

KG
11365
121

No. 1.

D. 1

Minutes of Chronometer
Expedition
Commencing April 1849.
Terminating Feb'y 1850.
No. 1.

KG 11365.121

KG 11365.121



$$\begin{array}{r} 15 \overline{) 89} \quad .593 \\ \underline{140} \\ 135 \\ \underline{50} \end{array}$$

$$\begin{array}{r} 14 \overline{) 13994} \quad 9996 \\ \underline{136} \\ 136 \\ \underline{126} \\ 134 \\ \underline{126} \\ 80 \end{array}$$

West Point N.Y.
February 18th 1873

Dear Sir.

I inclose all papers concerning the observations taken at your observatory last Autumn, in order to compare ours with, for longitude determination - Copious remarks on each copy of a night's work, will I think explain everything.

Mr Rogers and myself agreed to leave the polar star out in getting the clock errors - which will account for ~~the~~ large number not used on several evenings. On Sept-30th the first-determination of the hourly rate of your clock for the evening, seemed so enormously large, that I applied the sunset test, ^{but} with the same result. The first-four nights corroborate each other with sufficient-accuracy to indicate a good longitude determination, - but unfortunately I cannot make the error of our clock on Oct 2nd come out, as every other night indicates ~~as~~ it should. The only variation in the circumstances for that evening from the two preceding, was a very large level error throughout - which I had allowed to increase owing to your suggestion "not to disturb the instrument by making it go before commencing the observations" - I cannot see how it could

affect the result - as it was measured frequently and remained quite constant - all the evening.

In case the trouble is not discovered I shall reject the entire night's work, and consider the difference in longitude equal to $11'' 18.33$ minus personal equation which will have to rest on the determination of last fall - I believe Mr Rogers made it - "Rogers minus Bass . $03''$ " - If I am wrong please let me know - Also be kind enough to look over the results and send me any suggestions that may occur to you -

Have I your correct longitude from Menanach
 $4^h 44^m 29.6$?

I have been ordered to Washington and expect to go out with some party to Transit - Venus - I shall therefore leave here by March 1st.
 Remember me kindly to your family and Mr Rogers.

Very truly yours

E. W. Bass

B

Professor J. Winlock

Cambridge
 Mass

HARVARD COLLEGE OBSERVATORY.

REDUCTION OF THE APPARENT RIGHT ASCENSION AND DECLINATION OF

ε. Urs. Min

TO MEAN 18740

$a = 16^h 58^m 57^s$ $a = 254^d 48'$ $\delta = +82^{\circ} 14'$ $\log \tan \delta = 0.8652$ $\log \sec \delta = 0.8692$ $\log \sin \delta = 9.9960$ $\log \cos \delta = 9.1308$

Date.	G	H	G + a	Δ_1	H + a	Δ_1	$\log g$	$\log h$	$\log i$	τ	μ
July 13	315 17	160 6	210 0	1 1	54 49	0 1	1.0226	1.3067	0.4747		
21	316 47	152 53	211 30	1 30	47 36	7 13	1.0428	1.3023	0.5986		
29	317 58	145 31	212 41	1 11	40 14	7 22	1.0622	1.2979	0.6882		
Aug 5	318 49	138 56	213 32	0 51	33 39	6 35	1.0781	1.2936	0.7486		
13	319 34	131 14	214 20	0 48	25 57	7 42	1.0948	1.2886	0.8023		

Date.	July 13	July 21	July 29	Aug. 5	Aug. 13	July 13	July 21	July 29	Aug. 5	Aug. 13
$\log \sin (G + a)$	9.6990	9.7181	9.7324	9.7423	9.7513	$\log \cos (G + a)$	9.9376	9.9308	9.9251	9.9209
$\log g \tan \delta$	1.8874	1.9080	1.9274	1.9433	1.9600	$\log g$	1.0226	1.0428	1.0622	1.0781
$\log I_a$	1.5867	1.6261	1.6598	1.6856	1.7113	$\log I_g$	0.9600	0.9736	0.9873	1.0017
$\log \sin (H + a)$	9.9133	9.8683	9.8102	9.7436	9.6411	$\log \cos (H + a)$	9.7588	9.8288	9.8828	9.9203
$\log h \sec \delta$	2.1751	2.1715	2.1671	2.1628	2.1578	$\log h \sin \delta$	1.3019	1.2983	1.2939	1.2896
$\log II_a$	2.0884	2.0398	1.9773	1.9164	1.8489	$\log II_g$	1.0607	1.1271	1.1767	1.2099
$\tau \mu$						$\log III_g$	2.6062	2.7294	2.8190	2.8794
I_a	+17.18	+18.46	+19.63	+20.68	+21.75	$\tau \mu$				
II_a	-3.86	-4.23	-4.57	-4.85	-5.14	I_g	-9.12	-9.41	-9.71	-9.98
$(a' - a)''$						II_g	+1.50	+13.40	+15.02	+16.21
$\frac{1}{2}(a' - a)$						III_g	+ .40	+ .54	+ .66	+ .76
$(a' - a)''$						$\delta' - \delta$	+2.78	+4.53	+5.97	+6.77

a
 Δa
 a 1875.0
 a "
 $\log \sin a$
 $\log \tan \delta$
 $\log \text{const.}$
 $\log F$
 const.
 F
 da
 dt
 a
 const.
 $a + \text{const.}$
 $2a$
 $\log \tan \delta$
 $\log \tan^2 \delta$
 $\tan^2 \delta$
 $\tan^2 \delta + \frac{1}{2}$

$\log (\tan^2 \delta + \frac{1}{2})$
 $\log \sin 2a$
 $\log \text{const.}$
 $\log I_a$
 $\log \sin a$
 $\log \tan \delta$
 $\log \sin (a + \text{const.})$
 $\log \text{const.}$
 $\log II_a$
 const.
 I_a
 II_a
 $(\text{sec. var.})_a$

$+2.78$
 $+1.75$
 -81
 144
 42
 102
 91

δ
 $\Delta \delta$
 δ 1875.0
 $\log \cos a$
 $\log \text{const.}$
 $\log \frac{d\delta}{dr}$
 $\frac{d\delta}{dr}$
 $\frac{d\delta}{a'}$
 $\log \tan \delta$
 $\log \sin^2 a$
 $-\log \text{const.}$
 $\log I_g$
 $\log \text{const.}$
 $\log \cos (a + \text{const.})$
 $\log II_g$
 I_g
 II_g
 $(\text{sec. var.})_g$

Washington

Range Program

4.9	-	11.1	47 ± 111
3.7	+	9.2	35.84
4.4	-	13.1	19.37
6.3	-	17.0	25.41
1.8	+	5.8	13.46
4.05	+	11.4	0.8.33
2.9	±	8.0	53.126
3.7	±	9.8	102.63
2.3	±	7.8	21.80
4.8	±	14.1	26.79
4.5	±	12.3	28.0 ± 100
2.6	±	7.8	
2.0		4.8	
3.3		8.6	
3.6		8.0	
2.1		8.8	± 8.9
4.3		11.1	
2.3		3.1	
4.4		13.1	
5.2		12.6	
6.2		13.8	
4.7		9.5	
1.8		5.8	

6.2	± 13.8
3.9	8.2
4.7	9.5
1.8	5.8
3.4	8.5
3.2	9.5
3.1	10.2
4.0	10.3
2.3	5.5
2.2	5.8
1.1	3.4
3.4	8.2
2.0	5.4
2.2	6.2
2.9	7.2
1.7	2.6
2.9	7.4
2.3	6.8
2.3	6.5
1.8	4.8
1.5	3.8
2.36	6.33

3.9	± 12.8
1.7	5.6
1.9	5.4
3.0	7.8
1.2	3.7
3.3	9.0
2.1	6.3
2.7	5.6
2.1	6.4
2.1	6.3
2.40	6.93

2.80	± 0.70
3.36	8.9
3.48	8.7
2.36	6.3
2.40	6.9
1.65	4.8
3.13	8.4
1.40	3.28
2.88	3.78
	± 7.6

HARVARD COLLEGE OBSERVATORY.

