

KG

11366

v. 929

L III

Plates

2076

2081

2082

Harvard Lunar Plates

Measures and Reductions

Mary Fowler

Volume LIII

Plate No.	Date	Page
2076	1912 Oct 21	1
2081	1912 Oct. 30	10
2082	1912 Oct 30	20

2

 $\frac{1}{10}$
1 $\frac{2}{17}$
24 $\frac{3}{27}$
16

2076	Stars		Lucasmas	1918	December 18.		1
	d	y	n	d	x	w	
1	16446		18480	17490		17254	
10.5	10376	76	14568	13109	10	11611	11
17.6		70	60		02		10
		66	82		86		50
	<u>17.6084</u>		<u>6081</u>	<u>10.5619</u>		<u>5641</u>	
2							
17.3	15460		16888	16319		17660	
28.3	13067	65-	9267	9457	64	14729	10
		61	70		49		20
		68	89		24		57
	<u>28.2398</u>		<u>2380</u>	<u>17.3134</u>		<u>2935</u>	✓
				Should be 2939			
3							
27.8	19256		15090	19258		14445	
16.2	17898	95-	76430	16989	89	6712	13
		89	44		84		09
		40	06		39		59
	<u>16.1360</u>		<u>1340</u>	<u>27.7733</u>		<u>7745</u>	

Grade 3.

2076	Stars		1913 December 18	1
	α	δ	α	δ
1	16446	18450	17490	17254
105	10376	14568	13109	11611
176	70	6057	0210	10
	66	82	86	50
	<u>170084</u>	<u>6081</u>	<u>10.5619</u>	<u>5641</u>
2				
173	15460	16888	16319	17660
287	130676	926770	945764	1472910
	61	70	4960	2020
	68	89	24	57
	<u>282398</u>	<u>2380</u>	<u>17.3134</u>	<u>2939</u>
			should be 2939	
3				
278	19256	15090	19258	14445
162	178989	7645041	1698989	671213
	89	44	84	09
	40	06	39	59
	<u>16.1360</u>	<u>1340</u>	<u>17.7733</u>	<u>7745</u>

Grade 3.

2076 Moon Measures.

2

1
18.0 13212
17.0+ 12848.9
53

1256358
56
12205

possibly on
terminator

17.0359.0354

2

17.6 1330608
17.0 0208
min
13244

13170
1312008
01

16.9939.9940

3

17.0 12286
17.1 1144850
50

1398380
71
13435

17.0837.0843

4

16.0 17531
17.8 935358
73
21

19927
1805375
7364
30

17.8162.8135

5

15.9
18.0

16268
1511014
10
68

15.8843

15270
643324
30
73

8843

6

15.8
19.0
min
16
16

15202
1167055
6158
02

15.6459

16348
987190
8980
56

6471

2

$\frac{1}{180} \quad 13212 \quad 1256358$
 $180 \quad 1284819 \quad 56$
 $170 \quad 53 \quad 12201$

possibly or
termination

1 2 0 3 5 9

0	3	5	4
---	---	---	---

$$\begin{array}{r} 2 \\ 176 \\ 170 \\ \hline 13306 \\ 0208 \\ \hline 13249 \\ 169939 \end{array}$$

3
17.0 1 2 2 8 6 1 3 9 8 3
17.1 1 1 9 4 8 50 7 1
 50 1 3 4 3 5

1 7 0 8 3 7

0	8	4	3
---	---	---	---

$\frac{4}{16.0} \quad 17531 \quad 19927$
 $17.8 \quad 935358 \quad 1805325-$
 $73 \quad 7369$
 $21 \quad 30$
 $17.8162 \quad 8135$

17.8162

8	1	3	5
---	---	---	---

$$\begin{array}{r} 5- \\ \hline 14.9 \\ 18.0 \end{array}$$
$$\begin{array}{r} 16248 \\ 15110 \\ \hline 10 \\ 68 \end{array}$$

158843

1	5	2	7	0	
6	4	3	3	2	4
		3	0		
		7	3		

5 4 3

15.8
19.0

$$\begin{array}{r} 15202 \\ 11670 \\ \hline 6155 \\ 02 \end{array}$$

15.6459

$$\begin{array}{r} 16398 \\ 987190 \\ 8980 \\ 56 \end{array}$$

6471

2076

known-measures

3

2 scratch

15.8	15300	16765	15615	16670
19.6	911918	12969	1334040	8922
	18	5660	36	3024
	90	78	05	66
	<u>19.6176</u>	<u>.6192</u>	<u>15.7726</u>	<u>.7743</u>

8	9955	11658
14.0	942970	5950
20.1	7170	11210

<u>20.0482</u>	<u>.0446</u>
----------------	--------------

9 scratch

16.7	20200	18880	18928	18609
20.5	1418989	1489893	1498985	1260004
	88	8093	89	09
	00	90	20	78
	<u>20.6011</u>	<u>.6060</u>	<u>16.6063</u>	<u>.6070</u>

2076

Hiron - Macanus

3

2 scratch

158	15300	16761	15615	16670
196	91191	12969	13340	8922
	18	5660	3640	3025
	90	78	05	66
	<u>19.6176</u>	<u>.6192</u>	<u>15.7726</u>	<u>.7743</u>

160	9955	11658
W1	947970	5950
	71	11210

<u>20.0482</u>	<u>.0446</u>
----------------	--------------

9 scratch

167	20200	18880	18928	18669
W1	1418987	1489893	14959	1260004
	88	8093	8985	09
	00	90	20	78
	<u>20.6011</u>	<u>.6066</u>	<u>16.6063</u>	<u>.6070</u>

2076

Times etc.

4

Eph to slant 1912 Oct 21 21^h 59^m ✓ -22^m 11^m ✓
 " " Moon 22 04 52.0 -22 04 52.4 ✓
 Clock slow 0 24.4 ✓

H. Sid T. 22 05 16.6 ✓ G-A = -0^m 50^m
~~Sid T. in Moon~~ 44 44 31.0 ✓
 G. Sid T. 26 49 47.6 ✓
 Sid T. in Moon 13 58 14.9 ✓
 Interval 12 51 32.6 ✓
 Reduction 2 06.40 ✓
 G. M. T. 12 49 26.27 ✓

From Kant Alman R. A. - Weel.
 Moon 13^h 22^m 55^m 40.48 -9° 47' 39.8 ✓
 Contin in 1.8216 ✓ 13.731 ✓
 ... -10.5622 ✓ -19.24 ✓ -2 25.0 ✓
 Tabular place 22 55 21.24 -9 50 04.8 ✓

Moon's age 11 days

checked
forward 2^h

934 = 9.35
 8955 = 8.6

... parallax 54' 40.6 ✓
 ... Semidiam 14 55.5 ✓
 R 895.5 ✓
 Augmentation + 8.6 ✓
 Irradiation (3) - 0.7 ✓
 R 903.4 ✓
 R 1.9365 ✓
 (1+a) R 1.9364 ✓
 R² 3.7497 ✓

a = -0.6

2076

Times etc.

9

Exp. R. station	1912 Oct 21	21"	59"	-22"	11"
moon		22	04	52.0	-22 04 52.4
Check star			0	24.4	

H. Sid. T.	22	05	166	G-A = -0'50"
Sid. time	44	44	31.05	
G Sid. T.	26	49	47.65	
Sid. T. in moon	13	58	149.85	
Interval	12	51	32.67	
Reduction		2	06.40	
G in T.	12	49	26.27	

from Kant Atlas.

R. G.

W. G.

moon 13"	22"	55"	40'48"	-9"	47'	39'8"
moon 13"						13.731
-10 5622			-1924		-2	25.0
Tabular place	22	55	21.24	-9	50	048

Moon's age 11 days

parallel	54'	40.6
sinus	14	55.5
R		895.5
Amplitude		+8.6
Irregularity (3)		-0.7
R		903.4
R		1.936.5
11.11 R		1936.4
R		3.749.7

a - 0.6

2076

Plate Constants

5

	1	2	3
x	10.5630	17.2936	27.7739
y	12.7104	19.4022	29.4278
$x-y$	-2.1474	-2.1086	-2.1539
u	17.6082	28.2389	16.1350
v	18.5561	29.2166	17.1411
$u-v$	-9479	-9777	-1.0061

$$\begin{array}{rclcl}
 x-3 & -36.94 & & +0.6x & +2.2118 \\
 -2.1474 & -650 & = & -2.2124 + 6 & = -2.2118 = 0 \\
 -2.1086 & -1042 & = & -2.2128 + 10 & = -2.2118 = 0 \\
 -2.1539 & -595 & = & -2.2134 + 17 & = -2.2117 = +1 \\
 17.5828 & +698 & & +11 & = 19.7257
 \end{array}$$

$$\begin{array}{rclcl}
 u-v & +34.6x & & +6.6y & -2x-3y & +9005 \\
 -9479 & +365 & = & -9114 + 116 & = -8998 -2-5 & = -9005 = 0 \\
 -9777 & +598 & = & -9179 + 186 & = -8993 -3-6 & = -9004 = +1 \\
 -1.0061 & +961 & = & -9100 + 106 & = -8994 -6-5 & = -9005 = 0 \\
 18.9295 & +608 & & +126 & & -4-6 = 19.9024
 \end{array}$$

$$\begin{array}{llll}
 \text{Tables } a = +0.7 & e = -4.3 & a-e = +5.0 & b+a = +2.0 \\
 \text{Obs } a = -0.6 & e = -6.3 & a-e = +5.7 & b+a = +2.5
 \end{array}$$

2076

Plate constants

5

	1	2	3
x	10.5630	17.2936	27.7739
y	12.7104	19.4022	29.9278
$x-3$	-2.1474	-2.1046	-2.1539
y	17.6082	28.2389	16.1350
y	18.5561	29.2166	17.1411
$y-y$	-9479	-9777	-10061

$$\begin{array}{rclcl}
 x-3 & -36.94 & & +0.6x & +2.2118 \\
 -2.1474 & -650 & : & -2.2124 + 6 & : -2.2118 = 0 \\
 -2.1046 & -1042 & : & -2.2124 + 10 & : -2.2118 = 0 \\
 -2.1539 & -595 & : & -2.2134 + 17 & : -2.2117 = +1 \\
 17.5826 & 694 & & +11 & = 19.7259
 \end{array}$$

$$\begin{array}{rclcl}
 y-x & +34.62 & & +6.6y & -22.34 & +9005 \\
 -9479 & +365 & : & -9114 + 116 & : -8998-2-5 & -9005 = 0 \\
 -9777 & +598 & : & -9179 + 186 & : -8993-3-8 & -9004 = +1 \\
 +10061 & +961 & : & -9100 + 106 & : -8994-6-5 & -9005 = 0 \\
 18.9295 & +608 & & +126 & & -4-6 = 19.9024
 \end{array}$$

$$\begin{array}{lclcl}
 \text{Tables } a = +0.7 & a = -4.3 & a = -2 + 5.0 & b + a = +2.0 \\
 \text{Obs } a = 0.6 & a = -6.3 & a = -2 + 5.7 & b + a = +2.5
 \end{array}$$

ph	pos. $\angle$	residual
1	167.6	+157
2	1800	+5
3	1975	-11
4	2349	-24
5	2413	-13
6	2721	+34
7	290.8	-16
8	3051	+36
9	3298	-12

