KG
11366
v.786

astrophys.proj.1790R

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1870phae.proj.1790R

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.

init = 2.064 log = 0.31471
274 = 11.360 log. = 1.05538
175 = 22.701 log. = 1.35605
Meridian Circle. wire intervals

△

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1878phae.proj.17906

Clock Errors —

From Oct. 14. 1878

to

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 14th 1878. Instrument, R. T. Observer, AM.

Timepiece, Recorder,

Object,					α Cephei			β Cephei				
Circle,												
	w		e		w		e	w		e	w	e
Level Direct,	.		.		21.2		11.3	.		.	.	.
Reversed,	.		.		21.0		11.3	.		.	.	.
Sums,	.		.		42.2		.	.		.	.	.
Difference,					22.6							
b.					19.6							
					+1.65							
					62° 4'							
					21° 6'			70° 2				
	h	m	s		h	m	s	h	m	s	h	m s
Wire, I.			.		I 15		26.8	III		16.5		.
II.			.		II 16		11.8			26.5		.
III.			.		III 16	57	3			36.8		.
IV.			.				.	28		47.0		.
V.			.				.	28		57.5		.
Sum,			.				.	28	184	3		.
Mean,			.				.	28	36	86		.
Bb,			.		201		+1.30	257		+1.67		.
Ce,			.		2.14		.	2.92		.		.
Aa,			.		-.72		.	-1.35		.		.
Corr'd Transit,			.				.			.		.
R. A.			.		21	15	42.10	21	27	6.40		.
Error of Timepiece,			.				.			.		.

21 27 6.40
15 42.10
11 24.30

28 26.86
16 57.30
1

28 38.53
16 58.60
11 39.93
11 24.30
5
−63 15.63 / +25 @
126
300

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 15.3 Oct. 1878. Instrument, Rues Transit. Observer, Gilb.

Timepiece, 3451 Recorder,

Object,	~~θ Pegasi~~ β Peg				α Peg				π Pegasi				ε			
Circle,																
	w		e		w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.		.		.	
Sums,	.		.		.		.		.		.		.		.	
Difference,																
b.	27°25′								74°44′							
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.	I	58	10	.6			.		I.		50.5		~~I.~~		~~55~~	
II.			—	.			.				3.8				58.	
III.			58,.5				44·5				17·5				11	
IV.	IV	~~21~~	48	51.3			.				25·5				25	
V.				.			.				43·5		23	7	52·5	
Sum,				.			.				140.8				186.10	
											60				60	
											80				126.0	
Mean,				.			.				16:16			7	25.20	
Bb,	1.10			.			.		3.21			.				.
Cc,	1.13		−2.40				.		3.80		−7.04					.
Aa,	.29		−1.94				.		−2.03		+13.56					.
Corr'd Transit,		58	51.76				.			4	57.20					.
R. A.	22	57	55.50				.		23	4	5:48					.
Error of Timepiece,			+56.26				.				51.72					.

42.516
38
340128
127548
161.5608

4 50.68
6.52
4 57.20

58 56.10
4.34
58 51.76

7 25.20 ×
2 41.56
4 43.64
E,

4 43.64
+6.52
4 50.16

2 16.16 π
2 41.56
4 57.72
43.64
2)14.08
+3.8 17.04 1.85
38
324
304
200
C.π.
13
585
240 5

4 α'-95.48
57 55.50
6 09.98
5 54.56
-2.37 15.42 -6,68 ④
29
1392
1500
1392
2080
1937
168
203
2004
13360
13560 4

4 50.68 ε
58 56.10
5 54.56

1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 15.3 1878. Instrument, Mer. Circle. Observer, W. A. R.

Timepiece, 1327 Recorder, Chas. F. W. Coup.

Object,	ζ Cygni		~~γ Cygni~~ β Cephei		ε Pegasi			
Circle,	.57		275		.16			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.					9° 18'		65° 34'	
	h m s		h m s		h m s		h m s	
Wire, I.	~~0.3~~		25.5 28.5		41.3			.
II.	~~2.7~~ 13.3		31.6		43.4			.
III.	15.8		35.1		45.5			.
IV.	18.2		37.8 40.6		47.6			.
V.	20.5		43.9 46.8 50.1		49.7			.
Sum,	90.7		91339.9		27.5			.
Mean,	18.14		37.77		45.50			56.18
Bb,	These observations were not used, as there was a mistake							.
Cc,	in the adjustment of the Meridian Circle.							.
Aa,	.		.		.		22 45	23.91
Corr'd Transit,	.		.		.			.
R. A.	21 7	47.65	21 27	6.38	21 38	15.29	22 45	23.91
Error of Timepiece,	.		.		.			.

P $0 = 3\ 31.39 + 2.98 m + \dots$

$3\ 30.35 + .36$

$1.04 \quad 2.39$

$3 \quad 31.35 + 2.98 m$

$3 \quad 30.35 + .36$

$1.00 \quad 1.84$

$1.84 \mid 1.00 \quad 1.51$

920

180

$0 = 3\ 30.49 + .57 + \dots$

$0 = 3\ 30.21 + .16$

$.70 + .73$

$0 = 3\ 30.35 + .36$

$0 = 3\ 30.35 - .54 + 16 = 3\ 31.43$

$0 = 3\ 30.35 - .18 + .72$

$0 = 3\ 30.89$

$3\ 31.6$

$40 \quad 15.6 \quad 34.51$

$0\ 42 \quad 50. \quad 1327$

$3 \quad 90.51$

$39 \quad 19.49$

15.60

$+56.11$

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1878phae.proj.1790f

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 16.3 1878 Instrument, R J Observer, Fitz.

Timepiece, 3451 Recorder,

Object, Circle,	δ Aquilae W	33 Cygni W	χ Cephei W	ε Delphini W
	w | e	w | e	w | e	w | e
Level Direct,	. | .	. | .	. | .	. | .
Reversed,	. | .	. | .	. | .	. | .
Sums,	45.9 / 24.5	. .	. .	. .
Difference,	21.4 / 3.1			
b.		56° 11	77° 21′	10° 53′
	h m s	h m s	h m s	h m s
Wire, I.	.	10 24.0	43.0	43.0
II.	.	2.5	59.5	28 4.8
III.	03.1	41.0	14 16.0	28 26.5
IV.	24.5	.	14 32.0	.
V.	20 6 45.9	.	47.5	9.8
Sum,	.	.	197.5 / 77.5	49.3
Mean,	6 3.1	11 41.0	15.50	28 26.43
Bb,	75 .	1.73 .	3.74 .	87 .
Cc,	100 -1.94	1.80 -3.49	4.56 -8.85	1.02 -1.98
Aa,	.68 +2.72	-.43 -1.72	-2.62 .	.53 2.12
Corr'd Transit,	6 3.88	35.79	.	26.57
R. A.	20 5 3.90	20 10 35.10	20 12 55.65	20 27 26.18

20 27 26.18
12 55.65
14 30.53
17.80
3.15 | 12.73 | +4.00
1260
130

28 24.45
14 6.65
14 17.80

59.98
60.39
60.05
60.02
.144
+60.11 Err of 3451.

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1878phae.proj.17905

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, 16.3 Oct. 1878. Instrument, R.J Observer, Fitz.

Timepiece, 345' Recorder,

Object, Circle,	73 Draconis W		ε		δ Delphini		ε Aquarii	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.			+74°32'		14°39'		−9°56'	
	h m s		h m s		h m s		h m s	
Wire, I.	I 15.0		IV 59.0		1.2		19.7	
II.	31 27.5		12.8		38 23.0		41.1	
III.	41.0		25.0		45.0		2.5	
IV.	54.0		39.0		6.8		02 24.5	
V.	32 07.5		35 52.3		39 29.1		46.0	
Sum,	145.0 / 60 / 205.0		188.1 / 60 / 128.1		105.1 / 120 / 225.1		133.8 / 120 / 13.8	
Mean,	31 41.0		25.62		45.02		2.76	
Bb,	3.17	.		.	.92	.	.62	.
Cc,	3.75	.		.	1.04	+2.02	1.02	+1.98
Aa,	−1.99	.		.	.48	+1.92	.81	+3.24
Corr'd Transit,		.		.		48.96		7.98
R. A.	20 33 5.19			.	20 37 48.91		20 41 7.96	
Error of Timepiece,		.		.		60.05		60.02

42.516
3.75
212580
25.93
29.4612
12.7548
2)159.43500
79.72

31 41.0
2 39.43
34 20.43
05.90
2)14.53
375 7.26
375
3510
3375
1350

35 25.62
1 19.72
34 05.90

1.94 = m
456
1164
970
776
884

1.94
1.8
1552
194
3.492

3451 = 21 33 17 − ½m
394 =

3451 =
1329 = 21 37 00

25.15
60.11
2499
5
24.994 24.94

25.15
24.94
3 35.06

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 16. 3 1878. Instrument, Mer. Circle Observer, M.A.R.

Timepiece, Recorder,

Object,	α Cygni		ζ Cygni		β Cephei			
Circle,	1,00		,57		2,75			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	44°50′							
	h m s		h m s		h m s		h m s	
Wire, I.		47.0		16.9		31.2		.
II.		50.2		19.2		34 5 .		.
III.		53.0		21.7		37 5 40 3	4.24 20	.
IV.		56.0		24.0		43.4	4.44	.
V.		59.0		26.5		46.5 49 5 52.4 55.2	34.67 39.11	.
Sum,		15.2 .		8.3 .		390.5 30.5		.
Mean,		53.04		21.66		43.40		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	20 37	18.65	21 7	47.63	21 27	6.33		.
Error of Timepiece,		.		.		.		.

0 = +3 37.07 + 2,75 m

3 34.21 + 78

2,86 + 1,97 m

1,97 | 2,86 | -1,45 = m

78

1160

1005

1121 0

197

890

885

788

1020

145

91

145

1305

132

26

158

0 = 3 334,39 + 1,00 m

0 = 3 34,03 + ,57 m

42 1,57 m

0 = 3 34.21 + ,78 m

0 = 3 34.21 + 1,12 + 1,58

+327

3451 =

1327 =

21 37 25.15 00

3 34.77

21 33 25.23

25 15

59.92

A 3 34.67 Error 1327.

3 30.42

24.25

2 | 4.25

2 | 2.12 | .09

216

12

106

4

1.10

6.36

27

6.63

34.62

3 41.25

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1878phae.proj.17905

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 20th 1878. Instrument, Mer. Cir. Observer, J.A.M.

Timepiece, 1327 Recorder,

Object,	δ Aquilae				α Aquilae		
Circle,	.05				.15		
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+2°52′				+8°32′			
	h m s		h m s		h m s		h m s	
Wire, I.	1.8		.		30.8		.	
II.	3.9		.		33.0		.	
III.	5.9		.		35.0		.	
IV.	7.8		.		37.1		.	
V.	10.0		.		39.2		.	
Sum,	29 4		.		25.1		.	
Mean,	5:88		.		35.02		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	19 19 23.67		.		19 44 52.75		.	
Error of Timepiece,	.		.		.		.	

145
2

0 = 3 42.21 − .07 + 1.58 = 3 43.72

0 = 3 42.27 − .21 + 1.58 = 3 43.64

1.36

3 43.66

34.64

4 | 9.00

2.25

1.12
18
1.30

34
56 = 3451
23 38 35 = 1327
3 44
23 34 51
56
65

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 21 1878. Instrument, Observer, H.M.

Timepiece, Recorder,

Object, Circle,	β Cephei W		74 Cygni W		ε Regasi W		11 Cephi W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	18.8	12.0	18.8	12.0	.	.
Reversed,	.	.	18.5	12.2	18.5	12.2	.	.
Sums,	.	.	~~42.8~~ 24.2	~~24.2~~	37.3	24.2	.	.
Difference,			3 | 18.1 6	.	24.2 3 | 13.1 .44	.		
b. + .44	70° 2'		39° 52'		9° 19'		70° 45'	
	h m s		h m s		h m s		h m s	
Wire, I.	I .		16.3		3 3 37.0		II. 54.3	
II.	47.0		44.1		58.0		.	
III.	17.2		33 11.8		19.9		41 16.0	
IV.	30 27.5		39.4		41.6		.	
V.	21 30 37.5		34 7.3		35 3.2		37.5	
Sum,	51 7 .		113 9 60 58.9		159 7 60 99.		107 8 60 47.8	
Mean,	21 30 17.14		33 1 ~~9~~.78		39 19.94		41 15.~~93~~	
Bb,	+2.57	+1.13 .	1.30	+.57 .	.85	+.37 .	2.67	+1.17 .
Ce,	+2.92	.	1.31	-1.05	1.02	-.82	3.03	-2.50
Aa,	-1.35	.	.06	+.03	.55	+.25	-1.45	-.~~6~~5
Corr'd Transit,		.		11.33 .		19.74 .		43.95
R. A.	21 27 6.08		21 32 6.42		21 38 15.16		21 40 9.37	
Error of Timepiece,		.	+ 64.91		+ 64.68		+ 64.58	

257 44 1028 1028 1.1308

130 44 52 52 .572

85 44 340 340 .374

267 44 1068 1068 1.1748

107 .40 428 428 .4708

73 44 292 292 .3212

44 8. 352

45 5 225 225 .2455

145 5 725 725 .7975

45 32 90 135 1.440

68 45 340 272 .3060

145 45 725 580 .6525

α' − α

21 40 9.37
21 38 15.16
1 54.21

t' − t

41 14.60
39 19.49
1 55.11
54.21
-200 | -.90 | +.45 (a)

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1878phae.proj.1790f

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

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

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

Object,	11 Cephei				16 Pegasi				α Aquarii				ν Pegasi			
Circle,	E.				E				E				E			
Level Direct,	w		e		w		e		w		e		w		e	
Reversed,	23.5		12.2		.		.		.		.		.		.	
	.		.		.		.		.		.		.		.	
Sums,	.		.		.		.		.		.		.		.	
Difference,																
b.					25°21'				−0°54'				+5°36'			
	h	m	s		h	m	s		h	m	s		h	m	s	
Wire, I.	IV		.				.				.				28.2	
II.			.				.				17.9			4	49.6	−
III.			.				2.3				39.3				11.0	
IV.		43	30.5				2.3				0.6				31.5	
V.			.		21	49	25.7		22	1	22.0				53.5	
Sum,			.				.				57.8				93.9	
											6				60	
											117.				33.9	
Mean,		41	10.95			48	38.60			0	39.27				11.23	
Bb,	2.67		+1.17		1.07		.47		73		+ 32		.80		+ 35	
Cc,	3.03		+2.50		1.11		+.89		1.00		+ 80		1.01		+ .81	
Aa,	−1.45		−.85		.32		+.14		68		+.31		60		+.27	
Corr'd Transit,			13.97				10 10				40 70				12 66	
R. A.			9 37			47	53.99		21	59	34.87		22	4	6.50	
Error of Timepiece,			+64.60				66.11				65.83				66.16	

3.54
3.03
1062
10620
10.72 62
42.516
303
12754 8
127548 0
128.82348

43 30.5
10.73
43 19.77
2 8.82
41 10.95
1.17
12.12

Det C. C = −.80 Cw.
41 17.10
41 12.10
2 | 5.100 −0.80 = C
303 | 2.50 | 0.8 Cw.
224
19
424

3.54
141
354
354
354
3.9294

21 258
212 5-8
212 5-8
23.5964

47.20 2.3
25.7 23.6
38.5 38.7

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1878phae.proj.1790f

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 21 1878. Instrument, Observer, J. F. M.

Timepiece, Recorder,

Object,	β Aquilæ		α Cygni					
Circle,	10		100					
	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.		2.5		58.2		.		.
II.		48.6		1.2		.		.
III.		6.7		4.1		.		.
IV.		8.8		7.0		.		.
V.		10.9		10.6		.		.
		33 5		70 5				
Sum,		.		.		.		.
Mean,		6.7		20.1		.		.
Bb,		.		.		.		.
Ce,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	19 49	22.18	20 37	18.52		.		.
Error of Timepiece,		.		.		.		.

49 22
3 46.
~~45 3~~ 6
53 08

0 = 3 44.52 − .14 + 1.58 = 3 45.96
0 = 3 45.58 − 1.45 + 1.58 = 3 45.71
167
3 45.83

2.20
26
.45

0 = 3 44.52 − .13 + 1.48 = 3 45.87 3 48.28
0 = 3 45.58 − 1.34 + 1.48 = 3 45.72
169
3 45.84

49.6 ch.
22 38 30 cl

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 22nd 1878. Instrument, ... Observer, J.A.M.

Timepiece, ... Recorder, ...

Object,	β Cephei		ε Pegasi		ζ aquarii			
Circle,	2.75		.16		+1° .02			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	70°2'				−1°			
	h m s		h m s		h m s		h m s	
Wire, I.	44.2		57.8		17.5			.
II.	47.5 50.4		59.9		19.6			.
III.	53.8 56.3		2.0		21.7			.
IV.	59.3 2.6		4.2		23.8			.
V.	5.2 8.1		6.3		25.7			.
Sum,	327.4		130.2		108.3			.
	180		10.		.			.
	507.4							
Mean,	56.38		2.04		21.66			.
Bb,	.		.		.			.
Cc,	.		.		.			.
Aa,	.		.		.			.
Corr'd Transit,	.		.		.			.
R. A.	21 27 6.80		21 38 15.20		21 59 34.86			.
Error of Timepiece,	.		.		.			.

$0 = 3\,50.38 + 2.75m$

$3\,46.82 + .09m$

$0 = 3.56 + 2.66m$

$m = -1.34$

266 | 356 | 1.34
266
900
798
1020
1064

1.34
.16
804
134
.214

1.34
91
134
1206
1.2194
1.22
26
1.48

$0 = 3\,46.84 + .16m +$

$0 = 3\,46.80 + .02m$

$3\,46.82 + .09m$

$3\,46.84 - .21 + 1.48 = 3\,48.11$

$3\,46.80 - .05 + 1.48 = 3\,48.23$

3 48.04
3 45.84
+ 2.20
rate.

3 48.17
3 45.74
3

3 48.17
4.40
3 52.57
4
3 52.53

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1878phae.proj.1790f

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 26 1878. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,	32 Vulpeculae	β Cephei	β Cephei	β Cephei
Circle,		E	W	W
	w | e	w | e	w | e	w | e
Level Direct,	~~48.5~~ 13.0	17.9 | 13.8	. | .	. | .
Reversed,	. | .	. | .	. | .	. | .
Sums,	. .	19.5 12.5 / 37.4 26.3	. .	. .
Difference,		26.3 / 3 | 11.1 / +.37		
b.		7 on 2		
	h m s	h m s	h m s	h m s
Wire, I.	.	I 54.7	IV 1.8	V 3.8
II.	.	5.2	12.2	14.5
III.	.	15.0	22.5	24.3
IV.	~~50~~ 58.6	25.5	32.8	34.7
V.	.	26 35.8	29 43.5	30 46.5
Sum,	.	136.2 / 60 / 76	112.8	122.8
Mean,	.	15.24	22.56	24.56
Bβ	.	2.57	1 2.24	.
Cc,	.	2.93	28 20.27	.
Aa,	.	-1.35	.	.
Corr'd Transit,	.	.	.	.
R. A.	.	21 27 5.80	.	.
Error of Timepiece,	.	.	.	.

Oct. 23.1

3451 19 44 8.2
1327 46.50
3 50.2
42 59 8
44 8.2
Emp 3451 +68.4

1.10
.78
1.28
50.20
3 51.48

87
37
60
261
32

.74
.26

21 58 16 = 3451
0 = 1327

15.24
2.57
17.81
28 19.81

21.258
2.93
63774
191322
42516
62.286 94
124.572

30 24.56
2 4.56
28 20.00
20.26
28 20.13 W
19.81
21.32
293 416
14.65

2.93
.005
1.465

21 58 16
1 12.95
21 57 3.05
00
+3 56.95
2.07
3 59.02
2.23
4 01.25

3 59.02
~~4.2~~

.005
O−C.

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct 26 1878. Instrument, Observer,

Timepiece, Recorder,

Object,	ε Regasi		π² Cygni		16 Regasi			
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	19 .5	12.5	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	9°18'		+8°45'		25°21'			
	h m s		h m s		h m s		h m s	
Wire, I.		43.6		17.0		47 58.8		.
II.		39 5.2		28 3 38.8		22.3		.
III.		26.7		49.8		46.2		.
IV.		48.3		0 5 11 3		9.7		.
V.		40 9.8		21.3 (4)		49 33.4		π²Cygni .
Sum,		133 6 .		32.3		180.4 60 230.4		.
Mean,		26.72		43.4 53 8		46.08		32.47
Bb,	87.	+.32		46	1.06	+.40	1.51	+.55
Cc,	1.02	.	44	15.7	1.10	.	1.52	.
Aa,	55	+.96		24.5 37 0	33	+.58	-.18	-.32
Corr'd Transit,		28 00 .		44 47.8		7.06		32 60 .
R. A.	21 38	15.09		427.1 60 15 487.1 32.47	21 47	33.91	21 42	19.83
Error of Timepiece,		+72.91		.		+73.15		+72.77

Determine a.

$\alpha_1 - \alpha$: 21 38 15.09 − 27 5.80 = 11 9.29

t − t: 39 27.04 − 28 21.07 = 11 05.97

5.194

+1.90 | +3.32 | +1.75 = (a)

196 1420 1330 900

57 875 962

175 18 1400 175 315

28 21.07 + x − 3.32 = 28 17.75 − 27 5.80 = 1.95

72.91 + 73.15 − 72.77 = 8.83

+72.94 Error of 345

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 28 1878. Instrument, ... Observer, G.M.

Timepiece, ... Recorder, ...

Object,	ν Pegasi	70 Pegasi	λ Andromedae	γ Cephei
Circle,	W	W	W	W
Level Direct, w	.	.	19.2	.
Level Direct, e	.	.	14.0	.
Reversed, w	.	.	19.3	.
Reversed, e	.	.	14 5	.
Sums,	.	.	38 5 / 28 5 / 3|10 / .37	.
Difference,				
b.	22°43′	12°4′	45°47′	
Wire, I.	23 19 49.9	23 33.8	54.6	III 13.5
II.	13.0	23 55.3	32 24.8	29.5
III.	36.8	24 17.7	55.2	45.5
IV.	59.2	39.4	26.2	0.5
V.	21 22.4	1.8	55.8	36. 16.0
Sum,	1813	1480 / 60 / 88	2166 / 60 / 276.6	1050 / 120 / 221.0
Mean,	36.26	17.60	55.32	45.0
Bb,	1.02 .38	88 .33	1.43 +.53	3.66 +1.35
Ce,	1.08 ~~-.67~~	1.02 .	1.43 .	4.43 .
Aa,	.37 +.67	53 +.96	-.08 -.15	-2.52 .
Corr'd Transit,	37.31	18.89	55.72	.
R. A.	23 19 21.46	23 23 3.13	23 31 39.87	.
Error of Timepiece,	+ 1 15.85	+ 1 15.76	+ 1 15.85	.

0 17 19.2 ch 3451
0 19 5 ch 1327

17 19.2
1 15.8
16 03.4
5.0
4 01.60
25
1.35

366
37
2562
1098
13542
88
37
296
296
.3256

17 19.2
1 15.82
16 03.38
5.00
1.62

23 α'-α 34 26.01
23 3.13
11 22.88

t'-t
35 46.35
24 17.93
1128.42
22.88
-3.05 | -5.54 | +1.82
305
2490
2460
30

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 28. 1878. Instrument, ... Observer, A.W.

Timepiece, ... Recorder, ...

Object,	γ Cephei		α Piscium		α Andromedæ						
Circle,	E										
Level Direct,	w	e	w	e	w	e			w	e	
Reversed,			19 .3	14 .5							
Sums,											
Difference,											
b.	76°57'		6°11		28°40'						
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			21.5			.			35.8			.
II.			37.5			.			59.5			.
III.		38	53.0			.			23.8			.
IV.		39	9.5			.			48.5			.
V.		39	25.0			.		4	12.4			.
Sum,			146 5 120 266.5			.			18 0 0 6 120.0			.
Mean,			53,30			.			24.00			.
Bb,			.		80	.			41			.
Cc,			.		1.01	.			.			.
Aa,			.		,60	.			+.49			.
Corr'd Transit,			.			.			24 80			.
R. A.			.			.			.			.
	23	34	26,01				0	2	9 22			
Error of Timepiece,			.			.			+ 1 15.68			.

42.516
4.43
127548
1700 64
182.8188
1700 64
188,2433 88

38 53.30
3 08.34
35 44.96
35 45.00
.04
Q = 0.

182
37
1274
546
.6734

182
53
546
910
.9646

182
8
.1456

182
27
1304
364
.4944

1.62
57.20
44.42
2.21

1.62
56.95

1 15.68
15.81
15.76
15.85
3.14
1 15.79

3 1.30
3.02
1.72

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 29 1878 Instrument, Mer. Circle. Observer, W. A. R.

Timepiece, Recorder,

Object,	ζ Heygei		τ Hygei					
Circle,	.57		.77					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	29°44′		37°31′					
	h m s		h m s		h m s		h m s	
Wire, I.	45.1		55.3		.		.	
II.	47.5		57.8		.		.	
III.	50.0		0.5		.		.	
IV.	52.2		3.0		.		.	
V.	54.6		5.7		.		.	
Sum,	249 4		122 3		.		.	
Mean,	49.88		0.46		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	21 7 47.50		21 9 57.86		.		.	
Error of Timepiece,	.		.		.		.	

0 = 4 02.38 − .77 + 1.48 = 4 3.09

0 = 4 02.50 − 1.03 + 1.48 = 4 2.95

Error + 4 3.02 1.35

4 3.02 4.20 4 7.22 40 47.62

4 3.02 48.12 7 | 14.9 0 2.13

4 3.02 1.15 4 4.17

4 3.02 2.23 5.25

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1878phae.proj.17908

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.	~~2 6.6~~		.		$23^h\ 40^{\sim}$	75.80	~~76~~	.
III.	10	26	40	1327	.	1.35	2 1 35	.
IV.	10	.	53.3	3451	.	.60	62 .60	.
V.	.		.		.	77.75		.
						1.35	53.3	
						79.10		
Sum,	.		.		.		1 ~~57~~.75	
							55.55	.
Mean,	.		.		.		40	.
							4.45	
Bb,	.		.		.		4.18	
							62	.
Cc,	.		.		.		.32	.
Aa,	.		.		.			.
Corr'd Transit,	.		.		.			.
R. A.	.		.		.			.
Error of Timepiece,	.		.		.			.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 1 1878. Instrument, Rue Transit Observer, F.W.

Timepiece, 345 1 Recorder,

Object,	1 Cyg		ε Delphini		δ Delphi		β Delphini	
Circle,							W	
	w	e	w	e	w	e	w	e
Level Direct,	20.5	13.0	.	.	.	.	.	.
Reversed,	20.3	14.2	.	.	.	.	.	.
	40.8	27.2						
	27.2							
Sums,	313.6	.	.	.	.	.	.	.
Difference,	+.45							
b.	39°52'		10°54'				16°11'	
	h m s		h m s		h m s		h m s	
Wire, I.	20 18 17.9		2.3		▽ .		32 28.6	
II.	55.5		28 24.2		.		50.5	
III.	13.0		46.0		.		12.5	
IV.	41.2		7.5		.		34.5	
V.	8.9		29.5		30 41.8		56.5	
Sum,	136 5		109 5		.	.	182 6	
	4w 76.5		120 9.5				120 62.6	
Mean,	13.3		45.90		.		12.52	
Bb,	1,30	+.60	87	.39	.	.	,92	,41
Cc,	1,31	.	1.02	.	.	.	1,04	.
Aa,	.06	.09	.53	+.79	.	.	,48	+.72
Corr'd Transit,		1399		4708	.	.		1365
R. A.	20 17	52.91	20 27	25.94	.	.	20 31	52.50
Error of Timepiece,	+1	21.08	+1	21.14	.		+1	21.15

345 1 20 48 ~6)
344 = . 00)
345 1 ~ 50 11.7
1327 20 53 00)

4 3.02
9.05
6.03

b

20 50 11.4
1 21
48 50.7
53 00
4 09.3
1.3
4|8.0
2.00 ratio of 1327

1 21
1 15.7
4|5.3
+1.32

1 21.08
21.14
21.15
20.88
20.86
20.85
5 9 6
1 20.99

66
5
71

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 1 1878. Instrument, Observer, H.M.

Timepiece, Recorder,

Object, Circle,	α Ophiuchi E	γ delphini	γ Cephei	
Level Direct, Reversed,	w . . / e . .	w . . / e . .	w . . / e . .	w 20 . 3 / e 14 . 2
Sums, Difference, b.	14° 39′	15° 41′	61° 22	10
Wire, I.	h m s 24.5	h m s 38.3	h m s IV 39.8	h m s V 2 40
II.	46.5	50.3	47.0	31.0
III.	39 8.4	42 22.4	54.7	39.0
IV.	30.4	44.4	20	46.5
V.	523	6.6	45 9.5	45 54.0
Sum,	1 20 2 1 / 42 1	1 2 0 / 22.4	15 3 0 / 1 23 / 273.0	19 4 5 / 38.9
Mean,	8.42		54.60 / 44 10.17	44 10.04
Bb,	92 .41	93 .41	1.97 +.88	+.88
Cc,	1.04 .	1.04 .	2.09 .	.
Aa,	48 +.72	.47 +.91	.67 −1.00	.
Corr'd Transit,	9.55	23.52	10 0 5	.
R. A.	20 37 48.67	20 41 2.66	20 42 49.20	.
Error of Timepiece,	1 20.88	+1 20.86	20.85	.

20 α−α 42 49.20 / 41 2.66 / 1 46.54

t − t 44 10.98 / 42 22.81 / 1 48.17 / 46.54 + / −1.14 | 1.63 | 1.43a assume a = 1.50 / 1.60 / .67 / .33 / 1.00 / 490 / .456 / 340

21.258 / 209 / 19322 / 425160 / 44429 22 / 44.43 / 88.86 / 128.86

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 2 1878. Instrument, ... Observer, F.W.

Timepiece, 3451 Recorder, ...

Object, Circle,	~~ι~~ Peg		ν Peg		ξ Cephei		24 Cephei ε	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	w. 3 13.8		.	.
Reversed,	.	.	.	.	21. 3 13.0		.	.
					41.6 26.8			
Sums,	.	.	.	.	26.18		.	.
Difference,					3|14.8			
b.	24° 45′		5° 36′		1.49 57° 37′		71° 45′	
	h m s		h m s		h m s		h m s	
Wire, I.	1 57.9		4 45.1		22.4		V 46.3	
II.	2 21.4		6.3		8 2.5		58.5	
III.	2 44.7		27.7		42.3		9.3	
IV.	8.2		49.2		21.7		20.6	
V.	31.7		6 10.4		.		11 31.4	
Sum,	1639		1389		692		1661	
	60				4.5		1.20	
	173.9		.		.		46.1	
Mean,	44.78		27.74		2.5		9.22	
Bb,	1.05	.52	.80	.40	1.29	.89	2.79	1.40
Cc,	1.10	.	1.01	.	1.87	.	3.19	.
Aa,	34	+.65	60	1.14	-49	-.93	-1.57	.
Corr'd Transit,		45.95		29.28		2.46		.
R. A.	22 1	23.15	22 4	6.36	22 6	39.79	22 7	29.10
Error of Timepiece,	1	22.80	1	22.92	1	22.67		.

3451 = 22 26 56.15
1327
3774 = 2 29 45.00

22 26 56.15
1 22.76
22 25 33.40
29 45.00
4 11.60
15
4 11.45
9 30
24 2.15 1.09
1.92
.23

Emf 1327

42.516
3.19
38.2644
4.2516
1.27548
135.626.04
2 15.63
19
24 19
7.6 1.14
57
.646
2.15
.65
1.50

11 9.22
2 15.63
8 53.59
1.40
8 54.99
~~8 3.39~~
t'-t ~~51.60~~
19 49.40
49 ~~2.20~~
171
46
.931

~~7 29.10~~
~~6 39.79~~
49.41
7 29.10
4 6.36
3 22.74
t'-t
19 19
53 26
57 1.14
95 .38
1.007 .49

t'-t
8 54.99
6 28.14
26.85
22.74 ①
-2.17 4.11 +1.90
2.17
1940
1736
1953

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov 2 1878. Instrument, ... Observer, AH

Timepiece, 3451 Recorder, ...

Object,			31 Reg			3 Lac					
Circle,			W			W					
Level Direct,	W	E	W	E	W	E	W	E	W	E	
Reversed,	21.1	13.0	.	.	.	.	.	.	.	.	
	.	.	.	.	.	.	.	.	.	.	
Sums,	.	.	.	.	.	.	.	.	.	.	
Difference,											
b.			11°36'			51°38'					
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			12.5		19	2.8			.			.
II.		16	34.0	32		36.6			.			.
III.			50.7			11.2			.			.
IV.			17.5			45.1			.			.
V.			39.5		21	19.7			.			.
Sum,			102.7			115.4			.			.
			60			60						
			55			55.4						
Mean,			.			11.08			.			.
Bb,		87	.43		1,58	.79			.			.
Cc,		1.02	.		1.60	.			.			.
Aa,		53	+1.01		-.26	-.50			.			.
Corr'd Transit,			.			11 37			.			.
R. A.		22 15	34.32		22 18	48.72			.			.
Error of Timepiece,			.			+1 22.65			.			.

1 22.80
22.92
22.67
22.65
3.04
Err of 3451 +1 22.76
10
22.66
21 40
+1.66 rate of 3451

24 11 50 10.63
1.44 17
60 44.1
63
1.07

1 22.76
1.07
1 23.83

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 2d 1878. Instrument, ... Observer, M.A.R.

Timepiece, ... Recorder, ...

Object, Circle,	~~ζ Regaai~~ α Aquarii		β Aquilae		β Cephei		γ Aquarii	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	$-0^{\circ}5'6$				$70^{\circ}2'$		-2°	
	h m s		h m s		h m s		h m s	
Wire, I.	41.0	.		.	6 9 9.7			31.1
II.	43.0	.		.	12 6 15.7			33.2
III.	45.1	.		.	19.0			35.3
IV.	47.0	.		.	21 7 24.9			37.5
V.	49.1	.		.	28 0 31.0			39.5
Sum,	25.2	.		.	169.5	.		266 .
Mean,	45.04	.		.	18.84			35.32
Bb,	.		.		.		.	
Ce,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	21 59	34.72		.	21 27	5.36	22° 15'	25.96
Error of Timepiece,	.		.		.		.	

0 = 4 10.32 + .02

0 = 4 10.23 + .03

55

0 = 4 10.27 − .02

2 = 4

4 10.32 + 1.33 = 4 11.65

4 10.22 + 1.33 = 4 11.58

4.23

Err of 13.27 4 11.62 at 21h 50m

0 = 4 13.48 + 2.75

0 = 4 10.27 − .02

0 = 3.21 + 2.77

2.77 | 3.21 | 1.16 m

277

440

277

1630

1.16
91
116
1044
1055
26
1.32

1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 3 5th 187 . Instrument, Observer, M.a.R.

Timepiece, Recorder,

Object,	β Cephei			α aquarii			γ aquarii				
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.			9 0			03.2			33.3		.
			12.0			.			.		
II.			15.2			45.0			35.3		.
			18.2			.			.		
III.			21.2			47.1			37.5		.
			23 7			.			.		
IV.			26 8			49.1			39.5		.
			30 0			.			.		
V.			32.7			51.3			41.5		.
			.			.			.		
Sum,			18 8 8			35 7			37 1		.
			60 .			.			.		.
Mean,			20.98			47.14			37.42		.
Bb,			.			.			.		.
Cc,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	21	27	5.30	21	59	34.70	22	15	25.07		.
Error of Timepiece,			.			.			.		.

0 = 4 15.68 + 2.75 m + etc.
12.40 − .02 m

277 | 3.28 m = 1.18
2.77
510
277
2330

0 = 4 12.44 − .01 m
0 = 12.35 − .03 m
.79
4 12.40 − .02 m

0 = 4 12.44 + 1.34 = 413.78
0 = 4 12.35 + 1.37 = 413.72
+.5 0
4 12.75
4 1.62
rate 2.13

0. 24 | 213 | 9
216 13
117

11h 5m 35.5 3451
25 1327
1 35.5
1 25.38
10.2
25
14.8

0 39 35.65 3451
25 1327
4 14.03
10.97
35.65
1 24.68

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 4 d 1878. Instrument, Mer. Cir Observer, W.A.R.

Timepiece, Recorder,

Object,	α aquilae		α Aqui					
Circle,	8° 33'		44° 57'					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	.15		1.00					
	h m s		h m s		h m s		h m s	
Wire, I.		2.5		27.5		.		.
II.		4.5		30.5		.		.
III.		6.6		33.5		.		.
IV.		8.7		36.4		.		.
V.		10.9		39.2		.		.
Sum,		33.2		171		.		.
Mean,		6.64		33.42		.		.
Bb,		.		.		.		.
Ce,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	19 44 52.52		w 37 18.15			.		.
Error of Timepiece,		.		.		.		.

Assume n = 1.18

.15
1.18
.1770

4 14.12 − .18 + 1.33 = 4 15.27

4 15.27 − 1.18 + 1.33 = 4 15.42

.69

Err of 1327 + 4 15.35 at 20h 10m

20

4 15.55
4 13.75

ratio of 1327 + 1.80

4 15.55
35
4 15.90

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov 5 1878. Instrument, Mer. Cir Observer, Mak

Timepiece, 1327 Recorder,

Object,	γ aquilae		α aquilae		β aquilae			
Circle,	10°19'				6°6'			
Level Direct,	w	e	w	e	w	e	w	e
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	18		15		11			
	h m s		h m s		h m s		h m s	
Wire, I.	42.0		4.5		33.9			.
II.	44.1		6.5		36.0			.
III.	46.2		8.6		38.0			.
IV.	48.3		10.7		40.0			.
V.	50.4		12.8		42.1			.
Sum,	31 0		43 1		40 0			.
Mean,	46.20		8.62		38.00			.
Bb,	.		.		.			.
Ce,	.		.		.			.
Aa,	.		.		.			.
Corr'd Transit,	.		.		.			.
R. A.	19 40 30.15		19 44 52.51		19 49 21.95			.
Error of Timepiece,	.		.		.			.

1.18 18 118 15 590 118 .1770

118 11 118 118 .1298

0 = 4 16.05 − .21 + 1.33 = 4 17.16

0 = 4 16.11 − .18 + 1.33 = 4 17.26

0 = 4 16.05 − .13 + 1.33 = 4 17.25

67

4 17.22

4 15.35

1.97

5

2.024 ratio of 1327.

1327 = 23 11 0

3451 = . 8 9

23 11 0

4 17.30

23 6.42.70

8 9

26.30

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 6d 1878. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder,

Object,	0 Cygni	L² Capricorni	α Cygni	β Cephei
Circle,	46° 21'	−12° 55'	44° 50'	70° 2'
	w | e	w | e	w | e	w | e
Level Direct,	. | .	. | .	. | .	. | .
Reversed,	. | .	. | .	. | .	Dec = 2.93 .
Sums,	. .	. .	. .	. .
Difference,				
b.	1.05	−.23	1.00	Dec = 2.75

	h m s	h m s	h m s	h m s
Wire, I.	1.5	33.7	.	14.1 / 17.0 2.9
II.	4.5	35.8	.	19.8 2.8
III.	7.5	37.8	.	22.4 2.6
IV.	10.6	39.9	.	43.3
V.	13.6	42.0	.	18.42
				18.06
Sum,	37.7	39.2	.	33.54 / 25.48
Mean,	7.54	37.84	.	.

2.064 / 293

Bb,	.	.	.	.
Cc,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	20 9 48.75	20 11 20.38	20 37 18.11	21 27 5.12
Error of Timepiece,	.	.	.	.

105 / 118 / 840 / 105 / 105 / 12390 / 118 / 23 / 354 / 236 / .2714

0 = 4 18.79 − 1.24 + 1.32 = 4 18.87

0 = 4 17.46 + .27 + 1.32 = 4 19.05

25

4 18.2 + .41

1.92

4 18.96

17.22

+ 1.74

+ 1.70

105 / 23 / 82 / 41

4 18.79 − 1.05 + 1.17 = 4 18.91

17.46 + .23 + 1.17 = 4 18.86

1.77

4 18.88

17.22

1.61

24 | 1.65 | .07

168

.91 / 26 / 1.17

4 18.96 / 1.70 / 40 / 4 21.06

+.42

20.36 + 2.75

19.12 + .41

2.24 + 2.34

2.34 | 2.24 | −0.95

2.06

134 n = −1.00

1327 = 22 55 45

3451 = 54.1

55 45 / 4 19.08 / 51 25.98 / 54.1 / 28.18

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1870phae.proj.17008

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 10 1878. Instrument, Mer. Cir. - Observer, W.A.R.

Timepiece, 1327 Recorder,

Object,			ν Aquarii			ϑ Pegasi			ν Cephei		
Circle,			-.03			.57			468		
		w		e	w		e	w		e	w	e
Level Direct,		.		.	.		.	.		.	.	.
Reversed,		.		.	.		.	.		.	.	.
Sums,		.		.	.		.	.		.	.	.
Difference,												
b.			-2°			29°35'			74° 57'			
		h	m	s	h	m	s	h	m	s	h	m s
Wire,	I.			45.5			41.1			37.2 41.2 45.9 50.5		.
	II.			47.6			43.3			55.0		.
	III.			49.7			45.8			59.3 45		.
	IV.			51.8			48.2			85 130		.
	V.			53.9			50.6			.		.
Sum,				248.5 .			290 .			3151 180 475.1		.
Mean,				49.70			45.80			55.01		.
Bb,				.			.			.		.
Cc,				.			.			.		.
Aa,				.			.			.		.
Corr'd Transit,				.			.			.		.
R. A.		22	15	24.98	22	37	20.46	23	34	25.27		.
Error of Timepiece,				.			.			.		.

4 18.88
3.40
.40
4 22.68

4 24.72 - .03n +
4 25.34 + .57n
.16 54
4 25.08 + .27n

4 29.74 + 4.68
4 25.08 + .27
4.66 + 4.41
441 | 4.66 | 1.05 = pm.
441
2250

4 25.96
1.78
4 27.82

1.05
91
105
445
.95 .96
26
1.22

105
57
735
525
2835
.22
25.
34.3

1327 = 0 58
3451 =

4 24.72 + .04 + 1.22 = 25.98
4 25.34 - .68 + 1.22 = 25.88
25.44
0 58 25
4 26.16
58.84
34.3
35.46

4 25.96
18.83
4 | 7.13
1.78

24 | 1.80 | .075
168
120

25.96
19
4 26.15

1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 12 1878. Instrument, Mer. Cir. Observer, Nar.

Timepiece, 1327 Recorder,

Object,	γ Cephei							
Circle,			−8°15′					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	4.68		−.15					
	h m s		h m s		h m s		h m s	
Wire, I.	3 9 9		4 2.4			.		.
II.	44.4		44.4			.		.
	49.2							
	53 6							
III.	58.5		46.5			.		.
	2 7							
IV.	7.3		48.7			.		.
	12 0							
V.	16.5		50.7			.		.
	284 1		232 7					
Sum,	240.		.			.		.
	524 1							
Mean, 5 2 6 5	58.28		46.54			.		.
Bb,	.		.			.		.
Ce,	.		.			.		.
Aa,	.		.			.		.
Corr'd Transit,	.		.			.		.
R. A.	23 34 25.15		2 2 46 18.82			.		.
Error of Timepiece,	.		.			.		.

3457: 23 57 55.2
1327: 45
4 29.24
15.76
55.20
+1 39.44

0 = 4 33.08 + 4.68
0 = 4 27.72 − .15
0 = + 5.36 + 4.83 m

483 | 5.36 | 1.11 = m.
483
530
483
470

91
111
999
1,0101
26
1.27

111
15
555
111
.166
.17

0 = 4 27.72 + .17 + 1.27 = 4 29.16
26.00
2 | 3.16
+1.58 rate

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1879phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 13 1878. Instrument, Mer. Cir. Observer, Mark.

Timepiece, 1327 Recorder,

Object,	3 Pegasi		1 Pegasi				
Circle,	.54		.42				
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	29° 35′		22° 55′					
	h m s		h m s		h m s		h m s	
Wire, I.	4 2 45.6		8.1		.		.	
II.	41 48.0		45 10.3		.		.	
III.	50.3		12.8		.		.	
IV.	52.7		14.9		.		.	
V.	55.2		17.1		.		.	
Sum,	1.8		13.2		.		.	
Mean,	50.36		12.64		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	22 37 20.41		22 40 42.76		.		.	
Error of Timepiece,	.		.		.		.	

111
57
777
555
.6327

111
42
222
444
.0662

0 = 4 29.95 − .63 + 1.27 = 4 30.59
0 = 4 29.88 − .47 + 1.27 = 4 30.68

24 | 1.148 | .062
144
40

.67
4 30.63
29.16
1.47
1
1.148

83
83
.913
41.43
42.34

1327 = 0 3 55
3451 = 5.7

0 3 55
4 30.73
23 59 24.27
5.70
41.43
39.44
2.00

24 | 2.00 | .083
192
80

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 14 1878. Instrument, Mu. Cir Observer, W.A.R.