REDUCTION OF THE APPARENT RIGHT ASCENSION AND DECLINATION OF

B.A.C. 2557

TO MEAN 1870

$a = 8^{\text{h}} 28^{\text{m}} 59^{\text{s}}$	$a = 127^{\circ} 15'$	$\delta = 45^{\circ} 51'$	$\log \tan \delta =$	$\log \sec \delta =$	$\log \sin \delta =$	$\log \cos \delta =$					
Date.	G	H	$G + a$	Δ_1	$H + a$	Δ_1	$\log g$	$\log h$	$\log i$	τ	μ
Mar 23	273 6	266 16	40 21				0.8943	1.2733	0.9098m		
31	272 28	257 42	39 43				0.8959	1.2747	0.9020m		
Apr. 8	278 14	249 14					0.8964	1.2775	0.8858m		

Date.	<i>March 23</i>	<i>March 31</i>	<i>Apr. 8</i>	<i>March 23</i>	<i>March 31</i>	<i>April 8</i>
$\log \sin (G + a)$				$\log \cos (G + a)$		
$\log g \tan \delta$				$\log g$		
$\log I_a$				$\log I_\delta$		
$\log \sin (H + a)$				$\log \cos (H + a)$		
$\log h \sec \delta$				$\log h \sin \delta$		
$\log II_a$				$\log II_\delta$		
				$\log III_\delta$		
$\tau \mu$				$\tau \mu$		
f	<i>+ 0.94</i>	<i>+ 1.74</i>	<i>+ 2.56</i>	I_δ		
I_a				II_δ		
II_a				III_δ		
$(a' - a)''$				$\delta' - \delta$		
$\frac{1}{2} (a' - a)$						
$(a' - a)^2$						
a				δ		
Δa				$\Delta \delta$		
$a 1875.0$				$\delta 1875.0$		
a''				$\log \cos a$		
$\log \sin a$				$\log \cos \delta$		
$\log \tan \delta$				$\log \cos a$		
$\log \cos \delta$				$\log \cos \delta$		
$\log F$				$\log \frac{d\delta}{dr}$		
$\log \cos \delta$				$\frac{d\delta}{dr}$		
F				$\frac{d\delta}{dr}$		
$\frac{da}{dt}$				$\log \tan \delta$		
a				$\log \sin^2 a$		
$\log \cos \delta$				$-\log \cos \delta$		
$\log \tan \delta$				$\log I_\delta$		
$\log \tan^2 \delta$				$\log \cos \delta$		
$\log \tan^2 \delta$				$\log \cos(a + \text{const.})$		
$\log \tan^2 \delta + \frac{1}{2}$				$\log II_\delta$		
				I_δ		
				II_δ		
				$(\text{sec. var.})_\delta$		

Lead in gum.

Dritter allgemeiner Briefwechsel

Europäischen Godmessung.

Handwritten numbers on a grid background, arranged in a 10x10 pattern. The numbers are written in black ink and are mostly integers, with some fractions and decimals. The numbers are arranged in a way that suggests a sequence or a pattern, possibly related to the Fibonacci sequence or a similar mathematical concept. The numbers are written in a cursive style, and the grid lines are faint and light blue.

[illegible]

9	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----

REDUCTION OF THE APPARENT RIGHT ASCENSION AND DECLINATION OF *22 Camelopardalis*

TO MEAN 18740

Date.	Aug. 3	Aug. 11	Aug. 19	Aug. 27	Sept. 4	Aug. 3	Aug. 11	Aug. 19	Aug. 27	Sept. 4
$\log \sin (G + \alpha)$	9.8834	9.8886	9.8928	9.8965	9.8999	9.8803	9.8817	9.87953	9.8783	9.87836
$\log g \text{ tang } \delta$	1.4977	1.5149	1.5304	1.5443	1.5565	1.0737	1.0907	1.1062	1.120	1.1323
$\log I_a$	1.3813	1.4033	1.4232	1.4408	1.4564	0.8830	0.8924	0.9015	0.9094	0.9157
$\log \sin (H + \alpha)$	9.8971	9.8453	9.7763	9.6791	9.5402	9.7884	9.8536	9.9047	9.9438	9.9721
$\log h \text{ sec } \delta$	1.7477	1.7422	1.7379	1.7335	1.7298	1.266	1.2611	1.2561	1.2517	1.2480
$\log II_a$	1.6450	1.5882	1.5731	1.5126	1.2700	1.0545	1.1147	1.1608	1.1955	1.2201
$\log III_0$						0.2794	0.3372	0.3810	0.4138	0.4369
$\frac{7\pi}{f}$										
I_a	+20.40	+21.47	+22.50	+23.44	+24.31	-7.64	-7.51	-7.97	-8.12	-8.24
II_a	+2.41	+2.53	+2.65	+2.76	+2.86	+11.54	+13.02	+14.48	+15.69	+16.60
$(\alpha' - \alpha)^{1/2}$	+18.59	+20.18	+21.90	+23.61	+25.31	-1.91	-2.17	-2.40	-2.59	-2.74
$\frac{1}{2}(\alpha' - \alpha)$	+6.130	+6.717	+7.600	+7.870	+8.437	+6.79	+3.04	+4.17	+4.98	+5.62
$(\alpha' - \alpha)^3$	+1.226	+1.393	+1.460	+1.574	+1.687					

[illegible]

0.09
34

~~Σ = West~~

~~-0.53
+1.0
+3.2
+7.1~~

~~W - S. C. Fulcrum~~

~~-54
-49
+51
-84~~

Mel from 1465

40 ± 98
20 ± 63
18 ± 43
14 ± 51
20 ± 62
26 ± 19
17 ± 48
11 ± 33
13 ± 40
19 ± 57
178 ± 506
51

10 ± 35
14 ± 38
16 ± 42
13 ± 33
32 ± 100
17 ± 61
28 ± 74
28 ± 86
24 ± 73
0.9 ± 25
191 ± 537
154

22 ± 50
22 ± 63
16 ± 45
11 ± 34
15 ± 30
08 ± 16
16 ± 45
08 ± 21
37 ± 67
19 ± 37
174 ± 408

10 ± 28
18 ± 58
14 ± 40
16 ± 46
11 ± 35
06 ± 15
25 ± 55
18 ± 48
18 ± 49
10 ± 28
146 ± 402

07 ± 27
39 ± 64
11 ± 39
24 ± 66
13 ± 26
18 ± 50
10 ± 36
10 ± 28
11 ± 35
15 ± 53
152 ± 424

178 ± 51
191 ± 54
174 ± 41
146 ± 40
152 ± 42
341 ± 228
168 ± 46

I - I I - I I - I I - I

I - I I - I I - I I - I

11/11/1

8

REDUCTION OF THE APPARENT RIGHT ASCENSION AND DECLINATION OF *18 Draconis*

$a = 21^{\text{h}} 19^{\text{m}} 6^{\text{s}}$ $a = \quad^{\circ} \quad'$ $\delta = +80^{\circ} 53'$ $\log \tan \delta =$ $\log \sec \delta =$ $\log \sin \delta =$ $\log \cos \delta =$

Date.	G	H	$G + a$	Δ_1	$H + a$	Δ_1	$\log g$	$\log h$	$\log i$	τ	μ
-------	---	---	---------	------------	---------	------------	----------	----------	----------	--------	-------

Oct- 3
11
19
26

Date.

$$\begin{array}{l} \log \sin (G + a) \\ \log g \operatorname{tang} \delta \\ \log I_a \end{array}$$
$$\begin{aligned} & \log \sin (H + a) \\ & \log h \sec \delta \\ & \log \Pi_a \end{aligned}$$
$$\begin{array}{c} \tau\mu \\ \mathbf{f} \\ \mathbf{I}_a \\ \Pi_a \\ (a' - a)'' \\ \frac{1}{2}(a' - a) \\ (a' - a)^S \end{array}$$
$$\begin{array}{l} \log \cos (G + a) \\ \log g \\ \log I_{\delta} \end{array}$$
$$\begin{array}{l} \log \cos (H + a) \\ \log h \sin \delta \\ \log \Pi_{\delta} \end{array}$$
 $\log III_{\delta}$
$$\begin{array}{l} \tau\mu \\ \text{I}_{\delta} \\ \text{II}_{\delta} \\ \text{III}_{\delta} \end{array}$$
$$\delta' - \delta$$