2076

Muvoris Center

6

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$0 - c$
1	18.0000	+0.4180	+4	0.1751	3.7699	+202
2	17.5820	0.0000	+4	0.0000	3.7543	+46
3	17.0000	-0.5820	+4	0.3383	3.7519	+22
4	16.0000	-1.5820	+2	2.5021	3.7480	-17
5	15.8843	-1.6977	+2	2.8815	3.7485	-12
6	15.6465	-1.9355	-0	3.7461	3.7509	+12
7	15.7734	-1.8086	-1	3.2714	3.7447	-50
8	16.0000	-1.5820	-2	2.5033	3.7492	-5
9	16.6066	-0.9754	-3	0.9520	3.7439	-58

Comp. R^2 : 3.7497

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	17.0356	-1.8951	-9	3.5948
2	16.9940	-1.9367	-9	3.7543
3	17.0840	-1.8467	-9	3.4136
4	17.8150	-1.1157	-5	1.2459
5	18.0000	-0.9307	-4	0.8670
6	19.0000	+0.0693	0	0.0048
7	19.6184	+0.6877	+3	0.4733
8	20.0464	+1.1157	+5	1.2459
9	20.6008	+1.6701	+8	2.7919

Alpha Center

$$x = 16.09 = 17.8150$$

$$20.0464$$

$$3.78614$$

$$y_0 = 18.9307$$

$$y - \text{min} = 16.9940$$

$$R = 1.9367$$

$$x - \text{min} = 15.6450$$

$$x_0 = 17.5820$$

$$\text{Center} \begin{cases} x_0 = 17.5820 \\ y_0 = 18.9307 \end{cases}$$

2076

Munroe Center

6

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0) + (y - y_0)$	$0 - c$
1	18.0000	+0.4180	+4	0.1751	3.7699	+202
2	17.5520	0.0000	+4	0.0000	3.7543	+46
3	17.0000	-0.5820	+4	0.3383	3.7519	+22
4	16.0000	-1.5820	+2	2.5021	3.7480	-17
5	15.8843	-1.6977	+2	2.8815	3.7485	-12
6	15.6465	-1.9355	-0	3.7461	3.7509	+12
7	15.7734	-1.8086	-1	3.2714	3.7447	-50
8	16.0000	-1.5820	-2	2.5033	3.7492	-5
9	16.6066	-0.9754	-3	0.9520	3.7439	-58

Comp. 10 3.7497

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	17.0356	-1.8951	-9	3.5948
2	16.9940	-1.9367	-9	3.7543
3	17.0840	-1.8467	-9	3.4136
4	17.8150	-1.1157	-5	1.2459
5	18.0000	-0.9307	-4	0.8670
6	19.0000	+0.0693	0	0.0048
7	19.6184	+0.6877	+3	0.4733
8	20.0464	+1.1157	+5	1.2459
9	20.6008	+1.6701	+8	2.7919

Alpha Center

$$x = 16.09 + 17.8150$$

$$20.0464$$

$$37.8614$$

$$y_0 = 18.9307$$

$$y = 16.9940$$

$$19.367$$

$$x = 15.6453$$

$$x_0 = 17.5820$$

$$\text{Center } \left\{ \begin{array}{l} X = 17.5820 \\ Y = 18.9307 \end{array} \right.$$

Formation of Novae

row	cl	ac	bn
1	- 0.20	+ 21.2	- 96.0
2	- 0.00	+ 0.0	- 89.4
3	+ 1.07	- 12.8	- 40.7
4	+ 1.82	+ 26.7	+ 19.8
5	+ 1.58	+ 20.4	+ 11.2
6	- 0.14	- 23.3	+ 0.8
7	- 1.25	+ 90.5	- 34.5
8	- 1.42	+ 7.9	- 5.8
9	- 1.64	+ 56.9	- 97.0
	- 0.58	+ 187.5	- 331.6
	- 0.20	+ 21.2	- 96.0
	- 0.78	+ 208.7	- 427.6

2076 Moon - ~~transverse~~ Center
Conditional Equations

7

	a	b	c	c	0 - c
1	+ 0.42	- 1.90	= + 202	+ 5 + 40 = + 45	+ 157
2	0.00	- 1.94	= + 46	0 + 41 = + 41	+ 5
3	- 0.58	- 1.85	= + 22	- 6 + 39 = + 33	- 11
4	- 1.58	- 1.16	= - 17	- 17 + 24 = + 7	- 24
5	- 1.70	- 0.93	= - 12	- 18 + 19 = + 1	- 13
6	- 1.94	+ 0.07	= + 12	- 21 - 1 = - 22	+ 34
7	- 1.81	+ 0.69	= - 50	- 20 - 19 = - 39	- 16
8	- 1.58	+ 1.16	= - 5	- 17 - 24 = - 41	+ 36
9	- 0.98	+ 1.67	= - 58	- 11 - 35 = - 46	- 12
				Average	34

Normal Equations

$$\begin{aligned}
 +16.28 - 0.58 &= +188 \\
 -0.58 + 15.59 &= -332 \\
 +0.58 - 0.02 &= +7 \\
 +15.57 &= -325 \\
 +16.28a + 188 - 12 &= +176
 \end{aligned}$$

$$\begin{aligned}
 b &= -20.9 \\
 a &= +10.8
 \end{aligned}$$

giving (1) full wt.

$$\begin{aligned}
 +16.37 - 0.78 &= +209 \\
 -0.78 + 17.39 &= -428 \\
 +0.78 - 0.04 &= +10 \\
 +17.35 &= -418
 \end{aligned}$$

$$b = -24.1$$

$$+16.37a = +209 - 19 = +190$$

$$a = +11.6$$

2076 ~~known~~ ~~known~~ ~~known~~ Center

7

Conditional Equations

	a	b	c	0	c	0-c
1	+0.42	-1.90	:	+2.02	+5 + 40 = +45	+157
2	0.00	-1.94	:	+4.6	0 + 41 = +41	+5
3	-0.58	-1.81	:	+2.2	-6 + 39 = +33	-11
4	-1.18	-1.16	:	-1.7	-17 + 29 = +12	-24
5	-1.70	-0.93	:	-1.2	-18 + 19 = +1	-13
6	-1.94	+0.07	:	+1.2	-21 - 1 = -22	+34
7	-1.81	+0.64	:	-1.0	-20 - 14 = -34	-16
8	-1.58	+1.16	:	-1.5	-17 - 24 = -41	+36
9	-0.98	+1.67	:	-1.8	-11 - 35 = -46	-12
Average:						39

Normal Equations

$$\begin{aligned}
 +16.28 - 0.58 &= +188 \\
 -0.58 + 15.59 &= 332 \\
 +0.58 - 0.02 &= +7 \\
 +15.57 &= 325 \\
 +16.28a + 188b + 12c &= 176
 \end{aligned}$$

$$b = -20.9$$

$$a = +10.8$$

Giving (1) full wt

$$\begin{aligned}
 +16.37 - 0.78 &= +209 \\
 -0.78 + 17.39 &= -428
 \end{aligned}$$

$$\begin{aligned}
 +0.78 - 0.04 &= +10 \\
 +17.35 &= -418
 \end{aligned}$$

$$b = -24.1$$

$$+16.37a + 209b - 19c = 190$$

$$a = +11.6$$

Red. ad E. app.

$$\begin{aligned}
 H + \alpha_0 & \quad 254 = 43^\circ 30' \\
 H & \quad 53 \quad 58 \\
 \alpha_0 & = 22 \quad 56 \\
 G & \quad 21 \quad 48 \\
 G + \alpha_0 & \quad 20 \quad 44 = 311^\circ
 \end{aligned}$$

$$S = -10^\circ 34'$$

$$\begin{aligned}
 \log i & = 0.8551 \\
 \log S & = 9.9926 \\
 \hline
 \therefore (i) & \quad 0.8477
 \end{aligned}$$

$$\begin{aligned}
 \log \cos(G + \alpha_0) & = 9.8169 \\
 q & = 1.2343 \\
 \therefore \sin(G + \alpha_0) & = 9.8778 \\
 \therefore \tan S & = 9.2704 \\
 \therefore \frac{1}{\tan} & = 8.8239
 \end{aligned}$$

$$\begin{aligned}
 \log \sin S & = 9.2630 \\
 \therefore \cos(H + \alpha_0) & = 9.8606 \\
 \therefore h & = 1.2827 \\
 \therefore \sin(H + \alpha_0) & = 9.8378 \\
 \therefore \sec S & = 0.0074 \\
 \therefore \frac{1}{\sec} & = 8.8239
 \end{aligned}$$

$$\begin{aligned}
 \log(g') & = 1.0512 \\
 \therefore (g) & = 9.2064
 \end{aligned}$$

$$\begin{aligned}
 \log(h') & = 0.4063 \\
 \therefore (h) & = 9.9518
 \end{aligned}$$

$$\begin{array}{r}
 b \\
 (g) \\
 (h) \\
 \hline
 + 2.20 \\
 + 0.16 \\
 + 0.90 \\
 \hline
 7326
 \end{array}$$

$$\begin{array}{r}
 (g') \\
 (h') \\
 (i) \\
 \hline
 + 11.25 \\
 - 2.55 \\
 + 7.04 \\
 \hline
 + 15.74
 \end{array}$$

2076 Moon's Mean Position (1912.0)

$$\begin{array}{rcl}
 X_0 = 17.5820^\circ & Y_0 = 18.9307^\circ & \\
 \frac{1}{2}a = +6^\circ & \frac{1}{2}b = -12^\circ & \\
 \hline
 17.5826^\circ & 18.9295^\circ &
 \end{array}$$

From Plate Constants $X = 19.7257^\circ$ $Y = 19.9024^\circ$

$$S = +1.7257^\circ$$

$$\eta = -2.0976^\circ$$

$$\log 3 = 0.23694^\circ$$

$$\log \tan S = 7.0534^\circ$$

$$\dots \text{w.s.} = 9.99258^\circ$$

$$\dots S = 0.4739^\circ$$

$$\dots \text{const.} = 8.50724^\circ$$

$$\dots \eta_1 = 6.7953^\circ$$

$$-(K-A) = 1.73714^\circ$$

$$\eta_1 = -6^\circ$$

$$K-A + 54.59^\circ$$

$$\eta_0 = -2.0970^\circ$$

$$A = 22 \ 55 \ 00^\circ$$

$$\log \eta_0 = 0.32160^\circ$$

$$\alpha_0 = 22 \ 55 \ 59.59^\circ$$

$$\dots (\eta - \eta_0) = 2.99045^\circ$$

$$\text{Red. add. ahh} + 3.26^\circ$$

$$S D = -16 \ 18.2^\circ$$

$$V' = 22 \ 55 \ 57.85^\circ$$

$$D = -10 \ 17 \ 14^\circ$$

$$\delta_0 = -10 \ 33 \ 32.2^\circ$$

$$\text{Red. add. ahh.} + 15.7^\circ$$

$$\delta' = -10 \ 33 \ 16.5^\circ$$

2076 hours mean Position (1912.0)

