

KG

11366

v.921

VOL XLV.



Plates

1827.

1884



Harvard Lunar Plates.

Measurements and Reductions.

Mary Fowler.

Volume XLV.

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1827 Stars - measures

1913 Nov. 11

1

	d	y	v	d	x	w
1	15388	15578		15210		17361
196	752220	1345052		1136160		1118980
167	24	50		5560		94
	90	77		06		61
	<u>26.7868</u>	<u>7873</u>		<u>11.6151</u>		<u>.6173</u>

2	19900	19760	19249	19610
11.6	12040	1761119	1520900	1363238
19.8	5243	0219	00	3138
	98	55	40	10
	<u>14.8853</u>	<u>7849</u>	<u>11.5958</u>	<u>.5976</u>

3	17370	17798	19098	12998
26.6	1022021	1492238	1484850	1212288
30.7	19	3030	42	1788
	60	85	00	00
	<u>30.7143</u>	<u>17136</u>	<u>26.5748</u>	<u>.5776</u>

4	1085050	11830	1351820	11208
32.1	50	11370	19	1012010
12.9	10380	6571	12430	18
	<u>12.9530</u>	<u>.9539</u>	<u>32.1089</u>	<u>.1092</u>

Grade 2,

1827 Stan - measures

1913 Nov. 11.

1

	d	y	v	d	v
1	15388	15578	15210	17361	
1/6	7522	13450	11361	11189	
1/7	24	50	5560	94	
	90	77	06	61	
	<u>26.7868</u>	<u>7873</u>	<u>11.6151</u>	<u>6173</u>	
2					
1/6	19900	19760	19249	19610	
1/8	12040	17611	15209	13632	
	52	02	00	31	
	98	55	40	10	
	<u>14.8853</u>	<u>7849</u>	<u>11.5958</u>	<u>5976</u>	
3					
266	17370	17898	19098	17898	
307	10220	19922	14848	12122	
	19	30	42	17	
	60	30	00	00	
	<u>30.7143</u>	<u>7136</u>	<u>26.5748</u>	<u>5776</u>	
4					
121	10850	11830	13518	11208	
129	50	11370	19	10120	
	10380	6571	12430	1810	
	<u>12.9530</u>	<u>9539</u>	<u>32.1089</u>	<u>1092</u>	

Grade 2,

1827

Hydro - measure

d

y

v

d

v

v

2

$$\begin{array}{r} 17.0 \\ 17.5 \\ 18.0 \end{array}$$

15050

$$\begin{array}{r} 18.5 \\ 1047869 \\ 64 \\ 44 \end{array}$$
18.4577

15334

$$\begin{array}{r} 9550 \\ 8502 \\ 38 \end{array}$$
.4553

17190

1156080

80

90

17.4383

15940

1149529

2522

40

.4422

$$\begin{array}{r} 2 \\ 17.0 \\ 18.5 \end{array}$$

15050

$$\begin{array}{r} 18.5 \\ 1047869 \\ 64 \\ 44 \end{array}$$
18.4577

15334

$$\begin{array}{r} 9550 \\ 8502 \\ 38 \end{array}$$
.4553

19660

16980

6660

52

16.7312

15580

1823030

2530

70

.7345

$$\begin{array}{r} 3 \\ 16.7 \\ 19.0 \end{array}$$

$$\begin{array}{r} 16.7 \\ 19.0 \end{array}$$

$$\begin{array}{r} 4 \\ 16.6 \\ 19.5 \end{array}$$

$$\begin{array}{r} 16.6 \\ 19.5 \end{array}$$

$$\begin{array}{r} 16.6 \\ 19.5 \end{array}$$

$$\begin{array}{r} 16.6 \\ 19.5 \end{array}$$

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$$\begin{array}{r} 16.6 \\ 19.5 \end{array}$$

$$\begin{array}{r} 16.6 \\ 19.5 \end{array}$$

$$\begin{array}{r} 16.6 \\ 19.5 \end{array}$$

1927

Hydrogen - H α

2

$$\begin{array}{r} 1 \\ 175 \\ 180 \end{array}$$

$$\begin{array}{r} 17190 \\ 1156080 \\ 80 \\ 90 \\ \hline 17.4383 \end{array}$$

$$\begin{array}{r} 15940 \\ 1149129 \\ 2522 \\ 40 \\ \hline 4422 \end{array}$$

$$\begin{array}{r} 2 \\ 170 \\ 185 \\ 15050 \\ 1047869 \\ 64 \\ 44 \\ \hline 18.4577 \end{array}$$

$$\begin{array}{r} 15334 \\ 9880 \\ 8502 \\ 38 \\ \hline 4153 \end{array}$$

$$\begin{array}{r} 3 \\ 167 \\ 190 \end{array}$$

$$\begin{array}{r} 19660 \\ 1698060 \\ 6674 \\ 52 \\ \hline 16.7312 \end{array}$$

$$\begin{array}{r} 15580 \\ 1823030 \\ 2530 \\ 70 \\ \hline 7345 \end{array}$$

$$\begin{array}{r} 4 \\ 166 \\ 195 \\ 206 \end{array}$$

$$\begin{array}{r} 19286 \\ 1565052 \\ 5886 \\ \hline 16.6367 \end{array}$$

$$\begin{array}{r} 14609 \\ 820203 \\ 09 \\ 02 \\ \hline 6400 \end{array}$$

$$\begin{array}{r} 5 \\ 170 \\ 207 \\ 18678 \\ 1111005 \\ 01 \\ 82 \\ \hline 20.7176 \end{array}$$

$$\begin{array}{r} 19839 \\ 1737580 \\ 40 \\ \hline 7539 \end{array}$$

$$\begin{array}{r} 6 \\ 173 \\ 210 \end{array}$$

$$\begin{array}{r} 18727 \\ 1091520 \\ 1920 \\ 19 \\ \hline 7.1997 \end{array}$$

$$\begin{array}{r} 17916 \\ 1590010 \\ 92 \\ 09 \\ \hline 2014 \end{array}$$

1827	d	y	known - measured	d	n
180	16160		18289		
21.5	11080	70	13368	62	
	87		62		
	70		86		
	<u>21.5086</u>		<u>.5078</u>		
180	16150		17355		
21.5	100313		13440	36	
may	31		39		
	50		07		
	<u>21.6119</u>		<u>.6126</u>		
9	15140		16332		
19.0	9317	25	12127	31	
21.5	12		30		
	32		20		
	<u>21.5818</u>		<u>.5802</u>		

possibly on
termination.

1827 4 brown breasted
 2 d ~ d ~
 180 16160 18289
 21.5 1108070 1336862
 87 62
 70 86
21.5086 .5078

8
 180 16150 17355
 21.5 1003131 1344036
 31 39
 50 07
21.6119 .6126

9
 180 15140 16332
 21.5 931721- 1212731
 12 30
 32 20
21.5818 .5802

possibly on
 termination.

1827

Times etc.

Eph. stars 1912 May 27 12^h 58^m - 13^h 10^m
 Moon 13 03 33.4 - 13 03 33.7^v
 clock slow 1 27.8^v

H. id. T. 13 05 01.35^v
 R. long 4 44 31.05^v
 G. S. T. 17 49 32.40^v
 S. T. 4 18 41.23^v
 Interval 13 30 51.17^v
 Reduction 2 12.84^v
 G. M. T. 13 28 38.33^v $\theta - \chi = -0^h 53^m 51^s$

From hour alm. R. A. Decl.
 Moon 13^h 57^m 34.24^v - 13 04 35.4^v
 Motion in $\alpha = 2.0406^v$ - 13.890^v
 " " 28.6388^v + 57.58^v - 6 37.8^v
 Tabular place 13 58 31.82^v - 13 11 13.2^v

Moon's age 11 days.

Parallax 56' 36.7^v
 Semidiameter 15 27.0^v
 R = 9 27.0^v
 Augmentation + 8.5^v
 Irradiation - 0.5^v
 R = 9 35.0^v
 = 2.0043^v
 $a = +0.4$ (a+1) R = 2.0044^v
 $R^2 = 4.0176$

1827

Times etc.