α
$\Delta \alpha$
α 1875.0
α "
$\log \sin \alpha$
$\log \tan \delta$
$\log \text{const.}$
$\log F$
const.
F'
$\frac{da}{dt}$
-
α
const.
$\alpha + \text{const.}$
2α
$\log \tan \delta$
$\log \tan^2 \delta$
$\tan^2 \delta$
$\tan^2 \delta + \frac{1}{2}$

$$\begin{array}{l} \log (\tan ^2 \delta + \frac{1}{2}) \\ \log \sin 2 \alpha \\ \log \text { const.} \\ \log I_{\alpha} \\ \\ \log \tan \delta \\ \log (\sin (\alpha + \text { const.})) \\ \log \text { const.} \\ \log II_{\alpha} \end{array}$$
$$\begin{array}{c} \text{const} \\ I_a \\ II_a \end{array}$$

(sec. var. α)

$$\begin{aligned} & \delta \\ & \Delta \delta \\ & \delta 1875.0 \\ & \log \cos \alpha \\ & \log \text{const.} \\ & \log \frac{d\delta}{dr} \\ & \frac{d\delta}{dr} \\ & \log \text{tang } \delta \\ & \log \sin^2 \alpha \\ & - \log \text{const.} \\ & \log I_{\delta} \\ & \log \text{const.} \\ & \log \cos(\alpha + \text{const.}) \\ & \log II_{\delta} \\ & I_{\delta} \\ & II_{\delta} \\ & (\text{sec. var.})_{\delta} \end{aligned}$$

Roper N.C. o
 Range ~~Barium~~
 1.60 ± 46
 3.1 ± 99
 2.0 ± 52
 2.1 ± 54
 2.4 ± 84
 1.6 ± 45
 4.0 ± 85 ± 66
 1.8 ± 42
 2.2 ± 59
 2.9 ± 97
 1.2 ± 46
 2.1 ± 54
 2.4 ± 71
 1.9 ± 34
 1.1 ± 26 $\times 53$
 2.6 ± 89
 2.2 ± 40
 2.4 ± 59
 2.1 ± 57
 2.2 ± 49
 1.6 ± 87
 0.9 ± 35
 1.5 ± 23
 2.5 ± 80 ± 48
 1.5 ± 32
 1.3 ± 58
 1.7 ± 53
 1.9 ± 66
 2.2 ± 63
 0.7 ± 23

240
 201
 168
 212
 1.88
 1009

± 2.02

Range Barium 857
 1.5 ± 42
 1.5 ± 37
 1.1 ± 29
 3.0 ± 57
 2.2 ± 72
 4.0 ± 97 $\times 59$
 2.5 ± 77
 1.6 ± 39
 1.9 ± 63
 2.9 ± 80
 4.8 ± 35
 1.9 ± 48
 1.9 ± 49
 1.5 ± 45
 2.1 ± 50
 2.1 ± 43 $\times 51$
 1.6 ± 63
 3.1 ± 78
 2.0 ± 49
 3.5 ± 69

66
 53
 48
 59
 51

277

± 55

98.8
107
107

$$m=0$$
$$\begin{array}{r} 42^23 \\ 42^24 \\ 41^0 \\ 41^4 \end{array}$$

16/5/2019

2

$$3 = 42 - 0$$

$$U = 42$$
$$3 = 4 - U$$
$$42 = 42$$
$$U = 42 - 0$$

R R R R R R R R

424
434

$$\begin{array}{r} 414 = 02 \\ 424 = 00 \\ 434 \end{array}$$

$$\begin{array}{l} 424 = 00 \\ 414 = 2 \\ 404 = 3 \\ 394 = 1 \end{array}$$

5.8866 b	25
5.5336 b	58
6.5485 b	25
6.6246 b	70
6.5528 b	59
6.5735 b	09
6.5336 b	55
6.8488 b	25
6.8494 b	53
6.8008 b	46
6.7557 b	55
6.9697 b	80
6.6273 b	25
6.5345 b	22
6.4130 b	15
6.2396 b	10
8.4030	5
	0



RS

for me

New discussion of (109)

Elements.

Epoch Oct 31.1 1869 Berlin M.T.

Ineq. 1169 {

M	343	62	29.16	"
Ω	4	56	5.99	+49.49
ω	57	04	48.46	
i	8	2	58.43	+0.46
φ	17	28	9.73	
u	802.00077			
$h\alpha$	4305544			
π	56	00	54.40	+50.245

x penguins

Bz.	N.C.	Bz. - N.C.
268	256	+12
492	495	-0.3
366	368	-0.2
436	32	+0.4
331	331	+0.0
103	109	-0.6
257	249	+0.8
191	178	-0.7
60.2	58.1	+2.1
426	427	-0.1
		64

14
 0.1
 0.6
~~0.2~~
 0.7
 1.1
 0.5
 0.5
 1.8
 0.1
 0.8

 7.9

~~Original Observations~~
~~General Catalogue~~ ~~Recent Sherg.~~

A Original Observations

Circle readings and explanatory notes.

Recent Sherg.

~~Recent~~

From A₁ to A₁₈ inclusive.

General Catalogue A₁₁ to A₁₄ inclusive

Polan. Catalogue A₁₂-3 A₄ to A₁₄ inclusive

General Catalogue A₁₄ to A₁₆ inclusive.

Cambridge,

1849. April 21st W. C. Bond (B¹) and R. F. Bond (B³) observed for Personal Equation. Instrument 23 feet Refractor. Stars Polaris. dist of wires 15th. half seconds sidereal Chronometer. No 5557. * 1/2 hour past the meridian

B¹ Leads8^h 08^m 4.8

14.4 ~ 9.6

28.0

37.5 ~ 9.5

43.4

53.0 ~ 9.6

21.6

31.4 ~ 9.8

18.4

27.9 ~ 9.5

49.3

59.0 ~ 9.7

* 7.7

17.3 ~ 9.6

20.4

29.7 ~ 9.3

45.3

55.0 ~ 9.7

7.2

16.9 ~ 9.7

19.1

28.8 ~ 9.7

29.07

38.07 ~ 9.0

13.0

22.5 ~ 9.5

25.4

55.5 ~ 10.1

45.3

54.9 ~ 9.6

B¹ Mean 9.593B³ Leads8^h 08^m 49.8

9.0 ~ 9.2

11.6

21.7 ~ 10.1

21.9

31.9 ~ 10.0

06.5

16.4 ~ 9.9

11.8

22.0 ~ 10.2

17.0

27.0 ~ 10.0

19.0

29.0 ~ 10.0

1.3

11.4 ~ 10.1

25.3

35.3 ~ 10.0

39.8

50.2 ~ 10.4

56.8

6.9 ~ 10.1

17.3

27.5 ~ 10.2

46.3

55.5 ~ 9.2

7.0

17.0 ~ 10.0

B³ mean 9.996B¹ - mean - 9.593

2/408

0.204

(Note. B³ has been observing at the Transit two hours - B¹ observed only 2 stars. Both have been in Boston during the forenoon busied about other matters. They were neither of them in good condition for nice observing.

* This was recorded 8.7 - no doubt a second wrong.

Cambridge

1849 April 24th W.C.B (B¹) and R.F.B (B³) observed for Personal equation, Lelerope 23 feet Equatorial, spider line micrometer, star Procyon about two hours east of the meridian, circumstances favourable, Lidenal, half seconds, Chronometer. distance of wires - 15".

B ¹ Leads	B ³ Leads	B ¹ Leads	B ³ Leads changed sides
5.17.09.2	4.2	18.9	31.0
17.19.1 - 9.9	14.0 - 9.8	28.6 - 9.7	31.0 - 10.0
44.0	40.0	22.9	50.2
* 54.6 - 10.6	49.8 - 9.8	32.7 - 9.8	00.0 - 9.8
22.0	2.4	27.4	53.2
31.5 - 9.5	12.4 - 10.0	37.3 - 9.9	03.0 - 9.8
39.0	17.5	31.5	01.7
48.9 - 9.9	27.4 - 9.9	41.2 - 9.7	11.3 - 9.6
57.9	52.7	37.0	4.2
7.7 - 9.8	2.6 - 9.9	46.9 - 9.9	14.0 - 9.8
28.2	9.2	45.4	11.6
38.1 - 9.9	19.0 - 9.8	55.1 - 9.7	21.6 - 10.0
46.0	18.2	48.6	15.5
56.0 - 10.0	28.0 - 9.8	58.4 - 9.8	25.3 - 9.8
6.3	43.2	6.3	36.0
16.0 - 9.7	53.0 - 9.8	16.2 - 9.9	46.0 - 10.0
15.4	55.5	01.0	59.0 -
25.7 - 10.3	5.3 - 9.8	11.0 - 10.0	09.0 - 10
34.2	15.5	11.0	28.6
43.8 - 9.6	25.3 - 9.8	20.6 - 9.6	38.5 - 9.9
9.920	9.844	9.800	9.877

distance of wires 20"

B ¹ Leads	B ³ Leads	B ¹ Leads changed sides	B ³ Leads
59.2	30.6	03.0	38.6
12.2 - 13.0	43.7 - 13.1	15.9 - 12.9	41.4 - 12.8
17.3	45.0	15.0	37.2
20.7 - 13.4	58.0 - 13.0	27.9 - 12.9	50.5 - 13.3
22.6	4.2	36.0	45.6
35.5 - 12.9	17.7 - 13.5	49.2 - 13.2	59.0 - 13.4
40.8	12.5	57.5	12.4
53.9 - 13.1	25.5 - 13.0	64.7 - 13.3	25.4 - 13.0
48.8	22.1	24.7	38.4
61.9 - 13.1	35.5 - 13.4	37.6 - 12.9	57.4 - 13.0
mean 13.100	13.200	13.040	13.100

Cambridge.

