

KG  
11365  
338

07

Observations for Time.  
Harvard College Observatory,  
Harvard College Observatory

1869, 1870  
1869



year  
1869-}U. S. Coast Survey  
Transit No. 55 hrs. min  
1 observationT. Y. C. 1879  
1 obs -K Cephei  
4 obs -Approximate  
Thread Intervals

	B	C	D	E	F
1	+36.451	+36.479	+36.482	+36.476	B 1
2	33.953	33.884	33.906	33.910	2
3	31.299	31.356	31.313	31.318	3
4	28.810	28.870	28.788	28.805	4
5	26.172	26.092	26.208	26.183	5
6	20.964	20.910	20.971	20.959	C 1
1	18.336	18.301	18.316	18.314	2
2	15.628	15.695	15.781	15.741	3
3	13.127	12.915	13.055	13.044	4
4	10.502	10.461	10.510	10.500	5
5	5.287	5.286	5.207	5.234	D 1
6	+2.494	+2.572	+2.557	+2.549	2
1	-0.102	-0.087	-0.102	-0.099	3
2	2.603	2.591	2.680	2.652	4
3	5.256	5.226	5.321	5.294	5
4	10.393	10.431	10.385	10.394	E 1
5	12.964	12.998	12.982	12.982	2
6	15.624	15.544	15.598	15.593	3
1	18.231	18.201	18.226	18.223	4
2	20.790	20.739	20.743	20.750	5
3	26.101	26.165	26.147	26.142	F 1
4	28.689	28.646	28.697	28.687	2
5	31.548	31.497	31.466	31.485	3
6	34.036	34.052	34.063	34.057	4
1	-36.685	-36.644	-36.682	-36.676	5
					+243.036
					-243.034



## U. S. Coast Survey Transit No. 5.

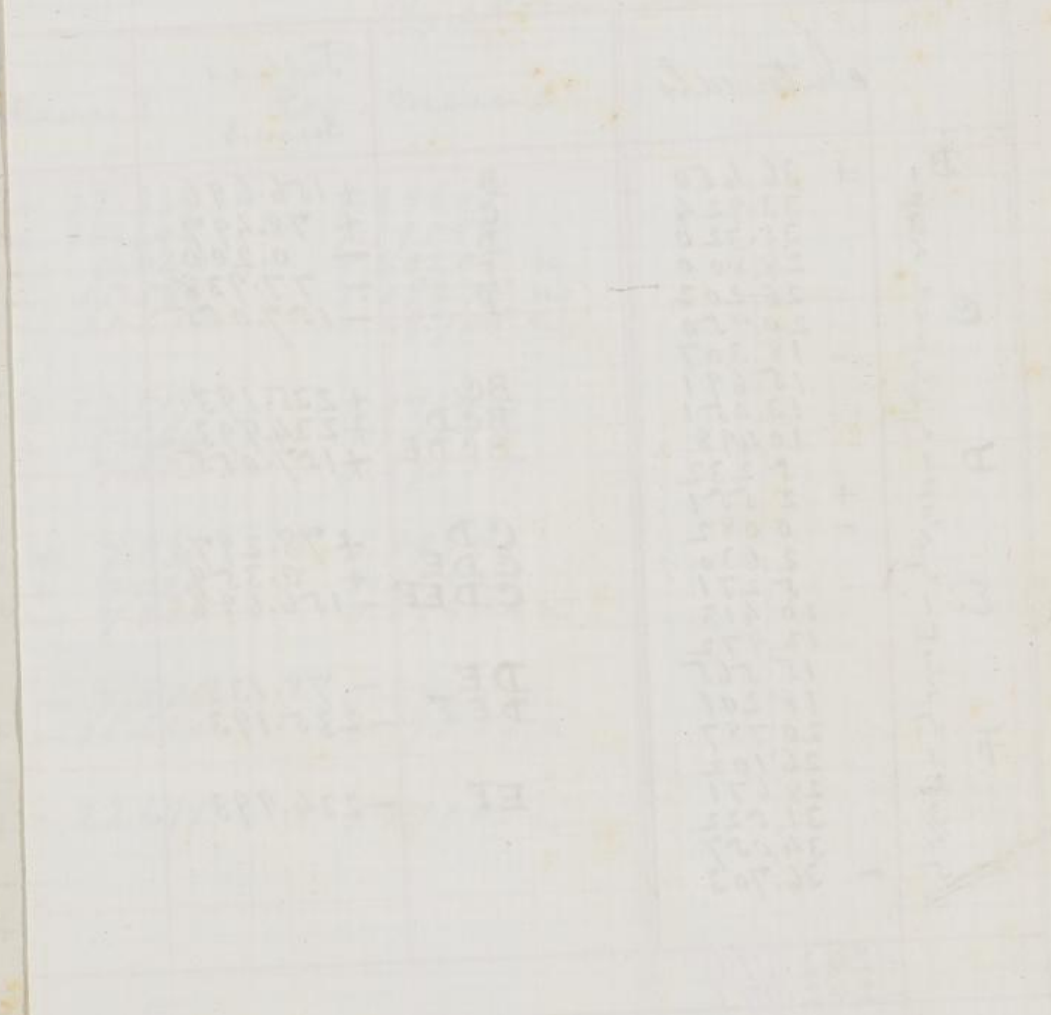
Thread IntervalsDeduced from 24 obs. of Circumpolars at Cambridge, 1869  
By J. B.

Intervals			Tallies & Sums	means	log. means -
B	+	36.450	B	+ 31.339	1.49609
		33.924	C	+ 15.699	1.19584
		31.320	D	- 0.040	8.60206 n
		28.800	E	- 15.588	1.19279 n
		26.202	F	- 31.411	1.49708 n
C		20.750			
		18.307	BC	+ 23.519	1.37142
		15.691	BCD	+ 15.666	1.19496
		13.051	BCDE	+ 7.853	0.89504
		10.498			
D		5.232			
	+	2.551	CD	+ 7.830	0.89346
		0.082	CDE	+ 0.024	8.38021
		2.630	CDEF	- 7.835	0.89404 n
		5.271			
E		10.413			
		12.972	DE	- 7.814	0.89284 n
		15.565	DEF	- 15.680	1.19535 n
		18.201			
		20.787			
F		26.102	EF	- 23.499	1.37105 n
		28.671			
		31.522			
		34.057			
	-	36.703			
+ 242.976					
- 242.976					

U.S. Coast Survey

Chart of the Coast of the State of New York

from the Survey of 1854





Wire intervals of East Transit from observations  
of circumpolar stars Sept. 19 1869.  
The seeing was very good.

Illumination East. Wires reckoned in the order  
of the transits of stars at the upper culmination.

Interval of each wire and mean of the 5 middle wires,  
divided by the secant of the star's declination.

Star.	a	b	c	1	2	3*	4	5	d	e	f
$\kappa$ Cephei	36. <sup>s</sup> 321	25. <sup>s</sup> 420	14. <sup>s</sup> 591	7. <sup>s</sup> 211	3. <sup>s</sup> 563	-. <sup>s</sup> 005	3. <sup>s</sup> 567	7. <sup>s</sup> 200	14. <sup>s</sup> 462	25. <sup>s</sup> 497	36. <sup>s</sup> 418
Gr. 3241	.422	.446	.575	.360	.585	-.111	.668	.163	.477	.418	.308
J.Y.C. 1879		.530	.551	.318	.630	-.031	.632	.285	.454	.497	.408
$\gamma$ Dra.	.191	.415	.441	.248	.558	+.008	.588	.229	.520	.423	.226
$\beta$ Cephei	.291	.425	.562	.260	.569	-.003	.688	.144	.466	.421	.462
$\eta$ Cephei	.307	.409	.449	.267	.574	+.023	.627	.241	.518	.442	.300
	1532	2645	3169	1664	3479	-.119	3770	1262	2897	2698	2152
Mean	36.306	25.441	14.528	7.277	3.580	-.020	3.628	7.210	14.483	25.450	36.359
	76.275					Residuals.†					76.292
$\kappa$ Cephei	+.015	-.021	+.063	-.066	-.017	+.015	-.061	-.010	-.021	+.047	+.089
Gr. 3241	+.116	+.005	+.047	+.083	+.005	-.091	+.040	-.047	-.006	-.032	-.051
J.Y.C. 1879		+.089	+.023	+.041	+.050	-.011	+.004	+.075	-.029	+.047	+.049
$\gamma$ Dra.	-.115	-.026	-.087	-.029	-.022	+.028	-.040	+.019	+.037	-.027	-.132
$\beta$ Cephei	-.015	-.016	+.034	-.017	-.011	+.017	+.060	-.066	-.017	-.029	+.103
$\eta$ Cephei	+.001	-.032	-.079	-.010	-.006	+.043	-.001	+.031	+.035	-.008	-.059
	+.132	+.094	+.167	+.124	+.055	+.103	+.104	+.125	+.072	+.094	+.241
	-.130	-.095	-.166	-.122	-.056	-.102	-.102	-.123	-.073	-.096	-.242

\* In the middle column + indicates that the transit takes place  
over wire 3 earlier than over the mean of the 5.

† The signs relate merely to numerical values, except for wire 3.

[Illumination East. Upper Culminations, reduced to  
Equator. Mean of 6 outside wires 0.<sup>s</sup>.003 later than  
mean of 5 middle wires.]



## Harvard College Observatory

Longitude W.  $4^h 44^m 29.5$  Greenwich  
 E.  $0^h 23^m 41.5$  Washington

Latitude  $42^\circ 22' 48''.6$  nat. tan. 0.9125  
 log. tan. 9.96022  
 nat. sec. 1.353  
 log. sec. 0.1315

Wire intervals from last Time Book.  
 Illumination West. Reduction of each wire  
 to mean of the five for  $0^\circ$  declination.

No. 1	+ 7 <sup>s</sup> .25	} from observations of 5 Ursa Minoris & $\beta$ Ursa Min. made Aug. 3, 1868.
2	+ 3.62	
3	- 0.01	
4	- 3.60	
5	- 7.26	

Value in seconds of time of one  
 revolution of the micrometer screw  
 determined roughly June 2, 1869, at 2.324









Date 1869 Aug. 29  
 Observer A.S.  
 Illumin'n E.  
 Star  $\alpha$  Lyrae  $\beta$  Lyrae  $\zeta$  Aquilae  
 Mag.  $38^{\circ} 40'$   $33^{\circ} 13'$   $13^{\circ} 41'$   
 $\delta$

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

18 33 21.8 18 46 6.7 19 0 16.8  
 26.0 11.1 20.7  
 15.2 24.6  
 35.4 19.6 28.2  
 40.0 23.9 31.8

Sum 123.20  
 Mean 123.19  
 18 33 30.80 18 46 15.30 19 0 24.42

Red'n to m +1.03 +1.03 +1.03  
 n. tan.  $\delta$  - .05 - .11 - .31  
 c. sec.  $\delta$  + .44 + .41 + .35

$r$   
 T 18 33 32.22 18 46 16.63 19 0 25.49  
 a 18 32 31.88 18 45 16.33 18 59 25.12  
 $\Delta T$  1 0.34 1 0.30 1 0.37

Aug. 29 1869. Illumination East.  
 c' assumed +.34 n assumed +.46 (as on Aug. 22)

Block fast (at  $18\frac{3}{4}$ )  $1^m$  0.34  
 Note Dec. 14, 1880. Block fast Sept. 2 (see next page)  $1^m$  3.80  
 Gain in 5 days 3.46  
 " " 1 day 0.69  
 " " 1 hour 0.03



Date 1869 Sept. 2

Observer A. S.

Illumin'n E.

Star  $\alpha$  Lyrae 51 Cephei  $\beta$  Lyrae  
 Mag.  $38^{\circ} 40'$   $87^{\circ} 14'$   $33^{\circ} 13'$   
 $\delta$

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 —  $\bar{m}$ 

a

 $\Delta T + \bar{m}$ 

18	33	25.1	18	37	2.6	18	46	10.2
		29.8		38	19.4			14.6
		34.3		39	35.1			19.0
		39.0		40	48.7			23.2
		43.8		42	5.0			27.7

		172.0			165.8			94.7
18	33	34.40	18	39	33.16	18	46	18.94

		-0.06			-12.17			-0.14
		+1.44			-7.08			+1.41

18	33	34.78	18	39	13.91	18	46	19.21
				Reduced				
18	32	31.83	18	38	10.68	18	45	16.35
1		2.95			3.23			2.86

Sept. 2 1869 Illumination East.

c' assumed +.34 as determined Aug. 22  
 n from 51 Cephei } 50 Draconis +.56

 $\Delta T + \bar{m}$  (at  $18^{\frac{3}{4}}$ )  $1^m$  2<sup>s</sup>.88 $\bar{m}$  determined Sept. 4 + 0.92Clock Fast (at  $18^{\frac{3}{4}}$ )  $1^m$  3<sup>s</sup>.80



Date	1869	Sept. 2		
Observer		A. S.		
Illumin'n		E.		
Star		$\alpha$ Sagittarii	$\gamma$ Draconis	$\zeta$ Aquilae
Mag.				
$\delta$		$26^{\circ} 27' S.$	$75^{\circ} 17'$	$13^{\circ} 41'$
Wire	a			
"	b			
"	c			
"	1	18 48 5.7	18 51 8.8	19 0 20.5
"	2	10.0	23.4	24.3
"	3	14.1	37.8	28.0
"	4	18.0	51.7	31.8
"	5	22.2	52 5.5	35.7
"	d			
"	e			
"	f			
Sum		70.0	187.2	140.3
Mean		18 48 14.00	18 51 37.44	19 0 28.06
Red'n to				
m				
n. tan. $\delta$		- .79	+ 1.62	- .38
c. sec. $\delta$		+ .37	+ 1.34	+ .35
$r$				
T	$-\bar{m}$	18 48 13.58	18 51 40.40	19 0 28.03
a		18 47 10.73	18 50 37.28	18 59 25.17
$\Delta T$	$+\bar{m}$	2.85	3.12	2.86



Date	1869	Sept. 11					
Observer		A. S.					
Illumin'n		E.					
Star		11 Cephei	79 Draconis	2	Aquarii		
Mag.							
$\delta$		$70^{\circ} 43'$	$73^{\circ} 5'$		$0^{\circ} 57'$		
Wire	a						
"	b						
"	c						
"	1	21 40 51.3	21 52 3.1	22 0 9.6			
"	2	41 1.8	15.4	13.0			
"	3	13.0	27.9	16.7			
"	4	24.4	41.2	20.5			
"	5	35.0	53.4	24.0			
"	d						
"	e						
"	f						
Sum		65.5	141.0	83.8			
Mean		21 41 13.10	21 52 28.20	22 0 16.76			
Red'n to							
m		+ .91	+ .91	+ .91			
n. tan. $\delta$		+ .88	+ 1.08	- .42			
c. sec. $\delta$		+ 1.03	+ 1.16	+ .34			
$\tau$							
T		21 41 15.92	21 52 31.35	22 0 17.59			
a		21 40 4.27	21 51 19.47	21 59 5.75			
$\Delta T$		1 11.65	1 11.88	1 11.84			

Sept. 11 1869 Illumination East.  
 $c'$  assumed +.34 n from 79 Draconis 32 hrs. Neg. +.45  
 Clock fast (at 22<sup>h</sup>) 1<sup>m</sup> 11<sup>s</sup>.88  
 " " (at 0<sup>h</sup>) 1<sup>m</sup> 11<sup>s</sup>.47



Date	1869 Sept. 11					
Observer	A. S.					
Illumin'n	E.					
Star	32 Ues. Maj. $\gamma$ Aquarii $\pi$ Aquarii					
Mag.						
$\delta$	65° 45'	8° 26' S.	0° 43'			
Wire	a					
"	b					
"	c					
"	1	22 9 23.3	22 11 1.6	22 19 41.5		
"	2	31.8	5.2	45.1		
"	3	41.0	8.7	48.8		
"	4	49.6	12.4	52.5		
"	5	58.7	16.0	56.0		
"	d					
"	e					
"	f					
Sum		204.4	43.9	243.9		
Mean	22 9	40.88	22 11	8.78	22 19	48.78
Red'n to						
m		+ .91	+ .91	+ .91		
n. tan. $\delta$		- 1.41	- .48	- .41		
c. sec. $\delta$		- .83	+ .34	+ .34		
r						
T	22 9	39.55	22 11	9.55	22 19	49.62
a	10 8	27.67	22 9	57.68	22 18	37.68
$\Delta T$	1	11.88	1	11.87	1	11.94



Date	1869	Sept. 16			
Observer		A. S.			
Illumin'n		E.			
Star		$\delta$ Aquilae	$\kappa$ Aquilae	$\gamma$ Aquilae	
Mag.		$2^{\circ} 52'$	$7^{\circ} 19' \delta$	$10^{\circ} 18'$	
$\delta$					
Wire	a				
"	b				
"	c				
"	1	19 20 3.3	19 31 0.6	19 41 11.6	
"	2	7.1	<del>4.3</del>	15.4	
"	3	10.8	7.9	18.9	
"	4	14.4	11.8	22.7	
"	5	17.9	15.1	26.4	
"	d				
"	e				
"	f				
Sum		53.5	39.7	95.0	
Mean		19 20 10.70	19 31 7.94	19 41 19.00	
Red'n to					
m		+ .91	+ .91	+ .91	
n. tan. $\delta$		- .39	- .47	- .23	
c. sec. $\delta$		+ .34	+ .34	+ .35	
r					
T		19 20 11.56	19 31 8.72	19 41 19.93	
a		19 18 55.40	19 29 52.51	19 40 3.79	
$\Delta T$		1 16.16	1 16.21	1 16.14	

Sept. 16 1869. Illumination East.  
 $c$  assumed + .34  $n$  assumed + .25  
 block fast (at  $19 \frac{1}{2}$ )  $1^m 16^s 13$



Date *1869 Sept. 16*  
 Observer *A. S.*  
 Illumin'n *E.*  
 Star  $\alpha$  Aquilae  $\beta$  Aquilae  $\lambda$  Urs. Min.  
 Mag. *8° 32'* *6° 5'* *88° 55'*  
 $\delta$

Wire a  
 " b  
 " c

"	1	19 45 33.2	19 50 2.6	
"	2	36.8	6.4	19 53 5.5
"	3	40.8	9.9	56 11.2
"	4	44.4	13.6	
"	5	47.9	17.3	

" d  
 " e  
 " f

Wire 2 reduced by  
 old wire intervals  
 19 56 13.01  
 Wire 3 by same process  
 19 56 11.72

Sum		203.1	48.8	24.73
Mean	19 45	40.62	19 50 9.76	19 56 12.36

Red'n to

m		+ .91	+ .91	+ .91
n. tan. $\delta$		-.34	-.36	+ 23.63
c. sec. $\delta$		+ .34	+ .34	+ 17.71

r

T	19 45	41.53	19 50 10.65	19 56 54.01
a	19 44	25.42	19 48 54.64	19 55 37.09
$\Delta T$	1	16.11	1 16.01	1 16.92

*Reduced by Eph. for 1870*

*Stars taken over outside wires by eye & ear*  
*Differences - Chronograph Observation later than eye & ear*

$\alpha$ Aquilae	+ 0.02
$\beta$	+ 0.11
$\lambda$	- 0.07
$\beta$	+ 0.09
	-.15
Mean	+ .04



Date	1869	Sept. 19				
Observer		A. S.				
Illumin'n		E.				
Star		$\kappa$ Cephei	$\pi$ Capricorni	Gr. 3241		
Mag.		77° 19'	18° 38' S.	72° 6'		
$\delta$						
Wire	a	20 11 47.95			20 29 54.05	
"	b	12 37.55			30 29.72	
"	c	13 26.82			31 5.05	
"	1	14 0.40	20 21 2.0			28.50
"	2	17.00	5.6			40.77
"	3	33.23	9.5			52.78
"	4	49.44	13.4		32 4.34	
"	5	15 5.97	17.0			15.70
"	d	39.01				39.47
"	e	16 29.22			33 15.03	
"	f	17 19.05				50.42
Sum of middlewires		166.04	47.5			262.09
Mean of 5 middlewires	20 14	33.21	20 21 9.50		20 31	52.42
Red'n to m		+1.91	+1.91			+1.91
n. tan. $\delta$		+1.44	+1.51			+1.89
c. sec. $\delta$		+1.55	+1.36			+1.10
$\tau$						
T	20 14	37.14	20 21 10.26		20 31	55.32
a	20 13	18.32	20 19 51.46	Reduced	20 30	36.30
$\Delta T$	1	18.79	1 18.80		1	19.02

1869 Sept. 19. Illumination East  
 c' assumed +.34  $\pi$  from  $\kappa$  Cephei  $\pi$  Capr. +.41  
 Clock fast (at 20 $\frac{1}{3}$ ) 1<sup>m</sup> 18.79.



Date	1869	Sept. 19							
Observer		A. P.							
Illumin'n		E.							
Star		$\alpha$ Cygni							
Mag.									
$\delta$		$144^{\circ} 49'$							
Wire	a								
"	b			20	52	18.15			
"	c				53	21.72			
"	1	20	38	7.4	54	3.60			
"	2			12.4		24.95			
"	3			17.6		46.15			
"	4			22.7	55	7.00			
"	5			27.9		28.15			
"	d				56	9.66			
"	e				57	13.60			
"	f				58	16.77	21	1	44.40
							Less	1	35.50
Sum of middle wires				88.0		229.85			
Mean of 5 middle wires	20	38	17.60	20	54	45.97	21	0	8.90
Red'n to									
m				+ .91		+ .91			+ .91
n. tan. $\delta$				+ .63		+ 1.96			- 1.37
c. sec. $\delta$				+ .48		+ 1.97			- .89
r									
T	20	38	19.02	20	54	50.81	21	0	7.55
a	20	37	0.24	20	53	31.93	8	58	49.14
$\Delta T$			1 18.78			1 18.88			1 18.41

Eye & ear observations  
over the six outside wires

$\pi$  Capricorni 20 21 9.44  
 $\alpha$  Cygni 20 38 17.58

From the circumpolar stars,  
the mean of the six outside wires  
is, 0<sup>s</sup>.003 later than the mean  
of the 5 middle wires.

Sept. 19, 1869. Illumination East.

If c' is assumed at +.34,  $\pi$  is found by  
Cauchy's method from all the stars to be +.372  
giving  $\sigma^2$  Ues. Maj.

Then  $\Delta T + m = -77.85$  (or clock fast 1<sup>m</sup> 18<sup>s</sup>. 76)

	Residuals.	Sec'd	Quotient.
$\pi$ Cephei	+ .09	4.55	.02
$\pi$ Capricorni	- .09	1.06	.08
$\sigma$ 8241.	- .18	3.25	.06
$\alpha$ Cygni	- .02	1.41	.01
$\gamma$ Ues. 1879	- .06	5.79	.01
$\gamma$ Draconis	+ .10	7.11	.01
$\beta$ Cephei	- .03	2.92	.01
$\gamma$ Cephei	- .07	2.60	.02



Date	1869 Sept. 19									
Observer	A.S.									
Illumin'n	E.									
Star	1 Draconis				$\beta$ Cephei			$\eta$ Cephei		
Mag.										
$\delta$	81° 54'				70° 0'			70° 43'		
Wire	a	21	15	11.93	21	26	31.80	21	39	30.00
"	b		16	28.74		27	3.53		40	3.02
"	c		17	46.26			35.25			36.23
"	1		18	38.10			56.57			57.99
"	2		19	3.99		28	7.35		41	9.18
"	3			29.56			17.78			19.94
"	4			54.80			28.54			31.00
"	5		20	21.02			38.63			41.95
"	d		21	12.41		29	0.01		42	4.00
"	e		22	30.20			32.00			37.10
"	f		23	46.82		30	4.24		43	40.00
Sum of middle wires				147.48			88.87			100.06
Mean of 5 middle wires		21	19	29.50	21	28	17.77	21	41	20.01
Red'n to										
m				+1.91			+1.91			+1.91
n. tan. $\delta$				-3.26			+1.75			+1.80
c. sec. $\delta$				-2.42			+1.99			+1.03
$\tau$										
T		21	19	24.73	21	28	20.42	21	41	22.75
a		9	18	6.38	21	27	1.56	21	40	3.99
$\Delta T$				1 18.35			1 18.86			1 18.76

Date	1869	Sept. 24			
Observer		A. S.			
Illumin'n		E.			
Star		$\kappa$ Cephei	$\pi$ Capricorni	$\epsilon$ Delphini	
Mag.					
$\delta$		$77^{\circ} 19'$	$18^{\circ} 38' S.$	$10^{\circ} 52'$	
Wire	a				
"	b				
"	c				
"	1	20 14 4.0	20 21 5.8	20 28 13.7	
"	2	20.2	9.5	17.4	
"	3	36.7	13.4	21.1	
"	4	53.4		24.8	
"	5	15 9.6	20.9	28.4	
"	d				
"	e				
"	f				
Sum		183.9	53.45	105.4	
Mean		20 14 36.78	20 21 13.36	20 28 21.08	
Red'n to					
m		+ .98	+ .98	+ .98	
n. tan. $\delta$		+ 1.31	- .46	- .27	
c. sec. $\delta$		+ 1.55	+ .36	+ .36	
$\tau$					
T		20 14 40.62	20 21 14.24	20 28 22.14	
a		20 13 17.86	20 19 57.39	20 26 59.25	
$\Delta T$		1 22.76	1 22.85	1 22.89	

{  $\epsilon$  Delphini by eye & ear over }  
 6 outside wires 20<sup>h</sup> 28<sup>m</sup> 21.08

Sept. 24, 1869. Illumination East.  
 c' assumed +.34 n assumed +.372  
 Clock fast (at 20<sup>h</sup> 1/2) 1<sup>m</sup> 22.86



Date 1869 Sept. 24  
 Observer A.S.  
 Illumin'n E.  
 Star  $\gamma$  Cygni  $\mu$  Aquarii  
 Mag. 72° 6' 44° 49' 9° 28' S.

