----	-------	----	----	-------	----	----	-------

 $\Delta T$



Date 1870 July 21

Observer

E. P. A.

Illumin'n

E.

Star

Mag.

 $\delta$ preceding Gr. 2320  $\pi$  Herculis A Drac.

Wire

a

16 2

53.3

16 15

29.7

16 27

5.7

"

b

3

26.7

47.8

39.8

"

c

4

59.8

16

5.6

28

14.7

"

1

6.9

9.0

21.7

"

2

13.0

12.8

28.5

"

3

19.8

16.2

35.5

"

4

32.9

23.5

48.7

"

5

46.1

30.6

29

53.3

"

6

53.0

34.4

09.8

"

d

5

59.4

37.9

16.7

"

e

6.1

41.8

23.7

"

f

6

39.5

59.8

58.2

Sum

297.0

211.5

24

2026

Mean

16 4 33.00

16 16 23.53

16 28 49.18

Red'n to

m

+36

n. tan.  $\delta$ 

c

2.68

1.47

+39280

c. sec.  $\delta$ 

n

2.49

1.06

-0292161

 $\tau$ 

T

2407

a

16 15 51.44 16 28 17.11

 $\Delta T$ 

$$c = +^s 264$$

$$n = -.20$$

$$g = + 40$$

$$h = + 13$$

$$m = + 36$$

$$\Delta + = - 32.45^s$$

Date 1870 July 21  
 Observer E. P. A.  
 Illumin'n E.  
 Star  $\eta$  Herculis & Cam. I.C. & Ophiuchi  
 Mag.  
 $\delta$

Wire	a	16	38	12.0	—	16	51	26.9
"	b			28.3	—			39.2
"	c			44.2	10.2			51.9
				47.6	42 04.1			54.7
"	1			50.2	58.0			57.0
"	2			53.7	52.1			59.4
"	3			—	16 41 39.6	52		41.5
"	4	39		6.4	—			9.7
"	5			9.2	—			12.1
				12.8	—			14.5
"	d			14.0	—			17.0
"	e			—	—			—
"	f			—	—			—

Sum 240.1 164.0 250.8  
 Mean 16 39 0.01 16 41 56.80 16 52 45.3

Red'n to  
 m

n. tan.  $\delta$   
 c. sec.  $\delta$

1.29  
 81

-247  
 -226

101  
 +17

r

T

a

16 38 28.00 4 41 7.80 16 51 32.56

$\Delta T$



Date 1870 July 21

Observer

E. R. A.

Illumin'n

E.

Star

 $\epsilon$  Urs. Min., 44 Ophiuchi & Ophiuchi

Mag.

 $\delta$ 

Wire

a

13 rev. micr.

17

18

18.8

17

28

49.9

"

b

16 56 47.3

32.3

29

21.2

"

c

57 06.2

46.0

15.0

23 rev.

48.9

17.6

"

1

58 20.3

54.1

20.0

"

2

38.2

59.7

22.6

"

3

33 rev.

19

50.0

27.8

"

4

59 52.1

7.9

32.7

"

5

17 0 10.2

10.3

35.2

"

5

28.7

13.1

37.8

"

d

43 rev.

26.6

40.3

"

e

1 24.0

40.2

53.0

"

f

2 0.2

30

5.8

Sum

Mean

24  
246.4 249.0  
17 18 59.60 17 29 27.67

Red'n to

m

n. tan.  $\delta$ 

7.41

109

1.02

c. sec.  $\delta$ 

7.35

+75

+0.22

 $\tau$ 

T

a

16 59 28.19 17 18 28.03 17 28 55.81

 $\Delta T$

Date	1870	July 22			
Observer		E P at			
Illumin'n		W			
Star		Kellphirchi d Herenly & Wodlin			
Mag.					
$\delta$					
Wire	a				
"	b				
"	c	16 57 52.9			
		55.3			
"	1	57.8			
"	2	52 0.2		16 59 27.2	
"	3	5.2	16 57 20.8	17 0 2.9	
"	4	10.4	29.1	39.7	
"	5	12.9	32.0	52.0	
		15.2	34.9		
"	d	18.0	38.1		
"	e				
"	f				
		18			
Sum		227.9	154.9	121.8	
Mean		16 52 5.32	16 57 30.98	17 0 15.45	
Red'n to				- 14.00	
m					
n. tan. $\delta$					
c. sec. $\delta$					
$\tau$					
T					
a		16 57 32.55	16 56 49.96	16 59 28.05	
$\Delta T$					



Date

Observer

Illumin'n

Star

Mag.

 $\delta$ 

Wire

a

"

b

"

c

"

1

"

2

"

3

"

4

"

5

"

d

"

e

"

f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $\tau$ 

T

a

 $\Delta T$  $\alpha$  Herculis  $\gamma$   $\alpha$   $\beta$   $\gamma$   $\delta$   $\epsilon$   $\zeta$   $\eta$   $\theta$   $\iota$   $\kappa$   $\lambda$   $\mu$   $\nu$   $\xi$   $\omicron$   $\pi$   $\rho$   $\sigma$   $\tau$   $\upsilon$   $\phi$   $\chi$   $\psi$   $\omega$   $\alpha$   $\beta$   $\gamma$   $\delta$   $\epsilon$   $\zeta$   $\eta$   $\theta$   $\iota$   $\kappa$   $\lambda$   $\mu$   $\nu$   $\xi$   $\omicron$   $\pi$   $\rho$   $\sigma$   $\tau$   $\upsilon$   $\phi$   $\chi$   $\psi$   $\omega$ 

17	9	5.0	17	17	30.8	17	27	44.9
		7.5			33.6			49.0
		10.1			36.2			52.9
		12.7			38.9			57.1
		17.9			44.3			
		22.9			48.8			
		25.3			52.7			
		27.9			55.2			
		30.6			57.8			

		159.9			399.3			2039
17	9	17.77	17	17	44.37	17	27	50.98

17	8	44.93	17	18	28.03	17	27	31.79
----	---	-------	----	----	-------	----	----	-------

Date	1870	July 22 <sup>d</sup>			
Observer		E. P. Ab			
Illumin'n		West			
Star	-	$\alpha$ Draconis	$\mu$ Herculis	$\gamma$ Draconis	
Mag.					
$\delta$					
Wire	a				
"	b				
"	c	17 37 45.6	17 41 43.0	17 53 51.1	
		52.8	45.9	55.0	
"	1	58.9	48.9	59.1	
"	2	38 6.0	57.6	54 3.2	
"	3	19.9	57.1	10.7	
"	4	33.4	42 2.8	18.7	
"	5	40.8	5.7	22.8	
		47.3	8.6	26.5	
"	d	54.3	11.1	30.8	
"	e				
"	f				
		18	24	19	
Sum		359.0	274.7	277.9	
Mean		17 38 19.89	17 41 57.19	17 54 10.88	
Red'n to					
m					
n. tan. $\delta$					
c. sec. $\delta$					
$\tau$					
T					
a		17 37 45.85	17 41 24.13	17 53 37.61	
$\Delta T$					



Date

Observer

Illumin'n

Star

Mag.

 $\delta$ 

Wire

a

"

b

"

c

"

1

"

2

"

3

"

4

"

5

"

d

"

e

"

f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $\tau$ 

T

a

 $\Delta T$  $\gamma^2$  Segittarii 1110 51 61 16

17	57	48.1	18	11	43.8	18	34	28.4
		51.0		12	26.8		35	22.8
		54.0		13	8.3		36	11.0
		56.8		13	49.7		37	4.5
58		2.5		15	13.4			
		8.3		16	36.4			
		11.2		17	19.1			
		14.1		18	0.6			
		17.1		18	42.6			

		263.1			240.7			67.7
17	58	257	18	15	13.41	18	35	46.92

+ 2.59.59

17	57	29.78	18	14	32.346	38	23.42
----	----	-------	----	----	--------	----	-------

Date 1870 July 23

Observer E. V. At

Illumin'n M

Star K Ophiuchi e vis olin d Herculis

Mag.

 $\delta$ 

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$ 

r

T

a

 $\Delta T$ 

58 32.5

50.1 17 9 8.0

59 9.2 10.7

27.5 13.0

4.0 18.1

40.5 23.3

58.3 26.0

1 16.1 28.7

35.9 31.0

24

2741 158.8

17 0 3.79 17 9 1985

-1.59

16 59 27.92 17 8 44 92



Date										
Observer										
Illumin'n										
Star	<i><math>\alpha</math> Ophiuchi w Draconis polaris</i>									
Mag.										
$\delta$										
Wire	a									
"	b									
"	c	17	29	16.3	17	37	46.0	17	41	43.6
"	1			19.0			52.7			46.4
"	2			21.5			59.7			49.0
"	3			24.0		38	6.4			54.9
"	4			29.0			20.0			57.7
"	5			34.0			33.8	42		3.0
"	d			36.8			40.9			6.0
"	e			39.0			47.5			8.8
"	f			41.9			54.2			11.6
Sum				261.5		18	361.2		24	278.0
Mean		17	29	29.06	17	38	20.13	17	41	57.56
Red'n to										
m										
n. tan. $\delta$										
c. sec. $\delta$										
r										
T										
a		17	28	55.80	17	37	45.81	17	41	24.12
$\Delta T$										

# Eastro Transit

Date	1970	July 27			
Observer	E. P. A.				
Illumin'n	West				
Star	A Draconis & Ophiuchi & Hercules				
Mag.					
$\delta$					
Wire	a				
"	b				
"	c				
"	1	16 28 31.2	30 30.6	16 38 54.3	
"	2	42.2	34.3	54.0	
"	3	52.5	38.1	39 0 3.0 + 6	
"	4	29 2.0	41.8	8.2	
"	5	12.0	45.5	12.9	
"	d				
"	e				
"	f				
Sum		134.4	190.3	137.4	
Mean		51.48	38.06	16 39 3.48	3.60
Red'n to					
m					
n. tan. $\delta$		+112	- 8	+ 33	
c. sec. $\delta$		- 90	-33	- 41	
r					
T		52.20	37.65	3.52	
a		16 28 16.81	16 30 1.80	16 38 27.92	
		35.39	35.85	35.60	
$\Delta T$					

$$\begin{aligned}
 c &= -0.32 & 4t + m &= -36.01 \\
 n &= +0.43 & 4t + 2 &= -36.81 \\
 h &= +0.88 \\
 m &= +80
 \end{aligned}$$



Date							
Observer							
Illumin'n							
Star	K Ophiuchi of Herault's E. 23.00						
Mag.							
$\delta$							
Wire	a						
"	b						
"	c						
"	1	16 52	1.7	16 57	17.2	16 59	8.5
"	2		5.2		21.6		35.3
"	3		8.9		26.1	17 0	2.7
"	4		12.4		30.5		30.0
"	5		16.1		34.7		56.5
"	d						
"	e						
"	f						
Sum			44 3		130.1		133.0
Mean		16 52	8.86	16 57	26.02	17 0	2.60
Red'n to							
m							
n. tan. $\delta$			+ 7		+ 29		+ 319
c. sec. $\delta$			- 32		- 38		- 2 37
$\tau$							
T			8.61		2593		342
a		16 57	32.51	16 56	49.89	16 59	27.38
			36.10		36.04		36.04
$\Delta T$							

E Transit

Meridian Circle

Date	1870	July 27	July 29	29	
Observer		E. Peab			
Illumin'n		W			
Star		$\alpha$ Herculis	$\alpha$ Aurigae	$\beta$ Orionis	
Mag.					
$\delta$					
Wire	a				
"	b				
"	c		5-4 7m 26.2		
"	1	17 9 13.7	29.8		
"	2	17.3	33.3		
"	3	24.1	37.0	8	50.7
"	4	25.0	44.0		55.7
"	5	28.7	51.2	9	0.8
"			54.7		3.2
"			58.1		5.7
"	d		8 1.8		8.2
"	e				
"	f				
Sum		105.8	336.1		124.3
Mean		17 9 21.16	5 7 44.01	5 9	4.05
Red'n to					0.72
m					-5.00
n. tan. $\delta$		+11.5	+11.43 -39	+101	-27
c. sec. $\delta$		-33	+12 -3 -106		+28
$r$					
T		2094	4359	8	5573
a		17 8 44.89	5 7 5.32	5 8	17.34
		36.05	-38.27		-38.39
$\Delta T$					



## Meridian Circle Micrometer at 26° 16'

Date 1870 July 29 Astronomical

Observer E. P. A.

Illumin'n West

Star B. Lani Orion's &amp; Orion's

Mag.

 $\delta$ 

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $\tau$ 

T

a

 $\Delta T$ 

5-18	29.0	5-25	47.9	5-30	3.0
	31.9		50.4		5.8
	34.7		52.8		8.0
	37.5		55.3		10.5
	43.0	26	0.1		15.3
	48.7		5.1		20.3
	57.5		7.7		22.8
	54.4		10.2		25.3
	57.1		12.7		27.8

3878	242.2	138.8
5-18 43.09	5-26 0.24	5-30 15.42

+113	-31	+100	-27	100	-27
-037	+10	-92	+24	-94	+24

4289	0.21	15.39
5-18 4.50	5-25 21.84	5-29 36.90
-38.39	-38.37	-38.49

$c = -.27$   
 $n = -.26$   
 $h = +.16$   
 $a = +.44$   
 $m = +.15$

$\Delta t + m = -38.56$  at  $12^h$   
 $\Delta t = -38.72$

Date	1870	July 29		
Observer	E. P. A. West			
Illumin'n				
Star	$\alpha$ Orionis $\gamma$ Geminae & Bradley			
Mag.				
$\delta$				
Wire	a			
"	b			
"	c	5 48 33.8	6 30 37.4	
		36.4	40.1	
"	1	38.4	42.7	
"	2	41.4	45.2	
"	3	46.3	50.3	
"	4	51.4	55.5	
"	5	53.9	58.2	
		56.2	31 0.8	
"	d	58.8	3.3	
"	e			
"	f			
Sum		417.1	12 333.5	
Mean		5 48 46.34	6 30 50.39	
Red'n to m				
n. tan. $\delta$	+101	-27	104	-28
c. sec. $\delta$	-78	+20	-62	+16
$\tau$				
T		46.27	50.27	
a	5 48 7.90	6 30 11.82	6 30	
	-38.37	-38.45		
$\Delta T$				



Date	July 29		July 30		
Observer			E. Pol		
Illumin'n					
Star	α Cancler		Palais 16		5 Virginis
Mag.					
δ					
Wire	a				
"	b				
"	c	6 39 49.9	13	13 28 31.0	
		52.6		33.5	
"	1	55.2	13 6 57.4	36.0	
"	2	57.8	8 39.0	38.4	
"	3	40 2.9		43.3	
"	4	8.1	15 27.1	48.3	
"	5	10.8	17 9.3	50.8	
		13.0	18 50.3	53.2	
"	d	16.0	20 34.7	55.8	
"	e				
"	f				
Sum		266.3		390.3	
Mean		6 40 2.92	13 12 3.23	13 28 43.37	
			reduced		
Red'n to					
m					
n. tan. δ		104 - 28 - 415.6 + 11.22 + 100		- 27	
c. sec. δ		- 1.21 + 31 - 42.46 + 11.04 - 81		+ 24	
τ					
T		2.95	25.49	43.34	
a		6 39 24.51	1 11 47.00	13 28 4.76	
Δ T		- 38.44	- 38.49	- 38.58	

Date 1870 July 30

Observer E P A

Illumin'n West

Star

Mag.

 $\delta$ E Bootis 2<sup>d</sup> Librae 3<sup>d</sup> Ursa Min

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

14 39	44.1	14 46	8.2	14 51	0.0
	47.0		10.9		9.7
	49.9		13.4		19.0
	52.6		16.0		28.6
	58.2		21.0		47.1
40	03.8		26.1	52	5.9
	6.5		28.7		15.1
	9.2		31.2		24.5
	12.2		33.9		34.0

Sum

Mean

24	283.5	189.4	24	183.9	
14 39	58.17	14 46	21.04	14 51	47.10

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$ 

113	-31	104	-28	379	-1.02
-39	+10	-119	+31	+274	-71

 $\tau$ 

T

57.96	21.07	45.37
-------	-------	-------

a

14 39	19.36	14 43	42.48	14 51	6.70
	-38.60		-38.59		-38.67

 $\Delta T$



Date

July 30

Observer

Illumin'n

Star

Mag.

 $\delta$ 

B Baurts

Wire a

" b

" c

15 57 26.3

29.8

" 1

33.0

" 2

36.2

" 3

42.9

" 4

49.3

" 5

52.7

" d

55.9

" e

59.2

" f

Sum

385.3

Mean

15 57 42.81

Red'n to

m

n. tan.  $\delta$ 

132

-36

tg.  $\delta$ 

-05

+1

 $r$ 

T

42.46

a

14 57 3.72

-3874

 $\Delta T$

## New Meridian Circle

Date	1870	Aug 31			
Observer		W. S. R.			
Illumin'n		W			
Star		Polaris S. P.	Polaris	Arcturus Maj	
Mag.					
$\delta$		88 36 44 All. W	All. E	All. E	
Wire	a	13 03 46.3	13 17 18.9	13 42 46.0	
"	b	5 31.4	19 26	49.7	
"	c	7 13.0	20 45.4	53.5	
"	1			57.2	
"	2			56	
"	3	13 12 20.1	13 12 11.6	12.8	
"	4	19.8	14.4	16.6	
"	5	21.1	10.8	20.3	
"	d	61.1	36.8	24.2	
"	e				
"	f				
Sum				285.3	
Mean		13 12 20.33	13 12 12.24	246 45.3	13 43 5.03
Red'n to					
m					
n. tan. $\delta$					
c. sec. $\delta$					
r					
T					
a		13 11 48.5		13 42 25.05	
$\Delta T$					



Date

Aug 31

Observer

M. S. R.

Illumin'n

Star

a Bootis

δ Bootis

ε Serpentis  
Remund.