April 24th - star Procyon $1\frac{1}{2}$ from the meridian, dist of wires 15th
 changed sides

B ¹ leads	B ³ leads	B ¹ leads	B ³ leads
6.0 - 28.6	3.0	42.7	58.5
38.7 - 10.1	12.5 - 9.5	52.7 - 10.0	7.5 - 9.0
53.4	25.8	53.0	12.6
63.2 - 9.8	35.5 - 9.7	62.9 - 9.9	22.8 - 10.2
56.6	33.3	54.4	22.2
66.4 - 9.8	43.1 - 9.8	64.5 - 10.1	32.0 - 9.8
3.5	42.7	54.0	26.2
13.3 - 9.8	52.6 - 9.9	64.1 - 10.1	36.0 - 9.8
11.3	47.0	50.0	22.0
21.8 - 10.5	56.8 - 9.8	60.0 - 10.2	32.0 - 10
13.3	48.8	10.060	9.760
23.5 - 10.2	58.5 - 9.7	Procyon near the meridian	
22.4	50.2	B ¹ leads	B ³ leads
32.2 - 9.8	60.2 - 10.0	7.29.47.0	13.5
20.8	59.4	57.0 - 10.0	23.7 - 10.2
30.7 - 9.9	69.3 - 9.9	54.5	21.5
27.7	8.6	64.5 - 10.0	31.3 - 9.8
37.7 - 10.0	18.8 - 10.2	14.0	18.7
37.0	11.7	23.5 - 9.5	28.5 - 9.8
46.8 - 9.8	21.5 - 9.8	23.4	47.0
9.977	9.833	33.4 - 10.0	56.6 - 9.6
		29.0	57.5
		38.9 - 9.9	67.2 - 9.7
		49.0	8.2
		58.7 - 9.7	18.1 - 9.9
		54.8	21.6
		64.7 - 9.9	31.7 - 10.1
		10.9	39.1
		21.2 - 10.3	49.2 - 10.1
		31.8	57.0
		41.7 - 9.9	60.5 - 9.5
		37.5	2.4
		47.5 - 10.0	12.2 - 9.8
		9.902	9.850

Disturbed by visitors.

1 st Mean	9.929	2 nd - 9.800
	844	.877
	185	277
B ¹ + B ²	.042	- 0.038
3 rd -	9.977	4 th - 9.902
	833	9.850
	4094	2/52
	+ .047	+ .026
	+ .042	
	- .038	
	+ .026	
	477	
	+ .019	
		5 th - .050
		- .030
		+ .150
		3/070
		+ .023

13.100
200
1100
- .050
13.040
13.100
160
- .030
1080
- .040
10.060
9.760
300
+ .150
- .040
1116
+ .055

Sub. from B30.02 to equal B¹.

Liverpool Observatory.

1849. May 23. John Hartnup (H) and R. H. Bond (B3)
observed for Personal Equation with the Equatorial
by passages of stars over the parallel wires of the
Spider line micrometers.

	H leads.	B3 leads	H leads	B3 leads
H	4.65	24.3	8.8	42.7
B3	24.9 ~ 20.25	40.8 ~ 16.5	29.5 ~ 20.7	59.3 ~ 16.6
	8.3	25.2	58.7	30.3
	29.0 ~ 20.7	41.7 ~ 16.5	19.3 ~ 20.6	47.2 ~ 16.9
	32.25	32.7	42.5	21.5
	53.00 ~ 20.75	49.3 ~ 16.6	62.9 ~ 20.4	38.0 ~ 16.5
	49.60	21.4	39.9	53.9
	70.40 ~ 20.80	37.7 ~ 16.3	60.5 ~ 20.6	10.5 ~ 16.6
	36.40	21.8	57.25	36.0
x	57.30 ~ 20.90	38.3 ~ 16.5	19.6 ~ 20.35	52.3 ~ 16.3
	20.68	16.48	20.53	16.58
	-2	+2	-2	+2
	18.68	18.48	18.53	18.58
	18.48		18.58	
	1.20		105	
	+ .10		-.02	
	-.02			
	1.08			
	+ .04			

Liverpool Observatory, July 6th 1849. observations for Personal Equation - S. Hartnup and R. F. Bona (B3) Refracting Telescope Equatorially mounted. Star, Aldebaran, distance of micrometer wires 14^m.

H leads.

40.9

56.1 - 15.2

14.2

39.4 - 15.2

7.2

22.3 - 15.1

15.17
+ 2

13.17

13.20

+ 0.03

$\frac{1}{2} = +0.015$
 -0.005
 $+0.005$

B3 leads

47.5

58.7 - 11.2

11.0

22.2 - 11.2

cloudy

11.2
- 2

13.20

Star Procyon

H leads

6.3

21.0 - 14.7

38.0

52.7 - 14.7

55.8

70.6 - 14.8

cloudy

14.73

- 2

12.73

B3 leads

29.0

39.7 - 10.7

52.0

62.7 - 10.7

31.9

42.7 - 10.8

7.0

17.7 - 10.7

10.72

+ 2

12.72

July 7th - Aldebaran, dist microm wires 14^m

H leads

56.7

72.1 - 15.4

6.2

21.3 - 15.1

55.25

14.5 - 15.25

14.2

29.5 - 15.3

32.1

47.6 - 15.5

12.2

27.7 - 15.5

23.7

38.9 - 15.2

15.32

- 2

13.32

B3 leads

58.5

9.8 - 11.3

23.5

35.0 - 11.5

21.9

33.2 - 11.3

26.3

37.3 - 11.0

6.9

18.3 - 11.4

10.0

21.2 - 11.2

11.28

2

13.28

1849. July 8th Liverpool Observatory, ^{1st} Equatorial
 Personal Equation J Hartnup and R. H. Bond (B3)
 Star β Leonis. dist. microm. wires - 14th

H leads

H - 11.75 ^s
 B3 - 27.20 - 15.45
 26.3
 41.8 - 15.5
 10.25
 25.8 - 15.55
 52.0
 67.2 - 15.20
 41.2
 56.7 - 15.50
 35.8
 57.3 - 15.5
 3.1
 18.4 - 15.3
 30.2
 45.4 - 15.2
 23.2
 38.3 - 15.1
 59.8
 15.0 - 15.2 ———
 24.4 35
 39.5 - 15.1 15.37
 53.2
 68.45 - 15.25
 55.7
 70.9 - 15.2
 7.55
 22.8 - 15.25
 33.25
 48.60 - 15.35
 1.8
 17.0 - 15.2
 4.85

B3 leads

B3 - 58.7 ^s
 H - 69.7 - 11.0
 7.85 - 11
 18.9 - 11.05
 18.4
 29.35 - 10.95
 56.9
 68.2 - 11.3
 35.4
 46.4 - 11.0
 56.5
 67.7 - 11.2
 11.3
 22.3 - 11.0
 46.9
 58.2 - 11.3
 27.45
 38.75 - 11.3
 53.5
 4.7 - 11.2 ———
 6.8 11.13 = t_a
 17.8 - 11.0 11.35 t_b
 58.5 22
 69.8 - 11.3 11
 52.7
 63.75 - 11.05
 11.3
 22.3 - 11.0
 36.9
 47.9 - 11.0
 11.75
 22.80 - 11.05
 1.70

Liverpool.

same continued

H leads	
H - 25.7	
B3 - 41.0 - 15.3	
41.05	
56.3 - 15.25	
59.7	
15.1 - 15.4	
23.8	
39.2 - 15.4	
1.35	15.265
4.85	15.030
20/6.20	
15.31	185
-0.2	
13.31	
13.10	
2.21	
.105	

B3 leads	
B3 - 24.0	
H - 35.25 - 11.25	
45.6	
56.8 - 11.2	
56.85	
67.8 10.95	
16.2	
27.2 - 11.0	
.240	11.08 to
1.70	
20/2.16	11.265 to
11.10	185
+2	
13.10	-0.093

Recapitulation of observations by Hestonup and B3 for Personal Equation.