Wire	a	b	c
"	1	2	3
"	4	5	6
"	d	e	f

Sum	20	31	32.2	20	38	10.9	20	46	52.2
Mean	20	31	55.80	20	38	21.26	20	46	59.50

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

T	20	31	58.69	20	38	22.75	20	47	0.42
a	20	30	35.99	20	37	0.13	20	45	37.33
$\Delta T$	1	22.70		1	22.62		1	23.09	

$\left\{ \begin{array}{l} \gamma \text{ Cygni by eye \& ear} \\ \text{over wires d, e, f,} \\ 20^h 31^m 56^s.06 \end{array} \right\}$ 
 $\left\{ \begin{array}{l} \mu \text{ Aquarii by eye \& ear} \\ \text{over wires c, d, e, f,} \\ 20^h 38^m 21^s.48 \end{array} \right\}$ 
 $\left\{ \begin{array}{l} \mu \text{ Aquarii by eye \& ear} \\ \text{over 6 outside wires} \\ 20^h 46^m 59^s.43 \end{array} \right\}$



Date	1869 Sept. 27		
Observer	A. S.		
Illumin'n	E.		
Star	E Delphinii Gr. 3241		
Mag.	α Cygni		
δ	10° 52'	72° 6'	44° 49'
Wire	a		
"	b		
"	c		
"	1	20 28 16.1	20 31 34.7
"	2	19.8	46.4
"	3	23.4	58.4
"	4	27.2	32 10.1
"	5	30.9	21.4
"	d		
"	e		
"	f		
Sum		117.4	291.0
Mean	20 28 23.48	20 31 58.20	20 38 23.78
Red'n to			
m	+ .91	+ .91	+ .91
n. tan. δ	- .14	+ .44	+ .62
c. sec. δ	+ .35	+ 1.10	+ 1.48
r			
T	20 28 24.60	20 32 0.65	20 38 25.19
a	20 26 59.19	20 30 35.06	20 37 0.04
Δ T	1 25.41	1 25.59	1 25.15
<div style="display: flex; justify-content: space-around;"> <div>             { E Delphinii: mean of 5 middle wires by eye and ear over 6 outside wires 20 28 23.35           </div> <div>             { Gr. 3241: mean of 5 middle wires by eye and ear over 6 outside wires 20 31 56.83           </div> <div>             { α Cygni: mean of 5 middle wires by eye and ear over 6 outside wires 20 38 23.30           </div> </div>			

Sept. 27 1869. Illumination East  
 c' assumed +.34 or from Gr. 3241 502<sup>nd</sup> Mer. +.20  
 Clock fast (at 20<sup>h</sup> 2<sup>m</sup> 3<sup>s</sup>) 1<sup>st</sup> 25<sup>h</sup> 39<sup>m</sup>



Date 1869 Sept. 27  
 Observer A. S.  
 Illumin'n E.  
 Star  $\mu$  Aquarii  $\nu$  Cygni  $\sigma^2$  Urs. Maj.  
 Mag.  $9^\circ 28' \phi$   $40^\circ 40'$   $67^\circ 39'$   
 $\delta$

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

20	46	54.5	20	53	34.0	20	59	57.2
		58.3			38.9	21	0	6.2
	47	1.9			43.7			15.5
		5.6			48.3			25.4
		9.1			53.0			34.9

Sum		9.4			217.9			79.2	
Mean	20	47	1.88	20	53	43.58	21	0	15.84

Red'n to

m

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

+ .91	+ .91	+ .91
- .22	- .01	- .67
+ .34	+ .45	- .89

 $\tau$ 

T

20	47	2.91	20	53	44.93	21	0	15.19
----	----	------	----	----	-------	----	---	-------

a

20	45	37.28	20	52	19.55	8	58	49.58
----	----	-------	----	----	-------	---	----	-------

 $\Delta T$ 

1	25.63	1	25.38	1	25.61
---	-------	---	-------	---	-------

$\left\{ \begin{array}{l} \mu \text{ Aquarii: mean of} \\ 5 \text{ middle wires by} \\ \text{eye and ear over} \\ 6 \text{ outside wires} \\ 20 \ 47 \ 1.45 \end{array} \right\}$ 
 $\left\{ \begin{array}{l} \nu \text{ Cygni: mean of} \\ 5 \text{ middle wires by} \\ \text{eye and ear over} \\ 6 \text{ outside wires} \\ 20 \ 53 \ 43.58 \end{array} \right\}$ 
 $\left\{ \begin{array}{l} \sigma^2 \text{ Urs. Maj.: mean} \\ \text{of 6 middle wires} \\ \text{by eye and ear over} \\ 6 \text{ outside wires} \\ 21 \ 0 \ 15.83 \end{array} \right\}$



Date	1869	Oct. 1					
Observer		A. S.					
Illumin'n		E.					
Star		1 Draconis	5 Aquarii		ε Pegasi		
Mag.		81° 54'	8° 26' S.		9° 17'		
Wire	a						
"	b						
"	c						
"	1		21 32	8.5	21 39	6.9	
"	2	21 19	13.8	12.2		10.6	1.
"	3		40.0	15.9		14.2	
"	4	20	5.2	19.5		18.0	
"	5		30.6	23.4		21.5	
"	d						
"	e						
"	f						
Sum		Loss	209.60				
			54.26				
			158.34				
Mean		21 19	39.58	21 32	15.90	21 39	14.24
Red'n to							
m			+1.91		+1.91		+1.91
n. tan. δ			-1.99		-1.24		-1.19
c. sec. δ			-2.42		+1.34		+1.34
r							
T		21 19	36.08	21 32	16.91	21 39	15.30
a		9 18	7.94	21 30	48.85	21 37	47.41
Δ T		1	28.14	1	28.06	1	27.89

{ 1 Draconis; mean } { 5 Aquarii; mean } { ε Pegasi; mean }  
 of 5 middle wires } of 5 middle wires } of 5 middle wires }  
 by eye and ear } by eye and ear } by eye and ear }  
 over 6 outside wires } over 6 outside wires } over 6 outside wires }  
 21: 19 39.52 } 21 32 15.90 } 21 39 14.15 }

Oct. 1 1869. Illumination East. C assumed +.34, n assumed +.25

Block fast (at 21 $\frac{1}{2}$ ) 1<sup>m</sup> 27.98



Date 1869 Oct. 5  
 Observer A. S.  
 Illumin'n E.  
 Star 79 Draconis  $\alpha$  Aquarii 32 Urs. Major.  
 Mag.  $73^{\circ} 5'$   $0^{\circ} 57' S.$   $65^{\circ} 45'$

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

Sum	Mean
21 52 21.6 22 0 29.2 22 9 44.4	21 52 47.04 22 0 36.62 22 10 1.54

Red'n to	m	n. tan. $\delta$	c. sec. $\delta$
	+0.91	+1.62	+1.17
	+0.91	-0.40	+0.34
	+0.91	-1.35	-1.83

T	a	$\Delta T$
21 52 50.14 22 0 37.47 22 10 0.27	21 51 18.42 21 59 5.59 10 8 28.55	1 31.72 1 31.88 1 31.72

{ 79 Draconis: mean of 5 middle wires by eye and ear over wires c, d, e, f, 21 52 47.29 }  
 {  $\alpha$  Aquarii: mean of 5 middle wires by eye and ear over wires d, e, f, 22 0 36.71 }  
 { 32 Urs. Major: mean of 5 middle wires by eye and ear over 6 outside wires 22 10 1.42 }

Oct. 5 1869, Illumination East.  
 c' assumed +0.41 m from 79 Draconis & 32 Urs. Major. +0.43  
 Clock fast (at 22<sup>h</sup>) by  $\alpha$  Aquarii 1<sup>m</sup> 31.88



Date	1869	Oct. 6			
Observer		A. S.			
Illumin'n		E.			
Star		$\mu$ Aquarii	$\nu$ Cygni	J. Y. C. 1879	
Mag.		9 <sup>o</sup> 28' 21"	40 <sup>o</sup> 40'	80 <sup>o</sup> 4'	
$\delta$					
Wire	a				
"	b				
"	c				
"	1	20 47 1.8	20 53 41.5		
"	2	5.7	46.0		
"	3	9.3	51.1	20 54 58.1	
"	4	13.2	55.8	55 18.7	
"	5	16.8	54 0.7	40.3	
"	d				
"	e				
"	f				
Sum		46.8	255.1	237.10	
Mean		20 47 9.36	20 53 51.02	20 54 58.08	
Red'n to					
m		+1.82	+1.82	+1.82	
n. tan. $\delta$		-.43	-.02	+1.92	
c. sec. $\delta$		+1.34	+1.45	+1.97	
r					
T		20 47 10.00	20 53 52.27	20 55 2.79	
a		20 45 37.16	20 52 19.37	20 53 30.04	
$\Delta T$		1 32.93	1 32.90	1 32.75	

{  $\mu$  Aquarii: mean  
of 5 middle wires  
by eye and ear over  
6 outside wires  
20 47 9.23 }

Oct. 6 1869. Illumination East.

C assumed +1.34 n from J. Y. C. 1879  $\delta^2$  W. by +1.40

clock fast (at 2.1<sup>h</sup>) 1<sup>m</sup> 32.81



Date	1869 Oct. 6					
Observer	And.					
Illumin'n	E.					
Star	$\sigma^2$ Urs. Maj.	61' Cygni	$\xi$ Cygni			
Mag.						
$\delta$	$67^\circ 39'$	$38^\circ 7'$	$29^\circ 42'$			
Wire	a					
"	b					
"	c					
"	1	21 0 5.4	21 2 26.1	21 8 47.3		
"	2	14.4	30.8	51.4		
"	3	24.4	35.5	55.2		
"	4	33.4	40.0	59.6		
"	5	43.5	44.6	9 3.6		
"	d					
"	e					
"	f					
Sum		121.1	177.0	277.1		
Mean		21 0 24.22	21 2 35.40	21 8 55.42		
Red'n to						
m		+1.82	+1.82	+1.82		
n. tan. $\delta$		-1.34	-.05	-.14		
c. sec. $\delta$		-.89	+1.43	+1.39		
r						
T		21 0 22.81	21 2 36.60	21 8 56.49		
a		8 58 50.11	<sup>Revised</sup> 21 1 3.95	21 7 23.75		
$\Delta T$		1 32.70	1 32.65	1 32.74		

Date	1869	Oct. 9			
Observer		A. S.			
Illumin'n		E.			
Star		$\mu$ Aquarii	$\gamma$ Cygni	J. Y. C. 1879	
Mag.		9° 28' S.	40° 40'	80° 4'	
$\delta$					
Wire	a				
"	b				
"	c				
"	1	20 47 4.0	20 53 43.6		
"	2	7.8	48.4		
"	3	11.4	53.0	20 55 0.1	
"	4	15.2	57.9	20.7	
"	5	18.8	54 2.7	40.9	
"	d				
"	e				
"	f				
				61.70	
				62.86	
Sum		57.2	26 5.6	178.84	
Mean		20 47 11.44	20 53 53.12	20 54 59.61	
Red'n to					
m		+ .82	+ .82	+ .82	
n. tan. $\delta$		- .52	- .02	+ 2.30	
c. sec. $\delta$		+ .34	+ .45	+ 1.97	
$\tau$					
T		20 47 12.08	20 53 54.07	20 55 4.70	
a		20 45 37.12	20 52 19.31	20 53 29.68	
$\Delta T$		1 34.96	1 35.06	1 35.02	

$\left\{ \begin{array}{l} \mu \text{ Aquarii: mean of} \\ 5 \text{ middle wires by} \\ \text{eye and ear over} \\ 26 \text{ outside wires} \\ 20 \text{ 47 } 11.50 \end{array} \right\}$

Oct. 9, 1869. Illumination East.  
 C assumed + .34 n from J. Y. C. 1879  $80^\circ$  W. Mag. + .48  
 Clock fast (at 24h) 1<sup>m</sup> 34.<sup>s</sup> 98



Date	1869	Oct. 9					
Observer		A. S.					
Illumin'n		E.					
Star		$\alpha^2$ Urs. Maj.	61' Cygni	5 Cygni			
Mag.							
$\delta$		$67^\circ 39'$	$38^\circ 7'$	$29^\circ 42'$			
Wire	a						
"	b						
"	c						
"	1	21 0 8.0	21 2 28.5	21 8 49.3			
"	2	17.4	33.0	53.5			
"	3	26.9	37.6	57.6			
"	4	36.3	42.3	9 1.8			
"	5	46.2	46.8	5.8			
"	d						
"	e						
"	f						
Sum		134.8	188.2	288.0			
Mean		21 0 26.96	21 2 37.64	21 8 57.60			
Red'n to							
m		+1.82	+1.82	+1.82			
n. tan. $\delta$		-1.61	-.06	-.16			
c. sec. $\delta$		-.89	+1.43	+1.39			
r							
T		21 0 25.28	21 2 38.80	21 8 58.65			
a		8 58 50.29	21 1 3.89	21 7 23.69			
$\Delta T$		1 34.99	1 34.94	1 34.96			
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <math>\left\{ \begin{array}{l} 61' \text{ Cygni: mean of} \\ 5 \text{ middle wires} \\ \text{by eye and ear} \\ \text{and 6 outside wires} \\ 21 \ 2 \ 37.65 \end{array} \right\}</math> </div> <div style="text-align: center;"> <math>\left\{ \begin{array}{l} 5 \text{ Cygni: mean of} \\ 5 \text{ middle wires by} \\ \text{eye and ear wires} \\ \text{and 6 outside wires} \\ 21 \ 8 \ 57.65 \end{array} \right\}</math> </div> </div>							

Date 1869 Oct. 17

Observer A.S.

Illumin'n E.

Star

Mag.

 $\delta$ 61 Cygni  
38° 7' $\xi$  Cygni  
29° 42' $\alpha$  Cephei  
62° 2'

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

21	2	35.5	21	8	56.2	21	16	53.9
		40.0		9	0.4		17	1.8
		44.6			4.8			9.2
		49.1			8.9			17.0
		53.8			12.9			24.5

Sum

Mean

223.0	23.2	46.4
21 2 44.60	21 8 4.64	21 17 9.28

Red'n to

m

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

+90	+90	+90
-1.05	-1.13	+1.37
+1.43	+1.39	+1.72

 $\tau$ 

T

a

 $\Delta T$ 

21	2	45.88	21	9	5.80	21	17	11.27
Rebend								
21	1	3.72	21	7	23.54	21	15	29.25
1		42.15	1		42.26	1		42.02

61 Cygni: mean of 5 middle wires by eye and ear over 6 outside wires 21 2 44.76	$\xi$ Cygni: mean of 5 middle wires by eye and ear over 6 outside wires 21 9 4.69	$\alpha$ Cephei: mean of 5 middle wires by eye and ear over 6 outside wires 21 17 9.40
---	---	--

Oct. 17, 1869, Illumination Coast.  
 C assumed +.34 from  $\beta$  Aquarii &  $\alpha$  Cephei +.38  
 Clock fast (at 21  $\frac{1}{4}$ ) 1<sup>m</sup> 42.14



Date	1869 Oct. 17		
Observer	A. S.		
Illumin'n	E.		
Star	$\beta$ Aquarii	$\beta$ Cephei	$\eta$ Cephei
Mag.	6° 8' S.	70° 0'	70° 43'
$\delta$			
Wire	a		21 39 52.0
"	b		40 25.1
"	c		
"	1	21 26 15.0	41 20.2
"	2	19.7	31.4
"	3	23.0	42.4
"	4	26.9	21 28 50.0
"	5	30.4	29 0.8
"	d		42 3.6
"	e		
"	f		
		110.80	
		Less 31.65	
Sum	115.0	79.15	210.6
Mean of 5 middle wires	21 26 23.00	21 28 39.57	21 41 42.12
Red'n to			
m	+ .90	+ .90	+ .90
n. tan. $\delta$	- .39	+ .70	+ .74
c. sec. $\delta$	+ .34	+ .99	+ 1.03
r			
T	21 26 23.85	21 28 42.16	21 41 44.79
a	21 24 41.71	21 27 0.19	21 40 2.65
$\Delta T$	1 42.14	1 41.97	1 42.14
$\left\{ \begin{array}{l} \beta \text{ Aquarii: mean of} \\ 5 \text{ middle wires by eye} \\ \text{and ear over} \\ \text{outside wires} \\ 21 \ 26 \ 23.28 \end{array} \right\}$			
$\left\{ \begin{array}{l} \beta \text{ Cephei: mean of} \\ 5 \text{ middle wires by} \\ \text{eye and ear over} \\ \text{wires d, e, f.} \\ 21 \ 28 \ 39.66 \end{array} \right\}$			
$\left\{ \begin{array}{l} \text{Count lost in} \\ \text{attempted eye and} \\ \text{ear observation.} \\ \text{Hau gives } 52.05 \\ \text{" b " } 25.25 \end{array} \right\}$			

Date 1869 Oct. 25

Observer E. P. A.

Illumin'n E.

Star  $\delta$  Aquarii  $\gamma$  Aquarii  $\pi$  Aquarii  
Mag.  $8^{\circ} 26' S.$ 

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

 $\Delta T$ 

22 16	38.7	22 16	36.8	22 20	18.8
	42.3		40.6		22.7
	45.9		44.1		26.0
	49.8		47.8		29.8
	58.5		51.2		33.3

Sum	230.2	220.5	130.6
Mean	22 16 46.04	22 16 44.10	22 20 26.12

Red'n to	
m	+ .82
n. tan. $\delta$	- .40
c. sec. $\delta$	+ .34

T	22 19 46.80
---	-------------

a	22 9 57.28
---	------------

$\Delta T$	1 49.52
------------	---------

Oct 25 1869 Illumination East.  
m assumed +.82 as in Oct. 9, as the weather has been  
Cold since Oct. 17.

c' +.34 n +.38 as on Oct. 17  
A from English Almanac, Am. Eph. having been lost.  
Clock fast (at 22  $\frac{11}{4}$ ) 1<sup>m</sup> 49.58



Date	1869	Oct. 25	Nov. 7	
Observer	E. P. A.	A. S.		
Illumin'n	E.	E.		
Star	$\gamma$ Draconis	$\eta$ Aquarii	$\epsilon$ Piscium	
Mag.		$0^{\circ}47'S$	$4^{\circ}55'$	
$\delta$				
Wire	a			
"	b			
"	c			
"	1	22 25 12.4	22 30 21.0	23 35 5.5
"	2	28.3	24.8	9.0
"	3	43.8	28.4	12.8
"	4	59.0	32.1	16.3
"	5	26 14.4	35.9	20.0
"	d			
"	e			
"	f			
Sum		217.9	142.2	63.6
Mean		22 25 43.58	22 30 28.44	23 35 12.72
Red'n to				
m			+ .82	+ .66
n. tan. $\delta$			- .35	- .37
c. sec. $\delta$			+ .34	+ .34
$\tau$				
T			22 30 29.25	23 35 13.35
a			22 28 39.62	23 33 15.22
$\Delta T$			1 49.63	1 58.13

Date	1869	Nov. 7							
Observer		A. S.							
Illumin'n		E.							
Star		$\gamma$ Cephei	Gr. 4163				$\omega$ Piscium		
Mag.		76° 55'					6° 9'		
$\delta$									
Wire	a								
"	b								
"	c								
"	1			23	50	4.2	23	54	28.0
"	2					17.2			31.6
"	3	23	36	0.0		29.3			35.1
"	4			15.8		42.6			38.8
"	5			31.9		53.7			42.3
"	d								
"	e								
"	f								
Sum									
Mean									
Red'n to									
m									
n. tan. $\delta$									
c. sec. $\delta$									
r									
T		23	36	3.56			23	54	35.80
a		23	34	5.49			23	52	37.65
$\Delta T$				1 58.07					1 58.15

Nov. 7 1869. Illumination E.  
 D<sub>g</sub> 2 from Greenwich Almanac.  
 c) assumed +1.34  
 n by Cauchy's method +.45  
 clock fast (at 0<sup>h</sup>) 1<sup>m</sup> 58.14



Date	1869	Nov. 7			
Observer		A. S.			
Illumin'n		E.			
Star		$\alpha$ Androm.	4 Drac.	$\gamma$ Pegasi	
Mag.		28° 22'		14° 28'	
$\delta$					
Wire	a				
"	b				
"	c				
"	1		0 7 22.8		
"	2	0 3 33.2	41.0		
"	3	<del>37.1</del>	58.5	0 8 29.7	
"	4	<del>41.5</del>		33.2	
"	5	45.6		36.8	
"	d				
"	e				
"	f				
Sum		$\begin{array}{r} 157.40 \\ 8.30 \\ \hline 149.10 \end{array}$	$\begin{array}{r} 122.30 \\ 53.75 \\ \hline 176.05 \end{array}$	$\begin{array}{r} 99.70 \\ 11.18 \\ \hline 88.52 \end{array}$	
Mean		0 3 37.27	0 7 58.68	0 8 29.51	
Red'n to					
m		+ .66		+ .66	
n, tan. $\delta$		- .17		- .29	
c. sec. $\delta$		+ .39		+ .35	
$\tau$					
T		0 3 38.15		0 8 30.23	
a		0 1 39.98		0 6 32.13	
$\Delta T$		1 58.17		1 58.10	

Date 1869 Nov. 12

Observer

A. S.

Illumin'n

E.

Star

 $\alpha$  Draconis & Cassiopeae  $\beta$  Octi

Mag.

 $\delta$ 

55° 50'

18° 42' S.

Wire

a

0<sup>h</sup> 28 3.91 0 34 3.40

"

b

36.28 22.70

"

c

29 9.23 41.86

"

1

30.72 54.84 0 38 55.5

"

2

41.78 35 1.32 59.3

"

3

52.43 7.80 39 3.0

"

4

30 3.00 14.28 7.0

"

5

14.66 20.53 10.7

"

d

36.05 33.63

"

e

31 8.81 53.22

"

f

41.54 36 12.83

Sum

262.58 38.80 15.5

Mean

of 5 middle wires 0 29 52.52 0 35 7.76 0 39 3.10

Red'n to

m

+ .60 + .60

n. tan.  $\delta$ 

+ .25 - .56

c. sec.  $\delta$ 

+ .61 + .36

r

T

0 35 9.22 0 39 3.50

a

0 33 9.32 0 37 3.25

 $\Delta T$ 

1 59.90 2 00.25

Nov. 12 1869 Illumination East.  
 R. A. from Greenwich Almanac  
 c assumed +.36 n +.65 as on Nov. 7  
 Clock fast (at 0<sup>h</sup> 2<sup>m</sup>) 2<sup>m</sup> 0<sup>s</sup> 12



Date 1869 Nov. 12

Observer A.S.

Illumin'n E.

Star 32 Cam. foll.  $\epsilon$  Piscium PolarisMag.  $7^{\circ} 11'$ 

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

 $\Delta T$ 

11	48	55.7	0	58	3.8	1	8	35.5
	49	30.8			7.4		11	6.1
	50	5.4			11.1		13	32.6
		41.0			14.8		16	1.5
	51	16.1			18.5		18	32.5

		29.0			55.6			168.2
0	50	5.80	0	58	11.12	1	13	33.64

+ .60  
- .35  
+ .34

0 58 11.71

0 56 11.58

2 0.13

Date 1869 Nov. 21

Observer A. S.

Illumin'n E.

Star

Mag.

 $\delta$  $\beta$  Urs. Min. $\alpha$  Ceti

48 Cephei

 $74^{\circ} 41'$  $3^{\circ} 35'$  $77^{\circ} 15'$ 

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

 $\Delta T$ 

2	52	37.5	2	57	23.2	3	5	25.1
		51.0			27.0			42.1
	53	5.0			36.7			58.4
		18.4			34.3	6		14.6
		32.2			37.8			31.1

		24.1			153.0			291.3
2	53	4.82	2	57	30.60	3	5	58.26

		+ .63			+ .63			+ .63
		- .91			- .17			+ .70
		- 1.29			+ .34			+ 1.57

2	53	31.25	2	57	31.40	3	6	1.13
---	----	-------	---	----	-------	---	---	------

14	51	1.04	2	53	29.09	3	3	58.96
----	----	------	---	----	-------	---	---	-------

2	2.21	2	2.31	2	2.17
---	------	---	------	---	------

Nov. 21 1869 Illumination East.  
 $c'$  assumed + .34 n from  $\beta$  Urs. Min & 48 Cephei + .20  
 Clock fast (at 3<sup>h</sup>) 2<sup>m</sup> 25.29.



Date	1869	Nov. 21	Dec. 9
Observer		A. S.	E. P. A.
Illumin'n		E.	W.
Star		$\delta$ Arietis	Coast Highway Transit
Mag.		$\alpha$ Persei	$\beta$ Arietis
$\delta$		$20^{\circ} 34'$	$20^{\circ} 10'$
Wire	a		
"	b		
"	c		
"	1	3 9 19.5	1 49 23.2
"	2	23.6	25.7
"	3	27.4	29.0
"	4	31.3	32.0
"	5	35.0	34.6
"	d		
"	e		
"	f		
Sum		136.8	23.4
Mean		3 9 27.36	3 17 4.68
Red'n. to			
m		+ .63	+ .63
n. tan. $\delta$		- .11	- .14
c. sec. $\delta$		+ .36	+ .35
$r$			
T		3 9 28.24	3 17 5.88
a		3 7 25.95	3 15 3.60
$\Delta T$		2 2.29	2 2.28

# Coast Survey Transit No. 5

Date	1869	Dec. 9						
Observer		E. P. A.						
Illumin'n		W. Coast Survey Transit				E		
Star		50 Class.		$\alpha$ Arietis		65 beti		
Mag.								
$\delta$		$71^{\circ} 47'$		$22^{\circ} 51'$		$8^{\circ} 14'$		
Wire	a							
"	b							
"	c							
"	1	1 54	8.5	2 1	46.8	2 8	4.1	
"	2		15.9		49.2		6.8	
"	3		24.5		52.4		8.8	
"	4		33.9		55.3		11.9	
"	5		42.5		58.1		14.2	
"	d							
"	e							
"	f							
Sum			125.3		261.8		45.8	
Mean		1 54	25.06	2 1	52.36	2 8	9.16	
Red'n to								
m	Bh		+ .17		+ .06		.00	
n. tan. $\delta$	Aa		+ .58		- .13		- .24	
d. sec. $\delta$	Cc		+ 1.12		+ .38		- .35	
r								
T		1 54	26.93	2 1	52.67	2 8	8.60	
a		1 52	24.80	1 59	50.81	2 6	6.46	
$\Delta T$		2	2.13	2	1.86	2	2.14	

Value of 1 division of level, Coast Survey Transit, 0.064

Dec. 9 Level read before observations, Ill. W.  $b = +0.008$

" " after " E.  $b = 0.000$

a & c found from all the stars by Cauchy's method.

$a = -.37$   $c = +.35$  Illumination West.