Eph. star 1912 May 27 12^h 58^m - 13^m 10^m
 Moon 13 03 33.4 - 13 03 33.7
 clock slow 1 27.8

H. J. d. T. 13 05 01.35
 H. long 4 44 31.05
 G. S. T. 17 49 32.40
 S. T. M. 4 18 41.23
 S. L. W. 13 30 51.17
 Reduction 2 12.84
 G. M. T. 13 28 38.33 $\theta - \lambda = -0^h 53^m 51^s$

From hour circle. R. A. Decl.
 Moon 13^h 57^m 34.24 - 13 04 35.4
 Motion in $\alpha = 2.0106$ 13.890
 28.6388 + 57.58 - 6 87.8
 Tabular place 13 58 31.82 - 13 11 18.2

Moon's age 11 days.

parallel 56' 36.7
 eccentric 15 27.0
 R. 9 27.0
 Augmentation +8.5
 Irradiation -0.5
 R. 9 35.0
 = 2.0043
 a = 704 (a+1) R. 2.0044
 R. 4.0176

1827

Plate Constants

x

y

$$\begin{array}{r}
 11.6162 \\
 11.5967 \\
 26.5762 \\
 32.1090 \\
 \hline
 418190 \\
 20.48 \\
 -18 \\
 \hline
 2.48 \\
 31 \\
 \hline
 77
 \end{array}$$

$$\begin{array}{r}
 267870 \\
 147851 \\
 30.7140 \\
 129534 \\
 \hline
 8524 \\
 21.31 \\
 -22 \\
 \hline
 69 \\
 465
 \end{array}$$

$$\begin{array}{r}
 13 \quad 55 \quad 24 \quad -13 \quad 02 \quad 26 \\
 \quad 55 \quad 43 \quad 14 \quad 31 \quad 30 \\
 14 \quad 03 \quad 19 \quad 12 \quad 30 \quad 28 \\
 \quad 06 \quad 26 \quad 14 \quad 47 \quad 25 \\
 \hline
 14 \quad 119 \quad 112 \quad 13 \quad 110 \quad 109 \\
 14 \quad 00 \quad 13 \quad -13 \quad 42 \quad 57 \\
 \quad - \quad 1 \quad 17 \quad \quad 5 \quad 25 \\
 \hline
 13 \quad 58 \quad 56 \quad -13 \quad 37 \quad 32
 \end{array}$$

$$\begin{aligned}
 A &= 13^h \quad 58^m \quad 56^s \\
 D &= -13^\circ \quad 57' \quad 32''
 \end{aligned}$$

$$\begin{array}{r}
 x - \bar{x} \quad -1204 \\
 +2674 - 3214 = -540 \\
 +3151 - 3686 = -535 \\
 +1023 - 1554 = -531 \\
 186415^v - 2353^v \\
 \hline
 -0426 \\
 -5 = -545 \\
 -14 = -546 \\
 -13 = -544 \\
 -7^v \\
 \hline
 +545 \\
 = 0 \\
 = -1 \\
 = +1 \\
 = 18.4600^v
 \end{array}$$

$$\begin{array}{r}
 y - \bar{y} \quad +119.236 \\
 +2835 + 1385 = +4220 \\
 +1039 + 3168 = +4207 \\
 +437 + 3827 = +4266 \\
 19.6086^v + 2222^v \\
 \hline
 +3.44 \\
 +91 = +4311 \\
 +104 = +4311 \\
 +44 = +4310 \\
 +67^v \\
 \hline
 -4311 \\
 = 0 \\
 = 0 \\
 = -1 \\
 = 19.4064^v
 \end{array}$$

$$\begin{array}{llll}
 \text{Tables} & a = +0.5 & e = -5.8 & a - e = +6.3 \\
 \text{Obs.} & a = +0.4 & e = -3.4 & a - e = +3.8
 \end{array}$$

$$\begin{array}{llll}
 c - 0 & +0.1 & -2.4 & +2.5 \\
 & & & +1.9
 \end{array}$$

1827

Plate Constants

x

y

11.6162	26.7870	13	55	24	-13	02	26
11.5967	14.7851		55	43	14	31	30
26.5762	30.7140	14	03	19	12	30	28
32.1090	12.9534		06	26	14	47	25
4 8190	8524	14	114	112	13	110	109
2048	21.31	14	00	13	-13	42	57
	-22		-1	17		5	25
248	69	13	58	56	-13	37	32
31	465						
77							

$$A = 13^h 58^m 56^s$$

$$D = -13^\circ 57' 52''$$

$$\begin{aligned}
 & 2 - 3 = 1204 & - 0436 & + 545 \\
 & + 2674 = 3214 & - 540 & - 5 = -545 = 0 \\
 & + 3151 = 3686 & - 535 & - 11 = -546 = -1 \\
 & + 1023 = 1554 & - 531 & - 13 = -544 = +1 \\
 & 186415 = 2353 & - 7 & = 184600
 \end{aligned}$$

$$\begin{aligned}
 & 4 - 7 + 119236 & + 344 & - 4311 \\
 & + 2835 + 1385 = +4220 & + 91 = +4311 & = 0 \\
 & + 1039 + 3168 = +4207 & + 104 = +4311 & = 0 \\
 & + 437 + 3827 = +4266 & + 44 = +4310 & = -1 \\
 & 196086 + 2222 & + 67 & = 194064
 \end{aligned}$$

$$\begin{aligned}
 \text{Tables } a &= +0.5 & e &= -6.0 & a - e &= +6.5 & b + a &= +2.7 \\
 \text{obs. } a &= +0.4 & e &= -3.4 & a - e &= +3.8 & b + a &= +0.8
 \end{aligned}$$

$$c = 0 \quad + 0.1 \quad - 2.6 \quad + 2.7 \quad + 1.9$$

1827. Standard Coordinates.

Cape No. 1901 my 6.2				Cape No. 1903 my 7.8				Cape No. 1919 my 7.7			
C	13 ^h	54 ^m	45.01	13 ^h	55 ^m	03.97		14 ^h	02 ^m	40.31	
L			08			04.04				.31	
B			06			03.93				.34	
Mean	13	54	45.05	13	55	03.98		14	02	40.32	
Prece		+	38.65		+	38.87			+	38.77	
X	13	55	2370	13	55	4285		14	03	1909	
A	13	58	56	13	58	56		13	58	56	
A-A	-	3	32.30	-	3	13.15		+	4	23.09	
h(d)		-	212.29		-	193.14			+	263.07	
log.			2.32693m			2.28587m				2.42007	
cos			9.98866			9.98590				9.98957	
sin			0.82283m			0.77901m				0.91648	
tan			-6.6501			-6.0119				+8.2582	
sec			-			-				+	29
tan			11.3488			11.9868				26.2611	
X			11.6162			11.5967				26.5762	
Y			+2674			-3901				+3151	
C	-12°	58'	54.4	-14°	27'	58.7		-12°	26'	59.3	
L			54.9			58.6				59.6	
B			55.5			59.0			27	0.07	
Mean	-12	58	54.9	-14	27	58.8		-12	26	59.9	
Prece		-	30.9		-	30.7			-	30.1	
X	-13	02	25.8	-14	31	29.5		-12	30	28.0	
D	-13	37	32	-13	37	32		-13	37	32	
A-D		+	35 06.2		-	53 57.5		+	1 07 04.0		
h(d)		+	2106.3		-	3237.8			+	4024.5	
log.			3.32352			3.51025m				3.60472	
cos			0.65467			0.84140m				0.93587	
tan			1.3648m			9.4434m				9.3460m	
sec			1.6457			1.5580				1.8338	
tan			8.0639m			8.0248m				8.2332m	
tan			+4.5151			-6.9407				+8.6272	
tan			-			-				-	
tan			116			106				171	
tan			26.5035			15.0487				30.6101	
tan			26.7870			14.7851				30.7140	
tan			+2835			-2636				+1039	

1827

Standard Coordinates

Cape W. 1901 mag 6.2

Cape W. 1903 mag 7.8

Cape W. 1919 mag 7.7

C	13° 54'	45.01	13° 55'	03.97	14° 02'	40.31
L		08		04.04		31
E		06		03.93		34
Mean	13	54	45.05	13	55	03.98
Pre		+	38.65		+	38.87
X	13	55	2370	13	55	4285
A	13	58	56	13	58	56
1-4	-	3	3230	-	3	13.15
m(1-4)		-	21229		-	193.14
Mag.			2.32693			2.28587
WSS			998866			998590
3 ₀			0.82283			0.77901
3 ₀			-6.6501			-6.0119
3 ₁			-			1.3
3 ₂			11.3488			11.9868
X			116162			115967
1-3			+2674			-3901

C	-12° 58'	54.4	-14° 27'	58.7	-12° 26'	59.3
L		54.9		58.6		59.6
E		55.5		59.0		27
Mean	-12	58	54.9	-14	27	58.8
Pre		-	3	30.9		-
d	-13	02	258	-14	31	295
D	-13	37	32	-13	37	32
1-4		+	35	062		-
m(1-4)			+21063			-3237.8
Mag.			3.32352			3.51025
M ₀			065467			084140
WSS			93648			9.4134
3 ₀			16457			15580
3 ₁			80639			80248
3 ₂			+4.5151			-6.9407
3 ₃			-			106
3 ₄			265035			150487
3 ₅			267870			147851
3 ₆			+2835			-2636

v1 Standard Coordinates

7

Cape No. 1927 mg 8.9

C	14	05	47.19
L			28
B			26
mean	14	05	47.24
Proc		+	39.08
X	14	06	26.32
A	13	58	56
X-A		+	7 30.32
(X-A)		+	450.24
log II			2.65345
log S			9.98536
S ₀			1.44605
S ₀	+		13.9974
S ₁	+		93
S ₂			32.0067
X			32.1090
S ₃			-11023

