

KG
11366
v. 928



Harvard Lunar Plates
Measurements and Reductions,

Mary Fowler.

Volume LII

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1
16
2

2
17
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3
2
2

2014		Stars Measured -		1913 December 13.		1
d	v	d	v	d	v	
1 14531	19101	1 5930	19258			
14.1 725554	1639087	697245	18210			
29.6 52	91	5560	0700			
37	00	30	60			
<u>29.7281</u>	<u>7289</u>	<u>14.1028</u>	<u>1051</u>			
2 10230	1314054	10670	17685			
17.8 1006049	4959	1203128	929080			
10.0 56	12978	32	9580			
		60	72			
<u>10.0175</u>	<u>0172</u>	<u>17.8362</u>	<u>8387</u>			
3 19450	16280	18765	17637			
26.1 1240601	1332728	1051010	1587164			
23.6 09	21	10	6064			
40	83	60	35			
<u>23.7038</u>	<u>7044</u>	<u>26.1749</u>	<u>1772</u>			

Grade 4 or 5

2014

Stars Measured -

1913 December 13

1

	d	v	d	v
1	14531	19101	15930	192158
141	725554	1639087	697245	1821000
296	52	91	5560	0710
	37	00	30	60
	<u>297281</u>	<u>7289</u>	<u>141028</u>	<u>1051</u>
2	10230	1314054	13670	176815
178	1006049	4959	1203128	929080
100	55	12978	32	9150
			60	72
	<u>100175</u>	<u>0172</u>	<u>178362</u>	<u>8387</u>
3	19410	16280	18765	17637
261	1240601	13327	10510	1587164
236	09	2128	10	60
	40	83	60	35
	<u>237038</u>	<u>7044</u>	<u>261749</u>	<u>1772</u>

Grade 4 or 5

2014

Moon-measures

	d	N
1	16960	19700
18.0	896061	1770500
17.7	61	03
	61	98
	<u>17.80009</u>	<u>8004</u>

possibly a
terminator

2
18.3
18.0

18160	14559
1095551	1172910
70	10
59	82
<u>18.2800</u>	<u>2851</u>

3
18.9
19.0

13290	1040191
1247080	9191
70	9618

4
19.0-
19.5
may
26

<u>18.9183</u>	<u>9224</u>
13280	1069481
1324050	7581
40	10644

5
18.9
20.0

<u>18.9963</u>	<u>9961</u>
12285	1216060
1173021	60
20	11630

6
18.4
21.0
indistinct point
Remeasure gives
 d N
18.3842 18.3806

<u>18.9439</u>	<u>9470</u>
15839	16870
962010	1309082
10	80
35	58
<u>18.3776</u>	<u>3781</u>

2014

Moon - measures

d

7

N

d²⁰

N

1	16960	19700
180	896061	1770500
177	61	03
	61	98
	<u>17.80009</u>	<u>.5004</u>

possibly a
terminal2183
180

181.60	14589
1095551	1172910
70	10
59	82
<u>18.2800</u>	<u>2851</u>

3189
190

13290	1040191
1247050	9191
70	9618

18.9183.92244190
193
194
195

13280	10694
1324050	7181
40	10644

18.9963.99615189
200

12285	1216060
1173021	60
20	11630

18.9439.9470618.4
21.0indifferent point
Remeasures gives18.3843 18.3806

15839	16870
962010	1309082
10	80
35	58
<u>18.3776</u>	<u>3781</u>

2014

Moon-measures

3

$$\begin{array}{r}
 7 \quad 19712 \\
 18.0 \quad 16750 \\
 21.5 \quad 3257 \\
 \quad \quad 09 \\
 \hline
 21.2967
 \end{array}
 \qquad
 \begin{array}{r}
 16609 \\
 1951219 \\
 \quad 1019 \\
 \quad 96 \\
 \hline
 .2914
 \end{array}$$

$$\begin{array}{r}
 8 \quad 19309 \\
 17.0 \quad 1348370 \\
 21.5 \quad 9078 \\
 \text{max} \quad 15 \\
 \hline
 21.5832
 \end{array}
 \qquad
 \begin{array}{r}
 16590 \\
 1238100 \\
 \quad 8997 \\
 \quad 82 \\
 \hline
 .5806
 \end{array}$$

9 scratch.

$$\begin{array}{r}
 16.6 \quad 18749 \\
 21.5 \quad 1313026 \\
 \quad \quad 1116 \\
 \quad \quad 50 \\
 \hline
 21.5629
 \end{array}
 \qquad
 \begin{array}{r}
 17940 \\
 1305148 \\
 \quad 48 \\
 \quad 29 \\
 \hline
 .5613
 \end{array}
 \qquad
 \begin{array}{r}
 19882 \\
 16752 \\
 \quad 5857 \\
 \quad 80 \\
 \hline
 16.6874
 \end{array}
 \qquad
 \begin{array}{r}
 18795 \\
 1192820 \\
 \quad 20 \\
 \quad 93 \\
 \hline
 .6871
 \end{array}$$

2014

Moon - measures

5

	a	b	c	d
7	19712	16609		
18.0	16750	19512		
21.3	3257	1019		
	09	96		
	<u>212967</u>	<u>2914</u>		

8	19309	16590		
17.0	1348370	1238100		
21.5	9078	8997		
max	15	82		
	<u>215832</u>	<u>5806</u>		

9 scratch

16.6	18749	17940	19882	18795
21.5	1313026	1355148	16752	1192820
	1116	48	5857	20
	50	29	80	93
	<u>215629</u>	<u>5613</u>	<u>166874</u>	<u>6871</u>

cy
c
h
s

L
h
T

2014	Times etc.					
Exh. total	1912 Sept 29	3 ^h	28 ^m	- 3 ^h	40 ^m	
" " Moon		3	33	43.4	- 3	33 43.6
clock slow			0	41.4		
H. S. d. T.		3	34	24.9		G - α - + 0' 20"
H. long		4	44	31.05		
G. S. d. T.		8	18	55.95		
Sid. T. h. Moon		12	31	30.79		
Interval		19	47	25.16		
Reduction			3	14.53		
G. M. T.		19	44	10.63		

From hant alum	R. a	Decl.
Moon 20 ^h	3 ^h 15 ^m	12° 9' 4" + 21° 35' 10.8"
Moon in 1 ^m = 2.2378		10.940
" " - 15.8228		- 35.31
Tabular place	3 14	37.63 + 21 32 18.2

Moon's Age 19 days

Moon's parallax

Semidiameter

$$934 = 14.6$$

$$935 = 14.6$$

R

Augmentation

Inradial in 40(5)

R

R

$$a = -3.1$$

$$(1+a) R$$

R²

$$57' 05.8"$$

$$15 35.1$$

$$935.1$$

$$+ 14.6$$

$$- 0.9$$

$$948.8$$

$$2.0339$$

$$2.0333$$

$$41343$$

2014 Times etc.

Whitman 1912 Sept. 29	3 ^m	28 ^m	-3 ^m	40 ^m
known	3	33	434	-3 33 436
clock slow		0	414	
to S. of J.	3	34	249	
Whitman	4	44	3105	
G. J. d. I.	8	18	5595	
Sid. H. known	12	31	3479	
In. line	19	47	2516	
Reduction		3	19.53	
G. H. T.	19	44	10.63	

How Hunt Allen	Ra	Decl
known 20 ^m	3 ^m 15 ^m 1294	+21° 35' 10.8
known 1 ^m 2.2318		10.940
-15.8238	-35.31	-2 52.6
Tabular place	3 14 37.63	+21 32 18.2

known Age 19 days

known parallax

57' 05.8

Cambridge

15 35.1

RP

9351

Augmentation

+146

Int. radial in 0.51

-09

RP

9488

RP

20339

a - - 3.1

1 + d / RP

20333

RP

41343

2014

Plate Constants.

5

α	δ	R.A.	Decl.
14.1040	297.285	3 12 42 +22 30 39	
17.8374	10.0174	14 49 19 57 29	
26.1760	23.7041	19 27 21 43 44	
3 58.12	63.45	15 11 8 62 130 112	
19.37	21.15	3 15 39 +21 23 57	
-1.5	-22	- 42 + 6 35	
137	0.85	3 14 57 +21 30 32	
31	465		
42	395		

$$A = 3^h 14^m 57^s$$

$$D = +21^\circ 30' 32''$$

$$\begin{aligned}
 &2 - 5 - 134 & + 3.12 & - .14 & - 749 \\
 &+ 1095 - 386 = +709 + 44 = +753 - 3 = +750 = +1 \\
 &+ 825 - 1303 + 695 + 55 = +750 - 1 = +749 = 0 \\
 &+ 978 - 308 = +670 + 81 = +751 - 2 = +749 = 0 \\
 &16.9622 - 254 & + 53 & - 2 & = 16.8670
 \end{aligned}$$

$$\begin{aligned}
 &4 - 7 & + 11.32 & + 1.84 & + .14 & - 102 \\
 &- 113 + 159 = +46 + 53 = +99 + 3 = +102 = 0 \\
 &- 118 + 202 = +84 + 18 = +102 + 1 = +103 = +1 \\
 &- 239 + 296 = +57 + 43 = +100 + 2 = +102 = 0 \\
 &19.5463 + 192 & + 35 & + 2 & = 19.5590
 \end{aligned}$$

Tables	$a = -0.7$	$c = -0.7$	$a - c = 0.0$	$b + a = 0.0$
Obs	$a = -3.1$	$c = -1.9$	$a - c = -1.2$	$b + a = +1.8$

2014

Plate Constants

5

α	δ	R	A	μ_{α}	μ_{δ}		
14.1040	29.7285	3	12	42	+22	30	39
17.8374	10.0179		14	49	19	57	29
26.1762	23.7041		19	27	21	43	44
3 58.12	63.45		15	118	62	130	112
19.37	21.15	3	25	39	+21	23	57
-1.5	2		-	42		4	35
1.37	685	3	14	57	+21	30	32
31	465						
42	395						

$A = 0^h 19^m 57^s$

$$A = 3^{\circ} 14' 57''$$

$$1) = +21^{\circ} 30' 32''$$

$$\begin{aligned}
 &2 - 3 = -134 \quad +312 \quad -14 \\
 &+1095 - 386 = +709 + 44 = +753 - 3 = +750 = 11 \\
 &+825 - 130 = +695 + 55 = +750 - 1 = +749 = 0 \\
 &+978 - 308 = +670 + 81 = +751 - 2 = +749 = 0 \\
 &16.9622 - 254 \quad +53 \quad -2 \quad = 16.8670
 \end{aligned}$$

$$\begin{aligned}
 &4 - 11 \quad +11.32 \quad +184 \quad +14 \quad -102 \\
 &-113 + 159 = +46 + 53 = +99 + 3 = +102 = 0 \\
 &-118 + 202 = +84 + 18 = +102 + 1 = +103 = +1 \\
 &-239 + 296 = +57 + 43 = +100 + 2 = +102 = 0 \\
 &19.463 + 192 \quad +35 \quad +2 = 19.5590
 \end{aligned}$$

$$\begin{aligned}
 \text{Tables: } \alpha &= -0.7 & \delta &= -0.7 & \alpha - \delta &= 0.0 & b + a &= 0.0 \\
 \text{Obs} &= -3.1 & &= -1.9 & &= -1.2 & &= +1.8
 \end{aligned}$$