Clock fast (at 2<sup>h</sup>) 2<sup>m</sup> 18.7



## Coast Survey Transit No. 5

Date	1869	Dec. 9				Dec. 14.
Observer		E. P. A.				E. P. A.
Illumin'n		E.				W.
Star		Coast Survey Transit				Coast Survey Transit
Mag.		& Cass.		$\gamma$ Ucti		& Persei
$\delta$		$66^{\circ} 49'$		$2^{\circ} 41'$		$219^{\circ} 24'$
Wire	a					3 16 30.9
"	b					35.5
"	c					39.3
						43.7
						47.6
"	1	2 20 13.7		L 38 31.2		55.6
"	2	20.3		33.6		59.4
"	3	26.2		36.5		40
"	4	33.3		39.0		7.3
"	5	39.5		41.4		11.8
"	d					19.2
"	e					24.1
"	f					28.0
						32.0
						35.9
Sum		133.0		181.7	Tally D	18.1
Mean		2 20 26.60		2 38 36.34	3 17 3.62	
					Red. to mean	.09
					3 17	3.71
Red'n to						
m		1.00		1.00	m	-.27
n. tan. $\delta$		+.39		-.24		
c. sec. $\delta$		-.89		-.35		
$\tau$						
T		2 20 26.10		2 38 35.75		
a		2 18 24.50		2 36 33.89	3 15 3.64	
$\Delta T$		2 1.60		2 1.86		

3 middle tallies

Dec. 14, 1869. Level readings  
 At 3<sup>h</sup> 11<sup>m</sup>  $b = -.20$   
 3<sup>h</sup> 20<sup>m</sup>  $b = -.22$   
 3 56  $b = -.10$   
 After 4<sup>th</sup> Transit  $b = -.11$   
 At 4 52  $b = -.13$   
 Camp W. 1<sup>st</sup> 2<sup>nd</sup> 3<sup>rd</sup> 4<sup>th</sup> 5<sup>th</sup> readings  
 E. 3<sup>rd</sup> 4<sup>th</sup>



## Coast Survey Transit No. 5

Date	1869	Dec. 14			
Observer		E. P. A.			
Illumin'n		W.			
Star		$\gamma$ Urs. Min.	$\delta$ Persi	$\gamma$ Tauri	
Mag.		72° 18'	47° 22'	23° 42'	
$\delta$					
Wire	a	3 19 46.0	3 35 56.7	3 39 15.0	
"	b		36 0.2		
"	c	20 3.7	4.0	20.8	
"	1	13.4	8.0	23.3	
"	2	29.9	11.9	26.2	
"	3	38.7	19.3	29.1	
"	4	47.0	23.7	34.8	
"	5	56.4	27.6	37.8	
"	d	21 4.0	31.6	40.7	
"	e		35.3	44.0	
"	f			46.3	
				49.8	
		Tally C wire 4.3.2.1	Tally D wire 5.7.1		
		Tally B.	Tally E.F.		
		Tally D 36.0	158.3	Tally E.F. 34.8	
		3 20 47.20	3 36 15.83	3 39 34.98	
Sum		Red. to mean 103.12	Red. to mean 34.68		
Mean		3 19 4.08	3 35 41.15		
Red'n to m					
n. tan. $\delta$					
c. sec. $\delta$					
r					
T					
a		15 20 52.89	3 33 41.04	3 39 45.73	
$\Delta T$					

This observation  
was of a star  
preceding  
 $\gamma$  Urs. Min.

- .30

Dec. 14 1869.  
The stars observed after  $\delta$  Urs. Min. give by  
Cauchy's method  $c = +.21$  Lamp West  $m = +1.62$ .  
Clock fast (at 4<sup>h</sup>  $\frac{1}{2}$ ) 2<sup>m</sup> 0.79  
but the others cannot apparently be made  
to agree with these.  
The azimuth of the instrument is supposed  
to have been disturbed in reversing on  $\delta$  Urs. Min.



Mean of tally B	from mean of stalkies (e Tauri, & Tauri, & Aurigae, 11 Crinis)	31.25
— " — C	( Same stars )	15.60
— " — D	( e Tauri omitted )	.06
— " — E	( same as for tally B )	15.64
— " — F	( Same )	31.23



## Coast Survey Transit No. 5

Date 1869 Dec. 14  
 Observer E. P. A.  
 Illumin'n E. E. W.  
 Star  $\epsilon$  Tauri  $\alpha$  Tauri  $\gamma$  Camel.  
 Mag.  $18^{\circ} 53'$   $16^{\circ} 15'$   $66^{\circ} 7'$   
 $\delta$

Wire	a	4	22	23.2	4	29	49.9	4	41	53.8
"	b			26.0			52.1		42	0.0
"	c		(144.6)	29.0		(277.1)	55.4			7.0
			(28.92)	32.0		(55.42)	58.7			
				34.4			0.8			
				40.0			3.5			32.8
"	1		(227.9)	42.1		(56.5)	9.0			40.4
"	2		(45.58)	45.6		(11.30)	11.9			46.7
"	3			48.3			14.4			
"	4		(10.0)	51.1		(140.4)	17.2			59.9
"	5		(2.00)	56.4		(28.08)	22.5		43	5.6
				59.3			25.4			12.7
				7.8			28.0			18.8
				7.7			30.9			25.0
				13.0			33.6			
"	d		(93.4)	15.8		(222.4)	39.0			37.9
"	e		(18.68)	18.6		(44.48)	44.7			14.4
"	f			21.4			44.4			50.6
				24.6			47.3		44	57.0
				30.0			50.0			3.4
			(176.8)	32.6		(41)	55.3			17.0
			(35.36)	36.2		(0.82)	58.2			22.7
				38.0			6.9			30.0
				41.0			6.6			36.2
Sum				10.54						43.3
Mean				4	23	2.11	4	30	28.02	Tally D
										62.0
										2.43
										12.14
										15
										Red. to mean
										4 43 12.53
Red'n to										
m				- .14			- .15			- .18
n. tan. $\delta$				+ .92			+ 1.00			- 2.19
c. sec. $\delta$				- .22			- .22			+ .52

r

T

a

 $\Delta T$ 

Mean of tally B from mean of 5 tallies	33.25	32.80	$\Delta t - 2^m$	0.60
" " C	16.57	16.46	at	4.4
" " D	.17	.06		4.47
" " E	16.53	16.72		
" " F	33.19	32.60		

Same reduced  
to equator.

31.37	30.94
15.63	15.53
.10	.06
15.60	45.77
31.31	30.75



Coast Survey Transit N<sup>o</sup> 3

Date	1869 Dec. 14	Dec. 15
Observer	E. P. A.	E. P. A.
Illumin'n	W.	W.
Star	$\alpha$ Aurigae	$\eta$ Crinis
Mag.		
$\delta$	$32^{\circ} 57'$	$15^{\circ} 13'$
Wire	a	4 49
"	b	(274.7) 50
"	c	(689) 13.78
"	1	(161.7) 32.34
"	2	(255.3) 51.06
"	3	(49.7) 9.94
"	d	51
"	e	3.6
"	f	10.7
Sum	162.06	42.48
Mean	4 50 32.44	4 59 8.50
Red'n to		
m	- .18	- .18
n. tan. $\delta$	+ .42	+ 1.04
c. sec. $\delta$	+ .25	+ .22
$\tau$		
T	4 50 32.90	4 59 9.58
a	4 48 32.11	4 57 8.79
$\Delta T$	2 0.79	2 0.79

Mean of tally B from mean of 5 tallies	37.47	32.46
" " C " "	18.63	16.22
" " D " "	.07	.06
" " E " "	18.65	16.16
" " F " "	37.53	32.56
Same reduced to equator	31.49	31.21
	15.66	15.60
	.06	.06
	15.67	15.54
	31.54	31.31

Lead readings  
Dec. 15 1869  
At 1<sup>h</sup> 57<sup>m</sup> temp. W. b = - .16.  
3<sup>h</sup> 57<sup>m</sup> " W. b = - .17.  
4 32 " E. b = - .04  
5 13 " E. b = - .03

# Coast Survey Transit No. 5

Date *Mtg Dec. 15*  
 Observer *E. P. A.*  
 Illumin'n *W.*  
 Star *50 Cassio. & Arctis*  
 Mag. *65 lati*  
 $\delta$  *22° 54'*

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

*C.D.E.P.  
 Tallies observed & lost.  
 D.C. entered here.  
 Tallies D.C. entered here.*

*1 52 30.0  
 37.8  
 47.0  
 55.0  
 53 3.9  
 54 10.6  
 19.8  
 27.9  
 36.8  
 44.6*

*3 middle tallies observed  
 tally D entered here.*

*2 1 44.8  
 47.4  
 50.5  
 53.2  
 56.2*

*Entered D  
 Tallies observed, C.D.E.*

*2 8 0.2  
 3.0  
 5.8  
 8.4  
 11.1*

Sum *252.1*  
 Mean *28.5*  
 Red'n to m *- .22*  
 n. tan.  $\delta$  *+ .65*  
 c. sec.  $\delta$  *+ .23*  
 T *2 1 51.08*  
 a *1 52 24.56 1 59 50.76 2 6 6.43*  
 $\Delta T$  *2 0.32*



## Coast Survey Transit No. 5

Date	1869 Dec. 15		
Observer	E. P. A.		
Illumin'n	W.	W.	E.
Star	$\gamma$ Tauri	$\epsilon$ Tauri	$\alpha$ Tauri
Mag.			
$\delta$	$15^{\circ} 19'$	$18^{\circ} 53'$	$16^{\circ} 15'$
Wire	a		
"	b		
"	c		
"	1		
"	2		
"	3		
"	4		
"	5		
"	d		
"	e		
"	f		
Sum	232.6	5.9	137.3
Mean	4 14 23.26	4 23 1.28	4 30 27.46
Red'n to			
m	-.23	-.23	-.05
n. tan. $\delta$	+ .84	+ .75	+ .82
c. sec. $\delta$	+ .22	+ .22	-.22
$\tau$			
T	4 14 24.09	4 23 1.82	4 30 28.01
a	4 12 24.00	4 21 1.85	4 28 27.99
$\Delta T$	2 0.09	1 59.97	2 0.02

*Tallies observed, C, D, E.  
Wire 3 of tally lost.  
Tallies entered here, C, E.*

*Tallies observed, C, D, E.  
Apparently lost tally, C.  
Entered here, D.*

*Tallies observed, C, D, E.  
Entered here, D.*

## Coast Survey Transit No. 5

Date 1869 Dec. 15  
 Observer E. P. A.  
 Illumin'n E.  
 Star  $\alpha$  Camelopard. 11 Orionis & Aurigae  
 Mag.  $66^{\circ} 7'$   $45^{\circ} 52'$   
 $\delta$

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

Tallies observed  
 E. E. D. C. B.  
 May last 5 E  
 Entered here tally D.

4 52 59.7  
 53 5.8  
 12.11  
 19.0  
 25.8  
 3 middle tallies observed  
 Middle tally entered

4 59 2.9  
 5.7  
 8.1  
 10.8  
 10.5  
 8 preceding tallies observed  
 last of them entered

5 8 58.7  
 9 2.8  
 6.4  
 10.1  
 14.2

Sum 62.7 41.0 32.2  
 Mean 4 43 12.574 4 59 8.20 5 9 6.44  
 Red'n to  
 m - .05 - .04 - .04  
 n. tan.  $\delta$  - .16  
 c. sec.  $\delta$  - .30

r  
 T 5 9 5.94  
 a 4 41 9.91 4 57 8.80 5 7 5.84  
 $\Delta T$  2 0.13

Dec. 15 1869  
 c appears from the time stars to be near +.20 Lamp West.  
 Assuming it at +.21 Lamp West as Dec. 14  
 w from  $\alpha$  Aurigae &  $\beta$  Orionis is -1.32  
 Clock fast (at  $(4\frac{3}{4})$ )  $2^m$  0.09  
 at 3.92 2 0.20



## Coast-Survey Transit No. 5

Date	1869 Dec. 15		
Observer	E. P. A.		
Illumin'n	E.		
Star	$\beta$ Orionis	$\beta$ Tauri	$\delta$ Orionis
Mag.			
$\delta$	$-8^{\circ} 21'$	$28^{\circ} 30'$	
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			
$\Delta T$			

3 middle tallies observed.  
 1 preceding wire in middle tally lost.  
 The other 5 tallies entered here.

5 9 55.7  
 1 10 58.6  
 1.2  
 3.4  
 6.1  
 3 middle tallies observed.  
 Middle tally entered.

5 19 58.8  
 20 1.8  
 4.7  
 7.7  
 10.8

Tally at end of transit

5 27 47.9  
 50.4  
 52.7  
 55.0  
 58.0



## Coast Survey Transit No. 5

Date	1869	Dec. 17							
Observer		E. P. A.							
Illumin'n		W.							
Star		$\alpha$ Androm.		$\gamma$ Pegasi		$\delta$ Ceti			
Mag.									
$\delta$		$28^{\circ} 22'$		$14^{\circ} 28'$		$-8^{\circ} 51'$			
Wire	a	Tally D.		Tally D.		Tally D.			
"	b								
"	c								
"	1	0 3 32.8		0 8 25.6		1 19 24.5			
"	2	35.9		28.1		27.2			
"	3	39.0		31.0		30.0			
"	4	41.8		33.4		32.5			
"	5	44.7		36.4		35.3			
"	d								
"	e								
"	f								
Sum		194.2		154.5		149.5			
Mean	" 3	38.84		0 8 30.90		1 19 29.90			
Red'n to									
m		+ .08		+ .08		- .16			
n. tan. $\delta$		+ .23		+ .41		+ .67			
c. sec. $\delta$		+ .05		+ .04		+ .04			
$r$									
T	0 3	39.20		0 8 31.43		1 19 30.45			
a	0 1	39.53		0 6 31.78		1 17 31.00			
$\Delta T$		1 59.67		1 59.65		1 59.55			

Level readings  
 Dec. 17 1869 Value of b.  
 23<sup>h</sup> 41<sup>m</sup> (W.) + .06  
 1 29 (W.) - .12  
 1 42 (E.) - .06  
 2 10 (E.) - .12  
 After v. Cass. (W.) - .10  
 3<sup>h</sup> 5<sup>m</sup> (E.) - .06

no from v. Cass. & 5 Vrs. Moir.  
 - .63  
 c from 5 Vrs. Moir.  
 + .04 W.C. Lamp West  
 Clock fast (at  $\frac{1}{6}$ ) 1<sup>m</sup> 59.71



## Coast Survey Transit No. 5

Date	1869 Dec. 17		
Observer	E. P. A.		
Illumin'n	E.		
Star	$\alpha$ Piscium	$\beta$ Arietis	$\delta$ Ceti
Mag.			
$\delta$	$8^{\circ} 30'$	$20^{\circ} 10'$	$8^{\circ} 14'$
Wire	Tally D	Tally D.	Tally D
a			
b			
c			
1	1 40 25.6	1 49 21.2	2 8 0.6
2	28.4	24.3	3.0
3	30.8	27.1	5.8
4	33.5	29.7	8.6
5	36.1	32.8	11.2
d			
e			
f			
Sum	154.4	135.1	29.2
Mean	1 40 30.88	1 49 27.02	2 8 5.84
Red'n to			
m	- .08	- .08	- .16
n. tan. $\delta$	+ .48	+ .53	+ .45
c. sec. $\delta$	- .04	- .04	- .04
r			
T	1 40 31.24	1 49 27.43	2 8 6.09
a	1 38 31.52	1 47 27.45	2 6 6.42
$\Delta T$	1 59.72	1 59.98	1 59.67

## Coast Survey Transit No. 5

Date	1869	Dec. 17		
Observer		E. P. A.		
Illumin'n	E	W	W	E
Star		$\epsilon$ Cassiop.	5 hrs. Min.	
Mag.		$66^{\circ}49'$	$76^{\circ}16'$	
$\delta$		Tally F	Tally F	
Wire	a			
"	b			
"	c	2 18 52.0 58.8 19 5.1 12.8 19.2	2 27 7.4 18.4 29.4 41.7 53.0	
"	1			
"	2	2 19 27.9	2 27 149.9	
"	3	2 19 5.58	2 27 29.98	
"	4			
"	5			
"	d	2 21 30.6 37.6 44.6 51.0 57.6	2 31 31.0 41.0 52.1 4.2 45.8	
"	e		32 4.2	
"	f	2 21 22.1.4 44.28	2 31 266.4 53.22	
Sum		Red. to mean 79.32	131.79	
Mean	{ Lamp E	2 20 24.90	2 29 41.43	
	" W	24.96	41.77	
	Mean	24.93	41.60	
Red'n to				
m		- .15	- 1.11	
n. tan. $\delta$		- .89	+ 3.16	
c. sec. $\delta$				
r				
T		2 20 23.89	2 29 44.65	
a		2 18 24.30	14 27 45.05	
$\Delta T$		1 59.59	1 59.60	



## Coast Survey Transit No. 5

Date

1869

Dec 23

Observer

E. P. Chastin

Illumin'n

W

W

E

Star

3 Arctis

50 Cassiope

1 Cassiope

Mag.

 $\delta$ Lineal  $1^h 29^m - 0.064$  $2^h 4^m - 0.040$  $2^h 14^m - 0.042$ 

Wire

a

"

b

"

c

"

1

D 1 49 20.4 1 54 7.0 2 20 11.2

"

2

23.2 16.4 17.9

"

3

26.0 24.8 24.1

"

4

28.8 32.4 31.0

"

5

31.7 40.8 38.2

"

d

Bl

- 06 - 11 - 23

"

e

A

+ 28 - 10 - 71

"

f

Sum

30.1

21.4

22.4

Mean

1 49 26.02 1 54 24.28 2 20 24.48

Red'n to Mean

- 04

- 11

+ 09

m

Bl

- 06

- 11

- 24

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

r

T

a

1 47 27.40 1 52 24.20 2 18 24.12

 $\Delta T$ 

A

+ 40

- 1.57

- 1.05

B

+ 99

+ 2.79

+ 2.31

C

+ 1.07

+ 3.20

- 2.54

## Coast Survey Transit No. 5

Date				
Observer				
Illumin'n	E	E	E	
Star	$\gamma$ Ceti	$\beta$ Uscellin LG	$\alpha$ Ceti	
Mag.				
$\delta$			$3^h 3^m - 0.048$	
Wire	a			
"	b			
"	c			
"	1	6 2 38 43.0	0-2 52 37.4	2 57 22.7
"	2	45.8	48.5	25.3
"	3	48.5	58.7	27.9
"	4	51.1	53 7.8	30.6
"	5	53.5	18.0	<u>33.2</u>
"	d	- 07	+ 10	- 04
"	e	+ 45	+ 236	+ 44
"	f			
Sum		41.9	170.4	39.7
Mean		2 38 48.38	2 52 58.08	2 57 27.94
Red'n to		- 1.470	- .15	+ 0.4
m		- 6	+ 10	- 4
n. tan. $\delta$				
c. sec. $\delta$				
r				
T				
a		2 36 33.82	14 57 2.45	2 55 29.06
$\Delta T$				
		+ 64	+ 3.37	+ 63
		+ 0.27	- 1.72	+ 78
		- 1.00	+ 3.78	- 1.00



## Coast Survey Transit No. 5

Date	869 Dec 23		
Observer	E P A		
Illumin'n	E 8 E		
Star	Ednietis & Persei & Aurig		
Mag.			
$\delta$	4 <sup>h</sup> 3 <sup>m</sup> -0.024		
Wire	a		
"	b		
"	c		
"	1	P 3 9 19.1 3 16 54.6 B 4 14 50.0	
"	2	22.2 59.1 52.7	
"	3	25.0 17 2.6 55.5	
"	4	27.8 6.8 58.1	
"	5	30.7 10.9 15 0.9	
"	d	Bb -04 -0.5 -02	
"	e	+28 -14 +33	
"	f		
Sum		24.8 14.0 27.2	
Mean		3 9 24.96 3 17 2.80 4 14 55.44	
Red'n to		+04 +.06 -32.59	
m			
n. tan. $\delta$			
c. sec. $\delta$			
$\tau$			
T			
a		3 7 25.97 3 15 3.58 4 12 24.92	
$\Delta T$			
A		+40 -19 +47	
B		99 +152 92	
-C		-1.07 -1.54 -1.04	
N			

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## Coast Survey Transit No. 5

Date	1869	Dec 23		
Observer		S P A		
Illumin'n		W	W	W
Star		1 Arcturus	11 Minors	2 Arcturus
Mag.				
$\delta$				
Wire	a			
"	b			
"	c			
"	1	D 4 <sup>h</sup> 50 <sup>m</sup> 24.7	4 59 1.9	5 8 57.2
"	2	27.8	4.7	9 1.2
"	3	31.1	7.3	4.9
"	4	34.0	10.0	8.5
"	5	37.1	12.6	12.5
"	d	B.L. -12	-0.9	-14
"	e			
"	f			
Sum		4.7	36.5	24.3
Mean		4 50 30.94	4 59 7.30	5 9 4.86
Red'n to		-0.5	-0.4	-0.6
m				
n. tan. $\delta$				
c. sec. $\delta$				
r				
T				
a		4 48 32.16	4 57 8.85	5 7 5.89
$\Delta T$				
A		+19	+17	-09
B		+115	+92	+143
G		+1.19	+1.04	+1.44
N				

## Coast Survey Transit No. 5

Date				
Observer				
Illumin'n	W	W	W	
Star	$\beta$ Orionis	$\beta$ Tauri	$\gamma$ 966	
Mag.				
$\delta$	$5^h 12^m -0.096$			
Wire	a			
"	b			
"	c			
"	1	D 5 10 11.0	5 19 57.7	5 24 3.8
"	2	13.8	20 0.9	13.9
"	3	16.4	3.6	24.6
"	4	19.0	6.5	32.9
"	5	21.8	9.5	44.5
"	d	-06	-10	
"	e			
"	f			
Sum	32.0	18.2	29.7	
Mean	5- 10 16.40	5- 20 3.64	5- 24 23.94	
Red'n to	-04	-05		
m				
n. tan. $\delta$				
c. sec. $\delta$				
$\tau$				
T				
a	5 8 17.85	5 18 4.84	5 22 24.48	
$\Delta T$				
	+78	+27		
	+64	+110		
	+101	+114		

Clock fast

1<sup>m</sup>59<sup>s</sup> 06Mean of last set (10 signals) of arbitrary signals from  
Duxbury to Cambridge3<sup>h</sup> 30<sup>m</sup> 50.<sup>s</sup> 71Mean of last set (6 signals) of arbitrary signals from  
Cambridge to Duxbury3<sup>h</sup> 30<sup>m</sup> 41.<sup>s</sup> 81







# Survey Transit No. 5

Dec. 31

E. P. A.

E.

Polaris

D'Arctis

$\eta$  Piscium

88° 37' 2

8° 52' S,

140° 40'

Tally D

Tally D

Tally D

1

1 10 18.9

1 19 23.8

1 26 24.3

2

12 8.2

26.3

26.8

3

13 53.9

29.1

29.7

4

15 49.9

31.7

32.4

5

17 42.6

34.4

35.1

d

e

f

Sum

293.5

145.3

148.3

Mean

1 13 58.70

1 19 29.06

1 26 29.66

Red'n to

m

Bb

-.58

-.01

-.02

n. tan.  $\delta$

Aa

-24.01

+ .63

+ .38

c. sec.  $\delta$

-12.47

- .30

- .31

r

T

1 13 21.64

1 19 29.38

1 26 29.71

a

Redward  
1 11 34.14

1 17 30.85

1 24 31.15

$\Delta T$

1 47.50

1 58.53

1 58.56

Level readings Dec. 31 1869. Values of b.

At 1<sup>h</sup> 28<sup>m</sup>

Lamp E.

-0.02

1 55

E.

-0.08

2 9

W

-0.19

2 24

E

-0.13

2 40

W

-0.13

3 11

W

-0.12



## Coast Survey Transit No. 5

Date	1869	Dec. 31		
Observer	E. P. A.			
Illumin'n	E.	<del>P. E.</del>	W. - E.	
Star	$\beta$ Arietis	50 Cassiop.	$\epsilon$ Cassiopei	
Mag.				
$\delta$	20° 10'	71° 47'	66° 49'	
Wire	a	Tally D	Tally D	Tally B.C. C.B.
"	b			2 18 50.3
"	c			57.0
"	1	1 49 20.1	1 54 8.1	19 3.4
"	2	22.8	16.2	10.0
"	3	25.6	24.2	16.7
"	4	28.6	33.0	29.9
"	5	31.3	41.8	36.8
"	d			43.0
"	e			49.8
"	f			56.5
				20 50.9
				21 17.4
				17.0
				17.5
				30.9
				37.5
				44.0
				50.7
				57.2
Sum		128.4	123.3	Lamp W. 23.4
Mean		1 49 20.68	1 54 24.66	2 19 23.34
Red'n to				Lamp E. 24.6
m	B.L.	- .08	- .22	2 21 24.16
n. tan. $\delta$	Aa	+ .32	- 1.26	Red. to mean 59.71
c. sec. $\delta$		- .32	- .98	Lamp W. 2 20 23.05
				E. 2 20 24.45
				Lamp W - .44
				E - .30
				- .84
T		1 49 25.60	1 54 22.22	2 20 22.54
a		1 47 27.31	1 52 23.79	2 18 23.85
$\Delta T$		1 58.29	1 58.43	1 58.69

Clock fast at 2<sup>h</sup>  
1<sup>m</sup> 58<sup>s</sup>.48

c from  $\epsilon$  Cass. - .30 Lamp E.  
5 hrs. Min. - .28 E.

c assumed - .30 Lamp E  
a from  $\epsilon$  Cass. } 5 hrs. Min. + 0.99  
Polaris }  $\delta$  Ceti + 0.40  
50 Cass. }  $\gamma$  Ceti + 0.80  
0.80 assumed



## Coast Survey Transit No. 5

Date	1869 Dec. 31		
Observer	E. P. A.		
Illumin'n	E. W. W.		
Star	5 Urs. Min.	$\gamma$ Ceti	$\xi$ Arctis
Mag.			
$\delta$	$76^{\circ} 16'$	$2^{\circ} 41'$	$20^{\circ} 34'$
	Tally D Lamp E	Tally D.	Tally D
Wire	a	" B " W.	
"	b	2 29 17.0	
"	c	28.1	
		40.7	
"	1	30 51.8	2 38 26.1 3 9 18.3
"	2	2 29 199.3	29.0 21.0
"	3	Red. to mean 37.86	31.7 24.1
"	4	2 29 37.69	34.2 26.7
"	5		36.7 29.6
		31 32.2	
"	d	43.1	
"	e	32 54.6	
"	f	4.9	
		15.2	
		270.0	
		2 31 54.00	
		Red. 2 12.03	
Sum	2 29 211.97	157.7	119.7
Mean		2 38 31.54	3 9 23.94
Red'n to			
m	Bt (E & W)	+ .26	- .10
n. tan. $\delta$	A =	+ 2.96	+ .51
c. sec. $\delta$		+ .30	+ .32
r			
T	2 29 44.05	2 38 32.25	3 9 24.46
a	1 27 46.16	2 36 33.76	3 7 25.92
$\Delta T$	1 57.89	1 58.49	1 58.54

Arbitrary signals from Durham  
last before rattle  
4<sup>h</sup> 7<sup>m</sup>

16.570  
21.82  
26.67  
30.98  
36.61  
41.54  
46.50  
50.96  
56.10  
1.50  
7.55  
12.05  
27.15

8

Arbitrary signals from Cambridge  
last before rattle  
4<sup>h</sup> 18<sup>m</sup>

41.60  
46.10  
48.08  
49.79  
51.50  
53.86



## Coast Survey Transit No. 5

Date	1870	Jan. 3			
Observer		E. P. A.			
Illumin'n		W.			
Star		$\gamma$ Piscium	$\alpha$ Piscium	$\beta$ Arietis	
Mag.		14° 40'	8° 30'	20° 10'	
$\delta$		Tally D	Tally D	Tally D	
Wire	a				
"	b				
"	c				
"	1	1 26 23.5	1 40 23.7	1 49 19.2	
"	2	26.2	26.3	22.4	
"	3	29.0	28.9	25.0	
"	4	31.6	31.5	27.9	
"	5	34.4	34.2	30.7	
"	d				
"	e				
"	f				
Sum		144.7	144.6	125.2	
Mean		1 26 28.94	1 40 28.92	1 49 25.04	
Red'n to		1 26 28.90	1 40 28.88	1 49 25.00	
m	B <sub>6</sub>	- .14	- .13	- .15	
n. tan. $\delta$	A <sub>6</sub>	+ .14	+ .15	+ .13	
c. sec. $\delta$		+ .26	+ .25	+ .27	
r					
T		1 26 29.49	1 40 29.55	1 49 25.51	
a		1 24 31.11	1 38 31.36	1 47 27.27	
$\Delta T$		1 58.38	1 58.19	1 58.24	

Level readings Jan. 3 1870. Value of b.