C	-14	44	20.1
L			19.9
B			19.5
mean	-14	44	19.8
Proc		-	3 250
S	-14	47	448
D	-13	37	32
D	-1	10	12.8
(D-B)			-4213.4
log II			3.62463m
log S			0.95578m
log S			9.9218m
S ₂			22921
S ₃			8.3673m
S ₀			-1.0320
S ₁			-585
S ₂			12.9095
S ₃			12.9534
S ₄			+439

1827 Standard Coordinates

7

Cape no. 1927 mg 89

C	14	05	47.19
L			28
B			26
Mean	14	05	47.24
Pre		+	39.08
X	14	06	26.32
A	13	58	56
X-A		+	7 30.32
ln(X-A)		+	450.24
log ₁₀			2.65395
log ₁₀			9.98536
Σ			1.44605
Σ	+		13.9974
Σ	+		93
Σ			32.0067
Σ			32.1090
Σ			41023

C	-14	44	20.51
L			19.9
B			19.5
Mean	-14	44	19.8
Pre		-3	25.0
S	-14	47	448
D	-13	37	32
S-D	-1	10	128
ln(S-D)			-42134
log ₁₀			3.62463
η			0.95578
tan δ			94218
Σ			22921
η			83673
η			-10320
η			-585
η			12.9095
η			12.9534
η			439

pt	pos. $\angle$	resid.
1	216 ⁰ .8	+157
2	235.0	+49
3	252.4	-44
4	270.0	-53
5	305.0	-45
6	314.0	-18
7	341.2	+76
8	0.0	+18
9	10.2	+60

1827

Moon's Center

	x	$(x - X_0)$	Δx	$(x - X_0)^2$	$(x - X_0)^2 + (y - Y_0)^2$	$O - C$
1	17.4402	-1.2042	+4	1.4491	4.0325	+1.49
2	17.0000	-1.6444	+3	2.7030	4.0264	+8.8
3	16.7328	-1.9116	+2	3.6534	4.0213	+3.7
4	16.6384	-2.0060	0	4.0240	4.0240	+6.4
5	17.0000	-1.6444	-3	2.7050	4.0282	+1.06
6	17.2006	-1.4438	-4	2.0857	4.0309	+1.33
7	18.0000	-0.6444	-5	0.4159	4.0381	+2.05
8	18.6444	0.0000	-5	0.0000	4.0292	+1.16
9	19.0000	+0.3556	-5	0.1261	4.0311	+1.35
				Comp R^2	4.0176	

	y	$(y - Y_0)$	Δy	$(y - Y_0)^2$
1	18.0000	-1.6062	-11	2.5834
2	18.4565	-1.1497	-7	1.3234
3	19.0000	-0.6062	-4	0.3679
4	19.6062	0.0000	0	0.0000
5	20.7558	+1.1496	+7	1.3232
6	21.0000	+1.3938	+9	1.9452
7	21.5082	+1.9020	+12	3.6222
8	21.6122	+2.0060	+13	4.0292
9	21.5810	+1.9748	+13	3.9050

Approximate Center

$$x = 17. \quad y = 18.4565$$

$$20.7558$$

$$39.2123$$

$$Y_0 = 19.6062$$

$$y = \max \quad 21.6122$$

$$R = 2.0060$$

$$x = \min \quad 16.6384$$

$$X_0 = 18.6444$$

$$\text{Center } \begin{cases} X_0 = 18.6444 \\ Y_0 = 19.6062 \end{cases}$$

1827

known Center

	x	$(x - X_0)$	Δx	$(x - X_0)^2$	$(x - X_0) + (y - Y_0)^2$	$O - C$
1	17.4402	-1.2042	+4	1.4491	4.0325	+1.49
2	17.0000	-1.6444	+3	2.7030	4.0264	+88
3	16.7328	-1.9116	+2	3.6534	4.0213	+37
4	16.6384	-2.0060	0	4.0240	4.0240	+64
5	17.0000	-1.6444	-3	2.7030	4.0282	+106
6	17.2006	-1.4438	-4	2.0817	4.0309	+133
7	18.0000	-0.6444	-5	0.4159	4.0381	+205
8	18.6444	0.0000	-5	0.0000	4.0292	+116
9	19.0000	+0.3556	-5	0.1261	4.0311	+135
comp R^2					4.0176	

	y	$(y - Y_0)$	Δy	$(y - Y_0)^2$
1	18.0000	-1.6062	-11	2.5834
2	18.4565	-1.1497	-7	1.3234
3	19.0000	-0.6062	-4	0.3679
4	19.6062	0.0000	0	0.0000
5	20.7558	+1.1496	+7	1.3232
6	21.0000	+1.3938	+9	1.9412
7	21.5082	+1.9020	+12	3.6222
8	21.6122	+2.0060	+13	4.0292
9	21.5810	+1.9748	+13	3.9050

Approximate Center

$$x = 17. \quad y = 18.4565$$

$$20.7558$$

$$39.2123$$

$$Y_0 = 19.6062$$

$$y = \text{max} \quad 21.6122$$

$$R = 2.0060$$

$$x = \text{min} \quad 16.6384$$

$$X_0 = 18.6444$$

$$\text{Center} \begin{cases} X_0 = 18.6444 \\ Y_0 = 19.6062 \end{cases}$$

Formation of Normals

	ab	an	bn
1	+ 1.93	- 178.8	- 239.9
2	+ 1.89	- 144.3	- 101.2
3	+ 1.17	- 70.7	- 22.6
4	- 0.00	- 128.6	+ 0.0
5	- 1.89	- 173.8	+ 121.9
6	- 2.00	- 191.5	+ 184.9
7	- 1.22	- 131.2	+ 389.5
8	+ 0.00	+ 0.0	+ 233.2
9	+ 0.71	+ 48.6	+ 266.0
	+ 0.59	- 970.3	+ 891.8

1827

Moon's Center.

9

Conditional Equations

	a	b	c		c	o-c
1	-1.20	-1.61	= +149	+ 70 -	78 = - 8	+ 157
2	-1.64	-1.15	= + 88	+ 95 -	56 = +39	+ 49
3	-1.91	-0.61	= + 37	+ 111 -	30 = +81	- 44
4	-2.01	+0.06	= + 64	+ 117 +	0 = +117	- 53
5	-1.64	+1.15	= -106	+ 95 +	56 = +151	- 45
6	-1.44	+1.39	= +133	+ 89 +	67 = +151	- 18
7	-0.64	+1.90	= +205	+ 37 +	92 = +129	+ 76
8	+0.00	+2.01	= +116	- 0 +	98 = + 98	+ 18
9	+0.36	+1.97	= +135	- 21 +	96 = + 75	+ 60

Average = 58

Normal Equations.

$$\begin{aligned}
 +17.16 + 0.59 &= -970 \\
 + 0.59 + 19.10 &= +892 \\
 - 0.59 - 0.02 &= + 33 \\
 + 19.08 &= +925
 \end{aligned}$$

$$b = +9.85$$

$$\begin{aligned}
 - 0.02 - 0.59 &= - 28 \\
 + 17.14 &= -998
 \end{aligned}$$

$$a = -58.2$$

1827

Inson's Center

9

Conditional Equations

	a	b	c	d	e	f	g
1	-1.20	-1.61	+1.49	+7.0	-7.8	-8	+1.57
2	-1.64	-1.15	+8.8	+9.5	-5.6	+3.9	+4.9
3	-1.91	-0.61	+3.7	+1.1	-3.0	+8.1	-4.4
4	-2.01	+0.00	+6.4	+1.17	+0	+1.17	-5.3
5	-1.64	+1.15	-1.06	+9.5	+5.6	+1.51	-9.5
6	-1.44	+1.39	+1.33	+8.4	+6.7	+1.51	-1.8
7	-0.64	+1.90	+2.05	+3.7	+9.2	+1.29	+7.6
8	+0.00	+2.01	+1.16	-0	+9.8	+4.4	+1.4
9	+0.36	+1.97	+1.35	-2.1	+9.6	+7.5	+6.0

Average = 5.8

Normal Equations

$$+17.16 + 0.59 = -9.70$$

$$+ 0.59 + 19.10 = +8.92$$

$$- 0.59 = 0.02 = + 3.3$$

$$+ 19.08 = +9.25$$

$$b = +4.85$$

$$- 0.02 = 0.59 = - 2.8$$

$$+ 17.14 = -9.98$$

$$a = -58.2$$

1827 Moonishuan Position (1912.0)

10

$$\begin{array}{rcl}
 X_0 = 18.6444^\circ & Y_0 = 19.6062^\circ \\
 \frac{1}{2}a = -29^\circ & \frac{1}{2}b = +24^\circ \\
 \hline
 18.6415^\circ & 19.6086^\circ
 \end{array}$$