Mag.

δ

Ill W

Wire

a

14 10

113

14 21

6.5

15 44 48.8

"

b

140

106

57.3

"

c

166

146

53.8

"

192

188

58.3

"

1

246

270

46 11

"

2

298

349

6.3

"

3

325

389

8.8

"

4

349

430

11.2

"

5

377

470

13.7

"

d

"

e

"

f

220.6

244.3

24  
251.3

Sum

Mean

14 10 24.51

14 21

27.14

15 46 1.26

Red'n to

m

n. tan. δ

c. sec. δ

τ

T

a

14 9 44.52 14 20 46.55 15 44 21.52

Δ T

Date

July 31

Observer

M. R.

Illumin'n

W

Star

z Mus Min

p. Scorpion

2320 Gr.

Mag.

 $\delta$ 

Wire

a

15-58 209

16 6 74

" b

237

141

" c

15 49 40

264

207

" 1

277

289

273

" 2

518

342

418

" 3

42

394

539

" 4

158

420

05

" 5

279

446

70

" 5

472

136

" d

15 49 283279

277 275

" e

279 277

1863

" f

277 281

180

Sum

245 273

3663

Mean

271 275

15-49 2790 15-58 3415 16 6 4070

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$ 

r

T

a

15-48 46.53 15-57 39.76 16 5-59.78

 $\Delta T$



Date	1870	Aug 1					
Observer	W A R						
Illumin'n	West						
Star	$\alpha$ Leonis $\beta$ Leonis $\delta$ Leonis						
Mag.							
$\delta$							
Wire	a						
"	b						
"	c	11 7	38.6	11 42	53.4	12 28	14.2
"	1		41.2		56.0		19.7
"	2		43.8		58.4		22.4
"	3		46.7		6.3		24.9
"	4		51.9		11.3		27.8
"	5		57.0		13.9		
"		<del>8</del>	59.7		16.4		
"		<del>8</del>	2.5		18.8		
"	d		5.1				
"	e						21.80
"	f						109.0
Sum			12		18		
Mean			346.5		235.4		
		11 7	51.85	11 43	6.16	12 28	14.30
							reduced
Red'n to							
m							
n. tan. $\delta$		-52		-63		-133	
c. sec. $\delta$		+1.07		+1.04		+1.08	
$r$							
T							
a		11 7	11.29	11 42	25.53	12 27	33.98
$\Delta T$							

Date	1870	Aug 1st			
Observer		W A R			
Illumin'n		West			
Star		12 Con Ven	Polaris 10	& Virginis	
Mag.					
$\delta$					
Wire	a				
"	b				
"	c	12 50 20.2	13 8 0.0	13 18 49.2	
"	1	23.5		57.6	
"	2	26.7		54.2	
"	3	29.9	9 1.0	56.8	
"	4	36.2	12 25.0	19 1.8	
"	5	42.7		7.0	
"	d	45.8	17 32.0	9.2	
"	e	48.9		11.8	
"	f	52.1	18 12 26.3	14.5	
			25.0		
			23.8		
Sum		326.0		256.0	
Mean		12 50 37.22	13 42 25.03	13 19 1.76	
Red'n to					
m					
n. tan. $\delta$		-10	-42.46	-1.10	
c. sec. $\delta$		12.9	-41.56	-1.02	
r					
T					
a		12 49 56.53	13 11 48.52	13 18 21.34	
$\Delta T$					

Aug 1. 1870  $n = -.20$   
 $b = 1''.76$   $a = +6''.0$   
 $\Delta T + m = -40.75$   
 $\Delta T = -41.11$



Date

Observer

Illumin'n

Star

Mag.

 $\delta$ 

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $\tau$ 

T

a

 $\Delta T$ *3 Virgin*

23 28 52.7  
 55.2  
 57.6

15.5

55.7

-9.07

-91

1.00

13 28 47.3

# East Transit

Date	1870	Aug. 6			
Observer		N. S.			
Illumin'n		W.			
Star		1 Aquilae	2 Lyrae	51 Cephei	
Mag.		8° 20' S.	38° 40'	87° 14'	
δ					
Wire	a				
"	b				
"	c				
"	1	18 28 48.6	18 33 10.7	18 36 47.1	
"	2	52.4	15.0	38 1.8	
"	3	53.9	19.8	39 16.8	
"	4	59.7	24.1	40 33.7	
"	5	29 3.2	29.0	41 48.7	
"	d				
"	e				
"	f				
Sum		279.8	98.6	88.1	
Mean		18 28 55.96	18 33 19.72	18 39 17.62	
Red'n to					
m					
n. (tan. δ - tan φ)		- .58	- .06	- 11.91	
c. sec. δ		- .36	- .46	+ 7.48	
τ					
T - b sec φ		18 28 55.02	18 33 19.20	18 39 13.19	
a		18 28 9.94	18 32 34.23	6 38 28.20	
ΔT + b sec φ		- 45.08	- 44.97	- 44.99	

Level observed before transits, Aug. 6, 1870. Illum. West.

Obj. glass North  $b = \frac{115\frac{1}{2} - 64}{60} = +0.858$

" " South  $b = \frac{117\frac{1}{2} - 62}{60} = +0.925$

Level observed after transits, Illum. East

Object glass North,  $b = \frac{120 - 68}{60} = +0.867$

" " South,  $b = \frac{122 - 68}{60} = +0.900$

$b \sec \phi = .891 \times 1.354 = +1.21$

$b \sec \phi = .883 \times 1.354 = +1.20$



## East Transit

Date 1870 Aug. 6  
 Observer A. S.  
 Illumin'n W. E.  
 Star  $\beta$  Lyrae  $\gamma$  Aquilae  $\alpha$  Aquilae  
 Mag. 33° 13' 10° 18' 8° 32'

Wire	a	b	c
"	1	18 45 55.9	19 40 44.7
"	2	46 0.2	48.4
"	3	4.5	52.0
"	4	8.8	55.8
"	5	13.0	59.4
"	d		
"	e		
"	f		

Sum 22.4 260.3 68.4  
 Mean 18 46 4.48 19 40 52.06 19 44 13.68

Red'n to  
 m  
 n. (tan.  $\delta$  - tan  $\phi$ ) - .14 - .40 - .42  
 c. sec.  $\delta$  - .41 + .35 + .34

T - bsec  $\phi$  18 46 3.93 19 40 52.01 19 44 13.60  
 a 18 45 18.83 19 40 6.85 19 44 28.54  
 $\Delta T + b \sec \phi$  - 45.10 - 45.16 - 45.06

c' by Cauchy's method Aug. 6 1870 - .36 Ill. W. + .34 Ill. E.  
 n " " " + .55

$\Delta T + b \sec \phi$  from 1 Aquilae,  $\alpha$  Lyrae,  $\beta$  Lyrae,  $\gamma$  Aquilae,  $\alpha$  Aquilae,  $\tau$  Aquilae  
 - 45.07  
 bsec  $\phi$  (as opposite) + 1.20  
 Clock fast (at 19<sup>h</sup> 12<sup>m</sup>) 46.27



1870phae. prof. .340S  
 A fresh computation of the disappearance of the same  
 as 8<sup>h</sup> 49<sup>m</sup> 17<sup>s</sup> 4 with  
 chron. H. 301 was therefore 8<sup>h</sup> 50<sup>m</sup> 17<sup>s</sup> 4 with  
 hardly any drift; and the corresponding mean time 8<sup>h</sup> 49<sup>m</sup> 26<sup>s</sup> 6. S. Newcomb used  
 the first Egyptian trial, according to the present reduction of A.S.

# East Transit

Date	1870 Aug. 6				
Observer	N. S.				
Illumin'n	E.				
Star	ε Draconis & Aquilae	3 Urs. Maj.			
Mag.	69° 56'	6° 55'	68° 51'		
Wire	a				
"	b				
"	c				
"	1	19 49 1.6	19 58 27.4	20 0 16.1	
"	2	12.2	31.0	26.8	
"	3	22.8	34.7	36.6	
"	4	33.7	38.2	46.8	
"	5	44.0	41.9	56.7	
"	d				
"	e				
"	f				
Sum		114.3	173.2	183.0	
Mean		19 49 22.86	19 58 34.64	20 0 36.60	
Red'n to					
m					
n (tan. δ - tan φ)		+ 1.00	-.43	-1.92	
c. sec. δ		+ .99	+ .34	-.94	
τ					
T - bsec φ		19 49 24.85	19 58 34.55	20 0 33.74	
a		19 48 39.83	19 57 49.49	7 59 48.61	
ΔT + bsec φ		- 45.02	- 45.06	- 45.13	

(Note Dec. 14, 1880. A fresh computation of the disappearance of the same  
 as 8<sup>h</sup> 49<sup>m</sup> 17<sup>s</sup> 4 with  
 chron. H. 301 was therefore 8<sup>h</sup> 50<sup>m</sup> 17<sup>s</sup> 4 with  
 hardly any drift; and the corresponding mean time 8<sup>h</sup> 49<sup>m</sup> 26<sup>s</sup> 6. S. Newcomb used  
 the first Egyptian trial, according to the present reduction of A.S.

Aug. 6 1870. Chronometer H. 301 fast of Cambridge mean time 50<sup>s</sup> 80  
 (both at 8<sup>h</sup> 30<sup>m</sup> & 10<sup>h</sup> 49<sup>m</sup> mean time)  
 Chronometer B. 236 slow of Cambridge sidereal time  
 (at 18<sup>h</sup> 25<sup>m</sup>) 2<sup>h</sup> 7<sup>m</sup> 56<sup>s</sup> 53 & (at 20<sup>h</sup> 6<sup>m</sup>) 2<sup>h</sup> 7<sup>m</sup> 56<sup>s</sup> 40  
 Immersion of B. A. C. 5866 observed with chron. H. 301 by A.S. at 8<sup>h</sup> 49<sup>m</sup> 17<sup>s</sup> 4  
 " " " B. 236 " S. A. " 15 43 0.  
 The time by B. 236 must have been 1<sup>m</sup> earlier than stated,  
 as the predicted mean time was 8<sup>h</sup> 48<sup>m</sup> 26<sup>s</sup> 6. S. A. considered  
 his observation doubtful within 1 second.  
 Mean time of immersion (A.S.) 8<sup>h</sup> 48<sup>m</sup> 26<sup>s</sup> 6 { (S. A.) 8<sup>h</sup> 49<sup>m</sup> 26<sup>s</sup> 0 }  
 Immersion observed by A.S. with chron. H. 301 at 10<sup>h</sup> 3<sup>m</sup> 55<sup>s</sup> 0 { should be 8<sup>h</sup> 48<sup>m</sup> 26<sup>s</sup> 2 }  
 Mean time of immersion 8<sup>h</sup> 48<sup>m</sup> 26<sup>s</sup> 2

The predicted  
 time of the  
 immersion being 10<sup>h</sup> 3<sup>m</sup> 55<sup>s</sup> 0  
 it is quite possible  
 that the prediction  
 was in two parts  
 of the mean time of  
 immersion is correct.



## Coast Survey Transit No. 5

Date	1870	Aug. 15		
Observer		E. P. A.		
Illumin'n		E.		
Star		$\gamma$ Aquilae	$\alpha$ Aquilae	$\epsilon$ Drac.
Mag.		10° 18'	8° 32'	69° 56'
$\delta$		Tally B	Tally D	Tally C
Wire	a			
"	b			
"	c			
"	1	19 44 22.0	19 45 11.6	19 50 27.0
"	2	24.7	14.2	34.5
"	3	27.5	16.7	42.6
"	4	29.9	19.4	50.2
"	5	32.5	22.0	57.3
"	d	136.6	83.9	211.6
"	e	Mean 19 41 27.32	19 45 16.78	19 50 42.32
"	f	Reduction - 31.84	+ .04	- 45.78
Sum				
Mean		19 40 55.48	19 45 16.82	19 49 56.54
Red'n to				
m	Bt	+ .14	+ .13	+ .41
n	tan $\epsilon$ Aa	+ 7.87	+ 8.16	- 19.68
c. sec. $\delta$		- .25	- .25	- .73
r				
T		19 41 3.24	19 45 24.86	19 49 36.54
a		19 40 6.83	19 44 28.52	19 48 39.58
$\Delta T$		- 56.41	56.34	56.96

Level read between transits of  $\alpha$  Aquil. &  $\epsilon$  Drac.  
 $b = +.16$

c from  $\gamma$  Aquil. &  $\epsilon$  Delph. +.25 Lamp West.  
 a by Bessel's method +14.58

Clock fast (at 20<sup>h</sup>) 56<sup>s</sup>.33



## Coast Survey Transit No. 5

Date 1870 Aug. 15

Observer

E. P. A.

Illumin'n

W.

Star

 $\kappa$  Cephei $\pi$  Capric. $\epsilon$  Delphini

Mag.

 $\delta$  $77^{\circ} 19'$  $18^{\circ} 38' S.$  $10^{\circ} 52'$ 

Tally D

Tally E

Tally D

Wire

a

"

b

"

c

1

20 14 27.2

20 20 48.6

20 27 45.2

2

39.0

51.3

47.8

3

51.3

54.1

50.8

4

15 3.0

56.6

53.3

5

13.8

59.6

55.8

d

254.3

270.2

252.9

e

Mean 20 14 50.86

20 20 54.04

20 27 54.58

f

Reed. — .18

— 16.46

— .04

Sum

Mean

20 14 50.68, 20 20 37.59 20 27 50.54

Red'n to

B6

+ .41

+ .04

+ .04

n. tan.  $\delta$  Aa

- 38.05

+ 13.41

+ 7.73

c. sec.  $\delta$ 

+ 1.14

+ .26

+ .25

r

T

20 14 14.18 20 20 51.30 20 27 58.56

a

20 13 18.54 20 19 55.02 20 27 2.29

 $\Delta T$ 

- 55.64 56.28 56.27

Level read before transit of  $\kappa$  Cephei. (Camp West)  $b = +.11$   
 " " after " "  $\pi$  Capr. " "  $b = +.04$



		East Transit	C.S. Transit No. 5	East Transit
Date	1870	Aug. 17		
Observer		E. P. A.		
Illumin'n		E.	E.	E.
Star		$\epsilon$ Urs. Min.	44 Ophiuchi	$\gamma$ Cr. 966
Mag.				
$\delta$		$82^{\circ} 15'$	$24^{\circ} 3' S.$	$74^{\circ} 57'$
			Tully D	
Wire	a			
"	b			
"	c			
"	1	16 59 21.3	17 19 5.6	17 22 55.1
"	2	48.0	8.7	23 9.4
"	3	17 0 14.6	11.4	23.0
"	4	41.6	14.2	36.6
"	5	1 8.3	17.0	51.0
"	d		56.9	
"	e		17 19 11.38	
"	f		+ .04	
Sum		73.8		115.1
Mean		17 0 14.76	17 19 11.42	17 23 23.02
Red'n to				
m			B $\delta$ + .08	
n ( $\tan. \delta - \tan \varphi$ )		+ 3.79	Aa + 14.85	$\tan(\delta - \tan \varphi) - 2.73$
c. sec. $\delta$		+ 2.52	- .50	- 1.31
r				
T - bsec $\varphi$		17 0 21.07	T 17 19 25.85	T - bsec $\varphi$ 17 23 18.98
a		16 59 24.10	17 18 27.77	5 22 22.00
$\Delta T + bsec \varphi$		- 56.97	$\Delta T - 58.08$	$\Delta T + bsec \varphi - 56.98$

## Coast Survey Transit No. 5

Date	1870	Aug. 17		
Observer		E. P. A.		
Illumin'n		E.		
Star		$\beta$ Drac.	$\alpha$ Ophiuchi	$\omega$ Drac.
Mag.		52° 54'	12° 40'	69° 49'
$\delta$		Tally E	Tally B	Tally F
Wire	a			
"	b			
"	c			
"	1	17 27 59.7	17 30 13.0	17 37 20.2
"	2	28 4.0	15.9	27.8
"	3	8.1	18.6	34.8
"	4	12.8	21.2	42.6
"	5	17.0	23.7	49.8
"		<u>41.6</u>	<u>92.4</u>	<u>175.2</u>
"	d	17 28 8.32	17 30 18.48	17 37 35.04
"	e	+ 25.56	- 32.12	+ 86.95
"	f			
Sum				
Mean		17 28 33.88	17 29 46.36	17 39 1.99
Red'n to				
m	B b	+ .29	+ .16	+ .45
n. tan. $\delta$	A a	- 4.22	+ 7.51	- 18.22
c. sec. $\delta$		- .75	- .47	- 1.27
r				
T		17 28 29.20	17 29 53.56	17 38 42.95
a		17 27 31.16	17 28 55.54	17 37 44.62
$\Delta T$		58.04	58.02	58.33