8

$$\begin{array}{rcl}
 X_0 & = & 17.5820 \\
 \frac{1}{2} \Delta & = & +5 \\
 \hline
 & = & 17.5825
 \end{array}
 \qquad
 \begin{array}{rcl}
 Y_0 & = & 18.9307 \\
 \frac{1}{2} \Delta & = & -10 \\
 \hline
 & = & 18.9297
 \end{array}$$

From Plate Constant $X = 19.7256$ $Y = 19.9026$

$$S = +1.7256$$

$$q = -2.0974$$

$$\log 3 = 0.23694$$

$$\log 5 = 0.4739$$

$$\log 8 = 0.7224$$

$$\log 10 = 0.92680$$

$$S = 0.4739$$

$$m_1 = 6.7953$$

$$(X-A) = 17.3712$$

$$m_2 = -6$$

$$X-A = +54.59$$

$$m_3 = +2.0968$$

$$A = 22.55.00$$

$$\log m_0 = 0.32116$$

$$7.33115$$

$$\alpha_0 = 22.55.59.59$$

$$((+1)) = 2.99041$$

$$\text{Read and add} = +326$$

$$S-D = -16.182$$

$$Y' = 22.55.57.85$$

$$D = -10.17.14$$

$$S' = -10.33.32.2$$

$$\text{Read and add} = +15.7$$

$$S' = -10.33.16.5$$

2076 Lunar parallax

$$\alpha' = 22^{\text{h}} 55^{\text{m}} 57.85^{\text{s}}$$

$$\delta = 22^{\circ} 05' 16.6''$$

$$G - \alpha = -0^{\text{h}} 50^{\text{m}} 41.2^{\text{s}}$$

$$= -12^{\circ} 40' 28''$$

$$- 4^{\text{h}} 30^{\text{m}}$$

$$- 12^{\circ} 35' 50''$$

$$9.95727^{\text{v}}$$

$$0.00000^{\text{v}}$$

$$001059^{\text{v}}$$

$$996786^{\text{v}}$$

$$\gamma = 42^{\circ} 52' 55.2''$$

$$- 10^{\circ} 33' 16.5''$$

$$53^{\circ} 26' 11.7''$$

$$9.82640^{\text{v}}$$

$$8.20151^{\text{v}}$$

$$9.90482^{\text{v}}$$

$$0.16718^{\text{v}}$$

$$8.09991^{\text{v}}$$

$$+ 43^{\circ} 16.2''$$

$$\delta = -9^{\circ} 50' 00.3''$$

$$\text{Ann. Eph. } \delta = -9^{\circ} 50' 04.8''$$

$$+ 4.5''$$

$$\delta' = -10^{\circ} 33' 16.5'' \quad 9$$

$$\Gamma = 54' 40.6''$$

$$9.86913^{\text{v}}$$

$$8.20151^{\text{v}}$$

$$9.34119^{\text{v}}$$

$$000643^{\text{v}}$$

$$\sin(\alpha - \alpha') \quad 7.41824^{\text{v}}$$

$$\alpha - \alpha' = -9' 00.34''$$

$$= -36.02''$$

$$\alpha = 22^{\text{h}} 55^{\text{m}} 21.83^{\text{s}}$$

$$\alpha = 22^{\text{h}} 55^{\text{m}} 21.24^{\text{s}}$$

$$+ 0.59''$$

2076 *hannan parallax* $\alpha = 22^{\circ} 55' 57.85''$ $\delta = 22^{\circ} 05' 16.6''$ $\mu_{\alpha} = -0.50 \quad 41.2$ $\mu_{\delta} = 12'' 40' 20''$ $\pi = 9.30$ $\rho = 12.35 \quad 50$

995727

000000

001059

996786

 $\gamma = 42.52 \quad 55.2$ $\delta = 10.33 \quad 16.5$

53.26 117

9.82640

820151

990482

0.16718

8.09991

 $\tau = 93.16.2$ $\delta = -9.50 \quad 00.3$ *Am. Eph.* $\delta = -9.50 \quad 04.8$ $+ 4.5''$ $\delta = -10^{\circ} 33' 16.5''$ $\mu_{\alpha} = 54' 40.6''$

9.86913

820151

9.34119

000643 $\sin(\alpha - \alpha') = 7.41826$ $\alpha - \alpha' = -9' 00.36$ $= -36^{\circ} 02'$ $\alpha = 22.55 \quad 21.83$ $\alpha = 22.55 \quad 21.24$ $+ 0.59$

2081 Stars - measure

1913 Dec. 20.

	d	W	d	W
1	20015	16065	19875	15925
12	18170	7886	11910	13879
153	60	9685	1109	8075
	06	65	70	25
	<u>15.1846</u>	<u>1824</u>	<u>12.2039</u>	<u>2047</u>
2				
23.2	13737	8770	19259	14225
231	13040	6865	11189	12275
	48	8089	82	70
			54	15
	<u>23.0693</u>	<u>0684</u>	<u>23.1930</u>	<u>1950</u>
3				
30.1	1265139	11711	18235	16538
129	4239	11508	9421	15311
	12442	0104	21	10
			00	44
	<u>12.9799</u>	<u>9793</u>	<u>30.1218</u>	<u>1228</u>

Grade 3 or 2.

16.5	14331	19220	14505	19181
32.2	12850	10675	9690	13950
	1070	6973	9700	4453
	30	00	01	69
	<u>32.1479</u>	<u>1469</u>	<u>16.5193</u>	<u>5221</u>

2081

Stars - measure

1913 Dec. 20.

	α	δ	μ
1	20015	16065	
12	1817070	78865	
13	60	9090	
	06	65	
	<u>15.1846</u>	<u>1824</u>	

α	δ	μ
19875	15925	
11910	1387975	
1109	8075	
70	25	
<u>12.2039</u>	<u>2047</u>	

α	δ	μ
23213737	87706	
2311304044	6860	
48	8089	
<u>23.0693</u>	<u>0684</u>	

α	δ	μ
19259	14225	
1118985	1227574	
82	70	
54	15	
<u>23.1930</u>	<u>11950</u>	

α	δ	μ
3011265139	11711	
1794239	1150804	
12442	01	
<u>12.9799</u>	<u>9793</u>	

α	δ	μ
18235	16538	
942123	153111	
21	10	
00	44	
<u>30.1218</u>	<u>1228</u>	

Grade 3 or 2.

α	δ	μ
16514331	19220	
5221285055	1007573	
50	69	
30	00	
<u>32.1479</u>	<u>1469</u>	

α	δ	μ
19505	19151	
969000	1395053	
97	44	
01	69	
<u>165193</u>	<u>5221</u>	

2081

moon-measures

11

d 4 n d x w

1

min in γ = about 16.4120

1	15109	15942
19.0	7278	1378080
16.7	76	80
	97	38
	<u>16.7825</u>	<u>7839</u>

2

19.3	8
17.0	

16065	17050
875069	1431002
6863	10
57	38
<u>19.2704</u>	<u>.2738</u>

3

19.8
18.0

19054	18144
1746272	973030
70	3030
52	38
<u>19.8414</u>	<u>.8409</u>

4

19.9
18.5
max
in
x

19035	18211
1806065	917880
5069	61
21	12
<u>19.9027</u>	<u>.9039</u>

5

19.8
19.0

18035	19269
1647780	1083022
20	29
	68
<u>19.8447</u>	<u>.8441</u>

2081

moon: line answer

11

d 4 n d $2L$ w
 1
 min in y : about 16.4120.

1	15109	15942
190	7278	1378080
167	7673	80
	97	38
	<u>107823</u>	<u>7839</u>

16065	17050
875069	1431502
6863	10
57	38
<u>192704</u>	<u>2738</u>

19054	18144
1746272	973030
70	30
52	38
<u>198414</u>	<u>8409</u>

19035	18211
1806065	917850
5069	61
21	12
<u>199027</u>	<u>9039</u>

18035	19269
1647780	1083022
20	29
	68
<u>198947</u>	<u>8441</u>

2
 193
 170

3
 198
 180

4
 199
 185
 moon
 w
 v

5
 198
 190

2081

moon measures

12

$$\begin{array}{r} 6 \\ 19.3 \\ 20.0 \end{array}$$
 α

4

 n d n

16970

19400

9679

16690

70

9399

70

80

19.2703.2701

$$\begin{array}{r} 7 \\ 19.0 \\ 20.2 \end{array}$$

16249

19935

1399602

1215960

91

60

34

30

20.2250.2229

8 Scratch

18.2

15925

15704

17165

15841

20.4

10650

1096055

1061010

1241010

45

50

09

08

20

95

60

37

20.5275.525528.3449.3431

2081

moon measures

12

$$\begin{array}{r} 6 \\ 19.3 \\ 20.0 \end{array}$$

a

u

r

a

u

16970

19400

967969

1669099

70

93

70

80

19.27032701

7

19.0

16249

19935

20.2

1399602

1215960

91

60

34

30

20.22502229

8 Scratch

182

15925

15704

17165

11841

20.4

10650.50

10960.55

10610.10

12410.10

45

50

09

08

20

95

60

37

20.5275525518.34493431

2081

Times etc.

Ephemeris	1912 Oct 30	3 ^m	41 ^m	✓	-3 ^m	✓	53 ^m	✓
" - Moon		3	47		22.7 ^s	3	47	23.1 ^s
clock slow			0		16.1 ^s			
H Sid T.		3	47		39.0 ^s		6 - 12 - 3 ^m	09 ^m ✓
A Sid		4	44		31.0 ^s			
P Sid T.		8	32		10.0 ^s			
Sid T. in Moon		14	33		43.9 ^s			
Interval		17	58		26.0 ^s			
Red			2		56.6 ^s			
G.M.T.		17	55		29.3 ^s			

Sun haut. Alm

Moon 18^m

Moon in 2 6322 ✓

-4.5102 ✓

R.A

Decl.

6 56 32.98 ✓ + 28° 04' 09.0 ✓

3.429 ✓

- 11.87 ✓

+ 15.5 ✓

Tabular place

6 56 21.11 ✓ + 28 04 24.5 ✓

Moon's age 21 days

" parallel

58' 53.3 ✓

" semidiam

16' 04.3 ✓

R 39 = +12.0 ✓

P 64 = +12.8 ✓

R

964.3 ✓

Augmentation

+ 12.8 ✓

Irradiation 2

- 0.6 ✓

R

976.5 ✓

R

20932 ✓

a = -5.6

(1 + a) R

20921 ✓

P²

43769 ✓

2081. Tunnies etc.

Exhibition 1912 Oct 30	3"	41"		-3"	53"
known	3	47	22.7	-3	47 231
clockwise		0	1.61		
N. L. 11.1"	3	47	39.0		0-X = +3" 09"
+ known	4	44	31.05		
P. S. 11.1"	8	32	10.05		
Self to known	14	33	43.98		
Interval	17	58	26.07		
Red		2	56.68		
G. H. T.	17	55	29.39		

Brickhampton Cline			K. C.		Red
known 18"	6	56	32.98	+28"	04' 09"
known 26322	-		3.429		
-4.5102	-		11.87	+	15.5
Tubular plane	6	56	21.11	+28"	04' 24.5

Known age 21 days.