Timepiece, 1327 Recorder,

Object, Circle,	ν Cephei		γ Aquarii		α Cygni			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	4.68		-.15		1.00			
	h m s		h m s		h m s		h m s	
Wire, I.	38 42.9		45.3		.		.	
II.	46.9		47.3		46.6		.	
III.	51 6		49.5		49.5		.	
IV.	56 8		51.6		52.5		.	
V.	0 9.6		53.7		.		.	
	5.6							
	10 7							
	15.6							
	19.3							
Sum,	2496		476		286		.	
	9.6		.		.		.	
Mean,	1.07		49.48		49.53		.	
Bb,	.		.		.		4 31.84	
Cc,	.		.		.		2.60	
Aa,	.		.		.		1.05	
							4 35.49	
Corr'd Transit,	.		.		.		.	
R. A.	23 34 25.00		22 46 18.80		20 37 17.92		.	
Error of Timepiece,	.		.		.		.	

111 / 15 / 555 / 111 / 1665

0 = 4 30.68 − .17 + 1.27 = 4 31.78

0 = 4 31.61 − 1.11 + 1.27 = 4 31.90

1.68

α 1 30 L

35 16 / 21 48 / 13 1 / 84 / 74 / 2 58 / 1

1327 = −2 16 10.15

3451 = 21.5

8.65

4 31.84 ah 21h 40m

30.63

1.21

09

24 | 1.30 05 4

120

100

1 43.45

1.80

1 45.25

16 10.15

4 32.10

11 38.05

21.5

+1 43.45

41.43

2.02

1.86 rate Chron

4 31.84

1.30

78

4 33.9

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 15 1878 Instrument, Observer, Hill

Timepiece, 3451 Recorder, Ring for seeing

Object, Circle,	β Andromedæ E		Thuban E		Polaris E		δ Cassiop E	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	21.9	15.3	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.								
	h m s		h m s		h m s		h m s	
Wire, I.	1 3 51.5		.		III 12 25.		18.0	
II.	17.4		21.0		.		1 19 0.5	
III.	43.4		45.5		.		42.3	
IV.	9.3		10.5		.		—	
V.	35.2		7 34.5		22 33.		21 6.3	
Sum,	15 6 8 / 6 6 / 22 2.8		4 6.7 0 / 137.		34 58		66 6 / 66 / 126.6	
Mean,	44.56		45.66		17 29.		42.2	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	.		.		.		.	
Error of Timepiece,	.		.		.		.	

1 44 57.65 = 3451
47 45 = 1327
~~7.55~~

44 57.65
1 45.25
12.40
45
32.60

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

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

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

Object,	3 Piscium						
Circle,	W						
	w	e	w	e	w	e	w	e
Level Direct,	22.4	15.0	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.								
	h m s		h m s		h m s		h m s	
Wire, I.	~~24.6~~		.		12.2		.	
II.	24.4		.		.		.	
III.	1 26 46.5		.		.		.	
IV.	8.3		.		.		.	
V.	.		.		.		.	
	69 2							
Sum,	60		.		.		.	
	129.9							
Mean,	.		.		.		.	
Bb	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	.		.		.		.	
Error of Timepiece,	.		.		.		.	

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1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 19.5 1878. Instrument, Trans. Transit Observer, [illegible]

Timepiece, 3451 Recorder,

Object, Circle,		α Persei E								α Persei	
		w	e	w	e	w	e	w	e	w	e
Level Direct,		23.0	14.0	23.0	14.0	.	.	.	.	.	.
Reversed,		23.	14.	.	.	.	.	.	.	.	.
Sums,		46	28	.	.	.	.	.	.	.	.
Difference,		18.	14	.	.	.	.	.	.	.	.
b.		.60	.912							49° 26'	
		h	m s	h	m s	h	m s	h	m s	h	m s
Wire,	I.	3	16 31.5		13 27 =	3	28 15.			3	16 31.5
	II.		50(2)		3451 =	3	25 31.7				.
	III.		36.8		.		.				36.8
	IV.		480	3	11 03 31.3.		.				.
	V.		95		36.8 42.3		.			18	42.3
Sum,		18	42.3		3 12 68		.				11 06
Mean,			31.3		42.3		.			3	17 36.86
Bb,			42.3		19 .		.			1.52	+.91
Cc,			53.2		18 .		.			1.52	.
Aa,			.		152 .		.			-.19	-.34
			.		19 .		.				
			.		34 2 .		.				
Corr'd Transit,			.		.		.				17 37.48
R. A.			.		.		.			3	15 43.73
Error of Timepiece,			.		.		.				+1 53.70

4 | 2.00 | .083 — 192 — 80 — 83 — 15 — 415 — 83 — 1245

1 | 3.80 — 1.24 — +1 55.04

1 53.80 — 43.45 — 5 | 10.35 — 35 — 5 | 10.00 — rate of chron = 2.00

3 25 31.7 — 1 53.8 — 23 37.9 — 28 15 — 4 37.1 — 31.84 — 5321 | 5.26 — rate of 1327. +1.00

+1 53.80 — 4 | 31.84

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 21-3 1878. Instrument, Merid. Observer, W.A.R.

Timepiece, 1327 Recorder, W.

Object, Circle,	α Pegasi		ν Piscium		α Pegasi			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.		14° 3' 2		2°36'		14 3 2		
	h m s		h m s		h m s		h m s	
Wire, I.	IV 30.3		28.3		II 18.5			.
II.	32.3		30.3		20.8			.
III.	34.6		32.5		22.9			.
IV.	36.8		34.5		25.0			.
V.	23 3 39.0		23 15 36.6		27.1			.
	2 3 0		12 2		14 3			.
Sum,	.		.		.			.
Mean,	34.60		32.44		22.86			.
Bb	.		.		.			.
Cc,	.		.		.			.
Aa,	.		.		.			.
Corr'd Transit,	.		.		.			.
R. A.	23 58 44.71		54.28		22 58 44.71		1 56.18 1.8	.
Error of Timepiece,			4 38.16					

assume n = -1.00

.91
.26
1.17

4 38.16 +.05 +.25n
4 38.15 +.25n

4 38.16 −.05 + 1.17 = 4 39.28
4 38.15 −.25 + 1.17 = 4 39.07
35
4 39.18
31.84
7.34
10
7 ⌊ 73.4 ⌊ 1.03 ratio of 1327

0 14 21.1 = 1327
0 11 38.0 = 3451

0 14 20. 0 14 21
11 38 4 39.18
42 0 9 41.82
11 38.00
1 56.18
53.80
156.18 2.38
43.45
7 ⌊ 12.73 ⌊ 1.82
7
51

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 23 1878. Instrument, Mer. Ci Observer, Mak.

Timepiece, 1327 Recorder, A.W.

Object,	α Andromeda	γ Pegasi	κ Cassiop	
Circle,	.54	.26	1.90	
Level Direct,	w 22.9 / e 13.0	w . / e .	w . / e .	w . / e .
Reversed,	. / .	. / .	. / .	. / .
Sums,	. .	. .	. .	. .
Difference,				
b.	+28° 25′	14° 31′	62° 16′	
	h m s	h m s	h m s	h m s
Wire, I.	6 45.6	38.2	48.0	.
II.	48.0	40.3	50.0	.
III.	50.5	42.4	52.3	.
IV.	52.9	44.6	54.4	.
V.	55.2	46.8	56.7	.
Sum,	2 2	12 3	11 4	.
Mean,	50.44	42.46	52.28	.
Bb,	.	.	.	.
Cc,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	0 2 9.02	0 7 01.37	0 26 9.34	.
Error of Timepiece,	.	.	.	.

$0 = 4\ 42.94 + 1.90m +$

$0 = 4\ 41.25 + 1.40m$

$0 = 1.69 + 1.50m$

$m = -1.13$

$0 = 4\ 41.42 + .54m$

$0 = 4\ 41.09 + .26m$

$0 = 4\ 41.25 + 1.40m$

4 41.42 − .61 + 1.29 = 4 42.10

4 41.09 − .29 + 1.29 = 4 42.09

4 42.10

4 39.18

2 | 2.92

+.4

+ 2.47 rate chron.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

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

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

Object, Circle,	α Andromedæ.		γ Pegasi		κ Cassiop.			
	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.	0 2 9.02		0 7 01.37		0 26 09.34		.	
Error of Timepiece,	.		.		.		.	

59.5 3451
21 30. 40.15 1327
+9.35

15.15
44.50
30.65
24.50
+2 3.85
2 01.32
12.53

1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 24. 3 1878. Instrument, Mer. Circle Observer, Pitt. Mark.

Timepiece, 1327. 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,																

	1 Regasi	α Regasi
	.42	.26
w		
e		
Sums,		2 06.92
		1.32
Difference,		3 | 5.60
b.	22°55′	44°33′
Wire, I.	45 21.0	23.0
II.	23.2	25.1
III.	25.4	27.2
IV.	27.7	29.4
V.	29.9	31.6
Sum,	77.2	363
Mean,	25.44	27.26
Corr'd Transit, R. A.	22 40 42.62	22 58 44.66

n = -1.13

42
226
452
.4746
1.13
26
678
226
2938

4 42.82 - .47 + 1.29 = 4 43.64
4 42.60 - .29 + 1.29 = 4 43.60

4 43.62
4 42.10
1.52
8
24 | 1.60 | .067
144
160

4 43.62
1.60
.22
4 45.44

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 26.3 1878. Instrument, Mer. Ci Observer, W.A.R.

Timepiece, 1327 Recorder, H.W.

Object,	γ Peg.		λ Pegasi		i Cephei		α Peg.	
Circle,	.18		.42		2.20		.26	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,			rep.					
b.	+10° 12′		22°56		65° 34′		14 32	
	h m s		h m s		h m s		h m s	
Wire, I.	4 2 0.7		23.2		59 4 / 1.8		25.3	
II.	3.2		25.5		4.2 / 7.1		27.4	
III.	5.4		27.7		9.5 / 12.0		29.5	
IV.	7.7		30.0		14.5 / 17.0		31.8	
V.	10.0		32.3		19.4		33.9	
Sum,	27 0		3 8 7		144 9 / 60 / 84.9		47 9	
Mean,	5.40		27.74		9.43		29.58	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	22 37 20.23		22 40 42.58		22 45 22.37		22 58 44.60	
Error of Timepiece,	.		.		.		.	

0 = 4 47.06 + 2.20 n

0 = 4 45.17 + .29

0 = 1.89 + 1.91 n

n = −1.00 / .91 / .26 / 1.17

0 = 1.89 + 1.98

1.98 | 1.890 | −.95 / 1782 / 1080

.95 / .18 / 760 / 95 / .171 0

0 = 4 45.17 + .18 n

0 = 4 45.16 + .42 n

0 = 4 45.18 + .26 n

1 / 86

4 45.17 / .29

.95 / .91 / 95 / 855 / .864 / .26 / 1.12

.95 / .26 / 570 / 190 / .247

4 45.17 − .18 + 1.17 = 4 46.08 / 1.23 / 9 / 4 47.40

4 45.16 − .42

4 45.17 − .17 + 1.12 = 4 46.12

4 45.18 − .25 + 1.12 = 4 46.05

Error 1327 = 4 46.08 / 43.62 / 2 | 2.46 rate. 1.23

1327 = 1 24 40 / 345 1 = 0.7

40 / 46.22 / 53.78 / 0.7 / 2 6.92

1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Nov. 29 1878. Instrument, Mer. Cir. Observer, J. H. M.

Timepiece, Recorder, F. W.

Object,					ε Cassiop					β arietis									
Circle,					1.97					.37									
		w			e			w			e			w			e		
Level Direct,		.			.			.			.			.			.		
Reversed,		.			.			.			.			.			.		
Sums,		.			.			.			.			.			.		
Difference,																			
b.					63° 5'					20° 13'		307 329							
		h	m	s				h	m		s			h	m	s			
Wire,	I.		50	25.2 27.5						3583 37.4 39.5				15	589.1 120				
	II.			30.0 32.3						42.9 45.0				15	709	47.2			
	III.			34.6						47.3					109 105				
	IV.			37.0 39.0						49.4 51.5					40				
	V.			41.5 43.6						55.0 57.2 59.4					7. 7				
Sum,				407						16 3.9 5930					5890 196.33				
Mean,				3452						197.67 47.26					47.26				
Bb,				.						.					.				
Cc,				.						.					.				
Aa,				.						.					.				
Corr'd Transit,				.						.					.				
R. A.		1	45	44.56				1	47	58.91					.				
Error of Timepiece,				.						.					.				

4 46.08
2.46
20
4 48.74

.91
.26
1.17

+ 4996 + 197m
4 48.35 + .37m
0 = +1.61 + 1.60 m
m = −1.00

4 48.35 − .37 + 1.17 = 4 49.15 Error 1327.

1327 − 3451 = 8.55
20 45.00
4 49.18
55.82
8.55
+2 12.73

4 46.08
3.07
12
3 | 2.95
+.98 rate .1327.

1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 1 1878. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, W.W.

Object,	η Regasi	λ Peagasi	α Regasi	γ Cephei
Circle,	.18	.42	.26	4.33
Level Direct, w	.	.	.	.
Level Direct, e	.	.	.	.
Reversed, w	.	.	.	.
Reversed, e	.	.	.	.
Sums,	.	.	.	.
Difference,				376.58
b.				73°44
	h m s	h m s	h m s	h m s
Wire, I.	5.7	28.6	03 30.6	0.2
II.	8.3	31.0	32.6	5.0 9.8
III.	10.5	33.2	34.7	14.0 18.4
IV.	13.0	35.4	36.9	23.0 27.8
V.	15.4	37.5	39.0	32.0 36.6
Sum,	52.9	165.7	178.8	166.8
Mean,	10.58	33.14	34.76	18.53
Bb, 13.00 / 2.40 / 10.20	.	.	.	.
Cc,	.	.	.	.
Aa, .88 / 3 / .91 / 216.9	.	.	.	.
Corr'd Transit, 17.8	.	.	.	23.65
R. A.	22 37 20.15	22 40 42.51	22 58 44.58	23 34 58.38
Error of Timepiece,	.	.	.	.

0 = 4 54.88 + 4.33

4 50.41 + .29

4.47 + 4.04

4.04 | 4.47 | 1.11

4 04

430

4 04

260

111 / 91 / 111 / 999 / 10101 / 26 / 1.27

1327 = 2 45 00.

3451 = 25.3

0 = 4 50.43 + .18

0 = 4 50.63 + .42

0 = 4 50.18 + .26

1.24 .86

0 = 4 50.41 + .29

111 / 42 / 222 / 444 / .4662

181 / 63 / .44

111 / 26 / 666 / 222 / .2886

2.10 / 35 / 175 / 216.4 / 218.65

2.10 / 89 / 1.23

0 = 4 50.43 - .20 + 1.27 = 4 51.50

0 = 4 50.63 - .46 + 1.27 = 4 51.44

~~0 = 4 50.18 - .28 + 1.27~~

4 51.46

49.15

2 | 2.31

+1.15

1327

2 45 00

4 51.60

2 40 8.4

25.3

+2 16.9 Corr. of 3451

12.7

2 | 4.2

24 + 2.10 | .0875 rate.

192

180

168

120

.56 / .10 / .66

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 6. 1878. Instrument, Mer. Cir. Observer, J. F. W.

Timepiece, 1327. Recorder, F. W.

Object,	γ Cephei				α Andromedae				~~Δ Andromedae.~~ α Regan						
Circle,	4.33				.54				26						
	w		e		w		e		w		e		w		e
Level Direct,	.		.		.		.		.		.		.		.
Reversed,	.		.		.		.		.		.		.		.
Sums,	.		.		.		.		.		.		.		.
Difference,															
b. = +.13 S	+76° 57′				+28° 25′				~~+45° 48′~~						
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.		5	8				1.1			3	37.0				.
			10.7												
II.			.				3.5				39.0				.
III.			24.0				5.8				41.0				.
IV.			.				8.0				43.1				.
			38.0												
V.			42.5				10.4				45.3				.
		12	1 0			2	8 8				5 4				
Sum,			.				.				.				.
Mean,			2.420				5.76				41.08				.
Bb,			.				.				.				.
Cc,			.				.				.				.
Aa,			.				.				.				.
Corr'd Transit,			.				.				.				.
R. A.	23 34		23.25		0	2	8.88		22 58		41.49				.
Error of Timepiece,			.				.				.				.

4 51.46
2.30
30
4 54.06

4 51.46
3.45
4 54.91

0 = 5 00.95 + 4.33 m
0 = 4 56.73 + .40 m
4.22 + 3.93 m

393 | 422 | -1.07
393
2900
54
428
535
.5778
-.58
-.28
.86

1.07
91
107
963
.9737
+.17
+1.14

18
13
39
13
169

107
26
642
214
.2782

0 = 4 56.88 + .54 m
0 = 4 56.59 + .26 m
147 80

0 = 4 56.73 + .40 m

1327 =
3451 = 2.25

15
45.3

15
4 57.60
17.40
45.3
+2 27.90

+4 56.88 + .56 = +4 57.44
+4 56.59 + .86 = 4 51.45

at 2h 30m + 4 57.45 C. of 1327
4 51.46
5 | 6.00
+1.20
ratio of 327.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 7 1878. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, F. W.

Object,	γ Pegasi.				α Pegasi.							
Circle,	~~+8.75~~ +8.57				26							
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.												
	h	m	s		h	m	s		h	m	s	
Wire, I.	14		13.3				38.0				.	
II.			15.7				40.0				.	
III.			18.0				42.2				.	
IV.			20.4				44.3				.	
V.			22.8				46.3				.	
			90 2				108					
Sum,			.				.					
Mean,			18.04				42.16				.	
Bb,			.				.				.	
Ce,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.	22	37	20.07		22	~~58~~ 57	44.51				.	
Error of Timepiece,			.				.				.	

107 75 535 749 −.8025 1.14 +37 107 .6179 26 647 214 .28 114 .86

107 57 749 535 1.14 52

0 = 4 57.97 ~~+.52~~ = + 4 58.49

0 = 4 57.65 +.86 = + 4 58.51

+ 4 58.50

1327 = 3451 = 1 37 31.35

00 00 4 58.65

1.35

31.35

+ 2 30.00

27.90

+ 2.10

8

2.20

Error 3451

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1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 8 1878. Instrument, Mer. Cir. Observer, W.A.P.

Timepiece, 1327 Recorder, F.W.

Object,			λ Pegasi			α Pegasi					
Circle,			.42			.26					
	w		e		w		e		w		e
Level Direct,	.		.		.		.		.		.
Reversed,	.		.		.		.		.		.
Sums,	.		.		.		.		.		.
Difference,											
b.											
	h	m	s		h	m	s		h	m	s
Wire, I.			~~36.9~~				38.9				.
II.			39.1				41.1				.
III.			41.4				43.3				.
IV.			43.7				45.3				20 4 59.85 .
V.			~~45.6~~				47.5				20.15 .
			4.2				16 1				52.3 + 2 32.45
Sum,							.				30.00 .
Mean,			41.40				43.22				2.45 .
											10
											2.35
Bb,			.				.				.
Cc,			.				.		2.35		.
Aa,			.				.		2.18		.
									53		.
									+2.26		.
									3		
									+6.78		
Corr'd Transit,			.				.		+0		.
									6.68		.
R. A.	2	40	42.43		22	58	44.50		46		.
									+6.32		
Error of Timepiece,			.				.				14.5 5 .725 .

107 42 214 428 −.454 1.14 .69

0 = 4 58.97 + .69 = 4 59.68

0 = 4 58.72 + .86 = 4 59.62

4 59.65

4 58.50

+ 1.15

107 26 642 214 .2782 1.14 .86

1327 = 20.

3451 = 2 25 52.6

2 32.45 6.68 6.32 2 38.77

4 59.65 1.15 5 01.52

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 11. 1878. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, W. Cruft.

Object,	γ Regasi				β Andromedae														
Circle,	.26				.70														
	w			e	w			e	w			e	w			e			
Level Direct,	.			.	.			.	.			.	.			.			
Reversed,	.			.	.			.	.			.	.			.			
Sums,	.			.	.			.	.			.	.			.			
Difference,																			
b.	14°30′				34°54′														
	h	m	s		h	m	s		h	m	s		h	m	s				
Wire, I.		11	59.0				56.3				.				.				
II.		12	1.3				58.9				.				.				
III.			3.3				1.5				.				.				
IV.			5.5				4.0				.				.				
V.			7.6				6.5				.				.				
Sum,			16.7				12.72				.				.				
Mean,			3.34				1.44				.				.				
Bb,			.				.				.				5.0 41.3				
Cc,			.				.				.				5.0 41.25				
Aa,			.				.				.				5.0 3.02				
Corr'd Transit,			.				.				.				1.98 41.3				
R. A.	0	7	1.18		1	2	58.83				.				40.37 52.45				
Error of Timepiece,			.				.				.				3 17 87 | 2.6 6 16 18				

1327 = 345.1 = 2.43

30.65 = 3451

55.02 = 1327 13

5 02.68

52.32

30

32.65

30.7

39 55

5 27

52.3

30.7

38.4

107 / 26 / 642 / 214 / 2782

107 / 7 / 749

5 2.26 − .28 + 1.14 = 5 3.02

5 2.61 − .75 + 1.14 = 5 3.00

5 3.01

4 59.65

3.36

.09

3 | 3.27

1.09

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 12 1878. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, Recorder, H.W.

Object,	γ Pegasi		λ Peg.					
Circle,	.51		.42					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	29°35'		22°56'					
	h m s		h m s		h m s		h m s	
Wire, I.		18.8		41.3		.		.
II.		21.1		43.5		.		.
III.		23.5		45.8		.		.
IV.		25.9		48.0		.		.
V.		28.3		50.3		.		.
		17 6		28 9				
Sum,		.		.		.		.
Mean,		23.52		45.78		.		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	22 37	19.99	22 40	42.37		.		.
Error of Timepiece,		.		.		.		.

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 14 1878. Instrument, Mer Cir. Observer, Mak.

Timepiece, 1327. Recorder, D.W. Coutts

Object,	λ Regni		α Regni		γ Ceph.		
Circle,	42		26				
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	22°55'		14°33'		76°58'			
	h m s		h m s		h m s		h m s	
Wire, I.	45 43.1		45.4		.		.	
II.	45.5		47.5		.		.	
III.	47.7		49.7		.		.	
IV.	50.0		51.8		.		.	
V.	52.1		53.9		.		.	
Sum,	238 4		488		.		.	
Mean,	47.68		49.66		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	22 40 42.35		22 58 44.43		23 34 23.48		.	
Error of Timepiece,	.		.		.		.	

107 / 42 / 214 / 428 / .4494 / 1.14 / .70

107 / 26 / 642 / 214 / .2808 / 1.14 / .86

5 0 5.83 + .70 = 5 6.03

5 0 5.23 + .86 5 6.09

5 6.06

5 4.12

= 1.97

.97 rate.

5 6.06 / .80 / 5 6.86

2451 : 18 27 39.5 / 00, 15 (Dec. 15).

1327 :

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 16 1878. Instrument, Merid. Observer, Mak.

Timepiece, 1327 Recorder, F.W. Comp.

Object,	γ Capth.		β Trianguli		50 Cassiopeiae			
Circle,	.37		.68		3.04			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b. +.13	+20°13'		34°25'		71°50'			
	h m s		h m s		h m s		h m s	
Wire, I.	53 2.6		25.7		14.5			.
II.	4.7		28.2		17.7			.
III.	6.9 ~~7.8~~		30.7		21.0			.
IV.	9.0		33.2		24.5			.
V.	11.1		35.6		27.7			.
Sum,	~~34.3~~ 36		3.4		5.4			.
Mean,	6.86		30.68		21.08			.
Bb,	.		.		.			.
Cc,	.		.		.			.
Aa,	.		.		.			.
Corr'd Transit,	.		.		.			.
R. A.	~~1 47 58.83~~		2 2 22.32		1 53 10.42			.
Error of Timepiece,	.		.		.			.

0 = 5 10.66 + 3.04 m

5 8.20 + .52 m

0 = 2.46 + 2.52 m

252 | 2.46 | .97 m.

2268

1720

.97
91
.97
873
.8827
+16
1.04

.13
13
.16

0 = 5 8.03 + .37 m

0 = 5 8.36 + .68 m

39 105

5 8.70 + .52 m

.97
37
679
291
.3589
.36
164
.68

97
68
776
582
.6596
104
.38

5 8.71

5 8.74

5 8.72

5 6.06

2.66
20
2|2.46
+1.23 value

1327 = 25.1
3451 = 3 40 5.5

25.1
8.8
16.3
5.5
49.2

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 17 1878. Instrument, Mer. Cir. Observer, W. A. K.

Timepiece, 1327 Recorder, F. W. Coupe.

Object,	α Andromedae		γ Pegasi				
Circle,	.54		.26				
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	-28° 25′		14° 30′					
	h m s		h m s		h m s		h m s	
Wire, I.		13.1		12 6.0		.		.
II.		15.5		8.0		.		.
III.		18.0		10.0		.		.
IV.		20.3		12.1		.		.
V.		22.6		14.3		.		.
Sum,		89 5 .		0.4 .		.		.
Mean,		17.90		10.08		.		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	0 2	8.73	0 7	1.11		.		.
Error of Timepiece,		.		.		.		.

1.04 .52 .52 — 1.04 .25 .79

0 = 5 9.17 + .52 = 5 9.79

0 = 5 8.97 + .79 = 5 9.76

5 9.75 − 5 8.72 = 1.06 / 8 = +1.14 rate 1327

3451 = 2 58

1327 = 2 58

36 55.15

5 5.15 − 9.90 = 45.25 − 36.00 = 50.75

1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 18 1878. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, H.W. Cook.

Object,	γ Regasi			β Arietis							
Circle,	26			37							
	w		e	w		e	w		e	w	e
Level Direct,	.		.	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.				+ 20° 13'							
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.		12	6.6			.			.		.
II.			8.8			.			.		.
III.			10.9			.			.		.
IV.			13.0			.			.		.
V.			15.1			.			.		.
Sum,			44 .			.			.		.
Mean,			10.88			.			.		.
Bb,			.			.			.		.
Ce,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	0	7	1.10	1	47	58.83			.		.
Error of Timepiece,	0		.			.			.		.

5 9.78 +.79 = 5 10.57
9.77
+.80

00

18.05

5 10.73
9.32
00
2 50.68

345' = 4 50 00
1327 = 18.05
±

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 19 1878. Instrument, Mer. Cir. Observer, Mak.

Timepiece, 1327 Recorder,

Object,	β Andromedae				β Arietis				50 Cassiop										
Circle,		.70				.37				304									
	w		e		w		e		w		e		w		e				
Level Direct,	.		.		.		.		.		.		.		.				
Reversed,	.		.		.		.		.		.		.		.				
Sums,	.		.		.		.		.		.		.		.				
Difference,																			
b.																			
												10.6 11.0							
	h	m	s		h	m	s		h	m	s		h	m	s				
Wire, I.			~~19~~.				5.2				17.2				.				
		8	4 9																
II.			7.3				7.4				20.2	3			.				
III.			9.9				9.7				23.9 -	3.7			.				
IV.			12.5				11.9				27.0				.				
V.			15.0				14.2				30.0 23.6 36.7				.				
Sum,			49 6 .				48 4 .				~~11 8 3~~ 21 3.2 23.69				.				
Mean,			9.92				9.68				~~3.66~~				.				
Bb			.				.				.				.				
Cc,			.				.				.				.				
Aa,			.				.				.				.				
Corr'd Transit,			.				.				.				.				
R. A.			.				.				.				.				
	1	2	58.74		1	47	5880		1	53	10 30				.				
Error of Timepiece,			.				.				.				.				

5 13.39 + 3.04
11.03 + .53
2.51 | 2.36 | .94 ~
22 59
10 10
10 04
94
.91
94
846
.8554
16
102

.94
7.
.658
1.02
.36

5 11.18 + .20
5 10.88 + .37
06 107
5 11.03 + .53

.94
.37
658
282
.3478
.35
1.02
.67

5 11.18 + .36 = 5 11.54
5 10.88 + .67 = 5 11.55

5 11.50
5 10.57
rate. + .93

5 11.55
.93
.12
5 12.60

55
47
12.02

11.55
1.86
5 13.41
3
5 13.44.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 20 1878. Instrument, Russ. Tr. Observer, F.W.

Timepiece, 34 51 Recorder,

Object, Circle,					o Tauri W		ζ Tauri W	
Level Direct, Reversed,	w 25.7 .	e 13.7 .	w . .	e . .	w . .	e . .	w . .	e . .
Sums, Difference, b.	.	.	.	.	.	.	.	.
	h m s		h m s		h m s		h m s	
Wire, I.	III .		V .		5 .			24.7
II.		50.5		.	53.1		26	46.5
III.		6.5		21.0	14.7			8.5
IV.		22.5	11	36.5	21 36.2			30.3
V.	3 8	39.5		.	57.5			52.0
Sum,		.		.	104.50			162.0
Mean,		.		.	14.67		27	8.40
Bb,		.		.	.83 +.68	.88		.72
Ce,		.	2.35	.	1.04 +.73	1.03		+1.65
Aa,		.	16 45	.	1.34			1.20
			1175		.50 +.74	.51		.64
			1339.5					
Corr'd Transit,		.	1.17	.	21 17 7.0			11 41
R. A.		.	2	.	16.69			10.32
			1.19		3 18 19.97		3 24	18.50
							3	38.36
Error of Timepiece,		.	166		2 55.60		2	55.75
			57		2 56.72			56.82
			1162		+ 2 57.73		+ 2	57.91
			830					
			.9462					

82 83 46 656 6806

166 57 166 830 .8466

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec 20 1878 Instrument, Rus. Tr. Observer, FH.

Timepiece, 3451 Recorder,

Object,	S Hemelop		Z Ursæ	ε Ursæ
Circle,	W	E.	E.	E.
Level Direct,	W 26.5	E 13.9	W .	E .
Reversed,	26.3	14.2	.	.
Sums,	52.8	28.1	.	.
Difference,	24.7	.	.	.
	+.82			
b.	70° 58′	2.90	31° 32′	39° 40′
Wire, I.	h m s I 7.0	h m s VII 27.5	h m s 48 38.8	h m s 51 46.8
II.	18.0	38.5	4.0	14.5
III.	28.0	49.5	29.0	42.0
IV.	39.0	60.5	53.7	9.7
V.	38 50.5	43 11.5	19.2	37.3
Sum,	142.5	127.5	144.7	150.3
		120		60.
		247.5		210.3
Mean,	28.50	49.50	28.94	42.06
Bb,	2.70	+ 2.21	1.14	.93	1.29	1.04
Ce,	3.07	− 2.23	1.16	+.84	1.30	.95
Aa,				.42		+.16
	−1.47		.24	+.80 .07		+.09
Corr'd Transit,				30.89		44.10
R. A.	3 37 40.80		3 46 33.82	30.67	3 49	46.37
Error of Timepiece,				56.85		56.89
			2 57.07		2 57.80	
			2 57.31			

3 18 19.97
3 20 38.36
82 27 574 164 2214
114 82 228 912 9348
42.516 .29 382644 85032 12329.64

4.25 128 82 256 1024 1.04

9.5 ch. 245 25 44.5

38 30.71 2 3.30 40 34.01
40 43.99 −4.99 40 39.00

42 47.29 2 03.30 40 43.99 34.01 2 19.98
3.07 | 4.99 | +1.62 C. CW.
307 1920 1842 780

3/3 46 33.82 37 40.80 8 53.02 50.87
a'-x +1.71 | +2.15 | +1.26 @
171 440 342 980 855

49 29.87 40 39.00 8 50.87
8 s

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1878phae.proj.1790f

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

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

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

		w	e	w	e	w	e	w	e
Object,									
Circle,									
Level Direct,		.	.	.	.	.	.	.	.
Reversed,		.	.	235.07	235.80	.	.	.	.
				.1645					
Sums,		.	.	.	.	.	.	.	.
Difference,									
b.									
		h m s		h m s		h m s		h m s	
Wire,	I.	42.516.		38 30.71.		42 47.29.		.	
	II.	307		2 10.52.		2 10.52.		77 77	
	III.	29761 2.		40 41.23.		40 36.77.		24 .7	
	IV.	1275480		36.77.		2.23		168.539	
	V.	1305241 2.		24.46.		40 39.00.		154	
Sum,		.		307 2.23 ÷ 73 + C.E.		.		116 116	
Mean,		.		21 49		.		73 13	
				.810				348 348	
				921				812 116	
Bb,		.		.		.		.8468.508	
Cc,		8 53.02		.		.		13	
Aa,		51.71		53.94		.		73	
				30.71				39	
		1.71 | 1.31 ÷ 0.44		39.00				71	
		1197		51.71				94	
Corr'd Transit,		1130		.		.		.	
R. A.				.		.		.	
Error of Timepiece,		.		.		.		.	

3 37 40.80
24 13.50
13 27.30

40 41.23
−2.23
40 39.00
27 8.40
13 30.60
27.30
−1.98 \| 3.30 ÷ 1.66 (a).
198
1320
1188
132

166
107
1162
#1166
.42

2 56.85
56.89
56.72
56.82
3.28
56.82
59.72
2.90
2 \| 3.10
1.55

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 22 1878. Instrument, Rues. Jr. Observer, P.W.

Timepiece, 345 Recorder,

Object,	ζ Piscium		ϰ Andromedæ.		ν Cephei		
Circle,	ϰ Andromedæ		α		ε		π
	w	e	w	e	w	e	w	e
Level Direct,	.	.	24.7	12.4	.	.	.	.
Reversed,	.	.	24.8	12.6	.	.	.	.
Sums,	.	375 13 125 375 48 7.5	49.5 25 4	.	.	.	.	.
Difference,			3 | 24.1 .80					
b.			45° 48'		76° 58' 74 44'			
	h m s		h m s		h m s		h m s	
Wire, I.		426.6		36.3	III	36 53.	IV	1.8 15.7
II.		40 486.6 | 37.43		46.3		8.3		40 17.5 15.8
III.		13 | 39 96		56.8		24.3		33.3 5.5
IV.		91 56		6.9		40.3		48.8
V.		52 40		16.9		55.8		41 04.5 6.5
				27.1	37			
Sum,		426.6		34 37.5		181.7 121.7		105.4 40 46
Mean,		34 37.43		47.7		24.34		40 38.14
				5.75				
Bb,	1.44	+1.15		8.10	3.65	+2.92		
Ce,	1.44	.		18.0	4.43	.		
Aa,	-.09	-.21		28.2	-2.51	.		
				35 38.8				
Corr'd Transit,		34 38 37 91		.		.		
R. A.		23 31 38.97		.	23 34	21.95		
Error of Timepiece,	+	2 59.46		.		.		

42516
443
1275 48
170064
170064
188.34588

40 33.14
36.06
3 8.34
27.72

27.26
27.72
2 \| 46
443 \| .23 \| .05

24.34
2.92
27.26

33.14
8.34
24.80

33.14
2.92
36.06
8.34
27.72

40 33.14
242
40 36.06
3 08.34
37 27.72

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1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 22 187 . Instrument, R.J. Observer, D.W.

Timepiece, 3457 Recorder,

Object,			4 Reg			& Andromeda					
Circle,			W								
Level Direct,		W		E	W		E	W		E	W		E
Reversed,			24.8	12.6									
Sums,													
Difference,													
b.			18°27′			28°26′							
		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.		48	34.0			18.5						
	II.			56.2		4	42.7			0.9		11.6	3451
	III.			18.4			6.9					25	1327
	IV.			41.0			31.0						
	V.		50	3.5			55.3		5	13.1		9 11.6	
										.30		2 59.7	
									5	13.40			
Sum,			153 1			154 4						6 11.9	
			60			60						20.0	
			93			94.4							
Mean,			18.62			6.88						+5 13.1	Err of 1327
Bb,		.97		+.78	1.11		+.89					5 11.55	
Cc,		1.06			1.13							3 1.55	+.652
Aa,		.43		1.01								15	
				21.95			+.63					5	
					.27								
Corr'd Transit,				20.41			8.40					1.55	
R. A.		23 46		20.55	0	2	8.67					.77	
												15	
												59.92	
												3006	
Error of Timepiece,			2	59.86			59.73				+ 2 59.70 Mean Error.		
											+1.55 rate of Chron.		

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 23 1878. Instrument, Mer. Cir. Observer, WAR.

Timepiece, 1327 Recorder,

Object,	ν Regasi		β Andromeda					
Circle,	26		1					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+14°31'		34°59'					
	h m s		h m s		h m s		h m s	
Wire, I.	12 9.3			.		.		.
II.	11.5			.		.		.
III.	13.6			.		.		.
IV.	15.7			.		.		.
V.	17.8			.		.		.
Sum,	67 9 .			.		.		.
Mean,	13.58			.		.		.
Bb		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	0 7 1.05		1 2 58 71			.		.
Error of Timepiece,		.		.	3451 = 4 50 1327 = .		3.3 15.0	.

94
26
174
188
.2054

5 12.53 − .20 + 1.02 = 5 13.35
5 11.55

411.80
+.45 rate of 1327.

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1878phae.proj.1790f

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 25 1878. Instrument, Mk Ci. Observer, mak.

Timepiece, 1327 Recorder,

Object,	β Andromeda		γ Piscium					
Circle,	.83		.42					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	34°59′		14°43′					
	h m s		h m s		h m s		h m s	
Wire, I.	7.1		10.7		.		.	
II.	9.6		12.9		.		.	
III.	12.1		15.0		.		.	
IV.	14.6		17.1		.		.	
V.	17.3		19.3		.		.	
Sum,	60.7		75.0		.		.	
Mean,	12.14		15.00		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	1 2 58.65		1 25 1.72		.		.	
Error of Timepiece,	.		.		.		.	

.94 5 13.49 + .24 = 5 13.73 5 0 1.75 3451
83 5 13.28 + .62 = 5 13.90 10 1327
282
752
.7802
+102
24

94
42
188
376
.3948
102
.63

16.3
5 13.82
13.35
2.47
+.24 rate of 1327.

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 26 1878. Instrument, Mer. Cir Observer, F.R.A.R.

Timepiece, 1327. Recorder, D.W.

Object,	β Andromedae		ξ Ursae Min.		η Piscium			
Circle,	.83		43.17		.42			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	44.066 40.917	.	.	.	.	.
Sums,	.	.	6 | 3.149 .525 4 2.100	40.92 2.25 43.17	.	.	.	.
Difference,								
b. +.13			88° 40' 16"					
	h m s		h m s		h m s		h m s	
Wire, I.		7.4		238 7.3		11.0		.
II.		9.9		50 7 38.0		13.0		.
III.		12.5		20 21 2 - 7.4		15.2		.
IV.		14.9		53.3 37 4		17.4		.
V.		17.4		22 3		19.5		.
Sum,		12 1 .		261 4 9201.4		26 1 .		.
Mean,		12.42		22.38		5.22		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	1 2	58.65	1 14	31.49	1 25	1.72		.
Error of Timepiece,		.		.		.	1327 = 3 m	59.8
							3451 =	53.
								.

.87 .91 .87 | 18.3 .79 1 7 16 .95 .72 .23 | 42.54 | 37.26 | .87 | 34032 3228

.87 .83 261 646 .722

.87 .42 174 348 .37 5 .95 .58

5 13.77 + .83m

5 13.50 + .42m

127 125

5 13.63 + .63m

5 50.89 + 43.57m

37.26 + 42.54m

m = -.87

5 13.77 + .23 = 5 14.00

5 13.50 + .58 = 5 14.08

5 14.04 Sr. of 1327

5 13.80

+.24 rate 1327.

59.8 14.04 | 05.73 53.00 | 307.27

1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec 29 1878. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object, Circle,	σ Piscium W		α Trianguli W		50 Ceresiop W		ε W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	27.2	12.9	.	.	.	.
Reversed,	.	.	26.8	13.5	.	.	.	.
			54.0	26 4				
Sums,	.	.	26.4		.	.	.	.
Difference,			27.6					
			.91					
b.	+8°32'		+28°59'		71°50'			
	h m s		h m s		h m s		h m s	
Wire, I.	1 41 28.0		48 33.8		II 52.5		V 15.7	
II.	49.8		58.3		4.5		27.0	
III.	11.3		22.6		14.5		38.0	
IV.	33.0		46.9		26.0		50.5	
V.	54.6		50 11.2		37 0		59m 2.0	
Sum,	176 7		176 2 8		133 5		133 2	
	120		60		60		6	
	56 7		112.8		73.5		193.2	
Mean,	11.34		22.56		14.70		38.64	
Bb,	.85	.	1,12	.	2.80	.	.	.
Cc,	1,02	.	1,14	.	3.21	.	.	.
Aa,	.55	.	,27	.	-1.58	.	.	.
Corr'd Transit,		.		.		.		.
R. A.	1 39	1.68	1 46	12.49	1 53	9.86		.
Error of Timepiece,		.		.		.		.

21.258
3 21
21 258
4 2 5 16
6 3 7 7 4
68.238 18
136.48

58 38.64
2 16.48
56 22.26

~~+4.70~~
~~36.48~~
14.70
8.24
22.94
22.26
3 21 3 68
1 34 +10 C. 58.

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 29 1876. Instrument, ... Observer, DW

Timepiece, 3451 Recorder, ...

Object,	α Arietis			β Trianguli							
Circle,	E										
	W		E	W		E	W		E	W		E
Level Direct,	26 .4		13.5	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	22° 54'			34° 25' / ~~22° 54'~~								
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			46.3			~~6.6~~			.			.
II.			9.2			6.6			.			.
III.		3	32.2		5	32.4			.			.
IV.			55.4			58.5			.			.
V.			19.0			.			.			.
Sum,			162 1			97 5			.			.
Mean,			32.42			32.5			.			.
Bb,	1.02		.	1.21		.			.			.
Cc,	1.08		.	1.22		.			.			.
Aa,	.37		.	.16		.			.			.
Corr'd Transit,			.			.			.			.
R. A.	2 0 22.64			2 2 22.23					.			.
Error of Timepiece,	-		.			.			.			.

1327 = 2 11 15

3451 = . 14.7

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 30 1878. Instrument, Mer. Cir Observer, Mak.

Timepiece, 1327 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.			43.1				.				.				.		
II.			46.2				.				.				.		
III.			49.5				.				.				.		
IV.			52.5				.				.				.		
V.			55.6				.				.				.		
Sum,			246.9				.				.				.		
Mean,			49.38				.				.				.		
Bb,			.				.				.				.		
Cc,			.				.				.				.		
Aa,			.				.				.				.		
Corr'd Transit,			.				.				.				.		
R. A.	1	30	35.43				.				.				.		
Error of Timepiece,			.				.				.				.		

5 13.95 − .01 = 5 13.95
Err of 1327

87
111
87
87
87
−.965

1327 =
3451 = 2 50 00

00
13.95
46.05
00
+3 13.95 Empfelum
3 07.27
16.68
46.80
24 | +1.70 h

.85
13.95
3 14.80

1878phae.proj.1790f

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Dec. 31 1878. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, F.H.

Object,	α Lus. Min.	β Andromedae	β Aurigæ	
Circle,	43.17	73	37	
	w | e	w | e	w | e	w | e
Level Direct,	. | .	. | .	. | .	. | .
Reversed,	. | .	. | .	. | .	. | .
Sums,	. .	. .	. .	. .
Difference,				
b.		+34°59'	+28°13'	
	h m s	h m s	h m s	h m s
Wire, I.	19 1 1.8	5.9	6.3	.
II.	52.6	8.4	8.7	.
III.	36.0 16 0-	10.9	11.0	.
IV.	3.2	13.3	13.2	.
V.	47.5 33 2 +2 5	15.8	15.4	.
Sum,	221.7 9 | 161.7	43 .	46 .	.
Mean,	16.86	10.86	10.92	.
Bb,	.	.	.	.
Ce,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	1 14 26.83	1 2 58.61 / 1 47 58.71	1 47 58.74	.
Error of Timepiece,	.	.	.	.

5 50.03 + 43.17 m
5 12.23 + .60 m
37.80 43.57

4257 | 37.80 | 1.89
.4056 m = -.89
3744

5 12.25 + .83 m
5 12.88 + .37 m
120

5 12.23 + .60 m

.83 / 9 = .747
-.75
+.75
.03
.32

37 / 4 = .333
.95
.62

5 12.45
5 12.80
5 12.62

95
20
1.25

12.70
1.50
11.40

5 12.58
12.80
1.38
5 12.69

25.1
12.5
12.6
28.0
3 15.4
13.95
+1.45
1.35

4 20 28 = 3451
25.1 = 1327

3 15.4
1.45
.65
3 17.50

3 15.4
2.6
3 18.0

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan 3 1879. Instrument, Russ. Jr. Observer, DW.

Timepiece, 3451 Recorder, DW.