Level read  
b = +.18



## Coast Survey Transit No. 5

Date	1870	Aug. 17		
Observer	E. P. A.			
Illumin'n	W.			
Star	$\omega$ Drac.	$\mu$ Herculis	$\gamma$ Drac. pr.	
Mag.	69° 49'	27° 48'	72° 13'	
$\delta$	Tully F	Tully D	Tully D	
Wire	a			
"	b			
"	c			
"	1	17 40 11.9	17 42 11.2	17 45 20.4
"	2	18.7	14.2	29.2
"	3	26.7	17.2	37.9
"	4	33.8	20.0	46.3
"	5	41.0	23.0	54.9
"		132.1	85.6	188.7
"	d	17 40 26.42	17 42 17.12	17 45 37.74
"	e			
"	f	- 86.95	- .05	- .13
Sum				
Mean		17 38 59.47	17 42 47.07	17 45 37.61
Red'n to				
m	Bh	+ .42	+ .19	+ .48
n. tan. $\delta$	Aa	- 18.22	+ 4.21	- 24.08
c. sec. $\delta$		+ 1.19	+ .49	+ 1.44
r				
T		17 38 42.86	17 42 21.96	17 45 15.42
a		17 37 44.62	17 41 23.82	17 44 17.25
$\Delta T$		- 58.14	58.14	58.17

Secret read  
 $b = + .17$



## C.S. Transit No. 5 East Transit

Date	1870	Aug. 17		
Observer		E. P. A.		
Illumin'n		W.	E.	
Star		$\gamma^2$ Sagittarii	$\eta$ Serpentis	1 Aquilae
Mag.		30° 25' S.	2° 56' S.	8° 20' S.
$\delta$		Tally D		
Wire	a			
"	b			
"	c			
"	1	17 58 4.8	18 15 26.9	18 28 59.8
"	2	7.7	30.5	29 3.7
"	3	11.0	34.0	7.2
"	4	14.0	37.8	11.0
"	5	16.8	41.4	14.6
"		54.3		
"	d	17 58 10.86		
"	e			
"	f	- .05		
Sum			170.6	36.3
Mean		17 58 10.81	18 15 34.12	18 29 7.26
Red'n to				
m	Bb	+ .06		
n. tan $\delta$	Aa	+ 16.39	n(tan $\delta$ - tan $\delta$ ) = .57	- .62
c. sec. $\delta$		+ .50	+ .34	+ .34
$\tau$				
T		17 58 27.76	<sup>T-bsecg</sup> 18 15 33.89	18 29 6.98
a		17 57 29.59	18 14 36.17	18 28 9.86
$\Delta T$		- 58.17	$\Delta T + bsecg$ - 57.12	57.12

Aug. 17 1870. Coast Survey Transit No. 5

c' from  $\omega$  Drac. (Lamp E) - .46 (Lamp West) + .43  
 a from  $\psi$  Drac. and  $\gamma^2$  Sagittarii + 14.79

Clock fast at 17<sup>h</sup> 37<sup>m</sup> (mean of 44 Oph.,  $\beta$  Drac.,  $\alpha$  Oph.,  $\mu$  Herc.,  $\psi$  Drac.,  $\gamma^2$  Sag.)  
 58<sup>s</sup> 10



# East Transit

Date	1870	Aug. 17			
Observer		E. P. A.			
Illumin'n		E.			
Star		$\alpha$ Lyrae	$\beta$ Lyrae	$\sigma$ Sagittarii	
Mag.					
$\delta$		$38^{\circ} 40'$	$33^{\circ} 13'$	$26^{\circ} 27' S.$	
Wire	a				
"	b				
"	c				
"	1	18 33 21.4	18 46 6.8	18 48 3.8	
"	2	26.1	11.0	8.0	
"	3	30.8	15.6	11.9	
"	4	35.3	19.8	16.1	
"	5	39.9	24.1	20.0	
"	d				
"	e				
"	f				
Sum		153.5	77.3	59.8	
Mean		18 33 30.70	18 46 15.46	18 48 14.96	
Red'n to					
m					
n ( $\tan. \delta - \tan \varphi$ )		-.07	-.15	-.83	
c. sec. $\delta$		+ .44	+ .41	+ .38	
r					
T - bsec $\varphi$		18 33 31.07	18 46 15.72	18 48 11.51	
a		18 32 34.07	18 45 18.70	18 47 14.49	
$\Delta T + bsec \varphi$		- 57.00	57.02	57.02	

Aug. 17 1870. East Transit. Illum. East { Level read  
 c assumed as on Aug. 6 +.34 { b = +0.767  
 n from E. Mrs. Mein. Gr. 966 +.59 { obj. glass N.  
 bsec  $\varphi$  = +1.04  
 $\Delta T + bsec \varphi$  (mean of  $\eta$  Serp., 1 Aquil.,  $\alpha$  Lyrae,  $\beta$  Lyrae,  $\sigma$  Sag.) - 57.06  
 Clock fast (at 18<sup>h</sup> 34<sup>m</sup>) 58<sup>s</sup>.10



## Meridian Circle

Date	1870	Aug. 18			
Observer		E. P. A.			
Illumin'n		W.			
Star		$\zeta$ Aquilae	$\delta$ Sagittarii	$\delta$ Draconis	
Mag.		13° 41'	19° 11' S.	67° 26'	
$\delta$					
Wire	a				
"	b	C 1	19 0 14.1	19 10 49.4	
"	c	2	16.8	52.0	
"		3	19.2	54.7	19 13 14.6
"	1	4	21.8	57.3	20.7
"	2				
"	3	D	26.8	11 2.6	33.6
"	4				
"	5	E 1	32.0	7.7	
"		2	34.6	10.4	
"	d	3	37.0	12.9	
"	e	4	39.5	15.6	
"	f				
Sum			241.8	22.6	68.9
Mean			19 0 26.87	19 11 2.51	19 13 22.97
Red'n to	D		+ .01	+ .01	+ 10.72
m					
n (tan. $\delta$ - tan $\varphi$ )			+ .32	+ .60	- .72
c. sec. $\delta$			+ .03	+ .03	+ .08
$\tau$					
T - bsec $\varphi$		19 0 27.23	19 11 3.15	19 13 33.05	
a		18 59 27.96	19 10 3.86	19 12 33.98	
$\Delta T + bsec \varphi$		- 59.27	59.29	59.07	

Aug. 18 1870 Meridian Circle.  $c' = +.03$   
 $n$  from  $\epsilon$  Draconis 3 Mrs. May.  $-.48$   
 $a = b \tan \varphi - n \sec \varphi = +0.58 = +8".7$   
 $\Delta T + bsec \varphi$  (mean of  $\zeta$  Aquil.,  $\delta$  Sag.,  $\kappa$  Aquil.,  $\gamma$  Aquil.,  $\tau$  Aquil.)  $- 59.28$   
 $b \sec \varphi = 1".1 = -0.073$   $bsec \varphi = -(0.073 \times 1.354) = -.10$   
 Clock fast (at 19<sup>h</sup> 28<sup>m</sup>)  $59^s.18$



# Meridian Circle

Date 1870 Aug 18  
 Observer E. P. A.  
 Illumin'n W.  
 Star  $\kappa$  Aquilae  $\gamma$  Aquilae  $\epsilon$  Draconis  
 Mag.  $7^{\circ} 19' S.$   $10^{\circ} 18'$   $69^{\circ} 56'$   
 $\delta$

Wire	a								
"	b	C 1	19	30	42.3	19	40	53.0	19 49 3.2
"	c	2			44.8			55.7	10.7
"		3			47.2			58.2	17.9
"	d	4			49.8		41	0.6	24.8
"	e								
"	f	D			54.6			5.5	39.4
"	g								
"	h	E 1			59.7			10.7	53.9
"	i	2		31	2.1			13.3	50 1.0
"	j	3			4.7			15.8	7.8
"	k	4			7.1			18.2	15.3
"	l								

Sum				492.3				51.0	354.0
Mean			19	30	54.70		19	41	5.67
Red'n to	D				+ .01			+ .01	+ .03
m									
n. (tan. $\delta$ - tan $\phi$ )					+ .50			+ .35	- .88
c. sec. $\delta$					+ .03			+ .03	+ .09

T - b sec $\phi$		19	30	55.24		19	41	6.06	19 49 38.57
a		19	29	55.92		19	40	6.81	19 48 39.47
$\Delta T + b \sec \phi$				- 59.32				59.25	59.10

## Meridian Circle

Date 1870 Aug. 18  
 Observer E. P. A.  
 Illumin'n W.  
 Star  $\tau$  Aquilae 3 Mrs. May, L.C.  
 Mag.  $6^{\circ} 55'$   $68^{\circ} 51'$   
 $\delta$

Wire	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z



# Meridian Circle

Date	1870 Aug. 19	Aug. 24	
Observer	A.S.	E.P.A.	
Illumin'n	W.	W.	
Star	J.Y.C. 1879	5 <sup>2</sup> Urs. Maj. L.C.	1 Aquilae
Mag.	80° 4'	67° 39'	8° 20' S.
δ			
Wire	a		
"	b	C 1	21 0 24.0
"	c	2	17.3
"	d	3	29 53 50.4
"	e	4	54 5.0
"	f		5.0 18 29 9.4
"	g	D	33.8
"	h	29 59 51.6	14.2
"	i	E 1	58 2.2
"	j	2	16.0
"	k	3	30.8
"	l	4	45.0
"	m		38.5
"	n		32.0
"	o		25.6
"	p		18.8
"	q		19.1
"	r		22.0
"	s		24.3
"	t		26.7
Sum	363.2	464.0	115.7
Mean	29 54 51.89	29 59 51.56	18 29 19.28
Red'n to	D	- 18.41	- .02
m			- 5.01
n (tan. δ - tan φ)	- 2.40	+ 1.67	+ .53
c. sec. δ	.00	.00	
τ			
T - b sec φ	29 54 31.08	29 59 53.21	18 29 14.80
a	29 53 31.17	8 58 53.30	18 28 9.78
Δ T + b sec φ	- 59.91	- 59.91	- 1 5.02

Aug. 19 1870 Wire adjusted to  
correct collimation

$$n = -.50$$



## Meridian Circle

Date	1870	Aug. 24			
Observer		E. P. A.			
Illumin'n		W.			
Star		$\beta$ Lyrae	$\zeta$ Aquilae	$\gamma$ Aquilae	
Mag.		33° 13'	13° 41'	10° 18'	
$\delta$					
Wire	a				
"	b	C 1	19 0 19.7	19 40 58.7	
"	c	2 18 46 11.6	22.5	41 1.3	
"		3	24.8	3.9	
"	d	4	27.5	6.4	
"	e				
"	f				
"	g	D	23.5	11.4	
"	h				
"	i	E 1	29.5	16.4	
"	j	2	32.4	18.9	
"	k	3	35.3	21.6	
"	l	4	38.0	24.0	
"	m				
Sum		20 2.2	292.8	102.6	
Mean		18 46 25.28	19 0 32.53	19 41 11.40	
Red'n to	D	- 1.69	+ .01	+ .01	
m					
n	( $\tan. \delta - \tan \varphi$ )	+ .13	+ .33	+ .36	
c. sec. $\delta$					
r					
T - b sec $\varphi$		18 46 23.72	19 0 32.87	19 41 11.77	
a		18 45 18.59	18 59 27.90	19 40 6.78	
$\Delta T + b \sec \varphi$		- 1 5.13	1 4.97	1 4.99	

Aug. 24 1870 Meridian Circle.

c assumed 0.00 n assumed -.50  
 $\Delta T + b \sec \varphi$  (mean of  $\gamma$  Aquilae,  $\beta$  Lyrae,  $\zeta$  Aquilae,  $\gamma$  Aquilae) - 65.03  
 $b \sec \varphi$  (level read Aug. 24, 23<sup>h</sup> mean time) + .13  
 Clock fast at 19<sup>h</sup> 0<sup>m</sup> 65.16



## Meridian Circle.

Date	1870	Aug. 26					
Observer		E. P. A.					
Illumin'n		W.					
Star		$\delta$ Urs. Min.	$\alpha$ Lyrae	$\beta$ Lyrae			
Mag.		$86^{\circ} 37'$	$38^{\circ} 40'$	$33^{\circ} 13'$			
$\delta$							
Wire	a						
"	b	C 1	18 12 4.5	18 33 24.6	18 46 10.4		
"	c	2	47.0	27.9	13.6		
"		3	13 27.4	31.0	16.2		
"	1	4	14 9.8	34.0	19.4		
"	2						
"	3	D		40.3	25.0		
"	4						
"	5	E 1	16 57.4	46.7	31.0		
"		2	17 37.8	50.0	34.0		
"	d	3	18 19.0	53.7	36.7		
"	e	4	19 2.9	56.4	39.9		
"	f						
Sum			265.8	364.6	226.2		
Mean			18 15 33.22	18 33 40.51	18 46 25.13		
Red'n to	D		+ .19	+ .01	+ .01		
m							
n. (tan. $\delta$ - tan $\phi$ )			- 4.79	+ .03	+ .08		
c. sec. $\delta$							
$\tau$							
T - $b \sec \phi$			18 15 28.62	18 33 40.55	18 46 25.22		
a			18 14 21.27	18 32 33.89	18 45 18.56		
$\Delta T + b \sec \phi$			- 1 7.35	1 6.66	1 6.66		

Aug. 26 1870 Meridian Circle.

$c$  assumed 0.00  $n$  assumed -.30  
 $b \sec \phi$  assumed +.13

Clock fast at  $18^h 40^m$ 

66.79

collimation found to be -.15 after observations  
 but this is supposed to be due to farring caused by closing up  
 cube of axis after the above transits



# East Transit.

Date	1870	Sept. 4			
Observer		A. S.			
Illumin'n		E.			
Star		$\pi$ Capricorni	$\epsilon$ Delphini	Gr. 3241	
Mag.		18° 38' S.	10° 52'	72° 6'	
$\delta$					
Wire	a				
"	b				
"	c				
"	1	20 21 1.8	20 28 9.3	20 31 24.6	
"	2	6.0	13.0	36.7	
"	3	9.8	16.8	48.3	
"	4	13.7	20.5	59.9	
"	5	17.4	24.1	32 12.0	
"	d				
"	e				
"	f				
Sum		48.7	83.7	241.5	
Mean		20 21 9.74	20 28 16.74	20 31 48.30	
Red'n to					
m					
n (tan. $\delta$ - tan $\phi$ )		-.83	-.45	+1.45	
c. sec. $\delta$		+1.36	+1.35	+1.11	
$\tau$					
T - bsec $\phi$		20 21 9.27	20 28 16.64	20 31 50.86	
a		20 19 54.95	20 27 2.20	20 30 36.55	
$\Delta T + bsec \phi$		- 14.32	1 14.44	1 14.31	

Sept. 4 1870 c' assumed + .34  
 n from  $\pi$  Capr. ) Gr. 3241 + .67

$\Delta T + bsec \phi$  = - 14.40  
 Level observed; bsec  $\phi$  = + 1.13

clock fast (at 20<sup>h</sup> 1<sup>m</sup>) 75.53

Immersion of a star 5 or 6 mag. (observed with W. Equatorial)  
 opposite crater Cassendi at 8<sup>h</sup> 54<sup>m</sup> 28<sup>s</sup> by chron. H. 301

Chron. fast of Camb. mean time 8<sup>h</sup> 53<sup>m</sup> 59.2<sup>s</sup>  
 Camb. time of immersion 8<sup>h</sup> 53<sup>m</sup> 29.5<sup>s</sup>



## Meridian Circle.

Date 1870 Sept. 6

Observer E. P. A.

Illumin'n W.

Star 50 Draconis { Aquilae Pi. VII 67

Mag. 75° 17' 13° 41' 68° 43'

Wire	a						
"	b	C 1		19 0	32.1	19 19	10.1
"	c	2			34.8		3.3
"	d	3			37.5	18	56.6
"	e	4			39.9		49.7
"	f						
"	g						
"	h	D	18 51	53.6	45.0		35.5
"	i						
"	j	E 1	52	13.3	50.0		22.1
"	k	2		23.2	52.6		16.0
"	l	3		32.7	55.1		8.6
"	m	4		42.6	57.9	18	1.7
"	n						
"	o						

Sum 405.4 404.9 323.6  
 Mean 18 51 81.08 19 0 44.99 19 18 35.96

Red'n to D - 27.24 +.01 -.03  
 m  
 n. tan.  $\delta$  - 1.45 -.09 +.98  
 c. sec.  $\delta$  - .25 -.06 +.18

T - m 18 51 52.14 19 0 44.85 19 18 37.09  
 a 18 50 35.00 18 59 27.73 7 17 19.97  
 $\Delta T + m$  - 1 17.14 1 17.12 1 17.12

Sept. 6 1870 Meridian Circle  
 c observed -.064 n from 50 Draconis { Pi. VII 67 -.38

$\Delta T + m$  (mean of  $\delta, \kappa, \gamma, \alpha$  Aquilae) - 1<sup>m</sup> 17<sup>s</sup>.10

Level could not be observed Sept. 6 (astr.) in the forenoon for want of small level to serve as a cross level. The small level could not be found. Assuming  $b_{\text{sec}} = +.13$  as Aug. 24,  $m = +.38$

and clock fast (at 19<sup>h</sup> 32<sup>m</sup>) 1<sup>m</sup> 17<sup>s</sup>.48

Immersion of  $\eta$  Capricorni observed with W. Equatorial and  
 chronometer H. 298 at 20<sup>h</sup> 48<sup>m</sup> 39<sup>s</sup>.5

Chronometer fast 15.1  
 Cambridge sidereal time of immersion 20<sup>h</sup> 48<sup>m</sup> 24<sup>s</sup>.4  
 Emission looked for but seeing was not good enough for stars to be detected



# Meridian Circle

Date 1870 Sept. 6  
 Observer E. P. A.  
 Illumin'n W.  
 Star  $\alpha$  Aquilae  $\gamma$  Aquilae  $\epsilon$  Aquilae  
 Mag.  $7^{\circ} 19' S.$   $10^{\circ} 48'$   $8^{\circ} 32'$   
 $\delta$

Wire	a						
"	b	C 1		19	41	11.1	19 45 32.9
"	c	2				13.9	35.3
"		3	19 31	5.4		16.4	38.0
"	1	4		8.0		18.9	40.6
"	2						
"	3	D		12.9		23.8	45.5
"	4						
"	5	E 1		17.9		28.8	50.6
"		2				31.3	53.0
"	d	3		22.9		33.9	55.8
"	e	4		25.4		36.1	58.1
"	f						

Sum 92.5 214.2 409.8  
 Mean 19 31 15.42 19 41 23.80 19 45 45.53

Red'n to D - 2.49 + .01 + .01  
 m  
 n. tan.  $\delta$  + .05 - .07 - .06  
 c. sec.  $\delta$  - .06 - .07 - .06

$\tau$   
 T - m 19 31 12.92 19 41 23.67 19 45 45.42  
 a 19 29 55.74 19 40 6.63 19 44 28.34  
 $\Delta T + m$  - 17.18 1 17.04 1 17.08



# Meridian Circle

Date 1870 Sept. 15

Observer E. P. A.