... parallel		58'	53'3"
... perpendicular		16'	04'3"
8.29 = +12.0	R		964.3
8.29 = +12.8			+12.8
Amplification			-0.6
Amplification 2	R		976.5
	R		20932
a = -5.6	11.2/11		20921
	P		43769

20
165207

4
321474

2081

Rate Constants.

14

α	γ	$R.A.$	$Decl.$
12.2043 [✓]	15.1835 [✓]	6 55 29	+27 16 49
23.1940 [✓]	23.0688 [✓]	7 01 54	28 18 47
30.1223 [✓]	12.9796 [✓]	7 05 56	27 00 07
3 65.52	51.23	21 01 13.9	182 34 10.3
21.84	17.08	7 01 06	27 31 54
-1.8	-2.2	-2 04	+38 12
3.84	4.92	6 59 02	28 09 66
31	466.5		
124 ^s	2292 ["]		

$$A = 6^h 59^m 02^s$$

$$D = +28^\circ 40' 06''$$

$$\begin{aligned}
 &2-3 \quad -644 \quad +56x \quad -2x-14 \quad -1994 \\
 &+2902 - 1972 = +1930 + 68 = +1998 - 2 - 2 = +1994 = 0 \\
 &+3299 - 1476 = +1823 + 130 = +1953 - 5 - 2 = +1946 = \\
 &+2663 - 831 = +1832 + 169 = +2001 - 6 - 1 = +1994 = 0 \\
 &+3965 - 2057 = +1908 + 193 = +2001 - 3 - 3 = +1995 = +1 \\
 &17.8102[✓] - 1184[✓] \quad +101[✓] \quad -4-2 = 17.5019[✓]
 \end{aligned}$$

$$\begin{aligned}
 &4-m \quad +64.2x \quad +2.84 \quad -988 \\
 &+161 + 784 = +945 + 42 = +987 = -1 \\
 &-624 + 1489 = +865 + 65 = +930 = \text{reject} \\
 &-981 + 1934 = +953 + 36 = +989 = +1 \\
 &-163 + 1061 = +898 + 90 = +988 = 0 \\
 &18.5035[✓] + 1143[✓] \quad +52[✓] \quad = 18.5242[✓]
 \end{aligned}$$

$$\begin{aligned}
 \text{Tables } a &= -2.4 & a &= -1.8 & a - a &= -0.6 & b + a &= +2.0 \\
 \text{Obs } a &= -5.6 & a &= -2.8 & a - a &= -2.8 & b + a &= -0.2
 \end{aligned}$$

2081

Rate Constant

14

x	y	$R.A$	$Wad.$
11.2043	15.1835	6 55 29	+27 16 49
23.1940	23.0688	7 01 59	28 18 47
30.1223	12.9796	7 05 56	27 05 03
65.52	51.23	21 01 13.9	152 34 10.3
21.84	17.08	7 01 06	27 31 54
18	22	1 - 2 09	+38 12
384	4.92	6 59 02	28 09 66
31	466.5		
124 ³	2292 ³		

$$A = 6^h 59^m 02^s$$

$$D = +28^\circ 10' 06''$$

$$\begin{aligned}
 & x - z = -0.44 \\
 & +2902 - 1972 = +1930 + 68 = +1998 - 2 - 2 = +1994 = 0 \\
 & +3299 - 1476 = +1823 + 130 = +1953 - 5 - 2 = +1946 = 0 \\
 & +2663 - 831 = +1832 + 169 = +2001 - 6 - 1 = +1994 = 0 \\
 & +3965 + 2057 = +1908 + 193 = +2007 - 3 - 3 = +1995 = 0 \\
 & 17.8102 + 1189 \quad +101 \quad -4 - 2 = 17.5019
 \end{aligned}$$

$$\begin{aligned}
 & y - x = +6428 \quad +284 \quad -988 \\
 & +161 + 784 = +945 + 42 = +987 = -1 \\
 & -624 + 1489 = +865 + 65 = +930 = \text{neglect} \\
 & -981 + 1934 = +953 + 36 = +989 = +1 \\
 & -163 + 1061 = +898 + 90 = +988 = 0 \\
 & 18.5035 + 1143 \quad +52 \quad = 18.5242
 \end{aligned}$$

$$\begin{aligned}
 \text{Tables } a = -2.4 \quad a = -1.8 \quad a = -0.6 \quad b + a = +2.4 \\
 \text{Obs } a = -5.6 \quad a = -2.8 \quad a = -2.8 \quad b + a = -0.2
 \end{aligned}$$

Cape W. 1009 mag 5.9

C 6 57 09.18

22

19

6 57 09.20

+ 45.80

6 57 55.00

6 59 02

- 1 07.00

- 67.00

1.82607m

9.93975

0.27306m

- 1.8753

- 5

3 16.1242

2 16.5207

2-8 + 3965

+ 29 30 15.1

14.1

14.9

+ 29 30 14.7

- 1 09.3

S = + 29 29 05.4

+ 28 10 06

+ 1 18 59.4

+ 47 40.2

3.67580

1.00695

9.7524

0.5461

7.3519

+ 10.1614

+ 27

32.1637

32.1474

- 1.63

2081

Standard Coordinates

15

Cape W. 1002 mag 7.2				Cape W. 1015 mag 6.2				Cape W. 1022 mag 5.6			
C	6 ^h	54 ^m	44 ^s 17 ^v	7 ^h	01 ^m	08 ^s 63 ^v		7 ^h	05 ^m	10 ^s 98 ^v	
L			21			62				11.05	
B			16 ^v			62				10.95	
Mean	6	54	44 18	7	01	08.62		7	05	10.99	
Prece			+ 44.90 ^v			+ 45.20 ^v				+ 44.69 ^v	
δ	6	55	29 08 ^v	7	01	53.82 ^v		7	05	55.68 ^v	
A	6	59	02	6	59	02		6	59	02	
$\delta - A$	-3	32	92 ^v	+	2	51.82 ^v		+	6	53.68 ^v	
$\sin(\delta - A)$	-21	29	1 ^v	+	17	1.82 ^v		+	41	3.62 ^v	
log.			2.32820 ^v			2.23507 ^v				2.61660 ^v	
cos			9.94879 ^v			9.94466 ^v				9.94987 ^v	
-3			0.78423 ^v			0.68697 ^v				1.07371 ^v	
δ_0	-6.08	46 ^v		+	4.86	38 ^v		+	11.89	97 ^v	
δ_1	-	13 ^v		+		3 ^v		+		63 ^v	
δ_2	11.91	41 ^v		22.86	41 ^v			29.85	60 ^v		
δ_3	12.20	43 ^v		23.19	40 ^v			30.12	23 ^v		
$\delta - \delta_3$	+	29	02 ^v	+	32	99 ^v		+	26	63 ^v	
C	+27°	17'	46".1 ^v	+28°	19'	50".7 ^v		+27°	01'	15".1 ^v	
L			46.4 ^v			50.1 ^v				14.6 ^v	
B			46.2 ^v			51.6 ^v				15.2 ^v	
Mean	+27	17	46.2 ^v	+28	19	50.8 ^v		+27	01	15.0 ^v	
Prece	-		57.3 ^v	-	1	03.8 ^v		-	1	08.4 ^v	
δ	+27	16	48.9 ^v	+28	18	47.0 ^v		+27	00	06.6 ^v	
D	+28	10	06 ^v	+28	10	06 ^v		+28	10	06 ^v	
$\delta - D$	-53	17	1 ^v	+	8	41.0 ^v		-	1	09	59.4 ^v
$\tan(\delta - D)$	-31	97	4 ^v	+	52	1.0 ^v		-	42	00.0 ^v	
log.			3.50480 ^v			2.71684 ^v				3.62325 ^v	
-20			0.83595 ^v			0.04799 ^v				0.95440 ^v	
tan			9.7124 ^v			9.7314 ^v				9.7072 ^v	
δ_2			1.5685 ^v			1.3739 ^v				2.1474 ^v	
δ_1			8.3343 ^v			8.1587 ^v				8.9080 ^v	
δ_0	-6.85	47 ^v		+	1.11	68 ^v		-9.00	32 ^v		
δ_1	+	21	6 ^v	+		144 ^v		+		809 ^v	
δ_2	15.16	74 ^v		23.13	12 ^v			13.97	77 ^v		
δ_3	15.18	35 ^v		23.06	88 ^v			12.97	96 ^v		
$\delta - \delta_3$	+	16	4 ^v	-	62	4 ^v		+	98	1 ^v	

2051

Standard Crown diamonds

15

Cape W. 1002 mag 7.2 Cape W. 1015 mag 6.2 Cape W. 1022 mag 5.6

C	6"	54"	44.17"	7"	01"	08.63"	7"	05"	10.98"
L		21			62			11.05"	
E		16			62			10.95"	
mean	6	54	44.18"	7	01	08.62"	7	05	10.99"
Prece			+ 44.90"			+ 45.20"			+ 44.69"
x	6	55	29.08"	7	01	53.82"	7	05	55.68"
A	6	59	02	6	59	02	6	59	02
x-A		-3	32.92"		+2	51.82"		+6	53.68"
tan(x-A)			-21.291"			+171.82"			+413.62"
log			2.32820"			2.23507"			2.61660"
cos			9.94879"			9.94466"			9.94987"
S			0.78423"			0.68697"			1.07371"
S ₀			-6.0846"			+4.8638"			+11.8997"
S ₁			-1.5"			3"			63"
S			11.9148"			22.8641"			29.8560"
x			12.2043"			23.1940"			30.1223"
x-S			+29.02"			+32.99"			+26.63"
C	+27°	17'	46.1"	+28°	19'	50.7"	+27°	01'	15.1"
L			46.4			50.1			14.6
E			46.2			51.6			15.2
mean	+27	17	46.2"	+28	19	50.8"	+27	01	15.0"
Prece			-57.3"			-1.03.8"			-1.08.9"
S	+27	16	48.9"	+28	18	47.0"	+27	00	06.6"
D	+28	10	06	+28	10	06	+28	10	06
S ₀			-53.17.1"			+8.41.0"			-1.09.59.4"
tan(S ₀ -D)			-319.74"			+521.0"			-920.00"
log			3.50480"			2.71684"			3.62325"
cos			0.83595"			0.04799"			0.95440"
tan			4.7124"			9.7314"			9.7072"
S ₁			1.5685"			1.3739"			2.1474"
S ₂			8.3343"			8.1587"			8.9080"
S ₃			-6.8548"			+1.1168"			-9.0032"
S ₄			+2.16"			+1.44"			+8.09"
S ₅			1.5167"			2.31312"			1.39777"
S ₆			1.51835"			2.30688"			12.9796"
S ₇			+1.60"			-6.24"			+9.81"

pt.	pos. α	resid.
1	14 50.4	-14
2	13 5.7	-77
3	10 4.0	+19
4	9 0.0	+42
5	7 6.2	+71
6	4 4.2	-71
7	3 4.6	-27
8	1 4.8	-5