At 1<sup>h</sup> 30<sup>m</sup> -0.15 Lamp W.

2 11 -0.19 " W.

Between Cass. & 5<sup>th</sup> Mrs. Min. -0.10 " E.

At 3<sup>h</sup> 25<sup>m</sup> -0.20 " E.

c from  $\alpha$  Cassio. (too large)  
+ .25 Lamp West.

a from  $\alpha$  Cass. & 5<sup>th</sup> Mrs. Min.  
+ .97

Block fast at 2<sup>h</sup>  $\frac{1}{2}$   
1<sup>m</sup> 58.105



## Coast Survey Transit No. 5

Date	1870 Jan. 3			
Observer	E. P. A.			
Illumin'n	W. W. E. E.			
Star	50 Cassiopea & Cassiop.	5 Urs. Min.		
Mag.				
$\delta$	71° 48'	66° 49'	76° 16'	
	Tally C.	Tallies B.C. C.B.	Tally D	
Wire	a	2 18	50.0	
"	b	19	56.7	
"	c		3.5	
"	1		9.3	
"	2		18.2	
"	3		29.6	
"	4		36.6	
"	5		42.7	
"	d		48.1	
"	e		50.0	
"	f		56.8	
Sum	163.2	2 20	23.83	
Mean	1 53 32.64			199.1
Reduction	+ 50.28			2 29 39.81
Red'n to	1 54 22.92			2 29 39.64
m	- 4.53	Lamp W. - .44		+ .20
n. tan. $\delta$	- 1.52	E. - .23		+ 3.58
c. sec. $\delta$	+ .80	- 1.02		+ 1.05
T	1 54 21.67	2 20 21.94	2 29 44.47	
a	1 52 23.63	2 18 23.73	14 27 46.43	
$\Delta T$	1 58.04	1 58.21	1 58.04	

4<sup>h</sup> 7<sup>m</sup> Arbitrary signals from Duxbury (last before cattle)

8.20  
9.62  
11.60  
13.65  
15.96  
17.59  
20.82  
22.47  
25.41  
27.59



## Coast Survey Transit No. 5

Date	1870 Jan. 3								
Observer	E. P. A.								
Illumin'n	E.								
Star	$\delta$ Arietis	$\alpha$ Persei		$\beta$ Persei					
Mag.									
$\delta$	$20^{\circ} 34'$	$49^{\circ} 24'$		$47^{\circ} 22'$					
	Tally D	Tally D		Tally D					
Wire	a								
"	b								
"	c								
"	1	3 9 18.2	3 16 54.0	3 35 31.8					
"	2	21.2	58.0	35.8					
"	3	23.9	17 1.8	39.3					
"	4	26.8	6.2	43.6					
"	5	29.8	10.1	47.3					
"	d								
"	e								
"	f								
Sum		119.9	10.1	197.8					
Mean	3 9	23.98	3 17 2.02	3 35 39.56					
Reduction		+ .04	+ .06	+ .06					
Red'n to	3 9	34.02	3 17 2.08	3 35 39.62					
m		- .15	- .30	- .29					
n. tan. $\delta$		+ .39	- .18	- .12					
c. sec. $\delta$		- .27	- .38	- .37					
r									
T	3 9	23.99	3 17 1.22	3 35 38.84					
a	3 7	25.90	3 15 3.42	3 33 40.91					
$\Delta T$	1	58.09	1 57.80	1 57.93					

Arbitrary signals from Cambridge (last before rattle)

4<sup>h</sup> 16<sup>m</sup> 20.99  
 22.43  
 23.91  
 25.32  
 26.60  
 27.98  
 29.57  
 31.55



## Coast Survey Transit No. 5

Date	1870 Jan. 7				
Observer	E. P. A.				
Illumin'n	E				
Star	$\gamma$ Ceti	$\beta$ Urs. Min.	$\alpha$ Ceti		
Mag.					
$\delta$	$2^{\circ} 41'$	$74^{\circ} 41'$	$3^{\circ} 35'$		
	Tally D.	Tally D.	Tally E & Co.		
Wire	a				
"	b			2	57 5.0
"	c				8.0
					10.7
"	1	2 38 25.5	2 52 35.7		12.9
"	2	28.4	46.3		15.8
"	3	34.0	56.6		
"	4	33.7	53 5.7		36.3
"	5	36.0	15.9		38.9
					41.6
"	d				44.4
"	e				46.9
"	f				
Sum		154.6	280.2		260.5
Mean	2 38	30.92	2 52 56.04	2 57	26.05
Reduction		+ .04	- .15		- .14
Red'n to	2 38	30.96	2 52 55.89	2 57	25.94
m. Bb		- .12	+ .26		- .13
n. tan. Aa		+ .77	+ 4.04		+ .76
c. sec. d		- .30	+ 1.14		- .30
T	2 38	31.34	2 53 1.33	2 57	26.27
a	2 36	33.69	14 54 3.54	2 55	23.88
$\Delta T$	1 57.62		1 57.79	This is another star near $\alpha$ Ceti	

Level readings Jan. 7, 1870. Value of b.

At	$2^h 42^m$	- 0.15	Lamp E.
	3 10	- 0.17	E.
	3 27	- 0.18	W.
	3 49	- 0.21	W.

a by estimation + 1.20  
 { c " " } + .30  
 Ill. West  
 Clock fast at  $3^h \frac{1}{4}$   
 1<sup>m</sup> 57.36



## Coast Survey Transit No. 5

Date	1870 Jan. 7										
Observer	E. P. A.										
Illumin'n	E. <del>W.</del> E. W.										
Star	48 Caphei & Arietis & Persei										
Mag.											
$\delta$	$77^{\circ} 15'$ $20^{\circ} 34'$ $49^{\circ} 24'$ Tally D Tally D Tally D										
Wire	a										
"	b										
"	c										
"	1	3	5	34.6	3	9	17.7	3	16	52.3	
"	2			46.0			20.2			56.6	
"	3			57.2			23.0		17	0.8	
"	4		6	9.7			25.9			4.3	
"	5			21.4			28.9			8.8	
"	d										
"	e										
"	f										
Sum				288.9			115.7			2.8	
Mean		3	5	57.78		3	9	23.14	3	17	0.56
Reduction				+ .18			+ .04			- .06	
Red'n to		3	5	57.96		3	9	23.18	3	17	0.50
m	Bb			-.63			-.77			-.37	
n. tan. $\delta$	Aa			-.31			+ .48			-.23	
c. sec. $\delta$				-1.36			-.32			+ .46	
$\tau$											
T		3	5	58.66		3	9	23.17	3	17	0.46
a		3	3	57.32		3	7	25.85	3	15	3.36
$\Delta T$			1	58.34			1	57.32		1	57.10

## Coast Survey Transit No. 5

Date	1890	Jan. 7			
Observer		E. P. A.			
Illumin'n		W.			
Star		$\gamma^2$ Urs. Min.	$\delta$ Persei		$\eta$ Tauri
Mag.					
$\delta$		$72^\circ 18'$	$47^\circ 22'$		$23^\circ 42'$
		Tally D	Tally D		Tally P
Wire	a				
"	b				
"	c				
"	1	3 22 31.2	3 35 30.4	3 41 36.8	
"	2	40.7	34.3	39.8	
"	3	47.7	38.2	42.8	
"	4	57.5	42.0	45.4	
"	5	23 6.4	45.9	48.3	
"	d				
"	e				
"	f				
Sum		243.5	190.8	213.1	
Mean		3 22 48.70	3 35 38.16	3 41 42.62	
Reduction		+ .13	- .06	- .04	
Red'n to		3 22 48.83	3 35 38.10	3 41 42.58	
$\mu$	Bb	+ .25	- .27	- .22	
$n \tan \delta$	Aa	+ 3.59	- .15	+ .42	
c. sec. $\delta$		- .99	+ .45	+ .33	
$\tau$					
T		3 22 51.68	3 35 38.13	3 41 42.15	
a		15 20 54.11	3 33 40.85	3 39 45.65	
$\Delta T$		1 57.57	1 57.28	1 57.48	



## Coast Survey Transit No. 5

Date	1870 Jan. 11						
Observer	E. P. A.						
Illumin'n	W.						
Star	38 Cassio. $\eta$ Piscium					$\epsilon$ Piscium	
Mag.							
$\delta$	$69^{\circ} 36'$			$11^{\circ} 40'$		$8^{\circ} 30'$	
Wire	Tally D			Tally D		Tally D	
a							
b							
c							
1	1 23 16.1		1 26 20.8		1 40 21.0		
2	24.0		23.7		23.6		
3	32.1		26.4		26.2		
4	38.9		29.0		28.9		
5	47.0		31.8		31.4		
d							
e							
f							
Sum	158.1		131.7		131.1		
Mean	1 23 31.62		1 26 26.34		1 40 26.22		
Reduction							
Red'n to	1 23 31.51		1 26 26.30		1 40 26.18		
<del>n</del> Bb	- .31		- .12		- .13		
n. tan $\delta$ Aa	- 1.19		+ 1.44		+ .51		
c. sec. $\delta$	+ .77		+ .28		+ .27		
r							
T	1 23 30.78		1 26 26.90		1 40 26.83		
a	1 24 35.38		1 24 31.02		1 38 31.26		
$\Delta T$	1 55.40		1 55.88		1 55.57		

Value of  $b$ , Jan. 11 1870.  
 At 1' 16" Lamp West - .12  
 1 42 " West - .15  
 3 57 " East - .10  
 4 32 " East - .10

$c = +.27$  Lamp West  
by time stars.

$a = +.91$  by 50 Cass. 2320 Gr

Clock fast at 3<sup>h</sup>

1<sup>m</sup> 55.70



## Coast Survey Transit No. 5

Date	1870	Jan. 11		
Observer		E. P. A.		
Illumin'n		W.		E.
Star		$\beta$ Arietis	50 Cassiopeae	Lyrae 2320
Mag.		20° 10'	71° 48'	68° 9'
$\delta$		Tally D	Tally D	Tally D
Wire	a			
"	b			
"	c			
"	1	1 49 16.8	1 54 3.3	4 7 34.7
"	2	19.6	12.2	41.7
"	3	22.6	20.4	48.6
"	4	25.1	28.5	55.6
"	5	28.0	37.0	8 2.6
"	d			
"	e			
"	f			
Sum		112.1	101.4	243.2
Mean		1 49 22.42	1 54 20.28	4 7 48.64
Reduction		-.04	-.13	-.11
Red'n to		1 49 22.38	1 54 20.15	4 7 48.53
m	Bb	-.15	-.142	+.09
n. tan. d	Aa	+.37	-1.43	+2.29
c. sec. d		+.29	+.86	+.72
r				
T		1 49 22.89	1 54 19.16	4 7 57.63
a		1 47 27.17	1 52 23.17	16 5 55.64
$\Delta T$		1 55.72	1 55.99	1 55.99



## Coast Survey Transit No. 5

Date	1870	Jan. 11		
Observer		E. P. A.		
Illumin'n		E.		
Star		$\gamma$ Tauri	$\epsilon$ Tauri	$\alpha$ Tauri
Mag.		15 <sup>0</sup> 19'	18 <sup>0</sup> 53'	16 <sup>0</sup> 15'
$\delta$		Tully D	Tully D	Tully D
Wire	a			
"	b			
"	c			
"	1	4 14 14.1	4 22 51.8	4 30 18.0
"	2	17.0	54.7	21.0
"	3	19.5	57.4	23.5
"	4	22.4	23 0.1	26.3
"	5	25.1	3.1	28.9
"	d			
"	e			
"	f			
Sum		98.1	287.1	117.7
Mean		4 14 19.62	4 22 57.42	4 30 23.54
Reduction		+ .04	+ .04	+ .04
Red'n to		4 14 19.66	4 22 57.46	4 30 23.58
m	Bb	-.09	-.10	-.09
n. tan. $\delta$	Aa	+ .43	+ .38	+ .42
c. sec. $\delta$		-.28	-.29	-.28
r				
T		4 14 19.72	4 22 57.45	4 30 23.63
a		4 12 23.96	4 21 1.82	4 28 27.98
$\Delta T$		1 55.76	1 55.63	1 55.65

## Coast Survey Transit No. 5

Date	1870	Jan. 12			
Observer		E. P. A.			
Illumin'n		E.			
Star		$\zeta$ Arietis	$\delta$ Persei	$\gamma$ Tauri	
Mag.		20° 34'	47° 22'	23° 42'	
$\delta$		Tally D	Tally D	Tally D	
Wire	a				
"	b				
"	c				
"	1	3 9 15.3	3 35 28.7	3 41 35.0	
"	2	18.1	32.6	37.8	
"	3	20.8	36.2	40.6	
"	4	23.8	40.2	43.6	
"	5	26.6	44.1	46.5	
"	d				
"	e				
"	f				
Sum		104.6	181.8	203.5	
Mean		3 9 20.92	3 35 36.36	3 41 40.70	
Red'n to					
m $\rho b$		+ .02	- .03	- .02	
n. tan. $\delta$ Aa		+ .36	- .12	+ .32	
c. sec. $\delta$		- .29	- .40	- .29	
$\tau$					
T		3 9 21.01	3 35 35.81	3 41 40.71	
a		3 7 25.80	3 33 40.78	3 39 45.60	
$\Delta T$		1 55.21	1 55.03	1 55.11	

Jan. 12 1870 Value of b.

At  $3^h 27^m$  Lamp East +.02  
3 37 East -.02e assumed +.27 } as on Jan. 11  
a " +.91 }Clock fast at  $3^h \frac{1}{2}$  1<sup>m</sup> 55.12



## Coast Survey Transit No. 5

Date	1870	Jan. 16			
Observer		E. P. A.			
Illumin'n		E.			
Star		$\alpha$ Piscium	$\beta$ Arietis	$\delta$ Cassiop.	
Mag.		8° 30'	20° 10'	71° 48'	
$\delta$		Tally D	Tally D	Tally C. B.	
Wire	a				
"	b				
"	c				
"	1	1 40 19.1	1 49 15.1	1 54 52.8	
"	2	21.9	18.0	55 1.1	
"	3	24.5	20.8	9.0	
"	4	27.3	23.6	17.8	
"	5	29.9	26.4	26.2	
"	d			43.1	
"	e			51.4	
"	f			59.3	
				56 1.6	
				16.3	
Sum		122.7	103.9	344.6	
Mean		1 40 24.54	1 49 20.78	1 55 34.46	
Reduction		+ .04	+ .04	- 75.26	
Red'n to		1 40 24.58	1 49 20.82	1 54 19.20	
m	Bb	- .04	- .07	- .20	
n. tan. $\delta$	Ac	+ .54	+ .39	- 1.50	
c. sec. $\delta$		- .09	- .10	- .28	
r					
T		1 40 24.99	1 49 21.04	1 54 17.22	
a		1 38 31.19	1 47 27.10	1 52 22.87	
$\Delta T$		1 53.80	1 53.94	1 54.35	

Jan. 16 1870. Value of b  
 At 1<sup>h</sup> 4<sup>m</sup> Lamp East - .05  
 1 56 East - .07  
 3 1 West - .24  
 3 42 West - .22

c by Cauchy's method + .090 Ill. West  
 " " " + .958

clock fast (at 2<sup>h</sup> 3<sup>m</sup> 4<sup>s</sup>) 1<sup>m</sup> 53.71



## Coast Survey Transit No. 5

Date	1870 Jan. 16		
Observer	E. P. A.		
Illumin'n	E. W.		
Star	65 Octi 48 Cephei $\gamma^2$ Ues. Min.		
Mag.			
$\delta$	$8^{\circ} 14'$ $77^{\circ} 15'$ $72^{\circ} 18'$		
Wire	Tally D Tally D Tally C.B.		
a			
b			
c			
1	2 7 54.4	3 5 28.5	3 23 20.4
2	57.0	40.6	28.8
3	59.6	52.8	37.9
4	8 2.2	6 3.8	46.1
5	4.9	46.6	54.8
d			
e			
f			
Sum	2 7 298.1	3 5 262.3	3 24 29.8
Mean	2 7 59.62	3 5 52.46	3 24 2.98
Reduction	+ .04	- .18	- 77.35
Red'n to	2 7 59.66	3 5 52.28	3 22 45.63
m	- .06	- .89	+ .33
n. tan. $\delta$	+ .54	- .25	+ 2.86
c. sec. $\delta$	- .09	+ .41	- .30
r			
T	2 8 0.05	3 5 51.55	3 22 48.52
a	2 6 6.10	3 3 56.64	45 20 54.74
$\Delta T$	1 53.95	1 54.91	1 53.78



## Coast Survey Transit No. 5

Date	1870	Jan. 16		
Observer		E. P. A.		
Illumin'n		W.		
Star		$\delta$ Persei	$\eta$ Tauri	$\delta$ Persei
Mag.				
$\delta$		$47^{\circ} 22'$	$28^{\circ} 42'$	$31^{\circ} 30'$
		Tally D	Tally D	Tally D.
Wire	a			
"	b			
"	c			
"	1	3 35 26.7	3 41 33.0	3 47 45.1
"	2	30.8	36.1	48.4
"	3	34.7	39.2	51.5
"	4	38.3	41.9	54.4
"	5	42.2	44.8	57.5
"	d			
"	e			
"	f			
Sum		172.7	195.0	256.9
Mean		3 35 34.54	3 41 39.00	3 47 51.38
Reduction		-.06	-.04	-.05
Red'n to		3 35 34.48	3 41 38.96	3 47 51.33
m	Bk	-.32	-.23	-.25
n. tan. $\delta$	Aa	-.12	+.33	+.21
c. sec. $\delta$		+.13	+.10	+.10
r				
T		3 35 34.17	3 41 39.19	3 47 51.39
a		3 33 40.72	3 39 45.36	3 45 57.91
$\Delta T$		1 53.45	1 53.63	1 53.48



## Coast Survey Transit No. 5

Date	1870	Jan. 18		
Observer		E. I. A.		
Illumin'n		E.		
Star		$\alpha$ Tauri	$\alpha$ Comae Ber.	$\alpha$ Aurigae
Mag.		16° 15'	66° 7'	32° 57'
$\delta$		Tally D	Tally D	Tally D
Wire	a			
"	b			
"	c			
"	1	4 30 15.1	4 42 51.0	4 50 19.0
"	2	18.1	57.6	22.2
"	3	20.7	43 4.4	25.2
"	4	23.6	10.8	28.5
"	5	26.4	17.4	31.6
"	d			
"	e			
"	f			
Sum		103.9	21.2	126.5
Mean		4 30 20.78	4 43 4.24	4 50 25.30
Reduction		+ .04	+ .10	+ .04
Red'n to		4 30 20.82	4 43 4.34	4 50 25.34
m Bb		- .17	- .43	- .21
n. tan. $\delta$ Aa		+ .37	- .80	+ .16
c. sec. $\delta$		- .27	- .64	- .31
r				
T		4 30 20.75	4 43 2.47	4 50 24.98
a		4 28 27.93	4 41 9.58	4 48 32.11
$\Delta T$		1 52.82	1 52.89	1 52.87

Jan. 18 1870. Value of  $b$   
 At 4<sup>h</sup> 15<sup>m</sup> Lamp East - .18  
 4<sup>h</sup> 45<sup>m</sup> East - .19  
 5<sup>h</sup> 2<sup>m</sup> West - .17  
 5 33 West - .14

c by Cauchy's method + .258  
 Lamp West.

a by Cauchy's method + .804

Clock fast (at 5<sup>h</sup>) 1<sup>m</sup> 52<sup>s</sup> 85



## Coast Survey Transit No. 5

Date	1870 Jan. 18		
Observer	E. P. A.		
Illumin'n	E. W.		
Star	$\alpha$ Orionis & Aurigae $\beta$ Orionis		
Mag.	$15^{\circ} 13'$ <del><math>45^{\circ} 52'</math></del> $8^{\circ} 21' S.$		
$\delta$	Tally D Tally D Tally D		
Wire	a		
"	b		
"	c		
"	1	4 58 56.2	5 8 51.0
"	2	58.9	54.8
"	3	59 1.7	58.7
"	4	4.4	9 2.3
"	5	7.1	6.2
"	d		
"	e		
"	f		
Sum		8.3	293.0
Mean	4 59	1.76	5 8 58.60
Reduction		+ .04	- .06
Red'n to	4 59	1.80	5 8 58.54
$\alpha$ B6		- .17	- .24
$\alpha$ tan. $\delta$ Aa		+ .38	- .07
c. sec. $\delta$		- .27	+ .37
r			
T	4 59	1.74	5 8 58.60
a	4 57	8.82	5 7 57.85
$\Delta T$		1 52.92	1 52.75

1 52.80

## Coast Survey Transit No. 5

Date

1870 Jan. 18

Observer

E. P. A.

Illumin'n

W.

Star

 $\beta$  Tauri

Gr. 966.

 $\delta$  Orionis

Mag.

 $28^{\circ} 30'$  $74^{\circ} 57'$  $0^{\circ} 24' S.$  $\delta$ 

Tally D

Tally D

Tally D

Wire

a

"

b

"

c

"

1

5

19 57.5

5

23 58.5

5

27 9.2

"

2

54.6

24

8.1

11.8

"

3

57.7

18.7

14.6

"

4

20 0.4

28.4

17.0

"

5

3.4

38.9

19.9

"

d

"

e

"

f

Sum

287.6

92.6

72.5

Mean

5

19 57.52

5

24 18.52

5

27 14.50

Reduction

5

19 57.05

5

24 18.15

5

27 14.04

Red'n to

5

19 57.47

5

24 18.37

5

27 14.46

m

B b

- .17

- .58

- .11

n. tan.  $\delta$ 

A a

+ .22

- 1.67

+ .55

c. sec.  $\delta$ 

+ .30

+ 1.00

+ .26

 $\tau$ 

T

5

19 57.82

5

24 17.12

5

27 15.16

a

5

18 4.87

5

22 24.18

5

25 22.35

 $\Delta T$ 

1 52.95

1 52.84

1 52.81



## Coast Survey Transit No. 5

Date	1870 Jan. 19			
Observer	E. P. A.			
Illumin'n	W.			
Star	$\alpha$ Persei	$\delta$ Persei	$\eta$ Tauri	
Mag.				
$\delta$	$49^{\circ} 24'$	$47^{\circ} 22'$	$23^{\circ} 42'$	
	Tally D	Tally D	Tally D	
Wire	a			
"	b			
"	c			
"	1	3 16 47.3	3 35 25.0	3 41 31.9
"	2	54.2	29.0	34.8
"	3	55.7	32.9	37.8
"	4	59.5	36.9	40.7
"	5	17 3.6	40.8	43.5
"	d			
"	e			
"	f			
Sum	277.3	164.6	188.7	
Mean	3 16 55.46	3 35 32.92	3 41 37.74	
Reduction	-.06	-.06	-.04	
Red'n to				
m Bb	-.34	-.32	-.16	
n. tan. $\delta$ Aa	-.15	-.10	+.28	
c. sec. $\delta$	+.38	+.37	+.27	
r				
T	3 16 53.29	3 35 32.81	3 41 38.09	
a	3 15 3.13	3 33 40.66	3 39 45.52	
$\Delta T$	1 52.16	1 52.15	1 52.57	

Jan. 19 1870 Value of b.  
 At 2<sup>h</sup> 45<sup>m</sup> Lamp West -.22  
 3 24 West -.22  
 3 50 West -.15  
 5 38 East -.08

c assumed +.25 Ill. West.  
 a " +.80

Clock fast (at 4<sup>h</sup> 2<sup>m</sup>) 1<sup>m</sup> 52.25

## Coast Survey Transit No. 5

Date	1870	Jan. 19		
Observer		E. P. A.		
Illumin'n		E.		
Star		$\delta$ Orionis	$\epsilon$ Orionis	$\delta$ Columbae
Mag.		$5^{\circ} 24' S.$	$1^{\circ} 17' S.$	$34^{\circ} 9' S.$
$\delta$		Tally C	Tally E.	Tally C
Wire	a			
"	b			
"	c			
"	1	5 27 25.0	5 31 8.3	5 37 1.7
"	2	27.6	11.3	4.5
"	3	30.0	11.0	7.6
"	4	32.9	16.6	10.8
"	5	35.4	19.2	14.0
"	d			
"	e			
"	f			
Sum		150.9	69.4	38.6
Mean		5 27 30.18	5 31 13.88	5 37 7.72
Reduction		-15.70	+15.59	-18.97
Red'n to				
m	Bb	- .06	- .06	- .02
n. tan. $\delta$	Aa	+ .54	+ .55	+ .94
c. sec. $\delta$		- .25	- .25	- .30
$\tau$				
T		5 27 14.71	5 31 29.71	5 36 49.37
a		5 25 22.35	5 29 37.44	5 34 57.40
$\Delta T$		1 52.36	1 52.27	1 51.97



## Coast Survey Transit No. 5

Date	1870 Jan. 21		
Observer	E. P. A.		
Illumin'n	W.		
Star	48 Cephei	2 Persei	3 Persei
Mag.	77° 15'	49° 24'	47° 22'
$\delta$	Tully F	Tully D	Tully D
Wire	a		
"	b		
"	c		
"	1	3 16 46.4	3 35 24.5
"	2	59.7	50.3
"	3	8 12.7	54.8
"	4	23.3	58.5
"	5	36.1	17 2.7
"	d		
"	e		
"	f		
Sum	59.7	272.7	160.8
Mean	3 8 11.94	3 16 54.54	3 35 32.16
Reduction	-142.32	-106	-106
Red'n to			
m B <sub>h</sub>	- .63	- .26	- .34
n. tan. $\delta$ A <sub>a</sub>	- .62 + <del>.28</del>	- <del>.16</del> <del>.28</del>	- .12
c. sec. $\delta$	+ 1.13	+ .38	+ .37
$\tau$			
T	3 5 49.50	3 16 53.89	3 35 32.08
a	3 3 56.23	3 15 31.09	3 33 40.62
$\Delta T$	4 <del>58.63</del> 1 <del>55.27</del>	1 <del>51.33</del> 1 <del>51.38</del> 1 <del>50.80</del>	1 51.39

Jan. 21 1870 Value of b.  
 At 3<sup>h</sup> 12<sup>m</sup> Lamp West - .17  
 After 3 Persei West - .28  
 At 6<sup>h</sup> 45<sup>m</sup> East - .06  
 7<sup>h</sup> 16<sup>m</sup> East - .01

c assumed + .25 H. W.  
 a estimated + .95

Clock fast (at 4<sup>h</sup> 1<sup>m</sup>) 1<sup>m</sup> 51.38



## Coast Survey Transit No. 5

Date 1870 Jan. 21

Observer E. P. A.