Illumin'n W.

Star  $\alpha$  Aquarii 32 Urs. Maj.  $\pi$  Aquarii

$\delta$

Wire	a										
"	b	C 1	22	0	20.9	22	10	26.3	22	19	52.9
"	c	2			23.7			19.9			55.3
		3			25.9			14.4			57.8
"	d	4			28.3		10	8.3		20	0.2
"	e										
"	f	D			33.2		9	56.3			5.1
"	g										
"	h	E 1			38.3			144.3			10.1
"	i	2			40.6			38.4			12.8
"	j	3			43.1			32.1			15.1
"	k	4			45.8			26.0			17.7
"	l										

Sum					299.8			506.0			47.0
Mean					33.31			56.22			5.22

Red'n to	D				+ .01			- .02			+ .01
m											
n (tan. $\delta$ )	$\tan \phi$				+ .44			+ 1.47			+ .42
c. sec. $\delta$					.00			.00			.00

T - bsec $\phi$	22	0	33.76	22	9	57.67	22	20	5.65
a	21	59	8.68	10	8	32.39	22	18	40.59
$\Delta T + bsec \phi$	-	1	25.08		1	25.28		1	25.06

Sept. 15, 1870. Meridian Circle.  
 $c = +.011$  by collimators.  
 $c'$  should be 0.00

$n$  from circumpolars - .47

$\Delta T + bsec \phi$  (mean of  $\alpha$  Aquarii,  $\pi$  Aquarii,  $\zeta$  Peg.,  $\alpha$  Per. Aust.) - 85.09  
 $bsec \phi$  by level readings 12' after observations + 0.47  
Clock fast at 22<sup>h</sup> 27<sup>m</sup> 85<sup>s</sup> 56



## Meridian Circle

Date 1870 Sept. 15  
 Observer E. P. A.  
 Illumin'n W.  
 Star  $\gamma$  Draconis 226 Cep.  $\zeta$  Pegasi  
 Mag.  
 $\delta$

Wire	a											
"	b	C	1	22	26	10.4	22	30	41.2	22	36	13.2
"	c		2		25	59.4			51.7			15.9
"			3			49.1		31	1.0			18.2
"	1		4			38.3			11.1			21.0
"	2											
"	3	D				17.4			30.9			25.9
"	4											
"	5	E	1		24	56.4			51.0			30.9
"			2			46.1		32	0.5			33.2
"	d		3			35.7			10.7			36.0
"	e		4			25.0			20.5			38.3
"	f											

Sum 157.8 278.6 232.6  
 Mean 22 25 17.53 22 31 30.96 22 36 25.84

Red'n to D - .04 + .04 + .01  
 m  
 n (tan.  $\delta$  - tan.  $\phi$ ) + 2.37 - 1.42 + .34  
 c. sec.  $\delta$  .00 .00 .00

$\tau$   
 T - b sec  $\phi$  22 25 19.86 22 31 29.58 22 36 26.19  
 a 10 23 54.93 22 30 4.64 22 35 1.06  
 $\Delta T + b \sec \phi$  -1 24.93 -1 24.94 -1 25.13



# Meridian Circle

Date *1870 Sept. 15*  
 Observer *E. P. A.*  
 Illumin'n *W.*  
 Star  *$\epsilon$  Cephei & Pisc. Aust.*  
 Mag.  
 $\delta$

Wire	a					
"	b	<b>C</b>	1	22 46	3.3	22 51 40.5
"	c		2		9.6	43.4
"			3		15.2	46.1
"	1		4		21.1	49.0
"	2					
"	3	<b>D</b>			33.2	54.8
"	4					
"	5	<b>E</b>	1		45.0	52 0.4
"			2		51.0	3.4
"	d		3		56.9	6.1
"	e		4	47	3.1	9.0
"	f					

Sum *298.4*  
 Mean *22 46 33.16 22 51 54.74*

Red'n to **D** *+0.02*  
 m *+0.01*  
 n ( $\tan. \delta - \tan \phi$ ) *-0.60*  
 c. sec.  $\delta$  *+0.70*  
*.00*

$T - b \sec \phi$  *22 46 32.58 22 51 55.45*  
 a *22 45 7.43 22 50 30.36*  
 $\Delta T + b \sec \phi$  *-1 25.15 1 25.09*

## Meridian Circle

Date	1870	Sept. 18								
Observer		A. S.								
Illumin'n		W.								
Star		Polaris		$\alpha$ Drac. I.C.		$\epsilon$ Cass.				
Mag.		$88^{\circ} 37'$		$65^{\circ} 0'$		$66^{\circ} 49'$				
$\delta$										
Wire	a									
"	b	C 1		2	2	57.6	2	19	12.1	
"	c	2				51.5			18.0	
"		3				46.0			24.6	
"	1	4	1	10	36.0	40.2			30.8	
"	2									
"	3	D	1	14	1.4	28.3			43.3	
"	4									
"	5	E 1				16.4			55.9	
"		2				10.6	20		2.1	
"	d	3				4.5			8.2	
"	e	4				58.6			14.7	
"	f									
$C_4$ reduced to D		1	13	59.0						
Sum				0.4		253.7			389.7	
Mean		1	14	0.20	2	2	28.49	2	19	43.30
Red'n to										
m										
n. tan. $\delta$										
c. sec. $\delta$						- 9.72			+ 12.47	
$\tau$										
T										
a		1	12	18.55	14	0	50.24	2	18	27.73
$\Delta T$										

Micrometer (unless read wrong) at  $30^{\circ} 6' 45''$  during observations of  $\alpha$  Drac. and  $\epsilon$  Cass. Previous setting of micrometer remained during observation of Polaris.  $c$  for  $\alpha$  Drac. &  $\epsilon$  Cass.  $+ 4.91$  but this was agreed with probable azimuth error.



## Meridian Circle

Date 1870 Sept. 19

Observer E. P. A.

Illumin'n W.

Star  $\gamma$  Aquilae & Draconis & Aquilae

Mag.

 $\delta$ 

Wire

a

"	b	C 1	19	41	22.1	19	49	31.0		
"	c	2			24.8			38.7		
"	d	3			27.2			45.5		
"	e	4			29.9			52.5		
"	f									
"	g	D			34.9	50	7.1	19	59	17.5
"	h									
"	i	E 1			39.7			21.3		22.4
"	j	2			42.2			29.0		24.9
"	k	3			44.9			36.0		27.4
"	l	4			47.3			43.6		29.8

Sum

Mean

343.0 64.7 122.0  
 19 41 34.77 19 50 7.19 19 59 24.40

Red'n to D

m

n (tan.  $\delta$  - tan.  $\phi$ )c. sec.  $\delta$ 

+ .27

- .68

+ .29

r

T - bsec  $\phi$  19 41 35.04 19 50 6.51 19 59 17.72

a

19 40 6.45 19 48 37.90 19 57 49.15

 $\Delta T + bsec \phi$  - 1 28.59 1 28.61 1 28.57

Sept. 19, 1870  
 c by collimators + .011  
 Diurnal aberration considered to balance collimation & reduction to D.  
 n estimated - .37

 $\Delta T + bsec \phi$  (mean of  $\gamma$  Aquilae,  $\tau$  Aquil.,  $2^2$  Capri.,  $\pi$  Capri.) - 88.59bsec  $\phi$  as determined Sept. 15 + .47Clock fast at 20<sup>h</sup> 0<sup>m</sup>

89.06

Date

1870 Sept. 19

Observer

Illumin'n

Star

Mag.

 $\delta$  $\alpha$  Capri.  $\pi$  Capri.  $\sigma^2$  Urs. Major.

Wire

a

"	b	C <sub>1</sub>	20	12	7.9	20	21	9.9	21	0	54.6
"	c	2						12.6			47.9
"		3			13.0			15.0			41.6
"	d	4			15.5			17.7			35.1
"	e										
"	f										
"	g	D			20.7			22.9			22.1
"	h										
"	i										
"	j	E <sub>1</sub>			25.8			28.0			9.2
"	k	2			28.2			30.6			12.8
"	l	3			30.8			33.3	20	59	56.1
"	m	4			33.2			36.2			50.0
"	n										

Sum

Mean

175.1      206.2      199.4  
 20 12 21.89    20 21 22.91    21 0 22.16

Red'n to

D

- 1.25

m

n. (tan.  $\delta$  - tan  $\varphi$ )

+ .42

+ .46

+ 1.16

c. sec.  $\delta$ 

r

T - 6 sec  $\varphi$     20 12 21.06    20 21 23.37    21 0 23.32

a                    20 10 52.49    20 19 54.79    8 58 54.58

$\Delta T$  + 6 sec  $\varphi$     - 1 28.57            1 28.58            1 28.74



Date	Sept 20																	
Observer	E. J. West																	
Illumin'n																		
Star	$\pi$ Capricorn $\sigma^2$ Urs Maj & Cephei																	
Mag.																		
$\delta$																		
Wire	a	h m s																
"	b	20	21	11.1	24	0	57.0	21	16	34.1								
"	c			13.9			50.1			39.8								
				16.6			43.8			44.9								
"	1			19.2			37.3			50.3								
"	2																	
"	3			24.5			24.5	17		0.7								
"	4																	
"	5			29.7			11.0			11.2								
				32.3	21	0	5.0			16.7								
"	d			34.9			58.4			22.0								
"	e			37.4	20	59	51.6			27.2								
"	f																	
Sum				21 96			33 87			24 6.9								
Mean		20	21	24 40	21	0	24.30	21	17	0.77								
Red'n to																		
m																		
n(tan. $\delta$ - $\frac{1}{2}\phi$ )			- 05				- 13		+ 4									
c. sec. $\delta$																		
$r$																		
T																		
a	20 19 54.77 8 58 54.63 21 15 31.34																	
$\Delta T + \bar{m}$	- 1 29 54 - 1 29 54 - 1 29 47																	

$$n = +0.04$$

Date	1970	Sept 20		
Observer	E. P. A.			
Illumin'n	West			
Star	3 Aquarii      ε Pegasi      μ Capricorn			
Mag.				
δ				
Wire	a			
"	b	21 32 9.0	21 39 7.3	21 47 31.8
"	c	11.7	9.9	34.2
		14.0	12.2	36.7
"	1	16.7	14.9	39.2
"	2			
"	3	21.8	19.8	44.3
"	4			
"	5	26.8	24.8	49.4
		29.0	27.4	52.0
"	d	31.5	30.0	54.4
"	e	34.1	32.3	57.0
"	f			
Sum		1946	1786	399.0
Mean		21 32 21.62	21 39 19.84	21 47 44.33
Red'n to				
m				
n. tan. δ		- 4	- 3	- 5
c. sec. δ				
τ				
T				
a		21 30 52.03	21 37 40.30	21 46 14.73
		- 1 29 55	- 1 29 51	- 1 29 55
Δ T				



Date			
Observer			
Illumin'n			
Star	79 Dracanis		
Mag.			
$\delta$			
Wire	a		
"	b	21 52	6.1
"	c		14.9
			23.3
"	1		31.7
"	2		
"	3		49.0
"	4		
"	5	53	5.6
			14.3
"	d		23.0
"	e		31.7
"	f		
Sum			199.6
Mean	21 52		48.84
Red'n to			
m			
n. tan. $\delta$			+9
c. sec. $\delta$			
$\tau$			
T			
a	21 57	19.32	
$\Delta T$	-1	29.61	

## Meridian Circle

Date	Sept 26.					
Observer	E. P. A.					
Illumin'n	W.					
Star	$\alpha$ Ophiuchi, $\mu$ Herculis, $\gamma$ Draconis					
Mag.						
$\delta$						
Wire	a					
"	b	18.30.16.5	42.43.1	54.49.9		
"	c	19.0	46.1	54.1		
		21.6	48.9	58.0		
"	1	24.0	51.6	55.2.0		
"	2			+0.4		
"	3	29.1	57.3	10.0+8.4		
"	4					
"	5	34.2	43.02.9	18.0		
		36.9	5.8	21.9		
"	d	39.3	8.5	25.7		
"	e	42.0	11.3	30.0		
"	f					
Sum		262.6	275.5	269.6		
Mean		17 30 29.18	17 42 57.28	17 55 9.96		
Red'n to						
m						
n. tan. $\delta$	-69	-03	-38	-02	+03.4	+01
c. sec. $\delta$	+102		+113		+160	
$\tau$						
T		29.15	57.26	99.7		
a		17 28 54.85	17 41 22.99	17 53 35.75		
$\Delta T$		- 1 34.30	34.27	34.22		



# Meridian circle.

Date					
Observer					
Illumin'n					
Star	γ <sup>2</sup> Sagittarii ii Sagittarii 5 Urs. Min.				
Mag.					
δ					
Wire	a				
"	b	58.49.0	18. 7.	21. 9	12. 12. 2
"	c	51.8		24.5	55. 6
"		54.7		27.1	13. 36. 9
"	1	57.5		29.7	14. 18. 9
"	2			3.	
"	3	59.03.2		35.1	15. 42. 7
"	4	"			
"	5	9.0		40.4	lost
"		11.9		43.0	17. 47. 2
"	d	14.8		45.8	18. 29. 5
"	e	17.8		48.4	19. 11. 9
"	f				
Sum		<sup>24</sup> 269.7		315.9	236.0
Mean		17 59 3.30	18 7	38 10	18 15 42.28
Red'n to					
m					
n. tan. δ	-150	- 06 -130		-05 +15.97	+ 65
c. sec. δ	+116	+107		+16 91	
r					
T		324		35.05	42.94
a		17 57 28.88	18 6	0.71	18 14 8.64
Δ T		34.36		<sup>4</sup> 34.34	34.30

## Russian Transit Instrument

Date		Sept 26	26	26
Observer		E. P. A.	E	E.
Illumin'n		E.	E	E.
Star		$\alpha$ Cygni	$\delta$ Cygni	$\gamma$ Cephei
Mag.		1.2	3	3.4
$\delta$		$44^{\circ}.49'$	$33.29$	$61.15$
Wire	a	20.37 10.8	41.20.7?	44.48.1
"	b	32.0	39.0	45.17.3
"	c	49.3	53.6	27.0
"	1		42 4.8	
"	2	38 14.9	15.4	
"	3	37.1	34.0	
"	4	58.9	52.7	44.48.1
"	5		43.39	45.07.3
"	d		15.0	27.0
"	e	39.42.7	29.7	45.52.5
"	f	40.04.1	48.0	
Sum				74.9
Mean		38.31.23	42.34.25	45.18.73
Red'n to	middle wire	+5.84	-1.14	
m	Bb	-18		
n tan. $\delta$	Ca	+32		
c sec. $\delta$	Cc	-35		
r				
T		20 36 36.56		
a		20.37.01.91		
$\Delta T$		- 1 34.65		

— 0<sup>s</sup> 246



## Russian Transit Instrument.

Date	26	26	26
Observer	E. P. A.	E	E
Illumin'n	E	E	E
Star	$\alpha$ Aquarii.	12 $\beta$ . b. 1879.	$\sigma^2$ Mus Maj. Lib.
Mag.	5.4	6.	5.
$\delta$	-9.28	80.04	67.40
Wire	a		
"	b	20. 50. 36.6	20. 58. 26.7
"	c	51. 47.2	59. 00.1
"	1	52. 41.1	59 24.4
"	2	20.46. 59.64	53. 32.8
"	3	47. 15.7	55. 03.8
"	4	31. 5	21. 00. 29.6
"	5	41.0	56. 33.8
"	d	50.1	1. 11.2
"	e	48. 2.7	1. 35.0
"	f		1 58.8.
Sum		27.430	553
Mean	47 33.43	53.57.57	21. 0.14.41
Red'n to middle wire.	-17.76	+ 1 6.09	+ 15.39
m	(38) -00.08	-59-59	+12+12
n. tan. $\delta$	-21	+95	- .66
c. sec. $\delta$	-25	-1.42	+65
r			
T	47 15.13	55 26.0	21 0 29.91
a	20.45.40.42	20.53.28.10	8.58.54.96
$\Delta T$	-1 34.71	-1 34.50	-1 34.95

$$\Delta t = -1 34.58 \text{ at } 21^h 60^m = 0.900^d$$

$$\text{Ill } E \quad C = -5.246$$

$$a = -269$$

$$\text{Ill } W \quad C = +5.246$$

$$a = -464$$

## Russian Transit

Date	Sept 26.		
Observer	E. P. A.		
Illumin'n	E	E.	E.
Star	61 Cygni.	61 <sup>2</sup> Cygni.	$\gamma$ Equulei.
Mag.	5.6	5.6	5.
$\delta$	38.07	38.07	9.37
Wire a			
" b			
" c			
" 1			5. 22.3
" 2			38.3
" 3			54.1
" 4			6. 03.7
" 5	3. 13.3	3. 14.6	12.7
" d	24.8	26.3	25.6
" e	40.4	42.4	
" f	4. 0.3	4. 01.8	
Sum			
Mean	3. 34.70	3. 26.28	5. 56.12
Red'n to	-53.09		
m	38. -46.16		
n. tan. $\delta$	-3		
c. sec. $\delta$	-31		
$\tau$			
T	2 41.11		
a	21. 01.06.60.		
$\Delta T$	-1 34.51		