2081

Moon's Center

16

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$O - C$
1	19.00000	+1.1880	+3	1.4120	4.3728	- 41
2	19.2721	+1.4601	+3	2.1037	4.3654	- 115
3	19.8412	+2.0292	+1	4.1180	4.3720	- 49
4	19.9033	+2.0913	0	4.3736	4.3736	- 33
5	19.8444	+2.0324	-1	4.1302	4.3762	- 7
6	19.2702	+1.4582	-3	2.1255	4.3632	- 137
7	19.0000	+1.1880	-3	1.4106	4.3683	- 86
8	18.3440	+0.5320	-4	0.2826	4.3723	- 46

Comp $K^2 = 4.3769$

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	16.7831	-1.7209	+2	2.9608
2	17.0000	-1.5040	+1	2.2617
3	18.0000	-0.5040	0	0.2540
4	18.5040	0.0000	0	0.0000
5	19.0000	+0.4960	0	0.2460
6	20.0000	+1.4960	-1	2.2377
7	20.2240	+1.7200	-2	2.9577
8	20.5265	+2.0225	-2	4.0897

After Center

$$\begin{aligned}
 x &= 19.0 & y &= 16.7831 \\
 & & & \underline{20.2240} \\
 & & & 37.0071 \\
 y_0 &= 18.5036 \\
 y - \text{min} &= 16.4120 \\
 R &= 20916 \\
 x - \text{max} &= 19.9033 \\
 x_0 &= 17.8117
 \end{aligned}$$

$$\text{Center } \begin{cases} x_0 = 17.8120 \\ y_0 = 18.5040 \end{cases}$$

2081

Moor's Center

16

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$O - C$
1	19.00000	+1.1880	+3	1.4120	4.3728	+ 47
2	19.2721	+1.4601	+3	2.1037	4.3654	- 115
3	19.8412	+2.0292	+1	4.1180	4.3720	- 49
4	19.9033	+2.0913	0	4.3736	4.3736	- 33
5	19.8444	+2.0324	-1	4.1302	4.3762	- 7
6	19.2702	+1.4582	-3	2.1255	4.3632	- 137
7	19.0000	+1.1880	-3	1.4106	4.3683	- 86
8	18.3440	+0.5320	-4	0.2826	4.3723	- 46

Comp. K^2 : 4.3769

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	16.7831	-1.7209	+2	2.9608
2	17.0000	-1.5040	+1	2.2617
3	18.0000	-0.5040	0	0.2540
4	18.5040	0.0000	0	0.0000
5	19.0000	+0.4960	0	0.2460
6	20.0000	+1.4960	-1	2.2377
7	20.2240	+1.7200	-2	2.9577
8	20.5265	+2.0225	-2	4.0897

Upper Center

$$\begin{aligned}
 x &= 19.0 & y &= 16.7831 \\
 & & & \underline{20.2240} \\
 & & & 37.0071 \\
 y_0 &= 18.5036 \\
 y - \text{min} &= 16.4120 \\
 R &= 2.0916 \\
 x - \text{max} &= 19.9033 \\
 x_0 &= 17.8117
 \end{aligned}$$

$$\begin{aligned}
 \text{Center} \left\{ \begin{aligned} x_0 &= 17.8120 \\ y_0 &= 18.5040 \end{aligned} \right.
 \end{aligned}$$

Formation of moments

	ab	an	b	bu
1	- 2.04	- 48.9	+ 70.5	
2	- 2.19	- 168.0	+ 172.5	
3	- 1.02	- 99.5	+ 24.5	
4	+ 0.00	- 69.0	- 0.0	
5	+ 1.02	- 14.2	- 3.5	
6	+ 2.19	- 200.0	- 205.5	
7	+ 2.04	- 102.2	- 148.0	
8	+ 1.07	- 24.4	- 93.0	
	+ 1.07	- 726.2	- 182.5	

2081

Moon's Center

17

Conditional Equations

	a	b	0	c	0-c
1	+1.19	-1.72	= -41	-43 + 16 = -27	-14
2	+1.46	-1.50	= -115	-52 + 14 = -38	-77
3	+2.03	-0.50	= -49	-73 + 5 = -68	+19
4	+2.09	+0.00	= -33	-75 - 0 = -75	+42
5	+2.03	+0.50	= -7	-73 - 5 = -78	+71
6	+1.46	+1.50	= -137	-52 - 14 = -66	-71
7	+1.19	+1.72	= -86	-43 - 16 = -59	-27
8	+0.53	+2.02	= -46	-19 - 19 = -38	-8

Average: 41

Normal Equations

$$\begin{aligned}
 +19.96 + 1.07 &= -726 \\
 + 1.07 + 15.01 &= -182 \\
 - 1.07 - 0.06 &= +39 \\
 + 14.95 &= -143
 \end{aligned}$$

$$b = -9.6$$

$$+19.96 = -726 + 10 = -716$$

$$a = -35.9$$

2081

Innova's Center

17

Conditional Equations

	a	b	c	0	c	0 - c
1	+1.19	-1.72	-41	-43 + 16	-27	-14
2	+1.46	-1.50	-115	-52 + 14	-38	-77
3	+2.03	-0.50	-49	-73 + 5	-68	+19
4	+2.04	+0.00	-33	-75 - 0	-75	+42
5	+2.03	+0.50	-7	-73 - 5	-78	-71
6	+1.46	+1.50	-137	-52 - 14	-66	-71
7	+1.19	+1.72	-86	-43 - 16	-59	-27
8	+0.53	+2.02	-46	-19 - 19	-38	-8

Average = 41

Normal Equations

$$+19.96 + 1.07 = -726$$

$$+ 1.07 + 15.01 = -182$$

$$- 1.07 - 0.06 = + 39$$

$$+ 14.95 = -143$$

$$b = -9.6$$

$$+19.96 = -726 + 10 = -716$$

$$a = -35.9$$

2081 Lirionis Mean Position (1912.0)

$$\begin{array}{rcl}
 X_0 & = & 17.8120^{\circ} \\
 Y_0 & = & 18.5040^{\circ} \\
 \text{ra} & = & -18^{\circ} \\
 \text{dec} & = & 5^{\circ} \\
 \hline
 X & = & 17.8102^{\circ} \\
 Y & = & 18.5035^{\circ}
 \end{array}$$

From Plate Constant $X = 17.5019^{\circ}$ $Y = 18.5242^{\circ}$

$$Z = -0.4981^{\circ}$$

$$\eta = -34758^{\circ}$$

$$\begin{array}{r}
 \log 3 = 9.69732^{\circ} \\
 9.94706^{\circ} \\
 \hline
 8.50724^{\circ}
 \end{array}$$

$$\begin{array}{r}
 \log \tan S = 9.7211 \\
 9.3946 \\
 \hline
 \eta_1 = 6.1691
 \end{array}$$

$$(X-A) = 124302^{\circ}$$

$$\eta_1 = +1$$

$$X-A = 17.50^{\circ}$$

$$\eta_0 = -3.4759^{\circ}$$

$$A = 65902^{\circ}$$

$$\begin{array}{r}
 \log = 0.54107^{\circ} \\
 7.33115^{\circ}
 \end{array}$$

$$X_0 = 65844.50^{\circ}$$

$$(S-D) = 320992^{\circ}$$

$$\text{Red} = +3.47^{\circ}$$

$$S-D = -2701.5^{\circ}$$

$$\alpha' = 65847.97^{\circ}$$

$$D = +281006^{\circ}$$

$$S_0 = +27^{\circ}43'04.5''$$

$$\text{Red} = +2.5^{\circ}$$

$$\delta' = +27^{\circ}43'07.0''$$

2081 Lagoon Lagoon Portals (1912 0)

$$X_0 = 17.8120$$

$$Y_0 = 18.5040$$

$$\text{cor} = -1.8$$

$$\text{cor} = .5$$

$$X = 17.8102$$

$$18.5035$$

From Plate Constant $X = 17.5019$ $Y = 18.5242$

$$S = -0.4981$$

$$\eta = -3.4758$$

$$\log 3 = 9.69732$$

$$9.94706$$

$$8.50724$$

$$\log T_2 S = 9.7211$$

$$9.3946$$

$$\eta_1 = 6169.1$$

$$(X - A) = 124302$$

$$\eta_1 = +1$$

$$X - A = 17.50$$

$$\eta_0 = -3.4759$$

$$A = 6.5902$$

$$\log = 0.54107$$

$$7.33115$$

$$X_0 = 6.584450$$

$$(S - D) = 320992$$

$$\text{Red} = +3.47$$

$$S - D = -27.015$$

$$X' = 6.584797$$

$$D = +28.1006$$

$$S = +27.43045$$

$$\text{Red} = +2.5$$

$$S = +27.43070$$

2081 Red. ad. Pocom. aph.

19

$$H + \alpha_{10} = 19^{\circ} 154' 45''$$

$$H = 3^{\circ} 20'$$

$$\alpha = 6^{\circ} 59''$$

$$G = 21^{\circ} 55'$$

$$G + \alpha = 28^{\circ} 54' = 73^{\circ} 30'$$

$$l. \cos(G + \alpha) = 9.4533$$

$$g = 1.2402$$

$$\sin \dots = 9.9817$$

$$\tan S = 9.7205$$

$$\frac{1}{\tan} = 8.8239$$

$$l. (g') = 0.6935$$

$$(g) = 9.7663$$

$$\begin{array}{r} f \\ g \\ h \\ \hline + 2.27 \\ + 0.58 \\ + 0.62 \\ \hline + 3.47 \end{array}$$

$$S + 27^{\circ} 43'$$

$$\cos S = 9.9471$$

$$L = 0.8104$$

$$\therefore (L) = 0.7575$$

$$l. \sin S = 9.6676$$

$$\cos(H + \alpha) = 9.9564$$

$$h = 1.2883$$

$$\sin \dots = 9.6800$$

$$\sec S = 0.0529$$

$$\frac{1}{\tan} = 8.8239$$

$$(h') = 0.9123$$

$$(h) = 9.7951$$

$$\begin{array}{r} f' \\ g' \\ h' \\ \hline + 4.94 \\ - 8.17 \\ + 5.72 \\ \hline + 2.49 \end{array}$$

