http://hdl.handle.net/2027/uc1.b4794447

NG
11366
v.790

L. VI

Time Service,

1.

Russian Transit

Feb 16th 1877 to July 1st 1877.

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1972phac.proj.1.94m

SMITH & PORTER,
Steam Printers,
Old South Chapel, Spring Lane, BOSTON.
No. 1064 | When another book like this is required, it will be only necessary to send this number.

h	d
1	=0.04
2	= .08
3	= .13
4	= .17
5	= .21
6	= .25
7	= .29
8	= .33
9	= .38
10	= .42
11	= .46
12	= .50
13	= .54
14	= .58
15	= .62
16	= .67
17	= .71
18	= .75
19	= .79
20	= .83
21	= .87
22	= .92
23	= .96
24	= 1.00

Bond 394. Pendulum weights.

Add 1 gram = $0^s.027$ gaining per hour.

2	0.054	
3	0.081	= $1^s.94$ per day.
4	0.108	= 2.59 per day.
5	0.135	= 3.24 per day.
6	0.162	
7	0.189	
8	0.216	
9	0.243	
10	0.270	
20	0.540	

75 No 12 Shot, Tatham & Bros. Am. Standard. weight 2 grams.
" 10 " " " " " " $0^{gr}.027$

Mem.

1. Wind 312 & 394 Mondays & Thursdays 10 Am
2. Correct error of 394 at night if possible.
3. Saturdays at 3.30 P.M. an important distribution of time over the W.U. Wires takes place.
4. Examine batteries Mondays 10 Am.

2 lbs Cacl per week for clock room – from Billings Clapp & Co. chemists, Boston.

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1877phae.proj.1794w

Time Service.

Observations and records of clock errors and rates. No. 1.

February 16. 1877 to July 1st.

The dates throughout this book are in Mean Astronomical Time.
Thus, Civil time Jan 21st 10 AM = Jan 20d 22h m. ast. time.

S. W.

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Error of the clock transmitting the time Signals, on Hc.0. Mean time, at 20 22 h m. Assumed Boston time being East 0m 16s.0 of Hc.0. mean time.

1877.

Clock Date	Error	Clock Date	Error	Clock Date	Error	Clock Date	Error	Clock Date	Error	
Bnd 394										
February										
16										
17										
18										
19	+16.0									
20	+16.3									
21	+16.0									
22	+16.0									
23	+16.0									
24	Su									
25	+16.3									
26	+16.0									
27	+16.0									
28	+16.0									
March										
1	+16.0									
2	+16.0									
3	Su									
4	+16.0									
5	+16.0									
6	+17.0									
7	+16.0									
8	+16.0									
9	+16.0									
10	Bnd Batt. cl. in circuit									
11	+15.8									
12	+17.1									
13	+16.6									
14	+15.6									
15	+16.1									
16	+16.0									
17	+16.0									
18										
19	+16.2									
20	+16.1									
21	+15.8									
22	+16.0									
23	+16.0									
24	+16.0									
25	+ ~~0.0~~									
26	+16.0									
27	+16.0									
28										
29	+15.4									
30	+16.4									
31	+16.4									

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1877. Russian Transit Constants.

Mean day hr.	a	b	c		Remarks.
	s	s			
February 15.9 w	−2.00	+0.13	—		
16d.9 w	+ .48	+0.44	—		
18 . 9 w	−12.8	+0.02			
19 . 9	− 0.20	0.0	W. −0s.106		
20 . 18 w	+ 0.18	+0.3	e +0.27		
21 . 8	+ 0.21	+ 0.13	e +0.25		
25d.19 w	+ 0.80	+0.08	e +0.08		
27 . 7 w	+ 1.00	− 0.03	e +0.08		
28 . 10 w	+ 1.25	+ 0.04	e −0.06		Previous to this date adjustments much disturbed by setting up the transit, carpenters work, focussing, etc
March 1d 8 w	+ 1.30	+0.06	e		Eyepiece III, 99 diamtrs is almost invariably used in all the Observations.
4d 8 w	{+1.09 ce / +1.25 cw.	+ 0.08	e +0.161		
6 . 33	{+1.84 ce. / +1.93 c.w.	+ 0.10	e −0.02		
7 . 38	+1.71 ce	+ 0.11	e +0.13		
9 . 35	+2.22 ce / +2.13 cw	+ 0.00	e +0.13		
16 . Tarcen down to have the hole cut in top piece for a collimator.					
18 . 33	+2.58	+ 0.03			
20 . 45	+2.85	+ 0.04			
23 . 30	+ 2.31 (W)	+ 0.08	e +0.26		
29 . 92	{+3.27 e / +3.01 w	− 0.03	w +0.03		
30 . 33	{+1.37 E / +1.22 w	+ 0.06	w +0.03		
Apr. 3 . 30	−				
6 . 33	+2.82 e / +2.89 w	+0.045	E +0.206		
9 . 35		+ 0.05			
12 . 35		− 0.01			
13 . 39		− 0.05	+ 0.14 E		
15 . 33	+ 2.94	+0.00			
22 . 38	+ 3.00	− 0.1			
24 . 35		− 0.01			
26 . 32		− 0.06			
May 2 . 45	adjusted in Azimuth.	− 0.16			
7 . 38	− 0.66	0.00	+0.14 (E)		
11 . 73	− 0 . 51	+0.06			
14 .	0.00				
16 . 35	+ 0.19	+ 0.03			
18 . 35		− 0.04			
19 . 35	+ 0.01	− 0.04	+ 0.14 (E)		
27 . 32	− 0.09	+ 0.11	+ 0.23 (E)		
29 . 63	+ .20	+ .14	+ .31 (E)		
30 . 39	+ .32	+ .11			

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1870phae.proj.1794w

Error

~~20~~
22

Clock
Date

Bond 3s

Febru

16
17
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19
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Marc

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1877. Sid. Clock Frodsham 1327.

Mean date	Error	Δε.	Int.	Rate (daily)
Feb. 16.9	+10.67			
17.9	+10.61			
18.9	+10.15			
19.9	+9.80			
20.9	+9.30			
20.7	+8.79			
21.3	+8.34			
21.7	+7.9?			
22.3	+7.86			
25.8	+6.25			
26.8	+5.3?			
27.7	+5.21			
28.10	+4.61			
March 1.8	+3.90			
2.9	+3.42	⊙		
4.3	+2.71			
5.80	+1.16	−3.25	4.55	−0.s71
[6.33]	+0.90?			
7.38	+0.21	⊙		
9.37	−0.60	−3.41	3.97	−0.86
11.35	−3.22	⊙		
13.50	−5.17	−3.87	4.10	−0.94
15.45	−7.09	⊙		
18.33	−9.70			
20.45	−12.46	⊙		−1.07
23.45	−15.?	⊙		
29.80	−18.0	−2.7	6.85	−0.39
30.30	−18.37	⊙		
April 3.30	−22.4	−1.8	3.05	−0.6
6.35	−24.26	−1.9	3.00	−0.6
9.35	−26.2	−2.5	3.00	−0.8
12.35	−28.7	−0.3	1.00	−0.34
13.39	−28.95	−1.66	2.00	−0.84
15.33	−30.61	−3.03	7.05	−0.43
22.38	−33.64	−0.6	2.00	−0.3
24.35	−34.2	−0.7	2.00	−0.35
26.32	−34.9	−2.3	6.13	−0.4
May 2.45	−37.20			

Mean date	Error	Δε	Int	Rate (daily)
May 2.45	−37.20	⊙		
5.35	−38.3	2.0	5	−0.4
7.38	−39.2	⊙		
8.35	−39.5			
11.33	−40.9	⊙ 1.7	4.0	−0.47
14.35	−42.8	⊙ 2.66	5	−0.58
16.35	−43.56	⊙		
18.35	−43.80	⊙ 24		
19.35	−44.3	−0.5	4.0	−0.5
24.43	−45.91			−.32
27.32	−48.31	2.04	2.0	−1.83
29.33	−51.35			−1.02
30.39	−52.64			
31.37	−53.72			
June 1.35	−53.90			
2.33	−54.45			
4.35	−54.96			
8.38	−54.37			
11.37	−56.12			
13.34	−57.06			
14.39	−57.34			
15.44	−57.82			
18.38	−58.50			
19.37	−58.48			
22.33	−58.45			
24.42	−58.70			
25.32	−58.84			
27.33	−59.29			
29.35	−59.41			

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1877 Sid. Clock Bond 312.

Mean date	Error	Δ_2	Interval	Daily Rate.	
March 1 3 P.M.	Mr Asten completes putting Bond 312 in the new (cellar) clock room. set very nearly to sid. time. No weights in the pendulum. clock frankly cleaned and oiled.				
1d 8h	0s.0				
3 5 20h	−10.5	−10.5	2d.50	−4.5	
4 8	−11.86				
4d.85	added to pendulum 4.5 grams. after adding, compared and found the error to be				
4. 85	−13.1				
5. 35	Compairn				
5. 80	−13.50				
6.33	−13.44	⊙⊙			
7.38	−14.12	−4.59	5.02	−0.91	
9.37	−15.06				
11.35	−18.03	⊙? Probably −7.10	9.12	−0.78	
13.50	−20.14	−2.51	4.10	−0.61	
15.45	−20.54	⊙⊙			Mch 17. and 18. Cl. case open much of time while putting in case for 394.
18.33	−25.13				
20.45	−29.43	⊙		−1.78	Mch. 19. Removed Ca Cl from clock case.
23.30	−33.45	⊙			" 21 added 1.5 grms. so that there is now in the pendulum bob 6 grams.
29.80	−33.96	−.66	7.03	−.09	
30.33	−34.11	⊙			
April 3 30	−32.00	⊙			
6.33	−30.92	⊙ 1.08	3.03	+.36	
9.35	−26.6	⊙ 4.3	3.	+1.4	
12.35	−22.9	⊙ 3.7	3	+1.2	
15.33	−21.8	⊙ 1.1	3	+0.4	
22.38	−39.44	17.6	7	−2.5	
24.35	−57.2?				
May 7.38	+33.8				
8.35	+35.1	1.3	1	+1.3	
11.33	+41.1	6.0	3	+2.0	
12.35	+44.1	3.0	1	+3.0	
June 10.94	+2 33.0				
June 18.91	+2 26.6	6.4	8	−.8	
June 22.90	+2 26.3	∓1.3	4	−.10	
June 29.91	+2 27.45	1.2	6	+.2	

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1877 Sid. chronometer Frodsham 2451

Meandate	Error	Δ_2	Interval	Daily Rate	Meandate	Error	Δ_2	Interval	Daily Rate
Feb. 16d 9w	+22.s02								
17 9	+24.27								+3.11
18 9	+26.66				stopped to have lead circuit repaired				+3.38
19 9	+15.26				18.35	+1 44.70			
20 9	+16.90				19.35	+1m 47.88	+3.28	1.00	+3.28
20 18	+18.60				22.85	+1 57.33	9.45	3.5	+3.1
21 8	+19.36				(23.85	+2 00.53)			
21 19	+20.62				24.43	+2 00.75	3.42	1.58	
22 7	+21.04				27.32	+2 07.19			
25 19	+21.65				29.33	+2 12.16			
26 19	+20.6				30.39	+2 14.86			
27 7	+20.44				31.37	+2 17.28			
28 10	+19.47				June 1.35	+2 20.35			
Mch. 1 8	+19.88				2.33	+2 23.05			
2 19	+20.04				4.35	+2 29.04			
9d.35	+20.51				8.38	240.13			
10.38	+20.25				11.37	+248.43			
11.35	+19.48				13.34	+2 53.94			
13.50	+19.42				14.39	+2 58.66			
18.33	+14.12				15.44	+2 59.68			
24.	Stopped and set again ±2.s				18.38	+3 07.10			
29.80	+1.02				19.37	+3 09.02			
30.33	+0.79				22.33	+3 17.92			
Apr 3.30	Ran down and set with 312 ±0.s5				24.42	3 23.30			
3.30	-32.21				25.32	3 25.66			
6.35	-28.10	9.11	3.05	+3.s0	27.33	3 31.21			
9.35	-14.45	8.65	3.00	+2.9	29.35	3 36.59			
12.35	-10.42			+1.9					
13.35	-6.78								
15.33	-1.31			+2.7					
22.38	+22.21	23.52	7.05	+3.3					
24.38	+28.90								
26.38	+35.63								
May 2.45	±56.30								
5.35	+64.9								
7.38	+71.8								
8.35	+74.6								
11.33	+1m 23.6	8.1	3.00						
14.35	+1 31.72								
16.35 (16.35)	+1 37.94	6.22	2.00	3.11					
18.35	+1 44.70	6.76	2.00	3.38					

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1877 Mean Time clock Bond 394.

Date (mean)	Error	Δ_2	Interval	Daily Rate.
Feb 16. 9	+16.66			
17 9	+16.67			
18 9	+15.81			
19 9	+14.92			
20 9	+15.46			
20 18	+16.38			
21 8	+15.65			
21 19	+15.85			
22 9	+16.85			
25 7	+16.85			
26 19	+15.8			
27 7	+16.40			
27 19	+16.			
28 10	+15.48			
Mch 1 8	+15.73			
2 10	+16.22			
4 8	+20.16			
5.80	+15.32			
6.33	+16.36			
7.38	+15.77			
9.37	+13.10 Not on the line. storm.			

10. Removed to Boston to be cleaned etc. Bond Boston clock put in circuit.

Mch 19. 394 Put in basement.
Cael removed from clock case.
19. 17h 394 stopped. Set again at 7 P.M. 20s.
April 11. clock after running since Monday last suddenly stopped without apparent cause.

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1877. Mean Time clock, Howard

Mean Date	Error	Δ_2	Interval	Daily Rate.

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Russian Transit Constants

Mean date	a	b	c.
June 1877.			
1.35	+.05	+.11	—
2.33	−.24	+.12	+.33 C.E.
4.35	+.65	+.13	
11.37	+.28	+.03	
13.34	+.35	−.01	
14.39	−1.80	+.10	
15.44	−1.72	+.02	
18.38	−1.44	+.11	
19.37	−1.00	+.08.	
22.33	−.05 (?)	−.07	
22.44	−.90	−.09	+.28 C.E.
24.42	−.80	+.00	+.28 C.E.
25.32	−.63	+.05	+.30 C.E.
27.33	−.90	−.01	+.25
29.35	−.70	−.03	+.23 C.E.

Took the mean of the last + Mar. 5; this will eliminate c.

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1877.

Mar. 8. Experiments on methods of controlling the swing of clocks by magnets suspended from pendulum rod. After tieing to the rod a 6in magnet which can vibrate with the pendulum, and passes within about 1/16 in. of the top of a small coil.

March

(8) 2.35 P.M. Current through the coil ① El. back of 3451 = 0.5 hourly rate = +3.5 = Rate accelerating.

3.50 P.M. Cut off all current " " " ② " " " " = 4.5 " " = +2.3 = ordinary rate.

9.10 P.M. Reversed the current " " ③ " " " " = +18. " " = +1.2 = Rate retarding.

22.00 A.M. Reversed the current " " ① " " " " = +34.

(9) 1.30 P.M. Cut off the current " " ② " " " " = +44.5 " " = +3.2

+55.5 " " = +1.8

7.30 P.M. — No current +83.5 " " = +1.8

21.30 A.M. — No current

16

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date,.....187 . Instrument,..... Observer,.....

Timepiece,..... Recorder,.....

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.								
	h m s		h m s		h m s		h m s	
Wire, I.	.		.		.		.	
II.	.		.		.		.	
III.	.		.		.		.	
IV.	.		.		.		.	
V.	.		.		.		.	
Sum,	.		.		.		.	
Mean,	.		.		.		.	
Bb,	.		.		.		.	
Ce,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	.		.		.		.	
Error of Timepiece,	.		.		.		.	

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar 2 1877. Instrument, RT. Observer, Lw.

Timepiece, 3451. Recorder, Lw.

Object,	γ Draco		α Syrae					
Circle,	W		e					
	w	e	w	e	w	e	w	e
Level Direct,	19.0	18.0	19.0	18.0	.	.	.	.
Reversed,					.	.	.	.
Sums,	38.0	36.0	.	.	.	.	.	.
Difference,	36.0							
	20							
b.	+0.05				1327		394	
	h m s		h m s		h m s		h m s	
Wire, I.		56.8		11.5	18 8 16.0	= 19 23 0.0		
II.		51.0		38.7	arcmm sum ∓ 3.0			.
III.		5.3		6.3	42 8 13.0			.
IV.		39.4		33.2	22 42 17.80			.
V.	17 55	13.6	18 34	0.6	19 25 55.20			.
					3 11.00			44.2
					19 22 44.20			+15.8
Sum,		146 1		90 3	.			.
		2922		18.06				
		24						
Mean,	17 54	5.22	18 33	6.06	.			.
					3451		394	
Bb,		+.08		+.06	18 35 17.0	= 19 49 40.0		
Cc,		+.09		−.06	24 −20 24			.
Aa,		−.30		+.11	42 34 56.46			.
					22 42 17.80			.
					19 52 38.66			
					3 19.38			
Corr'd Transit,	54	5.09		6.17	23.78		23.78	
							16.22	
R. A.	17 58	44.92	18 32	46.25	.			
					312			
Error of Timepiece,		+29.17		+19.92	19 37 10.0 =		0.0	
		+19.92			.			
		+40.09						

∴ 3451 = +20.04

3451

18 56 32.5 = 20
24 −20.0
42 56 12.5
22 42 17.8
20 13 54.7
3 18.87
20 10 35.8

394

10 52.0

35.8

16.2

Rem. 12 gr. at 20h 15m

1327

18 50 23.0 = 20 5 0.0
24 arcmm −3.4
42 50 19.6
22 42 17.8
20 8 1.8
3 17.9
20 4 43.7

43.7
44.5
−5.5
16.22

19 49 46
19 23 0
26 40
438
0 26 44.38
18 34 56.46
18 8 12.08
8 16.0

∴ 1327 = +3.42

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar 2 1877. Instrument, Observer,

Timepiece, Recorder,

Object,															
Circle,															
	w		e		w		e		w		e		w		e
Level Direct,	.		.		.		.		.		.		.		.
Reversed,	.		.		.		.		.		.		.		.
Sums,	.		.		.		.		.		.		.		.
Difference,															
b.	1327 = 394				1327 = 394										
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.	20	8	36.0		20	32	40.0 − 3.4		20	51	43.0 − 3.4				.
II.	24		− 3.4		44	32	36.6		44 22	51 42	39.6 17.8				.
III.	44	8	32.6		22	42	17.8		22	9	21.8				.
IV.	22	42	17.8		21	50	18.8			3	37.8				.
V.	21	26	14.8			3	34.7								.
		3	30.7				44.1				44.0				.
Sum,			44.1				.		∴ 394 = + 16.0						.
Mean,	∴ 394 = + 15.9 add 5qr.		.		add 5qr		.				.				.
Bb,			.				.				.				.
Cc,			.				.				.				.
Aa,			.				.				.				.
Corr'd Transit,			.				.				.				.
R. A.			.				.				.				.
Error of Timepiece,			.				.				.				.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 3. 1877. Instrument, ... Observer, Lw.

Timepiece, 3451 Recorder, ...

Object,	K Cancri +11 10 42 27			
Circle,	E 3, 8 44 13			
	w | e	w | e	w | e	w | e
Level Direct,	. | .	. | .	. | .	. | .
Reversed,	. | .	. | .	. | .	. | .
Sums,	. .	.	. .	. .
Difference,		10 Am.		
b.		1327 = 394.	312	394
	h m s	h m s	h m s	h m s
Wire, I.	III 57.8	20 47 31.0	4521 24 24.0 =	22 35 0.0
		− 2 8	22 46 14 4	− 22.4
II.	III 19.8	44 47 28.2	22 38 9.6	22 34 37.6
		22 46 14 4	3 42.5	
III.	IV 41.0			
		22 1 19.8	22 34 27.51	22 34 27.1
IV.		3 36.4		
V.	.	21 57 37.54	∴ 312 = −	10.5
Sum,	.	∴ 394 = + 72.56	.	.
Mean,	.	= 9h. 394. 58 0.0	.	.
Bb,	.	.	.	.
Cc,	.	.	.	.
Aa,	.	.	.	.
		20 53 32.0		
		24 − 2.8		
Corr'd Transit,	.	44 53 29.2	.	.
R. A.	.	22 46 14.4	.	.
		22 07m 14s.8		
		3 37.4		
Error of Timepiece,	.	22 3 37.4	.	.
		∴ 394 = + 22.56		

16.0

10 gr. in 24 = + 6.6

∴ 1 gr. in 1m = 0s.027

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 4. 187 . Instrument, Observer,

Timepiece, Bond 312 Recorder,

Object,	μ Geminor		23 H Camelop.		δ = +79° 41′		15 Monocerotis	
Circle,	E		2		π = 37 18 cut.		π	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	19 · 3	18 · 2	.	.	20 .0	18 : 0
Reversed,	.	.	20 · 0	18 · 0	.	.		
Sums,	.	.	39 · 3 / 36 2	36 2	Cn 79° 41′ = 9.2531		.	.
Difference,			3 1	.	sec = 0.7469			
b. + 0.08			+ 0.08					
	h m s		h m s		h m s		h m s	
Wire, I.		34 · 5		32 · 5		30 · 6		18.1
II.		57 · 6	1808 2686 24	52. 5 / 12 · 0		51 · 0 / 10 3	17 14 3428	40 · 0
III.		20 · 5		32 · 0		30 0		1. 5
IV.		44 · 2	6 21 12.16	51. 8 / 30 · 0 ?		49. 5		23 · 0
V.	6 15	6 · 4		51. 8	6 27 10.28	29 · 0 / 49. 5	6 34	44. 6
Sum,		163 2 / 3264		11. 6 / 31. 5		8 3 / 28 5		127 2 / 2544
Mean,	6 15	20.64	6 23 11.2	17 5 9 / 51.0	6 29	48 · 0	6 34	1 : 44
Bb,		+ . 12	6 25	9 · 7	6 29 8.66	11 · 5		+ . 07
+.16(e) Ce,		+ . 24		+ . 36	25	+ . 36		— . 16
Aa,	+37	+ . 41	-3.38	+ . 90		— . 90	+54	+ . 67
Corr'd Transit,		21 . 41		.		.	34	2.02
R. A.	6 15	32 · 77	6 25	18 · 72		.	6 34	13 · 83
Error of Timepiece,	—	11 .36		.		.		— 11 · 81

(E)

25 11.0
14 21.0
t′ − t = 10? 50.0

25 18.72
15 32.77
α′ − α 9 45.95
− 4.05

a = −4.05 / −3.88 − .37 = +1.09 fm e, e

a = +4.86 / 54 + 3.38 = +1.25 fm e m

6 23 11.2
6 27 10.3
1 58.7

25 09.9 e = t
25 11.6 m = t′
+ 1.7
+ 0.85 fm e

61.628 55
0.7469
1.3275
2.3754 = 237.3
2.0744 = 118.7

9.2531
1.9543
9.2073
+ 0.161

6 6 21 12.2
6 29 8.7
3 57.3

6 25 9.5 (e)
6 25 11.4 (m)
+ 1.9
+ 0.95 fm e

(m) 6 34 1.35
25 11.0
t′ − t 8 50.35
8 55.11
+ 4.86

11.36
11.81
2) 23.17
− 11.58 = Error 312.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 4. 1877 Instrument, RT Observer, SW

Timepiece, 312. Recorder, SW

Object,	ξ Geminor			
Circle,	W			
	w / e	w / e	w / e	w / e
Level Direct,	. / .	. / .	. / .	. / .
Reversed,	. / .	. / .	. / .	. / .
Sums,	. .	. .	. .	. .
Difference,				
b.		312	394	1327
	h m s	h m s	h m s	h m s
Wire, I.	.	6 50 58·0	= 8 0 0·0	.
II.	~~I~~ 55·0	24 + 11.6	7 59 39.84	6 43 11·0
III.	~~II~~ 12·3	30 51 9 60	20.16	8 1.31
IV.	~~IV~~ 6 38 19·5	22 50 10·91		6 51 12.31
V.	.	8 1 58.69	7 52 0·0 =	6 51 9 60
		1 18 85	.	.
		7 59 39.84		+ 2.71
Sum,	.	.	.	.
Mean,	.	.	.	.
Bb,	.	.	.	.
Cc,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	.	.	.	.
Error of Timepiece,	.	.	.	.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 4 1877. Instrument, Observer,

Timepiece, Recorder,

		w	e	w	e	w	e
Object,							
Circle,							
Level Direct,							
Reversed,							
Sums,							
Difference,							
b.		1327		394		312	394

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.	18	53	14.0 =	20	0	0.0	19	37	6.0 =	20	44	0.0
		24		− 2 51							21	23	0.0
	II.	42	53	11.49			43.50						39m 0s
		22	50	10.91			+ 16s.50						
	III.	20	3	0.58	at 8 A.M.								
	IV.		3	17.08									
	V.	19	59	43.50								39	6.4
											20	16	25.5
Sum,											19	37	19.1
Mean,											19	37	6.0
								1327			1.32 = −		13s.1

Bb,		20	16	28.0 =	21	23	0.0	20	45	33.0			
				− 2.5						− 7.5			
Cc,		44	16	25.5				44	45	30.5			
Aa,		22	50	10.9				22	50	10.9			
		21	26	14.6			43.9	21	55	19.6			
			3	30.7					3	35.5			
Corr'd Transit,		21	22	43.9	= 1.394 = +		16.1	21	52	44.1			
R. A.													

added 40 gr. for 4m 10 a.m. 129 r. 7 m/sec.

24 − 2.5

45 29 37.5
22 50 10.9
22 39 26.6
3 42.6
22 35 44.0
1.394 = + 16.0

Bmo 312. (after adding 45.5)

21 38 56.0 − 22 45 30.0
24 22 36 0.0
8 30.0
1.56
8 31.56

21 29 40.0 − 2.5
21 29 37.5
9 31.56
21 39 9.06
21 38 56.0
− 13.06

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar 5 1877. Instrument, RT Observer, SW.

Timepiece, 312 Recorder,

Object,						α Ophiuchi				ι Herculis		
Circle,						W.				W		
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		20 . 7	19 . 0
Reversed,	.		.		.		.		.			
Sums,	.		.		.		.		.		.	
Difference,												
b.	1327				394							
	h	m	s		h	m	s		h	m	s	
Wire, I.	7	10	15.0	=	8	15	0.0				16.5	16.6
II.		11	15.0			16	0.0				38.3	
III.	7	10	45.0	=	8	15	30.0				0.2	III 46.8
IV.	24 31	— 10	2 21 42.79								22.0	17 35 56.8
V.	22 8	54 16	7 46 35.33									
	1		21.34									
Sum,			.		394 =		+ 16.0				121.0	180.2
Mean,			.				.				24 20	
	312.				394.				17	29	0.20	17 35 46.73
Bb	7	23	2.0	=	8	28	0.0				+ .11	+ .19
		+	30.			+	30.0				— .16	— .23
Ce,			.				.				= .52	— .11
Aa,			.		8	28	30.0				.	— .90
					8	15	30.0		+.51			-.09
Corr'd Transit,			.			13m	0.0					
							2.14			29	0.13	46.66
R. A.			.		7	10	42.79					
					7	23	44.93		17	29	14.17	17 35 60.17
Error of Timepiece,			.		7	23	32.0					
					∴ 312 =	−	12.93			−	14.04	− 13.51

1327
20 23 24.0 = 394 21 26 0.0
— 1.15

44 23 22.85
22 54 7.46
21 29 15.4
3 31.2
21 25 44.2 ∴ 394 = + 15.8

17 37 24.46
29 14.17
α'−α 8m 10.29
37 10.38
29 10.15
t'−t 8 10.23
.06
−1.23−.51
∴ a = − 0.03

14.04 W
13.51
13.30 E
13.15 E
14.00
−13.50

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 5. 80 1877 — Instrument, RT — Observer, Lit

Timepiece, 312 — Recorder,

Object,	β Ophiuchi		μ Herculis		Draco		α Lyrae	
Circle,	W		E		E		E	
	w	e	w	e	w	e	w	e
Level Direct,	21 : 0	18 : 6	21 : 5	18 : 5	.	.	22 : 0	19 : 0
Reversed,			22 0	19 0	.	.		
	20.7	19.0	4 3.5	37.5				
Sums,	20.9	18.8	21.7	18.7	.	.	.	.
Difference,	21.7	18.7						
b. = + 0.12	42.6	37.5						
	37.5							

R.T. Paine 1878 J.R. Arnold

	h		s		h	m	s
Wire, I.							38.4
a II.							5.6
c = +.16 c.e. III.							32.8
Azimuth IV.							0.1
a = +1.52 V.	17				18	33	27.3
Sum,							104.2
Mean,	17				18	32	32.84
Bb,							+ 15
Ce,							+.20
Aa,							
	-1.73				+09		
Corr'd Transit,		10.72		25.87			33.19
R. A.	17 37	24.46	17 41	39.17	18	32	46.34
Error of Timepiece,		-14.04		-13.30			-13.15

1876
Aug. 7
9 28 24.3
4 46 25.7
4 44 15.0
9 30 40.7
+ 2m 16.4

Aug 7 25.7
8 27.2 −0.3 +1.5 +1.2
9 28.1 +0.7 +0.6
10 28.5 +0.4 +0.1
11 28.9 +0.4 +0.1
12 29.0 +0.1 −0.2
14 29.4 +0.2 −0.1
16 30.9 +0.7 +0.4

1876
Aug 26 29.8 −0.5 +0.1 −0.8
Sept 5 24.5 −0.5 −1.0
15 8.0 −1.6 −2.1
25 48.2 −0.4 −2.0 −2.4

18 [1327] 6 2.0 = 19 [394] 9.0.0

19 13 0.0 =
4 0.66
18 6 2.00
18 10 2.66
18 10 1.50
∴ 1327 = + 1.16

312
18 9 48.0
24 + 13.50
42 10 1.50
22 57 7.46
19 15 54.04
3 9.36
19 2 44.68
∴ 394 = + 15.32

20 49 28.0 [1327]
− 1.10
44 49 26.90
22 54 7.46
21 55 19.44
3 35.47
44.0

1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar 6. 33 1877. Instrument, RT Observer, LW

Timepiece, Bond 312 Recorder, LW

Object,	23 H Camelop		γ gemini		15 Mocentis		ε gemini.	
Circle,	E.		E		W		W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	21 .0	18 .5	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b. = +0.10								
	h m s		h m s		h m s		h m s	
Wire, I.		30.8		39.1		16.0		53.8
II.		57.0		1.7		37.8		1.7
III.		9.9		23.6		59.2		9.3
IV.		30.1		46.1		21.3		17.2
V.	6 25	50.0	6 31	8.0	6 34	42.2	-6 36	25.0?
Sum,		171.8		118.5		176.5		107.0
		34.36		23.70		35.30		21.40
Mean,	6 25	10.36	6 30	23.70	6 33	59.30	6 36	9.40
Bb,		+.45		+.10		+.08		+.10
Cc,		-.11		-.02		+.02		+.02
Aa,		-6.42		+.87		+1.03		+.63
	-3.38		+.46		+54		+33	
Corr'd Transit,	6 25	4.28	30	24.65		60.43		10.15
R. A.	6 25	18.52	6 30	38.18	6 34	13.80	6 36	23.57
Error of Timepiece,		.		-13.53		-13.37		-13.42

312 394 1377 C.W.

4 54.0 = 8.70.0 6 42 37.5

+13.44 24 13.8

7 5 7.44 2'-2 18 23.7

22 58 4.02 42 51.18

8 7 3.42 33 59.40

1 19.78 t'-t 18 52.78

8 6 43.64 (2'-2)-(t'-t) = -29.1

394 = +16.36 = -14.6-54 = +1.93 C.W.

10 0.0 = 7 9 9.0

7 5 7.44 7 9 8.10

4 0.66 +0.90

7 9 8.10

= Sun 1377

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar 6.33 1877. Instrument, RT Observer,

Timepiece, Bond 312 Recorder,

Object,	51 Hcephei				51 Hcephei,														
Circle,	W				E														
	w		e		w		e		w		e		w		e				
Level Direct,	20 . 9		19 . 1		21 . 3		19 . 1		.		.		.		.				
Reversed,					21 . 3		19 . 2		.		.		.		.				
Sums,	21.5		19 0		21 . 3		19 . 2		Mch										
Difference,	21.2		19.0						6d. 84		.		.		.				
b.	21.2		19.2																
	42.4		38.2		∴ 7 + 0s.10				1327				394						
	h	m	s		h	m	s		h	m	s		h	m	s				
Wire, I.	6	40	22.0		6	47	43.0		19	12	7.0	=	20	11	0.0				
II.		41	36.0			48	56.5		4		− 0 60					added 15 sec			
III.		42	50.0			50	10.0		43	12	6.40					at 8.30 mc			
IV.		44	3.0			51	24.0		22	58	4.02								
V.		45	15.5			52	37.5		20	14	2 38					Rem 39 sec			
										3	18.89					at 10 mc			
									20	10	43.5								
Sum,		126	5				181 0												
		25	30				34.20												
		24					24												
Mean,	6	42	49.30		6	50	10.70												
									19	19	57.0	=	20	19	0.0				
Bb,			+1.47				+ 1 47												
Cc,			+ .41				− .41												
Aa,	−14.6		−27.7		−14.6		−27.7												
Corr'd Transit,			51.18						21	5	25 0								
			−27.7						24		−0.6								
		42	24.5						45	5	24.4								
R. A.	6	42	37.47						22	58	4.0								
Error of Timepiece,									22	7	20.4								
										3	37.4								
											43.0								

1.3163
1.3275
2.6488
440.2
= 7m 20.2

6 50 10.2
7 20.2
6 42 50.0
6 42 49.3
t'−t = + 0.7
½ = + 0s.35 for C.M.

6 42 50.0
+ 1.06
6 42 51.1
6 30 23.8
t'+t 12 27.3
t'−t 12 54.29
28.0
−14.6-46 = +1.84 for ε

∴ 394 = +17.0

1.5441
8.6837
2 .2278 ∴ C = +0s.017 for CW.

13.53
13.37
13.42
13 2
− 13s.44 = Error 312

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar 7. 38 1877. Instrument, RT3 Observer, Lis

Timepiece, 312 Bond Recorder, Lis

Object,	π Gemin		Gr 1374		Gr 1374		6 Cancri	
Circle,	E		E		W		W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	20 . 5	17 . 7	19 . 9	18 . 5	.	.
Reversed,	.	.			20 . 0	18 . 2	.	.
Sums,	.	.	40 . 5	35 . 9	20 . 0	18 . 3	.	.
Difference,			36 . 0					
b. = +0.11			4 . 5	+0.11				
	h m s		h m s		h m s		h m s	
Wire, I.		32 . 5	II	36 . 5	IV	13 . 8		57 . 2
II.		56 . 0		48 . 8		26 . 8		21 . 2
III.		21 . 7		1 . 7		40 . 0		45 . 3
IV.		47 . 2		15 . 3		52 . 5		9 . 2
V.	7 40	13 . 1	7 44	28 . 0	7 47	5 . 8	7 56	33 . 1
Sum,		190 . 5		130 3		138 9		166 0
		34 10		26 06		27 78		23 20
		12		24		12		12
Mean,	7 39	22 . 10	7 44	2 . 06	7 46	39 . 7	7 55	45 . 20
				18 . 36				
Bb,		+ 13	7 45	20 . 42	1	18		+ 12
Cc, +0.13 CE		+ . 16		+ . 34	45	+ . 34		.
Aa,		+ . 35		+ . 50		- . 50		- . 14
	+.19	.		- 3 . 34		- 3 . 49		+ . 50
	+.28		-1.94		-1.94		+28	
Corr'd Transit,		22 74		.		.		.
R. A.	7 39	36 . 72	7 45	31 . 94		.	7 55	60 . 95
Error of Timepiece,		- 13 . 98		- 13 . 99		.		.
	1327		394					

0.5399 0.5663 8 5 14.0 = 9 2 0.0 312 −14.00

1.3275 1.3275 2 0.33 −14.32

1.8674 1.8938 8 7 14.33 14.12

7836 8 7 14.12 9 4 0.0 = 8 7 0.0

9 3 44.73 + 14.12 312

7 45 21.42 + 0 0.21 394 15.77 32 7 14.12

20.42 = 1327 23 2 0.57

1.00 9 5 13.55

0.50 1 29.32

= +0.13 for Aa Circle E. 9 3 44.23

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 7.38 1877. Instrument, RT Observer, Lcd

Timepiece, B.T. 312. Recorder, Lcd

Object,	27 Lyncis										
Circle,	W.										
	w		e		w		e		w		e		w		e	
Level Direct,	20	0	18	2												
Reversed,																
Sums,					May 7.d 84											
Difference,																
b.					1327				394				312			
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.		52	0		18	55	0.0	=	~~20~~	~~10~~	0.0					
					24		+ 0.14		19	50						
II.		26	8		42	55	0.14		~~20~~	52	0.0	=	18	56	46.0	
III.		1	1		23	2	0.57		19				24		+ 14.42	
IV.		35	7		19	52	59.57						42	57	0.42	
						3	15 44						23	2	0.57	
V.	8	0	10	2		19	49 44.42				44.08		19	54	59.85	
			12.58											3	15.17	
Sum,			25.16		÷ 394 = +15.87				÷ 394 = +15.92							
			24										19	51	44.08	
Mean,	7	59	1.16		by 1327				by 312							
Bb,			+ .17													
Cc,			− .20													
Aa,	-26		− .47		9.45 to 9.55 after 0h.1 mug ht.											
Corr'd Transit,		59	0.66													
R. A.	7	59	14.90													
Error of Timepiece,			−14.24													

Cc 7 45 31.94 / 39 36.72 / 5 55.22

45 21.26 / 39 22.39 / 5 58.87

Cm 7 55 60.95 / 45 31.94 / 10 29.00

55 45.18 / 45 21.26 / 10 23.92

24 + 0.14 / 44 3 11.14 / 23 2 0.57 / 21 1 10.57 / 3 26.6 / 44.0 ÷ 394 = +16.0

α'-α (t'-t) = − 3.65 / 2.63 = +1.80 / +1.71

Cz

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar 8.87 1877. Instrument, R1 Observer,

Timepiece, Recorder,

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	312		394		1327			
	h m s		h m s		h m s		h m s	
Wire, I.	20 40 58.0		21 25 0.0		20 34 11.0			.
II.	24 +15.1			.	24 +.7			.
III.	44 41 13.1			.	44 34 11.7			.
IV.	23 5 57.5			.	23 5 57.1			.
V.	21 35 16.0			.	21 28 14.6			.
					3 31.0			
Sum,	3 32.2			.	21 24 43.6			.
Mean,	21 31 43.8		= 21 32 0.0			.		.
Bb,		.		.		.		.
Cc,	∴ 394 = +16.2			.	∴ 394 = +16.4			.
Aa,	by 312.			.	by 1327			.
Corr'd Transit,		.		.		.		.
R. A.		.	Transit over		W. H. Line	= +16.0		.
Error of Timepiece,	at 10h m, by removing 12.5 sec.			.				.

10h m added 12 sec.

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar. 9d.37 1877. Instrument, ... Observer, ...

Timepiece, Gutzkow. Recorder, ...

Object,																
Circle,																
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.		.		.	
Sums,	.		.		.		.		.		.		.		.	
Difference,																
4b. 12.8 8.45 Hubbard	3451				394				312				1327			
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.	7	55	15.0	=	8	43	48.0				.				.	
0.027 II.			.		8	50	30.0				.		8	1	37.0	
12																
8.12 Hubbard III.	8	3	54.5	=	8	52	26.0				.				.	
7.916 IV.			.		8	59	30.0		8	10	24.0				.	
V.			.				.				.				.	
Sum,			.				.				.				.	
Mean,	3451				3451				15		42.0				.	
Bb,	7 24	55	15.0 − 20.51		8 32	3	54.5 − 20.51			15	2.57 44.57				.	
Cc,	31	54	54.49		23	3 39	33.99 53.67		7	54	54.49				.	
Aa,	23	9	53.67		8	53	40.32		8	10	39.06 24.0				.	
Corr'd Transit,	8	45	0.82			1	27.42		Sum 312 = − 15.06						.	
		1	26.00		8	52	12.90				.				.	
R. A.	8	43	34.82				.				.				.	
	8	43	48.0		8	52	26.00			7	4.0				.	
Error of Timepiece,	1.394 = + 13.518				1.394 = + 13.10				8	3	1.16 33.99				.	
									8	10	39.15 24.0					

312 = − 15.15

Mean = − 15.10 = 312.

Mean = − 0.60 = 1327

Add 12 gr to 394 which am to remain until 9d 7.30 sm

9 = 9d.82

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar. 9d 31 1877. Instrument, R9. Observer, [illegible]

Timepiece, 3451 Recorder,

Object,	63 Aurigæ	δ Geminorum	9h 1308	9h 1308
Circle,	W	W.	W	W
	w | e	w | e	w | e	w | e
Level Direct,	. | .	18 .1 | 18 .5	. | .	18 .6 | 18 .6
Reversed,	. | .	. | .	. | .	18 .3 | 18 6
Sums,	. .	. .	. .	. .
Difference,				
b.				
	h m s	h m s	h m s	h m s
Wire, I.	39.0	22.2	IV 12.0	III 11 .3
II.	6.7	45.1	24.0	21 .7
III.	34.1	8.3	31.8	30 .6
IV.	1.7	31.0	41.5	42.5
V.	7 4 29.5	7 13 54.1	51.2	7 23 51.0?
Sum,	1870 / 27.20 / 12	1607 / 32.14 / 24	1605 / 32.10	1521 / 31.42
Mean,	7 3 34.20	7 13 8.14	.	7 18 31.42
Bb,	.	.	.	.
Ce,	— .16	— .13	.	— .36
Aa,	+.07 + .15	13 8.01 +.37 + .78	.	31.06 −1.22 − 2.60
Corr'd Transit,	34.19	8.79	.	29.46
R. A.	7 3 13.74	7 12 48.43	.	7 18 8.10
Error of Timepiece,	+ 20.45	+ 20.36	.	+ 20.36

20.45
20.36
20.59
20.66
20.6

20.51 = Error 3451.

7 12 48.42
α-α 6 19.67
t-t 23.05
−3.38
−1.59

a = cm = + 2.13

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 9.35 1877. Instrument, RT Observer, EW

Timepiece, 245 Recorder, EW

Object,	α Geminor		α Geminor		α Can. Min.		gm 1374	
Circle,	E		E		E		E	
	W	E	W	E	W	E	W	E
Level Direct,	.	.	19 : 1	18 : 5	.	.	.	.
Reversed,	.	.	18.3	18.6	.	.	.	.
Sums,	.	.	37.4	37.1	.	.	.	.
Difference,			37.1					
			.30					
b.	+0.00							
	h m s		h m s		h m s		h m s	
Wire, I.		16.5		29.8	II	10.8	I	7.2
II.		41.5		51.3		24.5		20.2
III.		6.7		12.5		36.7		33.3
IV.		33.27		33.8		50.0		46.07
V.	7 27	56.5		55.6	7 45	3.1	7 48	59.0
Sum,		154.4 / 30.88		183.0 / 36.60 / 24		125.1 / 25.02 / 12		165.7 / 33.14
Mean,	7 27	6.88		12.60	7 44	37.02 / +1 18.36	7 48	33.14 / −2 26.6
					7 45	55.4	7 45	56.5 / 55.4 / 1.1
Bb,		.		.		.		
Ce,		+.15		+.13 / 12.73		+.50 / 55.9		+0.50
Aa,	+.22	+.47	+.60	+1.33	−1.94	−4.20		= +0.13 .50 for CE
Corr'd Transit,		7.50		14.06		45 51.7		
R. A.	7 26	46.91	7 32	53.40	7 45	31.84		
Error of Timepiece,		+20.59		+20.66		+19.9		

1566 3
1.6286
2.1949
156.6

1327

19 8 53 +20.0 =19 50 : 0.0
20 +0.8
43 9 13.8 = 20.0
23 9 53.7 3.6
19 59 20.1 +16.4
3 16.5
19 56 3.6

7 32 53.40
α-α 12 38.40
t-t 43.2
a = C.E. = −4.8 / −2.16 = +2.22

19 17 36.0 ?
24 or 40.0 ?
+15.3
43 17 55.3
23 9 53.7
20 8 1.6
3 17.9
20 5 43.7
1'.394 = +16.3

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar. 9 90 187 . Instrument, Observer,

Timepiece, Recorder,

Object,												
Circle,												
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.	1327				394				1327			
	h	m	s		h	m	s		h	m	s	
Wire, I.	20	51	10.0	=	21	38	0.0		23	51	36.0	
	54		+0.8						24	+0	9	
II.	44	51	10.8				.		47	51	35.9	
III.	23	9	58.7				.		23	13	50.2	
IV.	21	41	17.1				.		24	37	46.7	
		3	13.1						0	37	46.7	
V.			44.0				.			0	6.2	
Sum,			.				.		0	37	40.5	= 0 38 0.0
Mean,			.				.				.	
									∴ Bmd Bct =			+19.5
Bb,			.				.				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.			.				.				.	
Error of Timepiece,			.				.				.	

10

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 10 & 38 Mch 1877. Instrument, RT. Observer, LW

Timepiece, 3451 Recorder, LW

Object,	19 Lyncis			Grw 1308			α Geminor				
Circle,	W.			W			E				
	w		e	w		e	w		e	w	e
Level Direct,	20	.0	19.6	.		.	.		.	.	.
Reversed,				.		.	.		.	.	.
Sums,	assume a = +2.2										
Difference,	c = +0.1 cc										
b.	b = 0.0										
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			58.4			33.8			16.6		.
II.			36.3			32.0			41.2		.
III.			13.4			30.3			6.8		.
IV.			51.2			29.1			31.7		.
V.	7	14	28.5	7	20	27.5	7	22	57.0		.
Sum,			18.7.8 / 32.4.6			.			153.3 / 30.66 / 24		.
Mean,	7	13 14	13.56			.	7	22	6.66		.
Bb,			.			.			.		.
Ce,			−.20			.			+.45		.
Aa,			−.88			.			+.12		.
Corr'd Transit,		13	12.48			.		22 / 21	7.23		.
R. A.	7	12	52.3			.	7	26	46.9		.
Error of Timepiece,			+20.5.2			.			+20.5.3		.

3451 Bust Brit.

8 2 19.7 = 8 47 0.0

24 − 20.2

23 13 59.5 / 23 13 50.2

8 48 39.3 − 26.3 = 8 46 42.8 at 8.47 P.M.

312

42.8 + 17.2

6 3 24.0 = 6 49 0.0

24 − 15.6

30 3 8.4 / 23 13 50.2

6 49 18.2 + 31.2

6 49 49.4 / 7.1

6 48 42.3 at 7 P.M.