## Instrument

Date	Sept 26.		
Observer	E. P. A.		
Illumin'n	E.	W	W
Star	$\zeta$ Cygni.	$\alpha$ Cephei.	$\gamma$ Aquarii.
Mag.	3.	3.2	3.
$\delta$	29.42	62.2	-2.8
Wire	a	1	
"	b		
"	c	15. 52.0	22. 15. 46.9
"	1	16 11.6	3 59.4
"	2	32.0	16 8.7
"	3	17 5.0	17.9
"	4	38.3	23.5
"	5	57.2	49.0
"	d	18. 17.2	58.0
"	e		17. 7.3
"	f		
Sum			
Mean	8. 47.57	21. 17. 4.76	22. 16. 26.34
Red'n to	+ 13.67	+ 0.10	
m	<del>-14</del> -14	<del>-20</del> -20	
n. tan. $\delta$	-7	+ 33	
c. sec. $\delta$	-28	+ 52	
r			
T	9 075	17 5.51	
a	21. 7. 26.30	21. 15. 31.14	
$\Delta T$	-1 34.45	-1 34.37	

## Russian Transit

Date	Sept 26.		
Observer	E. P. A.		
Illumin'n	W	W	W
Star	$\pi$ Aquarii	$\eta$ Draconis	226 Cephei.
Mag.	5.4	5.4, L.L.	5.6
$\delta$	0.43	76.23	75.33
Wire	a		
"	b	22.14.8	
"	c	23.07.8	
"	1	23.46.5	29.58.0
"	2	24.24.5	30.35.2
"	3	25.31.0	31.38.2
"	4	26.37.0	-32.40.3
"	5	27.17.0	33.16.6
"	d	27.55.5	33.53.0
"	e		
"	f		
Sum		234.1	
Mean	20.15.11	25.00.76	32.00.22
Red'n to	+0.05	+24.34	-22.82
m	-07	+23	-47.44
n. tan. $\delta$	-31	-173	+102
c. sec. $\delta$	+25	-104	+99
r			
T	20 15.03	25 28.56	31 38.97
a	22.18.40.55	10.23.55.47	22.30.4.27
$\Delta T$	-1 34.48	-1 33.09	-1 34.70



# Instrument.

Date	Sept 26.			
Observer	E. P. A.			
Illumin'n	rr	rr	rr	
Star	$\zeta$ Pegasi.	$\eta$ Pegasi	$\lambda$ Pegasi	
Mag.	3.4	3.	4.8	
$\delta$	10.09	29.32	22.53	
Wire	a			
"	b			
"	c	36. 01.3	37. 52.8	41. 16.2
"	1	10.5	38. 03.0	26.3
"	2	20.0	13.9	36.4
"	3	35.8	31.8	53.4
"	4	51.8	49.8	42 10.6
"	5	37. 00.8	59.9	19.9
"	d	10.0	39. 10.5	29.9
"	e			
"	f			
Sum		2217	372.7	
Mean	36. 35.74	38. 31.67	41. 53.24	
Red'n to	+05-			
m	<del>-12</del> -12			
n. tan. $\delta$	-25-			
c. sec. $\delta$	+25-			
r				
T	36 35.67			
a	22. 35. 01. 03			
$\Delta T$	- 1 34.64			

Date	Sept. 26.		
Observer	E. P. A.		
Illumin'n	W	W	W
Star	$\alpha$ Pegasi	$\alpha$ Cephei.	$\gamma$ Pis Aus.
Mag.	4.	4.3	1.2
$\delta$	23.55.	65.31.	-30.18
Wire	a	44. 13.2	
"	b	30.3	
"	c	43.6	51. 25.8
"	1	53.8	36.4
"	2	45. 4.0	46. 03.7
"	3	20.9	41.0
"	4		47. 19.3
"	5		40.8
"	d		48. 03.0
"	e		44.3
"	f		
Sum			
Mean	44. 47.63	47. 09.56	52. 05.20
Red'n to		- 28.27	+ 0.5
M	33.	- 35	- 06-06
$\mu$ trans. Aa		+ 44	- 51
c. sec. $\delta$		+ 59	+ 28
r			
T		46 41.97	52 49.6
a		22. 45.07.28	22. 50.30.34
$\Delta T$		- 1 34.69	- 1 34.62



## Instrument.

Date	Sept 26		
Observer	E. P. A.		
Illumin'n	W	W	E.
Star	2 Uis Maj.		
Mag.	2. L. 6.		
$\delta$	62.27	67.24	
Wire	a		
"	b		
"	c	56.01.9	
"	1	22.0	
"	2	40.8	
"	3	57.14.8	15.38.7 70
"	4	48.6	16. 2.8 8
"	5	58.8.8	16. 26.3 9
"		16. 27.4	17. 58.9 10
"		76. 55.4	
"	d	58 28.4	17. { 21.1
"	e	microm. { 32.8	{ 23.4
"	f	wires. { 30.4	
		23. 12.15.0	17. 38.9 11
Sum			
Mean	57.15.04		
Red'n to			
m	Bb.		
AAAAA	Aa		
c. sec. $\delta$			
r			
T			
a	10.55.40.80		
AT			

# Russian Transit.

Date	Sept. 26	
Observer	E. P. A.	
Illumin'n	E	W.
Star	$\gamma$ Draconis. $\lambda$ Draconis	
Mag.	3.4	L. lo.
$\delta$	70.23.	
Wire	a 1	23. 22. 10.8
"	b	micron { 27.1
"	c	wires - { 30.6
"	2	55.9
"	3	23. 31.8
"	4	58.9
"	5	
"	d	
"	e	
"	f	
Sum		
Mean		
Red'n to		
m		
n. tan. $\delta$		
c. sec. $\delta$		
r		
T		
a		
$\Delta T$		

28. 14.7  
 { 57.2  
 { 53.1  
 27. 28.4  
 2



## Instrument

Date	Sept 27.		
Observer	E. P. A.		
Illumin'n	W.	W.	W.
Star	T Aquilae & Aquilae $\theta$ Capricorni.		
Mag.	20. 11. 43.3.		
$\delta$			
Wire	a		
"	b		
"	c	20. 11. 53.3	
"	1	<del>12. 2.6</del>	
"	2	12. 2.6	
"	3	12.3	
"	4	28.2	
"	5	44.3	
"		53.2	
"	d	13 2.9	
"	e		
"	f		
Sum		196.8	
Mean		20 12 28.11	
Red'n to			+05
m	+82	+31	-01
n. tan. $\delta$	+88	+84	-41
c. sec. $\delta$	+101	1.03	+27
r			
T			12 27.97
a	19.57. 49.03	20.10.52.28	
$\Delta T$			35.69

$$\text{All W } C = +.260$$

$$u = -.487$$

$$\text{All E } C = -.260$$

$$u = -.313$$

$$1 = 5.69 \text{ at } 20 \ 11$$

$$1.60 \quad 20 \ 29$$

$$52 \quad 20 \ 37$$

$$60 \quad 20 \ 45$$

$$68 \quad 21 \ 07$$

$$\text{Sept 27. } .860$$

$$1.35.61$$

$$.860$$

# Russian Portable

1870phae.proj..340S

Date	Sept 27.		
Observer	E.P.A.		
Illumin'n	W W W		
Star	K Cephei, $\pi$ Capricorni, 41. Cygni		
Mag.			
$\delta$			
Wire	a		
"	b		
"	c		
"	1	20.54.4	
"	2	21 4.2	
"	3	14.2	
"	4	14.49.0	30.4
"	5	16. 0.8	47.0
"		41.0	56.6
"		17. 22.8	22.6.3
"	d		
"	e		
"	f		
Sum		21 3.1	
Mean		21 30.44	
Red'n to		+ 05	
m	+373	+471	-05
n. tan. $\delta$	-261	+72	-45
c. sec. $\delta$	+456	+406	+28
			-17
$\tau$		21 30.27	
T			
a	20.13.15.33	20.19.54.67	
$\Delta T$		5.30	



## Transit Instrument.

Date	Sept 27.		
Observer	E. P. A.		
Illumin'n	W W E		
Star	E Delphini Groom, 3241		
Mag.	E loygue		
$\delta$			
Wire	a		
"	b		
"	c		
"	1	28.02.8	30.18.6
"	2	12.3	49.1
"	3	21.8	31 18.7
"	4	37.5	32 10.2
"	5	53.8	33. 0.6
"	d	29.02.5	29.6
"	e	12.0	33.59.8
"	f		
Sum		142.5	126.6
Mean		28 37.50	32 9.59
Red'n to		+ 5	+ .15
m	+ 17	- 12 + 282	- 42
n. tan. $\delta$	+ 53	- 26 - 1.61	
c. sec. $\delta$	+ 1.02	+ 27 + 3.25	
r		- 16	
T		37.44	
a		20.27.01.92	20.30.35.25
$\Delta T$		25.52	

## Russian Portable

Date	Sept 27.		
Observer	E. P. A.		
Illumin'n	E E E		
Star	$\eta$ Cephei in Aquarii.		
Mag.	12 4.6.1879		
$\delta$	80.04		
Wire	a		
"	b		
"	c		
"	1	46. 42.3	51. 49.1
"	2	51.5	52. 42.8
"	3	47. 0.5	53. 34.3
"	4	16.7	55. 04.6
"	5	32.3	56. 35.2
"	d	41.9	57. 28.8
"	e	57.4	58. 22.0
"	f		
Sum		<sup>12</sup> 236.6	216.8
Mean		47 16.66	55 5.26
Red'n to		-0.05	- 27
m	+63	- 9 + 115	- 69
n. tan. $\delta$	+80	- 25 - 354	+ 1.10
c. sec. $\delta$	+101	- 26 + 5.79	- 1 50
$\tau$		65	
T		1601	
a		20.45.40.41	20.53.27.99
$\Delta T$		35.60	



## Transit Instrument.

Date	Sept. 27.		
Observer	E. P. A.		
Illumin'n	E	E	E
Star	$\alpha$ Urs. Maj.	$\beta^1$ Cygni	$\beta^2$ Cygni.
Mag.			
$\delta$			
Wire	a		
"	b		
"	c		
"	1		
"	2		
"	3		
"	4		
"	5		
"	d		
"	e		
"	f		
Sum			
Mean			
Red'n to			
m	-60	+117	
n. tan. $\delta$	+247	+109	
c. sec. $\delta$	-263	+127	
r			
T			
a	8. 58. 55.02	21. 01. 06. 58	
$\Delta T$			

## Russian Portable

Date	Sept 27.	
Observer	E. P. A.	
Illumin'n	E	E
Star	$\zeta$ Cygni. + Cygni. L. Cygni.	
Mag.		
$\delta$		
Wire	a	
"	b	
"	c	
"	1	21.08.23.5
"	2	34.1
"	3	44.3
"	4	9.02.5
"	5	20.3
"	d	30.9
"	e	41.7
"	f	
Sum		197.3
Mean	21 9	247
Red'n to		- 5
m	+12	-17
n. tan. $\delta$	+25	- 8
c. sec. $\delta$	+11	- 29
		54
	9	184
T		
a		21.07.26.25
$\Delta T$		35.63
		18.55.2
		16 14.9
		33.8
		17.07.2
		40.1
		18.00.3
		20.1
		171.6
	17	7.37
		- 10
	+20	-30
	+12	+22
	+13	- 55



## Transit Instrument.

Date Sept 27.

Observer E. P. A.

Illumin'n

8

W.

Star

Mag.

 $\delta$ d. Vis. Maj. L. 6  
Reversed Lamp E 6 W

Wire

a

2

22.18.5

27.36.3

"

b

3

50.0

26.50.2

"

c

4

23.16.8

~~25.46.3~~

13.4

"

d

5

46.2

~~7 13.4~~

25.46.3

"

e

~~26.50.2~~

"

f

~~27.36.3~~

"

g

"

h

"

i

"

j

"

k

"

l

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $r$ 

T

a

 $\Delta T$ 
~~1.5  
 12.8  
 2.88~~ 
~~8  
 9  
 10  
 11~~

## Russian Portable

Date	Sept 28.		
Observer	E.P.A.		
Illumin'n	W		
Star	$\gamma$ Equulei	$\zeta$ Cygni	$\alpha$ Cygni.
Mag.	9.36	29.42	38.51
Wire	a		
"	b		
"	c		
"	1	8 23 5	13.13.3
"	2	33.9	24.8
"	3	44.8	37.1
"	4	9 2.5	57.0
"	5	20.6	14.17.0
"	6	31.0	28.4
"	7	41.4	40.2
"	d		
"	e		
"	f		
Sum			
Mean	21. 5 39.46	9 02.53	13 56.97
Red'n to mean wire	+ .05	+ .08	+ .06
m $\beta\beta$	+ .01	- .03	- .17
n. tan $\delta$ Aa	- .17	- + .07	- .02
c. sec. $\delta$	+ .36	+ + .40	+ .45
r $\delta$	+ .25	+ .38	+ .22
T	21 5 39.71	21 9. 02. <del>96</del>	13 57.29
a	21. 4. 3. 31	21 7 26.23	<del>21. 4. 3. 31</del>
$\Delta T$	1. 36.40	1. 36. <del>88</del>	21 12 20.78

1.36.68  
65  
50

C = .35 + 2amp W.  
a = .40 Samp E, .30 2amp W.  
r =



## Transit Instrument.

Date	Sept. 28.		
Observer	E. P. A.		
Illumin'n	W	W	E.
Star	2 Cephæi		
Mag.	1 Draconis B Cephæi.		
$\delta$	62.2	L.b. 81.54	70.0
Wire	a		
"	b		
"	c		
"	1	15.54.2	
"	2	16.13.6	
"	3	34.0	
"	4	17 7.1	19.56.9
"	5	40.4	21.46.6
"	6	59.7	22.52.4
"	7	18.19.2	23.59.2
"	d		29 57.5
"	e		30. 19.2
"	f		55.0
Sum			
Mean	17 6.89	22.08.78	30 21.90
Red'n to	mid wire.	+10	-2.11.44
m	Bb.	-22	+56
n. tan. $\delta$	Aa	+44.22	-41.70
c. sec. $\delta$		+74	-42.49
r		+84	-47
		-400	+54
		2.16.19	+1.02
T	21.17.7.73	19 52.59	1.43.55
a	21.15.31.08	9.18.17.20	28.38.35
$\Delta T$	6.65 1.34.78	1 35 39	21.27.1.54

$$14 W a = -36 \quad L b \quad E a = -245$$

$$C = +30$$

$$C = -30$$

$$\Delta t = -1 \quad 36.59 \quad at \quad 21.645 = .902$$

# Russian Portable

Date	Sept 28.		
Observer	E. P. A		
Illumin'n	E	E	E
Star	$\gamma$ Capricorni 11 Cephei $\alpha$ Pegasi		
Mag.			
$\delta$		70.42	5.34
Wire	a		
"	b		
"	c		
"	1	33.57.0	4. 44.0
"	2	34. 6.7	53.3
"	3	16.0	5 2.4
"	4	32.5	18.1
"	5	48.7	38.6
"	6	58.6	42.9
"	7	35. 8.1	52.2
"	d		
"	e		
"	f		
Sum			
Mean	34.32.51	42.17.22	5 18.07
Red'n to mid. mean wire		-88.88	-05
m B6		-35.52.50	-14
n. tan. & Aa		+58	+24
c. sec. $\delta$		-1.06	-36
r		-36.50	-79
T		41.40.72	5 17.28
a		21. 40.04.14	22. 3.40.67
$\Delta T$		1.36.58. 87	1. 36.44



## Transit Instrument.

Date	Sept 28.		
Observer	E. C. A.		
Illumin'n	E	E	E
Star	$\zeta$ Kiphei	$\gamma$ Aquarii	$\pi$ Aquarii
Mag.		-2.8	0.43
$\delta$			
Wire	a		
"	b		
"	c		
	6. 58.0	16 1.8	19. 43.9
"	7. 15.1	11.1	53.1
"	31.6	20.0	20 2.0
"	8. 0.8	35.7	17.7
"		51.3	33.2
"	47.4	17 0.5	42.5
"	9 4.2	9.8	52.0
"			
"	d		
"	e		
"	f		
Sum			
Mean	8. 56.18	16 35.74	20 17.75
Red'n to	mid. mean wire	-0.05	-0.05
m	Bv	-13	-14
n. tan. $\delta$	Aa	-129	-27
c. sec. $\delta$		-135	-4.35
r		-82	-76
T		16. 34.92	20 17.94
a		22. 14. 54.71	22. 18. 40.84
		1 36.21	
$\Delta T$			1. 37.20
			1, 36.50

## Russian Transit Instrument

Date	Sept 28.	
Observer	E. P. A.	
Illumin'n	E	E.
Star	9 Draconis 226 Cephei	
Mag.		
$\delta$	76.22	75.35
Wire	a	
"	b	
"	c	
"	1	23 7.1
"	2	46.4
"	3	24. 26.5
"	4	25. 31.9
"	5	26. 38.8
"	d	27 16.6
"	e	55.6
"	f	
Sum		
Mean	25. 31.84	29. 45.35
Red'n to <sup>mid.</sup> <del>mean</del> wire	-.20	+ 1 57.25
m <sup>B3</sup>	+.37	-.60
<del>a</del> tan $\delta$ <sup>Aa</sup>	- 1.49	+.88
c. sec. $\delta$	++ 1.48	- 1.40
$\tau$	+ .17	1. 56. 13
T	25. 32. 01	31. 41. 48
a	10. 23. 55. 58	22. 30. 4. 19
$\Delta T$	1. 36. 43	1. 37. 29.