2081 Red. and Eocum. app.

19

$$\begin{array}{rcl}
 H+X & 10 & 19 = 154^{\circ} 45' \\
 H & 3 & 20 \\
 X & 6 & 59 \\
 G & 21 & 55 \\
 G+X & 28 & 54 = 73^{\circ} 30'
 \end{array}$$

$$\begin{array}{rcl}
 \cos(G+X) & 9 & 4533 \\
 \sin & 1 & 2402 \\
 \cos & 9 & 9817 \\
 \tan & 9 & 7205 \\
 \sin & 8 & 1239
 \end{array}$$

$$\begin{array}{rcl}
 \cos & 0 & 6935 \\
 \sin & 9 & 7663
 \end{array}$$

$$\begin{array}{r}
 +227 \\
 +0.58 \\
 +0.62 \\
 \hline
 +347
 \end{array}$$

$$S + 27 \quad 43$$

$$\begin{array}{rcl}
 \cos S & 9 & 9471 \\
 \sin & 0 & 8104 \\
 \cos & 0 & 7575
 \end{array}$$

$$\begin{array}{rcl}
 \cos S & 9 & 6676 \\
 \cos(H+X) & 9 & 9564 \\
 \sin & 1 & 2883 \\
 \sin & 9 & 6300 \\
 \sin S & 0 & 0529 \\
 \sin & 8 & 8239
 \end{array}$$

$$\begin{array}{rcl}
 \cos & 0 & 9123 \\
 \sin & 9 & 7951
 \end{array}$$

$$\begin{array}{r}
 +494 \\
 -817 \\
 \hline
 +572 \\
 +249
 \end{array}$$

2081

Lunar Parallax

$$\begin{aligned} \alpha' &= 6^h 58^m 47.97^s \\ \delta &= -3^\circ 47' 39.0'' \\ \alpha - \alpha' &= -3 \quad 11 \quad 09.0'' \\ &= - \quad 47^\circ 47' 15'' \end{aligned}$$

$$- \quad \quad \quad 18 \quad 17''$$

$$- \quad 47 \quad 28 \quad 58''$$

$$\begin{aligned} &9.95727 \\ &9.99999 \\ &\underline{0.17018} \\ &0.12794 \end{aligned}$$

$$\gamma = 53 \quad 17 \quad 48''$$

$$\delta = 27 \quad 43 \quad 07''$$

$$\gamma - \delta = 25 \quad 34 \quad 11''$$

$$\begin{aligned} &9.82640 \\ &8.23374 \\ &9.63509 \\ &\underline{0.09601} \\ &7.79124 \end{aligned}$$

$$\delta - \delta' = - \quad + 21 \quad 25.5''$$

$$\delta = +28 \quad 04 \quad 22.5''$$

$$\text{Ann Eph. } \delta = +28 \quad 04 \quad 24.5''$$

$$\delta - \delta' = - \quad 2.0''$$

$$\delta' = +27^\circ 43' 07.0''$$

$$\pi = 58' 53.3''$$

$$\begin{aligned} &9.86913 \\ &8.23374 \\ &9.86962 \\ &\underline{0.05436} \\ &8.02685 \end{aligned}$$

$$\alpha - \alpha' = -36' 34.25''$$

$$= -2'' 26.28''$$

$$\alpha = 6 \quad 56 \quad 21.69''$$

$$\alpha = 6 \quad 56 \quad 21.11''$$

$$+ 0.58''$$

2081

Lunar Parallax

20

$$\begin{array}{rcl}
 \alpha & - & 6^{\circ} 58' 47.97'' \\
 \delta & - & 3^{\circ} 47' 39.0'' \\
 \alpha - \delta & - & 3^{\circ} 11' 09.0'' \\
 & - & 47^{\circ} 47' 15'' \\
 & - & 18' 17'' \\
 & - & 47' 28' 58''
 \end{array}$$

$$\begin{array}{r}
 9.95727 \\
 999999 \\
 \hline
 0.17048 \\
 0.12794
 \end{array}$$

$$\begin{array}{rcl}
 \alpha & - & 53' 17'' 48'' \\
 \delta & - & 27' 43'' 07''
 \end{array}$$

$$\alpha - \delta = 25' 34'' 41''$$

$$\begin{array}{r}
 982640 \\
 823374 \\
 953599 \\
 \hline
 009685 \\
 779124
 \end{array}$$

$$\delta - \delta' = -15' 15.5''$$

$$\delta = +28^{\circ} 04' 22.5''$$

$$\text{Cen Eclips} \quad \delta = +28^{\circ} 04' 24.5''$$

$$\alpha - \alpha' = -20''$$

$$\delta = +27^{\circ} 43' 07.0''$$

$$\alpha = 58' 53.3''$$

$$\begin{array}{r}
 9.86913 \\
 8.23374 \\
 9.86962 \\
 \hline
 0.05436 \\
 802685
 \end{array}$$

$$\alpha - \alpha' = -36' 34.25''$$

$$= -2^{\circ} 26.28''$$

$$\alpha = 6^{\circ} 56' 21.69''$$

$$\alpha = 6^{\circ} 56' 21.11''$$

$$+0.58''$$

2
1
11
15
2
22
23
2
2
1

2082 Stars - measures

December 22, 1913 71

1 20000
119 16152
15.5 47.5
00
153848

17405
1124752
5352
20
13837

18241
1705150
50
31
118810

16957
8145
4949
62
8813

2 18500
229 1627581
223 74
00
232223

15835
804942
4842
33
2213

15800
1489097
90
229092

862520
21
7720
9098

3 15389
29.8 14390
13.1 9500
130994

10095
9790
9112
6982

16848
1476270
6970
20
297930

16576
863040
30
90
17954

Stars 3

16.3 17114
32.3 1380010
06
20
323311

15772
9055
6261
45
3305

17652
1040899
01
55
162749

15409
1262928
30
70
2769

2082 Stars - measures

December 22, 1913 21

	d	n	d	n
1	20000	17405	18241	16957
119	1615257	1129752	1705150	8141
151	47	53	50	4949
	00	20	31	62
	<u>153848</u>	<u>3837</u>	<u>118810</u>	<u>8813</u>
3				
229	18500	15835	15800	8625
233	1627581	804942	1489097	2120
	74	48	90	7720
	00	33		
	<u>232223</u>	<u>2213</u>	<u>229092</u>	<u>9098</u>
3				
298	15389	1009590	16842	16576
131	14390	97	1476270	863040
	9500	9112	6970	30
			20	90
	<u>130994</u>	<u>0982</u>	<u>297930</u>	<u>7954</u>

made 3

163	17114	15772		
323	1380010	9055	17652	15409
	06	6261	1040899	1262928
	20	45	01	30
			55	70
	<u>323311</u>	<u>3305</u>	<u>162749</u>	<u>2769</u>

2

1

19.0

16.

2

19.0

17.

3

20

17.

4

W.2

18.

5

W.

18.

19.

20

6

W.

19

2052

Moon-measures.

22

1 16561
19.0 9835-33
16.6 25-33
58

16.6728

2

19.6

17.0

17576
1430009
10
68

.6726

16731 19005
1324955- 1248078
60 70
27 15
19.6525 .6535

3
20.0 15400
17.4 12120,1
00
90

17.3283

19492
1280504
00
05

.3302

4

20.4

18.0

14569 14140
833132 1037670
40 62
55- 44
20.3773 .3773

5
20.5
18.5
max

19500 15160
1439089 1025550
80 50
85 60
20.4896 .4908

6
20.5
19.0

18469 15200
1309094 1054947
95- 5247
60 00
20.4629 .4651

2082

known - measures

22

	d	u	d	u
1	12561	17576		
190	9835	143009		
166	2533	10		
	58	88		
	<u>166728</u>	<u>6726</u>		

2

196

170

16731	19005
132495	1248078
60	70
27	15
<u>19.6525</u>	<u>6535</u>

3

190

174

15400	19492
12120	1280504
00	00
90	05
<u>113243</u>	<u>3302</u>

4

194

170

14569	14140
833132	1037670
40	62
55	44
<u>20.3773</u>	<u>3773</u>

5

195

185

max

170

19500	15160
1439089	1025552
86	1052
85	60
<u>20.4496</u>	<u>4908</u>

6

195

170

18469	15200
1309094	1054947
95	52
60	00
<u>20.4629</u>	<u>4611</u>

2
7
20
20
5
19
20

2082 known - measures.

23

	α	δ	α	δ
2	13109	1134130		
20.0	1289600	2630		
20.0	58	13134		

20.0214.0198

19.0	17159	16058
20.6	1032033	1287369
	31	70
	59	65

20.6831.68104-min about 16.5830

2082 ~~Unknown - measured~~

2	1	3	1	0	9	1	1	3	4	1	3	0
0.0	1	2	8	9	6	0	0					
0.0				5	8			1	1	1	3	9

20.02140198

17	1	1	9	1	6	0	5	8
0.0	1	0	3	2	0	3	1	2
				3	1		7	0
				5	9		6	1

20.683168184 - ~~min~~ about 161830

2082

Times etc

29

Eph to stars	1912 Oct 30	3 ^h 57 ^m	-4 ^s 09 ^m
" " Moon		4 02	43.1 ^s -4 02 43.4 ^s
clock show		0	13.1 ^s
H. Sid T.		4 02	59.35 ^s 6-4-2 ^s 54 ^m
H. long		4 44	31.05 ^s
G. Sid T.		8 47	3040 ^s
Sid T. in hour	14	33	43.98 ^s
Interval	14	13	46.42 ^s
Red.		2	59.19 ^s
G. M. T.	18	10	47.23 ^s

from Kant. Alun		R-G	Week
Moon 18 ^s	6 ^m	56 ^m - 32 ^s 98 ^s	+ 24 ^s 04 ^m 09 ^s 0 ^m
Motion in ^m 2.6319 ^s			3.452 ^s
" " 10.7872 ^s		+ 28.39 ^s	- 37.2 ^s
Tabular place	6 57	01.37 ^s	+ 28 03 31.8 ^s

Moon's age 21 days

934 ^s 12.4	" " parallax	58 ^s 53.5 ^s
964 ^s 13.2	" " eccentricity	16 04.4 ^s
	R	964.4 ^s
	Augmentation	+ 13.2 ^s
	Irradiation (3)	- 0.7 ^s
	R	976.9 ^s
	R	2.0941 ^s
a - - 1.9	(1+a) R	2.0937 ^s
	R ²	4.3835 ^s

2082

Taurus str

29

1912 Oct 30	3	57	-4	09
1912 Nov 1	4	02	43	1-4 02 43 4
1912 Nov 2		0	16	1
1912 Nov 3	4	02	54.35	6-1-2 54
1912 Nov 4	4	44	31	01
1912 Nov 5	4	47	30	40
1912 Nov 6	14	53	43	98
1912 Nov 7	14	13	46	42
1912 Nov 8		2	59	19
1912 Nov 9	14	10	47	23

1912 Nov 10	R. G.	W. G.
1912 Nov 11	6	56-32.98
1912 Nov 12	2.6319	3452
1912 Nov 13	10.7872	-2839
1912 Nov 14	6	57 0137
1912 Nov 15		+28 03 318

Moon age 21 days

1912 Nov 16	parallel	58' 53" 5
1912 Nov 17	Remission	16 04.4
1912 Nov 18	R	9644
1912 Nov 19	Augmentation	+132
1912 Nov 20	Tranquil	+07
1912 Nov 21	R	9769
1912 Nov 22	R	20941
1912 Nov 23	(1.2) R	20937
1912 Nov 24	R	43835

a - 1.9

(1.2) R

R

43835

Plate Center

α	δ	R.A.	Decl.
11.8812	15.3842	6 55 29 +27	16 49
22.9095	23.2218	7 01 54 28	18 47
29.7942	13.0988	7 05 56 27	00 07
<u>64.58</u>	<u>51.70</u>	<u>20 61 13 9</u>	<u>82 34 103</u>
21.53	17.23	7 01 06 27	31 54
-18	-22	- 1 50	+ 37 00
353	477	6 59 16 28	08 54
31	465		
110	2220		

$$A = 6^h 59^m 16^s$$

$$D = +28^\circ 08' 54''$$

star 4

α	δ
162759	32.3308

2082

Plate Constants

25

	1	2	3
2	11.8812	22.9095	29.7942
3	11.9141	22.8641	29.8560
2-3	-329	+454	-618
4	15.3842	23.2218	13.0988
3	15.1674	23.1312	13.0777
4-3	+2168	+906	+211
2-3	-111.54		
-329	1715	-2044	
+454	2589	-2135	
-618	1461	-2079	