2014 Standard Coordinates

Cepheus. 476 mag 7.5				Cepheus. 486 mag 8.5				Cepheus. 498 mag 6.9			
C	3	12	00.37	3	14	07.65		3	18	45.69	
L						70				69	
E						64				65	
mean				3	14	07.66		3	18	45.68	
Prece	+		41.81	+		41.23		+		41.74	
α	3	12	42.18	3	14	48.89		3	19	27.42	
δ	3	14	57	3	14	57		3	14	57	
$\alpha - A$	-	2	14.82			-08.11		+	4	30.42	
$\sin(\delta - \delta_1)$			-134.82			-08.11				+270.40	
$\log \mu$			2.12975			0.90902				2.43201	
$\mu \cos \delta$			996558			997310				996799	
$\mu \sin \delta$			060257			938936				0.90724	
μ_0			-4.0047			-0.2451				+8.0768	
μ_1			-			0				+ 14	
μ_2			13.9945			17.7549				26.0782	
μ_3			14.1040			17.8374				26.1760	
$\mu - \mu_3$			+1095			+ 825				+ 978	
C + 22° 27' 57.9" + 19° 54' 49.8" + 21° 41' 09.5"											
L						50.2				08.9	
E						50.2				08.9	
mean	22	27	57.9	+19	54	50.1		+21	41	09.1	
Prece	+	2	40.7	+	2	39.0		+	2	35.3	
δ	+22	30	38.6	+19	57	29.1		+21	43	44.4	
ρ	+21	30	32	+21	30	32		+21	30	32	
δD	+1	00	06.6	-	1	33	02.9		+13	12.4	
$\sin(\delta - \delta_1)$			+3607.0			-55843				+792.4	
$\log \mu$			3.55715			3.74697				2.89894	
μ_0			0.88830			1.07812				0.23009	
$\mu \cos \delta$			9.6174			9.5601				9.6005	
μ_1			1.2071			8.7787				18.145	
μ_2			7.8779			5.3922				8.4684	
μ_3			+7.7322			-11.9708				+1.6986	
μ_4			+ 76			0				+ 294	
μ			29.7398			10.0292				23.7280	
μ_1			29.7285			10.0174				23.7041	
$\mu - \mu_1$			- 113			- 118				- 239	

2014 Standard Correlation

Capeln. 476 ng 75				Capeln. 486 ng 85				Capeln. 498 ng 69			
C	3	12	00.37	3	14	07.65		3	18	45.69	
L						70				69	
E						64				65	
mean				3	14	07.66		3	18	45.68	
Prec	+		41.81	+		41.23		+		41.74	
A	3	12	42.18	3	14	48.89		3	19	27.42	
A	3	14	57	3	14	57		3	14	57	
A-A	-	2	14.82			-08.11		+	4	30.42	
std(A)			-134.82			-08.11				+270.40	
log			212975			0.90902				243201	
log			9.90558			9.97310				9.96799	
log			0.60257			-9.38936				0.90724	
log											
log			-9.0092			-0.2451				+80768	
log			-			0				+14	
log			13.9945			17.7549				26.0782	
log			14.1040			17.4374				26.1760	
log			+1095			+825				+978	
C	+22	27	57.9	+19	54	49.8		+21	41	09.5	
L						50.2				08.9	
E						50.2				08.9	
mean	+22	27	57.9	+19	54	50.1		+21	41	09.1	
Prec	+	2	40.7	+	2	39.0		+	2	35.3	
S	+22	30	38.6	+19	57	29.1		+21	43	44.4	
P	+21	30	32	+21	30	32		+21	30	32	
std	+1	00	06.6	-1	33	02.9		+13	12.4		
std(A)			+3607.0			-5589.3				+792.4	
log			3.55715			3.74697				2.89894	
log			0.88830			1.07812				0.23009	
log											
log			9.6174			9.5601				9.6005	
log			12071			87787				15145	
log			78779			53922				84684	
log											
log			+77322			-11.9708				+1.6986	
log			+			0				+294	
log			24.7398			10.0292				23.7280	
log			24.7285			10.0174				23.7041	
log			5			-118				-237	

pt.	pos. L	resid.
1	1490.3	-78
2	1394	+8
3	1056	-11
4	500	+30
5	771	+46
6	[443]	-103
7	307	-24
8	1.1	+111
9	3522	+49

2014

Moon's Center

6

	x	$x - x_0$	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$0 - c$
1	18.0000	+1.0370	1.0754	4.1270	- 73
2	18.2826	+1.3196	1.7414	4.1349	+ 6
3	18.9204	+1.9574	3.8314	4.1306	- 37
4	18.9962	+2.0332	4.1339	4.1339	- 4
5	18.9454	+1.9824	3.9299	4.1351	+ 8
6	18.3801	+1.4171	2.0082	4.1197	- 146
7	18.0000	+1.0370	1.0754	4.1278	- 65
8	17.0000	+0.0370	0.0014	4.1426	+ 83
9	16.6872	-0.2758	0.0761	4.1371	+ 28

Comp R^2 4.1343

	y	$y - y_0$	Δy
1	17.8002	-1.7468	-1
2	18.0000	-1.5470	-1
3	19.0000	-0.5470	0
4	19.5470	0.0000	0
5	20.0000	+0.4530	0
6	21.0000	+1.4530	+1
7	21.2940	+1.7470	+1
8	21.5819	+2.0349	+1
9	21.5621	+2.0151	+1

Approx. Center

$$x = 18.0 \quad y = 17.8002$$

$$21.2940$$

$$39.0942$$

$$y_0 = 19.5471$$

$$y_{\text{max}} = 21.5819$$

$$R = 2.0348$$

$$x_{\text{max}} = 18.9962$$

$$x_0 = 16.9614$$

$$\text{Center} \begin{cases} x_0 = 16.9630 \\ y_0 = 19.5470 \end{cases}$$

2014

Moon's Center

6

	x	$x - x_0$	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$0 - C$
1	18.0000 + 1.0370	1.0754	4.1270	- 73	
2	18.2826 + 1.3196	1.7414	4.1349	+ 6	
3	18.9204 + 1.9574	3.8314	4.1306	- 37	
4	18.9962 + 2.0332	4.1339	4.1339	- 4	
5	18.9454 + 1.9824	3.9299	4.1351	+ 8	
6	18.3801 - 1.4171	2.0082	4.1197	- 146	
7	18.0000 + 1.0370	1.0754	4.1278	- 65	
8	17.0000 + 0.0370	0.0014	4.1426	+ 83	
9	16.6872 - 0.2758	0.0761	4.1371	+ 28	

Comp R^2 4.1343

	y	$y - y_0$	$0 - y$
1	17.8002 - 1.7468	-1	3.0516
2	18.0000 - 1.5470	-1	2.3935
3	19.0000 - 0.5470	0	0.2992
4	19.5470 0.0000	0	0.0000
5	20.0000 + 0.4530	0	0.2052
6	21.0000 + 1.4530	+1	2.1135
7	21.2940 + 1.7470	+1	3.0524
8	21.5819 + 2.0349	+1	4.1412
9	21.5621 + 2.0151	+1	4.0610

Approx Center

$$x = 18.0 \quad y = 17.8002$$

$$21.2940$$

$$39.0942$$

$$y_0 = 19.5471$$

$$y_{\text{max}} = 21.5819$$

$$R = 2.0348$$

$$x_{\text{max}} = 18.9962$$

$$x_0 = 16.9614$$

$$\text{Center} \begin{cases} x_0 = 16.9630 \\ y_0 = 19.5470 \end{cases}$$

Formation of Normals

	ab	ac	bc
1	- 1.82	- 76.0	+ 127.8
2	- 2.04	+ 7.9	- 9.3
3	- 1.08	- 72.5	+ 20.3
4	+ 0.00	- 8.1	- 0.0
5	+ 0.89	+ 15.8	+ 3.6
6	+ 0.51	- 51.8	- 52.9
7	+ 1.82	- 67.5	- 113.8
8	+ 0.08	+ 3.3	+ 168.4
9	- 0.57	- 7.8	+ 56.5
	- 2.21	- 256.7	+ 200.6
	+ 1.55	- 155.7	+ 158.2
	- 0.66	- 412.4	+ 359.2

giving (6) full wt

Residuals

	c	O	O - C
1	- 23 - 31 = - 54	- 73	- 19
2	- 20 - 28 = - 58	+ 6	+ 64
3	- 44 - 10 = - 54	- 37	+ 17
4	- 46 + 0 = - 46	- 4	+ 42
5	- 44 + 8 = - 36	+ 8	+ 44
6	- 32 + 26 = - 6	- 146	- 140
7	- 23 + 31 = + 8	- 65	- 73
8	- 1 + 26 = + 25	+ 83	+ 48
9	- 6 + 26 = + 20	+ 28	- 3

+ 215 - 235

Average = 50

2014

Moon's Center

7

Conditional Equations

1	+ 1.04	- 1.75	=	- 7.3	- 18 + 23	=	+ 5
2	+ 1.32	- 1.55	=	+ 6	- 22 + 20	=	- 2
3	+ 1.96	- 0.55	=	- 37	- 33 + 7	=	- 26
4	+ 2.03	+ 0.00	=	- 4	- 34 - 0	=	- 34
5	+ 1.98	+ 0.45	=	+ 8	- 34 - 6	=	- 40
$\frac{1}{2} \text{ wt}$ 6	+ 1.42	+ 1.45	=	- 14.6	- 24 - 19	=	- 43
7	+ 1.04	+ 1.75	=	- 65	- 18 - 23	=	- 41
8	+ 0.04	+ 2.03	=	+ 83	- 1 - 27	=	- 28
9	- 0.28	+ 2.02	=	+ 28	+ 5 - 26	=	- 21

Average = 51

Normal Equations

$$\begin{aligned}
 + 16.87 - 221 &= -257 \\
 - 221 + 18.26 &= -201 \\
 + 2.21 - 0.29 &= -34 \\
 + 17.97 &= -235 \\
 + 16.87 - 257 - 29 &= -286
 \end{aligned}$$

$$\begin{aligned}
 b &= -13.1 \\
 a &= -17.0
 \end{aligned}$$

Solution giving (b) full wt.