From plate constants $X = 18.4600^\circ$ $Y_0 = 19.4064^\circ$

$$\begin{array}{rcl}
 \xi = +0.4600^\circ \\
 \log \xi = 9.66276 \\
 \cos \delta = 9.98698 \\
 \sin \delta = 8.50724 \\
 \log \sin \delta = 1.16854 \\
 (\alpha - A)
 \end{array}$$

$$\alpha - A = +14.74^\circ$$

$$A = 13^\circ 58' 56''$$

$$\alpha_0 = 13^\circ 59' 10.74''$$

$$\eta = -2.5936^\circ$$

$$\begin{array}{rcl}
 \log \tan \delta & 9.3941 \\
 \log \eta & 9.3255 \\
 \log \eta_1 & 5.7730 \\
 \eta_1 & -1^\circ
 \end{array}$$

$$\eta_0 = -2.5935^\circ$$

$$\begin{array}{rcl}
 \log \eta_0 & 0.41388 \\
 \log \eta_1 & 7.33115
 \end{array}$$

$$(\alpha - D) = 3.08273^\circ$$

$$\delta - D = -20' 09.8''$$

$$D = -13^\circ 37' 32''$$

$$\delta_0 = -13^\circ 57' 41.8''$$

1827 *Woonsocket* Position (1912.0)

10

$$\begin{array}{rcl}
 X_0 = 18.6444 & Y_0 = 19.6062 \\
 \hline
 \Delta = -29 & \Delta = +24 \\
 \hline
 18.6415 & 19.6086
 \end{array}$$

Swing Plate Constant $X = 18.4600$ $Y = 19.4064$

$$\begin{array}{rcl}
 \xi = +0.4600 \\
 \log \xi = 9.66276 \\
 \log \xi = 9.98698 \\
 \log \xi = 8.50724 \\
 \log \xi = 1.16854 \\
 (X - A)
 \end{array}$$

$$X - A = 14.74$$

$$A = 13.5856$$

$$X_0 = 13.591074$$

$$\eta = -2.5936$$

$$\begin{array}{rcl}
 \log \eta = 9.3941 \\
 \log \eta = 9.3255 \\
 \log \eta = 5.7730 \\
 \log \eta = -1
 \end{array}$$

$$\eta_0 = -2.5935$$

$$\begin{array}{rcl}
 \log \eta_0 = 0.41388 \\
 \log \eta_0 = 7.33115
 \end{array}$$

$$(W - D) = 308273$$

$$S - D = -20' 09.8''$$

$$D = -13.3732$$

$$S_0 = -13^\circ 57' 41.8''$$

18
K₀
G
B+

1827

Red. to Apparent Place.

11

$$\begin{aligned} \alpha_0 &= 13^h 59^m 10.74^s \\ g &= 20 \quad 13 \quad 36 \\ g + \alpha_0 &= 10 \quad 12 \quad 46 \\ &= 153^\circ 11' 30'' \end{aligned}$$

$$\begin{aligned} \delta_0 &= -13^\circ 57' 41.8'' \\ H &= 13^h 28^m 24^s \\ H + \alpha_0 &= 3^h 26^m 35^s \\ &= 51^\circ 38' 45'' \end{aligned}$$

$$\begin{aligned} \log \frac{1}{r} &= 8.8239 \\ -g &= 0.9982 \\ \sin(g + \alpha_0) &= 9.6542 \\ \tan \delta_0 &= 9.3955 \\ \therefore (g) &= 8.8718m \end{aligned}$$

$$\begin{aligned} \log \frac{1}{r} &= 8.8239 \\ \therefore h &= 1.3055 \\ \sin(H + \alpha_0) &= 9.8944 \\ \sec \delta_0 &= 0.0130 \\ \therefore (h) &= 0.0368 \end{aligned}$$

$$\begin{aligned} \log c &= 0.5138m \\ -\cos \delta_0 &= 9.9870 \\ \therefore (c) &= 0.5008m \end{aligned}$$

$$\begin{aligned} \log g &= 0.9982 & \log h &= 1.3055 \\ -\cos(g + \alpha_0) &= 9.9506m & -\cos(H + \alpha_0) &= 9.7928 \\ (g') &= 0.9488m & \sin \delta_0 &= 9.3825m \\ & & \therefore (a') &= 0.4808m \end{aligned}$$

$$\begin{aligned} f &= +0.85 \\ (g) &= -0.07 \\ (h) &= +1.09 \\ &= +1.87 \checkmark \end{aligned}$$

$$\begin{aligned} g' &= -8.89 \\ h' &= -3.03 \\ c &= -3.17 \\ &= -15.09 \checkmark \end{aligned}$$

$$\alpha' = 13^h 59^m 12.61^s \checkmark$$

$$\delta = -13^\circ 57' 56.9'' \checkmark$$

1827

Red. to Apparent Place.

11

$$\begin{array}{rcl}
 \alpha_0 & 13^h & 59^m & 10^s & 74 \\
 \delta & 20 & 13 & 36 \\
 \alpha + \alpha_0 & 10 & 12 & 46 \\
 & 153^\circ & 11' & 30''
 \end{array}$$

$$\begin{array}{rcl}
 \delta_0 & -13^\circ & 57' & 41''8 \\
 H & 13^h & 28^m & 24^s \\
 H + \alpha_0 & 3^h & 26^m & 35^s \\
 & 51^\circ & 38' & 45''
 \end{array}$$

$$\begin{array}{rcl}
 \log r_0 & 8.8239 \\
 \log q & 0.9982 \\
 \sin(G + \alpha) & 9.6542 \\
 \log S & 9.3955 \\
 (q) & 88718
 \end{array}$$

$$\begin{array}{rcl}
 \log r_0 & 8.8239 \\
 \log h & 1.3055 \\
 \sin(H + \alpha) & 9.8944 \\
 \log S & 0.0130 \\
 (h) & 00368
 \end{array}$$

$$\begin{array}{rcl}
 \log c & 0.5138 \\
 \log q & 9.9870 \\
 (c) & 05008
 \end{array}$$

$$\begin{array}{rcl}
 \log q & 0.9982 \\
 \sin(G + \alpha) & 9.9506 \\
 (q') & 09488
 \end{array}$$

$$\begin{array}{rcl}
 \log h & 1.3055 \\
 \sin(H + \alpha) & 9.7928 \\
 \log S & 9.3825 \\
 (h') & 04808
 \end{array}$$

$$\begin{array}{rcl}
 f & +0.85 \\
 (q) & -0.07 \\
 (h) & +1.09 \\
 & +1.87
 \end{array}$$

$$\begin{array}{rcl}
 q' & -8.89 \\
 h' & -3.03 \\
 & -3.17 \\
 & -1.509
 \end{array}$$

$$\alpha' = 13^h 59^m 12^s 61$$

$$\delta = -13^\circ 57' 56.9''$$

1827

Luna Parallax

12

$$\begin{aligned} \alpha' &= 13^{\circ} 59' 12.56'' \\ \theta &= 13 \quad 05 \quad 01.35'' \\ \theta - \alpha' &= -54 \quad 11.26'' \\ &= -13^{\circ} 32' 50'' \end{aligned}$$

$$\frac{1}{2}(\alpha - \alpha') = - \quad 5 \quad 03$$

$$t - \frac{1}{2}(\alpha - \alpha') = -13 \quad 27 \quad 47$$

$$\begin{aligned} \log \tan \phi' &= 9.95727 \\ \cos \frac{1}{2}(\alpha - \alpha') &= 0.00000 \\ - \cos t - \frac{1}{2}(\alpha - \alpha') &= 9.98790 \\ \tan \gamma &= 9.96937 \end{aligned}$$

$$\gamma = +42 \quad 58 \quad 53.0''$$

$$\delta' = -13 \quad 57 \quad 56.9''$$

$$\delta - \delta' = +56 \quad 56 \quad 49.9''$$

$$\begin{aligned} \log \sin \phi' &= 9.82640 \\ \sin \pi &= 8.21661 \\ - \sin(\gamma - \delta) &= 9.92333 \\ - \sin \gamma &= 9.83363 \\ \sin(\delta - \delta') &= 8.13271 \end{aligned}$$

$$\delta - \delta' = +46 \quad 39.9''$$

$$\delta = -13 \quad 11 \quad 17.0''$$

$$\text{Amplph } \delta = -13^{\circ} 11' 13.2''$$

$$O - C = -3.8''$$

$$\delta' = -13^{\circ} 57' 56.9''$$

$$\pi = 56' 36.7''$$

$$\begin{aligned} \log \cos \phi' &= 9.86913 \\ \sin \pi &= 8.21661 \\ \cos(\theta - \alpha') &= 9.36967 \\ - \cos \delta &= 9.98839 \\ \sin(\alpha - \alpha') &= 7.46702 \end{aligned}$$

$$\alpha - \alpha' = -10' 04.57''$$

$$= -40.30''$$

$$\alpha = 13 \quad 58 \quad 32.31''$$

$$\alpha = 13^{\circ} 58' 31.82''$$

$$+0.49''$$

1827

Lunar Parallax

12

$$\begin{aligned}
 X' &= 13^\circ 59' 12.61'' \\
 0 &= 13 \quad 05 \quad 01.35'' \\
 0 - X &= -54 \quad 11.26'' \\
 &= -13^\circ 32' 50''
 \end{aligned}$$