Object,	β cast			γ Peg.			24.0	14.1											
Circle,	E			E			i Ceti												
							W	-9°30'											
	w		e	w		e	w	e					w		e				
Level Direct,				27.4		14.5	28.0	14.1					27.4		NH.5				
Reversed,								440					28.0		14.1				
													55.4		28.6				
Sums,			286			280		585					28.6						
Difference,			42.3			42.5		53					3	26	8				
b.	+58°29'		55.4		9	50.0		200					+90						
	7		93	+14°31'		37		270											
	h	m	s	h	m	s	h	m	s				h	m	s				
Wire, I.			230			11.8			34.5										
II.	0	5	36.3			19.2			41.5										
III.			500			26.5		16	48.5				0	23	48.7				
IV.			6 37			33.7			2.9						+3 20.27				
V.			17.0			48.5			10.3						28.43				
			305			55.6									40				
	~~46 21~~																		
	~~46 91~~		443			11 107			24.3				5		11.57				
Sum,			575			38 0 2			31 7 1						12.69				
Mean,	3.47		11.2			19.11			34.28						3 11.10				
															-.40				
Bb,	184	+1.66	248	91		+.81	.63		+.57						rate 10.27				
Cc,	1.91		38.2	1.04			1.07												
			47 2 1																
Aa,	-.54			.49		+1.24	.86		+1.97										
Corr'd Transit,						21 16			36 82										
R. A.	0	2	43.60	0	7~~8~~	00.93	0	13	16.52										
Error of Timepiece,				+	3	20.23	+	3	20.30										

1327 = 0
3451 = 0

40
23 48.7
00
8.7

0 7~~8~~ 00.93
2 43.60
4 17.33
14.79
+10 3 +2.54
2.06
480
412
680

19.92
5.13
14.79

2.46
1.968
1.24

3 20.30
3 20.23

+ 3 20.27
Error 3451

3 20.27
.28
3 20.55
15.4
3 5.15
1.72

3.7
15
185
37
555
421
60 | 4666 | 7
420

47 21
420.
15 | 522 | 3.47
45
71
60
110

522.1 | 13
45
72

60 | 466.6 | 8
480

522.1
55.5

522.1
1480
15 | 421 | 27 | 4
30
121
105
60

19
209

330.2
120
11 | 210.2 | 19.11
11
100
99
12

345
385
3795
60
11 | 319.5 | 3

11 | 377.1 | 34.28
33
47
44
31
23
90

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 5 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, W.

Object,	α Ceti			48 H Cephi.			β Persei				
Circle,	.06			4.44			85				
	w		e	w		e	w		e	w	e
Level Direct,	.		.	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.	+3°36'			77°18'			40°30'				
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.	3	1	5.5		21	6.5			25.7		.
II.			7.5			10.8			28.5		.
III.			9.6			16.3 20.5			31.3		.
IV.			11.6			25.4 30.3			34.0		.
V.			13.7			34.6 39.7			36.8		.
Sum,			47.9			186.2			63		.
Mean,			9.58			20.69			31.26		.
Bb,			.			.			.		.
Ce,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	2	55	58.91	3	5	5.92	3	0	19.94		.
Error of Timepiece,			.			.			.		.

345 = 4 25 44.7
1327 = 32

5 14.77 + 4.44m
5 11.00 + .45m
3.77 4.00m

4.00 | 3.77 | .94m
360
17
94
91
94
846
.8554
16
1.01

94
6
.0564

5 10.67 + .06m
5 11.32 + .85m
199 91
5 10.00 + .45m

94
.85
470
752
799
.80

5 10.67 + .95 = 5 11.62
5 11.32 + .21 = 5 11.53
115
5 11.57

32
11.55
20.45
44.7
24.25

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 6 1879. Instrument, Mer. Cir. Observer, W. A.R.
Timepiece, 1327 Recorder, A W.

Object,	α Ceti	η Persei	θ Persei	
Circle,	.06	1.35	1.14	
	w | e	w | e	w | e	w | e
Level Direct,	. | .	. | .	. | .	. | .
Reversed,	. | .	. | .	. | .	. | .
Sums,	. .	. .	. .	. .
Difference,				
b.	3°37′	53°24	48°43′	
	h m s	h m s	h m s	h m s
Wire, I.	3 1 5.1	.	3.5	.
II.	7.3	.	6.4	.
III.	9.6	.	9.5	.
IV.	11.6	.	12.8	.
V.	13.6	.	16.0	.
Sum,	47 2	.	48 2	.
Mean,	9.44	.	9.64	.
Bb,	.	.	.	.
Cc,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	2 55 58.90	2 41 54.88	2 35 58.30	.
Error of Timepiece,	.	.	.	.

5 10.54 +.95 = 5 11.49
5 11.34 +.06 = 5 11.40
5 11.44
5 11.57
−.13 rate 1327

94
114
376
994
1.07 16
1.01
6

4 47

48.5 − 3451
35.15 −1327
11.40
23.75
48.5
3 24.75

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 7 1878 Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, F.W. Jones

Object,	β Andromedæ	β Andromedæ	β Andro	
Circle,	70			
Level Direct, w	.	.	.	.
Level Direct, e	.	.	.	.
Reversed, w	.	.	.	.
Reversed, e	.	.	.	.
Sums,	.	.	.	.
Difference,				
b.	34° 58'			
Wire, I.	17.8	A 1 3.8	0 50.0	.
II.	20.3	6.3	52.5	.
III.	22.8	9.0	55.0	.
IV.	25.3	11.3	57.5	.
V.	1 8 28.0	14.0	60.1	.
Sum,	114.2	44.4	251	.
Mean,	22.84	8.88	55.02 / 2284	.
Bb,	.	.	2 | 137.86 / 68.93	.
Cc,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	1 2 58.55	.	.	.
Error of Timepiece,	.	.	.	.

90 / 70 / .65 8 / −.66 / +1.01 / .35

~~24.29~~

5 10.33 + .35 = +5 10.68 / .76

11.44

Err of 1327

.76 / 10 / .86

5 10.68 / .88 / 5 9.80

1.77 / 2 / 3.54

3 26.52 / 3.40 / 3 29.92

6 55 / 31.2 / 15 / 11.30 / .85

15 / ± 10.54 / 04.46 / 31.26 / 3 26.70 / 18 / 3 26.52 / 24.75

24 1.77 / .68 / 90

wrong 3451 / 1327

3 26.52 / 1.78 / 3 28.25

74 / 74 / .814

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan 10 1879. Instrument, Rus Jr. Observer, T.W.

Timepiece, Recorder,

Object,			R Cass			π Andr.			δ Andr.		
Circle,			W			W			W		
		w		e	w		e	w		e	w	e
Level Direct,		.		.	.		.	26.3		13.0	.	.
Reversed,		.		.	.		.	.		.	.	.
Sums,		.		535	.		.	.		.	.	.
Difference,		.		8.8	.		.	.		.	.	.
b.	= +.90	28		240								
		6215		348		33°3'			30°12'			
		h	m	s	h	m	s	h	m	s	h	m s
Wire,	I.			548			6.2			.		.
	II.	15	607.0	25.0	0	33	31.7			.		.
	III.			40.8			57.0	3.6	36	23.4		.
	IV.		29	55.5			22.3	4.4		48.0		.
	V.			25.5		34	47.9		37	12.4		.
				4.8								
b		4870		56.1			165.1			23.4		
		120		1.2			1.24			23.34		
Sum,		607.0		3128.0			285.1			23.08		.
				487.0						82		
Mean,				40.47			57.02			23.27		.
Bb,		20.1		1.81	11.8		1.06	1.14		+1.03	1 20	46.7
				.			.			.	3	32.7
Cc,		2.15		-.21	1.20		-.12	1.16		-.11	17	14.0
Aa,		-.73		.	.20		+.42	.24		+.50	+5	25
											Emf 37	11.0
Corr'd Transit,				.			58.38			24.69		.
R. A.		0	26	7.81	0	30	25.66	0	32	52.12		.
Error of Timepiece,				.		+ 3	32.72		+ 3	32.57		.

40.8 / 15 / 4080 / 2040 / 612.0 / 408 / 125 / 2 | 49.318 56 / 24.66

48.0 / 24.66 / 23.34 / 23.4

42.516 / 1.16 / 255096 / 42516 / 42516

C = +.10 C.E.

118 / 9 / 1062

1 20 46.7 3451 / 25. 1327

0 30 25.66 / 26 7.81 / 4 17.85 / 15.89 / 93 | 1.96 | +2.11 / 186 / 100 / 93 / 70

4 2.07 / 5 7.96 / 4.11 / 15.89

1 20 / 46.7 / 32.75 / 13.95 / 25.0 / 11.05

3 32.72 / 3 32.57 / 1.29 / + 3 32.65 Emf 3451 / 26.52 / 3 | 6.13 / 24 | 2.05 | 1085 / 192 / 130

1.03 / 17 / 1.20

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan 13 1879. Instrument, Merid. Observer, [illegible]

Timepiece, 3451 Recorder, [illegible]

Object, Circle,	α Persei E		ζ Tauri E		ζ Tauri W		α Persei W	
	w	e	w	e	w	e	w	e
Level Direct,	27.0	13.0	.	.	27.0	13.2	.	.
Reversed,	27.0	13.2	.	.	.	.	.	.
	54.0	26.2						
Sums,	3|27.8	.	.	.	.	.	.	.
Difference,	+.93							
b. +93	+49°25'		9°18'		12°31		47°23	
	h m s		h m s		h m s		h m s	
Wire, I.	18 14.2		23 30.4		27 4.7		3 36 54.3	
II.	46.7		52.0		26.5		25.7	
III.	19.5		24 13.5		48.4		37 57.2	
IV.	19 5.6		35.0		10.3		28.7	
V.	25.2		56.5		28 32.1		0.3	
Sum,	158.2		187.4		122.0		166.2	
	40.		120.		120.		120.	
	94.2		67.4		2.0		46.2	
Mean,	19.64		13.48		48.40		57.24	
Bb,	15 +1.39		85 +.79		89 +.82		147 +1.37	
Cc,	1.54 +.15		1.0 +.10		1.03 +.10		1.48 +.15	
Aa,	-.19 -.42		55 +1.21		51 +1.12		-.13 -.29	
Corr'd Transit,	20.76		15.58		50.44		58.47	
R. A.	3 15 43.60		3 20 38.25		3 24 13.37		3 34 21.06	
Error of Timepiece,	+3 37.16		+3 37.33		+3 37.07		+3 37.41	

1327 = 3451 = 5 / 14.

4 14 3

45.1

0.1 = 1327

26.0 = 3451

37.3

48.7

00.1

11.4

11.0

3\|+.4

+13 ratio of 13M

3 37.16

.33

.07

.41

.97

+3 37.24 Error 3451.

3 32.65

4.5.9

15

3\|4.4.6

+1.48 ratio 3451

147 93 441 1323 13671

896 93 9 1832

85 93 255 765 7905

27 93 81 243 2511

19 22 38 418

55 22 110 1210

57 22 10 1102 1122

13 22 26 286

147 22 294 294 3234

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 13 1879. Instrument, Rus. 7. Observer, F.W.

28°34' Timepiece, 3451 Recorder, F.W.

Object,	5 H Camelop		5 H Camelop.							
Circle,	W		E							
	w	e	w	e	w	e	w	e		
Level Direct,	.	.	.	.	.	.	.	.		
Reversed,	.	.	.	.	.	.	.	.		
Sums,	.	.	.	.	.	.	.	.		
Difference,										
b.	50° 57'									
	h m s		h m s		h m s		h m s			
Wire, I.	III 37.0		IV .		.		.			
II.	7.5		.		.		.			
III.	18.2		.		.		.			
IV.	29.3		.		.		.			
V.	3 41 40.5		43 50.2		.		.			
	152.5									
Sum,	92.5		.		.		.			
Mean,	18.50		.		.		.			
Bb,	2.70	+ 2.51	.		.		.			
Cc,	3.09	- .31	.		.		.			
Aa,	-1.47	-3.23	.		.		.			
Corr'd Transit,	4 ~~20.70~~	17.47	.		.		.			
R. A.	3 37 40.41		.		.		.			
Error of Timepiece,	+ 2 37.06		.		.		.			

3 37 40.41
24 13.37
α'-α 13 27.04

41 20.70
27 49 32
+3 31.38
27.04
-1.98 4.34 +2.19
396
380
198
1820
1782
38

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan 14 1879. Instrument, Mer. Cir. Observer, MAK.
Timepiece, 1327 Recorder, WH.

Object,	γ Aurigae	β Eridani	α Aurigae	
Circle,	41°04'	−5° 15'	45°53'	
	w | e	w | e	w | e	w | e
Level Direct,	. | .	. | .	. | .	. | .
Reversed,	. | .	. | .	. | .	. | .
Sums,	. .	. .	. .	. .
Difference,				
b.	.184	−.09	1.03	
	h m s	h m s	h m s	h m s
Wire, I.	5 3 10.1	7 2.2	12 53.1	.
II.	12.8	4.6	56.2	.
III.	15.7	6.5	59.0	.
IV.	18.2	8.4	2.3	.
V.	21.0	10.6	5.1	.
Sum,	77 8	32 3	1757 (w 295 7)	.
Mean,	15 56	6.46	59.14	.
Bb,	.	.	.	.
Cc,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	4 58 4.87	5 1 56.15	5 7 48.11	.
Error of Timepiece,	.	.	.	.

85
90
756
336
7896
1.01
+.22

8
1.01
1.09

103
84
41.2
8.24
.86 5.2
1.01
.15

5 10.99 + .22 = 5 11.21
5 10.31 + 1.09 = 5 11.40
5 11.03 + .15 = 5 11.18
.79
+ 5 11.26 Error 1327

3451 =
1327 = 5 54
5 11.26
49 03.74
42.8
39.06
37.24
+1.82

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1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 16 1879 Instrument, Rue Gr. Observer, G.R.

Timepiece, 3451 Recorder, G.W.

Object, Circle,	~~α Eridani~~ γ Tauri E	δ Tauri E	ε Tauri W	16 00
Level Direct, Reversed,	W: 27.9, 28.2 / E: 15.0, 14.7	W: . / E: .	W: 28.2 / E: 14.7	W: . / E: 13.4, 11.8
Sums, Difference, b. +.88	56.1 / 29.7 / 26.4 / 13.2 = B / +15°29′	. / . / +17° 15	. / . / +18° 54′	. / .
Wire, I.	h m s: 53.6	55.8	31.7	
II.	15.2	18.1	24 53.9	16.34
III.	37.3	19 40.5	16.2	16.22
IV.	16 59.4	02.5	.	16.20
V.	21.2	25.0	.	16.25
Sum,	186.7	151.9 / 60 / 201.9	.	.
Mean,	37.34	40.38	16.25	.
Bb,	93 +.82	95 +.84	97 +.86	3 42.80
Cc,	1.04 +.10	1.05 +.10	1.05 −.10	3 37.24
Aa,	47 +1.03	45 +.99	43 +.95	3 5.56 / +1.85 Sals.
Corr'd Transit,	39.29	42.31	17.96	24 / 185 / 168 / 170 / 168 / 1077
R. A.	4 12 56.48	4 15 59.49	4 21 35.19	.
Error of Timepiece,	+3 42.81	+3 42.82	+3 42.77	3 42.80 / 1.85 / .92 / 3 45.57

21258 / 1.05 / 106290 / 212580 / 2232090 / 2 / 44.64

93 / 88 / 744 / 744 / .8184

93 / 95 / 465 / 837 / .8835

31.7 / 44.64 / 76.34 / 53.9 / 22.32 / 16.22

a = +2.120

e = +.10 e.

47 / 22 / 94 / 94 / 1.034

45 / 22 / 90 / 90 / .99

43 / 22 / 86 / 86 / .946

3451 = 4 45

1327 =

31 / 00 / 6 / 35.05

3 42.81 / 42.82 / 42.77 / 0 / 3 42.80 Error of 3451

31.0 / 42.80 / 48.20 / 00 / +5 11.80 Error of 1327. / 5 11.26 / 54 / +.25 rate of 1327

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1878phae.proj.1790f

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan 18 1879. Instrument, Russ Jr. Observer, [illegible]
Timepiece, 3451 Recorder, [illegible]

Object,	δ Cass			ζ Piscium			40 Ceti					
Circle,										E		
	w		e	w		e	w		e	w		e
Level Direct,	26.9		12.3	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		16.4	.		.	.		.	.		.
Difference,												
b. = +.95	59°31'			14°43'			72°26'					
	h	m	12s 6	h	m	s	h	m	s	h	m	s
Wire, I.			26.6		28	1.3	II		6.1	V		37.4
II.		21	40 5			23.2			177.6			49.2
III.			54.7			45.3			295			1.5
IV.			22.7									
			36.7		29	7.4			41.2			13.2
V.			18.7			29.5		31	52.8		35	24.5
Sum,			429 2			10,206 7			147.2			125.8
Mean,		21	40.61			45.34			29.44			1.1 b
Bb,	1.88		+1.79	.92		+.91	2.87		+2.73			+2.73
Cc,	1.97		-.10	1.04		+1.95	3.32		.			.
Aa,	-.58		-1.39	+.48		+1.15	-1.65		.			.
Corr'd Transit,			40.91			47.85			.			.
R. A.	1	17	55.25	1	25	1.44	1	28	52.78			.
Error of Timepiece,		+ 3	45.66		+ 3	45.91			.			.

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1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 18 1879. Instrument, Russ Tr. Observer, F.H.?

Timepiece, 3451 Recorder, F.H.

Object,	♀ Reseir		○ Rischmin					
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	26.6	1 ~ .8	.	.	.	.
Reversed,	.	.	26.9	12.3	.	.	.	.
			53.5	25.1				
Sums,	.	.	25.1	.	.	.	.	.
Difference,			3|28.4					
b. +.95	50°4′		+.95	+8°33′				
	h m s		h m s		h m s		h m s	
Wire, I.	39.8		2.1		.		.	
II.	middle 50.3		23.7		.		.	
III.	40 1.7		42 45.2		.		.	
IV.	.		6.7		.		.	
V.	.		28.1		.		.	
	91.8		10 5 8					
Sum,	1 31.8		12 225.4		.		.	
Mean,	50.60		45.16		.		.	
Bb,	1.54	+1.47	.84	+.82	.		.	
Cc,	1.56	+.07	1.02	+.05	.		.	
Aa,	-.21	-.50	.56	1.35	.		.	
Corr'd Transit,		51.64		47.38	.		.	
R. A.	1 36	5.92	1 39	1.45	.		.	
Error of Timepiece,	+ 3	45.72	+ 3	45.93	.		.	

3 45.66
45.91
45.72
45.93
322
+3 45.80
42.80
300

3.00
45.80
17.20
30.20
+5 13.00

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1878phae.proj.17900

74

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 19 1879. Instrument, Mer. Cir Observer, W. A.R.

Timepiece, 1327 Recorder, H.D.

Object,	ζ Persei			ζ Persei								
Circle,	49° 26′			47° 24′								
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	1.17			1.09								
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	5	16	28.6	3	9	28.6			.			.
II.	5	41	31.8			31.8			.			.
III.	5	7.4	34.9			34.9			.			.
IV.	0	3	37.8			37.8			.			.
V.	3	6	41.0			41.0			.			.
Sum,	16	64	.			174 1			.			.
	12					.			.			.
	80	4										
Mean,			.			.			.			.
			5728			34.92						
Bb			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	3	15	43.46	3	34	20.97			.			.
Error of Timepiece,			.			.			.			.

1.17 94 468 1053 1.0998 101 -.09

109 94 436 981 1.02

5 13.82 b -.09 = 5 13.73

5 13.95 -.01 = 5 13.94

1.67

5 13.84

3451 =

1327 =

15 50 4.15 30 44.15 10 3451 1327 30.0

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1879phae.proj.1790f

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 20 1879. Instrument, Mer. Cir Observer, Mak
Timepiece, 1327 Recorder, W.

Object,	48 H Cephi	χ Ursæ	δ Ursæ.
Circle,	4.44	1.17	1.09

	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	77°18'							

	h m s	h m s	h m s	h m s
Wire, I.	3 8 8.7	51.8	29.5	.
II.	13 5 17.7	54.9	32.5	.
III.	23 0 26.8	57.9	35.6	.
IV.	31 8 37 2	1 0 .	38.6	.
V.	41.7	4.2	41.7	.
Sum,	204 2 .	269 8 120 . 289 8	177 9 .	.
Mean,	22.70	57.96	35.58	.
Bb,	.	.	.	.
Ce,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	3 5 5.07 ~~3 4 31.99~~	3 15 43.45	3 34 20.96	.
Error of Timepiece,	.	.	.	.

5 17.63 + 4.44
14.56 + 1.13
3.07 + 3.31

331 (307 | -93 ~
3973
970

.93
.91
.93
85.7
.846 3
16
1.01

5 14.51 + 1.17
5 14.62 + 1.09
113 26

5 14.56 + 1.13

93
117
651
9.43
93
1.08 81
107
.07

109
93
327
981

5 14.~~58~~44
5 14.62
106

5 14.53 Err 1327
13.84
.69
+.64 calc

1327 = 5 40 45.2
2451 = 20

55
67
.2 5
45.2
14.2
30.6
20
49.4

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan 22 1879. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,	ζ Aurigæ		β Tauri				
Circle,	,87		,54				
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	40°54'		28°30					
	h m s		h m s		h m s		h m s	
Wire, I.	4 59 13.7		57.1		.		.	
II.	16.5		53.6		.		.	
III.	19.0		55.9		.		.	
IV.	21.7		58.2		.		.	
V.	24.4		0.6		.		.	
Sum,	95.3		279.4		.		.	
Mean,	19.06		55.88		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	4 54 3.92		5 18 41.12		.		.	
Error of Timepiece,	.		.		.		.	

5 15.14 +.20 = 5 15.34

.93 5 14.76 +.51 = 5 15.27

.187

51

744

.8091

1.01

+.20

.93

.54

372

415

.502

.49

.51

61

+5 15.30 5 15.54

14.53

+.187

+.44 rate.

16 20 51 345

12.25 132

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1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 23 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, E.P.

Object,	~~β~~ Persei		ε Persei				
Circle,	1.09		.83				
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	47° 24′		39° 40′		39° 40′			
	h m s		h m s		h m s		h m s	
Wire, I.	39 30.6		56.4		.		.	
II.	33.6		59.0		.		.	
III.	36.6		1.8		.		.	
IV.	39.7		4.5		.		.	
V.	42.8		7.2		.		.	
Sum,	33 3		0 8 9		.		.	
Mean,	36.66		1.78		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	3 34 20.90		3 49 46.15		.		.	
Error of Timepiece,	.		.		.		.	

5 15.76 + 0 = 5 15.76

5 15.63 + 24 = 5 15.87

163

5 15.81 Error 1327

3

5 15.84 Err

15.54

+.30 rate

~~1327~~ 3451 = 4.35

1327 = 7.12

25

25.
15.85
09.15
4.35
5.20

109
93
327
981
.0137
93
83
279
744
.7719
101
.24

84
30
54
26
.80
.80
5 16.60

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 25 1878. Instrument, Mer. Ci Observer, mark.

Timepiece, 3 1327 Recorder, FW.

Object,	α Ceti			β Persei			48 Cephei				
Circle,		106			85			4.40			
	w		e	w		e	w		e	w	e
Level Direct,	.		.	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.	3° 37'			40° 30'			77° 18'				
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			11.0			31.0			5.8		.
									10.5		
II.			13.0			33.8			15.4		.
									19.9		
III.			15.0			36.6			24.5		.
									29.0		
IV.			17.1			39.3			38.6		.
V.			19.3			42.0			38.5		.
									43.3		
Sum,			25.4			327			204		.
Mean,			15.08			36.54			24.49		.
Bb,			.			.			.		.
Ce,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	2	55	58.68	3	0	19.56	3	4	64.66		.
Error of Timepiece,			.			.			.		.

5 20.83 + 4.44m
16.69 + .45
4 | 41.1 41.03 = m.
4 14 6
110
88
22
88
110
1.10
88
22

103
91
103
927
9373
94
16
1.10

5 16.40 + .06m
5 16.98 + .85m
138 91
5 16.69 + .45m

5 17.44
5 17.20
64
5 17.32 Error 1327
15.84
2 | 1.48
+ .74 rate of 1327

5 50

16.5 3405
35.1 1327
35.1 35.1
17.4 17.4
17.7 17.7
16.5 16.5
58.8
1.2

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1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 26 1879. Instrument, Mer. Cir. Observer, Mark

Timepiece, 3451 Recorder, WW

Object,	β Persei														
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.	5		32.6				.				.				.
II.			34.6				.				.				.
III.			37.3				.				.				.
IV.			40.0				.				.				.
V.			42.7				.				.				.
			36 6												
Sum,			.				.				.				.
Mean,			37.32				.				.				.
Bb,			.				.				.				.
Cc,			.				.				.				.
Aa,			.				.				.				.
Corr'd Transit,			.				.				.				.
R. A.	3	0	19.56				.				.				.
Error of Timepiece,			.				.				.				.

5 17.76 +.22 = 5 17.98
10
5 18.08
17.32
.76

15.0
18.1
56.9
58.3
1.4

58.3 Bus1
15.0 1227
4 32

1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 29 1879. Instrument, ... Observer, D.W.

Timepiece, ... Recorder, ...

Object,	50 Cass							
Circle,	W		E		E		E	
	w	e	w	e	w	e	w	e
Level Direct,	25.1	12.8	.	.	.	.	.	.
Reversed,	23.8	15.1	.	.	.	.	.	.
Sums,	53.9	27.9	.	.	.	.	.	.
	27.9							
Difference,	26.0	.						
b.	+.87							
	h m s		h m s		h m s		h m s	
Wire, I.	I 38.5		III .		V 2.5		V 10.3	
II.	49.5		5.0		13.5		22.0	
III.	0.5		16.5		25.0		33.7	
IV.	12.0		28.0		37.0		45.3	
V.	1 55 23.5		57 40.0		58 48.5		59 56.5	(2)
Sum,	1240		495		1265		1678	
	.		.		.		.	
Mean,	0.80		16.5		25.30		33.56	
Bb'	.		.		.		.	
Ce,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	.		.		.		.	
	~~+ 28 52.78~~		1 53 8 16					
Error of Timepiece,	.		.		.		.	

17. 3451 0.80 33.56 25.30
16.05 16.05 8.02
2 2.4 30.1 1527 16.85 17.51 7.28
16.50 28
16.67 .79
E 17.30 m.
16.67
2143
32/36 L13

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 29 187 . Instrument, Observer, FW

Timepiece, Recorder,

Object,	β Trianguli	ο esti				
Circle,	E					
	w / e	w / e	w / e	w / e	w / e	
Level Direct,	23.8 / 15.1	. / .	. / .	. / .	. / .	
Reversed,	. / .	. / .	. / .	. / .	. / .	
Sums,	. / 27.1	. .	. .	. .	. .	
Difference,	. / 36.0					
b.	34°25' / 44.6					
	+34°25' / 53.0					

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.	41	09	10.3			.			.			.
	II.			18.8			.			.			.
	III.			27.3			.			.			.
	IV.			36.2			.			.			.
	V.			44.3			.			.			.
				53.5			.			.			.
				1.5									
Sum,				10.3			.			.			.
				19.0									
Mean,		2	4m	27.3			.			.			.
				27.40									
Bb,		1.21		+1.05			.			.			.
Cc,		1.22		+.12			.			.			.
Aa,		.16		+.38			.			.			.
Corr'd Transit,				28.95			.			.			.
R. A.		2	2	21.76			.			.			.
Error of Timepiece,		+	4	07.19			.			.			.

a = +2.44 / .16 / 144 / 24 / .58

87 / 121 / 87 / 174 / 87 / 10527

24 30.1 / 4 7

4 07.2 / 58.8 / 4|8.4 / 2.1

17 / 7.2 / 9.8 / 30.1 / 20.3 / 18.8 / 1.5 / 2 / 3|1.7 / +.56

21.05 / 18.80 / 3.5|2.25|.65 / 21 6 / 150

21.05 / 18.80 / 2.25 / 2.25 / 100 / +.73

59.15 1327 / 46.5 3451 / 8.4 / 38.1 / 59.15 / +21.05

3 57.56

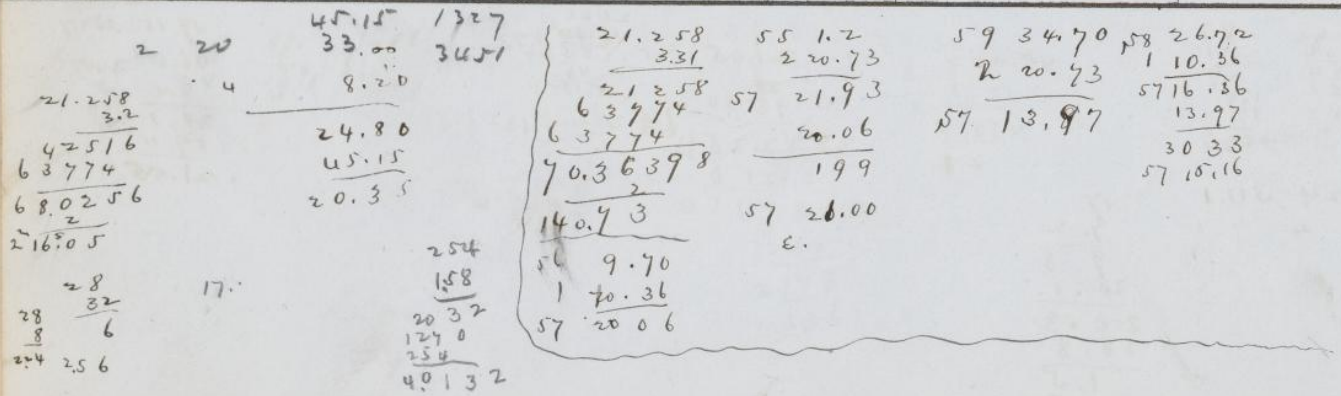
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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan 30 1879. Instrument, Rue Fr. Observer, A.C.
Timepiece, 3451 Recorder, F.W.

Object,	50 Camel			
Circle,	E	E	W	W
	w | e	w | e	w | e	w | e
Level Direct,	25.3 | 14.1	. | .	. | .	. | .
Reversed,	26.3 | 13.5	. | .	. | .	. | .
	51.6 | 27.6			
Sums,	3|24.0 | .	. | .	. | .	. | .
Difference,	+.80			
b.	71° 50'			
	h m s	h m s	h m s	h m s
Wire, I.	I .	II 47.2	IV 4.0	V .
II.	49.8	58.3	15.5	23.8
III.	55 1.3	9.5	26.6	34.5
IV.	12.5	21.0	38.0	45.8
V.	24.5	56 32.5	58 49.5	59 57.5
Sum,	6 3 6	16 8 5	13 3 6	10 4 1
	.	48.5	.	.
Mean,	55 1.2	9.70	26.72	34.70
Bb,	2.87 2.39	2.80 +2.24	.	.
Cc,	3.31 .	3.20 +.64	.	.
Aa,	-1.65 .	-1.58 -4.01	.	.
		17.49		
		16 3 6		
		57		
Corr'd Transit,	.	.	.	.
R. A.	1 28 52.12	1 53 8.10	.	.
Error of Timepiece,	.	+ 4 08.26	.	.



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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan 30 1879. Instrument, Rect. Tr. Observer, F.W.

Timepiece, 3451 Recorder, F.W.

Object,	γ Andr		α Arietis		β Trianguli						
Circle,	~~α Arietis~~										
	w		e		w		e		w		e
Level Direct,	.		.		.		.		26.3		13.5
Reversed,	.		.		22° 54′		.		.		.
Sums,	.		.		378.6		35 2		.		.
Difference,					60		50.6				
b.	41° 45′				3186		58 2		34° 24′		
					28.05		13 7				
	h	m	s		h	m	s		h	m	s
Wire, I.			.		28.9		21 3				3.0
II.			.				289				11.6
III.			36.6				35 7				~~28.3~~
IV.		1	5.1				44 2				28.9
V.		1	33.8				59.7				37.3
							7.3				460
Sum,			.				227				7546
Mean,		0	36.68				378.6				28.82
Bb,	1,34		+1.07		1,03		+.81		1,22		.97
Cc,	1.34		-.27		1.08		-.22		1.22		-.24
Aa,	+.02		+.05		.37		+.94		.16		+.41
Corr'd Transit,			7.53				10.49				29.96
R. A.	1	56	29.37		2	0	22.24		2	2	21.70
Error of Timepiece,	+	4	08.16		+	4	08.25		+	4	08.21

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Jan. 31 187 . Instrument, Russ Jr. Observer, FW.

Timepiece, 345 1 Recorder, FW.

Object,	ν Aurigae		ν Orionis		η Geminorum						
Circle,	E.		E		W						
	+37°12'										
	w	e	w	e	w	e			w	e	
Level Direct,	25.4	13.2	25.4	13.2	25.9	13.0			.	.	
Reversed,	.	.	25.9	13.0	.	.			.	.	
Sums,	39.7	37 7	51.3	26 2		51 8					
	15		26.2								
Difference,	1985	46.3	3 | 25			7.2			.	.	
	397		4,84'								
b. +.84	5955	55 2				146					
78		42	14047'		22°32'	30 0					
	h m	s	h m	s	h m	s			h m	s	
Wire, I.	4 7 6 2	13 2	4	6.3		37.7				.	
	120	21.7			41						
II.	15 | 596 2 | 39.74	30.7		28.2	492	45.2				.	
	45										
III.	146	39.7		50.3	11 | 4990	52.9				.	
	135				45.36						
IV.	112	48.7		12.2		60.7				.	
	105										
	70					16.2					
V.		6.6	5	34.4	45	23.5				.	
		15 4		131 4	12	39 2					
Sum,		24.4		120		379 0					
		32 8		25 | 1.4		120				.	
Mean,	56m	41.9		50.28		499.0				.	
		39.74				45.36					
Bb,	1.25	1.05	.92	+.78	102	+.86				.	
Ce,	1.26	+.25	1.04	+.21	1.08	+.23				.	
Aa,	1.2	+.31	48	1.22	.37	.85				.	
	5 51 31 05		6 0 42.22		6 7 36 97						
Corr'd Transit,		41 35		2.49		6.94				.	
R. A.	5 51 31 05		6 0 42.22		6 7 36.97						
Error of Timepiece,	+ 14	10.30	+ 4	10.27		09.97				.	

254
12
3048
88

6 37 33.8 3451
4 10.25
23.55
45
21.45
20.35
28 \| 11.1 0 \| .04

4 10.30
10.27
9.97
5 4
+4 10.18
8.21
28 \| 1,97 \| .07
196 +1.68 rate >345(

Error 3451

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb 1 1879. Instrument, Ross 7r Observer, AW.

Timepiece, 3457 Recorder, AW.

Object,	~~Vo~~ Tauri				Cpersei				C Persei						
Circle,	W				W				E						
	w		e		w		e		w		e		w		e
Level Direct,	27.0		13.1		.		.		26.8		13.2		.		.
Reversed,	.		.		.		.		27.0		13.1		.		.
Sums,	.		11.2		.		3.3		53.8		26.3		.		.
Difference,			18.7				13.2		26.8						
b. +.92	5°39'		25.5		47°24'		24.0		3[27].5 +.92						
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.			40.0		15.8		36.5				.				.
II.			54.4		58		44.5				.				.
III.			7.5		15		55.3				.				.
IV.		1m	43.8		290		5.8				.				.
V.			.		58		16.2				.				.
					57.6	5.77	27.1				.				.
					15		37.3				.				.
					75		47.3				.				.
					116										
					105										
					11										
Sum,			149.2				58.3				.				.
			120				8.3				.				.
			29.2				19.2				.				.
Mean,			5384		5m						5.77				.
Bb,	.80		+.73		1.47		4466				+1.36				.
							360								
Cc,	101		−.20		1.48		86.6				−.29				.
Aa,	.60		+1.52		−.13		5.77				−.33				.
Corr'd Transit,			5.89				.				6.51				.
R. A.	3	56	44.90	3	59	55.02			3	59	55.02				.
Error of Timepiece,	+	4	10.99				.		+	4	11.49				.

20 1327

4 10 9.3 3457

4 11.3

580

20

380

22.0

21.45

.55

5

+.60 rate of 1327.

22.0

.60

10

22.70

11.49

11.49

10.99

.97

+ 4 11.32 Error 3457

C = +.20

a = +25.4

6

152.4

254

13

762

254

330.2

148

2

296

1332

1361.6

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 2 1879. Instrument, Russ Jr. Observer, D.W.
Timepiece, 34 51 Recorder, D.W.

Object,	63 Aurigae		ζ Gemin					
Circle,	E		W					
Level Direct,	w 26 .8	e 14.1	w 27.2	e 13.8	w 27.2	e 13.8	w .	e .
Reversed,	.	.	13.8	.	26.8	14.1	.	.
			1 0					
Sums,	.	30 4	.	30 6	54 0	27 9	.	.
Difference,	.	39.4	.	45.1	27.9		.	.
b.	39° 31'	48 5	16° 46'	52 4	26.1			
				7 3	.87			
Wire, I.	h m 5 7 s 8	7.3	h m 14 s 6	22.2	h m s	.	h m s	.
II.		16.1		29.5		.		.
III.		25 3		36.8		.		.
IV.		34.3		51.5		.		.
V.		43.6		59.1	2.54	2.54		.
		53.0		13 7	13	46		
		2 2	16		76 2	15 24		
Sum,	45 94	11 3		36 2 8	2.54	10 16		.
	6 60	20.5		120	.330 2	11 68 4		
	5190	29.7		2428				
Mean,	8 m	39 0		22.07		.		.
		34.63						
Bb,	130	1.15	.94	.82		.		.
Cc,	130	.		.		.		.
Aa,		+.26	1.05	-.21		13.92		.
	.07	+.33	.46	+1.17		13.17		.
						09		
Corr'd Transit,		36 37		23 85		13.04		.
R. A.		.		.		.		.
	7 3	23.09	7 11	10 98				
Error of Timepiece,	+ 4	13.28	+ 4	12.87				

7 20 20 3327
10 3437
4 13.3
7 15 56.7
20
5 23.3

5 23.3
22.0
1.3 55
+1.10 rate 1327

+ 13.28
12.87
7 15
4 13.07
4 11.32
7 5

15
7 20 10
15.8
19 59.9
20
+5 23.80 Emf 1327

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb 3 1879. Instrument, Russ B. Observer, RW.

Timepiece, 3451 Recorder, DH.

Object,	α Aurigæ			β Aurigæ			ι Cassiop				
Circle,	W			W			66°51′ W			W	
	w		e	w		e	w		e	w	e
Level Direct,	26.3		12.5	.		.	.		.	.	.
Reversed,	26.0		13.0	.		.	.		.	.	.
Sums,	52.3		25.5	.		.	.		.	.	.
Difference,	26.8		.	.		.	.		.	.	.
b. +.89	+90										
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			48.3			42.7	I		16.3	II	10.0
II.			11.4			8.7			25.0		9.1
III.		4	34.5		6	34.6			33.8		27.7
IV.			57.6			60.4			43.0		36.7
V.			20.7			26.2		-1m	52.0	22	46.0
Sum,			172.5			172.6			170.1		139.5
Mean,			34.50			34.52			34.02		27.90
Bb,	102		+.92	1.21		1.09	2.31		22.02		21.90
Cc,	109		+.11	1.22		+.12	2.54		.		.
Aa,	37		+.92	.16		+.40	-1.05		.		.
Corr'd Transit,			36.45			36.13			.		.
R. A.	2	0	22.18	2	2	21.67	2	19	7.61		.
Error of Timepiece,	+	4	14.27	+	4	14.46			.		.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, February 3 1879. Instrument, Rues Jr. Observer, D.W.

Timepiece, 3451 Recorder, D.W.

Object,	ι Cassiopeiae.		τ Aurigæ								
Circle,	E		E +21°26'								
	w	e	w	e	w	e	w	e	w	e	
Level Direct,	26.0	13.0	.	.	.	.	.	.	.	.	
Reversed,	.	.	.	.	.	.	.	.	.	.	
Sums,	.	.	.	.	.	.	.	.	.	.	
Difference,											
b.											
	h m s		h m s		h m s		h m s		h m s		
Wire, I.	V 52.3		5 5.				.		.		
II.	1.0		10 15.4 middle				.		.		
III.	10.3		36 25.5				.		.		
IV.	19.8		.				.		.		
V.	25 28.7		.				.		.		
Sum,	11 2 1		46 4				.		.		
Mean,	52. 1		.				.		.		
	10 42		10 48								
Bb,	48.80		1.00		+.90		.		.		
Cc,	58.42		1.07		−.11		.		.		
Aa,	22.43		.39		+.97		.		.		
Corr'd Transit,	.		.		17 23		.		.		
R. A.	.		2 31 58.03				.		.		
Error of Timepiece,	.		+ 4 14.20				.		.		

3 .0 20.2 1327
11 3451
3 14.35
56.85
20.2
+5 23.55
25
+5 23.80

4 14.27
46
20
93
+4 14.31

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb 4 1879 Instrument, Russ 7in. Observer, GW

Timepiece, 3451 Recorder, GW

Object, Circle,	γ Androm E		α Aurig E		β Persei W		ζ Cass E	
	w	e	w	e	w	e	w	e
Level Direct,	25.4	13.2	.	.	.	.	.	.
Reversed,	25.8	13.2	.	.	.	.	.	.
Sums,	50.8	26.4	.	.	.	.	.	.
	264							
Difference,	24.4	.	.	.	.	.	.	.
b. +.81	.81							
	4.045							
	h m s		h m s		h m s		h m s	
Wire, I.	24.7		3 49.9		.		I 17.7	
II.	34.4		13.0		27.0		.	
III.	44.0		4 36.0		36.2		36.5	
IV.	53.5		59.1		6 44.3		46.5	
V.	2.7		22.0		.		21 54.0	
Sum,	159.3		180.0		107.5		108.2	
	219.3							
Mean,	43.86		36.00		35.83		36.07	
							24.07	
Bb,	1.34	1.08	+.22 1.02	+.82	1.21	.98	2.31	+1.87
Cc,	1.34	+.15	+.21 1.09	+.12	1.22	+.14	2.54	+.25
Aa,	+.02	+.05	+.37	+1.01	.16	.44	-1.05	.
Corr'd Transit,		45.14		37.95		7.39		.
R. A.	1 56	29.27	2 0	22.17	2 2	21.61	2 19	7.50
Error of Timepiece,	+ 4	15.87	+ 4	15.78	+ 4	15.74		.

2.31 1.21 1.34
.81 .81 .81
231 121 134
1848 968 1072
1.87 11 .98 0 1085 4

.87
.78
.74
239
+4 15,80
14.80
1.00

19 7.50
22.17
18 45.13

15,80
.75
.18
16.73

36.82
12
36.94
26.19
49.25
45.33
1.42 13.92 +2.73 @
284
1040
994
460

273 273
37 16
1911 1638
819 273
1.0101 .4368

w 24.65
24.07
21.58
2454 29.41

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb 4 1879. Instrument, Russ Jr. Observer, FH

Timepiece, 3451 Recorder, FH

Object,																			
Circle,																			
	w			e			w			e			w			e			
Level Direct,	.			.			25.8			13.2			.			.			
Reversed,	.			.			.			.			.			.			
Sums,	.			.			.			.			.			.			
Difference,																			
b.																			
	h	m	s				h	m	s				h	m	s				
Wire, I.	IV		0.5				V		54.5						.				
II.			9.5						3.5						34.7				
III.			18.5						12.5						42.3				
IV.			27.8						21.7						57.6				
V.	24		37.5				25		30.5				37m		5.5				
Sum,			93.8						172.7				.		.				
Mean,			18.76						17.54						.				
			24.76						24.54										
Bb,			.						.						.				
Cc,			.						.						.				
Aa,			.						.						.				
Corr'd Transit,			.						.						.				
R. A.			.						.						.				
Error of Timepiece,			.						.						.				

~~3449~~ 1327
2 40. ~~27~~ 3451
14.9
7
15.85
51.15
14.9
+5 23.75 Corr[n 13°]
23.55

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1878phae.proj.1790f

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb 6 8th 1879. Instrument, Russ Jr. Observer, F.W.

Timepiece, 3451 Recorder, F.W.

Object, Circle,	γ Leps. 2r			ε Cor. 2r			ν Draconis E				
	w		e	w		e	w		e	w	e
Level Direct,	.		.	27 .0		13 .2	26 .2		14 .4	.	.
Reversed,	.		.	26 .2		14 .4	.		.	.	.
Sums,	.		.	53 2		27 6	58°53′		358		
				27 .6		.	.		50 .0	.	.
Difference,				3 25 .6							
				.85			58.2		3 5	131 76	58.47
b. +85							3			65	
	16°3′			27°.14′			1749		17 3	170	
							583			104	
	h	m	s	h	m	s	7579h	m	s	h	m s
Wire, I.			27.8			39 .2			31 .3		61 57 .
II.			50 .2			.	76.		44 .5		90 .
III.			12 .5			55 .4			58 .3		85 85 .
IV.			34 .7			.			12 .0		94 245 .
V.			57 .2			57 11 .3			26 .5		340 680 .
									39 .8		765 704 5 .
									53 3		799
Sum,			182 4			105 9			5 20 .0		47 26 27 26
			120 .4			60 .9			20 .8		3 .78 156
			62			165			400		182 13.0
Mean,			12.48			55.30			360		104 1456
									760.1		12 2
									58 .47		
Bb,	.94		.80	1.09		.92	1.85		+1 55		.
Cc,	1.04		+.10	1.12		+.11	1.93		+.19		.
Aa,	.47		1.22	.30		+.78	.56		−1 46		.
Corr'd Transit,			14 40			56 .89			58 .75		.
R. A.	15	50	52.82	15	52	35.60	15	59	37.48		.
Error of Timepiece,	+ 4		21.58	+ 4		21.29	+ 4		21.27		.

assum a +2.60

21.58
21.29
21.27
114
+ 4 21.38
4 15.80
25 | 5.58 +22.3
50
58
50

24.57
13
24.80

47.15
44
25.15
22
21.42
00.58
25.15
24.57
23.75
25 | 1.88
+.352
rate
of 1.32?