$$\begin{aligned}
 + 17.87 - 0.66 &= -41.2 \\
 - 0.66 + 19.32 &= +35.9
 \end{aligned}$$

$$\begin{aligned}
 + 0.66 - 0.02 &= -1.5 \\
 + 19.30 &= +34.4
 \end{aligned}$$

$$b = +17.8$$

$$+ 17.87 = -41.2 + 12 = -400$$

$$a = -22.4$$

2014

Moor's Center

7

Conditional Equations

1	+1.04	-1.75	=	-7.3	-18	+23	+5
2	+1.32	-1.55	=	+6	-22	+20	-2
3	+1.96	-0.55	=	-37	-33	+7	-26
4	+2.03	+0.00	=	-4	-34	-0	-34
5	+1.98	+0.45	=	+8	-34	-6	-40
$\frac{1}{2}wv$ 6	+1.42	+1.45	=	-146	-24	-19	-43
7	+1.04	+1.75	=	-65	-18	-23	-41
8	+0.04	+2.03	=	+83	-1	-27	-28
9	-0.28	+2.02	=	+28	5	-26	-21

Average: 51

Normal Equations

$$\begin{aligned}
 +16.87 - 2.21 &= -257 \\
 -2.21 + 18.26 &= -201 \\
 +2.21 - 0.29 &= -34 \\
 +17.97 &= -235 \\
 +16.87 - 2.57 - 29 &= -286
 \end{aligned}$$

$$b = -13.1$$

$$a = -17.0$$

Substitution giving (b) full wt

$$\begin{aligned}
 +17.87 - 0.66 &= -412 \\
 -0.66 + 1.932 &= +359 \\
 +0.66 - 0.02 &= -15 \\
 +1.930 &= +344
 \end{aligned}$$

$$b = +17.8$$

$$+17.87 - 41.2 + 12 = -400$$

$$a = -22.4$$

2014

Moonshinean Position (1912.0)

4

$$\begin{array}{rcl}
 X_0 = 16.9630^\circ & Y_0 = 19.5470^\circ & 16.9630 \quad 19.5470 \\
 \frac{1}{2}a = \quad \quad \quad \frac{1}{2}b = \quad \quad \quad & \quad \quad \quad & \quad \quad \quad \\
 \hline
 16.9622^\circ & 19.5463^\circ & 16.9619 \quad 19.5479
 \end{array}$$

From Plate Constants. $X = 16.8667^\circ$ $Y = 19.5590^\circ$ 19.5606

$$\xi = -1.1333^\circ$$

$$\eta = -2.4410^\circ \quad -2.4394$$

$$\begin{array}{lcl}
 \log 3 = 0.05423^\circ & (0.05434) & \\
 \cos 3 & 9.96959^\circ & \\
 \text{const} & 8.50724 &
 \end{array}$$

$$\begin{array}{lcl}
 \log \tan 5 = 9.5909^\circ & & \\
 \frac{1}{3} & 0.1085^\circ & \\
 \eta_1 = 6.7528^\circ & & \\
 \eta_2 = +6^\circ & &
 \end{array}$$

$$(d-A) = 1.57740^\circ \quad (1.57751)$$

$$\eta_0 = -2.4416^\circ \quad (-2.4400)$$

$$d-A = -37.79^\circ \quad (-37.80)$$

$$A = 3 \quad 14 \quad 57^\circ$$

$$\begin{array}{lcl}
 \log \eta_0 = 0.38768^\circ & (0.38739) & \\
 \text{const} = 7.33115^\circ & &
 \end{array}$$

$$d_0 = 3 \quad 14 \quad 19.21^\circ \quad (19.20)$$

$$S-D = 3.05653^\circ \quad (3.05624)$$

$$\text{Red. ad. L. aff.} + 3.14$$

$$S-D = -18.59.0^\circ \quad (58.3)$$

$$d' = 3 \quad 14 \quad 22.35^\circ \quad (22.34)$$

$$D = +21 \quad 30 \quad 32^\circ$$

$$S_0 = +21 \quad 11 \quad 33.0^\circ \quad (33.7)$$

$$\text{Red. ad. L. aff.} + 18.9^\circ$$

$$S' = +21 \quad 11 \quad 51.9^\circ \quad (52.6)$$

2014 Red. ad l. app.

9

$$\begin{array}{rcl}
 H + \alpha_0 & 8^m & 45^m = 131^\circ 15' \\
 H & 5 & 31 \\
 \alpha_0 & 3 & 14 \\
 G & 21 & 38 \\
 G + \alpha_0 & 24 & 52 = 13^\circ
 \end{array}$$

$$\delta_0 = +21 \quad 12$$

$$\begin{aligned}
 \log \cos \delta &= 0.9081 \\
 \therefore \cos \delta &= \frac{99696}{0.8777}
 \end{aligned}$$

$$\begin{aligned}
 \log \cos (G + \alpha) & 9.9887 \\
 \therefore \cos & 1.2098 \\
 \therefore \sin (G + \alpha) & 9.3521 \\
 \therefore \tan \delta & 9.5887 \\
 \therefore \frac{1}{\tan} & = 8.8239
 \end{aligned}$$

$$\begin{aligned}
 \log \cos (H + \alpha_0) & 9.8191 \\
 \therefore \sin \delta_0 & 9.5583 \\
 \therefore h & 1.2742 \\
 \therefore \sin (H + \alpha_0) & 9.8761 \\
 \therefore \sec \delta & 0.0304 \\
 \therefore \frac{1}{\sec} & = 8.8239
 \end{aligned}$$

$$\begin{aligned}
 \log (g') & 1.1985 \\
 \therefore (g) & 8.9745
 \end{aligned}$$

$$\begin{aligned}
 \log (h') & 0.6516 \\
 \therefore h & 0.0046
 \end{aligned}$$

$$\begin{array}{rcl}
 f & + & 2.04 \\
 g & + & 0.09 \\
 h & + & 1.01 \\
 \hline
 & + & 3.14 \checkmark
 \end{array}$$

$$\begin{array}{rcl}
 (g') & + & 15.79 \\
 (h') & - & 4.48 \\
 (i) & + & 7.55 \\
 \hline
 & + & 18.86 \checkmark
 \end{array}$$

2014 Rec. ad t. app.

9

$$H+X \quad 8^{\circ} \quad 45' \quad : \quad 131^{\circ} \quad 15'$$

$$H \quad 5 \quad 31$$

$$X \quad 3 \quad 14$$

$$G \quad 21 \quad 38$$

$$G+X \quad 24 \quad 52 \quad : \quad 13^{\circ}$$

$$S_0 \quad + \quad 21 \quad 12$$

$$\log \cos \delta = 0.9081$$

$$\cos \delta = 99696$$

$$08777$$

$$\log \cos (G+X) \quad 9.9887$$

$$g \quad 1.2098$$

$$\sin (G+X) \quad 9.3521$$

$$\cos S \quad 9.5887$$

$$\frac{1}{\sin} \quad 8.8239$$

$$\log \cos (H+X) \quad 9.8191$$

$$\sin S_0 \quad 9.5583$$

$$h \quad 1.2742$$

$$\sin (H+X) \quad 9.8761$$

$$\cos S \quad 0.0304$$

$$\frac{1}{\sin} \quad 8.8239$$

$$\log (g')$$

$$1.1985$$

$$g \quad 8.9745$$

$$\log (h')$$

$$0.6516$$

$$h \quad 0.0046$$

$$f \quad + \quad 2.04$$

$$g \quad + \quad 0.09$$

$$h \quad + \quad 1.01$$

$$T \quad 3.14$$

$$(g') \quad + \quad 1.579$$

$$h \quad - \quad 4.48$$

$$i \quad + \quad 7.55$$

$$+ \quad 18.86$$

2014

Lunar Parallax

$$\begin{array}{rcl}
 \alpha' & 3^{\circ} & 14'' & 22.35(34) \\
 \delta & 3 & 34 & 299 \\
 \delta - \alpha & + & 20 & 02.6 \\
 & & + & 5^{\circ} & 00' & 40''
 \end{array}$$

$$+ \quad 2$$

$$+ 4 \quad 59$$

$$9.95727$$

$$0.00000$$

$$0.00164$$

$$\tan f = 9.95891$$

$$f = 42 \quad 17 \quad 37.0''$$

$$+ 21 \quad 11.51.9$$

$$Y - \delta = 21 \quad 05 \quad 45.1''$$

$$9.82640$$

$$8.22033$$

$$9.55622$$

$$0.17203$$

$$\sin \delta - \delta' = 7.77498$$

$$\delta - \delta' = 20 \quad 28.6''$$

$$\delta + 21 \quad 32 \quad 21.2''$$

$$\text{Am Eph } \delta = + 21 \quad 32 \quad 18.2''$$

$$O - C = + 2.3''$$

$$\text{Giving (b) full mt. } \left. \begin{array}{l} \text{error correction} \end{array} \right\} + 2.0$$

$$\text{Cor to stand radia} - 0.1$$

$$O - C \quad (+ 2.9)$$

$$\delta' = + 21^{\circ} \quad 11' \quad 51.9'' \quad (526) \quad 10$$

$$17. \quad 57' \quad 05.8''$$

$$9.86913$$

$$8.22032$$

$$8.94124$$

$$0.03144$$

$$\sin(\delta - \delta') = 7.06213$$

$$\alpha - \alpha' = + 3' \quad 57.99''$$

$$= + 15^{\circ} 87''$$

$$\alpha = 3 \quad 14 \quad 38.22 \quad (3821)$$

$$\alpha = 3 \quad 14 \quad 37.63''$$

$$+ - 0.59''$$

$$(+ 0.58)$$

$$- 0.02$$

$$+ 0.56$$

2014 Lunar Parallax
 $\alpha = 3^h 14^m 22.3^s (34)$
 $\delta = 3^{\circ} 34' 29.9''$
 $\delta - \alpha = +20^{\circ} 02.6'$
 $\sim +5^{\circ} 00' 70''$

$$\delta = +21^{\circ} 11' 54.9'' (526)$$

$$17 \quad 57^{\circ} 05.8'$$

$$9.86913$$

$$8.22032$$

$$8.94124$$

$$0.03151$$

$$s - (\delta - \alpha) \quad 7.06220$$

$$9.95727$$

$$0.00000$$

$$0.00164$$

$$\text{True } \gamma = 9.95891$$

$$\alpha - \alpha' = +3^{\circ} 58' 03''$$

$$+15^{\circ} 87'$$

$$\gamma = 42^{\circ} 17' -37.0$$

$$\delta = 21^{\circ} 11' 51.9$$

$$\gamma - \delta = 21^{\circ} 05' 45.1$$

$$9.82640$$

$$8.22033$$

$$9.55622$$

$$0.17203$$

$$\sin \delta - \delta = 7.77498$$

$$\delta - \delta' = 20^{\circ} 28.6'$$

$$21.2$$

$$\delta + 21^{\circ} 32' - 20.5$$

$$\text{Am Eph } \delta = +21^{\circ} 32' 18.2$$

$$0 - \epsilon = +2.3$$

$$\text{Quint (6) full int } \gamma + 2.0$$

$$\text{Cor. to stand radium } -0.1$$

$$0 - \epsilon = +2.91$$

$$(3821)$$

$$\alpha = 3^h 14^m 38.22^s$$

$$\alpha = 3^h 14^m 37.63^s$$

$$+0.59$$

$$(+0.58)$$

$$-0.02$$

$$+0.56$$

2
13
14
2
17
9
3
2
2

2015 Stars measures. —

1913 December 15.

11

	d	4	v
1	19504	15133	
13.6	1717975	7446	44
29.2	6880	40	
	01	19	
	<u>29.2327</u>	<u>.2321</u>	

	d	x	v
	19475		16662
	1637262		972020
	6670		2020
	69		38
	<u>13.6895</u>		<u>.6925</u>