$$\delta' = -13^\circ 57' 56.9''$$

$$\mu = 56' 36.7''$$

$$\frac{1}{2}(X - X') = -5' 03''$$

$$E - \frac{1}{2}(X - X') = 13 \quad 27 \quad 47$$

$$\log \tan f' = 9.95727$$

$$\cos \frac{1}{2}(X - X') = 0.00000$$

$$- \cos E - \frac{1}{2}(X - X') = 9.98790$$

$$\tan \gamma = 9.96937$$

$$\gamma = +42 \quad 58 \quad 53.0''$$

$$\delta' = -13 \quad 57 \quad 56.9''$$

$$\delta - \delta' = -56 \quad 56 \quad 49.9''$$

$$\log \sec f' = 9.82640$$

$$\sin \mu = 8.21661$$

$$\sin(\gamma - \delta) = 9.92333$$

$$- \sin \gamma = 9.83363$$

$$\sin(\delta - \delta') = 8.13271$$

$$\delta - \delta' = +46 \quad 39.9''$$

$$\delta = 13 \quad 11 \quad 17.0''$$

$$X = 13 \quad 58 \quad 32.31''$$

$$\text{Amplitude } \delta = -13^\circ 11' 18.2''$$

$$X = 13^\circ 58' 31.82''$$

$$O - C = -3.8''$$

$$+0.49''$$

1884

Stars - measures

1913 Nov. 13

15

	d	v
1	15182	18090
8.3	10145	13120
10.5	40	18
17	66	88
10.5031		5029

2	15417	17625
22.4	8311	14730
51.7	05	31
	17	18
31.7108		7109

3	15137	10574
4.8	39	10170
17.9	14748	79
17.9605		9600

d	v
16532	19900
8940	17455
40	56
15	90
9.2424	2440

15020	17751
9035	13715
3530	10
29	40
22.4008	4036

19080	17287
17070	927070
65	70
60	86
24.7991	8016

Grade 3.
Additional Stars

8.3	19029	16439
16.3	15688	9780
17.9	80	70
4.8	80	83
	40	36
16.3350		3341

10.0	16210	19280
17.7	8990	16519
17.9	85	23
8.2	24	85
27.7234		7234

17787	16975
10390	14370
88	64
81	65
8.2600	2604

12285	10155
90	9891
12043	90
10.0246	0265

18
1
3
10.5
6
2
22
31.7
3
24
17.5
83
16.3
10.0
27
46

1884 Stars - measures

15

	α	δ
1	15 18 2	150 9 0
83	10 14 5	13 12 20
10.5	40	13
7	66	88
61	10 50 31	50 29

2	15 41 7	17 62 5
224	83 11	14 73 0
31.7	05 12	31 39
	17	18
	31.7 10 8	71 09

3	15 13 7	16 57 4
24.8	39 45	10 17 0
17.9	14 74 8	79 72
	17 96 05	96 00

α	δ
16 53 2	19 90 0
89 40 48	17 45 5
40	56 60
15	90
9.24 24	24 40

15 02 0	17 75 1
90 35	13 71 0
35 30	10 09
29	40
22.40 08	40 36

19 08 0	17 28 7
17 07 0	92 70 70
61	70
60	86
24.79 91	80 16

Grade 3
Additional Stars

83	19 02 9	16 43 9
16.3	15 68 8	97 80 70
mg	80	83
87	40	36
	16.33 50	33 41

10.0	16 21 0	19 28 0
27.7	89 90 86	16 51 9
49	85	23
82	24	85
	27.72 34	72 34

17 78 7	16 97 5
10 39 0	14 37 0
88	64
81	65
8.26 00	26 04

12 28 5	10 15 5
90	98 91 89
12 04 3	90
10.02 46	02 65

1884 moon measures

	a	y	w
18.0	1325040	12485	
16.8	12079	1135646	
		50	

possibly on
terminator16.8829.8866

3 scratch

18.5	18061
17.5	1417280
	72
	43
	<u>17.3879</u>

16211
1006068
70
10
<u>.8856</u>

18319
1390020
11
00
<u>18.5600</u>

14866
928488
86
63
<u>.5577</u>

3
18.8
18.0

18285
1690711
05
75
<u>18.8624</u>

14767
6135
3433
62
<u>.5629</u>

4
18.9
18.5
max
in
2

17260
1659688
90
52
<u>18.9332</u>

13770
1448825
22
72
<u>.9350</u>

5
18.8
19.0

16195
1500010
10
80
<u>18.8884</u>

13790
X497160
68
90
<u>.8824</u>

6
18.3
20.0

15166
764537
30
50
<u>18.2483</u>

13850
1134040
40
50
<u>.2510</u>

18

1

18

6

2

85

175

3

18

18

4

18

18

18

18

18

5

18

19

6

18

20

1884

Moon measures

a

4

n

d^{sc}

n

13250
180 6040
12079

12485
1135646
50

possibly on
terminator16.882988663 scratch

85 18061
175 1917280
72
43
17.3879

16211
1006068
70
10
3856

18319
1390020
11
00
18.5600

14866
928488
88
63
5577

3
188
180

18285
1690711
0511
75
18.8624

14767
6135
3433
62
8629

4
189
185
max
n
2

17260
1659688
90
52
18.9332

13770
1441825
22
72
9350

5
188
190

16195
1506010
10
80
18.8884

13790
1497160
68
90
8824

6
18.3
200

15166
764537
30
50
18.2483

13850
1134040
40
50
2510

18
7
18.0
10.3

5
17.0
10.3
10.3
10.3

18.7
17.0

1884

Moon measures

17

	a	y	n	d^2	n
7	19661		20058		
18.0	17888	90	11835	48	
10.3	77		30		
	61		56		
	<u>20.1776</u>		<u>.1782</u>		

17.0	18684		19038		
10.5	14297	84	13421	31	
10.0	90		30		
10.0	90		20		
	<u>20.4397</u>		<u>.4399</u>		

Point to reference point (1)

18.2	19055	19280
17.0	10760	17575
	50	80
	48	80
	<u>18.1711</u>	<u>18.1700</u>

1884

Moon measures

17

	a	y	z	d	n
2	19661	20058			
180	17888	11835			
W3	77 ⁹⁰	30 ⁴⁸			
	61	56			
	<u>20.1776</u>	<u>.1782</u>			

170	18684	19038
20.5	14297 ⁸⁴	13421 ³¹
W3	90	30
	90	20
	<u>20.4397</u>	<u>.4399</u>

Point to reinforce point(1)

19055	19280
10760 ⁷⁰	17575 ⁵⁵
50	50
48	80
<u>18.1711</u>	<u>18.1700</u>

18
Exp
cl
H
St.
G
Si
I
R
G
S
li
li
Ta

884

Times etc.

18

App to stars 1912 July 2, 20^h 46^m - 20^h 58^m
 Moon 20 52 25.7 - 20 52 26.1
 clock slow 1 39.7

H Sid T.	20	54	05.6
G. long.	4	44	31.05
G Sid T.	25	38	36.65
Sid. in Moon	6	40	37.33
Interval	18	57	59.32
Reduction		3	06.43
G. in T.	18	54	52.896 - $\alpha = -0^h 48^m$

From hant. alum	R _h	Decl
Moon 19 ^m	21 ^h 42 ^m 09.10	-18° 10' 22.8"
Motion in 1 ^m = 1.9252		11.102
-5.1185	-9.85	-56.8
Tabular place.	21 41 59.25	-18 11 19.6

Moon's age. 18 days.
 parallax 54" 05.0
 semidiam 14 45.8
 R = 885.8
 Augmentation + 6.6
 Irradiation (3) - 0.7
 R = 891.7
 = 1.9115
 (1 + α) R = 1.9114
 R² = 3.6534

934 = 7.35
 886 = 6.6

$\alpha = -0.5$

1884 Turner etc.

Exp. to star 1912 July 2, $20^{\circ} 46''$ $-20^{\circ} 58''$

Moon	20	52	257	-20	52	261
clock slow		1	397			
H Sid T.	20	54	056			
G home	4	44	31.05			
G Sid T.	25	38	3665			
Sid T. in Moon	6	40	37.33			
Interval	18	57	59.32			
Reduction		3	0.643			
G in T.	18	54	52.896	-X = -0	48	

From Hunt Allen	Ra	Decl.
Moon 19"	$21^{\circ} 42'' 09.10$	$-18^{\circ} 10' 22.8$
motion: $1'' = 1.9252$		11.102
-5.1185	-9.85	-568
Tabular place.	21 41 59.25	-18 11 19.6

Moon's age 18 days.