∴ Bust Brit = +17.5

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar 11.35 d 1877. Instrument, RT Observer, LW.

Timepiece, 3451 Recorder, LW.

Object,	κ Geminor				π Geminor				gr 1374				gr 1374			
Circle,	E				E				E				gr 31 51			
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		21.0		18.0		.		.	
Reversed,	.		.		.		.		20 8		18 4					
Sums,	.		.		.		.		41 8		36.4		.		.	
Difference,									36.4							
b. = +0.13									5.4							
									0.18							
C = +0.15 CE	h	m	s		h	m	s		I h	m	s		III h	m	s	
Wire, I.			35.3				~~30.2~~				52.0				29.0	
II.			38.6				38.3				5.3				42.0	
III.			22.3				47.2				18.6				55.3	
IV.			45.5				55.6				31.5				8.0	
V.	7	38	8.7		7	40	12.8		7	43	44.2		7	46	21.4	
			17.04				158.2				151.6				155.7	
Sum,			34.08				31.64				30.32				31.14	
			12.				4.3				12.				24.	
Mean,	7	37	22.08		7	39 ~~40~~	55.64		7	43 2	18.32 36.6		7	45	55.14	
Bb,			+.14				+.15		7	45	54.9				+.4	
Ce,			+.03				+.04				+.4				−.6	
Aa,	+.33		+.69		+.19		+.40		−1.94		+.1				55.4	
Corr'd Transit,			22.94			39	56.23				.				.	
R. A.	7	37	3.38		7	39	36.66		7	45	31.73				.	
Error of Timepiece,			+19.56				+19.57				3451 =				+19.48	
	312				B.R.											

Mar. 11d 17.

3 9 48.0 = 3 52 0.0
24 +15.9 +1.3
27 10 3.9
23 17 46.8
3 52 17.1
0 38.05
3 51 39.05

1327 = 3 58 0.0

3 16 4.0
24 +1.3
27 16 5.3
23 17 46.8
3 58 18.5
0 39.04
3 57 39.46

3 29 9
24 +1.3
27 29 10.3
23 17 46.8
4 11 23.5
0 41.2
42.3

3 42 11.0
+1.3
27 42 12.3
23 17 46.8
4 24 25.5
0 42.3
4 23 42.2

7 45 55.14
54.9
+1.2 CE.
+0.6
31.68

1 C = +0.15
CE
1/37 = +0.03

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar 11.d 35 1877. Instrument, RT Observer, Lw

Timepiece, 3457. Recorder, Lw

Object,	b Cancri																		
Circle,	T																		
	w		e		w		e		w		e		w		e				
Level Direct,	20 . 8		18 . 4		.		.		.		.		.		.				
Reversed,					.		.		.		.		.		.				
Sums,	.		.		Mar. 11d 83				.		.		.		.				
Difference,																			
b.					1327				B.13.				3451						
	h	m	s		h	m	s		h	m	s		h	m	s				
Wire, I.			30 . 1		19	18	42.0	=	19	58	0.0								
II.			54 6		24	+	4 2												
III.			18 . 6		43	18	46 . 2				.	=	19	19	5.0				
IV.			42 . 7		23	17	46 8				.		24	−	19 . 2				
V.	7	57	7 . 0		20	0	59 . 4				.		43	18	45 . 8				
			153.0			3	16 7				.		23	19	46 . 8				
			30.60			57	42 . 7				.		20	0	59.0				
Sum,			12				.				.			3	16.7				
Mean,	7	56	18 . 60		19	20	37 . 0							57	42.3				
													19	21	0.0				
Bb,			+ . 14		19	21	20 . 0												
Cc,			− . 03				.				.		19	21	43 . 0				
Aa,	+ . 28		+ . 59				.				.								
					312														
Corr'd Transit,		56	19 . 30		19	26	28.0				.								
R. A.	7	55	59 . 90		24		+ 18.8				.								
					43	26	46 . 8				.								
					23	17	46 . 8				.								
									3451										
Error of Timepiece,			19 . 40		20	9	00 . 0		19	29	6.5 =		20	7	0.0				
			5			3	18 1				.								
			1327			5	41 . 9				.								
					B.B.				312				B.B.						

7 45 55.4
37 22.25
8m 33.15

45 31.73
37 3.38
8 28.35

t − t = −4.8

8

−4.8 / −227 = +2.s1

7 50 51.0 = 8 32 0.0
14 2.30
7 64 53.30
56.52

∴ 1327 = −3.22

8 1 38.0 = 8 43 0.0

∴ Error 312 = −18.03

Send Error at 8.30 AM = 20h 30m

+1.9

3451 = B13.

5 16.0 = 8 46 0.0
− 19.48
32 4 56.52
23 17 46.78
8 47 9.74
8 45 16.35
8 45 43.39

∴ B.B.B = +16.61

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 11.90 1877. Instrument, Observer,

Timepiece, Recorder,

Object,				
Circle,				
Level Direct,	w . .	e . .	w . .	e . .
Reversed,				
Sums,	23 17 50.67 / 3.89	. .	. .	. .
Difference,	23 17 46.78			
b.	3451	B.B.	312	B3451
Wire, I.	h m s: 20 59 13.0	21 38 0.0		.
II.	24 − 18.9	.	20 0 32.0	21 1 10.5
III.	44 59 04.1	21 46 0.0	21 6 46.0	− + 18.9
IV.	21 41 17.3	.	24 + 19.4	.
V.	3 33.2	.	45 7 5.4	.
	44.5.1	.	21 49 18.6	.
			3 34 5	
Sum,	.	.	44.1	.
Mean,	.	.	.	.
			1327	B.B.
Bb,	.	.	21 10 2.0	21 49 0.0
Cc,	.	.	24 + 4.1	.
Aa,	.	.	45 10 6.1	.
			21 52 19.3	.
			3 35.0	
Corr'd Transit,	.	.	44.3	.
R. A.	.	.	.	.
Error of Timepiece,	.	.	.	.

15.9
15.9
15.7
25
15.8 at Mch 11d 22h

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 12. 85 187 . Instrument, Observer,

Timepiece, Recorder,

	w	e	w	e	w	e	w	e
Object, Circle,								
Level Direct, Reversed,	. .	. .	. .	. .	. .	. .	. .	. .
Sums, Difference, b.	. . 312	. .	. . BB	. .	. . 1327		. .	

	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	19	44	26.0 =	20	20	.			.			.
II.	24		+19.2	20	24	.	19	48	42.0			.
III.	43	44	45.2			.	24		+4.2			.
IV.	23	21	43.3			.	43	48	46.2			.
V.	20	23	1.9			.	23	21	43.3			.
		3	20.4				20	27	2.9			.
Sum,	20	19	41.5			.		3	21.0			.
Mean,	312	Marcus	BB+18.5			.	20	23	47.9			.
									+18.1			
Bb,			.			.			.			.
Cc,			.	Sig. Sent 8:30 PM = 20h 30m								.
Aa,			.			.			= +1.9			.
Corr'd Transit,			.			.			.			.
R. A.			.			.			.			.
Error of Timepiece,			.			.			.			.
				21	44	0.0 =	21	8	56.0			
							24		+4.5			
							45	9	0.5			
							23	21	43.3			
							21	47	17.2			
								3	34.2			
							21	43	43.0			

21 15 42.0 = 21 51 0.
24 +19.1 =
45 16 01.1
23 21 43.3
21 54 17.8
3 35.3
21 50 42.5

Sig. Sent 22h
+1.1

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 13d.50 1877. Instrument, Pt Observer, Lw

Timepiece, 3451 Recorder, Lw

Object,	δ Leonis		Gr. 1757		Gr 1771		ε Leonis	
Circle,	~~E~~ 21° 12′		ε 352 14		π 22 37		W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	20.5	18.5	.	.	19.4	19.5
Reversed,	.	.	19.4	19.5	.	.		
Sums,	.	.	39 9	38.0	.	.	.	.
			38.0	.				
Difference,			1.9					
b. = +0s.05			0s.05					
	h m s		h m s		h m s		h m s	
Wire, I.		9.2		46.8		25.0		7.9
II.		31.8		57.3		41.3		29.8
III.		55.1		8.7		58.1		51.6
IV.		17.7		20.0		15.2		13.3
V.	11 8	40.8	11 10	31.2	11 16	32.5	11 18	34.8
Sum,		11546 / 30.92 / 24		16402 / 32.80 / 20		17221 / 34.42 / 20		13714 / 27.48 / 16
Mean,	11 7	57.92	11 10	8.80	11 15	58.42	11 17	51.48
assume C(e) = +0s.13								
Bb,		+.05		+.07		+.11		+.04
Ce,		+.14		+.20		−.30		−.13
						58.22		51.39
Aa,	+.39	+.82	−.21	−.43	−.91	−1.91	+.53	+1.11
Corr'd Transit,	7	55.93	10	8.64	15	56.31		52.50
R. A.	11 7	36.46	11 9	49.27	11 15	36.88	11 17	33.05
Error of Timepiece,		+19.47		+19.37		+19.43		+19.43

19.47
19.37
19.43
19.43
170

∴ 3451 = +19s.42

11 15 36.88
α = 2 1 56.19
51.39
58.22
53.17
(α′ − α) − (t′ − t) = +3.02
a = + 3.02/144 = +2.1

1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 13d. 50 1877 Instrument, RT. Observer, Lis

Timepiece, Empaims Recorder, Lw

Object, Circle,								
Level Direct, Reversed,	w . .	e . .	w . .	e . .	w . .	e . .	w . .	e . .
Sums, Difference, b.	. .	. .	. .	. .	. .	. .	. .	. .
	1327 =		B.B.		3451		312	
	h m s		h m s		h m s		h m s	
Wire, I.	11 36 19.0 =		12 9 0.0					
II.			12 12 0.0		= 11 39 44.0			
III.			− 30.0		− 30.0			
IV.			12 11 30.0					
V.			12 21 0.0				11 48 6.0	
Sum,								
Mean,	3451.		B.B.					
Bb,	11 39 14.0 =		12 11 30.0		11 38 54.58		11 38 54.58	
Cc,	24 − 19.42				2 30.41		9 31.56	
Aa,	35 38 54.58				11 36 24.17		11 48 26.14	
	23 25 39.89				11 36 19.0		11 48 6.0	
Corr'd Transit, R. A.	12 13 14.69				∴ 1327 = − 5.17		∴ 312 = − 20.14	
	2 0.12							
	12 11 14.57		14.57					
Error of Timepiece,			BB = + 15.43					

1327 . 312 .

11 36 19.0 11 48 6.0

24 + 5.17 24 + 20.1

35 36 24.17 35 48 26.14

23 25 39.89 23 25 39.89

12 10 44.28 12 22 46.25

1 59.71 2 1.68

12 8 44.57 12 20 44.57

12 9 0.00

∴ BB = + 15.43 ∴ BB = + 15.43

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 13.83d 1877 Instrument, Observer, SW

Timepiece, Recorder,

Object,												
Circle,												
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.	1327				BB				312			
	BB.											
	h	m	s		h	m	s		h	m	s	
Wire, I.	19	43	44.0		20	15	0.0		19	51	26.0 =	20 23 0.0
II.	24		+5 .34				.		24	+20	.38	.
III.	43	43	49 3				.		43	51	46.4	.
	23	25	39.9				.		23	25	39.9	.
IV.	20	18	9.4				.		20	26	6.5	.
		3	19.55							3	20.85	
V.	20	14	49.85				.		20	22	45.65	.
Sum,			.				.				.	.
Mean, Mch 13.90			.				.				.	.
	21	24	54.0 =		21	56	0.0					
Bb,	24		+5 .41				.			+20	.47	.
Cc,	45	24	59 .41				.				.	.
Aa,	23	25	39 .9				.				.	.
	21	59	19.5									
		3	36.1									
Corr'd Transit,			.				.				.	.
R. A.		56	43.4				.				.	.
			16.6									
Error of Timepiece,			.				.				.	.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 14.85 1877 Instrument, Observer, Lis

Timepiece, Ampanions Recorder,

		w		e		w		e		w		e		w		e	
Object,																	
Circle,																	
Level Direct,																	
Reversed,																	
Sums,																	
Difference,																	
b.		1327				= BB				312							
		h	m	s		h	m	s		h	m	s		h	m	s	
Wire,	I.	19	~~47~~ 45	34.0	=	20	~~12~~ 13	0.0	//	19	48	21.0					
	II.	24	0	+6.1		20	16	0.0	//	24		20 6					
	III.	43	45	~~40~~ 1						43	48	41.6					
	IV.	23	29	36.5						23	29	36.5					
	V.	20	~~16~~ 15	~~03~~ 3.6						20	19	5.1					
			3	19.2							3	19.7					
Sum,		20	12	44.4						20	~~16~~ 15	45.4					
Mean,		∴ BB = + 15.6								∴ BB = + 14.6 ?							
Bb,																	
Cc,																	
Aa,																	
Corr'd Transit,																	
R. A.		1327				J 1436				312				J 1436			
Error of Timepiece,		20	26	11.0	=	20	58	28.4		20	32	12.0	=	8	59	42.0	
		24		6.1						24		20.6					
		44	26	17.1						44	33	32.6					
		23	29	36.5						23	29	36.5					
		20	56	40.6						21	2	56.1					
			3	25.9							3	28.9					
		50	53	14.7		14.7				20	59	29.2		59	29.2		
		∴ J 1436 = + 13.7								Assume 312 Err = 21.4				∴ J 1436 = + 12.8			

No signal sent at 8.30 w 10 Am
Sine cannot be worked.
Cannot send to Bonds store.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 15.45 1877. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,				
Circle,				
	w | e	w | e	w | e	w | e
Level Direct,	. | .	. | .	. | .	. | .
Reversed,	. | .	. | .	. | .	. | .
Sums,	. .	. .	. .	. .
Difference,				
b.	1327	B,B.	312	3451.
	h m s	h m s	h m s	h m s
Wire, I.	10 9 54.0 =	10 35 0.0	.	.
II.	.	10 56 0.0	10 30 44.0	.
III.	25 4 11	.	+ 0.0	.
IV.	10 34 58 11	.	==========	10 35 23 0
V.	10 35 5.20	11 0 0.0	.	− 17.80
	1327 = − 7.09	.	.	31 10 35 5.20
Sum,	.	.	10 30 44.0	23 33 33.00
			14 0.66	11 1 32.20
Mean,	.	.	10 34 44.66	1 48.30
			10 35 5.20	10 59 43.90
Bb	.	.	312 − 20.54	11 0 0.00
Ce,	.	.	.	.
Aa,	.	.	.	+ 16.1
Corr'd Transit,	.	.	.	.
R. A.	.	.	.	.
Error of Timepiece,	.	.	.	.
	312	B,B	1327 =	312
	19 52 16.0 =	20 16 0.0	20 1 31.0	20 25 0.0
	24 + 20 54		24 + 7.09	
	43 52 36.54		44 1 38.09	
	33 33 33.00		33 33 33.00	
	20 19 3.54		20 28 5.09	
	3 19.71		3 21.19	
	15 43.83		24 43.90	

∴ BB = +0.1

Signals Sent 8.30 AM +0.1

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 15.40 1877 Instrument, RT Observer, LW

Timepiece, 3457 Recorder, SW

Object,	ε Serpis				ν Ophs. Mag				τ Serpis			
Circle,	W				W				E			
	w		e		w		e		w		e	
Level Direct,	.		.		20.2		19.1		.		.	
Reversed,	.		.		20.6		19.8		.		.	
					20.4		19.4					
Sums,	.		.		41.5		18.5		.		.	
					41.9		37.9					
Difference,					32.9							
b. = +0.10					40							
					7 = +0.10							
	h	m	s		h	m	s		h	m	s	
Wire, I.			.				.				.	
II.			.				.				.	
III.			.				.				.	
IV.			.				.				.	
V.			.				.				.	
Sum,			.				.				.	
Mean,	9	39	11.52		9	42	36.94		9	54	1.56	
Aa												
Bb,			+.10				+.19				+.08	
c = +0.10 Cc,			−.81				−.20				+.10	
a = +2.1 Aa,			+.74				−1.25				+1.18	
Corr'd Transit,		39	12.25				35.68				2.92	
R. A.	9	38	54.50		9	42	18.13		9	53	44.98	
Error of Timepiece,			17.75				17.55				17.94	

ν Ophs. Mag					τ Serpis				η Serpis			
W					E				E			
w		e			w		e		w		e	
21.5		18.5			.		.					
.		.			.		.					
h	m	s			h	m	s		h	m	s	
		.					.				.	
		.					.				.	
		.					.				.	
		.					.				.	
		.					.				.	
		.					.				.	
10	0	56.68										
		+.10										
		+.10										
		+.95										
		57.83										
10	0	39.87										
		17.96										

17.75
.55
.94
.96
3 2 0
+ 17.80 = Error 3457

1327 RB

21 20 44.0 = 21 44 0.0
24 +7.1
45 20 51.1
23 33 33.0
21 47 18.1
3 34.1
21 43 44.0

Signal Sent 10h 0m
+0.0

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 16d 85 1877. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	23 37 33.44 3.89	.	.	.	.	.	.	.
Difference,	23 37 29.55							
b.	312		R.B.		1327		BB	
	h m s		h m s		h m s		h m s	
Wire, I.	19 55 12.0 =		20 15 0.0		19 58 24.0 =		20 18 0.0	
II.	19 56 12.0 =		20 16 0.0		24 +22.0			
	24 +8.8				43 58 46.0			
III.	43 56 20.8				23 37 29.55			
IV.	23 37 29.55				20 21 18.45			
V.	20 19 51.25				8 20.1			
	3 19.8							
Sum,	20 16 31.3				20 17 58.3			
	13.2				13.2			
Mean,	20 16 44.5				45.1			
Bb,	.		∴ Error sent at 8.30 AM = −1.5.1		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	.		.		.		.	
Error of Timepiece,	.		.		.		.	

1327

21 25 39.0 = 21 45 0.0
24 8.8
45 25 47.8
23 37 29.55
21 48 18.25
3 24.3
21 44 44.0

∴ Error sent at 10 AM. = 0.5.0

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 18h. 33 1877. Instrument, R.T. Observer, L.W.

Timepiece, 3451 Recorder, L.W.

Object,	gr. 1308				β Can. Min.				α Geminor				α Can. Min.			
Circle,	W.				W				W				E			
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		20	7	20	7	21	0	20	0
Reversed,	.		.		.		.		21	4	20	0				
Sums,	.		.		.		.		42.1		40.7					
Difference,									1.4							
b. = +0.03																
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.			.				.				.				.	
II.			.				.				.				.	
III.			.				.				.				.	
IV.			.				.				.				.	
V.			.				.				.				.	
Sum,			.				.				.				.	
Mean,	7	18	25.52		7	20	43.28		7	27	0.28		7	33	5.72	
Bb,			+ 08				+ 03				+ 03				+ 02	
Ce,			− .36				− 13				− .15				+ .13	
Assume e = e + .13 Aa,	18	25	14		20	43	18				.				.	
	−1.22		− 3.14		+.57		+1.47		+.22		+ 57		+.60		+1.55	
Corr'd Transit,		18	22.00				44.65			27	0.73			33	7.42	
R. A.	7	18	7.73		7	20	20.38		7	26	46.77			32	58.29	
Error of Timepiece,			+ 14.27				+ 14.27				+13.96				+14.13	

7 18 7.73
α'−α 7 22.65

20 43.18
18 25.14
t'−t 2 18.04

a = + 4.61 / + 1.79
= + 2.58

.6637
2529
4108
.0864
4972

.411
156
1167

52

14.27
13.96
14.13
12.36

∴ 3451 = + 14.5 12

1877phae.proj.1794w

+19.0

Mauk

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 18 d. 33 1877 Instrument, RT. Observer, SW

Timepiece, 245 Recorder, SW

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	245		B13		1327		B13.	

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.	7	48	40.0	= 8	2	0.0	7	53	17.0	= 8	7	0.0
	II.	24		− 14.12			.		5	0.82			.
										+6.01			
	III.	31	48	25.88			.	7	48	16.18			.
		23	45	22.66						25.88			
	IV.	8	3	3.22			.						.
			1	19.13				∴ 1327 =		− 9.70			
	V.	8	1	44.09			.						.
Sum,				.			.			.			.
Mean,		245			1327			312			B13.		
Bb,		9	25	54.7	= 9	25	31.0	9	33	18.0	= 9	47	0.0
Cc,			26	34.7	=	26	11.0	−1	45	17.25	8	2	0.0
Aa,				− 14.1			+9.7	7	48	00.75	1	45	0.0
check				20.6		26	20.7	7	48	25.88			
Corr'd Transit,				.			.			− 25.13			.
R. A.				.			.			.			.
		245			B13.								
Error of Timepiece,		9	28	56.5	= 9	42	0.0			.			.
		24		− 14.12			.						
		33	28	42.38									

23 45 22.66

9 43 19.72

1 35.56

9 41 44.16

∴ 312 = − 25.13

B13 = + 16.1

9 33 18.0

24 + 25.13

33 33 43.13

23 45 22.66

9 49 ~~30.79~~

~~1 36.50~~

~~29.29~~

9 48 20.47

1 36.38

9 46 44.09

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March HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 18.85 1877 Instrument, Observer,

Timepiece, Recorder,

Object, Circle,								
Level Direct, Reversed,	w . .	e . .	w . .	e . .	w . .	e . .	w . .	e . .
Sums, Difference, b.	. .		. .		. .		. .	
	1327							
	h m s		h m s		h m s		h m s	
Wire, I.	20 13 18.0 =		20 25 0.0		.		.	
II.	24 +10.1		.		.		.	
III.	44 13 28.1		.		.		.	
IV.	28 45 22.7		.		.		.	
V.	20 28 05.4		.		.		.	
	3 21.2		.		.		.	
Sum,	20 24 44.2	Signal cut. at 8.30 Hm	.		.		.	
Mean,	.	−0.2	.		.	1327	.	
	1327 =		R.B.					
Bb,	.		.		21 41 32.0		.	
Cc,	21 35 31.0		.		24 +10.1		.	
Aa,	24 +10.1		.		45 41 42.1		.	
	45 35 41.1							
Corr'd Transit,	23 45 22.7		.		23 45 22.7		.	
R. A.	21 50 18.4		.		21 56 19.4		.	
	3 34.6		.		3 35.6		.	
					SR 4 3.8			
	21 46 43.8							
Error of Timepiece,	.		.		.		.	
	∴ 10 Hm. Sig. cut = +0.2				+0.2			
	1327							

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 19.85 1877 Instrument, Campaium Observer, Sw.

Timepiece, Recorder,

Object,												
Circle,												
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	1833	-9.70	.		.		.		.		.	
Difference,		.94										
b.		.47										
	1327	-11.11			BB							
	h	m	s		h	m	s		h	m	s	
Wire, I.	20	16	13.0 =		20	24	0.0				.	
	24		+11.1									
II.	44	16	24.1				.				.	
III.	23	49	19.2				.				.	
IV.	20	27	4.9				.				.	
	3	21	0									
V.	20	28	43.9				.				.	
Sum,	Signal sent at 8.30 Hm = + 0s.1										.	
Mean,			.				.				.	
Bb			.				.				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.			.				.				.	
Error of Timepiece,			.				.				.	

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 20.45 1877. Instrument, ... Observer, SW

Timepiece, Chron. Recorder, ...

		w		e		w		e		w		e	
Object,													
Circle,													
Level Direct,													
Reversed,													
Sums,													
Difference,													
b.		Bwd 312				1327				394			
		h	m	s		h	m	s		h	m	s	
Wire,	I.					11	12	39.0					
	II.	11	20	40.0						11	26	20.0	
	III.	11	24	24.0									11 30 0.0
	IV.			+ 29.43									
	V.	11h	24m	53s.43									
			12	1.97									
Sum,		11	12	51.46		11	12	51.46					
Mean,						1327 = — 12.46							
		24				1218				1327			1218
Bb,		24		53.43	=	11	30	0.0		11	12	51.46	= 11 18 0.0
Cc,		53		15.77						53		15.77	
Aa,		11	31	37.66						11	19	35.49	
			1	53 30							1	51 32	
Corr'd Transit,			29	44.36							17	44.17	
R. A.						+		15.64					+ 15.83
Error of Timepiece,		Mch 20.90								Mch 20.85			
		1327			=	1218				1327			1218

21 51 23.0 — 0.0
24 +13.0

45 51 36.0
23 53 15.8
21 58 20.2
3 36.0
55 44.2

Sig'nals sent 10 hour
— 0.52 = RB.

20 22 9.0 — 0.0
24 12.9

44 22 21.9
23 53 15.8
20 29 6.1
8 21.8
20 25 44.8

∴ Sig. sent
8.30 hour
— 0.58 = RB.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 20.45 1877 Instrument, RT Observer, SW

Timepiece, 312 Recorder, SW

Object,	35 Ursae		7 Leonis		46 Leonis		
Circle,	e		e		e		
	w	e	w	e	w	e	w e
Level Direct,	.	.	.	.	20 .5	19 .4	. .
Reversed,	.	.	.	.	20 .1	19 .8	. .
Sums,	.	.	.	.	40 .6	39 .2	. .
Difference,					39 .2		
b. = +0s.04					1.4		
					+0s.04		
	h m s		h m s		h m s		h m s
Wire, I.	.		.		.		.
II.	.		.		.		.
III.	.		.		.		.
IV.	.		.		.		.
V.	.		.		.		.
Sum,	.		.		.		.
Mean,	10 33 54.36		10 42 19.02		10 45 58.72		.
Aumer +0s.13 ce							
Bb,	+ .10		+ .03		+ .05		.
Cc,	+ .38		+ .13		+ .15		.
Aa,	33 54.84		42 19.18		+ .34		.
	-1.32 -3 43		+.53 +1.38		+.13		
Corr'd Transit,	33 51.41		42 20.56		45 59.36		.
R. A.	10 34 20.69		10 42 49.83		10 46 28.64		.
Error of Timepiece,	−29s.28		−29.27		−29.28		.

34 20.69

α'-α 8 29.14

+'+ 24 34

4.80

1.86

.6812

.3895

41 17

a = +7.58

ce

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 20. 45 1877. Instrument, RT Observer, Lw

Timepiece, 312 Recorder, Lw

Object,	~~W~~ Br 1508				χ Leonis				ψ Ursæ maj.						
Circle,	W δ = 78° 25′				W				W δ = +44° 10′						
	w		e		w		e		w		e		w		e
Level Direct,	.		.		20 · 1		19 · 8		.		.		.		.
Reversed,	.		.		.		.		.		.		.		.
Sums,	log 1.3275								31.887				1.5494		
Difference,	9.3027								3.5243				9.8482		
b.	2.0248								35.430				1.7012		
	= 1059												50.25		
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.	~~IV~~		.				.		V (I)		.				.
II.	mean		.				.		mean		.				.
III.	10	51	38.94				.		11	3	9.08				.
		− 1	45.9								− 50.25				
IV.			.				.				.				.
V.			.				.				.				.
Sum,			.				.				.				.
Mean,	10	49	53.0		10	58	11.60		11	2	18.83				.
Bb,			+ .16				+ .04				+ .06				.
Cc,			− .65				− .13				− .20				.
Aa,		49	52.5			58	11.51				− .17				.
	−2.94		8 0		+.50		+1.36		−.06						
Corr'd Transit,			44.5			58	12.87			2	18.52				.
R. A.	10	50	14.19		10	58	42.63		11	2	47.92				.
Error of Timepiece,			− 29.7				− 29.76				− 29.40				.

29.27 ε
29.28 ε
29.76
29.40
171
− 29.43 = 312

2.58
2.72
130
2.65

50 14.19
α-α 8 28.44
t-t 8 19.01
+ 9.4
+ 3.44

.9731
J-367
4054

a = + 2.72 cm

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 21. 85 1877. Instrument, Chronometers Observer, Lis.
Timepiece, Recorder,

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	8.30 Am .	.	.	.	10 Am .	.	.
Difference,								
b.	1327		B.B.		1327		B.B.	
	h m s		h m s		h m s		h m s	
Wire, I.	20 18 3.0	=	20 18 0.0		21 53 18.0 =			.
	24 +13.96			.	24 +1.40			.
II.	44 18 16.96			.	45 53 32.0			.
III.	53 57 12.92			.	23 57 12.3			.
IV.	20 24 04.64			.	21 56 19.7			.
	3 20.04			.	3 35.7			.
V.	20 17 44.60			.	21 53 44.0			.
Sum,	.			.	Signal Sent 10. Am			.
Mean,	Signal Sent 8. 30 Am = BB - 0.6			.	= BB = 0.0			.
Bb,	.			.	.			.
Cc,	.			.	.			.
Aa,	.			.	.			.
Corr'd Transit,	.			.	.			.
R. A.	.			.	.			.
Error of Timepiece,	.			.	.			.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 23.30 1877. Instrument, R1. Observer,
Timepiece, B 312 Recorder,

Object,	19 Lyncis Sup		9r 1308		α Geminor.		α Can. Min.	
Circle,	W.		W.		W. Med.		W.	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	19 .0	17.5	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b. = +0s.08								
	h m s		h m s		h m s		h m s	
Wire, I.		4.6		15 40.3		23.0		35.5
II.		42.3		38.5		48.1		57.0
III.		19.9		37.5		13.0		18.2
IV.		57.5		36.0		38.3		40.3
V.	7 13	34.8	7 19	34.5		2.2	7 33	1.5
Sum,		15 9 1		18 6 8		12 4 6		15 2 5
		31.82		37.36		24.92		30.50
Mean,	7 13	19.82	7 17	37.36		12.92	7 32	18.50
Bb,	4	+.10		+.20		+.09		+.06
Ce, c=+0s.26		−.44	7	−.69		−.30		−.26
Aa,		−.92	17	36.87			32	18.30
	−40		−122	−2.82	+22	+.57	+60	+1.39
Corr'd Transit,	13	18.62		17 34.05		12.80	32	19.69
R. A.	7 12	51.94	7 18	7.49	7 26	46.69	7 32	53.22
Error of Timepiece,		−33s.32		−33.44		−33.89		33s.53

18 7.49
14 45.73
14 41.53
+ 4.20
18.2

∴ a = +2.31

0.6232
.2601
3631

1.22
2.31
462
462
231
2.8182

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 23.30 187 . Instrument, R[illegible] Observer, Lw

Timepiece, 31 Recorder, Lw

Object,	1 Gemin		~~2 Gemin~~ 1374		Gr 1374			
Circle,	2		E. .328 9.		W. 31 51.			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	19.3	16.9	18.5	17.5	.	.
Reversed,	.	.	18.5	17.5			.	.
Sums,	.	.	37.8	34.4	.	.	.	.
Difference,			24.1					
b. +.08			3.4					
			+0s.08					
	h m s		h m s		h m s		h m s	
Wire, I.		42.0	II	18.4	IV	15.0		.
II.		5.5		30.4		28.0		.
III.		28.5		44.0		41.0		.
IV.		52.1		58.0		54.0		.
V.	7 37	15.7	7 44	10.4	7 48	6.5		.
Sum,		143.8		161.2		144.5		.
		28.76		32.24		28.90		
Mean,	7 36	28.76	7 +43	44.24	47	40.90		.
				18.36	-2	36.6		
			7 44	62.60	7 45	4.3		.
Bb,		+.09		.		2.6		.
Cc, +0.26 = cE.		+.28		.		+1.7		.
Aa,		+.71		.		½++ = +0s.85 for cE		.
a = +1.31						p .9294		
						9.48 45 = cos δ = 72°14'		
Corr'd Transit,		29.74		.		9.41 39		.
R. A.	7 29	3.21		.		∴ c = +0.26 for cE.		.
Error of Timepiece,		— 33.47		.				.

33.32
33.53
85
33.43 for c n.
33.47 " cE
— 33.45 = Sun 3/2

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 23. 45 1877. Instrument, ... Observer, Leo

Timepiece, Comp. Recorder, Leo

	w	e	w	e	w	e	w	e
Object, Circle,								
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	1327		R.B.					

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.	10	58	21.0	= 10	52	0.0			.			.
				+ 20.0			+ 20.0			.			.
	II.			.			.			.			.
	III.			.			.			.			.
	IV.			.			.	1327		.	RB		.
	V.	1327		.	312		.	~~RB~~		.	~~+329~~		.
Sum,		10	5	17.8	=		0.0			.			.
Mean,				.			+ 33.5			.			.
					= 10	5	33.5	20	42	57.0	=		0.0
Bb,				.			5 17 8			+ 16.2			.
Cc,				.			− 15.7	20	43	13.2			.
Aa,				.			.	0	5	5.4			.
					= Sum 1327			20	38	7.8			
Corr'd Transit,				.			.		3	22.8			.
R. A.				.			.	34	45	0			.
Error of Timepiece,				.			.	Signal Sent 8.20 Mer. = ~~11h~~ 1.5.0 slow					.

22 8 10.0
+16.2

22 8 26.2
5 5.4

22 3 20.8
3 36.8

44.0

∴ Signal sent 10 Mer
Sum RB = 0.5.0

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 24.45 1877. Instrument, R.T. Observer, LW

Timepiece, 3451 Recorder,

Object,															
Circle,															
	w		e		w		e		w		e		w		e
Level Direct,	.		.		.		.		.		.		.		.
Reversed,	.		.		.		.		.		.		.		.
Sums,	.		.		.		.		.		.		.		.
Difference,															
b.	1327				BB.										
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.	10	56	16.0	=	10	46	0.0				.				.
II.			.				.				.				.
III.			.				.				.				.
IV.	3451		.	=			.				.				.
V.	10	58	30.0	=	10	48	0.0				.				.
Sum,			.				.				.				.
Mean,			.				.				.				.
Bb,			.				.				.				.
Ce,			.				.				.				.
Aa,	Mch 25.80 ~~B~~		.				.				.				.
Corr'd Transit,	1327		.		394		.				.				.
R. A.	20	55	0.0	=	20	39?	0.0				.				.
Error of Timepiece,			.				.				.				.

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1877phae.proj.1794M

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 25.80 1877. Instrument, ... Observer, Lw

Timepiece, Arnpanieus Recorder, ...

Object,											
Circle,											
Level Direct,	w		e		w		e		w		e	
Reversed,												
Sums,												
Difference,												
b.												
	1327				1327 ~~B.13.~~							
	h	m	s		h	m	s		h	m	s	
Wire, I.	20	34	47.0		22	6	0.0					
			+18.1				+18.1					
II.												
	20	35	5.1		22	6	18.1					
III.		12	58.5			12	58.5					
	20	22	6.6		21	53	19.6					
IV.		3	20.2			3	35.7					
							43.9					
V.	20	18	46.4									
									Signac Lunit at 10 Am			
									1327 = +0.5.0			
Sum,												
Mean,												
	312				~~B13~~							
Bb,	20	42	0.0	=			26.0					
			+33.5									
Cc,	20	42	33.5									
Aa,		12	58.5									
	20	29	35.0									
Corr'd Transit,		3	21.4									
R. A.	20	26	13.6									
Error of Timepiece,												

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 26. 80 1877 Instrument, Observer,

Timepiece, Recorder,

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	1327		BB		1327		BB	
	h m s		h m s		h m s		h m s	
Wire, I.	20 39 39.0		= 20 20 0.0		21 8 55.0			.
	+19.1			.	+19 1			.
II.				.	21 9 14 1			.
III.	20 39 58 1			.	16 55.1			.
	16 55 1			.	20 32 19.0			.
IV.	20 23 03.0			.	3 25 4			.
V.	3 20.4			.	43.9.			.
	20 19 42.6			.		.		.
Sum,	.			.		.		.
Mean,	.			.		.		.
	Signal Sent 8.30 PM				Signal Sent 10 AM			
	= +1.4			.		+0.0		
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.		.		.		.		.
Error of Timepiece,		.		.		.		.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date,.....187 . Instrument,..... Observer,.....

Timepiece,..... Recorder,.....

Object,																		
Circle,																		
	w			e			w			e			w			e		
Level Direct,	.			.			.			.			.			.		
Reversed,	.			.			.			.			.			.		
Sums,	.			.			.			.			.			.		
Difference,																		
b.													Mch 28. d 80			Mch 28.9		
	h	m	s	h	m	s	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			.			.						1327 = 1213.				1327		.
II.			.			.	20	46	33.0				22	20	47.0			
III.			.			.			21.4						21 4			
IV.			.			.	20	46	54.4				22	21	8 4			
								24	48.2					24	48.2			
V.			.			.	20	22	6.2				21	56	20 2			
								3	20.2					3	35 6			
Sum,			.			.	20	18	46.0				21	52	44.6			
Mean,			.			.			.						.			
Bb,			.			.	Signal Sent 10hm											
Cc,			.			.	Slow 0.6											
Aa,			.			.												
Corr'd Transit,			.			.			.						.			
R. A.			.			.			.						.			
Error of Timepiece,			.			.			.						.			

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 29. 19 1877. Instrument, RS Observer, SW.

Timepiece, 2451 Recorder, SW.

Object,	δ Draco 67 26				δ Draco				δ Aquilae				α Aquilae			
Circle,	4½ 23															
	W 25 03				E				E				W			
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		19.1		18.5		.		.	
Reversed,	.		.		.		.		18.2		20.1		18.2		20.1	
Sums,	.		.		.		.		37.3		38 6		.		.	
Difference,											37.3					
b. = −0ˢ.03									−0ˢ.03		1.3					
	I	h	m	s	IV	h	m	s	h	m	s		h	m	s	
Wire, I.				.				.			.				.	
II.				.				.			.				.	
III.		19	9 (10)	43.68		19	13	30.20			.				.	
			1	50.9				57.43								
IV.		19	12	34.6		19	12	34.77			.				.	
V.				.				.			.				.	
Sum,				.				.			.				.	
Mean,				.				.	19	19	17.18		19	44	46.78	
Bb,				−.07				−.07			−.02				−.03	
				+.08				−.08			−.08				+.03	
Ce, +0.03 c W										19	17.13			44	46.78	
Aa,				.		19	12	34.62		12	34.62			12	34.62	
		−1.10							+.64		+12.09		+.58		+1.68	
Corr'd Transit,				.				.		19	19.82			44	48.46	
R. A.		19	12	30.44					19	19	18.64		19	44	47.59	
Error of Timepiece,				.				.			+1.18				+0.87	

Cn δ Draco δ = 9.5838
1.6285
2.0447 = 110ˢ.9

2) 0ˢ.17
0ˢ.08

1.3275
1.7437 = 55ˢ.43

2.9083
9.5833
2.486
+0.03 for C W

3451
+1.18 (E)
+0.87 (W)
205
+1.02 = 3451

19 12 30.44
6 48.20
6 42.51
+5.69
I. a = +1.74

19 12 30.44
32 17.15
32 12.16
4.99
W. a = 1.66

C E a = +3.27
C W a = +3.01

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 29.80 Mch 1877. Instrument, RA Observer, Lw.

Timepiece, 3451 Recorder,

		w		e		w		e		w		e	
Object,													
Circle,													
Level Direct,													
Reversed,													
Sums,													
Difference,													
b.		3451				BB.				1327			
		h	m	s		h	m	s		h	m	s	
Wire,	I.	19	29	33.5	=	18	58	0.0		19	32	15.0	=
	II.			1.02							3	0.49	
	III.	19	29	32.48						19	29	14.51	
	IV.		28	44.75						19	29	32.48	
	V.	19	0	47.63						1327	=	17.97	
			3	6.78									
Sum,		18	57	40.85				40.9		19	32	15.0	
								+ 19.1			+	18.0	
Mean,										19	32	33.0	
											28	44.8	
Bb,										9	03	48.2	
Cc,											3	7.3	
Aa,											0	40.9	
Corr'd Transit,													
R. A.		312.				BB.							
Error of Timepiece,		19	38	0.0	=	19	7	0.0					
			9	1.48		18	58	0.0					
		19	28	58.52									

3451 = 19 29 32.48

35.96

19 38 34.0

28 44.8

19 9 49.2

3 8.3

19 6 40.9

BB = + 19.1

21 5 49.5

− 1.0

21 5 48.5

28 44.8

20 37 03.7

3 22.6

3 41.1

18.9

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1877phad.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 29.92 1877. Instrument, Trans. Observer, ...

Timepiece, ... Recorder, ...

Object,												
Circle,												
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.	1327				BB.							
	h	m	s		h	m	s		h	m	s	
Wire, I.	22	18	45.0		29	47	0.0				.	
II.			+18.0				.				.	
III.	22	18	63 0				.				.	
IV.	21	50	18.2				.				.	
V.	21	46	43.6				.				.	
Sum,			.				.				.	
Mean,			.				.				.	
	1436 = +1 5 2 7 BB											
Bb,	312		0.0		= 21	48	31.4				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			30.0		21	52	0.0				.	
R. A.			.		21	51	42.6 = m.t.				.	
					21	52	18.1					
Error of Timepiece,			.		21	28	02.9				.	

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 30/30 1877. Instrument, ... Observer, SW

Timepiece, Chronometers. Recorder, SW.

		w	e	w	e	w	e
Object,							
Circle,		3451 = +0.79					
Level Direct,							
Reversed,							
Sums,							
Difference,							
b.		1327		BB		3451	312

		w h	w m	w s	w h	w m	w s	w h	w m	w s	w h	w m	w s
Wire,	I.				7	8	0.0 =	7	41	36.5 − 0.79			
	II.	7	42	17.0 =	7	9	0.0	7	41	35.71			
	III.	7	41	35.71	7	11	0.0						2.0
	IV.	7	42	35.87									
	V.	∴ 1327 = −		18.5 87	7	14	0.0 =	7	47	37.5	7	41	35.71
												3	0.49
Sum,											7	44	36.20
Mean,					8	12	0.0 =	8	45	47.0		2	00
													34.20
Bb,					1	4	0.0 =	1	4	10.5			
Cc,							+ 10.5						
Aa,								7	41	35.71			
									32	41.30			
Corr'd Transit,								7	8	54.41			
R. A.									1	10.26			
					7	8	0.0	7	7	44.15			
Error of Timepiece,					∴ BB = +		15.85						

BB

1327

7 42 17.0
+ 18.9
7 42 35.9
32 41.3
N 17.2
7 9 54.6
1 10.4
7 8 44.2

∴ BB = +15.58

7 10 44.15 =
1 10.66
32 41.30
7 44 36.11

312

7 44 2.0
+ 34.11
7 44 36.11
32 41.3
7 11 54.8
1 10.7
7 10 44.1

∴ BB = +15.9

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 30.33 187 . Instrument, Observer, SW

Timepiece, 3451 Recorder, SW

Object, Circle,	β Cancri W		31 Lyncis W		o Ursae W		Gr 1446 W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	19 : 0	18 : 7
Reversed,	.	.	.	.	.	.	20 . 0	17 . 8
Sums,	.	.	.	.	.	.	39.0	36.5
Difference,							26.5 / 2.5	
b. +0ˢ.06							+0ˢ.06	
	h m s		h m s		h m s		h m s	
Wire, I.		9.6		29.1		—	II	24.5
II.		30.7		58.5		—		37.3
III.		52.3		27.7	8 20	6.8		50.7
IV.		14.1		57.2		50.8		3.7
V.	8 10	35.7	8 15	26.7	4	35.0	8 25	16.0
Sum,		142.4 / 28.48		199.2 / 39.84		.		132.7 / 26.44 / 22
Mean,	8 9	52.48	8 14	27.82		.	8 24 +1	50.44 / 17.31
Bb,		+.05		+.08		.	8 26	07.80
Cc, +0.03 cor		+.03		+.04		.		+.19
Aa,	9	52.56				.		+.18
	+.55	+.72	−.03	−.04		.	8 26	8.17.0
							−1.90	−2.47
Corr'd Transit,	9	53.28	14	27.90		.	26	5.69
R. A.	8 9	52.33	8 14	27.09		.	8 26	4.87
Error of Timepiece,		+1.95		+0.81		.		.76

W .95 .81 .71 .68 = 31.5

E .71½ .68

∴ 3451 = +.79

8 26 4.87
9 52.33

α'−α 16 12.54
t'−t 16 15.84

a = C n = −3.00 / −1.90 − .55 = +1.22 / 1.37

∴ a = +1.30

Gr = 74° 3' = 9.43901
1.32752
1.88851

77.36
1.62855

2.18954
15472

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1877phae.proj.1794

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 30. 33. 187 . Instrument, RT Observer, SW

Timepiece, 345 Recorder,

Object,			α Pr 1446			δ Cancri			ε Hydrae			
Circle,			E			E			E			
	w		e		w		e		w		e	
Level Direct,	20.0		17.8		.		.		.		.	
Reversed,					.		.		.		.	
Sums,												
Difference,												
b. +.06												
	h	m	s		h	m	s		h	m	s	
Wire, I.	V		126.5				58.6				34.6	
II.			30.2				21.2				56.1	
III.			43.0				43.8				17.4	
IV.			55.5?				6.2				38.7	
V.	8	29	8.5?		8	38	28.5		8	41	0.2	
Sum,			1537 / 30.724 / 12				1583 / 31.66 / 12				1470 / 2940 / 12	
Mean,	8	28	42.74		8	37	43.66		8	40	17.40	
Bb,		−2	24.72				+.06				+.05	
	8	26	8.02				−.03				−.03	
Cc, — 0.03 c e			+.19						8	40	17.42	
			−.11									
Aa,	8	26	8.10				+.60				+.75	
			−2.47		+.46				+.18			
Corr'd Transit,			5.63			37	44.29			40	18.17	
R. A.	8	26	4.87		8	37	43.58		8	40	17.49	
Error of Timepiece,			+.76				+.71				+.68	

7.80
+0.22
½ ·+0.11

9.0412
9.4390
8.4804
+.03 fr cm.

d-d 14 12.62
t-t 14 9.32
+3.40 = +1.37
+248

C.E. d =

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 30. 83 1877. Instrument, R1 Observer, Lw

Timepiece, Compariom Recorder, Lw

Object,															
Circle,															
	w		e		w		e		w		e		w		e
Level Direct,	.		.		.		.		.		.		.		.
Reversed,	.		.		.		.		.		.		.		.
Sums,	.		.		.		.		.		.		.		.
Difference,															
b.	1327				BB				312						
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.	20	57	26.0	=	8	22	0.0								
II.			+18.37						21	0					
			+ .37		8	22	0.0	=	0	0	12.0				
III.	20	57	44.74								+34.2				
IV.		32	41.30						21	0	46.2				
V.	20	25	3 44							32	41.3				
			3 20.7						20	28	04.9				
										3	21.2				
Sum,	20	22	42.7						20	24	43.7		0	32	45.19
														3	89
Mean,	Signal sent at 8.30 Mm = +1s												0	32	41.30
Bb,															
Cc,															
Aa,															
	1327				BB				312						
Corr'd Transit,	22	22	41.0	=	9	47	0.0								
			+18.57								+34.15				
R. A.	22	22	59.57												
		32	41.30												
Error of Timepiece,	21	50	18.27												
		3	34.64												
	21	46	43.63												

2451

Sun sent +0s.4

10 Mm.

0.0 = 10 32 4.0
−0.5
22 32 3.5
32 41.3
21 59 22.2
3 26.1
21 55 46.1

312 2451

23 5 24. = 23 6 0.0

BB

22 32 0.00 23 8 10.0

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 31. 33 1877. Instrument, RT Observer, SW

Timepiece, 345 Recorder,

Object,	J Cancri										
Circle,	W.			W							
	w		e		w		e		w		e	
Level Direct,	18	.0	18	.2	18	.0	18	.0	.		.		.		.	
Reversed,									.		.		.		.	
Sums,	.		.		.		.		.		.		.		.	
Difference,																
b.																
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.			1	.6			.				.				.	
II.			23	.8	Missed, many seconds						.				.	
III.			46	.5			.				.				.	
IV.			8	.7			.				.				.	
V.	8	38	31	.3			.				.				.	
Sum,			.				.				.				.	
Mean,			.				.				.				.	
Bb,			.				.				.				.	
Cc,			.				.				.				.	
Aa,			.				.				.				.	
Corr'd Transit,			.				.				.				.	
R. A.			.				.				.				.	
Error of Timepiece,			.				.				.				.	