2	16782	18953	
174	1158080	1415060	
9.6	81	51	
	70	89	
	<u>9.5196</u>	<u>.5183</u>	

	18130	19598
	12256	1544041
	5950	48
	05	28
	<u>17.4140</u>	<u>.4167</u>

3	16518	20154
258	1450000	1217275
233	00	75
	04	79
	<u>232015</u>	<u>.2000</u>

	15152	19132
	12735	1153025
	3630	30
	38	47
	<u>25.7585</u>	<u>.7615</u>

Grade 3 or 4.

2015 Star measures

1913 December 15

11

	d	"	"
1	19504	15133	
136	1717975	744644	
292	6880	40	
	01	19	
	<u>29.2327</u>	<u>2321</u>	

	d	"	"
	19475	16662	
	1637262	972020	
	6670	20	
	69	38	
	<u>13.6895</u>	<u>6925</u>	

	d	"	"
2	16782	18953	
174	1158060	1415060	
96	81	51	
	70	89	
	<u>9.5196</u>	<u>5183</u>	

	d	"	"
	18130	19598	
	1225650	1544041	
	59	48	
	05	28	
	<u>17.4140</u>	<u>4167</u>	

	d	"	"
3	16518	20154	
158	1450000	1217275	
233	00	75	
	04	79	
	<u>232015</u>	<u>2000</u>	

	d	"	"
	15152	19132	
	1273520	1153025	
	36	30	
	38	47	
	<u>25.7585</u>	<u>7615</u>	

Grade 3 or 4.

2015

moon-measures

12

1
18.6
18.8

1 5411
1 2105
90
91
18.6692

1 7103
1 0400
02
03
.6705

2
19.0 19613
18.5 1457060
65
99
18.5041

1 6365
1 135975
61
60
.5003

3
19.2
19.0

19112
1061620
18
90
19.1525

18000
1644943
46
00
.1554

4
19.3
19.5
min
in
2
5
19.1
20.0

18072
9749
4240
60
19.1882

18010
16099
95
02
.1915

6
19.0 17395
20.2 1514855-
41
78
20.2243

18303
1056550
70
98
2263

18021
887579
70
20
19.0855

19032
1815848
54
20
0878

2015

lunar measures

12

1
18.6
188

1 5411
12105-
90 95-
91
18.6692

17103
1040093
02
03
6705

190 19613 16365-
185 1457060 1135975-
65-60 61
99 60
185041 5003

19112
1061620
18
90
19.1525

18000
1644943
46
00
1554

3
92
90

18072
994940
42
60
19.1552

18010
16099
95-85-
02
1915

9
45
45
45

18021
887579
70
20
19.0855

19032
18158
5448
20
6878

5
91
0.0

6
190 17395- 18303
02 1514855- 1056550
91 70
78 98
20.2243 2263

2015

Moon measures

13

2
18.4
21.0

17073
10757 69
6359
61
183695

200 11
163 20 30
30 30
01
3680

8
18.0 15128 15260
21.3 12966 7389
60 60 80 85
18 50
21.2164 12133

9 15190 15230
17.0 11258 70 9130 30
21.4 70 25 30
max 70 20
21.3916 3904
21.3916 3904

maxim = about 213980

2015

Moon measures

10

2
184
21.0

17073
10751
6359
61
183695

20011
16320
3030
01
3680

8
180 15128
21.3 12966
60
18
21.2164

15260
7389
80
50
12133

9
170 15190
214 11258
70
70
21.3916

15230
913030
2130
20
3904

21.3980

2015	Times	etc.	
Sept 29	3 ^h 42 ^m	- 3 ^h 54 ^m	
moon	3 47	48.6 ^v - 3 47	48.8 ^v
clock slow	0	41.4	
H Sid T.	3 48	30.1 ^v	
H long	4 44	31.0 ^v	
G Sid T.	8 33	01.15 ^v	
Sid T. w. moon	12 31	30.79 ^v	
Interval	20 01	30.36	
Radiation	3	16.84 ^v	
G.M.T.	19 58	13.52 ^v 6-X- + 0 ^h 33 ^m	

From Want Alm.	R.A.	Decl.
moon 20 ^h	3 ^h 15 ^m 12.94 ^v + 21° 35'	10.8 ^v
motion in 1 ^m = 2.2326 ^v		10.898 ^v
" " - 1.7747 ^v	- 3.96 ^v	- 19.3 ^v
Tabular place	3 15 08.98 ^v + 21	34 51.5 ^v

Moon's age 19 days.

$$934 = 14.5^v \\ 935 = 14.6$$

fractals	57' 06.0 ^v
semicircle	15 35.1 ^v
R	935.1 ^v
Augmentation	+ 14.6 ^v
Irradiation 304	- 0.7
R	939.0 ^v
R	2.0343 ^v
(1+a) R	2.0336 ^v
R ²	4.1356 ^v

$$a = -3.4$$

2015

Times etc.

14

Sybilian 19.2 Sept. 29 3" 42" 3' 59"
 known 3 +7 486 - 3 47 48.8
 clock flow 0 414

H. Sid. 3 48 30.1
 H. long 4 44 31.05
 G. Sid. 8 33 01.15
 Sid. H. known 12 31 30.79
 T. L. W. 20 01 30.36
 R. L. W. 3 16.84
 G. W. Y. 19 58 13.52 6-4- +0" 33"

From Want. Allen R. A. Dec.
 known 20" 3" 15" 12.94 +21° 35' 10.8
 motion 12" = 2.2326 10.898
 ... -1.7747 - 3.96 - 19.3
 Tabular place 3 15 08.98 +21 34 51.5

known age 19 days.

... parallel 57' 06.0
 15 35.1
 934 = 14.5 R 935.1
 131 = 14.6 +14.6
 Augmentation - 0.7
 Irradiation 3 m. R 9.90
 R 2.0343
 C - 34 (1+2) R 2.0336
 R 4.1356

2015

Plate Constant

15

	1	2	3
x	136910	174154	257600
z	139945	177549	260782
x-z	-3035	-3395	-3182
y	292324	95190	232008
η	297398	100292	237280
y-η	-5074	-5102	-5272

$$\begin{array}{rcl}
 x-z & -17.64 & +3.4x & +3503 \\
 -3035 - 514 & = -3549 & +47 & = -3502 & = +1 \\
 -3395 - 168 & = -3563 & +59 & = -3504 & = -1 \\
 -3182 - 408 & = -3590 & +88 & = -3502 & = +1 \\
 17.1571 & -341 & +58 & & = 17.4791
 \end{array}$$

$$\begin{array}{rcl}
 y-\eta & +17.32 & +1.94 & +4782 \\
 -5074 + 237 & = -4837 & +55 & = -4782 & = 0 \\
 -5102 + 301 & = -4801 & +18 & = -4783 & = -1 \\
 -5272 + 446 & = -4826 & +44 & = -4782 & = 0 \\
 19.3631 & +297 & +37 & & = 19.8747
 \end{array}$$

Tables $a = -0.8$ $a = -0.8$ $a - e = 0.0$ $b + a = 0.0$
 Obs $a = -3.4$ $a = -1.9$ $a - e = -1.5$ $b + a = +0.3$

2011

Plate Constant

15

	1	2	3
x	136910	174154	257600
y	139945	177549	260782
x-3	-3035	-3395	-3182
y	292324	95190	232008
y	297398	100292	237280
y-y	-5074	-5102	-5272

$$\begin{array}{rcl}
 x-3 & -17.64 & +34x & +3503 \\
 -3035 & -514 & -3599 + 47 & -3502 = +1 \\
 -3395 & -168 & -3563 + 59 & -3504 = -1 \\
 -3182 & -408 & -3590 + 88 & -3502 = +1 \\
 17.1571 & -341 & +58 & -17.4791
 \end{array}$$

$$\begin{array}{rcl}
 y-y & +17.32 & +1.94 & +4782 \\
 -5074 & +237 & -4837 + 58 & -4782 = 0 \\
 -5102 & +301 & -4801 + 18 & -4783 = -1 \\
 -5272 & +446 & -4826 + 44 & -4782 = 0 \\
 19.3631 & +297 & +37 & = 19.8747
 \end{array}$$

Tables $a = -0.8$ $a = -0.8$ $a - a = 0.0$ $b + a = 0.0$
 (lbs) $a = -3.4$ $a = -1.9$ $a - a = -1.5$ $b + a = +0.3$

pk	pos. L	resid.
1	132.1	+110
2	115.1	+18
3	100.3	-162
4	90.0	-38
5	71.7	-71
6	65.0	+38
7	36.6	+122
8	24.5	+38
9	355.7	+60

2015

Lewors Center

16

	x	$x - x_0$	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$0 - c$
1	18.6698 + 1.5142	2.2928	4.1530	+ 1.74	
2	19.0000 + 1.8444	3.4018	4.1441	+ 8.5	
3	19.1540 + 1.9984	3.9936	4.1260	- 9.6	3/4
4	19.1898 + 2.0342	4.1380	4.1380	+ 2.4	
5	19.0866 + 1.9310	3.7288	4.1336	- 2.0	
6	19.0000 + 1.8444	3.4018	4.1439	+ 8.3	
7	18.3688 + 1.2132	1.4719	4.1494	+ 1.38	1/2
8	18.0000 + 0.8444	0.7130	4.1396	+ 4.0	
9	17.0000 - 0.1556	0.0242	4.1341	- 1.5	

$$\text{Comp } R^2 = 4.1356$$

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	18.0000 - 1.3638	- 1	1.8602	
2	18.5022 - 0.8616	0	0.7423	
3	19.0000 - 0.3638	0	0.1324	
4	19.3638 0.0000	0	0.0000	
5	20.0000 + 0.6362	0	0.4048	
6	20.2253 + 0.8615	0	0.7421	
7	21.0000 + 1.6362	+ 1	2.6775	
8	21.2148 + 1.8510	+ 1	3.4266	
9	21.3910 + 2.0272	+ 1	4.1099	