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 8 1879. Instrument, Russ 2. Observer, AH

Timepiece, 3451 Recorder,

Object, Circle,	α Aurigæ E		β Tauri E		ε Aurigæ W		σ Orionis W.	
	w	e	w	e	w	e	w	e
Level Direct,	26.0	13.6	.	.	.	.	26.2	13.1
Reversed,	.	.	.	.	.	.	26.0	13.0
Sums,	.	18 3	.	6 0	.	58 4	52 2	.
		28.7		21.8			27 3	
Difference,		38 4		30 2		13.2	24.9	
							.83	
b. +.83	+45°53′	49 3	+28°30′	46 0	−1°17′	27 2	−2°40′	
				54 0				
	h m	s	h m	s	h m	s	h m	s
Wire, I.	98	59 7		2 3		41 3		20.4
	78	9.8	12 12 36 12.15	10.2	34	55.7		42.0
II.	78	19.7	22	18.4				
	1078		16					
III.	11 1050	29.3	11	34.0		.		37 3.3
	99							
	60			42 4				24.4
IV.	15	40.3				.		
	5			58.3				
V.	5 8	50 5	23	.		.		45.8
		1.0						
Sum,		345 0		323 6		195 8		135 9
		240		300		120		120
		105 0		23.6		135.8		15.9
Mean,		9.55		2.15		27.16		3.18
Bb,	1.40	+1.20	1.11	+.92	.72	+.60	.71	+.60
	1.44							
Cc,		+.14	1.13	+.11	1.00	−.10	1.00	−.10
Aa,	−.09	−.23	.27	+.70	.69	1.79	.70	+1.82
Corr'd Transit,		10.66		3.88		9.45		5.50
R. A.	5 7	47.83	5 18	40.95	5 30	6.49	5 32	42.30
Error of Timepiece,	+ 4	22.83	+ 4	22.93	+ 4	22.96	+ 4	23.20

5 42 20 18.4 23.0 55.4 20.0 +5 24.6 1327 3451 Err of 1327 4 22.83 .93 .96 1.20 39.2 22.98

26 2.6 27 15.2 5.2 .70.2 83 72 166 171 .976 26 1.82 1 44 83 2 3 2 2 3 2 83 1.19 5.2 83 83 .9213

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1878phae.proj.1790f

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 10 1879. Instrument, Observer, Ell

Timepiece, 3451 Recorder,

Object,	C Ursæ		γ Ursæ		δ Ursæ		ε Ursæ	
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	27.0	13.1	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	doubtful.							
Difference,	.	.	.	.	.	.	.	.
b.	47° 23′		15 20		17 15		18 54	
	h m s		h m s		h m s		h m s	
Wire, I.		0.7		36.7		39.4		14.8
II.		10.3		58.9		1.7		37.3
III.		20.7	17	21.3		24.2		59.7
IV.		31.3		43.0		46.2	26	22.3
V.	4	41.7		4.9	21	8.7		44.7
Sum,		104.7		164.8		120.2		178.8
				60				120
				104.8				298.8
				20				4
Mean,		20.94		20.96		24.04		59.76
Bb,	1.47	1.32	.92	.83	95	.85	.96	+.86
Ce,	1.48	−.16	1.04	−.11	1.05	−.11	1.05	+.11
Aa,	−13	−.29	48	1.08	45	1.02	44	.99
Corr'd Transit,		21.81		22.76		25.80		11.72
R. A.	3 59	54.82	4 12	56.21	4 15	59.21	4 21	34.91
Error of Timepiece,	+ 4	26.99	+ 4	26.55	+ 4	26.59	+ 4	26.81

5h 37m

25.1 13.27
28 3451 4 26.55
26.75 26.59
1.38 26.81
25.1 26.68
+5 23.88 263
23.8 +4 26.66
.06 22.98
23.8 26.68
.40 +1.84

26.76
.92
4 27.68

26.66
1.54
28.50
.98
29.48

223
13
669
223
2899
.29

223
2.67
1.05

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1878phae.proj.1790R

326 28

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 10 1879 Instrument, Observer,

Timepiece, Recorder,

Object,	α Tauri						W	
Circle,	E		E		E		10 Cumulus	
	w	e	w	e	w	e	w	e
Level Direct,	27.0	13.5	.	.	.	.	.	.
Reversed,	27.6	13.1	.	.	.	.	.	.
	54.0	26.6						
Sums,	26.6	.	.	.	.	.	.	.
Difference,	327.4							
b. +.91	.91							
	16°16'							
	h m s		h m s		h m s		h m s	
Wire, I.	41.0		I 7.5		II 23.5		I 29.3	
II.	2.7		30.0		46.5		36.7	
III.	25.3		37 53.5		40 8.5		47.4	
IV.	47.6		.		30.5		58.7	
V.	34 9.4		15.5		54.0		55 57.7	
			385					
Sum,	126.0		.		.		217.8	
Mean,	25.20		.		.		43.56	
Bb,	93	+.83	.		.		1.91	+1.72
Ce,	1.04	+.11	.		.		2.02	−.20
Aa,	.47	+1.05	.		.		.62	.
Corr'd Transit,		27.19	.		.		.	
R. A.	4 29	00.51	.		.		4 52	42.78
Error of Timepiece,	+ 4	26.68	.		.		.	

21.258
202
42516
425160
429416
85.88

W
43.56
1 25.88
69.44
8.94
2|50
2|1,25
+.12 c.c.

E
51.88
42.94
08.94

4 52 42.78
4 21 34.91
α−α 31 07.87

223
47
1481
94
94
10481

4508
0073

45.08
85.88
130.96
40.73
10.23
7.87
1.06 | 2.36 +2.23
212
240
212
280

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1879phae.proj.17006

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Febr 10 1879. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,															
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.	IV		37.4		X		20 2				.				.
II.			45.0				27.8				.				.
III.			51.7				.				.				.
IV.			57.8				34.8				.				.
V.			6.3			59	41.3				.				.
							49.3								
Sum,			199 4				176 4				.				.
			(40)												
			259.4												
Mean,			51 88				35.28				.				.
Bb,			.				.				.				.
Cc,			.				.				.				.
Aa,			.				.				.				.
Corr'd Transit,			.				.				.				.
R. A.			.				.				.				.
Error of Timepiece,			.				.				.				.

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 12 1879. Instrument, Pt. Observer, HH.

Timepiece, 34-7 Recorder,

Object, Circle,	ν Draconis E		δ Draconis E		ε Draconis E		gr. 848 E	
	w	e	w	e	w	e	w	e
Level Direct,	25.0	12.5	.	.	.	.	.	.
Reversed,	26.5	12.5	.	.	.	.	.	.
Sums,	51.5	25.0	.	.	.	.	.	.
Difference,	26.0	.						
b.	3 | 25.5							
	.85							
							75°43'	
	h m s		h m s		h m s		h m s	
Wire, I.		40.4		43.2		18.6	E	50.5
II.		2.6		5.7 (2)		41.0		4.5
III.		17 24.7		20 27.8		3.4		19.5
IV.		46.8		50.2		26 25.9		33.5
V.		8.7		12.1 (2)		48.5		34 47.5
Sum,		123.2		139.0		137.4		155.5
						120.		60.
Mean,		24.64		27.80		17.4		95.5
						3.48		19.10
Bb,	96	+.78	95	+.80	96	+.80		52.18
Ce,	1.04	+.18	105	+.18	105	+.18		11.28
Aa,	48	+1.13	45	1.06	44	1.04		
Corr'd Transit,		26.73		29.84		5.50		
R. A.	4 12	56.17	4 15	59.18	4 21	34.89	4 32	39.01
Error of Timepiece,	+ 4	30.56	+ 4	30.66	+ 4	30.61		

21.258 405 10 \| 6290 . 85 92 170

850320

86.09490

126.09

2 52.18

4 30.56 30.66 30.61 30.15 30.37 5 \| 2 35 4 30.47 4

30.56 30.66 30.61 ~~30.15~~ 30.37 ~~25~~ 4 \| 220 30.55 Emf 34 51 26.65 2 \| 3.90 +1.95

5 40

30.2 37 1327 3451

37. 30.65 6.35 30.15 +5 2380 Emf 34 51

55. 1.9 30.6 31.3 55.0 5 23.8

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1878phae.proj.1790

33° 20

75 42
42 23
33 19
3 26 40

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 12 1879. Instrument, Observer,

Timepiece, Recorder,

Object,											
Circle,	E				W						
	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		16.7	II		10.5	II		36.2			33.3
II.			30.5			24.5			50.5			54.3
III.			45.0			38.5			4.7			15.6
IV.			59.5			53.0			19.0			37.2
V.			14.0		39	7.5		40	34.5		49	58.4
Sum,			165.7			134.0			74.2			198.8
			60			6			14.2			20
			225.7			194.						78.
Mean,			45.14			38.80			4.73			15.76
									52.18			
Bb,	3.39		26.09			26.09			12.55			+.68
			11.23			12.71						
Cc,	4.05					12.63						-.17
						-.69						
Aa,	-2.22					11.94						+1.41
						2.88						
			14.82			14.82						
Corr'd Transit,			.22			.22						.68
			9.60			9.60						
R. A.			39.01			39.01				4	44	47.53
Error of Timepiece,			30.59			30.59				+	4	30.15

Rej. This.

12.55
12.71
126
12.63
11.25
21.38
405 1.69 +.17 C.E.
405
2850
2835

11.25
69
11.94
+2.88
14.82

α' − α
4 32 39.01
21 54.89
10 04.12

+'−+
37 14.82
26 04.46
11 10.36
04.12
266 6.24 +2.35 ②
532
920
798
1220

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb 12 1879. Instrument, RG. Observer, FW.
Timepiece, 3451 Recorder, "

Object,	π 5 orionis										
Circle,	W										
	w		e		w		e		w		e	
Level Direct,	26	.5	12	.5	.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.	-2° 15'											
	h	m	s		h	m	s		h	m	s	
Wire, I.			44.6				.				.	
II.			5.7				.				.	
III.			27.2				.				.	
IV.			48.4				.				.	
V.		53	9.6				.				.	
Sum,			135 .				.				.	
Mean,			27.10				.				.	
Bb,	.76		.66				.				.	
Cc,	1.50		-.17				.				.	
Aa,	.64		+1.50				.				.	
Corr'd Transit,			29.09				.				.	
R. A.	4	47	58.32				.				.	
Error of Timepiece,	+	4	30.37				.				.	

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 13 1879. Instrument, R.V. Observer, CU

Timepiece, 345 Recorder, CU.

Object,	α Geminorum			α Canis min			β Geminorum				
Circle,		E			E			E			
	w		e	w		e	w		e	w	e
Level Direct,	~~28.0~~		.	26.8		13.0	26.0		14.0	.	.
Reversed,	.		.	.		.	26.8		13.0	.	.
			28 8				52 8		27 0		
Sums,	.		65 3	.		.	27.0		.	.	.
Difference,			53 4				3|25.8				
b. +.86	+32°09'		10 7	+5°32'			86				
	+28°19'										
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			18.4			.			40.2		.
II.	11 29 75/27.05		27.2			9.7			4.3		.
III.	22 77 77/53		35.6			31.2			28.5		.
IV.	7	31	43.7	3+	37	52.6			52.6		.
V.			0 4								
			8 9			14.1	7	43	16.8		.
Sum,			32 25 6			935			142 4		.
			297.5								
Mean,			27.05			31.17			28.48		.
Bb,	1.16		+1.00	.80		+.69	1.10		.94		.
Cc,	1.18		-.20	1.01		-.17	1.13		+.19		.
Aa,	.22		+.52	.60		+1.41	.28		+.66		.
Corr'd Transit,			28.37			33.10			30.27		.
R. A.	7	26	55 47	7	33	00.49	7	37	57.56		.
Error of Timepiece,	+	4	32.90	+	4	32.61	+	4	32.71		.

c = +.17 e.s.
a = +2.35

32.90
61
71
3\|2.22
32.74 Error 345 1
30.55
27\|2.19 ±.081
216
30

32.74
.81
33.55

15.2 13.7
23.5 34.5 1
25.2
33.5

23.5
32.78
50.72
15.2
5 24.48
23.80
.68

24.48
27
24.75

1878phae.proj.1790

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 14 1879. Instrument, R 7. Observer, FLV.

Timepiece, 3451 Recorder,

Object, Circle,	α Ceti E		α Lyncis E		ι Tauri W		ε Eridani W	
	w	e	w	e	w	e	w	e
Level Direct,	26.3	14.4	.	.	27.7	13.6	.	.
Reversed,	.	.	.	.	26.3	14.4	.	.
Sums,	.	.	.	003 22.2	540 280	.	.	.
Difference,				324	326 1.87			
b. +.87	+3°36'		+49°25'	54.7	+12°31'		-9°52'	
	h m s		h m s		h m s		h m s	
Wire, I.		.		56		01.7		.
II.		27.4		16.2		23.8	21	25.3
III.		30.7		27.2		45.5	31	47.1
IV.		.		37.9		7.3		8.5
V.	3 0	37.7	21	59.9	29	29.2		30.2
Sum,		1.8		10.7	1675	1475		809
Mean,		30.60		299.8	2275	207.5		1409
				16.35		45.50		46.97
Bb,	.78	+.68	1.52	+1.32	.84	.99	.62	.54
Cc,	1.01	-.06	1.54	-.09	1.03	+.06	1.02	+.06
Aa,	.63	+1.71	-.19	-.52	.51	+1.39	.81	+2.20
Corr'd Transit,		32.93		17.06		47.92		9.77
R. A.	2 55	58.72	3 15	42.88	3 24	12.99	3 27	15.02
Error of Timepiece,	+4	34.21	+4	34.18	+4	34.93	+4	34.75

Assume C = +.10 e.s.

4 34.33
.36
.81
63
213
4 34.54

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 14 1879 Instrument, R I. Observer, AV.

Timepiece, 3451 Recorder, 3451

Object,	5 H Corvelop.										
Circle,	W		W		E						
Level Direct,	w	e	w	e	w	e			w	e	
Reversed,	.	.	.	.	27.2	14.9			.	.	
	.	.	.	.	.	.			.	.	
Sums,	65.05										
Difference,	.	.	.	.	.	.			.	.	
b.	70°58′										
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	I		43.0	II		47.8	V		3.6			.
II.			54.2			59.3			14.5			.
III.			4.3			10.3			25.3			.
IV.			15.2			20.5			36.2			.
V.		40	26.3		41	31.4		44	46.8			.
Sum,			143.0			169.3			126.4			.
			120			120						
			23.0			49.3						
Mean,			4.60			9.86			25.28			.
						1.05			10.10			
Bb,	2.70		10.10			14.91			15.18			.
			14.70			12.35			.			.
Cc,	3.06		.			1.19			.			.
Aa,	−1.47		.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	8 37		38.59			.			.			.
Error of Timepiece,			.			.			.			.

14.91
14.70
14.80 W.
15.18
−.38
30619
−.06 C.E.

14.80
2.35
.19
17.34
47.57
29.77
23.57
2.2816.20 1.2.72 @
456
1640
1368
1596
440

4.4

α − α
37 38.59
27 15.02
23.57

34.54
32.74
2780
.09
14
1.26
34.54
35.80

24
9
216
1
225
358
38.05

8 40

15.15 13.7
25 2451
34.6
50.4
15.15
24.75
48
.27
+.32

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1878phae.proj.1790R

33
05
.12

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 28 1879. Instrument, Mer. Cir. Observer, Wak.

Timepiece, 1327 Recorder, Fill.

Object,	Trigonis			α Serpentis			ζ Ser. Mer.				
Circle,	.04			.12			4.76				
	w		e	w		e	w		e	w	e
Level Direct,	.		.	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b. +.14	+2°08'			+6°48'			78°8+				
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			50.9			~~29.3~~			13 8 23.0		.
II.			53.0			31.5	533 479 7		32 8 42.7		.
III.			55.2			39 7 41 8			53 3- 5.3		.
IV.			57.2			44 0			13 0 23.0		.
V.		55	59.3			45 8 47 9			33.1		.
Sum,			256			192			2374 240 9 479 7		.
Mean,			55.12			43.84			53.08		.
Bb,			.			.			.		.
Cc,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	12	55	31.21	15	38	19.81	15	48	24.12		.
Error of Timepiece,			.			.			.		91/12 .03

23.91 +.04
24.03 +.12
794
23.97 +.08

.14
135
70
42
10
.1890

28.96 + 4.76
23.97 + .08
4.99 + 4.68

468 | 4.99 | ~1.07
468
3100

1.07
4
.0428

107
12
1284
.13

91
107
963
.97
.19
+1.16

23.91 − .13 +1.16 = 25.03
24.03 − .13 +1.16 = 25.06
+ 25.08

Smf 1327.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 16 1879. Instrument, Merci. Observer, Pak.

Timepiece, 1327 Recorder, F.W.

Object,	γ Orionis				δ Orionis						ε Serpentis.		
Circle,											.12		
	w		e		w		e		w		e	w	e
Level Direct,	.		.		.		.		.		.	.	.
Reversed,	.		.		.		.		.		.	.	.
Sums,	.		.		.		.		.		.	.	.
Difference,													
b.	+6°14'				-0°23'								
	h	m	s		h	m	s		h	m	s	h m	s
Wire, I.			0.4				11.2				.		36.8 0
II.			2.5				13.3				.		38 0
III.			4.5				15.4				.		40 0
IV.			6.6				17.4				.		42.1
V.		19	8.6				19.5				.		44.2 —
													46 3
													48.4
													50.3
													52.5
Sum,			22.6				96.8				.		397.8
													60.0
Mean,			4.52				15.36				.		9)337.8
													9)297.8
													44.20
Bb,			.				.				.		+1.03
Ce,			.				.				.		45.23
Aa,			.				.				.		.
Corr'd Transit,			.				.				.		.
R. A.	5	18	40.45		5	25	51.50				.	15 38	1983
Error of Timepiece,			.				.				.		+25.40

+24.07 +.11 24.07 − .12 = 23.95 + 1.16 = 25.11

+23.86 −.01 23.86 − .01 = 23.87 + 1.16 = 25.03

25.07 End 1327

h = -1.07

107

12

6 32 25

25.07

59.93

38.15

+4 38.22

18 20 10

25.15

44.5

23.7

39.2

38.2

1.0

2

+2.0 rate of 3451

3451 38.15

1327 6 32 25.

25.40

25.07

33

.03

237 3451

18 20 10 1327

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb 18 1879. Instrument, Observer,

Timepiece, Recorder,

Object,	α Aquilæ			ζ Ophiuchi								
Circle,	-.49			-.18								
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	-26° 10'			-10° 19'								
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			21.6			48.0			.			.
II.			23.8			50.2			.			.
III.			26.0			52.5			.			.
IV.			28.3			54.1			.			.
V.			30.8			56.5			.			.
						58.6						
						06						
						2.7						
						50						
Sum,			130.4			328.2			.			.
Mean,			26.08			54.70			.			.
Bb,			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	16	22	0.81	16	30	31.65			.			.
Error of Timepiece,			.			.			.			.

107 25.27 +1.62 = 26.89
25.42 +1.35 26.77
1.56
+ 26.83 Error 1.327.
25.40
2 | 1.43
.71

107
18
856
107
19
116
1.35

83
.77
27.60

11 34.51
18 4 55.12 1327.
26.7
28.5
11
42.5 Error 3451

26.83
33
27.16 +4

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1878phae.proj.17905

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 21 1879. Instrument, mu. Cri. Observer, W.A.R.

Timepiece, 1327 Recorder, F.W.

Object,	α Arietis			α Ceti							
Circle,	.42			.06							
	w		e	w		e	w		e	w	e
Level Direct,	.		.	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.	+22°53′			+3°37′			+88° 40′ 14″				
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			45.4			21.9			.			.
II.			47.7			24.0			.			.
III.			49.9			26.0			.			.
IV.			52.2			28.1			.			.
V.			54.4		56	30.0			.			.
Sum,			249 6			130 0			.			.
Mean,			49.92			26.00			.			.
Bb,			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	2	0	21.94	2	55	58.30	1	13	42.30			.
Error of Timepiece,			.			.			.			.

107 42 214 428 4494 107 6 642

27.98 − .45 + 1.16 = 28.69

27.70 − .06 + 1.16 = 28.60

28.65

26.83

58 | 11.8 2.03 hourly rate.

17 4

1 80

+ 58

26 16 10.

18 0

33.2 345.1 15 1327 29.1 459 33.2 47.3 42.5 3148 rate +1.6

Grw 345.1 + 4

1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 23.3 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, F.W.

Object,	Plaris				S Orionis				E Orionis			
Circle,		43.03				-01				-02		
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.	+88° 40' 13"				-023				-1°16'			
	h	m	s		h	m	s		h	m	s	
Wire, I.	4 55 9		14 3				16.4		355 5		31.5	
	456 5		19.0						1775			
			24 3									
II.			41.3				18.6				33.5	
III.			48.5 - 54 4				20.7				35.5	
IV.			11 .7 18 .0				22.8				37.6	
V.			25 4				24.7				39.6	
Sum,			25 69 180 9 | 63 69				10 3 2				4 9 4 177	
Mean,			48.54				20.64				35.54	
Bb,			.				.				.	
Ce,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.	1	13	40 97		5	25	51 34		5	30	6.25	
Error of Timepiece,			.				.				.	

67.57 + 43.03
29.29 - .02
48.28 + 43.01

4301 | 48.28 | -1.12 = 4.
43.01 | 91
5270 | 1008
4301 | 1.0192
9690 | 18
1.20

29.30 -.01
29.29 -.02

29.30 + 1.19 = 30.49
29.29 + 1.18 = 30.47
30.48

43.01 | 38.28 | -.90
3870

7 35 49.2 3451
30 1327
30.53
59.45
49.2
49.75
47.3
2 | 2.45
1.20

Error 3451 + 4

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Oct. 23.8 1879. Instrument, Observer,

Timepiece, 1327 Recorder,

Object,	β Scorpii	α Scorpii		α Ophiuchi
Circle,	35	.49		22
Level Direct,	w .		e .	w . e .
Reversed,	.		.	. .
Sums,	.		.	. .
Difference,				
b.	−19°29′			+12°39′
	h m		m s	h m s
Wire, I.	5		.	46.0
II.	5		.	48.1
III.	5		.	50.0
IV.	5		.	52.1
V.	5		.	54.2
Sum,	2		.	250.4
Mean,	5		.	50.08
Bb,			.	.
Ce,			.	.
Aa,			.	.
Corr'd Transit,			.	.
R. A.	15 58 2		.	17 29 19.90
Error of Timepiece,	.	.	.	.

γ Cass. L.C.
0 49 25
δ Cass. L.C.
1 17
η Urs. Maj.
13 42 46
η Bootis
13 48 55
Γ Virginis
13 55 27

112 / 35 / 560 / 336 / 3920

29.58 + 1.59 = 31.17
29.43 + 1.73 = 31.16

31.16
30.48
10 | .68
.068

112 / 49 / 908 / 448 / 5388 / 120

120 / 39 / 1.59

112 / 72 / 24 / 336 / 25 / 120 / 95

30.18 + .95 = 31.13

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Apl. 23.8 1879. Instrument, Observer,

Timepiece, 1327 Recorder,

Object,	β Scorpii		α Scorpii				α Ophiuchi	
Circle,	35		.49				22	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	-19°29'		-26°10'				+12°39'	
	h m s		h m s		h m s		h m s	
Wire, I.		50.4		25.8		.		46.0
II.		53.2		28.0		.		48.1
III.		55.3		30.4		.		50.0
IV.		57.5		32.9		.		52.1
V.		59.8		35.0		.		54.2
Sum,		26.7		21 .		.		250.4
Mean,		55.34		30.42		.		50.08
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	15 58	25.76	16 22	00.99			17 29	19.90
Error of Timepiece,		.		.		.		.

112 / 35 / 560 / 336 / 3920

29.58 + 1.59 = 31.17

29.43 + 1.73 = 31.16

31.16 / 30.48 / 10[1.68] / .068

112 / 49 / 908 / 448 / 5388 / 120

120 / 39 / 1.59

112/72 / 224 / 224 / 25 / 120 / .95

30.18 + .95 = 31.13

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 24.3 1879. Instrument, Merc. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, F.W.

Object,	α Columbae		κ Orionis		α Orionis		ε Orionis.	
Circle,	-.68				13		02	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	-34°8′		-9°43′		+7°23′		-1°17′	
	h m s		h m s		h m s		h m s	
Wire, I.		42.6		.		5.8	30	32.5
II.		45.0		.		8.0		34.5
III.		47.6		.		10.0		36.7
IV.		49.9		.		11.9		38.7
V.		52.4		.		14.0		40.8
Sum,		237.5		.		49.7		183.2
Mean,		47.50		.		9.94		36.64
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	5	35 17.68		.	5	48 39.28	5	30 6.23
Error of Timepiece,		.		.		.		.

112 / 68 / 896 / 672 / 7616 / 112 / 1.88 / 8 / 96

112 / 13 / 336 / 112 / 1456 / 120 / 15 / 1.05

29.82 + 1.96 = 31.78
30.66 + 1.05 = 31.71
30.41 + 1.18 = 31.59
208
+ 31.69 Error of 1327.
31.16
131.53 1.04
52

52.1
1.6
53.9

7 40

0.5 3451
40.15 1327
31.75
8.40
0.5
52.1
47.3
3 | 4.8
1.6

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 24 1879. Instrument, Mer. Cir Observer, W. A. R.

Timepiece, 1327 Recorder, F. W.

Object,	δ Virginis		ε Virginis					
Circle,	.07		.21					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+4°3′		+11°37′					
	h m s		h m s		h m s		h m s	
Wire, I.		59.9		38.8		.		.
II.		2.0		40.6		.		.
III.		3.9		42.9		.		.
IV.		6.1		44.9		.		.
V.		8.2		46.9		.		.
Sum,		80 1 / 20.1		214 1		.		.
Mean,		4.02		42.82		.		.
Bb,		.		.		.		.
Ce,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	12 49 32.94 ~~12 50 24.28~~		12 56 11.62			.		.
Error of Timepiece,		.		.		.		.

1.12 / .07 / 784 — 1.12 / 21 / 112 / 224 / 23.52

32.08 + 1.12 = 32.20

31.20 + .96 = 32.16

32.18 / 31.69 / 8 | .49 / .06

~~38~~ 23 / 12 45 / 20 / 6 / 1.20 — 32.18 / 1.22 / 33.40

8 24 / 5 / 1.20 / 32.18 / 33.38 / 30 / 33.68

1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 26 1879. Instrument, ... Observer, WAR.

Timepiece, 1327 Recorder, ...

Object,	ε Orionis		α Orionis.		δ Orionis		γ Orionis	
Circle,	-.02		.13					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.					-.23'			
	h m s		h m s		h m s		h m s	
Wire, I.		34.4		7.3		3.		30.9
II.		36.4		9.3		.		33.0
III.		38.4		11.3		.		31.0
IV.		40.6		13.4		.		37.0
V.	30	42.5	69	15.5		.	42	39.1
Sum,		1923		568		.		250
		.		.		.		.
Mean,		38.46		11.36		.		5.00
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	5 30	6.23	5 48	39.23	5 25	51.33	5 42	2.80
Error of Timepiece,		.		.		.		.

1
1.20
1
.91
.16
1.07

32.23 +1.22 = 33.45
32.13 +1.22 =
32.20 +1.22 = 33.42

33.44
32.18

47 | 136 (2.89)
123
130

1.034
13
102
34
68

.034
24
136
68
.816

7 40

22.7 47.7
00. 25.
33.5 33.5
51.5
26.5
22.7

4 | 56.2
52.1
2 | 4.1
2.05

4 56.2
.92
57.12

1.00
8
.92

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1878phae.proj.1790

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb 24 1879 Instrument, Mer. Cir. Observer, Wak

Timepiece, 1327 Recorder, DP

Object,	α Aquilae						
Circle,	+ 15						
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+8°33′							
	h m s		h m s		h m s		h m s	
Wire, I.		22.0		.		.		.
II.		24.1		.		.		.
III.		26.2		.		.		.
IV.		28.1		.		.		.
V.		30.4		.		.		.
		130 8						
Sum,		.		.		.		.
Mean,		26.16		.		.		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	19 44	53,16		.		.		.
Error of Timepiece,		.		.		.		.

112 / 15 / 566 / 112 / 17 / 129 / 107 / 15 / 92 — 91 / 16 / 107

33.00 + 1.03 = 34.0

33.90

34.0 / 33.44 / 14.56 / 56 — 14 / 4 / 96

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 27 1879 Instrument, Merci. Observer, W.A.R.

Timepiece, 1327 Recorder, F.W.

Object,	α Ursæ Min		δ Orionis		ε Orionis.		44 Camelop. Ursæ min	
Circle,			-.011		-.02			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	48.0 9 4374 150
Difference,							97°46' 82°14'	
b.	+88°40' 12"		-0°23'		-1°17'		+60°45'	

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.	23 9 w 8		46.7 53.1			20.6			35.3		46.9 2.3 17.5 33.5 48.6 2.9 18.5 33 4 48.0 251 6 130 9 43.1 47.95	58	57.3 57.6 0.7 1.8 24.5 32.3
	II.			57.1 17.5			22.5			37.5			
	III.			23.2 28.5			24.5			39.5			
	IV.			50.0 57.1			26.6			41.6			
	V.			0.7			28.6			43.6			
Sum,				33.39 9 213.9			22.8 24.56			197.5			
Mean,				23.77	5		51.32			39.50			
Bb,				.			.			.			.
Ce,				.			.			.			.
Aa,				.			.			.			.
Corr'd Transit,				.			.			.			.
R. A.		1	13	39.36	5	25	51.33	5	30	6.23	4	58	22.0
13 39 10 47													
Error of Timepiece,				.			.			.			.

91 16 108 135 14

~~44.41 + 43.03~~

25.95 - 7.34

33.25 - 0.01

-7.30 ∓ 7.33

x = -1.00

3323 - .01

33.27 -.02

33.23 + 1.09 = 34.32

33.27 + 1.10 = 34.37

69

34.35

100 04 35 72 12 .84

34.35 20 .45

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Feb. 28. 4 1879. Instrument, Mer. Cir. Observer, W. W.

Timepiece, 1327 Recorder, Fb.

Object,	β Canis Min				α Canis Min										
Circle,			+.15				.10								
	w		e		w		e		w		e		w		e
Level Direct,	.		.		.		.		.		.		.		.
Reversed,	.		.		.		.		.		.		.		.
Sums,	.		.		.		.		.		.		.		.
Difference,															
b.	+8°32'				+5°32'										
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.			7·3				30.1				.				.
II.			9·3				32·0				.				.
III.			11·6				34·4				.				.
IV.			13·5				36·3				.				.
V.			15·5				38·3				.				.
Sum,			57.2				211				.				.
Mean,			11·44				34·22				.				.
Bb,			.				.				.				.
Cc,			.				.				.				.
Aa,			.				.				.				.
Corr'd Transit,			.				.				.				.
R. A.	7	20	37.70		7	33	0 37				.				.
Error of Timepiece,			.				.				.				.

.15
108
.93

33.74 + .73 = 34.67
33.85 + .98 = 34.83
150
34.75

35.20

75
35
40

18 45

56.2 3451
30. 1327
35.0
55
56.2
+5 01.2

1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 23 1879. Instrument, Merz Cir. Observer, W. A. K.

Timepiece, 13217 Recorder, F. W.

Object,	γ Camelop.			β Eridani			β Orionis					
Circle,	2.26			−.09			−.15					
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b. 4.14	+66°8′		206	−5°15			−8°21′					
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			30.7			25.9			15.2			.
II.			36.1			28.0			17.3			.
III.			41.0			30.0			19.4			.
IV.			45.9			32.1			21.4			.
V.			51.1			34.2			23.5			.
			56 3									
			15			00 2			96 8			
Sum,			309 1			.			.			.
			60									
			369 1									
Mean,			.			30.04			19.36			.
			41 01									
Bb,			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	4	42	4.13	5	1	55.58	5	8	44.92			.
Error of Timepiece,			.			.			.			.

.91
.14
+1.05

36.88 + 2.26 =
34.45 − .12 =
2.43 + 2.38 =

34.46 − .09 =
34.44 − .15 =
34.45 − .12 =

34.46 + 1.14 = 35.60
34.44 + 1.30 = 35.74
+35.62
34.75
+.87
2)92
.46

233 | 243 | −7.02 = 2.

2.38
500

8 35

58.2 34.51
30 1327
35.67
54.33
58.2
3.87
1.2
2.67
13
2)80
1.40 rate 3451

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 29 1879. Instrument, Mer. Cir. Observer, W.A.P.

Timepiece, 1327 Recorder, W.W.

Object,	ε Virginis		ζ Virginis.					
Circle,	.20		-.19					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+11°37′		-10°32′					
	h m s		h m s		h m s		h m s	
Wire, I.		42.1		22.0		.		.
II.		44.3		24.0		.		.
III.		46.6		26.1		.		.
IV.		48.6		28.2		.		.
V.		50.7		30.2		.		.
Sum,		232.3		130.5		.		.
Mean,		46.46		26.10		.		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.		.		.		.		.
Error of Timepiece,	12 56	11.75	13 18	51.65		.		.

.85 3471 +.85 = 35.56

34.55 +1.24 = 35.79

135

35.68

35.62

106

19 20 54 3451

25.2 1327

35.7

49.5

54.0

5 04.5

3.87

11 1.68

.057

(24

228

114

1.068

1.37 value of 45′

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 3. 1879 Instrument, Mer. Cir Observer, W. A. R.

Timepiece, 1327 Recorder, D.W.

Object,	ε Ursæ Min.		γ Orionis		δ Orionis			
Circle,	S.P 82° 14′ −7.34		+11		−.01			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.			+6° 14′		−0° 23′			
	h m s		h m s		h m s		h m s	
Wire, I.	49 3 5.4		10.9		26 21.7			.
II.	19.9		13.0		23.8			.
III.	33.9 49.9−		15.0		25.9			.
IV.	4.6 20.3		17.1		28.0			.
V.	35.9 50.8		19.0		30.0			.
Sum,	270 0 180 450.0		250 .		1294 .			.
Mean,	50.00		15.00		25.88			.
Bb,	.		.		.			.
Ce,	.		.		.			.
Aa,	.		.		.			.
Corr'd Transit,	.		.		.			.
R. A.	4 58 22.56		5 18 40.20		5 25 51.25			.
Error of Timepiece,	.		.		.			.

+1.04 +.01 1.05

27.44 −7.34m
34.72 +.05m
−7.28 −7.39m

739 / 17280 [−.99m
6651
6290

34.80 +.11m
34.63 −.01m
143
34.72 +.05m

34.80 +.93 = 35.73
34.63 + 1.05 = 35.68
141
35.70

7h 0m

50.15 34.51
20 13.27
35.7
44.3
50.15
+5 05.85 Error 34.51

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mch 3 1879. Instrument, Mu Cii Observer, WAR.

Timepiece, 1327 Recorder, HH

Object,	L Scorpii		ζ ~~Scorpii~~ Opiuchi				
Circle,	-.149		.18				
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	-26° 16'		-10° 19'					
	h m s		h m s		h m s		h m s	
Wire, I.	31.01.8		1.8		.		.	
II.	33.43.8		3.8		.		.	
III.	35.56.0		6.0		.		.	
IV.	37.88.0		8.0		.		.	
V.	40.10.1		10.1		.		.	
Sum,	177.9		29.7		.		.	
Mean,	35.56		5.94		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	16 22 04.39		16 30 31.47		.		.	
Error of Timepiece,	.		.		.		.	

104 34.17 + 1.53 = 35.70
49
53 34.47 + 1.22 = 35.69
35.70

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 4-5 1879. Instrument, Mu. Ci Observer, W. A. K.

Timepiece, 13 7 Recorder, P. W.

Object,	3 Serpentis														
Circle,	-.05														
	w		e		w		e		w		e		w		e
Level Direct,	.		.		.		.		.		.		.		.
Reversed,	.		.		.		.		.		.		.		.
Sums,	.		.		.		.		.		.		.		.
Difference,															
b.	-2°56'														
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.	358 9 3492		30.5				.				.				.
II.			32.5				.				.				.
III.			34 7 36.8				.				.				.
IV.			38 8- 40.9				.				.				.
V.			43 0 41.0 47 0				.				.				.
		9	349												
Sum,			38.80				.				.				.
Mean,			.				.				.				.
Bb,			.				.				.				.
Cc,			.				.				.				.
Aa,			.				.				.				.
Corr'd Transit,			.				.				.				.
R. A.	18 15		3.97				.				.				.
Error of Timepiece,			.				.				.				.

34.83 + 1.10 = 35.93

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1879phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 5 1879. Instrument, Merci Observer, W. A. R.

Timepiece, 1327 Recorder,

Object,	α Ceti			ε Ursæ							
Circle,				−.18							
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	+3°37′			−9°52′								
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			.			45.3		37	58.6			.
II.			.			47.3			0.7			.
III.			.			49.5			2.9			.
IV.			.			51.6			5.0			.
V.			.			53.7			7.0			.
Sum,			.			247.4			.			.
Mean,			.			49.58			.			.
Bb,			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	2	55	58.13	3	27	14.70			.			.
Error of Timepiece,			.			.			.			.

105
18
1.25

34.88 + 1.23 = 36.11

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1878phae.proj.1790

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 7 1879. Instrument, ____ Observer, ____

Timepiece, ____ Recorder, ____

Object,	δ Virginis			ε Virginis			Polaris				
Circle,	.07			.21			43.03				
	w		e	w		e	w		e	w	e
Level Direct,	.		.	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.	+4°03′			+11°37′							
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			4.1			42.9	26.6		53.5		.
							9		57.0		
							239 4		~~38.1~~ 36		
II.			6.3			44.9			22.5		.
									26.6		
III.			8.1			47.0			32.5		.
									48 C		
IV.			10.1			49.0			53.7		.
									0.3		
V.			12.3			51.2			29.93		.
			40 9			235 0			60		
Sum,			.			.			9 | 238.3		.
Mean,			8.18			47.00			26.48		.
Bb,			.			.			.		.
Ce,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	12	49	33.72	12	56	11.80	13	13	35.83	36.13	.
										35.53	
										60	
										.30	
Error of Timepiece,			.			.			.		.

105
4
84

35.08 + .98 = 36.04

35.20 + 1.84 = 36.04

36.04 Err of 1327.

35,12 + .14

− 9.35 − 43.03 n

35,12 + .14 n

− 44.47 − 43.17 n

43.17 | 44.47 | 1.03 = n

43 17

1 3000

12951

March b. ||

3451 =

1327 = 9 18

13.3
5.85
7.45
3.7
3 | 7.10
2.37
rate of 3.7

57.2
20
36.1
43.9
57.2
+5 13.3

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 7 1879. Instrument, Mer. Cir. Observer, ~~H.A.R.~~ H. W.

Timepiece, 1327 Recorder, D.W.

Object,	~~δ Orionis~~ ε Orionis			κ Orionis			α Orionis.				
Circle,	-.02			-.17			+.13				
	w		e	w		e	w		e	w	e
Level Direct,	.		.	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.	-1°17'			-9°43'			+7°23'				
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			37.0			33.5			10.1		.
II.			39.0			35.6			12.3		.
III.			41.1			37.6			14.4		.
IV.			43.2			39.7			16.6		.
V.			45.2			41.8			18.5		.
Sum,			205 5			38 2			21 9		.
			.			.			.		.
Mean,			41.10			37.64			14.38		.
Bb,			.			.			.		.
Cc,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	5	30	6.10	5	42	2.66	5	48	39.10		.
Error of Timepiece,			.			.			.		.

1.08

35.00 + 1.10 = 36.10
34.98 + 1.25 = 36.23
35.28 + .95 = 36.23
5 6
36.19 Error, 1327

8 30 4.2 3657
25.0 1327
36.2
29 48 8
4.2
+5 15.4
13.3
2.1
1
+2.2 value of 3657

1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 8. 6 1879. Instrument, Mer. Cir. Observer, Wak.

Timepiece, 1327 Recorder, AH

Object,	δ Virginis			δ virginis			Polaris						
Circle,	~~43.03~~ 0.07			.21			43.03						
	w		e	w		e	w		e	w		e	
Level Direct,	.		.	.		.	.		.	.		.	
Reversed,	.		.	.		.	.		.	.		.	
Sums,	.		.	.		.	.		.	7 30.2	8	3.0	
										3.0		58.7	
Difference,										8 28.7			
										58.7	9	57.2	
b.	+14°03'			11°36'			88°40'10"			9 25.0	10	58.0	
										10 0.4	11	56.3	
										28.8	12	58.6	
										58.0	13	58.8	
	h	m	s	h	m	s	h	m	s	25.95	14	56.8	
Wire, I.			4.1			43.4			52.8	56.2	15	55.5	
II.			6.3			45.4			8.6	12 33.3	16	56.5	
									3.9	58.6	17	56.5	
III.			8.4			47.5			17 3	13 25.7		.	
							12		25.8	58.8			
IV.			10.5			49.5			32.6	14 25.7			
									54 0	53.3		.	
V.			12.5			51.4			58.9	15 26.4			
									3.4	55.4			
Sum,			41 8			236 9			9 257 6	16 25.1		.	
			.			.			28.63	56.5			
Mean,			8.36			47.38			.	17 26.0		.	
										56.1			
Bb,			.			.			.			.	
Ce,			.			.			.			.	
Aa,			.			.			.			.	
Corr'd Transit,			.			.			.			.	
R. A.	12 49		33.14	12 56		11.83	1 13		34.18			.	
Error of Timepiece,			.			.			.			.	

-5.55 − 43.03 =
35.38 + .14 =
− 40.95 = 43.17 ~

35.22 + .07 ~
35.55 + .21 ~
77
35.38 + .14 ~

35.22 + .98 = 36.20
35.58 + +.84 = 36.39
59
+ 36.30

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1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March. 9. 1879. Instrument, Mer. Circle Observer, W. A. R.

Timepiece, 132 P Recorder, D. W.

Object,												
Circle,												
	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,			.									.

Lyncis Mer. — Bλ Lyncis Mer. — E Orionis

.15 — −.03

+8° 3′ 32 — −1° 17′

8.8 — 37.0

10.8 — 39.1

12.9 — 41.2

14.9 — 43.3

17.1 — 45.3

64.5 — 205.9

12.90 — 41.18

7 20 37.57 — 5 30 6.06

1.05

35.33 +.90 = 36.23

35.13 +1.02 = 36.14

37

36.19

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 10. & Aristis 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, F. W.

Object,	α Aristis		κ Cetæ γ' Eridani		Polaris.		κ Cetæ	
Circle,	.42		.05 −.25		43.03		.05	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b. +.14	+2°54′		−13°51′ +0°44					
	h m s		h m s		h m s		h m s	
Wire, I.	0 52.9		54.7		13.0			58.8
II.	53		56.8		20.5			1.0
III.	57.4		59.0		25.0			3.1
IV.	59.6		1.1		41.2			5.2
V.	2.0		3.2		14 45.4			
					51.5			
					10.9			
					16.5			
					15 23.5		37	7.3
Sum,	39.2		44.9		247.5			
					160			
					9[40]7.5			
Mean,	57.44		58.98		45.28			
Bb,	.		.		.			
Cc,	.		.		.			
Aa,	.		.		.			
Corr'd Transit,	.		.		.			
R. A.	.		3 52 24.00		.			
	2 0 21.74		2 37 2.61		1 13 33.53			
Error of Timepiece,	.		34.98		.			

.87 135
9. 14
87 540
.783 135
.791 18
.80
.19
.99

7175 + 43.03 n
35.34 + .08 n
36.41 + 42.95

+42.95 | 36.41 | −.87 = n.
33360
30500
3 5
30065

35.70 + .42 n
36.38 +.05
34.98 − .25 n
68 17
35.34 +.08

42
84
294
336
.3654
00
.14

.22

35.70 + .64 = 36.34
34.98 + 1.22 = 36.20
54
36.27

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 10 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, D. W.

Object,	15 Monocerotis		β Canis Min.		α Canis Min			
Circle,			.15		.10			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+10°0′		+8°32′		+5°32′			
	h m s		h m s		h m s		h m s	
Wire, I.	.		8.7		31.3		.	
II.	.		10.8		33.4		.	
III.	.		12.8		35.5		.	
IV.	.		14.9		37.6		.	
V.	.		17.1		39.7		.	
Sum,	.		14 3 .		27 5 .		.	
Mean,	.		12.86		35.50		.	
Bb,	.		.		.		.	
Ce,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	.		7 20 37.58		7 33 0.25		.	
Error of Timepiece,	.		.		.		.	

15 / 9 / .135 .12

35.28 + 100 + 12 = 36.14

35.25 + 100 − 08 = 36.17

36.16

Assum w = 90

8 35 56.5 3451 31.5

10.2 1327 45.2

36.12

34.0

56.5

+5 22.5 Emf 3451

1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 11 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, F. W.