Illumin'n W.

E.

Star

Mag.

 $\delta$ 

Wire

a

"

b

"

c

"

1

"

2

"

3

"

4

"

5

"

d

"

e

"

f

Sum

Mean

Reduction

Red'n to

m Bk

p. tan.  $\delta$  Aac. sec.  $\delta$  $\tau$ 

T

a

 $\Delta T$  $\eta$  Tauri $23^{\circ} 42'$ 

Tally D

 $\zeta$  Persei $31^{\circ} 30'$ 

Tally F

 $\delta$  Draconis $75^{\circ} 17'$ 

Tally D

3 41 30.8  
33.6  
36.8  
39.6  
42.53 48 19.6  
22.9  
25.9  
28.8  
32.06 51 55.1  
52 5.7  
16.2  
26.2  
36.6

Sum	183.3	129.2	79.8
Mean	3 41 36.66	3 48 25.84	6 52 15.96
Reduction	- .04	-36.84	- .16
Red'n to			
m Bk	- .26	- .32	+ .11
p. tan. $\delta$ Aa	+ .32	+ .24	+3.22
c. sec. $\delta$	+ .27	+ .29	+ .99

$\tau$			20.14
T	3 41 36.95	3 47 49.18	6 52 18.16
a	3 39 45.50	3 45 57.85	18 50 28.17
$\Delta T$	1 51.45	1 51.33	1 46.43
			1 51.37



## Coast Survey Transit No. 5

Date	1870	Jan. 21		
Observer		E. P. A.		
Illumin'n		E.		
Star		E Can. Major	S Can. Major	S Gemini.
Mag.				22° 13'
$\delta$		Tally D	Tally D	Tally D
Wire	a			
"	b			
"	c			
"	1			7 14 7.8
"	2			10.7
"	3			13.2
"	4			16.1
"	5			19.0
"	d			
"	e			
"	f			
Sum				66.8
Mean				7 14 13.36
Reduction				+ .04
Red'n to				
<del>m</del> Bb				- .01
<del>n</del> tan $\delta$ Aa				+ .35
c. sec. $\delta$				- .27
r				
T				7 14 13.47
a				7 12 22.05
$\Delta T$				1 51.42

## Coast Survey Transit No. 8

Date	1870 Jan. 26		
Observer	E. P. A.		
Illumin'n	E.		
Star	$\gamma^2$ Urs. Min.	$\delta$ Persei	$\eta$ Tauri
Mag.			
$\delta$	$72^\circ 18'$	$47^\circ 22'$	$23^\circ 42'$
Wire	Tally D	Tally D	Tally D
a			
b			
c			
1	3 22 24.6	3 35 22.9	3 41 29.4
2	33.0	26.8	32.3
3	41.7	30.8	35.1
4	49.8	34.1	38.2
5	58.5	38.7	40.9
d	207.60	153.90	175.90
e			
f			
Reduction	— .66	+ .129	+ .122
Sum	206.94	154.19	176.12
Mean	3 22 41.29	3 35 30.84	3 41 35.22
Red'n to			
m. $Bh$	+ .03	— .03	.00
n. tan. $\delta$ $Aa$	+ 2.61	— .11	+ .31
c. sec. $\delta$	+ .82	— .37	— .27
$\tau$			
T	3 22 44.75	3 35 30.33	3 41 35.26
a	15 20 55.48	3 33 40.57	3 39 45.43
$\Delta T$	1 49.27	1 49.82	1 49.83

Jan. 26 1870 Value of  $b$   
 At 3<sup>h</sup> 29<sup>m</sup> Lamp East — .02  
 3 51 " East + .03  
 6 46 " West — .14  
 7 15 " West — .04

c estimated + .25 M. West  
 + .87

Clock fast (at 5<sup>h</sup>) 1<sup>m</sup> 49.82  
 (mean of  $\delta$  Persei,  $\eta$  Tauri,  $\delta$  Persei,  $\epsilon$  Cassiopei,  $\delta$  Gemini.)



## Coast Survey Transit No. 5

Date	1870	Jan. 26		
Observer	E. P. A.			
Illumin'n	E.	W.		
Star	$\delta$ Persei	$\delta$ Draconis	$\epsilon$ Canis Maj.	
Mag.	31° 30'	75° 17'	28° 48' S.	
$\delta$	Tally D	Tally D	Tally D	
Wire	a			
"	b			
"	c			
"	1	3 47 41.6	6 51 56.4	6 55 14.5
"	2	44.6	52 6.0	17.6
"	3	47.6	15.9	20.7
"	4	50.8	26.1	23.4
"	5	53.9	36.7	26.5
"	d	(238.50)	(81.10)	(102.70)
"	e			
"	f.			
Reduction	+ .23	+ .79	- .23	
Sum	238.73	81.89	102.47	
Mean	3 47 47.15	6 52 16.38	6 55 20.49	
Red'n to				
m	+ .03	+ .25	- .04	
n. tan. $\delta$	+ .19	+ 3.05	+ .95	
c. sec. $\delta$	- .29	- .98	+ .28	
r				
T	3 47 47.68	6 52 18.70	6 55 21.68	
a	3 45 57.76	18 50 28.91	6 53 32.04	
$\Delta T$	1 49.92	1 49.79	1 49.64	

## Coast Survey Transit No. 5

Date	1870	Jan. 26		
Observer		E. P. A.		
Illumin'n		W.		
Star		$\delta$ Can. Mag.	$\delta$ Gemin.	P. zyg. VII b7
Mag.		26° 11' S.	22° 13'	68° 44'
$\delta$		Tally D	Tally D	Tally D
Wire	a			
"	b			
"	c			
"	1	7 4 50.0	7 14 5.7	7 18 57.6
"	2	52.9	8.6	19 5.0
"	3	55.9	11.6	12.4
"	4	58.1	14.3	19.1
"	5	5 1.5	17.0	26.8
"	d	(279.00)	(57.20)	(60.90)
"	e			
"	f			
Reduction		— .22	— .22	— .55
Sum		278.78	56.98	60.35
Mean		7 4 55.76	7 14 11.40	7 19 12.07
Red'n to		— .03	— .04	— .10
m Bb		+ .91	+ .33	— 1.07
n. tan. $\delta$ Aa		+ .28	+ .27	+ .69
c. sec. $\delta$				
r				
T		7 4 56.92	7 14 11.96	7 19 11.59
a		7 3 7.32	7 12 22.07	7 17 24.82
$\Delta T$		1 49.60	1 49.89	1 49.77



## Coast Survey Transit No. 5

Date	1870 Jan. 28		
Observer	E. P. A.		
Illumin'n	E.		
Star	$\epsilon$ Cassiop.	$\delta$ Urs. Min.	$\gamma$ Ceti
Mag.	66° 49'	76° 16'	2° 41'
$\delta$	Tully D	Tully D	Tully D
Wire	a		
"	b		
"	c		
"	1	2 29 11.8	2 38 17.0
"	2	20 6.4	20.0
"	3	12.9	22.2
"	4	19.6	25.2
"	5	26.3	27.8
"	d	64.60	171.80
"	e		112.20
"	f		
Reduction	+ .51	- .84	+ .20
Sum	65.11	170.96	112.40
Mean	2 20 13.02	2 29 34.19	2 38 22.48
Red'n to			
m	100	100	100
n. tan. $\delta$	- .76	+ 2.66	+ .46
c. sec. $\delta$	- .64	+ 1.05	- .19
r			
T	2 20 11.62	2 29 37.90	2 38 22.75
a	2 18 22.62	14 27 48.88	2 36 33.42
$\Delta T$	1 49.00	1 49.02	1 49.33

Jan. 28 1870 Value of  $b$ .

At 2 <sup>h</sup> 23 <sup>m</sup>	Loamp. East	0.00
2 59	" East	- 0.02
3 12	" West	- 0.09
3 25	" West	- 0.13
3 49	" West	- 0.10

$\epsilon$  estimated +.25 W. W.  
 $\alpha$  from  $\epsilon$  Cass &  $\delta$  Urs. Min. +.72

clock fast (at 3<sup>h</sup> 1<sup>m</sup>) 1<sup>m</sup> 49.36  
 (mean of  $\gamma$  Ceti & Ceti, & Persi,  
 & Persi  $\gamma$  Tauri)



## Coast Survey Transit - No. 5

Date	1870	Jan. 28		
Observer	E. P. A.			
Illumin'n	e.	W.		
Star	$\alpha$ Ceti	$\alpha$ Persei	$\gamma^2$ Urs. Min.	
Mag.	3° 35'	49° 24'	72° 18'	
$\delta$	Tally D	Tally D	Tally D	
Wire	a			
"	b			
"	c			
"	1	2 57 12.2	3 16 44.3	3 22 24.8
"	2	15.3	48.0	34.0
"	3	17.8	52.2	42.2
"	4	20.1	56.4	51.0
"	5	23.2	17 0.8	59.8
"	d	88.60	261.40	211.80
"	e			
"	f			
Reduction	+ .20	- .31	+ .66	
Sum	88.80	261.09	212.46	
Mean	2 57 17.76	3 16 52.22	3 22 42.49	
Red'n to				
m	Bb	- .02	- .14	+ .18
n. tan. $\delta$	Aa	+ .145	- .14	+ 2.15
c. sec. $\delta$		- .25	+ .27	- .82
r				
T	2 57 17.94	3 16 52.21	3 22 44.00	
a	2 55 28.69	3 15 29.2	15 20 55.64	
$\Delta T$	1 49.25	1 49.29	1 48.36	



## Coast Survey Transit No. 5

Date	1870 Jan. 28			
Observer	E. P. A.			
Illumin'n	W.			
Star	$\delta$ Persei	$\gamma$ Tauri	$\delta$ Persei	
Mag.	47° 22'	23° 42'	31° 30'	
$\delta$	Tally D	Tally D	Tally D	
Wire	a			
"	b			
"	c			
"	1	3 35 22.0	3 41 28.7	3 47 40.8
"	2	26.0	31.5	43.8
"	3	29.8	34.6	47.2
"	4	33.7	37.2	50.0
"	5	37.9	40.1	53.0
"	d	149.40	172.00	234.80
"	e			
"	f			
Reduction	— .30	— .22	— .23	
Sum	149.10	171.78	234.57	
Mean	3 35 29.82	3 41 34.36	3 47 46.91	
Red'n to				
m B <sup>h</sup>	— .18	— .11	— .12	
n. tan. $\delta$ Aa	— .09	+ .25	+ .16	
c. sec. $\delta$	+ .37	+ .27	+ .29	
$\tau$				
T	3 35 29.92	3 41 34.77	3 47 47.24	
a	3 33 40.47	3 39 45.30	3 45 57.73	
$\Delta T$	1 49.45	1 49.47	1 49.51	



## Coast Survey Transit No. 5

Date	1870	Feb. 1		
Observer		E. P. A.		
Illumin'n		W.		
Star		$\alpha$ Columbae & Orionis	P. U. S. Min.	
Mag.		$34^{\circ} 9' 1''$	$7^{\circ} 23'$	$86^{\circ} 36'$
$\delta$		Tally F	Tally D	Tally F
Wire	a			
"	b			
"	c			
"	1	5 37 15.4	5 49 50.2	6 5 26.0
"	2	18.4	52.9	9.0
"	3	21.8	55.8	52.5
"	4	24.7	58.3	41.6
"	5	27.9	50 0.9	22.8
"	d	108.2	278.1	271.9
"	e	21.64	55.62	54.38
"	f	Reduction - 37.94	- .04	+ 531.25
Sum				
Mean		5 36 43.70	5 49 55.58	6 15 45.63
Red'n to				
m	186	- .02	- .02	- .32
n. tan. $\delta$	Aa	+ .85	+ .41	+ 9.46
c. sec. $\delta$		+ .30	+ .25	- 4.23
r				
T		5 36 44.83	5 49 56.22	6 15 50.54
a		5 34 57.23	5 48 8.40	18 14 2.64
$\Delta T$		1 47.60	1 47.82	1 47.90

Level Feb. 1 1870  
Value of b

At 5 41 Level West - .06  
5 53 " West - .03  
6 48 " East - .14

a assumed + .72  
c as " Jan. 28 1/2 + .25 Ill. W.  
Block fast (at  $6\frac{1}{4}$ ) 1<sup>m</sup> 47.82  
mean of  $\alpha$  Col. & Orion. p. Gen. Plan. May.



## Least Squares Transit No. 5

Date	1870	Feb. 1		
Observer	E. P. A.			
Illumin'n	E.			
Star	$\mu$ Geminor. S. Urs. Min. P. Cam. Maj.			
Mag.	22° 35' 86° 36' 26° 11' S.			
$\delta$	Tally D Tally E Tally D			
Wire	a			
"	b			
"	c			
"	1	6 16 48.2	6 18 26.2	7 4 49.2
"	2	50.9	19 8.5	52.2
"	3	53.9	52.5	55.1
"	4	57.0	20 50.9	58.0
"	5	59.7	21 24.4	5 0.9
"	d	269.7	282.5	275.4
"	e	53.94	56.50	55.08
"	f	Reduction +.04	- 263.64	+ .04
Sum				
Mean		6 16 53.98	6 15 32.86	7 4 55.12
Red'n to				
m	Bh	- .14	- 1.49	- .06
n. tan. $\delta$	Ha	+ .26	+ 9.46	+ .74
c. sec. $\delta$		- .27	+ 4.23	- .28
r				
T		6 16 53.83	6 15 45.12	7 4 55.52
a		6 15 6.20	18 14 2.64	7 3 7.29
$\Delta T$		1 47.63	42.48	48.23



## Coast Survey Transit No. 5

Date	1870	Feb. 7		
Observer		E. P. A.		
Illumin'n		E.		
Star		$\epsilon$ Tauri	A Draconis	$\gamma$ Tauri
Mag.		18° 53'	69° 3'	16° 15'
$\delta$		Tally D	Tally C	Tally D
Wire	a			
"	b			
"	c			
"	1	4 22 39.8	4 28 56.2	4 30 5.7
"	2	42.9	29 4.0	8.8
"	3	45.5	10.5	11.2
"	4	48.1	19.4	11.3
"	5	50.9	26.0	17.0
"		227.2	56.10	57.00
"	d			
"	e		4 29 11.22	
"	f			
Reduction		+ .21	+43.95	+ .21
Sum		227.41		57.21
Mean		4 22 45.48	4 29 55.17	4 30 11.44
Red'n to				
m	156	+ .07	- .07	+ .07
n. tan. $\delta$	A a	+ .21	+ 1.30	+ .22
c. sec. $\delta$		- .31	+ .84	- .31
$\tau$				
T		4 22 45.45	4 29 57.24	4 30 11.12
a		4 21 1.52	16 26 13.43	4 28 27.69
$\Delta T$		1 43.93	1 43.81	1 43.73

Feb. 7 1870 Value of b.

At 4<sup>h</sup> 15<sup>m</sup> Comp. East +.07  
 4 51<sup>m</sup> East +.07  
 5 1 West -.02  
 5 11 West -.02

c estimated +.20 Comp W.  
a " +.50

Clock fast at 5 h  
 (mean of  $\epsilon$  Tauri,  $\gamma$  Tauri,  
 $\epsilon$  Aurigae,  $\Pi$  Orionis  
 $\gamma$  Aurigae,  $\beta$  Orionis,  $\beta$  Tauri)  
 1<sup>m</sup> 43.91



## Coast Survey Transit No. 5

Date	1870	Feb. 7		
Observer	E. P. A.			
Illumin'n	E.		W.	
Star	$\alpha$ Camelopardis	$\epsilon$ Aurigae	$\eta$ Orionis	
Mag.	66° 7'	32° 57'	15° 13'	
$\delta$	Tully D	Tully D	Tully D	
Wire	a			
"	b			
"	c			
"	1	4 42 40.6	4 50 9.4	4 58 46.7
"	2	47.2	12.8	49.4
"	3	53.3	15.9	52.1
"	4	59.9	18.9	54.8
"	5	43 6.7	22.2	57.5
"		267.70	79.20	260.50
"	d			
"	e			
"	f	Reduction + .49	+ .24	- .21
Sum		268.19	79.44	260.29
Mean		4 42 53.64	4 50 15.89	4 58 52.06
Red'n to				
m	Bt	+ .15	+ .08	- .02
n. tan. $\delta$	Ha	- .50	+ .10	+ .24
c. sec. $\delta$		- .74	- .36	+ .31
$\tau$				
T		4 42 52.55	4 50 15.75	4 58 52.59
a		4 41 8.90	4 48 31.85	4 57 8.62
$\Delta T$		1 43.65	1 43.90	1 43.97

## Coast Survey Transit No. 5

Date	1870	Feb. 7		
Observer	E. P. A.			
Illumin'n	W.			
Star	$\alpha$ Aurigae		$\beta$ Orionis	$\beta$ Tauri
Mag.	45° 52'		8° 21' $\frac{1}{2}$	28° 30'
$\delta$	Tally D		Tally D	Tally D
Wire	a			
"	b			
"	c			
"	1	5 8 41.6	5 9 55.7	5 19 42.2
"	2	45.2	58.0	45.2
"	3	49.2	10 1.0	48.5
"	4	53.0	3.4	51.6
"	5	56.6	6.1	54.3
"	d	245.60	4.20	241.80
"	e			
"	f			
Reduction	- .29	- .20	- .23	
Sum	245.31	4.00	241.57	
Mean	5 8 49.06	5 10 0.80	5 19 48.31	
Red'n to				
m	- .03	- .04	- .02	
n. tan. $\delta$	- .04	+ .39	+ .14	
c. sec. $\delta$	+ .43	+ .30	+ .34	
$\tau$				
T	5 8 49.42	5 10 1.48	5 19 48.77	
a	5 7 5.56	5 8 17.61	5 18 4.68	
$\Delta T$	1 43.86	1 43.87	1 44.09	



## Coast Survey Transit No. 5

Date	1870 Feb. 10			
Observer	E. P. A.			
Illumin'n	E.			
Star	$\alpha$ Tauri	$\gamma$ Camelopard.	$\epsilon$ Aurigae	
Mag.	16° 15'	66° 7'	32° 57'	
$\delta$	Tally D	Tally D	Tally D	
Wire	a			
"	b			
"	c			
"	1	4 30 4.4	4 42 38.8	4 50 7.8
"	2	7.0	45.2	11.0
"	3	9.8	51.4	14.0
"	4	12.6	58.3	17.0
"	5	15.3	43 3.2	20.5
"	d			
"	e			
"	f			
Sum	49.1	256.9	70.3	
Mean	4 30 9.82	4 42 51.38	4 50 14.06	
Reduction	+ .04	+ .10	+ .05	
Red'n to	4 30 9.86	4 42 51.48	4 50 14.11	
m Bk	+ .02	+ .05	+ .02	
n. tan. $\delta$ A c	+ .02	- .04	+ .01	
c. sec. $\delta$	- .31	- .74	- .36	
T	4 30 9.59	4 42 50.75	4 50 13.78	
a	4 28 27.65	4 41 8.78	4 48 31.80	
$\Delta T$	1 41.84	1 41.97	1 41.98	

Feb. 10 1870 Value of  $t$ .

At 4<sup>h</sup> 25<sup>m</sup> Lamp East 0.00  
 5<sup>h</sup> 2<sup>m</sup> East +0.02  
 5<sup>h</sup> 14<sup>m</sup> West -0.03

$c$  assumed +.30 Lamp West.  
 $a$  from  $\gamma$  Cam.  $\beta$  Orion +.04

Clock fast at 4<sup>h</sup> 58<sup>m</sup>  
 mean of  $\alpha$  Tauri  $\gamma$  Cam.  $\epsilon$  Aur. 11 Orion.  $\beta$  Orion.  
 1<sup>m</sup> 41.592



## Coast Survey Transit No. 5

Date	1870	Feb. 10			
Observer		E. P. A.			
Illumin'n		E.	W.	W.	
Star		$\alpha$ Orionis	$\beta$ Orionis	$\kappa$ Cephei	
Mag.		15° 13'	8° 21'	77° 19'	
$\delta$		Tally C.	Tally E	Tally D	
Wire	a				
"	b				
"	c				
"	1	4 59 1.6	5 10 9.8	8 14 24.7	
"	2	4.2	12.4	36.7	
"	3	7.0	15.0	49.0	
"	4	9.9	17.5	15 0.5	
"	5	12.4	20.1	13.0	
"	d				
"	e				
"	f				
Sum		35.1	74.8	243.9	
Mean		4 59 7.02	5 10 14.96	8 14 48.78	
Red'n to		-16.32	-15.74	+ 1.86	
m		4 58 50.70	5 9 59.22	8 14 48.96	
n. tan. $\delta$	Bb	+ .02	- .02	+ .05	
c. sec. $\delta$	Aa	+ .02	+ .03	+ .02	
		- .31	+ .30	- 1.37	
T		4 58 50.43	5 9 59.53	8 14 47.16	
a		4 57 8.58	5 8 17.57	20 13 8.42	
$\Delta T$		1 44.85	1 44.96	1 39.24	

Value of  $t$  for  $\kappa$  Cephei  
 c probably too large  
 by a two small  
 but the other stars  
 will not bear much  
 change.



## Coast Survey Transit No. 5

Date	1870	Feb. 16			
Observer		E. P. A.			
Illumin'n		E.	W.	W.	
Star		$\beta$ Tauri	Gr. 966	$\epsilon$ Orionis	
Mag.		28° 30'	74° 57'	1° 17' S.	
$\delta$		Tally D	Tally D	Tally D	
Wire	a				
"	b				
"	c				
"	1	5 19 37.2	5 23 41.7	5 31 10.2	
"	2	40.5	52.6	13.0	
"	3	43.3	24 2.7	15.8	
"	4	46.3	11.9	18.0	
"	5	49.5	22.1	20.8	
"	d	216.8	11.0	77.8	
"	e	5 19 43.36	5 24 2.20	5 31 15.56	
"	f				
Reduction		+ .05	- .15	- .04	
Sum					
Mean		5 19 43.41	5 24 2.05	5 31 15.52	
Red'n to					
m Bb		+ .11	+ .32	+ .00	
n. tan. $\delta$ Aa		+ .24	- 1.81	+ .60	
c. sec. $\delta$		- .28	+ .96	+ .25	
r					
T		5 19 43.48	5 24 1.52	5 31 16.37	
a		5 18 4.53	5 22 22.67	5 29 37.25	
$\Delta T$		1 38.95	1 38.85	1 39.22	

Feb. 16 1870 Value of b.  
 At 4<sup>h</sup> 47<sup>m</sup> Lamp East +.03  
 5 14 East +.40  
 5 20 West +.10  
 5 32 West .00  
 5 52 West +.05  
 6 7 West .00  
 6 24 East +.01  
 6 46 East .00

c from S. U. S. M. G. +.25 Lamp West.  
 a " circumpolars +.875  
 Clock fast at 5<sup>h</sup> 50<sup>m</sup>  
 (mean of  $\beta$  Tauri,  $\epsilon$  Orion,  $\alpha$  Orion,  $\gamma$  Gem.)  
 1<sup>m</sup> 39.02



## Coast Survey Transit No. 5

Date	1870	Feb. 16		
Observer		E. P. A.		
Illumin'n		W.	W.	W.
Star		$\psi$ Draconis	$\alpha$ Orionis	$\delta$ Urs. Min.
Mag.				
$\delta$		$72^{\circ} 12'$	$7^{\circ} 23'$	$86^{\circ} 36'$
		Tally D	Tally D	Tally E
Wire	a			
"	b			
"	c			
"	1	5 45 33.2	5 49 41.2	6 9 51.0
"	2	42.0	43.9	10 34.3
"	3	50.0	46.7	11 18.3
"	4	58.9	49.1	12 1.5
"	5	46 7.9	51.9	12 46.9
"	d	252.0	232.8	92.0
"	e			
"	f	5 45 50.40	5 49 46.56	6 11 18.40
Reduction		+ .13	- .04	+ 263.60
Sum				
Mean		5 45 50.53	5 49 46.52	6 15 42.00
Red'n to				
m $\gamma$ b		- .05	+ .04	+ .00
n. tan. $\delta$ Aa		+ 2.60	+ .51	+ 11.49
c. sec. $\delta$		- .82	+ .25	- 4.23
$\tau$				
T		5 45 52.26	5 49 47.32	6 15 49.26
a		17 44 13.30	5 48 8.23	18 14 6.38
$\Delta T$		1 38.96	1 39.09	1 42.88



## Coast Survey Transit No 5

Date	1870 Feb 16			
Observer	Ex R. H.			
Illumin'n	E.			
Star	S. Urs. Minor	$\gamma$ Geminorum	$\delta$ Capricorn	
Mag.				
$\delta$	$86^{\circ} 36'$	$16^{\circ} 30'$	$87^{\circ} 14.5'$	
	Tally E	Tally D	Tally D	
Wire	a			
"	b			
"	c			
"	1	6 18 27.7	6 31 45.4	6 38 55.1
"	2	19 11.7	48.5	39 51.3
"	3	20 0.6	51.0	40 45.5
"	4	40.0	54.0	41 40.4
"	5	21 26.3	56.7	42 35.8
"	d	286.3	255.6	228.1
"	e	6 19 57.26	6 31 51.12	6 40 45.62
"	f			
Reduction	-263.60	+ .04	+ .83	
Sum				
Mean	6 15 33.66	6 31 51.16	6 40 46.45	
Red'n to				
m	R36	-.11	.00	.00
n. tan. $\delta$	Aa	+ 11.49	+ .40	- 12.82
c. sec. $\delta$		+ 4.23	-.26	5.19
r				
T	6 15 49.27	6 31 51.30	6 40 38.44	
a	18 14 6.38	6 30 12.46	6 38 55.88	
$\Delta T$	1 42.91	1 38.84	1 42.56	