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 1. 1877. Instrument, Transit Observer, Lin

Timepiece, Hartnett Recorder,

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	1327 .		312 .		. .		. .	
Difference,	Δt = + 19.37		Δt = + 54.36					
b.	1327				312		BB	
	h m s		h m s		h m s		h m s	
Wire, I.	20 21 12.0		.		20 54 6.0		= 20 11 0.0	
	+ 19 37				+ 34 36			
II.	20 21 31.37		.		20 54 40.36		.	
III.	40 24.41		.		40 24.41		.	
IV.	19 40 56.96		.		20 14 5 95		.	
	3 13 46				3 18.89			
V.	19 37 43.50		.		20 10 47.06		.	
Sum,	.		.		.		.	
Mean,	Signal sent P. Jones		.		.		.	
Bb,	+ 0.5		.		.		.	
Cc,	.		.		.		.	
Aa,	1327 .		.		.		.	
	22. 42 35.5							
Corr'd Transit,	+ 19.4		.		.		.	
R. A.	22 42 54.9		.		.		.	
	46 34.4							
Error of Timepiece,	22 02 20.5		.		.		.	
	3 36.5							
	22 59 44.0							

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 2. 85 1877. Instrument, ... Observer, DW

Timepiece, Chronometer. Recorder, ...

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		.	.	.	.	.	.	.	.
Reversed,		.	.	.	.	.	.	.	.
Sums,		.	.	.	.	.	.	.	.
Difference,									
b.		1327		BW3		1327		R.B.	
		h m s		h m s		h m s		h m s	
Wire,	I.	21 10 16.0		20 23 0.0		22 47 32.0			.
	II.	+ 19.8			.	+ 19.8			.
	III.	21 10 36.8			.	22 47 51.8			.
	IV.	44 31.0			.	44 31.0			.
	V.	20 26 4.8			.	22 3 20.8			.
		3 20.9			.	3 36.8			.
						44.0			.
Sum,		20 22 43.95			.		.		.
Mean,		Signal Clock			.	Sig. Clock			.
		± 0.0 8.30 from				10 Am			
Bb,			.		.		.		.
Cc,			.		.	± 0.0	.		.
Aa,			.		.		.		.
Corr'd Transit,			.		.		.		.
R. A.			.		.		.		.
Error of Timepiece,			.		.		.		.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 3. 30 1877 Instrument, RT Observer, SW

Timepiece, 345 Recorder, SW

Object,	β Cancri						31 Lyncis						Gr 1446					Gr 1446				
Circle,	rr						rr						rr					Ee 328 20				
	w			e			w			e			w			e		w			e	
Level Direct,	.			.			.			.			18·6			18·0		.			.	
Reversed,	.			.			.			.			19·3			17·2		.			.	
Sums,	.			.			.			.			37·9			35·2		.			.	
Difference,													1·3									
b. +0ˢ·07													27									
	h	m	s				h	m	s				h	m	s			h	m	s		
Wire, I.			.						55·4				II		52·3			IV		45·5		
II.			57·3						25·3						4·7					58·7		
III.			11·6						54·3						17·8					11·5		
~~IV~~ V.			18·6						24·0						30·6					24·5		
V.	8	9	26·0				8	14	53·2				8	24	43·8			8	28	37·3		
			40·2																			
			15 3 7						21 2 2						12 9 2					1 27 5		
Sum,			3,20 74						42 42						29·84					35·50		
															12							
Mean,	8	9	18·74				8	13	54·44				8	24	17·84			8	28	11·50		
Bb,			+·06						+·10				8	+1 25	17·41			8	−2 25	34·83		
Cc,			+·24						+·28						35·25					36·67		
			19·04						.						+ 2·17					+ 2·17		
Aa,	+55.		+ 1·46				−53		−·08				−1·90		+ ·73					− ·73		
															25 38·15					25 38·11		
Corr'd Transit,		9	20·50					13	54·74				Assume: t =		38·13			8	25	38·18 + te		
R. A.	8	9	52·25				8	14	26·99				8	26	32·41 4·83				25 26	5·45 33·08 4·83		
Error of Timepiece,			− 31ˢ·75						− 32·25				(Ee)		32·42			(Cm)		− 31·75		

0.452
1·740 ·192
2·477 ·929
·279 ·731
634 086
415ⁿ ·867

α′ − α 16 12·58
t′ − t 16 19·09
− 6·51
−1·90 − 55 =

2.45 | 6.57 | 2ˢ.66
490
1610
1470
1400

+ 2ˢ·66 Cm (?)
+ 3·00 C Ee
assume + 2ˢ·83 = a.z.

Ar 74° 8′ 41″ = 9.72871
1.62855
1.32752
2·18984 = 154.83
1·88881 = 77.41
T·8513
9·2900 = +0ˢ.1950 Cm
= +0ˢ.20

3.10
7
21.7

25 35.25
+ 1.42
+0ˢ.71

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 3.30 1877. Instrument, RT Observer, SW

Timepiece, 345 Recorder, SW

Object,	δ Cancri		ι Cancri								
Circle,	E		E 13 11								
	w	e	w	e	w	e	w	e			
Level Direct,	19.3	17.2	.	.	.	.	.	.			
Reversed,			.	.	.	.	.	.			
Sums,	.	.	.	.	.	.	.	.			
Difference,											
b.											
	h m s		h m s		h m s		h m s				
Wire, I.		24.8		27.9		.		.			
II.		47.5		55.9		.		.			
III.		10.1		43.8		.		.			
IV.		32.6		52.1		.		.			
V.	8 37	54.8	8 39	0.3		.		.			
Sum,	8	169.8 33.96 24		160.0 32.00 12		.		.			
Mean,	8 37	9.96	8 38	44.00		.		.			
Bb,		+.07		+.08		.		.			
Ce,		−.21		−.05		.		.			
Aa,	37	9.82				.		.			
	+.43	+1.29	+.76	+.74		.		.			
Corr'd Transit,	37	11.~~04~~ 11	38	44.77		.		.			
R. A.	8 37	43.54	8 39	17.18		.		.			
Error of Timepiece,		−32.~~50~~ 43		−32.41		.		.			

α-α 11m 38s.71
t'-t 11 37.69
233) 7.02 (3.01
699
~~336~~
0300

1.90
43
2.33

Ce	Cm
−32.25	32.43
−31.75	32.41

32.25
31.75
32.43
32.41
84
32.21 = Error 3451

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr. 3. 30 1877. Instrument, Transit. Observer, [illegible]

Timepiece, [illegible] Recorder, LW

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	1327		BB		3451		312	
	h m s		h m s		h m s		h m s	
Wire, I.	9 67 13.0		= 8 8/13 0.0			.		.
II.		.		.		3.0		.
III.		.	8 18	0.0 =	9 7	+ 32.4		.
IV.	9 7 35.4			.	9 7	35.4		.
V.	— 22.4			.	0 48	27.5		.
Sum,		.		.	8 19	07.9		.
					1	21.8		
Mean,		.		.	8 17	46.1		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
	Error 312 = −32.0							
Corr'd Transit,		.		.		.		.
R. A.		.		.		.		.
Error of Timepiece,		.		.		.		.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr. 3-85 1877. Instrument, ... Observer, ...
Timepiece, Cmp. Recorder, Lw.

Object,																
Circle,																
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.		.		.	
Sums,	.		.		.		.		.		.		.		.	
Difference,																
b.	1327				R10											
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.	21	19	13.0	=	20	28	0.0				.				.	
II.	21	18	13.0	=	20	27	0.0				.				.	
III.		+	22.9				.				.				.	
	2118		35.9				.				.				.	
IV.		48	27.5				.				.				.	
V.	20	30	8.4				.				.				.	
		3	11.5													
Sum,	20	26	46.9		Rail flow 2.9						.				.	
Mean,			.								.				.	
	∴ Signal sent at 8.30 Rail flow 2.0															
Bb,			.				.				.				.	
Ce,		1327					.				.				.	
Aa,			.				.				.				.	
	22	50	76.0													
		+	23.0													
Corr'd Transit,			.				.				.				.	
R. A.	22	50	49.0				.				.				.	
		48	27.5													
	22	2	21.5													
Error of Timepiece,		3	26.6				.				.				.	
			44.9		Rail flow 0.9 = Eur 10.30 AM.											

34 ST.

R13.

23	6	20.5 =	22	15	0.0	
			1327			
23	8	17.0 =	23	8	25.0	
			312			
23	9	1.5 =	23	9	0.0	

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr. 4. 85 1877. Instrument, ... Observer, ...

Timepiece, Amp. Recorder, DW.

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.								
	h m s		h m s		h m s		h m s	
Wire, I.	8.30 Unable to make the line mine - Molingual.							
II.	.		.		.		.	
III.	14 26 = .		50.+13 = .	55.2				
IV.	.		.		.		.	
V.	.		.		.		.	
Sum,	.		.		.		.	
Mean,	.		.		.		.	
	22 13 14.5				22 50 14.80			
Bb,	24.0		.		3.9		.	
Cc,	22 13 38.5		.		22 50 10.9		.	
Aa,	0 52 24.1		.		.		.	
	21 21 14.4				0 52 28.8			
Corr'd Transit,	3 29.9		.		3.9		.	
R. A.	21 18 44.5		.		0 52 24.1		.	
Error of Timepiece,	.		.		.		.	

22 48 20.0
23.9
22 48 43.9
52 24.1
21 56 19.8
3 35.6
58 44.2

∴ Clock slow 0s.2

1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr. 5. 85 1877. Instrument, ... Observer, Lit.

Timepiece, Amp. Recorder, ...

Object,											
Circle,											
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.		.		.	
Sums,	0	56	24.52		.		.		.		.		.		.	
			3.89													
Difference,	0	53	20.63		.		.		.		.		.		.	
b.	1327				BB.											
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.	21	20	0.0	=	20	21	0.0				.				.	
			+ 24.4													
II.	21	20	24.4				.				.				.	
III.	0	56	20.6				.				.				.	
IV.	20	24	3.8				.				.				.	
		3	30.5													
V.	20	30	43.3				.				.				.	
Sum,	8.30 Am Signals Rec'd, Flash 0.5.7										.				.	
Mean,											.				.	
Bb,	10. Am Signals sent Flash 0.5.3 (sent by A.S.)															
Cc,			.				.				.				.	
Aa,			.				.				.				.	
Corr'd Transit,			.				.				.				.	
R. A.			.				.				.				.	
Error of Timepiece,			.				.				.				.	

8.30
5.25
2.55
2 1/2 @ 0.8
2.0

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr. 6. 33 1877. Instrument, RT Observer,
Timepiece, 345 Recorder, EW.

Object,	1 Hydrae		11 Hydrae		Gr. 1564		ε Serpentis	
Circle,	E		W.		W		W	
	w	e	w	e	w	e	w	e
Level Direct,	19:0	17:5	17:8	18:5	18:5	18:1	.	.
Reversed,			18.5	18 1				
Sums,	18.2	18.3	16.3	16 6	.	.	37 4	.
Difference,	19.2	17.3	18.2	18.3			35.6	
b. = +0.045	37.4	35.6					1.8	
							∴ 7 = 2.05 + .045	
	h m s		h m s		h m s		h m s	
Wire, I.	III 18 32.5		V 36.5		24.3?		43.6	
II.	57.3		1.5		IV 3 29.5		6.8	
III.	19 23.5		24 26.4		IV 5 49.6		30.1	
IV.	47.5		57.2		clouds .		53.7	
V.	9 20 12.8		9 25 16.1		.		9 39 1.6.8	
Sum,	17 3.5		131 7		.		151 D	
	3 4 7 2		26.34				30.20	
Mean,	9 19 12 23.72		9 24 26.34		.		9 38 30.20	
	+ 0.25		−5 0171					
Bb,	+1.46		9 19 25.63		.		+ .05	
Cc,	19 24.43		+ .25		.		− .26	
Aa,	.		− 1.46		.		9 38 30.00	
			19 19 24.42				+.35 + 1.00	
Corr'd Transit,	.		.		.		9 38 31.00	
R. A.	9 19 34.75		.		.		.	
							9 38 54.34	
Error of Timepiece,	.		.		.		− 23.34	

Reg Obs. 7.501 cw.

81 52 20
42 22 48
390 29 32
Φ 0
Sin = 9.80343
Cos 9.88746

h Φ-δ = 9.8034
0.8496
0.6530
9.8875
0.8496
0.7371

δ 1 Hydrae = 81° 52' 20.4
Sin = 9.99561
Cos = 9.15040

1.62855
0.84960
247 815
300.71

Coll 9 19 25.63 cw.
19 22.72 CE
1/2 2.91 = 1.46 = D.1644
9.1504
9.3148

∴ Coll = + 0.206 for CE.

1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr. 6. 33 187 . Instrument, Observer, DW

Timepiece, 3451 Recorder,

Object,	ν Serpis			19 Sco. Nun			η Serpis			ζ Serpis									
Circle,	W			W			E			E									
	w		e	w		e	w		e	w		e							
Level Direct,	.		.	.		.	19	0	19.5	.		.							
Reversed,	.		.	.		.	19	5	17.0	.		.							
							19	0	17.4										
Sums,	.		.	.		.	.		.5	.		.							
Difference,	√								9										
b.							E	19	2	17.3									
	h	m	s	h	m	s	h	m	s	h	m	s							
Wire, I.	II$_5$		28.3			29.6			30.7			.							
II.	III$_1$		42.4			38.9			52.9	IV$_3$		48.7							
III.			6.3			48.4			15.1	V$_1$		3.0							
IV.	V$_1$	43	.			58.0			37.3			17.5							
V.			.	9	50	7.6	10	1	0.0	V$_5$									
						182.5			136.0										
Sum,			.			36.50			27.20										
Mean,			.	9	49	48.50	10	0	15.20										
Bb,			.			+.06			+.01										
Cc,			.			−.27			+.25										
Aa,			.				10	0	15.46										
				+.03		+.09	+.45		+1.28										
Corr'd Transit,			.		49	48.38		0	16.74										
R. A.			.	9	50	11.64	10	0	39.76										
Error of Timepiece,			.			−23.26			−23.02										

Wdraco.

Log A = 0.6530
B = 0.7371
C = 0.8496.

A = 4.498
B = 5.459
C = 7.076

41 38
42 23
0° 45'

α2. 10. 0 39.76 — 9 38 54.34
9 19 34.75 — 19 34.75
ζ-ζ 41 5.01 — ζ-ζ 19 19.59

10 0 15.46 — 9 38 30.00
19 24.42 — 19 24.42
t'-t 40 51.04 — t'-t 19 5.58

∴ cε, a = +13.97 / (4.50+45) = 13.97 / 4.95 — +14.01 / (4.50+35) = 14.01 / 4.85

Adopted a = +2.85

∴ a cε = +2.82 — 1.14.53, .09 46, 0.4507 — .1464, 6857, 0.4607
∴ a cπ = +2.89

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr 6.35 1877. Instrument, RT Observer, [illegible]

Timepiece, 3451 Recorder, [illegible]

Object, λ Urs Maj

Circle, E

	w	e	w	e	w	e	w	e
Level Direct,	19.0	17.4	.	.	.	.	.	.
Reversed,			.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.			3451		312			

	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			21.5	10	14	38.0	=10	14	30.0			.
II.			51.0	10	15	−8.0	=10	15	0.0			.
III.			20.2			.			.			.
IV.			49.8			.			.			.
V.	10	10	19.2			.			.			.
Sum,			161.7			.			.			.
Mean,			32.34			.			.			.
	10	9	20.34									
Bb,			+.06			.			.			.
Ce,			+.28			.			.			.
Aa,	−.03		−.09			.			.			.
Corr'd Transit,		9	20.59			.			.			.
R. A.	10	9	43.38			.			.			.
Error of Timepiece,			−22.79			.			.			.

43 31
42 .22
8
52

C n &

C n = −23.34
−23.26

C s = −23.02
−22.79
141

i 3451 = −23.10 at 6h.35

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr. 6. 35 1877. Instrument, Comp. Observer, LAM.
Timepiece, Recorder,

		w	e	w	e	w	e
Object, Circle,							
Level Direct, Reversed,							
Sums, Difference, b.		1327		1313		3451	312
		h m s		h m s		h m s	h m s
Wire,	I.			9 18 0.0	=	10 19 9.0	
	II.	10 20 8.0	=	9 19 0.0			
	III.						
	IV.			9 23 0.0	=		10 24 2.0
	V.			9 25 0.0	=	10 26 10.2	
Sum, Mean,		1327		312		3451	
Bb,		10 20 8.0		10 24 2.00		10 19 9.0	
		+ 24.26		+ 30.92		+ 23.10	
Cc,							
Aa,		10 20 32.26		10 24 32.92		10 19 32.10	
		1 0 17.18		1 0 17.18		1 0 17.18	
Corr'd Transit, R. A.		9 20 15.08		9 24 15.74		9 19 14.92	
		1 31.78		1 32.44		1 31.61	
Error of Timepiece,		9 18 43.30		9 23 43.30		9 18 43.31	
		19 0.00		23 0.0		18 0.0	

10 19 9.0
+ 23.10
10 14 32.10
1 0.16
10 20 32.26
20 8.00
∴ 1327 = 24.26

10 19 32.10
5 0.82
10 24 32.92
24 2.00
∴ 312 = −30.92

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 6. 8 5 Apr. 1877. Instrument, Transit. Observer, ...

Timepiece, ... Recorder, ...

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	BB		1327		312			
	h m s		h m s		h m s		h m s	
Wire, I.	20 21 0.0	=	21 23 56.0			.		.
			+ 24.7					
II.		.	21 24 20.7			.		.
III.		.	1 0 17.2			.		.
IV.		.	20 24 3.5			.		.
			3 20.5					
V.	20 43.0		20 20 43.0			.		.
	17.0							
Sum,				.		.		.
Mean,	1. BB = +1.00 at 8.30 AM			.		.		.
Bb,	10 AM.	.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
	21 44 0.0				22 47 4.0			
					+ 31.1			
Corr'd Transit,		.		.	22 47 35.1			.
R. A.		.		.	1 0 17.2			.
	21 46 0.0	=	22 49 8.0		21 47 17.9			
			+ 24.6		3 34.2			
Error of Timepiece,		.	22 49 32.6		43 43.7			.
			1 0 17.2					
			21 49 15.4					
			3 24.5					
			21 45 40.9					
			23 2 12.0					
			+ 24.6					
			23 2 36.6					
			1 0 17.2					
			22 2 19.4					
			3 36.6					
			21 58 42.8					

Signal Rock
= +0.3 at 10 AM
Depends on 312.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr. 8. 85 1877. Instrument, RT Observer, [illegible]

Timepiece, 3451 Recorder, [illegible]

Object, Circle,								
Level Direct, Reversed,	w	e	w	e	w	e	w	e
Sums, Difference, b.	8.30 AM BB		1327		312		10 AM 1327	
	h m s		h m s		h m s		h m s	
Wire, I.	28 19 0.0 =		21 29 46.0				23 8 4.0	
II.			+ 25.8		21 40 0.0		+ 25.8	
III.			21 30 11.8		+ 31.8		23 8 29.8	
IV.	20 29 14.0 =				21 40 31.8		1 8 10.3	
V.	1		1 8 10.3		1 8 10.3		22 0 29.5	
			20 22 01.5		20 32 21.5		3 30.8	
Sum,			3 20.2		3 21.9		21 56 43.2	
Mean,			20 18 41.3		20 28 59.6			
			19 0 0		29 140			
Bb,			+ 18.7		+ 14.4		Signals sent at 10 AM =	
Cc,							+ 0.58	
Aa,								
Corr'd Transit, R. A.								
Error of Timepiece,	21		21 48 59.2					

6.35 = − ~~24.26~~ 23.10

3.30 32.21

3 | + 9.11

3.04

231 / 7.6 / 15.5

2 / 6.08 / 1.5 / 7.6

+ 15.5

21 49 14.7

1 8 10.3

20 41 4.4

3 23.3

20 38 41.1

5

+ 18.9

3451 = +10s / 1327.

+ 25.8

+ 10

∴ − 35.8 = Sun's R.A. 1 9h 8.85

− 23.1 = " " Apr 6.35

12.7

∴ + rate = + 3.12

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1877phae.proj.1794w

Comparisons for bringing Bond 394 to running in mean time.

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

clock reading from Bond time and set up in Bruner Clock

Date, Apr 7, 3 187 . Instrument, 3451 Observer,

Timepiece, 394 Recorder,

Object, Circle,	3451		394		3451		394	
	w	e	w	e	w	e	w	e
Level Direct, Reversed,	. .	. .	. .	. .	. .	. .	. .	. .
Sums,	22 36.5		0 18 30.0		B, A,			
Difference,	30 7.0		26 0.0					
b.	7m 20.5		= 7 30.0					
	h m s		h m s		h m s		h m s	
Wire, I.	∴ 394 = + 7s fm Xmn.				6 11 40.0		0 5 28.	
II.	Sound bob = 5 secs.				22 18 0		= 16 0.0	
III.					10 33.0		= 10 32.0	
IV.	Magnet 0m.1 fm coil				0 1.7			
V.	5 38 8.5		= 0 33 0.0		10 31 3		= ∴ Bond 394	
Sum,	46 40.0		41 30.0				= +0s.7 in 15m.5	
Mean,	8 31.5		8 20.0		$B_3 A_3$			
	1.4							
Bb,	8 20.1		= 8 30.0		32 5.0		= 25 44.0	
Ce,								
Aa,	49 10.5		= 44 0.0		19 47.0		= 19 44.0	
	11 2.0		11 0.0		1.5			
Corr'd Transit,	0 1.8				9 45.5		= −1.5 in 19m.7	
R. A.	11 0.2							
Error of Timepiece,	∴ 394 = − 0s.1 in 5m				6 34 21.5		= 28 0.0	
	Mean Mag 0m.5 fm Coil				22 18.0		= 16 0.0	
					12 3.5		= 12 0.0	
					2.0			
					$B_3 A_3$ 12 1.5		= 12 0.0	
					B, A_1 10 31.3		= 10 32.0	
					$B_2 A_2$ at 38m 30s			
					39m 42.5		= 33 20.0	
					47 6.0		= 40 42.0	
					7 23.5		= 7 22.0	
					1.21			
					7 22.9			

and rain bob = ½ sec.

5 56 14.0 = 0 50 0.0

1 15.0 = 55 0.0

5 1.0 =

0.9 (?)

5 0.1

∴ 394 = − 0s.1 in 5 min (?)

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr 7.4 1877 Instrument, Observer,

Timepiece, Recorder,

Object, Circle,	Raised bob 1 rev.														
	w		e		w		e		w		e		w		e	
Level Direct, Reversed,	. .		. .		. .		. .		. .		. .		. .		. .	
Sums, Difference, b.	. .		345 1		. .		394		. .		. .		. .		. .	
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.	7	0	1.5	=	1	52	26.0				.				.	
II.	7	36	41.5	=	2	29	0.0				.				.	
III.			.				.				.				.	
IV.		36	40.0			36	34.0				.				.	
V.			5.90				.				.				.	
	36	34	.10	=	36	34	0.0				.				.	
Sum, Mean,	∴ 394 is losing 0.10 in 36.5 m										.				.	
	Raised pend. ¼ turn.															
Bb,	.						.				.				.	
Cc,	.						.				.				.	
Aa,	.						.				.				.	
	9	17	57.5	=	8	13	0.0				.				.	
Corr'd Transit, R. A.	21	57	12.0	=	20	48	0.0				.				.	
	12	37	14.5	=	12	35	0.0				.				.	
		2	4.05													
Error of Timepiece,	.						.				.				.	
	12	35	10.45	=	12	35	0.0				.				.	

+0.1 (−) Screw 5 revs,

− 0.02 + ½ rev.

− 0.04 = ——

− .125 = − 7.5 per turn B_3 A_3

= +7.5 " " B_1 A_1

Raised bob 1 rev. etc

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1877phae.proj.1794w

70 Adjustment of pendulum of Bnd 394.

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr. 8. 85 1877. Instrument, Chr 3451 and Bnd 394 Observer, [illegible]

Timepiece, Recorder, [illegible]

Object, Circle, 3451 is gaining 0s.01 in 5 minutes. = 3s.2 per day (+)

	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	3451		BB		3451	=	BB.	

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.	22	13	3.0	= 21	1	32.0	22	47	54.5	= 21	34	0.0
	II.	21	55	12.0	= 20	48	0.0	23	15	59.5	22	20	0.0
	III.	24h	17m	51s.0	= 24	13	32.0			28m 5s.0			28m 0s.0
	IV.			− 3.2						28m 4s.94			
	V.	24	17	47.8						0 4.60			
			3	55.9						28 0.34			
Sum,		24	13	51.9				∴ 394 = −0s.1 in 10m					
				32.0									
Mean,				19.9	∴ BB loses 0s.83			Raise Bob 3/8 of a turn					
Bb,				24.0	per hour.			and set the magnet centrac					
Cc,								to its arm.					
Aa,		24) 199 (.83											
		192											
		70											
Corr'd Transit,								23 31 37.5	= 22	15 10.0			
R. A.		Raised bob 1 rev. and measured						23 41 29.0	= 22	25 0.0			
Error of Timepiece,		distance from brass end of magnet to civil to 0mst.025.						9m 41s.5		9 50s.0			
								1.47					
								9 40.03					

22 30 31.0 = 21 17 10.0

22 40 22.5 = 21 27 0.0

9m 51s.5 9 50.0

−.02

9 51.48

1.61

∴ 394 = +0s.1 in 10m 9 49.87 = 9 50.0

Lowered the bob 3/4 rev.

23 52 31.0 = 22 36 0.0

20m 53s.5 20 50.0

−.04

20 53.46

3.42

20 50.04 = −0s.12 per hour

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1877phaet.proj.17040

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 9.5 20 1877. Instrument, Observer,

Timepiece, Recorder,

		w	e	w	e	w	e
Object, Circle,						16	
Level Direct, Reversed,							
Sums, Difference, b.		3451		394		Sound Magnit about ½ in: $A_3 B_3$	
Wire,	I.	h m s		h m s		h m s	h m s
	II.	28 48 50.5		27 31 30.0		6 18 23.0	5 5 30.0
	III.	23 52 31.0		22 36 0.0		6 33 15.5	5 20 20.0
	IV.	4h 56m 9.5s		4h 55m 30s.0		14 52.5	14 50.0
	V.	− 6				− .03	
		4 56 18.9				14 52.47	
		0 48.6				2.43	
		4 55 30.3		m 5m = 0s.06		14 50 04	
Sum,							
Mean,		$A_1 B_1$				$A_1 B_1$	
Bb,		5 29 45.5		= 4 17 0.0		7 55 13.5	= 6 42 0.0
Cc,		6 33 15.5					5 20 20.0
Aa,		5 41 47.5		= 4 29 0.0		1 21 58 0	= 1 21 40.0
Corr'd Transit, R. A.		12 2.0		12 0.0		− .16	
		12 1.98				1 21 57.84	
		1.97				13 42	
Error of Timepiece,		$A_1 B_1$ 12m 0s.01		= 12m 0s.00		1h 21m 44s.42	
		$A_3 B_3$				1 21 40.00	

= − 4s.42 in 82m

5 53 49.5 = 4 41 0.0

12 02.0 = 12 0.0

12 01.98

1.97

12 0.01

3451

394

$A_1 B_1$ 8 39 46.0 = 7 26 30.0

22 7 30.5 = 20 52 0.0

13 27 44.5 = 13 25 30.0

See page 74.

Altus to $A_3 B_3$

8 36 15.5 = 7 23 0.0

7 55 13.5 = 6 42 0.0

41 2.0 − .08 41 0.0

41 1.98

6.72

40 55.26

= + 4s.74 in 41m

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr 9, 35 1877. Instrument, RP Observer, L.W.

Timepiece, 3451 Recorder,

Object,	β Cancri				31 Sextantis				Oltmanns				Oltmanns						
Circle,	E				E.				E				N 18 44						
	w			e	w			e	w			e	w			e			
Level Direct,	.			.	.			.	18 .7			16.7	.			.			
Reversed,	.			.	.			.	18 0			18.0	.			.			
Sums,	.			.	.			.	36.7			34.7	.			.			
Difference,									24.7			24.0							
b.												.7 = +0.5							
									8	18	52.3 = mean N								
	h	m	s		h	m	s		h	m	s		h	m	s				
Wire, I.			52.8				52.6		I		8.6		I		5.6				
II.			14.6				2.3				16.0				13.2				
III.			.				12.1				23.4				20.6				
IV.			36.3				22.0				30.9				27.8				
V.	8	10	57.8 19.6		8	14	31.5				38.5		8	21	35.5				
Sum,			181.1				120.5				117.4				10 27				
			3622				24.10				2348				20.54				
Mean,	8	9	36.22		8	14	12.10				23.48		8	21	30.54				
Bb,			.				+ .07				.				.				
Cc,			.				+ .28				.				.				
Aa,			.				− .09				.				.				
Corr'd Transit,			.		8	14	12.4				.				.				
R. A.			.		8	14	26.8				.				.				
Error of Timepiece,			.				14.4 .				.				.				

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 9.35 1877. Instrument, [illegible] Observer, [illegible]

Timepiece, 2451 Recorder, [illegible]

Object,	Gr. 1446			Gr. 1460							
Circle,	[illegible]			[illegible]							
	w		e	w		e	w		e	w	e
Level Direct,	18.0		18.0	.		.	.		.	.	.
Reversed,				.		.	.		.	.	.
Sums,	.		.	.		.	Signal sent 8.30 a.m. = +0.5.8				
Difference,											
b.							1327			[illegible]	
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			48.1			48.3	21	35	44.0	= 20	21 0.0
									+ 26.5		
II.			15.6			23.5	21	35	70.5		
III.			42.3			59.6	1	12	6.8		
IV.			9.4			35.0	20	23	63.7		
								3	20.5		
V.	8	25	36.0	8	31	[illegible]	20	20	43.2		
Sum,			151.4			1181			.		
			30.28			39.36				[illegible]	
			12			20					
Mean,	8	24	42.28	8	30	59.36	23	9	0.0 =	21	54 0.0
									+ 26.5		
Bb,			.			+ .1	23	9	16.5		.
Cc,			.			− .4	1	12	6.8		.
Aa,			.			− .9	21	57 3	19.7		.
									3 5.8		
Corr'd Transit,			.	8	30	58.2	21	53	43.9±		.
R. A.			.	8	30	12.7			.		.
							Signal sent 10. a.m. = +0.5.0				
Error of Timepiece,			.			14.5			.		.

B. B. not running tonight.

Errs. Comparing 1327 & 312.

1327 3451

8 48 0.0 = 8 48 11.7 + 14.5 = 26.2

312 = 2451

8 50 0.0 = 8 50 12.1 + 14.5 = 26.6

14.4 E

14.5 W 1.65 1.67

− 14.45 = Error 3451

∴ − 26.2 = + 1327

∴ − 26.6 = 312

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, ... 187 . Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	Supra p. 71.	.	156 3 / 168	.	.	.	.	.
Difference,								
b.	3451		394					
	h m s		h m s		h m s		h m s	
Wire, I.	Inferred 13 27 44.5		13 25 30.0		23 9 0.0			.
II.	− 1.7			.		.		.
III.	13 27 42.8			.		.		.
IV.	2 12.3			.		.		.
V.	13 25 30.5	.		.		.		.
Sum,	$A_1 B_1$	.		.		.		.
Mean,	3451	.	394	.		.		.
Bb,	22 / 10 26 3.5		21 10 30.0			.		.
Cc,		.		.		.		.
Aa,	9 11 39.5		55 0.0			.		.
Corr'd Transit,	7 45 36.0		7 44 30.0			.		.
	− 0.8							
R. A.	7 45 35.2			.		.		.
	1 16.2							
	7 44 19.0							
Error of Timepiece,		:	394 = − 11.5.0 in 7h 44m			.		.

∴ Bnds 394

∴ $A_1 B_1$ = − 11.5.0 in 7.h63 = − 1.s44 per hour
$A_2 B_2$ = − 0.5 in 13h.42 =
$A_3 B_3$ = + 4.74 in 0.h70 = + 6.77 per hour
$A_4 B_4$ = − 4.42 in 1h.35 = − 3.28 per hour.

Corrections.

− 12s Clock of 1426 at 3h.m Apr. 11.

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1877phae.proj.17948

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr 10. 85 1877. Instrument, Amp. Observer, LW.
Timepiece, Recorder,

Object,																
Circle,																
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.		.		.	
Sums,	)	16	7.28	.		.		.		.		.		.		
			3.89													
Difference,	1	16	3.39													
b.			1327	=	PB.											
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.	21	41	41.0	=	20	23	0.0		23	13	56.0	=	22	53	0.0	
II.	−1	16	3.39				.				+27.1				.	
III.	20	25	37.61				.		23	14	23.1				.	
IV.			+27.1				.		1	16	3.4				.	
V.	20	26	4.7				.		21	58	19.7				.	
		3	20.8							3	36.0				.	
Sum,	20	23	43.9				.		21	54	43.7				.	
Mean,	∴ Signal at 8.30mm = +0.1								∴ Sig Emit. 10AM = +0.3							
Bb,		−26.2	.				.				.				.	
Ce,		9	.				.				.				.	
Aa,		−37.1	.				.				.				.	
Corr'd Transit,			.				.				.				.	
R. A.			.				.				.				.	
Error of Timepiece,			.				.				.				.	

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 11.85 1877. Instrument, C Observer, L.W.

Timepiece, Cmp. Recorder,

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	1377.		B.B.					
	h m s		h m s		h m s		h m s	
Wire, I.	21 43 36.0		= 20 21 0.0		.		.	
	+ 27.7							
II.	21 44 3.7		.		.		.	
III.	1 +9 0.0		.		.		.	
	20							
IV.	20 24 3.7		.		.		.	
	3 20.5							
V.	20 20 43.2		.		.		.	
Sum,	8.30 Am Signals = +0.8				.		.	
Mean,	.		.		.		.	
Bb,	23 12 57.0		.		.		.	
	+ 27.7							
Cc,			.		.		.	
Aa,	23 13 24.7		.		.		.	
	1 20 0.0							
Corr'd Transit,	21 53 24.7		.		.		.	
	3 35.2							
R. A.	21 50 49.5		.		.		.	
	− 6.0							
Error of Timepiece,	21 50 43.5		:: 10 Am		.		.	

BB = +0.5

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1877phae.proj.17944

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 12.35 1877. Instrument, RT Observer, Lff.

Timepiece, 3451 Recorder, Lff.

Object,	ollucamaj				η cancri				qr 1446				qr 1446			
Circle,	rr				rr				rr				e			
	w		e		w		e		w		e		w		e	
Level Direct,	17.4		18.4		.		.		.		.		.		.	
Reversed,	18.4		17.8		.		.		.		.		.		.	
Sums,	35.8		36.2		.		.		.		.		.		.	
Difference,			35.8													
b. = −0s.01			4													
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.			27.3				11.0		IV		57.0		V		—	
II.			41.8				18.7				3.2				—	
III.			56.5				26.8				16.5				33.5	
IV.			11.5				34.0				29.3				46.5	
V.	8	20	26.4		8	35	41.7				42.0		8	28	59.5	
Sum,			163.5				132.2				142.0					
			32.70				26.44				28.40					
			5								5					
Mean,	8	19	56.70		8	35	26.44				16.40		8	28	53.5	
Bb,			−.02				−.01				.				.	
Ce,			−.42				−.41				.				.	
Aa,			−1.90				+1.20				.				.	
Corr'd Transit,	8	19	04.36			35	27.22				.				.	
R. A.	8	20	4.89		8	35	37.42				.				.	
Error of Timepiece,			−10.53				−10.20				.				.	

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1877phae.proj.1794w

78

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr. 12. 35 1877. Instrument, R1 Observer, [illegible]

Timepiece, 3451 Recorder, [illegible]

Object,	δ Cancri			
Circle,	E			
	w | e	w | e	w | e	w | e
Level Direct,	18 .4 | 17.8	. . | . .	. . | . .	. . | . .
Reversed,				
Sums,	. .	. .	. .	. .
Difference,				
b.		3451	1327	BB.
	h m s	h m s	h m s	h m s
Wire, I.	47.2	8 39 42.5	.	7 15 0.0
II.	9.7	+ 10.4	8 44 28.0 =	7 30 0.0
III.	32.0	5 0.8	44 53.7	.
IV.	54.5	8 44 53.7	1327 = − 28.7	.
V.	8 38 17.0	.		.
	1604			
Sum,	32.08	.	.	.
Mean,	8 37 32.08	3451	312	.
Bb,	− .01	8 43 12.5 + 10.4	= 8 43 0.0	.
Cc,	+ .41	.	.	.
Aa,	+ 1.35	8 45 43.5	8 43 22.9	7 21 0.0
Corr'd Transit,	33.83	.	.	.
R. A.	8 37 43.40	.	312 = − 22.9	.
Error of Timepiece,	− 9.57	.	.	.

10.53
10.20
9.57
130

3451 = − 10.42

1327
21 42 32 =
+ 29.1
21 43 01.1
1 23 56.5
20 19 04.6
3 19.7
20 15 44.9

RB
20 16 0.0

Signal sent by
Mistake of reduction
8. 30 Am = − 22.8
should be − 0.9

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 2. 85 187? Instrument, Observer, AHP

Timepiece, Recorder,

Object,															
Circle,															
	w		e		w		e		w		e		w		e
Level Direct,	.		.		.		.		.		.		.		.
Reversed,	.		.		.		.		.		.		.		.
Sums,	.		.		.		.		.		.		.		.
Difference,															
b.	1327				813.										
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.	23	18	46.0		=21	52	0.0				.				.
II.		+	29.1				.				.				.
III.	23	19	15.1				.				.				.
IV.	1	23	56.5				.				.				.
V.	24	55	18.6				.				.				.
		3	35.5												
Sum,	24	51	43.1				.				.				.
Mean,	Signal sent 10 AM = Var. 0.9										.				.
Bb,			.				.				.				.
Ce,			.				.				.				.
Aa,			.				.				.				.
Corr'd Transit,			.				.				.				.
R. A.			.				.				.				.
Error of Timepiece,			.				.				.				.

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$0^s.129$

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 13.39 1877. Instrument, RA Observer, LW

Timepiece, 2455 Recorder,

Object,	9 Horace.	9 Draco.	41 Leonis	42 Leonis
Circle,	E 326 3	W 33 57	W	W
	w / e	w / e	w / e	w / e
Level Direct,	18.0 / 17.1	16.8 / 18.3	. / .	. / .
Reversed,				
Sums,	. / .	18.0 / 17.3	. / .	. / .
Difference,		34.8 / 35.6		
b. = −0.045		35.6 = 1.8		
	h m s	h m s	h m s	h m s
Wire, I.	III 12.2	V 13.5	51.6	40.1
II.	26.8	28.6	15.1	48.3
III.	41.8	43.7	38.6	56.5
IV.	57.5	58.3	1.8	4.3
V.	10 25 13.5	10 28 13.6	10 27 25.1	10 29 13.0
Sum,	15 1.8 / 3,2 36	15 8.1 / 31.62 / 12	13 22 / 26.44 / 12	10 22 / 32.44 / 24
Mean,	10 24 42.36	10 27 43.62	10 26 38.44	10 38 56.44
Bb,	.	−3m 0.10	−.05	.
Ce, = +.14	.	10 24 43.52 / 42.36	−.15	.
Aa,	.	2) +1.16	+.87	.
C.E.		+0.58		
Corr'd Transit,	.	.	36 39.11	.
R. A.	.	.	.	.
		10 24 43.28	10 36 46.03	
Error of Timepiece,	.	.	−6.92	.

42.516 = 1.628855
9.37204
2.25551

Corr
9.37304
1.76345
1.13647
= 180.10
+ 0.14 CE

A −2.36
3.51
4.22

10 27 43.62
− 0.58
− 0.15

10 27 42.90
− 3 0.10
10 24 42.80

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr 13-14 1877. Instrument, [illegible] Observer, [illegible]

Timepiece, 345 Recorder, [illegible]

Object,	ζ Leonis			
Circle,	E			
	w | e	w | e	w | e	w | e
Level Direct,	18.0 | 17.5	. | .	. | .	. | .
Reversed,		. | .	. | .	. | .
Sums,	18.0 17.1	. . .	. .	. .
Difference,	18.0 17.3			
b.		3451	394 ~~342~~	347
	h m s	h m s	h m s	h m s
Wire, I.	58.3	10 54 51.5	= 9 ~~55~~ 30.0	.
II.	20.0	.	.	~~20~~
III.	41.6	10 55 20.5	.	10 55 10.0
IV.	3.2	.	.	.
V.	10 43 34.8	.	.	.
Sum,	14779	.	.	.
Mean,	10 42 41.58	1327	B10.	.
Bb,	— .03	11 29 46.0	= 10 1 0.0	.
Cc,	+ .14	.	.	.
Aa,	+.53 +1.38	3451 =	B10.	.
Corr'd Transit,	42 43.67	11 32 8.5	= 10 30.0	.
R. A.	10 42 49.71	+6.78 11 32 15.28	.	.
		2 0.33		
Error of Timepiece,	— 6.64	11 30 14.95	.	.
		11 29 46.00	∴ 1327 =	— 28.95

10 24 43.28

−0.045 +1.84 α-α 18 6,43

−−0.03

6.64 6.92 176

3451 = − 6.78

2.61 53 783 1305 138 33

42 41.69 24 42.80 17 58.89

·8774 ·4609 4165 + 361 289 | 7.54

+ 7.54 +.53+2.36

∴ α = + 2.61 CE

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 13.85 1877. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object, Circle,								
Level Direct, Reversed,	w . .	e . .	w . .	e . .	w . .	e . .	w . .	e . .
Sums, Difference, b.	13d. 8.25 1327	. .	. .	. .	13d. 90 1327	. .	. .	. . R.B.
	h m s		h m s		h m s		h m s	
Wire, I.	21 56 29.0			.	23 21 43.0 =		21 51 0.0	
II.	+ 29.3			.	+ 29 3			.
III.	21 56 58 3			.	23 22 12 3			.
IV.	1 27 53.1			.	1 27 53.1			.
V.	20 29 5.2			.	21 54 19.2			.
	3 21.3			.	3 35.2			.
					44.0			.
Sum,	20 25 43.9			.	Signal Lost 10 Am = +0.5			
Mean,	13d. 35			.	" " 8.50 Am = +0.1			
Bb,	11 29 46.0 =		10 1 0.0	.		.		.
Cc,	+ 28.95			.		.		.
Aa,	11 30 15.0			.		.		.
	1 27 53.1			.		.		.
Corr'd Transit, R. A.	10 2 1 21.9			.		.		.
	1 38.7			.		.		.
	43.2		.	.		.		.
	3451							
Error of Timepiece,	11 32 8.5 =		10 3X 0.0					
	+ 6.8			.		.		.
	11 32 15.3							

10 4 22.2
1 39.0
43.2

1327 = -28.95
3451 = -6.78

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1877phae.proj.1794

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr 14 13 1877. Instrument, Transit. Observer,

Timepiece, Amp Recorder,

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	1327 372		394					
	h m s		h m s		h m s		h m s	
Wire, I.	4 36 34.0 + 29.3		= 3 5 0.0		4 40 30.0 + 29.5		1 35 50.06 3.89	
II.	4 37 3.3		.		4 40 59.5		1 35 44.17	
III.	1 31 49.6		.		1 35 46.2		.	
IV.	3 5 13.7		.		3 5 15.3		.	
V.	3 3 30.3		.		0 30.3		.	
	3 2 43.4		.		3 4 45.0		.	
					∴ 394 ∓ 1.5			
Sum,	apr. 14. 87 5		.		.		.	
Mean,	.		.		.		.	
	22 32 19.0 + 29.5		= 20 58 0.0					
Bb,	22 32 48.5		.		.		.	
Cc,	1 31 49.6		.		.		.	
Aa,	21 60 58.9 3 26.5		.		.		.	
	21 57 32.4							
Corr'd Transit,	.		.		.		.	
R. A.	.		.		.		.	
Error of Timepiece,	.		.		.		.	
	1327		1436					

13,39 = 28.9 − .50 − 29.5

23 14 58.0 = 21 39 50 + 4 + 29.5

23 15 27.5
1 31 49.6
21 43 37.9
3 33.6
21 40 04.3 =
21 39 51.6
125.7
16.0
28.7

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr. 15. 33 1877. Instrument, RT Observer, Litt.