Object,	Polaris		E Canis		Majoris		E Canis Maj.	
Circle,			-.55		-.49		-.55	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.			-28°48'		-26°12'		-29°48'	

		h m s	h m s	h m s	h m s
Wire,	I.	.	19.3 0 .57	4 0.5	24.0
	II.	.	21.7 2 .8	2.8	26.5
	III.	.	24.0 5 .0	5.0	28.9
	IV.	.	26.5 7 .4	7.4	31.2
	V.	.	28.9 9 .6	9.6	33.5
Sum,		.	20 4 .	25 3 .	144 1 .
Mean,		.	24.08	5.06	28.82
Bb,		.	.	.	.
Ce,		.	.	.	.
Aa,		.	.	.	.
Corr'd Transit,		.	.	.	.
R. A.		1 13 33.19	6 53 53.99	7 3 30.10	6 53 53.99
Error of Timepiece,		.	.	.	.

53 55
90 9
45 3 49 5
.4770 .49
.48 9
99 441
51 99 55
99 44
48 143
1.47

09
34.96 + .51 + 1.43 = 36.39
34.83 + .52 + 1.47 = 36.30
69
36.35

3451 =
1327. 9 36
3.8 53.8
15.0 45.0
36.4
386
3.8
+5 25.2

1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 11. 1879. Instrument, Merc Cir. Observer, WAR

Timepiece, 1327 Recorder, WW.

Object,	ζ Ophiuchi			α Ophiuchi			ε Ursæ min					
Circle,	−.18			+72			733					
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	−10°.9			+12°39′			+82°14′					
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			3.1			52.59.4	16	58	6.5			.
II.			5.2			54.4 1.5	69.4		21.4			.
III.			7.2			56.4 3.6			37.4			.
IV.			9.4			58.5 5.7		59	51.4 7.6			.
V.			11.5			0.6 7.9			23.4 38.0 53.6 7.9			.
Sum,			36.4			32.1			247.2 180 967.2			.
Mean,			7.28			56.42			7.47			.
Bb,			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	16	30	31.71	17	29	20.40	16	58	23.98			.
Error of Timepiece,			.			.			.			.

35.57 + 1.15 = 36.72
36.02 + .80 = 36.82
36.77

35.57 − .18 =
36.02 + .22 =
35.80 + .02 =

43.49 + 7.33 =
35.80 + .02 =
7.69 + 7.31 =

731 | 7.69 | −1.05 =

731
3800

35.57 + 1.33 = 36.90
36.62 + .92 = 36.94
36.92.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 12 1879. Instrument, Merc. Observer, W.A.R.

Timepiece, 1327 Recorder, F.W.

Object,	δ Orionis			ε Orionis			Polaris					
Circle,	−.01			+.13			+43.10					
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	−0° 23′			+7° 23′			+88° 40′ 10″					
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			22.8			11.0			19.5			.
									24.7			
II.			24.9			13.0			31.4	44066		.
III.			27.0			15.0		14	48.8	40.917		.
IV.			29.1			17.1			55.9	~~3.149~~		
									1.0	.05 for each m		
V.			31.1			19.2			19.5	6 3.149		.
									24.9	.52 = 1″		
									29.8			
Sum,			349			253			25555	4 2.08		.
			.			.			9 495.5	10 2.18		
Mean,			26.98			15.06			55.06	40.92		.
										43.10		
Bb,			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	5	25	51.06	5	48	39.01	1	13	32.89			.
Error of Timepiece,			.			.			.			.

107 91 107 963 .97 .18 1.15

107 13 321 107 14

82.17 + 43.10 =
35.98 + .06 =
46.19 + 43.04

43.04 | 46.19 | 7.07 =
43.04
4 | 3.1500

35.9 = −.01 =
36.05 + .13 =
11.97
35.98 #6 =
35.9 + .01 + 1.15 = 37.08
36.05 ∓ .14 + 1.15 = 37.06
37.07

9 7

42.8 365.1
52 1327
37.13
14.87
42.8
+5 27.93
25.20
2.73

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 12 1879. Instrument, Mer Cir. Observer, Mr. AR.
Timepiece, 1327 Recorder, D.W.

Object,	J Ophiuchi		α Ophiuchi +2.2					
Circle,								
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	-10°19'		+12°39'	48.3				
	h m s		h m 50 s5		h m s		h m s	
Wire, I.	.		52.5		.		.	
II.	.		54.6		.		.	
III.	.		57.0		.		.	
IV.	.		59.0		.		.	
V.	.		1.0		.		.	
			3 1					
			5.3					
Sum,	.		33 1 3		.		.	
			7 8 0					
			9 5 1 .3					
Mean,	.		56.81		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	16 30 31.73		17 29 20.42		.		.	
Error of Timepiece,	.		.		.		.	

105
22
210
230
23
1.15
.92

36.39 + .92 = 37.31

×2.5
1447 51.1 127
37.29
13.82
42.5
+28.68 Eof 3451.

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 13 1879. Instrument, Mer. Circle Observer, W. A. R.
Timepiece, 1327 Recorder, F. W.

Object,	β Canis Min.			α Canum Min.			ι Aegus					
Circle,	.15			.10			-.44					
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b. = +.14	+8° 32'			+5° 32'			-23° 57'					
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	21		9.6			32.4			56.8			.
II.			11.6			34.5			59.0			.
III.			13.8			36.5			1.3			.
IV.			16.0			38.6			3.5			.
V.			18.0			40.6			5.8			.
Sum,			69.0			326			1264			.
									126.4			
Mean,			13.80			36.42			1.28			.
Bb,			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	7	20	37.54	7	33	00.38	8	2	25.58			.
Error of Timepiece,			.			.			.			.

u = 1.85

105 115 36.26 + .99 = 37.25
525 36.04 + 1.05 = 37.09
105 35.70 + 1.61 = 37.31
.16 65
105 + 37.22 Emf 1327
44
420
4620
115
1.61

10 25

42.7 34.1
50 0 1327
37.26
12.74
42.7
+29.96

1878phae.proj.17905

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 13 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, F. W.

Object,	δ virginis		α virginis					
Circle,	.07		.20					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+4°03′		+11°36′					
	h m s		h m s		h m s		h m s	
Wire, I.	50 5.6		56 44.3			.		.
II.	7.7		46.4			.		.
III.	9.8		48.5			.		.
IV.	11.8		50.6			.		.
V.	13.9		52.7			.		.
	48 8							
Sum,	.		.			.		.
Mean,	9.76		48.50			.		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	12 49 33.21		12 56 18.93			.		.
Error of Timepiece,		.		.		.		.

105 36.55 + 1.08 = 37.63

.07 37 36.57 + .95 = 37.52

105 11.5

21.0 37.57

115

94

22 23

36.51

6.1 1327

37.67

28.43

60

+31.57

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar. 14 1879. Instrument, Mer Cir Observer, Wak.

Timepiece, 1327 Recorder, Gpf.

Object,	α aquilæ			
Circle,	115			
	w e	w e	w e	w e
Level Direct,	. .	. .	. .	. .
Reversed,	. .	. .	. .	. .
Sums,	. .	. .	. .	. .
Difference,				
b.	+8° 35′			
	h m s	h m s	h m s	h m s
Wire, I.	26.3	.	.	.
II.	28.4	.	.	.
III.	30.3	.	.	.
IV.	32.4	.	.	.
V.	34.6	.	.	.
Sum,	20 .	.	. .	.
Mean,	30.40	.	.	.
Bb,	.	.	.	.
Cc,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	. 19 44 53.54	.	.	.
Error of Timepiece,	~~19 44 53.54~~	.	.	.

10.5
10.5
25
5
.16
1 15
1

36.86 + 1.00 = 37.86

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1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar. 15 1879. Instrument, Mer. Cir. Observer, WAR

Timepiece, 1327 Recorder, D.P.

Object,					γ aquilae			α aquilae			
Circle,					.18			.15			
	w		e		w		e	w		e	w		e
Level Direct,	.		.		.		.	.		.	.		.
Reversed,	.		.		.		.	.		.	.		.
Sums,	.		.		.		.	.		.	.		.
Difference,													
b.					+10°19'			+8°33'					
	h	m	s		h	m	s	h	m	s	h	m	s
Wire, I.			.				4.2			26.8			.
II.			.				6.5			29.0			.
III.			.				8.5			30.9			.
IV.			.				10.6			33.1			.
V.			.				12.7			35.2			.
Sum,			.				42.5			5°.			.
Mean,			.				8.50			31.00			.
Bb,			.				.			.			.
Cc,			.				.			.			.
Aa,			.				.			.			.
Corr'd Transit,			.				.			.			.
R. A.			.		19	40	31.20	19	44	53.58			.
Error of Timepiece,			.				.			.			.

165
18
840
105
189

37.30 +86 = 38.16
37.42 +90 = 38.32
48
38.24 Emp 1327

00 3KW1
1933 2.7 1327
38.24
24.46
lw
35.54

1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar. 16 1879. Instrument, Merpi. Observer, W. A. R.

Timepiece, 1327 Recorder, F. W.

Object,	ε Canis Maj.	δ Canis Majoris	δ Mus Min. ? C.	α Orionis
Circle,	-.55	-.49	16.83	+.13
	w / e	w / e	w / e	w / e
Level Direct,	. / .	. / .	. / .	. / .
Reversed,	. / .	. / .	. / .	. / .
Sums,	. .	. .	. .	. .
Difference,				
b.	-28° 48	-26° 12	86° 36' / +93° 24	+7° 32'

		h	m	s	h	m	s	h	m	s	h	m	s
Wire,	I.			.		4	2.1			30 9 .			12.2
	II.			.			4.3			43 2 / 54.2			14.2
	III.			.			6.7			6 3 / 17.6			16.3
	IV.			.			9.1			29 3 / 40.8			18.4
	V.			.			11.3			57.3			20.5
Sum,				.			33 5 .			3 5 / 91 26 4 .			81 6 .
Mean,				.			6.70			29.38			16.32
Bb,				.			.			.			.
Ce,				.			.			.			.
Aa,				.			.			.			.
Corr'd Transit,				.			.			.			.
R. A.		6	53	53.8	7	3	30.01	6	11	8 90 / 30.01	5	48	38.95
Error of Timepiece,				.			.			.			.

14 / 135 / 540 / 135 / .19 / 91 / 1.10 / 49 / 1.59

36.69 - .49 = 37.37 + .13 = 37.03 - .18 = 37.03 - .18 ~

20.48 ∓ 16.83 = 37.03 - .18 = -16.55 - 16.65 = n = 7.00

36.69 + 1.59 = 38.28

37.37 + .97 = 38.34

38.31 / .24 / .07

60

00 / 1.3 / 38.3 / 23.0 / 06 / + 37.0

3457 / 1327

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1878phae.proj.17905

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 16 1879. Instrument, Mer. Cir Observer, WAR.

Timepiece, 1327 Recorder, DW.

Object,	η Serpentis			α Aquilae							
Circle,	-.05			-.09							
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	-2° 58'			+5° 4'								
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			38.0			24.5			.			.
II.			40.0			26.5			.			.
III.			42.0			28.6			.			.
IV.			44.1			30.9			.			.
V.			46.2			32.7			.			.
Sum,		10	3		43	2			.			.
Mean,			42.06			28.64			.			.
Bb,			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	18	15	4 32	18	59	50.88			.			.
Error of Timepiece,			.			.			.			.

10 5 / 5 / 1.15

37.74 + 1.20 = 38.94

77.76 + 1.225 = 39.01

9 5

38.98

180

00 3405

59.885 1327

38.98

20.887

60

39.13

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 18 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, W.R.

Object,	α Orionis		δ Canis Maj.		δ Ursæ. Min. L.C.			
Circle,	+.13		-.49		-16.83			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b. = +.14								

	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			12.6		4	2.4			.			.
II.			14.6			4.9			60 18.2			.
III.			16.7			7.1			29.1			.
IV.			18.8			9.5			40 1			.
V.			20.9			11.8			51 8			.
Sum,			33 6 .			35 7 .			145 2 .			.
Mean,			16.72			7.14			29.04			.
Bb,			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	5	48	38.91	7	3	29.97	6	11	9.56			.
Error of Timepiece,			.			.			.			.

108 91 108 972 9828 19 1.17

19.48 - 16.83 = n
37.49 - 1.18 = n
- 18.01 - 16.65 = n

16.65 | 18.01 | -1.08 = n.
16.65
1360

108 13 324 108 1404

37.81 + .13 = n
37.17 - .49 = n
98
37.49 - .18 = n

108 49 972 432 5292

37.81 + 1.03 = 38.84
37.17 + 1.70 = 38.87
+ 38.86

5 14 38.9 19.9 40.1

3451 1327 5 20 58.85

3451 1327

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1878phae.proj.1790

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar. 18 1879. Instrument, Mer Cir Observer, Mak.
Timepiece, 1327 Recorder, W.

Object,							γ Aquilae					α Aquilae						
Circle,								,18					,15					
	w		e		w		e		w		e		w		e			
Level Direct,	.		.		.		.		.		.		.		.			
Reversed,	.		.		.		.		.		.		.		.			
Sums,	.		.		.		.		.		.		.		.			
Difference,																		
b.							+10°19'						48°33'					
	h	m	s		h	m	s		h	m	s		h	m	s			
Wire, I.	13	20	25.3				5.2			45	27.5				.			
II.			27.3				7.2				29.5				.			
III.			29.5				9.2				31.6				.			
IV.			31.6				11.4				33.7				.			
V.			33.6				13.5				35.7				.			
Sum,			.				46 5				08 0				.			
Mean,			.				9.30				31.60				.			
Bb,			.				.				.				.			
Ce,			.				.				.				.			
Aa,			.				.				.				.			
Corr'd Transit,			.				.				.				.			
R. A.			.				.		19	40	31 26		19	44	53.66			
Error of Timepiece,			.				.				.				.			

10 8
18
864
108
.19
.16

38.04 + .98 = 39.02
37.94 + 1.01 = 38.95
197
38.98

345' =
1327 = 19 31 57.35
39.00
18.35
00
41.65

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 19 1879. Instrument, Mer. Cir. Observer, W.A.K.

Timepiece, 1327 Recorder, W.

Object,	κ Orionis		α Orionis		δ Ursæ Min.		α Leonis	
Circle,	−.17		+.13		−16.83		+.22	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	−9°43′		+7°23′				+12 33	
	h m s		h m s		h m s		h m s	
Wire, I.	.		12.7		.		32.5	
II.	.		14.8		.		34.6	
III.	.		16.9		.		36.7	
IV.	.		18.9		.		38.9	
V.	.		21.1		.		41.0	
Sum,	.		34 4		.		33 7	
Mean,	.		16.88		.		36.74	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	5 42 2.45		5 48 38.89		6 11 10.30		10 1 58.41	
Error of Timepiece,	.		.		.		.	

108/13 = .14

168/22 = 216, 216, .37

37.99 + .13 = 38.33 + .22

37.99 + .03 = 39.02 + .12 = 39.14

38.33 + .93 = 39.26

39.26

8 .40

39.20 Error 1327.

3451 =

1327 = 7 41 56.6

39.2

17.4

+42.6

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1879phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar. 19 1879. Instrument, Mu. Ci. Observer, Wall

Timepiece, 1327 Recorder, FW.

Object,			β aquilae		α aquilae						
Circle,			.18		.15						
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.	+10'19"				+8'33"							
	h	m	s		h	m	s		h	m	s	
Wire, I.			56				27.6				.	
II.			4.5				29.7				.	
III.			9.7				31.8				.	
IV.			14.8				33.9				.	
V.			13.8				35.9				.	
Sum,			38 4 .				08 9 .				.	
Mean,			9.68				31.78				.	
Bb,			.				.				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.	19	40	31 30		19	47	53 66				.	
Error of Timepiece,			.				.				.	

108
18
864
108
1944

108
15
5400
108
16

38.38 + 98 = 39.35
39.12 + 101 = 39.73
48
39.24

3451
1327
1936

00
55.7
39.24
16.46
00
+43.54

1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 20 1879. Instrument, Mer. Cir. Observer, Mak.
Timepiece, 1327 Recorder, FW

Object,	α Orionis		β Orionis		22 H Camelop.			
Circle,	.13		-.15		2.65			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+7°23'		-8°21'		+69°21			
	h m s		h m s		h m s		h m s	
Wire, I.		13.1		9 18.4		515		.
II.		15.2		20.5		573 32 8.9		.
III.		17.2		22.5		150 - 20.8		.
IV.		19.2		24.7		26 5 32 4		.
V.		21.3		26.8		38.4		.
Sum,		36 0		12 9		254 0 120 134		.
Mean,		17.20		22.58		19.30		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	5 48	38.88	5 8	44.61	6 5	34.02		.
Error of Timepiece,		.		.		.		.

.91
.19
1.10

40.78 + 2.65 n
38.15 - .01 n
2.63 + 2.66 n
n = -1.00

38.32 + .13 n
37.97 - .15 n
29
38.15 - .01 n

38.32 + .97 = 39.29
37.97 + 1.15 = 39.12
41
+ 39.20 Corrected

4h 29m
55.15 3.51
00.15 132
38.00
20.00
55.15

55.15
39.20
15.95
n
44.05

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1879phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 21 1879. Instrument, Mer. Cir. Observer, W. W

Timepiece, 1327. Recorder, F.W.

Object, Circle,	β Canis Min					α Canis Min													
	w		e			w		e			w		e			w		e	
Level Direct, Reversed,	.		.			.		.			.		.			.		.	
	.		.			.		.			.		.			.		.	
Sums,	.		.			.		.			.		.			.		.	
Difference,																			
b.	.15					.10													
	h	m	s			h	m	s			h	m	s			h	m	s	
Wire, I.			12.0					34.5					.					.	
II.			14.0					36.6					.					.	
III.			16.0					38.7					.					.	
IV.			18.1					40.8					.					.	
V.			20.3					42.9					.					.	
			30 4					43 5											
Sum,			.					.					.					.	
Mean,			16.08					38.70					.					.	
Bb,			.					.					.					.	
Cc,			.					.					.					.	
Aa,			.					.					.					.	
Corr'd Transit,			.					.					.					.	
R. A.			.					.					.					.	
	4	20	37.42			4	33	0 10											
Error of Timepiece,			.					.					.					.	

38.66 + .95 = 39.61

38 60 + 1.00 = 39.60

39.60

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 23 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, H.W.

Object,	ε Virginis		α Virginis					
Circle,	+.21		−.19					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+11°37′		−10°32′					
	h m s		h m s		h m s		h m s	
Wire, I.		47·8		19 27·1		.		.
II.		49·9		29·2		.		.
III.		52·0		31·3		.		.
IV.		54·0		33·5		.		.
V.		56·2		35·5		.		.
Sum,		259 9		0 66		.		.
Mean,		51·98		31·32		.		.
Bb,		.		.		.		.
Ce,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	12 56	12.05	13 18	52 00		.		.
Error of Timepiece,		.		.		.		.

1.10 39.93 + .89 = 40.82
21 .3932 + 1.29 = 40.61
89 14 3

40.72 Error
39.60
54 1.12 .0208 Rad. .021
108
400

41.16

12 46 48.17 1327
40.72
7.98
.00
7.98
+52.02 Error

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 25 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, F.W.

Object,	α Orionis		γ Geminorum		δ Mic. Min. Le.		51 H Cephi.	
Circle,	.13		.30					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b. = +.14	+7°23′		+16°30′		+93°24′		+87°14′11″	
	h m s		h m s		h m s		h m s	
Wire, I.	49 14.7		21.1		.		39.6	
II.	16.7		23.2		20.446		51.9	
III.	18.8		25.4		19.740		21.8	
IV.	20.9		27.5		61.706		35.7	
V.	23.0		29.6		118		51.5	
					14		5.5	
					472		19.1	
Sum,	941		268		1.18		34.7	
	.		.		.165 2		267.6	
Mean,	18.82		25.36		19.74		91337.6	
					19.90		36.40	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	5 48 38.78		6 30 45.15		6 11		6 43 34.62	
Error of Timepiece,	.		.		.		.	

108 135 61.78 + 19.90 n
91 14
108 440
972 135
.9828 1790
18
1.16
-24
.92

40.12 + .22 n
21.66 + 19.68 n

19.68 | 2.166 | 1.08 = n.
1968 22
17800 216
216
.2376

40.04 + .13 n
40.21 + .30 n
25 43
40.12 + .22 n
40.12 + .92 = 41.04

4 30 45.5
41.02
04.48
+55.52 Eq 34.51

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1878phae.proj.1790r

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, March 26 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, F. W. hazy.

Object,	ν Gem.				β Gem.				51 H Cephei.			
Circle,	30				.42				19.90			
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.					+22 34							
	h	m	s		h	m	s		h	m	s	
Wire, I.		31	21.2				16.1				54.1	
II.			23.3				18.4				8 7	
III.			25.5				20.6			44	23.0 400 −	
IV.			27.7				22.8				52.0	
V.			29.8				25.2				5-0 19.8	
Sum,			27.5				103.1				212.6 6 2727	
Mean,			25.50				20.62				38.96	
Bb,			.				.				.	
Ce,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.			.				.				.	
Error of Timepiece,	6	30	45.15		6	15	40.29		6	43	34.18	

n = 1.08
36
648
324
.3888
.39
1.16
.77

64.78 + 19.90n
40.34 + .36n
24.44 + 19.54n

19.54 | 24.44 | −1.25=n
19 54
4900
3908
9920

40.35 + .30n
40.33 + .42n
40.34 + .36n

40.34 − .39 + 1.16
40.34 + .77 = 41.11

6 53 42.80 (.05 .345) (.13 .27)
41.11
01.74
.05
58.26

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1878phae.proj.1790

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar. 30 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, W.

Object, Circle,	γ Virginis −.01		ε Virginis +.21		Polaris −43.10		Polaris.	
	w	e	w	e	w	e	w	e
Level Direct, Reversed,	. .	. .	. .	. .	. .	. .	. .	. .
Sums, Difference, b.	. . −0°47′		. . +11°37′		. .		. .	
	h m s		h m s		h m s		h m s	
Wire, I.	36 10·6		56 48·2		23 1			52.8
II.	12·8		50·3		27·6			56
III.	14·8		52·4		32·6			1·8
IV.	16·8		54·5		52 8		348.4	20 2
V.	19·0		56·7		56·6		1 20	4 5
					13 1 8		9 2 28.4	30.1
					20·2		25.37	48 2
					24·5			54 6
					30 6			59 6
Sum,	24·0		12 1		26 9 8			~~9 50 9.8~~
					3 1 0			~~56.64~~
					9 1 8			348. 4
Mean,	14·80		52·42		3·01			25.37
Bb,	.		.		.			.
Ce,	.		.		.			.
Aa,	.		.		.			.
Corr'd Transit,	.		.		.			.
R. A.	12 35 34.63		12 56 12.11		1 13 28.74		1 13 28.74	
Error of Timepiece,	.		.		.			.

1.08 .91 1.16 .16 1.05 1.91 1.35 .19 .14 1.10 5 4 0 1.35 .189 0

40.17 ∓ .01 n

40.31 + .21 n

48

40.24 + .10 n

40.24 + 1.05 = 41.29

~~−32.10 ∓ n~~

−3.37 ∓ 43.10 n

40.24 + .10 n

−43.61 − 43.20 n = 0

n = −1.01

43.20 | 43.61 | −1.01 < n

43.20

410

40.24 + 1.00 = 41.24

13 40 32.25 (32.27

45

32.25

41.25

−09.00

Eq 345 + 69.00

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1878phae.proj.1790f

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 1 1879. Instrument, Mer. Cir Observer, W. A. P.

Timepiece, 1327 Recorder, F. W.

Object,	α Geminor.			β Gemin.			λ Ursæ Min.					
Circle,	+.63			.54			L.C. − 53.94					
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	+32°9′			+28°19′			88°56′8″ 91°3′52″					
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			30.8			32.7			22 1 28.7			.
II.			33.2			35.0			35 9 59.2			.
III.			35.6			37.5			12.8			.
IV.			38.1			39.7			36 7 43 6			.
V.			40.4			42.1		44	50.2			.
Sum,			28 1 .			37.0 .			289.2 240 8|49.2			.
Mean,			35.62			37.40			6.15			.
Bb			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	7	26	54.82	7	37	56.95	19	44	15.80			.
Error of Timepiece,			.			.			.			.

I assumed n = 1.00 in this reduction, as I was afraid the change was too great.

.91 .19 1.10 .63 .47

−9.05 − 53.94 n
40.62 + .58 n
49.67 − 54.52 n

54.43 | 49.67 | −.91 = n

110 .54 56 110 58 52

4897 8
.6920

40.80 + .63 n
40.45 + .54 n
40.62 + .58 n

.94 .91 .94 .58 752 470 .545 2 1.05 +.50

40.62 + .50 = 41.12

40.80 + .47 = 41.27
40.45 + .56 = 41.01
41.14 Emf 1327

00 27.9 } 3451 / 1327

7 9 41.15
46.75
00
+1 13.25

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1879phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 1 1879. Instrument, "Merci" Observer, W.A.R.

Timepiece, 1327 Recorder, D.W.

Object,	δ Virginis		ε Virginis		Polaris Se.		ν Aquilae	
Circle,	.07		+.21		−43.10		+1°0 −.02	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+4°3'		111°36', +4°3				−1°2'	
	h m s		h m s		h m s		h m s	
Wire, I.		9.2		48.0		5 33 58.0		40.6
II.		11.3		50.2		27 23 2		42.6
III.		13.4		52.2		13 27.1 33 2		44.7
IV.		15.5		54.4		52.0 56 7		46.8
V.		17.6		56.5		4.0		48.8
Sum,		17 0		11 3		91 02 60		23 5
Mean,		13.40		52.26		91 250 2 27.80		44.70
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	12 49	33.42	12 56	12.18	1 13	28.48	20 5	4.92
Error of Timepiece,		.		.		.		.

.94 / 91 / 94 / 846 / .8554 / .86 / 19 / 1.05 / 13 / .92 ; 14 / 94 / 56 / 126 / .13

− 0.68 − 43.10 n
40.05 + .14 n
40.73 − 43.24 n = 0

43.24 | 40.73 | = .94 = n.
38916
1814 0

39.98 + .07 n
40.13 + .21 n
n 1
40.05 + .14 n

40.05 − .13 + 1.05 = 40.97

12 0 00.0 / 27.2 = 345' / 1327
41.0
46 2
00
+1 13.8

δ aquilae
39.78 + 1.07 = 40.85

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 2 1879. Instrument, Russ. Jr. Observer, Frank Waldo

Timepiece, Bond 236 Recorder, FW.

Object,	β Cancri			31 Lyncis			Gr 1446					
Circle,	W			W			W.			E W		
	w		e	w		e	w		e	w		e
Level Direct,	.		.	26.0		12.4	.		.	.		.
Reversed,	.		.	26.2		12.3	.		.	.		.
Sums,	.		.	52 2		24 7	.		.	.		.
Difference,				24.7		.						
b. = +.92				3127								
	+9°33′			+.92 = b.			+74°3′					
				+43°34′								
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			27.2			48.9	I		.	II		48.5
II.			48.7			18.3			45.5			3.0
III.			10.4		14	47.7			58.8			.
IV.	8	10	32.1			17.2	24		11.4			29.0
V.			53.7			46.5			.	25		42.0
Sum,			172 1			1786			1157			1225
			1w.			6w.			6w.			6w.
			52 1			238.6			191.7			62 5
Mean,			10.42			47.72			58.57			195.62
Bb,	.86		+.79	1.38		+1.27	3.10		+2.85			.
Ce,	1.02		+.04	1.38		+.05	3.64		+.12			.
Aa,	.54		+1.12	-.03		-.06	-1.91		.			.
Corr'd Transit,		10	12 37			48 98			.			.
R. A.	8	9	59.33	8	14	35.87	8	26	19.14			.
Error of Timepiece,		+	13.04		+	13.11			.			.

236 −½ᵐ = 394

8 45 53.5 = 00

53 57.5 · 236

8 52 25.2 1327

53 57.5 +12.93 = 54 10.43

53 57.5 − 12.93 = 44.57

25.2 − 40.63

Error 1327

21.258 × 364 = 85032 12754 8 63774 = 7737912

7737.912 = 2 = 154.76 = 2ᵐ 34.76 = 1ᵐ 17.38

23 58.57 + 2 34.76 = 26 33.33 + 33.00 = 26ᵐ 33.33 + 2.85 + .12 = 26 36.13

15.62 + 17.38 = 26ᵐ 33.00

.92 × 86 = 552 + 736 + .791

138 × 92 = 276 + 1242 + 1.27

31 × 92 = 62 + 279 + 7.852

13.04
13.11
12.78
12.79
3.72
+12.93 mean Error.
Bond. 236

as determined by my obs. with the Russ Jr. FW.

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 2 1879. Instrument, Russ 7r. Observer, H.W.

Timepiece, Bond 236 Recorder, H.W.

Object,	Gr. 1446			δ Cancri			ε Hydrae				
Circle,	E			E							
	w		e	w		e	w		e	w	e
Level Direct,	26.2		12.3	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b. = +.92				+18°36′			+6°52′				
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	V		41.8			17.1			52.5	2 36		= 39v
II.			56.0			39.4			13.7	8 45	53.5	00
III.			.			1.7			35.1		12.93	
IV.			20.5			24.4			56.7	8 46	06.43	
V.		29	34.3		38	46.7		41	18.2	8 03	29.53	
										1	19.12	
Sum,			152.6			+293			196.2	2	10.41	
			(120/32).6			.			.			
Mean,			8.15			1.96			35.24	8 45	53.5	
											12.93	
										8 45	40.57	
Bb,			.	.97		+.90	.82		+.76	42	36.90	
			.			.			.	8 03	03.67	
Cc,			.	1.06		−.04	1.01		−.04	1	19.05	
Aa,			.	43		+.89	.58		+1.20		44.62	
											60	
Corr'd Transit,			.			3.81			7.16		15.38	
											15.50	
R. A.			.	8	37	50.93	8	40	24.37		−.12	
											Error 39ᵘ as	
Error of Timepiece,			.		+	12.78		+	12.79		determined by observations with Russ 7r. H.W.	

29 8.15
2 34.76
26 33.39
26 33.16
23

3.64 1.1200 04 = C. (+ C.w).

α′−α
8 26 19.14
8 9 59.33
16 19.81

δ′−δ
26, 36.13
16 11.25
16 24.88
16 19.81

−2.45 −5.07 + 2.07 = a.
490
1700
1715

207 207 207
52 43 58
828 821 1626
1035 828 1035
1117 890 2066

1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 2 1879. Instrument, Mer. Cir. Observer, H.A.R.

Timepiece, 1327 Recorder, D.W.

Object,	β Geminorum			γ Argus.			α Canis Min.					
Circle,	+.54			−.40			+.10					
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	+28°20′			−23°58′			+5°32′					
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.		38	32.1			59.6		33	35.3	This does not belong to the reduction, rejected		
II.			34.5			1.9			37.5			
III.			36.9			4.2			39.5			
IV.			39.2			6.5			41.5			
V.			41.5			8.7			43.6			
Sum,			3 4 2			2 0 9			4 7 4			
Mean,			36.84			4.18			39.48			
Bb,			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	7	37	56.96	8	2	25.23	7	32	59.90			.
Error of Timepiece,			.			.			.			.

.94
.54
376
470
51

39.68 + .54 = 40.22
38.95 − .44 = 38.94 + 1.50 = 40.44
39.58 + .10 = 39.58 + .95 = 40.53
119
40.40 = Err of 1327

94
44
376
376
4136

39.88 + .78 = 40.66
38.95 + 1.65 = 40.60
39.58 + 1.04 = 40.62
8
40.63 Err of 1327.

N = 3451
8 55 24.5 = 13m
40.6
54 43.9
00

Err 3451 + 1 16.1

1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 2 1879. Instrument, Mer. Cir. Observer, Mark.
Timepiece, 1327 Recorder, C.W.

Object,	γ Aquilae		β Aquilae		δ Draconis			
Circle,	.18		.11		330			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+10°19′		+6°6′		+73°8′			
	h m s		h m s		h m s		h m s	
Wire, I.		6.9		58.6		19.3		.
II.		9.1		0.7		26.3		.
III.		11.2		2.9		33.5		.
IV.		13.3		5.0		40.5		.
V.		15.4		7.0	18	48.1		.
Sum,		59.		47.		167.		.
Mean,		11.18		2.8[illegible]		33.54		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	19 40	31.69	19 49	23.43	19 17	50.81		.
Error of Timepiece,		.		.	19	.		.

105
91
105
945
.9555
19
1.15

42.73 + 3.30 n
39.44 + .15 n
3.29 + 3.15 n

315 | 329 | 1.05 = n.
315
140

105
15
525
105
.1575

39.47 + .18 n
39.41 + .11 n
8 29
39.44 + .15 n

39.44 + 1.00 = 40.44.

40.97
40.44
.53
.40

20 0 00 : 34.5
42.8 : 1.32
40.45
42.35
60
+1 17.65

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 6 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, F.W.

Object,			α Canis Majoris			β Geminorum					
Circle,			.10			.54					
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.												
	h	m	s		h	m	s		h	m	s	
Wire, I.		3	32.4				29.3				.	
II.			34.5				31.6				.	
III.			36.6				33.9				.	
IV.			38.6				36.2				.	
V.			40.7				38.6				.	
Sum,			182.8				169.6				.	
Mean,			36.56				33.92				.	
Bb,			.				.				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.	7	32	59.85		7	37	56.86				.	
Error of Timepiece,			.				.				.	

115 11 1.03 . 115 54 660 575 6210 115 53 + 39.71 + .10 = 39.81 37.06 + 54 = 37.06 + 39.71 + 1.04 = 37.75 37.06 + .53 = 37.59 1.34 37.67 40.63 .08 42.96 .74

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 6 1879. Instrument, Mer. Cir Observer, Hall.

Timepiece, 1327 Recorder, [illegible]

Object,	δ Virginis				ε Virginis				α Mus. Min						
Circle,	+1.07				+.21				−43.10						
	w		e		w		e		w		e		w		e
Level Direct,	.		.		.		.		.		.		.		.
Reversed,	.		.		.		.		.		.		.		.
Sums,	.		.		.		.		.		.		.		.
Difference,															
b.					+11°36″										
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.			5.9				40.6				.				.
II.			8.0				42.6				.				.
III.			10.1				.				.				.
IV.			12.2				55.2				.				.
V.			14.2				57.4				.				.
Sum,			50.4				195.8				.				.
Mean,			10.08				48.95				.				.
Bb,			.				.				.				.
Cc,			.				.				.				.
Aa,			.				.				.				.
Corr'd Transit,			.				.				.				.
R. A.			.				.				.				.
	12	49	33.45		12	56	12.16								
Error of Timepiece,			.				.				.				.

105
7
735

105
21
105
210
2205
115
.93

36.63 + + 1.08 = 37.71

36.79 + .93 = 37.72

+37.72

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 7 1879. Instrument, Merid. Observer, W. A. P.

Timepiece, 1327 Recorder, F. W.

Object,	ζ Orionis		V Geminor		δ Ursæ Min. R.			
Circle,	.13		.30		−16.90			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	17°23'		+16°30'		186°36'8			
	h m s		h m s		h m s		h m s	
Wire, I.		10.0		16.5	9 52.4		17.34	.
					~~10 27.5~~		16.83	
II.		12.1		18.7	~~11 24.9~~		.51	.
					11 1.3		.07	
III.		14.2		20.7				.
IV.		16.3		22.9	11 58.5			.
					12 11.5			
V.		18.3		25.1	13 20.1			.
					~~13 55.4~~			
Sum,		70.9		93.9	133.8			.
					183.8			
Mean,		14.18		20.78	36.76			.
Bb,		.		.	.			.
Cc,		.		.	.			.
Aa,		.		.	.			.
Corr'd Transit,		.		.	.			.
R. A.	5 48	38.59	6 30	44.94	18 11	16.77		.
Error of Timepiece,		.		.	.			.

1.05

35.59 + .13n

35.84 + .30n

14.3 43

35.72 + .22n

19.99 − 16.90n

35.72 + .22n

−15.73 − 17.12n

17.12 | 15.73 | 1.92

15498

3120

35.59 + .93 = 36.52

35.84 + .77 = 36.61

11 3

36.56

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 7 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, H.M.

Object,	γ Aquilae			α Aquilae			β Aquarii				
Circle,	.18			.15			-.12				
	w		e	w		e	w		e	w	e
Level Direct,	.		.	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.	+10°19'			+8°33			-6°6'				
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.		41	3.0			25.4		25	43.3		.
II.			5.1			27.5			45.5		.
III.			7.2			29.6			47.5		.
IV.			9.3			31.7			49.6		.
V.			11.4			33.8			51.6		.
Sum,			36.0			.			37 5		.
Mean,			7.20			29.60			49.50		.
Bb,			.			.			.		.
Cc,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	19	40	31.84	19	44	54.20	21	25	12.42		.
Error of Timepiece,			.			.			.		.

92 42 35.36 + .88 = + 36.24 92 35.08 + 1.16 = 36.24
18 15
232 460
92 92
.165 .1380
.17 .14
.105 .105
.88

35.40 + .91 36.31
55
+ 36.28
184
92
.1124
105
.94
.16

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 8 1879. Instrument, Mer. Cir. Observer, W.A.R.
Timepiece, 1327 Recorder, W.W.

Object,	ℰ Leonis		ϰ Leonis				
Circle,	.45		.22				
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+24°20′		+12°33′					
	h m s		h m s		h m s		h m s	
Wire, I.		32.0		28.8		.		.
II.		34.3		30.8		.		.
III.		36.6		33.0		.		.
IV.		38.8		35.1		.		.
V.		41.1		37.2		.		.
Sum,		32.8		14.9	.	.		.
Mean,		36.56		32.98		.		.
Bb,		.		.		.		.
Ce,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	9	39 1.62	10	1 58.25		.		.
Error of Timepiece,		.		.		.		.

92 92 34.94 + .64 = 35.60
45 22
460 184
268 184
4140 2024
105 105
64 85

34.73 + .85 = 35.58
35.59

00. 3451
9 48 5.5 1327
35.8
29.9
00
+1 30.1

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 8 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, A.W.

Object,	γ Aquilae			ζ Aquilae			ε Draconis				
Circle,		.18			.15						
	w		e	w		e	w		e	w	e
Level Direct,	.		.	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.	+10.19'			+8.33			16°57'18"				
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			2.0			24.4			46.6		.
II.			4.0			26.5			52.5		.
III.			6.1			28.5			58.5		.
IV.			8.2			30.6			4.4		.
V.			10.3			32.7			10.7		.
									16.3		.
									22.3		.
									28.3		.
									34.5		.
Sum,			30.6			42.7			241		.
			.			.			180.		.
Mean,			6.12			28.54			10.46		.
Bb,			.			.			.		.
Cc,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	19	40	31.87	19	44	54.23	19	48	33.47		.
Error of Timepiece,			.			.			.		.

34.25 +.18n
34.31 +.15n
56
34.28 +.17n

34.28 +.97 = 35.25

36.94 + 2.74n
34.28 +.17n
2.71 + 2.57n

257 | 2.71 | -1.05 = n
257
1400

1.05
.17
735
105
180

105
91
105
945
96
14
1.15
11
97

00 3451
20 40 3.8 1327
35.25
28.55
00
+1 31.45

31.45
30.10
10 (1.35) .135
24
540
270
3240

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 9 1879. Instrument, Merici Observer, W.A.R.

Timepiece, 1327 Recorder, D.W.

Object,	ε Leonis			ζ Leonis			ε Draconis					
Circle,	.45			.22			−2.74					
	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.		39	30·8			27·7			16.4 22 4			.
II.			33·2			29·8			28·6			.
III.			35·5			31·9			40·6			.
IV.			37·8			34.0			~~5 6 6~~ 5 2 6			.
V.			40·0			36.2			~~5 8 7~~ ~~5 0~~ 224 9			.
Sum,			27 3 .			9 6 .			60 7254·3			.
Mean,			35·46			31·9½			40·71			.
Bb,			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	9	39	1.61	10	1	58.24	19	48	33.51			.
Error of Timepiece,			.			.			.			.

105 34 420 345 3570 .36 115 79

33.85 + .45 n

33.68 + .22 n

153 67

33.77 + .34 n

33.77 + .79 = 34.56

.20

1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 11 1879 Instrument, R.G. Observer, PM

Timepiece, 3451 Recorder, PM

Object,	α Cygni																		
Circle,	E +44°50′																		
	w		e		w		e		w		e		w		e				
Level Direct,	.		.		.		.		.		.		.		.				
Reversed,	.		.		.		.		.		.		.		.				
Sums,	.		93		.		.		.		.		.		.				
Difference,			193																
b. +.92	.1		39 2																
	h	m	s		h	m	s		h	m	s		h	m	s				
Wire, I.			39.2				.				.				.				
II.		37	49 1				.				.				.				
III.			59 0				.				.				.				
IV.			9 0				.				.				.				
V.			19 0				.				.				.				
		38	28.9				.				.				.				
Sum,			262 0 / 180 / 82				.				.				.				
Mean,			49.11				.				.				.				
Bb,	1.41		+ 1 30				.				.				.				
Cc,	1.41		− .16				.				.				.				
Aa,	−.06		+ 13				.				.				.				
Corr'd Transit,		37	50 38				.				.				.				
R. A.	m	37	18.85				.				.				.				
Error of Timepiece,			+ 31.53				.				.				.				

141 / 92 / 282 / 1269 / 1297 / 130

207 / 1242 / 13

20 40 15.2 1327

13.0 236

31.53

41.47

15.2

+ 33.73 Emf 1327

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1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 12 1879. Instrument, Merci Observer, W. A. K.

Timepiece, 1327 Recorder, G. M.

Object,	β Aquarii		α Aquarii					
Circle,	−.11		−.02					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	−6°6′		−0°54′					
	h m s		h m s		h m s		h m s	
Wire, I.		40.2		2.8		.		.
II.		42.2		4.8		.		.
III.		44.2		6.9		.		.
IV.		46.4		9.0		.		.
V.		48.4		11.1		.		.
Sum,		214		346		.		.
Mean,		24.28		6.92		.		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	21 25	12.53	21 29	35.11		.		.
Error of Timepiece,		.		.		.		.

105 / 11 / 105 / 105 / .12 / 105 / 2 / 02

+31.75 +1.29 = 33.02

+31.81 +1.17 = 32.98

33.00

21 30 51.9 1327

33.0

18.9

10

+1 41.1

000 3451

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 13 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, D.R.

Object,	δ Virginis				ε Virginis														
Circle,	+.07				+.21														
	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.			0.7				39.5				.				.				
II.			2.8				41.6				.				.				
III.			4.9				43.8				.				.				
IV.			6.9				45.9				.				.				
V.			9.0				48.0				.				.				
Sum,			24.3				18.8				.				.				
Mean,			4.86				43.76				.				.				
Bb,			.				.				.				.				
Cc,			.				.				.				.				
Aa,			.				.				.				.				
Corr'd Transit,			.				.				.				.				
R. A.	12	49	33.48		12	56	12.19				.				.				
Error of Timepiece,			.				.				.				.				

105 07 735 105 21 210

31.48 + 1.08 = 32.56

31.57 + .94 = 32.51

32.55

1.45 .3 .05

12 30 50.15 = 1327

32.55

17.60

00

+1 42.40

41.1

15 | 1.3 | .086

1 20

10

w = 3451

1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 14 1879. Instrument, Mer. Cir. Observer, W. A. R.
Timepiece, 1327 Recorder, A. W.

Object,	β Leonis Min.			α Leonis Min.								
Circle,	.15			.10								
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	+8°32′			+5°32′								
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			3·8			26·4			·			·
II.			5·9			28·5			·			·
III.			8·0			30·6			·			·
IV.			10·0			32·7			·			·
V.			12·1			34·7			·			·
Sum,			39·8			29			·			·
Mean,			7·96			30.58			·			·
Bb,			·			·			·			·
Cc,			·			·			·			·
Aa,			·			·			·			·
Corr'd Transit,			·			·			·			·
R. A.	7	30	37.04	7	32	59.73			·			·
Error of Timepiece,			·			·			·			·

105 / 15 / .15 30.92 + 1.00 = 31.92
30.85 + 1.05 = 31.90
+ 31.91

6 0 48. 1327 3451
31.91
16.09
+ 1 43.91
42.40
.51

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1879phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 14 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, P.M.

Object,	δ Virginis			ε Virginis			Polaris.					
Circle,	+.07			+.1			43.10					
	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.			0.2			39.0			39.2			.
									43.5			
II.			2.3			41.1			48.8			.
								13	8.6			
III.			4.4			43.3			13.5			.
									17.2			
IV.			6.5			45.4			34.1			.
									39.8			
V.			8.5			47.5			47.7			.
Sum,			21.9			16.3			290.4			.
			.			.			180			
								9	110.4			
Mean,			4.38			43.36			12.27			.
Bb,			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	12	49	33.48	12	56	12.20	1	13	29.55			.
Error of Timepiece,			.			.			.			.

30.90 +.07
31.16 +.21
.06
31.03 +.14 m
32.04

.8
−17.28 − 43.10 m
31.03 + .14 m
−48.31 − 43. m

43.4 | 48.31 | 1.12
43.4
5170
4340
8480

11 0 47.4 / 327
32.04
15.36
00
+1 44.64

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 14 1879. Instrument, Merdi. Observer, W. AR

Timepiece, 1327 Recorder, FW

Object,	~~ε Eq~~ nilei. ζ Cygni			E Pegasi								
Circle,	.57			.16								
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	+44°46'		+29°44'	+9°19'								
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			14.5			42.4			.			.
II.			16.9			44.5			.			.
III.			19.4			46.6			.			.
IV.			21.7			48.6			.			.
V.			24.1		38	50.7			.			.
Sum,			96.6			32.8			.			.
Mean,			19.32			46.56			.			.
Bb,			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	21	7	48.08	21	38	15.54			.			.
Error of Timepiece,			.			.			.			.