May 23 - H leads - 5 obs - 18.68	
B3 leads - 5 obs - 18.48	$0.20 = 0.10$ sub from B3 to = H
July 6 - H leads - 3 - 13.17	
B3 leads - 2 - 13.20	$0.03 = 0.01$ - add to B3 to = H
May 23 - H leads - 5 - 18.53	
B3 leads - 5 - 18.58	$0.05 = 0.01$ - add to B3 to = H
July 6 - H leads - 3 - 12.73	
B3 leads - 4 - 17.72	$0.00 = 0.00$ -
7 - H leads - 7 - 13.32	
B3 leads - 6 - 13.28	$0.04 = 0.02$ - sub from B3 to = H
8 - H leads - 20 - 13.31	
B3 leads - 20 - 13.10	$0.21 = 0.10$ sub from B3 to = H
45 obs - given	0.10 } to be sub from B3 to = H
40 -	0.10 }

September 24th obs. for Personal equation of B¹ & B³ continue as
changed sides

B¹ leads
B¹ — 11.0
B³ — 23.0 — 12.0
12.3
24.4 — 12.1
20.2
32.0 — 11.8
24.9
37.0 — 12.1
40.3
52.2 — 11.9
58.3
70.3 — 12.0
20.6
32.8 — 12.2
24.2
36.2 — 12.0
55.5
67.4 — 11.9
6.6
18.5 — 11.9

11.9
11.9
11.9
2/24

Subsequent to
the voyage
36 obs

+ 0.12
+ .25
2/37

.185 to be subtracted from the time of B³ to equal B¹

.024
2/209

.10 to be sub. from B³ to = B¹ 2
.10 to be sub. from B³ to = H } B¹ = to H.

B³ leads
B³ — 36.9
B¹ — 49.0 — 12.1
40.3
52.0 — 11.7
49.5
61.3 — 11.8
2.3
14.0 — 11.7
20.9
32.6 — 11.7
35.3
47.0 — 11.7
52.2
64.0 — 11.8
21.5
33.2 — 11.7
28.4
40.0 — 11.6
34.2
45.9 — 11.7
11.75

Arrivals and Departures of the Expedition
Chronometers at and from Liverpool.

1849

Arrivals,	No of Chrono ^s	
May — 22 nd	7	
September 18 th	12 ^x	
Sept ^r — 25	12 ^x	
Oct ^r — 8	12 ^x	
Nov ^r — 6	12 ^x	
Nov ^r — 19	6 ^x	
Dec ^r — 19	12	
Dec ^r — 31	3	

1849.

Departures,	No of Chrono ^s	
February 23 rd	5	
August — 3	48 ^x	
September 29	15 ^x	
October — 13	12 ^x	
Oct ^r — 27	12 — +4	
Nov ^r — 10	12	
Nov ^r — 24	6	
1850 Jan ^y — 12	11	

Arrivals, and Departures, of the Expedition Chronometers
at and from Liverpool.

Arrivals,	No of Chrono ^s	Departures,	No of Chrono ^s
1849		1849.	
Sept ^r 19 th	12 — "	February 23 rd	5 — "
Sept ^r 25 th	12 — "	Aug ^t 3	48 — "
Oct ^r 8	12 — "	Sept ^r 29	15 — "
Nov ^r 6	12 — "	Oct ^r 13	12 — "
Nov ^r 19	6 — "	Oct ^r 27	12 — "
Dec ^r 19	12 — "	Nov ^r 10	12 — "
Dec ^r 31	3 — "	Nov ^r 24	6 — "
		1850 Jan ^y 12	11 — "

Arrivals and Departures of the Expedition Chronometers at and from Liverpool.

Arrivals. No of Chron^s

Departures. No of Chron^s

1849

May	22 ^d	7
September	18 th 18 th	12 ^x
Sept ^r	25	12 ^x
Oct ^r	8	12 ^x
Nov ^r	6	12 ^x
Nov ^r	19	6 ^x
Dec ^r	19	12
Dec ^r	31	3

1849.

February	23 ^d	5
August	3	48 ^x
September	29	15 ^x
October	13	12 ^x
Oct ^r	27	12 + 4
Nov ^r	10	12
Nov ^r	24	6
1850 Jan ^y	12	11

Arrivals, and Departures, of the Expedition Chronometers at and from Cambridge.

Arrivals, No of Chros.

1849. March	5
August 16 th —	48 ^x
Oct ^r — 12 —	3 ^x
Oct ^r — 13 —	12 ^x
Oct ^r Nov ^r — 10 ²⁶ —	16 ^{12x}
Nov ^r — 25 —	12
Dec ^r — 9 —	6
1850. Jan ^y — 26 —	11

Departures, No of Chros.

1849	
May — 9 th —	7 & No. 3710
August — 28 —	12 ^x
September 11 th —	12 ^x
September 25 —	12 ^x
October — 23 —	12 ^x
Nov ^r — 6 —	6 ^x
Dec ^r — 5 —	12
Dec ^r — 19 —	3

List of the Chronometers employed in the Chronometric Expedition for determining the difference of Meridians of the Liverpool and Cambridge Observatories, between Feb'y 1849 and March 1850, Makers name and number and to whom belonging

No	makers name		owners		To whom to be returned
	John Fletcher		Wm Bond & Son		Boston
	do - do		do - do		do
	do - do		do - do		do
	do - do		do - do		do
	do - do		do - do		do
56 th	310 - Tobias -	belonging to the Phil ^a High school Observatory			Phil ^a
"	715 - Hornby	" " " " Wm Bond & Son			Boston
"	2663 - Parkinson & Frodsham	- Wm Bond & Son			Boston
"	776 - Barradas -	belongs to - Wm Bond & Son			Boston
"	1109 - Litherland & Davis	do - do - Wm Bond & Son			Boston
"	10 - Charles Young	- do - Wm Bond & Son			Boston
"	6755 - Tho ^s Posthouse	- do - Tho ^s Posthouse			London.
"	6701 - Tho ^s Posthouse	- do - Tho ^s Posthouse			London
"	2857 - Parkinson & Frodsham	- do - Wm Bond & Son			Boston
"	180 - John Hutton	- do - Wm Bond & Son			Boston
"	1519 - John Fletcher	- do - Wm Bond & Son			Boston
"	1510 - do - do	- do - do - do			do
"	1508 - " - "	- " - " - "			"
"	1506 - " - "	- " - " - "			"
"	1505 - " - "	- " - " - "			"
"	1503 - " - "	- " - " - "			"
"	1127 - John Fletcher	- do - John Fletcher			London
"	1454 - John Fletcher	- do - Wm Bond & Son			Boston
"	1488 - do - do	- do - Wm Bond & Son			do
"	1491 - " - "	- " - " - "			"
"	1492 - " - "	- " - " - "			"
"	1502 - " - "	- " - " - "			"
"	1522 - " - "	- " - " - "			"
"	1521 - " - "	- " - " - "			"
"	258 - Wm Shepherd	- " - Wm Shepherd			Liverpool
"	250 - do - do	- do - do - do			do
"	230 - do - do	- do - do - do			do
"	227 - do - do	- do - do - do			do