934 = 7.35	paraallax	54' 05.0
886 = 6.6	secundian	14 45.8
	R =	885.8
	Augmentation	+ 6.6
	Irradiation (3)	- 0.7
	R =	891.7
	=	1.9113
a =	1+a/R =	
	R' =	

1884

Plate Constants

x	y	K	a	b	c	d	e	f
92432	10.5030	21	38	18	-20	01	23	
224022	317108		45	23	-17	15	21	
248004	179602		46	49	-19	02	01	
35645	16017		9	90	-26	18	45	
18.82	20.06	21	43	30	-18	46	15	
18	-22		-	25		+15	03	
82	1.94	21	43	05	-18	37	49	
31	465				-18	31	12	
255	903							

$$A = 21^h 43^m 05^s$$

$$D = -18 \quad 31 \quad 12$$

$$\begin{aligned}
 x - \bar{x} &= -124.94 & +0.5x & & +2221 \\
 -912 & -1312 & -2224 & +4 & -2220 & = +4 \\
 +1729 & -3961 & -2232 & +11 & -2221 & = 0 \\
 +10 & -2243 & -2233 & +12 & -2221 & = 0 \\
 17.0274 & -2314 & +9 & & & = 17.0190 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 y - \bar{y} &= +119.5x & +8.74 & & -2546 \\
 +1350 & +1105 & +2455 & +91 & +2546 & = 0 \\
 -406 & +2677 & +2271 & +276 & +2547 & = +1 \\
 -575 & +2964 & +2389 & +156 & +2545 & = -1 \\
 18.5307 & +2035 & +161 & & & = 18.4957 \checkmark
 \end{aligned}$$

Tables	$a = -4.1$	$e = -10.1$	$u - v = +90$	$b + a = +3.5$
Obs	$a = -0.5$	-8.7	$+8.2$	$+54$
$c - 0$	-0.6	-1.4	$+0.8$	-1.9

1884

Plate Constants

$$\begin{array}{r}
 x \\
 9.2432 \\
 22.4022 \\
 24.5004 \\
 \hline
 56.45 \\
 18.82 \\
 18 \\
 \hline
 82 \\
 31 \\
 \hline
 213
 \end{array}
 \quad
 \begin{array}{r}
 y \\
 10.5030 \\
 31.7108 \\
 17.9602 \\
 \hline
 16017 \\
 20.06 \\
 -22 \\
 \hline
 1.94 \\
 465 \\
 \hline
 903''
 \end{array}$$

$$\begin{array}{r}
 K a \\
 21 \quad 38 \quad 18 \\
 45 \quad 23 \\
 \hline
 46 \quad 49 \\
 9 \quad 90 \\
 \hline
 21 \quad 43 \quad 30 \\
 -25 \\
 \hline
 21 \quad 43 \quad 05
 \end{array}
 \quad
 \begin{array}{r}
 Mech. \\
 -20 \quad 01 \quad 23 \\
 -17 \quad 15 \quad 21 \\
 \hline
 -19 \quad 08 \quad 41 \\
 -26 \quad 88 \quad 45 \\
 \hline
 -18 \quad 52 \quad 15 \\
 +15 \quad 03 \\
 \hline
 -18 \quad 37 \quad 49
 \end{array}$$

$A = 21^h 43^m 05^s$
 $D = -18 \quad 31 \quad 12$

$$\begin{array}{r}
 x - 5 \quad -12494 \\
 -912 \quad -1312 : -2229 + 4 : -2220 : +4 \\
 +1729 \quad -3961 : -2232 + 11 : -2221 : 0 \\
 +10 \quad -2243 : -2233 + 12 : -2221 : 0 \\
 17.0274 \quad -2319 : +9 : 17.0190
 \end{array}$$

$$\begin{array}{r}
 y - 4 \quad +119.5x \\
 +1350 +1105 : +2455 + 91 : +2546 : 0 \\
 -406 +2677 : +2271 + 276 : +2547 : +1 \\
 -575 +2964 : +2389 + 156 : +2545 : -1 \\
 18.5307 +2035 : +161 : 18.4957
 \end{array}$$

Tables $a = -0.6$ $b = -10.0$ $a - b = +9.4$ $b + a = +3.3$
 Obs $a = -0.5$ -8.7 $+8.2$ $+5.4$
 $c = 0$ $+1.2$ -2.1

1884

Standard Coordinates

Cape No. 3012 mag 6.1				Cape No. 3028 mag 6.5				Cape No. 3033 mag 6.1			
C	21 ^h	37 ^m	37.97 ^s	21 ^h	44 ^m	42.99 ^s	21 ^h	46 ^m	08.63 ^s		
L			96			43.10			69		
B			99			43.04			66		
Mean	21	37	37.97	21	44	43.04	21	46	08.66		
Proc		+	40.32		+	39.65		+	40.01		
δ	21	38	18.29	21	45	22.69	21	46	48.67		
A	21	43	05	21	43	05	21	43	05		
$\delta-A$	-	9	46.71	+ 2	17.69		+ 3	43.67			
$\sin(\delta-A)$		-	286.69	+ 137.69			+ 223.66				
log...		2.45742		2.13890			2.34959				
"0058		997292		998000			997558				
"30		093758		062618			083241				
3,		- 8.6612		+ 4.2281			+ 6.7984				
3,		-	44	+	12		+	10			
3		9.3344		22.2293			24.7994				
μ		92432		22.4022			248004				
$\mu-3$		- 912		+ 1729			+	10			
$\epsilon-20^\circ$	04'	39.0"		-17°	18'	40.2"	-19°	05'	21.0"		
L		38.6				40.0			21.8		
B		38.1				41.5			20.7		
Mean	-20	04	38.6	-17	18	40.6	-19	05	21.2		
Proc		+ 3	15.6	+	3	19.9	+	3	19.9		
δ	-20	01	23.0	-17	15	20.7	-19	02	01.3		
δ	-18	31	12	-18	31	12	-18	31	12		
$\delta-B$	-1	30	11.0	+ 1	15	51.3	-	30	49.3		
$\sin(\delta-B)$		- 5412.3		+ 4552.0			- 1849.3				
log...		3.73338		3.65820			3.26701				
" η		1.06453		0.98935			0.59816				
tan δ		9.5616		9.4922			9.5378				
"37		18752		12522			16648				
" η		84902		77978			82550				
η_0		- 11.6011		+ 97.577			- 3.9643				
η_1		-	309	-	63		-	180			
η		10.3680		31.7514			18.0177				
η		10.5030		31.7108			17.9602				
η		+ 1350		- 406			- 575				

1884

Standard Coordinates

Cape W. 3012 mag 6.1				Cape W. 2028 mag 6.5				Cape W. 3033 mag 6.1			
L	21	37	37.97	21	44	42.99	21	46	08.63		
L			96			43.10			69		
Q			99			43.04			66		
mean	21	37	37.97	21	44	43.04	21	46	08.66		
Prec			+ 40.32			+ 39.65			+ 40.01		
Q	21	38	18.29	21	45	22.69	21	46	48.67		
A	21	43	05	21	43	05	21	43	05		
x-A	-	4	46.71	+ 2	17.69		+ 3	43.67			
sin(A)			- 286.69	+ 137.69			+ 223.66				
Wg.			2.45742	2.13890			2.34959				
cos			9.97292	9.98009			9.97558				
S ₀			0.93738	0.62588			0.83247				
S ₁	-		8.6652	+ 4.2285			+ 6.7984				
S ₂	-		44	-	13		+ 10				
S ₃			9.3344	22.2293			24.7994				
x			9.2432	22.4022			24.8004				
x-3	-		9.12	+ 17.29			+ 10				
C	-20°	04'	39.0	-17°	18'	40.2	-19°	05'	21.0		
L			38.6			40.0			21.8		
Q			38.1			41.5			20.7		
mean	-20	04	38.6	-17	18	40.6	-19	05	21.2		
Prec			+ 3	15.6	+ 3	19.9	+ 3	19.9			
Q	-20	01	23.0	-17	15	20.7	-19	02	01.3		
D	-18	37	42	-18	37	42	-18	37	12		
S-D	-1	30	45.0	+ 1	15	54.5	-	30	49.3		
tan(S-D)			- 5462.3	+ 4552.0			- 1849.3				
Wg.			3.73338	3.65820			3.26701				
W ₀			1.06453	0.98933			0.59884				
tan S			9.5646	9.4922			9.5978				
S ₁			18.752	12.522			16.648				
S ₂			8.4902	7.7998			8.2580				
W ₀	-		11.6047	+ 9.7577			- 3.9843				
W ₁	-		30.9	-	63		-	180			
W ₂			10.3680	31.7459			18.0177				
W ₃			10.5030	31.7108			17.9602				
W ₄			+ 13.59	- 40.6			- 57.5				

1984 additional stars

21

Cape W. 3009 mag 4.8

Cape W. 3013 mag 4.2

C 21^m 37^m 04.56

21 38 00.70

L 57

77

E 53

77

mean

Proc + 40.25

+ 39.86

K

A

K-A

Curt. A)

mean

-0.05

-3.0

5

5

5

2

2-3

C -19° 19' 19.6 -17° 50' 38.4

L 19.6 38.4

E 19.6 38.6

mean

Proc + 3 15.4 + 3 16.0

S

D

S-D

Proc (A)

mean

-0.05

-3.0

-0.05

-3.0

-3.0

-3.0

-3.0

-3.0

-3.0

-3.0

-3.0

-3.0

-3.0

kt.	pos. 2.	resid.
1	149.3	+78
2	143.0	+19
3	126.7	+39
4	106.0	-27
5	90.0	-179
6	75.7	+58
7	40.0	+21
8	30.7	-99
9	0.0	-20