Timepiece, 345 Recorder,

Object,	δ Ursae Maj		10 Sco. Mem		9r 1564		o Leonis	
Circle,	E		E		W		W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	18 : 0	17 : 0	.	.	17 : 0	18 : 1
Reversed,	.	.	17	18 : 1	.	.		
Sums,	.	.	.	.	.	.	.	.
Difference,								
b. +0.00								
	h m s		h m s		h m s		h m s	
Wire, I.		19.8		48.3		28.5		17.5
II.		30.3		15.1		38.5		17.6
III.		41.1		41.7		49.2		34.3
IV.		57.7		8.5		59.5		56.1
V.	9 24	1.8	9 27	35.0	9 32	9.3	9 35	17.6
Sum,		144 7 / 29 94		148 6 / 29 72		185 0 / 37.00		17 21 / 34 42
Mean,	9 23	40.94	9 26	41.72	9 31	49.00	9 34	34.42
Bb,		—		—		—		—
Cc, c = +0.14 e		+ .41		+ .17		− .41		− .14
Aa,	−1.39	− 3.34	+1.12	+ .28	−1.33	− 3.92	+.52	+1.53
Corr'd Transit,		38.91		42.17		44.67		35.81
R. A.	9 23	39.47	9 26	43.62	9 31	45.84	9 34	36.98
			23	39.47			31	45.87
Error of Timepiece,		− 1.46		− 1.45		− 1.17		− 1.17

23 41 35

26 41.89
23 41.35
3 0.54
3 4.15

CE + 3.61/151 = +2.39

31 48.59

34 24.28
31 48.59
2 45.69
2 57.14
5.45

Cm + 5.45/185 = 2.94

1877phae.proj.1794

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apr 15, 33 1877 Instrument, RC Observer,
Timepiece, 345 Recorder,

Object, Circle,								
Level Direct, Reversed,	w	e	w	e	w	e	w	e
Sums, Difference, b.	Bnd 394		3451		1327		312	
	h m s		h m s		h m s		h m s	
Wire, I.	8 6 40.0		9 42 48.0					
II.	— 20.0		— 20.0					
III.	8 8 0.0				9 44 19.0			
IV.	— 30.0				— 20.0			
V.	8 21 0.0						9 57 30.0	
Sum,								
Mean,	8 5 40.0		9 42 28.0					
Bb,	1m 50s.0		+ 1.31		9 43 49.0			
Cc,	8 7 20.0		9 42 29.31		— 1 50.30			
Aa,	15 20.0				9 41 58.70		9 57 30.0	
	8 21 0.6				42 29.21		— 15 22.51	
Corr'd Transit, R. A.					1327 = — 30.61		9 42 07.49	
							42 29.21	
							312 = — 21.82	
Error of Timepiece,			9 42 29.31		9 44 19.61		9 57 51.82	
			1 35 46.17		1 35 46.17		1 35 46.17	
			8 6 43.14		8 8 33.44		8 22 5.65	
			1 19.73		1 20.03		1 22.25	
			8 5 23.41		7 13.41		43.40	

1.45
1.17
62
— 1.31 = 3457

1 35 50.06
3.89
1 35 46.17

4 40 30.0
30.4
4 41 0.4
1 35 46.2
3 5 14.2
0 30.3
3 4 43.9

∴ 394 = + 16s.59 at 8 P.m.
= 15h.93
= (+16.1 at 3 A.m)
∴ (gaining 2.0 per day.)

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 15d 22h p.m. 1877. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,						1 35 46.2					
Circle,						31.0					
						1 35 15.2					
Level Direct,	w		e		w		e		w		e
Reversed,	.		.		.		.		.		.
	.		.		.		1827		7.		394
Sums,	.		.		.		.		22 29 25.0 =	20 51	0.0
Difference,									1 35 15.2		
b.			1327				394		20 54 9.8		
									3	25.5	
									20 30	44.3	
	h	m	s		h	m	s		h	m	s
Wire, I.	21	0	8.0 =		19	22	0.0				
II.	21	1	8.0 =		19	23	0.0		1327 = −0.73 per day		
III.			+ 31.0						= −0.03 per hour		
IV.	21	1	39.0						21 51 19.0 =	20 13	0.0
V.	21	35	46.2						22 29 25.0 =	20 51	0.0
	19	25	52.8						38m 6.0		38m 0.0
		3	10.99						− 6.25		
Sum,			+.84						37m 59.75		
	19	22	41.81								
Mean,									∴ 394 is gaining 0.25 in 38m		
	∴ 394 = +18.2								with 20 gramme adjt.		
Bb,									= 0.25/38 × 60 ÷ +0.394 per hour.		
Ce,									.270 = 10 gr.		
Aa,									.108 = 4 gr.		
	7. 55/40 sm Lower bob = 7/16 rev								.013 = 0.5 gr.		
									+ .391 = 14.5 grammes.		
Corr'd Transit,	and sat clear right, mid pt 1436.										
R. A.	Compared.								22 51 28.0 =	21 12	0.0
Error of Timepiece,	21 37 12.0			=	19	59	0.0				
	+31.0										
	21 37 43.0										
	1 35 46.2										
	20 1 56.8										
	3 16.9										
	20 58 39.9										

Removed 20 gr. at 9h 28m

15.33 = − 30.61
9.35 = − 16.2
6 − 4.4
∴ 15 = −0.73

− 30.61
− .37
− 31.0

16.6 at

∴ + 2
40 = + 4s

21 48 18.2?
31.0
21 48 49.2
1 35 46.2
20 13 3.0
3 18.7
20h 9m 44.3?

21 51 19.0
31.0
50.0
1 35 46.2
20 16 3.8
3 19.2
20 12 44.6

added 20 gr. at 8.15 PM.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 15d 85 187 . Instrument, Observer,

Timepiece, Recorder,

Object,	1 35 50.06 − 3.89			15d 33 = − 30.61			.74										
Circle,	1h 35m 46s.17			15.88 = 21.01			.37										
	21.01			.895 31.02													
				.910 31.03													
	w		e				w		e				w		e		
Level Direct,	1 − 35	15.16	at 9h 20m	e													
Reversed,	1 35 −	15.15	at 9h 40	e													
Sums,	1 35	15.14	at 10 hm	e													
Difference,		1327															
b.	22 51	28.00					aft 16s										
							1327										
	h	m	s	h	m	s	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	1	35	15.16				25	20	53.0									
II.	21	16	12.84				1	35	15.10									
		3	29.08				23	45	37.90									
III.	21	12	43.76					3	53.55									
IV.							23	41	44.35									
V.							25	26	54.0									
	23	12	31.0 =	21m = +0s.43			1	35	15.10									
	1	35	15.15				23	51	38.90									
Sum,	21	37	15.85					3	54.54									
Mean,		3	32.52				23	47	44.36									
	21	33	43.33															
Bb,																		
Cc,							∴ 10.25 Am = + 0s.04											
Aa,							11.40 Am = − 0s.35											
	23	26	35.0	14m = +0s.31			1h 15m = −0s.39											
	1	35	15.15				∴ 1h = − 0s.32											
Corr'd Transit,	21	51	19.85															
R. A.		3	34.83															
	21	47	45.02															
			− 2.00															
			43.02															
Error of Timepiece,																		
	aft 16s.3						added 12gr at 12m											

24	3	40.0	1	39	46.61												
1	35	15.14			3.89												
22	28	24.86	1	39	42.72												
	3	40.90															
22	24	43.96															
24	9	41.00															
		− 31.04															
24	9	72.04															
1	35	46.17															
22	34	25.87															
	3	41.89															
		34.15															
23	31	43.98															

4w	23m	22s.0	=	2	44	0.0											
		31.3				31.3											
4	23	53.3															
1	39	42.7															
2	44	10.6															
	0	26.9															
2h	43m	43s.7															
4	30	23.0															
		31.3															
4	30	54.3															
1	39	42.7															
2	51	11.6															
	0	38.05															
2	50	43.60															

Recan 10 gr.

3 Rm

1327

8	35	5.0															
		21.4															
8	35	36.4															
1	39	42.7															
6	55	53.7															
	1	8.1															
		54 45.6															

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 16d 85 1877. Instrument, RT. Observer,
Timepiece, Cmp. Recorder,

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	7 Am = 19h = 0d.79.		− 30.61 = 15.33		April 17.	
Difference,			16.79		.74			
b.			1.44		.33			
					− 31.68		12.30 P.M.	
					1327			

	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	23	47	44.4	20	7	58.0	22	29	21.5	2	10	56.0
						+31.68			31.7			31.8
II.	2	43	43.7									
				20	8	29.68	22	29	54.2	2	11	27.8
III.	6	54	45.6	1	39	42.72	1	39	42.7	1	43	39.3
IV.			.	18	28	46.96	20	50	11.5	0	27	48.5
					3	1.64		3	24.8		0	4.45
V.	8	49	7.0	18	25	45.32	20	46	46.7			44.50
Sum,			31.4									
	8	49	38.4									
Mean,	1	39	42.7	A3B3 for 20m								
	7	9	55.9				1327					
	+	10	10.4									
Bb,	7	8	45.3	20	44	4.0	23	19	28.0			
						+31.7			31.7			
Cc,							23	19	59.7			
Aa,				20	44	35.7	1	39	42.7			
			added 10gr at	1	39	42.7	21	40	17.0			
Corr'd Transit,	7.35 P.M.			19	4	58.0		3	33.0			
					3	7.5			44.0			
R. A.				19	1	45.5						
				Removed 12gr at								
Error of Timepiece,				7 Am.			23	31	30.0			
									31.7			
				33			23	31	61.7			
				3			1	39	42.7			
				30			21	52	19.0			
								3	35.0			
							21	49	44.0			

∴ Signal sent
10 Am = +0s.0

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 80 187 . Instrument, Observer,

Timepiece, Recorder,

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	17.80 / 15.33 / 2.46	.74 / 1.48 / .37 / 2.1.85 / 20.61 / 32.46	.	.	6.33 = 30.92 / 15.33 = 21.18 / 9.00 = + 9.1 / .10 = +1.01		21.8 / 2.5 / 19.3	.
Difference,								
b.		1327		394				
	h m s		h m s		h m s		h m s	
Wire, I.	21 12 2.0		= 19 26 0.0		312			
II.	32.46 / 21 12 34.46				21 25 18.5 =		19 39 0.0	
III.	1 43 39.28				+19.3			
IV.	19 28 55.18				21 25 37.8			
V.	3 11.50				1 43 39.3			
	19 25 43.68				19 41 58.5 / 13.6			
Sum,					38 44.9			
Mean,	.: By 1327 = +0.3				21 27 19.0			
					+19.3			
Bb,					21 27 38.3			
Cc,	Removed 12 qr				1 43 39.3			
Aa,	at 7.45 AM				19 43 59.0 / 3 14.0			
Corr'd Transit,					19 40 45.0			
R. A.					By 312 = +9.0			
Error of Timepiece,					Re			

23 49 28.0
+32.5
23 50 0.5
1 43 39.3
22 6 21.2
3 37.2
22 2 44.0

∴ Signal sent
0.5 at 10 AM

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 18.85 187 . Instrument, Observer,

Timepiece, Recorder,

Object,																
Circle,																
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.		.		.	
Sums,	32.46 .74 33 20		.		.		.		.		.		.		.	
Difference,																
b.	1327.				= 394.				1327.							
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.	21	31	0.0	=	19	41	0.0		23	1	15.0					.
II.			33.20				.				38.2					.
III.	21	31	33 20				.		23	1	47.2					.
	1	47	35.83				.		1	47	35.8					.
IV.	19	43	57.37				.		21	14	11.4					.
		3	13.96				.			3	28.7					.
V.	19	40	43.41				.		21	10	43.7 + 3.0					.
Sum,	Assume that the						.				.					.
Mean,	Error of +0.6 is equally divided between						.		23	13	17.0					.
											33.2					
Bb,	1327 ∨ 394						.		23	13	50.2					.
Ce,							.		1	47	35.8					.
Aa,	at 7.55 Removed 10 gr.						.		21	26	14.4					.
										3	30.7					
Corr'd Transit,			.				.		21	22	43.7					.
R. A.			.				.			9						.
									added 8 gr. (There are now 11 gr. in							
Error of Timepiece,			.				.		the correspondence at 9.30 AM							
											.					.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 19.85 187 . Instrument, Observer,

Timepiece, Recorder,

Object,

Circle, 394 Fixed Slightest at 9.15 AM

	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	Circle face indicating				April 20. 85			
Sums,	33.2	.	1 50 3		1 55 32.82		.	.
Difference,	7		1 51 36.28		.	3.89		
b.	33.97		1 51 32.49		1 55 28.94			
					1327		B13	

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.	23 w.	21 m	14.0 s	= 21	28	0.0	22	9	59.0	= 20	12	0.0
	II.			33.9			.			+34.8			.
	III.	23	21	47.9			.	22	10	33.8			.
	IV.	1	51	32.5			.	1	55	28.9			.
	V.	21	30	15.4			.	20	15	4.9			.
			3	31.4			.		3	19.1			.
		21	26	44.0				20	11	45.8			
Sum,				.			.	∴ assume B13 =			slow 1.5		.
Mean,				.			.			.			.

Bb,		23	51	19.0			.	α Pegasi			+.14	32	.
				33.9			.				.27	51	.
Cc,							.	c. 2.					.
Aa,		23	51	52.9			.					29	.
		1	51	32.5			.						.
Corr'd Transit,		22	00	20.4			.						.
			3	36.3			.						.
R. A.				.			.						.
		assume sum B13 =		0.0									
Error of Timepiece,				.			.	23	54	15.0			.
										+34.8			
								23	54	49.8			
								1	55	28.9			
								21	59	20.9			
									3	36.3			
								21 h	55 m	44.6			

Assume B13 at 10AM is fast slow 0.3

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 22d. 38 1877. Instrument, RT Observer, EW

Timepiece, 3451 Recorder, EW

Object,	9 Horace		9 Horace		9 Horace.		41 Sco. Mus.	
Circle,	E W		E W		E		E	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.								
	h m s		h m s		h m s		h m s	
Wire, I.	by 11·5		by 42·5		by 42·3		21·0	
II.	26·3		56·7		57·5		44·1	
III.	41·5		12·5		12·5		7·6	
IV.	56·5		26·8		27·6		30·7	
V.	12·3		25 43·0?		10 28 42·5		10 37 54·1	
Sum,	.		181 5 / 36 30 / 24		18 24 / 36 48 / 24		157 5 / 31 50 / 24	
Mean,	.		10 25 12·30		10 28 / 3 12·28 / 0·10 / 10 25 12·18		10 37 7·50	
Bb,	.		∓ ·06		12·30 / − ·12 / + ·06		.	
Cc,	.		.		.		.	
Aa,	.		−2.37		.		+1·02	
Corr'd Transit,	.		10 25 12.24		10 25 12.24		37 8.52	
R. A.	.		10 24 42.79		.		10 36 46.95	
Error of Timepiece,	.		.		.		+21·57	

10 24 42.79

α : α 12 4·16

t : t 11 55·26

+ 8.90

ar (CE) = 2·71 =

ar 3·285

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 28 187 . Instrument, R1 Observer, SW

Timepiece, 2451 Recorder, SW

Object,	ζ 42 Scorpii				ζ Scorpii														
Circle,					W														
	w			e			w			e			w			e			
Level Direct,	18.1			17.6			17.3			18.4									
Reversed,	17.3			18.4															
Sums,	35.4			36.0															
Difference,																			
b.													1327			B13			
	h	m	s				h	m	s				h	m	s				
Wire, I.			9.2						27.3				10	51	57.0	=	8	48	0.0
II.			17.6						49.1					3451.		=	B13.		
III.			25.8						10.6				10	53	53.0	=	8	49	0.0
IV.			34.3						32.6										
V.	10	39	42.6				10	43	54.3					312.		=	B13.		
Sum,			1795 / 2590						17 39 / 3478 (?)				11h	4m	32.5 0	=	8	59	0.0
Mean,	10	39	25.90				10	43	10.78					3451					
Bb,													10	53	53.0				
Cc,															22.21				
Aa,													10	53	30.80				
	+.23		+.69				+.53		+1.59					1	0.16				
Corr'd Transit,		29	26.59					43	12.37				10	52	30.64				
R. A.	10	39	4.92				10	42	49.62					51	57.0				
													∴ 1327	=	33.64				
Error of Timepiece,			+21.67 / 57						22.75					10	1.64				
													10	54	32.44				
														53	53.0				

10 24 42.79 312 = − 39.44

ζ = 21.62

W = 22.75

Mean = 22.21

∴ 3451 = +22.21

α : α 18 6.83

t : t 17 58.54

+8.29 / 2.90 = 2.853 = a.

(W)

Memo. Can the Equatorial Intervals given by W.A.R. be right? I have suspected for some time they are not so.

SW.

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 22.85 1877 Instrument, Observer,

Timepiece, Recorder,

Object, Circle,			2 3 25,94 3.89					
	w	e	2w 3	22.e05	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	3.55 1		1327		1327		B.B.	
	h m s		h m s		h m s		h m s	
Wire, I.	22 10 1.7 − 23.9		= 22 9 10.0 + 33.85		22 32 57.0 + 33 9		= 20 27 0.0	
II.	9 43.8		9 43 8		22 33 24 9			.
III.	.		.		2 3 22. 0			.
IV.	.		.		20 0 2. 9 3 16. 6			.
V.	1436 .		1327 .		20 26 46. 3 .			.
Sum,	20 7 10+11 14.4 .		= 22 13 1.0 .		.			.
Mean,	8 10+3 11.2 .		13 58.0 .		.			.
Bb,	2 7 14.4 .		= 22 13 1.0 +33.9		23 34 4.0 33.9		= 21 28 0.0	.
Cc,	.		.		23 34 37. 9			.
Aa,	.		22 13 34 9 2 3 22.0		2 3 22. 0			.
					21 31 15.9 3 31 5			
Corr'd Transit,	.		20 10 12.9 3 18.2		21 27 44.4 .			.
R. A.	20 6 54.7 19.5 7		20 6 54. 7		add 20 qr 2h		9.30	.
Error of Timepiece,	i: 1436 = + 3.5 7		Mean mt.		.			.

Sp gr Lead = 11.35

Reg ball must weigh 14.5^{16} = 14500 gr.

= 14500 cu cent. H_2O

= 4.1614

+1.0550

3.1064

= 1278 cu cent.

Sog $\frac{4}{3} = 0.1249$

$\pi = 0.4971$

0.6220

3.1064

3) 12.48844

0.98281

6732

$ca \frac{4}{3}\pi r^3$.

∴ diameter = 9.

3.24

128

1.8

2.0

Penn balls 41.2 cent inches

24 4 9.0 33.9

24 4 42.9

2 3 22.0

22 1 20.9 3 56 mt

20 7 44.5 −0.3 by estimation in comparison

Signal sent 10h 0m

Clock 0.3

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 13 90 187 . Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object, Circle,	22.38 c -33.64 17.35 -28.7		33.64 .6								
Level Direct, Reversed,	w .	e .	w .	e .	w .	e .	w .	e .	w .	e .	
Sums, Difference, b.	1327		394								
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	22	25	49.0 + 34.3 =	20	16	0.0			.			.
II.	22	26	23.3			.			.			.
	2	7	18 6									
III.	20	19	4.7			.			.			.
		3	20.3									
IV.						.			.			.
	20	15	44.4									
V.	assume 1327 is 0s. 2 slow.					.			.			.
Sum,	added 10 gramms.					.			.			.
Mean,			.			.			.			.
	24	4	5 0									
			24 5									
Bb,	24	4	39.5			.			.			.
Cc,	2	7	18.6			.			.			.
Aa,	21	57	20.9			.			.			.
	~~20~~	~~19~~	~~4.7~~									
Corr'd Transit,		3	24.2/4			.			.			.
R. A.	21	53	44.5			.			.			.
Error of Timepiece,			.			.			.			.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 24, 25 1877. Instrument, RT Observer, SW

Timepiece, 3451 Recorder, SW

Object,	α Serpis	32 Musaemey	32 Musaemey	32 Musaemey
Circle,	(E)	(E) N A	(W) N.A.	(W)
	w | e	w | e	w | e	w | e
Level Direct,	16.4 | 16.2	. | .	. | .	. | .
Reversed,	15.9 | 17.5			
Sums,	32.3 | 33.7	. | .	. | .	. | .
Difference,	32.3 / 1.4			
b. = −0.s03				
	h m s	h m s	h m s	h m s
Wire, I.	34.6	I 40.2	III .	I IV 7.6
II.	56.6	48.5	.	16.5
III.	18.5	57.0	10 9 41.5	25.2
IV.	40.2	5.5	.	33.5
V.	10 3 2.1	10 8 14.6	.	10 11 42.3
Sum,	15 20 / 30 40 / 12	16 5 8 / 33.16 / 24	.	125.1 / 25.02
Mean,	10 2 18.40	10 7 57.16	.	10 11 25.02
Bb,	−.03	.	.	.
Cc,	+.14	.	.	.
Aa,	+1.50	.	.	.
Corr'd Transit,	2 20.01	.	.	.
R. A.	10 1 51.16	.	.	.
Error of Timepiece,	28.s85	.	.	.

C = +.14ε

Assume a = +3.s0

9.87 / 10

34.7 / .238

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 1877. Instrument, RT Observer, SW

Timepiece, 345 Recorder,

Object,	μ Ursae Maj		9 Draco		9 Draco		9 Draco	
Circle,	W		W		W		W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	15.6	17.6	.	.	.	.
Reversed,	.	.			.	.	.	.
Sums,	.	.	16.1 / 15.9	12.3 / 17.5	.	.	.	.
Difference,								
b.								
	h m s		h m s		h m s		h m s	
Wire, I.	34.3		I 48.3		II 18.7		III 48.5	
II.	3.1		3.3		33.4		4.3	
III.	31.5		17.6		48.6		19 3.5	
IV.	0.5		33.4		03.7		33.3	
V.	10 16 28.7		10 22 48.5		10 24 18.5		25 48.7	
Sum,	98.1 / 19.62		151.1 / 30.22 / 00		117.29 / 24.58 / 24		154.3 / 30.86 / 12	
Mean,	10 15 31.62		10 22 18.22		10 23 48.58		25 18.86	
Bb,	−.04		Cn					
Cc,	−.20		I 10 22 18.22			m s		
Aa,	+.03		23 48.58		>+1	30.36		
			25 13.86		>+1	30.28		
			26 48.62		>+1	29.76		
			28 19.12		>−1	30.50		
Corr'd Transit,	15 31.41					90		
R. A.	10h 15m 2.47					1m 30.22		
Error of Timepiece,	28.94				= 90.22 = I − II − III − IV − V			
					δ = 76° 20′ 54″			

38.85

Mean = 28.90

∴ 345 = + 28.90

1.95530
9.37295
1.32825 = 21.293
21.258
0.035

8.5441

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 24.25 1877. Instrument, RP Observer, CW

Timepiece, 345 Recorder, LW

Object,	9 Draco			9 Draco							
Circle,	W			W							
	w		e	w		e	w		e	w	e
Level Direct,	.		.	16 : 1		17 : 3	.		.	.	.
Reversed,	.		.				.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.							1327			312	
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.	VI		18.5	V		49.5	11	10	23.0 =		0.0
II.			33.6			3.6			.	1327	.
III.			48.8			18.5		3451			
IV.			3.6			34.5?	11	15	20.0 =	11	14 17.0
V.			18.6			49.5?			20.1 =		17.0
	10	27		10	28		11	14	28.9		.
			123.1			155.6		14	51.2		
Sum,			24.6.2			31.12		00	17.0		.
			24						34.2		.
Mean,	10	26	48.62	10	28	19.12	∴ 1327 = − 34.2				
Bb,			.			.			.		.
Cc,			.			.			.		.
Aa,			.			.	11	10	23.0		.
									24.2		
Corr'd Transit,			.			.	11	10	57.2		.
R. A.			.			.	∴ 312 = − 57.2? ?				.
Error of Timepiece,			.			.			.		.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 24. 1877. Instrument, Observer,

Timepiece, Recorder,

34.4

Object,																
Circle,																
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.		.		.	
Sums,	.		.		.		.		.		.		.		.	
Difference,																
b.	1377				BB				1827				BB			
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.	22	23	42.0	=	20	10	0.0		24	30	3.0	=	22	16	0.0	
II.			34.4				.				34.4				.	
III.	22	24	16.4				.		24	30	37.4				.	
IV.	2	11	15.2				.		2	11	15.2				.	
V.	20	13	01.2				.		22	19	22.2				.	
		3	18.7							3	39.4					
	20	9	42.5				42.5		22	15	42.8				.	
Sum,	Signal sent 8.20 Am = +1.5.5						17.5		Signal sent 10 Am = +1.5.2							
Mean,							3.12									
Bb,	22	28	22.0				0.0									
Ce,			34.4													
Aa,	22	28	56.4													
Corr'd Transit,																
R. A.																
Error of Timepiece,																

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April W. 25 1877. Instrument, [illegible] Observer, ...

Timepiece, Crumpanns Recorder, ...

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	1327		B13		1327		313	
	h m s		h m s		h m s		h m s	
Wire, I.	22 41 42.0		= 20 24 0.0		24 12 57.0		−0.1	.
II.	34.2 :6			.	24 . 2 6			.
III.	22 42 16.8			.	24 13 31 8			.
	2 15 11 7				2 15 11 7			
IV.	20 27 5.1			.	21 58 20.1			.
V.	3 21.0			.	3 36.0			.
					21 54 44.1			
	20 23 44.1							
Sum,	.			.	.			.
Mean,	.			.	.			.
	∴ Signal sent 10 am =		−0.1		Signal sent 10 AM		0.0	
Bb	.			.	.			.
Ce,	.			.	.			.
Aa,	.			.	.			.
Corr'd Transit,	.			.	.			.
R. A.	.			.	.			.
Error of Timepiece,	.			.	.			.

April 25, 3 Mr Holden takes the two wheels gearing into each other in the Bond 3pk to Boston and he is going to add another spring tooth to the lower one.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 26.32 1877. Instrument, RT Observer, SEW

Timepiece, 3451 Recorder, SEW.

Object,																			
Circle,																			
	w			e			w			e			w			e			
Level Direct,	15	0		17	4														
Reversed,	16	3		16	3														
Sums,	31	3		33	7														
Difference,				2	4														
b. = −0.06																			
c = +0.14 cf																			
	h	m	s				h	m	s				h	m	s				
Wire, I.			35.6						41.7				III		30.6		V		
II.			57.2						3.6						39.2				
III.			18.8						25.7						47.5		Missed		
IV.			40.1						47.1						56.5				
V.	9	55	1.7						9.0					10	4.6				
Sum,			153.4						127.1						178.4				
			30.68						25.42						35.68				
			12												12				
Mean,	9	54	18.68						25.42					10	47.68				
Bb,			−.05						−.05										
			−.10						−.10										
Cc,			+1.78						+1.50										
Aa,																			
	+.58						+.50												
Corr'd Transit,		54	20.31						26.77										
R. A.	9	53	44.61				10	1	51.14										
Error of Timepiece,			+35.70						+35.63										

+9.0
.56
1.68

Note SEW cries observe readily except the transits Temperature fr. about 65 one all the time in a higher field. Prism 100. 8.5 (MBG)

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 26.32 1877. Instrument, RT

Timepiece, 2W5 (Observer, ...

Recorder, ...

Object,	30 Camelop.		30 Camelop.		31 Sea. Mus			
Circle,	E.		E.		E			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	16.3	16.3	.	.
Reversed,	.	.	.	.			.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.								
	h m s		h m s		h m s		h m s	
Wire, I.	II .		III 57.7		30.2		.	
II.	.		27.3		57.3		.	
III.	57.3		57.5		23.7		.	
IV.	27.5		27.5		50.3		.	
V.	10 14 57.3		10 17 57.3		10 22 17.1		.	
Sum,	.		.		12 8 6 35.72 12		.	
Mean,	.		.		10 21 23.72		.	
Bb,	.		.		− .08		.	
Cc,	.		.		+ .17		.	
Aa,	.		.		+ .33		.	
					+.11			
Corr'd Transit,	.		.		21 24.14		.	
R. A.	.		.		10 20 48.57		.	
Error of Timepiece,	.		.		35.57		.	
	1327		B13					

10 34 39.0 = 8 15 0.0

3451 = 1327

10 37 40.5 = 10 36 30.0

10 38 30.5 = 10 37 20.0

35.70
.63
.57
190

∴ 3451 = + 35.63

10 37 40.5
− 35.6
10h 37m 4.9
10 36 30.0
∴ 1327 = − 34.9

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 26. 85 1877. Instrument, C. Observer, Lff.

Timepiece, Cumpar. Recorder,

Object,																
Circle,																
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.		.		.	
Sums,	.		.		.		.		.		.		.		.	
Difference,																
b.	1327				BB				1327				BB			
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.	22	44	39.0	=	20	23	0.0		24	8	53.0	=	23	52	0.0	
			25.1								35.1					
II.	22	45	14.1				.		24	9	28.1				.	
	~~2~~	~~15~~	~~11.7~~													
III.	2	19	8.3				.		2	19	8.3				.	
IV.	20	26	5.8				.		21	50	19.8				.	
		3	20.9							57						
V.							.		21		19.8				.	
										3	35.8					
	20	22	44.9								44.8					
Sum,			.				.				.				.	
Mean,			.				.				.				.	
	∴ 8.20 Equal sent				slow 0.5 9				∴ 10 Am Equal sent				0.0			
Bb,			.				.				.				.	
Cc,			.				.				.				.	
Aa,			.				.				.				.	
Corr'd Transit,			.				.				.				.	
R. A.			.				.				.				.	
Error of Timepiece,			.				.				.				.	

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 27.85 1877. Instrument, Arpaunus Observer, RH.
Timepiece, Recorder,

Object,																
Circle,																
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.		.		.	
Sums,	.		.		.		.		.		.		.		.	
Difference,																
b.	1327				RB											
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.	22	48	36.0 / 31.5		20	23	0.0				.				.	
II.	22	49	11.5				.				.				.	
	2	23	48													
III.	20	26	6.7				.				.				.	
IV.		3	20.9				.				.				.	
V.	20	22	48.8				.				.				.	
Sum,	∴ Signals at 8.30 Rm = Slow 1.5 8										.				.	
Mean,											.				.	
Bb,	24	25	50.0 / 24.5	+0.1			.				.				.	
Cc,							.				.				.	
Aa,	24	26	25.5				.				.				.	
	2	23	4 8													
Corr'd Transit,	22	3	20.7				.				.				.	
		2	36.8													
R. A.			.				.				.				.	
	∴ Signals at 10 Rm = 0.5 0															
Error of Timepiece,			.				.				.				.	

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 29.85 1877 Instrument, Comparisons. Observer, L.W.

Timepiece, Recorder,

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	16.32 = −34.9		35 3.5 175 10.5 11.225	.	.	.	.	.
Difference,	. −1.2							
b.	−36.1							
	1327		BB		1327		BB.	
	h m s		h m s		h m s		h m s	
Wire, I.	22 50 25.0		= 20 17 0.0		24 24 42.0			.
II.	+ 36.1			.		36.1		.
	22 51 1.1				24 25 18.1			
III.	2 30 57.9			.	2 30 57.9			.
IV.	20 20 3.2			.	21 54 20.2			.
	3 19.9				3 35.3			
V.				.				.
	20 16 43.3				21 50 44.9			
Sum,	∴ 8.20 Am Signal sent —			.		.		.
Mean,	Fact 0.5.7			.		.		.
					24 29 43.0		21 56 0.0	
						36.1		
Bb,		.		.	24 30 19.1			.
Ce,		.		.	2 30 57.9			.
Aa,		.		.	21 59 21.2			.
						3 36.1		
Corr'd Transit,		.		.	21 56 45.1			.
R. A.		.		.		.		.
					∴ Sun sent			
					10 Am			
Error of Timepiece,		.		.	= − 1.5.0.			.

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 30 85 1877. Instrument, Comparisons Observer, L.W.

Timepiece, Chronometer Recorder,

Object,											
Circle,											
Level Direct,	w	e	w	e	w	e	w	e			
Reversed,											
Sums,					April						
Difference,					May 1. 85						
b.											
	h m s		h m s		h m s		h m s				
Wire, I.	22 56 22.0		= 20 19 0.0		23 1 18.0		= 20 20 0.0				
	36 5		21		36 8						
II.	22 56 58.5		.		23 1 54.8		.				
III.	2 34 54.5		.		2 38 51.1		.				
IV.	20 24 4.0		.		20 23 3.7		.				
	3 20 4				3 20.4						
V.	20 18 43.6		.		20 19 43.3		.				
Sum,	∴ Signal Sent		.		∴ Signal Sent		.				
Mean,	.		.		.		.				
	8.30pm +0.4				8.30pm -0.7						
Bb,	.		.		.		.				
Ce,	.		.		.		.				
Aa,	.		.		.		.				
Corr'd Transit,	24 33 38.0		+0.1		24 45 35.5		= 22 4 0.0				
	36.5		.		36.8						
R. A.	24 34 14.5		.		24 46 12.3		.				
	2 24 54.5				4 38 51.1						
Error of Timepiece,	21 59 20.0		.		22 7 21.2		.				
	3 36.1				3 37.4						
	20 23 43.9				3 43.8						
	∴ 10pm Signal Sent 0.0										
					24 48 36.0						
					36.8						
					24 49 12.8						
					2 38 51.1						
					22 10 21.7						
					3 37.9						
					22 6 48.8						

Assumed 43.8 the mean of Bmdoclem V 1327

and ∴ Sent Signal 10PM = 0.0

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 2. 45 1877. Instrument, RT Observer, L.W.

Timepiece, 3451 Recorder,

Object,	84 Virginis		ε Virginis		17 Com. Ber.		20 Comæ Ber.	
Circle,	E		E		W		W	
	w	e	w	e	w	e	w	e
Level Direct, Reversed,	327 Camilop		16.8	18.9	.	.	15.6	20.0
							16 8	18 9
Sums,	.	.	.	.	.	.	32.4	38.9
Difference,								02.4
b. = ∓ 0.16								0.5
								02.16
	h m s		h m s		h m s		h m s	
Wire, I.		36.4		17.2		~~23.8~~		4 8
II.		11.6		38.3		.		33 2
III.		45.0		0.2		23.8		1 5
IV.		19.8		22.6		57.3		29 5
V.	12 50	54.8	12 57	44 1	13 6	18.6	13 13	57 8
Sum,		167.6		124		.		126 6
		33.52		24.48				25.32
Mean,	12 49	45.52	12 57	0.48		.	13 13	1.32
Bb, −0.16		−.15		−.15		.		−.29
Ce, +0.2 C.S.		+.20		+.20		.		−.26
Aa, +3.00		+1.56		+1.56		.		+.12
Corr'd Transit,		.		57 0.09		.		13 13 0.98
R. A.		.	12	56 5.77		.		13 12 4.71
Error of Timepiece,		.		+ 56.32		.		+ 56.27

42 23
11 37
30 46

39 9
42 23
2 14
41 13
42 43
1 10

56.32
.27
+56.30

3451 = 1327

h	m	s		h	m	s
13	22	83.5	=	13	21	0.0
13	23	8.5	=	13	24	25.0
		56.30				
13	22	12.20		13	22	12.20

∴ 1327 = + 37.20

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 2.85 1877. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,				
Circle,				
	w | e	w | e	w | e	w | e
Level Direct,	. | .	. | .	. | .	. | .
Reversed,	. | .	. | .	. | .	. | .
Sums,	. .	. .	. .	. .
Difference,				
b.	1327	. BB.		

	h m s	h m s	h m s	h m s
Wire, I.	23 10 14.5	= 20 25 0.0	±0.1 .	.
II.	.		.	.
III.	23 12 15.0	= 20 27 0.0	.	.
IV.	+ 37.4		.	.
V.	23 12 52.4		.	.
	2 42 47.6		.	.
Sum,	20 30 4.8		.	.
	3 21.5			
Mean,	20 27 43.3		.	.
Bb,	i.s. 30 degrees	= +0.7	.	.
Cc,	.		.	.
Aa,	.		.	.
Corr'd Transit,	.		.	.
R. A.	.		.	.
Error of Timepiece,	21 41 30.0	= 21 56 0.0	.	.
	37.4			
	24 42 7.4		.	.
	2 42 47.6			
	21 59 19.8			
	3 36.1			
	21 55 43.7			

∴ Signal sent

10 sec +0.5.2

Assumed mean = +0.2 Zw

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 3d 85 1877. Instrument, 1 Observer, [illegible]

Timepiece, Chronometer. Recorder, [illegible]

Object,									
Circle,									
	w	e	w	e	w	e	w	e	
Level Direct,	.	48.05	.	.	.	.	.	.	
Reversed,	.	3.89	.	.	.	.	.	.	
Sums,	2 46	44.16	.	.	.	.	.	.	
Difference,	.	.							
b.	[327]		1313.						
	h m s		h m s		h m s		h m s		
Wire, I.	23 14	10.0 = 37.8		.	Sun dominated the [illegible]				
II.	23 14	47.8		.	no signal.				
III.	2 46	44.2		.					
IV.	20 28	3.6		.		.		.	
V.	3	21.2		.		.		.	
	20 [illegible]	42.4							
Sum,		.		.		.		.	
Mean,		.		.		.		.	
Bb,	23 15	10.0 37.8		.		.		.	
Cc,	23 15	47.8		.		.		.	
Aa,	2 46	44.2		.		.		.	
Corr'd Transit,	20 29	3.6		.		.		.	
R. A.	3	21.3		.		.		.	
	20 25	42.3							
Error of Timepiece,	1m 8.30 Am Rent	.	Signals	.		.		.	
	+ 1s.7								

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 4. 85 1877. Instrument, 8 Observer, [illegible]

Timepiece, Comp. Recorder, [illegible]

Object,											
Circle,											
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.	1327				1436							
	h	m	s		h	m	s		h	m	s	
Wire, I.	23	44	46.0	= 20	51	40+.14	=45.6				.	
II.		45	22.0		52	20+.4	=16.0				.	
							21.6					
III.			.			.					.	
	∴ 23	45	22.0	= 20	52	21.6					.	
IV.			+38.1								.	
	23	46	00.1									
V.	2	50	40.7								.	
	20	55	19.4									
		3	25.7								.	
Sum,												
	20	51	53.7			51	53.7				.	
Mean,						+ 0	27.9					
						—	16.0					
Bb,			.		∴ 1436 =		+ 11.9				.	
Cc,			.				.				.	
Aa,			.		at 9 AM		.				.	
Corr'd Transit,			.				.				.	
R. A.			.				.				.	
Error of Timepiece,			.				.				.	

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 5. 35 1877. Instrument, RT Observer, DW

Timepiece, 3451 Recorder, S.J.J.

Object,							Eclipse Moon			i Leonis	
Circle,							W.			W	
	w		e		w		e		w		e
Level Direct,	.		.		.		.		16 : 1	18 : 0	.	.
Reversed,	.		.		.		.		.		.	.
Sums,												
Difference,	− 37.20		− 0.4									
b.	− 38.4											
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	1329		.	3451		.			53.8			53.3
II.	10	53	0.0	= 10	54	43.0			18.7			14.8
III.			38.4			.			44.6			36.5
IV.	10	53	38.4			.			9.6			58.1
V.		54	43.0			.			34.5	11	19	19.7
	+ 1m 4.s6						11	13				
Sum,			.			.						
Mean,			.			.				11h	18m	36.s68
Bb,			.			.			.			− .2
Cc,			.			.			.			− .2
Aa,			.			.			.			+1.5
Corr'd Transit,			.			.			.			11h 18m 37.s8
R. A.			.			.			.			11 17 32.9
Error of Timepiece,			.			.			.			+ 1m 4.s9

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 5.35 1877. Instrument, RP Observer, Lff.

Timepiece, 3451 Recorder,

Object,	γ Cephei sp		γ Cephei s.p.		γ cephei s.p.						
Circle,	W.		W = 103° 4'		W						
	w	e	w	e	w	e	w	e			
Level Direct,	16.1	18.0	60 41		14.8	19.5	.	.			
Reversed,							.	.			
Sums,	.	.	.	.	.	.	.	.			
Difference,											
b.											
	h m s		h m s		h m s		h m s				
Wire, I.	I 30.3		23 34 14.1		(IV) 23.5		.				
II.	.		— 1 4.6		38.7		.				
III.	61.4		23 32 9.5		54.6		.				
IV.	.		11h 32m 9s.5		10.5		.				
V.	11 37 37.3				11 37 26.7		.				
Sum,	124.0 +1.30		23 35 18.7		15 34 .		.				
Mean,	11 31 1.33		Mean Wire		11 36 20.68 54.68		.				
Bb,	.		.		.		.				
Cc,	.		.		.		.				
Aa,	.		.		.		.				
Corr'd Transit,	.		.		.		.				
R. A.	.		.		.		.				
Error of Timepiece,	.		.		.		.				

76 56
4
13
90
103 4

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 6.85 1877. Instrument, ... Observer, Sill.

Timepiece, ... Recorder, ...

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	1327		3411					
	h m s		h m s		h m s		h m s	
Wire, I.	12 5 0.0		=12 6 43.2		.		.	
II.	.		−1 4.9		.		.	
III.	.		5 38.3		.		.	
IV.	∴ 1327 = −38.3		= 5.25		.		.	
V.	.		6.85		.		.	
			1.5					
			.35					
Sum,	.		35		.		.	
Mean,	.		12		.		.	
	1327		1436					
Bb,	49.		50+.4		.		.	
Cc,	24 6 19.0		= 5 20+.4		.		.	
Aa,	.		.		.		.	
	0 6 19.0		=21 5 21.6					
	38.3							
Corr'd Transit,	.5		.		.		.	
R. A.	24 6 57.8		.		.		.	
	2 58 33.8							
	21 8 24.0							
Error of Timepiece,	3 77.8		.		.		.	
	21 4 56.2		21 4 56.2					

25s.4

∴ 1436 = + 9s.4

J Burton mst.

Signal sent from Cleaves & Garges store

Fast 9s.2 at 11. Am.

Since down since Saturday

Morning last about 9.45 Am.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 7. 85 1877. Instrument, Observer,
5.35
3.50
Timepiece, Recorder,

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	34 12 14 .	.	.	.	.	.	.	.
Difference,								
b.	1327		VB					
	h m s		h m s		h m s		h m s	
Wire, I.	23 25 55.5		= 20 21 0.0			.		.
II.	+ 38.3 / 4			.		.		.
III.	23 26 35.2			.		.		.
IV.	3 2 30.4			.		.		.
V.	20 24 04.8 / 6 20.5			.		.		.
Sum,	20 20 44.3			.		.		.
Mean,	8.30 Ann Arbor Signal			.		.		.
	Bmd clock slow 0.3							
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.		.		.		.		.
Error of Timepiece,		.		.		.		.

194 / 7.6 / 7.3

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 7. 38 1877. Instrument, RA Observer, [illegible]

Timepiece, 3451 Recorder, [illegible]

Object,	6 Cam		74 Ursae		8 Cam		γ Virgin	
Circle,	E		E		E		E	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	16.7	17.4	16.8	17.2
Reversed,	.	.	.	.	17.6	17.0		
Sums,	.	.	.	.	34.3	34.4	.	.
Difference,						34.7		
b.					0.7	.7		
	h m s		h m s		h m s		h m s	
Wire, I.		6.5		55.2		48.8		57.7
II.		33.8		8.4		59.3		18.9
III.		1.3	IV 5	22.6		8.5		40.4
IV.		29.1		36.0	30	18.2		01.5
V.	12 21	58.?	12 26	50.6	12 [illegible]		12 37	23.5
Sum,		12 8 [illegible]		.		.		14 20 0 28.4 0 12.
Mean,		.		.		.	12 36	40.40
Bb,		.		.		.		.
Ce,		.		.		.		+.10
Aa,		.		.		.		−.66
Corr'd Transit,		.		.		.	36	39.84
R. A.		.		.		.	35	28 06
Error of Timepiece,		.		.		.	+ 1m	11.5 78

γ Virgo ,t α

−0 46
42 23
42 89

32 Camelop

1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, ... 187 . Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	1327		3451		312			
	h m s		h m s		h m s		h m s	
Wire, I.	13 2 0.0		= 13 3 51.0		.		.	
II.	13 2 39.0		= 13 4 30.0		.		.	
III.	.		.		2 .		.	
IV.	.		38.0		0.0		.	
V.	.		13 10 0.0		= 13 9 22.0		.	
Sum,	.		.		.		.	
Mean,	.		.		.		.	
			13 4 30.0					
			1 11.8					
Bb,	.		13 3 18.2		.		.	
Cc,	.		2 39.0		.		.	
Aa,	.		— 0 39.2		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	.		.		.		.	
			13 10 0.0					
			1 11.8					
Error of Timepiece,	.		13 8 48.2		8 48.2		.	
					+ 33.8			

+ 84° 5'
42 23
41 42
319° 18'

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 7.38 1877. Instrument, RP Observer, SW

Timepiece, 3451 Recorder, SW

Object,								
Circle,	E		E		W		W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	16 .8	17 .J	.	.	.	.
Reversed,	.	.			.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,	pr		pr		pr		bad	
b.					Mean wire			
	h m s		h m s		h m s		h m s	
Wire, I.	II 12.8		2.5		III .		.	
II.	28.0		35.5		.		.	
III.	1.0		9.8		12 49 31.5		38.7	
IV.	35.7		44.4		.		.	
V.	12 47 10.5		12 47 18.3		39.5		47.0	
Sum,	128.0 25.60		11.05 22.10 12		.		.	
Mean,	12 46 1.60		12 46 10.10		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	.		.		.		.	
Error of Timepiece,	.		.		.		.	

5.28.5
2.5

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 7.38 1877. Instrument, RT Observer, SW

Timepiece, 345 Recorder, SW.

Object,	32 ~~Urs Maj~~										
Circle,	W Cumulo			W							
	w		e	w		e	w		e	w	e
Level Direct,	17.2		17.0	.		.	.		.	.	.
Reversed,				.		.	.		.	.	.
	16 8		17 2								
Sums,	4.0		4.2	.		.	.		.	.	.
Difference,											
b. = −0.001	for			foll.			Setting for 4 Usae Min.				
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.	IV		47.9			56.0			.		.
II.			22.7			31.3			.		.
III.			57.5			5.5			.		.
IV.			32.5			38.5?			.		.
V.	12	54	7.5			14.5			.		.
			16 8 1			14 5 8					
Sum,			3 3.6 2			29.16			.		.
Mean,	12	52	57.62		53	5.16			.		.
Bb,	~~12 46 1.60~~		6 52.34	32 Usa. Maj					.		.
Cc,	12	46	4.28	E		.	W		.		.
Aa,		46	1.60			.			.		.
				12	46	10.10	12	53	5.16		
			2.68		43	26.17		3	26,17		
Corr'd Transit,			1.34	12	49	36.27	12	49	38.99		.
R. A.						+1.36			36.27		.
									2.72		
				12	49	37.63			1.36		
Error of Timepiece,			.		36	40 40			.		.
				t'-t	12m	57.23					

1.32752
9.01328
2.31424

206.17
0.1335
9.1468

∴ c = +0.140 for ce

12 48 30.00
35 28.06
t'-t 13m 1.94

+4.71
−68.−6.45 =

7.11) 47.1 (−0.66
42 6
420

84° 5'
42 23
41° 42'
sin 9.82297
9.01328
0.80969
6.45

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 7, 85 1877. Instrument, Trans. Observer, Sew.