		makers	owners	Where to be returned
56 hours	A No 2239	Edw. Bent.	Edw. W. Blunt	New York
"	B " 2227	do - do	do - do	do
"	C " 2241	do - do	do - do	do
"	D " 2167	do - do	do - do	do
"	E " 2257	do - do	do - do	do
"	F " 2207	do - do	do - do	do
"	G " 2248	do - do	do - do	do
"	H " 2186	do - do	do - do	do
"	I " 2222	do - do	do - do	do
"	K " 2224	do - do	do - do	do
"	L " 2245	do - do	do - do	do
"	O " 2246	do - do	do - do	do
30 hours	Packet - 653	Barrands	Wm Bond Sten	Boston
"	" - 906	John Fletcher	Wm Bond Sten	Boston
"	" - 850	Barrands	Wm Bond Sten	Boston
"	" - 190	J. Lukens	Leas, C. Walker	Coast Survey Office
"	" - 2960	Parkinson & Frodsham	Wm Bond Sten	Boston
"	" - 2312	Parkinson & Frodsham	Wm Bond Sten	Boston
56 hours	Box 1807	John Fletcher	U. S. Coast Survey	Washington
"	" - 222	Wm Shepherd	Wm Shepherd	Liverpool
"	" - 876	Barrands	Wm Bond Sten	Boston
"	" - 2820	Barrands	Wm Bond Sten	Boston
"	" - 883	Barrands	Wm Bond Sten	Boston
"	" - 159	John Flutton	Wm Bond Sten	Boston
"	" - 191	John Flutton	Wm Bond Sten	Boston
"	" - 190	John Flutton	Wm Bond Sten	Boston
"	" - 183	John Flutton	Wm Bond Sten	Boston

8901 Recd by 9th at Camb.

In Transit Book Nov 12th

4.44	30.8	30.8	30.8
27.9	33.2	29.0	
30.3	24.9	30.7	
27.1	36.1	29.2	
25.2	14.4	27.9	
21.0	28.5	29.4	
04.7	24.3	14.9	
30.3	39.0	31.7	
27.5	34.0	14.4	
28.7	31.1	20.4	
27.3	16.8	17.9	
27.1	37.0	25.0	
59.9	49.7	39.4	
35.9	43.4	20.8	
21.8	30.8	34.2	
30.8	35.1	16.3	
30.8	39.4	15.4	
37.4	44.5	14.9	
28.0	42.6	23.8	
22.7	37.6	19.4	
38.3	30.1	30.0	
41.8	33.1	41.8	
27.5	38.7	51.2	
31.5	30.3	40.0	
29.9	39.2	35.9	
22.8	26.4	37.4	
32.7	47.4	29.2	
43.8	29.0	31.9	
31.2	45.4	30.8	
26.6	36.2	29.5	
26.0	65.4	35.9	
24.8	45.7	29.9	
30.1	38.5	28.0	
28.0	34.2	32.8	
26.6	33.0	17.1	
26.9	23.3	46.2	
23.4	32.0	32.8	
		33.7	

27.1	26.7
35.3	43.7
32.3	26.1
32.4	27.8
28.7	39.9
<u>29.1</u>	36.0
	21.6
37.2	25.7
22.0	45.9
37.0	29.7
20.3	36.2
27.1	25.5
31.8	
	30.2
29.6	24.9
15.7	25.4
32.6	30.9
38.0	19.9
30.2	
29.5	18.4
29.7	42.4
30.3	<u>24.1</u>
29.0	21.9
44.5	26.9
35.3	25.0
32.1	11.4
41.0	43. 53.0
19.2	20.2
28.1	22.1
32.3	22.6
10.8	69.9
25.8	14.4
42.6	20.0
34.8	
34.5	
41.3	
25.1	
<u>42.3</u>	

Seconds of Resulting Longitude from the Direct Comparisons both at Liverpool & Cambridge
 Aug 3 C Aug 16 C Sept 25th & Oct. 8th

1519	4 ^m 44. 30.8	180	24.4	1492	34.2
1510	27.9	<u>653</u> pocket	<u>36.1</u> $d, w = \frac{1}{2}$	6701	33.0
1508	30.3	2312	<u>39.0</u> $e, w = \frac{1}{4}$	1519	23.3
1506	27.7	906p	<u>14.4</u> $f, w = \frac{1}{2}$	1510	32.0
1505	25.2	2960p	<u>34.0</u> $g, w = \frac{1}{2}$	1488	30.8
1503	21.0	<u>2</u> p	<u>28.5</u> $h, w = 1$	1521	29.0
<u>1127</u>	α <u>04.7</u> $w = \frac{1}{3}$	<u>850</u> p	<u>31.1</u> $k, w = \frac{1}{4}$	1505	30.7
1454	30.3	1507	24.3	1522	29.2
1488	27.5	(C Aug 28 & Sept 19) α		1502	27.9
1491	28.7	2239	16.8	6755	29.4
patent: 1492	27.3	2227	37.0	p <u>190</u> p. Jenkins	<u>44.9</u> $w = \frac{1}{3}$
1502	27.1	2241	49.3	180	31.7
<u>1003</u>	β <u>59.5</u> $w = 0$	2167	43.4	Sept 29 th C Oct 13	
6755	35.9	2267	30.8	2239	15.4
6701	21.8	2248	35.1	2227	20.4
1522	30.8	2186	39.4	2241	17.9
1521 1310	30.8 137.4	2222	44.5	2167	25.0
2857	28.0	2224	42.6	2257	39.4
715	22.7	2245	37.6	2207	20.8
0 <u>2663</u>	<u>38.3</u> $w = \frac{1}{3}$	2246	30.1	2248	34.2
~~1178~~ $\frac{2}{776}$	41.8			2186	16.3
1109	27.5	C Sept 11 & Sept 25		2222	15.4
268	31.5	227	33.1	2224	14.9
250	29.9	258	38.7	2245	23.8
230	22.8	250	30.3	2246	18.4
227	32.7	230	39.2	C Oct 23 & Nov 6	
2239	43.8	1506	26.4	2239	30.0
2227	31.2	<u>1127</u>	<u>47.4</u> $w = \frac{1}{2}$	q <u>2227</u>	<u>41.8</u> $w = \frac{1}{2}$
2241	26.6	1109	29.0	2241	51.2
2167	28.0	<u>2</u>	45.4	2167	40.0
<u>2257</u>	γ <u>24.8</u> $w = \frac{1}{3}$	776	36.2	2257	35.9
2207	30.1	310	36.2	2207	37.4
2248	28.0	n <u>2257</u>	<u>65.4</u> $w = \frac{1}{2}$	2248	29.2
2186	26.6	o <u>2663</u>	<u>45.7</u> $w = \frac{1}{3}$	2186	31.9
2222	26.9	715	38.5	2222	30.8
2224	23.4			2224	29.5
2245	30.8			2245	35.9
2246	33.2			2246	29.9

Chronometrical Expedition from Aug 1849 to January 1850

2 Oct 13 C Oct 26th

1127	28.0
258	32.8
230	17.1
0 2663	46.2 $W = \frac{1}{3}$
227	32.8
250	33.7
1109	27.1
715	28.7
1506	29.1

C Nov 6th 2 Nov 19th

1127	37.2
258	22.0
230	37.0
0 2663	26.3 $W = \frac{1}{3}$
227	27.1
250	31.8

2 Oct 27th C Nov 10th

180	29.6
p 1902	15.7 $W = \frac{1}{3}$
1522	32.6
1510	38.0
6701	30.2
1521	29.5
1488	29.7
1502	32.1
1519 de	

2 Nov 10th C Nov 25th

2239	41.0
y 2227	19.2 $W = \frac{1}{2}$
2241	28.1
2167	32.3
r 2257	10.8
2207	25.8

2 Nov 10th C Nov 25th cont

2248	42.6
2186	34.8
2222	34.5
2224	41.3
2245	25.1
2246	42.3

C Dec 5th 2 Dec 19th

2239	28.7
2227	43.7
2241	26.1
2167	27.8
u 2257	39.9 $W = \frac{1}{3}$
2207	36.0
2248	21.6
v 2186	25.7 $W = \frac{1}{3}$
2222	45.9
2224	29.7
2245	36.2
2246	25.5

2 Nov 24th C Dec 9th

2901	30.2
227	24.9
250	25.4
1127	30.9
258	19.9

C Dec 19th 2 Dec 31st

s 6755	44.43.18.2 $W = 0$
t 6701	44.42.8 $W = 0 \frac{1}{4}$
1127	24.1
1505	44.44.30.3
6755	29.0
1519	44.5
1492	35.3

2 Jan 12th C Jan 26th 1850

2167	21.9
u 2257	86.9 86.9 $W = \frac{1}{3}$
2207	25.0
2239	11.4
x 2227	43. 53.0 $W = \frac{1}{3}$
2248	20.2
v 2186	22.1 $W = \frac{1}{3}$
2222	22.6
z 2224	40.9 89.9 $W = \frac{1}{3}$
2245	14.4
2246	20.0

The winter voyages with the Dents are not to have more than a weight of $\frac{1}{2}$ on account of their susceptibility to changes of temperature

Note (a) 1127 to have weight of $\frac{1}{3}$ because its rate at Cambridge (subsequent rate) was very irregular changing 4^s or 5^s between Aug 17th & 21st in its daily rate though going well at Liverpool.