## Russian Transit Instrument.

Date	Oct. 4,		
Observer	E. P. A.		
Illumin'n	E	E	E
Star	$\theta$ Aquilae $\delta^2$ Capricorni K. Cephei.		
Mag.			
$\delta$	-1.17	-12.57	77.19
Wire	a		
"	b		
"	c		
"	1	20. 5.46.5	
"	2	55.9	
"	3	6 4.6	12.19.0
"	4	20.6	35.1
"	5	36.0	51.0
"	d	45.3	13 0.9
"	e	54.3	10.0
"	f		
Sum			
Mean	20. 6.20.46	12.47.20	16.23.43
Red'n to			
m	$\theta$ -1.05	-12.96	
n. tan. $\delta$	$\theta$ -1.17	-10.04	-1.24.58
c. sec. $\delta$	$\theta$ -1.18	-10.08	-90
$r$	1.42.79	1.42.88	1.43.32
T			
a	20. 4.37.45	20. 10.52.18	20. 13 14.66
$\Delta T$	1.42.23	1.42.27	1.42.27

$$b = -.24 \text{ sec} -$$

$$c = .38$$

$$a = .26 \text{ } \pi .29 -$$

$$1.42.23$$

$$1.42.27 -$$

$$1.42.17$$

$$1.42.28 -$$

$$1.42.27 -$$

$$1.42.11 -$$

$$1.42.62$$

$$7195$$

$$1.42.28 - \delta T -$$

## Russian Portable

Date	Oct 4-		
Observer	E. P. A-		
Illumin'n	E	E	E
Star	$\pi$ Capricorni E Delphinii Lworm 3241		
Mag.			
$\delta$	-18.38	10.57	72.6
Wire	a		
"	b		
"	c		
	20. 21. 1.9	28. 10. 4	30. 28. 4
"	11.6	19.9	30. 58.1
"	20.7	28.7	31. 26.8
"	27.3	45.0	32. 17.9
"	53.8	29. 8.6	33. 18.8
"	22. 4.0	10.1	33. 39.3
"	13.5	19.5	34. 9.0
"	d		
"	e		
"	f		
Sum			
Mean	37.54	28.44.89	32.18.33
Red'n to	-05	-05	-15
m	<del>101</del> -12.67	<del>21</del> 2.82	-68
n. tan. $\delta$	<del>92</del> -24.53	-14 -1.61	+42
c. sec. $\delta$	<del>106</del> -40.62	-39 3.25	-1.23
r	1,42.81	1,42.81	1,42.70
T			
a	20. 19. 54.56	20. 27. 01. 82	20. 30. 34.80
$\Delta T$	1,42.17	1,42.28	1,41.89



## Transit Instrument.

Date				
Observer	E. P. A.			
Illumin'n	W W W			
Star	2 Cygni 2 Cygni 7 Cephei			
Mag.				
$\delta$	44.49	33.24	61.14.	
Wire	a			
"	b			
"	c			
"	1	37.53.7		
"	2	38 8.7		
"	3	22.1		
"	4	43.7		
"	5	39 6.0	43.0.0	44.55.1
"	d	18.5	10.2	
"	e	21.3	21.4	45.32.7
"	f		36.5	
Sum				
Mean	38.43.71	43 17.03	45.13.90	
Red'n to				
m	1.41	+07	-36.19	-57.48
n. tan. $\delta$	1.06	-34 1.99	-29 1.95	-47
c. sec. $\delta$	1.41	+02.19	-06-1.65	+1.19
r		+1.54 1.21	+46 2.06	+1.78
		1.41.71	1.41.71	1.41.64
T				
a	20, 37.01.73	20.40.58.84	20.42.40.31.	
$\Delta T$	1.42.27	1.42.11	1.42.71	

## Russian Transit Instrument.

Date Oct 4.  
 Observer E. P. A.  
 Illumin'n W  
 Star *maguarii.*  
 Mag. - 9.28  
 $\delta$

Wire	a.		
"	b		
"	c	1	
		2	46.57.5
"	1	3	47.7.1
"	2	4	23.1
"	3	5	39.0
"	4	6	47.8
"	5	7	57.2
"	d		
"	e		
"	f		

Sum  
 Mean 47.28.62  
           568  
           2294  
 Red'n to - 5.68  
 m .63 - .15  
 n. tan.  $\delta$  .80 - .23  
 c. sec.  $\delta$  1.01 + .38  
           1,42.47  
 $r$  15

T  
 a 20.45.40.32  
 $\Delta T$  1,42.62



Date 1870 Oct 7

Observer E P col

Illumin'n E

Star Jy 6 1879  $\alpha^2$  Urs Maj' 61 Cygni

Mag.

 $\delta$ 

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$ 

r

T

a

 $\Delta T$

Date	1870	Oct 7		
Observer		E P A		
Illumin'n		$\delta$	$\epsilon$	$\eta$
Star		$\xi$ Cygni	$\alpha$ Cephei	$\beta$ Cephei
Mag.				
$\delta$				
Wire	a			
"	b			
"	c			
"	1			
"	2			
"	3			
"	4			
"	5			
"	d			
"	e			
"	f			
Sum				
Mean				
Red'n to				
m				
n. tan. $\delta$				
c. sec. $\delta$				
$\tau$				
T				
a				
$\Delta T$				



Date

Observer

Illumin'n

Star

Mag.

 $\delta$  *$\gamma$  Capricorn  $\epsilon$  Pegasi // Cephei*

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$ 

r

T

a

 $\Delta T$

## Russian Transit | Meridian Circle

Date	Oct 7	Oct 8
Observer	E. P. Oet	E. P. Oet
Illumin'n	W	West
Star	$\mu$ Copicornis	$\alpha$ Agrani $\gamma$ Pegasi
Mag.		
$\delta$		
Wire	a	
"	b	
"	c	
"	1	
"	2	
"	3	
"	4	
"	5	
"	d	
"	e	
"	f	
Sum		
Mean		
Red'n to		
m		
n. tan. $\delta$		
c. sec. $\delta$		
$\tau$		
T		
a		
$\Delta T$		



Date

Observer

Illumin'n

Star

Mag.

 $\delta$  *$\epsilon$  Cephei & Pis et no & miscellaj*

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $r$ 

T

a

 $\Delta T$

Date

Oct 8

Observer

Illumin'n

Star

Mag.

 $\delta$  $\theta$  C<sup>2</sup> Aquarii  $\gamma$  Piscium  $\theta$  Piscium

Wire

a

"

b

"

c

"

1

"

2

"

3

"

4

"

5

"

d

"

e

"

f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $\tau$ 

T

a

 $\Delta T$



Date	Oct 10		
Observer			
Illumin'n			
Star	$\alpha$ Cephei		
Mag.	d 10.5 mag		
$\delta$	$\gamma$ Capricorni		
Wire	a		
"	b		
"	c		
"	1		
"	2		
"	3		
"	4		
"	5		
"	d		
"	e		
"	f		
Sum			
Mean			
Red'n to			
m			
n. tan. $\delta$			
c. sec. $\delta$			
$r$			
T			
a			
$\Delta T$			

Date

Oct 10

Observer

Illumin'n

Star

Mag.

 $\delta$  $\alpha$  Aquarii     $\theta$  Aquarii

Wire    a

"    b

"    c

"    1

"    2

"    3

"    4

"    5

"    d

"    e

"    f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $\tau$ 

T

a

 $\Delta T$



Date	1870	Oct 12								
Observer	E P A									
Illumin'n	West									
Star	79 Dracon & $\alpha$ Aquarii & $\alpha$ Aquarii									
Mag.										
$\delta$										
Wire	a									
"	b									
"	c	21	52	23.1	22	0	44.1	22	11	36.1
				32.0			46.7			38.6
"	1			40.3			49.1			41.0
"	2			48.8			51.6			43.7
"	3	53		60			56.5			48.7
"	4			22.8		2	1.5			53.6
"	5			31.5			4.0			56.0
				39.7			6.4			58.5
"	d			48.2			8.8		12	1.0
"	e									
"	f									
Sum				292.4			268.7			377.2
Mean		21	53	5.82	22	0	56.52	22	11	48.58
Red'n to										
m										
n. (tan. $\delta - \frac{1}{2}\phi$ )				+ 31			- 12			- 14
c. sec. $\delta$										
$\tau$										
T		53		6.13			56.40			48.44
a		21	57	18.21	21	59	8.47	22	10	0.53
$\Delta T + h \sec \phi$	- 1			47.92	- 1		47.93	- 1		47.91

Block fast at 22<sup>h</sup> If  $h \sec \phi = + 0.47$  as on Sept. 15  
198<sup>s</sup>.39

## Pulkowa Transit

Date 1870 Oct. 14

Observer

H. G.

Circle ~~Hummer's~~

E.

Star

 $\epsilon$  Pegasi $\eta$  Cephei $\mu$  Capricorni

Mag.

 $\delta$  $9^{\circ} 17'$  $70^{\circ} 43'$  $14^{\circ} 10' S.$ 

Wire

a

"

b

"

c

21 39 58

"

1

15.0

21 47 39.2

"

2

24.4

48.9

"

3

40.0

21 41 52.9

48 4.9

"

4

56.0

42 40.4

21.0

"

5

40 5.0

43 7.0

30.4

"

d

14.4

35.6

39.8

"

e

44 13.0

52.4

"

f

49 8.2

Sum

280.6

28.9

184.6

Mean

21 39 40.09 21 43 5.78 21 48 23.08

Red'n to middle wire

+ .05

- 1 12.81

- 18.20

m B b

- .39

- .93

- .20

n. tan. A a

- .13

+ .34

- .21

c. sec.  $\delta$ 

+ .36

+ 1.09

+ .37

r

T

21 39 40.07 21 41 53.47 21 48 4.84

a

21 37 50.04 21 40 3.24 21 46 14.50

 $\Delta T$ 

- 1 50.03 1 50.23 1 50.34

Level read before observations Circle E.  $b = -.29$   
 " " after transit of  $\alpha$  Aquar. " E.  $b = -.41$   
 " " " " "  $\alpha$  Aquar. " W.  $b = -.45$   
 " " " observations " W.  $b = -.37$

$b$  Circle E. assumed  $- .35$   
 $b$  " W. "  $- .40$



## Pulkowa Transit

Date 1870 Oct. 14

Observer  
Circle Illumin'nH. G.  
E.

W.

Star

2 Aquarii

32 Urs. Maj. I.C.  $\pi$  Aquarii

Mag.

0° 57' S.

65° 45'

0° 43'

Wire a

" b

" c

22 0 25.0

" 1

33.8

" 2

43.0

" 3

59.0

22 10 23.0 22 20 31.4

" 4

1 14.5

11 1.6

46.8

" 5

23.6

23.2

56.3

" d

32.8

46.0

21 5.2

" e

17.8

" f

12 51.8

33.1

Sum

411.7

145.6

10.6

Mean

22 0 58.81 22 11 29.12 22 21 1.77

Red'n to middle wire

+ .05

- 1 58.5

- 30.43

m Bb

- .25

+ .30

- .30

m. tan. Aa

- .16

- .56

- .16

c. sec. d

+ .36

+ .88

- .36

T

22 0 58.81 22 10 23.89 22 20 30.52

a

21 59 8.45 10 8 33.56 22 18 40.41

 $\Delta T$ 

- 1 50.36 1 50.33 1 50.11

1870 Oct. 14

By Cauchy's method

{ c = - .36 Circle West  
a = - .24Clock fast (at 22<sup>h</sup> 9<sup>m</sup>)

110.520

(mean of  $\epsilon$  Pegasi,  $\mu$  Capri.,  $\alpha$  Aquar.,  $\pi$  Aquar.,  $\gamma$  Aquar.,  $\delta$  Pegasi.)



Date 1870 Oct. 14

Observer H. G.

Illumin'n

Star

Mag.

 $\delta$ 9 Drac. L.C.  $\gamma$  Aquarii  $\zeta$  Pegasi

76° 23' 0° 47' S. 10° 10'

Wire

a

"

b

"

c

22 23 20.8 22 30 0.0 22 36 17.5

"

1

24 0.3 8.8 26.8

"

2

39.6 18.4 36.0

"

3

25 45.4 33.7 52.1

"

4

26 57.7 49.2 37 7.7

"

5

27 30.2 58.7 16.9

"

d

28 8.8 31 7.8 26.4

"

e

"

f

Sum

316.8 236.6 363.4

Mean

22 25 45.26 22 30 33.80 22 36 51.91

Red'n to

middle wire

+ .20 - .05 - .05

m Bb

+ .82 - .29 - .34

n. tan.  $\delta$ 

Aa

- .89 - .16 - .13

c. sec.  $\delta$ 

+ 1.53 - .36 - .36

 $\tau$ 

T

22 25 46.92 22 30 32.94 22 36 51.03

a

10 23 56.69 22 28 42.73 22 35 0.90

 $\Delta T$ 

- 1 50.23 1 50.21 1 50.13

Oct. 14 1870. Occultation of  $\zeta$  Tauri

Disappearance observed by A. C. Martin at H. C. Observatory with 8" Equatorial and stopwatch at  $0^h 4^m 43.5^s$  by South clock or in Cambridge sid. time  $0^h 2^m 53.2^s$  mean time  $10^h 29^m 4.1^s$  observation thought to be good but may have been hindered by dew between lenses of object glass

"

" by A. McConnell with his telescope at a station }  $10^h 28^m 43.0^s$

Reappearance

" " A. Searle with opera glass at Observatory }  $11^h 17^m 43.7^s$

"

" " A. McConnell at station above named }  $11^h 17^m 40.9^s$



# Meridian Circle

Date 1870 Oct 21  
 Observer E. D. A. West  
 Illumin'n  
 Star 79 Dracon & Aquarii & Aquarii  
 Mag.  
 $\delta$

Wire	a						
"	b						
"	c	21	52	30.5	22	0	52.0
"	1			39.4			54.7
"	2			47.9			57.0
"	3			56.2			59.7
"	4	43	13.3		1	4.6	
"	5			30.1			9.4
"	d			38.8			12.0
"	e			46.9			14.3
"	f			55.6			16.9

Sum  
 Mean 21 53 13.19 22 1 4.51 22 14 56.77

Red'n to  
 m  
 $n. \tan(\delta - \zeta \varphi) + 238$   
 c. sec.  $\delta$  -0.93 -1.06

r  
 T  
 a 21 57 17.65 21 59 8.35 22 10 0.43  
 $\Delta T$

Oct. 21 1870  
 $\Delta T + t \sec \varphi = -56.04$   
 $t \sec \varphi$  by guesswork + .20  
 Clock fast (at 22. h)  $\overline{1^m 56.24^s}$

Date	1870	Oct 22				
Observer		E. P. A.				
Illumin'n		West				
Star		$\alpha$ Cephei	$\mu$ Capricorn	79 Dracon		
Mag.						
$\delta$						
Wire	a	increase <del>Diminish</del> all these readings, m				
"	b	21 16 0.5	21 46 58.6	21 51 30.9		
"	c	5.7	47 4.3	39.7		
		10.9	3.7	48.2		
"	1	16.2	6.2	56.9		
"	2					
"	3	26.8	11.3	52 13.9		
"	4					
"	5	37.1	16.5	30.9		
		42.3	18.9	39.0		
"	d	47.9	21.7	48.1		
"	e	53.1	24.2	56.5		
"	f					
Sum		240.5	162.4	364.1		
Mean		21 16 26.72	21 47 11.38	21 52 13.79		
Red'n to						
m						
n. tan. $\delta$	- 30	+ 98	+ 19	- 116	- 22	+ 238
c. sec. $\delta$		+ 213	+ 10	+ 103	+ 05	344
						+ 17
r						
T		17 22.01	21 48 11.21	21 53 14.41		
a		21 15 30.15	21 46 14.39	21 51 17.55		
$\Delta T + \Delta \mu$		- 1 56.86	1 56.82	1 56.83		