Timepiece, Trans. Recorder, Sew

Object,																			
Circle,																			
Level Direct,	w			e			w			e			w			e			
Reversed,																			
Sums,																			
Difference,																			
b.																			
							1813						1327						
	h	m	s				h	m	s				h	m	s				
Wire, I.	21	57	0.0				0	57	10.0										
II.		39	6						39.6										
III.	21	57	39.6				24	57	49.6										
	3	3					3	2	30.4										
IV.							21	55	19.2										
V.								3	35.5										
							21	58	43.7										
Sum,							90 sec Signal												
Mean,							Sent = Fast 0.2												
Bb,																			
Cc,																			
Aa,																			
Corr'd Transit,																			
R. A.																			
Error of Timepiece,																			

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 8. 35 1877. Instrument, Pg Observer, SW

Timepiece, Gold Recorder, SW

Object,																			
Circle,																			
	w			e			w			e			w			e			
Level Direct,																			
Reversed,																			
Sums,																			
Difference,																			
b.																			
	h	m	s				h	m	s				h	m	s				
Wire, I.			45.5						18.5						11.7				
II.			2.8						47.5						32.5				
III.			19.3						14.8						53.8				
IV.			36.0						43.6						15.2				
V.	12	0	52.5				12	12	12.7				12	13	36.6				
Sum,			156.1						136.6						149.8				
			31.22						27.32						29.96				
Mean,	12	0	19.22				12	11	15.32				12	14	53.96				
Bb,	3.28						1.33						74						
Ce,	4.65												1.00						
Aa,				0		18.57	1.33			11		15.12							
	-2.68						+04						+67						
Corr'd Transit,																			
R. A.	11	58	66.07				12	9	60.56				12	13	39.05				
Error of Timepiece,							+ 1m 14s.56												

+.14
4.65
.4.65
.186
-4.65

41 20
42 13
1 3 Sec.

12 9 60.56
11 58 66.07
10 53.49
10 56.55
3.06 = -
.04 + 2.68

372 | 306 (1.12
372
340
372
180
1.12

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 8.35 1877. Instrument, RT Observer, SN

Timepiece, 345 Recorder, DW

Object, Circle,							
Level Direct, Reversed,	w . .	e . .	w . .	e . .	w . .	e . .	w . .	e . .
Sums, Difference, b.	. .		. .		. .		. .	
	1327		345				1327	
	h m s		h m s		h m s		h m s	
Wire, I.	12 18 36.0	=	12 20 20.1			.	25 2 7.0 ±	
II.	19 26.0		21 20.1			.	39.7	
III.	.		.			.	25 2 46.7	
IV.	.		39.5	=		0.0	3 6 26.9	
V.	.		.			.	24 56 19.8	
							3 35.7	
Sum,	.		12 21 20.1			.	52 44.4	
Mean,	.		— 1 14.6			.	.	
			12 20 5.5					
Bb,	.		19 26.0			.		
Ce,	.		.			.	∴ BB sum.	
Aa,	∴ 1327 =		— 39.5			.	= 0.0	
Corr'd Transit,	.		.			.	.	
R. A.	.		.			.	.	
Error of Timepiece,	.		.			.	.	
	1327		BB					

23 38 52.3 = 29 0.0 3 6 30.83

+ 39.7 3.89

23 39 3 20 3 6 26.94

3 6 26.9

20 33 5.1

3 72.0

20 29 43.1

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 9. 85 1877 Instrument, Observer, Lff.

Timepiece, Comparisons Recorder,

Object,																		
Circle,																		
	w			e			w			e			w			e		
Level Direct,	.			.			.			.			.			.		
Reversed,	.			.			.			.			.			.		
Sums,	3	10	27.39 3.89															
Difference,	3	.10	23.50															
b.	1327						RBB						1327				RBB.	
	h	m	s				h	m	s				h	m	s			
Wire, I.	23	35	48.0	=					0.0				25	4	3.0	=	21	51
II.	3	10	23.5						.						+ 40.0			0.10
III.	20	25	24.5						.				25	4	43.0			.
IV.		3	~~20.7~~						.				3	10	23.5			.
V.			~~3.8~~ 40.0						.				24	54	19.5			.
	20	26	4.5						.					3	~~35.3~~			.
		3	20.9												44.2			
Sum,									.						.			.
Mean,	20	23	43.7						.						.			.
	∴ 8.30 signal																	
Bb,	Sent +0.5.3								.				10 sent signal sent					
Cc,			.						.						.			.
Aa,			.						.						.			.
													25	11	4.0			
															40 0			
Corr'd Transit,			.						.				25	11	44.0			.
R. A.			.						.				3	10	23.5			.
													29	1	20.5			
														3	36.5			
Error of Timepiece,			.						.						~~4.2~~ .			.
															44.0			

+ 0.5.0

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 10. 85 1877. Instrument, ... Observer, L.W.

Timepiece, ... Recorder, ...

Object,								
Circle,								
Level Direct,	w . .	e . .	w . .	e . .	w . .	e . .	w . .	e . .
Reversed,								
Sums,	3 14 13.95 3.89							
Difference,	3 14 20 0.6							
b.	1327		RB		1327		R.B.	
	h m s		h m s		h m s		h m s	
Wire, I.	23 26 44 0 40.4		= 20 20 0.0		25 8 0.0 40 4			
II.	23 37 24.4				25 8 40.4			
III.	3 14 20.6				3 14 20.6			
IV.	20 23 03.8 3 20.4				21 54 19.8 3 33.3			
V.	20 19 43..4				21 50 44.5.5			
Sum,								
Mean,	∴ RB = + 0.6		at 8.30 Rec		∴ RB = − 0.5 at 10 Rec.			
Bb,								
Cc,								
Aa,								
Corr'd Transit,								
R. A.								
Error of Timepiece,								

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 11. 33. 1877. Instrument, RT Observer, Sew.

Timepiece, 94.5 Recorder, Sew.

Object,	χ Leonis		ψ Ursae Maj		Gr 1757		Gr. 1771	
Circle,	M.		M.		E.		E.	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	17.7	15.8	.	.	17.0	16.4
Reversed,								
Sums,	.	.	17.0 / 4.7	16 4 / 2.2	.	.	.	.
Difference,			2.2 / 2.5	2.5				
b. +0s.06			+0.06					
	h m s		h m s		h m s		h m s	
Wire, I.		23.6		10.5		49.6		17.5
II.		44.7		41.2		0.8		8.1
III.		6.7		10.7		11.7		58.6
IV.		27.8		41.5		22.5		49.2
V.	11 0	49.3	11 5	11.7	11 11	33.9	11 18	39.5
Sum,		15 21 / 30 42		11 56 / 23.12		11 85 / 23.70		17 29 / 34.58
Mean,	11 0	6.42	11 4	11.12	11 11	11.70	11 16	58.58
Bb,		+.05		+.08		+.09		+.13
Cc,		−.14		−.19		+.21		+.33
Aa,	11 0	6.33					16	59.04
	+.50	−.25	−.06	+.03	−.21	+.10	−.91	+.45
Corr'd Transit,	11 0	6..08	4	11.04	11 11	12.10	11 16	59.49
R. A.	10 58	47.31	11 02	47.31	11 9	48.63	11 15	35.73
Error of Timepiece,	1m	23s.77	1m	23s.73	1m	23.47	1m	23s.96

1 23.73
23.47
1 23s.60

140 | 710 | 1.51
700
400

11 16 59.04
0 6.33
16 52.71
58 42.31
α'−α 16 53.42
+ 0s.71
−.91−.50

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 11.33 1877. Instrument, R.T. Observer, S.W.

Timepiece, 3457 Recorder, S.W.

		w	e	w	e	w	e	w	e
Object, Circle,									
Level Direct, Reversed,		. .	. .	. .	. .	. .	. .	. .	. .
Sums, Difference, b.		. . 3457	. .	. . 1327	. .	. . 312	. .	. .	. .
		h m s		h m s		h m s		h m s	
Wire,	I.	11 24 10.5		——— .		11 23 28.0			.
	II.	11 24 42.5 (1) 23.6		———		11 24 0.0			.
	III.	11 23 18.9		.		11 23 18.9			.
	IV.	11 37 14.5 =		11 30 10.0		+ 41.1			.
	V.	−1 73.60		.		.			.
Sum,		11 20 50.90		.		.			.
Mean,		30 10.00		.		.			.
Bb,		11.33 = 40.90		.		.			.
Cc,		8.33 = 39.5		.		.			.
Aa,		3 = 1.4 / 0.5		.		.			.
Corr'd Transit,		.		.		.			.
R. A.		. May 11.85		. 3 18 20.51		. May 11.90			.
Error of Timepiece,		. 1327		3.89 . 3 18 16.62		.			.

23 45 42.0 = 20 25 0.0

41.1

23 46 23.1

3 18 16.6

20 28 6.5

3 21.2

Slow = 20 45.3

8.33 signal sent Slow 1.53

25 14 55.0 = 21 54 0.0

41.1

25 15 36.1

3 18 16.6

21 57 19.5

3 35.8

21 53 43.7

∴ 10 sec signal sent

Fast 0.53

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 12. 35 1877. Instrument, RT + chron. Observer, ...

Timepiece, 312 Recorder, ...

Object,			32 Camelop									
Circle,	n (25 wires)		n									
	w		e		w		e		w		e	
Level Direct,	.		.		18.5		15.0		.		.	
Reversed,	.		.						.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.					SW				AS		SW	
	h	m	s		h	m	s		h	m	s	
Wire, I.		36	43.7	II		44	35.6	III			.	IV
II.			51.6			45	2.8				.	
III.			59.5				10 3 36.4 44 0			X	.	missed by chron: failing
IV.			7.5			46	42.2 19.9				.	
V.			15.0				45.7 53.8				.	
Sum,			.				.				.	
Mean,			.				.				.	
Bb,			.				.				.	
Ce,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.			.				.				.	
Error of Timepiece,			.		/		.				.	

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 2. 35 1877. Instrument, RP & Chron. Observer,

Timepiece, 312 Recorder,

Object,	32 Camelop				32 Lynx														
Circle,	W				W														
	w				e				w				e				w				e			
Level Direct,	.				.				18	7			15	0			.				.			
Reversed,	.				.				17	8			16	0			.				.			
Sums,	.				.				36	5			31	0			.				.			
Difference,									31.0															
b. + 0.14									5.5															
	SW								SW								SW							
	h	m	s						h	m	s						h	m	s					
Wire, I.	V	57	48.0						I	5	58.7						II		22.7				III	47.0
II.		54	55.6							6	2.6								26.8					57.0
III.			22.3								6.6								30.7					54.9
IV.			29.8								10.6								34.8					59.1
V.			56.5							6m	14.8								38.7				7	3.2
		57	53.8																					
			31.0																					
			38.6																					
			51.1																					
Sum,			13.0								933								1537					7142
			.								18.66								30.74					42.84
Mean,			.								6.66								30.74				6	54.84
Bb,			.								.								.					+.15
Cc,			.								.								.					−.14
Aa,			.								.								.					.
Corr'd Transit,			.								.								.				6	17.85
R. A.			.								.								.				6	10.75
Error of Timepiece,			.								.								.				+	44.10

6.66
54.84
43.20
104.80
34.93
20
54.93

30.74
19.24
49.98
24.99
30
54.99

S − R = + 0.06

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 12.35 187 . Instrument, PT Zchum Observer, ...

Timepiece, 312 Recorder, ...

Object,					17 Can ven			
Circle,	W		W		E		E	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	17 .8	16.0	.	.
Reversed,	.	.	.	.			.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	SS		SW.		NS		SW	
	h m s		h m s		h m s		h m s	
Wire, I.	IV	11.3	V	35.4	I	11 47.6	II	11.0
II.		15.2		38.5		47.0		15.6
III.		19.3		43.5		51.8		20.0
IV.		23.2		47.4		56.6		24.8
V.		27.2		7m 51.6		12 1.1		29.4
Sum,		96 2 19.24		216 5 43.30		19 9 1 3,12 82		100 8 20 16
Mean,		19.24		43.30		51.82		20.16
Bb ,		.		.		+ .19		.
Cc,		.		.		+ .19		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		11 52.20		.
R. A.		.		.		13 12 4.65		.
Error of Timepiece,		.		.		.		.

43 Cmae 13h 6m 10.75

∴ 312 = + 44s.07 at 12d.35 — May.

312 1327

13 18 0.0 = 13 16 34.0

— 44.1

13 17 15.9

16 34.0

41s.9

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 12.35 1877. Instrument, R T x chron. Observer,

Timepiece, 312 Recorder,

		w	e
Object,			
Circle,			
Level Direct,		.	.
Reversed,		.	.
Sums,		.	.
Difference,		.	.
b.			

		h	m	s
Wire,	I.			.
	II.			.
	III.			.
	IV.			.
	V.			.
Sum,				.
Mean,				.
Bb,				.
Ce,				.
Aa,				.
Corr'd Transit,				.
R. A.				.
Error of Timepiece,				.

48.29

48.46

$S - R = -0^s.17$ (17 Can. Dmeds.)

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 12.35 1877. Instrument, RT x chron. Observer,

Timepiece, 312 Recorder,

Object,								
Circle,	E		E		E			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	AS		SLO		AS			
	h m s		h m s		h m s		h m s	
Wire, I.	IV 38.0		IV 13 [7]47.1		V 35.7			.
II.	43.8		12.0		40.1			.
III.	12 48.4		17.0		45.0			.
IV.	53.4		21.6		49.7			.
V.	58.0		26.1		13 54.6			.
Sum,	24 16 48 32		8 38 16.76		2 25 1 45.02			.
Mean,	12 48.32		16.76		45.02			.
Bb,	+0.19		.		.			.
Ce,	+.19		.		.			.
Aa,	.		.		.			.
Corr'd Transit,	12 48.70		.		.			.
R. A.	12 4.65		.		.			.
Error of Timepiece,	+ 44.05	3	.		.			.

51 82
48.32
45.02
145.16
48.29

20.16
16.76
36.92
18.46
20
48.46

$S - \pi = -0^s.17$ (17 Can. Dmah.)

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 13. 85 187 . Instrument, P.T. Observer, S.W.

Timepiece, 3451 Recorder, S.W.

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	13 85 .	.	.	.	.	.	.	.
Sums,	11.33 = 40.9 / 2.5 / 1.1 / 42.0		− 0s.45 / .45 / 22 / 1.12	.	.	.	.	.
Difference,								
b.	1327.		B.B.		1327.		B.B.	
	h m s		h m s		h m s		h m s	
Wire, I.	23 53 32.0 =		20 25 0.0		25 19 47.0 =		21 51 0.0	
II.	+ 42.0	.		.	+ 42.0	.		.
III.	23 54 14.0	.		.	25 20 29.0	.		.
IV.	3 26 9.7	.		.	3 26 9.7	.		.
V.	20 28 4.3	.		.	21 54 19.3	.		.
	3 21.2	.		.	3 35.3	.		44.0
Sum,	20 24 43.1	.		.	21 50 44.0	.		16.0
Mean,	∴ 8.30 the Signal sent	.		.	∴ 10th Signal = +0.5	.		.
Bb,	+0.9	.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.		.		.		.		.
Error of Timepiece,		.		.		.		.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 14.35 1877. Instrument, RT Observer, SCD

Timepiece, 3451. Recorder, SCD.

Object,	ν Draco		ν Serpis ?		γ Ursae Maj		β Virgo.	
Circle,	W.		W.		W		W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	14.8	14.2	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.								
	h m s		h m s		h m s		h m s	
Wire, I.		37.4		30.2		3.6		8.6
II.		39.7		51.6		35.7		29.8
III.		41.8		—		8.2		51.5
IV.		44.0		—		40.2		12.3
V.	11 27	46.3	11 32	55.5	11 42	12.3	11 46	34.2
Sum,		209.2 418.4		.		1000 2000 12		136.2 2724 24
Mean,	11 25	41.84		.	11 41	8.00	11 45	51.24
Bb,		.		.		.		.
Cc,		— .44		.		— .20		—.14
Aa,	-1.35	41 .40		.	-.16	.	+.65	51.10
Corr'd Transit,		25 41.40		.		41 7.80		51.10
R. A.		24 9.7		.		39 36.05		44 19.40
Error of Timepiece,		+1m 31.7s		.		+1m 31.75s		1m 31.70s

1327 3451

11 48 46.0 = 11 56 0.5

28.8 −1 31.7

11 54 28.8 ∴ 3451 = +1m 31.72

+7.2

42.8

45 51.10
25 41.40

20 9.70
20 9.7

1877phae.proj.1794W

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 14. 85 1877. Instrument, ... Observer, Hill.

Timepiece, ... Recorder, ...

Object, Circle,				
Level Direct, Reversed,	w . . / e . .	w . . / e . .	w . . / e . .	w . . / e . .
Sums, Difference, b.	. .	. .	. .	. .
	1327	B.B.	1327	394
	h m s	h m s	h m s	h m s
Wire, I.	23 55 29.0	20 13 0.0	25 29 43.0	21 57 0.0
II.	43.1	.	43.1	.
III.	23 56 12.1	.	25 30 26.1	.
	3 30 6.3	.	3 30 6.3	.
IV.	.	.	22 0 19.8	.
V.	20 26 5.8	.	3 36.3	.
	3 20.9	.		
Sum,	20 22 45.9	.	21 56 43.5	.
Mean,	∴ 8.30 Signal Sent Slow 0.9	.	.	.
Bb,	.	.	.	.
Cc,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	.	.	.	.
Error of Timepiece,	.	.	May 15.30 . 1327	. Bond 394.

1327 1436

25 13 6.0 = 21 40 10+8
43.1
25 13 49.1
3 30 6.3
21 43 42.8
3 33.6
21 40 9.2
21 40 15.2

+ 4.0 of HC
= −12.0 of Boston.

11 9 18.0 = 7 35 0.0
43.4
11 10 01.4
3 34 2.8
7 35 58.6
1 14.7
7h 34m 43.9

∴ 394 has lost 0.4 in 9.6
= 0.04 per hour.

31 35
21 57
9h 38m
= 9h.6

added 2 groups.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 15.85 1877. Instrument,..... Observer, Sw.

Timepiece,..... Recorder, Sw.

Object,																			
Circle,																			
	w			e			w			e			w			e			
Level Direct,	.			.			.			.			.			.			
Reversed,	.			.			.			.			.			.			
Sums,	.			.			.			.			.			.			
Difference,																			
b.	1327						394												
	h	m	s				h	m	s				h	m	s	h	m	s	
Wire, I.	24	14	26.0	=			20	38	0.0						.			.	
II.			43.7						.						.			.	
III.	24	15	09.7						.						.			.	
IV.	3	34	2.8						.						.			.	
V.	20	40	06.9						.						.			.	
		3	23.3						.						.			.	
Sum,	20	37	43.6						.						.			.	
Mean,	Removed 10 grms. 8.45 Aw								.						.			.	
Bb,			.						.						.			.	
Cc,			.						.						.			.	
Aa,			.						.						.			.	
	1327						394												
Corr'd Transit,	25	33	39.0	=			21	56	0.0						.			.	
R. A.			43.7						.						.			.	
	25	31	22.7																
	3	24	2.8																
Error of Timepiece,	21	57	19.9						.						.			.	
		3	35																
	3	35	.9																
	21	55	44.0																

Signal 10 Aw = 0.0

added 9 grams.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 16. 31 1877. Instrument, RT Observer, Lw

Timepiece, 3451 Recorder, Lw

Object,	ψ Ursae Maj				θ Serpis				9 Gr 1771				58 Ursae						
Circle,	W.				W				W				E						
	w			e			w			e			w			e			
Level Direct,										14.5		13.5	14.2			13.8			
Reversed,													14 5			13 5			
													8.7			7.3			
Sums,													7.3						
Difference,													1.4						
b.													+0s.03						
	h	m	s		h	m	s		h	m	s		h	m	s				
Wire, I.			25.2				43.0				33.5				32.7				
II.			55.2				5.5				23.4				2.6				
III.			25.6				27.6				14.3				31.9				
IV.			55.4				49.6				4.5				1.2				
V.	11	5	26.0		11	10	11.6		11	19	54.8		11	26	30.2				
			187 4				1367				1305				986				
Sum,			3748				27.34				26 10				19.72				
			12								12				12				
Mean,	11	4	25.48		11	9	27.34		11	18	14.10		11	25	31.72				
Bb,			+.05 .00				+.03				+0.06				+.03				
Cc, +0s.14 (E)			−.20				−.14				−.33				+.20				
Aa,		4	25.23		11	9	27.23			18	13.83				+.01				
	−.06		+.01		+.46		+.09		−.91		−.22		−.04						
Corr'd Transit,		4	25.22 .24			9	27.32 .14			18	13 61 14 .05			25	31.965				
R. A.	11	2	47.22		11	7	49.20		11	15	55.54 49 20		11	23	54.27				
Error of Timepiece,		1m	38s.00 .04			1m	38s.12 .94		?	1m	38.07 .34			1m	37s.69				
		1827				394													

11 38 18.0 = 8 0 0.0

3451

11 43 39.0 = 11 46 0.5

11 44 32.0 = 11 46 53.5

− 1 37.94

45 15.56 11 45 15.56

∴ 1827 = − 43.56

7 46.34

46.60

− 0.26 = +0s.2 (+0s.19)

− 137

1m 38.12

1m 38s.00

1 37.69

∴ Error 3451 = +1m 37.94

16s.35

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 16. 95 187 . Instrument, Observer,

Timepiece, Recorder,

	w	e	w	e	w	e	w	e
Object, Circle,								
Level Direct, Reversed,	. .	. .	. .	. .	May 17. 85 . .		. .	. .
Sums, Difference, b.	. .	1327	. .	394	16 35 / 1.5 .	1327	53 27 80 43.16 44.16 .	394
Wire, I.	h m s 23 6 11.0	=	h m s 19 26 0.0		h m s 23 32 11.0	=	h m s 19 48 0.0	
II.	44 0 .				44.4			
III.	23 6 55 0 / 3 37 59.4				23 32 55 4 / 3 41 56.0			
IV.	19 28 55.6 / 3 11 5				19 50 59.4 / 3 15 1			
V.	19 25 ~~54.0~~ 44.1				19 47 44.3			
Sum, Mean,	7.30 Added 2gr. Removed replaced at 9.10 Am.				added 2 grains 8 A.m.			
Bb, Ce, Aa,	24 44 27.0				1327		394	
Corr'd Transit, R. A.	44.0 / 24 45 11.0 / 3 37 59.4 / 21 7 11.6				25 34 31.0 / 44.4 / 25 35 15.4 / 3 41 56.0		50 0.0	
Error of Timepiece,	3 27.6 / 21 3 44.0				21 53 19.4 / 3 31.2 / 21 49 44.2			

9.10 Am removed 2gr.

added 30 grams.
10 Am.
Signal Sent 0s.0
Removed 31 grams.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 18.35 1877. Instrument, RT. Observer, Lw

Timepiece, 3451 Recorder, Lw

Object,	b Canes Venat	20 Comae	24 Comae Seq.	γ Virginis
Circle,	E	E	W	W
Level Direct, Reversed,	w: e:	w: 14:1 e: 15:3	w: 14:7 e: 15:0	w: e:
Sums,	. .	14 7 / 8.8 ; 15.0 / 10 3 / 8.8 / 1.5	. .	. .
Difference, b. −0s.04				
	h m s	h m s	h m s	h m s
Wire, I.	39.2	33.5	0.2	30.2
II.	6.6	56.6	22.7	51.6
III.	34.3	19.7	45.2	13.3
IV.	2.2	42.8	7.7	34.7
V.	12 22 29.7	12 26 5.8	12 31 30.1	12 37 35 5
Sum,	112.0 / 22.40	158.4 / 31.68	105.9 / 21.18	18 53 / 3 23.06
Mean,	12 21 34.40	12 25 19.68	12 30 45.18	12 37 13.06
Bb, b = −0s.04	−.04	−.04	−.04	−.03
Cc, c (ε) = +0.14	−.19	−.15	+.15	+.14
Aa, a = +0s.2	+.01	+.08	+.08	+.16
Corr'd Transit,	21 34.17	25 19.57	30 45.00	37 13.33
R. A.	12 19 50.10	12 25 35.11 −11.0	12 29 0.15	12 35 28.02
Error of Timepiece,	1m 44s.07 +.38	1m 44s.46 +.30	1m 44s.85 −.30	1m 45s.31 −.28
	1m 44s.45	1m 44s.76	1m 44s.55	1m 45s.03

.176
.555
1.03
279

+1m 44s.70

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 18.35 1877. Instrument, RT Observer, SW

Timepiece, 3451 Recorder, SW.

	w	e	w	e	w	e	w	e
Object, Circle,								
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	1327		3451		394			

	h m s	h m s	h m s	h m s
Wire, I.	12 38 10.0	= 12 40 38.5		
II.	38 19.0	44.7 58.8	8 52 0.0	
III.				
IV.	12 39 12.0	= 12 41 40.5		
V.		− 1 44.70		
		12 39 55.80		
Sum,		39 12.00		
Mean,	∴ 1327 =	− 43.80	at May 18.35	
Bb,			43.80	
Cc,			+ .25	
Aa,			44.05	
Corr'd Transit,				
R. A.	May 18.85.			1 44.70
				1.69
				1 46.4
Error of Timepiece,	1327	394		3451
	24 53 19.0		1327	

44.0

24 54 3.0

3 45 52.5

21 8 10.5

3 27.8

52.9

21 5 42.7

Put 394 back to 2.5.0 and add 30 grams at 9.23 Am.

1h 36 10.0 = 1h 38 40.5

1 46.4

1 36 54.1

1 36 10.0

Error 1327 by 3451 = + 44.5.1

1327 394

25 44 29.0 = 21 56 0.0

44.0

25 45 13.0

3 45 52.5

21 59 20.5

3 36.1

21 58 44.4

∴ Error Rent = Slow 0.5.3

Removed 31 grams at 10.18 AM

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 19.35 1877. Instrument, RT Observer, Sw.

Timepiece, 3451 Recorder, Sw.

Object, Circle,	χ Ursae Maj W	β Virginis W	γ Ursae Maj W.	4 H Draco W ?
	w | e	w | e	w | e	w | e
Level Direct,	. | .	. | .	13.5 | 14.3	17.0 | 14.1
Reversed,	. | .	. | .		13.0
Sums,	. .	. .	. .	13 7 | 14.2
Difference,				13.0 | 15.1
b. = −0.04				6.7 | 9.3
				6.7
				26
	h m s	h m s	h m s	III h m s
Wire, I.	20.1	24.8	48.5	26.5
II.	52.0	46.2	0.5	3.0
III.	24.4	7.5	12.7	21.2
IV.	56.2	28.7	24.5	38.6
V.	11 42 28.6	11 46 49.9	11 49 37.3	12 8 56.5
Sum,	1813	1571	1235	1658
	36.26	31.42	24.70	33.16
Mean,	11 41 24.26	11 46 7.42	11 49 12.70	12 8 21.16
Bb,	−.06	−.03	−.07	−.16
Cc,	−.21	−.14	−.24	−.68
Aa,	.	7.25	.	12 8 20.32
	−.16	+.65	−.36	4.00 −2.90
Corr'd Transit,	41 23.99	.	49 12.39	.
R. A.	11 39 35.99	11 44 19.37	11 47 24.58	12 6 32.39
Error of Timepiece,	+1m 48.00	+1 47.88	+1m 47.81	.

12 6 32.39
44 19.37
α′α 22 13.02
8 20.32
46 7.25
t′t 22 13.07
− .05
− 290 − 65
355

log I = 1.62855
Co δ = 9.20729
2.32126
209.53

21.16
19.79
2) 1.37
.68

9.8325
9.3073
9.1398

Add 0.14 for CE.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 19. 35 1877. Instrument, RT Observer, Edw.
Timepiece, 3451 Recorder, E. P.

Object,	4 H Draco		η Virginis					
Circle,	8 374° 5'		E					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	13 .0	15 .1	.	.	.	.
Reversed,	.	.			.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.					1327		3451	
	h m s		h m s		h m s		h m s	
Wire, I.	V 14.2		44.3?		12 51 48.0		20.2	
II.	31.5		5.5		12 54 42.0		= 12 56 10.2	
III.	49.5		26.5		" 20.0		52.2	
IV.	6.8		48.0		12 58 0.0		= 13 0 32.2	
V.	12 12 24.6		12 16 9.1		1327		394	
Sum,	1266 32		133.4		12 53 18.0		= 9 3 0.0	
Mean,	12 11 49 32		12 15 26.68					
Bb,	12 8 19.99		— .03		12 58 20.0		= 13 0 32.2	
Ce,	— .16		+ .14				— 1 47.9	
Aa,	+ .68		15 26.79				12 58 44.3	
	12 8 20.31		+ .02				0.0	
	−2.90		+.67	26.81			44.3	
Corr'd Transit,			— .03		12 51 48.0		= 12 20.2	
R. A.			+ .14				— 1 47.9	
	12		12 13 39.00				32.3	
							48.0	
Error of Timepiece,			+ 1m 47.81				44.3	

+1m 47.81
47.88
47.81
48.00
35.0
+1m 47.88

12 6 32.39
α'−α 56.61
15 26.79
8 20.31
56.48
0.13
= +0.03
+.67 +2.90
3.57

1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 20. 83 1877 Instrument, Comparison Observer, Lw

Timepiece, Recorder, Lw

Object,								
Circle,	19.35 = −44.3		−0.5 Sunday.					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	May 19.35		.	.	May 19.85		.	.
Difference,								
b. 1327	1327		394		1327		394	

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.	12	53	18.0 44.3	= 9	3	0.0	24	43	14.0	= 20	46?	0.0
	II.	12	54	02.3			~~44.5~~			44.5			.
	III.	3	49	49.1	~~9~~	~~3~~	~~44.5~~	24	43	58.5			.
	IV.	9	4 1	~~43.2~~ 29.2	~~3~~	~~49~~	~~49.1~~	~~3~~	49	49.1			.
	V.	9h	2	44.0			.	20	~~54~~	09.4			.
										35.84			.
Sum,		∴ 394 = +16.0					.			.			.
Mean,				.			.	∴ 394 =	50	44.0 +16.0			.
Bb,				.			.			.			.
Cc,				.			.			.			.
Aa,				.			.			.			.
		May 20.85			1436.								
Corr'd Transit,		23	36	5.0	= 19	40	20.8			.			.
R. A.				44.8			.			.			.
		23	36	49.8		39	50.4						
		3	53	45.6									
Error of Timepiece,		19	43	4.2			.			.			.
			3	13.8			+ 30.4						
		19	39	50.4			16.0						
					∴ 1436 =		+ 14.4						

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 20.83 187 . Instrument, Observer, Lw

19 35 Timepiece, Recorder, Lw

Object, 1 5.5				
Circle,	−44.3 −7			
Level Direct,	w 45.0 e	w e	w e	w e
Reversed,				
Sums,				
Difference,				
b.	1327	Rmd 394	1327	394
	h m s	h m s	h m s	h m s
Wire, I.	23 48 0.0 =	19 52 0.0	25 31 17.0 =	21 35 0.0
II.	45.0		45.0	
III.	23 48 45.0		25 32 02.0	
IV.	3 53 45.6		3 53 45.6	
V.	19 54 59.4		21 38 16.4	
	3 15.8		3 32.7	
Sum,	19h 51m 43.6s		21 34 43.7	
Mean,	3.3			
	3451 1.7	394		
Bb,	23 53 37.0 =	19 55 0.0	26 7 23.0 =	
Cc,	5.0		45.0	
Aa,	−41 47.9		26 8 8.0	
	1 52.9		3 53 45.6	
Corr'd Transit,	23 51 44.1		22 14 22.4	
R. A.	3 53 45.6		3 38.6	
	19 57 58.5			
	3 16.3		22 10 43.8	
Error of Timepiece,	54 42.2			

∴ assume 394 = +0s.4 at 8 A.M.
Removed 15 grms for 1 hr.

∴ 394 = +0s.2

~~Added~~
Removed 1 gramm.
∴ 15 gr remain.

(16 grams seems to be the right weight.)

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 21 85 187 . Instrument, Observer,

Timepiece, Recorder,

	w	e	w	e	w	e	w	e
Object,								
Circle,								
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	19.75	= −44.3	−0.5	.	.	.	.	.
Difference,	May 21.33	−1.0	−1.0	May 21.85				
b.	1327	−45.3	394		1327	=	394	

	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	11	52	59.0	= 7	55	0.0	13	33	54.0			0.0
II.			+45.3			.			45.5			.
III.	11	53	44.3			.	23	34	39.5			.
IV.	3	57	42.2			.	3	57	42.2			.
V.	7	56	2.1			.	19	36	57.3			00.0
		−1	18.0			.		3	12.8			44.5
Sum,	7	54	44.1			.	19	33	44.5			15.5
Mean,						.						.

∴ 394 = Slow 0ˢ.5

Bb, ∴ 394 = Slow 0ˢ.1 .

Cc, . .

Aa, added at 8:20 P.M . .

Corr'd Transit, 1 gram + 0gr.3 . May 21.85 . 0ˢ.5 .

R. A. . 19.35 2.5 1.25 .

44.3

45.55

Error of Timepiece, . . 0ʰ 30ᵐ . 3ˢ. .

1327 394

0 30 3.0 = 20 30 0.0

45.55

24 0 30 48.55

3 57 42.2

20 33 6.4

3 22.0

20 29 44.4 29 44.4

+ 15ˢ.6

∴ Slow 0ˢ.4

Correct for 0ˢ.2 added at 10ʰm

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 12. 85 1887. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object, Circle,							
Level Direct, Reversed,	w . .	e . .	w . .	e . .	w . .	e . .	w . .	e . .
Sums, Difference, b.	Add 8 grams 8.357 M.						
Wire, I.	h m s 13 27.		h m s 394		h m s		h m s	
	1 31 13.00		21 31 0.00					
II.	45.3							
III.	1 31 58.3							
IV.	3 57 42.19							
V.	21 34 16.1							
	−3 32.03							
Sum,	21 30 44.07		21 31 0.0					
Mean,	1327		21 30 44.07					
			+ 15.93					
			394					
Bb,					22.85			−.45
Ce,	h m s		h m s		19.35		−44.3	−.35
Aa,	23 46 51.0		= 0.0		3.5		−1.5	
	+ 45.8						45.8	
Corr'd Transit,	23 47 36.8							
R. A.	4 1 38.7							
Error of Timepiece,	19 45 58.1							
	3 14.3							
	19h 42m 43.8							

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 22.85 may 1877. Instrument, RT Observer, SEC

Timepiece, 3451 Recorder, SW

Object,	ℓ Andromedae						
Circle,	W.		E				
	w	e	w	e	w	e	w	e
Level Direct,	15.1	17.2	14.8	17.4	.	.	.	.
Reversed,					.	.	.	.
Sums,	.	.	15 1	17 2	.	.	.	.
			9.9	14 6				
Difference,				9.9				
b. = − 0s.16				4.7				
					3451		394	
	h m s		h m s		h m s		h m s	
Wire, I.	11.8		.		24 10 37.0		= 20 4 0.0	
II.	36.1		.		− 0 1 57.33			.
III.	0.2		.		24 8 39.67			.
IV.	24.5		.		4 1 38.74			.
V.	0 4 48.2		.		20 7 0.93			.
Sum,	120.8		.		3 17.74			.
	24 16							
Mean,	0 4 0.16		—		20h 7m 43s.20			.
Bb,	1.11	− .18		.		.		.
Ce, C = +0.14 (E)	1.13	− .15	,13	.	May 22.91.			.
Aa,	+0.27	.	1.8	.	(3451)			.
			,23		1 52 54.5 =		21 46	
			1 57.33		1 57.33			
Corr'd Transit,	0 3 59.83		+1 57.56.		1 50 56.94			.
R. A.	0 2 2.50		Er. of atran. May 22.91		4 1 38.74			.
					21 49 18.20			
					− 3 34.50			
Error of Timepiece,	0h 1m 57s.33			.	21 45 43.70			.
					21 46			

−.15
−.18
0.33

0 4 0.16
0.33
0 3 59.83

14 39
42 23
27 54
332 6

May 22d.199.
(3457)
2 21 43 = 2 19 00

00 16.30
16
+.30 Signal

May 23d.34
3451 1327
12 26 44 = 12 23 60

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1877phae.proj.1794

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 23, 85 1877. Instrument, ... Observer, W.

Timepiece, ... Recorder, W.

Object,								
Circle,		&						
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	3451	394	1327	394				
Difference,	0h 50m 43 =	20h 40m	0 56 59. =	20 49				
b.	+2 00.53	23.85	+46.89					
	24 48 42.4h	m s	h m s	h m s	h m s		h m s	
Wire, I.	−4 5 35.30	1.00	0 57 45.19					
II.	20 43 07.17	3.2	−4 5 35.30		3451		1327	
III.	−3 23.65	57.33	20 52 9.89		1 28		20.5 = 1 25 35	
		+2 00.53	− 3 25.14				(a transit 23.85 may)	
IV.	20 39 43.52		44.75					
V.	20 40		66					
			15.25					
Rate of 3451 = +3.20	16.48		16					
Sum,	12		−.75 (394).				−.75	
	+.48	Error of clock 394					+.48	
Mean,	Took off 16 grms. for 30m at 21.30.						1.23 dif.	

This makes Error of 394 at May 23d 22hrs = 48 − .21 = +.27 Signal.

Bb, assume that the Chron. 3451 is right in preference

Cc, to the Clock 1327 as the rate was established later.

Aa, Put back 16 grms at (22hrs).

Corr'd Transit,	Comparison at 23.d.94.		
R. A.	3451	1327	
	2 38 10.5 =	2 35 25	
	−2 00.82	+46.37	
Error of Timepiece,	2 36 9.68	2 36 11.37	
		2 36 9.68	
	23.94	23.94	1.69 dif.
	2.85	19.25	
	1.09	4.59	
	3.2 rate.	.45	
	218	2295	
	327	1836	
	3.49	2.0655	
	1 57.33	44.3	
	2 00.82 Error.	46.37	

42 22
28 25
13 58
446 52

3451 # 394h 24m

3 35 10.5 = 23h 24m

− 2 00.95

27 33 9.55

− 4 5 35.30

23 27 34.25

− 3 50.60

43.65

60

10.25

16

+.35 = (Er. of 394)

23.98
22.85
1.13
3.2
226
339
3.616
1 57.33
+2 00.95

1327 1327 1327 394

h
0 36 55.5 = 8 34 10 } 3 39 26 = 23 31

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 24. 1877. Instrument, ... Observer, W.

Timepiece, ... Recorder, W.

Object,																			
Circle,																			
	May 24, 18	w		e		w		e		w		e		w		e			
Level Direct,		.		.		.		.		.		.		.		.			
Reversed,	3451	1327		.		.		.		.		.		.		.			
	8 - 27 - 54 = 8 - 25 - 8 .																		
Sums,		.		.		.		.		.		.		.		.			
Difference,	1327	394																	
b.	8 - 27 - 13 = 4 - 18																		
	3451	394																	
	8 - 35 - 00 = 4 - 23	h	m	s		h	m	s		h	m	s		h	m	s			
Wire,	I.			.				.				.				.			
	II.			.				.				.				.			
	III.	3451/5		.		1327		.				.				.			
	IV.	15h 4m 42		=		15h 2m 55		.				.				.			
	V.			.				.				.				.			
		3451				394													
Sum,		15 8 5		=		10h 55m		.				.				.			
Mean,		.				.						.				.			
		1327				394													
Bb,		15 9 19		=		11 59		.				.				.			
Cc,				.				.				.				.			
Aa,				.				.				.				.			
Corr'd Transit,				.				.				.				.			
R. A.				.				.				.				.			
Error of Timepiece,				.				.				.				.			

S

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1877phae.proj.17944

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 24 35 187 . Instrument, RT Observer, F W

Timepiece, D45 1 Recorder, F. W.

Object,	43 Comae	3 Tusa maj	3 Bootis	2 Draco
Circle,	E	E.	E	(E)
	w / e	w / e	w / e	w / e
Level Direct,	16.2 / 17.4	. / .	. / .	15.5 / 18.2
Reversed,	17.4 / 16.2	. / .	. / .	16.5 / 17.2
Sums,	6|33.6 / 2|33.6	. / .	. / .	32.0 / 35.4
	16.8 / 16.8			32.0
Difference,				3|3.4
b.				Sum. 11 = 6
	h m s	h m s	h m s	h m s
Wire, I.	2.25	39.4	7.4	I 11.0
II.	46.4	12.0	30.3	19.6
III.	6.3	45.0	53.0	27.5
IV.	.	18.3	15.1	36.0
V.	13 8 59.3	51.2	13 51 38.0	1 43.5
Sum,	.	165.9	14 3 8 / 120 / 263.8	1376 / 252
Mean,	.	.	13 50 52.76	14w 1m 27s.52
Bb,	.	.	.	1 40.5
Cc,	.	.	.	14 3 08.02
Aa,	.	.	.	− .24 / + .83
				−.91 3 8.61
Corr'd Transit,	.	.	.	.
R. A.	.	.	.	14 1 7.99
Error of Timepiece,	.	.	.	.

b286
1.~~2175~~
9.6265
1.7010
2.0020

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 24.[5] 1877. Instrument, R. Transit Observer, LW.

Timepiece, Chron. 3457 Recorder, LW.

Object,	ξ Draco,		ξ Bootis		λ Bootis		ζ Bootis	
Circle,	W		W		W.			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	16.5	17.2	.	.
Reversed,	.	.	.	.			.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b. = −0ˢ.11								
	h m s		h m s		h m s		h m s	
Wire, I.	.		14 11 21.8		56.5		35.3	
II.	.		44.2		37.2		58.0	
III. mean =	9:62		6.8		47.1		20.1	
IV.	.		29.8		57.5		47.5	
V.	14 4 50.18		57.2		14 14 7.8		14 38 03.5	
Sum,	1 40.50		1548		1461		159 4	
	14 3 9.68		3096		3522		99 : 4	
Mean,	8.02		24.		14			
	21.66		14 12 6.96		14 13 47.22		14 37 19.88	
Bb,	9.9191	.83						
Ce, c = +6ˢ.35 (EE)	9.6265 3	8.61		−.11		−.16		.
	9.54556			−.33		−.51		.
Aa,	C = +.351 = aE.		+42 12ᵐ 6ˢ.52		−11	+.01		.
	−.91	+.06		−0 .03				
Corr'd Transit,		8.67		6.49	13	46.56		.
R. A.	14 1	7.99	14 10	5.82	14 11	45.73		.
Error of Timepiece,	+2ᵐ 0ˢ.68		+2 0.67		+2	0.83		.

1.6285
9.62655
2.0020
100,5

2 0.67
150

3451 = +2ᵐ 0ˢ.75

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1877phae.proj.1794

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 24.43 1877. Instrument, Rus. Transit Observer, F.W.
Timepiece, Chron. 3451 Recorder, F.W.

Object,	109 Virginis		109 Virginis		β Ursae Minor			
Circle,			W		W			
	w	e	w	e	w	e	w	e
Level Direct,	.	.			17.4	16.2	.	.	.	.
Reversed,	.	.			.	.	.	.	.	.
Sums,	.	.			.	.	.	.	.	.
Difference,										
b.							1327		3457	
	h m s		h m s		h m s		h m s		h m s	
Wire, I.		22.5			50 31.0		14 18 12.0 =		14 20 58.7	
II.		44.0			51 51.8				− 2 0.75	
III.		5.5			53 12.0		1327 s.		18 57 9 5	
IV.		26.9			54 32.5		= − 45.95		12.00	
V.	14 42 48.2		14 55 52.6				3451		394	
Sum,		147.1			179.9		14 22 57.5 =		10 10 0.0	
		29.1			59.9		− 2 0.75			
Mean,	14 42 5.42		14 53 11.98				+1 0.16			
Bb,	1327		394				14 20 56.75			
Cc,							1 0.54			
Aa,	22 41 33 =		18 30							
	+ 46.02						1327			
Corr'd Transit,	22 42 19.02		24.77				14 21 11.0 =		10 11 0.0	
R. A.	− 4 9 31.86		24.143				− 1 0.16			
	18 32 47.16		.34				14 20 10.84			
	− 3 2.30		32							
			128							
Error of Timepiece,	18 29 44.86		96							
	18 30 60		1088							
	15.14		− 45.91				1327 = − 45.91			
	15.50		− 46.02							
	− .36									

1327 394

0 18 49 = 20 07
+ 46.04

24 19 35.04
− 4 9 31.86
20 10 03.18
3 18.24
44.94
60
15.06
15.30
394 = − .24

added 16 grs for 1st ah 24.84.
Took off 16 grs at 2nd 21h 20m

1324 394
1 35 01 = 21 23
+ 46.06

1 35 47.06
− 4 9 31.86
24 26 15.20
3 30.72
44.48
60
15.52
15.30
+.02 Error of 394.

Error sent with a Correction of 15.5 instead of 16.0. To be sent from now forward.

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 24.92 1877. Instrument, ... Observer, F.W.

Timepiece, ... Recorder, F.W.

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	13 27		3 94					
	2 5 6 . =		21 52 .		.	.	.	.
Difference,	46.07							
b.	2 5 52.07		24.92					
	h m s		h m s		h m s		h m s	
Wire, I.	-49 31,86 .		47.43 .49 .		.	.	.	.
II.	21 56 20.71 .		.32 .		.	.	.	.
III.	8-3 35.65 .		98 .		.	.	.	.
	44.46 .		1.47 .		.	.	.	.
IV.	60 .		.1568 .		.	.	.	.
	15.54 .		.16 .		.	.	.	.
V.	15.50 .		45.191 .		.	.	.	.
	394 = +.04 .		46.07 .		.	.	.	.
Sum,	Signal for May 24d 22h 3				.	.	.	.
Mean,	Error est with a correction of 15.5 m ahead of 16.0.				.	.	.	.
	15.5 to be the correction from now forward.							
Bb,	.		.		.	.	.	.
Cc,	.		.		.	.	.	.
Aa,	.		.		.	.	.	.
Corr'd Transit,	.		.		.	.	.	.
R. A.	.		.		.	.	.	.
Error of Timepiece,	.		.		.	.	.	.

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1877phaer.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 25. 34 187 . Instrument, Observer, W.

Timepiece, Recorder, W.