105 / 57 / 735 / 525 / .598

105 / 16 / 630 / 105 / .17 / 105

1.15 / 60 / 55

31.24 + .57m

30.97 + .16m

31.24 + .55 = 31.79

30.97 + .98 = 31.95

174

31.87

22 9 ~~00~~ 34.51 / 46.2 1327 / 31.87 / 14.33 / 00 / + 1 45.67 Error 34.51

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 16 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, W.

Object,	β Canis Min				α Canis Min										
Circle,	.15				.10										
	w		e		w		e		w		e		w		e
Level Direct,	.		.		.		.		.		.		.		.
Reversed,	.		.		.		.		.		.		.		.
Sums,	.		.		.		.		.		.		.		.
Difference,															
b.	+8°32′				+5°32′										
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.			3.4				3326.0				.				.
II.			5.4				28.0				.				.
III.			7 5				30.1				.				.
IV.			9.6				32.2				.				.
V.			11.7				34.2				.				.
Sum,			37 6				150 5				.				.
			.				.				.				.
Mean,			7.52				30.10				.				.
Bb,			.				.				.				.
Cc,			.				.				.				.
Aa,			.				.				.				.
Corr'd Transit,			.				,				.				.
R. A.			.				.				.				.
	7	30	37.00		7	32	59.70								
Error of Timepiece,			.				.				.				.

110 91 110 990 101 19 1.26 11 110 15 1650 110

+30.52 +1.04 = 31.56

+30.40 +1.09 = 31.49

105

31.52

7 47 42.4 1327

31.52

7 47 10.88

00

+1 49.1 = Sum. 345 1

45.67

33 | 3.45 | 105

33

150

165

1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 19 1879. Instrument, Mer. Ci. Observer, W.A.K.

Timepiece, 1327 Recorder, D.W.

Object,			γ Aquilae			α Aquilae						
Circle,			.18			.15						
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.												
	h	m	s		h	m	s		h	m	s	
Wire, I.			58.7				20.9				.	
II.			0.6				23.1				.	
III.			2.8				25.1				.	
IV.			4.9				27.2				.	
V.			7.0				29.3				.	
Sum,			14 0				25 6				.	
			.				.		.		.	
Mean,			2.80				25.12				.	
Bb,			.				.				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.			.				.				.	
	19	40	32.20		19	44	54.56				.	
Error of Timepiece,			.				.				.	

119 91 11 99 100 19 119 1 — 18 11 18 18 198 15 5 .16

30.60 + .99 = 31.59

30.56 + 1.03 = 31.59

31.59

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1879phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 20 1879. Instrument, Nun Cir. Observer, Hark.

Timepiece, 1327 Recorder,

Object,	ζ Leonis			ζ Leonis							
Circle,											
	w		e	w		e	w		e	w	e
Level Direct,	.		.	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.	+26° 01'			+12°33'							
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			26.4	2		24.4			.		.
II.			28.6			26.5			.		.
III.			31.0			28.6			.		.
IV.			33.3			30.7			.		.
V.			35.5			32.8			.		.
Sum,			048			430			.		.
Mean,			30.96			28.60			.		.
Bb,			.			.			.		.
Cc,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	10 10		.			.			.		.
	~~19~~ ~~10~~		00.21	10	1	58 1/2					
Error of Timepiece,			.			.			.		.

11 45 55 44 49 5 — 11 22 22 29 24 119 95

30.75 + .45 = 31.20
30.48 + .22 = 30.70
30.75 + .69 = 31.44
30.48 + .95 = 31.43
31.44

00.0 = 3451
9 30 32.2 = 1327
31.44
00.76
00
59.24
+2 00.76

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 20 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, F.W.

Object, Circle,	α Aquilæ .15		β Aquilæ .12		θ Cephei 1.93			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+8°33′		+6°06′		62°35′			
	h m s		h m s		h m s		h m s	
Wire, I.	20.85 0.2		50.2		47.1			.
					51.7			
					56.1			
II.	22.9 52.3		52.3		0.5			.
					5 1			
III.	25.0 54.3		54.3		9.6			.
					14.1			
IV.	27.1 56.4		56.4		18.5			.
V.	45 29.1 58.6		58.6		23.1			.
Sum,	8		21 8		225 8			.
	24.9		.		180			
					45.8			
Mean,	25.98		54.36		5.09			.
Bb,	.		.		.			.
Cc,	.		.		.			.
Aa,	.		.		.			.
Corr'd Transit,	.		.		.			.
R. A.	19 44 54.69		19 49 23.97		20 27 32.94			.
Error of Timepiece,	.		.		.			.

91 / 19 / 110 . 32.15 + 1.93 n
30.39 + .13 n
1.76 + 1.80 n

18 | 176 | 1.98 = n.
162
140

30.39 + .15 n
30.39 + .12 n
78
30.39 + .13 n

30.39 + .95 = 31.34
30.39 + .98 = 31.37
31.35

19 15 31.15 = 1327
31.35
59.80
00
+2 00.20

00 00 = 3451

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1879phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 21 1879. Instrument, Mer. Cir. Observer, W.A.R.
Timepiece, 1327 Recorder, F.W.

Object,	α Canis Min.			β Canis Min.			α Canis Min.				
Circle,		10			15			10			
	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.		2.9			2.9			25.5			.
II.		5.0			5.0			27.6			.
III.		7.9			7.0			29.7			.
IV.		.			9.1			31.8			.
V.		.			11.2			33.8			.
Sum,		.			35.2			148.4			.
		.			.			.			.
Mean,		.			7.04			29.68			.
Bb,		.			.			.			.
Cc,		.			.			.			.
Aa,		.			.			.			.
Corr'd Transit,		.			.			.			.
R. A.		.			.			.			.
	7 32	59.62		7 20	36.93		7 32	59.62			
Error of Timepiece,		.			.			.			.

30.11 + .95 = 31.06
30.06 + 1.00 = 31.06
31.06

3451 =
1327 = 7 52 29.8
31.06
58.74
00
+2 01.26

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 21 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, [illegible]

Object,	α aquilae			β aquilae							
Circle,	.15			.12							
	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.			~~16~~ .4			50 50 .0			.		.
II.			~~18~~ . 20 6			52.0			.		.
III.			22.7			54.1			.		.
IV.			24.8			56.1			.		.
V.			26 8 28.9			58.2			.		.
Sum,			23 8 .			204 .			.		.
Mean,			24.76			54.08			.		.
Bb,			.			.			.		.
Cc,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.			. 19 44 54 62			. 19 49 24 00			.		.
Error of Timepiece,			.			.			.		.

30.14 + .95 = 31.09
30.08 + .98 = 31.06
31.08

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1879phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 22 1879. Instrument, Mer. Circle Observer, W. A. R.

Timepiece, 1327 Recorder,

Object,	β Canis Min			α Canis Min								
Circle,	.15			.10								
	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.			2 4		33	25.2			.			.
II.			4.6			27.3			.			.
III.			6.6			29.4			.			.
IV.			8.8			31.4			.			.
V.			10.7			33.5			.			.
Sum,			33 1			146 8			.			.
Mean,			6.62			29.36			.			.
Bb,			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	7	20	36.90	4	32	59.60			.			.
Error of Timepiece,			.			.			.			.

29.72 +1.95 = 30.67
29.76 +1.00 30.76
143
30.72

3451 =
1327 = 7 50 26.6
30.72
55.88
50
+2 04.12

1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 22 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, D. W.

Object,	ε Virginis		ζ Virginis		α Virginis		Polaris E.C	
Circle,	+.21				.19		−4296	
	W	E	W	E	W	E	W	E
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+11°36′		+4°3′		−10°32′			
	h m s		h m s		h m s		h m s	
Wire, I.		37.8		.		17.5		36.7 41.6
II.		39.9		.		19.5		47.5 13 8.2
III.		42.0		.		21.6		13.9 18.8
IV.		44.1		.		23.7		36.5 41.1
V.		46.2		.		25.7		48.3
Sum,		10 0 .		.		8 0 .		298.6 180. 118.6
Mean,		42.00		.		21.60		12.51
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.		12 56 12.21		12 49 33.49		13 18 52.26		1 13 31.40
Error of Timepiece,		.		.		.		.

1.10

29.79 + .21 n
29.34 − .19 n
113
29.57 + .01
29.57 + 1.09 = 30.66

+12.5
−18.89 − 42.96 n
29.57 + .01 n
− 48.46 − 42.97 n
42.97 | 48.46 | 1.12 n.
42.97
5490
4297
1193

12 18 25.9 = 1327
30.66
55.24
00
+ 2 04.76
= 3451

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 23 1879. Instrument, Merid. Observer, W.A.R.

Timepiece, 1327 Recorder, D.W.

Object,	α Leonis				ν Leonis							
Circle,		.22				.37						
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.	+12°33′				+20°27′							
	h	m	s		h	m	s		h	m	s	
Wire, I.			23.4				46.0				.	
II.			25.5				48.1				.	
III.			27.6				50.3				.	
IV.			29.6				52.5				.	
V.			31.7				54.8				.	
Sum,			137 8				0 1 7				.	
Mean,			27.56				50.34				.	
Bb,			.				.				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.	10	1	58.15		10	13	20.65				.	
Error of Timepiece,			.				.				.	

1.12
91
112
1008
1.0192
19
1.20
23

112
22
224
224
112
37
784
336
40
120
80

29.41 + .97 = 30.38
29.69 + .80 = 30.49
7
30.43 Emp 1327
30.66
22 | 23 | .010
22
10

3451 =
1327 = 11 20 23.0
30.43
19 52.57
00
+2 07.43
4 76
23 | 2.57 | .112
23
27
23
40

1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 23 1879. Instrument, Merc. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, W.

Object,	α Aquilae		β Aquilae		ε Pegasi			
Circle,	.15		.12		.16			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.					+9.19			
	h m s		h m s		h m s		h m s	
Wire, I.		19.9		49.3	21 38	41.2		.
II.		22.0		51.5		43.3		.
III.		24.0		53.6		45.4		.
IV.		26.2		55.6		47.4		.
V.		28.2		57.7		49.5		.
Sum,		203		177		268		.
		.		.		.		.
Mean,		24.06		53.54		45.36		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	19 44	54.68	19 49	24.48	21 38	15.82		.
Error of Timepiece,		.		.		.		.

112 · 15 · 560 · 112 · 1680 · 112 · 12 · 224 · 112 · 1344

29.38 + 1.03 = 30.42
29.06 + 1.08 = 30.14
56
30.28

112 · 16 · 672 · 112 · 1792 · 120

29.54 + 1.00
29.54 = 30.56
.42 · .14 · 112
+ 30.34 Emf. 13 m

000 = 3451
19 30 22.1 = 1327
30.34
51.76
50
+ 2 08.24 Emf 3451
7.43
81 1.100
80

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 24 1879. Instrument, Mer-Cir. Observer, W.A.R

Timepiece, 1327 Recorder, F.W.

Object,	} Leonis			V Leonis								
Circle,		.45			.37							
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	+24°1'			+20°27'								
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			25.3			45.9			.			.
II.			27.5			48.2			.			.
III.			29.8			50.3			.			.
IV.			32.0			52.5			.			.
V.			34.4			54.7			.			.
Sum,			49.0			1 6			.			.
Mean,			29.80			50.23			.			.
Bb,			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	10	10	00.16	10	13	20.64			.			.
Error of Timepiece,			.			.			.			.

112
45
560
448
504

112
37
784
336
414
120
.79

29.64 + .70 = 30.34
29.59 + .79 = 30.38
30.35

9 50
19 30
14 20

9 50 20.4 = 1327
30.35
50.05
00
+2 9.95 Sun 3451

8.24
1.71
3
14 | 17 | 8 | 1.127
14
38
28
100
78

00.0 3451

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 26 1879. Instrument, Mer. Ci. Observer, 1327

Timepiece, W&R Recorder, F.W.

Object,	α Aurorae.			
Circle,	.54			
	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.	35.6	.	.	.
II.	37.9	.	.	.
III.	40.2	.	.	.
IV.	.	.	.	.
V.	.	.	.	.
Sum,	11 3 7 .	.	.	.
Mean,	37.9	.	.	.
Bb,	.	.	.	.
Cc,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	0 2 8 60			
Error of Timepiece,	.	.	.	.

29.30 + .60 = 29.90

2 40 4.

2 4 4 12.6 1327

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 27 1877. Instrument, Mer. Cir. Observer, W. A.K.

Timepiece, 1327 Recorder, G.W.

Object,	B Leonis											
Circle,	27											
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.	+0°15											
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			20.8	12	3	20.8			.			.
II.			22.8			23.0			.			.
III.			24.9			25.5			.			.
IV.			27.0			27.6			.			.
V.			27.1			29.6			.			.
Sum,			246			.	April 28	10	13	9.1	1327	
Mean,			24.92			.						.
										00	20.81	
												39.49
Bb,			.			.	.115					9.1
Ce,			.			.	460					
Aa,			.			.	230					29.91
							2.760					
							2 18.05					
							+ 2 20.81					
Corr'd Transit,			.			.			.			.
R. A.			.			.			.			.
	11 42 56.16											
Error of Timepiece,			.			.			.			.

112
27
754
224
530
1m

28.82 + 90 = 29.72

29 90

1.18
2
.36

7m 52 .40

9 55 00 11.7 3451 1327
29.75
54 41.95
00
+ 2 18.05 (3451)
9.95
72 + 8.10 L.113
72
90
72
180

00 3451
12 15 11.4 1327

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178

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, April 30.3 1879. Instrument, Mer. Cir. Observer, H.A.R.

Timepiece, 1327 Recorder, F.W.

Object,	6 Ursae Maj.		ε Leonis					
Circle,	1.29		45					
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+52°13'		+24°20'					
	h m s		h m s		h m s		h m s	
Wire, I.		11.3		25.5		.		.
II.		14.7		27.7		.		.
III.		18.0		30.0		.		.
IV.		21.4		32.2		.		.
V.		24.7		34.5		.		.
Sum,		90 1		149 9		.		.
		.		.		.		.
Mean,		18.02		29.98		.		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.		.		.		.		.
	9 24	48 34	9 39	1.30				
Error of Timepiece,		.		.		.		.

129
112
258
129
129
1448
112
45
560
448
5040

29.68 − .24 = 29.44
28.68 + .70 = 29.38
82
29.41

10 17

68 = 345'
4 = 1327
29.4
346
+2 25.4 Sum of 345'
18.05
17.35
3 | 75 7 | 2.52
6
15
15
7

24 | 252 | 10.5
24
12

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 1st 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, F. W.

Object,	E Lewis			E Lewis								
Circle,		.45			.22							
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.				+12°33′								
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			25.1			21.9			.			.
II.			27.3			24.0			.			.
III.			29.6			26.1			.			.
IV.			31.9			28.1			.			.
V.			34.2			30.2			.			.
Sum,			148.1			130.3			.			.
Mean,			29.62			26.06			.			.
Bb,			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	9	39	1.29	10	1	57.99			.			.
Error of Timepiece,			.			.			.			.

112 / 45 / 560 / 448 / .50 — 112 / 22 / 224 / 224 / .25

28.33 + .45 = 28.78 — 28.33 + .70 = 29.03

28.07 + .22 = 28.29 — 28.07 + .95 = 29.02

29.02

9 6 14 1327

90 3451

29.02

32.38

+ 2 27.62 Emf 3451

25.4

23 | 22.2 | 2.097

207

150

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 17 1879. Instrument, Mer. Cir. Observer, W. A. R.
Timepiece, 1327 Recorder, F. W.

Object,	ε Regasi		α Aquarii		β Aquarii			
Circle,	.16		.02		.11			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	+9°19′		−0°54′		−6°6′			
	h m s		h m s		h m s		h m s	
Wire, I.		40.0		59.5		36.6		.
II.		42.1		1.5		38.6		.
III.		44.1		3.5		40.8		.
IV.		48.1		7.6		42.9		.
V.		48.4		7.7		45.0		.
Sum,		2 8 7		17.8		20 3 9		.
Mean,		44.14		3.56		40.78		.
Bb,		.		.		.		.
Ce,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	21 38	16.06	21 59	35.09	21 25	13.08		.
Error of Timepiece,		.		.		.		.

28.08 + 1.03 = 29.11
28.47 + 1.18 = (29.65)

27.70 + 1.31 = 29.31
8.42

29.21
29.02 .006 .155
12 1.19
12
70
60
10

1979phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 5 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, D. W.

Object,	ζ Orionis			β Cephei Lc.			α Leonis			γ Leonis		
Circle,		.15		70° 2′ −2.75			.22			.37		
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	5.43		.	.		.	.		.
Difference,				31								
				5.12								
b.	−8° 21′			−8			+12° 33′			+20° 27′		
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			6.7			.			21.1			43.7
II.			9.0			23.0			23.3			45.9
III.			11.0		27	27.1		27	25.4			48.2
IV.			13.1			35.3			27.6			50.3
V.			15.1			.			29.7			52.5
Sum,			149			874			271			406
Mean,			10.98			29.13			25.42			48.42
Bb,			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	5	08	44.06	21	27	5.12	10	1	58.00	10	13	20.50
Error of Timepiece,			.			.			.			.

112 15 560 112 17 120 1.37

26.92 + 1.37 = 28.29

ζ Orionis Reduction

29.21
28.41
35 | 80 | 2.3
70
10

m | 23 | 1.01

114 91 114 1026 1.04 19 1.23

114 22 228 2.28 25 114 37 798 342 .42 123

27.42 + .22n
27.62 + .37n
104 59n
27.52 + .30n
4.01 − 2.75n
3.51 + 3.05n

305 | 351 | 1.14 = n.
305
460
335
1250

27.42 + .98 = 28.40
27.62 + .81 = 28.43
Sum 1327/3451 + 28.41

0.0 = 3451
10 30 50.8 = 1327

28.4 22.4 00 37.6 27.6 10 0

m | 348 | 1.03
24
80

4 | 1990 | 2.48
8
19
16
30

34

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 5. 8 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, H.M.

Object,	β Cephei				ε Pegasi							
Circle,	-.11				.16							
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.	-6°6'				+9°19'							
	h	m	s		h	m	s		h	m	s	
Wire, I.			36.3				39.6				.	
II.			38.4				41.6				.	
III.			40.5				43.7				.	
IV.			42.5				45.8				.	
V.			44.6				47.9				.	
Sum,			02 3 .				18 6 .				.	
Mean,			40.46				3.72				.	
Bb,			.				.				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.	21	25	13 20		21	38	16.18				.	
Error of Timepiece,			.				.				.	

114 27.26 -.11 = 27.26 + 1.35 = 28.61 22 8 00.0 3451

11 27.54 +.16 = 27.54 + 1.01 = 28.55 49.7 1327

114 116 28.6

114 28.58 Error 1327 21.1

1254 28.41 .50

14 11|17.1015 +2 38.9 Error 0851

12 11 37.6

84 60 11.3

14 55 .2|1.35 .112

22 12

15

12

30

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 6. 3 1879. Instrument, Mer. Cir. Observer, W. A. P.

Timepiece, 1327 Recorder, D.W.

Object,	ζ Leonis			ϒ Leonis							
Circle,	.45			.37							
Level Direct,	w		e	w		e	w		e	w	e
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.	+24° 1′			+20° 29′							
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.			23.4			43.9			.		.
II.			25.6			46.2			.		.
III.			27.9			48.3			.		.
IV.			30.0			50.4			.		.
V.			32.3			52.5			.		.
Sum,			39 2 .			241 3 .			.		.
Mean,			27.84			48.26			.		.
Bb,			.			.			.		.
Cc,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	10 -10		00.00	10	+3	20.49			.		.
Error of Timepiece,			.			.			.		.

114
45
570
456
.5136
123
.72

27.84 + .45 m
27.77 + .37 m

27.84 + .72 = 28.56
27.77 + .81 = 28.58
28.57

9 30 48.6 3051 1327
28.57
20.03
60
+2 39.97
3890
1.07
5
12 | 112 | 1.0935
108
40

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 6·8 1879. Instrument, Observer,

Timepiece, Recorder,

Object,	ζ aquarii		ξ Cygni		β Cephei			
Circle,	-.01		.57		+2.75			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.	-0°55'		+29°44'					
	h m s		h m s		h m s		h m s	
Wire, I.		59.3		12.3		12 7 18.5		.
II.		1.3		14.6		24 8		.
III.		3.4		17.0		30 8 36.8		.
IV.		5.4		19.4		42 8 49.0		.
V.		7.4		21.7		54 8 0.8		.
Sum,		16 8		35 0		270 8 60 9|330 8		.
Mean,		3.36		17.00		36.76		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.	21	59 55.79	21	7 48.78	21	27 5.73		.
Error of Timepiece,		.		.		.		.

114
57
798
570
6498
123
58
H

27.57 + 1.14 = 28 8 1
28.22 + .58 = 28.80

1579
27.89 + .28 m
31.03 + 2.75 m
3.14 + 2.47 m

2 47 | 3,14 | 1.27
247
670
494
1760

28.80
28.57
11 | 23 | 1.021
22
10

22 6
9 30
12 36

22 6 47.4 1327
28.8
18.6
60
+ 2 41.4
39.97
1.43
5
12 | 1,38 | 1.15
12
18

3451
Error 3451

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1878phae.proj.1790

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, Mar 7.3 1879. Instrument, Mer. Cir Observer, W.A.R.
Timepiece, 1327 Recorder, [illegible]

Object, Circle,	ζ Leonis .45				ν Leonis .37				ε Cephei Lc.			
Level Direct, Reversed,	w		e		w		e		w		e	
Sums, Difference, b.												
	h	m	s		h	m	s		h	m	s	
Wire, I.			23.6				44.2				.	
II.			25.9				46.2				.	
III.			28.1				48.5				.	
IV.			30.4				50.7				.	
V.			32.7				52.9				.	
Sum,			40 7 .				42 5 .				.	
Mean,			28.14				48.50				.	
Bb,			.				.				.	
Ce,			.				.				.	
Aa,			.				.				.	
Corr'd Transit, R. A.	10	7	59.98		10	13	20.48				.	
Error of Timepiece,			.				.				.	

Polaris −42.96 Lc.												
w		e										
h	m	s										
1	13	32.2										
		37.1										
		42.1										
		57.6										
		4.2										
		12.5										
		28.0										
		33.8										
		41.2										
		288 7										
		48.1										
		5.41										
		.										
		.										
		.										
		33.15										
1	13	9.10										
		.										

28.16 + .45 m Assume m = 1.14
28.02 + .37 m
28.16 + .72 = 28.88
28.02 + .81 = 28.83
1327 28.85

28 85
28 50
12 | 1.00 | .04

9 45 46.5 1327
28.85
17.65
00
42.35 Emf 3451
41.4
95
12 | 100 | 1.084
96
40

39 45
22 6
11 39

+2

00.0 3451

−3.69 −32.74 − 42.96 −
28.09 + .41 m
50.83 + 43.37 m

43.37 | 58.83 | 1.17 = m.
4337
7460
4337
3123

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 8-3 1879. Instrument, Mer Ci. Observer, W.A.K.

Timepiece, 1327 Recorder, G.W.

Object,	ζ Leonis				ν Leonis							
Circle,	.45				.87							
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.												
	h	m	s		h	m	s		h	m	s	
Wire, I.		10	24.2				40.2				44.6	
II.			26.3				42.4				46.8	
III.			28.6				44.6				49.0	
IV.			30.9				46.8				51.2	
V.			33.1				49.0				53.3	
Sum,			431				230				449	
Mean,			28.62				44.60				48.98	
Bb,			.				.				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.	10	9	59.97		10	13	20.47		10	13	20.47	
Error of Timepiece,			.				.				.	

1.17
91
117
1053
106
19
125
53
72

28.65 +.45m
28.51 +.37m

117
45
585
468
526

117
37
819
351
4329
125
.82

28.65 +.72 = 29.37
28.51 +.82 = 29.33
29.35
28.85

24 | 50 | 48 | 2 | .021

9 50 00.0 3451
44.5 1327
29.35
15.15
00
+2 44.85 Smd 3451
42.35
24 | 2.50 | .104
24
100

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 8.8 1879. Instrument, Merc. ii. Observer, W.A.R.

Timepiece, 1327 Recorder, G.H.

Object,	β Aquarii				ε Pegasi							
Circle,	-.11				+.16							
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.	-1°6'				+9°19'							
	h	m	s		h	m	s		h	m	s	
Wire, I.			~~39.3~~				45.7				.	
II.			~~35.4~~ 37.5				42.8				.	
III.			39.5				44.9				.	
IV.			41.7 43.6				47.0				.	
V.			45.7				49.1				.	
Sum,			90 .				245 .				.	
Mean,			31.80				44.90				.	
Bb,			.				.				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.	21	25	13 30		21	38	16.27				.	
Error of Timepiece,			.				.				.	

117 / 11 / 117 / 117 / 1287 / .13 / 125 / 38

28.50 -.11 = 28.63 +.16

28.50 + 1.38 = 29.88

28.63 + 1.07 = 29.70 / 158

117 / 16 / 702 / 117 / 1872

29.77 / 29.35 / 11 / 1.44 / 1.04 / 29.79 / 29.75 / .84

20 30 43.6 / 327 / 29.77 / 20 30 13.83 / +2 46.17 / +4.85 / 1.32

1127 / .127

29.79 / .84 / 30.63

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 9 1879. Instrument, R.J. Observer, [illegible]

Timepiece, 236 Recorder, [illegible] 28 05

Object,	ζ Virginis	6 Canum venat.	28 Comae	K Draconis
Circle,	W	W	W	+70° 28'
	w / e	w / e	w / e	w / e
Level Direct,	22·7 / 9·3	. / .	. / .	. / .
Reversed,	21·6 / 11·0	. / .	. / .	. / .
Sums,	44 3 / 20 3	. / .	. / .	. / .
Difference,	24 0 / 180			
b. +.80	+0° 1'	+39° 42'		
	h m s	h m s	h m s	h m s
Wire, I.	13 45.7	44.4	I .	II 44.0
II.	6.8	20 12.3	51.2	55.0
III.	28·4 (3)	40.2	1.8	.
IV.	49·4	7.2	12.5	16.2
V.	12 15 10·6	21 34.5	27 23.2	28 27.0
Sum,	100 9 .	1386 60 19 8 . 6	65 5 .	142 2 1 22 . 2
Mean,	28.18	39 7 2	1.83	5.55
Bb,	.	.	.	.
Ce,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	.	.	.	.
Error of Timepiece,	.	.	.	.

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1878phae.proj.1798

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 9 1879. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,						ζ Virginis		ζ Virginis			
Circle,											
	w		e		w		e		w		e
Level Direct,	.		.		.		.		21.6		11.0		.		.
Reversed,	.		.		.		.		.		.		.		.
Sums,	.		.		.		.		.		.		.		.
Difference,															
b.									-0°46'				+4°4'		
	h	m	s		h	m	s		h	m	s		h	m	s
Wire, I.	IV		.		V		54.5				34.1				33.1
II.			.				—			35	55.2			49	54.4
III.			.				15.2				16.4				15.6
IV.			22.4				26.3				37.7				37.0
V.		30	33.5			31	37.0				59.2				58.2
Sum,			.				106 7				202 6				.
							6m 46.7				12m 8,56				
Mean,			.				15,57				16 5.2				.
Bb,			.				.				.				.
Cc,			.				.				.				.
Aa,			.				.				.				.
Corr'd Transit,			.				.				.				.
R. A.			.				.				.				.
Error of Timepiece,			.				.				.				.

55 13.7

12 57 9.15 2.36

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 10 1879. Instrument, Merc Cir Observer, ...

Timepiece, ... Recorder, ...

Object,	β Leonis			δ Virginis			γ Cephei Sc.					
Circle,	27			39								
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	15° 14'											
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.		43	21.1			8.0			.			.
II.			23.2			10.3			.			.
III.			25.4			12.5			.			.
IV.			27.6			14.7			.	R m s		.
V.			29.7			17.0			.	1 13 5		.
										1 13 38		.
Sum,			27.0			12.5			.			.
Mean,			5.40			12.50			.			.
Bb,			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	11	42	55.98	11	7	43.09	11	34	20.74			.
Error of Timepiece,			.			.			.			.

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1879phae.proj.1900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 12, 1879. Instrument, ... Observer, ...

Timepiece, ... Recorder, ...

Object,	γ Ursæ Maj.			ε Virginis							
Circle,											
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.	+54° 22′				+11° 36′							
	h	m	s		h	m	s		h	m	s	
Wire, I.			45 s 6				38.1				.	
			50 . 2									
			54 7									
II.			59 . 3				40.1				.	
			3 7									
III.		28	7 . 3				42.2				.	
		3.56	11 8									
IV.			15 . 5				44.3				.	
			20 . 0									
V.							46.4				.	
			38 1				21 1 1					
Sum,			.				.				.	
Mean,			3 . 56				42 . 22				.	
Bb,			.				.				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.			.				.				.	
	11 47		31 26		12	56	12.17					
Error of Timepiece,			.				.				.	

139
117
973
139
139
-1.6263
+125
37
117
234
125
1.02

32.30 − .37 = 31.97

30.05 + 1.02 = 31.07

31.07
30.28
2 | .79
.40

13 30 36.6 1377
23.4
12 36.6
31.1
5.5
000
54.5
60 0
5 5

54.5
49.6
4.9 | 25
2 | 465
24 | 2.32 | .097
216
160
168

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 13 1879. Instrument, Mer. Cir. Observer, W.A.R

Timepiece, 1327 Recorder, G.W.

Object,	ψ Urs. Maj.			δ Leonis			β Leonis				
Circle,	1.00			.39			.27				
	w		e	w		e	w		e	w	e
Level Direct,	.		.	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	.		.	.		.	.		.	.	.
Difference,											
b.	+45°9'			+21°1.9			+15°.14				
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.		3	19.1			8.3			21.2		.
II.			22.1			10.5			23.4		.
III.			25.0			12.7			25.6		.
IV.			27.9			15.0			27.6		.
V.			30.8			17.1			29.8		.
Sum,			24 9			13 6			27 1		.
Mean,			24.98			12.72			25.52		.
Bb,			.			.			.		.
Cc,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	11	2	54.37	11	7	42.96	11	12	55.95		.
Error of Timepiece,			.			.			.		.

117 30.61
125 -9.76
117 20.57
35
1053
351
45
125
50

117
27
819
234
32
125
93

+.08 = 30.69
+80 = 30.56
+93 = 30.50
175
30.58

3451
11 30 33.5 1327
30.58
2.92
Lee
+ 12 57.08
54.50
2.58
20
24 | 278
24
38
24
14

1.112 Table of 3451

1970phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 14 3 1879. Instrument, Mer. Cir. Observer, W. A. R.

Timepiece, 1327 Recorder, F. W.

Object, Circle,	γ Virginis −.01		ε Virginis +.21		δ Cassiop. Le. −1.70		γ Cassiop. Le. −1.73	
	w	e	w	e	w	e	w	e
Level Direct, Reversed,	. .	. .	. .	. .	. .	. .	. .	. .
Sums, Difference, b.	. . −8 47′		. . +11° 36′		. . 59° 36′		. . +60° 11′	
	h m s		h m s		h m s		h m s	
Wire, I.	59.1		56 36.9		4.5		42.7	
II.	1.2		38.9		8 5		46.7	
III.	3.2		41.0		12 5		50 8	
IV.	5.3		43.1		16.8		55.0	
V.	7.3		45.3		20 7		59.1	
					25 0			
					28.8			
Sum,	16 1		5 1		3 8		4 3	
Mean,	3.22		41.02		20.76		50.86	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	12 35 64.63		12 56 12.17		13 14 54.72		0 49 24.89	
Error of Timepiece,	.		.		.		.	

91 / 158 / 455 / 91 / 1.365 / 19 / 1.155

.2 / 1.5 / 21 / 15 / 30 / .31 / 1.55 / 1.24

28.59 −.01 m
28.85 +.21 m
144
28.72 +.10 m
26.04 −1.70 m
2.68 + 1.80 m =

180 | 2.68 | 1.49 = m.
180
880
720
160

28.72 +10 m
25.97 −1.73 m
2.75 − 1.73 m
183 | 275 | 1.50
183
+920
915
50

28 59

28.59 + 1.56 = 30.15
28.85 + 1.24 = 30.09
24
30.12 Env 1327.

13 46 29.95 = 1347
30.12
59.83
60
+3 00.17
57.08
3.09
24
24 | 285 | 11.9
24
45
24
210
216

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 15 1879. Instrument, R. J. 324 5 Observer, D.P.

Timepiece, 1327 Recorder, D.P.

Object,	ο Virginis		4 H Draconis							
Circle,	W		W		W		E	
Level Direct,	w	e	w	e	w	e	w	e
Reversed,	21.6	7.2	.	.	.	.	.	.
	.	.	.	.	.	.	.	.
Sums,	.	5.4 36	.	.	.	.	.	.
Difference,		4 0 35						
b. +.86		12 5 37						
		16 2 37						
		19 9 35						
	h m s		h m s		h m s		h m s	
Wire, I. 34		27 2 36	I	3 7.3	II	52.2	IV	20.6
II. 15 170		30.8 34		24.3 17.0		9.1		37.7
III. 34 510		34 2 34		41.7 17.4		27.0		8 55.4
IV.		37 6 37		59.2 17.5		44.6		12.7
V.		41 3 36		16.6 17.4		1.8		30.5
	12 0	48 3 39			6			
		52 2 35						
		55.7 35						
		59 2 35						
		2.9 37						
Sum,		452 4		149 1		134 7		156 8
		60		60				120
Mean,		512.4		209.1				276.8
		102.48						
		34.16		41.82		26.94		55.36
Bb,	.85	+.73		+3.44				
Cc,	1.02	-.09		-.43				
Aa,	.55	+1.21						
Corr'd Transit,		36.01						
R. A.	11	59 05.47	12	6 37.70				
Error of Timepiece,		30.54						

21.258
2.89
191322
170064
42516
61.43562

12.871

I
41.82
2 2.87
44.69

21.258
4.93
63774
191322
85032
104.80194
20.960

26.94 I. II. IV V
+ 41.82 26.94 ~~40.48~~ 14.09
29.60 44.80 ~~44.80~~ ~~39.60~~
~~31.42~~ ~~1.74~~ 55.36 40.48
11.42 11.74 44.80 29.60
11.42 10.56 10.88
1.16 10.56
mean. 11.58 W 144
10.72 E 10.72
2 86
493 | 43 | +.09 = C. C.E.
4437

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1879phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 15 1879. Instrument, R. T. Observer, F.W.

Timepiece, 1327 Recorder, F.W.

Object,	4 Hydrae			γ Virginis							
Circle,	E										
	w		e		w		e		w		e
Level Direct,	.		.		20.4		8.6		20.4		8.6
Reversed,	.		.		21.3		7.8		21.4		7.5
Sums,	.		.		.		45 5 / 49.9 / 52 4 / 56 2		41 8 / 16 1		16 1
Difference,									25.7		.
b. +.86							13 59 7		.86		
	h	m	s		h	m	s		h	m	s
Wire, I.	V		5.4				6 8 35			14 .	.
II.			23.3				10 3 38			15	.
III.			40.7				14 1 34			210	.
IV.			57.6				17 5 38			5 11	.
V.		11	15.4				21 3 38			301	.
							28 1 36				10.72
							31 7 34				3.44
							35 1 38		15 | 2113 | 14.09		.43
							38 9 35		15		14.59
					14	42.4			61		
Sum,		1424				511 3			60		
		6				300			130		
		2024				211 3					
Mean,		40.48				14.09					
Bb,	4.00	+3 44		.74		+.64		12	α'−α		t−t
Cc,	4.93	+.43		1.00		+.09			13 45.67		14.82
Aa,	−2.89	.		.67		+1.46			6 37.70		14.59
									7 07.97		.00.23
									0.23		
Corr'd Transit,		.				16 28			3.56 | 7.74 | +2.18 (a)		
R. A.		.							71.2.		
				12	13	45.67			6.20		
									3 56		
									264		
Error of Timepiece,		.				30.61			.		

α'−α
12 6 37.70
11 59 05.47
7 32.23

t'−t
11.58
+3.44
−.43
14.59
34 80
39.79
32.23
−3.44 \| −7.56 \| +2.20 (a)
6 88
6 80

30.61
30.54
115
30.58

218
67
1526
1308
14606

74 86 86
86 86 85
444
592
6364
86
4
344

6430
688
7310
55
22
110
110
1.21

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 16.3 1879. Instrument, Russ. Jr. Observer, FW.

Timepiece, 1327 Recorder, FW.

Object,	3 Urs. Maj. Br		ζ Virginis				
Circle,	E		E				
	w	e	w	e	w	e	w	e
Level Direct,	20.8	9.0	.	.	20.8	9.6	.	.
Reversed,	20.6	9.2	.	.	20.6	9.2	.	.
Sums,	.	+55°33' 47 0 53 3 59 6 1 0 122	0' .	35 4 39 0 42.3 46 1 49.6 567	41 4 18 2 3|23.2 .77	18 2	.	.
Difference,								
b. +.77								
	h m s		h m s		h m s		h m s	
Wire, I. 374 15		24 8		29 56 8 7		.		.
II. 1870 374 5-61 0		31.0		0.1		.		.
		19 37 4-		3 8 -		.		.
III.		43 5		4.2		.		.
		49 8		10 9		.		.
IV.		2 3		17 9		.		.
		8 5		21.5		.		.
V.		15 0		25 0		.		.
		21.2		28.7		.		.
		29 6		32 1				
Sum,		439 2 120 559.2		416. 2 360 56.2		.		.
Mean,		111.84 37.28		11.24 3.75		.		.
Bb,	1.72	+1 32	.74	+ 56		.		.
Cc,	1.77	+ .16	1.00	+ .09		.		.
Aa,	-.40	-.88	+.67	+ 1.47		.		.
Corr'd Transit,		37 88		5 87		.		.
R. A.	13 19	6 93	13 28	34.74		.		.
Error of Timepiece,		+ 30.95		+ 31.13		.		.

C = +.09

A = +2.20

31.13
31.13
30.95
3 21
31.07

31.07
30.61
25 | 46

00 34 51
13 48 25.00 1327
31.07
53.93
60
+3 06.07
5 00.17
48 | 590 1.1
48
110
96
140
144

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1879phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 18.3 1879. Instrument, R. Y. Observer, FW.

Timepiece, 236 Recorder, FW.

Object,	12 Cam. Tm.	Eniquin	43 Comae	
Circle,	W	W	E	
Level Direct,	w 20.4 | e 7.5	w . | e .	w 20.9 | e 7.2	w . | e .
Reversed,	. | .	. | .	. | .	. | .
Sums,	+38°59'	+11°28'	+28° 30'	213 | 147
Difference,	54 / 7 / 37.8	.	.	66
b.	+.86			

		h m s	h m s	h m s	h m s
Wire,	I.	21.8	.	56.4	20.5 7.5
	II.	35.7	18.7	6 20.7	20.4 7.5
	III.	1997 / 1 Lew / 35.97 — 46.8	40.4	45.0	40.9 15.0
	IV.	54.3	57 22	9.3	15.0 / 3 25.9 / .86
	V.	3.3	.	7 33.7	.
Sum,	1997	12 51 22.4	61 3	16 5 1	15 0 5
Mean,		54.1	40 43	45 02	54.1
Bb,		1.28 +1.10	.88 +.75	1.11 +.96	
Ce,		1.29 +0.12	1.00 +.09	1.13 +.11	
Aa,		+.04 +.17	.52 +1.15	.27 +1.59	
Corr'd Transit,		55.49	42.42	46.46	
R. A.		12 51 25.15	12 56 12.15	13 6 16.68	
Error of Timepiece,		30.74 / 30.54 / +30.10	+30.27 / +30.09	+29.78 / +30.00	

86 88 88 88 / 68 8 / 96 / 756 8

128 / 86 / 768 / 1024 / 1,100 8

B-H: 14.15

27 22 54 / 52 22 54 / 104 / 105 / 115 / 594

30.44 / 30.27

30.16 / 30.09 / 30.00 / 19

52.3 236 + 30.06 Mean Error

55 0 13.7

35 / 35 / 38

32.76 / 84 / 33.60

55 236 / 36.65 - 3451

55 / 30.06 / 24.94 / 36.65 / +3 11.71 Error of 3451

52.3 / 30.06 / 22 24 / 55 00 / 32.76 / 38 / 33.14

32.76 / 31.07 / 1.69 / 24 | 84 | 1.35 / 72 / 120

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 20 1879. Instrument, R. T. Observer, F.W.

Timepiece, 1327 Recorder, F.W.

Object,	Originis		4 Draco.		γ Virginis		κ Draconis.
Circle,	+49°24' W		+78°17' W		W		+70°27' W
	w	e	w	e	w	e	w	e
Level Direct,	20.5	8.0	.	.	.	.	.	.
Reversed,	.	.	13 [illegible]	.	+0°0' .	.	.	.
Sums,	11 53	9.7		55.7	. 7	50.1		26 36.0
Difference,	.	13.2	.59	13.4	.	53.6	.	.
b. +.84		17.0		30.6		57.0		
		20.5		48.7		0.6		
		24.0		45.5		4.1		
	h m s		h m s		h m s		h m s	
Wire, I.	11	31.2		57.2		11.4		20 31.0
II.		34.9	1	25.3		14.8	I	41.4
III.		38.4	13+1992	32.4		18.3		52.0
IV.		41.9		25.7		22.0		2.2
V.		45.5		42.0		25.5		13.3
		52.6		0.0		32.6		
		56.3		17.3		36.8		
		0.0		35.0		39.8		
		3.5	195			43.3		
		7.1				46.9		
Sum,	3958	3958	3792	3792	4561	45 6 1		1399
	180	120	1800	+00.	180	120.		120
	5758	5158	1992	2192	7 6 4	3 3 6 1		2599
	11516	10316	3978	4384	55.22	6 7 22		
Mean,	38.39	38.39	13.98	14.61	18.41	22 37		59.98
		38.34	15.32			18.41		
Bb,	.85	+.71	+4.00	336	.74	+.62	2.63	.
Cc,	1.02	−.03	4.92	−.15	1.00	−.03	2.99	.
Aa,	.55	+1.21	−2.89	.	.67	+1.47	−1.41	.
Corr'd Transit,		5.43		.		20 47		.
R. A.	11 59	5.143	12 6	37.31	12 13	45.64	12 28	23.32
Error of Timepiece,		34.85		.		34.83		.

42.516
.299
38.2644
38.2644
8.5032
127.122.54

51.98
7.12
59.10
58.92
2.18

6.04
7.12
58.92

3 | 1.09 | .03 + C.E = C.
.03 − C.W.

34.85
34.83
34.73
34.74
35
+34.79

Error 1327

α' − α
12 13 45.64
12 6 37.31
7 08.33
4.37
3.96
7 08.33
00.47
356 | 7.86 | 12.21
712
740
412
381

t' − t
29.90
19.03
18.53
4.37
00.47

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1879phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

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

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

Object,	K Draconis			ε Ursæ-Maj.			ι Cam.				
Circle,	E			+56°37' E			+38°58' E				
	w		e	w		e	w		e	w	e
Level Direct,	.		.	20 .8		8 .1	.		.	20 .5	8 .0
Reversed,	.		.	.		.	.		.	20 .8	8 .1
Sums,	.		.	42	24	.	~~44~~		.	41 3	16 1
Difference,	.		.	.	35.0	.	.		.	16 1	.
b.	+.84				41.4					3 | 25 2	
					47.5					.84	
					54.2						
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.		24	44.8			16.6		44	49.8		.
II.	~~IV~~		55.6			13.5 / 20.0			53.9		23 51.5
III.			5.9			26.4 / 33.0			58.7		1.9
IV.			16.5			45.5 / 52.0			3.0		13.0
V.			27.4		44	52.6 / 59.0 / 11.8			7.5		23.2
Sum,		15 0 2 / 60. / 120 / 30. / +.04				48 1 0 / 180 / 301.0			172 9 / 120 / 292.9		
Mean,		6.04				60.20 / 30.07			58.58		
Bb,			+2.20	1.75		+1.47	+1.28		+1.07		
Cc,			+.09	1.82		+.05	+1.29		+.04		
Aa,			.	-.45		-.99	+.08		+0.18		
Corr'd Transit,			.			30.60			9.87		
R. A.			.	12 48		~~33.43~~ 45.87	12 50		25.13		
Error of Timepiece,			.			34.73			34.74		

α'-α'

12 50 25.13
28 23.32
2201.81
~~8.13~~
58.38
+149 \| +3.43 \| +2.30 = a.
298
450
447
30

59.01
2.20
61.21

+'- +
59.69
61.21
58.38

55
22
110
110
121

67
22
134
134
1474

263
84
1052
2104
220

45
22
90
90
176

175
84
700
1400
147

128
84
512
1024
107

85
86
340
680
71

84
74
336
588
621

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 21 1879 Instrument, R. T. Observer, W. H.

Timepiece, 1327 Recorder, W.