2-3	-104.74	+1.92	-2084
+3671	-1611	+2060 + 23	= +2083 = -1
+4415	-2431	+1984 + 44	= +2028 = reject
+3400	-1371	+2029 + 57	= +2086 = +2
+5438	-3385	+2053 + 31	= +2084 = 0
18.3961	-1955	+35	= 17.9957

4-3	+104.62	+0.84	-1849
+592	+1243	+1835 + 12	= +1847 = 0
-615	+2396	+1781 + 19	= +1800 = reject
-1279	+3116	+1837 + 10	= +1847 = 0
+118	+1702	+1820 + 26	= +1846 = -1
18.6760	+1924	+15	= 18.6852

Tables a: -2.0 e: -1.0 a-e: -1.0 b+d: +1.5
 lbs a: -1.9 e: -0.8 a-e: -1.1 b+d: +0.1

2082

Plate Constants

15

$$\begin{array}{rcl}
 2. & -11.8812 & 22.9091 \\
 3. & 11.9141 & 22.8641 \\
 2-3 & - & 329 \quad + 454 \quad - 618
 \end{array}$$

$$\begin{array}{rcl}
 4. & 15.3842 & 23.2218 \\
 3. & 15.1674 & 23.1312 \\
 4-3 & + 2168 & + 906 \quad + 211
 \end{array}$$

$$\begin{array}{rcl}
 2-3 & - 11154 \\
 - 329 & - 1715 & - 2044 \\
 - 444 & - 2549 & - 4135 \\
 - 618 & - 1461 & - 2079
 \end{array}$$

$$\begin{array}{rcl}
 2-3 & - 10474 & + 192 & - 2084 \\
 + 3671 & - 1611 & + 2060 & + 23 & + 2083 & = -1 \\
 + 4415 & - 2431 & + 1984 & - 44 & + 2028 & = \text{reject} \\
 - 3400 & - 1371 & + 2029 & - 57 & + 2086 & = +2 \\
 + 5438 & - 3385 & + 2053 & + 31 & + 2084 & = 0 \\
 183961 & - 1955 & + 35 & & & = 179957
 \end{array}$$

$$\begin{array}{rcl}
 4-22 & + 10462 & + 084 & - 1849 \\
 + 592 & + 1243 & + 1835 & - 12 & + 1847 & = 0 \\
 - 615 & + 2396 & + 1781 & - 19 & + 1800 & = \text{reject} \\
 - 1279 & + 3116 & + 1837 & - 10 & + 1847 & = 0 \\
 + 118 & + 1702 & + 1820 & + 20 & + 1846 & = -1 \\
 186760 & + 1924 & + 15 & & & = 186852
 \end{array}$$

$$\begin{array}{l}
 \text{Tables } a: -2.0 \quad b: -1.0 \quad a-b: -1.0 \quad b+a: +1.0 \\
 \text{also } a: -1.9 \quad b: -0.8 \quad a-b: -1.1 \quad b+a: +0.1
 \end{array}$$

Ceph 1009

6 57 09.18

22

19

6 57 09.20

+ 45.80

6 57 55.00

6 59 16

- 1 21.00

- 81.00

1.90849m

9.93976

0.35549m

- 22672

-

15.7321

16.2759

+ 5438

+ 29 30 15.1

14.1

14.9

+ 29 30 14.7

- 1 09.3

+ 29 29 05.4

+ 28 08 5.4

+ 1 20 11.4

+ 4812.2

3.68235

1.01350

9.7524

0.7110

7.5168

+ 10.3157

+

33

32.3190

32.3308

+

118

2

11.8812

22.9095

29.7942

16.2759

4

15.3842

23.2218

13.0988

32.3308

2082

Standard Coordinates

Cape W. 1002 mag 7.2 Cape W. 1015 mag 6.2 Cape W. 1022 mag 5.6

C	6	54	44.17	7	01	08.63	7	05	10.98
L			21			62			11.02
E			16			62			10.95
mean	6	54	44.18	7	01	08.62	7	05	10.98
Proc			+44.90			+45.20			+44.69
A	6	55	29.08	7	01	53.82	7	05	55.67
A	6	59	16	6	59	16	6	59	16
A-A			-3			+2			+6
W(2A)			-226.91			+157.82			+399.61
Wg			2355585m			219816			260164
WSS			9.94879			9.94468			9.94987
30			081188m			065008			105875
30			-64846			+44677			+11.4484
31			-13			+3			+58
3			115141			224680			29.4542
3			11.8812			22.9095			29.7942
A-3			+3671			+4415			+3400

C	+27	17	46.1	+28	19	50.7	+27	01	15.1
L			46.4			50.1			14.6
E			46.2			51.6			15.2
mean	+27	17	46.2	+28	19	50.8	+27	01	15.0
Proc			-57.3			103.8			-108.4
S	+27	16	48.9	+28	18	47.0	+27	00	06.6
D	+28	08	54	+28	08	54	+28	08	54
S-A			-52			+9			-108
W(3-D)			-3125.3			+593.0			-4127.9
Wg			349489m			277305			361573m
W			0.82604m			0.10420			0.94688m
Wtans			9.7124			9.7314			9.7072
W			16238			13002			2.1175
W			83896			8.0850			8.8781
W0			-66995			+1.2711			-8.8488
W1			+245			+122			+755
W			153250			23.2833			13.2267
W			153842			23.2218			13.0988
W-W			+592			-615			-1279

2082

Standard Coordinates

Cape W. 1002 mag 7.2

Cape W. 1015 mag 5.2

Cape W. 1022 mag 5.6

C 6 54 44.17

7 01 08.63

7 05 10.98

L 21

62

11.02

E 16

62

10.95

Mean 6 54 44.18

7 01 08.62

7 05 10.98

P.M. + 44.90

+ 45.20

+ 44.69

A 6 55 29.08

7 01 53.82

7 05 55.67

A 6 59 16

6 59 16

6 59 16

A 6 59 16

+ 2 37.82

+ 6 39.67

A 6 59 16

+ 1 57.82

+ 3 99.61

A 6 59 16

2.19816

2.60164

A 6 59 16

9.94468

9.94987

A 6 59 16

0.65008

1.05875

A 6 59 16

+ 4.4677

+ 1.4484

A 6 59 16

+ 3

+ 5.8

A 6 59 16

22.4680

29.4542

A 6 59 16

22.9095

29.7942

A 6 59 16

+ 4.415

+ 3.900

A 6 59 16

+ 3.671

A 6 59 16

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+ 3.671

pt.	pos. $\angle$	resid
1	163.8	-5.9
2	143.0	+5.8
3	130.1	+3.2
4	108.9	-1.0
5	90.0	+1.5
6	81.1	-3.0
7	49.9	-4.1
8	16.8	+4.4

2082

Moon's Center.

27

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$O - C$
1	19.0000 + 0.6040	+4	0.3653	4.3821	-14	
2	19.6530 + 1.2570	+3	1.5808	4.3928	+93	
3	20.0000 + 1.6040	+2	2.5734	4.3897	+62	
4	20.3773 + 1.9813	+1	3.9260	4.3843	+8	
5	20.4902 + 2.0942	0	4.3856	4.3856	+21	
6	20.4640 + 2.0680	-1	4.2762	4.3805	-30	
7	20.0000 + 1.6040	-2	2.5722	4.3772	-63	
8	19.0000 + 0.6040	-4	0.3643	4.3843	+8	

Comp R^2 4.3835

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	16.6727	-2.0043	+1	4.0168
2	17.0000	-1.6770	+1	2.8120
3	17.3292	-1.3478	+1	1.8163
4	18.0000	-0.6770	0	0.4583
5	18.6770	0.0000	0	0.0000
6	19.0000	+0.3230	0	0.1043
7	20.0206	+1.3436	-1	1.8050
8	20.6821	+2.0051	-1	4.0200

Cephe Center: $X = 19.0$ $y =$

$$y = 16.6727$$

$$\underline{20.6821}$$

$$37.3548$$

$$Y_0 = 18.6774$$

$$x = 20.0$$

$$y = 17.3292$$

$$\underline{20.0206}$$

$$37.3498$$

$$Y_0 = 18.6749$$

$$Y_0 = 18.6770$$

$$y - \min = 16.5830$$

$$R = 2.0940$$

$$x - \max = 20.4902$$

$$X_0 = 18.3962$$

$$\text{Center } \begin{cases} X_0 = 18.3960 \\ Y_0 = 18.6770 \end{cases}$$

2082

Murray Center.

17

	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$O - C^2$
1	19.0000 + 0.6040	+4	0.3653	4.3821	-1.4	
2	19.6530 + 1.2570	+3	1.5808	4.3928	+9.3	
3	20.0000 + 1.6040	+2	2.1734	4.3897	+6.2	
4	20.3773 + 1.9813	+1	3.9260	4.3843	+8	
5	20.4902 + 2.0942	0	4.3856	4.3856	+2.1	
6	20.4640 + 2.0680	-1	4.2762	4.3805	-3.0	
7	20.0000 + 1.6040	-2	2.5722	4.3772	-6.3	
8	19.0000 + 0.6040	-4	0.3643	4.3843	+8	

Comp R^2

4.3835

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	16.6727	-2.0043	+1	4.0168
2	17.0000	-1.6770	+1	2.8120
3	17.3292	-1.3478	+1	1.8163
4	18.0000	-0.6770	0	0.4583
5	18.6770	0.0000	0	0.0000
6	19.0000	+0.3230	0	0.1043
7	20.0206	+1.3436	-1	1.8050
8	20.6821	+2.0051	-1	4.0200

Copper Center $X = 19.0$ g2 $y = 16.6727$ 20.6821

37.3548

 $Y_0 = 18.6774$ $x = 20.0$ $y = 17.3292$ 20.0206

37.3498

 $Y_0 = 18.6749$ $Y_0 = 18.6770$ $y = \text{min} = 16.5830$ $R = 2.0940$ $x = \text{max} = 20.4902$ $X_0 = 18.3962$ Center $\left\{ \begin{array}{l} X_0 = 18.3960 \\ Y_0 = 18.6770 \end{array} \right.$

Formation of journals.

	ab	an	bn
1	- 1.2.0	- 8.4	+ 28.0
2	- 2.1.2	+ 117.0	- 156.2
3	- 2.1.6	+ 99.2	- 83.7
4	- 1.3.5	+ 15.8	- 5.4
5	+ 0.0.0	+ 44.0	+ 0.0
6	+ 0.6.6	- 62.2	- 9.6
7	+ 2.1.4	- 100.8	- 84.5
8	+ 1.2.0	+ 4.8	+ 16.1
	- 2.8.3	+ 109.4	- 295.3

2082

Anno's Center.