Object,											
Circle,											
	w		e		w		e		w		
Level Direct,	.		.		.		.		.		
Reversed,	1327 .		394.		.		327 .		.		
Sums,	12 23 47 =		8 10				23 30 36 =		19 15		
Difference,	+46.20.		24,43				+46.35		.		
b.	12 24 33.20		25,34				23 31 22.35				
	-4 13 28.42		.91				-4 13 28,42				
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	8 11 04.78		182				19 17 53.93					
II.	1 20 .45		273				-3 9.69					
III.	89 44 33		29.12				44.24					
IV.	÷10		45,91				60					
	15 67		-46.20.				15.76					
	15 50						15.50					
	Error of 394 = +.17						Error of 394= +.26					
Sum,				at 19h 25m. take off 10 grs for 1 hr.								
Mean,				at 20h 25m. put back the 10 grs.								
Bb,				16 grs. is evidently too much; so at 20h 30m								
Ce,				I took off 3 dec. grains.								
Aa,												
Corr'd Transit,	1327			394								
R. A.	1 19 54 =			21 4 .								
	+46.37			25.87.								
	1 20 40.37			24.43								
	-4 13 28.42			1.44								
Error of Timepiece,	21 7 11.95			.132								
	-3 27.60			288								
				432								

44.35
60
15,65
15,50
+.15

.4608
45,91
-46,37

.227
1 56 = 394 21 40
46.38
1 56 46.38
-4 13 28.42
21 43 17.96
-3 33,51
44.45
60
15.55
15.50
+.05

Error of 394 =

1327
2 27 5 = 394 22 11
46.39
2 27 51.39
-4 13 28.42
22 14 22,97
-3 38.61
44.36
60
15.64
15.50
+.14

Error of 394 =

25,92
24,43
1,50

45,91
-46,39

25,90
24,43
1.47
32
294
441
.4704
45,91
46,38

Error 394=
Signal +.1

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, ... 187 . Instrument, ... Observer, F.M.

Timepiece, ... Recorder, F.M.

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		May 25.98 d.	.	.	.	.	.	.	.
Reversed,			.	.	.	.	.	.	.
Sums,		19 = 23 3.6	.	.	.	.	.	.	.
Difference,		+46.41	25.98						
b.		05.41	24.43			May 26.82 d			
		28.42	1.55						
Wire,	I.	36.99	46.50	h m s		h m s		h m s	
	II.	52.57	.4960	.0		3 37 = .19		44 .	
	III.	44.42	.50.			+46.67 .		26.82 .	
	IV.	60	45.91	.0		4 23.67 .		24.43 .	
	V.	15.58	-46.41.	-4		17 24.97 .		2.39. .	
		15.50	.	.19		46 58.70 .		.32 .	
		Error of 394 = +.08	.			3 14.46 .		478 .	
			.					717 .	
Sum,		1227	. 394			44.24 .		.7648 .	
Mean,	9	5 10 =	. 448			60 .		45.91 .	
		+46.48	26.20			15.76 .		-46.67 .	
						15.50			
Bb,	9	5 56.48	24.43			Error of 394 = +.26			
Cc,	-4	17 24.97	1.77						
Aa,	4	48 21.51	.32						
		-47.27	3354						
		44.24	5316						
Corr'd Transit,		60	.57						
R. A.		15.76	. 45.91						
		15.50	-46.48						
		Error of 394 = +.26							
Error of Timepiece,			.						

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1877phae.proj.1794

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 27. 32 1877. Instrument, Russ. Transit Observer, J.W.

Timepiece, Chron. 3451 Recorder, J.W.

Object,	ξ Ursae Maj. $\delta = 48°28'$	β Leonis $\delta = 15°16'$	γ Ursa. Maj	σ Virginis
Circle,	E.	E	E	E
Level Direct, w	15 .9	.	.	.
Level Direct, e	15 .6	.	.	.
Reversed, w	17 .5	.	.	.
Reversed, e	14 .6	.	.	.
Sums,	33 .4 / 30 .2	. .	. .	. .
Difference,	30 .2 / 313 .2 / .11			
b. ± 11		Not used.		Not used.
Wire, I.	h m s 38 .4	h m s 12 .3	h m s 17 .7	h m s 22 .7
II.	10 .3	34 .4	54 .5	44 .2
III.	42 .7	56 .5	31 .0	05 .7
IV.	14 .7	18 .5	7 .5	27 .3
V.	11 42 46 .5	11 45 40 .4	44 .3	49 .6
Sum,	152 .6 / 60 / 212 .6	162 .1 / 120 / 282 .1	155 .0	149 .4 / 120 / 29 .4
Mean,	11 41 42 .52	11 44 56 .42	11 49 31 .00	12 01 5 .88
Bb,	1.50 +.165 / +.36	.92 +.10	1.68 +.185 / +.402	.86 +.095 / 1.02 +.24
Cc,	1.50 .	1.04 +.244	1.71 .	.
Aa,	-.16 +.02	.48 -.04	-.35 +.03	+.54 -.05
Corr'd Transit,	11 41 43 .02	11 44 56 .72	11 49 31 .59	12 01 6 .77
R. A.	11 39 35 .83	11 42 49 .24	11 47 24 .41	11 58 58 .78
Error of Timepiece,	2 07 .19	2 07 .48	2 07 .18	2 07 .39

3451 1327 = 5 h

12 37 20.5 = 12 34 24

1327 394

12 36 40 = 8 15

11 58 58.78
11 47 24.41
11 34 37
11 35.14
−.77

.54 / .35 / .89

.185 / .402 / .159

t = 11 49 30.41

.33

t' = 12 01 5.55
t = 11 49 30.41
t'−t = 11 35.14

59 −.770 −.086 = −.09 = a.

713 / 580 / 534

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 27, 32 1877. Instrument, Rec. Transit Observer, F.W.

Timepiece, Chron. 34 51. Recorder, F.W.

Object,	4 H Draco		4 H Draco		6 Camm 4m		8 Camm 4m	
Circle,	E		W		W		W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	17.5	14.6
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b. +11								
	h m s		h m s		h m s		h m s	
Wire, I.	I 33.0		IV 49.0		1.5		6.8	
II.	50.0		6.0		29.5		35.3	
III.	07.5		24.5		57.3		4.4	
IV.	24.5		42.0		25.3		33.0	
V.	12 5 42.0		12 12 59.0		12 22 52.8		12 30 1.4	
Sum,	157.5		180.5		166.4		80.9	
	120		60		120		60	
	37.5		120.5		286.4		20.9	
Mean,	12 5 7.5		12 12 24.10		12 21 57.28		12 29 4.18	
Bb,	4.00 12 8 37.03		1 47.96 12 8 39.34		1.30	+1.43	1.35	+.15
	+.44		+.44			−.31		
Cc,	4.93	+1.16		−1.16	1.31	.	1.35	−.31
Aa,	−2.90	+.26		+.26	+.06	−.005	+.01	.00
Corr'd Transit,	12 8 38.89		12 8 38.88		12 21 57.11		12 29 4.02	
R. A.	12 06 31.71		12 06 31.71		12 19 49.98		12 27 56.73	
Error of Timepiece,	2 07.18		2 07.17		2 07.13		2 07.29	

12 8 39.34
12 8 37.03
2 | 2.31
1.16
12028
1,16
121.68
20 28
20 28
C = +1.35246 C.E.

07.19
07.18
07.18
07.17
07.13
07.29
6 | 43.14
2m 07.19 = Error of 3451

12 37 20.5
2 07.19
12 34 24.100
Error of 1327 = −48.31

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1877phae.proj.1794W

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 14 May 1877. Instrument, ____ Observer, Fitz.

Timepiece, ____ Recorder, Fitz.

Object,

Circle, May 27.32

		w	e	w	e	w	e	w	e
Level Direct,		1327							
Reversed,	/2	36. 40. =		8h. 15m.					
Sums,		+48.31							
Difference,	12	37 28.31				1327			
b.	−4	21 21.53			1	20 44 =		20 57	
	8	16 06.78				49.03			

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.	−1	21	28.			.1	21	33.	03			
	II.	15	45	50			.4	21	21.	53			
	III.		60				.21	00	11.	50			
	IV.		14.	50				3	26.	45			
	V.		15.	50					45.	05			
			−1.	00					60				
Sum,	23	1327			394				14.	95			
Mean,		18	25	= 18	55				15.	50			
		48.7			27.79				−.	55			
	23	19	13.7		27.32								
Bb,		4	21	21.53	.47								
Cc,		18	57	52.17	.83								
Aa,			3	06.41	141								
			45	7.6	376								
			60		39 01								
Corr'd Transit,			14.	24	48.31								
R. A.			15.50	− 48.10									
		394=	−1.	26									
Error of Timepiece,		added 21 grs. for two hours at 19 hrs											

Took off 1 grn. at 21 hrs, left 20 grs. for next 22 hrs

1327 / 1 45 48 = 48.78 / 1 46 36.78 / 4 21 21.53 / 21 25 15.25 / 3 30.56 / 44.69 / 60 / 15.31 / 15.50 / Error of 394 = −.19

394 / 21 22 = 48.31 / −48.78 / .89 .32 .57 .83 171 456 .47 31

1327 / 2 5 51 = 48.82 / 2 6 39.87 / 4 21 21.53 / 21 45 18.29 / 3 33.84 / 44.45 / 60 / 15.55 / 15.50 / Error 394 +.05

394 / 21 42 = .93 .32 .61 .83 183 488 .50 63 .57 48.31 48.82

1327 / 2 12 52 = 48.80 / 2 13 40.89 / 4 21 21.53 / 21 52 19.27 / 3 34.99 / 44.28 / 60 / 15.72 / 15.50 / .22

394 / 21 44 = 27.91 27.32 .59 .83 177 497 .49 48.31 48.80

Signal wrong. 2

Signal "no Error". Error of 394 = ±.22

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date,.....187 . Instrument,..... Observer, ...

Timepiece,..... Recorder,.....

Object,												
Circle,												
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	May 27/93		394									
Difference,	2 43 57 = 22 20											
b.	48,82		,93									
			,32									
	2 44	45,82	m ,61	s	h	m	s		h	m	s	
Wire, I.	4 21	21,53	,83	.			.				.	
II.	22 23	24.29	183	.			.				.	
	3	40,08	488									
III.		44.21	50.63	.			.				.	
		60	48.31									
IV.		15.79	48.82	.			.				.	
V.		15,50		.			.				.	
	Error of 394 = +.29											
Sum,			.				.				.	
Mean,			.				.				.	
Bb,			.				.				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.			.				.				.	
Error of Timepiece,			.				.				.	

24 57 1327

28δ 13h 30m } 18 0 40.5 = 17 57 40

2 10.9

17 57 29.6

57 40

−49.6 = Error of 1327

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 28.73 187 . Instrument, Observer, W.

Timepiece, Recorder, W.

Object,	β Draconis				α Herculis				γ Draconis				ε						
Circle,	W				E				W				E						
	w		e		w		e		w		e		w		e				
Level Direct,	16.7		13.0		~~15.3~~		~~14.2~~		16.0		13.9		15.6		14.2				
Reversed,	15.3		14.2						16.5		13.1		16.8		13.3				
Sums,	32.0		27.2						32.5		27.0		32.4		27.5				
	27.2								27.0				27.5						
Difference,	34.8								35.5				34.9						
b.	c=+.16								c=.18				.16						
	C. W				C.W.				C.E.										
	h	m	s		h	m	s		h	m	s		h	m	s				
Wire, I.			42.7				11.5				18.7		16.1		15.0				
II.			17.6				42.4				57.6		16.2		14.8				
III.			52.5				12.7				36.5		32.3		29.8				
IV.			27.5				43.5				15.5		29.8						
V.	17	31	2.4		17	39	13.7		17	54	54.6		32.5						
													+.08 = 6,						
													C=.23						
Sum,			142.7				123.8				182.9		C+.24 C.E,						
			~~142.7~~				60						a=-.09						
			282.7				63												
Mean,	17	29	52.54		17	38	12.76		17	53	36.58								
Bb,	1.62		+.13		~~1.44~~		.12		1.77		.14								
											-.34								
Cc,	1.64		+.39		1.44		.34		1.84										
Aa,	-.29		-.03		-.09		-.01		-.47		-.04								
Corr'd Transit,	17	29	53.03			38	13.21		17	53	36.24								
R. A.	17	27	42.14		17	36	2.29		17	51	27.09		17	51					
Error of Timepiece,		2m	10.89			2	10.92			2	~~10.93~~ 10.03								

2m 10.90 = Error 345 1

1327 394

2 8 46. = 21 41

49.79

2 9 35.79

4 25 18.09

21 44 17.70

3 33.68

44.02

60

15.98

15.50

.48

Error clock +.4

1227 394

2 14 47 = 21 47

49.79

2 15 36.79

4 25 18.09

21 50 18.70

3 34.66

44.04

60

15.96

15.50

+.46

25.91

27.32

1.59

83

1.48

48.31

49.79

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date,..... 187 . Instrument,..... Observer, ...

Timepiece,..... Recorder,.....

Object, Circle,	ε	ε Hercules.	16 ε 30	W.
	w | e	w | e	w | e	w | e
Level Direct,	16.6 | 14.2	16.0 | 15.1	16.1 | 15.0	16.2 | 14.8
Reversed,	16.0 | 15.0	16.6 | 14.3	15.8 | 15.1	16.0 | 15.0
Sums,	32.6 | 29.2	32.6 | 29.4	31.9 | 30.1	32.2 | 29.8
	29.2 |	29.4 |	30.1 |	29.8 |
Difference,	3|3.4 |	3|3.2 |	3|1.8 |	3|2.4 |
b.	.11 |	.11 |	.06 |	.08 |
	h m s	h m s	h m s	h m s
Wire, I.	.	.	.	.
II.	.	.	.	.
III.	.	.	.	.
IV.	.	.	.	.
V.	.	.	.	.
Sum,	.	.	.	.
Mean,	.	.	.	.
Bb,	.	.	.	.
Cc,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	.	.	.	.
Error of Timepiece,	.	.	.	.

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1877phae.proj.17944

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 29.33 1877. Instrument, C.E. Observer, F.N.
Timepiece, Recorder, F.N.

Object,	γ Ursæ Min.		δ Piscis Cir. E.		4 Hydræ C.E.		4 Hydræ C.W.	
Circle,	W							
	w	e	w	e	w	e	w	e
Level Direct,	16.1	15.0	14.6	13.0	.	.	.	.
Reversed,	16.8	14.5	15.2	12.5	.	.	.	.
Sums,	32.9	29.5	29.8	25.5	.	.	.	.
Difference,	29.5 / 3.4	.	25.5 / 4.3	.	.	.	.	.
b.	.11		b = +.14					

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.			22.7			27.3	I.		37.0	III.		9.5
	II.			59.3			48.9			54.5			27.0
	III.			35.7			10.4			12.2			44.8
	IV.			12.3			32.0			29.5			2.3
	V.	11	50	48.7	12	1	53.4			47.3	12	9	20.0
Sum,				178.7			172.0			180.5			103.6
				.			120 / 52			120 / 60			120 / 223.6
Mean,		11	49	35.74	12	1	10.40	12	5 3	12.1 / 29.13	12	8	44.72
Bb,		1.67		+.24	.85		+.12	4.00	1.28	41.63			+.56
				.			.			+.56			-1.53
Cc,		1.70		+.53	1.02		+.31	4.93		1.53			.
Aa,		-.36		-.07	+.55		+.11	-2.90		-.58			-.58
Corr'd Transit,		11	49	36.44	12	1	10.91	12	8	43.14	12	8	43.17
R. A.		11	47	24.34	11	58	58.73	12	6	31.53	12	6	31.53
Error of Timepiece,			2	12.10		2	12.21		2	17.61			V-III = 20.98
												2	11.64

12 30 40.5
12 27 37.
3 03.50
2 12.15
Error of 1327 = −51.35

12 8 44.72
12 8 41.63
2 | 3.09
1.55
12028
10140
10120
2028
E.T. = C + .314340

1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 29, 32 1877. Instrument, ... Observer, W.W.

Timepiece, ... Recorder, W.W.

Object,	γ Virginis		~~ζ Draconis~~								
Circle,	C.W.		C.W.								
	w	e	w	e	w	e			w	e	
Level Direct,	15.2	12.5	.	.	.	.			.	.	
Reversed,	.	.	.	.	.	.			.	.	
Sums,	.	.	.	.	.	.			.	.	
Difference,											
b.											
	h m s		h m s		h m s				h m s		
Wire, I.		8.2		1.5		.				.	
II.		30.0		24.5		.				.	
III.		57.3		47.3		.				.	
IV.		12.5		16.3		.				.	
V.	12 16	33.7	12 26	33.0		.				.	
Sum,		135.8 24 255.8		116.6 120 236.6		.				.	
Mean,	12 15	51.08	12 25	47.32		.				.	
Bb,	.74	.10	1.01	+.14		.				.	
Cc,	1.00	−.31	1.08	−.22		.				.	
Aa,	+.67	.12	+.39	+.08		.				.	
Corr'd Transit,	12 15	50.99	12 25	47.21		.				.	
R. A.	12 13	38.91	12 23	35.01		.				.	
Error of Timepiece,	2	12.08	2	12.20		.				.	

12 15 50.87 = t' 12 N

11 49 36.51 = t.

26 14.36

12 13 38.91 = α'

11 47 24.34 = α

26 14.57

26 14.36

67
36
1.03

1.03 | +.210 | 0.2

206
40

+ 0.2 = a.

2 12.10
2 12.21
2 12.08
2 12.20

.59

2 12.15 = Error of 3451

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

May 29-87 — 1877. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		.	.	.	.	.	.	.	.
Reversed,		1327.		394	.	.	.	.	.
Sums,		13h 40m 39.	= 9. 11.			.	.	.	.
Difference,		50,40		,97					
b.		13 41 29,40		,105					
				.0485					
				50,35					
		h m s		h m s		h m s		h m s	
Wire, I.		4 29 14,65		-50,40	.	.	.	.	.
II.		9 12 14.75			.	.	.	.	.
III.		1 30,47			.	.	.	.	.
IV.		44.28			.	.	.	.	.
V.		60 .			.	.	.	.	.
Sum,		15.72			.	.	.	.	.
Mean,		15,30			.	.	.	.	.
		Error of 394 = +,22			.	.	.	.	.
Bb,		1327 .			.	.	.	.	.
Cc,				394	.	.	.	.	.
Aa,		2 3 53 19 =		19 22	.	.	.	.	.
		+50,77		29,77					
Corr'd Transit,		2 3 54 09,77	.	29,35	.	.	.	.	.
R. A.		4 29 14,65	.	,44	.	.	.	.	.
		19 24 55,12		,97					
		3 10,84		388					
		44,28		,388					
		60 .	50,35	.42 68					
Error of Timepiece,		15,72	-50,77		.	.	.	.	.
		15,50							
		+,22							

1327
1 32 35 = 21 394 added
50,87
1 33 26,87
4 29 14,65
21 4 12,22
3 27,11
45,11
60
14,89
15,50
+,39

Took off .5 gre. at 9h 5m

1327
2 20 43 = 21 394 49
50,91
2 21 34,91
4 29 14,65
21 52 20,26
3 34,99
45,27
60
14,73
15,50
+,77

Signal +.2

took off .5 gre at 8h 55m

,91
,133
,58
,97
406
522
,5626
50,35
-50,91

just back .5 gre at 10h 5m

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 39. 39 1877. Instrument, R. Transit Observer, F.W.

Timepiece, Chron. 3417 Recorder, F.W.

Object, Circle,	β Leonis	γ Vir. Maj.	η Virginis	δ Corvi Vir.
	w | e	w | e	w | e	w | e
Level Direct,	13.5 | 13.0	. | .	. | .	. | .
Reversed,	15.0 | 12.3	. | .	. | .	. | .
Sums,	28.5 | 25.3	. | .	. | .	. | .
Difference,	25.6			
b.	3 | 3.2			
	b = +.11			
	h m s	h m s	h m s	h m s
Wire, I.	19.8	26.2	.	9.8
II.	42.0	3.3	32.5	37.5
III.	4.0	39.5	53.8	5.2
IV.	26.0	16.0	8.4	32.5
V.	11 45 48.3	11 50 52.3	16 36.4	23 90.3
Sum,	140.1	137.3	117.0	85.3
	120	60		60
	20	197.3		25
Mean,	11 45 4.20	11 49 39.46		12 22 5.06
Bb, .92	1.68	19		1.29 .14
Cc, 1.04	1.71			
Aa, +.48	1.30			
	-.36 +.20	-.15		.07 .03
Corr'd Transit,	45 4.50	49 39.50		12 22 5.23
R. A.	11 42 49.24	11 47 24.32		12 19 49.94
Error of Timepiece,	2 15.29	2 14.18		2 15.29

24517 12 27

1 44 16.5 = 1 41 9

1327

12 45 35 = 294 9 12

44 16.5
2. 14.86
42 1.64
41 9
-52.64 Error (327.) +2

12 28 17.98
11 42 49.24
45 88.77
-1.78 | -.76 | .43 a.
712
480

,29
.18
,29
,24
5 71.0 0
,20
15.20 Error Chron C.W.

12 30 33.83
11 45 4.3
45 29.53
45 28.77
-.76
-1.78

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 30, 39 187 . Instrument, Observer, G.H.

Timepiece, Recorder, G.H.

Object,	χ Draco		γ Virginis		ε Ursæ Maj		~~β~~ #3 Cygnæ ~~γ Virginis~~	
Circle,	E		E		E		E	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	15·0	12·3	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.								
	h m s		h m s		h m s		h m s	
Wire, I.		12.3		59.8		37.4		36.7
II.		22.5		20.8		15.8		1.0
III.		33.5		42.5		54.5		25.2
IV.		43.8		3.9		33.6		49.5
V.	12 30	54.7	12 ~~38~~	24.8	12 52	11.9	13 9	13.7
Sum,		166.8		151.8 / 60 / 210.8		152.6 / 120 / 272.6		126.1 / 126
Mean,	12 30	33.56	12 37	42.16	12 50	54.52	13 8	25.22
Bb,	2.46	.27	0.73	.16	1.75	.19	1.11	.12
Cc,	3.00	.	1.05	.	1.92	.	1.14	.
Aa,	−1.42	−.61	+.68	.13	−.45	−.09	+.24	.05
Corr'd Transit,	12 30	33.22	12 37	42.45	12 50	54.42	13 8	25.39
R. A.	12 28	17.98	12 35	27.94	12 48	40.26	13 6	10.62
Error of Timepiece,	2	15.24	2	14.51	2	14.36	2	14.77

13 23 5.08
13 6 10.62
16 54.46

13 25 20.08
13 8. 25.34
16 54.74
54.46
1.98 | −.38 +.20

1.74
.24
1.98

1.51
1.36
1.77
3|1.64
2 14.53 Error chron. E.
2 15.20
2|29.73
14.86

Error 3451 = 2

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 30, 31 1877. Instrument, ... Observer, F.W.

Timepiece, ... Recorder, F.W.

Object,	2101 gr.		2029 gr.				
Circle,	E		E				
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.								
	h m s		h m s		h m s		h m s	
Wire, I.	55.5		11.		13 27		394	
II.	7.8		22.5		23 55		14 = 19	20
III.	19.5		33.5				53.17	
IV.	32.5		45.		23 56		07,17	82 39 .82
V.	13 25 43.5		13 36 56.		4 33		11,20	43 .34
					19 21		55.97	-2.64
					3		10.21	51.35
Sum,	13 25 158.8		168,0		18		45.62	1.05 1.29 1.23
	60						60	105
	985							240
Mean,	13 25 19.76		13 36 33.6				14.38	210
								310
Bb,	2,95	,32	2,81	,31				364
Cc,	3,42		3,21					492
Aa,	-1,74	-,35	-1.58	-,32				-53 89
								-52,64
								53.17
Corr'd Transit,	13 25 19,73		13 36 33.59		1327		394	
R. A.					0 8 . 16		= 19 33	
	13 23 5.08		13 34 18.92		53.16			
Error of Timepiece,	2 14.65		2 14.61		0 8 09,16			
					4 23 11.20			
					19 34 57.96			
					3 13 .49			
					= 45,47			
					60			
					14,53			
					15,50			

13 45 35 = 1327 394 9-12

+52.64

13 46 27.64

4 33 11,20

9 13 16.44

1 30.64

11 45.80

60

14.20

15,50

-1.30 Error 394

added 3 grs at 30 11h for 8.5, to be taken off at 7.30

Error of 394 = -.97

7.45 added 20 grs for 1h45m

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1677phae.proj.17944

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date,..... 187 . Instrument, R. Transit Observer, F.H.

Timepiece, Chron. 3451 Recorder, F.H.

	w	e	w	e	w	e	w	e
Object,								
Circle,								
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	1 . 5 25		= 8.30 .		. . 8		.90 .39 .51	.
Difference,	53,21		.85				1,23	
b.	1 6 18.21		.39				.57	
	4 33 11.20		.46				1,23	
							6 1 5	
	h m s		h m s		h m s		h m s	
Wire, I.	20 33 07,01		1,23 .		.		.627 3	
II.	3 22,01		.46 .		.		,63 .	
III.	45:00		738 .		. 5		2,64 .	
IV.	60.		492 .		. -5		3,27 .	
V.	15,00		,5658 .		,1327 .			
	15-.50		-.57 .		2 3 34. =		21 28 .	
	Error of 394 -.50		52,64 .		53,27			
			93 .		2 4 27,27			
			53,21		4 33 1,20			
Sum,	.		.		21 31 16,07			
Mean,	.		.		3 31 .05			
Bb,	.		.		45,52			
Cc,	2 21 37 =	21 46 .			60:00		.91 .	
Aa,	53,28				1,02		.39 .	
	2 22 30,28				15:.48		,52 .	
Corr'd Transit,	4 33 11.20				15-.50		1,23 .	
R. A.	21 49 19.08				-.02		2 46	
	3 34.50						6 1 5	
	44.58						.639 6	
Error of Timepiece,	60.						.64	
	15,42						52,64	
							5-3,28	

Error 394 = 15,50 / -.08

Signal 0.0

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 31. 37 1877. Instrument, RT. Observer, FM.

Timepiece, 3451 Chron. Recorder, FM.

Object, Circle,	δ Ursæ Maj. E	κ Draconis E	γ Niginis E	ε Ursæ Maj. W
Level Direct, Reversed, w	. .	~~H~~w 14·0 .	. .	. .
Level Direct, Reversed, e	. .	12·1 .	. .	. .
Sums, Difference, b.	. . 51° 43'	. . 70° 28'	. . 0° 46'	. . 56° 38'
Wire, I.	h m s 20·7	h m s 13.7	h m s 2·5	h m s 41·0
II.	0·5	24.3	23·8	19·7
III.	40.2	34.8	45.0	58·5
IV.	20·0	43.0	6.5	37·0
V.	12 12 59.7	12 30 56.0	12 38 24.5	12 52 15.7
Sum,	141.1	173.8	1,05·3	171·9
	60 / 201		120 / 225	120 / 291·9
Mean,	12 11 40.20	12 30 34.76	12 37 45.06	12 57 58.38
Bb,	1.80 +.25	2.64 +.37	.73 .11	1.76 +.25
Cc,	1.87 +.02	3.00 .	1.00 .	1.82 .
Aa,	-.50 :03	-1.42 +:10	.68 -:05	-.45 +:33
Corr'd Transit, R. A.	12 11 40.48	30 35.23	37 45.12	12 51 38.95
	12 9 23.37	12 28 18.03	12 35 27.93	12 48 40.25
Error of Timepiece,	2 17.11	2 17.20	2 17.19	18.41

13 27 = 3451

13 31 20 = 13 34 31

13 27 = 394

13 53 30 = 916

13 34 31
2 17.28
13 32 13.72
13 31 20
53.72
5

Error 1327

12 35 27.93
12 28 18.03
7 09.90

12 37 45.17
12 30 35.13
7 10.04
7 9.90
.14
2|1
.07 (a)

2 17.11
2 17.19
30
2 17.15

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1977phae.proj.17044

402.23
57 43
344 40

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 31.37 1877. Instrument, P. Transit Observer, F.W.

Timepiece, 3451 Chron Recorder, F.W.

Object,	ε Virginis		43 Comae		2001 Groom		
Circle,	W		W.				
	w	e	w	e	w	e	w	e
Level Direct,	.	.	14.4	12.2	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	14.0 12.1		.	.	.	.
			28.4					
Difference,			2.3					
			3)4.7					
b.	11° 37′		b = .14	28°30′	73° 2′			
	h m s		h m s		h m s		h m s	
Wire, I.	40.0		09.7		.01			
II.	1.5		4.3		11.7			
III.	23.5		28.4		24.5			
IV.	45.0		52.5		36.5			
V.	12 59 06.5		13 9 17.0		13 25 47.5			
Sum,	116.5		141.9		120.2			
Mean,	12 58 23.30		13 8 28.38		13 25 24.04			
Bb,	.89	.12	1.12	.16	2.95	.41		
Cc,	1.02	.	1.14	.	3.42	.		
Aa,	.52	−.37	.27	−.19	−1.74	+1.25		
Corr'd Transit,	12 58 23.05		13 8 28.35		25 5.70			
R. A.	12 56 5.65		13 6 10.61		13 23 5.07			
Error of Timepiece,	2 17.40		2 17.74		.			

13 23 5.07
12 56 5.65
26 59.39

13 25 24.45
12 58 23.42
26 01.03
26 59.39
−1.64 = .72
− 2.26

2 17.40
2 17.15
2 17.28 Error 3451

2 17.40
2 17.74
2)35.14
2 17.57

13 53 30 = 9 16
5272
13 54 23.72
4 37 07.96
9 17 15.76
1 31.29
44.47
6
15.153
15.150
+.03 Error 394

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 31. 1877. Instrument, ... Observer, F.W.

Timepiece, ... Recorder, F.W.

	w	e	w	e	w	e	w	e
Object,								
Circle,								
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	1327	.	394	.	1327	.	394	.
Sums,	23 43 7 =	.	19. 9 =	.	0 00 9.0 =	.	19 - 21	.
	+54.19		53.72		54.20			
Difference,	23 44 1.19		52.64		24 1 3.20			
b.	4 37 7.96		1.08		4 37 7.96			
			1.0 reduced 327.					
	19 6 h 53. m 3 s		h m s		h m s		h m s	
Wire, I.		.	.80	.	19 23 55.24	.		.
			.07		3 10.68			
II.		.	.43	.		.		.
			1.1		44.56			
III.		.	43	.	60	.		.
			.473		15.44			
IV.		.	53.72	.	15.50	.		.
			54.19		-.06			
V.		.		.	Error of 394	.		.
Sum,	6	.		.	added, disc'g. pendulum	.	added 1 Gram for half an hour	.
Mean,	1 31 24 = 20	5		.		.	at 8h 15m took off at 8h 5.	.
	54.26						added 1 gram at 9h	
Bb,	25 32 18.26	.		.		.	took off 195. at 9 35	.
Cc,	4 37 7.96	.		.		.		.
Aa,		.		.		.		.
	20 5T 10.30							
	3 25.63							
Corr'd Transit,	44.67	.		.		.		.
R. A.	60							
	15.33							
	15.50							
Error of Timepiece,	-.17	.		.	2 21 32 = 21	.	42 91	.
					54.29		37	
					2 22 26.29		.54	
					4 37 7.96		11	
					21 45 18.33		54	
					3 37.84		54	
					44.49		.594	
					60		53.70	
					15.57		54.29	
					15.50			
					Error of 394 = +.01			

Signal 0.0

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1877phae.proj.17948

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 1. 35 1877. Instrument, R. Transit Observer, F.W.

Timepiece, Chron. 3451 Recorder, F.W.

Object,	K Draconis	γ Virginis	δ Virginis	ε Virginis
Circle,	N.	N.		
Level Direct, w	13.5	13.5	.	.
Level Direct, e	11.5	12.6	.	.
Level Reversed, w	.	.	.	.
Level Reversed, e	.	.	.	.
Sums,	13 5 / 12 00 / 14 3 / 12.5 / 27 8	.	.	.
Difference,	in .5 / 3 | 3.9 / 8=.11	.	.	.
b.	70° 28'	0° 46'	4° 4'	11° 37'
Wire, I.	h m s 17.5	h m s 6.0	h m s 4.7	h m s 42.5
Wire, II.	28 7	27.0	26.1	3.7
Wire, III.	39.0	48.4	47.5	25.6
Wire, IV.	49.7	9 9.7	8.7	47.5
Wire, V.	12 30 60.5	12 38 31.0	12 52 30.0	12 59 9.2
Sum,	195.4	122.1 / 120 / 24 2	117.0 / 120 / 237.0	129.5
Mean,	12 30 39.08	12 37 48.42	12 51 47.40	12 58 25.61
Bb,	2,64 +.29	1,75 .08	,80 .09	,87 .10
Ce,	3,00 .	1,02 .	1,01 .	1,03 .
Aa,	-1.42 -.07	,66 +.03	,60 +.03	,52 +.00
Corr'd Transit, R. A.	12 30 39.30	12 37 48.53	51 47.56	58 25.71
	12 28 17.88	12 35 27.94	12 49 26,83	12 56 5.55
Error of Timepiece,	2 21.42	2 20.59	2 20.73	2 20.16

13 28 16 = 13 31 30.25 / 2 20.35 / 13 29 9.90 / 28 16 / Error of 1327 = -53.90

12 35 27.94 / 12 28 17.88 / 7 10.06 / 12 37 48.50 / 12 30 39.37 / 7 9.13 / 7 10.06 / .60 / 1.42 / 2.02 / +.93 / 2.02 = / 2.02 | 1.930 | +.046 = a. / 80 8 / 1220 / 1212

2 20.59 / 2 20.73 / 2 | 41.32 / 20.66 / 2 20.05 / 2 | 40.71 / + 2 20.35

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 1.33 1877 Instrument, R Transit Observer, F.W.

Timepiece, Chron 3451 Recorder, F.W.

Object,	43 Comae	} Ursæ Maj	20 Draconis				
Circle,	W						
	w	e	w	e	w	e	w	e
Level Direct,	14.6	12.1	14.2	12.9	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
	14.3	12.5						
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	28° 30′		55° 34′		13° 2			
	h m s		h m s		h m s		h m s	
Wire, I.		42.0		31.4		0.5		.
II.		6.0		56.6		13.0		.
III.		30.7		21.6		24.5		.
IV.		54.7		46.8		37.0		.
V.	13 9	18.9	13 22	11.7	13 25	49.5		.
Sum,		152.3		167.9 (60) 107.9		124.5		.
Mean,	13 8	30.46	13 21	21.58	13 25	24.9		.
Bb,	1.11	.12	1.72	.19	2.95	.32		.
Ce,	1.13	.	1.77	.	3.42	.		.
Aa,	.27	.	-.40	.	-1.74	-.04		.
Corr'd Transit,		8 30.58		21 21.77		.		.
R. A.		.		.		.		.
	13 6	10.63	13 19	1.74	13 23	4.98		.
Error of Timepiece,		2 19.95		2 20.03		.		.

13 23 4.98
12 56 55
26 59.43

13 25 25.22
12 58 25.71
26 59.51
59.43
−.08
−2.26

2.26 | 10.8 | 20.4

2 19.95
20.03
20.16
360.14
2 20.05

14 54 35 = 10.394 (1327)
+53.95
14 55 28.95
4 44 04.32
10 14 24.63
1 40.66
43.97
60
16.03
15.50
Error 294 = +.53

13
.75
.07
.0525
53.90
−53.95

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1877phaer.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 1. 96 1877. Instrument, Observer, F.P.

Timepiece, Recorder, F.P.

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		.	.	.	.	.	.	.	.
Reversed,		.	.	.	.	.327	.	.394	.
		1327		394					
Sums,	0	18. 7		19 35	.	1 23 18		= 20 40	.
Difference,		54.18		.81		1 24 12.81		.86	.
b.	0	19 1.18		.35		4 +1 4.32		.31	.
				.46		20 43 7.89		.51	.
								.6	
		h m s		h m s		h m s		h m s	
Wire, I.	4	41 4.32	.	.6	.	3 23.66	.	.306	.
II.	19	37 56.86	.	.276	.	.31	.	.31	.
III.		12.98	.	53.90	.	44.23	.	53.90	.
IV.		43.88	.	54.18	.	60	.	54.21	.
V.		60	.		.	15.97	.		.
		16.22	.		.	15.50	.		.
		15.50	.		.		.		.
		Error of 394 = +.72	.		.	Error of 394 = +.27	.		.
Sum,			.		.		.		.
Mean,			.		.		.		.
Bb,			.		.		.		.
Ce,			.		.		.		.
Aa,	2	17 27 =	.	21 34	.		.		.
		54.22		59					
				35					
Corr'd Transit,	2	18 21.22	.	.54	.		.		.
R. A.	4	41 4.32	.	.6	.		.		.
	21	37 16.90		324	.		.		.
				53.90					
		3 32.53		54.22		2 35 30 =		21 52	
Error of Timepiece,		44.37	.		.	54.23	.		.
		60				2 36 24.23			
		15.63							
		15.50				4 41 4.32			
		Error of 394 = +.13				21 55 19.91			
						3 35.49			
						44.42			
						60			
						15.58			
						15.50			
						Error of 394 = +.08			

Put back 15 grs at 9 25

took off 15 grs.

took off 5 grs at 9 40. Signal no Error.

put back 5 grs at 10 05

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 2, 33 1877. Instrument, Brauer Observer, FH.

Timepiece, Chron. 3457 Recorder, FH.

Object,	ζ Ursæ Maj.				γ Virginis				κ Draconis										
Circle,	E				E				E				W						
	w		e		w		e		w		e		w		e				
Level Direct,	13·4		11·3		.		.		.		.		.		.				
Reversed,	13·2		12·1		.		.		.		.		.		.				
Sums,	13.3		11.7		13,3 / 14,0 / 27.3		11,7 / 12,0 / 23·7		.		.		.		.				
Difference,					27·7														
b. =+,12	54° 23′				b = 3[3].6 = .12 / 0 46′				70° 28′										
	h	m	s		h	m	s		h	m	s		h	m	s				
Wire, I.			33.8				19.0		I.		12.2		III		21.5				
II.			10.0				40.5				22.5				31.5				
III.			46.6				1.5				33.2				42.3				
IV.			23.5				22.5				43.5				53.5				
V.	11	50	59.8		12	16	44.1		1	28	54.9		12	31	03.5				
Sum,			173.7 / 60 / 233				127.6 / 120 / 7				166.3				15 2.3 / 60 / 212.3				
Mean,	11.	49	46.74		12	16	1.52		12	28	33.26		12	30	42.47				
Bb,	1,68		,20		,75		,09		2,64		,32				,32				
Cc,	1.71		+.56		1.00		+.33		3.00		ε.								
Aa,	,36		+.09		,66		−,18		−1.42										
Corr'd Transit,	11	50	47.59		12	16	1.81												
R. A.	11	47	24.23		12	13	38.88						12	28	17.78				
Error of Timepiece,	2	23.36			2	23.93													

3457 — 1327

12 57 0.5 = v 2 53 43

2 23.37 / 54 37.5 / 53 43 / 54.12

2 22.83 / 2 22.69 / 41.52

12 57 2 22.76 Error of chron

12 57 2 23.37

12 55 0.61

12 57 0.5 / 2 22.76 / 55 37.74 / 43 / −54.74 Error of 1327

12 28 33.38 / 2 7.16 / 12 30 40.74 / 12 30 42.74 / 2 2.00 / 1,00 / .3338 / C = +.33 C.E.

12 13 38.88 / 11 47 24.23 / 26 14.65

1,02 | 1,25 / 204 / 460 / 408

12 16 1.28 / 11 49 46.38 / 26 14.90 / 14.65 / −.25 / 1.02

24 a.

1 22.05 = Error chron 1457

12 57 0.5

12 54 37.45

53 43

−54.45 = Error of 1327.

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1877phae.proj.1794W

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 2.33 187 . Instrument, L Transit Observer, FW.

Timepiece, Chron. 3407 Recorder, FW

Object,	χ Draconis	γ Virginis	ε Urs. Maj.	
Circle,	W	W	W	
Level Direct, w e	. .	14.0 12.0	. .	. .
Reversed,	. .	. .	. .	. .
Sums,	. .	. .	. .	. .
Difference,				
b.		0° 46'	56° 38'	
h m s				
Wire, I.	V 28.0	8.5	46.4	.
II.	38.7	29.6	25.0	.
III.	49.3	51.0	3.6	.
IV.	59.5	12.3	42.5	.
V.	12 33 10.00	12 38 33.5	12 52 21.0	.
Sum,	185.5 60. 245.5	134.9 120. 254.9	138.5 120 18.5	
Mean,	12 32 49.1	12 37 50.98	12 51 3.70	
Bb,	.	.74 .09	1.76 .21	.
Cc,	.	1.00 .33	1.83 .60	.
Aa,	.	.67 −.18	−.46 +.09	.
Corr'd Transit,	.	37 50.64	12 51 3.40	.
R. A.	.	12 35 27.92	12 48 40.20	.
Error of Timepiece,		2 22.69	2 23.20	.

14 2 32 = 10 − 17 (1327, 394)
−54.36
15 3 26.36
−4 45 0 88
10 18 25.48
1 41.31
44.17
60
15.83
15.30
7.33

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 3.40 1877. Instrument, ... Observer, ...

Timepiece, ... Recorder, ZZ

Object,																			
Circle,				ZZ															
			w		e		w		e		w		e		w		e		
Level Direct,			13 20		12.4		.		.		.		.		.		.		
Reversed,			.		.		.		.		.		.		.		.		
		1327			394		2 84				0 16 58 =				19 26				
Sums,							2 33				. 55.26				.				
Difference,	14 17		20 =		9.28		1.48				24 17 53.26								
b.	14 18		15.04		-54.45		.55				4 48 57.43								
					-53.90		7 40												
	4 48		57.43	m	s .35		h 7 m 0	s			h m s				h m s				
Wire, I.	9 29		17.61		1.107		.8140				19 28 55.8 3								
II.	1		33.26		.33		54145				3 11.50								
III.			44.35		57.5		55.26				44.33								
IV.			60		.5885						60								
V.			15.65		54.45						15.67								
			15.50		-55.04						15.50								
	Error 394 = +.15										Error 394 +.17								
Sum,											Take off 5 gra for 1.25 at 7 30								
Mean,																			
		1327					394												
Bb,	1	41	12 =				20 50				2 19 18 =				21 28				
Ce,			55.29				3.86				55.31				3.90				
Aa,	1	42	07.29				2.23				2 20 13.31				2.33				
	4	48	57.43				1.53				4 48 57.43				1.57				
							.55								.78 5				
Corr'd Transit,	20	53	09.86				7.65				21 31 15.88				.86 3 5				
R. A.		3	25.30				1.65				3 31.57				54.45				
			44.56				.841 5				44.34				55.31				
			60				54.45				60								
Error of Timepiece,			15.44.				55.29				15.66								
			15.50								15.50								
											+.16								

Error 394 = +.06

1327 394

2 25 19 = 21 34
55.31
2 26 14.31
4 48 57.43
21 37 16.88
3 32.53
44.35
60
15.65
15.50
+.15

2 40 22 = 21 52
55.32
2 44 17.32
4 48 57.43
21 55 19.89
3 35.49
44.40
60
15.60
15.50
+.10

Clock still losing

Look off 5 gra at 9.40
Put back 5 gra at 10.00

Signal No Error

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 4. 35 1877 Instrument, R. Transit Observer, FW.

Timepiece, Chron. 3451 Recorder, FW.

Object,	δ Urs. Maj.	κ Draconis	γ Virginis	δ Virginis
Circle,	N	W	W	E
Level Direct, w	14 . 1	.	.	14 . 5
Level Direct, e	12 . 5	.	.	12 . 3
Reversed, w	14 . 7	.	.	.
Reversed, e	12 . 3	.	.	.
Sums,	28 . 8 / 24 . 8	.	.	.
Difference,	4 . 0	.	.	.
b. +.13	b = .13	70° 28′	−0° 46′	4° 4′

	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			32.7			26.5			14.0			12.5
II.			12.5			36.7			35.1			33.7
III.			52.5			47.5			56.7			55.2
IV.			32.5			58.2			18.0			16.5
V.	12	13	12.3	12	31	8.6	12	38	39.4	12	52	37.7
Sum,			142.5			177.5			163.2			155.6
Mean,	12	11	52.50	12	30	47.5	12	37	56.70	12	51	55.12
Bb,			1.80 / +.23			2.64 / +.34			.73 / +.10			.80 / .10
Cc,			1.88			3.00			1.00			1.01
Aa,			−.50 / −.29			−1.42			.68 / +.39			.61 / +.43
Corr'd Transit, R. A.	12	11	52.44			.	12	37	57.19			55.65
	12	9	22.96	12	28	17.73	12	35	27.91	12	49	26.80
Error of Timepiece,	+ 2		29.48			.			2 29.28		2	28.65

1 32 15 = 1 28 51 (3451 − 1327)

2 29.04

29 45.96

28 51.00

− 54.96 = Error 1327.

54.45

2 1.51

−.36 rate 1327

12 35 27.91 12 37 56.80

12 28 17.73 12 30 47.84

7 10.18 7 8.96

7 8.96

1.22

2.10 =

2.1 | 1.22 | 1.05 8 = a.

170

168

2 29.35

2 28.70

24 58.08

+ 2 29.04

Error of Chron.

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 4th 35 1877. Instrument, Trans. Transit Observer, JH-

Timepiece, Obsn. 3451 Recorder, JH.

Object,	ε Virginis		2101 Yr.								
Circle,	E		E.								
	w	e	w	e	w	e	w	e	w	e	
Level Direct,	14.9	12.2	.	.	.	.	.	.	.	.	
Reversed,	.	.	.	.	.	.	.	.	.	.	
Sums,	.	.	.	.	.	.	.	.	.	.	
Difference,											
b.	11° 37'		7° 3° 21								
	h m s		h m s		h m s		h m s		h m s		
Wire, I.		50.5		9.0		.		.		.	
II.		12.2		21.5		.		.		.	
III.		34.0		33.8		.		.		.	
IV.		55.7		46.0		.		.		.	
V.	12 5 9	17.5	13 26	02.8		.		.		.	
Sum,		169.9		113.1 (60) 173.1		.		.		.	
Mean,	12 5 8	33.90	13 25	34.62 ~~13 23 4.80~~		.		.		.	
Bb,	89	+.12	3,01	+.39		.		.		.	
Cc,	1,02	~~+.77~~	3.50	.		.		.		.	
Aa,	1,52	.36	-1.81	.		.		.		.	
Corr'd Transit,	~~5 8~~	34,38		.		.		.		.	
R. A.	12 56	5.63	13 23	4.80		.		.		.	
Error of Timepiece,	2	28.75		.		.		.		.	