Approx. Center $x = 19.0$

$$y = 18.5022$$

$$\underline{20.2253}$$

$$38.7275$$

$$y_0 = 19.3638$$

$$y_{\text{max}} = 21.3980$$

$$R = 2.0342$$

$$x_{\text{max}} = 19.1898$$

$$x_0 = 17.1556$$

$$\text{Center } \begin{cases} x_1 = 17.1556 \\ y_1 = 19.3638 \end{cases}$$

2015

Linnorms Center

16

	x	$x - x_0$	$(x - x_0)^2$	$(x - x_0)(y - y_0)$	$y - y_0$
1	186698	+15142	22928	41530	+174
2	190000	+18444	34018	41441	+85
3	191540	+19984	39936	41260	-96
4	191898	+20342	41380	41380	+24
5	190866	+19310	37288	41336	-20
6	190000	+18444	34018	41439	+83
7	183688	+12132	14719	41444	+138
8	180000	+08444	07130	41396	+40
9	170000	-01556	00242	41341	-15

Comp $\Sigma = 41356$

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	180000	-13638	-1	18602
2	185022	-08616	0	07423
3	190000	+03638	0	01324
4	193638	00000	0	00000
5	200000	+06362	0	04048
6	202253	+08615	0	07421
7	210000	+16362	+1	26775
8	212148	+18510	+1	34266
9	213910	+20272	+1	41099

Aphrs Center $X = 19.0$ $y = 18.5022$ 203253

387275

 $y_0 = 19.3638$ $y_{\text{max}} = 21.3980$ $R = 20342$ $z_{\text{max}} = 19.1898$ $x_0 = 17.1556$ Center $\begin{cases} X_0 = 17.1556 \\ Y_0 = 19.3638 \end{cases}$

Formation of kounts

	at	an	bn
1	- 2.06	+ 263.0	- 236.7
2	- 1.58	+ 156.5	- 73.1
3	- 0.18	- 48.0	+ 86
4	+ 0.00	+ 48.8	+ 00
5	+ 1.23	- 38.6	- 12.8
6	+ 1.58	+ 152.9	+ 71.4
7	+ 0.50	+ 41.8	+ 56.5
8	+ 1.55	+ 33.6	+ 74.0
9	- 0.32	+ 2.4	- 30.5
	+ 0.72	+ 612.4	- 142.6

Residuals

O	C	O - C
+ 1.74	+ 49 + 19 = + 68	+ 106
+ 85	+ 60 + 12 = + 72	+ 13
- 96	+ 65 + 5 = + 70	- 166
+ 24	+ 66 - 0 = + 66	- 42
- 20	+ 63 - 9 = + 54	- 74
+ 83	+ 60 - 12 = + 48	+ 35
+ 138	+ 39 - 23 = + 16	+ 122
+ 40	+ 27 - 26 = + 1	+ 39
- 10	- 5 - 28 = - 33	- 18
		+ 315 - 300
		Average = 68

2015

Huron's Centaur

17

Conditional Equations

	a	b	c	0 - c	
1	+ 1.51	- 1.36	= + 1.74	+ 46 + 18 = + 64	+ 110
2	+ 1.84	- 0.86	= + 85	+ 56 + 11 = + 67	+ 18
3	+ 2.00	- 0.36	= - 96	+ 61 + 5 = + 66	- 162
4	+ 2.03	+ 0.00	= + 24	+ 62 - 0 = + 62	- 38
5	+ 1.93	+ 0.64	= - 20	+ 59 - 8 = + 51	- 71
6	+ 1.84	+ 0.86	= + 63	+ 56 - 11 = + 45	+ 38
7	+ 1.21	+ 1.64	= + 138	+ 37 - 21 = + 16	+ 122
8	+ 0.84	+ 1.85	= + 40	+ 26 - 24 = + 2	+ 38
9	- 0.16	+ 2.03	= - 15	- 49 - 20 = - 75	+ 60

Average = 73

Normal Equations

$$\begin{aligned}
 +20.43 + 0.72 &= +612 \\
 +0.72 + 12.69 &= -143 \\
 -0.72 - 0.03 &= -22 \\
 +12.66 &= -165 \\
 +20.43a &= +612 + 9 = +621
 \end{aligned}$$

$$b = -13.1$$

$$a = +30.5$$

Corrected sol. giving 3 + 7 inst

$$\begin{aligned}
 +19.07 + 0.73 &= +612 \\
 +0.72 + 11.99 &= -143 \\
 -0.72 - 0.03 &= -23 \\
 +11.96 &= -166 \\
 +19.07 &= +612 + 7 = +619
 \end{aligned}$$

$$b = -13.9$$

$$a = +32.4$$

Are measured = 136

$$\frac{P_0}{m} = 0.09$$

Average (0 - c) = +1.7

$$+ \frac{1.7}{0.9} = +0.22 \quad \Delta n = +0.2$$

Wagner's Cautions

Concluded Equations

Answer = 73

Normal Equation

$$66 + 30.5$$

Corrected sol giving 3 + 7 inv

$$C = \frac{1}{2} + \frac{1}{2} = 1$$

Average 0-6 $+ + 1.7$

$$+\frac{1.7}{1.9} = +0.22 \quad \Delta n = +0.2$$

Red. ad. 2. uph

$$\begin{array}{rcl}
 H + 4 & 8 & 45 = 131^{\circ} 15' \\
 \# & 5 & 30 \\
 + & 3 & 15 \\
 Q & 21 & 38 \\
 2 + 8 & 0 & 53 = 13^{\circ} 15'
 \end{array}$$

$$\begin{array}{rcl}
 \cos (Q + u) & 9.9883 \\
 g & 1.2098 \\
 \sin \alpha & 9.3602 \\
 \tan \alpha & 9.5894 \\
 \frac{1}{\sin} & 8.8239
 \end{array}$$

$$\begin{array}{rcl}
 8' & 1.1981 \\
 9 & 89833
 \end{array}$$

$$\begin{array}{rcl}
 h & +2.04 \\
 g & +0.10 \\
 h & +1.01 \\
 \hline
 & +3.15
 \end{array}$$

$$S = +21^{\circ} 14'$$

$$\begin{array}{rcl}
 \cos S & 9.9695 \\
 \sin & 0.9079 \\
 (L) & 0.8774
 \end{array}$$

$$\begin{array}{rcl}
 \sin S & 9.5589 \\
 \cos (H + \alpha) & 9.8191 \\
 h & 1.2743 \\
 \sin \alpha & 9.8761 \\
 \sec S & 0.0305 \\
 \frac{1}{\sin} & 8.8239
 \end{array}$$

$$\begin{array}{rcl}
 8' & 0.6523 \\
 h & 0.0048
 \end{array}$$

$$\begin{array}{rcl}
 8' & +1.578 \\
 h & -4.49 \\
 L & +7.54 \\
 \hline
 & -18.83
 \end{array}$$

2015 Moon's Mean Position (1912.0)

18

$$\begin{array}{rcl}
 X_0 & = & 17.1556^{\circ} \\
 \frac{1}{2}a & = & +15^{\circ} \\
 \hline
 & & 17.1571^{\circ}
 \end{array}
 \qquad
 \begin{array}{rcl}
 Y_0 & = & 19.3638^{\circ} \\
 \frac{1}{2}b & = & -7^{\circ} \\
 \hline
 & & 19.3631^{\circ}
 \end{array}$$

From plate constants $X = 17.4791^{\circ}$ $Y = 19.8747^{\circ}$

$$\bar{s} = -0.5209^{\circ}$$

$$\eta = -2.1253^{\circ}$$

$$\log \bar{s} = 9.71675^{\circ}$$

$$\log \tan \delta = 9.5879$$

$$\log \bar{s} = 9.96947^{\circ}$$

$$\log \bar{s} = 9.4335^{\circ}$$

$$\log \text{const} = 8.50724$$

$$\log \eta = 6.0748$$

$$\log (\alpha - \alpha_0) = 1.24004^{\circ}$$

$$\eta = +1$$

$$\alpha - \alpha_0 = 17.38^{\circ}$$

$$\eta_0 = -2.1254^{\circ}$$

$$A = 3^{\circ} 14 57^{\circ}$$

$$\log \eta_0 = 0.32744^{\circ}$$

$$\alpha_0 = 3^{\circ} 14 39.62^{\circ}$$

$$(\alpha - \alpha_0) = 2.99629^{\circ}$$

$$\text{Red. alt. app.} = +3.15^{\circ}$$

$$\delta - \delta_0 = -16 31.5^{\circ}$$

$$\alpha' = 3^{\circ} 14 42.77^{\circ}$$

$$\delta + 21 30 32^{\circ}$$

$$\delta_0 + 21 14 00.5^{\circ}$$

$$\text{Red. alt. app.} = +18.8^{\circ}$$

$$\delta' + 21 14 19.3^{\circ}$$

2015 known mean Position (1912.0)

18.