Object, Circle,	ν Bootis E.		μ Bootis E.		ε Coronae E.		Glas Mins, E.	
	w	e	w	e	w	e	w	e
Level Direct,	19.√	10.√	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
		10 41.3		19 57.1		29 39.7		
Sums,	.	45.4	.	1.6	.	43.7	.	.
Difference,		49.√		6.0		47.√		
b.		√4.0		10.7		51.6		
		√1.1		1√.1		55.6		
	h m s		h m s		h m s		h m s	
Wire, I.		6.√		24.0		30 3.6		4√ √.0
II.		10.9		28.7		7.3		
		1√.3 −		33.1 −		11.6 −	I	24.4
III.		19.6		37.1		1√.6		
		24.0		42.2		19.4		41.4
IV.		32.3		√1.1		27.6		
		36.4		√√.√		31.√		58.0
V.		40.8	21	0.2		3√.3		
		4√.0		4.4		39.3		1√.8
		49.3		9.0		43.4		
Sum,		.		.		.		.
Mean,		.		.		.		.
Bb,		.		.		.		.
Cc,		.		.		.		.
Aa,		.		.		.		.
Corr'd Transit,		.		.		.		.
R. A.		.		.		.		.
Error of Timepiece,		.		.		.		.

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1970phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

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

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

Object, Circle,	ζ Ursæ min. W.		δ Ophiuchi W.		π Herculis W.		β Herculis. W.	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	24.0	8.0
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	8 9.4		16 3.4		
				13.0	.	7.9	.	.
Difference,				16.5		14.3		
b.				20.1		19.1		
				23.7		24.3		
	h m s		h m s		h m s		h m s	
Wire, I.	52 2.2			30 6		34.1		.
				34.2		39.8		
II.	V 19.6			37.8		44.5		.
				41.3		1.2		
III.	37.6			45.0		55.1		.
				52.1	17	1.1		
IV.	52.7			55.7		11.0		.
				59.3		16.0		
V.	11.9			2.8		20.8		.
			9	6.0		25.9		
Sum,	.		.		.		.	
Mean,	.		.		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	.		.		.		.	
Error of Timepiece,	.		.		.		.	

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 22 1879. Instrument, Russ. Tr. Observer, HW.

Timepiece, 1327 Recorder, HW. Chronogr.

Object, Circle,	κ Ursæ Majoris +48°28' W		β Leonis +15°41' W		β Virginis +2°27' W		ζ Ursæ Majoris +55°33' E	
	w	e	w	e	w	e	w	e
Level Direct,	21.1	9.7	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	35 8 41 3 46 8	.	18 36 54 39 9.2 35	.	32 8 36 1 33 39.9 38	.	53 0 59 3 5.2
Difference,		52 0		12 7 39		43.2 33		11 .3
b. +.75		57 6		16.6		47.0 38	19	17 .7
						70		
	h m s		h m s		h m s		h m s	
Wire, I.	7 9		238 37		54 0 35		38 9	
II.	40 13.6 18.7		143 27.5 26 38.1		57.5 38 45 01.3		19 36.3 42.6	
III.	24 0 29.6		34.5 38.3		08 1 15.0		49.3 55 3	
IV.	34 9 45.5		45 7 49.1		19 0 22.4		8.7 14 14.4	
V.	51 0 55.9		53 0 56.7		25 8 29.4		20.5 26 9	
	1.3		0.6				33.0	
Sum,	55 0 9 14 0 0 280.9		406 0 40 466 0		431 5 420 0 11.5		464 4 180 644 4	
Mean,	56.18 18.73		93.20 30.07		2.30 01.77		128.88 42.96	
Bb,	1.49	+1.12	92	+.69	77	.57	1.72	1.29
Cc,	1.50	-.07	1.04	-.05	1.00	-.05	1.77	+.09
Aa,	-.16	-.37	.48	1.12	.64	1.80	-.40	-.94
Corr'd Transit,		19.41		2.73		3.79		3.40
R. A.	11	39 42.56	11 42	55.87	11 44	26.09	13 29	06.84
Error of Timepiece,		+36.85		+36.86		36.70		36.56

Assuming Collins +.05 C.C.

3451 = 0.00
1327 = 13 35 15.35
36.9
34 38.45
50
+3 21.45 Error of 3451

36.89
36.90
36.74
37.03
27 56
36.89 Error of 1327.

t : t
49.11
2.29
44.27
4.84
1.09
134 | 3.75 | 2.
268
1070

23 7.93
2.06.84
1.09

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1979phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 22 1879. Instrument, R. T. Observer, F.W.

Timepiece, 1327 Recorder, F.W.

Object,	gr. 2001		~~Sagittarii~~						ζ Virginis		
Circle,	E +73°1′		E						+0°1′ E		
	w	e	w	e	w	e			w	e	
Level Direct,	.	.	.	.	.	.			21.5	10.4	
Reversed,	.	.	.	.	.	.			21.1	9.7	
Sums,	.	.	.	.	.	.			42.6	20.1	
Difference,	.	.	.	.	.	.			3)22.5	.	
b. +.75									.75		
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	III		32.2	IV		35.8	V		47.8	V		45.0
II.			35.0			47.6			59.8			48.7
III.			46.4			59.7		26	12.0			52.1
IV.			58.6			11.3			22.8			55.6
V.		24	10.17		25	23.3			35.4	13	29	59.3
Sum,			17 29 32.7			17 59 29.7			17 57 57.8			26 07 42.51
Mean,	mean.		46.58 46.73			59.54			11.56			52.14 09.63
Bb,	2.95		2.21			12.50			21.60	.74		+.55
Cc,	3.42		+.17			47.04			46.56	1.00		. +.05
Aa,	-1.74		.	46.58 47.04 46.56 2.18 46.73		.			.	.67		+1.57
Corr'd Transit,			.			.			.			11.80
R. A.	13	23	7.93			.			.	13	28	34.70
Error of Timepiece,			.			.			.			37.07

α′−α

13 28 34.73
23 7.93
5 26.80
2.1.12
2.41 | 5.68 | + 2.35 = (a)
482
860
723
1330
1205
125

t′−t

52.74
49 1 1
43.63

10.23
49.11
21.12

21.258
342
42516
8 3 0 3 2
6 3 7 7 4
7 2.5 0 2 3 6
2
145.00
3.42
1710
21.258
42.51

42.516
18.73
+1.07
-.07
+.35
19.40
42.56
36.84
+.08
36.92
24.96
36.94 mean.
34.70
2.15 | 1.08
60
36.94
37.54

52.14
42.52
09.62
34.73
34.89
+.55
+.05
+1.47
36.96

75 14 300 525 55
67 22 134 134 1.47 4
149 75 5 2.5 107
22 16 32 32

1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 22 1879 Instrument, R. T. Observer, W.
Timepiece, 1327 Recorder, W.

Object, Circle,	4 H Draco. W.		Urs. Maj. W.		η Virginis. W.		K Draco W	
	w	e	w	e	w	e	w	e
Level Direct, Reversed,	78° 14'.		57° 42'.		22 0° 01' . 1	9 . 2	70° 27'.	
Sums, Difference, b. +.78	.5	57.7 15.9 33.3 51.2 8.3	IV 228.7 45.74 5.99	32.5 39.3 45.8 52.0 59.1	14	52.1 55.7 59.0 3.0 6.3		
	h m	s	h m	s	h m	s	h m	s
Wire, I. II. III. IV. V.	16.8 15 7 8 9	42.3 0.8 16.8 35.7 52.8 28.2 45.4 2.0 19.6 37.3	V 11 128.2 25.64 6.14 6.07	12.6 19.2 25.4 32.1 38.9		13.8 17.1 20.4 24.1 27.3 34.4 38.3 41.8 45.3 48.9	I 26	32.9 43.6 54.3 4.8 15.2
Sum, Mean,		447.3 180. 267.3 53.46 17.82		.9 6.07		487.5 180 307.5 61.50 20.50		150.8 120 270.8 54.16
Bb, Cc, Aa,	+4.00 +4.92 −2.89	+3.12 −.49	+1.80 +1.87 −.50	+1.40 −.19 −1.11	+.74 +1.00 +.67	+.58 −.10 +1.49	2.68 2.99 −1.41	+2.05 −.30 ~~−1.49~~
Corr'd Transit, R. A.	12 6	37.15	12 9	6.17 29.68	12 13	22.47 45.62	12 28	23.24
Error of Timepiece,				36.49		36.85		

3 22 1

H

57.7
75.9
93.2
111.3
128.3
160.8
180.8
196.7
215.7
232.2
268.4
285.0
302.6
319.3
337.8 / 197.8 / 17.8
15) 2967 / 15 / 146 / 135 / 117 / 105 / 12

1.80
.78
1440
1260
14040

−1.30
.38
−6.07
5.69

42.516
2.99
382644
382644
85032
127.12284
54.16
181.28

407.3
240.0
167.3

407.3
120.0
287.3 / 18
15) 287 / 15 / 137 / 135 / 17

7.80
127.12
0.68
1.28
−.60
−.30
−.10 = c circle west.

20.7
1.97
20.50
22.47

7.47
1.30
6.17

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

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

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

Object,	κ Draconis		γ Virginis		ι Virginis						
Circle,	E		E								
	w		e		w		e		w		e
Level Direct,	20.5		10.0		.		.		21.0		10.5
Reversed,	.		.		−0° 4′.		.		+4° 3′.		.
Sums,	.		.		.		35 41.0		49		39.9
							44.5				43.7
Difference,	.		.		.		48.0		.		46.8
							51.4				50.5
b. +.78							54.9				54.1
	h	m	s		h	m	s		h	m	s
Wire, I.	37	30	46.4		36		2.4		50		1.4
							5.7				4.7
II.			58.0				9.3				8.3
							12.5				11.7
III.			7.2				16.2				15.3
							23.4				22.5
IV.			18.8				27.0				25.5
							30.6				29.7
V.			28.6				34.1				33.1
							37.5				36.7
Sum,			159.0				438.8				424.2
			120.				300.				300.
Mean,			39.0				138.8				124.2
			7.80				27.76				24.84
							9.25				8.28
Bb,			.		+.73		+.57		+.79		+.62
Cc,			.		+1.00		+.10		+1.01		+.10
Aa,			.		+.68		+1.52		+.64		+1.43
Corr'd Transit,			.				11.44				10.43
R. A.			.				.				.
					12	35	34.58		12	49	33.48
Error of Timepiece,			.				36.86				37.02

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 23. 1879. Instrument, R. T. Observer, W.

Timepiece, 1327 Recorder, W.

Object,	γ Virginis.			ι Bootis							
Circle,	+0° 1′ E.			+19° 49′ E.							
	w		e	w		e	w		e	w	e
Level Direct,	21 : 0		12 . 8	.		.	21 : 0		12 : 8	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	~~IV~~		25. ✓	1st four wires			42 5		25 . 8	.	.
			29. 0				25 ✓				
Difference,	1622.		32. 3	Band IV.			3 17 . 0				
	32.44		35. 8				.57				
b.	31.26		39. 6								
	~~1.86~~										
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	V		46. 9			3 . 1			.			
II.			✓0 . 1	32.4		6 . 8			.			
III.	2080		✓3 . 8	10.8		10 . 9			.			
IV.	2689		✓7 . 1	~~3 ✓ ✓~~		14 . 7			.			
V.	53.74		0 . 8	~~7.10~~		.			.			
	42.52											
	11.22											
			~~10.86~~			10 . 8						
Sum,			11 . 18			22 . 53			.			
			11 . 22									
Mean,			11 . 20			47 . 27			.			
Bb,	+.74		+.42	+.99		+.56			.			
Cc,	+1.00		+.10	+1.06		+.11			.			
Aa,	+.67		+1.51	+.41		+.91			.			
Corr'd Transit,			13 23 .			48 85 .			.			
R. A.	13	28	34.72	14	10	11 . 67			.			
Error of Timepiece,	13	2	+38 51 .			+37 . 18			.			

21.258
106
127548
212580
22533

220
.67
1571
1358
1511

223
41
223
892
.91

74
57
518
370
.421

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 14 3 1879. Instrument, Mer. Cir. Observer, W.A.R.

Timepiece, 1327 Recorder, F.W.

Object,	ν Virginis			ε Virginis			δ Canis Ml.					
Circle,	−.01			+.21			−1.70					
	w		e	w		e	w		e	w		e
Level Direct,	.		.	.		.	.		.	.		.
Reversed,	.		.	.		.	.		.	.		.
Sums,	.		.	.		.	.		.	.		.
Difference,												
b.	+.14											
	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.			.			.			.			.
II.			.			.			.			.
III.			.			.			.			.
IV.			.			.			.			.
V.			.			.			.			.
Sum,			32 .			.			.			.
Mean, t		36	32.2 / 3.22		56	41.02		18	20.76			.
Bb,			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A. α	12	35	34.63	12	56	12.17	13	17	54.72			.
Error of Timepiece,			.			.			.			.

$0 = 28.59 + m - .01n + \Delta t$

$0 = 28.85 + m + 21n + \Delta t$

144

time $0 = -28.7n + m + .10n + \Delta t$

Polar $0 = 26.04 + m - 1.70n + \Delta t$

$0 = -2.68 + 1.80n$

185 | 2.68 | 1.49 = n.

185: 18 → 880, 720, 1600

149: 21 → 149, 298, 30

$0 = 28.59 + 1.51 - .01 + \Delta t$

$0 = 28.85 + 1.51 - .30 + \Delta t$

$\Delta t = -30.10$

$\Delta t = -30.06$

$\Delta t = -30.08$

Sent 1327.

$n = \sec\varphi - n\tan\varphi$

$\sec\varphi = 1.35$

$\tan\varphi = .91$

135 / 14 → 540, 135 → 189°

.19 = sec φ.

145 / 91 → 145, 1305 → 1.32 → .14

n = 1.51

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 24 1879 Instrument, R. V. Observer, W.

Timepiece, 1327. Recorder, W.

Object,	γ Ursæ Maj.				γ Bootis				τ Virginis				δ Draco,						
Circle,	E.				E.				E.				E.						
	w		e		w		e		w		e		w		e				
Level Direct,	.		.		.		.		26.8		11.5		2nd band						
Reversed,	+49°55'		.		+19 0.		.		22.0		10.9		+64°57'		.				
Sums,	19	42	43.3		13	49	5.8		42.8		22.4		.		.				
	.		48.8		.		9.3		22.4		40.9								
Difference,			54.2				13.2		20.4		44.5								
			59.4				16.7		3/		51.7								
b.		43	5.3				20.7		+.68		55.4								
	h	m	s		h	m	s		h	m	s		h	m	s				
Wire, I.			16.1				28.2				2.6			14	0	41.8			
II.			21.7				31.7				5.9					50.9			
III.			27.2				35.7				9.4					58.7			
IV.			32.5				39.4				12.9								
V.			38.7				43.2				16.5		II						
			49.3				50.8				23.5								
			54.7				54.6				27.1			1	7.0				
		44	0.5				58.1				30.5								
			5.9			50	2.0				34.0					14.9			
			11.3				5.7				37.9								
Sum,			468.9				415.1				9.39					173.3			
			60				120									120			
			408.9				535.1									293.3			
Mean,			27.26				35.67									58.66			
Bb,	+1.54		+1.05		+.98		+.67		+.77		+.52		+2.18			+1.48			
Cc,	+1.56		+.16		+1.06		+.71		+1.00		+.10		+2.36			+.24			
Aa,	-.21		-.47		+.42		+.94		+.64		+1.43		-.91						
Corr'd Transit,			28.00				37.39				11.44					59.24			
R. A.	13	42	49.81		13	48	58.51		13	55	32.47		14	1	11.01				
Error of Timepiece,			38.19				38.85				38.97					58.58			

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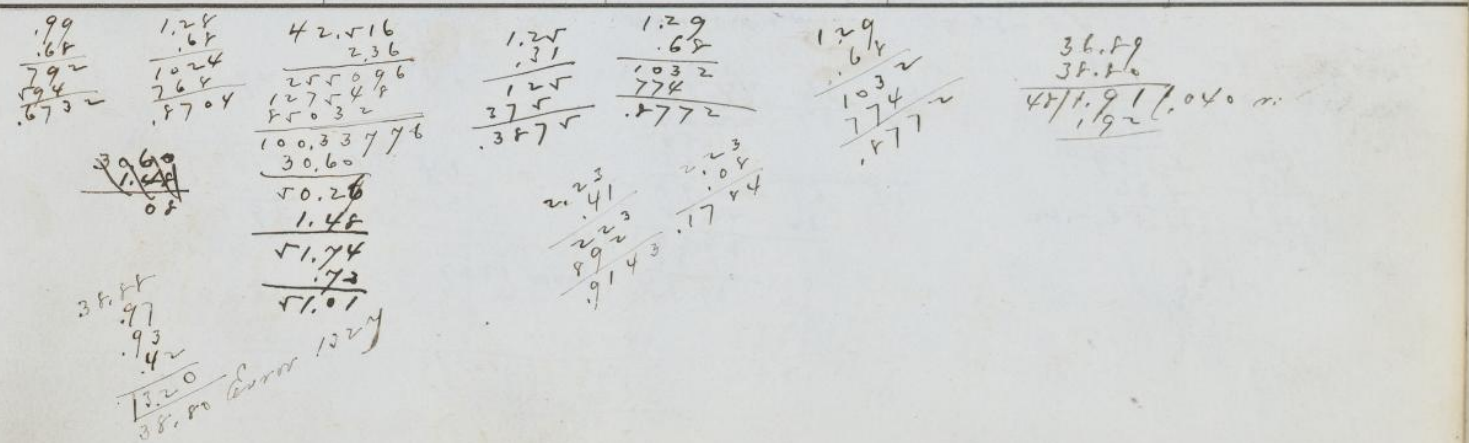
1878phad.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

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

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

Object, Circle,	δ Draco. W.		δ Bootis. W.		φ Virginis. W.		γ Bootis. W.	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	22.0	40.9
Reversed,	.	.	+19 49	.	.	.	+38 √0	.
Sums,	.	.	14 10 19.0		.	.	14 27 16.√	
Difference,			. 22.√				. 26.6	
b.			26.4				26.0	
			30.2				30.√	
			34.2				35.0	
	h m s		h m s		h m s		h m s	
Wire, I.	14 3 13.7		41.7		.		44.0	
II.	21.9		45.3		II		48.9	
III.	30.0		49.2		+		√3.1	
IV.	38.8		√3.0		IV		√7.7	
V.	47.4		56.8		.		28 2.√	
			11 4.0		very		11.3	
			7.9		faint.		16.1	
			12.0				20.√	
			15.√				25.1	
			19.2				29.7	
Sum,	151.8		436.9		.		488.√	
	30.60		300.				360.	
Mean,	.		736.9		.		848.√	
			49.13		.		√3.23	
Bb,	.		+.99	+.67	.		+1.29	+.88
Cc,	.		+1.06	+.11	.		+1.2√	+.12
Aa,	.		+.41	+.91	.		+.08	+.18
Corr'd Transit,	.			√0.60	.			√4.17
R. A.	.		14 10	11.67	.		14 27	15.√
Error of Timepiece,	.			38.93	.			38.42
				~~39.1√~~				~~38.6√~~



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1878phae.proj.1796R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 25. 1879. Instrument, Mer Circ. Observer, W. A. R.

Timepiece, 1327 Recorder, W.

Object,	μ Virginis.			109 Virginis.								
Circle,	−.09			+.04								
	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.	14	37	14.0	14	40	41.2			.			.
			16.1			43.3						
II.			18.2			45.3			.			.
			20.3			47.3						
III.			22.3			49.3			.			.
IV.			24.4			51.3			.			.
			26.4			53.5						
V.			28.4			55.5			.			.
			30.6			57.6						
			200.7			444.3						
Sum,	14	37	22.30	14	40	49.37			.			.
Mean,			.			.			.			.
Bb,			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	14	36	44.38	14	40	11.20			.			.
Error of Timepiece,			.			.			.			.

δ = −5°

δ = −5° 8′

δ = +20° 24′

Sec. φ = 1.35

tan φ = .91

1.35
+.14
5-40
135

−1.49
.91
149
1341
13559

+1.89°
+1.36
+1.55 = m.

−1.49
−.09
+1.341

14 36 44.38
14 37 22.30
1.55
.13
14 37 23.98
36 44.38
39.60
45
39.72 = Error 1327

145

14 40 49.37
1.55
.13
14 40 51.05
40 11.20
39.85

1878phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 26. 1879. Instrument, Mer. Circ. Observer, C.

Timepiece, 1327 Recorder, H.

Object,	Polaris. L.C.			ζ Virginis.			τ Bootis.				
Circle,				.00			+0.33				
	w		e	w		e	w		e	w	e
Level Direct,	.		.	.		.	.		.	.	.
Reversed,	.		.	.		.	.		.	.	.
Sums,	13	12	59.1	~~+3~~	~~29~~	~~7.1~~					
		13	4.8	.		.	.		.	.	.
Difference,			17.3								
b.			75.2								
			5.07								
	h	m	s	h	m	s	h	m	s	h	m s
Wire, I.		13	33.6	13	29	7.0 7.1	13	42	5.1		.
II.			48.1			9.2			7.0 9.3		.
III.			45.2			11.3			11.6		.
IV.		14	118.9 39.63 3.7			13.1			13.8 15.9		.
V.			6.9			15.2 17.3			18.1 20.3		.
			12.4 23.0			19.5 21.7			22.6		.
			7.67			119.4			123.7		
Sum,	13	13	3.	13	29	13.80	13	42	13.74		.
Mean,			.			.			.		.
Bb,			.			.			.		.
Ce,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	13	13	0.67	13	28	34.72	13	41	33.86		.
Error of Timepiece,			.			.			.		.

+0° 1′ +18° 3′

13 5.73
40.63
14 8.67
5.03
6.0
3/11 5.03
3 8.34

195.2
65.07

34.72
13.80
20.92

34.72
12.51
22.01

33.86
13.74
20.12

$0 = 20.92 + m + 0 + \Delta t$

$0 = 20.12 + m + .33\,u + \Delta t$

1.04

$0 = 20.52 + m + .16\,u + \Delta t$

13 29 13.80
1.5
.00
13 29 15.3
28 34.72
40.63

13 42 13.74
1.5
-.49
13 42 14.80
41 33.86
40.94
.63
1.57
40.78 + Error.

-1.49
.33
447
447
.4917

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 28. 1879. Instrument, Mer. Circ. Observer, H. A. R.

Timepiece, 1327 Recorder, H.

Object,	β Bootis				δ Bootis.				γ Urs. Min.										
Circle,	+.87				+0.67				+3.13										
	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.	14	57	55.6		15	11	10.5		15	21	16.2								
		58	3				13.0				22.9								
		58	1.1				15.4				30.0								
II.			3.8				18.4				36.8								
			6.7				22.9				43.6								
III.			9.2				25.4				50.4								
			12.0				27.9				57.0								
IV.			14.7				30.2			22	3.6								
			17.4								10.7								
V.			178.8				183.7				271.2								
			120				2				120								
			58.8				20.41				391.2								
			6.53								43.47								
Sum,			.				.				.								
Mean,			.				.				.								
Bb,			.				.				.								
Ce,			.				.				.								
Aa,			.				.				.								
Corr'd Transit,			.				.				.								
R. A.	14	57	26.61		15	10	40.81		15	21	50.53								
Error of Timepiece,			40.30				40.25				.								

+40 52 +33 46 +72 16

57 26.61
57 40.08

11 20.41
10 40.81
39.60

22 43.47
21 0.53
42.94

58 6.53
57 26.61
39.92

$39.92 + u + .87v + \Delta t$
$39.60 + u + .67v + \Delta t$
$0 = 39.76 + u + .77v + \Delta t$
$0 = 42.94 + u + 3.13v + \Delta t$
$0 = 3.18 + 2.36v$

$v = -1.35$

$0 = 39.92 + 1.55 - 1.17 + \Delta t$
$0 = 39.60 + 1.55 - .90 + \Delta t$

$\Delta t = -40.30$
$\Delta t = -40.25$
mean $= -40.28$ (1327)

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 29 1879. Instrument, Ener. Circ. Observer, H. A. P.

Timepiece, 1327 Recorder, H.

Object,	β Leonis.		δ Virginis		Polaris.			
Circle,	+0.27		+0.07		−42.78 L.C.			
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	13 17 57.7		.	.
Difference,					13 3.0			
b.					10.2			
					20.9			
					3.63			
	h m s		h m s		h m s		h m s	
Wire, I.	11 43 26.2		12 50 3.9		13 13 32.1			.
II.	28.4		6.0		34.0			.
III.	30.6		8.0		35.4			.
IV.	32.7		10.1		101.5			.
V.	34.9		12.0		33.83			.
	37.0		14.2		58.0			.
	39.0		16.2		14 2.0			.
	41.2		18.2		7.7			.
	43.3		20.3		67.7			.
	313.3		108.9		2.57			
Sum,	34.81		12.10		13 33.34			.
Mean,	.		.		.			.
Bb,	.		.		.			.
Ce,	.		.		.			.
Aa,	.		.		.			.
Corr'd Transit,	.		.		.			.
R. A.	11 42 55.80		12 49 33.37		13 13 53.110			.
Error of Timepiece,	.		.		.			.

+15° 15′ +4° 31

43 34.81
42 55.80
39.01

50 12.10
49 33.37
38.73

39.01 + m + .27 n + Δt
38.73 + m + .07 n + Δt
0 = 38.87 + m + .17 n + Δt
0 = −19.66 + m − 42.71 n + Δt
0 = 58.53 + 42.95 n
n = −1.36

−39.01
−1.43
+.37
−40.07

1.36
.27
952
2752
.3672

−38.73
−1.43
+.10
−40.06
−40.07
−40.06 Corr. (1327.)

Δt = −39.01 − 1.43 + .37
Δt = −38.73 − 1.43 + .10

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 29 1879. Instrument, Mur. Circ. Observer, Jr. A. R.

Timepiece, 1327, Recorder, Jr.

Object,	+ Pegasi																		
Circle,	+0.26																		
	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.	22	59	16.4				.				.				.				
			18.7																
II.			20.8				.				.				.				
			23.0																
III.			25.1				.				.				.				
			27.2																
IV.			29.3				.				.				.				
			31.5																
V.			33.6				.				.				.				
			225.6																
			25.07																
Sum,			.				.				.				.				
Mean,			.				.				.				.				
Bb			.				.				.				.				
Cc,			.				.				.				.				
Aa,			.				.				.				.				
Corr'd Transit,			.				.				.				.				
R. A.	22	58	45.99				.				.				.				
Error of Timepiece,			.				.				.				.				

+14° 33'

59. 25.07
58 45.99
39.08

39.08 + 1u + .26u + 4t

39.08 1.36
1.43 .26
40.51 816
.35 272
40.16 = Error 1327 .3536

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, January 30 + 29, 1879. Instrument, Liver. Cir. Observer, W. A. R.

Timepiece, 1327. Recorder, W.

Object,	δ Aurigæ		δ Arietis.								
Circle,	+1.03		+0.42								
	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.	5 8 14.0		2 0 52.5		.				.		
	17.0		54.8								
II.	19.9		57.0		.				.		
	23.1		59.3								
III.	26.0 –		1 1.5		.				.		
	28.8		3.8								
IV.	31.7		6.0		.				.		
	34.9		8.1								
V.	37.9		10.5		.				.		
	233.3		253.5								
	25.92		24.0								
Sum,			13.5		.				.		
Mean,	.		1.50		.				.		
Bb,	.		.		.				.		
Cc,	.		.		.				.		
Aa,	.		.		.				.		
Corr'd Transit,	.		.		.				.		
R. A.	5 7 46.28		2 0 22.42								
Error of Timepiece,	.		.		.				.		

+4r° 52′ +22° 53′

5 8 25.92
7 46.28
39.64

~~369~~ 39.64
1.43
41.07
1.40
39.67

−1.36
1.03
408
136
−1.408

2 1 1.50
0 22.42
39.08
1.43
40.51
−.57
39.94

−1.36
.42
2 54
.57 12

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, May 31 1879. Instrument, Wer. Circ. Observer, W. A. R.

Timepiece, 1327 Recorder, W.

	η Bootis.	τ Virginis.	γ Urs. Maj.	Polaris.
Object,				
Circle,	+11.34	+0.04	+1.19	−42.86
	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.	13 49 25.6	13 56 2.5	13 43 16.5	13 13 42.5
II.	30.8	4.6	19.8	46.7
III.	33.0	6.8	23.0	55.3
IV.	35.1	8.8	26.2	.
V.	37.3	10.9	29.3	.
	39.4	12.9	32.6	144.5
	41.6	15.0	35.9	
	43.8	17.1	39.0	
	46.0	19.2	42.2	
	335.6	97.8	264.5	
Sum,	13 49 37.29	13 56 10.87	13 43 29.39	13 13 46.17
Mean,	.	.	.	.
Bb,	.	.	.	.
Ce,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	13 48 58.47	13 55 32.45	13 42 49.70	13 13 54.42
Error of Timepiece,	.	.	.	.

+19° 0′ +2° 8′ +49° 55′

37.29 / 58.47 / 38.82

10.87 / 32.45 / 38.42

29.39 / 49.70 / 39.69

46.17 / 54.42 / −8.25

1.35 / 1.14 / +40 / 1.35 / +1.19° / .992 / 1.181

−1.09 / .91 / 1.09 / 9.81 / −.9919

38.82 + m + .34 m + 4t
38.42 + m + .04 m + 4t
39.69 + m + 1.19 m + 4t
38.98 + m + .52 m + 4t
−8.25 + m − 42.86 m + 4t
0 = 47.23 + 43.38 m

43.38 / 47.23 / 4.38 / 3.850

+1.09 = m

1.09 / .34 / 436 / 327 / .3706

38.82 / 1.18 / 40.00 / .37 / 39.63 / .56 / .57 / 311.76 / 39.59 Error +327.

38.42 / 1.18 / 39.60 / .04 / 39.56

39.69 / 1.18 / 40.87 / 1.30 / 39.57

1.09 / .04 / .0436

1.19 / 1.09 / 1071 / 119 / 1.2971

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1878phae.proj.17908

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 1 1879 Instrument, Mer. Circ. Observer, W. C. R.

Timepiece, 1327 Recorder, W.

	ε Virginis. −11.19		η Bootis +11.34		ζ Virginis. +0.04		Polaris. −42.86	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	13	13 10.0
Difference,							.	14.7
b.								21.0
								3/45.7
								15.23
	h m s		h m s		h m s		h m s	
Wire, I.	13 19 21.7		13 49 28.4		13 56 2.5			38.9
II.	23.9		30.5		4.4			43.6
III.	26.0		32.8		6.5			51.5
IV.	28.0		35.0		8.6			134.07
V.	30.0		37.1		10.5		14	9.8
	32.2		39.2		12.8			13.8
	34.3		41.5		14.7			19.6
	36.3		43.7		16.9			42.4
	38.4		45.9		19.0			14.13
Sum,	270.8		334.1		95.9		13 13	44.68
Mean,	30.09		37.12		10.66			
Bb,	.		.		.			
Cc,	.		.		.			
Aa,	.		.		.			
Corr'd Transit,	.		.		.			
R. A.	13 18 52.22		13 48 58.47		13 55 32.45		13 13	54.86
Error of Timepiece,	.		.		.			

−10° 32′ +19″ 0′ +20 81 88 39 45.1

30.09 / 52.22 / 37.87 — 37.12 / 58.47 / 38.65 — 10.66 / 32.45 / 38.21 — 44.68 / 54.86 / −10.18 — .189 — 1.12 / .91 / 1.12 / 100 / 1.012 / .189 / 1.201 — 1.12 / .19 / 1.12 / 100 / .2128

37.87 + m − .19 m + Δt
38.65 + m + .34 m + Δt
38.21 + m + .04 m + Δt
38.24 + m + .19 m + Δt
−10.18 + m − 42.86 m + Δt
0 = 48.42 + 43.05 m
m = −1.12

37.87 / 1.21 / .21 / 39.29 / 39.48 / 39.38 / 3/118.15 / 39.38 = Error 1327.

38.65 / 1.21 / 39.86 / 38 / 39.48

38.21 / 1.21 / 39.42 / .04 / 39.38

1.12 / .34 / 446 / 3406

1.12 / .04 / .0448

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 1 1879. Instrument, Mer. Circ. Observer, W. A. P.

Timepiece, 1327 Recorder, W.

Object,	η Pegasi		ι Pegasi.		δ Arietis.							
Circle,	+0.57		+0.26		+0.44							
	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.	22	37	51.6	22	59	16.2	2	0	53.0			.
II.			53.9			18.3			55.2			.
III.			56.3			20.6			57.5			.
IV.		38	58.5			22.7			59.7			.
V.			1.0 –			24.9 –		1	2.0			.
			3.3			27.0			4.2			.
			5.7			29.0			6.3			.
			8.0			31.3			8.5			.
			10.4			33.3			10.9			.
			248.7			2233			257.3			
Sum,	22	38	0.97	22	59	24.81	2	1	1.92			.
Mean,			.			.			.			.
Bb,			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	22	37	21.86	22	58	46.08	2	0	22.50			.
Error of Timepiece,			.			.			.			.
	+ 29° 35′			+ 14° 33′			+ 23° 53′					

~~1.189~~

38 0.97
37 21.86
39.11

39.11
1.21
40.32
.64
39.68

~~59~~ ~~37.92~~
~~58~~ ~~46.08~~
59 24.81
46.08
38.73
1.21
39.94
.27
39.67
.64
39.66

1. 1.92
0 22.50
39.42
1.21
40.63

−1.12
.57
.44
560
−.6344

1.12
.44
448
448
4928

1.12
.26
672
224
.2912

1879phae.proj.17968

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 4 1879. Instrument, Mer. Circ. Observer, H. A. R.
Timepiece, 1327. Recorder, W.

	η Bootis.		ε Virginis.		ι Bootis.		Polaris.	
Object,								
Circle,	+0.34		+0.04		+0.36		−42.W	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.								
Wire, I.	h 13 m 49 s 28.8		h 13 m 56 s 3.0		h 14 m 10 s 42.0		h 13 m 12 s 35.7	
II.	31.0		5.0		44.2		13 7.1	
III.	33.2		7.0		46.2		13 35.8	
IV.	35.3		9.0		48.5		14 4.7	
V.	37.5 −		11.1 −		50.8 −		14 34.1	
	39.8		13.2		52.9			
	42.0		15.2		55.1			
	44.0		17.3		57.3			
	46.3		19.5		59.4			
	337.9		100.3		456.4			
Sum,	13 49 37.54		13 56 11.14		14 10 50.71		13 13 35.48	
Mean,	.		.		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	13 48 58 46		13 55 32.44		14 10 11.63		13 13 58.19	
Error of Timepiece,	.		.		.		.	
	+19° 0′		+2° 81		+19° 491		+8 80° 39′ 47.7″	

37.54 − 58.46 = 39.08
11.14 + 32.44 = 38.70
50.71 − 11.63 = 39.08
35.48 − 57.19 = −22.71
+1.89 − 1.30 = u = 1.49
1.43 × .91 = 1.3013
1.43 × .34 = .4862

39.08 + u + .34u + Δt
38.70 + u + .04u + Δt
39.08 + u + .36u + Δt
38.95 + u + .25u + Δt
−22.71 + u + 42.5u + Δt
61.66 + 43.10u

u = −1.43

39.08 − 1.49 = 40.57 − .49 = 40.08
40.13 − 40.06 = .27
40.09 = Error 1327

38.70 − 1.49 = 40.19 − .06 = 40.13

1.43 × .04 = .0572
39.08 − 1.49 = 40.57 − .51 = 40.06

1.43 × .36 = .5148
4.29 − .51 = 4.29 − .51 = 3.78

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 5. 1879 Instrument, Iver. Circ. Observer, W. A. R.

Timepiece, 1327. Recorder, W.

	η Bootis. +0.34		ζ Virginis. +0.04		δ Bootis. +0.36		Polaris. −42.85	
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.	13 49 28.9		13 56 3.0		14 10 42.0		13 12 34.4	
	31.0		5.0		44.2			
II.	33.2		7.0		46.4		13 4.8	
	35.4		9.2		48.7			
III.	37.6 −		11.1 −		50.9 −		34.0	
	39.8		13.2		53.0			
IV.	42.0		15.4		55.2		14 5.4	
	44.0		17.5		57.3			
V.	46.3		19.5		59.5		34.0	
	328.2		100.9		457.2			
Sum,	13 49 37.58		13 56 11.21		14 10 50.80		13 13 35.32	
Mean,	.		.		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	13 48 58.45		13 55 32.44		14 10 11.62		13 13 59.20	
Error of Timepiece,	.		.		.		.	
	+19° 0′		+20° 8′		+19° 49′		+88° 39′ 47″.6	

37.58 − 58.45 = 39.13

11.21 + 32.44 = 38.77

50.80 − 11.62 = 39.18

35.32 − 59.20 = −23.88

+189 + 1.329 = m = +1.51

−1.46 − .91 = 1.46 + 13.14 = 1.3286

39.13 + m + .34 m + Δt

38.77 + m + .04 m + Δt

39.18 + m + .36 m + Δt

0 = 39.03 + m + .25 m + Δt

0 = −23.88 + m − 42.85 m + Δt

0 = 62.91 + 43.10 m

m = −1.46

39.13 − 1.51 = 40.64 − .50 = 40.14 + 40.22 − 40.16 = .52

40.17 Error 1327

38.77 − 1.51 = 40.28 − .06 = 40.22

1.46 + .54 = 1.58 − 1.54 = .4964

1.46 + .04 = .5484

39.18 − 1.51 = 40.69 − .53 = 40.16

1.46 + .76 = .8876 − .4378 = .52256

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 6 1879. Instrument, Merc. Circ. Observer, H. U.
Timepiece, 1327. Recorder, W.

Object,	d Bootis.		d Bootis.								
Circle,	+0.48		+11.36								
	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.	14 5 26.3		14 10 42.0		.				.		
II.	28.7		44.3		.				.		
III.	31.0		46.7		.				.		
IV.	33.2		48.8		.				.		
V.	35.6		51.0		.				.		
	38.0		53.2		.				.		
	40.0		55.4		.				.		
	42.4		57.7		.				.		
	44.8		59.8		.				.		
	320.0		458.8								
Sum,	14 5 35.56		14 10 50.98		.				.		
Mean,	.		.		.				.		
Bb,	.		.		.				.		
Ce,	.		.		.				.		
Aa,	.		.		.				.		
Corr'd Transit,	.		.		.				.		
R. A.	14 4 56.02		14 10 11.62		.				.		
Error of Timepiece,	.		.		.				.		

+25° 40′ +19° 49′

35.56 50.98 −1.46 1.46
56.02 11.62 .48 .36
39.54 39.36 11.68 1.76
1.51 1.51 584 436
41.05 40.87 .7008 .2756
.70 .53
40.35 40.34
40.34 Error 1327.

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1878phae.proj.17900

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 7. 1879. Instrument, Merc. Circ. Observer, W. A. R.

Timepiece, 1327. Recorder, W.

Object,	γ Androm.		ζ Arietis		Polaris.			
Circle,	+0.89		+0.42		−42.85			
	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.	1	56	59.8	2	0	54.2	1	14	45.4			.
			57	2.5			56.1						
	II.			57.3			58.3		15	14.1			.
				8.0		1	0.7			42.4			
	III.			11.0 −			3.0 −						.
				13.6			57.1		16	12.4			
	IV.			16.3			7.3			43.5			.
				19.2			9.6			157.8			
	V.			22.0			11.9			66			.
				157.7			206.2			217.8			
				63			360.						
				94.7			566.2						
Sum,		1	57	10.86	2	1	2.91	1	15	43.56			.
Mean,				.			.			.			.
Bb,				.			.			.			.
Cc,				.			.			.			.
Aa,				.			.			.			.
Corr'd Transit,				.			.			.			.
R. A.		1	56	29.80	2	0	22.65	1	14	1.29			.
Error of Timepiece,				.			.			.			.

+41° 45′ +22° 53′ 88° 39′ 47″.4

57 10.86
56 29.80
41.06

1 2.91
0 22.65
40.26

15 43.56
14 1.29
1 42.27

−1.42
.91
142
128
1.29 22

41.06 + u + .89 u + Δt
40.26 + u + .42 u + Δt
40.66 + u + .66 u + Δt
102.27 + u − 42.85 u + Δt
0 = 61.61 + 43.51 u

u = − 1.42

.189
1.29 2
u = 1.48

41.06
1.45
42.54
1.26
41.28
41.14
41.21

1.42
.89
1278
1136
1.2638

40.26
1.45
41.71
.60
41.14

1.42
.42
284
568
5964

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1970phae.proj.17906

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 8. 1879. Instrument, Iver. Circ. Observer, W. A. R.

Timepiece, 1327 Recorder, W.

Object,	τ Virginis.			τ Bootis.			η Bootis.				
Circle,	+0.04			+0.36			+0.34				
	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.	13	56	4.2	14	10	43.3	13	49	30.2		.
II.			6.2			45.5			32.3		.
			8.2			47.7			34.7		
III.			10.3			49.9			36.8		.
			12.3			52.1			38.9		
IV.			14.4			54.3			41.0		.
			16.6			56.6			43.2		
V.			18.6			58.7			45.5		.
			20.7	11		0.9			47.6		
			111.6			409.0			3510.2		
						469.0					
Sum,	13	56	12.40	14	10	52.11	13	49	38.91		.
Mean,			.			.			.		.
Bb,			.			.			.		.
Cc,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	13	55	32.43	14	10	11.61	13	48	58.43		.
Error of Timepiece,			.			.			.		.

56 12.40
55 32.43
39.97
1.48
41.45
-.06
41.39
41.47
41.48
3)124
41.45 Error 1327.

10 52.11
11 11.61
40.50
1.48
41.98
-.51
41.47

Assume same value of "n" as obtained this A. M. +19°

-1.42
.04
.0568

-1.42
.36
5 5 2
426
-.5112

-1.42
.34
5 68
426
-.4828

49 38.91
48 58.43
40.48
1.48
41.96
.48
41.48

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 9. 1879. Instrument, Mer. Circ. Observer, W. A. P.

Timepiece, 1327. Recorder, W.

Object, Circle,	β Urs. Min. +3.64		β Librae. −0.16		+ Cor. Bor. +0.51		δ Serpentis. +0.12	
Level Direct, Reversed,	w	e	w	e	w	e	w	e
Sums, Difference, b.								

	h	m	s	h	m	s	h	m	s	h	m	s
Wire, I.	14	51	23.5	15	11	5.2	15	30	9.1	15	38	54.3
II.			31.2			7.3			11.5			56.5
III.			38.9			9.4			13.8			58.5
IV.		52	47.5			11.5			16.0		39	0.4
V.			54.7 −			13.6			18.4 −			2.8 −
			2.5			15.6			20.8			4.9
			10.4			17.8			23.1			6.8
			18.2			19.9			25.4			8.8
			25.8			22.0			27.8			10.9
			252.7			122.4			165.9			203.9
			240									180
			492.7									23.9
Sum,	14	51	54.74	15	11	13.60	15	30	18.43	15	39	2.66
Mean,												
Bb,												
Cc,												
Aa,												
Corr'd Transit,												
R. A.	14	51	9.11	15	10	33.31	15	29	37.19	15	38	21.92
Error of Timepiece,												

11 13.60
10 33.31
40.29

+74 39

30 18.43
29 37.19
41.24

−8 56

39 2.66
38 21.92
40.74

+27 7

51 54.74
51 9.11
45.63

+6 48

40.29 + 11 − 16 u + Δ+
40.74 + u + 12 u + Δ+
40.52 − .02 u
45.63 + 3.64 u
−5.11 − 3.66 u

3.66 | 5.11 | 1.40 = u
366
1450
1098
352

+.189
1.274
u = 1.463

−1.40
.91
140
1260
−1.274 0

40.74
1.46
42.20
.17
42.03

41.24
1.46
42.70
−.71
41.99

40.29
1.46
41.75
.22
41.97
41.99
42.03
42.00 Corr 1327

−1.40
−.16
540
140
2240

−1.40
.51
140
700
−.7140

−1.40
.12
280
140
−.1680

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 12 1879 Instrument, Iver Circ. Observer, W. A. R.

Timepiece, 1327 Recorder, O. C. W.

Object,	μ Boötis			β Coronae							
Circle,	+0.78			+0.57							
	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.	15	20	31.6	15	23	27✓			.		.
II.			34.1			30.0			.		.
III.			36.8			32.2			.		.
IV.			39.4			34.9			.		.
V.			42.0			37.3			.		.
			44.7			39.6			.		.
			47.3			41.9			.		.
			49.9			44.✓			.		.
			✓2.✓			46.9			.		.
			378.3			334.8					
Sum,	15	20	42.03	15	23	37.20			.		.
Mean,			.			.			.		.
Bb,			.			.			.		.
Cc,			.			.			.		.
Aa,			.			.			.		.
Corr'd Transit,			.			.			.		.
R. A.	13	19	58 41	15	22	53 72			.		.
Error of Timepiece,			.			.			.		.

+37° 48′ +29° 31′

20 42.03
19 58.41
43.62
1.46
45.08
-1.09
43.99
44.14
2.13
44.06 Error 1327

23 37.20
22 ✓3.7✓
43.48
1.46
44.94
-.80
44.14

Assume same value of "u" as on June 9.

-1.40 -1.40
.78 .57
1120 980
980 700
-1.0920 -.7980

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 13 1879. Instrument, Merc. Circ. Observer, J. F. Hs.