13 23 4.80
12 49 26.80
33 38.00

13 25 35.01
12 51 55.22
33 39.79
33 38
-1.79 = a
2.42

13 27 394
14 1 13 = 9 8
54.97
14 2 07.97
4 52 53.99
9 9 13.98
1 29.98
44.00
60
16.00
15.50
+.50 = Error of 394

,26
,03
.007 8
.01

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, ... 187 . Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		.	.	.	.	.	.	.	.
Reversed,		.	.	.	.	.	.	.	.
Sums,	23	30.46 = .736				1 29 6 = 20.34			
Difference,		55.08 .81				55.09 .85			
b.	23	31 51.08 .35				1 30 1.09 .50			
Wire, I.	4	52h 53m 99s .46		h m s		4 h 52 m 53s 99		h m 13 s	
II.	19 38	57.09 .26				7.10		54.96	
III.		3 13.44 .92 .1216				20 37 3 22.87		55.09	
IV.		43.95 54.96				44.43			
V.		60 55.08				60			
Sum,		16.05 15.10 +.55				15.57 15.10 +.07			
Mean,		Took off 10 grams at 8h 45m Am. Took off just back 10 grams, 8h 40m							
Bb,		1327 .		394 .		.		.	
Cc,	2	24 15 =		21 29		.		.	
Aa,		55.10		90		.		.	
	2	25 10.10		35		.		.	
Corr'd Transit,	4	52 53.99		.53 126		.		.	
R. A.	21	32 16.11		330		.		.	
		3 31.71		110		.		.	
		4440		.1430					
		60		54.96					
		15.160		55.10					
Error of Timepiece,		15.10 Error 294 + .10		Clocks not together the minute		.		.	

Signal No. Error.

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 5, 50 1877. Instrument, Comparisons Observer, ...
Timepiece, ... Recorder, H.

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	0 19 50.		=19.21					
Difference,	55.34							
b.	54.34		5.80 4.35 1.45					
	24 20 45.34							
	h m s		h m s		h m s		h m s	
Wire, I.	4 56 50.55		870					
II.	19 23 54.79		290					
III.	3 10.68		1770					
IV.	44.11		54.96					
V.	60		55.34					
	15.89							
	15.50							
Sum,	Error of 394 +.39							
Mean,	take off 10 gives for 1h 30m at 7 30 Am							
Bb,								
Ce,	2 32 12 =		21 33					
Aa,	55.56		90					
	2 33 07.56		31					
			1.55					
Corr'd Transit,	4 56 50.55		126					
	21 36 16.81		930					
R. A.	3 32.36		3 10					
	44.45		40 30					
	60		54.96					
	15.55		55.36					
Error of Timepiece,	15.00							
	Error 394 = +.05							

put back 10 gives 9 40 Am

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 6. 80 1877. Instrument, Comparison Observer,
Timepiece, Recorder, W.P.

	w	e	w	e	w	e	w	e
Object,								
Circle,								
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	0 19 46 =	19 17 .	1 39 59 =	20 37 .				
	. 55.66	6.50 .	. 55.61	6.85 .				
Difference,	24 20 41.60	4.35 .	1 40 54.61	4.35 .				
		2.45		2.50				
b.	5 0 47.11	.26	5 0 47.11	.26				
			20 40 07.50					
	h m s	h m s	h m s	h m s				
Wire, I.	19 19 54.49	14 70 .	3 23 17	150 .				
	3 10.82	490 .	3 23.17	50 .				
II.	44.67	637 0 .	44.33	54.96 .				
	60 .	54.96 .	60 .	-55.61 .				
III.	15.55	-55.60 .	15.67	.				
IV.	15.50	.	15.50	.				
V.	Error of 394 = +.07	.	.17	.				
Sum,	.	.	.	.				
Mean,	1 51 1 =	20 48 .	1 58 .2 =	20 55 .				
	55.61	6.86	55.62	.87				
	1 51 56.61	4.35 .	1 58 57.62	.35				
Bb,	5 0 47.11	2.51 .	5 00 47.11	2.52 .				
Cc,		.26 .		.26 .				
Aa,	20 51 9.50	1506 .	20 58 10.51	1512 .				
	3 24.97	5.02 .	3 26.12	504 .				
		.6526		.66				
Corr'd Transit,	44.53	-55.61 .	44.39	54.96 .				
R. A.	60 .	.	60 .	-55.62 .				
	15.47		15.61					
	15.50		15.50					
	-.02		+.11					
Error of Timepiece,	.	.	.	.				

+.327 394

2 4 3. = 21 1
55.62
2 4 58.62
5 0 47.11
21 4 11.51
3 27.11
44.40
60
15.60
15.50
Error of 394 = +.10

.327 394
2 22 6 = 21 19
55.62
2 23 01.62
5 0 47.11
21 22 14.51
3 30.07
44.44
60
15.66
15.50
Error of 394 = +.06 later than mean
Took off 15 gr for 2 signal no. Error

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, ... 187 . Instrument, ... Observer, ...

Timepiece, Compared Recorder, J.M.

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct, June 6th 98		.	.	.	.	.	.	.	.
Reversed,		.	.	.	.	.	.	.	.
		1327	394						
Sums,	4 30 27 = 23.27	.	.	.	.	.	.	.	.
Difference,	55.64								
b.	4 31 22.64	.98							
	5 00 47.11	.35							
		2.63							
		26							
	23 30 45.53	h 1578 m	s	h m	s	h m	s	h m	s
Wire, I.	3 51.12	526	.		.		.		.
	44.41	1.68 38							
II.	60	14.96	.		.		.		.
	15.59	55.64							
III.	15.55		.		.		.		.
Error IV. 294 = +.09			.		.		.		.
V.			.		.		.		.
	June 6th			Rate of 1327 = −.35 as reduced from last Mr. Rogers observations					
Sum,	1327		.		.		.		.
Mean,	14 5 1 = 9h		.		.		.		.
		56.01	7.35						
Bb,			4.35						
Cc,	14 5 57.01		3.03		.		.		.
Aa,	5 4 43.67		.35		.		.		.
	9 1 13.34		3						
			1.05						
Corr'd Transit,	1 28		54.96						
R. A.	1 28.67		56.01		1327		.		.
	44.67				23 27	33 = 18.21			
	60					56.15	7.76		
	15.33				23 28	29.15	4.35		
Error of Timepiece,	15.50	.			5 4	43.67	3.41		.
							.35		
					18 23	45.48	17.05		
					3	0.82	1023		
						44.66	1.1935		
						60	54.96		
						15.34	−56.15		
						15.17			
						−.16			

Error .394 = −.13

1 5 49 = 18 59

	56.18	7.83
1 5	45.18	4.35
5 4	43.67	3.48
16 1	04.51	.35
2	27.45	17.40
	27.06	10.44
		12.80
		1.22
		54.96
		56.18

1 11 50 = 20 5

	56.18
1	12 46.18
5	4 43.67
20	8 2.51
	3 17.91
	44.60
	60
	15.40
	15.50
	−.10

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, ... 187 . Instrument, ... Observer, ...

Timepiece, Computed Recorder, [illegible]

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		June 7	.84	.	.	.	.	.	.
Reversed,		.	.	.	.	.	.	.	.
Sums,	2	19 . 1 =		21 12	.	.	.	.	.
Difference,		56.18		7.84					
b.	2	19 57.18		4.35					
	5	4 43.67		3.49					
				35					
		h m s		h m s		h m s		h m s	
Wire, I.	21	15 13.51	.	17 4 15	.	.	.	.	.
II.		3 28.91	.	1 4 7	.	.	.	.	.
III.		44.60.	.	1.2 1 15	.	.	.	.	.
IV.		60	.	5 4.96	.	.	.	.	.
V.		15.40	.	56.18	.	.	.	.	.
		15.50	.						
		−.10 Error of clock,							
		as clock is evidently gaining a little the error							
		will be less than .1 at 2 P.M.							
Sum,		.	.	.	.	.	.	.	.
Mean,		.	.	.	.	.	.	.	.
Bb,		Signal this morning by advice of Eb.							
Cc,		took off 10 grains at 10 a.m. for two hours.							
Aa,		Assuming that Clock is +.50.							
		Put back the 10 grains at 12 m.							
Corr'd Transit,		.	.	.	.	.	.	.	.
R. A.		For several days it has been cloudy all the time							
		and consequently no observations.							
Error of Timepiece,		.	.	.	.	.	.	.	.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 6.38 1877. Instrument, Russ. Transit Observer, F.W.

Timepiece, Chron. 1451 Recorder, F.W.

Object, Circle,	η Ursæ Maj. E		η Bootis E		τ Virginis W			
	w	e	w	e	w	e	w	e
Level Direct,	15.0	15.0	.	.	14.8	15.2	.	.
Reversed,	14.8	15.2	.	.	.	.	.	.
Sums,	29.8	30.12	.	.	.	.	.	.
Difference,	.	29.8 / 3 / .7 / .101	.	.	.	.	.	.
b.	49° 53′		19° 1′		20° 8′			

	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			18.5			47.0			.			.
II.			51.6			9.5			.			.
III.			24.4			32.0			.			.
IV.			57.5			57.5			.			.
V.	13	46	30.3	13	52	17.0			.			.
Sum,			162.3 / 60 / 12 / .3			160.0			.			.
Mean,	13	45	24.46	13	51	32.0			.			.
Bb,	1.54			.98					.			.
Cc,	1.56		+.53	1.06		.37			.			.
Aa,	-.21			.42					.			.
Corr'd Transit,	13	45	24.99	13	51	32.37			.			.
R. A.	13	42	44.76	13	48	52.35			.			.
Error of Timepiece,		2	40.23		2	40.02			.			.

1327

14.12 30 = 14 16 5.5

2 40.13

14 13 25.37

14 12 30

Error of 1327 −55.37

−54.96

H −.41

2 40.13

29.04

H 11.09

+2.77

13 48 52.35 13 51 32.0

13 42 44.76 13 45 24.46

6 07.59 6 07.54

+.05

.63 a=0.

Assume

@ = +.35 @.51

2 40.23

2 40.02

.25

+2 40.13 Error of Chron 1451

106

105

530

318

.371

1.56

35

680

468

.5360

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1877phae.proj.1794

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 8. 90 1877. Instrument, Observer,

Timepiece, Computed Recorder, Mr

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,									
Reversed,									
Sums,		1327	394			1327		394	
Difference,		14 49 4 =	9 40			0 10 37. =	19 h 0		
b.		54,37				54.31		8.79	
						31.31		4.35	
						40.73		4.44	
		h m s		h m s		h m s		h m s	
Wire,	I.	14 49 58,37				19 2 51,08		4.44	
	II.	5 8 40,23				3 7.22		1.46	
	III.	9 41 18,14				48.86		1.32	
	IV.	1 35,23				60		.19	
	V.	42.91				16.14		4.44	.38
		60				12.10		.14	.41
		17.09				Error of Clock = +.04		16	.14
Sum,		15150						4.1	4.1
Mean, Err of 394 =		+1.59						.037	.037
								+06	+06
								-54.37	-54.31
Bb,		at 9.50 PM. knocked off 5 grs for 10 hrs						.44 .41	7.09
Cc,									.7
Aa,		0 1327 10 37 =		394 19 00					.36
		55.41		55.37					-.04
Corr'd Transit,		0 11 32.41		,04					
R. A.		5 8 40.23		55.41					
		19 2 52.18							
		3 7.23				2 10 57 = 21		5-	
Error of Timepiece,		44.95				55,42		55,42	
		60				2 16 52,42			
		15.05				5 8 40,23			
		15,50				21 8 12.19			
		-.45				3 27.76			
						44.43			
						60			
						15,57			
						15,50			
						Err of 394 = +.07			

Took back the 5 grains at 19h 15m.
and added 10 grains for 1 1/2 hrs.

Signal No. Error.

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 10th 1877. Instrument, Comparison Observer, P.H.

Timepiece, Recorder,

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		.	.	.	.	.	.	.	.
Reversed,		.	.	.	.	.	.	.	.
		1327		394					
Sums,	13	56 47.=		8 .40	.	.	.	.	.
Difference,		+55.59		10.37					
b.				8.38					
	13	57 42.59		2					
		h m s		h m s		h m s		h m s	
Wire, I.	5	16 33.35		11 .22	.		.		.
II.	6	41 09.24		55.37	.		.		.
III.		1 25.38		-55.59	.		.		.
IV.		43.86			.		.		.
V.		60.			.		.		.
		16.14							
		15.50							
Sum,					.		.		.
Mean,		Error 394 = +.64			.		.		.
		Loses off 2 grains at 9h for 10 hrs.							
Bb,		.			.		.		.
Ce,		1327 .			.	1327 .		394 .	
Aa,		0 0 26 =			.	14 2 46. =		.86 .	
		55.64		10.78		55.65		.38	
Corr'd Transit,	24	1 21.64		8.38	.	3 41.65		2.52	.
R. A.	5	16 33.35		2.48	.	5 16 33.35		.11	.
				11				2.41	
	18	44 48.29		2.48		20 47 08.30		.27	
		3 14.10		.2748		3 24.30		.28	
Error of Timepiece,		30.19		37		44.00		37	
		60		55.64		60		55.65	
		15.81				15.50			
		15.50							
		Error 394 = +.31				Error 394 = +.50			

added 2 grs at 18h 45m
took off 5 grs from 2 hrs at 8h 42m

2 8 47 = 50
55.65
2 9 42.65
5 16 33.35
20 53 9.30
3 25.20
44.00
16.00
15.50
+.50 = Error 394 took off 15 grs at 20h 15m

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 10 Pk 1877. Instrument, Comparison Observer, Y

Timepiece, Recorder, PR

	w	e	w	e	w	e	w	e
Object,								
Circle,								
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.327	.	.394	.	.	.	.	.
Sums,	2 25 50 = 21 7	.	.	2	37 52	.	= 21 19	.
Difference,	55.65	.	.	.	55.66	.	.	.
b.	2 26 45.65	.	.	2	38 47.66	.	.	.
	5 16 33.35	.	.	5	16 33.35	.	.	.
	h m s	h m s	h m s	h m s	h m s	h m s	h m s	h m s
Wire, I.	21 10 12.30	.	.	21	22 14.31	.	.	.
II.	3 28.09	.	.	.	3 30.06	.	.	.
III.	44.21	.	.	.	44.25	.	.	.
IV.	60	.	.	.	60	.	.	.
V.	15.79	.	.	.	15.75	.	.	.
	15.50	.	.	.	15.00	.	.	.
	.29	.	.	.	+.25	.	.	.
	1327		394	Error of 394 =				
Sum,	1 56 =	21 43	.	.	1327	.	394	
Mean,	55.66	.	.	.	7.57 =	21 49	.	.
					55.66			
	3 2 51.66	.	.	.	3 8 52.66	.	.	.
Bb,	5 16 33.35	.	.	.	5 16 33.35	.	.	.
Cc,	21 46 18.31	.	.	.	21 52 19.31	.	.	.
Aa,	3 34.00	.	.	.	3 34.99	.	.	.
	44.31	.	.	.	44.32	.	.	.
Corr'd Transit,	60	.	.	.	60	.	.	.
R. A.	15.69	.	.	.	15.68	.	.	.
	15.50	.	.	.	15.00	.	.	.
Error of Timepiece,	Error of 394 = +.19	.	.	.	Error of 394 = +.18	.	.	.
	1327		394					

3 13 58 = 21 58

55.66

2 14 53.66

5 16 33.35

21 58 20.31

3 35.98

47.33

60

15.67

15.50

Error of 394 = +.17

Error check +.1

H 2 6 = 22 43

55.66

4 3 01.66

5 16 33.35

22 46 28.31

3 42.86

44.45

60

15.55

15.50

+.05 Error of 394.

Run back 15 qrs at 20.h 10m and look off 1 dec. gram.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

13 35 14

Date, June 11.37 1877. Instrument, R Transit Observer, C.A.

Timepiece, Chron. 3451 Recorder, F.W.

Object,	5 Lus. May		2001 Gr		2029 Gr.		1 Lus May	
Circle,	E		E		W		W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	15.2	14.6	.	.
Reversed,	.	.	.	.	15.2	15.0	.	.
Sums,	.	.	.	.	30.4 29.6 31.8 +.03	29.6	.	.
Difference,								
b. = +.03	55° 34'		73° 2'		71° 52'		49° 56'	
	h m s		h m s		h m s		h m s	
Wire, I.		35.0	IV	30.0	II	36.5		27.4
II.		12.7		42.0		48.0		0.5
III.		50.2		54.5		59.5		33.4
IV.		27.5		06.0		10.5		6.5
V.	13 23	5.5	13 26	18.0	13 36	22.3	13 46	39.5
Sum,		130.9 180 280		150.5 120 270.5		176.8 120 296.8		107.3 40 167.3
Mean,	13 21	50.18	13 25	54.10	13 35	59.36	13 45	33.46
Bb,	1.72	+.05	2.95	+.09	2.80	+.09	1.54	+.05
Cc,	1.77	.	3.42	.	3.22	.	1.56	.
Aa,	-.40	-.17	-1.74	.	-1.59	.	-.21	-.09
Corr'd Transit, R. A.	13 21	50.04		.		.	13 45	33.42
	13 19	1.57	13 23	04.42	13 34	18.35	13 42	44.67
Error of Timepiece,	2	48.53		.		.	2	48.75

1327 34.57

12 47 50 = 12 51 34.57

2 48.43

48 46.07

47 50

-56.07

-56.17

-56.12

Err of 1327. at June 11.37

34.57 1327

14 38 20 = 14 54 35

2 48.43

55 31.17

54 35.00

56.17

2 48.75

2 48.53

.28

2 48.64

2 48.23

.87

Err of 3457 = +2 48.43

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1877phae.proj.1794

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 11. 37 1877 Instrument, R Transit Observer, G.M.W.

Timepiece, Shran 345 Recorder,

Object,	η Bootis		α Draco		α Bootis		β Bootis	
Circle,	W		E		E		E	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	15 .3	14 .7	15 .4	15 .2	.	.
Reversed,	.	.	15 .2	15 .2	.	.	.	.
			15,2	15,0				
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	19°1		64° 58'		19°49		30° 55'	
	h m s		h m s		h m s		h m s	
Wire, I.		55.7		39.0		8.5		33.5
II.		18.3		47.2		31.3		58.1
III.		41.0		55.5		54.0		22.8
IV.		3.5		04.5		16.4		47.6
V.	13 52	25.8	14 4	12.5	14 13	39.0		— . —
Sum,		144.3 / 60 / 204.3		158.7 / 120 / 278.7		149.2 / 120 / 269.2		128.5 / 60 / 68.5
Mean,	13 51	40.86	14 3	55.74	14 12	53.84	14 29	22.83
Bb,	,98	+.03	2,18	+.06	,97	+.03	1,14	+.03
Cc,	1,06	+.	2,37	.	1,06	.	1,16	.
Aa,	.42	+.18	-,91	.	.42	+.05	,24	+.03
Corr'd Transit,	57	41.07		.		12 53.92		29 22.99
R. A.	13 48	52,31	14 1	7,49	14 10	5.74	14 26	34,60
Error of Timepiece,		2 48.76		.		2 48,18		2 48,29

13 48 52,31 13 51 40.89
13 34 18.33 13 37 07.77
14 33.98 14 33.12
14 32,12
+,86
2.04 = +.43 a.

13 48 52,31 13 51 40.89
13 23 04.43 13 25 41.74
25 47.88 ,155

14 10 5.74 12 53.87
14 1 7.49 3 55.80
8 58.25 8 58.07
,07
,18
1.33 = .13 c

2 48.23

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date,.....187 . Instrument,..... Observer, ...

Timepiece,..... Recorder,.....

Object,				
Circle,				
	w | e	w | e	w | e	w | e
Level Direct,	. | .	. | .	. | .	. | .
Reversed,	. | .	. | .	. | .	. | .
Sums,	1327 / 16 29 8	394 / 11 . 8 .	0 2.6	26 = 19 4
Difference,	56.15	56.12	56.22	19
b.	16 30 4.15	55.37	0 27 2 2.22	.37
				142
	h m s	h m s	h m s	h m .10 s
Wire, I.	5 20 29.90	3 .75 .	5 20 29.90	56.12
II.	11 9 34.25	.25 .	19 6 . 52.3	56.22
III.	1 49.69	.	3 . 7.89	.
IV.	44.56	.	.4 4.43	.
V.	60	.	60	.
	15.44	.	15.17	.
	15.50	.	15.20	.
Sum,	Error 394 = — .06	.	Error 394 = +.07	.
Mean,		.		.
Bb,	1327 .	394 .	.	.
Cc,	1 58 41 =	20 36 .	.	.
Aa,	56.24	.85	.	.
	1 59 37.24	.37	.	.
		1.48		
Corr'd Transit,	5 20 29.90	56.12	.	.
R. A.	20 39 07.34	56.44	.	.
	3 23.00		.	.
Error of Timepiece,	44.34		.	.
	20 .			
	15.66			
	15.50			

Error 394 = +.16 took off 5 sec for 1 hour 21h 40m
put back 5 21 45

3 4 1327
3 4 52 =
56.25
3 5 48.25
5 20 29.90
21 45 18.35
3 23.84
44.51
20
15.49
15.50
Error 394 = — .01 Signal no error

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar 12 PM 80 1877. Instrument, Observer,

Timepiece, Recorder,

		w		e		w		e		w		e		w		e	
Object,																	
Circle,																	
Level Direct,																	
Reversed,																	
Sums,																	
Difference,																	
b.																	
Wire,	I.	h	m	s		h	m	s		h	m	s		h	m	s	
	II.																
	III.																
	IV.																
	V.																
Sum,																	
Mean,																	
Bb,																	
Cc,																	
Aa,																	
Corr'd Transit,																	
R. A.																	
Error of Timepiece,																	

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1877phae.proj.1794W

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 13.14 1877 Instrument, Russian Transit Observer, FH.

Timepiece, Chron. 3451 Recorder, FH.

Object,	43 Comae	2001 Gr	ζ Virginis	Gr 2029
Circle,	E	E	E	W
	w | e	w | e	w | e	w | e
Level Direct,	. | .	. | .	13.4 | 14.	. | .
Reversed,	. | .	. | .	13.9 | 13.7	. | .
Sums,	. .	. .	27.3 27.7	. .
			27.3	
Difference,			3|.4	
b. = −.01	28° 30′	73° 2′	~~72~~ 10° 2′	41° 5′ 2″
	h m s	h m s	h m s	h m s
Wire, I.	15.5	34.3	39.0	50.3
II.	39.6	46.1	0.5	01.5
III.	4.0	58.5	21.5	13.0
IV.	28.3	10.4	42.8	24.5
V.	13 9 52.4	13 26 22.8	13 32 09.1	13 37 35.9
Sum,	139.8 / 120 / 19:8	172.1 / 120 / 292	112.9	125.2 / 60 / 65.2
Mean,	13 9 3;96	13 25 58;40	13 31 22;58	13 37 13;04
Bb,	1,11 −.01	2,95 −.03	,74 −.01	2,58 −.03
Cc,	1,13 .	3,42 .	1,00 .	3,22 .
Aa,	+,27 +;13	−1,74 .	+.67 +.31	−1,59 .
Corr'd Transit,	13 9 4,08 .	. .	22.88 .	. .
R. A.	13 6 10.44	13 23 4,30	13 28 27.97	13 34 18.22
Error of Timepiece,	2 53.64	.	2 53.71	.

14 1327 2 39 = 14 3451 6 30

2 53,64

14 3 36.06

2 39,00

Error 1327 = −57.06

−57.06

−56.12

2|.94

−.47 rate of 1329.

13 23 4,30

6 10.44

16 53.46

13 25 58,37

9 3.96

16 54.41

53.46

−.95

−2.01 = a

2.|95 +.47 = a

|18

15

14

+2 53.67

2 54.21

2|107,88

+2 53.94 Error Chron.

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 13. 74 187 . Instrument, Pass. Transit Observer, T.H.

Timepiece, Chron. 3451 Recorder, T.H.

Object,	ν Ursæ Maj.		ν Bootis		τ Virginis						
Circle,	E	W									
	w	e	w	e	w	e	w	e	w	e	
Level Direct,	13.5	14.0	14.0	.	14.3	13.5	.	.			
Reversed,	14.3	13.5	.	.	.	.	.	.			
Sums,	27.8	27.5	.	.	.	.	.	.			
Difference,	13.9	13.7									
b.	49°56′		19°1′		2°8′						
	h m s		h m s		h m s		h m s		h m s		
Wire, I.	32.5		01.5		.		.		.		
II.	5.8		24.0		.		.		.		
III.	38.9		46.5		.		.		.		
IV.	11.8		08.6		.		.		.		
V.	13 46 45.0		13 52 31.5		.		.		.		
Sum,	134.0 / 40 / 194.0		11 21 / 120 / 232.10		.		.		.		
Mean,	13 45 38.80		13 51 46.52		.		.		.		
Bb,	1.54	−.02	.98	−.01	.		.		.		
Cc,	1.56	.	1.06	.	.		.		.		
Aa,	−.21	−.05	.42	+.09	.		.		.		
Corr'd Transit,	45 38.73		51 46.60		.		.		.		
R. A.	13 42 44.64		13 48 52.26		.		.		.		
Error of Timepiece,	2 54.09		2 54.34		.		.		.		

13 48 52.26
13 34 18.22
14 34.04
33.50
.44
2.04 = +.22 a. Diff.

13 51 46.51
37 13.01
14 33.50

2 54.21

2.44 / 4 = 1.22

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 13 1877. Instrument, Transit Observer, J.M.

Timepiece, Dolland Recorder,

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		June 13	.	.	.	.	.	.	.
Reversed,		1327	.	394	.	.	.	.	.
Sums,	14	50 . 43 =	9 22 .			1327 .	.	394 .	.
Difference,		57.07	0			26 17 =		15 56	
b.	14	51 40.07				57.27			

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I. 5	28	23.02.			24.		27	14.27	.	13.79		
	II. 9	23	17.05			18		28	23.02	.	34		.
	III.	1	32.28.			.		58	51.25	.	45		.
	IV.		44.77.			.		3	6.57	.	47.		.
	V.		60 .			.			44.68	.	31 5		.
			15.23						60		180		.
Sum,			15 150						15.32	.	21		.
Mean,		Error of 394 =	.27		Error of 394 =		−.18 .		15.50		57.06		.
					Look off 5 grams. at 19h for 1¼ hrs.						57.27		

Bb,			1327	.	394 put back at 20		20			.			.
Cc,		1	45	30 =	20	15	.			.			.
Aa,				57.29.			.		1327	.			.
		1	46	27.29			2		47	40 =	394		
Corr'd Transit,		5	28	23.02			.			57.31.	21	17	.
R. A.	20		18	04.27			2		48	37.31.	55		.
			3	19.55			5		28	23.02	34		
				44.72			21		21	14.29	54		
Error of Timepiece,				60			.		3	29.73	25		
				15.58						44.56	57.06		
				15.50						60	57.31		
		Error of 394 =		−.32						15.44			
										15.50			
										−.06			

added 10 great 20 20

took off 10 grams at 21 20

3 23 46 = 21 53
57.32

3 24 43.32
5 28 23.02
21 56 20.30
3 35.35
44.65
60
15.35
15.50
−.15 Error 394

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1877phao.proj.1704w

(Boötis = 14 14 48.2

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 14 Ph 39 1877 Instrument, Transit Observer, T.H.

Timepiece, Chron. 3451 Recorder, T.H.

Object,	4 Ursæ Minoris				δ Boötis				ρ Boötis				π Boötis		
Circle,	N.				N				N				E		
	w		e		w		e		w		e		w		e
Level Direct,	14 · 1		12 . 7		.		.		.		.		.		.
Reversed,	14 · 5		13 . 0		.		.		.		.		.		.
	28,6		25,7												
Sums,	25.7		.		.		.		.		.		.		.
Difference,	3 [2.9														
b. = +.10	+10														
	78° 8'				52° 25'				30° 55'				16° 57		
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.			44 · 5				50 . 5				42 . 5				12 . 1
II.			1 · 8				25 . 5				7 . 0				34 . 5
III.			19 · 1				1 . 4				32 . 0				56 . 5
IV.			36 · 5				40 . 1				56 . 6				18 . 9
V.	14	12	53 · 1		14	25	10 . 0		14	31	21 . 6		14	38	41 . 4
			155.0				126.5				159.7				163.4
Sum,			60				120								120
			95 . 1				6 . 5				.				283.4
Mean,	14	12	19.02		14	27	0.50		14	29	31.94		14	37	56.68
Bb,	3.96		.40		1.62		.16		1.14		.11		.95		.09
Cc,	4.87		.		1.64		.		1.16		.		1.05		.
Aa,	- 2.84		.		- .29		+ .52		.24		— .43		.45		- 1.07
Corr'd Transit,			.		14	24	0.98		14	29	31 .62			37	55 70
R. A.			.				.				.				.
	14	9	27.55		14	24	3.77		14	26	34.57		14	34	59.49
Error of Timepiece,			.		2		58[7.21		2		57,05		2		56.21

14 58 54 = 14 55 (54.57 / 1327)
2 56.66
14 55 57.34
55
Sm[137 — 57.34
57.06
-.28
rate

14 26 34.57
9 27.55
17 7.02

29 32.05
12 19.42
17 12.63
7.02
3.08 | -5.61 | -1.80 a.
3.08
2530

1.29 1.8
.24
162 72
36 36
.52 2 .43 2

2 .39
.45
1195
956
1.0715

57.21
57.05
57.13
+ 2 56.23
2 56.66 - Sm[Chron 3451
+ 2 53.94
2.72

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 14, 39 1877 Instrument, Rust Transit Observer, HR

Timepiece, Chron. 345 1 Recorder, HR

Object,	69 Aquilae		β Aquilae					
Circle,	E		E					
	w	e	w	e	w	e	w	e
Level Direct,	14·5	13·0	.	.	.	.	.	.
Reversed,	.	.	.	.	.	old rate	.	.
Sums,	.	.	.	.	13 27	394	.	.
					+5 37 49	=10 25		
Difference,						57.61	14.44	
							13.14	
b.	2°25′		74°39′		15 58 46.61		1.7	
	h m s		h m s		h m s		h m s	
Wire, I.		19.6		35.0	19.38		57.06	
					10 26 27.03		57.61	
II.		41.0		48.5	1 42.63			
III.		2.5		1.8	44.40			
IV.		23.5		15.0	.60			
V.	14 43	44.6	14 54	29.5	15.60			
					15.50	Error 394		
					+.10			
Sum,		131.2		129.8	.			
		120		120				
		11.2		9.8				
Mean,	14 43	2.24	14 54	1.96	.			
					1327	394		
Bb,	,76	,08	3.19	,32	1 3 .18	=19 29		
Cc,	1,00	.	3.46	.	57.89	.51		
						.34		
Aa,	,64	−1;53	−2,01	.	1 4 15.89	1.47		
						1.5		
Corr'd Transit,	14 43	0.89		.	5 32 19.18	,835		
						7.06		
R. A.		.		.	19 31 56.31	57.89		
	14 40	4.63	14 51	10.91	3 11.99			
					44.32			
	2	56.26			20			
Error of Timepiece,		.		.	15.68			
					15.50			
					+.18	taken		

14 51 10.91
14 40 4.63
11 6.28
10 59.96
−2.65 | 6.32 | −2.39 = a
5 30
10 95 20
9 95
2 25 0

14 54 2.28
14 43 2.32
10 59.96

239
.64
956
14.34
15296
15 3

Error 394.
taken off 10 grains at 20 30

2 56.24
Error 1327. from Chron. June 14.4 = −57.49

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 1877 Instrument, Rues transit Observer, GH

Timepiece, Arran 3451 Recorder, GH

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		Newrati							
Reversed,		1.27		.94		Newrati			
Sums,	15	57 49=		10 25		3 . 18 =		19 .29	
Difference,		. 57.36		.	1.	57.47		81	
b.	15	58 46.36						39	
	5	32 19.58			1	4 65.47		.42	
		h m s		h m s		h m s		h .3m s	
Wire, I.		26 26.78			5.	32 19.58.		.126	
II.	10	1 42 .63			19.	37 55.89.		.13	
III.		44:15			.	3 11.99		51.34	
IV.		60.			.	3.90		57.47	
V.		15.85			.	60			
		15.50				16.10.			
Sum,		Emf 394= +.35			.	15.50			
Mean,		.			.	Emf 394=+.60			
Bb,	3	9 39=.		21 35	.				
Cc,		57.83		.89	.				
Aa,		3 10 36.83.		.34	.				
		5 32 19.58		1.55	.				
				.5					
Corr'd Transit,	21	38 17.25.		.775	.				
R. A.		3 32.69.		51.06	.				
		44.56		57.83					
		60							
		15.44							
		15.50							
Error of Timepiece,		-.06			.				

Signal Rush No. error.

57.49
57.06
-.43 Rate of 1327.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 15, 1877 Instrument, Russian Transit Observer, J.M.

Timepiece, Arrow. 3457 10.30 Recorder, J.M.

Object,	δ Coronae		ξ Serpentis		μ Serpentis		ξ Ursæ Minoris	
Circle,	E		E		E		E	
	w	e	w	e	w	e	w	e
Level Direct,	13.5 / 13.6	13.0 / 13.4	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	26.4 / 27.1 / .02	26.4	.	.	.	.	.	.
Difference,								
b. = + 0.02	31°46'		6° 48'		− 3° 31'		78°9'	
	h m s		h m s		h m s		h m s	
Wire, I.		10.6		33.0		33.3		54.0
II.		35.8		54.5		54.5		11.0
III.		1.0		16.0		16.0		28.5
IV.		25.5		37.5		37.0		45.5
V.	15 31	50.5	15 41	58.6	15 46	58.5	15 52	3.0
Sum,		123.4 / 124 / 3.4		199.6 / 200 / 79.6		199.3		142.0
Mean,	15 31	0.68	15 41	15.92	15 46	15.86	15 51	28.4
Bb	1.16	.02	.81	.02	.70	.01	3.89	.08
Cc,	1.18	.	1.82	.	1.00	.	4.87	.
Aa,	+.22	−.47	+.59	−1.26	.71	−1.51	−2.85	.
Corr'd Transit,	15 31	0.23	15 41	14.78	15 46	14.36		.
R. A.	15 28	1.04	15 38	15.54	15 43	15.16	15 48	35.44
Error of Timepiece,		2 59.19		2 59.24		2 59.20		.

16 21 34.51 27.50 − 16 17 13.27 30 = 57.82

2 59.68

16 18 27.82 16 18 27.82

Error 137 =

57.82 / 57.49 / −.33 rate −.35

57.53 / 57.34 / .45 rate = .45

15 48 35.44 / 43 15.16 / 5 20.28 / 12.61 / 3.56 | 7.57 | −2.13 = a.

51 28.48 / 46 15.87 / 5 12.61

213 / .71 / 213 / 1491 / 1.51

389 / .102 / .778 / .108 / .02

2.13 / 22 / 4.26 / 4.26 / 1.2567 / .468 / .47 — 213 / 59 / 1917 / 1065 / 126

$9 / .24 / .20 / 3|6.3 / .21

2 59.21 / 3 00.14 / .35

+2 59.68 = Error of Chron.

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 15/16 1877 Instrument, R. Transit Observer, G.M.

Timepiece, Chron. 3455-1 Recorder,

Object,	ϕ Herculis				δ Ophiuchi								19 Tau. Nu			
Circle,	M				M								M			
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.		13.6		13.4	
Reversed,	.		.		.		.		.		.		.		.	
Sums,	.		.		.		.		.		.		.		.	
Difference,																
b.	45° 14′				−3° 24′				−3° 24′				76°10			
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.			56.4				15.5				.				53.5	
II.			26.6				36.7				.				8.3	
III.			56.6				58.0				.				22.8	
IV.			26.8				19.3				.				38.0	
V.	16	8	57.3		16	11	40.5				.		16	17	53.5	
Sum,			223.7				170.0				.				176.1	
			60				120								60	
			223.7				290.0								176.1	
Mean,	16	17	56.72		16	10	58.0				.		16	17	23.22	
Bb,	1.42		.03		.70		.01				.		3.48		.08	
Cc,	1.42		.		1.00		.				.		4.19		.	
Aa,	−.07		+.09		.71		−.92				.		−2.33		.	
Corr'd Transit,	16	17	56.84		16	10	57.19				.				.	
R. A.	16	4	56.60		16	7	57.15				.		16	14	26.37	
Error of Timepiece,	3	00	.24		3	00	.04				.				.	

16 14 26.37 — 17 23.30
7 57.15 — 10 58.01
6 29.22 — 7 25.29

30H | 3.93 | = 1.29 = a. 1.30 + .07 = .091

3 00.14

1.3 / 13 / 91 = −.92

1.30
2.13
3.43
1.7

1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 15 85 1877. Instrument, Comparisons Observer, J.M.

Timepiece, Recorder,

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		.	.	.	.	.	.	.	.
Reversed,		.	.	.	.	1327 .	. 394	.	.
Sums,	1	7 14 = 19. 29	.	.	2	6 24 = 58,10	20 28 .	.	
Difference,		58,08	15,81		2	7 22,10	15.85		
b.	1	8 12.08	14.40 1.41		5	36 16.14	14.40 1,45		
	5	36 16.14	2.82						
		h m s		h m s		h m s		h m s	
Wire, I.	19	31 55,94	.564		21	31 05.96	2.90		.
II.		3 11.99	1,522			3 21,69	5.80		.
III.		23.95	-57,49			44.27	.6090		.
IV.		60	.59			60	57,61		.
V.		16,05	-58,08			15,73	58,10		.
		15,50				15,50			.
		+.55				Error of 394 = +.23			.
Sum,									
Mean,	2	47 31 = 21 9			2	24 37 = 21	4 16		
Bb,		58,12				58,13			
Cc,	2	48 29.12			3	25 35.13			
Aa,	5	36 16,14			5	36 16,14			
	21	12 12.98			21	49 18.99			
Corr'd Transit,		5 28.42				5 34,50			
R. A.		44,56				44.49			
		60				60			
		15.44				15,51			
		15,00				15,50			
Error of Timepiece,		Error of 394 = -.06				Error of 394 = +.01			

Diurnal Rate of Error.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 17 29 187 . Instrument, Observer,

Timepiece, Recorder,

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		June 17. 29							
Reversed,		1327		394					
Sums,		12 40 38 =		6 56					
		58,65		17.29					
Difference,				15.44					
b.		12 41 01.65		1,85					
		5 44 9.26		,45					
		h m s		h m s		h m s		h m s	
Wire,	I.	6 56 52.39		9 25					
		1 8.29		7 40					
	II.	44.10	57.82	1,85 25					
	III.	60	58.65						
		15,90							
	IV.	15,50							
		+.40							
	V.	Took off 45 grains for 2 hrs each							
Sum,		1327	394						
Mean,		2 7 15 = 20 21		1327	394				
Bb,		8 13.90	17.84	2 19 11 = 2 33				17.85	
			15.44	58.91				15.44	
Cc,		2	2.48					2.41	
			1.45	2 20 15.98				1.46	
Aa,		5 44 9.26		5 44 9.26				14 46	
		20 24 4.64	12 0					964	
			96					+.086	
Corr'd Transit,		3 20.54	3 48 0	20 36 6.72				1.09	
R. A.		44.10	1.08	+ 3 22.51				57.82	
		60	57.82	44.21				58.91	
		15.90	58.90	60					
		15.50		15.79					
Error of Timepiece,		+.40		15.50					
		1327	394	+.29					
				1327					

took off 10 grains at 8 35

2 43 21 = 20 57
58.92
2 44 19.82
5 44 9.26
22 00 10.56
3 26.28
44 38
60
15,62
15,50
+.12

3 1 25 = 21 21
58.93
3 8 23.93
5 44 9.21
21 2 14.67
3 30.39
44 28
60
15,72
15,50
+.22

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 14.91 1877. Instrument, Comparison Observer, ...
Timepiece, ... Recorder, HW.

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		. .	. .	. .	. .	. .	. .	. .	. .
Reversed,		. .	. .	. .	. .	. .	. .	. .	. .
Sums,		.	.	.	.	.	.	.	.
Difference,									
b.						1327		394	

		h m s	h m s	h m s	h m s
Wire,	I.	3 13 26 = 21	27 .	3 26 28. =	21 39 .
		58.93		58.94	
	II.	3 14 24.93	.	3 27 26.94	.
	III.	5 44 9.26	.	5 44 9.26	.
	IV.	21 30 15.67	.	21 43 17.68	.
		3 31.38		3 33.51	
	V.	44.29	.	44.17	.
		60		60	
Sum,		15.71	.	14.83	.
Mean,		15.30	.	15.10	.
		+ .21		+ .33	

Bb,		.	.	.	.
Ce,	3	31 29 .	3 37 .30 =	21 51 .	17.92
		58.94	58.94		15.14
Aa,		.	.	.	2.48
	3	32 27.94	3 38 28.94		.45
					60
	5	44 9.26	5 44 9.26	.	1.16
Corr'd Transit,		48 18.68	21 54 19.68	.	57.82
	21	3 34.33	3 35.32		1.12
R. A.		44.35	44.36	.	58.94
		60	60		
Error of Timepiece,		15.65	15.64	.	.
		15.50	15.50		
		+ .15	+ .14		

3 43 31
58.94
3 44 29.94
5 44 9.26
22 00 20.68
21 56.31
44.37
60
15.63
15.50
+ .13

3 43 36
58.94
3 43 29.94
5 44 9.26
21 59 20.68
3 36.14
44.54
60
15.46
15.30
− .04
+ .13
2697
4.98

Error of 394 = Signal clock +.1

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date,.....187 . Instrument,..... Observer,.....

Timepiece,..... Recorder,.....

Object,															
Circle,															
	w		*e*		*w*		*e*		*w*		*e*		*w*		*e*	
Level Direct,	.		.		.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.		.		.	
Sums,	.		.		.		.		.		.		.		.	
Difference,																
b.																
	h	*m*	*s*		*h*	*m*	*s*		*h*	*m*	*s*		*h*	*m*	*s*	
Wire, I.			.				.				.				.	
II.			.				.				.				.	
III.			.				.				.				.	
IV.			.				.				.				.	
V.			.				.				.				.	
Sum,			.				.				.				.	
Mean,			.				.				.				.	
Bb,			.				.				.				.	
Cc,			.				.				.				.	
Aa,			.				.				.				.	
Corr'd Transit,			.				.				.				.	
R. A.			.				.				.				.	
Error of Timepiece,			.				.				.				.	

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 18.38 1877 Instrument, Russ. Transit Observer, F.H.

Timepiece, Chron. 3451 Recorder, F.H.

Object,	δ Draconis	χ Draconis	4 Ursæ Minoris	θ Draconis
Circle,	W	W	W	W
	w | e	w | e	w | e	w | e
Level Direct,	14.0 | 13.0	. | .	. | .	. | .
Reversed,	15.3 | 13.1	. | .	. | .	. | .
Sums,	29.3 | 26.1	. | .	. | .	. | .
Difference,	3 | 3.2 .11			
b. = +.11	64° 58′	−9° 42′	78° 8′	−1′ 40″
	h m s	h m s	h m s	h m s
Wire, I.	56.5	48.3	55.5	20.5
II.	5.0	9.6	12.6	41.6
III.	13.5	31.4	29.6	03.0
IV.	21.7	53.0	47.0	24.1
V.	14 4 30.0	14 10 14.5	14 13 04.2	45.5
Sum,	126.7	156.8	148.9	134.7
	60			120
	66.7			14.7
Mean,	14 4 13.34	14 09 31.36	14 12 29.78	14 25 2.94
Bb,	2.18 +.24	.62 .07	3.96 .43	.72 .08
Cc,	2.37 .	1.02 .	4.87 .	1.00 .
Aa,	−.91 .	+.81 −1.24	−2.84 .	.69 −1.07
Corr'd Transit,	.	14 9 30.19	.	25 1.95
R. A.	14 1 7.24	14 6 22.79	14 9 27.25	14 21 54.68
Error of Timepiece,	.	3 7.40	.	3 7.27

15 34 51 / 00 0.5 = 14 13 27 / 55 55

3 7.0

14 56 53.50

14 57 55.1

Error of 1327 = −58.50

57.82

31.68

.23 = rate.

14 9 27.25

14 6 22.79

3 04.46

2 58.78

3.65 | 5.68 | −1.55 = (a).

3.65

2030

1825

205.0

12 30.21

9 31.43

2 58.78

3 7.40

.67

3 7.34

3 6.64

.98

Error of Chron. 3 6.99

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 18.38 187 7 Instrument, Russ. Transit Observer, G.M.

Timepiece, Arron. 3K 57 Recorder, G.M.

Object,	ψ Bootis		ψ Bootis		109 Virginis		Blue Meridl.	
Circle,	E							
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	15.3	13.1
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	38° 57		16° 57		2° 25'		74° 39'	
	h m s		h m s		h m s		h m s	
Wire, I.		22.3		22.3		29.5		46.5
II.		49.5		44.5		51.0		0.5
III.		17.0		6.7		11.9		13.5
IV.		44.5		28.8		33.5		27.0
V.	14 31	11.5	14 39	51.1	14 43	55.1	14 54	40.0
Sum,		144.8		153.4		181.0		127.5
		60.		120.		120.		60.
		84.8		33.4		61.		67.5
Mean,	14 30	16.96	14 39	6.68	14 43	12.2	14 54	13.50
Bb,	1.28	+.14	.95	+.10	.76	.08	3.19	.31
Cc,	1.29	.	1.05	.	1.00	.	3.76	.
Aa,	+.08	−.11	.45	−.70	.64	−.85	−2.01	.
	30	16.99	38	6.08	43	11.43		
Corr'd Transit,		.		.		.		.
R. A.	14 27	10.48	14 34	59.47	14 40	4.62	14 51	9.72
Error of Timepiece,	3	6.51	3	6.61	3	6.81		

14 51 9.72 54 13.85 3 6.51
46 4.62 43 12.28 6.81
11 5.10 11 1.57 1.93
1.57
2.65 | 3.53 | −1.33 @ 3 6.64
265
880
795
850

1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 18, 88 187 7 Instrument, Comparisons, Observer, [illegible]

Timepiece, [illegible] Recorder, [illegible]

Object,				
Circle,				
Level Direct,	w . .	e . .	w . .	e . .	w . .	e . .	w . .	e . .
Reversed,	1327 .	. .	394 .	. .	. .	. .	. .	. .
Sums,	15 . 39 28 = 58,57	9 51 .	* 0 . 58 := 58,61	19 8 .
Difference,	15 40 26,51			57.82
b.	5 48 5,82		0 58 58,61	
	h m s	h m s	h m s	h m .11 s
Wire, I.	9 52 20.69	.	5 h 48 m 5,82	52.79	.	57,50 .
II.	1 37.04	.	19 10	58.61 .
III.	43.55	.	3 85.4	.
IV.	60	.	44.25	.
V.	16.45	.	60.	.
	15,50	.	15.75	.
	.95	.	15,50	.
Sum,	Look off 4 grams for 10hrs at 10 P.M.	.	Error 394 +.25	.
Mean,		.		.
Bb,	1327 394	.	1327 .	094 .
Cc,	2 4 11 = 20	14	.	2 28 15 = 58,63	20 38 .
Aa,	58,62 .	.	2 29 13,12	.
	2 5 09.62			
	5 48 5,82		5 48 5,82	
Corr'd Transit,	20 17 3.80.	.	20 41 7.81	.
R. A.	3 19,39	.	3 23.33	.
	44.41		44.48	
	60		60	
	15.59.		15,52	
Error of Timepiece,	15,50	Error 394	15,50 +.02	.