$$X_0 = 17.1556$$

$$Y_0 = 19.3638$$

$$\begin{array}{r} + 15 \\ \hline 17.1571 \end{array}$$

$$\begin{array}{r} - 7 \\ \hline 19.3631 \end{array}$$

From plate constants $X = 17.4791$ $Y = 19.8747$

$$z = -0.5209$$

$$\eta = -2.1253$$

$$\log T = 9.71675$$

$$\log \tan \delta = 9.5879$$

$$\log S = 9.96947$$

$$S = 9.4335$$

$$\log w = 8.50729$$

$$\eta = 6.0748$$

$$(9 - 15) = 1.24004$$

$$\eta = +1$$

$$\eta_0 = -2.1254$$

$$X - H = 17.38$$

$$\log \eta = 0.32744$$

$$4 \quad 3'' \quad 14 \quad 57$$

$$733115$$

$$A_0 \quad 3 \quad 14 \quad 39.62$$

$$(H - D) = 2.49629$$

$$\text{Red. ad. aph} = 3.18$$

$$\delta - 1) = -16 \quad 31.5$$

$$X' \quad 3 \quad 14 \quad 42.77$$

$$D + 21 \quad 30 \quad 32$$

$$S_0 + 21 \quad 14 \quad 00.5$$

$$\text{Red. ad. aph} = 18.8$$

$$\delta' + 21 \quad 14 \quad 19.3$$

2015 Lunar Parallax.

$$\begin{array}{rcl}
 \alpha' & = & 3^{\circ} 14' 42.77'' \\
 \delta & = & 3^{\circ} 48' 30.1'' \\
 \delta - \alpha' & = & + 33' 47.3'' \\
 & + & 8'' 26.50'' \\
 & + & 3' 20'' \\
 & + & 8' 23' 30''
 \end{array}$$

$$\begin{array}{r}
 9.95727 \\
 0.00000 \\
 \hline
 000467 \\
 996194
 \end{array}$$

$$\gamma = 42' 29' 33.7''$$

$$\delta = 21' 14' 19.4''$$

$$21' 15' 14.3''$$

$$\begin{array}{r}
 9.82640 \\
 9.22034 \\
 9.55931 \\
 0.17038 \\
 \hline
 \sin(\delta - \delta') = 7.77643
 \end{array}$$

$$\delta - \delta' = 20' 32.7''$$

$$\delta = +21' 34' 52.0''$$

$$\text{Ann Eph } \delta = +21' 34' 51.5''$$

$$O-C = + 0.5''$$

$$\delta' = +21^{\circ} 14' 19.3''$$

$$\pi = 57.06.0''$$

$$\begin{array}{r}
 9.86913 \\
 8.22034 \\
 9.16702 \\
 0.03156 \\
 \hline
 \sin(\alpha - \alpha') = 7.28805
 \end{array}$$

$$\sin(\alpha - \alpha') = 7.28805''$$

$$\alpha - \alpha' = + 6' 40.39''$$

$$+ 26.69''$$

$$\alpha = 3' 15' 09.46''$$

$$\alpha = 3' 15' 08.98''$$

$$0.48''$$

2015" Linear Parallax

$$\begin{array}{r}
 \alpha' : 3' 14'' 42.77 \\
 \theta \quad 3 \quad 48 \quad 30.1 \\
 \theta - \alpha' : + 33 \quad 47.3 \\
 \quad \quad + \quad 8'' \quad 26 \quad 50''
 \end{array}$$

$$\begin{array}{r}
 + \quad \quad \quad 3 \quad 20 \\
 + \quad 8 \quad 23 \quad 30
 \end{array}$$

$$\begin{array}{r}
 995727 \\
 000000 \\
 \hline
 000467 \\
 996194
 \end{array}$$

$$\gamma \quad 42 \quad 29 \quad 33.7$$

$$\delta \quad 21 \quad 14 \quad 19.4$$

$$21 \quad 15 \quad 14.3$$

$$\begin{array}{r}
 982640 \\
 922034 \\
 955931 \\
 \hline
 017038
 \end{array}$$

$$\sin(\alpha - \delta) = 7.77643$$

$$\delta - \delta' = 20 \quad 32.7$$

$$\delta = +21 \quad 34 \quad 52.0$$

$$\text{Ann Eph } \delta = +21 \quad 34 \quad 51.5$$

$$0 - 0 \quad \quad \quad + 0.5$$

$$\delta' = +21' 14' 19.3$$

$$\pi \quad 57 \quad 06.0$$

$$\begin{array}{r}
 9.86913 \\
 8.22034 \\
 9.16702 \\
 \hline
 0.03156
 \end{array}$$

$$\sin(\alpha - \delta) = 728805$$

$$\alpha - \alpha' = + 6' 40.39$$

$$+ 26.69$$

$$\alpha = 3 \quad 15' 09.45$$

$$\alpha \quad 3 \quad 15 \quad 08.98$$

$$0.48$$

1
12
18
2
1
2
3
1
1

2074

Stars - measures

1913 Dec. 17.

20

	d	n	d	n
120	19145	19731	13561	1325960
186	1252530	1633136	1316260	66
	2031	3536	7260	12871
	50	24		
	<u>18.6621</u>	<u>.6605</u>	<u>11.9602</u>	<u>.9609</u>
2				
18.7	17100	17549	17147	17815
29.3	1469790	994044	1487175	1006660
	96	50	70	61
	05	34	45	05
	<u>29.2407</u>	<u>2407</u>	<u>18.7725</u>	<u>.7745</u>
3				
29.2	10830	1343133	17442	14972
17.1	1026464	36	900905	1337870
	58	12863	00	72
			20	63
	<u>17.0568</u>	<u>.0570</u>	<u>29.1581</u>	<u>.1598</u>

Grade 3.

2074

Stars - measures

1913 Dec. 17.

20

	d		d		d
1	19145	19731	13561	1325960	
120	1252530	1633136	1312260	66	
186	2031	3536	7260	12871	
	50	24			
	<u>18.6621</u>	<u>.6606</u>	<u>11.9602</u>	<u>9609</u>	
3					
187	17100	17549	17147	17815	
213	1469790	994044	1487175	1006660	
	96	50	70	61	
	05	34	45	05	
	<u>292407</u>	<u>2407</u>	<u>157725</u>	<u>7745</u>	
5					
192	10830	1343133	17442	14972	
171	1026464	3633	900905	1337870	
	5864	12863	00	7270	
			20	63	
	<u>17.0568</u>	<u>0570</u>	<u>291581</u>	<u>1598</u>	

Grade 3

2074

moon - measures

21

	d	4	n	d	2	n
1	19939		14930			
18.0	1816152		671818			
17.3	42		30			
min	25		22			
4	<u>171784</u>		<u>1799</u>			
8						
17.0	20002		15868			
174	15850		1000001			
	42	42	90			
	89		64			
	<u>174152</u>		<u>4131</u>			

3

16.4

18.0

4 scratch

16.2	18060		17349
18.5	13147		12219
	0095		1921
	50		41
	<u>18.4858</u>		<u>4875</u>

5

16.0

19.0+

min

2

6 scratch

16.1	17834		18197
19.5	11590		1444050
	9596		50
	40		98
	<u>19.6243</u>		<u>6250</u>

19710	16777
1314950	1332722
40	1022
90	67
<u>163449</u>	<u>3454</u>

19660	17991
10689	1698990
8582	90
63	81
<u>16.1022</u>	<u>1000</u>

11448	1297879
11080	71
7077	12920

<u>15.9928</u>	<u>9944</u>
10750	15300
4947	1467054
10119	5555
<u>16.0630</u>	<u>0642</u>

2079

Moon - measures

21

	d	4			
1	19939		14930		
170	1816152		671818		
173	42		30		
	25		22		
	<u>17.1784</u>		<u>1799</u>		
170	20002		15868		
174	1585042		1000001		
	42		90		
	89		64		
	<u>174152</u>		<u>4131</u>		

3
164
150

4 Scratch

162	18060		17349
165	131970095		1221921
	50		41
	<u>184858</u>		<u>4875</u>

5
160
140
120
100
80
60
40
20

6 Scratch

161	17834		18197
175	115909596		1494050
	40		98
	<u>196243</u>		<u>6250</u>

19710	16777
1319950	1332722
40	1022
90	67
<u>163449</u>	<u>3454</u>

19660	17991
10689	1698990
8582	90
63	81
<u>161022</u>	<u>1000</u>

11848	1297879
1108077	71
7077	12920

<u>159928</u>	<u>9944</u>
1075047	15300
49	1467054
10119	5555
<u>160630</u>	<u>6642</u>

7
2
16
20
8
17.
20

2074

snow-measure

22

2
163
20.0

16501
857670
70
85
16,2084

19218
1712128
27
22
.2094

8
M.O
W7
16231
81128
1818
27
20.8112

19581
1769084
50
77
.8105

2074

a

4

v

d

n

22

2

16501

19218

143

857670

1712128

20.0

70

27

85

22

1620842094

x

170

16231

19581

27

81128

1769084

18

50

27

77

2081128105

2074

Times etc.

v3

Eph. to stan	1913 Oct 21	21 ^h	30 ^m		- 21 ^h	42 ^m	
... moon		21	35	39.7 ^v	- 21	35	39.9 ^v
H. Sid clock low			0	24.4 ^v			
H. Sid T.		24	36	04.2 ^v			
H. hong		44	44	31.05 ^v			
G. Sid T.		26	20	35.25 ^v			
Sid T. in moon		13	58	14.98 ^v			
Interval		12	22	20.27 ^v			
Reduction			2	01.61 ^v			
G. h. 4.		12	20	18.66 ^v			

from hant. Alm				R. A.			Decl.
Moon 12 ^h	22 ^h	53 ^m	51.315 ^v		- 10°	01'	22.5 ^v
Motion in ^m							
" " W. 311 ^v							
Tabular place	22	54	28.17 ^v		- 9	56	44.3 ^v

Moon's age 11 days.

939 = 8.9	parallax	54°	40.2 ^v
895 = 8.2	semidiameter	14	55.4 ^v
	R		895.4 ^v
	Augmentation		+ 8.2 ^v
	Irradiation (3)		- 0.7 ^v
	R		902.9 ^v
	R		1.9355 ^v
a - - 0.3	(1+a)R		1.9354 ^v
	R ²		3.7458 ^v

2074

Times etc.

v3

Eph. to Jan	1913 Oct. 21	21"	30"	- 21"	42"
moon		21	35	397	- 21 35 399
H. Sid. I.			0	244	
H. Sid. I.		24	3'6	042	0-12-1" 18"
H. Sid. I.		44	44	31.05	
G. Sid. I.		26	20	35.25	
Sid. I. in moon		13	58	14.98	
Interval		12	22	20.27	
Reduction			2	01.01	
G. Sid. I.		12	20	18.66	

From hand Alman		R. G.		Red.
moon 12"	22"	53"	51.5	- 10" 01' 22.5"
moon 11"	1.8227			13.696
20.311		43702		+ 4 382
Tabular place	22	54	28.17	- 9 56 443

Moon's age 11 days

939	8.9	parallax	54"	40.2
875	8.2	semidiam	14	5.54
		R		895.4
		Circumference		+ 8.2
		radial 131		- 0.7
		R		902.9
		R		1.9355
0 - - 0.3		(1+a)R		1.9354
		R		3.7458