## Coast Survey Transit No. 5

Date	1870	Feb. 19			
Observer		E. P. A.			
Illumin'n		W.			
Star		$\alpha$ Camelopard.	$\epsilon$ Aurigae	$\alpha$ Aurigae	
Mag.		66° 7'	32° 57'	45° 52'	
$\delta$		Tully D	Tully D	Tully D	
Wire	a				
"	b				
"	c				
"	1	4 42 33.4	4 50 2.0	5 8 34.5	
"	2	39.9	5.1	38.3	
"	3	46.3	8.6	42.2	
"	4	52.8	11.6	45.9	
"	5	59.4	14.7	49.6	
"		<u>231.8</u>	<u>42.0</u>	<u>210.5</u>	
"	d				
"	e	4 42 46.36	4 50 8.40	5 8 42.10	
"	f				
Red'n		— .10	— .05	— .06	
Sum					
Mean		4 42 46.26	4 50 8.35	5 8 42.04	
Red'n to					
<del>m</del> $\beta$ h		— .05	— .16	— .20	
n. tan. $\delta$ Aa		— .96	+ .19	— .08	
c. sec. $\delta$		+ .27	+ .13	+ .16	
T					
		4 42 45.52	4 50 8.51	5 8 41.92	
a		4 41 8.38	4 48 31.63	5 7 57.29	
$\Delta T$		1 37.14	1 36.88	1 36.63	

Feb. 19 1870 Value of  $b$

At 2 40" Lamp West — .02  
 5 0 West — .14  
 5 12 East — .02  
 5 51 East + .03  
 5 59 West — .03  
 6 33 West .00

c from  $\beta$  Tauri,  $\alpha$  Orion,  $\mu$   $\gamma$  Gem.  
 + .11 Lamp West.  
 a from  $\epsilon$  p. 966 &  $\psi$  Draconis + .97

Clock fast at 5<sup>h</sup> 40<sup>m</sup>  
 (mean of  $\epsilon$  Tauri,  $\alpha$  Aur,  $\beta$  Tauri,  $\alpha$  Orion,  $\mu$   $\gamma$  Gem.)  
 1<sup>m</sup> 36.94



## Coast Survey Transit No 5

Date	1870	Feb. 19		
Observer		E. P. A.		
Illumin'n		E.		
Star		$\beta$ Tauri	Gr 966	$\psi$ Draconis
Mag.		28° 30'	74° 57'	72° 12'
$\delta$		Tally D	Tally D	Tally D
Wire	a			
"	b			
"	c			
"	1	5 19 35.2	5 23 41.6	5 45 30.0
"	2	38.2	51.8	38.6
"	3	41.1	24 1.4	47.7
"	4	44.2	11.2	55.7
"	5	47.6	21.9	46 41.0
"	d	206.3	7.9	236.0
"	e	5 19 41.26	5 24 15.8	5 45 47.20
"	f			
Reduction		+ .05	+ .15	- .13
Sum				
Mean		5 19 41.31	5 24 1.73	5 45 47.07
Red'n to				
m	136	- .02	- .05	- .03
n. tan. $\delta$	Aa	+ .26	- 2.01	+ 2.89
c. sec. $\delta$		- .13	- .42	+ .36
r				
T		5 19 41.42	5 23 59.25	5 45 50.29
a		5 18 41.48	5 22 22.46	17 44 13.51
$\Delta T$		1 36.94	1 36.79	1 36.78

## Coast Survey Transit No. 5

Date	1870	Feb. 19		
Observer		E. P. A.		
Illumin'n		E.	W.	
Star		$\alpha$ Orionis	$\mu$ Geminor.	$\gamma$ Geminor.
Mag.		7 <sup>o</sup> 23'	22 <sup>o</sup> 35'	16 <sup>o</sup> 30'
$\delta$		Tally D	Tally D	Tally D
Wire	a			
"	b			
"	c			
"	1	5 49 39.8	6 16 36.7	6 31 43.5
"	2	42.2	39.8	46.2
"	3	44.8	42.8	48.9
"	4	47.3	45.6	51.6
"	5	50.0	48.2	54.4
"	d	224.1	213.1	244.6
"	e	5 49 44.82	6 16 42.62	6 31 48.92
"	f			
Reduction		+ .04	- .04	- .04
Sum				
Mean		5 49 44.86	6 16 42.58	6 31 48.88
Red'n to				
m	Bh	+ .02	- .03	.00
n. tan. $\delta$	Aa	+ .56	+ .36	+ .44
c. sec. $\delta$		- .11	+ .12	+ .11
$\tau$				
T		5 49 45.33	6 16 43.03	6 31 49.43
a		5 48 8.19	6 15 6.01	6 30 12.42
$\Delta T$		1 37.14	1 37.02	1 37.01



Date	1870 Feb. 23
Observer	A. S.
Illumin'n	E.
Star	$\alpha^2$ Geminorum & Can. Min. & Geminorum
Mag.	
$\delta$	$32^\circ 10'$ $5^\circ 33'$ $27^\circ 6'$
Wire	a
"	b
"	c
"	1
"	2
"	3
"	4
"	5
"	d
"	e
"	f
Sum	264.6      24.1      36.1
Mean	7 27 52.92      7 34 4.82      7 47 7.22
Red'n to $\overline{m}$	+ .26      + .26      + .26
n. tan. $\delta$	- .09      - .27      - .13
c. sec. $\delta$	+ .11      + .09      + .10
$r$	
T	7 27 53.20      7 34 4.90      7 47 7.45
a	7 26 18.38      7 32 30.35      7 45 32.93
$\Delta T$	1 34.82      1 34.55      1 34.52

Feb. 23 1870.  $c'$  observed + .09  
 $\overline{m}$  " " + .26  
 n from 3 Hrs. Maj. & E. Drac. + .33

$\alpha$  Geminorum in the almanac seems to be the mean of the stars  
 Clock fast (at  $f \frac{3}{4}$ ) 1<sup>m</sup> 34.54  
 (mean of  $\alpha$  Can. Min. & Gem. 15 Argus)

Date 1870 Feb. 23

Observer A. S.

Illumin'n E.

Star

Mag.

 $\delta$ E Draconis 3 Urs. Maj. 15 Argus  
69° 56' 68° 51' 23° 56' S.

Wire

a

"

b

"

c

"

1

"

2

"

3

"

4

"

5

"

d

"

e

"

f

7	49	48.1	8	1	6.0	8	3	28.2
		58.4			16.1			32.0
	50	9.3			26.1			36.0
		19.5			36.2			40.0
		30.4			45.6			44.0

Sum

Mean

		45.7			130.0			180.2
7	50	9.14	8	1	26.00	8	3	36.04

Red'n to

m

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

		+26			+26			+26
		-1.20			+55			-45
		-.26			+25			+10

 $\tau$ 

T

a

 $\Delta T$ 

7	50	7.94	8	1	27.06	8	3	35.95
19	48	33.29	7	59	52.42	8	2	1.41
		34.65			34.64			34.54



## Boat Survey Transit No 5

Date 187 Feb 24

Observer E. P. A.

Illumin'n W W W

Star 57 Cephei 50 Draconis 16 E Can Major

Mag.

 $\delta$   
level -0.01 at 45<sup>m</sup> -0.01 at 57

Wire a

" b

" c

" 1 E 6 44 08.2 F 6 49 39.6 D 6 54 59.1

" 2 45 02.6 50.3 55 2.1

" 3 45 56.2 59.6 5.2

" 4 46 53.9 50 10.7 8.2

" 5 47 47.0 20.8 11.2

" d

" e

" f

Sum 167.9 181.0 258

Mean 12

Red'n to 6 45 57.58 6 50 0.20 6 55 5.16

m -5 23.76 +2 3.76 -5

m h.B -12 +02 0

n. tan.  $\delta$  +4.36 -83 +24c. sec.  $\delta$  -10.69 +2.54 +79

7

r

T 6 40 27.37 6 52 5.69 6 55 6.14

a 6 38 52.86 15 50 30.47 6 53 31.72

 $\Delta T$  -1 34.51 1 35.22 1 34.42

A -14.657 +3.48 +1.08

h +14.72 -1.83 +0.37

C +20.77 -3.94 +1.14

a<sup>2</sup> 214.558 12.15 +1.17C = +0.21<sup>m</sup> a = +0.73<sup>s</sup>  
 $\Delta t = -1$  34.46 at 7<sup>h</sup> 29

Date	1870	Feb 24			
Observer		E P A			
Illumin'n		W	W	E	
Star		Non Maj	S Geminae	Pi VII 67	
Mag.					
$\delta$					- 0 2
Wire	a				
"	b				
"	c				
"	1	07 4 34.6	07 13 50.5	07 18 41.5	
"	2	37.5	53.0	49.0	
"	3	40.6	56.0	56.0	
"	4	43.3	58.9	19 3.3	
"	5	46.4	14 1.7	11.0	
"	d				
"	e				
"	f				
Sum		2.4	30.1	30.8	
Mean					
		7 4 40.48	7 13 56.02	7 18 56.16	
Red'n to		- 4	- 4	+ 10	
m		0.0	- 01	- .05	
n. tan. $\delta$		+ 23	+ 23	- 56	
c. sec. $\delta$		+ 76	+ 27	- 89	
$\tau$					
T		7 4 41.43	7 13 56.47	7 18 54.75	
a		7 3 7.03	7 12 21.91	7 17 21.25	
$\Delta T$		- 1 34 40	1 34.56	- 1 33.50	
		+ 1.04	+ 0.37	- 1.22	
		+ 0.41	+ 1.01	+ 2.47	
		+ 1.11	+ 1.08	+ 2.76	
		1.08	0.14	1.50	



Date				
Observer				
Illumin'n	E	E	E	
Star	ε Ducon LG α <sup>2</sup> Geminar α Can Min			
Mag.				
δ	-0.02 at 22 <sup>m</sup>			
Wire	a			
"	b			
"	c			
"	1	E 7 20 7.8	D 7 27 46.9	D 7 33 59.2
"	2	15.9	50.0	34 2.0
"	3	25.1	52.9	4.4
"	4	34.6	56.0	7.0
"	5	43.4	59.2	9.8
"	d			
"	e			
"	f			
Sum		26.8	15.0	22.4
Mean		7 20 25.86	7 27 53.00	7 34 4.48
Red'n to		- 53.62	+ 4.5	+ 4
m		+ 03	<del>50.02</del>	+ 00
n. tan. δ		+ 72	- 25	- 21
c. sec. δ		+ 2.27	+ 15	+ 44
τ				
T		7 19 34.76	7 27 52.93	7 34 4.76
a		19 17 59.56	7 26 18.37	7 32 30.33
Δ T		1 35.20	1 34.56	1 34.43
		+ 3.11	+ 21	+ 60
		- 1.48	1.16	80
		- 3.44	1.18	100
		9.64	.04	36

65 transit No 5

Date	1870	Feb 24		
Observer		E. P. C.		
Illumin'n		E	E	
Star		$\beta$ Geminor	$\gamma$ Geminor	$\delta$ Cephei
Mag.				
$\delta$		+0.02 at 39 <sup>m</sup>		
Wire	a			
"	b			
"	c			
"	1	D 7 38 50.4	6 31 38.8	6 37 49.2
"	2	53.3	42.5	
"	3	56.3	46.2	40 21.7
"	4	59.4	50.1	
"	5	39 2.5	53.8	42 53.5
"	d			
"	e			
"	f			
Sum		31.9	31.4	124.4
Mean		7 38 56.38	6 31 46.28	6 40 21.47
Red'n to		+ 5		+ 33
m		+ .02		
n. tan. $\delta$		- 24		
c. sec. $\delta$		+ 20	+ .07	+ 1.40
T		7 38 56.41		
a		7 37 22.03	6 30 12.36	6 38 52.86
$\Delta T$		- 1 34.38		
		+ 0.28	- .62	+ 19.84
		1.10	+ 1.04	20.77
		1.14		
		.08		



## Transit Circle

Date						
Observer						
Illumin'n						
Star	50 Dracon LC $\phi$ Geminor $\epsilon$ Draconis <sup>LG</sup>					
Mag.						
$\delta$						
Wire	a					
"	b					
"	c					
"	1	6 51 38.0	7 <del>46 54.9</del>	7 49 47.0		
"	2	52.0	58.7	57.9		
"	3	52 5.9	47.5 2.8	50 8.3		
"	4	20.0	6.8	14.0		
"	5	33.9	10.8	24.6		
			14.8			
"	d					
"	e					
"	f					
Sum		27.8	14.0	41.8		
Mean		6 52 5.96	7 47 6.78	7 50 8.36		
Red'n to						
m						
n. tan. $\delta$						
c. sec. $\delta$		-28	+08	-20		
r						
T						
a		18 30.47	7 45 32.92	19 48 33.34		
$\Delta T$						
		-4.72	-4.0	-3.65		
		-3.84	+1.12	-2.92		

Date 1870 Feb 24

Observer E. P. O. S.

Illumin'n E

Star  $\lambda$  Ursae minor 16 3 Ursa Major H 15 Argus

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

 $\Delta T$ 

8 1	5.2	8 3	27.4
7 52	14.3		37.6
55	24.8		35.5
			39.4
			43.5

	2.5		2.4
8 1	25.50	8 3	35.48

+ 20	+ 0.8
------	-------

19 53	37.38	7 59	52.39	8 2	1.40
-------	-------	------	-------	-----	------

-54.03	+1.67	-1.36
-53.13	+2.77	+1.09



Date							
Observer							
Illumin'n							
Star	+ Cephei LG Gr 3241 LG & Hydruce						
Mag.							
$\delta$							
Wire	a						
"	b						
"	c						
"	1	8 14 28.6	8 31 41.9	8 40 37.2	20.8		
"	2	44.7	53.8	42.4	26.4		
"	3		32 5.1	47.5	28.0		
"	4	15 0.6	16.6	52.7	31.7		
"	5	17.6	28.8	57.8	35.3		
"	d						
"	e						
"	f						
Sum			26.2	40.2			
Mean			8 32 5.24	8 41 28.04			
Red'n to							
m							
n. tan. $\delta$							
c. sec. $\delta$			+22	+7			
r							
T							
a		20 13 9.01	20 30 29.74	8 39 54.16			
$\Delta T$							
		- 5.36	- 4.01	- 0.78			
		- 4.56	- 3.25	+ 1.01			

Date	1870	Feb 24	March 2	
Observer		E. P. C.	A. S.	
Illumin'n		E	E	
Star		$\epsilon$ Usc. Maj.	3 Usc. Maj.	15 Argus
Mag.				
$\delta$			$68^{\circ} 51'$	$23^{\circ} 56' S.$
Wire	a			
"	b			
"	c			
"	1	8 51 41.4	8 1 1.9	8 3 24.1
"	2	47.0	11.8	27.9
"	3	52.4	21.8	31.9
"	4	58.0	31.6	35.9
"	5	52 3.4	41.6	39.8
"	d			
"	e			
"	f			
Sum		12.2	108.7	159.6
Mean		8 51 52.44	8 1 21.74	8 3 31.92
Red'n to				
m			+2.6	+2.6
n. tan. $\delta$			+2.5	-.20
c. sec. $\delta$		+11	+2.5	+1.10
r				
T			8 1 22.50	8 3 32.08
a		8 50 18.73	7 59 52.21	8 2 1.33
$\Delta T$			1 30.29	1 30.75
		+0.22		
		+1.51		



Date	1870	March 2		
Observer		A. S.		
Illumin'n		E.		
Star		$\kappa$ Cephei	$\epsilon$ Hydrae	$\epsilon$ Urs. Maj.
Mag.				
$\delta$		$77^{\circ} 19'$	$60^{\circ} 54'$	$48^{\circ} 33'$
Wire	a			
"	b			
"	c			
"	1	8 14 7.9	8 41 17.1	8 51 38.1
"	2	24.4	21.0	43.6
"	3	41.0	24.5	48.8
"	4	56.6	28.2	54.6
"	5	15 13.4	31.9	59.9
"	d			
"	e			
"	f			
Sum		203.3	122.7	245.0
Mean		8 14 20.66	8 41 24.54	8 51 49.00
Red'n to				
m		+ .26	+ .26	+ .26
n. tan. $\delta$		- .80	- .12	+ .03
c. sec. $\delta$		- .41	+ .09	+ .14
r				
T		8 14 39.71	8 41 24.71	8 51 49.43
a		20 13 9.37	8 39 54.13	8 50 18.69
$\Delta T$		1 30.34	1 30.64	1 30.74

March 2, 1870.

 $m$  assumed +.26 $c'$  " +.09  
 $n$  (3 Urs. Maj. &  $\kappa$  Cephei) + 0.15Clock fast (at  $8\frac{1}{2}$ )  $1^m 30^s.71$   
(mean of 15 Argus,  $\epsilon$  Hydrae, & Urs. Maj.)



Date 1870 March 8  
 Observer A. S.  
 Illumin'n E.  
 Star  $\phi$  Geminorum  $\epsilon$  Draconis 3 Uro. Maj.  
 Mag. 27° 6' 69° 56' 68° 51'

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

7	46	54.2	7	49	40.6	8	0	57.6
		55.2			51.0		1	7.7
		59.2		50	1.9			17.8
	47	3.5			12.2			27.1
		7.4			22.4			37.6

Sum		296.5			8.1			87.8	
Mean	7	46	59.30	7	50	1.62	8	1	17.56

Red'n to

m		+ .28			+ .28			+ .28
n. tan. $\delta$		- .12			- 1.10			+ .50
c. sec. $\delta$		+ .10			- .26			+ .25

r

T	7	46	59.86	7	50	0.54	8	1	18.59
a	7	45	32.77	19	48	33.92	7	59	52.00
$\Delta T$		1	26.79		1	26.62		1	26.59

March 8 1870 by observation + 0.2045  
 by eq + 0.28  
 c assumed + .09

clock fast at 8<sup>h</sup> 10<sup>m</sup> (mean of  $\phi$  Gem., 15 Argus, & Hydrae) 1<sup>m</sup> 26.565  
 (mean of all the stars 1<sup>m</sup> 26.69)



1669phae.proj..339S

Date 1870 March 8  
Observer A. S.  
Illumin'n E.  
Star 15 Argus  $\gamma$ . 3241  $\epsilon$  Hydrae  
Mag. 23° 56' S. 72° 5' 6° 54'

Wire	a									
"	b									
"	c									
"	1	8	3	20.0	8	31	35.0	8	41	13.4
"	2			24.2			46.5			16.9
"	3			27.9			58.4			20.4
"	4			31.9		32	9.8			24.2
"	5			35.8			22.0			27.7
"	d									
"	e									
"	f									

Sum			139.8			291.7			102.6
Mean	8	3	27.96	8	31	58.34	8	41	20.52

Red'n to									
m			+1.28			+1.28			+1.28
n. tan. $\delta$			-.41			-1.20			-.24
c. sec. $\delta$			+1.10			-.29			+1.09

$\tau$									
T	8	3	27.93	8	31	57.13	8	41	20.65
a	8	2	1.24	20	30	30.24	8	39	54.08
$\Delta T$	1		26.69	1		26.89	1		26.57

Date	1870 March 14		
Observer	A. S.		
Illumin'n	E.		
Star	$\epsilon$ Hydrae & Urs. Maj.		
Mag.	T.Y.C. 1879		
$\delta$	6° 54'	48° 33'	80° 4'
Wire	a		
"	b		
"	c		
"	1	8 41 9.9	8 51 30.7
"	2	13.6	35.9
"	3	17.2	41.3
"	4	20.8	47.0
"	5	24.4	52.4
"	d		
"	e		
"	f		
Sum	85.9	207.3	224.9
Mean	8 41 17.18	8 51 41.46	8 54 44.98
Red'n to			
m	+ .26	+ .26	+ .26
n, tan. $\delta$	-.21	+ .06	-1.72
c. sec. $\delta$	+ .09	+ .13	-.52
r			
T	8 41 17.32	8 51 41.98	8 54 43.00
a	8 39 54.02	8 50 18.53	20 53 09.66
$\Delta T$	1 23.30	1 23.38	1 23.34

March 14 1870  $\delta$  sec  $\phi$  observed +0.26  
 c' assumed +0.09  
 n from T.Y.C. 1879  $\delta$  Urs. Maj. +0.26  
 Clock fast (at 9<sup>h</sup> sid. time) 1<sup>m</sup> 23.32  
 (mean of  $\epsilon$  Hydrae, Urs. Maj.,  $\alpha$  Cancri, & Hydrae.)



Date	1870	March 14	21.11.11
Observer	A. S.		
Illumin'n	E.		
Star	$\sigma^2$ Urs. Maj. K. Cancri & Hydrae		
Mag.			
$\delta$	67° 40'	11° 11'	8° 6' S.
Wire	a		
"	b		
"	c		
"	1	9 0 0.3	9 1 58.7
"	2	9.7	2 2.4
"	3	19.4	6.0
"	4	28.2	9.7
"	5	38.4	13.4
"	d		
"	e		
"	f		
Sum		96.0	30.2
Mean	9 0	19.20	6.04
Red'n to			
m		+1.26	+1.26
n. tan. $\delta$		+1.40	-1.19
c. sec. $\delta$		+1.24	+1.09
r			
T	9 0	20.10	6.20
a	8 58	56.78	42.87
$\Delta T$	1	23.32	23.33

1 23.25

Date	1870 March 19			
Observer	A. S.			
Illumin'n	E.			
Star	$\alpha$ Geminor. $\alpha$ Can. Min. $\beta$ Geminor			
Mag.				
$\delta$	32° 10'	50° 33'	28° 20'	
Wire	a			
"	b			
"	c			
"	1	7 27 30.3	7 33 43.6	7 38 34.3
"	2	34.8	47.3	38.5
"	3	39.0	50.9	42.8
"	4	43.2	54.6	46.8
"	5	47.4	58.2	50.8
"	d			
"	e			
"	f			
Sum	194.7	254.6	213.2	
Mean	7 27 38.94	7 33 50.92	7 38 42.64	
Red'n to				
m	+ .31	+ .31	+ .31	
n. tan. $\delta$	-.08	-.24	-.11	
c. sec. $\delta$	+ .11	+ .09	+ .10	
r				
T	7 27 39.28	7 33 51.08	7 38 42.94	
a	7 26 18.00	7 32 30.01	7 37 21.70	
$\Delta T$	1 21.28	1 21.07	1 21.24	

March 19 1870 Illumination East.

$\Delta$  (object glass north) + 0.242 (south) + 0.218

$$\bar{m} = r \sec \varphi = 0.23 \times 1.364 = + 0.31$$

c assumed + .09

n. from  $\epsilon$  Drac. } 3 Urs. Maj. + .29

clock fast at 7<sup>h</sup> 37<sup>m</sup> (mean of  $\alpha$  Gem.,  $\alpha$  Can. Min.,  $\beta$  Gem.,  $\gamma$  Gem.)

1<sup>st</sup> 21.19



Date	1870 March 19		
Observer	A. S.		
Illumin'n	E.		
Star	$\phi$ Geminos. $\epsilon$ Drac.	3 Urs. Maj.	
Mag.			
$\delta$	$27^{\circ} 6'$	$69^{\circ} 56'$	$68^{\circ} 51'$
Wire	a		
"	b		
"	c		
"	1	7 46 45.5	8 0 51.6
"	2	49.4	1 1.8
"	3	53.4	7 49 56.9
"	4	57.6	50 7.2
"	5	47 1.5	18.0
"	d		
"	e		
"	f		
Sum	267.4	less $\frac{202.10}{31.61}$	58.8
Mean	7 46 53.48	7 49 $\frac{170.49}{56.83}$	8 1 11.76
Red'n to			
m	+ .81	+ .31	+ .31
n. tan. $\delta$	- .12	- 1.06	+ .50
c. sec. $\delta$	+ .10	- .26	+ .25
r			
T	7 46 53.77	7 49 55.82	8 1 12.82
a	7 45 32.60	19 48 34.54	7 59 54.54
$\Delta T$	1 21.17	1 21.28	1 21.28



Date	1870	March 22		
Observer		A. S.		
Illumin'n		E.		
Star		Piazzi VII 67	$\alpha$ Gem (mean)	$\alpha$ Can. Min.
Mag.				
$\delta$		68° 44'	32° 10'	30° 33'
Wire	a			
"	b			
"	c			
"	1	7 18 19.3	7 27 29.0	7 33 42.6
"	2	29.6	33.3	46.2
"	3	39.0	37.8	49.8
"	4	49.1	42.0	53.3
"	5	59.0	46.3	57.0
"	d			
"	e			
"	f			
Sum		196.0	188.4	248.9
Mean		7 18 39.20	7 27 37.68	7 33 49.78
Red'n to				
m		+ .38	+ .38	+ .38
n. tan. $\delta$		+ .53	- .09	- .26
c. sec. $\delta$		+ .25	+ .11	+ .09
r				
T		7 18 40.36	7 27 38.08	7 33 49.99
a		7 17 20.11	7 26 17.94	7 32 29.96
$\Delta T$		1 20.25	1 20.14	1 20.03

March 22 1870. Object glass  $N. ; b = \frac{158 - 142}{60} = +0.267$   
 " "  $S. ; b = \frac{160 - 142}{60} = +0.300$

$$\bar{m} = b \sec \varphi = 0.284 \times 1.354 = +0.38$$

c assumed + .09

n from Piazzi VII 67  $\delta$   $\epsilon$  Draconis + 0.32

Clock fast at 7<sup>h</sup> 36<sup>m</sup> (mean of  $\alpha$  Gem.  $\alpha$  Can. Min.  $\beta$  Gem.  $\phi$  Gem.)

$\alpha$  Gem. in almanac perhaps preceding star



Date 1870 March 22

Observer A. S.

Illumin'n E.

Star

Mag.