" (b) CY No 10 to be rejected bad going at Cambridge changing its daily rate 4^s or 5^s & had only two days rating at Liverpool

" (c) 2257 Mainspring broke at Cambridge consequently there was no subsequent rate weight $\frac{1}{3}$

" d $\frac{2}{653}$ pocket goes pretty well weighs $\frac{1}{2}$

" e 2312 pocket 5 days rate at Camb. weight $\frac{1}{3}$ rate ~~irregular~~ ^{pretty} regular $\pm 1^s$ weight $\frac{1}{3}$

" f 906 pocket " goes pretty well $\pm 1^s$ daily weighs $\frac{1}{2}$

" g ~~2960~~ ²⁹⁶⁰ pocket " goes well " $\frac{1}{2}$

" h $\frac{2}{650}$ " " goes well " 1

" k 190 Lukens pocket goes badly weight $\frac{1}{4}$

• L All these should have a weight of $\frac{1}{2}$ on account of the length of the voyage & of the Steamer running ashore $\frac{1}{2} = \frac{3}{5} - \frac{1}{10}$

m 1127 Previous rate at Camb. was irregular weight = $\frac{1}{2}$

n 2257 New main spring, Rate at A & C from 4 days int. voyage 20 days $w = \frac{1}{2}$

o 2663 Liverpool rate changes 3^s or 4^s weight = $\frac{1}{3}$ This chronometer was exchanged for a better going instrument

p 190 Pocket A.P.'s rate changes 3^s or 4^s weighs $\frac{1}{3}$

q 2227 Lpool rate irregular weight = $\frac{1}{2}$

Note sat Liverpool rates of s differ 10^5 Those of t 4.5 or 5^5 wth $s=0$ of $t=\frac{1}{4}$

2,000 " irregular vers wt $\approx \frac{1}{2}$

The Winter voyages should not have a greater weight than $\frac{1}{2}$ with the Dents.

2 L'bt rates varies 4.5 or 5^5 $w=\frac{1}{3}$

1519
 L to C 30.8
 C to L 23.3
 L to C 44.5
 86
 Mean = 32.9 $\pm 6^s$ 10^s

probable error
 of each

1505
 L to C 25.2
 C to L 30.7
 L to C 30.3
28.7

1454
 L to C 30.3

1510
 L to C 27.9
 C to L 32.0
 L to C 38.0
 79
32.6

1503
 L to C 21.0

1488
 L to C 27.5
 C to L 30.8
 L to C 29.7
29.3

1508
 L to C 30.3

1127
 L to C 04.7 $w = \frac{1}{3}$
 C to L 47.4 $= \frac{1}{2}$
 L to C 28.0
 C to L 37.2
 L to C 30.9
 C to L 24.1

1491
 L to C 28.7

Mean by
 weights 30.1

1506
 L to C 27.7
 C to L 26.4
 L to C 29.1
 232
27.7

1507
 L to C 24.3

1492
 L to C 27.3
 C to L 34.2
 L to C 35.3
32.3

1502
 L to C 27.1
 C to L 27.9
 L to C 32.1
 Mean 29.0

1522
 L to C 30.8
 C to L 29.2
 L to C 32.6
30.9

715
 L to C 22.7
 C to L 38.5
 L to C 28.7
 88.9
30.0

Cy10
 L to C 59.9 $w=0$ reject

1521
 L to C 30.8
 C to L 29.0
 L to C 29.5
29.8

2663
 L to C 38.3 $w=\frac{1}{3}$
 C to L 45.7 $w=\frac{1}{3}$
 L to C 46.2 $w=\frac{1}{3}$
 C to L 20.3 $w=\frac{1}{3}$
 30.5
37.6

6755
 L to C 35.9
 C to L 29.4
 L to C 29.0
 C to L 43.1 18.4 $w=0$ reject
31.4

310
 L to C 37.4
 C to L 36.2
 L to C 32.4 ✓
35.3

$\frac{2}{776}$
 L to C 41.8
 C to L 45.4 reject
 L to C 35.3
40.8

180
 L to C 24.9
 C to L 31.7
 L to C 29.6
28.7

2857
 L to C 28.0

1109
 L to C 27.5
 C to L 29.0
 L to C 27.1
27.9

Δ to C 258
 C to Δ 31.5
 Δ to 3 38.7
 C to Δ 32.8
 Δ to C 22.0
 Δ to C 19.9
 1449
29.0

Δ to C 227
 C to Δ 32.7
 C to Δ 33.1
 Δ to C 32.8
 C to Δ 27.1
 Δ to C 24.9
 6
30.1

Δ to C 2227
 C to Δ 31.2
 Δ to C 37.0
 Δ to C 20.4
 C to Δ 41.8 $W = \frac{1}{2}$
 Δ to C 19.2 $W = \frac{1}{2}$
 C to Δ 43.7 $W = \frac{1}{2}$
 Δ to C 43.0 53.0 $W = \frac{1}{3}$
30.0

Δ to C 250
 C to Δ 29.9
 Δ to C 30.3
 Δ to C 33.7 N
 C to Δ 31.8
 Δ to C 25.4
30.2

Δ to C 2239
 C to Δ 43.8
 C to Δ 16.8
 Δ to C 15.4
 C to Δ 30.0
 Δ to C 41.0
 C to Δ 28.7
 Δ to C 11.4
26.7

Δ to C 2241
 C to Δ 26.6
 Δ to C 49.3
 C to Δ 17.9
 Δ to C 51.2
 C to Δ 28.1
 Δ to C 26.4
33.2

Δ to C 230
 C to Δ 22.8
 Δ to C 39.2 N
 C to Δ 17.1
 C to Δ 37.0
29.0

Δ to C 222
32.3

2401 PaP
30.2

2167

α to C	28.0
C to α	43.4
α to C	25.0
C to α	40.0
α to C	32.3
C to α	27.8
α to C	21.9

31.2

2248

α to C	28.0
C to α	35.1
α to C	34.2
C to α	29.2
α to C	42.6
C to α	21.6
α to C	20.2

30.1

2224

α to C	23.4
C to α	42.6
α to C	14.9
C to α	29.5
α to C	41.3
C to α	29.7
α to C	14 $69.9 W = \frac{1}{3}$ reject

30.2

2257

α to C	24.8 $W = \frac{1}{3}$
C to α	65.4 $= \frac{1}{2}$ reject
α to C	39.4
C to α	35.9
α to C	10.8 $W = \frac{1}{2}$
C to α	39.9 $W = \frac{1}{3}$
α to C	26.9 $W = \frac{1}{3}$

29.6

2186

α to C	26.6
C to α	39.4
α to C	16.3
C to α	31.9
α to C	34.8
C to α	29.7 $W = \frac{1}{3}$
α to C	22.1 $= \frac{1}{2}$

28.1

2245

~~α to C~~	2245
~~C to α~~	30.8
C to α	37.6
α to C	23.8
C to α	35.9
α to C	25.1
C to α	36.2
α to C	14.4

29.1

2207

α to C	30.1
C to α	30.8
α to C	20.8
C to α	37.4
α to C	25.8
C to α	36.0
α to C	25.0

29.4

2222

α to C	26.9
C to α	44.5
α to C	15.4
C to α	30.8
α to C	34.5
C to α	45.9
α to C	22.6

31.5

2246

α to C	33.2
C to α	30.1
α to C	18.4
C to α	29.9
α to C	42.3
C to α	25.5
α to C	20.0

28.5

Pocket Chronometers

190 Lukens =

α to C 31.1 $W = \frac{1}{4}$
 C to α 44.9 $W = \frac{1}{3}$
 α to C 157 $= \frac{1}{3}$
 17
30.6