Date					
Observer					
Illumin'n					
Star	$\alpha$ Aquar $\theta$ Aquar $\gamma$ Draconis				
Mag.	16				
$\delta$					
Wire	a	except the last			
"	b	21 59 52.9	22 10 44.8	23 24 59.4	
"	c	55.4	47.3	25 6.8	
		58.0	49.8	14.1	
"	1	22 0 0.4	52.2	21.4	
"	2				
"	3	5.2	57.4	35.7	
"	4				
"	5	10.2	11 2.3	50.0	
		12.6	4.9	57.4	
"	d	15.0	7.1	26 4.1	
"	e	17.6	9.9	11.8	
"	f				
Sum		<sup>18</sup> 227.3	<sup>24</sup> 275.7	260.7	
Mean		22 0 52.6	22 10 57.30	23 25 35.63	
Red'n to					
m					
n. tan. $\delta$		-93	-18 -106	-20 -367	-70
c. sec. $\delta$		+100	+5 +1.01	+5 -2.93	-15
$\tau$					
T		22 1 5.13	22 11 57.15	23 25 34.78	
a		21 59 8.35	22 10 0.41	11 23 37.85	
$\Delta T$		1 56.78	1 56.74	1 56.96	

$\Delta t + h \sec \phi - 1 56.78$  at  $21^h 59^m$

Date	1870	Oct 23			
Observer		E. P. A.			
Illumin'n		West			
Star		$\epsilon$ Regasi	in Capricorn 79 Draconis		
Mag.					
$\delta$					
Wire	a				
"	b	21 39 34.8	21 47 58.0	21 52 31.1	
"	c	37.1	48 1.8	40.6	
		39.8	4.3	48.8	
"	1	42.3	6.9	57.4	
"	2				
"	3	47.3	11.9	53 14.5	
"	4				
"	5	52.4	17.0	31.6	
		54.8	19.7	40.0	
"	d	57.0	22.0	48.3	
"	e	59.9	24.7	57.0	
"	f				
Sum		425.4	167.3	369.3	
Mean		21 39 47.27	21 48 11.92	21 53 14.37	
Red'n to					
m					
n. tan. $\delta$					
c. sec. $\delta$					
$\tau$					
T					
a		21 37 49.91	21 46 14.38	21 51 17.52	
$\Delta T$					



Date							
Observer							
Illumin'n							
Star		<i>d. Aquarii</i>	<i>32 UMa</i>	<i>d. Aquarii</i>			
Mag.							
$\delta$							
Wire	a						
"	b	22	0	53.1	22	8	37.0
"	c			56.0			42.3
				58.3			47.2
"	1	1		0.7			52.4
"	2				9	9	
"	3			6.0	9	2.5	
"	4						
"	5			10.7			12.7
				13.2			17.9
"	d			15.8			22.8
"	e			18.3			27.9
"	f						
Sum				232.1			262.7
Mean		22	1	5.79	22	9	2.52
Red'n to							
m							
n. tan. $\delta$							
c. sec. $\delta$							
$\tau$							
T							
a		21	54	8.33	10	8	34.04
$\Delta T$							

Date	1870	Oct 23			
Observer		E Post			
Illumin'n		West			
Star		226 Cephei y Regasi		1 Cephei	
Mag.					
$\delta$					
Wire	a				
"	b	22 31 9.9	22 37 40.0	22 46 33.8	
"	c	20.0	42.8	40.0	
"		28.9	45.5	45.5	
"	1	39.7	48.4	52.0	
"	2				
"	3	59.7	54.1	47 3.8	
"	4				
"	5	32 19.9	59.8	15.7	
"		29.2	38 2.5	21.3	
"	d	39.0	5.3	27.3	
"	e	49.4	8.5	33.2	
"	f				
Sum		4.7	306.9	272.6	
Mean		22 31 59.52	22 37 54.10	22 47 36.2	
Red'n to					
m					
n. tan. $\delta$					
c. sec. $\delta$					
$r$					
T					
a		22 30 2.78		22 45 6.54	
$\Delta T$					

$\Delta T + \text{base } \phi = 117.52$   
 base  $\phi$  assumed  $+ .20$

clock fast 117.72 at 22<sup>h</sup> 1/2



Date

Observer

Illumin'n

Star

Mag.

 $\delta$ *d Noct Maj*

Wire

a

"

b

"

c

"

1

"

2

"

3

"

4

"

5

"

d

"

e

"

f

22 57 11.8

17.0

22.5

27.7

38.5

49.2

54.6

59.8

58 55

Sum

286.6

Mean

22 57 38.51

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $\tau$ 

T

a

10 55 40.67

 $\Delta T$

Date	1870	Oct 28 <sup>th</sup>			
Observer		E. P. A.			
Illumin'n		Wist			
Star		$\alpha$ Aquarii	32 hrs Maj	$\theta$ Aquarii	
Mag.					
$\delta$					
Wire	a				
"	b	22 <sup>1</sup> 0	58.0	22 9	22 11 48.0
"	c		58.8		50.8
"			1.0		53.2
"	1		3.6		55.2
"	2				
"	3	1	8.6		22 12 0.6
"	4				
"	5		13.5		5.8
"			15.8	20.8	8.1
"	d		18.4	25.8	10.2
"	e		20.8	31.0	13.1
"	f				
Sum			196.5		246.0
Mean		22 1	8.50		22 12 0.67
Red'n to					
m					
n. tan. $\delta$		-93	-22	-313	-106 -24
c. sec. $\delta$					
r					
T					
a		21 59	8.27	10 8	34.27 22 10 0.34
$\Delta T + h$ sec $\phi$		-2	0.01		-2 0.09

If. bsec  $\phi \approx +.20$   
 Clock fast at 22<sup>h</sup> 11<sup>m</sup> 48<sup>s</sup>

120<sup>s</sup>.24



Date									
Observer									
Illumin'n									
Star		$\gamma$ Aquarii $\pi$ Aquarii $\eta$ Draconis							
Mag.									
$\delta$									
Wire	a								
"	b	22	16	46.2	22	20	28.0	22	25 7.0
"	c			48.8			30.6		16.9
"				57.2			33.0		28.1
"	1			53.7			35.5		37.8
"	2								
"	3			58.6			40.7		58.8
"	4								
"	5			3.7			45.5	26	20.0
"				6.0			47.9		30.8
"	d			8.5			50.4		40.8
"	e			11.0			52.8		51.5
"	f								
Sum						364.4		291.5	
Mean					22	20	40.49		59.06
Red'n to									
m									
n. tan. $\delta$					-0.40	-22	-5.04		-1.21
c. sec. $\delta$									
$\tau$									
T									
a		22	18	40.25	10	23	57.80		
$\Delta T$		-	2	0.02	-2		0.05		

$$c = +0.03$$

Date 1870 Nov 2

Observer R

Illumin'n West

Star 2 hrs min

Mag.

 $\delta$  $\alpha^2 \text{ Cap}$ 

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $r$ 

T

a

 $\Delta T$ 

19	44	13.0	20.5	20	12	41.7
		19.2				44.2
		22.7				46.7
		27.2				49.3

46	28.4	35.6	
	35.0		
	43.2		

48	40.0	47.1	
	47.0		
	54.2		

51	52.0	00.9	
	61.0		
	69.8		

- 55	10.8	- 21.3	
	20.7		
	32.3		

57	37.1	47.1	
	46.1		
	58.0		

1	47.2	58.2	
	58.3		
	8.8		

21	57.8	08.9	
	66.9		
	80.2		

6	13.2	23.4	
	24.8		
	32.4		

243.0	243.0
24.0	6.0
3.0	183.0

20 10 52.20

19	51	0.33	20.33	2	2.18
19	53	34.92			

19	55	25.33
19	53	34.92
1		45.41



Date

Observer

Illumin'n

Star

Mag.

 $\delta$  $\pi$  Capri

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

20 21 43.8

46.3

48.8

51.5

58.8

2.0

4.4

7.0

9.9

Sum

Mean

20 21

$$\begin{array}{r} 270.5 \\ 267.5 \\ \hline 538.0 \\ 567.2 \end{array}$$

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$ 

2

r

T

a

20 19 54.59

2 2.13

 $\Delta T$ 

$$a \text{ Cap. } 0 = +2 \overset{m}{02.18} - 23 + 1.03$$

$$\pi \text{ " } 0 \quad 2.13 - 34 + 1.05$$

$$2 \text{ Muscim. } 0 \quad 1 \quad 45.41 + 53.13 + .812$$

$$2 \quad 2.15 - .30 + 1.04$$

$$0 = - 16.74 + 53.43 + 52.08$$

$$0 = - .31 + n + .9$$

$$0 = - .31 + n + .03$$

$$n = +28$$

Date *Nov 10 1870*

Observer

Illumin'n

Star

Mag.

 $\delta$ *a legygni**u Aquarii 1879 J. B. L.*

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $r$ 

T

a

 $\Delta T$ *20<sup>n</sup> 39 8.8**6**47 336**365**388**414**462**512**537**564**589**54 153**299**410**583**271**550**88**237**56 383**20 39 7.80**20 47 46.30**20 55 26.71**20 37 0.74 20 45 39.76 20 52 23.34**2 6.06**2 6.54**3 4.37**a legygni**o = +2**806 + .99 + 141**+ 271**6.43**u Aquarii**6.54 - 17 + 1.01**- 56**48**3 legygni**6.29 + .57 + 1.15**+ 21**50**J. B. L. 1879**2**4.37 + 5.71 + 5.79**7.49 6.47**2**6.88 + 0.4 + 1.19**-**1.93 + 5.25 + 4.60**n = +37**dT + m = -2 6.47**2**6.80 + 1.7*



## Meridian Circle

Date 1870

Observer  
Illumin'nStar  
Mag.  
 $\delta$  $\gamma$  *legni*

Nov. 11

A. S.  
W.3 hrs. Maj.  
68° 51'

Wire	a	21 9	174
"	b		204
"	c		237
			260
"	1		318
"	2		343
"	3		402
"	4		430
"	5		459
"	d		
"	e		
"	f		

D 8 2 1.4

E 1	15.2
2	21.9
3	28.8
4	35.8

Sum	285.7
Mean	21 09 31.74

8 2	103.1
	206.2

Red'n to D  
m  
n. ( $\tan. \delta - \tan \phi$ )  
c. sec.  $\delta$

- 19.17  
+ .62  
.00

 $r$ T -  $t \sec \phi$ 

8 2 2.07

a

21 07 25.45

7 59 54.89

 $\Delta T$ 

26.29

 $\Delta T + t \sec \phi - 2$  7.18

$t \sec \phi$  supposed about +.20  
Clock fast at 8<sup>h</sup> 127.<sup>s</sup>38

" " " " 6<sup>h</sup> 127.34  
B.236 slow of S. Clock 2<sup>m</sup> 0.<sup>s</sup>3  
B.236 fast of Cambridge sid. time 7.<sup>s</sup>0.

Immersion of  $\mu$  Geminorum  
at 6<sup>h</sup> 20<sup>m</sup> 32.<sup>s</sup>0 Cambridge sid. time  
Emission 7 33 52.0  
For original notes of observations see  
book containing clock comparisons.



Date 1870

Nov 13

C=0

Observer

W A R

Illumin'n

Star

Polaris Pol of Wollin &amp; Lyrae

Mag.

 $\delta$ 

Wire

a

"	b	56.5	13	5	56.5	18		34	238	
"	c	42.1		7	35.8	41.7	48.6		272	
"		9	24.9	9	24.0	24.7	29.2	15	54.6	
"		11	31	6.9	11.3	8.		17	20.4	
"		21	32.4	14	28.1	32.2	37.8		33.4	
"		3						18	0.3	
"		4							39.7	
"		5	7	59.8	17	56.0	59.7	63.7	18	41.3
"		19	41.6	19	37.5	41.3	46.0	19	22.7	
"		d	21	23.6	21	19.1	23.8	27.9		460
"		e	23	10.3	23	4.7	9.8	16.3		491
"		f								52.4
										55.7

Sum

298.6

Mean

13/4 33.18

14 33.18

12 17.96

18

33 29.9

18 21.18

2 26.5

15 54.7

15 54.68

13 49.39

18 34 35.66

32 32.05

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $\tau$ 

T

a

 $\Delta T$ 

2 15.22

2 52.9

-2 7.58

$\alpha$  Lyrae  $0 = +2 \times 7.58 + 80 + 128$   $\alpha$  Lyrae  $0 = 2 \times 7.58 + 169 + 100$   
 $\text{Polaris S.P.}$   $2 \times 15.22 - 41.56 - 41.55$   $\text{Mushu}$   $52.9 + 16.9 + 10.8$   
 $0 = -7.64 + 42.36 + 42.83$   $0 = -2.29 + 16.14 + 6.0$   
 $0 = -1.8 + n +$   $0 = -1.4 + n -$   
 $n = +1.8$   $n = +1.4$

Assume  $n = .16$



Date					
Observer					
Illumin'n					
Star		<i>Alcyon?</i>		<i>?</i>	
Mag.					
$\delta$					
Wire	a				
"	b	21	<del>40.8</del>	21	37 4.5
"	c		<del>40.0</del>		13.3
"					17.8
"	1				22.2
"	2				27.0
"	3	27	48.0		
"	4		55.2		
"	5		58.7		
"			62.3		
"	d	27	66.0		
"	e				
"	f		2432		803
					2077
Sum			6080		
Mean			25.41	3539	
Red'n to					
m					
n. tan. $\delta$					
c. sec. $\delta$					
r					
T					
a					
$\Delta T$					

Nov. 13 1870

*Alcyon* from observation opposite

$$\alpha - T = -127^{\circ}58'$$

c. sec.  $\delta$

0.00

(set at no collimation)

n as opposite.

n (true  $\delta$  tan  $\phi$ )

- .02

b. sec  $\phi$  as found Nov. 25

+ .12

Clock fast at 18 $\frac{1}{2}$  127 $^{\circ}$ 58'

Occultation of  $\mu^2$  Cancri observed with stopwatch. No correction seems needed for rate of stopwatch from comparisons made. Cambridge sidereal time of disappearance 5 $^h$ 7 $^m$ 25.3 errors not likely to amount to much more than 3 seconds.

Mer. Circle

Date Nov 15

Observer E. P. A.

C = 0

Illumin'n

Star  
Mag.  
 $\delta$ 

n Mus. maj. 2 Bootis a Draconis

Wire a  
" b  
" c  
" 1  
" 2  
" 3  
" 4  
" 5  
" d  
" e  
" f

13 44	134	13 50	252	14 2	280
	173		280		350
	210		306		405
	250		332		463
-	324		384		583
	404		434		9.9
	442		464		10.4
	480		489		21.4
	519		513		27.6

Sum  
Mean

2939			3457		2840
44	3265	13 50	3841	14 02	5822

Red'n to  
m  
n. tan.  $\delta$   
c. sec.  $\delta$ 

r

T

a

13 42 2426 13 48 2991 14 0 50.00

 $\Delta T$ 

2 8.39 8.50 8.22

n Mus. maj 0 = 2 839 + 119 + 155 + 20 = 859  
 n Bootis 8.50 34 + 1.06 + 0.6 = .56  
 a Bootis 8.58 + 36 + 1.06 + 0.6 = .61

a Draconis

822 + 214 + 284  
 8.48 + .63 + 1.22  
 = .26 + 1.51 = 2.59  
 1.15

n = +.17



	Mer. Circle	E. Transit	Mer. Circle
Date	1870	Nov. 17	Nov. 25
Observer		A. S.	E. Peet
Illumin'n		E	W
Star	$\alpha$ Bootis	$\rho$ Leon.	$\delta$ Piscium
Mag.		226 Ceph. L.C.	
$\delta$		$\beta$ Leonis	
		$9^{\circ}58', 75^{\circ}34', 11^{\circ}14'$	
Wire	a	14 11 39.3	23 23 32.9
"	b	42.0	20.3
"	c	44.6	23.0
"	1	47.4	29.3
"	2	52.6	27.8
"	3	57.7	
"	4	60.4	
"	5	63.0	
"	d	65.9	
"	e		
"	f		
Sum		472.7	51
Mean	14 11	52.52	23 23 32.79
Red'n to m			
n. tan. $\delta$			-81
c. sec. $\delta$			100
r			
T			32.60
a	14 9	43.97	23 21 24.42
$\Delta T$	2	8.55	2 <sup>m</sup> 8.18

Nov. 17 1870

E. Transit

 $b \sec \phi = +.79$  $\Delta T + b \sec \phi = -127.82$ Clock fast at  $10^{\frac{1}{2}}$ 128<sup>s</sup>.61 $n = +0.65$ 

c' Ill. E.

(determined Nov. 26 1870)

Occultation of  $\gamma$  Virg. Nov. 17 1870; disappearance  $8^{\text{h}} 51^{\text{m}} 26.3^{\text{s}}$  reapparance  $10^{\text{h}} 0^{\text{m}} 39.3^{\text{s}}$  Cambridge sidereal time.

Date 1870 crav 25

Observer

Illumin'n

Star

Mag.

 $\delta$ 

Wire

a

"

b

"

c

"

1

"

2

"

3

"

4

"

5

"

d

"

e

"

f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $r$ 

T

a

 $\Delta T + \text{Blacc}$  $\Delta t$ E Pcd  
West32 Ursellae 16  $\gamma$  Aquarii  $\gamma$  Aquarii

15.2

20.8

27.0

33.0

22 10 45.0

57.0

3.3

9.0

15.0

22 5.3

22 10 45.00

-39 -3.31 -76

-243

44 24

10 8 36.13

-2 8.18

8.23

35.8

38.3

40.8

43.3

22 20 48.4

53.5

55.7

58.2

60.8

434.9

22 20 48.32

-90 -21  
100

48.11

22 18 39.89

8.22

8.34



Date								
Observer								
Illumin'n								
Star	7 Drac 16 $\gamma$ Aquarii & Persei Ref							
Mag.								
$\delta$								
Wire	a							
"	b				38.2			56.9
"	c				40.8			0.5
"					43.1			4.4
"	1				45.6			8.2
"	2							
"	3	22 26	10.2	22 30	50.8	3	17	15.9
"	4							
"	5		31.4		55.5			23.7
"			41.5		58.0			27.4
"	d		51.8		0.4			31.0
"	e		62.4		3.0			34.9
"	f							
Sum		197.3			335.4			142.9
Mean		39.46		22 30	50.60	3	17	15.88
Red'n to		29.38						
m								
n. tan. $\delta$		<del>504</del> 104	-116	-93		-21	+26	+06
c. sec. $\delta$		-4 25 5.25		100			154	
r								
T		8.92			50.39			15.84
a		10 24	0.72	22 28	42.23	3	15	7.52
$\Delta T$		8 20			8.76			8.42
								+ 12
		8.82			8.28			8.30
		$h \text{ sec } \phi = +0.12$						
		$m = +0.23$						

## Mer. Circle

Date 1870 Nov. 30

Observer

E. P. A.

Illumin'n

W.