2074

Plate Constant

24

x	y	R.A	Decl.
11.9606	18.6614	22 52 13	-10 43 58
18.7735	29.2407	22 55 44	-9 21 08
29.1590	17.0569	23 00 02	-10 54 46
3 59.89	64.96	7 10.7	59 1-30 58 11.2
19.96	21.65	22 56 00	-10 19 57
-1.8	-22.	- 1"	+ 2 43
1.96	.35	22 55 00	-10 17 14
31	465		
61 ⁵			

$$A = 22^h 55^m 00$$

$$D = -10^{\circ} 17' 14''$$

$$\begin{array}{rclcl}
 x-3 & -114.64 & +.3x & +9.633 & \\
 -7498 & -2139 & = -9637 & +4 & = -9633 \\
 -6287 & -335 & = -9638 & +6 & = -9632 \\
 -7688 & -1955 & = -9643 & +9 & = -9634 \\
 17.9295 & -2190 & +5 & & = 18.6743
 \end{array}$$

$$\begin{array}{rclcl}
 y-m & +110.7x & +5.5y & -2480 & \\
 +1053 & +7324 & = +2377 & +103 & = +2480 \\
 +241 & +2078 & = +2319 & +161 & = +2480 \\
 -842 & +3228 & = +2386 & +94 & = +2480 \\
 19.1129 & +1985 & +105 & & = 19.0739
 \end{array}$$

$$\begin{array}{llll}
 \text{Tabes.} & a = +0.2 & e = -4.8 & a-e = +5.0 & b+a = +3.6 \\
 \text{Obs} & a = -0.3 & e = -5.5 & a-e = +5.2 & b+a = +3.9
 \end{array}$$

2074

Plate Constant

24

z	y	$R.A.$	$\mu\text{Sec.}$
11.9606	18.6614	22 52 13 -10	43 58
18.7735	29.2407	22 55 44 -9	21 08
29.1590	17.0569	23 00 02 -10	54 41
5 59.89	64.96	7 107 59 -30	58 11.2
1996	21.65	22 56 00 -10	19 57
-15	-22	-1	+20 43
196	.35	22 55 00 -10	17 14
31	465		
61			
		A = 22 55 00	
		D = -10 17 14	

$$\begin{array}{rclcl}
 z-3 & -114.64 & +.32 & +9633 & \\
 -7498 & -2139 & = -9637 & +9 & = -9633 & = 0 \\
 -6287 & -3311 & = -9638 & +6 & = -9632 & = +1 \\
 -7688 & -1915 & = -9643 & +9 & = -9634 & = -1 \\
 17.9295 & -2190 & +5 & & = 18.6743 &
 \end{array}$$

$$\begin{array}{rclcl}
 y-m & +110.72 & +5.54 & -2480 & \\
 +1053 & +8329 & = +2377 & +103 & = +2480 & = 0 \\
 +241 & +2478 & = +2319 & +161 & = +2480 & = 0 \\
 -842 & +3228 & = +2386 & +94 & = +2480 & = 0 \\
 19.1129 & +1985 & +105 & & = 19.0739 &
 \end{array}$$

Tables. $a = +0.5$ $c = -4.8$ $a-b = +5.0$ $b+a = +3.5$
 Obs. $a = -0.3$ $c = -5.5$ $a-c = +5.2$ $b+a = +3.9$

2074 Standard Coordinates

25

Cape No. 3182 mag 8.6				Cape No. 3194 mag 6.8				Cape No. 3213 mag 7.1			
C	22	51	34.80	22	55	06.59	23	00	40.01	✓	
L			82			62			05		
B			82			57			63		
mean	22	51	34.82	22	55	06.59	23	00	40.03		
Pre		+	37.76		+	37.60		+	37.66		
X	22	52	12.58	22	55	44.19	23	01	17.69		
A	22	55	00	22	55	00	22	55	00		
$\alpha - A$	-	2	47.42		+	44.19		+	6	47.69	
$\sin(\alpha - A)$		-	1.67.42		+	44.19		+	377.64		
log.	2.22381	m		1.64532			2.57708				
-ws	9.99233			9.99419			9.99207				
-B	0.72338	m		0.14675			1.07639				
β_0	-5.2891			+1.4020			+1.9231				
β_1	-	5		+	2		+	47			
β_2	12.7104			19.4022			29.9278				
α	11.9606			18.7735			29.1590				
$\alpha - \beta$	-7.498			-6.287			-7.688				
C	-10	47	47.9	-9	24	58.5	-10	58	38.4		
L			47.3			58.1			38.4		
B			48.3			58.1			39.2		
mean	-10	47	47.8	-9	24	58.2	-10	58	38.7		
Pre		+	3	50.0		50.7		+	3	52.6	
B	-10	43	57.8	-9	21	07.5	-10	54	46.1		
D	-10	17	14	-10	17	14	-10	17	14		
$\delta - D$	-	26	43.8		+	56	06.5		-37	32.1	
$\tan(\delta - D)$		-	1.603.8		+	33	66.8		-22	52.2	
log.	3.20515	m		3.52721			3.35261	m			
-m	0.53630	m		0.85836			0.68376	m			
$\tan \delta$	9.2777	m		9.2168	m		9.2850	m			
-3	14.468			0.2935			2.1528				
- η	7.7779	m		6.5637	m		8.4912	m			
η_0	-3.4379			+7.2170			-4.8279				
η_1	-	60		-	4		-	310			
η	18.5561			29.2166			17.1411				
η	18.6614			29.2407			17.0569				
$\eta - m$	+10.53			+2.41			-8.42				

2074 Standard Coordinates

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Capulin 3182-48.6				Capulin 3194-48.6				Capulin 3213-48.6			
C	22	51	34.80	22	55	06.59	23	00	40.01		
L			83			62			05		
E			82			57			63		
Mean	22	51	34.82	22	55	06.59	23	00	40.03		
Prec		+	37.76		+	37.60		+	37.66		
X	22	52	12.58	22	55	44.19	23	01	17.69		
A	22	55	00	22	55	00	22	55	00		
A-A	-	2	47.42		+	44.19		+	6	17.69	
W-A		-	1.67.42		+	44.19		+	37.76		
log	2.22381~			1.64532				2.57708			
mag	9.99233			9.99419				9.99207			
3.	0.72338~			0.14675~				1.07639			
3.	-5.2891			+1.4020				+1.19231			
3.	-	5		+	2			+	47		
3	12.7104			19.4023				29.9278			
2	11.9606			18.7735~				29.1590			
2-3	-7.498			-6.287				-7.688			
C	-10	47	47.9	-9	24	58.5	-10	58	38.4		
L			47.3			58.1			38.4		
E			48.3			58.1			39.2		
Mean	-10	47	47.8	-9	24	58.2	-10	58	38.7		
Prec		+	3	50.0		50.7		+	3	52.6	
8	-10	43	57.8	-9	21	07.5	-10	54	46.1		
D	-10	17	14	-10	17	14	-10	17	14		
S-D	-	26	43.8		+	56	06.5	-	37	32.1	
(S-D)		-	1.6038		+	33	66.8		-	22	52.2
log	3.20515~			3.52721				3.35261~			
mag	0.53630~			0.85836				0.68376~			
10ms	9.2777~			9.2168~				9.2850~			
5	14.468			0.2935				2.1528			
4	7.7779~			6.5637~				8.4912~			
3	-3.4379			+7.2170				-4.8279			
2	-	60		-	4			-	390		
1	18.5561			29.2166				17.1412			
0	18.6614			29.2407				17.0569			
4-0	+10.53			+24.1				-8.42			

ph	pos. $\angle$	resid.
1	177°8	+22
2	208.6	+54
3	235.0	+27
4	251.1	-108
5	270.0	+20
6	285.4	-18
7	297.4	+33
8	331.4	+46

2074

Moon's Center.

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	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)^2 + (y - y_0)^2$	$0 - c$
1	18.0000	+0.0731	+7	00055	3.7467	+9
2	17.0000	-0.9269	+6	0.8580	3.7449	-9
3	16.3452	-1.5817	+4	2.5005	3.7393	-65
4	16.1011	-1.8258	+2	3.3328	3.7249	-209
5	15.9936	-1.9333	0	3.7377	3.7377	-81
6	16.0636	-1.8633	-2	3.4726	3.7350	-108
7	16.2089	-1.7180	-3	2.9526	3.7409	-49
8	17.0000	-0.9269	-6	0.8602	3.7471	+13

$$\text{Comp } R^2 = 3.7458$$

	y	$y - y_0$	Δy	$(y - y_0)^2$
-1	17.1792	-1.9333	-9	3.7412
2	17.4142	-1.6983	-8	2.8869
3	18.0000	-1.1125	-5	1.2388
4	18.4866	-0.6259	-3	0.3921
5	19.1125	0.0000	0	0.0000
6	19.6246	+0.5121	+2	0.2624
7	20.0000	+0.8875	+4	0.7883
8	20.8108	+1.6983	+8	2.8869

Affine Center

$$x = 17.0 \quad y = 17.4142$$

$$20.8108$$

$$3.82250$$

$$y_0 = 19.1125$$

$$y - \text{min} = 17.1792$$

$$R = 1.9333$$

$$x - \text{min} = 15.9936$$

$$x_0 = 17.9269$$

$$\text{Center} \begin{cases} x_0 = 17.9269 \\ y_0 = 19.1125 \end{cases}$$

2074

Known Center.

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	x	$x - x_0$	Δx	$(x - x_0)^2$	$(x - x_0)(y - y_0)$	$y - y_0$
1	18.00000	+0.0731	+7	0.0055	3.7467	+9
2	17.00000	-0.9269	+6	0.8586	3.7449	-9
3	16.3452	-1.5817	+4	2.5005	3.7393	-65
4	16.1011	-1.8258	+2	3.3328	3.7249	-209
5	15.9936	-1.9333	0	3.7377	3.7377	-81
6	16.0636	-1.8633	-2	3.4726	3.7350	-108
7	16.2089	-1.7180	-3	2.9526	3.7409	-49
8	17.00000	-0.9269	-6	0.8602	3.7471	+13

Comp $\bar{R}^2$: 3.7458

	y	$y - y_0$	Δy	$(y - y_0)^2$
1	17.1792	-1.9333	-9	3.7412
2	17.4142	-1.6983	-8	2.8869
3	18.0000	-1.1125	-5	1.2388
4	18.4866	-0.6259	-3	0.3921
5	19.1125	0.0000	0	0.0000
6	19.6246	+0.5121	+2	0.2624
7	20.0000	+0.8875	+4	0.7883
8	20.8108	+1.6983	+8	2.8869

After Center

$$x = 17.0 \quad y = 17.4142$$

$$\underline{20.8108}$$

$$3.82250$$

$$y_0 = 19.1125$$

$$y - \text{min} = 17.1792$$

$$R = 1.9333$$

$$x - \text{min} = 15.9936$$

$$x_0 = 17.9269$$

$$\text{Center} \begin{cases} x_0 = 17.9269 \\ y_0 = 19.1125 \end{cases}$$

Formation of homologs.