 $\frac{2}{653} h$
 $36^s 1 W = \frac{1}{2}$
 $\frac{2}{850}$
 $28.5 W = 1$

36.1

39.0

14.4

34.0

28.5

1520

30.4

2312 h

 $39^s 0 W = \frac{1}{4}$

906 h

 $14^s 4 W = \frac{1}{2}$

2960 h

 $34.0 W = \frac{1}{2}$

No of Voyages

1519	32.9	3
1510	32.6	3
1506	27.7	3
1505	28.7	3
1127	30.1	6
1508	24.3	3
1503		
1507		
1488	29.3	3
1492	32.3	
1502	29.0	3
6755	31.4	3
180	28.7	3
1522	30.9	3
1521	29.8	3
310	38.0	6
776		
1454	29.0	3
1491		
2857	30.0	3
715		
1109	27.9	3
258	29.0 wt $\frac{1}{2}$	5
250	30.2 wt $\frac{1}{2}$	5
230	29.0	4
227	30.1 wt $\frac{1}{2}$	5
2239	26.7	7
2227	30.0	7
2241	33.2	7
2167	31.2	7
2257	29.6	7
2207	29.4	7
2248	30.1	7
2186	28.1	7
2222	31.5	7
2224	30.2	6
2245	29.1	7
2246	28.5	7

190 dunks

34.1 7

2663

$$\begin{array}{r} 2 \\ 653 \\ 2312 \\ 906 \\ 2960 \\ 2 \\ 850 \end{array}$$

30.4 5

120

161

18

35) 353.0 (10.1 + 29 = 30.1

35

30

Final Mean result without further consideration of weights & probable errors than appears in the foregoing pages & in the groups on this page which have been arranged so as to give most weight to the best going Chronometers

4^h 44^m 30.^s1

from 175 results by
50 Chronometers in
13 Voyages.

Least 24.3
greater - 38.0
62.3
31.15

1849-50

16 Voyages

at Camb. about 420 Transits

Liv - " 150 "

2500 Direct Comparisons at Camb

1000 Coincidence & Sid Comp. "

2500 Direct Comp at Liverpool

1300 Coincidence = $\frac{1}{2}(2000) + 300$ "

300 Coincidence at Sea voyage

300 Sid to Mean Solar at Camb

300 " Dpl

45 Measures of No 3 Marks & Levelings

1851 6 Voyages

at Camb

500 Transits

Dpl 100

800 Direct

800 Coinc. Comp.

2700 Coinc on Ship board.

800 Coin

800 Direct at Dpl.

150 Sid to inst "

150 " Camb

Estimate for forms made May 31/1852

Total 2500

1200 Transits = 250 f No 1 300

14000 Comp = 1400 No 4 1500

900 Sid to des. = 900 No 3 150

100 Marks = 100 No 2 150

Tables to be computed.

Values of $\cos \delta$ double argument at top declination
 $\delta = 5^\circ, 10^\circ, 15^\circ, 20^\circ, 25^\circ, 30^\circ, 32^\circ, 34^\circ, 36^\circ, 38^\circ, 40^\circ, 41^\circ, 42^\circ, 43^\circ$ etc up to 60° or to 75° if there be room
 arg at side $c = 0.10, 0.20, 0.30, 0.40, 0.50$ etc to 50 then $c = 0.01, 0.02, 0.03, 0.04$
 etc up to 0.50

To be computed to three figures - but copied only to the nearest hundredths - on a single 4 to sheet page two copies.

The numbers may be calculated taken at once for each argument of declination and for $c = 0.01$ - from a table of latitude & declination - to 4 decimal places all the rest to be formed from them by continued addition & multiplication of the value for $c = 0.01$ to the preceding & the last line tested will test all the rest. Each addition will be easiest made by copying the value for $c = 0.01$ on a slip of paper & move it from line to line as the addition is made.

If every full tenth is formed by multiplication only two significant figures will be needed in the addition.

In the same manner compute values of $a \cdot \frac{\sin(\varphi - \delta)}{\cos \delta}$ for $\varphi = 42^\circ 22' 48''$
 Two copies of each
 for each degree of declination between -35° & due to the Equator and $a = 0.01$
 to $a = 0.50$ for the 1st 4 to sheet from $\delta = 0$ to $\delta = 35^\circ$ for the 2nd
 $\delta = +35^\circ$ to $\delta = +70$ for the 3rd calculating the head of each column for $a = 0.01$
 to 4 places & filling up by continued addition & testing the last line.

It will be easier to form each tenth line by direct multiplication from the values for $c = 0.01$ & use only 3 places that is two significant figures in the continued addition. The last figures in each column will circulate by an easily followed law.

Compute also values of $\frac{\cos(\varphi - \delta)}{\cos \delta}$ with the same arguments & same no of sheets

Calculate the coefficients $\sec \delta$, $\frac{\sin(\varphi - \delta)}{\cos \delta}$, $\frac{\cos(\varphi - \delta)}{\cos \delta}$

for all the N.A. stars between 70° & the pole. There may be put on the margin of the sheet $\cos \delta$ or perhaps it will be better to calculate a table ~~having a column for each star~~ a table for each star with the corrections for collim. α & δ for values of each error forming an argument at the side from 0.01 to 0.50 & each table having three columns for cor in α - δ & δ corresponding to the side arguments

It appears more convenient to compute a special table for each star of the N.A. visible at Cambridge arranged in the order of their right ascensions. The side argument being 0.01, 0.02, 0.03 &c and under each heading (the name of the star) the three corrections answering to the α - δ & δ of the side argument.

There will be 40 stars. 18° will come easily on the upper half of a 4to sheet with side argument from 0.01 to 0.30 or 0.35 and 18° on the lower half. The horizontal lines will best be arranged in threes. There will then be 18 stars on each sheet & 5 sheets will complete the number needed. June 26th prepared copy for above for ruling & gave to Bartlett.

Compute argument from 0.01 to 0.40

the coefficient of $\frac{1}{2}$ in the first term, and the coefficient of $\frac{1}{2}$ in the second term, are both equal to $\frac{1}{2}$.

It is not difficult to see that the coefficient of $\frac{1}{2}$ in the first term, and the coefficient of $\frac{1}{2}$ in the second term, are both equal to $\frac{1}{2}$. This is because the coefficient of $\frac{1}{2}$ in the first term, and the coefficient of $\frac{1}{2}$ in the second term, are both equal to $\frac{1}{2}$.

It is not difficult to see that the coefficient of $\frac{1}{2}$ in the first term, and the coefficient of $\frac{1}{2}$ in the second term, are both equal to $\frac{1}{2}$. This is because the coefficient of $\frac{1}{2}$ in the first term, and the coefficient of $\frac{1}{2}$ in the second term, are both equal to $\frac{1}{2}$.

Probable Errors of combination of Observations

Let n = no. of obs ε = probable error of result.

$x' - x = e$ = individual differences from mean

$$\varepsilon = 0.6745 \sqrt{\frac{\sum e^2}{n-1}} \quad \text{when } n \text{ is very large} \quad \varepsilon = 0.845 \frac{\sum e}{n-1}$$

For The probable error of $y = f(x, x', x'', \dots)$, putting $\frac{dy}{dx} = a$, $\frac{dy}{dx'} = a'$

Probable error of $y = \sqrt{a^2 \varepsilon^2 + a'^2 \varepsilon'^2 + \dots}$

$Ax + Ax' + \dots = y$ Probable error of $y = \sqrt{A^2 \varepsilon^2 + A'^2 \varepsilon'^2 + \dots}$

$Bx + Bx' + \dots = y$ " $= \sqrt{(Bx + Bx' + \dots)^2 \varepsilon^2 + (Bx' + \dots)^2 \varepsilon'^2 + \dots} = Bx + Bx' + \dots \sqrt{\frac{\varepsilon^2}{x^2} + \frac{\varepsilon'^2}{x'^2} + \dots}$

Must distinguish between the probable error of nx , and of the sum of n independent values of x

Prob. error of $nx = n\varepsilon$ Prob. error of $(x+x+x+\dots) = \varepsilon\sqrt{n}$

" $xx' = xx' \sqrt{\frac{\varepsilon^2}{x^2} + \frac{\varepsilon'^2}{x'^2}}$ Prob. error of $\frac{x}{x'} = \frac{x}{x'} \sqrt{\frac{\varepsilon^2}{x^2} + \frac{\varepsilon'^2}{x'^2}}$

Orizaba Obscuro