28

	a	b	c		c	o-c	
1	+0.60	-2.00	= -1.4	+	2+38	= +40	-54
2	+1.26	-1.68	= -1.93	+	3+32	= +35	+58
3	+1.60	-1.35	= +6.2	+	4+26	= +30	+32
4	+1.98	-0.68	= +8	+	5+13	= +18	-10
5	+2.09	+0.00	= +2.1	+	6-0	= +6	+15
6	+2.07	+0.32	= -3.0	+	6-6	= 0	-30
7	+1.60	+1.34	= -6.3	+	4-26	= -22	-41
8	+0.60	+2.01	= +8	+	2-38	= -36	+44

Average = 35

Normal Equation.

$$+20.04a - 28.3b = +109$$

$$- 28.3a + 15.03b = -295$$

$$+ 28.3 - 0.40 = + 15$$

$$+ 14.63 = - 280$$

$$b = -19.2$$

$$+20.04a = +109 - 54 = +55$$

$$a = + 2.7$$

20820

Innovis Center

28

	a	b	0		c	0-c	
1	+0.60	-2.00	= -1.4	+	2+3.8	= +4.0	-5.4
2	+1.26	-1.68	= -1.93	+	3+3.2	= +3.5	+5.8
3	+1.60	-1.35	= +6.2	+	4+2.6	= +3.0	+3.2
4	+1.98	-0.68	= +8	+	5+1.3	= +1.8	-1.0
5	+2.09	+0.60	= +2.1	+	6-0	= +6	+1.5
6	+2.07	+0.32	= -3.0	+	6-6	= 0	-3.0
7	+1.60	+1.34	= -6.3	+	4-2.6	= -2.2	-4.1
8	+0.60	+2.01	= +8	+	2-3.8	= -3.6	+4.4

Average = 3.5

Normal Equations

$$+20.04a - 2.83b = +1.09$$

$$-2.83a + 15.03b = -2.95$$

$$+2.83a - 0.40b = +1.15$$

$$+14.63b = -2.80$$

$$b = -1.92$$

$$+20.04a + 1.09 - 5.4 = +5.5$$

$$a = +2.7$$

2082 Moon's Mean Position (1912.0)

29

$$\begin{array}{r}
 X_0 = 18.3960^\circ \\
 + 1^\circ \\
 \hline
 18.3961^\circ
 \end{array}
 \qquad
 \begin{array}{r}
 Y_0 = 18.6770^\circ \\
 - 1.0^\circ \\
 \hline
 18.6760^\circ
 \end{array}$$

From Plate Constants $X = 17.9957^\circ$ $Y = 18.6852^\circ$

$$\bar{z} = -0.0043^\circ$$

$$\eta = -3.3148^\circ$$

$$\begin{array}{r}
 \log \bar{z} = 7.63347^\circ \\
 \dots \cos 5 \quad 9.94706^\circ \\
 \quad \quad \quad 8.50724^\circ
 \end{array}$$

$$\begin{array}{r}
 \log \tan \delta = 9.7211 \\
 \quad \quad \quad 5.2669 \\
 \quad \quad \quad 2.0414
 \end{array}$$

$$(\alpha - \alpha) \quad 9.17917^\circ$$

$$\begin{array}{r}
 \log \eta_0 = 0.52045^\circ \\
 \quad \quad \quad 7.33115^\circ
 \end{array}$$

$$\alpha - A \quad - \quad 0.15^\circ$$

$$(\delta - \delta) = 3.18930^\circ$$

$$A \quad 6 \quad 59 \quad 16^\circ$$

$$\delta - \delta = -25 \quad 46.3^\circ$$

$$\alpha_0 \quad 6 \quad 59 \quad 15.85^\circ$$

$$\delta = +28 \quad 08 \quad 54^\circ$$

$$P_{\alpha} = \quad + \quad 3.47^\circ$$

$$\delta_0 = +27 \quad 43 \quad 07.7^\circ$$

$$\alpha' = 6 \quad 59 \quad 19.32^\circ$$

$$P_{\delta} = \quad + \quad 2.5^\circ$$

$$\delta' = +27 \quad 43 \quad 10.2^\circ$$

2082 known mean position (1912.0)

29

$$X_0 = 183960$$

$$Y_0 = 186770$$

$$\begin{array}{r} 183960 \\ + 1 \\ \hline 183961 \end{array}$$

$$\begin{array}{r} 186770 \\ + 10 \\ \hline 186780 \end{array}$$

from Plate Constant $X = 179957$ $Y = 186852$

$$\bar{z} = -0.0043$$

$$\eta = -3.3148$$

$$\begin{array}{r} \log \bar{z} = 7.63347 \\ - \cos \delta \quad 994706 \\ \hline 850724 \end{array}$$

$$\begin{array}{r} \log \tan \delta = 9.7211 \\ \quad \quad \quad 52669 \\ \hline 20414 \end{array}$$

$$(z - z_0) = 9.17917$$

$$\log \eta_0 = 0.52045$$

$$z - A = 0.15$$

$$(z - D) = 3.18930$$

$$A = 6.5916$$

$$S - D = 2.5463$$

$$\alpha_0 = 6.591585$$

$$D = 128.0854$$

$$Rea = 3.47$$

$$S_0 = 27.43077$$

$$\alpha = 6.591932$$

$$Rea = 2.5$$

$$S = 27.43102$$

2082 Red ad. l. app.

30

$$\begin{array}{rcl}
 H + \alpha & - & 10 \quad 20 = 155^\circ \\
 H & & 3 \quad 21 \\
 \alpha & & 6 \quad 59 \\
 G & & 21 \quad 55 \\
 G + \alpha & & 28 \quad 54 = 73^\circ 30'
 \end{array}$$

$$\begin{array}{rcl}
 l \cos(G + \alpha) & & 9.4533 \\
 q & & 1.2400 \\
 \sin & & 9.9817 \\
 \tan & & 9.7205 \\
 \frac{1}{\tan} & & 8.8239
 \end{array}$$

$$\begin{array}{rcl}
 (g') & = & 0.6933 \\
 (g) & = & 9.7661
 \end{array}$$

$$\begin{array}{rcl}
 b & + & 2.27 \\
 g & + & 0.58 \\
 l & + & 0.62 \\
 \hline
 & + & 3.47
 \end{array}$$

$$\begin{array}{rcl}
 S & + & 27 \quad 43 \\
 \cos S & & 9.9471 \\
 L & & 0.8104 \\
 (L) & & 0.7575
 \end{array}$$

$$\begin{array}{rcl}
 l \sin S & & 9.6676 \\
 \cos(H + \alpha) & & 9.9573 \\
 L & & 1.2883 \\
 \sin & & 9.6260 \\
 \sec S & & 0.0529 \\
 \frac{1}{\tan} & & 8.8239
 \end{array}$$

$$\begin{array}{rcl}
 (h') & & 0.9132 \\
 (h) & & 9.7911
 \end{array}$$

$$\begin{array}{rcl}
 g' & + & 4.94 \\
 L & - & 8.19 \\
 l & + & 5.72 \\
 \hline
 & + & 2.47
 \end{array}$$

2082 Red and E. apph.

30

$$H+x = 10 \quad 20 = 115^\circ$$

$$H \quad 2 \quad 21$$

$$v \quad 6 \quad 59$$

$$G \quad 21 \quad 55$$

$$G+x \quad 28 \quad 54 = 73^\circ 30'$$

$$\cos(G+x) \quad 94133$$

$$q \quad 12900$$

$$\sin \quad 99817$$

$$\tan S \quad 97205$$

$$\frac{1}{\sin} \quad 88239$$

$$\left(\frac{S}{q}\right) \quad 06933$$

$$\left(\frac{G}{q}\right) \quad 97661$$

$$\frac{1}{q} \quad +227$$

$$\frac{1}{S} \quad +0.58$$

$$\frac{1}{G} \quad +0.62$$

$$-399$$

$$S \quad +27 \quad 43$$

$$\cos S \quad 99971$$

$$L \quad 08104$$

$$(L) \quad 07575$$

$$\cos S \quad 96676$$

$$\cos(H+x) \quad 99573$$

$$L \quad 12883$$

$$\sin \quad 96260$$

$$\sec S \quad 00529$$

$$\frac{1}{\sin} \quad 88239$$

$$\left(\frac{L}{S}\right) \quad 09132$$

$$\left(\frac{L}{G}\right) \quad 97971$$

$$\frac{1}{S} \quad +494$$

$$\frac{1}{L} \quad -819$$

$$\frac{1}{G} \quad +572$$

$$+247$$

2082

Lunar Parallaxes

$$\begin{array}{rcl}
 \alpha & = & 6^{\circ} 59' 19.32'' \\
 \delta & = & 4^{\circ} 02' 59.35'' \\
 \alpha - \alpha' & = & -2^{\circ} 55' 19.96'' \\
 & = & -44^{\circ} 05' 00''
 \end{array}$$

$$- 17 10$$

$$43 47 50''$$

$$\begin{array}{r}
 995727 \\
 999999 \\
 \hline
 014159 \\
 0.09885
 \end{array}$$

$$8 - 51 27 53''$$

$$27 43 10''$$

$$23 44 43''$$

$$\begin{array}{r}
 9.82640 \\
 8.23376 \\
 9.60495 \\
 \hline
 0.10667 \\
 7.77178
 \end{array}$$

$$S - S' = + 20 19.6''$$

$$S = + 28 03 29.8''$$

$$\text{Ann Eph } S = + 28 03 31.8''$$

$$O - C = - 2.0''$$

$$S = + 27^{\circ} 43' 10.2''$$

$$\Pi \quad 58' 53.5''$$

$$\begin{array}{r}
 9.86913 \\
 8.23376 \\
 9.84242 \\
 \hline
 005430 \\
 799961
 \end{array}$$

$$\alpha - \alpha' = - 34 20.82''$$

$$= - 2^{\circ} 17.39''$$

$$\alpha = 6 57 01.93''$$

$$\alpha = 6 57 01.37''$$

$$+ 0.56''$$

2082

Lunar Parallel Circle

31

$$\begin{array}{r}
 \lambda - 6^{\circ} 59' 19.32'' \\
 \phi - 4^{\circ} 02' 59.35'' \\
 \text{G.A.} - 2^{\circ} 56' 19.96'' \\
 \quad - 44'' 08'
 \end{array}$$

$$S = +27^{\circ} 43' 10.2''$$

$$i = 58' 53.5''$$

$$- 17 1.0$$

$$43 \quad 47 \quad 50$$

$$995727$$

$$999999$$

$$019159$$

$$009885$$

$$9.86913$$

$$823376$$

$$984242$$

$$005430$$

$$799961$$

$$X-X' = -34 \quad 20.82''$$

$$= -2 \quad 17.39$$

$$j - 51 \quad 27 \quad 53$$

$$27 \quad 43 \quad 16$$

$$23 \quad 44 \quad 43$$

$$9.82640$$

$$823376$$

$$960495$$

$$010667$$

$$772178$$

$$S-S' = +20 \quad 19.6$$

$$S = +28 \quad 03 \quad 29.8$$

$$X = 6 \quad 57 \quad 01.92$$

$$\text{Ann Eph. } S = +28 \quad 03 \quad 31.8$$

$$X = 6 \quad 57 \quad 01.37$$

$$O-C = -20$$

$$+0.55$$