Timepiece, 1327. Recorder,

Object,	♃ Leonis.	♀ Virg. Inf.	♃ Leonis.	
Circle,	+0.22	+1.09	+0.39	
	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.	10 2 32.6	11 3 26.8	11 8 17.6	.
	34.7	29.6	19.7	
II.	36.9	32.7	21.9	.
	38.9	35.4	24.1	
III.	41.10	38.3	26.3	.
	43.0	41.2	28.7	
IV.	45.2	44.1	30.9	.
	47.3	47.1	33.0	
V.	49.3	50.2	35.3	.
	365.9	345.4	237.5	
Sum,	10 2 40.99	11 3 38.38	11 8 26.39	.
Mean,	.	.	.	.
Bb,	.	.	.	.
Cc,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	10 1 57.51	11 2 53.88	11 7 42.61	.
Error of Timepiece,	.	.	.	.
	+12 33	+45 9	+21 11	

2 40.99
1 57.51
43.48
1.46
44.94
.31
44.63
.64
.69
44.67 Error 1327

3 38.38
2 53.88
44.58
1.46
46.04
1.40
44.64

8 26.39
7 42.61
43.78
1.46
45.24
.55
44.69

1.40
.22
280
280
.3080

1.40
.39
1260
420
.5460

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 14 1879. Instrument, Mer. Circ, Observer, J. Fi. Wa.

Timepiece, 1327. Recorder,

Object,	β Leonis.										
Circle,	+0.27										
	w		e		w		e		w		e	
Level Direct,	.		.		.		.		.		.	
Reversed,	.		.		.		.		.		.	
Sums,	.		.		.		.		.		.	
Difference,												
b.												
	h	m	s		h	m	s		h	m	s	
Wire, I.	11	43	31.7				.				.	
II.			33.8				.				.	
III.			35.9				.				.	
IV.			38.0				.				.	
V.			40.0				.				.	
			42.1				.				.	
			44.3				.				.	
			46.5				.				.	
			48.7				.				.	
			361.0									
Sum,	11	43	40.11				.				.	
Mean,			.				.				.	
Bb,			.				.				.	
Cc,			.				.				.	
Aa,			.				.				.	
Corr'd Transit,			.				.				.	
R. A.	11	42	55.63				.				.	
Error of Timepiece,			.				.				.	

+15 15

43 40.11
42 55.63
44.48
1.46
45.94
.38
45.56

140
.27
980
280
.3780

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 16. 1879. Instrument, Mer. Circ. Observer, J. A. Ke.
Timepiece, 1327. Recorder,

	γ Ursæ Minoris	ι Coronæ.	ζ Coronæ, pec.	
Object,				
Circle,	+3.13	+0.51	+0.75	
	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.	15 21 23.6	15 30 15.4	15 35 30.0	.
	30.8	17.7	32.6	.
II.	36.7	19.9	35.1	.
	43.9	22.2	37.9	.
III.	50.5 −	24.4 −	40.1 −	.
	57.4	26.9	42.8	.
IV.	22 4.0	29.1	45.6	.
	11.0	31.3	48.2	.
V.	17.8	34.0	50.9	.
	275.7	220.9	363.0	
	150			
	425.7			
Sum,	.	.	.	.
Mean,	15 21 50.63	15 30 24.54	15 35 40.33	.
Bb,	.	.	.	.
Ce,	.	.	.	.
Aa,	.	.	.	.
Corr'd Transit,	.	.	.	.
R. A.	15 20 59.93	15 29 37.16	15 34 52.52	.
Error of Timepiece,	.	.	.	.
	+72 16	+24 7	+37 2	

21 50.63
20 59.93
50.70

30 24.54
29 37.16
47.38

35 40.33
34 52.52
47.81

+.189
1.128
m = +1.31

1.24
.91
124
1116
1.1284

47.38 + m + .51 m + Δt
47.81 + m + .75 m + Δt
47.60 + m + .63 m + Δt
50.70 + m + 3.13 m + Δt
−3.10 −2.50 m

2.50 / 3.10 (+1.24 = m
250
600
510
900

47.38
1.31
48.69
.63
48.06
48.19
48.12 Error 1327

47.81
1.31
49.12
.93
48.19

1.24
.51
124
620
.6324

1.24
.62
.31
.93

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 26. 1879. Instrument, Iver. Circ. Observer, W. A. R.

Timepiece, 1327 Recorder,

Object,	δ Androm.										
Circle,	+ 0.54										
	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.	0	2	48.5			.			.			.
			50.9									
II.			53.0			.			.			.
			55.5									
III.			57.8			.			.			.
		3	0.0									
IV.			2.5			.			.			.
			4.8									
V.			7.2			.			.			.
			280.2									
			240.									
			520.2									
Sum,			.			.			.			.
Mean,	0	2	57.78			.			.			.
Bb,			.			.			.			.
Cc,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	0	2	10.19			.			.			.
Error of Timepiece,			.			.			.			.

+28 25

2 57.78
2 10.19
47.59
1.31
48.90
.67
48.23 Error 1327

1.24
.54
496
620
.67

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1878phae.proj.1790

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 17. 1879. Instrument, Mer. Circ'. Observer, W. A. R.

Timepiece, 1327 Recorder,

Object, Circle,	+ Cor. Bor. +0.49		+ Serpentis. +0.12				June 17.8, + Aretis. +0.42	
	w	e	w	e	w	e	w	e
Level Direct,	.	.	.	.	.	.	.	.
Reversed,	.	.	.	.	.	.	.	.
Sums,	.	.	.	.	.	.	.	.
Difference,								
b.								

Wire,	h	m	s	h	m	s	h	m	s	h	m	s
I.	15	30	15.9	15	39	1.1			.	2	1	2.1
			18.1			3.1						4.3
II.			20.4			5.2			.			6.5
			22.9			7.2						8.8
III.			25.0			9.5			.			11.1
			27.4			11.4						13.3
IV.			29.8			13.5			.			15.5
			32.1			15.6						17.8
V.			34.3			17.7			.			20.0
			225.9			84.3						99.4
Sum,	15	30	25.10	15	39	9.37			.	2	1	11.04
Mean,			.			.			.			.
Bb,			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	15	29	37.15	15	38	21.91			.	2	0	22.96
Error of Timepiece,			.			.			.			.

+ 26° 7' + 6° 48' + 22 54

30 25.10
29 37.15
47.95
1.31
49.26
.61
48.65
.62
48.64 Error 1327

39 9.37
38 21.91
47.46
1.31
48.77
.15
48.62

1.24
.49
1116
496
.6076

1.24
.12
248
124
.1488

1 11.04
0 22.96
48.08
1.31
49.39
.52
48.87
Error 1327

-1.24
.42
248
496
.5208

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1878phae.proj.1790R

HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 18 1879. Instrument, Mer. Circ. Observer, W. A. R.

Timepiece, 1327. Recorder,

	η Bootis. +0.34		ι Virginis. +0.04		ν Bootis. +0.36		β Ursa. Min. +3.64	
Object, Circle,	w	e	w	e	w	e	w	e
Level Direct, Reversed,	. .	. .	. .	. .	. .	. .	. .	. .
Sums, Difference, b.	. .		. .		. .		. .	
Wire, I.	h 13 m 49 s 38.0		h 13 m 56 s 12.0		h 14 m 10 s 51.1		h 14 m 1 s 30.4	
II.	40.1		14.0		53.3		38.2	
III.	42.2		16.0		55.4		46.1	
IV.	44.2		18.1		57.7		54.3	
V.	46.7		20.1		59.9		2 1.9	
	48.8		22.2		11 2.6		9.1	
	51.0		24.4		4.1		17.7	
	53.2		26.3		6.3		24.8	
	55.3		28.4		8.8		32.8	
	419.5		181.5		298.6		255.3	
					240		240	
					58.6		15.3	
Sum,	13 49 46.61		13 56 20.17		14 10 59.84		14 2 1.70	
Mean,	.		.		.		.	
Bb,	.		.		.		.	
Cc,	.		.		.		.	
Aa,	.		.		.		.	
Corr'd Transit,	.		.		.		.	
R. A.	13 48 58.35		13 55 32.37		14 10 11.54		14 1 8.54	
Error of Timepiece,	.		.		.		.	

+19 0 +2 8 +19 49 +74 39

49 46.61 — 48 58.35 = 48.26

56 20.17 — 55 32.37 = 47.80

10 59.84 — 10 11.54 = 48.30

2 1.70 — 1 8.54 = 53.16

48.26 + m + .34u + Δt
47.80 + m + .04u + Δt
48.30 + m + .36u + Δt
48.12 + m + .25u + Δt
53.16 + m + 3.64u + Δt
−5.04 − 339u

339 | 5.04 (1.49 = u
339
1650
1356
294 0

u = .189 / 1.356 / 1.546

1.49 × .91 = 1.49 × .09 = 1.49 × .34 = 1.49 × .36 = 1.49 × 4 = 1.49 × .04 = 1.49 × .004 = 1.49 × .0006

1.49
.91
149
1341
1.3559

1.49
.34
596
447
.5066

1.49
.36
894
447
.53664

1.49
4
.0596

48.26 + 1.546 = 49.80 + .51 = 49.29 + .28 = 49.57 + .30 = 49.27

47.80 + 1.546 = 49.34 + .06 = 49.28

48.30 + 1.546 = 49.84 + .54 = 49.30

Error 1327.

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HARVARD COLLEGE OBSERVATORY TIME SERVICE.

Date, June 18. 1879. Instrument, Mur. Circ. Observer, H. A. P.

Timepiece, 1327. Recorder,

Object,	γ Pegasi.			+ Androm.								
Circle,	+0.39			+0.54								
	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.	0	7	42.4	0	2	49.7			.			.
II.			44.5			52.0			.			.
			46.6			54.1			.			.
III.			49.0			56.6			.			.
			50.9			58.9			.			.
IV.			53.1		3	1.3			.			.
			55.1			3.7			.			.
V.			57.2			6.0			.			.
			59.4			8.3			.			.
			458.2			290.6						
						2.40						
						530.6						
Sum,			.			.			.			.
Mean,	0	7	50.91	0	2	58.96			.			.
Bb,			.			.			.			.
Ce,			.			.			.			.
Aa,			.			.			.			.
Corr'd Transit,			.			.			.			.
R. A.	0	7	2.58	0	2	10.26			.			.
Error of Timepiece,			.			.			.			.
	+14		31	+28		25						

7 50.91 / 2.58 / 48.33 / 1.54 / 49.87 / .39 / 49.48 / .44 / 49.46 Error 1327.

1.49 / .26 / 594 / 298 / .3874

2 58.96 / 10.26 / 48.70 / 1.54 / 50.24 / .80 / 49.44

1.49 / .54 / 596 / 745 / 8046

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1878phae.proj.1790R

June 19. 1879. Mer. Circ. Fr. A. R.

1327.

γ Cassiop. L.C. −1.74			ε Bootis. +11.36			γ Bootis. +0.80		
12	49	56.0	14	10	51.5	14	27	54.0
	50	0.3			53.8			56.7
		4.0			55.8			59.3
		8.4			58.0		28	2.0
		12.5		11	0.3			4.8
		16.6			2.4			7.5
		20.7			4.6			10.0
		24.8			6.8			12.7
		28.9			9.0			15.3
		172.2			242.2			222.3
		60.			240			180.
		112.2			2.2			42.3
12	50	12.47	14	11	0.24	14	28	4.70
12	49	26.68	14	10	11.53	14	27	15.53

60 4 19 49 38 50

50	12.47	11	0.24	28	4.70
49	26.68	10	11.53	27	15.53
	45.79		48.71		49.17

48.71 + m + .36 m + Δt
49.17 + m + .80 m + Δt
48.94 + m + .58 m + Δt
45.79 + m − 1.74 m + Δt
3.15 + 2.32 m

2.32 / 3.15 / −1.36 = m
2320
830
696
1340
1392

.189
1.228
m = 1.427

1.36
.91
136
1224
1.2376

1.36
.8
1.088

1.36
.36
816
408
.4896

48.71		49.17	
1.43		1.43	
50.14		50.60	
.49		1.09	
49.65		49.51	
.51			
49.58	Error 1327.		

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1878phae.proj.17900

	1327		5451		JC 191			
Novemb.	Ch. Error	Ch. rate	Ch. Error	Ch. rate	C. Error	Cr. Ch. rate from obs.	Ch. rate	
1.3	+ 4 09.3	+ 2.00	+ +1 21	+1.32				
2.3	+ 4 11.62	+ 2.16	1 22.76	+1.66				
3.3	+ 4 13.75	+ 2.13	1 24.68					
4.2	+ 4 15.35	+ 1.80			4.4 +.7			
5.2	+ 4 17.22	+ 2.02	1 26.30		5.3 +.9			
6.3	+ 4 18.88	+ 1.70	1 28.18	+1.88	6.3 +.9			
10.3	+ 4 25.96	+ 1.78	1 35.46	+1.79	10.3 +1.4			
12.3	+ 4 29.16	+ 1.58	1 39.44	+2.02	12.3 +1.1			
13.3	+ 4 30.63	+ 1.48	1 41.43	+ 2.00	13.3 +0.5			
14.3	+ 4 31.84	+ 1.30	1 43.45		14.4 +0.6			
19.3	+ 4 37.10	+ 1.00	1 53.80	+ 2.00	20.8 −0.2			
21.3	+ 4 39.18	+ 1.03	1 56.18		21.8 −.8	− .8		
28.3	+ 4 42.10	+ 1.41	+1 06.32		22.3 −1.0			
24.3	+ 4 43.64	+ 1.60			2.3.3 −1.6	− 1.6	− .4	
26.3	+ 4 46.08	+ 1.23	+ 2 06.92	+ 1.85	24.3 −1.8	− 1.8	− .2	
29.3	4 49.15	+ 0.98	+ 2 12.73	+1.97	25.8 −1.8			
					26 −2.4	−2.4	−.3	
1878								
Dec.								
1.3	+ 4 51.46	+ 1.15	+ 2 16.9	+ 2.10	−.2			
6.3	4 57.45	+ 1.20	+ 2 27.9		+1.3			
7.3	4 58.50	+ 1.10	+ 2 30.0	+ 2.20				
8.3	4 59.65	+ 1.15	+ 2 32.45	+ 2.35	+ 2.1			
11.3	+ 5 03.01	+ 1.09	+ 2 40.32	+ 2.62	+ 1.5			
12.3	5 4.12	+ 1.23	+ 2 41.57		+ 1.3			
14.3	5 6.06	+ 0.97						
16.3	5 8.72	+ 1.23	+ 2 49.2		−.1			
17.3	5 9.78	+ 1.14	+ 2 50.75		−.2			
18.3	5 10.57	+ .80			−.6			
19.3	5 11.55	+ .93			−.7			
20.4			+ 2 56.82					
22.4			+ 2 59.70		−1.3			
23.3	+ 5 13.35	+ .45			−1.4			
25.3	+ 5 13.82	+ 24			− 2.0			
26.3	+ 5 14.04	+ 22	+ 3 07.27		→ 1.3(?)			
30.3	+ 5 13.95	− .02	+ 3 13.95	+ 1.70	− 2.9			
31.3	+ 5 12.69	− 1.25	+ 3 15.40	+ 1.35	− 2.8			
Jan. 1879.								
3.3					− 3.0			
5.3	+ 5 11.57		+ 3 24.25	(?)	− 3.6			
6.3	+ 5 11.44	−.13	+ 3 24.75	+ 1.56				
7.3	+ 5 10.68	−.76	+ 3 26.52	+ 1.77	− 1.2			
10.3	+ 5 11.00	+ .00	+ 3 32.65	+ 2.05	0.0	+ 0.4		
13.3	+ 5 11.40	+ .13	+ 3 37.24	+ 1.48	+ 1.2	+ 0.4		
14.3	+ 5 11.26	− .14	+ 3 39.06	+ 1.82	+ 1.5	+ 0.3		
16.3	+ 5 11.80	+ .27	+ 3 42.80	+ 1.87	+ 1.9	+ 0.4		
18.3	+ 5 13.00	+ .60	+ 3 47.80	+ 1.50				
19.3	+ 5 13.84	+ .84	+					
20.3	+ 5 14.53	+ .65	+ 3 49.4	+ 1.80				
22.3	+ 5 15.30	+ .44	+					
23.3	+ 5 15.81	.51	+ 3 55.2	+ 1.93				
25.3	+ 5 17.32	+ .74	+					
26.3	+ 5 18.08	+ .76	+ 4 1.4	+ 2.6				
29.8	+ 5 21.	+ .73	3.3 + 4 7.2	+ 2.1	29.3 −.3			
30.3	+ 5 20.35		+ 4 8.2					
31.3	+ 5 21.45		+ 4 10.18	+ 1.7				
Feb. 1.3	+ 5 22.0	+ .60	+ 4 11.82					
2.4	5 23.0	+ .80	+ 4 13.28					
3.2	5 23.55	+ .70	+ 4 14.31					
4.2	5 23.75	+ .20	+ 4 15.80	+ 1.5	+ .1			
6.8	24.57	+ .35	+ 4 21.38	+ 2.2				
8.3	5 24.6	.0	+ 4 22.98					
10.3	5 23.85	− .40	+ 4 26.66	+ 1.84				
12.3	5 23.80	+ .0	+ 4 30.55	+ 1.95				
13.4	5 24.48	+ .6	+ 4 32.74	+ 1.92				
14.3	5 24.75	+ .32	+ 4 34.54	+ 2.16				
15.8	25.08							
16.3	25.07		~~+ 39.2~~	~~+ 2.~~				
16.8	25.40	+.33	4 39.2	+ 2				
18.7	26.93	.71	42.5	+ 1.65				

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1879.

Feb.	Prof. Haw. 1327 Error	rate.	Brodsham 3451 Error.	rate.	Howard. 191 Error.	rate	Wale for H191.	Batt for 91 d.p. a.m.
21.1	+28.65	+.75	+4 47.3	+1.6	-.3			
23.3	30.48				-.8			
23.8	31.16				-.8			
24.3	31.69	+.96	+4 52.10	+1.6	-.7			
24.7	32.18	+1.44				*Chron. Comp.		
26.3	33.44	+.82	4 56.2	+2.05	-1.36			26 7 57
26.8	34.00	+.96						
27.3	34.35	+.84						
28.4	34.75	+.37						
(28.7)			+5 01.2					
March.								
2.3	35.62	+.46	+5 3.87	+1.40				
2.6	35.68	+.20	+5 4.50	+1.37				
3.3	35.70	+.00	+5 5.85					
3.7	35.93	+.00						
4.8	35.93	+.20						
5.2	36.11	+.35						
5.7	36.04	-.14	+5 13.3	+2.37				
7.3	36.19		15.4	+2.2				
8.C	36.30							
9.3	36.19				-4.72			9 6 48
10.11	36.27				-4.61			10 7 57
10.4	36.16		+5 22.5					
11.3	36.35		+5 25.2	+2.6	-4.65			11 7 30
11.8	36.77				-4.36			11 18 28
12.3	37.07		+5 27.93	+2.73	-4.37			12 6 41
12.8	37.31		+5 28.68	+1.80	-4.15			12 19 05
13.3	37.22		29.96	+2.02	-4.35			13 7 7
13.5	37.57		31.57	+3.22	-4.08			13 12 43
14.8	37.86		3					
15.8	38.24		35.54	+2.10				
16.3	38.31		37.00	+2.90	-4.34			16 7 34
16.8	38.98		39.13					
18.3	38.86		40.10	+1.60	-4.22			18 8 7
18.8	38.98		41.65	+3.10				
19.2	39.20		42.60	+1.90	4.50		19.3	6 41
19.8	39.24		43.54	+1.90	5.10		20.2	4 31
20.2	39.20		44.05	+1.37	5.27		21.3	8 16
21.3	39.60				5.21		23.6	12 38
23.6	41.16		52.02	+1.80	5.00		24.3	7 58
25.3	41.04		55.52	+2.14	5.40		25.2	4 14
26.3	41.11		58.26	+2.50	-5.67		26.3	6 37
30.5	41.24		69.00		-6.50	+.20	30.5	12 15
				after this hourly rates are given.				
April.								
1.3	41.12		+1 13.25		-6.42			1 6 28
1.5	40.97		+1 13.8	+.13	-6.44			1 11 15
2.3	40.63		+1 16.9	+.16	-6.84 (?)			2 7 9
2.8	40.44		+1 17.65	+.141	-6.50			2 18 52
6.3	39.69				-7.92			6 6 47
6.5	39.72							
7.3	38.56							
7.8	38.28							
8.4	35.59		+1 30.10	+.10	-7.91			8 8 0
8.8	35.25		+1 31.45	+.13	-7.15			8 17 30
9.4	34.56				-8.94			9 8 22
RT 11.8	33.73				[-10.06]	R.Jr.		
12.8	33.00		1 41.10	+.10				
13.5	32.55		+1 42.40	+.086	-9.21		13.4	13 10 51
14.3	31.91		+1 43.91	+.09				
14.5	32.04		+1 44.64	+.15				
14.8	+31.87		+1 45.67	+.094	-10.69			
16.3	+31.52		1 49.12	+.105				16 19 49
19.8	+31.59							
20.4	31.44				-11.30		20.3	20 7 37
20.8	31.35				-11.32			20 17 29
21.3	31.06				-11.63		21.2	21 5 50
21.8	31.08							
22.3	30.72							
22.5	+30.66		+2 04.76	+.105	-11.65		22.8	22 5 49
23.4	+30.43	-.010	+2 07.43	+.112	-11.77		23	23 7 24
23.8	30.34		+2 08.24	+.100				

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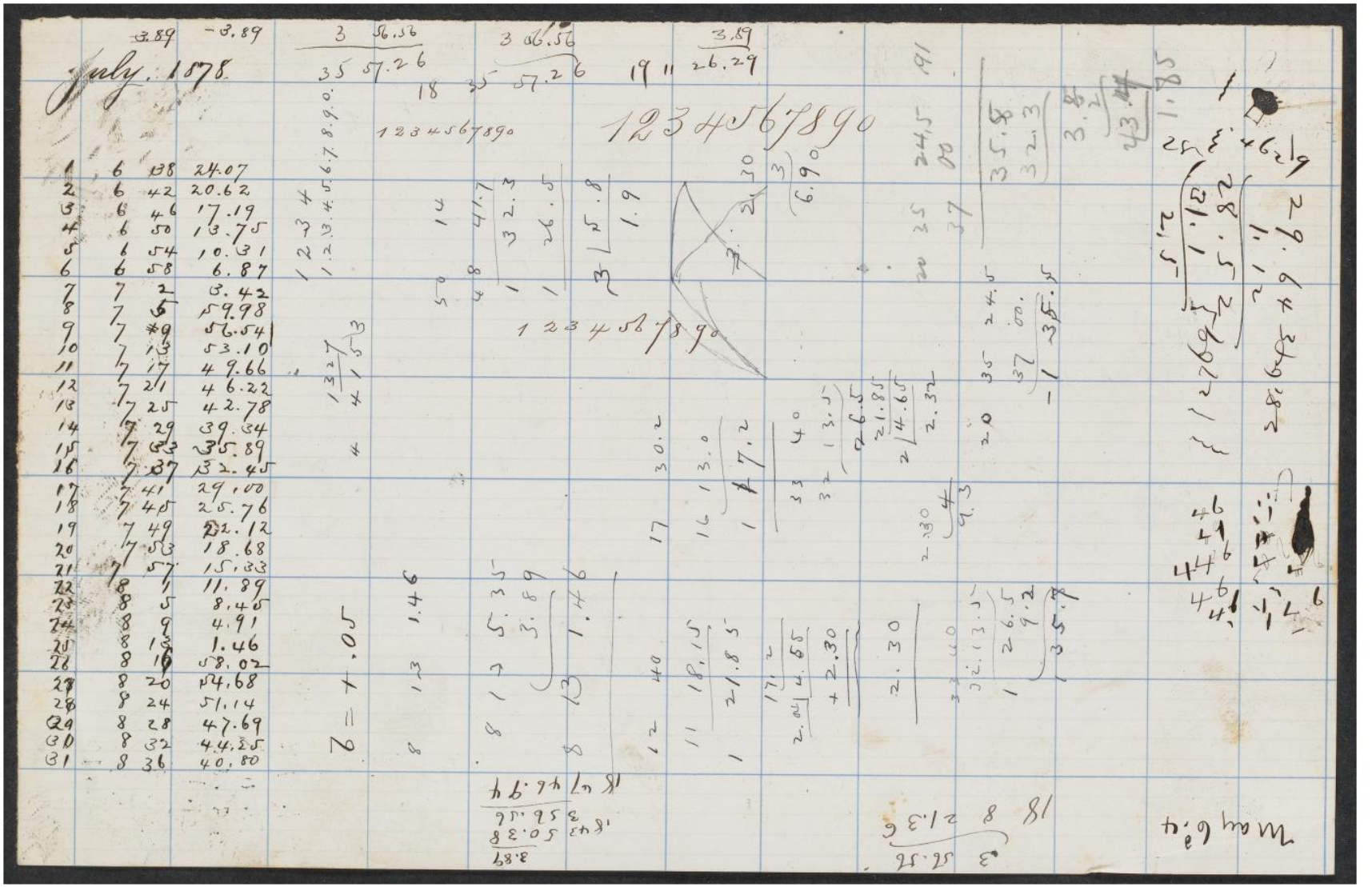
1879.

April.	1327 Frodsham. Error.	Rate. (Yearly)	3451 Frodsham. Error.	Rate. (Yearly)	191 Howard. date.	Error.	Daily Rate.	Hourly rate	Date. day h. min.
24.3	+ 30.35		+ 2 9.95	+ .127		-12.16			24 7 37
26.9	+ 29.90								
27.5	+ 29.72		+ 2 18.05	.113	27.3	-12.98			27 7 32
30.3	+ 29.41		+ 2 25.4	.105		-13.24	-.09	-.00375	30 7 16
May.									
1.3	+ 29.02		+ 2 27.62	.097		-13.30	-.06	-.00 25	
1.8	+29.21	+.016							
5.3									
5.3	+ 28.41	-.01	+ 2 37.60	.103		-13.57	-.07	-.00 29	
5.8	+ 28.58	+.015	2 38.90	.112		-13.40	+.38	+.016	
6.3	+ 28.57	.000	+2 39.97	.094		-13.44	-.074	-.0031	
6.8	+ 28.80	+.021	+2 41.40	.115		-13.29	+.29	+.012	
7.3	+ 28.85	+.004	+2 42.35	.084		-13.37	-.17	-.007	
8.3	+ 29.35	+.021	+2 44.85	.104		-13.17	+.20	+.008	
8.8	+ 29.79	+.04	+2 46.17	.127					
10.3	+ 30.28	+.013	+2 49.60	.090		-13.10	-.035	-.0013	
12.3	+ 31.07	+.016	+ 2 54.5	.097		-13.07	-.01	-.0004	
13.3	+ 30.58	-.021	+ 2 57.08	.112		-13.11	-.04	-.0018	
14.3	+ 30.12	-.018	+ 3 00.17	.119		-13.21	-.10	-.0038	
15.3	+ 30.58								
16.3	+ 31.07		+ 3 06.07	.123		-13.58	-.135	-.0056	
18.3	+ 32.76	+.035	+ 3 11.71	.118		-14.15 (31)	-.285	-.012	
20.3	+ 34.79					-14.97	-.41	-.017	
22.3	+ 36.89		+ 3 21.45	.101		+ 15.53			
23.3			+ 3 24.10	.110		-15.75	-.22	-.009	
24.3	+ 38.80	+ 040	+ 3 25.60	.062		-16.19	-.44	-.018	
25.4	+ 39.72	+ 035	+ 3 27.52	.073		-16.42	-.21	-.009	
26.4	+ 40.78	+ 044	+						
28.4	+ 40.25	- 010	+ 3 35.44	.110		-16.98	-.19	-.0118	
(29.4	+ 40.06	-.009)				(-17.39	-.41	-.017	
29.8	+ 40.16	+.010)	+ 3 37.86	.072		(-17.82	-.32	-.013	
(29.9	+ 39.94	-.092)							
30.0	+ 39.67	-.112)							
31.4	+ 39.59	- 006	+ 3 41.29	.089		- 18.60	-.64	-.027	
June.									
1.4	+ 39.38	-.009	+ 3 43.38	+ .087		-19.16	-.56	-.023	
1.9	+ 39.66	+.023							
4.3	+ 40.09	+.009	+ 3 50.09	+ .096		-19.89	-.73	-.010	
5.4	+ 40.17	+.003	+ 3 53.4	+ .136		-20.18	-.26	-.011	
6.4	+ 40.34	+.007							
7.9	+ 41.21	+.024	+ 3 59.91	+ .104		- 20.72	-.22	-.009	
8.4	+ 41.45	+.020	+ 4 0.71	+ .067		- 20.98	-.26	-.022	
9.4	+ 42.00	+.023	+ 4 3.60	+ .120		- 21.30	-.32	-.013	
12.4	+ 44.06	+.029	+ 4 11.16	+ .105		- 21.84	-.18	-.007	
13.2	+ 44.65	+.031	+ 4 12.95	+ .093		- 22.14	-.37	-.016	
14.2	+ 45.56	+.038	+ 4 15.56	+ .109		- 22.42	-.28	-.012	
16.4	+ 48.12	+.048	+ 4 21.12	+ .105		- 22.70	-.13	-.005	
16.8	+ 48.23	+.011	+ 4 21.63	+ .053		- 22.91	-.52	-.022	
17.4	+ 48.64	+.028	+ 4 22.84	+ .084		- 22.98	-.12	-.005	
17.8	+ 48.87	+.024	+ 4 23.67	+ .086		- 23.11	-.32	-.014	
18.3	+ 49.29	+.034	+ 4 24.99	+ .110		- 23.00	+.22	+.009	
18.8	+ 49.46	+.014	+ 4 26.36	+ .114		- 23.19	-.20	-.008	
19.3	+ 49.58	+.010	+ 4 27.25	+ .077		- 23.24	-.28	-.012	
20.3	+ 50.02	+.018	+ 4 29.42	+ .089		- 23.38	-.14	-.006	

Annual Sums Sheets

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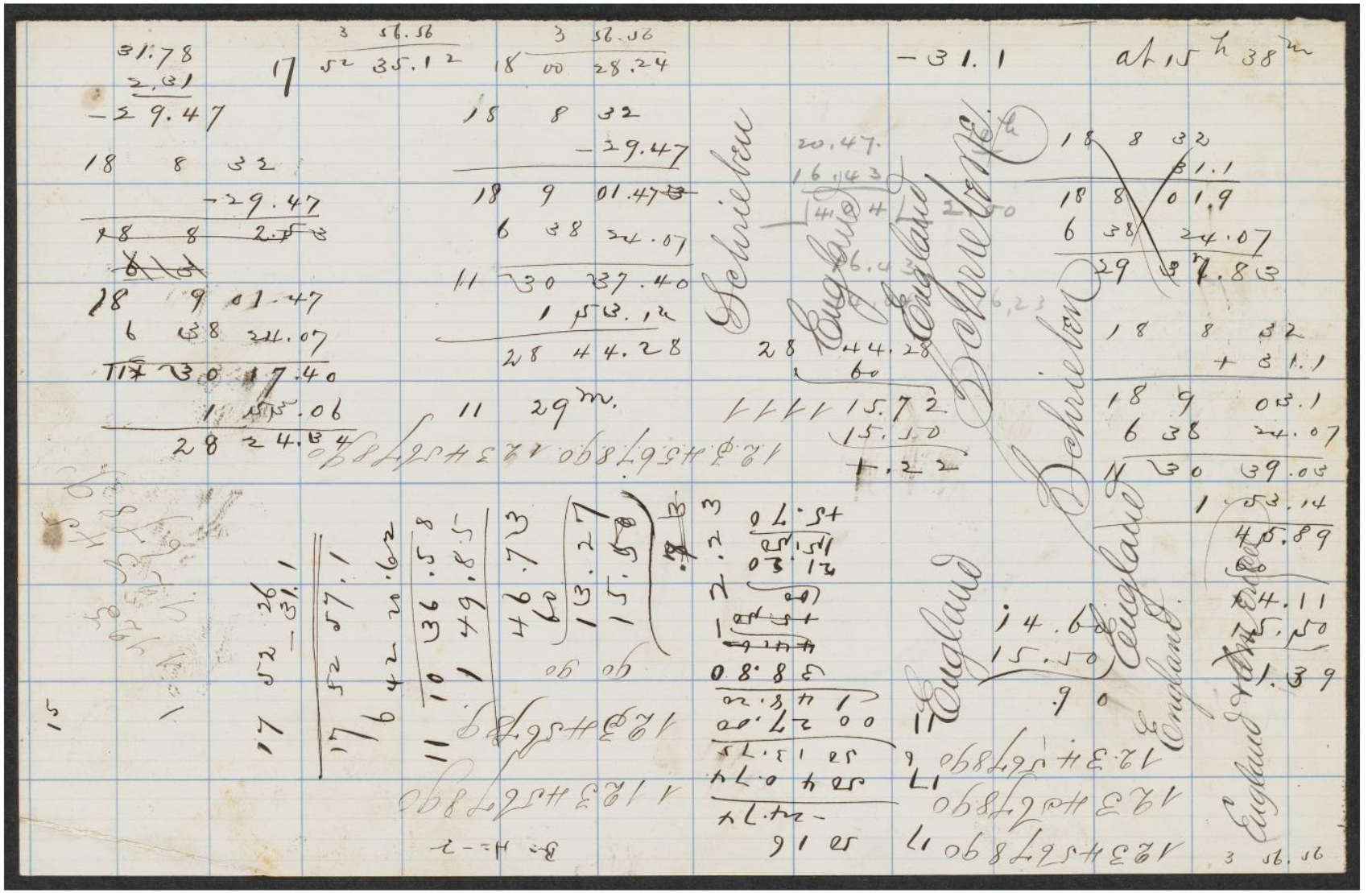
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July. 1878.

1	6	38	24.07
2	6	42	20.62
3	6	46	17.19
4	6	50	13.75
5	6	54	10.31
6	6	58	6.87
7	7	2	3.42
8	7	5	59.98
9	7	9	56.54
10	7	13	53.10
11	7	17	49.66
12	7	21	46.22
13	7	25	42.78
14	7	29	39.34
15	7	33	35.89
16	7	37	32.45
17	7	41	29.00
18	7	45	25.76
19	7	49	22.12
20	7	53	18.68
21	7	57	15.23
22	8	1	11.89
23	8	5	8.45
24	8	9	4.91
25	8	13	1.46
26	8	16	58.02
27	8	20	54.68
28	8	24	51.14
29	8	28	47.69
30	8	32	44.25
31	8	36	40.80

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1878phae.proj.1

added 20 shot to 191 Jan. 23. 1879. & added several shot Mar. 4.

Omitted.

Feb.

d	26.
26	18 c
27	5
28	4

March

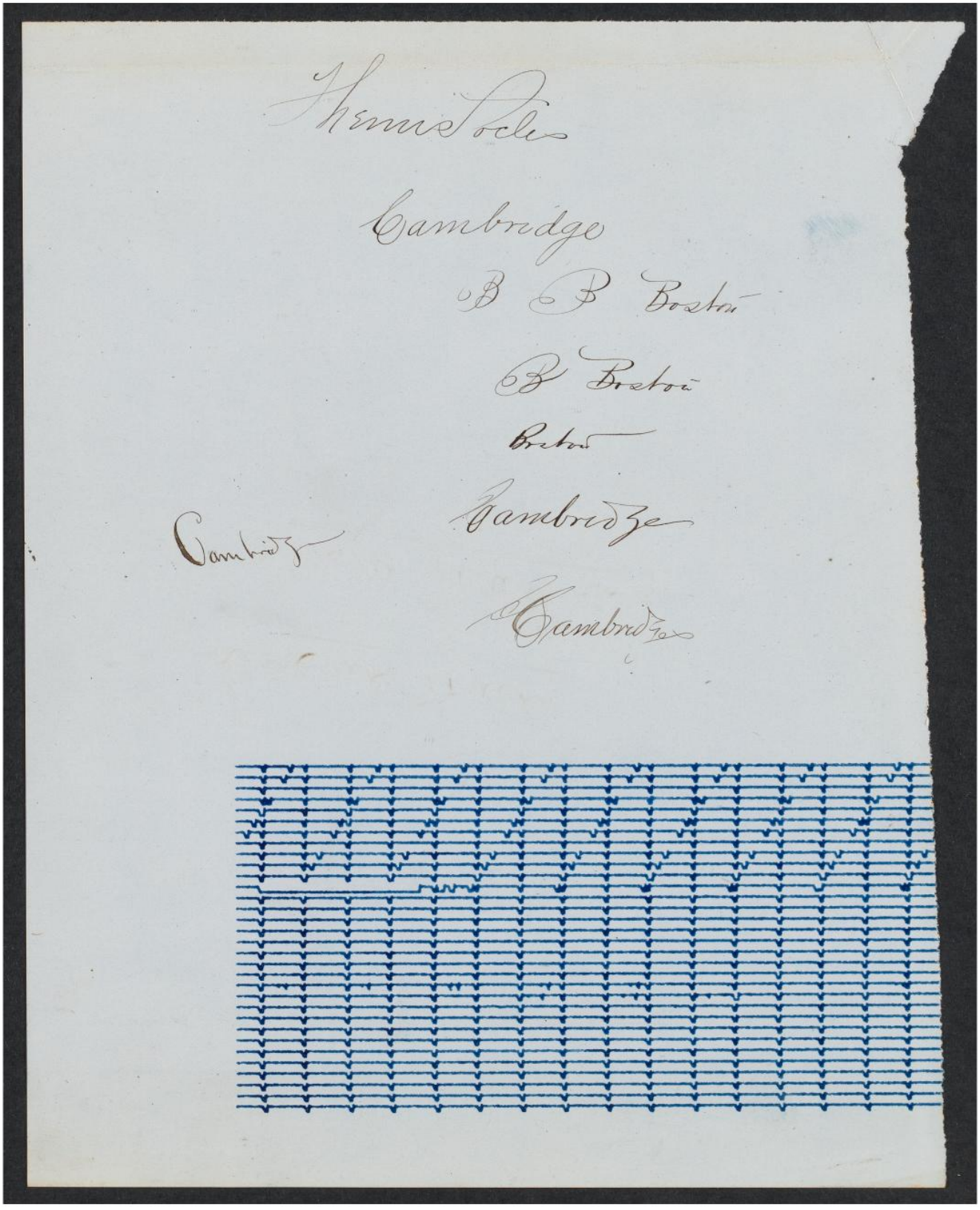
d	
2	5 a
3	16
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April

4	6
7	18
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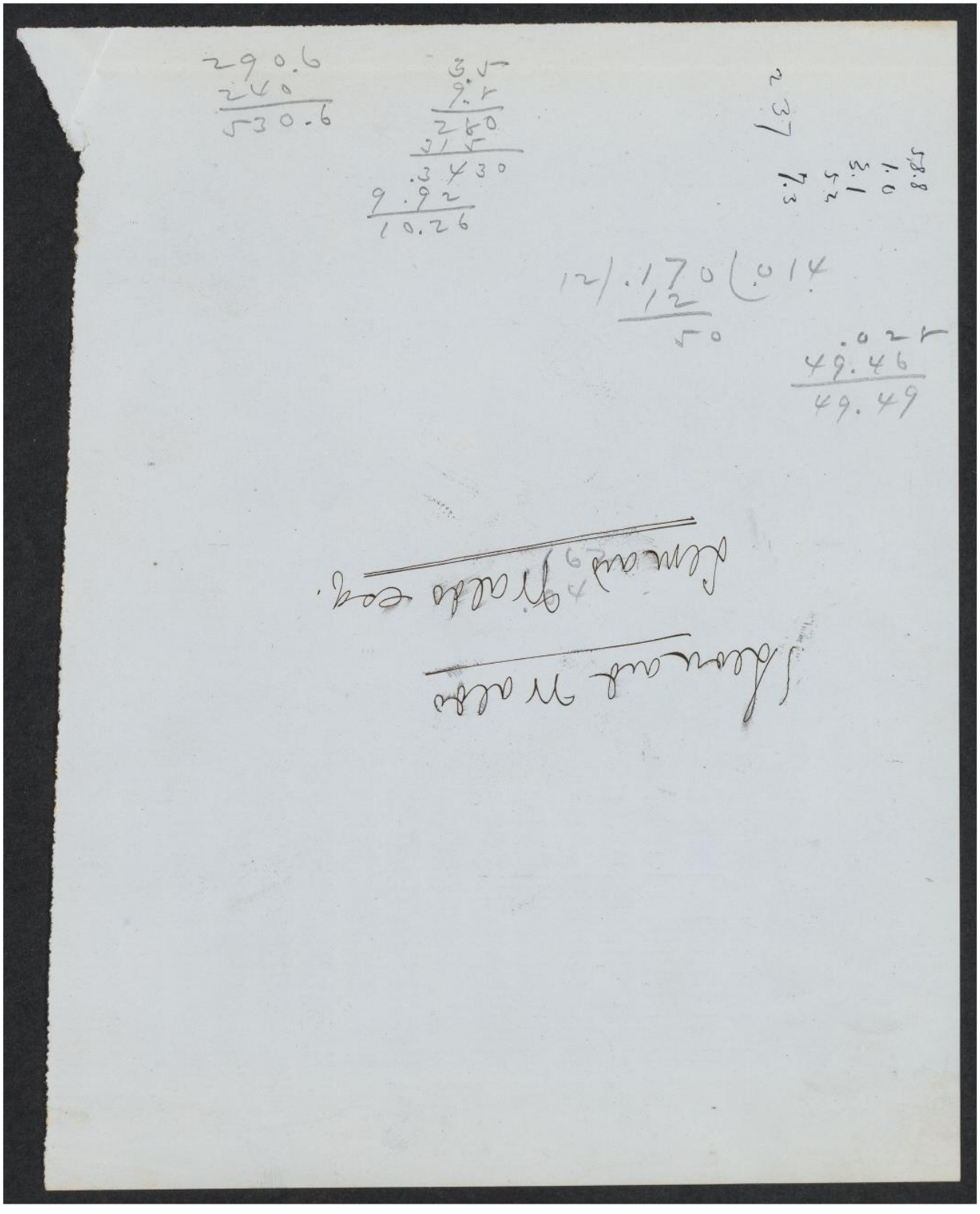
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1879. Clock Comparisons. Harvard Observatory.

	1327.		3451.		191.
June.	Error.	hourly rate.	Error.	hr. rate	
20.3	+ 50.02		+ 4 29.42		− 23.38
21.3	+ 50.48		+ 4 31.75		− 23.54
22.3	+ 51.15		+ 4 34.50		− 23.74
23.3	+ 52.07		+ 4 36.92		− 23.72
24.3	+ 52.85		+ 4 39.7		− 24.00
25.3	+ 53.47	+.026	+ 4 42.0		− 24.45
26.3	+ 54.41	.025			
30.3	+ 54.25		+ 4 53.75		− 26.83
July.					
1.3	+ 54.08				
2.3	+ 53.60				
3.3	+ 53.67		+ 5 02.89		− 27.90
5.3	+ 53.95		+ 5 06.2		− 29.18
6.3	+ 54.54		+ 5 08.6		− 29.65
6.3	+ 55.11				
9.3	+ 55.70				
10.3	+ 56.60				
10.3	+ 57.27				− 31.58
14.3	+ 59.03	+.48	+ 5 28.70		− 33.6
17.	+ 00.40		5 35.27	.093	
19.3	1 00.40				
21.3	1 01.48				
23.3	1 03.40		5 50.38		
24.3			5 52.68		
27.3			5 59.30		
31.3			6 07.92		
August.					
2.3	1 11.85		6 11.95		− 43.4
6.3	1 12.15		6 19.26	.076	46.2
10.3	1 13.8		6 26.92	.080	48.65
11.3	1 14.8		6 29.09		49.0
12.3	1 15.94		6 31.33		48.64
13.3	1 16.28		6 32.05		49.37
			6 33.00		49.75
14.3	1 17.42		6 35.15		50.16
19.3	1 23.53		6 45.95		52.02
19.7	1 23.95		6 46.45		52.10 (?)
20.3	1 24.52		6 49.00		52.39
21.3	1 26.18		6 50.00		52.82
23.3	1 29.09				
24.3	1 29.99		6 55.85		54.85
24.3	1 30.40		6 56.62		55.10
28.3	1 36.05		7 4.83		56.5
29.3	1 38.2		7 7.23		
31.3	1 40.8	.070	7 10.87	.093	57.35
8					
September.					
4.9+	1 47.09				
5.0	1 47.36				
6.3	1 48.83				
7.2	1 50.09				
8.2	1 51.41	.065			
8.7	1 52.19	.065			
9.3	1 53.03	.055			
10.3	1 54.88				
11.3	1 56.22				
12.2	1 56.90	.065			
14.3	2 00.06				
15.2	2 01.40	.076			
16.7	2 04.23				
17.8	2 06.23				
19.3	2 08.82	.076			
20.3	2 11.20	.066			
23.3	2 15.33				
23.6	2 15.84	.07			
24.7	2 17.64				
25.7	2 19.16				
26.2	2 19.63	.043			
29.3	2 22.20				
30.24	2 22.36				
30.78	2 23.00				

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10 40.82

41.3
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54.0
58.1

06.5
10.9
15.3
19.6
23.9

32.3
36.4 .19
40.8 1.21
45.0
49.3 +18

76 2
15.24
+ 1.50
+ .05
− .40
15.89
40.82
35.07

18
22
36
36
39

119
84
476
952
999 6

3 56.56

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