Star

δ Piscium

e Cass.

5 Mrs. Min. I.C.

Mag.

δ

5<sup>h</sup> 40'

66° 49'

76° 16'

Wire

a

"

b

"

c

D

23 23 31.5 2 20 33.4 2 29 59.0

E {

1

36.3

46.2

37.9

2

39.0

52.8

28.1

3

41.5

58.9

17.1

4

44.0

21 5.2

6.5

5

"

d

"

e

"

f

Sum

192.3

256.5

148.6

Mean

23 23 38.46 2 20 51.30 2 29 29.72

Red'n to

D

- 6.95

- 17.57

+ 29.15

m

n (tan. δ - tan φ)

- .17

+ .30

- 1.05

c' sec. δ

+ 1.23

+ 3.10

- 5.14

r

T - b sec φ

23 23 33.57 2 20 37.13 2 29 52.68

a

23 21 24.37 2 18 28.94 14 27 44.47

ΔT + b sec φ

- 2 8.20 2 8.19 2 8.21

Nov. 30 1870

Mer. Cir. }

Ill. W. }

c = + 1.24 as determined.

c' = + 1.22

n = + 0.21

ΔT + b sec φ = - 128.30

b sec φ assumed

+ .12

Clock fast at 0<sup>h</sup>128<sup>s</sup>. 32



5 50.1  
22<sup>h</sup> 8 53.1  
52.6

Date	1870	Dec 3		
Observer		E P Col		
Illumin'n		W		
Star		79 Draconis	32 Ursae maj'	<del>Hydrae</del> Cephelii ref
Mag.				
$\delta$				
Wire	a			
"	b	21 <sup>h</sup> 52 39.9	22 <sup>h</sup>	22 46 42.3
"	c	48.4		48.1
"	1	56.7	10 27.3	54.4
"	2	53 53	33.6	47 0.6
"	3	22.0	46.0	12.2
"	4	"		
"	5	38.9	59.6	24.3
"		47.8	11 3.8	30.6
"	d	55.8	9.7	36.2
"	e	54 4.8	16.0	42.0
"	f			
Sum		12 819.6	16 196.0	18 290.7
Mean		21 53 22.18	22 10 53.71	22 47 12.30
			- 7.72	
Red'n to	alt W		22 10 45.99	
m	a.A	+84	-1.1 + 46	+46
n. tan. $\delta$	b.B	-24	+6 + 18	+18
c. sec. $\delta$				
$\tau$				
T		22 78	44.94	12.94
a		21 57 14.57	10 8 36.67	22 45 4.81
$\Delta T$		- 2 8.21	- 2 8.27	8.13

58<sup>m</sup> 418  
54.8

11 56.3  
12 7.4  
12 1.85

a = - .48  
b = - .08

n = + 30

sec  $\phi$  = - .11

Chief Cephelii not good

2 27  $\begin{matrix} 25.5 \\ 29.6 \\ 32.4 \end{matrix}$

Date	1870	Dec 3					
Observer		E. P. A.					
Illumin'n		W					
Star		$\lambda$ Draconis		$\mu$ Piscium		5th Mint G	
Mag.							
$\delta$							
Wire	a						
"	b	23 25	14.1	23 54	36.3		
"	c		21.1		39.0		
"			28.1		41.3	2 29	23.2
"	1		35.3		43.8		33.5
"	2						
"	3		50.0		48.9		54.5
"	4						
"	5	26	4.2		53.8	30	15.3
"			11.4		56.1		26.1
"	d		19.0		58.8		36.5
"	e		25.9		61.2	2 30	46.9
"	f						
Sum			$\begin{matrix} 24 \\ 209.1 \end{matrix}$		439.2		236.0
Mean		23 25	49.90	23 54	48.80	2 30	<del>98.00</del> -13.37
Red'n to						2 29	54.03
m							
n. tan. $\delta$	aob		-130		-29		-1.77
c. sec. $\delta$	h B		+09		-6		+0.16
r							
T			48.69		48.45		53.02
a		11 23	40.49	23 52	40.33	14 27	44.64
$\Delta T$		-2	8.20	-2	8.12	-2	8.38

32 49.1 ?  
55.8 ?

33 14.7

33 1.9.0 an

33 5.25



Date

Observer

Illumin'n

Star

Mag.

 $\delta$ 

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

Sum

Mean

Red'n to

m

n. tan.  $\delta$ c. sec.  $\delta$  $\tau$ 

T

a

 $\Delta T$

Date	1870	Dec 8 <sup>th</sup>				
Observer	E. P. A					
Illumin'n	Wut					
Star	$\gamma$ Bootis $\alpha$ Draconis $\alpha$ Bootis					
Mag.						
$\delta$						
Wire	a					
"	b					
"	c		14 2	<del>20.3</del> 30.0	14 <sup>h</sup> 11 <sup>m</sup>	40 <sup>s</sup> 0.
"	1			35.5		42.8.
"	2			41.2		45.2.
"	3	13 50	33.8	47.1		48.0.
"	4		39.1	2	58.9	53.2.
"	5		44.3	3	10.7	58.4.
"	d		57.0		16.6	1.1.
"	e		59.3		22.4	3.8.
"	f		52.3		28.0	6.3.
Sum				290.4		298.8
Mean			14 2	58.93	14 11	53.20
Red'n to						
m						
n. tan. $\delta$						
c. sec. $\delta$						
r						
T						
a	13	48	30.46	14 0	50.79	14 9 44.48
$\Delta T$						



Date	1890	Dec 8 <sup>th</sup>		Dec 9	
Observer					
Illumin'n					
Star	α Bootis 5 hrs Min 13 20s Min 16				
Mag.					
δ					
Wire	a				
"	b	14 22 34.0	14 29 0.9	2 52 23.7	
"	c	38.0	11.0	34.5	
		42.0	21.6	43.9	
"	1	46.0	32.0	53.1	
"	2				
"	3	54.1	53.0	43 11.9	
"	4				
"	5	2.3	30 13.8	30.0	
		6.4	23.5	39.9	
"	d	10.4	34.6	49.0	
"	e	14.5	45.0	58.2	
"	f				
Sum		247.7	235.4	344.2	
Mean		14 22 54.19	14 29 52.82	2 53 11.58	
Red'n to					
m					
n. tan. δ					
c. sec. δ					
r					
T					
a		14 20 45.64	14 27 44.93	14 57 1.93	
Δ T				- 2 <sup>m</sup> 8.86	

# E. Transit

Date	1870 Dec. 9				
Observer	A. S.				
Illumin'n	W.				
Star	γ Urs. Maj. o Virg.	γ Virg.			
Mag.	54° 25'	9° 27'	0° 3'		
δ					
Wire	a				
"	b				
"	c				
"	1	12 0 37.8	12 15 18.1		
"	2	41.7	22.0		
"	3	45.1	25.5		
"	4	49.0	29.0		
"	5	52.5	32.8		
"	d				
"	e				
"	f	11 50 10.5			
	Less	62.41			
Sum		226.1	12 7.4		
Mean	11 49 8.09	12 0 45.22	12 15 25.48		
Red'n to					
m					
n (tan. δ - tan φ)	+ .32	- .48	- .59		
c. sec. δ	- .57	- .34	- .33		
r					
T - b sec φ	11 49 7.84	12 0 44.40	12 15 24.56		
a	11 47 0.28	11 58 36.75	12 13 16.82		
ΔT + b sec φ	- 2 7.56	2 7.65	2 7.74		

$c' \text{ Ill. West} = - .33$  (see Nov. 17)  
 $n = + .65$

$\Delta T + b \sec \phi = - 127.70$   
 $b \sec \phi \text{ observed} = + .65$

block fast (at 12<sup>h</sup>) 128.35  
 Cambridge sid. time immersion of 44 Gem. 10<sup>h</sup> 10<sup>m</sup> 24.5  
 emersion 11 8 44.2



## Meer. Circle

Date	1870	Dec 14 <sup>th</sup>		
Observer		E. P. A.		
Illumin'n				
Star		$\kappa$ Draconis & Cass	21 Cass	
Mag.				
$\delta$				
Wire	a			
"	b			
"	c	82	0 35 19.1	0 39 17.8
"	1	52 29 28.2	28.0	36.0
"	2	35.4	32.3	45.3
"	3	42.6	36.7	54.4
"	4	49.9	41.4	40 3.7
"	5			
"	d	30 4.8		
"	e			
"	f			
Sum		220.9	157.5	217.2
Mean		0 29 44.18	0 35 31.50	0 39 43.44
Red'n to	D	+ 20.73	- 12.32	- 25.54
m				
n. (tan. $\delta$ - tan $\phi$ )		- 1.23	+ .18	+ .87
c. sec. $\delta$				
r				
T - bsec $\phi$		0 30 3.68	0 35 19.36	0 39 18.77
a		12 27 55.52	0 33 11.57	0 37 10.59
$\Delta T + bsec \phi$		- 2 8.16	2 7.79	2 8.18

Dec. 14 1870.

c assumed 0.00

n from  $\kappa$  Draconis & 21 Cass + .33

$$\Delta T + bsec \phi \text{ (mean of } \kappa \text{ Cass. \& 11 Orionis)} - 127.82$$

$$\Delta T - bsec \phi + 2bsin \phi (tan \delta - tan \phi) \text{ (from } \kappa \text{ Aurigae observed by reflection)} - 128.24$$

$$b = +.18$$

$$bsec \phi = +.24$$

Clock fast at 3h

128.06

Mer. Circle

Date	1870	Dec 14 <sup>th</sup>	Dec. 21		
Observer		E.P.A.	E.P.A.		
Illumin'n			W		
Star		$\epsilon$ Aurigae	11 Orionis		
Mag.			32 Ann. foll. Z.C.		
$\delta$			84° 7'		
Wire	a	C 1	4 <sup>2</sup> 50 29.2	4 59 7.2	0 52 20.1
"	b	2	32.2	10.0	51 54.5
"	c	3	35.2	12.6	30.8
"		4	38.2	14.9	6.8
"	1				
"	2	D	44.0	20.1	50 18.5
"	3				
"	4	E <sub>1</sub>	50.7	25.3	
"	5	2	52.9	27.8	
"		3	55.8	30.2	
"	d	4	58.7	32.9	
"	e				
"	f				
Sum			397.1	181.0	130.2
Mean			4 50 44.12	4 59 20.11	0 51 26.04
Red'n to m	D		+ .01	+ .01	- 67.69
n. (tan. $\delta$ - tan $\varphi$ )			- .08	- .21	- 3.19
c. sec. $\delta$					
$\tau$					
T - 6 sec $\varphi$			4 50 44.05	4 59 19.91	0 50 15.16
a			4 48 35.81	4 57 12.06	<del>12 48</del> 8.08
$\Delta T$ + 6 sec $\varphi$			- 2 8.24	2 7.85	2 7.08



## Mer. Circle.

Date	1870	Dec. 21								
Observer		E. F. A.								
Illumin'n		W.								
Star		Polaris			$\gamma$ Piscium		$\alpha$ Piscium			
Mag.										
$\delta$		$88^{\circ} 37' 5$			$14^{\circ} 41'$		$8^{\circ} 30'$			
Wire	a	C <sub>2</sub>	1	6	58.0					
"	b	3		8	39.2					
"	c	4		10	22.7					
<b>D</b>				13	43.9	1	26	42.3		
<b>E</b>				17	17.6					
"	1						1	40		
"	2									
"	3									
"	4									
"	5									
"	d									
"	e									
"	f									
Sum				127.4		247.5		247.4		
Mean			1	11	25.48	1	26	49.50		
							1	40		
Red'n to	D			+ 143.38		- 7.12		- 6.99		
m										
n (tan. $\delta$ - tan $\phi$ )				+ 12.19		- .19		- .23		
c. sec. $\delta$										
$\tau$										
T - b sec $\phi$	1	14	1.05		1	26	42.19	1	40	42.26
a										
	1	11	53.86		1	26	34.30	1	38	34.57
$\Delta T + b \sec \phi$	- 2		7.19		2		7.89	2		7.75

Dec. 21 1870.

c assumed 0.00

w from 32 Cam.  $\gamma$  Polaris + .30 $\Delta T + b \sec \phi$  from  $\gamma$  Piscium - 127.82b sec  $\phi$  assumed as Dec. 14 + .24Clock fast at  $1\frac{1}{2}$ 

128.06

## Mer. Circle

Date 1871 Jan. 4

Observer E. P. A.

Illumin'n W. W.

Star

Mag.

 $\delta$  $\gamma$  Ceti $\beta$  Urs. Min. I.C. $\gamma$  Tauri $2^{\circ} 41'$  $74^{\circ} 41'$  $15^{\circ} 19'$ 

Wire a

" b

" c

D  
E

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

2 38 39.2 2 53 7.6 4 14 29.8

44.0 52 48.6 34.8

46.6 39.0 37.3

49.2 30.0 39.9

51.7 20.5 42.4

Sum

Mean

230.7 205.7 185.2

2 38 46.14 2 52 41.14 4 14 37.04

Red'n to D

m

 $n(\tan. \delta - \tan \varphi)$ c. sec.  $\delta$ 

- 6.94

+ 26.29

- 7.20

- .29

- 1.51

- .21

- .01

- .04

- .01

r

T - sec  $\varphi$ 

2 38 38.90 2 53 5.98 4 14 29.62

a

2 36 36.72 14 51 3.57 4 12 27.26

 $\Delta T + b \sec \varphi$ 

- 2 2.18 2 2.31 2 2.36

Jan. 4 1871  $c = 0.00$   $c' = 0.01$   $n = +.33$  $\Delta T + b \sec \varphi = - 2^m 2.27$   
 $b \sec \varphi$  assumed  $+ .24$ 

Clock fast (at 3h) 122.51



## Mer. Circle

Date	1871	Jan. 13								
Observer	E. P. A.									
Illumin'n	W.									
Star	$\beta$ Uro. Min. L.C. 48 Cephei $\zeta$ Arctis									
Mag.										
$\delta$	$74^{\circ} 41'$ $77^{\circ} 16'$ $20^{\circ} 34'$									
Wire	a									
"	b									
"	c									
D		2	53	3.8	3	5	59.9	3	9	27.0
"	E 1		52	45.2		6	22.6			32.3
"	2			36.4			33.2			35.0
"	3			26.1			44.8			37.7
"	4			16.9			56.2			40.3
"	5									
"	d									
"	e									
"	f									
Sum		188.4				156.7		172.3		
Mean		2	52	37.68	3	6	31.34	3	9	34.46
Red'n to	D	+ 26.26				- 31.47		- 7.41		
m										
n. (tan. $\delta$ - tan. $\varphi$ )		- 1.78				+ 1.37		- .21		
c. sec. $\delta$		0.00				0.00		0.00		
r										
T - bsec $\varphi$		2	53	2.16	3	6	1.24	3	9	26.85
a		14	51	4.29	3	4	3.37	3	7	29.06
$\Delta T + bsec \varphi$		- 1	57.87		1	57.87		1	57.79	

Jan. 13 1871  $c' = 0.00$  ~~W.~~  $n = +.39$

$\Delta T + bsec \varphi = - 117.79$  at  $3^h$   
 $bsec \varphi$  assumed  $+ .24$   
 Clock fast (at  $3^h$ )  $- 118.03$

Jan. 18 1871

$\Delta T + m$  by obs. of  $-2^m$   $\left. \begin{array}{l} + 3.34 \\ m \text{ about } 0.00 \end{array} \right\} - 116.66$   
 $n = +.23$  W. A. Rogers

# Mer. Circle

Date	1871	Jan. 27		
Observer		E. P. N.		
Illumin'n		W.		
Star		Sp. 966		$\epsilon$ Orionis
Mag.				
$\delta$		$74^{\circ} 57'$		$1^{\circ} 17' S$
Wire	a			
"	b			
"	c			
D			5 31	31.4
E	1	5 24 39.0		36.4
"	2	48.6		38.9
"	3	58.2		41.3
"	4	25 8.0		43.8
"	5			
"	d			
"	e			
"	f			
Sum		213.8		191.8
Mean		5 24 53.45	5 31	38.36
Red'n to D		-33.41		-6.94
m				
n (tan. $\delta$ - tan $\phi$ )		+ 1.12		- .37
c. sec. $\delta$				
$\tau$				
T - bsec $\phi$	5 24	21.16	5 31	31.05
a	5 22	31.43	5 29	40.34
$\Delta T + bsec \phi$	-1	49.73	1	50.71

c neglected n assumed +.40

bsec  $\phi$  assumed +.24

clock fast at  $5^h \frac{1}{2}$

110.95



















16701222, 16701223, 16701224