 $\delta$  $\beta$  Gemin. $28^{\circ} 20'$  $\gamma$  Gemin. $27^{\circ} 6'$  $\epsilon$  Draconis $69^{\circ} 56'$ 

Wire

a

"

b

"

c

"

1

"

2

"

3

"

4

"

5

"

d

"

e

"

f

Sum

Mean

Red'n to

 $\overline{m}$ n. tan.  $\delta$ c. sec.  $\delta$  $r$ 

T

a

 $\Delta T$ 

7	38	33.2	7	46	44.0	7	49	35.0
		37.2			48.3			45.6
		41.4			52.3			56.0
		45.4			56.2		50	6.5
		49.6		47	0.3			17.1

		206.8			261.1			280.2
7	38	41.36	7	46	52.22	7	49	56.04

		+ .38			+ .38			+ .38
		- .12			- .13			- 1.17
		+ .10			+ .10			- .26

7	38	41.72	7	46	52.57	7	49	54.99
7	37	21.64	7	45	32.52	19	48	34.72
		1 20.08			1 20.03			1 20.27



Date	1870	March 25			
Observer	N. S.				
Illumin'n	E.				
Star	σ <sup>2</sup> Urs. Maj., κ Cancri & Draconis				
Mag.					
δ	67° 40'      11° 11'      81° 54'				
Wire	a				
"	b				
"	c				
"	1	8 59 53.3	9 1 53.8	9 18 49.6	
"	2	9 10 4.4	57.4	19 16.0	
"	3	14.4	2 1.2	41.3	
"	4	23.4	4.9	20 6.9	
"	5	32.8	8.6	32.7	
"	d				
"	e				
"	f				
Sum		9 0 70.3	9 2 5.9	9 19 206.5	
Mean		9 0 14.06	9 2 1.18	9 19 43.30	
Red'n to					
m		+ .34	+ .34	+ .34	
n. tan. δ		+ .30	- .14	+ 1.22	
c. sec. δ		+ .24	+ .09	+ .64	
r					
T		9 0 14.94	9 2 1.47	9 19 43.50	
a		8 58 56.41	9 0 42.75	9 18 24.53	
Δ T		1 18.53	1 18.72	1 18.97	

March 25 1870 Level readings

$$\text{Object glass north, } b = \frac{175\frac{1}{2} - 160\frac{1}{2}}{60} = +0.250$$

$$\text{" " south, } b = \frac{173\frac{60}{60} - 158}{60} = +0.250$$

$$\bar{m} = b \sec \varphi = 1.354 \times 0.25 = +0.34$$

$$c' \text{ assumed } +.09$$

clock fast at 9<sup>h</sup> 46<sup>m</sup> (mean of σ<sup>2</sup> Urs. Maj., κ Cancri, & Draconis, & β Lephei +.20  
from σ<sup>2</sup> Urs. Maj., & Draconis, & κ Cancri, & U. Maj.)  
18.80



Date 1870 March 25

Observer A. S.

Illumin'n East

Star

Mag.

 $\delta$ 
 $\alpha$  Hydrae 2 Urs. Maj.  $\beta$  Cephei  
 $8^{\circ} 6' S.$   $52^{\circ} 16'$   $69^{\circ} 59'$ 

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

9 22	24.0	9 25	16.2	9 27	54.4
	27.6		22.0	28	5.0
	31.2		28.0		15.4
	34.9		33.9		26.2
	38.5		39.7		36.5

Sum

Mean

9 22	156.2	9 25	139.8	9 28	77.5
	31.24		27.96		15.50

Red'n to

m

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

+	.34	+	.34	+	.34
-	.21	+	.08	-	.73
+	.09	+	.15	-	.26

r

T

a

 $\Delta T$ 

9 22	31.46	9 25	28.53	9 28	14.85
9 21	12.62	9 24	9.70	21 26	56.18
1	18.84	1	18.83	1	18.72

Date 1870 March 31  
 Observer A. S.  
 Illumin'n E.  
 Star 1 Draconis & Hydrae & Urs. Major.  
 Mag. 81° 34' 8' 6' S. 52° 16'

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

9 18 47.2 9 22 21.0 9 25 13.3  
 19 12.9 24.7 19.0  
 3 37.3 28.2 25.1  
 4 20 41.8 32.0 31.1  
 5 30.0 35.4 36.8

Sum  
 Mean

19 2.2 14 1.3 12 5.3  
 9 19 38.44 9 22 28.26 9 25 25.06

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

+ .31 + .31 + .31  
 + .61 - .11 + .04  
 + .64 + .09 + .15

T

9 19 39.70 9 22 28.55 9 25 25.56

a

9 18 23.87 9 21 12.54 9 24 9.57

$\Delta T$

1 15.83 1 16.01 1 15.99

March 31 1870. Level readings

Object glass h = +.208

b = +.217

" " S. h = +.217

" " h = +.267

c assumed +.09  
 or estimated +.10

Mean h = +.227  
 $m = \delta \sec \varphi = + 0.31$



Date	1870 March 31		
Observer	A. S.		
Illumin'n	E.		
Star	$\beta$ Cephei $\epsilon$ Leonis $\alpha$ Leonis		
Mag.	69° 59' 24° 22' 12° 36'		
$\delta$			
Wire	a		
"	b		
"	c		
"	1	9 27 51.3	9 39 36.4 10 2 35.7
"	2	28 2.5	40.3 39.6
"	3	12.7	44.3 43.2
"	4	23.5	48.4 46.9
"	5	33.7	52.2 50.7
"	d		
"	e		
"	f		
Sum		63.7	221.6 216.1
Mean		9 28 12.74	9 39 44.32 10 2 43.22
Red'n to			
m		+ .31	+ .31 + .31
n. tan. $\delta$		- .37	- .05 - .07
c. sec. $\delta$		+ .26	+ .10 + .09
r			
T		9 28 12.42	9 39 44.68 10 2 43.55
a		21 26 56.43	9 38 28.72 10 1 27.51
$\Delta T$		1 15.99	1 15.96 1 16.04

Date	1870	April 8		
Observer		A. S.		
Illumin'n		E.		
Star		1 Draconis & Hydrae		J Mrs. May.
Mag.				
$\delta$		81° 54'	8° 6' S.	52° 16'
Wire	a			
"	b			
"	c			
"	1	9 18 12.8	9 22 18.2	9 25 10.1
"	2	19 8.0	21.8	
"	3	33.9	25.2	22.1
"	4	59.4	29.0	28.0
"	5	20 25.5	32.5	33.8
"	d			
"	e			
"	f			
Sum		169.6	126.8	88.15
Mean		9 19 33.92	9 22 25.36	9 25 22.04
Red'n to				
m		+ .37	+ .37	+ .37
n. tan. $\delta$		+1.16	-.20	+ .07
c. sec. $\delta$		+ .64	+ .09	+ .15
$\tau$				
T		9 19 36.09	9 22 25.62	9 25 22.63
a		9 18 22.94	9 21 12.44	9 24 9.39
$\Delta T$		1 13.15	1 13.18	1 13.24

April 8, 1870. Level readings

Object glass N.  $b = \frac{151.5 - 136}{60} = +0.258$

" " S.  $b = \frac{153 - 136}{60} = +0.283$

$m = b \sec \varphi = 0.27 \times 1.354 = +0.37$

c assumed +.09

n from 1 Draconis & 3 Cephei +.19

clock fast at 4h 33m (mean of 1 Hydrae, J Mrs. May, & Leon.  $\mu$  Leon) 1<sup>m</sup> 13.20



Date	1870	April 8		
Observer		A. S.		
Illumin'n		E.		
Star		$\beta$ Cephei	$\epsilon$ Leonis	$\mu$ Leonis
Mag.				
$\delta$		$69^{\circ} 59'$	$24^{\circ} 22'$	$26^{\circ} 37'$
Wire	a			
"	b			
"	c			
"	1	9 27 49.6	9 39 33.5	9 46 27.2
"	2	28 0.0	37.6	31.2
"	3	10.7	41.6	35.2
"	4	21.0	45.4	39.3
"	5	31.8	49.3	43.2
"	d			
"	e			
"	f			
Sum		53.1	207.4	176.1
Mean		9 28 10.62	9 39 41.48	9 46 35.22
Red'n to				
$\bar{m}$		+ .37	+ .37	+ .37
n. tan. $\delta$		- .69	- .09	- .08
c. sec. $\delta$		- .26	+ .10	+ .10
$r$				
T		9 28 10.04	9 39 41.86	9 46 35.61
a		21 26 56.87	9 38 28.62	9 45 22.45
$\Delta T$		1 13.17	1 13.24	1 13.16

Date	1870	April 12		
Observer		A. S.		
Illumin'n		E.		
Star		$\alpha$ Hydrae	Mrs. May.	$\epsilon$ Leonis
Mag.		8° 6' 12"	52° 16'	24° 22'
$\delta$				
Wire	a			
"	b			
"	c			
"	1	9 22 16.6	9 25 <del>18.8</del>	9 39 32.0
"	2	20.3	14.8	36.1
"	3	23.9	20.6	40.0
"	4	27.6	26.5	44.0
"	5	31.2	32.4	48.0
"	d			
"	e			
"	f			
Sum		119.6	103.1	200.1
Mean		9 22 23.92	9 25 20.62	9 39 40.02
Red'n to				
m		+ .37	+ .37	+ .37
n. tan. $\delta$		- .19	+ .07	- .08
c. sec. $\delta$		+ .09	+ .15	+ .10
$r$				
T		9 22 24.19	9 25 21.21	9 39 40.41
a		9 21 12.38	9 24 9.29	9 38 28.56
$\Delta T$		1 11.81	1 11.92	1 11.85

April 12 1870 Level readings

Object glass N.  $b = \frac{152 - 136}{60} = +0.267$

" " S.  $b = \frac{149.5 - 133}{60} = +0.275$

$\bar{m} = b \sec \phi = 1.354 \times 0.271 = +0.37$

c assumed + .09

n from Mrs. May, 11 Cephei, 79 Draconis, +0.18

look fast at 933 (mean of  $\alpha$  Hydrae, Mrs. May,  $\epsilon$  Leonis,  $\mu$  Leonis) 1<sup>m</sup> 11.38



Date	1870	April 12		
Observer		A. S.		
Illumin'n		E.		
Star		11 Cephei	$\mu$ Leonis	$\gamma$ Draconis
Mag.		70° 43'	26° 37'	73° 5'
$\delta$				
Wire	a			
"	b			
"	c			
"	1	9 40 49.8	9 46 25.9	9 52 1.2
"	2	41 0.6	29.9	13.2
"	3	11.8	34.0	25.8
"	4	22.4	37.9	38.0
"	5	33.4	42.0	50.6
"	d			
"	e			
"	f			
Sum		58.0	169.7	128.8
Mean		9 41 11.60	9 46 33.94	9 52 28.76
Red'n to				
m		+ .37	+ .37	+ .37
n. tan. $\delta$		- .69	- .07	- .76
c. sec. $\delta$		- .27	+ .10	- .31
r				
T		9 41 11.01	9 46 34.34	9 52 28.06
a		21 39 59.09	9 45 22.39	21 51 13.16
$\Delta T$		1 11.92	1 11.95	1 11.90



Date 1870 April 14

Observer A. S.

Illumin'n E.

Star

Mag.

 $\delta$ 

$\sigma^2$  Uro. Maj. 1 Draconis 2 Hydraz  
 $67^\circ 40'$   $81^\circ 54'$   $8^\circ 6' S.$

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

 $\Delta T$ 

8 59 46.8 9 18 39.2 9 22 15.7  
 " 2 56.1 19 5.6 19.4  
 " 3 9 0 5.5 30.8 23.0  
 " 4 15.0 56.0 26.6  
 " 5 24.6 20 21.8 30.3

Sum 28.0 153.4 115.0  
 Mean 9 0 5.60 9 19 30.68 9 22 23.00

Red'n to  
 m +.43 +.43 +.43  
 n. tan.  $\delta$  +.40 +1.59 +.27  
 c. sec.  $\delta$  +.24 +.64 +.09

 $\tau$ 

T 9 0 6.67 9 19 33.34 9 22 23.25

a 8 58 53.56 9 18 22.19 9 21 12.35

$\Delta T$  1 11.11 1 11.15 1 10.90

April 14 1870 Level readings.

Object glass N.  $b = \frac{138\frac{1}{2} - 118}{60} = +0.342$ " "  $\delta$ .  $b = \frac{135 - 117}{60} = +0.300$  $b \sec \phi = m = 0.321 \times 1.354 = +0.43$  c assumed + 0.09n from  $\sigma^2$  Uro. Maj., 1 Draconis,  $\beta$  Capri + 0.26Clock fast at 9<sup>h</sup> 29<sup>m</sup> (mean of 2 Hydraz, 1 Uro. Maj., 1 Leonis) 1<sup>m</sup> 11.01



Date 1870 April 14

Observer A. S.

Illumin'n E.

Star

Mag.

 $\delta$ 

$\beta$  Urs. Maj.  $\beta$  Cephei  $\epsilon$  Leonis

$52^{\circ} 16'$   $69^{\circ} 59'$   $24^{\circ} 22'$

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

 $\Delta T$ 

$q$  25 8.0  $q$  27 47.9  $q$  39 31.2  
 $13.8$   $58.7$   $35.2$   
 $19.7$  28 8.9  $39.1$   
 $25.6$   $19.6$   $43.1$   
 $31.4$   $30.3$   $47.0$

$98.5$   $45.4$   $195.6$   
 $q$  25  $19.70$   $q$  28  $9.08$   $q$  39  $39.12$

$+ .43$   $+ .43$   $+ .43$   
 $+ .10$   $- .96$   $- .12$   
 $+ .15$   $- .26$   $+ .10$

$q$  25 20.38  $q$  28 8.29  $q$  39 39.53  
 $q$  24 9.24 21 26 57.17  $q$  38 28.53  
 $1$  11.14  $1$  11.12  $1$  11.00

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

 $\Delta T$  $\alpha$  Leonis 32 Urcellaj  $\gamma$  Leonis

10	1	333	8	29.8	10	12	54.4
		320		38.7			58.2
		40.9		47.3			2.1
		44.4		56.2			6.0
		<u>48.1</u>		<u>5.2</u>			<u>9.9</u>

		3.7		237.2			10.6
10	1	40.74	10	8	47.44	10	13
							2.12

		+1.15		+1.45		+1.45
+1.28	+1.42	-	1.53	2.28	-	2.1
	+1.92		+2.28		+1.96	
	<u>9</u>		<u>23</u>		<u>10</u>	

10	1	27.23	10	8	34.58	10	12	48.58
----	---	-------	----	---	-------	----	----	-------

+1.02	+2.43	+1.07
0.22	2.26	-0.54
-0.69	+1.31	

look fast 13.67  
at 10  $\frac{1}{4}$



Date										
Observer										
Illumin'n										
Star	g Draconis g Leonis 226 Cephei									
Mag.										
$\delta$										
Wire	a									
"	b									
"	c									
"	1	10	23	46.1	26	46	29	43.6		
"	2			56.5		8.3		57.8		
"	3	24		11.7		11.9		12.2		
"	4			27.1		15.5		26.7		
"	5			42.5		19.2		41.1		
"	d									
"	e									
"	f									
Sum				58.9		59.5		61.4		
Mean		10	24	11.78	10	26	11.90	20	30	12.28
Red'n to										
m				+1.45		+1.45		+1.45		
n. tan. $\delta$				+1.31		-.30		-1.97		
c. sec. $\delta$				+8.82		+9.2		-3.61		
				38		09		-36		
r										
T										
a		10	24	0.67	10	25	58.46	22	29	57.07
$\Delta T$										
				+425		102		-401		
				+3.21		-.74		-4.80		

Date	1870	April 25			
Observer		H. S.			
Illumin'n		E.			
Star		$\alpha$ Leonis	32 hrs. Maj.	$\gamma'$ Leonis	
Mag.		12° 36'	65° 45'	20° 30'	
$\delta$					
Wire	a				
"	b				
"	c				
"	1	10 1 33.3	10 8 29.8	10 12 54.4	
"	2	37.0	38.8	58.3	
"	3	40.8	47.6	13 2.1	
"	4	44.5	56.6	6.0	
"	5	48.0	9 5.1	9.9	
"	d				
"	e				
"	f				
Sum		203.6	237.9	10.7	
Mean		10 1 40.72	10 8 47.58	10 13 2.14	
Red'n to					
$\bar{m}$		+1.43	+1.43	+1.43	
n. tan. $\delta$		-1.19	+1.35	-1.15	
c. sec. $\delta$		+1.09	+1.21	+1.09	
$r$					
T		10 1 41.05	10 8 48.57	10 13 2.51	
a		10 1 27.22	10 8 34.56	10 12 48.57	
$\Delta T$		13.83	14.01	13.94	

April 25 1870 Level readings  
 Object glass N.  $b = \frac{149\frac{1}{2} - 132}{60} = +0.292$

" " S.  $b = \frac{151\frac{1}{2} - 131}{60} = +0.342$

$\bar{m} = b \sec \varphi = 1.354 \times 0.317 = +0.43$

c by Cauchy's method +1.087

n " " " +1.27



Date	1870	April 25		
Observer		A. S.		
Illumin'n		E.		
Star		$\gamma$ Draconis	$\rho$ Leonis	226 Caphei
Mag.				
$\delta$		$76^{\circ} 23'$	$9^{\circ} 58'$	$75^{\circ} 33'$
Wire	a			
"	b			
"	c			
"	1	10 23 41.4	10 26 4.7	10 29 43.6
"	2	56.9	8.4	57.6
"	3	24 12.1	12.0	30 12.1
"	4	27.3	15.6	26.8
"	5	42.7	19.3	40.9
"	d			
"	e			
"	f			
Sum		60.4	60.0	61.0
Mean		10 24 12.08	10 26 12.00	10 30 12.20
Red'n to				
$\overline{m}$		+ .43	+ .43	+ .43
$n. \tan. \delta$		+ .87	- .20	- 1.30
$c. \sec. \delta$		+ .37	+ .09	- .35
$r$				
T		10 24 13.75	10 26 12.32	10 30 10.98
a		10 24 0.09	10 25 58.44	22 29 57.15
$\Delta T$		13.66	13.88	13.83

Clock fast at  $10^h 28^m$   
 (mean of  $\alpha$  Leonis,  $\gamma'$  Leonis,  $\rho$  Leonis,  $\iota$  Leonis, & Mrs. May.)  
 $13^s.88$

But if  $c$  is taken equal to +.21 (see next page) we have  
 with equally small residuals  $n = +.15$  and  
 Clock fast at  $10^h 28^m$  (mean of stars as above)  $14^s.09$



Date	1870	April 25		
Observer	A. S.			
Illumin'n	E.			
Star	$\gamma$ Leonis	$\epsilon$ Cephei	$\alpha$ Urs. Maj.	
Mag.	11° 14'	65° 31'	62° 27'	
$\delta$				
Wire	a			
"	b			
"	c			
"	1	10 42 32.1	10 44 59.6	10 55 39.6
"	2	35.8	45 7.8	47.6
"	3	39.5	16.8	55.0
"	4	43.2	25.3	56 2.8
"	5	46.9	34.2	11.0
"	d			
"	e			
"	f			
Sum	197.5	83.7	276.0	
Mean	10 42 39.50	10 45 16.74	10 55 55.20	
Red'n to				
m	+ .43	+ .43	+ .43	
n. tan. $\delta$	- .19	- .84	+ .27	
c. sec. $\delta$	+ .09	- .21	+ .19	
$\tau$				
T	10 42 39.83	10 45 16.12	10 55 56.09	
a	10 42 25.93	22 45 2.11	10 55 42.16	
$\Delta T$	13.90	14.01	13.83	

1	Ill. E.	E. P. A. obs.	Middle Wire West of East Spot on N. meridian mark	0.868	Seeing bad.
2	"	W.	" " " " " " " "	1.036	
3	"	E.	" " " " " " " "	0.825	
4	"	W.	" " East " centre square " " "	0.261	
5	"	E.	" " " " " " " "	0.413	
6	"	W.	" " " " " " " "	0.201	
7	"	E.	" " " " " " " "	0.426	
8	"	W.	" " West " East Spot " " "	1.082	
9	"	E.	" " " " " " " "	0.838	

Co-observers, observed April 25 make middle wire east of mean of the 5. 05.021  
 & same observations make distance of the two eastern wires (Ill. East) 3.652, which measures 1.596. Hence  
 1.596 + 2.056 = 3.652. C (obs. 112) = +1.4 (2.322) + 2.19 (3.34) + 1.53 (5.86) + 2.35 (7.88) + 2.58. Mean Ill. East + 2.07



Date	1870	April 27 <sup>th</sup>					
Observer	A. S.						
Illumin'n	E						
Star	$\alpha$ Urs Maj		$\delta$ Luminis		o Cephei		
Mag.							
$\delta$	+ 62° 27'		+ 210 14'		+ 67° 24'		
Wire	a						
"	b						
"	c						
"	1	10 55	39.2	11 7	18.0	11 13	12.4
"	2		47.0		21.8		21.8
"	3		55.0		25.6		31.2
"	4	56	2.8		29.6		40.5
"	5		10.4		33.8		50.0
"	d						
"	e						
"	f						
Sum			274.4		128.5		155.9
Mean		10 55	54.88	11 7	25.70	11 13	31.18
Red'n to							
m			+ .51		+ .51		+ .51
n. tan. $\delta$			+ .24		- .13		- .80
c. sec. $\delta$			+ .47		+ .23		- .55
r							
T		10 55	56.10	11 7	26.31	11 13	30.34
a		10 <sup>h</sup> 55 <sup>m</sup>	42.09	11 7	12.24	23 13	16.27
$\Delta T$			14.01		14.07		14.07

Date	1870	April 27		
Observer		A-S		
Illumin'n		E		
Star		$\gamma$ Leonis	$\delta$ Draconis	$\eta$ Leonis
Mag.		3° 34'	70° 3'	0° 6' S.
$\delta$				
Wire	a			
"	b			
"	c			
"	1	11 21 22.0	11 23 32.5	11 30 24.8
"	2	25.8	43.0	28.4
"	3	29.2	53.9	32.0
"	4	32.9	24 4.4	35.8
"	5	36.7	14.9	39.2
"	d			
"	e			
"	f			
Sum		146.6	268.7	160.2
Mean		11 21 29.32	11 23 53.74	11 30 32.04
Red'n to				
m		+ .51	+ .51	+ .51
n. tan. $\delta$		- .20	+ .44	- .22
c. sec. $\delta$		+ .21	+ .62	+ .21
$r$				
T		11 20 29.83	11 23 55.31	11 30 32.54
a		11 21 15.89	11 23 46.15	11 30 18.42
$\Delta T$		13.94	14.16	14.12

April 27 1870  
 b obj. glass N.  $\frac{138\frac{1}{2} - 116\frac{1}{2}}{60} = +0.367$   
 b " " S  $\frac{137\frac{1}{2} - 114\frac{1}{2}}{60} = +0.383$

$m = b \sec p = +0.375 \times 1.354 = +0.51$   
 c assumed + .21

n from  $\delta$  Draconis & mean of  $\alpha$  Cephei &  $\gamma$  Cephei + .24  
 Clock fast at 11<sup>h</sup> 24<sup>m</sup> (mean of 2 Mrs. May's,  
 $\delta$  Leonis,  $\gamma$  Leonis,  $\eta$  Leonis,  $\beta$  Leonis, & Mrs. May's) 14<sup>s</sup>. 06



Date	1870	April 27		
Observer		A.S.		
Illumin'n		E.		
Star		$\gamma$ Cephei	$\beta$ Leonis	$\gamma$ Ues. Major
Mag.		76° 54'	15° 18'	54° 25'
Wire	a			
"	b			
"	c			
"	1	11 33 42.9	11 42 32.5	11 47 0.8
"	2	58.4	36.3	7.1
"	3	34 14.8	40.0	13.2
"	4	30.8	43.9	19.4
"	5	46.6	47.4	25.8
"	d			
"	e			
"	f			
Sum		73.5	200.1	66.3
Mean		11 34 14.70	11 42 40.02	11 47 13.26
Red'n to				
m		+ .51	+ .51	+ .51
n. tan. $\delta$		- 1.25	- .15	+ .12
c. sec. $\delta$		- .93	+ .22	+ .36
r				
T		11 34 13.03	11 42 40.00	11 47 14.25
a		28 33 58.78	11 42 26.47	11 47 0.15
$\Delta T$		14.25	14.13	14.10

Date	1870	May 2		
Observer	A. S.			
Illumin'n	E.			
Star	$\delta$ Leonis $\epsilon$ Cephei $\alpha$ Urs. Maj.			
Mag.	11° 14' 65° 31' 62° 27'			
$\delta$				
Wire	a			
"	b			
"	c			
"	1	10 42 30.8	10 45 59.0	10 55 37.8
"	2	34.7	45 7.4	45.6
"	3	38.2	16.2	53.3
"	4	41.9	24.8	56 1.4
"	5	45.7	33.7	9.0
"	d			
"	e			
"	f			
Sum	191.3	81.1	267.1	
Mean	10 42 38.26	10 45 16.22	10 55 53.42	
Red'n to				
$\overline{m}$	+48	+48	+48	
n. tan. $\delta$	-19	-82	+27	
c. sec. $\delta$	+21	-50	+45	
$r$				
T	10 42 38.76	10 45 15.38	10 55 54.62	
a	10 42 25.85	22 45 24.7	10 55 41.94	
$\Delta T$	12.91	12.91	12.68	

May 2 1870  
 Object glass North,  $b = \frac{141 - 114.5}{60} = +0.388$   
 " " South,  $b = \frac{142 - 117.5}{60} = +0.408$   
 $\overline{m} = b \sec p = 0.383 \times 1.354 = +0.48$   
 $c$  assumed +0.21  
 $n$  from  $\epsilon$  Cephei &  $\delta$  Draconis = +0.27  
 block fast at 11<sup>00</sup> (mean of  $\delta$  Leonis,  $\alpha$  Urs. Maj.,  $\delta$  Leonis,  $\delta$  Crateris) 12<sup>5.81</sup>



Date	1870	May 2		
Observer	A. S.			
Illumin'n	E.			
Star	$\delta$ Leonis $\delta$ Crateris $\lambda$ Draconis			
Mag.				
$\delta$	21° 14'	14° 5' S.	70° 3'	
Wire	a			
"	b			
"	c			
"	1	11 7 16.7	11 12 56.4	11 23 31.2
"	2	20.6	13 0.0	41.7
"	3	24.4	8.9	52.4
"	4	28.3	7.5	24 2.9
"	5	32.1	11.4	13.1
"	d			
"	e			
"	f			
Sum	22.2.1	19.2	261.3	
Mean	11 7 24.42	11 13 3.84	11 23 52.26	
Red'n to				
m	+ .48	+ .48	+ .48	
n. tan. $\delta$	- .14	- .31	+ .50	
c. sec. $\delta$	+ .22	+ .22	+ .62	
r				
T	11 7 24.98	11 13 4.23	11 23 53.86	
a	11 7 12.19	11 12 51.35	11 23 40.95	
$\Delta T$	12.79	12.88	12.91	

Date	1870	May 13 <sup>th</sup>	Chronometer	F 345-1
Observer		E. P. C.		
Illumin'n		6		
Star		4 Draconis n Virgins	B. Corri	
Mag.				
$\delta$				
Wire	a			
"	b			
"	c			
"	1	12 <sup>L</sup> 5- 37.0	12 13 16.7	12 27 -
"	2	5 55.1		
"	3	12.2	24.2	42.6
"	4	30.7		
"	5	6 48.3	31.3	50.7
"	d			
"	e			
"	f			
Sum		1833	72.2	
Mean		12 6 12.66	13- 24.07	12 27 42.53
Red'n to				
m		+ 48	+ 38	+ 48
n. tan. $\delta$		+ 1.62	60	- 1.4
c. sec. $\delta$		+ 1.03	+ 21	+ 23
$\tau$		8-		
T		15-80	24.76	43.10
a		12 <sup>L</sup> 6 7.61	12 <sup>L</sup> 13 16.23	12 27 34.86
$\Delta T$		8.19	8.53	8.24



Date										
Observer										
Illumin'n										
Star	21 Cassiopeia 12 Canum & Virginis									
Mag.										
$\delta$										
Wire	a									
"	b									
"	c									
"	1					55.7	13.2	3.2	14.8	
"	2					0.3				
"	3								22.2	
"	4	12	37	26.2	12	50	57.1			
"	5			40.6			9.8		29.4	
"							14.4			
"	d						3			
"	e									
"	f									
Sum						257.3			66.4	
Mean		12	37	13.62	12	50	5.06	13	3	22.13
Red'n to										
m				+ 48			+ 48			+ 48
n. tan. $\delta$				- 118		50	+ 27			60
c. sec. $\delta$				- 77			+ 27			+ 21
r										
T		25	12	15	18	21	6.08			22.82
a		2	37	3.91	12	49	57.71	13	3	14.39
$\Delta T$		50	8.24	18	8.37					8.43

Chronometer fast 8<sup>s</sup> 33

Date 1870

May 17

Observer

A. S.

Illumin'n

E.