1884 Moon's Center

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 (y - y_0)^2$	$0 - c$
1	18.0000	+0.9774	+6	0.9565	3.6628	+94
2	18.1706	+1.1480	+5	1.3190	3.6590	+56
3	18.5588	+1.5362	+4	2.3612	3.6667	+133
4	18.8626	+1.8400	+2	3.3863	3.6659	+125
5	18.9341	+1.9115	0	3.6538	3.6538	+4
6	18.8819	+1.8593	-2	3.4563	3.6792	+258
7	18.2496	+1.2270	-5	1.5043	3.6743	+209
8	18.0000	+0.9774	-6	0.9541	3.6806	+272
9	17.0000	-0.0226	-7	0.0005	3.6607	+73
Comp. R^2					3.6534	

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	16.8848	-1.6435	-16	2.7063
2	17.0000	-1.5283	-14	2.3400
3	17.3868	-1.1415	-11	1.3055
4	18.0000	-0.5283	-5	0.2796
5	18.5283	0.0000	0	0.0000
6	19.0000	+0.4717	+4	0.2229
7	20.0000	+1.4717	+14	2.1700
8	20.1779	+1.6496	+16	2.7265
9	20.4398	+1.9115	+18	3.6607

$$x = 18.0 \quad y = 16.8848$$

$$20.1779$$

$$3.70627$$

$$y_0 = 18.5314$$

$$y = \max = 20.4398$$

$$R = 1.9084$$

$$y = \max = 20.4398$$

$$\text{Comp. } R = 1.9115$$

$$y_0 = 18.5283$$

$$x = \max = 18.9341$$

$$R = 1.9115$$

$$x_0 = 17.0226$$

$$\text{Center } \begin{cases} x_0 = 17.0226 \\ y_0 = 18.5283 \end{cases}$$

1884 moons center

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 / (y - y_0)^2$	$0 - C$
1	18.0000	+0.9774	+6	0.9565	3.6628	+94
2	18.1706	+1.1480	+5	1.3190	3.6590	+56
3	18.5588	+1.5362	+4	2.3612	3.6667	+133
4	18.8626	+1.8400	+2	3.3863	3.6659	+125
5	18.9341	+1.9115	0	3.6538	3.6538	+9
6	18.8819	+1.8593	-2	3.4563	3.6792	+258
7	18.2496	+1.2270	-5	1.5043	3.6743	+209
8	18.0000	+0.9774	-6	0.9541	3.6806	+272
9	17.0000	-0.0226	-7	0.0005	3.6607	+73
Comp. R^2					3.6534	

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	16.8848	-1.6435	-16	2.7063
2	17.0000	-1.5283	-14	2.3400
3	17.3868	-1.1415	-11	1.3055
4	18.0000	-0.5283	-5	0.2796
5	18.5283	0.0000	0	0.0000
6	19.0000	+0.4717	+4	0.2229
7	20.0000	+1.4717	+14	2.1700
8	20.1779	+1.6496	+16	2.7265
9	20.4398	+1.9115	+18	3.6607

 $x = 18.0$ $y = 16.8848$ 20.1779

3.70627

 $y_0 = 18.5314$ $y = \text{max} = 20.4398$ $R = 1.9084$ $y = \text{max} = 20.4398$ Comp $R = 1.9115$ $y_0 = 18.5283$ $x = \text{max} = 18.9341$ $R = 1.9115$ $x_0 = 17.0226$ Center $\begin{cases} x_0 = 17.0226 \\ y_0 = 18.5283 \end{cases}$

Normal Equations

	ab	bu	bu
1	- 1.61	+ 921	- 154.0
2	- 1.76	+ 64.5	- 85.7
3	- 1.76	+ 205.0	- 151.8
4	- 0.97	+ 230.0	- 66.4
5	+ 0.00	+ 76	+ 0.0
6	+ 0.87	+ 480.0	+ 121.2
7	+ 1.81	+ 257.0	+ 307.5
8	+ 1.62	+ 266.5	+ 449.5
9	- 0.04	- 1.5	+ 139.5
	- 1.84	+ 1601.2	+ 559.8

884

Huber's Center

Conditional Equations

	a	b	0		c	0-c	
1	+ 0.98	- 1.64	= + 94	+ 94	- 78	= + 16	+ 78
2	+ 1.15	- 1.53	= + 56	+ 110	- 73	= + 37	+ 19
3	+ 1.54	- 1.14	= + 133	+ 148	- 54	= + 94	+ 39
4	+ 1.84	- 0.53	= + 125	+ 177	- 25	= + 152	- 27
5	+ 1.91	+ 0.00	= + 4	+ 183	+ 0	= + 183	- 179
6	+ 1.86	+ 0.47	= + 258	+ 178	+ 22	= + 200	+ 58
7	+ 1.23	+ 1.47	= + 209	+ 118	+ 70	= + 188	+ 21
8	+ 0.98	+ 1.65	= + 272	+ 94	+ 79	= + 173	+ 99
9	- 0.02	+ 1.91	= + 73	+ 2	+ 91	= + 93	- 20

Average = 60

Normal Equations

$$+ 17.59 - 1.84 = + 1601$$

$$- 1.84 + 15.41 = + 560$$

$$+ 1.84 - 0.19 = + 168$$

$$+ 15.22 = + 728$$

$$b = + 47.8$$

$$- 0.22 + 1.84 = + 67$$

$$+ 17.37 = + 1668$$

$$a = + 76.0$$

1884

Lunar Center

Conventional Equations

	a	b	c		a	b	c
1	+0.98	-1.64	+94		+94	-28	+16
2	+1.15	-1.53	+56		+110	-73	+37
3	+1.54	-1.14	+133		+148	-54	+94
4	+1.84	-0.53	+125		+177	-25	+152
5	+1.91	+0.00	+4		+183	+0	+183
6	+1.86	+0.47	+258		+178	+22	+200
7	+1.23	+1.47	+209		+118	+70	+188
8	+0.98	+1.65	+272		+94	+79	+173
9	-0.02	+1.91	+73		+2	+91	+93

Average = 60

Normal Equations

$$+17.59 = 1.84 = +1601$$

$$-1.89 + 1.541 = +560$$

$$+1.84 = 0.19 = +168$$

$$+15.22 = +728$$

$$b = +47.8$$

$$-0.22 + 1.84 = +67$$

$$+17.37 = +1668$$

$$a = +76.0$$

1884 Moon's Mean Position (1912.0)

$$\begin{array}{rcl}
 X_0 & = & 17.0226 \\
 Y_0 & = & 18.5283 \\
 \hline
 \Delta a & = & + 48 \\
 \hline
 & & 17.0274 \\
 \hline
 \Delta b & = & + 24 \\
 \hline
 & & 18.5307
 \end{array}$$

From Plate Constant $X = 17.0190$ $Y = 18.4957$

$$\begin{array}{rcl}
 \bar{z} & = & -0.9810 \\
 \log \bar{z} & = & 9.99167 \\
 \cos \delta & = & 9.97574 \\
 \sin \delta & = & 8.50729
 \end{array}$$

$$(X-A) = 1.50869$$

$$X-A = 32.26$$

$$A = 21 \quad 43 \quad 05$$

$$X_0 = 21 \quad 42 \quad 32.74$$

$$\eta = -3.5043$$

$$\begin{array}{rcl}
 \log \tan \delta & = & 9.5369 \\
 \log \sec \delta & = & 9.9833 \\
 \eta_1 & = & 6.5736 \\
 \eta_1 & = & 4
 \end{array}$$

$$\eta_0 = -3.5039$$

$$\begin{array}{rcl}
 \log \eta_0 & = & 0.54455 \\
 \log \eta_1 & = & 7.33115
 \end{array}$$

$$(d-D) = 3.21340$$

$$(d-D) = -27 \quad 14.6$$

$$D = -18 \quad 31 \quad 12$$

$$S_0 = -18^{\circ} 58' 26.6''$$

1884 known mean Position (1912.0)

$$\begin{array}{rcl}
 X & = & 17.0226 \\
 Y & = & 18.5283 \\
 \hline
 \Delta & = & +48 \\
 \hline
 & & 17.0274
 \end{array}
 \qquad
 \begin{array}{rcl}
 Y & = & 18.5283 \\
 \hline
 \Delta & = & +24 \\
 \hline
 & & 18.5307
 \end{array}$$

from Plate constant $X = 17.0190$ $Y = 18.4917$

$$\begin{array}{rcl}
 z & = & -0.9810 \\
 \log S & = & 9.99167m \\
 \cos & & 9.97579 \\
 \sin & & 8.50729
 \end{array}$$

$$(X-A) = 1.50869m$$

$$X-A = 32.26$$

$$A = 21 \ 43 \ 05$$

$$X_0 = 21 \ 42 \ 32.74$$

$$y = -3.5043$$

$$\begin{array}{rcl}
 \log \tan S & = & 9.5369m \\
 \log S & = & 9.9833 \\
 \log y & = & 6.5736m
 \end{array}$$