	ab	ac	bc
1	- 0.13	+ 0.6	- 17.4
2	+ 15.8	+ 8.4	+ 15.3
3	+ 17.5	+ 102.8	+ 72.1
4	+ 11.5	+ 382.5	+ 131.8
5	- 0.00	+ 156.2	- 0.0
6	- 0.95	+ 201.0	- 55.1
7	- 1.53	+ 84.3	- 43.6
8	- 1.58	- 12.1	+ 22.1
	+ 0.29	+ 923.7	+ 125.2

2074

Moon's Center
Conditional Equations

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	a	b	0		c	0-c	
1	+ 0.07	- 1.93	= + 9	+ 4	- 17	= - 13	+ 22
2	- 0.93	- 1.70	= - 9	- 48	- 15	= - 63	+ 54
3	- 1.58	- 1.11	= - 65	- 82	- 10	= - 92	+ 27
4	- 1.83	- 0.63	= - 209	- 95	- 6	= - 101	- 108
5	- 1.93	+ 0.00	= - 81	- 101	+ 0	= - 101	+ 20
6	- 1.86	+ 0.51	= - 108	- 97	+ 5	= - 92	- 18
7	- 1.72	+ 0.89	= - 49	- 90	+ 8	= - 82	+ 33
8	- 0.93	+ 1.70	= + 13	- 48	+ 15	= - 33	+ 46

Average = 41

Normal Equation

$$\begin{aligned}
 &+ 17.72 + 0.29 = + 924 \\
 &+ 0.29 + 12.20 = + 125 \\
 &- 0.29 - 0.00 = - 15 \\
 &\quad + 12.20 = + 110 \\
 &- 17.72 = + 924 - 3 = + 921
 \end{aligned}$$

$$\begin{aligned}
 b &= + 9.0 + \\
 a &= + 52.0
 \end{aligned}$$

2074

Miron's center

26

Conditional Equations

	a	b	c	d	e	f	g-h
1	+0.07	-1.93	+9	+0.4	-1.7	-1.3	+2.2
2	-0.93	-1.70	-9	-4.8	-1.5	-6.3	+5.4
3	-1.58	-1.11	-6.5	-8.2	-1.0	-9.2	+2.7
4	-1.83	-0.63	-2.09	-9.5	-6.2	-10.1	-10.4
5	-1.93	+0.00	-8.1	-10.1	0	-10.1	+2.0
6	-1.86	+0.51	-10.8	-9.7	-5	-9.2	-1.4
7	-1.72	+0.89	-4.9	-9.0	-8	-8.2	+3.3
8	-0.93	+1.70	+1.3	-4.8	-1.5	-3.3	+4.6

Average = 4.1

Normal Equations

$$\begin{aligned}
 +17.72 &= 0.29 = +9.24 \\
 +0.29 &= 12.20 = +1.20 \\
 -0.29 &= 0.00 = 1.5 \\
 +17.72 &= 12.20 = +1.10 \\
 +17.72 &= +9.24 = 7.321
 \end{aligned}$$

$$\begin{aligned}
 b &= +9.0 \\
 a &= +5.20
 \end{aligned}$$

Red. ad. C. apt.

$$d_0 = -10 \quad 40$$

$$H + \alpha_0 = 2 \quad 53 = 43^\circ 15'$$

$$H = 3 \quad 58$$

$$\alpha_0 = 22 \quad 55$$

$$G = 21 \quad 48$$

$$G + \alpha_0 = 21 \quad 43 = 310^\circ 45'$$

$$\log i = 0.8558$$

$$\cos S = 9.9924$$

$$(i) = 0.8482$$

$$\log \cos(G + \alpha) = 9.8148$$

$$g = 1.2342$$

$$\sin(G + \alpha_0) = 9.8794 m$$

$$\tan S = 9.2750 m$$

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

$$\log \cos(H + \alpha_0) = 9.8624$$

$$\sin S_0 = 9.2674 m$$

$$h = 1.2827$$

$$\sin(H + \alpha_0) = 9.8358$$

$$\sec S = 0.0076$$

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

$$\log(g') = 1.0490$$

$$(g) = 9.2125$$

$$\log(h') = 0.4125 m$$

$$(h) = 9.9500$$

$$p = +2.20$$

$$(g) = +0.16$$

$$(h) = +0.89$$

$$+3.25$$

$$(g') = +11.19$$

$$(h') = -2.59$$

$$(i) = +7.05$$

$$+15.65$$

2074 Moon's Mean Position 1912.0

27

$$\begin{array}{r} X_0 = 17.9269 \\ + 26 \\ \hline 17.9295 \end{array}$$

$$\begin{array}{r} Y_0 = 19.1125 \\ + 4 \\ \hline 19.1129 \end{array}$$

From Plato constants $X = 18.6743$ $Y = 19.0739$

$$\xi = +0.6743$$

$$\eta = -2.9261$$

$$\log T = 9.82885$$

$$\log S = 9.99243$$

$$\log wst = 8.50724$$

$$(X-A) = 1.32918$$

$$X-A = +21.34$$

$$A = 22 \ 55 \ 00$$

$$X_0 = 22 \ 55 \ 21.34$$

$$\text{Redd c. app.} = +3.25$$

$$X_1 = 22 \ 55 \ 24.59$$

$$\log \tan S = 9.2963$$

$$\xi^2 = 9.6577$$

$$\eta_1 = 5.9874$$

$$\eta_1 = -1$$

$$\eta_0 = -2.9260$$

$$\log \eta_0 = 0.46627$$

$$733115$$

$$(D-D) = 3.13512$$

$$S-D = -22 \ 45.0$$

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

$$S_0 = -10 \ 39 \ 59.0$$

$$\text{Redd} = +15.6$$

$$S' = -10 \ 39 \ 43.4$$

2074 ~~Massive~~ ~~Linear~~ ~~Parabola~~ (1912.0)

17

$$\begin{array}{r}
 X = 17.9269 \\
 + 0.0026 \\
 \hline
 17.9295
 \end{array}
 \qquad
 \begin{array}{r}
 Y = 19.1125 \\
 + 0.0004 \\
 \hline
 19.1129
 \end{array}$$

From Plate constants $X = 18.6743$ $Y = 19.0739$

$$T = +0.6743$$

$$\eta_1 = 2.9261$$

$$\log T = 9.82885$$

$$\log S = 9.99243$$

$$\log W = 8.50724$$

$$\log T_{\text{obs}} = 9.2463$$

$$T = 9.6577$$

$$\eta_1 = 19.574$$

$$(X - 1) = 1.32918$$

$$\eta_1 = -1$$

$$X - 1 = +21.34$$

$$\eta_1 = -2.9260$$

$$A = 22.5500$$

$$\log \eta_1 = 0.46627$$

$$733115$$

$$X = 22.552134$$

$$(X - 0) = 2.13512$$

$$\log W = 8.50724$$

$$S - 0 = 22.450$$

$$A = 22.552459$$

$$D = -1.01714$$

$$S_0 = -1.039590$$

$$\text{Red} = 15.6$$

$$S = -1.039434$$

2074

Lunar parallax

$$\begin{aligned}
 \alpha &= 22^{\circ} 55' 24.5'' \checkmark \\
 \delta &= 21^{\circ} 36' 04.2'' \checkmark \\
 \alpha - \alpha' &= -1^{\circ} 19' 20.4'' \checkmark \\
 &= -19^{\circ} 50' 06'' \checkmark
 \end{aligned}$$

$$\begin{aligned}
 &= 6^{\circ} 58' \checkmark \\
 &= 19^{\circ} 43' 08'' \checkmark
 \end{aligned}$$

$$\begin{aligned}
 &9.95727 \checkmark \\
 &0.00000 \checkmark \\
 &\underline{0.02624} \checkmark \\
 &9.98351 \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \gamma &= 43^{\circ} 54' 45.5'' \checkmark \\
 &= 10^{\circ} 39' 43.4'' \checkmark
 \end{aligned}$$

$$\gamma - \delta = 54^{\circ} 34' 28.9'' \checkmark$$

$$\begin{aligned}
 &9.82640 \checkmark \\
 &8.20146 \checkmark \\
 &9.91109 \checkmark \\
 &\underline{0.15891} \checkmark \\
 \sin(\delta - \delta') &= 8.09786 \checkmark
 \end{aligned}$$

$$\delta - \delta' = +43^{\circ} 04' 0'' \checkmark$$

$$\delta = -9^{\circ} 56' 39.4'' \checkmark$$

$$\text{Current } \delta = -9^{\circ} 56' 44.3'' \checkmark$$

$$0 - c = +4.9'' \checkmark$$

$$\delta' = -10^{\circ} 39' 43.4'' \checkmark$$

$$\pi = 54' 40.2'' \checkmark$$

$$\begin{aligned}
 &9.86413 \checkmark \\
 &8.20146 \checkmark \\
 &9.53060 \checkmark \\
 &\underline{0.00657} \checkmark
 \end{aligned}$$

$$\sin(\alpha - \alpha') = 7.60776'' \checkmark$$

$$\alpha - \alpha' = -13^{\circ} 55' 9.6'' \checkmark$$

$$= -55.73'' \checkmark$$

$$\alpha = 22^{\circ} 54' 28.86'' \checkmark$$

$$\alpha = 22^{\circ} 54' 28.17'' \checkmark$$

$$+0.69'' \checkmark$$

2074

~~human parallel~~

$$\lambda = 22 \quad 55 \quad 24.59$$

$$\mu = 21 \quad 36 \quad 042$$

$$\sigma = -1 \quad 19 \quad 204$$

$$= -19^{\circ} \quad 50' \quad 06''$$

$$= \quad \quad \quad 6 \quad 58$$

$$= 19 \quad 43 \quad 08$$

$$9.95727$$

$$0.00000$$

$$0.02624$$

$$9.98351$$

$$\gamma = 43 \quad 54 \quad 45.5$$

$$= 10 \quad 39 \quad 43.4$$

$$\gamma - \delta = 54 \quad 34 \quad 28.9$$

$$9.92640$$

$$8.20146$$

$$9.91109$$

$$0.15891$$

$$\sin(\delta - \gamma) = 8.09786$$

$$\delta - \delta = \quad + 43 \quad 64.0$$

$$\delta = -9 \quad 56 \quad 39.4$$

$$\text{Circ Gph } \delta = -9 \quad 56 \quad 44.3$$

$$0 - 6 \quad \quad \quad + \quad 4.9$$

$$\delta = -10 \quad 39 \quad 43.4$$

$$\Pi = 54' \quad 40.2$$

$$9.86913$$

$$8.20146$$

$$9.53060$$

$$0.00657$$

$$\sin(\alpha - \gamma) = 7.60776$$

$$\alpha - \alpha = 13 \quad 55.96$$

$$= \quad 55.73$$

$$\alpha = 22 \quad 54 \quad 28.86$$

$$\alpha = 22 \quad 54 \quad 28.17$$

$$+ 0.69$$