Star

 $\gamma^2$  Urs. Min. & Cor. Bor. & Serpenti

Mag.

 $\delta$  $72^\circ 18'$  $27^\circ 9'$  $6^\circ 50'$ 

Wire

a

"

b

"

c

"

1

15 20 46.6 15 29 15.0 15 37 57.0

"

2

58.8

19.0

38 0.6

"

3

21 10.7

23.1

4.5

"

4

22.2

27.3

7.8

"

5

34.1

31.3

11.6

"

d

"

e

"

f

Sum

52.4

115.7

21.5

Mean

15 21 10.48 15 29 23.14 15 38 4.30

Red'n to

m

+ .67

+ .67

+ .67

n. tan.  $\delta$ 

+ .84

- .15

- .30

c. sec.  $\delta$ 

+ .69

+ .24

+ .21

 $\tau$ 

T

15 21 12.68 15 29 23.90 15 38 4.88

a

15 21 1.06 15 29 12.55 15 37 53.36

 $\Delta T$ 

11.62

11.35

11.82

May 17 1870. Level readings.

Object glass North  $b = \frac{147 - 117.5}{60} = +0.492$ " " South  $b = \frac{149 - 119}{60} = +0.500$  $m = b \sec \varphi = 0.496 \times 1.354 = +0.67$ 

$c'$  assumed +.21  
 n from  $\gamma$  Urs. Min. &  $\delta$  Serpenti +.37 $\frac{1}{2}$   
 Clock fast at 15<sup>h</sup> 41<sup>m</sup>  
 (mean of  $\alpha$  Cor. Bor.,  $\alpha$  Serp.,  
 $\epsilon$  Serp.,  $\delta$  Serpenti)  
 11.540



Date	1870 May 17			
Observer	A. S.			
Illumin'n	E.			
Star	$\epsilon$ Serpentis	$\zeta$ Urs. Min.	$\delta$ Scorpii	
Mag.	4° 52'	78° 12'	22° 15' S.	
Wire	a			
"	b			
"	c			
"	1	15 44 25.2	15 48 24.0	15 52 43.8
"	2	28.9	41.6	47.8
"	3	32.5	59.4	51.6
"	4	36.0	49 17.0	55.4
"	5	39.5	34.9	59.4
"	d			
"	e			
"	f			
Sum	162.1	296.9	258.0	
Mean	15 44 32.42	15 48 59.38	15 52 51.60	
Red'n to				
m	+ .67	+ .67	+ .67	
n. tan. $\delta$	- .131	+ 1.45	- .49	
c. sec. $\delta$	+ .21	+ 1.03	+ .23	
$\tau$				
T	15 44 32.99	15 49 2.53	15 52 52.01	
a	15 44 21.68	15 48 51.14	15 52 40.60	
$\Delta T$	11.31	11.39	11.41	

3 1/2

1/2

Date	1870	May 19		
Observer	E. P. A.			
Illumin'n	E.			
Star	$\alpha$ Virginis	$\eta$ Virginis	$\kappa$ Draconis	
Mag.	9.27'	0° 3'	70° 30'	
$\delta$				
Wire	a			
"	b			
"	c			
"	1	11 58 39.2	12 13 19.6	12 27 44.8
"	2	42.8	23.0	53.7
"	3	46.5	26.8	28 6.4
"	4	50.2	30.4	17.1
"	5	53.8	34.0	28.0
"	d			
"	e			
"	f			
Sum	232.5	133.8	32.0	
Mean	11 58 46.50	12 13 26.76	12 28 6.40	
Red'n to				
m				
n. tan. $\delta$	- .24	- .26	+ .56	
c. sec. $\delta$	+ .21	+ .21	+ .63	
$r$				
T - bsecq	11 58 46.50	12 13 26.71	12 28 7.59	
a	11 58 35.95	12 13 16.18	12 27 57.05	
$\Delta T + bsecq$	- 10.55	10.53	10.54	

c' assumed +.21 & n +.29  
 If bsecq = +.67 Clock fast (at 12<sup>h</sup> 13<sup>m</sup>) 11<sup>s</sup>.21



Date	1870	May 25					
Observer		N. S.					
Illumin'n		E.					
Star		$\delta$ Virginis	$\alpha^2$ Librae	$\beta$ Urs. Min.			
Mag.							
$\delta$		$0^{\circ} 4'$	$15^{\circ} 30' \delta$	$74^{\circ} 41'$			
Wire	a						
"	b						
"	c						
"	1	13 28	10.1	14 43	47.6		
"	2		13.8		51.3	14 51	7.5
"	3		17.2				20.1
"	4		21.0		59.0		34.8
"	5		24.6	44	2.6		
"	d						
"	e						
"	f						
Sum		86.7		220.5		62.4	
Mean		13 28 17.34	14 43 55.13	14 51 20.80			
Red'n to							
m							
n. tan. $\delta$		-.03	-.45	+1.04			
c. sec. $\delta$		+ .21	+ .22	+ .80			
r							
$T - b \sec \varphi$		13 28 17.16	14 43 54.90	14 51 22.64			
a		13 28 5.36	14 43 42.90	14 51 10.63			
$\Delta T + b \sec \varphi$		11.80	12.00	12.01			

Proper reduction rather uncertain: small in either case

$c'$  assumed +.21

$n$  +.38

$\Delta T + b \sec \varphi - 11.90$  at  $14^h$ .

Obj. passes North,  $b = \frac{139-107}{60} = \frac{32}{60} = +0.53$

$b \sec \varphi = .53 \times 1.354 = +0.72$

Clock fast at  $14^h$

$12.562$

Date	1870 May 26			
Observer	E. R. S.			
Illumin'n	E.			
Star	$\alpha$ Virginis	$\zeta$ Virginis	$\gamma$ Urs. Maj.	
Mag.	10° 29' 4",	0° 4'	49° 58'	
$\delta$				
Wire	a			
"	b			
"	c			
"	1	13 18 27.2	13 28 10.6	13 42 27.1
"	2	30.9	14.3	32.9
"	3	34.6	17.9	38.5
"	4	38.3	21.5	44.1
"	5	42.0	25.2	49.6
"	d			
"	e			
"	f			
Sum	173.0	89.5	192.2	
Mean	13 18 34.60	13 28 17.90	13 42 38.44	
Red'n to				
m				
n. tan. $\delta$	- .44	- .36	+ .11	
c. sec. $\delta$	+ .21	+ .21	+ .33	
$\tau$				
T - bsec $\varphi$	13 18 34.37	13 28 17.75	13 42 38.88	
a	13 18 21.99	13 28 5.36	13 42 26.43	
$\Delta T + bsec \varphi$	- 12.38	12.39	12.45	

$c'$  assumed +.21  
 $n$  (50 Cass. & Drac.) +.40

$\Delta T + bsec \varphi$  (at  $13^h \frac{1}{2}$ ) - 12<sup>s</sup>.42  
 If  $bsec \varphi = +0.72$  Clock fast 13<sup>s</sup>.14



1870 Date May 26

Observer

E. P. A.

Illumin'n

E.

Star

 $\gamma$  Bootis

50 Cassiope

Draconis

Mag.

 $\delta$  $19^{\circ} 3'$  $71^{\circ} 47'$  $65^{\circ} 0'$ 

Wire

a

"

b

"

c

"

1

13 48

35.7

13 52

12.2

14 0

48.8

"

2

39.6

23.9

57.6

"

3

43.3

35.4

1

6.0

"

4

47.2

46.9

14.6

"

5

51.2

38.7

23.2

"

d

"

e

"

f

Sum

217.0

177.1

30.2

Mean

13 48 43.40

13 52 33.42

14 1

6.04

Red'n to

m

n. tan.  $\delta$ 

- .23

- 1.58

+ .49

c. sec.  $\delta$ 

+ .22

- .67

+ .50

 $\tau$ T -  $b_{\text{sec } \varphi}$ 

13 48 43.39

13 52

33.17

14 1

7.03

a

13 48 30.91

1 52

20.60

14 0

54.44

 $\Delta T + b_{\text{sec } \varphi}$ 

- 12.48

12.57

12.59

Date	1870	May 30		
Observer		E. P. A.		
Illumin'n		E.		
Star		$\alpha$ Virginis	$\xi$ Virginis	$\eta$ Urs. Maj.
Mag.		10° 29' S.	0° 4'	49° 58'
$\delta$				
Wire	a			
"	b			
"	c			
"	1	13 18 28.8	13 28 12.2	13 42 28.9
"	2	32.6	15.9	34.6
"	3	36.2	19.7	40.2
"	4	39.9	23.1	45.6
"	5	43.6	26.8	51.3
"	d			
"	e			
"	f			
Sum		181.1	97.7	200.6
Mean		13 18 36.22	13 28 19.54	13 42 40.12
Red'n to				
m				
n. $(\tan. \delta - \tan. \varphi)$		-.41	-.34	+.10
c. sec. $\delta$		+.21	+.21	+.33
r				
T - bsec $\varphi$		13 18 36.02	13 28 19.41	13 42 40.55
a		13 18 21.97	13 28 5.34	13 42 26.37
$\Delta T + bsec \varphi$		- 14.05	14.07	14.18

$c'$  assumed  $+.21$   
 $n$  from  $\alpha$  Dracy 50 class.  $+.37$   
 $\Delta T + bsec \varphi$  at  $13^{\frac{3}{4}}$  - 14.07 (mean of  $\alpha$  Virg.  $\xi$  Virg.  $\eta$  Urs. Maj.  $\eta$  Bootis)  
 $bsec \varphi = +0.72$  by observations same evening.  
 Clock fast (at  $13^{\frac{3}{4}}$ ) 14.79



1870	Date	May 30					
	Observer	E. P. A.					
	Illumin'n	E.					
	Star	$\eta$ Bootis			50 Cassiope	& Draconis	
	Mag.						
	$\delta$	$19^{\circ} 3'$			$71^{\circ} 47'$	$65^{\circ} 0'$	
	Wire	a					
	"	b					
	"	c					
	"	1	13 48 37.2	13 52 14.2	14 0 50.2		
	"	2	41.0	25.8	59.0		
	"	3	44.8	37.3	1 7.6		
	"	4	48.8	48.3	16.1		
	"	5	52.6	53 0.0	24.8		
	"	d					
	"	e					
	"	f					
	Sum	224.4	185.6	37.7			
	Mean	13 48 44.88	13 52 37.12	14 1 7.54			
	Red'n to						
	m						
	n (tan. $\delta$ - tan $\varphi$ )	- .21	- 1.46	+ .46			
	c. sec. $\delta$	+ .22	- .67	+ .50			
	r						
	T - 6sec $\varphi$	13 48 44.89	13 52 34.99	14 1 8.50			
	a	13 48 30.89	1 52 20.84	14 0 54.34			
	$\Delta T + 6sec \varphi$	- 14.00	14.15	14.16			

Date 1870 June 2

Observer E. P. A.

Illumin'n

Star

Mag.

 $\delta$  $\gamma$  Virginis $\alpha$  Virginis

38 Cassiopeae

 $4^{\circ} 51' S.$  $10^{\circ} 29' S.$  $69^{\circ} 35'$ 

Wire a

" b

" c

" 1

" 2

" 3

" 4

" 5

" d

" e

" f

13	3	22.2	13	18	29.8	13	21	30.0
		25.7			33.4			39.4
		29.4			37.2			49.7
		33.0			40.8	22		0.0
		36.8			44.8			10.4

Sum

Mean

		147.1			186.0			249.5
13	3	29.42	13	18	37.20	13	21	49.90

Red'n to

m

n (tan.  $\delta$  - tan  $\phi$ )c. sec.  $\delta$ - .42  
- .26- .47  
- .26- 1.54  
+ .74 $\tau$ T - b sec  $\phi$ 

13	3	28.74	13	18	36.47	13	21	49.13
----	---	-------	----	----	-------	----	----	-------

a

13	3	14.28	13	18	21.95	1	21	34.31
----	---	-------	----	----	-------	---	----	-------

 $\Delta T + b \sec \phi$ 

- 14.46

14.52

14.82

{ Middle wire West of  
mean of 5 wires (ill. East) }{ Distance between  
extreme wires }{ 38 Cassiop. L.C.  
4 Draconis- .069  
+ .05114.508  
14.39

5 hrs. Min.

- .024

14.46

3 hrs. Min.

+ .084

14.43

48 Cephei L.C.

+ .049

14.45

 $\gamma^2$  hrs. Min.

- .054

14.40

Mean

+ .006

14.37



Date	1870 June 2			
Observer	E. P. A.			
Illumin'n	W.			
Star	$\zeta$ Virginis	$\eta$ Urs. Majoris	$\eta$ Bootis	
Mag.				
$\delta$	$0^{\circ} 4'$	$49^{\circ} 58'$	$19^{\circ} 3'$	
Wire	a			
"	b			
"	c			
"	1	13 28 13.1	13 42 29.9	13 48 38.2
"	2	16.9	35.5	42.0
"	3	20.6	41.0	45.8
"	4	24.0	46.8	49.6
"	5	27.6	52.2	53.6
"	d			
"	e			
"	f			
Sum	102.2	205.4	229.2	
Mean	13 28 20.44	13 42 41.08	13 48 45.84	
Red'n to				
m				
n. (tan. $\delta$ - tan $\phi$ )	-.38	+.12	-.24	
c. sec. $\delta$	-.26	-.40	-.27	
r				
T - bsec $\phi$	13 28 19.80	13 42 40.80	13 48 45.33	
a	13 28 5.33	13 42 26.32	13 48 30.88	
$\Delta T + bsec \phi$	- 14.47	14.48	14.45	



Date *1870 June 2*  
 Observer *E. P. A.*  
 Illumin'n *W. E.*  
 Star  *$\alpha$  Draconis  $\alpha$  Bootis  $\gamma$  Bootis*  
 Mag. *65° 0' 19° 52' 52° 27'*  
 $\delta$

Wire	a	b	c
"	1	14 0 52.0	14 9 51.8
"	2	1 0.4	56.0
"	3	8.8	59.6
"	4	17.3	10 3.4
"	5	26.1	7.4
"	d		
"	e		
"	f		

Sum	Mean
44.6	298.2
14 1 8.92	14 9 59.64
	14 21 1.96

Red'n to	m	n (tan. $\delta$ tan $\phi$ )	c. sec. $\delta$
		+ .52	-.23
		-.60	+ .27
			+ .16
			+ .42

T - bsec $\phi$	a	$\Delta T + bsec \phi$
14 1 8.84	14 9 59.68	14 21 2.54
14 0 54.27	14 9 45.16	14 20 47.86
- 14.57	14.52	14.68

$c'$  (by Cauchy's method from 48 stars) = +.278 Ill. East.  
 Error in entering  $\alpha$  of 48 Cephei may have made this  $c'$  a little too large. See note two pages beyond.

Collimation by meridian mark previous to observations.

Obs.	Wire	East	West	Spot	Square	c
E. P. A.	Middle wire	west of spot	(Ill. E.)	0.858	(Ill. W.)	1.093
A. S.	"	east	" square	0.390	"	0.164
"	"	west	" spot	0.895	"	0.132
"	"	east	" square	0.347	"	0.150

Half weight allowed to determinations from the square, which was not so well seen as the spot.

$c = +0.1135$  Illumination East, if middle wire agrees with mean of the 5, which seems to be nearly the fact from



Date	1870 June 2		
Observer	E. P. A.		
Illumin'n	E.		
Star	5 Urs. Min.	$\epsilon$ Bootis	$\alpha^2$ Librae
Mag.			
$\delta$	$76^\circ 17'$	$27^\circ 37'$	$15^\circ 30' S.$
Wire	a		
"	b		
"	c		
"	1	14 27 35.4	14 39 26.0 14 43 50.2
"	2	50.8	30.2 54.0
"	3	28 5.8	34.4 57.6
"	4	21.2	38.4 44 1.4
"	5	36.3	42.5 5.1
"	d		
"	e		
"	f		
Sum	29.5	171.5	288.3
Mean	14 28 5.90	14 39 34.30	14 43 57.64
Red'n to			
m			
n (tan. $\delta$ - tan $\varphi$ )	+ 1.33	-.16	-.50
c. sec. $\delta$	+ 1.08	+ .29	+ .27
$\tau$			
T - bsec $\varphi$	14 28 8.31	14 39 34.43	14 43 57.41
a	14 27 53.58	14 39 19.99	14 43 42.91
$\Delta T + bsec \varphi$	- 14.73	14.44	14.50

Value of 1 revolution of micrometer screw  $2^s.267$   
determined June 3.

$c = + 0.257$  Ill. E. (neglecting diurnal aberration)  
This value used above.

$n$  by Leachy's method  $+ 0.419$ .

$\Delta T + bsec \varphi$  at  $14^h 14^m$  from 12 stars =  $-14.48$

$bsec \varphi = + 0.93$  by four readings of level during observation

Clock fast at  $14^h 14^m$   $15^s.41$



Date	1870 June 2												
Observer	E. P. A.												
Illumin'n	E.												
Star	$\beta$ Urs. Min.				$\beta$ Bootis				48 Cephei				
Mag.													
$\delta$	74° 41'				40° 54'				77° 15'				
Wire	a												
"	b												
"	c												
"	1	14	50	55.3	14	57	9.0	15	3	36.4			
"	2		51	8.8			14.0			53.0			
"	3			23.0			18.8		4	8.9			
"	4			36.3			23.4			25.4			
"	5			50.0			28.0			41.9			
"	d												
"	e												
"	f												
Sum		113.4				93.2				45.6			
Mean		14	51	22.68	14	57	18.64	15	4	9.12			
Red'n to													
m													
$n(\tan. \delta - \tan \varphi)$		+ 1.15				- .02				- 2.24			
c. sec. $\delta$		+ .98				+ .34				- 1.17			
$\tau$													
$T - b \sec \varphi$		14	51	24.81	14	57	18.96	15	4	5.71			
a		14	51	10.35	14	57	4.54	3	3	51.18			
$\Delta T + b \sec \varphi$		- 14.46				14.42				14.53			

$c'$  recomputed by Cauchy's method + .244 Ill. E.  
 $n$  " " " " + .418

This makes  $\Delta T + b \sec \varphi$  (12 stars) - 14.49  
 Residuals nearly as before.



Date	1870 June 2											
Observer	E. P. A.											
Illumin'n	E.											
Star	$\beta$ Librae $\mu'$ Bootis $\gamma^2$ Urs. Min.											
Mag.												
$\delta$	8° 54' S.				37° 50'				72° 18'			
Wire	a											
"	b											
"	c											
"	1	15	10	9.6	15	19	41.4	15	20	49.8		
"	2			13.4			46.1		21	4.9		
"	3			17.0			50.6			13.4		
"	4			20.8			55.2			25.6		
"	5			24.1			59.7			37.2		
"	d											
"	e											
"	f											
Sum				84.9			253.0			67.9		
Mean		15	10	16.98	15	19	50.60	15	21	13.58		
Red'n to												
m												
n. (an. $\delta$ - tan $\phi$ )				-.25			-.05			+.93		
c. sec. $\delta$				+ .26			+ .33			+ .85		
$\tau$												
T - bsec $\phi$	15	10	16.79	15	19	50.88	15	21	15.36			
a	15	10	2.36	15	19	36.45	15	21	0.80			
$\Delta T + bsec \phi$			- 14.43			14.43			14.56			

$c$  found by observation (see note two pages back) + .257 Ill. E.  
 Correction for difference between middle wire  
 and mean of 5 (see note 5 pages back) + .006  
 Correction for diurnal aberration - .015  


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 $c' = 0.248$  Ill. E.

Date	1870 June 4		
Observer	E. P. A.		
Illumin'n	E.		
Star	$\alpha$ Virginis	38 Cassiopeae	$\gamma$ Virginis
Mag.			
$\delta$	$10^{\circ} 29' S$	$69^{\circ} 35'$	$0^{\circ} 4'$
Wire	a		
"	b		
"	c		
"	1	13 18 29.0	13 21 30.0
"	2	32.6	40.0
"	3	36.2	51.0
"	4	39.8	22 4.0
"	5	43.6	11.6
"	d		
"	e		
"	f		
Sum	181.2	253.6	98.0
Mean	13 18 36.24	13 21 50.72	13 28 19.60
Red'n to			
m			
$n(\tan. \delta - \tan \varphi)$	- .35	- 1.85	- .29
c. sec. $\delta$	+ .25	- .72	+ .25
$\tau$			
$T - b_{sec \varphi}$	13 18 36.14	13 21 48.85	13 28 19.64
a	13 18 21.94	1 21 34.44	13 28 5.31
$\Delta T + b_{sec \varphi}$	- 14.20	14.41	14.33

$c'$  assumed +.25  
 $n$  from 38 Cass. &  $\gamma$  Bortis +.32  
 $\Delta T + b_{sec \varphi}$  at  $13^h 34^m = -14.19$   
 If  $b_{sec \varphi} = +0.93$  Clock fast  $15^s.12$



Date	1870 June 4		
Observer	E. P. A.		
Illumin'n	E.		
Star	$\eta$ Urs. Maj.	$\eta$ Bootis	$\delta$ Bootis
Mag.			
$\delta$	$49^{\circ} 58'$	$19^{\circ} 3'$	$52^{\circ} 27'$
Wire	a		
"	b		
"	c		
"	1	13 42 28.7	13 48 37.4 14 20 49.6
"	2	34.4	41.0 55.9
"	3	39.8	44.8 21 1.8
"	4	45.5	48.7 7.6
"	5	50.8	52.6 13.6
"	d		
"	e		
"	f		
Sum	199.2	224.5	8.5
Mean	13 42 39.84	13 48 44.90	14 21 1.70
Red'n to			
m			
n. (tan. $\delta$ - tan $\phi$ )	+ .08	- .18	+ .12
c. sec. $\delta$	+ .39	+ .26	+ .41
r			
T - b sec $\phi$	13 42 40.32	13 48 44.98	2.23
a	13 42 26.29	13 48 30.87	14 20 47.84
$\Delta T + b \sec \phi$	- 14.03	14.11	14.39

Date	1870 June 6		
Observer	E. P. A.		
Illumin'n	E.		
Star	$\eta$ Urs. Maj. $\eta$ Bootis $\alpha$ Draconis		
Mag.			
$\delta$	49° 58'	19° 3'	65° 0'
Wire	a		
"	b		
"	c		
"	1	13 42 28.4	13 48 37.1 14 0 50.0
"	2	34.0	40.9 58.7
"	3	39.7	44.8 1 6.9
"	4	45.5	48.6 15.6
"	5	51.0	52.4 24.0
"	d		
"	e		
"	f		
Sum		198.6	223.8 34.2
Mean		13 42 39.72	13 48 44.76 14 1 6.84
Red'n to			
m			
n. (tan. $\delta$ - tan. $\varphi$ )		+ .14	- .28 +.62
c. sec. $\delta$		+ .39	+ .26 +.54
$\tau$			
T - bsec $\varphi$	13 42 40.25	13 48 44.74	14 1 8.00
a	13 42 26.25	13 48 30.85	14 0 54.15
$\Delta T$ + bsec $\varphi$	- 14.00	13.89	13.85

c' assumed +.25  
 n " +.50 (Lanchy's method gives .57)

$\Delta T$  + bsec  $\varphi$  at 13<sup>h</sup> 50<sup>m</sup> = -13.91 from the 3 stars.  
 If bsec  $\varphi$  = +0.93 Clock fast 14<sup>h</sup> 3.84



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

$\Delta T$

7)

Cambridge class

Date	Dec 15 Longitude of			
1869	Duxbury from coll sig			
Observer				
Illumin'n	1			
	be time of Dux sig of Ce sig			
Star		3 28 11.11	3 41 6.72	
Mag.		clock can -2 0 20	-2 0 20	
δ		time sid time 3 26 1091	3 39 652	
		Dux time of Dux sig of Ce sig		
Wire	a	3 27 58.40	40 53.94	
"	b	clock can + 2.90	+ 2.90	
"	c	3 28 1.30	3 40 56.84	
		w. - 1 50.39	- 1 50.32	
"	1			
"	2	Dec 23		
"	3	be time of Dux sig of Ce sig		
"	4	3 30 50.71	3 43 46.86	
"	5	- 1 59.06	- 1 59.06	
		3 28 51.65	3 41 47.80	
"	d	Dux time 3 30 44.45	3 43 40.61	
"	e	- 2.30	- 2.30	
"	f	3 30 42.15	3 43 38.31	
		w - 1 50.50	- 1 50.51	
Sum				
Mean				
Red'n to				
m				
n. tan. δ				
c. sec. δ				
τ				
T				
a				
Δ T				



















1869-1900, 1901-1905