$$y = 4$$

$$y = -3.5039$$

$$\begin{array}{rcl}
 \log y & = & 0.54455m \\
 \sin & = & 7.33115
 \end{array}$$

$$(d-D) = 3.21340m$$

$$(d-D) = -27 \ 14.6$$

$$D = -18 \ 31 \ 12$$

$$S_0 = -18^\circ 58' 26.6''$$

188.4

Reduction to Apparent Place

$$\begin{aligned}
 \alpha_0 &= 21^h 42^m 32.7^s 4 \\
 G &= 21 \quad 01 \quad 18 \\
 G + \alpha_0 &= 18 \quad 43 \quad 51 \\
 &= 280^\circ 57' 45''
 \end{aligned}$$

$$\begin{aligned}
 \delta_0 &= -18^\circ 59' 04.6'' \\
 H &= 11^h 20^m \\
 H + \alpha_0 &= 9^h 02^m 33.5'' \\
 &= 135^\circ 38' 15''
 \end{aligned}$$

$$\begin{aligned}
 \log \frac{1}{\sin} &= 8.8239 \\
 \therefore g &= 1.0690 \\
 \therefore \sin(H + \alpha_0) &= 9.9920 \\
 \therefore \tan \delta_0 &= 9.5366 \\
 \therefore (g) &= 9.4215
 \end{aligned}$$

$$\begin{aligned}
 \log \frac{1}{\sin} &= 8.8239 \quad \log \\
 \therefore h &= 1.3099 \\
 \therefore \sin(H + \alpha_0) &= 9.8446 \\
 \therefore \sec \delta_0 &= 0.0243 \\
 \therefore (h) &= 0.0029
 \end{aligned}$$

$$\begin{aligned}
 \log g &= 1.0690 \\
 \therefore \cos(G + \alpha_0) &= 9.2791 \\
 \therefore (g') &= 0.3481
 \end{aligned}$$

$$\begin{aligned}
 \log h &= 1.3099 \quad \log i = 0.1900 \\
 \therefore \cos(H + \alpha_0) &= 9.8543 \quad \therefore \cos \delta = 9.9757 \\
 \therefore \sin \delta_0 &= 9.5123 \quad \therefore (i) = 0.1657 \\
 \therefore (h') &= 0.6765
 \end{aligned}$$

$$\begin{aligned}
 f &= +0.26 \\
 (g) &= +0.26 \\
 (h) &= +1.01 \\
 \text{Red in } \alpha &= +2.53
 \end{aligned}$$

$$\begin{aligned}
 (g') &= +2.23 \\
 (h') &= +4.75 \\
 (i) &= +1.45 \\
 \text{Red in } \delta &= +8.43
 \end{aligned}$$

$$\alpha' = 21^h 42^m 35.27^s$$

$$\delta' = -18^\circ 58' 18.2''$$

1884

Reduction to Apparent Place

$$\begin{aligned}
 \alpha_0 &= 21^{\text{h}} 42^{\text{m}} 32.74 \\
 G &= 21 \quad 01 \quad 18 \\
 G + \alpha_0 &= 18 \quad 43 \quad 51 \\
 &= 280^{\circ} 57' 45''
 \end{aligned}$$

$$\begin{aligned}
 \delta_0 &= -18^{\circ} 59' 04.6 \\
 H &= 11^{\text{h}} 20^{\text{m}} \\
 H + \alpha_0 &= 9^{\text{h}} 02^{\text{m}} 33.5 \\
 &= 135^{\circ} 38' 15''
 \end{aligned}$$

$$\begin{aligned}
 \log \frac{1}{r} &= 8.8239 \\
 \log \frac{1}{h} &= 1.0690 \\
 \sin(H + \alpha_0) &= 9.9920 \\
 \tan \delta_0 &= 9.5366 \\
 (g) &= 9.4215
 \end{aligned}$$

$$\begin{aligned}
 \log \frac{1}{r} &= 8.8239 \\
 \log \frac{1}{h} &= 1.3099 \\
 \sin(H + \alpha_0) &= 9.8446 \\
 \sec \delta_0 &= 0.0243 \\
 (h) &= 0.0027
 \end{aligned}$$

$$\begin{aligned}
 \log g &= 1.0690 \\
 \cos(G + \alpha_0) &= 9.2791 \\
 (g') &= 0.3484
 \end{aligned}$$

$$\begin{aligned}
 \log h &= 1.3099 \\
 \cos(H + \alpha_0) &= 9.8543 \\
 \sin \delta_0 &= 9.5123 \\
 (h') &= 0.6765
 \end{aligned}$$

$$\begin{aligned}
 f &= +0.26 \\
 (g) &= +0.26 \\
 (h) &= +1.01 \\
 \text{Red in } \alpha &= +233
 \end{aligned}$$

$$\begin{aligned}
 (g') &= +223 \\
 (h') &= +4.75 \\
 (l) &= +1.41 \\
 \text{Red in } \delta &= +18.43
 \end{aligned}$$

$$\alpha' = 21^{\text{h}} 42^{\text{m}} 35.27$$

$$\delta' = -18^{\circ} 58' 58.2$$

1884

Lunar Parallax

$$\begin{aligned} \alpha' &= 21 \quad 42 \quad 35.27'' \\ \delta &= 20 \quad 54 \quad 05.6'' \\ \delta - \alpha' &= - \quad 48 \quad 29.7'' \\ &= -12^\circ \quad 07' \quad 26'' \end{aligned}$$

$$\delta' = -18^\circ \quad 58' \quad 18.2''$$

$$\pi = 54' \quad 05.0''$$

$$\frac{1}{2}(\alpha - \alpha') = - \quad 4 \quad 25''$$

$$2 \frac{1}{2}(\alpha - \alpha') = -12 \quad 03''$$

$$\log \tan \phi' = 9.95727''$$

$$\cos \frac{1}{2}(\alpha - \alpha') = 0.000000$$

$$\log \sec \frac{1}{2}(\alpha - \alpha') = 9.99032''$$

$$\log \phi = 9.96695''$$

$$\gamma = 42 \quad 49 \quad 19.0''$$

$$\delta' = -18 \quad 58 \quad 18.2''$$

$$\gamma - \delta' = 61 \quad 47 \quad 37.2''$$

$$\log \sin \phi = 9.82640''$$

$$\sin \pi = 8.19677''$$

$$\sin(\gamma - \delta') = 9.94510''$$

$$\sin \gamma = 9.83233''$$

$$\sin(\alpha \delta') = 8.13594''$$

$$\delta - \delta' = +47 \quad 00.9''$$

$$\delta = -18 \quad 11 \quad 17.3''$$

$$\text{An Elt } \delta = -18^\circ \quad 11' \quad 19.6''$$

$$o - c$$

$$+ 23''$$

$$+ 0.64''$$

$$\log \cos \phi' = 9.86913''$$

$$\sin \pi = 8.19677''$$

$$(\delta - \alpha') = 9.32228''$$

$$\cos \delta = 9.97774''$$

$$\sin(\alpha - \alpha') = 7.41044''$$

$$\alpha - \alpha' = -8' \quad 50.72''$$

$$= -35.38''$$

$$\alpha = 21 \quad 41 \quad 59.89''$$

$$\alpha = 21^h \quad 41^m \quad 59.25''$$

1884

Lunar Parallel

$$\alpha' = 21 \quad 42 \quad 35.27''$$

$$\theta = 20 \quad 54 \quad 05.6''$$

$$G - \alpha = - \quad 48 \quad 29.7''$$

$$= -12^{\circ} \quad 07' \quad 26''$$

$$\delta' = -18^{\circ} \quad 58' \quad 18.3''$$

$$\pi = \quad 54' \quad 05.0''$$

$$\frac{1}{2}(\alpha - \alpha') = - \quad 4 \quad 25''$$

$$2 \frac{1}{2}(\alpha - \alpha') = -12 \quad 03$$

$$\log \tan \phi' = 9.95727''$$

$$\cos \frac{1}{2}(\alpha - \alpha') = 0.000000$$

$$- \log \sec \frac{1}{2}(\alpha - \alpha') = 9.99032$$

$$\tan \phi = 9.96695''$$

$$\gamma = 42 \quad 49 \quad 19.0''$$

$$\delta' = -18 \quad 58 \quad 56.2''$$

$$\gamma - \delta' = 61 \quad 47 \quad 15.2''$$

$$\log \sec \phi = 9.82640''$$

$$\sin \pi = 8.19677$$

$$\sin(\gamma - \delta') = 9.94505''$$

$$- \log \gamma = 9.83233''$$

$$\sin(\delta - \delta') = 8.13599$$

$$\delta - \delta' = +47 \quad 00.9''$$

$$\delta = -18 \quad 11 \quad 57.3''$$

$$\alpha = 21 \quad 41 \quad 59.89''$$

$$\text{Airy Eff } \delta = -18^{\circ} \quad 11' \quad 19.6''$$

$$\alpha = 21^{\circ} \quad 41' \quad 59.25''$$

$$O - C = +23$$

$$+0.64''$$