1327 394

2 53 19= 58,64 — 2 h 394 .09 3

2 54 17,64
5 48 5,82
21 06 11.82
3 27.44
44.38
60
15.82
15,50
,12

2 58 20 = 58,64
2 59 18,64
5 48 5,82
21 11 12,82
3 28,58
44.24
60
15,76
15,50
,26

1327 394
3 5 21 = 58,64
3 6 19,65
5 48 5,82
21 18 13,83
3 29,41
44,42
60
15,58
15,50
+,08 Error 394.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 18. 1877. Instrument, Comparison Observer,

Timepiece, Recorder, F.H.

Object,															
Circle,															
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.		.		.	
Reversed,	1327.		394		.		.		.		.		.		.	
Sums,	3 29 25 =		21 39		.		.		.		.		.		.	
Difference,	58.65															
b.	3 30 13.65															
	5 48 5,82															
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I. 21 42	17, 8 3		.				.				.				.	
II.	3 33.35		.				.				.				.	
III.	44.48		.				.				.				.	
IV.	60		.				.				.				.	
V.	15, 5-2		.				.				.				.	
	15, 50		.				.				.				.	
	Error 394 = 1.02															
Sum,			.				.				.				.	
Mean,	Equal Rect Ms. Error		.				.				.				.	
Bb,			.				.				.				.	
Cc,			.				.				.				.	
Aa,			.				.				.				.	
Corr'd Transit,			.				.				.				.	
R. A.			.				.				.				.	
Error of Timepiece,			.				.				.				.	

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 19.37 1877. Instrument, Rues Transit. Observer, F.H.
Timepiece, Arran. 3451. Recorder, F.H.

Object,	η Bootis	11 Bootis	κ Virginis	4 Ursæ Minoris
Circle,	E	E	E	E
	w / e	w / e	w / e	w / e
Level Direct,	12.9 / 11.8	. / .	. / .	. / .
Reversed,	13.5 / 12.0	. / .	. / .	. / .
Sums,	26.4 / 23.8	. / .	. / .	. / .
Difference,	23.8 / .			
b. = +,08	3 | 2.6 / +.08			
	19° 1'	27 59	-9° 42	78° 8'
	h m s	h m s	h m s	h m s
Wire, I.	⊠ 16.8	0.0	49.8	57.0
II.	39.4	23.7	11.5	14.1
III.	1.6	48.0	32.8	31.4
IV.	24.5	12.0	54.5	48.5
V.	13 52 46.6	13 59 36.0	14 10 16.3	14 13 06.0
Sum,	128.9 / 120 / 8.9	119.7 / 120 / 2 39.7	164.9	157.0
Mean,	13 52 1.78	13 58 47.94	14 9 32.98	14 12 31.40
Bb,	,98 / +.08	1.10 / +.09	,62 / +.05	3.96 / +.32
Cc,	1.06 / .	1.13 / .	1.02 / .	4.87 / .
Aa,	,47 / -:65	,28 / -,44	,81 / -1.26	-2.84 / .
Corr'd Transit,	52 1.21	58 47.59	9 31.77	.
R. A.	13 48 52.25	13 55 38.47	14 6 22.78	14 9 27.16
Error of Timepiece,	3 08.96	3 09.12	3 8.99	.

14 59 0 0 = 14 54 52 (48) = (40)

3 9.52

14 55 50.48

54 52

Error = − 58.48

14 9 27.16
6 22.78
3 04.38
2 58.69
3.65 | 45.69
365
2040
1825
2150

31.72
33.03
3 | 58.69
(4.56 = a.)

8.96
9.12
8.99
3 | 27.07
0 9.02
3 10.03
6 | .19.05
3 9.52

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 19, 23, 1877 Instrument, Observer,

Timepiece, Recorder,

	ρ Ursæ Majoris	π Bootis	109 Ursæ Majoris	Bliss Number
Object,				
Circle,	W	W	W	W
	w | e	w | e	w | e	w | e
Level Direct,	13.0 | 12.0	. | .	. | .	14.0 | 12.0
Reversed,	14.0 | 12.0	. | .	. | .	. | .
	27.0 | 24.0			
Sums,	13.5 | 12	. | .	. | .	. | .
Difference,				
b.	−1 41	16° 51	2° 25′	74° 39′
	h m s	h m s	h m s	h m s
Wire, I.	22.3	25.1	32.5	51.5
II.	43.6	47.5	53.6	5.3
III.	05.0	9.5	15.0	18.8
IV.	26.4	32.0	36.5	32.0
V.	14 25 47.5	14 38 53.9	14 43 57.4	14 54 45.3
Sum,	144.8 / 120 / 24.8	168.0 / 120 / 48.0	195.0 / 120 / 75.0	152.9 / 60 / 92.9
Mean,	14 25 4.96	14 38 9.60	14 43 15.0	14 54 18.58
Bb,	.72 .08	.95 .08	.76 .07	3.19 .224
Cc,	1.00 .	1.05 .	1.00 .	3.76 .
Aa,	.69 −.30	.45 −.20	.64 −.29	−2.01 .
Corr'd Transit,	25 4.60	38 9.48	43 14.78	.
R. A.	14 21 54.68	14 34 59.46	14 40 4.62	14 51 9.66
Error of Timepiece,	3 9.92	3 10.02	3 10.16	.

51 9.66
21 54.68
40 14.98
11 5.04

54 18.82
43 15.07
11 3.75

9.92
10.16
10.10
3 10.03

14 51 9.66
21 54.68
29 14.98
13.80
1.18
108
100
−2.79

54 18.82
25 5.02
13.80

−0.44 (a).

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 19. 81 1877 Instrument, Observer, Mr.

Timepiece, Comparison Recorder,

	w	e	w	e	w	e	w	e
Object,								
Circle,								
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	1 21 59 = 19 28				1 34 1 = 19 40			
Difference,	58.48				58.48			
b.	1 22 57.48				1 34 59.48			

	h m s	h m s	h m s	h m s
Wire, I.	5 52 2,38		5 52 2,38	
II.	19 39 55.10		19 42 57.10	
III.	3 11.82		3 13.80	
IV.	43.28		43.30	
V.	60		60	
	16.38		16.70	
	15 30		15 30	
Sum,	1 1 6		1,20	
Mean,	.		.	

look off 1.59.ch 19 33

Bb,		1327		394		2 39 12 =	20 45	
Cc,	2	27 10 =	20 33			58.48		
Aa,	2	58.48				2 40 10.48		
	5	28 09.48				5 52 2,38		
Corr'd Transit,	20	52 2,38				20 48 8.10		
R. A.		36 6.10				3 24.48		
		3 22.51				43.62		
		48.59				60		
		60				16.38		
Error of Timepiece,		16.41				1.50		
		15.50				+ .88		
		.+.91						

3 38 22 = 21 44

58.48

3	39	20.48
5	52	2,38
21	47	18.10
	3	34.47
		13.93
		60
		16.07
		1.50
		+.57

Error cent +.4

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 20th 187 7 Instrument, Observer,

Timepiece, Recorder,

Object,											
Circle,											
Level Direct,	w 327	e	394	w	e		w	e		w	e
Reversed,	8 .4	7.=	= 9	.	.		.	.		.	.
Sums,	58.75										
Difference,	8 5 05.75			11	6 36 =		5 11				
b.	5 55 58.44				58.80						
	2 59 06.81			11	7 34.80						
	h m s		h m s		h m s		h m s			h m s	
Wire, I.	8 5 05.75				5. 55 58.44						
II.	5 55 58.44				5. 11 35.86						
III.	2. 09 06.81				51.05						
IV.	21.116				14.81						
V.	45.65				60						
	60				15.19						
Sum,	14.35				15.58						
Mean,	15.50				— .39						
	Err of 394 — 1.15		Took off 10 grains at 5 15 P.M. and								
Bb,	Put back weights at 15 & at 2h } added 1 gr.										
Cc,	added 10 grains more										
Aa,											
Corr'd Transit,											
R. A.											
Error of Timepiece,											

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan 20 1877 Instrument, Observer,

Timepiece, Recorder,

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		.	.	.	.	.	.	.	.
Reversed,		1327 ii = 58.84 from Mark. Obs.							
Sums,		1327	.	394	.	.	.	.	.
Difference,		17 46 41 = 11 50							
b.		58.185							
		h m s		h m s		h m s		h m s	
Wire, I.		17 47 39.85			.		.		.
II.		5 55 58.94			.		.		.
III.		11 51 40.91			.		.		.
IV.		1 56.59			.		.		.
V.		44.32			.		.		.
		60							
Sum,		15.88			.		.		.
Mean,		15.50			.		.		.
		+ .18			.		.		.
		took off 1 gr. mark 12h.							
Bb,			.		.	1327	.	394	.
Cc,		1327	= 58.90		.	1 14 54 =	.	19 17	.
Aa,	1	8 53 =	394		.	58.9	.		.
			19 11 0			115 52.90			
Corr'd Transit,		58.90	.		.	55 58.94	.		.
R. A.	1	9 51.90	.		.	19 19 53.96	.		.
	5	55 58.85				3 16.02			
						43.94			
	19	14 53.05				60			
Error of Timepiece,		3 9.20	.		.	16.06	.		.
		43.75				15.50			
		50							
		15.25							
		15.50							
		+ .75							

1327 394

2 49 10 = 20 51

58.91

2 50 08.91

5 55 58.85

20 54 10.06

3 25.46

44.60

60

15.140

15.50

Sum of 394 = . took off 19 gr at 19h 20

+ 0.56

3 27 16 = 21 29

58.91

3 28 14.91

5 55 58.85

21 32 16.06

3 31.71

44.35

60

15.65

Sum of 394 = −10.

put back 19 gr at 20 15 + added 9r

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 20 92 1877. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,											
Circle,											
	w		e		w		e		w		e
Level Direct,	3 22 17 = 58.91		.		.		.		.		.
Reversed,			.		3 51 20 = 21		53		.		.
Sums,	3 33 15.91 / 5 55 58.85		.		58.91 / 3 52 15.91 / 5 55 58.85		.		.		.
Difference,	21 38 17.06				21 56 20.06				.		.
b.	2 32.53				2 35.61						
	h	m	s		h	m	s		h	m	s
Wire, I.	4 m. 5 m 60 / 15.47		.		44.41 / 60 / 15.59		.				.
II.	15.50		.		15.50		.				.
III.	Sum 394 = -.03		.		7.09		.				.
IV.			.		Signal dust no Error.		.				.
V.			.				.				.
Sum,			.				.				.
Mean,			.				.				.
Bb,			.				.				.
Cc,			.				.				.
Aa,			.				.				.
Corr'd Transit,			.				.				.
R. A.			.				.				.
Error of Timepiece,			.				.				.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 21st 1877. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		.	.	.	.	.	.	.	.
Reversed,		1327 .	. 394	.	.	1327 .	. 394	.	.
	13	27	54=7	28	13	33	55=7	34	
Sums,		.	58.94	.	.	58.94	.	.	.
Difference,	13	28	52.94		13	34	53.94		
b.	5	59	55.49		5	59	55.49		

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.	7	28	57.45	7		34		58.45				
	II.		1	13 55				1	14.54				
	III.			43.90					43.91				
	IV.			60 .					60				
	V.			16.10					16.09				
				15.50					15.50				
				+.60			Error 344 = +.59						
Sum,				.			.		Took off 2 grains for 10 hrs.				
Mean,	.38		54=19	37.			.		at 7h 46m				
				59.00					1327			394	
Bb,	1 39			53.			.	3	3 8=		21	1	.
Cc,	5 59			55.49			.		59.01				.
Aa,	19 39			57.51			.	3	4 07.01				.
	3			13.31				5	59 55.49				
Corr'd Transit,				44.20			.	21	4 11.52				.
R. A.				60			.		3 27.11				.
				15.80					44.41				
				15.50					60				
Error of Timepiece,				+.30			.		15.59				.
									15.50				
									+.09				

Klein 5 sgls

took off 59 grains ab 19h 40m

Put back 4 grains ab 21h 10m

3 52. 16 = 21 50

59.02

3 53 15.02

5 59 55.49

19.53

21 53 3 35.16

44.37

60

15.63

15.50

Error 344 +.13

Clock losing

Original sent No Error

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1977phae.proj.1704w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 22, 33 1877 | Instrument, R Transit | Observer, ZW.
Timepiece, Chron 2254 | Recorder, ZW.

Object,	α Virginis	γ Virginis	ζ Bootis	α Draconis
Circle,	W	E	E	E
Level Direct,	w 13.6 / e 15.6	w ~~14.3~~ / e ~~15.~~	w 14.5 / e 14.5	w ~~14.3~~ / e ~~15.0~~
Reversed,	14.5 / 14.5	. / .	. / .	. / .
	28.1 / 30.1			
Sums,	. / 28.1	. / .	. / .	. / .
Difference,	3 | 2.0			
b. −.07	−.07			
	−10 71	+49° 5′6	19° 1′	64° 58′
	h m s	h m s	h m s	h m s
Wire, I.	20.5	56.5	24.7	50.1
II.	42.1	29.9	47.5	6.7
III.	03.6	2.5	10.0	23.9
IV.	25.5	35.5	32.5	40.4
V.	13 22 47.0	13 47 8.5	13 52 55.0	14 4 57.0
Sum,	138.7	132.9	169.7	178.1
	120	120	120	60
	18.7	12.9	49.7	118.1
Mean,	13 22 3.74	13 46 2.58	13 52 9.94	14 4 23.62
Bb,	.62 −.04	1.54 −.11	.98 −.07	2.18 −.15
Cc,	1.02 −.51	1.26 −.77	1.06 +.53	2.37 +1.17
Aa,	+.81 −.04	−.21 +.01	.42 −.02	.91 +.03
Corr'd Transit,	13 22 3.15	13 46 1.71	13 52 10.38	14 4 24.67
R. A.	13 18 45.20	13 42 44.17	13 48 52.10	14 1 6.59
Error of Timepiece,	3 17.95	3 17.54	3 18.28	3 18.08

Chron 2254
14 9 46.5 = 14 5 30.7
21.5
3 17.95
14 6 28.58
5 30.00
−58.58

α = +.50 Circle E.

13 42 44.17	13 46 1.70
18 45.20	22 3.19
23 58.97	23 58.51
51	
1.02 | 46	−.05

17.95
17.54
18.28
18.08
2.77
3 17.92

E.

14 1 6.59	14 4 24.64
48 52.10	10.40
12 14.49	1.32 | 46

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date,.....187 . Instrument,..... Observer,.....

Timepiece,..... Recorder,.....

Object,															
Circle,															
		w		e		w		e		w		e		w	e
Level Direct,															
Reversed,		1327				394									
	14	40	2 =	8		36									
Sums,			58,58												
Difference,															
b.	14	41	00,58												
	6	3	52,05												
		h	m	s		h	m	s		h	m	s		h	m s
Wire, I.	8	37	8,53												13.7
II.		1	24,72												44.4
			43,81												
III.			60												14.5
IV.			16,19												44.6
V.			15,50												14.5
			69											16	9
Sum,															131.7
															60
															71,7
Mean,														16	8 14,34
Bb,														1,43	-,13
Cc,														1,43	+,40
Aa,														-,09	+,07
Corr'd Transit,														16	8 14 68
R. A.														16	4 56,58
Error of Timepiece,						58,84								3	18,10
						58,45									
						2 | 0,39									
						0,195									

1327
. 17 24 29 = 11 R20
58,45
1 17 25 27,45
6 3 52,05
11 21 35,40
1 51,66
73,74
60
16,18
15,50
Error of 394 = +,78

Toothoff 3 gramsah 11 30

5=8
14 26,10
58 20,47
6,63

17 42,66
1 39,04
16 3,62

3,62
3,06 | 2,99 | ,97 a.
2754
2360
-,94 mean a.

16

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

215

Date, Jan 22, 1877. Instrument, Observer,

Timepiece, Recorder,

Object,	β Scorpii	19 Ursæ Majoris	12 Ursæ Majoris	ζ Herculis / Arphucha
Circle,	E	E	W	W
Level Direct, w	14.5			14.0
Level Direct, e	15.1			16.2
Level Reversed, w	14.0			
Level Reversed, e	16.2			
Sums,	31.3			
Difference,	27.5 / 32.8			
	−.09			
b.	−.09			
	−19°28′	76°11′10″		2°15′
	h m s	h m s	III h m s	h m s
Wire, I.	54.0	I 13.5	14.0	22.4
II.	16.5	29.0	28.5	43.4
III.	38.4	43.5	44.5	4.5
IV.	1.5	58.5	59.0	26.0
V.	16 2 24.2	16 15 13.5	16 18 13.5	16 28 47.0
Sum,	134.6 / 60 / 194.	158.0 / 60 / 218.0	159.0 / 60 / 219.5	143.3 / 120 / 23.7
Mean,	16 1 38.80	16 14 43.80	16 17 43.90	16 28 4.86
Bb,	,429 −.04	3.29 41.85 −.29	−.29	,76 −.07
Cc,	1,106 +.30	3.97 +1.10	−1,10	1,00 .28
Aa,	+.94 −.88	−2,12		.65 −.62
Corr'd Transit,	1 38.18			24 4.25
R. A.	15 58 20.47	16 14 26,10		16 24 45.81
Error of Timepiece,	3 18.71			+3 18.44

16 33 54.51 16.75 = 16 29 1327
3 18.141
24 58.34
24
−58134 Emf 1327.

17

+.28 a. Cc.

24 45.81
14 26,10
10 19.71

18.44
18.71
18,10
1.25
+3 18.41
Emf Chron

28. 4,66
17 42.51
10 22.15
19.71
277|2.4 40 [0.90]
2493
470

cw.
a.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 22 1877 Instrument, Comparison Observer, J.P.

Timepiece, Recorder,

Object, 58

Circle,

	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	1327	394	.	.	.	.	.	.
Sums,	2 29 57 = 20 24	.	.	1 36 00 =	.	.	.	.
Difference,	58.37	130	.	.	58.37	.	.	.
b.	2 30 57.37	148	.	2 36	58.37	.	.	.
	6 3 52.05	+.08	.	6 3	52.05	.	.	.

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.	20 27	5,32	.	20	.38	6,32	.					
	II.	3	21.03	.			3 22.01	.					
	III.		44.29	.			44,31	.					
	IV.		60	.			60,00	.					
	V.		15,71	.			15,69	.					
		Error	15.50	.			15,50	.					
			+.21	.			+,19	.					
Sum,				.				.					
Mean,				.				.					
		1327		394									
		3 30	9 =	21 24									
Bb,				.				.					
			58,35										
Cc,				.				.					
Aa,		3 31	07.35	.				.					
		6 3	52.05										
Corr'd Transit,	21	27	15.30	.				.					
R. A.		3	30.88	.				.					
			44.42										
			60										
			15,58										
Error of Timepiece,			15,50	.				.					
		Error	+,08										

put back graduat 21h 44m

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6 LHO .069

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 23.91 June 1877. Instrument, Comparison Observer, [illegible]

Timepiece, Recorder, [illegible] = 4.17 June

Object,	1327			394						1327			094						
Circle,	3	51	8 = 58.15	21	41					10	19	12 = 58.09	48						
	3	52	06.15	3 391															
Level Direct,	6	7	48.61	e 22.44		w		e		w		e	w		e				
Reversed,	21	44	17.54	.147				.10		20	10.09		24.17						
		8	33.68	.20				.6		11	45.17		22.40						
				.29 4					4	8	24.92		1.77						
Sums,			43.86	58.44							40.71		.20						
Difference,			60	-58.15							44.21		.354						
b.			16.14								60		58.144						
	Error 394 =		15.50										.079						
			+.64										58.09						
			h	m	s		h	m	s		h	m	s		h	m	s		
Wire, I.	look off 4 grains at 22hr										15	79							
II.											15.50								
III.											7.29 = Error 394.								
IV.											Interpolate 22hr 4m 45s								
V.																			
Sum,																			
Mean,																			
Bb,																			
Cc,																			
Aa,																			
Corr'd Transit,																			
R. A.																			
Error of Timepiece,																			

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 24 & 25 1877. Instrument, Rues Transit Observer, HW.

Timepiece, Owen 345. Recorder, HW.

Object,	ψ Ursæ Min.		ψ Ursæ Min.		α Coronæ		α Serpentis	
Circle,	E		E		E		E	
	w	e	w	e	w	e	w	e
Level Direct,	14.0	14.0	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b. = .00 Comparatively	-72 16' 48"		72 16 48		27° 8'		~~35~~ 6° 49'	
	h m s		h m s		h m s		h m s	
Wire, I.		15.0		58.5		7.1		56.0
II.		26.5		10.0		31.0		17.4
III.		38.0		21.5		55.0		39.0
IV.		49.5		33.0		18.9		00.5
V.	15 21	01.0	15 24	44.5	15 33	42.7	15 42	21.8
Sum,		130.0 / 6 / 190.0		167.5 / 60 / 107.5		154.7 / 12 / 274.7		124.7 / 60 / 184.7
Mean,	15 20	38.0	15 24	21.50	15 32	54.94	15 41	38.94
Bb		.		2.85		1.09		.87
Ce,		.		3.28		1.12		1.02
Aa,		.		-1.63		.27		.58
Corr'd Transit,		.		.		32 54 60		.
R. A.		.	15 21	0.68	15 29	31.74	15 38	15.53
			3	20.82	3	23.20	3	23.41
Error of Timepiece,		.		.		3 22.86		.

15 29 31.74
21 08.68
8 39.06

32 54.96
24 21.30
33 44
21.06
1.90 | 2.38 | 1.25 (a)
90
480
380
1000

22.86
23.73
2 | 23.59
3 23.30 Error of 345

Polar Equations

0 = 3 20.82 − 1.63a + 3.28 e
0 = 3 19.85 − 2.86a + 4.88 e
.67 .49 .16
0 = 3 20.32 − 2.25a + 4.08 e

C E.

0 = 3 20.20 + .27a + 1.12 a
0 = 3 23.41 + .58 + 1.02
0 = 3 23.36 + .47 + 1.04
.97 3.32
0 = 3 23.32 + .43a + 1.03a
(0 = 3 23.32 − .34 + .28 = 3 23.26)
0 = 3 20.32 − 2.25 + 4.08

0 = 0.34 + 2.68a − 3.05a (1)
0 = 1.02 + 2.79a + 4.24a (2)
0 = 1.12 + a − 1.14a (4)
0 = .40 + a + 1.52a
0 = .72 + 2.66a
−2.66 | .720 | .28
5 32
1 88

C E.

22 + .31 = 3 23.29
46 + .28 = 23.23
38 + .29 = 23.25
3 23.26 = 3 23.27

c = +.28 C. E.
a = −.80

Rule East.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 24. 42 1877. Instrument, Repsold Transit Observer, J.W.

Timepiece, Arron. 3451 Recorder, J.W.

Object,	β Serpentis		ξ Ursæ Majoris				Coronæ	
Circle,	E		E		W		W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	15° 4' 8		78° 10				27° 14'	
	h m s		h m s		h m s		h m s	
Wire, I.		12.8	I	52.5	III	22.8		8.6
II.		35.0		9.1		40.0		32.5
III.		57.0		26.5		57.5		56.5
IV.		19.0		44.0		15.0		20.8
V.	15 44	41.0	15 49	1.5	15 52	31.5	15 56	44.5
Sum,		164.8		133.6		166.8		162.9
		120				120		120
		284.8				286.8		282.9
Mean,	15	43 56.96	15 48	26.7	15 51	57.36	15 55	56.58
Bb,	193		3.97	27.33			1.09	
			15 51	54.05				
Cc,	1.04		4.88				1.12	
Aa,	47		-2.86				37	-.10
Corr'd Transit,								55 56.45
R. A.	15 40	33.60	15 48	34.20	15 48	34.20	15 52	32.75
		3 23.36		3 19.85		3 23.16		3 23.83
Error of Timepiece,								3 23.73

C. M.

$0 = 3\ 23.83 + .27^a + 1.12^c$

$0 = 3\ 24.12 - .07 + 1.42$

$0 = 3\ 24.22 + .01 + 1.00$

$0 = 3\ 24.06 + .30^a + 1.18^c$

$0 = 3\ 23.04 - 2.49^a + 4.42$

$0 = 1.02 + 2.79^a - 4.24^c$

$0 = 3\ 24.06 + .30^a + 1.18^c$

$0 = 3\ 24.06 - .24 - .33$

$0 = 3\ 23.49$

$0 = 3\ 23.16 - 2.86^a + 4.88^c$

$0 = 3\ 23.91 - 2.12^a + 3.97^c$

$0 = 0\ .13\ .97\ .98\ 2.85$

$0 = 3\ 23.04 - 2.49^a + 4.42^c$

Klein

$0 = 3\ 23.83 + .22 - .31 = 3\ 23.74$

$0 = 3\ 24.12 - .06 - .40 = 3\ 23.56$

$0 = 3\ 24.22 - .56 - .28 = 3\ 23.38$

$3\ 23.43$

57.36
54.05
2 33 31
+ 1.65
21
165
336
+ 346 5
+.35 = a, c, E1

.34
.27
6 5 3
.10 8

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 24.42 June 1877 Instrument, Russ Transit Observer, H.W.

Timepiece, Chron. 3457 Recorder, H.W.

Object,	ζ Herculis			δ Ophiuchi			19 Ursæ Minoris				
Circle,	W			W			W				
	w		e	w		e	w		e	w	e
Level Direct,	14.4		14.6	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.	45° 15'			−3° 23'			76 11				
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			20.1			38.7			19.0		.
II.			50.5			00.0			34.0		.
III.			20.8 (12)			21.6			49.0		.
IV.			51.0			42.6			3.5		.
V.	16	9	21.0	16	12	4.0	16	18	18.5		.
Sum,			1634			106.9			124.0		.
			40			.			120		.
			103.4			.			244.0		.
Mean,	16	8	20.68	16	11	21.38	16	17	48.80		.
Bb,	1.42		.	.70		.	3.29		.		.
Cc,	1.42		.	1.00		.	3.97		.		.
Aa,	−.07		.	.71		.	−2.12		.		.
Corr'd Transit,			.			.			.		.
R. A.	16	4	56.56	16	7	57.16	16	14	25.99		.
		3	24.12		3	24.22		3	22.91		
Error of Timepiece,			.			.			.		.

3451 1327
16 23 22 = 16 19
52
−3 23.30
19 58.70
19
Error 1327 − 58.70

16 14 25.99
52 32.75
21 53.24
52.32
2.40 1.92
72
200

17 48.90
55 56.58
21 52.32
−.39 (a).

3451 1327
16 23 22 = 16 19
3 23.35
19 58.65
00
−58.65
Error 1327.

−3 23.35
Error Chron.

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date,.....187 . Instrument,..... Observer,.....

Timepiece,..... Recorder,.....

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,									
Reversed,									
Sums,		1327 / 16 17 11.	394 / 10	.	.	1 3 2 41 =	19.	19.	
Difference,		-58.70				-58.75			
b.		16 18 09.70				1 33 39.75			
		h m s	h m s	h m s	h m s	h m s	h m s	h m s	h m s
Wire, I.		6 11 45.17		70 45 25 .13		6 11 45.17			
II.		10 6 24.53				21 54.58			
III.		1 39.35				3 10.35			
IV.		45.28				44.23			
V.		60				60			
		14.72				15.77			
		15150				15.50			
						+.27			
Sum,		Error of 394 = -.78				Took off 5 grains for two hours			
Mean,		added 5 grains each	10 30			and 4 grains permanently, at 19.25			
Bb,						put back .5 grains each 21h 1.0m			
Cc,		1327	394						
Aa,	3	20 59 = 21	.7						
		58.76							
Corr'd Transit,	3	21 57.76							
R. A.	6	11 45.17							
	21	10 12.59							
		3 28.09		1327	394				
		44.50		4 10	7 =	21 56			
Error of Timepiece,		60			58.76				
		15150		4 11	05.76				

6 11 45.17

21 59 20.59

3 36.14

44.48

60

15.52

15.50

Sup 394 = +.02

Reginald Rent No error

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 25.32 1877 Instrument, Fine Transit Observer, FLL

Timepiece, Dent 3451 Recorder, FLL

Object,	ζ Ursæ Maj.		ζ Ursæ Maj.		α Draco		α Bootis
Circle,	W		W		E		E
	w	e	w	e	w	e	w	e
Level Direct,	12.0	13.4	12.1	13.0	.	.	12.1	12.6
Reversed,	.	.	12.1	13.2	.	.	.	.
			12.1	12.6				
Sums,	.	.	24.2	25.8	.	.	.	.
				24.2				
Difference,				1.6				
b. −.05				.05				
	55° 0′ 34″		49° 5′ 6″		64° 5′ 8″		19° 49′	
	h m s		h m s		h m s		h m s	
Wire, I.		11.6		4.5	58.0			46.3
II.		49.5		37.5	14 5			8.5
III.		27.4		10.5	31.5			31.5
IV.		04.9		43.5	58.3			54.0
V.	13 23	42.5	13 47	16.5	14 5	5.0	14 14	16.6
Sum,		135.9		.		217.3		156.9
						157.3		
Mean,	13 22	27.18	13 46	10.50	14 4	31.46	14 13	31.38
Bb,	1.72	−.08	1.54	−.07	2.18	−.11	.99	−.05
Cc,	1.77	−1.53	1.06	−.47	2.37	+.81	1.06	+.31
Aa,	−.40	+.25	−.21	+.13	−.91	+.57	.42	+.26
Corr'd Transit,	22	26.82	46	10.09	14 4	32.73	13	31.38
R. A.	13 19	1.25	13 42	44.40	14 1	7.00	14 10	5.65
Error of Timepiece,	+3	25.57	+3	25.69	+3	25.73	+3	25.73

2 18 34.50 = 2 14 10

3 25.66

15 08.84

14 10.00

58.84

Error 1.327.

Assume C = +.30 C.E. from Each Obs.

14 10 5.65 14 32.16

1 7.00 13 31.63

8 58.65 8 59.47

58.65

1.30 .82 .63 (a).

.57

.69

.73

1.99

3 25.66

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 25 27 1877 Instrument, Observer,

Timepiece, Comparison Recorder, JW

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,									
Reversed,									
Sums,		13 27	394		2	1327	394		
Difference,		14 4 54 =	8 49			29.15 =	20 12		
b.		58.84				58.91			
					2	30 3.91			
Wire,	I.	14 5 52.84			.6	15 41.73			
	II.	6 15 41.73							
	III.	8 50 11.11			20	15 32.18			
	IV.	1 27.13				3 19.13			
	V.	43.98				12 13.05			
		60							
		16.02							
Sum,		15.50				2 34.	48 =		
Mean,		Err 394 = +.52					58.91		
						2 35	46.91		
Bb,						6 15	41.73		
Ce,						20 20.	04.18		
Aa,		2 40 49 =	20 24			3.	19.88		
		58.91					44.30		
Corr'd Transit,		2 41 47.91					60		
R. A.		6 15 41.73					15.70		
		20 26 06.18					15.50		
		25 20.86					Err 394 = +.20		
Error of Timepiece,		45.32							
		60							
		14.68							
		15.50							
		-.82							

Put back 4 grams & added 20 grains 20 30

1327

3 0 52 = 20 43

58.92

3 1 50.92

6 15 41.73

20 46 9.19

3 24.15

45.04

60

14.96

15.50

-.54

3 6 53

58.92

3 7 51.92

6 15 41.73

20 52 10.19

3 25.14

45.05

60

14.95

15.50

-.55

1327

3 45 59 =

58.92

3 46 57.92

6 15 41.73

24 31 16.19

3 31.55

44.64

60

15.36

15.50

-.14

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 25.91 1877. Instrument, ... Observer, ...

Timepiece, Dent Parsons Recorder, Mr.

	w	e	w	e	w	e	w	e
Object,								
Circle,								
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	1327	.	594	.	1327	.	594	.
Sums,	3 .52 00 = 21 . 34 .				12 . 9 21 = 58.98		5 50 .	
Difference,	58.92				12 10 19.98			
b.	3 52 58.92				6 19 38.29			
	h m s	h m s			h m s		h m s	
Wire, I.	6 15 41.73	.			50 41.69		.	
II.	21 37 17.19	.			57.45		.	
III.	3 32.53	.			44.24		.	
IV.	44.66	.			60		.	
V.	60	.			15.76		.	
	15.34	.			150		.	
	15.00	.			7.26		.	
Sum,	.	.			.		.	
Mean,	Err of 1327 394 = - .16	.			.		.	
	1327	394						
Bb,	4 11 3 = 21 53	.			.		.	
Ce,	58.92	.			.		.	
Aa,	4 12 1.92	.			.		.	
Corr'd Transit,	6 15 41.73	.			.		.	
R. A.	21 57 20.19	.			.		.	
	3 35.81							
	44.38							
Error of Timepiece,	60	.			.		.	
	15.62							
	14.50							
	.12							

Original Clock No Error!

Took off 20 transit 21h.55

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 29.6: 1877. Instrument, Comparison Observer, Flu.
Timepiece, Recorder,

Object,								
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	13.7 .		3.94 .		.	.	.	.
Reversed,	15 · 30 54 = 9 · N	.		.	13.7	.	394	.
Sums,	59				1 35 33 =		19 14	
	15 · 31 53.	.		.	. 59,15.		.	.
Difference,					1 36 32.15			
b.	6 19 38.29				6 19 38.29			
	h m s	h m s			h m s		h m s	
Wire, I.	9 12 14.31	.			19 16 53.86			.
II.	1 30.47	.			3 9.53.			.
III.	44.84	.			44.33			.
IV.	60	.			60			.
V.	15.76	.			15.67			.
	15.50	.			15.50.			.
	Error of 394 +.26				Error of 394 +.17			
Sum,	took off 1 gram at 9h 15m	.			took off = gram at 21 10			.
Mean,		.						.
Bb,	2 47 43 =	20 26 .			3 54.56 =	21 37 .		
Cc,	59.18	.			.59.16			.
Aa,	2 48 44.15	.			3 55 55.16			.
					6 19 38.29			
Corr'd Transit,	6 19 38.29	.			2 36 16.87			.
R. A.	20 29 05.86	.			3 32.36			.
	3 21.36				44.51			
	44.50				60			
Error of Timepiece,	60.	.			15.49			.
	15.50				15.50			
	15.50							
	Error of 394 = 0.0				Error of 394 = —.01			

Just back 2 grams at 20 25
just taken off grams at

Regular Rest No Error.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 27, 33 1877 | Instrument, Rues. Transit | Observer, WW

Timepiece, Arron. 3451 | Recorder, WW

Object,	3 Bootis			α Draconis			47 Ursæ Maj.				
Circle,	E			E			8			W	
	w		e	w		e	w		e	w	e
Level Direct,	14.1		14.1	.		.	.		.	.	.
Reversed,	14.5		14.9	.		.	.		.	.	.
	6		10								
Sums,	.		37.4	.		.	.		.	.	.
Difference,			.01								
b. = −.01	19° 1′			64° 57′						78° 7′	
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			38.8			56.3	III		20.0	V	48.5
II.			0.8	14	3	46.5			36.5		6.5
III.			23.5			36.8			54.0		23.0
IV.			46.0			27.5			11.5		40.5
V.	13	53	08.5	14	6	17.5	14	13	28.5	14	16 57.0
Sum,			117.6			184.6			150.5		175.5
Mean,	13	52	23.52	14	4	36.92	14	12	54.10	14	16 23.1
,	.98		−.01	2.18		−.02	3.95		−.04	14	12 56.50
Cc,	1.06		+.24	2.37		+.55	4.86		+1.02		−.04
Aa,	.42		−.38	−.91		+.81	−2.84				+1.02
Corr'd Transit,	13	52	23.37	4		38.26					
R. A.	13	48	52.19	14	1	6.93	14	9	26.45		
Error of Timepiece,	+ 3		31.18	3		31.33					

3451 — 1327

14 37 30.50 = 14 33 00

20.5 — 57

3 31.21

33 59.29

33 00

Smof 1327 = − 59.29

51.84

2.45

−.23 rate

14 12 56.46 — 19 9 26.45 — 14 12 55.08

12 54.06 — 13 48 52.19 — 13 52 23.75

2 2.40 — 20 34.26 — 31.33

1.20 — 31.33 — .90 (Cc)

.205 — 3.26 | 29.30

2.10 — 2934

2.05

.226

c = +.23 C.E.

31.18

31.38

31.08

.64

Smof 3451 = + 3 — 31.31

.42

.10

.378

.28

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 27.33 1877 Instrument, Russ Transit Observer, FW

Timepiece, Chron 345 Recorder, FW

Object,	δ Bootis			ρ Bootis							
Circle,											
	w		e	w		e	w		e	w	e
Level Direct,	.		.	14.5		14.9	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.	-2°25			30°54′							
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			25.5			16.5			.		.
II.			60.0			40.5			.		.
III.			35.0			06.0			.		.
IV.			10.0			31.0			.		.
V.	14	25	45.0	14	30	56.0			.		.
Sum,			175.5			150.0 / 120 / 30.			.		.
Mean,	14	24	35.10	14	30	6.0			.		.
Bb,	1.62		-.02	1.14		-.01			.		.
Cc,	1.64		-.38	1.16		-.27			.		.
Aa,	-.29		+.21	.24		-.18			.		.
Corr'd Transit,		24	35.91		30	05.64			.		.
R. A.	14	21	3.53	14	26	34.46			.		.
Error of Timepiece,		3	31.38		3	31.08			.		.

26 34.46
9 26.45
17 8.01

30 5.72
55.44
10.28
8.01
3.108 | 2.27 | 74
2186
1140

74 74
129 24
666 296
148 148
2146 1776

1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 29.90 1877 Instrument, Comparison Observer, Ill.

Timepiece, Recorder,

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		.	.	.	.	.	.	.	.
Reversed,		.	.	.	.	.	.	.	.
Sums,		15 25 49.=		9 . 2 .		2 48 41.=		20 23	
Difference,		59,30				59,40			
b.		15 26 48.30				2 49 40.40			
		h m s		h m s		h m s		h m s	
Wire, I.		6 23 34.85		.		6 23 34.85		.	
II.		9 3 13.45		.		20 26 05.55		.	
III.		1 29.00		.		3 20.87		.	
IV.		44.45		.		44.68		.	
V.		60		.		60		.	
		15.55		.		15.32		.	
		15.50		.		15.50		.	
Sum,		Err 394 = +.05		.		added 5 grains at 20h 30		.	
Mean,		.		.		.		.	
Bb,		3 50 51 = .21		25		.		.	
Ce,		59,41		.		.		.	
Aa,		3 51 50.41		.		.		.	
		6 23 34.85							
		21 28 15.56							
Corr'd Transit,		3 31.05		.		.		.	
R. A.		44.51		.		.		.	
		60							
		15.49							
Error of Timepiece,		15.50		.		.		.	
		Err 394 = -.01							

Signal sent at 10h 20m A.M.

No. Error

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 28/29 1877. Instrument, Observer,
Timepiece, Comparison Recorder, H.W.

Object,																				
Circle,																				
		w		e			w		e			w		e			w		e	
Level Direct,																				
Reversed,		1327																		
Sums,	15	15	43 =				8	48			2	1327	34	34 =			394	20	.5	
Difference,			59.55											59.65						
b.	15	16	42.55								7	35	33.65							
	6	h	m	s			h	m	s		6	h	m	s			h	m	s	
Wire, I.		2	31.41									2	31.41							
II.	8	49	11.14								20	8	2.24							
III.		1	26.67									3	17.90							
IV.			44.47										44.34							
V.			60										60							
			15.53										15.66							
			15.50										15.50							
Sum,		Error of 394 = +.03										Error of 394 = .16								
Mean,												look off 3 grains at 2h,5m								
		1327		394																
Bb,	4	4	49 =	21			35													
Cc,			59.66																	
Aa,	4	5	48.66																	
	6	27	31.41																	
Corr'd Transit,	21	38	17.25																	
R. A.		2	32.69																	
			44.56																	
			60																	
			15.44																	
			15.50																	
Error of Timepiece,		Error of 394 =		.06																

put back 3 grains at 2h 48m

Signal sent No Error.

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1877phae.proj.1794w

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 29.35 1877. Instrument, ... Observer, ...

Timepiece, ... Recorder, 54 43.5

Object,	ζ Bodis	109 Virginis	B Lus Minor	ψ Bootis
Circle,	W	W	W	E
Level Direct, w	.	13.3	.	14.1
Level Direct, e	.	14.3	.	14.0
Level Reversed, w	.	14.0	.	.
Level Reversed, e	.	.	.	.
Sums,	.	27.3 / 28.3 / 2.73 / 5|11.0	.	.
Difference,	.	−.03	.	I − III = 160.69
b. = −.03	14 15	2° 25′	74° 39′	
Wire, I.		59.3	I 37.5	V 56.5
II.		20.6	51.0	10.5
III.		42.0	04.0	23.5
IV.		03.5	17.0	37.5
V.	14 39 40.5	14 44 24.5	14 52 31.0	14 57 51.0
Sum,	14 2.9 / 120 / 28|2.9	14 9 9 / 60 / 209.9	140.5 / 120 / 20 / 40.69	179.0 / 120 / 119.0 / 40.69
Mean,	14 38 56.58	14 43 41.98	14 52 4.10 / 44.79	14 57 23.80
Bb,	,91 −.03	,76 −.02	3,19 −.09	14 54 43.11 −.09
Cc,	1,04 −.24	1,00 −.23	3,97 −.87	+.87
Aa,	,49 −.34	,65 −.45	−2,01	−1.40
Corr'd Transit,	38 55.97	43 41.28	.	.
R. A.	14 35 19.20	14 40 4.58	14 51 9.04	.
Error of Timepiece,	+3 36.77	+3 36.70	.	.

15 19 46 = 15 1327 / 15 10 45

3 36.59

15 16 09.41

15 10

Smof 1327 − 59.41

.29

2\|1.12

.06

.22

2\|2 8

−.14 = rate.

14 54 43.02

44.70

2\|1.68

.84

.26

5 0 4

178

2284

c = −.23 C.W.

c = +.23 C.E.

.77

.70

.31

3\|2.78

.59

+3 36.59 = Smof 3617

51 9.04

40 4.58

11 4.46

2,64

2,166 \| 1.82 \| .70 a.

1862

49 / 7 / .343

65 / 7 / .455

57 24.58

54 44.83

1 39.75

54 44.83

40 4.58

14 40.25

54 44.83

43 42.19

11 2.64

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, ... 187 . Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,			κ Bootis			ζ Bootis					
Circle,			E			E					
		w		e		w		e	w	e	w	e
Level Direct,		14·0		14.1		.		.	.	.	.	.
Reversed,		.		.		.		.	.	.	.	.
Sums,		.		.		.		.	.	.	.	.
Difference,												
b.			27°26				33°46′					
		h	m	s		h	m	s	h m s		h m s	
Wire,	I.			57.9				20.5		.		.
	II.			26.0				46.0		.		.
	III.			48.8				11.6		.		.
	IV.			13.6				37.5		.		.
	V.	15	3	37.6		15	15	3.0		.		.
Sum,			18	3.9			11	8.6		.		.
			60	.			60	.		.		.
			243	.9			58	.6		.		.
Mean,		15	2	48.78		15	14	11.72		.		.
Bb,		1.09		−.03		1.119		−.03		.		.
Cc,		1.12		+.26		1.21		+.28		.		.
Aa,		.29		−.21		.17		−.12		.		.
Corr'd Transit,			2	48.80			14	11.85		.		.
R. A.		14	59	13.31		15	10	35.54		.		.
Error of Timepiece,		3	35	.49		3	36	.31		.		.

10 3 54
5 9 1 8 3
11 2 2.2 3

59 13.31
51 9.04
8 4.27

14 11.97
2 49.01
2 21.96

2
54 49.01
43.59
8 5.42
4.27
2.29 1.85

10 35.54
51 9.04
19 26.50

15 14 11.97
54 43.89
19 28.08
26.50
2.18 1.58 .70 @

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 29,90 1877. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		1327.	.	394 .	.	.	.	.	.
Reversed,	16	24.	50 = 9	53.	.	2 . 12	36 = 20	39	.
Sums,		59,42				59,48			
Difference,	16	25 49,42				3 13	35,45		
b.	6	31 27,96				6 31	27.96		

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.	9	54	21.46			.	20	42	.7.49			.
	II.		1	37,37			.		3.	23.49			.
	III.			44.09			.			44,00			.
	IV.			60			.			60			.
	V.			15.191			.			16.00			.
				15.50						15.50			
				Error 394 = +1.41						50			
Sum,				took off 2 grams at 10h			.			.			.
Mean,				.37			.			.			.

Bb,	3	18	37 =	394 20 45	.	4	29. 49 =	21	56	.			
Cc,			59,45.		.		. 59,45			.			
Aa,	3	19	36,48		.	4	30 . 48.45			.			
						6	31 27,96						
Corr'd Transit,	6	31	27,96.		.	21	59 20.49			.			
R. A.	20	48	08.52		.		3 86 14			.			
		3	24.48				44.35						
			44.04				60						
Error of Timepiece,			60		.		15.65			.			
			15.96				.15,50						
			15,150				Error 394 = +.15						
			Error 394 = +.46										

took off 1½ grams at 20 50

~~Signal at~~ Put back 1½ grams at 2 2 25

4 17 47 = 21 44

59,45

4 18 46.45

6 31 27,96

2 4 47 18 49

3 34,17

44.32

60

15,68

15,50

+.18

Signal Rate +.1

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June 6.93 M.S.Clock.394 S.Clock 312
$22^h\ 12^m\ 30^s = 3\ 19\ 26$

June 30 1327 394
4 19 43 = 21 42

59.55

4	20	42.55	
6	35	24.52	
	45	18.03	
21	3	33.84	
		44.19	
		60	
		15.81	
		15.50	

Err of 394 = +.31
took off 2 grams at 25th

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May 28th

13 27 394

9 40 5 = 5 15

312 394

9h 48m 38s = 5h 20m 12s

312 is 2m 31.1 fast.

June 10th

312 394

3 46 48 = 22 24

(+.05 = Error).

312 is +2m 33 (fast)

June 1891

312 394

3 41 7.5 = 21 47

(No. Errors).

June 22nd

312 394

3 45 11.5 = 21 55 20

June 27th

312 394

4 4 36.5 = 20 35 00.6

(No Error)

June 28th

312 394

4 28 46.5 = 21 50 12

(No Error)

July 1st

312 394

4 50 35.5 = 22 5 12

(No Error)

July 3d

312 394

3 34 29.8 = 20 41 30

(-.1)

July 5

312

5 6 6 = 22 5 00

July 10

312 394

4 00 5 = 20 39 24

July 14

312 394

4 13 19.5 = 20 41

July 15

4 18 35 = 20 38 24

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http://www.nasa.gov/mission_pages/chandra/multimedia/photo-album.html

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